Stateflow®

Reference

MATLAB®&SIMULINK®

R2021a

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Stateflow® Reference

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Contents

Blocks

Chart

Implement control logic with finite state machine
Library: Stateflow

Description

A *finite state machine* is a representation of an event-driven (reactive) system. In an event-driven system, the system responds to an event by making a transition from one state (mode) to another. This transition occurs if the condition defining the change is true.

A Stateflow chart is a graphical representation of a finite state machine. *States* and *transitions* form the basic elements of the system. You can also represent stateless flow charts.

For example, you can use Stateflow charts to control a physical plant in response to events such as a temperature and pressure sensors, clocks, and user-driven events.

You can also use a state machine to represent the automatic transmission of a car. The transmission has these operating states: park, reverse, neutral, drive, and low. As the driver shifts from one position to another, the system makes a transition from one state to another, for example, from park to reverse.

A Stateflow chart can use MATLAB or C as the action language to implement control logic.

Ports

Input

`Port_1` — Input port
scalar | vector | matrix

When you create input data in the Symbols pane, Stateflow creates input ports. The input data that you create has a corresponding input port that appears once you create data.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `Boolean` | `fixed point` | `enumerated` | `bus`

Output

`Port_1` — Output port
scalar | vector | matrix

When you create output data in the Symbols pane, Stateflow creates output ports. The output data that you create has a corresponding output port that appears once you create data.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `Boolean` | `fixed point` | `enumerated` | `bus`

Parameters

Parameters on the Code Generation tab require Simulink® Coder™ or Embedded Coder®.

Main

`Show port labels` — Select how to display port labels

`FromPortIcon` (default) | `FromPortBlockName` | `SignalName`

Select how to display port labels on the Chart block icon.

`none`

Do not display port labels.

`FromPortIcon`

If the corresponding port icon displays a signal name, display the signal name on the Chart block. Otherwise, display the port block name.

`FromPortBlockName`

Display the name of the corresponding port block on the Chart block.

`SignalName`

If a signal name exists, display the name of the signal connected to the port on the Chart block. Otherwise, display the name of the corresponding port block.

Programmatic Use
Parameter: `ShowPortLabels`
Type: character vector
Value: `'FromPortIcon'` | `'FromPortBlockName'` | `'SignalName'`
Default: `'FromPortIcon'`

`Read/Write permissions` — Select access to contents of chart

`ReadWrite` (default) | `ReadOnly` | `NoReadOrWrite`

Control user access to the contents of the chart.

`ReadWrite`

Enable opening and modification of chart contents.

`ReadOnly`

Enable opening but not modification of the chart. If the chart resides in a block library, you can create and open links to the chart and can make and modify local copies of the chart but you cannot change the permissions or modify the contents of the original library instance.

`NoReadOrWrite`

Disable opening or modification of chart. If the chart resides in a library, you can create links to the chart in a model but you cannot open, modify, change permissions, or create local copies of the chart.

Programmatic Use
Parameter: `Permissions`
Type: character vector
Value: `'ReadWrite'` | `'ReadOnly'` | `'NoReadOrWrite'`
Default: `'ReadWrite'`

`Treat as atomic unit` — Control execution of a subsystem as one unit

off (default) | on

When determining the execution order of block methods, causes Simulink to treat the chart as a unit.

☐ off

When determining block method execution order, treat all blocks in the chart as being at the same level in the model hierarchy as the chart. This hierarchy treatment can cause the execution of methods of blocks in the chart to be interleaved with the execution of methods of blocks outside the chart.

☑ on

When determining the execution order of block methods, treat the chart as a unit. For example, when Simulink needs to compute the output of the chart, Simulink invokes the output methods of all the blocks in the chart before invoking the output methods of other blocks at the same level as the chart block.

Dependency

If you select this parameter, you enable the **Minimize algebraic loop occurrences**, **Sample time**, and **Function packaging** parameters. **Function packaging** requires the Simulink Coder software.

Programmatic Use

Parameter: `TreatAsAtomicUnit`
Type: character vector
Value: `'off'` | `'on'`
Default: `'off'`

See also

- "Generate Code from Atomic Subcharts"

`Minimize algebraic loop occurrences` — Control elimination of algebraic loops

off (default) | on

☐ off

Do not try to eliminate any artificial algebraic loops that include the atomic subchart.

☑ on

Try to eliminate any artificial algebraic loops that include the atomic subchart.

Dependency

To enable this parameter, select the **Treat as atomic unit** parameter.

Programmatic Use

Parameter: `MinAlgLoopOccurrences`
Type: character vector
Value: `'off'` | `'on'`
Default: `'off'`

`Sample time` — Specify time interval

`-1` (default) | `[Ts 0]`

Specify whether all blocks in this chart must run at the same rate or can run at different rates.

- If the blocks in the chart can run at different rates, specify the chart sample time as inherited (`-1`).
- If all blocks must run at the same rate, specify the sample time corresponding to this rate as the value of the **Sample time** parameter.
- If any of the blocks in the chart specify a different sample time (other than `-1` or `inf`), Simulink displays an error message when you update or simulate the model. For example, suppose all the blocks in the chart must run `5` times a second. To ensure this time, specify the sample time of the chart as `0.2`. In this example, if any of the blocks in the chart specify a sample time other than `0.2`, `-1`, or `inf`, Simulink displays an error when you update or simulate the model.

`-1`

Specify inherited sample time. If the blocks in the chart can run at different rates, use this sample time.

`[Ts 0]`

Specify periodic sample time.

Dependency

To enable this parameter, select the **Treat as atomic unit** parameter.

Programmatic Use
Parameter: `SystemSampleTime`
Type: character vector
Value: `'-1'` | `'[Ts 0]'`
Default: `'-1'`

`Treat as grouped when propagating variant conditions` — Control treating subsystem as unit

on (default) | `off`

When propagating variant conditions from Variant Source blocks or to Variant Sink blocks, causes Simulink to treat the chart as a unit.

☑ on

Simulink treats the chart as a unit when propagating variant conditions from Variant Source blocks or to Variant Sink blocks. For example, when Simulink computes the variant condition of the chart, it propagates that condition to all the blocks in the chart.

☐ off

Simulink treats all blocks in the chart as being at the same level in the model hierarchy as the chart itself when determining their variant condition.

Programmatic Use
Parameter: `TreatAsGroupedWhenPropagatingVariantConditions`
Type: character vector
Value: `'on'` | `'off'`
Default: `'on'`

Code Generation

`Function packaging` — Select code format

`Auto` (default) | `Inline` | `Nonreusable function` | `Reusable function`

Select the generated code format for an atomic (nonvirtual) subchart.

`Auto`

Simulink Coder chooses the optimal format for your system based on the type and number of instances of the chart that exist in the model.

`Inline`

Simulink Coder inlines the chart unconditionally.

`Nonreusable function`

Simulink Coder explicitly generates a separate function in a separate file. Charts with this setting generate functions that might have arguments depending on the “Function interface” (Simulink) parameter setting. You can name the generated function and file using parameters “Function name” (Simulink) and “File name (no extension)” (Simulink). These functions are not reentrant.

`Reusable function`

Simulink Coder generates a function with arguments that allows reuse of chart code when a model includes multiple instances of the chart.

This option generates a function with arguments that allows chart code to be reused in the generated code of a model reference hierarchy that includes multiple instances of a chart across referenced models. In this case, the chart must be in a library.

Tips

- When you want multiple instances of a chart represented as one reusable function, you can designate each one of them as `Auto` or as `Reusable function`. It is best to use one because using both creates two reusable functions, one for each designation. The outcomes of these choices differ only when reuse is not possible. Selecting `Auto` does not allow for control of the function or file name for the chart code.
- The `Reusable function` and `Auto` options both determine whether multiple instances of a chart exist and the code can be reused. The options behave differently when it is impossible to reuse the code. In this case, `Auto` yields inlined code, or if circumstances prohibit inlining, separate functions for each chart instance.
- If you select the `Reusable function` while your generated code is under source control, set **File name options** to `Use subsystem name`, `Use function name`, or `User specified`. Otherwise, the names of your code files change whenever you modify your model, which prevents source control on your files.

Dependency

- This parameter requires Simulink Coder.
- To enable this parameter, select **Treat as atomic unit**.
- Setting this parameter to `Nonreusable function` or `Reusable function` enables the following parameters:
  - **Function name options**
  - **File name options**
  - Memory section for initialize/terminate functions (requires Embedded Coder and an ERT-based system target file)
  - Memory section for execution functions (requires Embedded Coder and an ERT-based system target file)

- Setting this parameter to `Nonreusable function` enables **Function with separate data** (requires a license for Embedded Coder and an ERT-based system target file).

Programmatic Use
Parameter: `RTWSystemCode`
Type: character vector
Value: `'Auto'` | `'Inline'` | `'Nonreusable function'` | `'Reusable function'`
Default: `'Auto'`

Extended Capabilities

C/C++ Code Generation

Generate C and C++ code using Simulink® Coder™.

HDL Code Generation

Generate Verilog and VHDL code for FPGA and ASIC designs using HDL Coder™.

HDL Coder™ provides additional configuration options that affect HDL implementation and synthesized logic.

HDL Architecture

This block has a single, default HDL architecture.

Active State Output

To generate an output port in the HDL code that shows the active state, in the Properties window of the chart, select **Create output for monitoring**. The output is an enumerated data type. See “Simplify Stateflow Charts by Incorporating Active State Output”.

Registered Output

To insert an output register that delays the chart output by a simulation cycle, use the OutputPipeline (HDL Coder) block property.

HDL Block Properties

ConstMultiplierOptimization	Canonical signed digit (CSD) or factored CSD optimization. The default is `none`. See also “ConstMultiplierOptimization” (HDL Coder).
ConstrainedOutputPipeline	Number of registers to place at the outputs by moving existing delays within your design. Distributed pipelining does not redistribute these registers. The default is `0`. For more details, see “ConstrainedOutputPipeline” (HDL Coder).
DistributedPipelining	Pipeline register distribution, or register retiming. The default is `off`. See also “DistributedPipelining” (HDL Coder).
InputPipeline	Number of input pipeline stages to insert in the generated code. Distributed pipelining and constrained output pipelining can move these registers. The default is `0`. For more details, see “InputPipeline” (HDL Coder).
InstantiateFunctions	Generate a VHDL® `entity` or Verilog® `module` for each function. The default is `off`. See also “InstantiateFunctions” (HDL Coder).

LoopOptimization	Unroll, stream, or do not optimize loops. The default is `none`. See also “LoopOptimization” (HDL Coder).
MapPersistentVarsToRAM	Map persistent arrays to RAM. The default is `off`. See also “MapPersistentVarsToRAM” (HDL Coder).
OutputPipeline	Number of output pipeline stages to insert in the generated code. Distributed pipelining and constrained output pipelining can move these registers. The default is `0`. For more details, see “OutputPipeline” (HDL Coder).
ResetType	Suppress reset logic generation. The default is `default`, which generates reset logic. See also “ResetType” (HDL Coder).
SharingFactor	Number of functionally equivalent resources to map to a single shared resource. The default is 0. See also “Resource Sharing” (HDL Coder).
VariablesToPipeline	**Warning** `VariablesToPipeline` is not recommended. Use `coder.hdl.pipeline` instead. Insert a pipeline register at the output of the specified MATLAB® variable or variables. Specify the list of variables as a character vector, with spaces separating the variables.

Complex Data Support

This block supports code generation for complex signals.

Restrictions

To learn about restrictions of using charts, see “Introduction to Stateflow HDL Code Generation” (HDL Coder).

PLC Code Generation
Generate Structured Text code using Simulink® PLC Coder™.

Fixed-Point Conversion
Design and simulate fixed-point systems using Fixed-Point Designer™.

See Also
State Transition Table | Truth Table

Topics
“Construct and Run a Stateflow Chart”
“The Stateflow Chart”
“Specify Properties for Stateflow Charts”

Introduced before R2006a

Sequence Viewer

Display messages, events, states, transitions, and functions between blocks during simulation

Library: Simulink / Messages & Events
Simulink Test
SimEvents
Stateflow

Description

The Sequence Viewer block displays messages, events, states, transitions, and functions between certain blocks during simulation. The blocks that you can display are called lifeline blocks and include:

- Subsystems
- Referenced models
- Blocks that contain messages, such as Stateflow charts
- Blocks that call functions or generate events, such as Function Caller, Function-Call Generator, and MATLAB Function blocks
- Blocks that contain functions, such as Function-Call Subsystem and Simulink Function blocks

To see states, transitions, and events for lifeline blocks in a referenced model, you must have a Sequence Viewer block in the referenced model. Without a Sequence Viewer block in the referenced model, you can see only messages and functions for lifeline blocks in the referenced model.

Parameters

`Time Precision for Variable Step` — Digits for time increment precision

`3` (default) | scalar

Number of digits for time increment precision. When using a variable step solver, change this parameter to adjust the time precision for the sequence viewer. By default the block supports `3` digits of precision.

Suppose the block displays two events that occur at times `0.1215` and `0.1219`. Displaying these two events precisely requires `4` digits of precision. If the precision is `3`, then the block displays two events at time `0.121`.

Programmatic Use

Block Parameter: `VariableStepTimePrecision`
Type: character vector
Values: `'3'` | scalar
Default: `'3'`

`History` — Maximum number of previous events to display

`5000` (default) | scalar

Total number of events before the last event to display.

For example, if **History** is `5` and there are `10` events in your simulation, then the block displays `6` events, including the last event and the five events prior the last event. Earlier events are not displayed. The time ruler is greyed to indicate the time between the beginning of the simulation and the time of the first displayed event.

Each send, receive, drop, or function call event is counted as one event, even if they occur at the same simulation time.

Programmatic Use
Block Parameter: `History`
Type: character vector
Values: `'1000'` | scalar
Default: `'1000'`

Block Characteristics

Data Types	`Boolean` | `bus` | `double` | `enumerated` | `fixed point` | `integer` | `single`
Direct Feedthrough	`no`
Multidimensional Signals	`yes`
Variable-Size Signals	`no`
Zero-Crossing Detection	`no`

Extended Capabilities

C/C++ Code Generation
Generate C and C++ code using Simulink® Coder™.

This block can be used for visualizing message transitions during simulation, but is not included in the generated code.

HDL Code Generation
Generate Verilog and VHDL code for FPGA and ASIC designs using HDL Coder™.

This block displays messages during simulation when used in subsystems that generate HDL code, but it is not included in the hardware implementation.

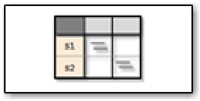
See Also

“Use the Sequence Viewer to Visualize Messages, Events, and Entities” (SimEvents)

Introduced in R2015b

State Transition Table

Represent modal logic in tabular format
Library: Stateflow



Description

When you want to represent modal logic in tabular format, use this block. The State Transition Table block uses only MATLAB as the action language.

Using the State Transition Table Editor, you can:

- Add states and enter state actions.
- Add hierarchy among your states.
- Enter conditions and actions for state-to-state transitions.
- Specify default transitions, inner transitions, and self-loop transitions.
- Add input or output data and events.
- Set breakpoints for debugging.
- Run diagnostics to detect parser errors.
- View automatically generated content as you edit the table.

For more information about the State Transition Table Editor, see “State Transition Table Operations”.

Ports

Input

`Port_1` — Input port
scalar | vector | matrix

When you create input data in the Symbols pane, Stateflow creates input ports. The input data that you create has a corresponding input port that appears once you create data.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `Boolean` | `fixed point` | `enumerated` | `bus`

Output

`Port_1` — Output port
scalar | vector | matrix

When you create output data in the Symbols pane, Stateflow creates output ports. The output data that you create has a corresponding output port that appears once you create data.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `Boolean` | `fixed point` | `enumerated` | `bus`

Parameters

Parameters on the Code Generation tab require Simulink Coder or Embedded Coder.

Main

`Show port labels` — Select how to display port labels

`FromPortIcon` (default) | `FromPortBlockName` | `SignalName`

Select how to display port labels on the Chart block icon.

`none`

Do not display port labels.

`FromPortIcon`

If the corresponding port icon displays a signal name, display the signal name on the Chart block. Otherwise, display the port block name.

`FromPortBlockName`

Display the name of the corresponding port block on the Chart block.

`SignalName`

If a signal name exists, display the name of the signal connected to the port on the Chart block. Otherwise, display the name of the corresponding port block.

Programmatic Use
Parameter: `ShowPortLabels`
Type: character vector
Value: `'FromPortIcon'` | `'FromPortBlockName'` | `'SignalName'`
Default: `'FromPortIcon'`

`Read/Write permissions` — Select access to contents of chart

`ReadWrite` (default) | `ReadOnly` | `NoReadOrWrite`

Control user access to the contents of the chart.

`ReadWrite`

Enable opening and modification of chart contents.

`ReadOnly`

Enable opening but not modification of the chart. If the chart resides in a block library, you can create and open links to the chart and can make and modify local copies of the chart but you cannot change the permissions or modify the contents of the original library instance.

`NoReadOrWrite`

Disable opening or modification of chart. If the chart resides in a library, you can create links to the chart in a model but you cannot open, modify, change permissions, or create local copies of the chart.

Programmatic Use
Parameter: `Permissions`

Type: character vector
Value: `'ReadWrite'` | `'ReadOnly'` | `'NoReadOrWrite'`
Default: `'ReadWrite'`

`Treat as atomic unit` — Control execution of a subsystem as one unit

off (default) | on

When determining the execution order of block methods, causes Simulink to treat the chart as a unit.

☐ off

When determining block method execution order, treat all blocks in the chart as being at the same level in the model hierarchy as the chart. This hierarchy treatment can cause the execution of methods of blocks in the chart to be interleaved with the execution of methods of blocks outside the chart.

☑ on

When determining the execution order of block methods, treat the chart as a unit. For example, when Simulink needs to compute the output of the chart, Simulink invokes the output methods of all the blocks in the chart before invoking the output methods of other blocks at the same level as the chart block.

Dependency

If you select this parameter, you enable the **Minimize algebraic loop occurrences**, **Sample time**, and **Function packaging** parameters. **Function packaging** requires the Simulink Coder software.

Programmatic Use

Parameter: `TreatAsAtomicUnit`
Type: character vector
Value: `'off'` | `'on'`
Default: `'off'`

See also

- "Generate Code from Atomic Subcharts"

`Minimize algebraic loop occurrences` — Control elimination of algebraic loops

off (default) | on

☐ off

Do not try to eliminate any artificial algebraic loops that include the atomic subchart.

☑ on

Try to eliminate any artificial algebraic loops that include the atomic subchart.

Dependency

To enable this parameter, select the **Treat as atomic unit** parameter.

Programmatic Use

Parameter: `MinAlgLoopOccurrences`
Type: character vector
Value: `'off'` | `'on'`
Default: `'off'`

`Sample time` — Specify time interval
`-1` (default) | `[Ts 0]`

Specify whether all blocks in this chart must run at the same rate or can run at different rates.

- If the blocks in the chart can run at different rates, specify the chart sample time as inherited (`-1`).
- If all blocks must run at the same rate, specify the sample time corresponding to this rate as the value of the **Sample time** parameter.
- If any of the blocks in the chart specify a different sample time (other than `-1` or `inf`), Simulink displays an error message when you update or simulate the model. For example, suppose all the blocks in the chart must run 5 times a second. To ensure this time, specify the sample time of the chart as `0.2`. In this example, if any of the blocks in the chart specify a sample time other than `0.2`, `-1`, or `inf`, Simulink displays an error when you update or simulate the model.

`-1`

Specify inherited sample time. If the blocks in the chart can run at different rates, use this sample time.

`[Ts 0]`

Specify periodic sample time.

Dependency

To enable this parameter, select the **Treat as atomic unit** parameter.

Programmatic Use
Parameter: `SystemSampleTime`
Type: character vector
Value: `'-1'` | `'[Ts 0]'`
Default: `'-1'`

`Treat as grouped when propagating variant conditions` — Control treating subsystem as unit
on (default) | `off`

When propagating variant conditions from Variant Source blocks or to Variant Sink blocks, causes Simulink to treat the chart as a unit.

☑ on

Simulink treats the chart as a unit when propagating variant conditions from Variant Source blocks or to Variant Sink blocks. For example, when Simulink computes the variant condition of the chart, it propagates that condition to all the blocks in the chart.

☐ off

Simulink treats all blocks in the chart as being at the same level in the model hierarchy as the chart itself when determining their variant condition.

Programmatic Use
Parameter: `TreatAsGroupedWhenPropagatingVariantConditions`
Type: character vector
Value: `'on'` | `'off'`
Default: `'on'`

Code Generation

`Function packaging` — Select code format

`Auto` (default) | `Inline` | `Nonreusable function` | `Reusable function`

Select the generated code format for an atomic (nonvirtual) subchart.

`Auto`

Simulink Coder chooses the optimal format for your system based on the type and number of instances of the chart that exist in the model.

`Inline`

Simulink Coder inlines the chart unconditionally.

`Nonreusable function`

Simulink Coder explicitly generates a separate function in a separate file. Charts with this setting generate functions that might have arguments depending on the “Function interface” (Simulink) parameter setting. You can name the generated function and file using parameters “Function name” (Simulink) and “File name (no extension)” (Simulink). These functions are not reentrant.

`Reusable function`

Simulink Coder generates a function with arguments that allows reuse of chart code when a model includes multiple instances of the chart.

This option generates a function with arguments that allows chart code to be reused in the generated code of a model reference hierarchy that includes multiple instances of a chart across referenced models. In this case, the chart must be in a library.

Tips

- When you want multiple instances of a chart represented as one reusable function, you can designate each one of them as `Auto` or as `Reusable function`. It is best to use one because using both creates two reusable functions, one for each designation. The outcomes of these choices differ only when reuse is not possible. Selecting `Auto` does not allow for control of the function or file name for the chart code.
- The `Reusable function` and `Auto` options both try to determine if multiple instances of a chart exist and if the code can be reused. The difference between the options' behavior is that when reuse is not possible. In this case, `Auto` yields inlined code, or if circumstances prohibit inlining, separate functions for each chart instance.
- If you select the `Reusable function` while your generated code is under source control, set **File name options** to `Use subsystem name`, `Use function name`, or `User specified`. Otherwise, the names of your code files change whenever you modify your model, which prevents source control on your files.

Dependency

- This parameter requires Simulink Coder.
- To enable this parameter, select **Treat as atomic unit**.
- Setting this parameter to `Nonreusable function` or `Reusable function` enables the following parameters:
  - **Function name options**
  - **File name options**

  - Memory section for initialize/terminate functions (requires Embedded Coder and an ERT-based system target file)
  - Memory section for execution functions (requires Embedded Coder and an ERT-based system target file)
- Setting this parameter to `Nonreusable function` enables **Function with separate data** (requires a license for Embedded Coder and an ERT-based system target file).

Programmatic Use
Parameter: `RTWSystemCode`
Type: character vector
Value: `'Auto'` | `'Inline'` | `'Nonreusable function'` | `'Reusable function'`
Default: `'Auto'`

Extended Capabilities

C/C++ Code Generation
Generate C and C++ code using Simulink® Coder™.

HDL Code Generation
Generate Verilog and VHDL code for FPGA and ASIC designs using HDL Coder™.

HDL Coder provides additional configuration options that affect HDL implementation and synthesized logic.

Tunable Parameters

You can use a tunable parameter in a State Transition Table intended for HDL code generation. For details, see “Generate DUT Ports for Tunable Parameters” (HDL Coder).

HDL Architecture

This block has a single, default HDL architecture.

Active State Output

To generate an output port in the HDL code that shows the active state, in the Properties window of the chart, select **Create output for monitoring**. The output is an enumerated data type. See “Simplify Stateflow Charts by Incorporating Active State Output”.

HDL Block Properties

ConstMultiplierOptimization	Canonical signed digit (CSD) or factored CSD optimization. The default is `none`. See also “ConstMultiplierOptimization” (HDL Coder).
ConstrainedOutputPipeline	Number of registers to place at the outputs by moving existing delays within your design. Distributed pipelining does not redistribute these registers. The default is `0`. For more details, see “ConstrainedOutputPipeline” (HDL Coder).
DistributedPipelining	Pipeline register distribution, or register retiming. The default is `off`. See also “DistributedPipelining” (HDL Coder).
InputPipeline	Number of input pipeline stages to insert in the generated code. Distributed pipelining and constrained output pipelining can move these registers. The default is `0`. For more details, see “InputPipeline” (HDL Coder).

InstantiateFunctions	Generate a VHDL `entity` or Verilog `module` for each function. The default is `off`. See also “InstantiateFunctions” (HDL Coder).
LoopOptimization	Unroll, stream, or do not optimize loops. The default is `none`. See also “LoopOptimization” (HDL Coder).
MapPersistentVarsToRAM	Map persistent arrays to RAM. The default is `off`. See also “MapPersistentVarsToRAM” (HDL Coder).
OutputPipeline	Number of output pipeline stages to insert in the generated code. Distributed pipelining and constrained output pipelining can move these registers. The default is `0`. For more details, see “OutputPipeline” (HDL Coder).
ResetType	Suppress reset logic generation. The default is `default`, which generates reset logic. See also “ResetType” (HDL Coder).
SharingFactor	Number of functionally equivalent resources to map to a single shared resource. The default is 0. See also “Resource Sharing” (HDL Coder).
VariablesToPipeline	**Warning** `VariablesToPipeline` is not recommended. Use `coder.hdl.pipeline` instead. Insert a pipeline register at the output of the specified MATLAB variable or variables. Specify the list of variables as a character vector, with spaces separating the variables.

PLC Code Generation
Generate Structured Text code using Simulink® PLC Coder™.

Fixed-Point Conversion
Design and simulate fixed-point systems using Fixed-Point Designer™.

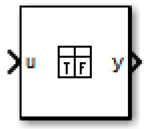
See Also
Chart | Truth Table

Topics
“State Transition Tables in Stateflow”
“State Transition Table Operations”
“Specify Properties for Stateflow Charts”

Introduced in R2012b

Truth Table

Represent logical decision-making behavior with conditions, decisions, and actions
Library: Stateflow



Description

The Truth Table block is a truth table function that uses MATLAB as the action language. When you want to use truth table logic directly in a Simulink model, use this block. This block requires Stateflow.

When you add a Truth Table block directly to a model instead of calling truth table functions from a Stateflow chart, these advantages apply:

- It is a more direct approach than creating a truth table within a Stateflow chart, especially if your model requires only a single truth table.
- You can define truth table inputs and outputs with inherited types and sizes.

The Truth Table block works with a subset of the MATLAB language that is optimized for generating embeddable C code. This block generates content as MATLAB code. As a result, you can take advantage of other tools to debug your Truth Table block during simulation.

If you double-click the Truth Table block, the Truth Table Editor opens to display its conditions, actions, and decisions.

Using the Truth Table Editor, you can:

- Enter and edit conditions, actions, and decisions.
- Add or modify Stateflow data and ports by using the Ports and Data Manager.
- Run diagnostics to detect parser errors.
- View generated content after simulation.

For more information about the Truth Table Editor, see “Use Truth Tables to Model Combinatorial Logic”.

Ports

Input

u — Input port
scalar | vector | matrix

When you create input data in the Symbols pane, Stateflow creates input ports. The input data that you create has a corresponding input port that appears once you create data.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `Boolean` | `fixed point` | `enumerated` | `bus`

Output

y — Output port
scalar | vector | matrix

When you create output data in the Symbols pane, Stateflow creates output ports. The output data that you create has a corresponding output port that appears once you create data.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `uint8` | `uint16` | `uint32` | `Boolean` | `fixed point` | `enumerated` | `bus`

Parameters

Parameters on the Code Generation tab require Simulink Coder or Embedded Coder.

Main

`Show port labels` — Select how to display port labels
`FromPortIcon` (default) | `FromPortBlockName` | `SignalName`

Select how to display port labels on the Chart block icon.

`none`

Do not display port labels.

`FromPortIcon`

If the corresponding port icon displays a signal name, display the signal name on the Chart block. Otherwise, display the port block name.

`FromPortBlockName`

Display the name of the corresponding port block on the Chart block.

`SignalName`

If a signal name exists, display the name of the signal connected to the port on the Chart block. Otherwise, display the name of the corresponding port block.

Programmatic Use
Parameter: `ShowPortLabels`
Type: character vector
Value: `'FromPortIcon'` | `'FromPortBlockName'` | `'SignalName'`
Default: `'FromPortIcon'`

`Read/Write permissions` — Select access to contents of chart
`ReadWrite` (default) | `ReadOnly` | `NoReadOrWrite`

Control user access to the contents of the chart.

`ReadWrite`

Enable opening and modification of chart contents.

`ReadOnly`

Enable opening but not modification of the chart. If the chart resides in a block library, you can create and open links to the chart and can make and modify local copies of the chart but you cannot change the permissions or modify the contents of the original library instance.

`NoReadOrWrite`

Disable opening or modification of chart. If the chart resides in a library, you can create links to the chart in a model but you cannot open, modify, change permissions, or create local copies of the chart.

Programmatic Use
Parameter: `Permissions`
Type: character vector
Value: `'ReadWrite'` | `'ReadOnly'` | `'NoReadOrWrite'`
Default: `'ReadWrite'`

`Treat as atomic unit` — Control execution of a subsystem as one unit

off (default) | on

When determining the execution order of block methods, causes Simulink to treat the chart as a unit.

☐ off

When determining block method execution order, treat all blocks in the chart as being at the same level in the model hierarchy as the chart. This hierarchy treatment can cause the execution of methods of blocks in the chart to be interleaved with the execution of methods of blocks outside the chart.

☑ on

When determining the execution order of block methods, treat the chart as a unit. For example, when Simulink needs to compute the output of the chart, Simulink invokes the output methods of all the blocks in the chart before invoking the output methods of other blocks at the same level as the chart block.

Dependency

If you select this parameter, you enable the **Minimize algebraic loop occurrences**, **Sample time**, and **Function packaging** parameters. **Function packaging** requires the Simulink Coder software.

Programmatic Use
Parameter: `TreatAsAtomicUnit`
Type: character vector
Value: `'off'` | `'on'`
Default: `'off'`

See also

- "Generate Code from Atomic Subcharts"

`Minimize algebraic loop occurrences` — Control elimination of algebraic loops

off (default) | on

☐ off

Do not try to eliminate any artificial algebraic loops that include the atomic subchart.

✓ on

Try to eliminate any artificial algebraic loops that include the atomic subchart.

Dependency

To enable this parameter, select the **Treat as atomic unit** parameter.

Programmatic Use
Parameter: `MinAlgLoopOccurrences`
Type: character vector
Value: `'off'` | `'on'`
Default: `'off'`

`Sample time` — Specify time interval

`-1` (default) | `[Ts 0]`

Specify whether all blocks in this chart must run at the same rate or can run at different rates.

- If the blocks in the chart can run at different rates, specify the chart sample time as inherited (`-1`).
- If all blocks must run at the same rate, specify the sample time corresponding to this rate as the value of the **Sample time** parameter.
- If any of the blocks in the chart specify a different sample time (other than `-1` or `inf`), Simulink displays an error message when you update or simulate the model. For example, suppose all the blocks in the chart must run `5` times a second. To ensure this time, specify the sample time of the chart as `0.2`. In this example, if any of the blocks in the chart specify a sample time other than `0.2`, `-1`, or `inf`, Simulink displays an error when you update or simulate the model.

`-1`

Specify inherited sample time. If the blocks in the chart can run at different rates, use this sample time.

`[Ts 0]`

Specify periodic sample time.

Dependency

To enable this parameter, select the **Treat as atomic unit** parameter.

Programmatic Use
Parameter: `SystemSampleTime`
Type: character vector
Value: `'-1'` | `'[Ts 0]'`
Default: `'-1'`

`Treat as grouped when propagating variant conditions` — Control treating subsystem as unit

`on` (default) | `off`

When propagating variant conditions from Variant Source blocks or to Variant Sink blocks, causes Simulink to treat the chart as a unit.

☑ on

Simulink treats the chart as a unit when propagating variant conditions from Variant Source blocks or to Variant Sink blocks. For example, when Simulink computes the variant condition of the chart, it propagates that condition to all the blocks in the chart.

☐ off

Simulink treats all blocks in the chart as being at the same level in the model hierarchy as the chart itself when determining their variant condition.

Programmatic Use

Parameter: `TreatAsGroupedWhenPropagatingVariantConditions`
Type: character vector
Value: `'on'` | `'off'`
Default: `'on'`

Code Generation

`Function packaging` — Select code format

`Auto` (default) | `Inline` | `Nonreusable function` | `Reusable function`

Select the generated code format for an atomic (nonvirtual) subchart.

`Auto`

Simulink Coder chooses the optimal format for your system based on the type and number of instances of the chart that exist in the model.

`Inline`

Simulink Coder inlines the chart unconditionally.

`Nonreusable function`

Simulink Coder explicitly generates a separate function in a separate file. Charts with this setting generate functions that might have arguments depending on the “Function interface” (Simulink) parameter setting. You can name the generated function and file using parameters “Function name” (Simulink) and “File name (no extension)” (Simulink). These functions are not reentrant.

`Reusable function`

Simulink Coder generates a function with arguments that allows reuse of chart code when a model includes multiple instances of the chart.

This option generates a function with arguments that allows chart code to be reused in the generated code of a model reference hierarchy that includes multiple instances of a chart across referenced models. In this case, the chart must be in a library.

Tips

- When you want multiple instances of a chart represented as one reusable function, you can designate each one of them as `Auto` or as `Reusable function`. It is best to use one because using both creates two reusable functions, one for each designation. The outcomes of these choices differ only when reuse is not possible. Selecting `Auto` does not allow for control of the function or file name for the chart code.
- The `Reusable function` and `Auto` options both try to determine if multiple instances of a chart exist and if the code can be reused. The difference between the options' behavior is that when reuse is not possible. In this case, `Auto` yields inlined code, or if circumstances prohibit inlining, separate functions for each chart instance.

- If you select the `Reusable function` while your generated code is under source control, set **File name options** to `Use subsystem name`, `Use function name`, or `User specified`. Otherwise, the names of your code files change whenever you modify your model, which prevents source control on your files.

Dependency

- This parameter requires Simulink Coder.
- To enable this parameter, select **Treat as atomic unit**.
- Setting this parameter to `Nonreusable function` or `Reusable function` enables the following parameters:
  - **Function name options**
  - **File name options**
  - Memory section for initialize/terminate functions (requires Embedded Coder and an ERT-based system target file)
  - Memory section for execution functions (requires Embedded Coder and an ERT-based system target file)
- Setting this parameter to `Nonreusable function` enables **Function with separate data** (requires a license for Embedded Coder and an ERT-based system target file).

Programmatic Use
Parameter: `RTWSystemCode`
Type: character vector
Value: `'Auto'` | `'Inline'` | `'Nonreusable function'` | `'Reusable function'`
Default: `'Auto'`

Extended Capabilities

C/C++ Code Generation
Generate C and C++ code using Simulink® Coder™.

HDL Code Generation
Generate Verilog and VHDL code for FPGA and ASIC designs using HDL Coder™.

HDL Coder provides additional configuration options that affect HDL implementation and synthesized logic.

Tunable Parameters

You can use a tunable parameter in a Truth Table intended for HDL code generation. For details, see “Generate DUT Ports for Tunable Parameters” (HDL Coder).

HDL Architecture

This block has a single, default HDL architecture.

HDL Block Properties

ConstMultiplierOptimization	Canonical signed digit (CSD) or factored CSD optimization. The default is `none`. See also “ConstMultiplierOptimization” (HDL Coder).

ConstrainedOutputPipeline	Number of registers to place at the outputs by moving existing delays within your design. Distributed pipelining does not redistribute these registers. The default is `0`. For more details, see “ConstrainedOutputPipeline” (HDL Coder).
DistributedPipelining	Pipeline register distribution, or register retiming. The default is `off`. See also “DistributedPipelining” (HDL Coder).
InputPipeline	Number of input pipeline stages to insert in the generated code. Distributed pipelining and constrained output pipelining can move these registers. The default is `0`. For more details, see “InputPipeline” (HDL Coder).
InstantiateFunctions	Generate a VHDL `entity` or Verilog `module` for each function. The default is `off`. See also “InstantiateFunctions” (HDL Coder).
LoopOptimization	Unroll, stream, or do not optimize loops. The default is `none`. See also “LoopOptimization” (HDL Coder).
MapPersistentVarsToRAM	Map persistent arrays to RAM. The default is `off`. See also “MapPersistentVarsToRAM” (HDL Coder).
OutputPipeline	Number of output pipeline stages to insert in the generated code. Distributed pipelining and constrained output pipelining can move these registers. The default is `0`. For more details, see “OutputPipeline” (HDL Coder).
ResetType	Suppress reset logic generation. The default is `default`, which generates reset logic. See also “ResetType” (HDL Coder).
SharingFactor	Number of functionally equivalent resources to map to a single shared resource. The default is 0. See also “Resource Sharing” (HDL Coder).
VariablesToPipeline	**Warning** `VariablesToPipeline` is not recommended. Use `coder.hdl.pipeline` instead. Insert a pipeline register at the output of the specified MATLAB variable or variables. Specify the list of variables as a character vector, with spaces separating the variables.

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See Also

Chart | State Transition Table

Topics
“Use Truth Tables to Model Combinatorial Logic”
“Program a Truth Table”
“Specify Properties for Stateflow Charts”

Introduced before R2006a

2

Functions

sfclipboard

Clipboard object

Syntax

```
clipboard = sfclipboard
```

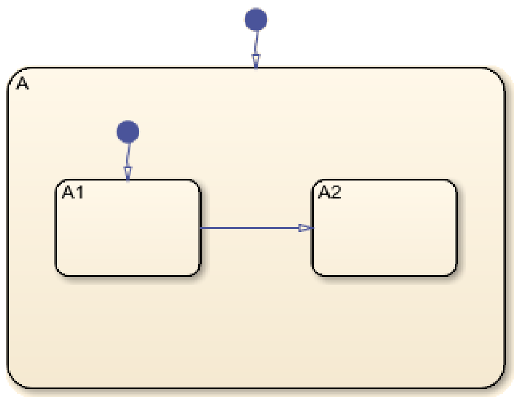
Description

`clipboard = sfclipboard` returns the `Stateflow.Clipboard` object. Use the `Clipboard` object to copy and paste objects within the same chart, between charts in the same Simulink model, or between charts in different models.

Examples

Copy and Paste by Grouping

Group state `A` and copy its contents to chart `ch`. When you group a state, box, or graphical function, you can copy and paste all the objects contained in the grouped object, as well as all the relationships among these objects. This method is the simplest way of copying and pasting objects programmatically. If a state is not grouped, copying the state does not copy any of its contents.



1. Find the `Stateflow.State` object named `A` in chart `ch`.

   ```
   sA = find(ch,'-isa','Stateflow.State','Name','A');
   ```
2. Group state `A` and its contents by setting the `IsGrouped` property for `sA` to `true`. Save the previous setting of this property so you can revert to it later.

   ```
   prevGrouping = sA.IsGrouped;
   sA.IsGrouped = true;
   ```
3. Change the name of the state to `'Copy_of_A'`. Save the previous name so you can revert to it later.

```
prevName = sA.Name;
newName = ['Copy_of_' prevName];
sA.Name = newName;
```

4 Access the clipboard object.

```
cb = sfclipboard;
```

5 Copy the grouped state to the clipboard.

```
copy(cb,sA);
```

6 Restore the state properties to their original settings.

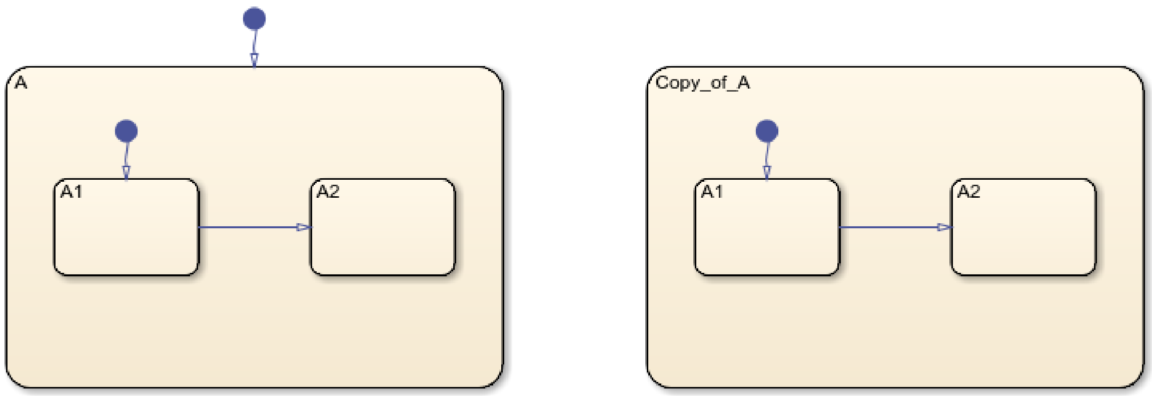
```
sA.IsGrouped = prevGrouping;
sA.Name = prevName;
```

7 Paste a copy of the objects from the clipboard to the chart.

```
pasteTo(cb,ch);
```

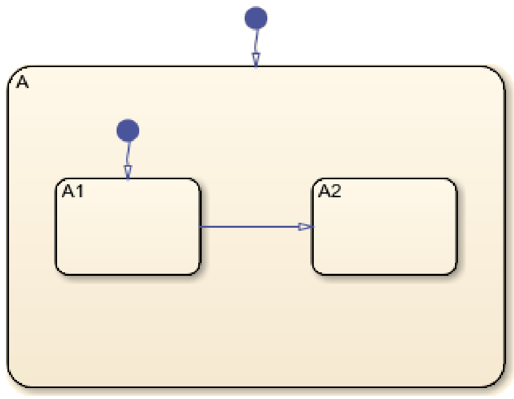
8 Adjust the state properties of the new state.

```
sNew = find(ch,'-isa','Stateflow.State','Name',newName);
sNew.Position = sA.Position + [400 0 0 0];
sNew.IsGrouped = prevGrouping;
```



Copy and Paste Array of Objects

Copy states A1 and A2, along with the transition between them, to a new state in chart ch. To preserve transition connections and containment relationships between objects, copy all the connected objects at once.



1. Find the `Stateflow.State` object named `A` in chart `ch`.

   ```
   sA = find(ch,'-isa','Stateflow.State','Name','A');
   ```
2. Add a new state called `B`. To enable pasting of other objects inside `B`, convert the new state to a subchart.

   ```
   sB = Stateflow.State(ch);
   sB.Name = 'B';
   sB.Position = sA.Position + [400 0 0 0];
   sB.IsSubchart = true;
   ```
3. Create an array called `objArray` that contains the states and transitions in state `A`. Use the function `setdiff` to remove state `A` from the array of objects to copy.

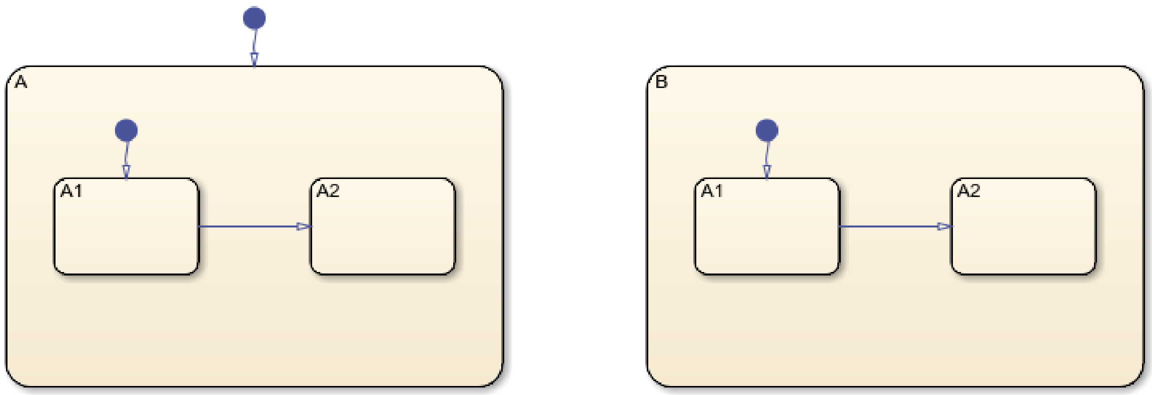
   ```
   objArrayS = find(sA,'-isa','Stateflow.State');
   objArrayS = setdiff(objArrayS,sA);
   objArrayT = find(sA,'-isa','Stateflow.Transition');
   objArray = [objArrayS objArrayT];
   ```
4. Access the clipboard object.

   ```
   cb = sfclipboard;
   ```
5. Copy the objects in `objArray` and paste them in subchart `B`.

   ```
   copy(cb,objArray);
   pasteTo(cb,sB);
   ```
6. Revert `B` to a state.

   ```
   sB.IsSubchart = false;
   sB.IsGrouped = false;
   ```
7. Reposition the states and transitions in `B`.

   ```
   newStates = find(sB,'-isa','Stateflow.State');
   newStates = setdiff(newStates,sB);
   newTransitions = find(sB,'-isa','Stateflow.Transition');
   newOClocks = get(newTransitions,{'SourceOClock','DestinationOClock'});
   for i = 1:numel(newStates)
   newStates(i).Position = newStates(i).Position + [25 35 0 0];
   end
   set(newTransitions,{'SourceOClock','DestinationOClock'},newOClocks);
   ```



See Also

Functions
`copy` | `find` | `get` | `pasteTo` | `set` | `setdiff`

Objects
`Stateflow.Clipboard` | `Stateflow.State`

Topics
"Overview of the Stateflow API"

Introduced before R2006a

sfclose

Close Stateflow chart

Syntax

```
sfclose
sfclose all
sfclose chartName
sfclose(___)
```

Description

`sfclose` closes the chart that was opened or modified most recently. Closing a chart in a Simulink model also closes the model.

`sfclose all` closes all open charts.

`sfclose chartName` closes all open charts called `chartName`.

`sfclose(___)` enables you to specify the input arguments in the previous syntaxes by using variables or strings. For example, `sfclose(var)` where the value of `var` is equal to `"My Chart"` or `"all"`.

Examples

Close Current Chart

Close the Stateflow chart that was opened or modified most recently.

```
sfclose
```

Close All Open Charts

Close all open Stateflow charts.

```
sfclose all
```

Close Specified Chart

Close all open Stateflow charts called `MyChart`.

```
sfclose MyChart
```

Close Chart Specified by Variable

Close the open Stateflow chart specified by the variable `chart`.

```
chart = "My Chart";
sfclose(chart)
```

Input Arguments

`chartName` — Name of chart

character vector | string

Name of Stateflow chart to close, specified as a chart name, character vector, or string.

If the name of the chart includes spaces, enclose the chart name in quotes.

To specify the name of the chart using a variable or a string, call `sfclose` with its input argument enclosed in parentheses.

Example: `sfclose MyChart`

Example: `sfclose 'My Chart'`

Example: `sfclose("My Chart")`

Data Types: `char` | `string`

See Also

`sflib` | `sfnew` | `sfopen` | `stateflow`

Introduced in R2006a

sfdebugger

Open Stateflow Debugger

Syntax

```
sfdebugger
sfdebugger('model_name')
```

Description

`sfdebugger` opens the Stateflow Debugger for the current model.

`sfdebugger('model_name')` opens the debugger for the Simulink model called `'model_name'`. Use this input argument to specify which model to debug when you have multiple models open.

See Also

`sfexplr` | `sfhelp` | `sflib`

Topics

"Debug Run-Time Errors in a Chart"

Introduced in R2006a

sfexplr

Open Model Explorer

Syntax

```
sfexplr
```

Description

`sfexplr` opens the Model Explorer. A model does not need to be open.

See Also

`sfdebugger` | `sfhelp` | `sflib`

Topics
"Use the Model Explorer with Stateflow Objects"

Introduced in R2006a

sfgco

Selected objects in chart

Syntax

```
objects = sfgco
```

Description

`objects = sfgco` returns a handle or vector of handles to the most recently selected Stateflow objects. If more than one chart is open, the function searches the last chart with which you interacted that is still open.

Examples

Zoom in on Selected State

In the Stateflow Editor, select a state by clicking on it.

Access the `Stateflow.State` object.

```
myState = sfgco;
```

Zoom in on the selected state.

```
fitToView(myState)
```

Display Names of Selected States

In the Stateflow Editor, simultaneously select several states by clicking each state while pressing the **Shift** key.

Access the `Stateflow.State` objects.

```
myStates = sfgco;
```

Display the names of the selected states.

```
get(mystates,'Name')
```

Output Arguments

`objects` — Selected graphical objects

handle | vector of handles

Selected graphical objects, returned as a handle or vector of handles to Stateflow API objects. This table describes the format and content of the output of the function, depending on your selection.

Value	Description
Empty matrix	You have not opened or edited any charts.
Handle to the chart most recently clicked	You clicked in a chart, but did not select any objects.
Handle to the selected object	You selected one object in a chart.
Vector of handles to the selected objects	You selected multiple objects in a chart.
Vector of handles to the most recently selected objects in the most recently selected chart	You selected multiple objects in multiple charts.

See Also

Functions
`find` | `fitToView` | `get`

Objects
`Stateflow.State`

Topics
"Overview of the Stateflow API"
"Access Objects in Your Stateflow Chart"
"Create Charts by Using the Stateflow API"

Introduced before R2006a

sfhelp

Open Stateflow online help

Syntax

```
sfhelp
```

Description

`sfhelp` opens the Stateflow online help in the MATLAB Help browser.

See Also

`sfdebugger` | `sfexplr` | `sfnew` | `stateflow`

Introduced before R2006a

sflib

Open Stateflow library window

Syntax

```
sflib
```

Description

`sflib` opens the Stateflow block library. From this library, you can drag Stateflow blocks into Simulink models and access the Stateflow Examples Library.

See Also

`sfdebugger` | `sfexplr` | `sfhelp` | `sfnew`

Introduced in R2006a

sfnew

Create Simulink model that contains an empty Stateflow block

Syntax

```
sfnew
sfnew chartType
sfnew modelName
sfnew chartType modelName
sfnew( ___ )
```

Description

`sfnew` creates an untitled Simulink model that contains an empty Stateflow chart.

`sfnew chartType` creates an untitled model that contains an empty block of type `chartType`.

`sfnew modelName` creates a model called `modelName` that contains an empty chart.

`sfnew chartType modelName` creates a model called `modelName` that contains an empty block of type `chartType`.

`sfnew( ___ )` enables you to specify the input arguments in the previous syntaxes by using variables or strings. For example, `sfnew(var1,var2)` where `var1` is equal to `"-C"` and `var2` is equal to `"MyModel"`.

Examples

Untitled Model with Chart

Create an untitled model that contains an empty Stateflow chart that uses the default action language for new charts.

```
sfnew
```

For more information, see “Modify the Action Language for a Chart”.

Untitled Model with Truth Table

Create an untitled model called `MyModel` that contains an empty Truth Table block.

```
sfnew -TT
```

Named Model with Chart

Create a model called `MyModel` that contains an empty Stateflow chart that uses MATLAB as the action language.

```
sfnew 'MyModel'
```

Named Model with Moore Chart

Create a model called `MyModel` that contains an empty Stateflow chart that uses Moore semantics.

```
sfnew -Moore 'MyModel'
```

Chart Type Specified as Variable

Create an untitled model that contains an empty Stateflow chart of the type specified by the variable `type`.

```
type = "-C";
sfnew(type)
```

Input Arguments

`chartType` — Type of block
`-MATLAB` (default) | `-M` | `-C` | `-Mealy` | `-Moore` | `-STT` | `-TT`

Type of Stateflow block to add to empty model, specified as one of these options.

Option	Description
`-MATLAB` or `-M`	Chart that uses MATLAB as the action language
`-C`	Chart that uses C as the action language
`-Mealy`	Chart that supports Mealy machine semantics
`-Moore`	Chart that supports Moore machine semantics
`-STT`	State Transition Table
`-TT`	Truth Table

Data Types: `char` | `string`

`modelName` — Name of model
character vector | string

Name of the Simulink model, specified as a character vector or string. To specify the name of the model using a variable or a string, call `sfnew` with its input arguments enclosed in parentheses.

Example: `sfnew MyModel`

Example: `sfnew 'MyModel'`

Example: `sfnew("MyModel")`

Data Types: `char` | `string`

Tips

- The default action language for new charts is MATLAB. To change the default action language to C, use the command `sfpref('ActionLanguage','C')`. For more information, see “Modify the Action Language for a Chart”.
- To create a standalone chart that you can execute as a MATLAB object, use the `edit` function. For example, in the MATLAB Command Window, enter:

  ```
  edit chart.sfx
  ```

  For more information, see “Create Stateflow Charts for Execution as MATLAB Objects”.

See Also

Blocks
Chart | State Transition Table | Truth Table

Functions
`sfclose` | `sflib` | `sfopen` | `stateflow`

Topics
“Differences Between MATLAB and C as Action Language Syntax”
“Overview of Mealy and Moore Machines”
“Use Truth Tables to Model Combinatorial Logic”
“State Transition Tables in Stateflow”

Introduced before R2006a

sfopen

Open existing Simulink model

Syntax

`sfopen`

Description

`sfopen` prompts you to select a Simulink model file and opens the model.

Tips

To open a standalone chart in MATLAB, use the `edit` function. For example, in the MATLAB Command Window, enter:

```
edit chart.sfx
```

For more information, see “Create Stateflow Charts for Execution as MATLAB Objects”.

See Also

`sfclose` | `sfdebugger` | `sfexplr` | `sflib` | `sfnew` | `stateflow`

Introduced in R2006a

sfpref

View and adjust user preferences in Stateflow charts

Syntax

```
actionLanguage = sfpref('ActionLanguage')
sfpref('ActionLanguage',newLanguage)

correctionSetting = sfpref('EnableLabelAutoCorrectionForMAL')
sfpref('EnableLabelAutoCorrectionForMAL',newSetting)

directory = sfpref('PatternWizardCustomDir')
sfpref('PatternWizardCustomDir',newDirectory)
```

Description

`actionLanguage = sfpref('ActionLanguage')` returns the default action language used by Stateflow charts.

`sfpref('ActionLanguage',newLanguage)` modifies the default action language. See “Change the Default Action Language”.

`correctionSetting = sfpref('EnableLabelAutoCorrectionForMAL')` returns if Stateflow automatically corrects common C constructs in charts that use MATLAB as the action language.

`sfpref('EnableLabelAutoCorrectionForMAL',newSetting)` enables or disables automatic correction of common C constructs in Stateflow charts that use MATLAB as the action language. See “Auto Correction When Using MATLAB as the Action Language”.

`directory = sfpref('PatternWizardCustomDir')` returns the directory for custom patterns created using the Stateflow Pattern Wizard.

`sfpref('PatternWizardCustomDir',newDirectory)` modifies the directory for custom patterns created using the Stateflow Pattern Wizard. See “Save Custom Flow Chart Patterns”.

Examples

Change Action Language

```
sfpref('ActionLanguage','C')
```

Change the action language being used in new Stateflow charts to C.

Enable Automatic Correction for C Constructs

```
sfpref('EnableLabelAutoCorrectionForMAL',1)
```

Enable automatic correction of common C constructs in new Stateflow charts when using MATLAB as the action language.

Assign Directory for Custom Patterns

```
sfpref('PatternWizardCustomDir','C:\')
```

Assign the directory for custom patterns created using the Stateflow Pattern Wizard to `C:\`.

Input Arguments

`newLanguage` — Action language used by Stateflow
`'MATLAB'` (default) | `'C'`

Action language used by Stateflow, specified as `'MATLAB'` or `'C'`.

Data Types: `char`

`newSetting` — Option for Stateflow automatic C construct correction
`1` (default) | `0`

Option for Stateflow automatic C construct correction while using MATLAB as the action language, specified as `1` or `0`.

Note When you change the action language of a chart from C to MATLAB, the `newSetting` value does not affect syntax conversion.

Data Types: `double`

`newDirectory` — Directory for Stateflow custom patterns
`''` (default)

Directory for Stateflow custom patterns created by the Pattern Wizard, specified as a character array.

Data Types: `char`

See Also
`sfclose` | `sflib` | `sfnew` | `sfopen` | `stateflow`

Topics
"Create Flow Charts by Using Pattern Wizard"
"Modify the Action Language for a Chart"

Introduced before R2006a

sfprint

Print graphical view of charts

Syntax

```
sfprint
sfprint(objects)
sfprint(objects,format)
sfprint(objects,format,outputOption)
sfprint(objects,format,outputOption,wholeChart)
```

Description

`sfprint` prints the current chart to the default printer.

`sfprint(objects)` prints all charts specified by `objects` to the default printer.

`sfprint(objects,format)` prints all charts specified by `objects` in the specified `format` to output files. Each output file matches the name of the chart and the file extension matches the `format`.

`sfprint(objects,format,outputOption)` prints all charts specified by `objects` in the specified `format` to the file or printer specified in `outputOption`.

`sfprint(objects,format,outputOption,wholeChart)` prints all charts specified by `objects` in the specified `format` to the file or printer specified in `outputOption`. As specified in `wholeChart`, prints either a complete or current view.

Examples

Print open chart

```
sfprint
```

Prints current chart to the default printer.

Print all charts specified in path

```
sfprint('sf_car/shift_logic');
```

Prints the chart with the path ‘sf_car/shift_logic’ to the default printer.

Print chart specified in path to a JPG file format.

```
sfprint('sf_car/shift_logic','jpg')
```

Prints a copy of the chart ‘sf_car/shift_logic’ in JPG format to the file ‘sf_car_shift_logic.jpg’.

Print chart in TIFF format to the clipboard.

```
sfprint(gcs,'tiff','clipboard')
```

Prints the chart in the current system to the clipboard in TIFF format.

Print the current view of a chart.

```
sfprint('sf_car/shift_logic','png','file',0)
```

Prints the current view of ‘sf_car/shift_logic’ in a PNG format to the file ‘sf_car_shift_logic.png’.

Input Arguments

`objects` — Identifier of charts to print

`gcb` (default) | `gcs` | character vector

Identifier of charts to print. Use:

- `gcb` to specify the current block of the model.
- `gcs` to specify the current system of the model.
- a character vector to specify the path of a chart, model, subsystem, or block.

Example: `sfprint(gcs)`

Prints all the charts in the current system to the default printer.

Example: `sfprint('sf_pool/Pool')`

Prints the complete chart with the path `'sf_pool/Pool'` to the default printer.

`format` — Output format of printed charts

`'bitmap'` | `'jpg'` | `'meta'` | `'pdf'` | `'png'` | `'svg'` | `'tiff'`

Output format of the printed charts specified as one of these values:

`'bitmap'`	Save the chart image to the clipboard as a bitmap (for Windows® operating systems only)
`'jpg'`	Generate a JPEG file
`'meta'`	Save the chart image to the clipboard as an enhanced metafile (for Windows operating systems only)
`'pdf'`	Generate a PDF file
`'png'`	Generate a PNG file
`'svg'`	Generate an SVG file
`'tiff'`	Generate a TIFF file

Example: `sfprint('sf_car/shift_logic','jpg')`

Prints the complete chart `'sf_car/shift_logic'` in a JPEG format to a file in the current folder named `'sf_car_shift_logic.jpg'`.

Example: `sfprint('sf_bounce/BouncingBall','meta','myImage')`

Prints the complete chart `'sf_bounce/BouncingBall'` as an enhanced metafile in the current folder named `'myImage.emf'`.

Data Types: `char`

`outputOption` — Name of the printer or output file
`'file'` (default) | character vector | `'clipboard'` | `'promptForFile'` | `'printer'`

Name of the output file or printer specified as one of these values:

`'file'`	Send output to a default file with the name *`chart_name.file_extension`*. The file name is the name of the chart, with an extension that matches the output format.
character vector	Specify the name of the output file with a character vector.
`'clipboard'`	Copy output to the clipboard
`'promptForFile'`	Prompts the user interactively for path and file name.
`'printer'`	Send output to the default printer (use only with `'ps'`, or `'eps'` formats)

Example: `sfprint('sf_car/shift_logic','png','myFile')`

Prints the complete chart whose path is `'sf_car/shift_logic'` in the PNG format to a file in the current folder with the name `'myFile'.png`.

Example: `sfprint('sf_car/shift_logic,'pdf','promptForFile')`

Prints all charts in the current block of the model in PDF format. A dialog box opens for each chart to prompt you for the path and name of the output file.

Data Types: `char`

`wholeChart` — View of charts to print
1 (default) | 0

View of charts to print specified as a integer of value 0 or 1. A value of 1 prints the complete views of all the charts, whereas a value of 0 prints the current views of all the charts.

Example: `sfprint(gcs,'png','file',0)`

Prints the current view of all charts in the current system in PNG format using default file names.

See Also
`gcb` | `gcs` | `sfhelp` | `sfnew` | `sfsave` | `stateflow`

Introduced before R2006a

sfroot

Root of Stateflow hierarchy

Syntax

```
root = sfroot
```

Description

`root = sfroot` returns the `Simulink.Root` object at the top level of the Stateflow hierarchy of objects. Use the `Root` object to access all other API objects in your charts. For more information, see “Access Objects in Your Stateflow Chart”.

Examples

Zoom in on State in Chart

Open a Simulink model called `myModel`. Suppose that the model contains a Stateflow chart with a state named `A`.

```
open_system('myModel')
```

Access the `Simulink.Root` object at the top level of the Stateflow hierarchy.

```
rt = sfroot;
```

Find the state named `A`.

```
st = find(rt,'-isa','Stateflow.State','Name','A');
```

Zoom in on the state in the Stateflow Editor.

```
fitToView(st);
```

See Also

Functions
`find` | `fitToView` | `open_system`

Objects
`Stateflow.State`

Topics
“Overview of the Stateflow API”
“Access Objects in Your Stateflow Chart”
“Create Charts by Using the Stateflow API”

Introduced before R2006a

sfsave

Save chart in current folder

Syntax

```
sfsave
sfsave('model_name')
sfsave('model_name','new_model_name')
sfsave('Defaults')
```

Description

`sfsave` saves the chart in the current model.

`sfsave('`*`model_name`*`')` saves the chart in the model called `'`*`model_name`*`'`.

`sfsave('`*`model_name`*`','`*`new_model_name`*`')` saves the chart in `'`*`model_name`*`'` to `'`*`new_model_name`*`'`.

`sfsave('Defaults')` saves the settings of the current model as defaults.

The model must be open and the current folder must be writable.

Examples

Develop a script to create a baseline chart and save it in a new model:

```
bdclose('all');

% Create an empty chart in a new model
sfnew;

% Get root object
rt = sfroot;

% Get chart
ch = rt.find('-isa','Stateflow.Chart');

% Create two states, A and B, in the chart
sA = Stateflow.State(ch);
sA.Name = 'A';
sA.Position = [50 50 100 60];
sB = Stateflow.State(ch);
sB.Name = 'B';
sB.Position = [200 50 100 60];

% Add a transition from state A to state B
tAB = Stateflow.Transition(ch);
tAB.Source = sA;
tAB.Destination = sB;
tAB.SourceOClock = 3;
tAB.DestinationOClock = 9;
```

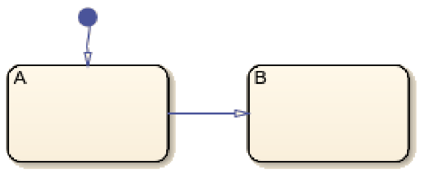
```
% Add a default transition to state A
dtA = Stateflow.Transition(ch);
dtA.Destination = sA;
dtA.DestinationOClock = 0;
x = sA.Position(1)+sA.Position(3)/2;
y = sA.Position(2)-30;
dtA.SourceEndPoint = [x y];

% Add an input in1
d1 = Stateflow.Data(ch);
d1.Scope = 'Input';
d1.Name = 'in1';

% Add an output out1
d2 = Stateflow.Data(ch);
d2.Scope = 'Output';
d2.Name = 'out1';

% Save the chart in a model called "NewModel" in current folder
sfsave('untitled','NewModel');
```

Here is the resulting chart:



See Also

find | sfclose | sfnew | sfopen | sfroot

Topics

"Create Charts by Using the Stateflow API"
"Create Charts by Using a MATLAB Script"

Introduced before R2006a

Simulink.sdi.compareRuns

Package: `Simulink.sdi`

Compare data in two simulation runs

Syntax

```
diffResult = Simulink.sdi.compareRuns(runID1,runID2)
diffResult = Simulink.sdi.compareRuns(runID1,runID2,Name,Value)
```

Description

`diffResult = Simulink.sdi.compareRuns(runID1,runID2)` compares the data in the runs that correspond to `runID1` and `runID2` and returns the result in the `Simulink.sdi.DiffRunResult` object `diffResult`. The comparison uses the Simulation Data Inspector comparison algorithm. For more information about the algorithm, see “How the Simulation Data Inspector Compares Data” (Simulink).

`diffResult = Simulink.sdi.compareRuns(runID1,runID2,Name,Value)` compares the simulation runs that correspond to `runID1` and `runID2` using the options specified by one or more `Name,Value` pair arguments. For more information about how the options can affect the comparison, see “How the Simulation Data Inspector Compares Data” (Simulink).

Examples

Compare Runs with Global Tolerance

You can specify global tolerance values to use when comparing two simulation runs. Global tolerance values are applied to all signals within the run. This example shows how to specify global tolerance values for a run comparison and how to analyze and save the comparison results.

First, load the session file that contains the data to compare. The session file contains data for four simulations of an aircraft longitudinal controller. This example compares data from two runs that use different input filter time constants.

```
Simulink.sdi.load('AircraftExample.mldatx');
```

To access the run data to compare, use the `Simulink.sdi.getAllRunIDs` (Simulink) function to get the run IDs that correspond to the last two simulation runs.

```
runIDs = Simulink.sdi.getAllRunIDs;
runID1 = runIDs(end - 1);
runID2 = runIDs(end);
```

Use the `Simulink.sdi.compareRuns` (Simulink) function to compare the runs. Specify a global relative tolerance value of `0.2` and a global time tolerance value of `0.5`.

```
runResult = Simulink.sdi.compareRuns(runID1,runID2,'reltol',0.2,'timetol',0.5);
```

Check the `Summary` property of the returned `Simulink.sdi.DiffRunResult` object to see whether signals were within the tolerance values or out of tolerance.

```
runResult.Summary
```

```
ans = struct with fields:
       OutOfTolerance: 0
      WithinTolerance: 3
            Unaligned: 0
        UnitsMismatch: 0
                Empty: 0
             Canceled: 0
          EmptySynced: 0
     DataTypeMismatch: 0
         TimeMismatch: 0
    StartStopMismatch: 0
          Unsupported: 0
```

All three signal comparison results fell within the specified global tolerance.

You can save the comparison results to an MLDATX file using the `saveResult` (Simulink) function.

```
saveResult(runResult,'InputFilterComparison');
```

Analyze Simulation Data Using Signal Tolerances

You can programmatically specify signal tolerance values to use in comparisons performed using the Simulation Data Inspector. In this example, you compare data collected by simulating a model of an aircraft longitudinal flight control system. Each simulation uses a different value for the input filter time constant and logs the input and output signals. You analyze the effect of the time constant change by comparing results using the Simulation Data Inspector and signal tolerances.

First, load the session file that contains the simulation data.

```
Simulink.sdi.load('AircraftExample.mldatx');
```

The session file contains four runs. In this example, you compare data from the first two runs in the file. Access the `Simulink.sdi.Run` objects for the first two runs loaded from the file.

```
runIDs = Simulink.sdi.getAllRunIDs;
runIDTs1 = runIDs(end-3);
runIDTs2 = runIDs(end-2);
```

Now, compare the two runs without specifying any tolerances.

```
noTolDiffResult = Simulink.sdi.compareRuns(runIDTs1,runIDTs2);
```

Use the `getResultByIndex` function to access the comparison results for the `q` and `alpha` signals.

```
qResult = getResultByIndex(noTolDiffResult,1);
alphaResult = getResultByIndex(noTolDiffResult,2);
```

Check the `Status` of each signal result to see whether the comparison result fell within our out of tolerance.

```
qResult.Status

ans = 
OutOfTolerance

alphaResult.Status

ans = 
OutOfTolerance
```

The comparison used a value of `0` for all tolerances, so the `OutOfTolerance` result means the signals are not identical.

You can further analyze the effect of the time constant by specifying tolerance values for the signals. Specify the tolerances by setting the properties for the `Simulink.sdi.Signal` objects that correspond to the signals being compared. Comparisons use tolerances specified for the baseline signals. This example specifies a time tolerance and an absolute tolerance.

To specify a tolerance, first access the `Signal` objects from the baseline run.

```
runTs1 = Simulink.sdi.getRun(runIDTs1);
qSig = getSignalsByName(runTs1,'q, rad/sec');
alphaSig = getSignalsByName(runTs1,'alpha, rad');
```

Specify an absolute tolerance of `0.1` and a time tolerance of `0.6` for the `q` signal using the `AbsTol` and `TimeTol` properties.

```
qSig.AbsTol = 0.1;
qSig.TimeTol = 0.6;
```

Specify an absolute tolerance of `0.2` and a time tolerance of `0.8` for the `alpha` signal.

```
alphaSig.AbsTol = 0.2;
alphaSig.TimeTol = 0.8;
```

Compare the results again. Access the results from the comparison and check the `Status` property for each signal.

```
tolDiffResult = Simulink.sdi.compareRuns(runIDTs1,runIDTs2);
qResult2 = getResultByIndex(tolDiffResult,1);
alphaResult2 = getResultByIndex(tolDiffResult,2);

qResult2.Status

ans = 
WithinTolerance

alphaResult2.Status

ans = 
WithinTolerance
```

Configure Comparisons to Check Metadata

You can use the `Simulink.sdi.compareRuns` function to compare signal data and metadata, including data type and start and stop times. A single comparison may check for mismatches in one or more pieces of metadata. When you check for mismatches in signal metadata, the `Summary` property of the `Simulink.sdi.DiffRunResult` object may differ from a basic comparison because the `Status` property for a `Simulink.sdi.DiffSignalResult` object can indicate the metadata mismatch. You can configure comparisons using the `Simulink.sdi.compareRuns` function for imported data and for data logged from a simulation.

This example configures a comparison of runs created from workspace data three ways to show how the `Summary` of the `DiffSignalResult` object can provide specific information about signal mismatches.

Create Workspace Data

The `Simulink.sdi.compareRuns` function compares time series data. Create data for a sine wave to use as the baseline signal, using the `timeseries` format. Give the `timeseries` the name `Wave Data`.

```
time = 0:0.1:20;
sig1vals = sin(2*pi/5*time);
sig1_ts = timeseries(sig1vals,time);
sig1_ts.Name = 'Wave Data';
```

Create a second sine wave to compare against the baseline signal. Use a slightly different time vector and attenuate the signal so the two signals are not identical. Cast the signal data to the `single` data type. Also name this `timeseries` object `Wave Data`. The Simulation Data Inspector comparison algorithm will align these signals for comparison using the name.

```
time2 = 0:0.1:22;
sig2vals = single(0.98*sin(2*pi/5*time2));
sig2_ts = timeseries(sig2vals,time2);
sig2_ts.Name = 'Wave Data';
```

Create and Compare Runs in the Simulation Data Inspector

The `Simulink.sdi.compareRuns` function compares data contained in `Simulink.sdi.Run` objects. Use the `Simulink.sdi.createRun` function to create runs in the Simulation Data Inspector for the data. The `Simulink.sdi.createRun` function returns the run ID for each created run.

```
runID1 = Simulink.sdi.createRun('Baseline Run','vars',sig1_ts);
runID2 = Simulink.sdi.createRun('Compare to Run','vars',sig2_ts);
```

You can use the `Simulink.sdi.compareRuns` function to compare the runs. The comparison algorithm converts the signal data to the `double` data type and synchronizes the signal data before computing the difference signal.

```
basic_DRR = Simulink.sdi.compareRuns(runID1,runID2);
```

Check the `Summary` property of the returned `Simulink.sdi.DiffRunResult` object to see the result of the comparison.

```
basic_DRR.Summary
```

```
ans = struct with fields:
       OutOfTolerance: 1
      WithinTolerance: 0
            Unaligned: 0
         UnitsMismatch: 0
```

```
             Empty: 0
          Canceled: 0
       EmptySynced: 0
  DataTypeMismatch: 0
      TimeMismatch: 0
 StartStopMismatch: 0
       Unsupported: 0
```

The difference between the signals is out of tolerance.

Compare Runs and Check for Data Type Match

Depending on your system requirements, you may want the data types for signals you compare to match. You can use the `Simulink.sdi.compareRuns` function to configure the comparison algorithm to check for and report data type mismatches.

```
dataType_DRR = Simulink.sdi.compareRuns(runID1,runID2,'DataType','MustMatch');
dataType_DRR.Summary
```

```
ans = struct with fields:
      OutOfTolerance: 0
     WithinTolerance: 0
           Unaligned: 0
       UnitsMismatch: 0
               Empty: 0
            Canceled: 0
         EmptySynced: 0
    DataTypeMismatch: 1
        TimeMismatch: 0
   StartStopMismatch: 0
         Unsupported: 0
```

The result of the signal comparison is now `DataTypeMismatch` because the data for the baseline signal is `double` data type, while the data for the signal compared to the baseline is `single` data type.

Compare Runs and Check for Start and Stop Time Match

You can use the `Simulink.sdi.compareRuns` function to configure the comparison algorithm to check whether the aligned signals have the same start and stop times.

```
startStop_DRR = Simulink.sdi.compareRuns(runID1,runID2,'StartStop','MustMatch');
startStop_DRR.Summary
```

```
ans = struct with fields:
      OutOfTolerance: 0
     WithinTolerance: 0
           Unaligned: 0
       UnitsMismatch: 0
               Empty: 0
            Canceled: 0
         EmptySynced: 0
    DataTypeMismatch: 0
        TimeMismatch: 0
   StartStopMismatch: 1
         Unsupported: 0
```

The signal comparison result is now `StartStopMismatch` because the signals created in the workspace have different stop times.

Compare Runs with Alignment Criteria

When you compare runs using the Simulation Data Inspector, you can specify alignment criteria that determine how signals are paired with each other for comparison. This example compares data from simulations of a model of an aircraft longitudinal control system. The simulations used a square wave input. The first simulation used an input filter time constant of `0.1s` and the second simulation used an input filter time constant of `0.5s`.

First, load the simulation data from the session file that contains the data for this example.

```
Simulink.sdi.load('AircraftExample.mldatx');
```

The session file contains data for four simulations. This example compares data from the first two runs. Access the run IDs for the first two runs loaded from the session file.

```
runIDs = Simulink.sdi.getAllRunIDs;
runIDTs1 = runIDs(end-3);
runIDTs2 = runIDs(end-2);
```

Before running the comparison, define how you want the Simulation Data Inspector to align the signals between the runs. This example aligns signals by their name, then by their block path, and then by their Simulink identifier.

```
alignMethods = [Simulink.sdi.AlignType.SignalName
               Simulink.sdi.AlignType.BlockPath
               Simulink.sdi.AlignType.SID];
```

Compare the simulation data in your two runs, using the alignment criteria you specified. The comparison uses a small time tolerance to account for the effect of differences in the step size used by the solver on the transition of the square wave input.

```
diffResults = Simulink.sdi.compareRuns(runIDTs1,runIDTs2,'align',alignMethods,...
    'timetol',0.005);
```

You can use the `getResultByIndex` function to access the comparison results for the aligned signals in the runs you compared. You can use the `Count` property of the `Simulink.sdi.DiffRunResult` object to set up a `for` loop to check the `Status` property for each `Simulink.sdi.DiffSignalResult` object.

```
numComparisons = diffResults.count;

for k = 1:numComparisons
    resultAtIdx = getResultByIndex(diffResults,k);

    sigID1 = resultAtIdx.signalID1;
    sigID2 = resultAtIdx.signalID2;

    sig1 = Simulink.sdi.getSignal(sigID1);
    sig2 = Simulink.sdi.getSignal(sigID2);

    displayStr = 'Signals %s and %s: %s \n';
    fprintf(displayStr,sig1.Name,sig2.Name,resultAtIdx.Status);
end
```

```
Signals q, rad/sec and q, rad/sec: OutOfTolerance
Signals alpha, rad and alpha, rad: OutOfTolerance
Signals Stick and Stick: WithinTolerance
```

Input Arguments

`runID1` — Baseline run identifier
integer

Numeric identifier for the baseline run in the comparison, specified as a run ID that corresponds to a run in the Simulation Data Inspector. The Simulation Data Inspector assigns run IDs when runs are created. You can get the run ID for a run by using the `ID` property of the `Simulink.sdi.Run` object, the `Simulink.sdi.getAllRunIDs` function, or the `Simulink.sdi.getRunIDByIndex` function.

`runID2` — Identifier for run to compare
integer

Numeric identifier for the run to compare, specified as a run ID that corresponds to a run in the Simulation Data Inspector. The Simulation Data Inspector assigns run IDs when runs are created. You can get the run ID for a run by using the `ID` property of the `Simulink.sdi.Run` object, the `Simulink.sdi.getAllRunIDs` function, or the `Simulink.sdi.getRunIDByIndex` function.

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'abstol',x,'align',alignOpts`

`Align` — Signal alignment options
string array | character vector array

Signal alignment options, specified as the comma-separated pair consisting of `'Align'` and a string array or array of character vectors.

Array specifying alignment options to use for pairing signals from the runs being compared. The Simulation Data Inspector aligns signals first by the first element in the array, then by the second element in the array, and so on. For more information, see “Signal Alignment” (Simulink).

Value	Aligns By
`Simulink.sdi.AlignType.BlockPath`	Path to the source block for the signal
`Simulink.sdi.AlignType.SID`	Simulink identifier “Simulink Identifiers” (Simulink)
`Simulink.sdi.AlignType.SignalName`	Signal name
`Simulink.sdi.AlignType.DataSource`	Path of the variable in the MATLAB workspace

Example: `[Simulink.sdi.AlignType.SignalName,Simulink.sdi.AlignType.SID]` specifies signal alignment by name and then by SID.

`AbsTol` — Absolute tolerance for comparison
`0` (default) | scalar

Positive-valued global absolute tolerance used for all signals in the run comparison, specified as the comma-separated pair consisting of `'AbsTol'` and a scalar. For more information about how tolerances are used in comparisons, see “Tolerance Specification” (Simulink).

Example: `0.5`

Data Types: `double`

`RelTol` — Relative tolerance for comparison
`0` (default) | scalar

Positive-valued global relative tolerance used for all signals in the run comparison, specified as the comma-separated pair consisting of `'RelTol'` and a scalar. The relative tolerance is expressed as a fractional multiplier. For example, `0.1` specifies a 10 percent tolerance. For more information about how the relative tolerance is applied in the Simulation Data Inspector, see “Tolerance Specification” (Simulink).

Example: `0.1`

Data Types: `double`

`TimeTol` — Time tolerance for comparison
`0` (default) | scalar

Positive-valued global time tolerance used for all signals in the run comparison, specified as the comma-separated pair consisting of `'TimeTol'` and a scalar. Specify the time tolerance in units of seconds. For more information about tolerances in the Simulation Data Inspector, see “Tolerance Specification” (Simulink).

Example: `0.2`

Data Types: `double`

`DataType` — Comparison sensitivity to signal data types
`'MustMatch'`

Specify the name-value pair `'DataType','MustMatch'` when you want the comparison to be sensitive to data type mismatches in compared signals. When you specify this name-value pair, the algorithm compares the data types for aligned signals before synchronizing and comparing the signal data.

The `Simulink.sdi.compareRuns` function does not compare the data types of aligned signals unless you specify this name-value pair. The comparison algorithm can compare signals with different data types.

When signal data types do not match, the `Status` property of the `Simulink.sdi.DiffSignalResult` object for the result is set to `DataTypeMismatch`.

When you specify that data types must match and configure the comparison to stop on the first mismatch, a data type mismatch stops the comparison. A stopped comparison may not compute results for all signals.

`Time` — Comparison sensitivity to signal time vectors
`'MustMatch'`

Specify the name-value pair `'Time','MustMatch'` when you want the comparison to be sensitive to mismatches in the time vectors of compared signals. When you specify this name-value pair, the algorithm compares the time vectors of aligned signals before synchronizing and comparing the signal data.

Comparisons are not sensitive to differences in signal time vectors unless you specify this name-value pair. For comparisons that are not sensitive to differences in the time vectors, the comparison algorithm synchronizes the signals prior to the comparison. For more information about how synchronization works, see "How the Simulation Data Inspector Compares Data" (Simulink).

When the time vectors for signals do not match, the `Status` property of the `Simulink.sdi.DiffSignalResult` object for the result is set to `TimeMismatch`.

When you specify that time vectors must match and configure the comparison to stop on the first mismatch, a time vector mismatch stops the comparison. A stopped comparison may not compute results for all signals.

`StartStop` — Comparison sensitivity to signal start and stop times
`'MustMatch'`

Specify the name-value pair `'StartStop','MustMatch'` when you want the comparison to be sensitive to mismatches in signal start and stop times. When you specify this name-value pair, the algorithm compares the start and stop times for aligned signals before synchronizing and comparing the signal data.

When the start times and stop times do not match, the `Status` property of the `Simulink.sdi.DiffSignalResult` object for the result is set to `StartStopMismatch`.

When you specify that start and stop times must match and configure the comparison to stop on the first mismatch, a start or stop time mismatch stops the comparison. A stopped comparison may not compute results for all signals.

`StopOnFirstMismatch` — Whether comparison stops on first detected mismatch
`'Metadata'` | `'Any'`

Whether the comparison stops without comparing remaining signals on the first detected mismatch, specified as the comma-separated pair consisting of `'StopOnFirstMismatch'` and `'Metadata'` or `'Any'`. A stopped comparison may not compute results for all signals, and can return a mismatched result more quickly.

- `Metadata` — A mismatch in metadata for aligned signals causes the comparison to stop. Metadata comparisons happen before comparing signal data.

  The Simulation Data Inspector always aligns signals and compares signal units. When you configure the comparison to stop on the first mismatch, an unaligned signal or mismatched units always causes the comparison to stop. You can specify additional name-value pairs to configure the comparison to check and stop on the first mismatch for additional metadata, such as signal data type, start and stop times, and time vectors.
- `Any` — A mismatch in metadata or signal data for aligned signals causes the comparison to stop.

Output Arguments

`diffResult` — Comparison results
`Simulink.sdi.DiffRunResult`

Comparison results, returned as a `Simulink.sdi.DiffRunResult` object.

Limitations

The Simulation Data Inspector does not support comparing:

- Signals of data types `int64` or `uint64`.
- Variable-size signals.

See Also

`Simulink.sdi.DiffRunResult` | `Simulink.sdi.DiffSignalResult` | `Simulink.sdi.compareSignals` | `Simulink.sdi.getRunCount` | `Simulink.sdi.getRunIDByIndex` | `getResultByIndex`

Topics

“Inspect and Compare Data Programmatically” (Simulink)
“Compare Simulation Data” (Simulink)
“How the Simulation Data Inspector Compares Data” (Simulink)

Introduced in R2011b

stateflow

Open Stateflow library window and create Simulink model that contains an empty chart

Syntax

```
stateflow
```

Description

`stateflow` creates an untitled Simulink model that contains an empty Stateflow chart. The function also opens the Stateflow block library. From this library, you can drag Stateflow blocks into models or access the Stateflow Examples Library.

Tips

- To only create a Simulink model that contains an empty Stateflow block, use the `sfnew` function.
- To only open the Stateflow block library, use the `sflib` function.
- To create a standalone chart that you can execute as a MATLAB object, open the Stateflow editor by using the `edit` function. For example, at the MATLAB Command Window, enter:

  ```
  edit chart.sfx
  ```

  For more information, see “Create Stateflow Charts for Execution as MATLAB Objects”.

Compatibility Considerations

Opening Stateflow
Behavior change in future release

The behavior of the `stateflow` function will change in a future release. Use `sfnew` and `sflib` instead.

See Also

`edit` | `sflib` | `sfnew`

Introduced before R2006a

Stateflow.exportAsClass

Export MATLAB class for standalone chart

Syntax

```
Stateflow.exportAsClass(source)
Stateflow.exportAsClass(source,destination)
```

Description

`Stateflow.exportAsClass(source)` saves a standalone Stateflow chart as a MATLAB class file in the current folder. The saved file has the same name as the chart. For example, if `source` is `chart.sfx`, the function saves the MATLAB class in the file `chart.m`.

`Stateflow.exportAsClass(source,destination)` saves the chart as a MATLAB class file in the folder `destination`.

Note The MATLAB class produced by `Stateflow.exportAsClass` is intended for debugging purposes only, and not for production use or manual modification. For more information, see “Tips” on page 2-39.

Examples

Export Chart in Current Folder

Save Stateflow chart `chart.sfx` as the MATLAB class file `chart.m` in the current folder.

```
Stateflow.exportAsClass('chart.sfx');
```

Export Chart in Folder Specified by Path

Save Stateflow chart `chart.sfx`, which is located in folder `dir1`, as the MATLAB class file `chart.m` in the current folder.

```
Stateflow.exportAsClass(fullfile('dir1','chart.sfx'));
```

Export Chart to MATLAB Class in Another Folder

Save Stateflow chart `chart.sfx`, which is located in the current folder, as the MATLAB class file `chart.m` in the folder `dir2`.

```
Stateflow.exportAsClass('chart.sfx','dir2');
```

Input Arguments

`source` — Path and file name of standalone Stateflow chart
character vector | string scalar

Path and file name of a standalone chart, specified as a string scalar or character vector. You can use the absolute path from the root folder or the relative path from the current folder. Standalone charts have the extension `.sfx`.

Data Types: `char` | `string`

`destination` — Path of destination folder for MATLAB class file
character vector | string scalar

Path of the destination folder for the MATLAB class file, specified as a string scalar or character vector. You can use the absolute path from the root folder or the relative path from the current folder. If not specified, the function saves the MATLAB script file in the current folder.

Data Types: `char` | `string`

Tips

- Use the code produced by `Stateflow.exportAsClass` to debug run-time errors that are otherwise difficult to diagnose. For example, suppose that you encounter an error while executing a Stateflow chart that controls a MATLAB application. If you export the chart as a MATLAB class file, you can replace the chart with the class in your application and diagnose the error by using the MATLAB debugger.

  Note Error messages produced by the MATLAB class point to different line numbers than the corresponding error messages produced by the Stateflow chart.

- When you execute the MATLAB class produced by `Stateflow.exportAsClass`, the Stateflow Editor does not animate the original chart.

See Also

`fullfile`

Topics

“Create Stateflow Charts for Execution as MATLAB Objects”

Introduced in R2019b

Stateflow.exportToVersion

Export standalone chart for use in previous version of Stateflow

Syntax

```
exported_file = Stateflow.exportToVersion(source,file_name,version)
```

Description

`exported_file = Stateflow.exportToVersion(source,file_name,version)` exports the chart `source` to a file named `file_name` in a format that the specified previous Stateflow `version` can load. You can only export to R2019a and later releases.

Examples

Export Chart to an Earlier Version of MATLAB

To complete the export process, you need access to the versions of Stateflow from which and to which you are exporting.

Using the later version of Stateflow, convert the standalone chart `chart.sfx`.

```
edit chart.sfx
Stateflow.exportToVersion('chart','chart_19a.sfx','R2019a')
```

Using the earlier version of Stateflow, open and resave the exported chart.

```
edit chart_19a.sfx
sfsave chart_19a
```

Input Arguments

`source` — Chart to export
character vector | string scalar

Chart to export, specified as a string scalar or character vector, without any file extension. The chart must be open in the Stateflow Editor and have no unsaved changes.

Example: `'chart'`

Data Types: `char` | `string`

`file_name` — Exported file name
character vector | string scalar

Exported file name, specified as a string scalar or character vector. The exported file must not have the same name as the source chart.

Example: `'chart_19a.sfx'`

Data Types: `char` | `string`

`version` — MATLAB release name
`'R2019a'` | `'R2019b'` | ...

MATLAB release name, specified as a string scalar or character vector. Release names are case sensitive. You can only export to R2019a and later releases.

Data Types: `char` | `string`

Output Arguments

`exported_file` — Absolute path to exported file
character vector

Absolute path to exported file, returned as a character vector.

Tips

Attempting to execute an exported chart before resaving it will result in an error.

See Also

`edit` | `sfsave`

Topics
"Create Stateflow Charts for Execution as MATLAB Objects"

Introduced in R2020a

Operators

after

Execute chart after event broadcast or specified time

Syntax

```
after(n,E)
after(n,tick)
after(n,time_unit)
```

Description

`after(n,E)` returns `true` if the event `E` has occurred at least `n` times since the associated state became active. Otherwise, the operator returns `false`.

`after(n,tick)` returns `true` if the chart has woken up at least `n` times since the associated state became active. Otherwise, the operator returns `false`.

The implicit event `tick` is not supported when a Stateflow chart in a Simulink model has input events.

`after(n,time_unit)` returns `true` if at least `n` units of time have elapsed since the associated state became active. Otherwise, the operator returns `false`.

In charts in a Simulink model, specify `time_unit` as seconds (`sec`), milliseconds (`msec`), or microseconds (`usec`). If you specify `n` as an expression, the chart adjusts the temporal delay as the expression changes value during the simulation.

In standalone charts in MATLAB, specify `n` with a value greater than or equal to `0.001` and `time_unit` as seconds (`sec`). The operator creates a MATLAB `timer` object that generates an implicit event to wake up the chart. MATLAB `timer` objects are limited to 1 millisecond precision. For more information, see “Events in Standalone Charts”.

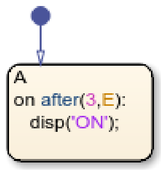
- The `timer` object is created when the chart finishes executing the `entry` actions of the associated state and its substates. If you specify `n` as an expression whose value changes during chart execution, the chart does not adjust the temporal delay of the `timer` object.
- The `timer` object starts running at the end of the chart step when the associated state becomes active. This step can include the execution of other parallel states in the chart.
- If the chart is processing another operation when it receives the implicit event from the `timer` object, the chart queues the event. When the current step is completed, the chart processes the event.
- If the state associated with the temporal logic operator becomes inactive before the chart processes the implicit event, the event does not wake up the chart.

Examples

Execute State Action on Event Broadcast

Display a status message when the chart processes a broadcast of the event E, starting on the third broadcast of E after the state became active.

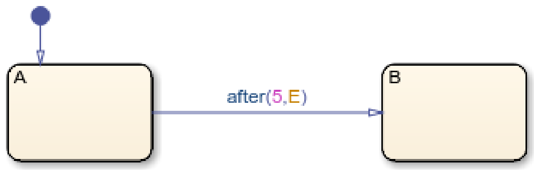
```
on after(3,E):
   disp('ON');
```



Trigger Transition on Event Broadcast

Transition out of the associated state when the chart processes a broadcast of the event E, starting on the fifth broadcast of E after the state became active.

```
after(5,E)
```

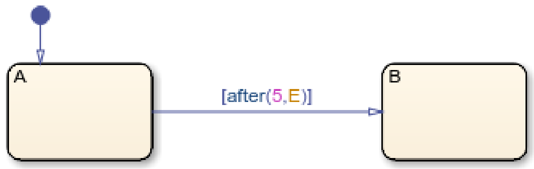


Guard Transition with Temporal Condition

Transition out of the associated state if the state has been active for at least five broadcasts of the event E.

In charts in a Simulink model, enter:

```
[after(5,E)]
```

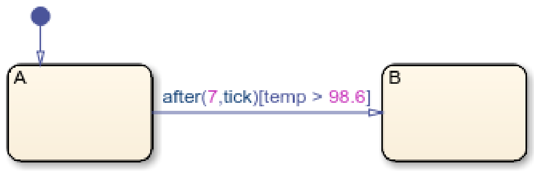


Conditional notation for temporal logic operators is not supported in standalone charts in MATLAB.

Trigger Transition on Chart Execution

Transition out of the associated state when the chart wakes up for at least the seventh time since the state became active, but only if the variable `temp` is greater than 98.6.

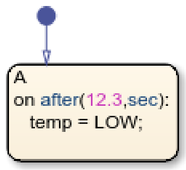
```
after(7,tick)[temp > 98.6]
```



Execute State Action After Specified Time

Set the `temp` variable to `LOW` every time that the chart wakes up, starting when the associated state is active for at least 12.3 seconds.

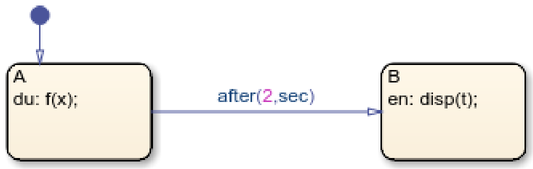
```
on after(12.3,sec):
   temp = LOW;
```



Tips

- You can use quotation marks to enclose the keywords `'tick'`, `'sec'`, `'msec'`, and `'usec'`. For example, `after(5,'tick')` is equivalent to `after(5,tick)`.
- The Stateflow chart resets the counter used by the `after` operator each time the associated state reactivates.
- The timing for absolute-time temporal logic operators depends on the type of Stateflow chart:
  - Charts in a Simulink model define absolute-time temporal logic in terms of simulation time.
  - Standalone charts in MATLAB define absolute-time temporal logic in terms of wall-clock time, which is limited to 1 millisecond precision.

  The difference in timing can affect the behavior of a chart. For example, suppose that this chart is executing the `during` action of state `A`.



- In a Simulink model, the function call to `f` executes in a single time step and does not contribute to the simulation time. The transition from state `A` to state `B` occurs the first time the chart wakes up and state `A` has been active for at least 2 seconds. The value displayed by the `entry` action in state `B` depends only on the step size used by the Simulink solver.
- In a standalone chart, the function call to `f` can take several seconds of wall-clock time to complete. If the call lasts more than two seconds, the chart queues the implicit event associated with the `after` operator. The transition from state `A` to state `B` occurs when the function `f` finishes executing. The value displayed by the `entry` action in state `B` depends on the time the function call to `f` takes to complete.

See Also
at | before | every | `timer`

Topics
"Control Chart Execution by Using Temporal Logic"
"Use Events to Execute Charts"
"Control Chart Behavior by Using Implicit Events"

Introduced in R2014b

ascii2str

Convert array of type `uint8` to string

Syntax

```
dest = ascii2str(A)
```

Description

`dest = ascii2str(A)` converts ASCII values in array `A` of type `uint8` to a string.

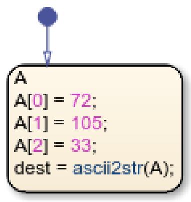
Note The operator `ascii2str` is supported only in Stateflow charts that use C as the action language.

Examples

Array of Type `uint8` to String

Return string `"Hi!"`.

```
A[0] = 72;
A[1] = 105;
A[2] = 33;
dest = ascii2str(A);
```



```
A
A[0] = 72;
A[1] = 105;
A[2] = 33;
dest = ascii2str(A);
```

See Also

str2ascii | strcpy

Topics

“Manage Textual Information by Using Strings”
“Share String Data with Custom C Code”

Introduced in R2018b

at

Execute chart at event broadcast or specified time

Syntax

```
at(n,E)
at(n,tick)
at(n,sec)
```

Description

`at(n,E)` returns `true` if the event `E` has occurred exactly `n` times since the associated state became active. Otherwise, the operator returns `false`.

`at(n,tick)` returns `true` if the chart has woken up exactly `n` times since the associated state became active. Otherwise, the operator returns `false`.

The implicit event `tick` is not supported when a Stateflow chart in a Simulink model has input events.

`at(n,sec)` returns `true` if exactly `n` seconds have elapsed since the associated state became active. Otherwise, the operator returns `false`.

In standalone charts in MATLAB, specify `n` with a value greater than or equal to `0.001`. The operator creates a MATLAB `timer` object that generates an implicit event to wake up the chart. MATLAB `timer` objects are limited to 1 millisecond precision. For more information, see “Events in Standalone Charts”.

- The `timer` object is created when the chart finishes executing the `entry` actions of the associated state and its substates. If you specify `n` as an expression whose value changes during chart execution, the chart does not adjust the temporal delay of the `timer` object.
- The `timer` object starts running at the end of the chart step when the associated state becomes active. This step can include the execution of other parallel states in the chart.
- If the chart is processing another operation when it receives the implicit event from the `timer` object, the chart queues the event. When the current step is completed, the chart processes the event.
- If the state associated with the temporal logic operator becomes inactive before the chart processes the implicit event, the event does not wake up the chart.

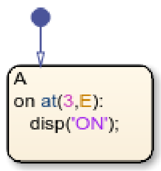
Note Using `at` as an absolute-time temporal logic operator is supported only in standalone charts in MATLAB. For charts in Simulink models, use the `after` operator instead. For more information, see “Do Not Use at for Absolute-Time Temporal Logic in Charts in Simulink Models”.

Examples

Execute State Action on Event Broadcast

Display a status message when the chart processes the third broadcast of the event E after the state became active.

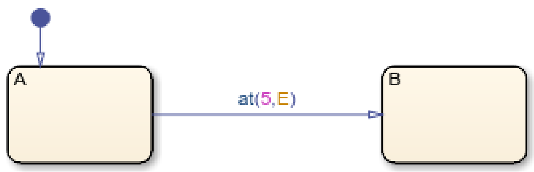
```
on at(3,E):
   disp('ON');
```



Trigger Transition on Event Broadcast

Transition out of the associated state when the chart processes the fifth broadcast of the event E after the state became active.

```
at(5,E)
```

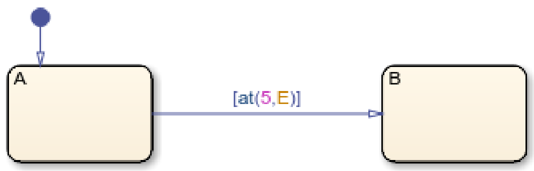


Guard Transition with Temporal Condition

Transition out of the associated state if the state has been active for exactly five broadcasts of the event E.

In charts in a Simulink model, enter:

```
[at(5,E)]
```

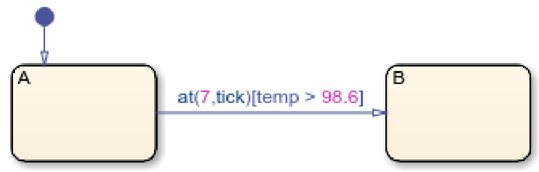


Conditional notation for temporal logic operators is not supported in standalone charts in MATLAB.

Trigger Transition on Chart Execution

Transition out of the associated state when the chart wakes up for the seventh time since the state became active, but only if the variable `temp` is greater than 98.6.

```
at(7,tick)[temp > 98.6]
```

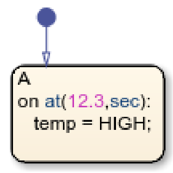


Execute State Action at Specified Time

Set the `temp` variable to `HIGH` if the state has been active for exactly 12.3 seconds.

In standalone charts in MATLAB, enter:

```
on at(12.3,sec):
   temp = HIGH;
```



Using `every` as an absolute-time temporal logic operator is not supported in charts in Simulink models.

Tips

- You can use quotation marks to enclose the keywords `'tick'` and `'sec'`. For example, `at(5,'tick')` is equivalent to `at(5,tick)`.
- The Stateflow chart resets the counter used by the `at` operator each time the associated state reactivates.
- Standalone charts in MATLAB define absolute-time temporal logic in terms of wall-clock time, which is limited to 1 millisecond precision.

See Also

after | before | every | `timer`

Topics

"Control Chart Execution by Using Temporal Logic"
"Use Events to Execute Charts"
"Control Chart Behavior by Using Implicit Events"

Introduced in R2014b

before

Execute chart before event broadcast or specified time

Syntax

```
before(n,E)
before(n,tick)
before(n,time_unit)
```

Description

`before(n,E)` returns `true` if the event `E` has occurred fewer than `n` times since the associated state became active. Otherwise, the operator returns `false`.

`before(n,tick)` returns `true` if the chart has woken up fewer than `n` times since the associated state became active. Otherwise, the operator returns `false`.

The implicit event `tick` is not supported when a Stateflow chart in a Simulink model has input events.

`before(n,time_unit)` returns `true` if fewer than `n` units of time have elapsed since the associated state became active. Otherwise, the operator returns `false`.

Specify `time_unit` as seconds (`sec`), milliseconds (`msec`), or microseconds (`usec`). If you specify `n` as an expression, the chart adjusts the temporal delay as the expression changes value during the simulation.

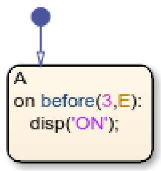
Note The temporal logic operator `before` is supported only in Stateflow charts in Simulink models.

Examples

Execute State Action on Event Broadcast

Display a status message when the chart processes the first and second broadcasts of the event `E` after the state became active.

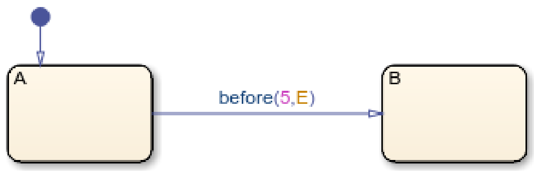
```
on before(3,E):
   disp('ON');
```



Trigger Transition on Event Broadcast

Transition out of the associated state when the chart processes a broadcast of the event E, but only if the state has been active for fewer than five broadcasts of E.

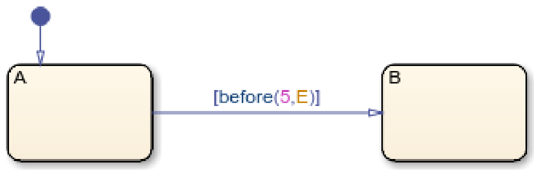
```
before(5,E)
```



Guard Transition with Temporal Condition

Transition out of the associated state if the state has been active for fewer than five broadcasts of the event E.

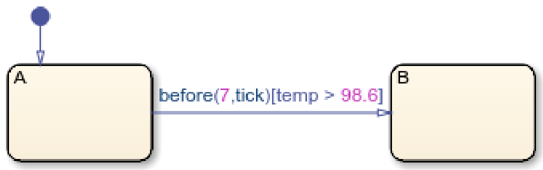
```
[before(5,E)]
```



Trigger Transition on Chart Execution

Transition out of the associated state when the chart wakes up, but only if the variable temp is greater than 98.6 and the chart has woken up fewer than seven times since the state became active.

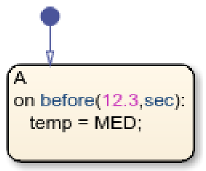
```
before(7,tick)[temp > 98.6]
```



Execute State Action Before Specified Time

Set the temp variable to MED every time that the chart wakes up, but only if the associated state has been active for fewer 12.3 seconds.

```
on before(12.3,sec):
   temp = MED;
```



Tips

- You can use quotation marks to enclose the keywords `'tick'`, `'sec'`, `'msec'`, and `'usec'`. For example, `before(5,'tick')` is equivalent to `before(5,tick)`.
- The Stateflow chart resets the counter used by the `before` operator each time the associated state reactivates.

See Also

after | at | every

Topics

"Control Chart Execution by Using Temporal Logic"

Introduced in R2014b

change, chg

Generate implicit event when data changes value

Syntax

```
change(data_name)
chg(data_name)
```

Description

`change(data_name)` generates an implicit local event when the chart sets the value of the variable `data_name`. If more than one data object has the same name, use dot notation to specify the name of the data object. For more information, see “Identify Data by Using Dot Notation”.

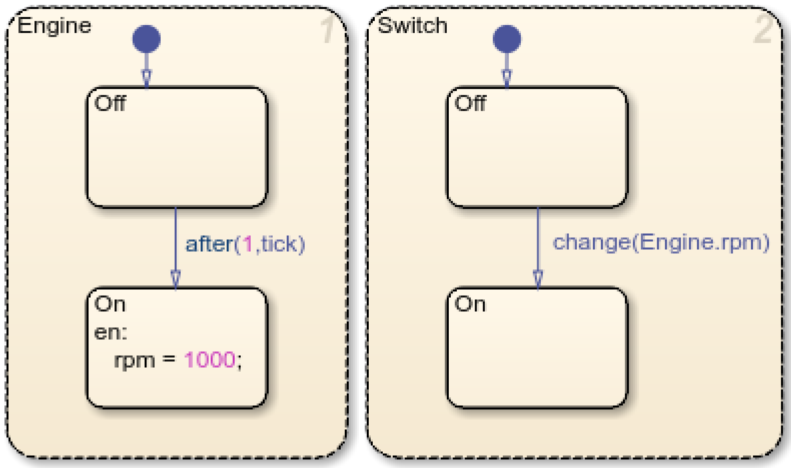
`chg(data_name)` is an alternative way to execute `change(data_name)`.

Examples

Implicit Event When Data Changes Value

Define an implicit local event when a state or transition action writes a value to the variable `Engine.rpm`.

```
change(Engine.rpm)
```



Tips

- The `change` operator is supported only in Stateflow charts in Simulink models.
- The `change` operator only works with data at the chart level or lower in the chart hierarchy. To determine when the value of machine-parented data changes, use change detection operators. For more information, see “Detect Changes in Data Values”.

See Also

hasChanged | hasChangedFrom | hasChangedTo

Topics

“Control Chart Behavior by Using Implicit Events”
“Use Events to Execute Charts”
“Detect Changes in Data Values”

Introduced before R2006a

count

Chart executions during which condition is valid

Syntax

```
count(C)
```

Description

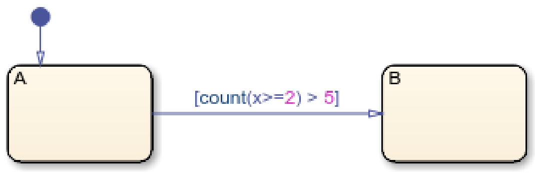
`count(C)` returns the number of times that the chart has woken up since the conditional expression `C` became `true` and the associated state became active.

Examples

Guard Transition with Temporal Condition

Transition out of the associated state when the variable `x` has been greater than or equal to 2 for longer than five chart executions.

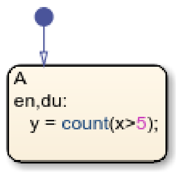
```
[count(x>=2) > 5]
```



Determine Number of Chart Executions

Store the number of chart executions since the variable `x` became greater than 5.

```
en,du:
   y = count(x>5);
```



Tips

- The Stateflow chart resets the value of the `count` operator if the conditional expression becomes `false` or if the associated state becomes inactive.

- When a chart in a Simulink model does not have input events, the value of `count` depends on the step size. Changing the solver or step size for the model affects the results produced by the `count` operator.
- To ensure that your Stateflow chart simulates without error, do not use count in these objects:
  - Continuous time charts
  - Graphical, MATLAB, or Simulink functions
  - Simulink based states
  - Transitions that can be reached from multiple states
  - Default transitions

See Also
duration | elapsed | temporalCount

Topics
"Control Chart Execution by Using Temporal Logic"

Introduced in R2019a

discard

Discard message

Syntax

```
discard(message_name)
```

Description

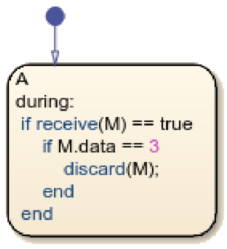
`discard(message_name)` discards a valid input or local message. After a chart discards a message, it can remove another message from the queue in the same time step. A chart cannot access the data of a discarded message.

Examples

Discard Message in State Action

Check the queue for message `M`. If a message is present, remove it from the queue. If the message has a data value equal to 3, discard the message.

```
during:
   if receive(M) == true
      if M.data == 3
         discard(M);
      end
   end
```



```
A
during:
 if receive(M) == true
    if M.data == 3
       discard(M);
    end
 end
```

See Also

receive

Topics

"Control Message Activity in Stateflow Charts"

Introduced in R2018b

duration

Time during which condition is valid

Syntax

```
duration(C,time_unit)
duration(C)
```

Description

`duration(C,time_unit)` returns the length of time that has elapsed since the conditional expression `C` became `true` and the associated state became active. Specify time in seconds (`sec`), milliseconds (`msec`), or microseconds (`usec`).

`duration(C)` is an alternative way to execute `duration(C,sec)`.

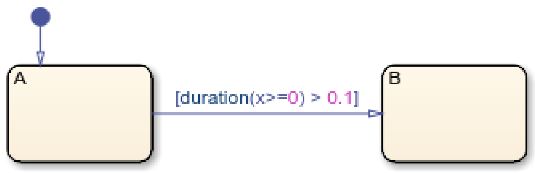
Note The temporal logic operator `duration` is not supported in standalone charts in MATLAB.

Examples

Guard Transition with Temporal Condition

Transition out of the state when the variable `x` has been greater than or equal to 0 for longer than 0.1 seconds.

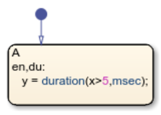
```
[duration(x>=0) > 0.1]
```



Determine Elapsed Time

Store the number of milliseconds since the variable `x` became greater than 5 and the state became active.

```
en,du:
   y = duration(x>5,msec);
```



Tips

- You can use quotation marks to enclose the keywords `'sec'`, `'msec'`, and `'usec'`. For example, `duration('sec')` is equivalent to `duration(sec)`.
- The Stateflow chart resets the value of the `duration` operator if the conditional expression `C` becomes `false` or if the associated state becomes inactive.
- The `duration` operator does not support conditions that depend on local or output structures. For more information, see “Access Bus Signals Through Stateflow Structures”.

See Also

count | elapsed | temporalCount

Topics

“Control Chart Execution by Using Temporal Logic”
“Control Oscillations by Using the duration Operator”
“Reduce Transient Signals by Using Debouncing Logic”
“Implement an Automatic Transmission Gear System by Using the duration Operator”

Introduced in R2017a

elapsed, et

Time since state became active

Syntax

```
elapsed(sec)
et
```

Description

`elapsed(sec)` returns the length of time that has elapsed since the associated state became active.

`et` is an alternative way to execute `elapsed(sec)`.

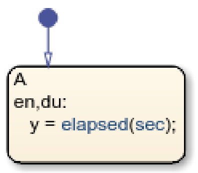
Note The expressions `elapsed(sec)` and `et` are equivalent to `temporalCount(sec)`.

Examples

Determine Time of State Activity

Store the number of seconds since the state became active.

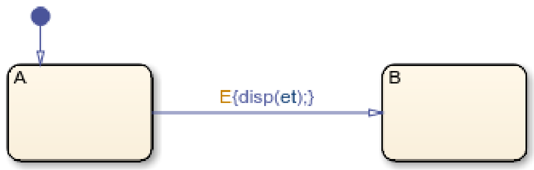
```
en,du:
   y = elapsed(sec);
```



Display Elapsed Time

When the chart processes a broadcast of the event `E`, transition out of the associated state and display the elapsed time since the state became active.

```
E{disp(et);}
```

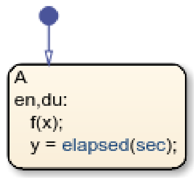


Tips

- In state and transition actions, you can use quotation marks to enclose the keyword `'sec'`. For example, `elapsed('sec')` is equivalent to `elapsed(sec)`.
- The Stateflow chart resets the counter used by the `elapsed` operator each time the associated state reactivates.
- The timing for absolute-time temporal logic operators depends on the type of Stateflow chart:

  - Charts in a Simulink model define temporal logic in terms of simulation time.
  - Standalone charts in MATLAB define temporal logic in terms of wall-clock time.

  The difference in timing can affect the behavior of a chart. For example, suppose that this chart is executing the `entry` action of state `A`.



```
A
en,du:
  f(x);
  y = elapsed(sec);
```

  - In a Simulink model, the function call to `f` executes in a single time step and does not contribute to the simulation time. After calling the function `f`, the chart assigns a value of zero to `y`.
  - In a standalone chart, the function call to `f` can take several seconds of wall-clock time to complete. After calling the function `f`, the chart assigns the nonzero time that has elapsed since state `A` became active to `y`.

See Also

count | duration | temporalCount

Topics

"Control Chart Execution by Using Temporal Logic"

Introduced in R2017a

enter, en

Generate implicit event when state becomes active

Syntax

```
enter(state_name)
en(state_name)
```

Description

`enter(state_name)` generates an implicit local event when the chart execution enters the state `state_name`. If more than one state has the same name, use dot notation to specify the name of the state. For more information, see “Identify Data by Using Dot Notation”.

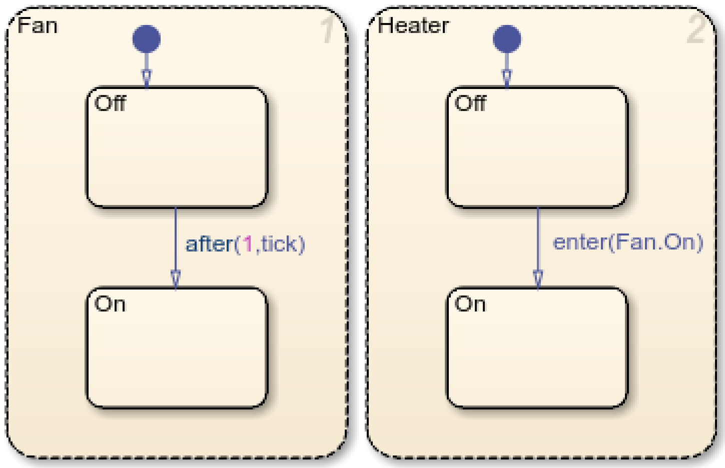
`en(state_name)` is an alternative way to execute `enter(state_name)`.

Examples

Implicit Event When State Becomes Active

Define an implicit local event when the chart execution enters the state `Fan.On`.

```
enter(Fan.On)
```



Tips

The `enter` operator is supported only in Stateflow charts in Simulink models.

See Also

exit | in

Topics
“Control Chart Behavior by Using Implicit Events”
“Use Events to Execute Charts”
“Check State Activity by Using the in Operator”

Introduced before R2006a

every

Execute chart at regular intervals

Syntax

```
every(n,E)
every(n,tick)
every(n,sec)
```

Description

`every(n,E)` returns `true` at every `n`th occurrence of the event `E` since the associated state became active. Otherwise, the operator returns `false`.

`every(n,tick)` returns `true` at every `n`th time that the chart wakes up since the associated state became active. Otherwise, the operator returns `false`.

The implicit event `tick` is not supported when a Stateflow chart in a Simulink model has input events.

`every(n,sec)` returns `true` every `n` seconds since the associated state became active. Otherwise, the operator returns `false`.

In standalone charts in MATLAB, specify `n` with a value greater than or equal to `0.001`. The operator creates a MATLAB `timer` object that generates an implicit event to wake up the chart. MATLAB `timer` objects are limited to 1 millisecond precision. For more information, see “Events in Standalone Charts”.

- The `timer` object is created when the chart finishes executing the `entry` actions of the associated state and its substates. For subsequent iterations, the `timer` object is reset when the chart finishes executing the `during` actions of the associated state and its substates. If you specify `n` as an expression whose value changes during chart execution, the chart adjusts the temporal delay only when the `timer` object is reset.
- The `timer` object starts running at the end of the chart step when the associated state becomes active. This step can include the execution of other parallel states in the chart.
- If the chart is processing another operation when it receives the implicit event from the `timer` object, the chart queues the event. When the current step is completed, the chart processes the event and resets the timer object for the next iteration.
- If the state associated with the temporal logic operator becomes inactive before the chart processes the implicit event, the event does not wake up the chart.

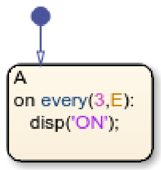
Note Using `every` as an absolute-time temporal logic operator is supported only in standalone charts in MATLAB. In charts in Simulink models, use an outer self-loop transition with the `after` operator instead. For more information, see “Do Not Use every for Absolute-Time Temporal Logic in Charts in Simulink Models”.

Examples

Execute State Action on Event Broadcast

Display a status message when the chart processes every third broadcast of the event `E` after the state became active.

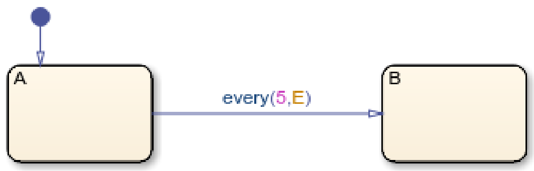
```
on every(3,E):
   disp('ON');
```



Trigger Transition on Event Broadcast

Transition out of the associated state when the chart processes every fifth broadcast of the event `E` after the state became active.

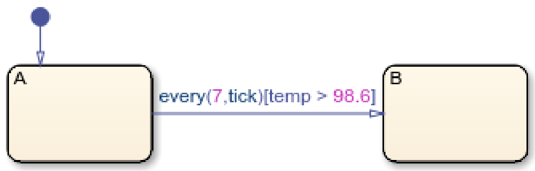
```
every(5,E)
```



Trigger Transition on Chart Execution

Transition out of the associated state every seventh `tick` event since the state became active, but only if the variable `temp` is greater than 98.6.

```
every(7,tick)[temp > 98.6]
```

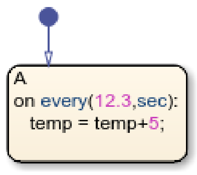


Execute State Action at Specified Time

Increment the `temp` variable by 5 every 12.3 seconds that the state is active.

In standalone charts in MATLAB, enter:

```
on every(12.3,sec):
   temp = temp+5;
```



Using `every` as an absolute-time temporal logic operator is not supported in charts in Simulink models.

Tips

- You can use quotation marks to enclose the keywords `'tick'` and `'sec'`. For example, `every(5,'tick')` is equivalent to `every(5,tick)`.
- The Stateflow chart resets the counter used by the `every` operator each time the associated state reactivates.
- Standalone charts in MATLAB define absolute-time temporal logic in terms of wall-clock time, which is limited to 1 millisecond precision.

See Also

after | at | before | `timer`

Topics

"Control Chart Execution by Using Temporal Logic"
"Use Events to Execute Charts"
"Control Chart Behavior by Using Implicit Events"

Introduced in R2014b

exit, ex

Generate implicit event when state becomes inactive

Syntax

```
exit(state_name)
ex(state_name)
```

Description

`exit(state_name)` generates an implicit local event when the chart execution exits the state `state_name`. If more than one state has the same name, use dot notation to specify the name of the state. For more information, see “Identify Data by Using Dot Notation”.

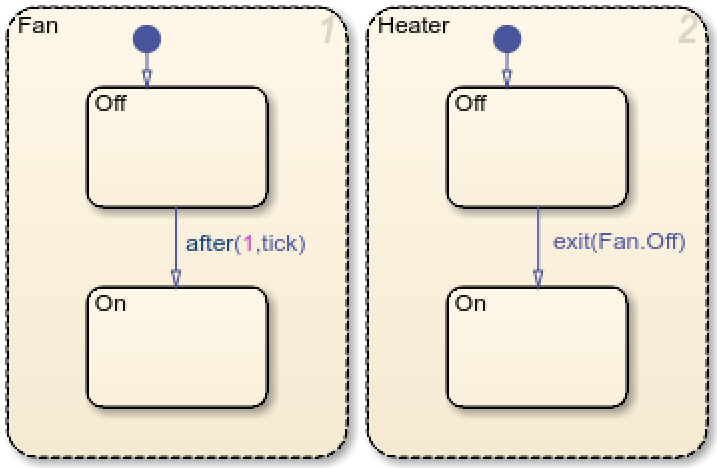
`ex(state_name)` is an alternative way to execute `exit(state_name)`.

Examples

Implicit Event When State Becomes Inactive

Define an implicit local event when the chart execution exits the state `Fan.Off`.

```
exit(Fan.Off)
```



Tips

The `exit` operator is supported only in Stateflow charts in Simulink models.

See Also

enter | in

Topics
“Control Chart Behavior by Using Implicit Events”
“Use Events to Execute Charts”
“Check State Activity by Using the in Operator”

Introduced before R2006a

forward

Forward message

Syntax

```
forward(message_in_name,message_out_name)
```

Description

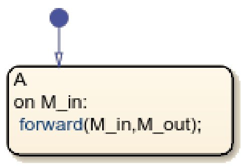
`forward(message_in_name,message_out_name)` forwards a valid input or local message to a local queue or an output port. After a chart forwards a message, it can remove another message from the queue in the same time step.

Examples

Forward an Input Message

Check the input queue for message `M_in`. If a message is present, remove the message from the queue and forward it to the output port `M_out`.

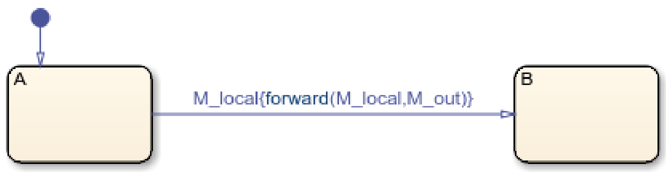
```
on M_in:
   forward(M_in,M_out);
```



Forward a Local Message

Check the local queue for message `M_local`. If a message is present, transition from state `A` to state `B`. Remove the message from the `M_local` message queue and forward it to the output port `M_out`.

```
M_local{forward(M_local,M_out)}
```



See Also

receive

Topics
"Control Message Activity in Stateflow Charts"

Introduced in R2018b

hasChanged

Detect change in data since last time step

Syntax

```
tf = hasChanged(data_name)
```

Description

`tf = hasChanged(data_name)` returns 1 (`true`) if the value of `data_name` at the beginning of the current time step is different from the value of `data_name` at the beginning of the previous time step. Otherwise, the operator returns 0 (`false`).

The argument `data_name` can be:

- A scalar variable.
- A matrix or an element of a matrix.
  - If `data_name` is a matrix, the operator returns `true` when it detects a change in any element of `data_name`.
  - Index elements of a matrix by using numbers or expressions that evaluate to a constant integer. See "Supported Operations for Vectors and Matrices".
- A structure or a field in a structure.
  - If `data_name` is a structure, the change detection operator returns `true` when it detects a change in any field of `data_name`.
  - Index fields in a structure by using dot notation. See "Index and Assign Values to Stateflow Structures".
- Any valid combination of structure fields or matrix elements.

The argument `data_name` cannot be a nontrivial expression or a custom code variable.

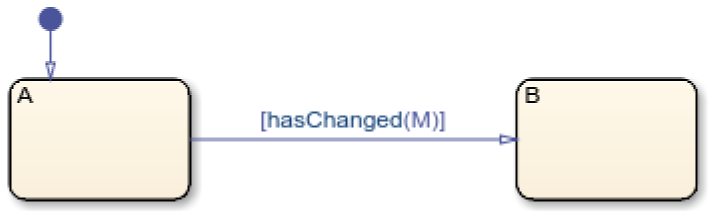
Note Standalone charts in MATLAB do not support change detection on an element of a matrix or a field in a structure.

Examples

Detect Change in Matrix

Transition out of state if any element of the matrix `M` has changed value since the last time step or input event.

```
[hasChanged(M)]
```

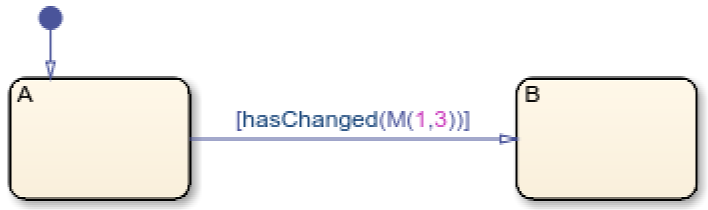


Detect Change in Matrix Element

Transition out of state if the element in row 1 and column 3 of the matrix `M` has changed value since the last time step or input event.

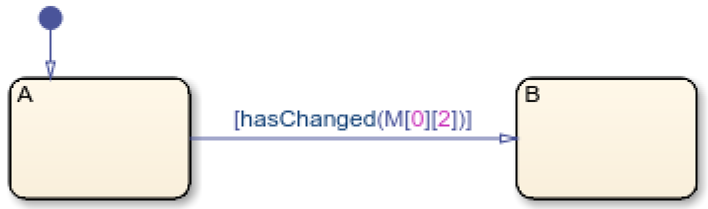
In charts that use MATLAB as the action language, use:

```
[hasChanged(M(1,3))]
```



In charts that use C as the action language, use:

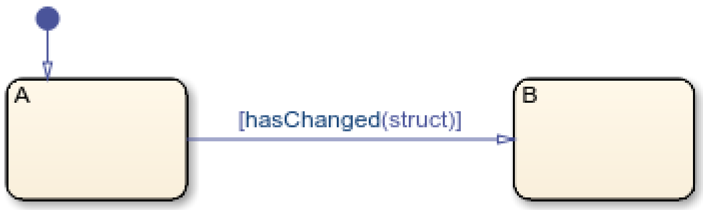
```
[hasChanged(M[0][2])]
```



Detect Change in Structure

Transition out of state if any field of the structure `struct` has changed value since the last time step or input event.

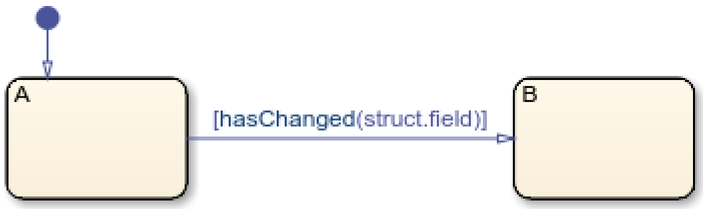
```
[hasChanged(struct)]
```



Detect Change in Structure Field

Transition out of state if the field `struct.field` has changed value since the last time step or input event.

```
[hasChanged(struct.field)]
```



Tips

- If multiple input events occur in the same time step, the `hasChanged` operator can detect changes in data value between input events.
- If the chart writes to the data object but does not change the data value, the `hasChanged` operator returns `false`.
- The type of Stateflow chart determines the scope of the data supported by the change detection operators:
  - Standalone Stateflow charts in MATLAB: `Local` only
  - In Simulink models, charts that use MATLAB as the action language: `Input` only
  - In Simulink models, charts that use C as the action language: `Input`, `Output`, `Local`, or `Data Store Memory`
- In a standalone chart in MATLAB, a change detection operator can detect changes in data specified in a call to the `step` function because these changes occur before the start of the current time step. For example, if `x` is equal to zero, the expression `hasChanged(x)` returns `true` when you execute the chart `ch` with the command:

  ```
  step(ch,'x',1);
  ```

  In contrast, a change detection operator cannot detect changes in data caused by assignments in state or transition actions in the same time step. Instead, the operator detects the change in value at the start of the next time step.
- In a chart in a Simulink model, if you enable the chart option **Initialize Outputs Every Time Chart Wakes Up**, using an output as the argument of the `hasChanged` operator always returns `false`. For more information, see “Initialize outputs every time chart wakes up”.

- When row-major array layout is enabled in charts that use `hasChanged`, code generation produces an error. Before generating code in charts that use `hasChanged`, enable column-major array layout. See “Select Array Layout for Matrices in Generated Code”.

See Also

hasChangedFrom | hasChangedTo

Topics

“Detect Changes in Data Values”
“Supported Operations for Vectors and Matrices”
“Index and Assign Values to Stateflow Structures”
“Assign Values to All Elements of a Matrix”

Introduced in R2007a

hasChangedFrom

Detect change in data from specified value

Syntax

```
tf = hasChangedFrom(data_name,value)
```

Description

`tf = hasChangedFrom(data_name,value)` returns 1 (`true`) if the value of `data_name` was equal to the specified `value` at the beginning of the previous time step and is a different value at the beginning of the current time step. Otherwise, the operator returns 0 (`false`).

The argument `data_name` can be:

- A scalar variable.
- A matrix or an element of a matrix.
  - If `data_name` is a matrix, the operator returns `true` when it detects a change in any element of `data_name` and the previous value of `data_name` was equal to `value`.
  - Index elements of a matrix by using numbers or expressions that evaluate to a constant integer. See “Supported Operations for Vectors and Matrices”.
- A structure or a field in a structure.
  - If `data_name` is a structure, the change detection operator returns `true` when it detects a change in any element of `data_name` and the previous value of `data_name` was equal to `value`.
  - Index fields in a structure by using dot notation. See “Index and Assign Values to Stateflow Structures”.
- Any valid combination of structure fields or matrix elements.

The argument `data_name` cannot be a nontrivial expression or a custom code variable.

Note Standalone charts in MATLAB do not support change detection on an element of a matrix or a field in a structure.

The argument `value` can be any expression that resolves to a value that is comparable with `data_name`:

- If `data_name` is a scalar, then `value` must resolve to a scalar value.
- If `data_name` is a matrix, then `value` must resolve to a matrix value with the same dimensions as `data_name`.

  Alternatively, in a chart that uses C as the action language, `value` can resolve to a scalar value. The chart uses scalar expansion to compare `data_name` to a matrix whose elements are all equal to the value specified by `value`. See “Assign Values to All Elements of a Matrix”.

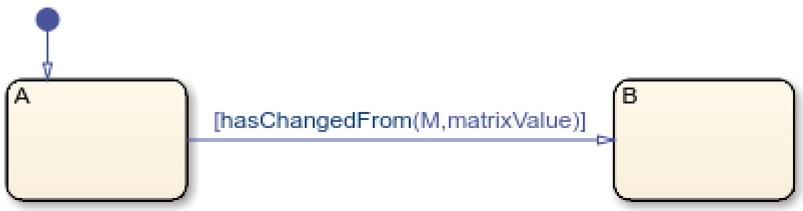
- If `data_name` is a structure, then `value` must resolve to a structure value whose field specification matches `data_name` exactly.

Examples

Detect Change in Matrix

Transition out of state if the previous value of the matrix `M` was equal to `matrixValue` and any element of `M` has changed value since the last time step or input event.

```
[hasChangedFrom(M,matrixValue)]
```

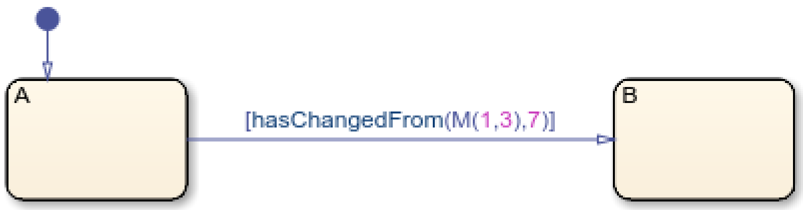


Detect Change in Matrix Element

Transition out of state if the element in row 1 and column 3 of the matrix `M` has changed from the value 7 since the last time step or input event.

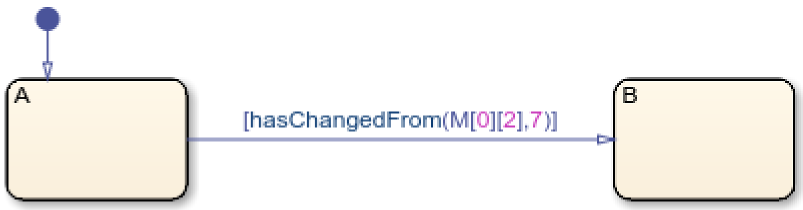
In charts that use MATLAB as the action language, use:

```
[hasChangedFrom(M(1,3),7)]
```



In charts that use C as the action language, use:

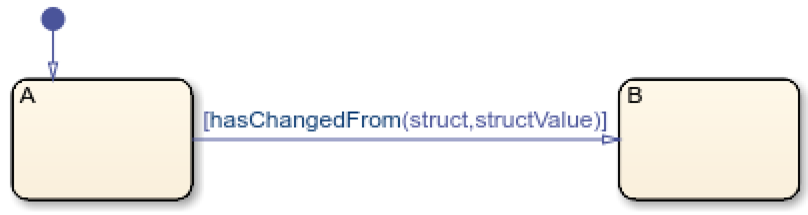
```
[hasChangedFrom(M[0][2],7)]
```



Detect Change in Structure

Transition out of state if the previous value of the structure `struct` was equal to `structValue` and any field of `struct` has changed value since the last time step or input event.

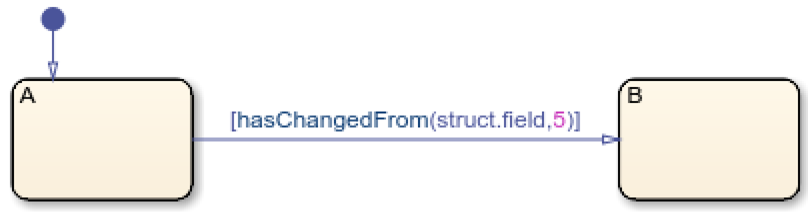
```
[hasChangedFrom(struct,structValue)]
```



Detect Change in Structure Field

Transition out of state if the field `struct.field` has changed from the value `5` since the last time step or input event.

```
[hasChangedFrom(struct.field,5)]
```



Tips

- If multiple input events occur in the same time step, the `hasChangedFrom` operator can detect changes in data value between input events.
- If the chart writes to the data object but does not change the data value, the `hasChangedFrom` operator returns `false`.
- The type of Stateflow chart determines the scope of the data supported by the change detection operators:
  - Standalone Stateflow charts in MATLAB: `Local` only
  - In Simulink models, charts that use MATLAB as the action language: `Input` only
  - In Simulink models, charts that use C as the action language: `Input`, `Output`, `Local`, or `Data Store Memory`
- In a standalone chart in MATLAB, a change detection operator can detect changes in data specified in a call to the `step` function because these changes occur before the start of the current time step. For example, if `x` is equal to zero, the expression `hasChangedFrom(x,0)` returns `true` when you execute the chart `ch` with the command:

  ```
  step(ch,'x',1);
  ```

In contrast, a change detection operator cannot detect changes in data caused by assignments in state or transition actions in the same time step. Instead, the operator detects the change in value at the start of the next time step.

- In a chart in a Simulink model, if you enable the chart option **Initialize Outputs Every Time Chart Wakes Up**, using an output as the argument of the `hasChanged` operator always returns `false`. For more information, see “Initialize outputs every time chart wakes up”.
- When row-major array layout is enabled in charts that use `hasChangedFrom`, code generation produces an error. Before generating code in charts that use `hasChangedFrom`, enable column-major array layout. See “Select Array Layout for Matrices in Generated Code”.

See Also

hasChanged | hasChangedTo

Topics

“Detect Changes in Data Values”
“Supported Operations for Vectors and Matrices”
“Index and Assign Values to Stateflow Structures”
“Assign Values to All Elements of a Matrix”

Introduced in R2007a

hasChangedTo

Detect change in data to specified value

Syntax

`tf = hasChangedTo(data_name,value)`

Description

`tf = hasChangedTo(data_name,value)` returns 1 (`true`) if the value of `data_name` was not equal to the specified `value` at the beginning of the previous time step and is equal to `value` at the beginning of the current time step. Otherwise, the operator returns 0 (`false`).

The argument `data_name` can be:

- A scalar variable.
- A matrix or an element of a matrix.
  - If `data_name` is a matrix, the operator returns `true` when it detects a change in any element of `data_name` and the new value of `data_name` is equal to `value`.
  - Index elements of a matrix by using numbers or expressions that evaluate to a constant integer. See “Supported Operations for Vectors and Matrices”.
- A structure or a field in a structure.
  - If `data_name` is a structure, the change detection operator returns `true` when it detects a change in any element of `data_name` and the new value of `data_name` is equal to `value`.
  - Index fields in a structure by using dot notation. See “Index and Assign Values to Stateflow Structures”.
- Any valid combination of structure fields or matrix elements.

The argument `data_name` cannot be a nontrivial expression or a custom code variable.

Note Standalone charts in MATLAB do not support change detection on an element of a matrix or a field in a structure.

The argument `value` can be any expression that resolves to a value that is comparable with `data_name`:

- If `data_name` is a scalar, then `value` must resolve to a scalar value.
- If `data_name` is a matrix, then `value` must resolve to a matrix value with the same dimensions as `data_name`.

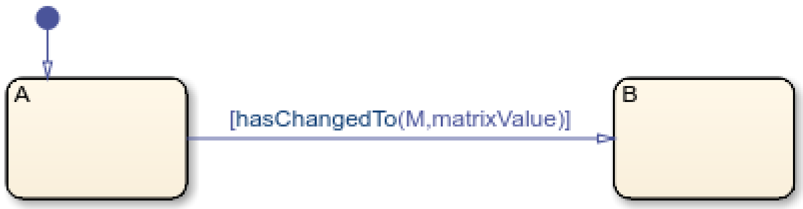
  Alternatively, in a chart that uses C as the action language, `value` can resolve to a scalar value. The chart uses scalar expansion to compare `data_name` to a matrix whose elements are all equal to the value specified by `value`. See “Assign Values to All Elements of a Matrix”.
- If `data_name` is a structure, then `value` must resolve to a structure value whose field specification matches `data_name` exactly.

Examples

Detect Change in Matrix

Transition out of state if any element of `M` has changed value since the last time step or input event and the current value of the matrix `M` is equal to `matrixValue`.

```
[hasChangedTo(M,matrixValue)]
```

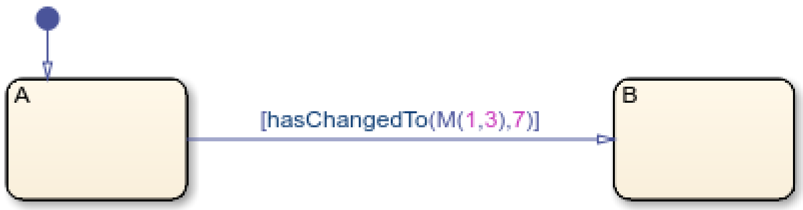


Detect Change in Matrix Element

Transition out of state if the element in row 1 and column 3 of the matrix `M` has changed to the value 7 since the last time step or input event.

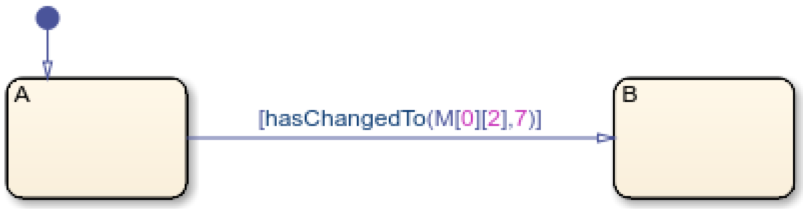
In charts that use MATLAB as the action language, use:

```
[hasChangedTo(M(1,3),7)]
```



In charts that use C as the action language, use:

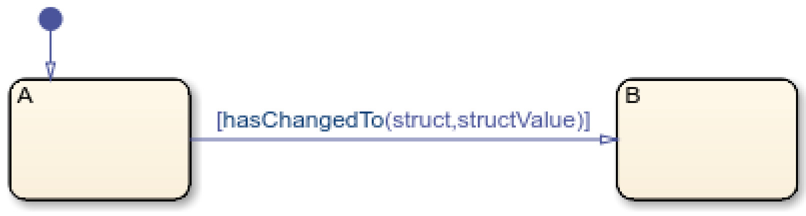
```
[hasChangedTo(M[0][2],7)]
```



Detect Change in Structure

Transition out of state if any field of the structure `struct` has changed value since the last time step or input event and the current value of `struct` is equal to `structValue`.

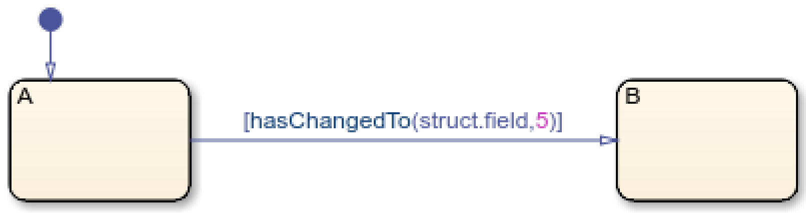
```
[hasChangedTo(struct,structValue)]
```



Detect Change in Structure Field

Transition out of state if the field `struct.field` has changed to the value `5` since the last time step or input event.

```
[hasChangedTo(struct.field,5)]
```



Tips

- If multiple input events occur in the same time step, the `hasChangedTo` operator can detect changes in data value between input events.
- If the chart writes to the data object but does not change the data value, the `hasChangedTo` operator returns `false`.
- The type of Stateflow chart determines the scope of the data supported by the change detection operators:
  - Standalone Stateflow charts in MATLAB: `Local` only
  - In Simulink models, charts that use MATLAB as the action language: `Input` only
  - In Simulink models, charts that use C as the action language: `Input`, `Output`, `Local`, or `Data Store Memory`
- In a standalone chart in MATLAB, a change detection operator can detect changes in data specified in a call to the `step` function because these changes occur before the start of the current time step. For example, if `x` is equal to zero, the expression `hasChangedTo(x,1)` returns `true` when you execute the chart `ch` with the command:

  ```
  step(ch,'x',1);
  ```

In contrast, a change detection operator cannot detect changes in data caused by assignments in state or transition actions in the same time step. Instead, the operator detects the change in value at the start of the next time step.

- In a chart in a Simulink model, if you enable the chart option **Initialize Outputs Every Time Chart Wakes Up**, using an output as the argument of the `hasChanged` operator always returns `false`. For more information, see “Initialize outputs every time chart wakes up”.
- When row-major array layout is enabled in charts that use `hasChangedTo`, code generation produces an error. Before generating code in charts that use `hasChangedTo`, enable column-major array layout. See “Select Array Layout for Matrices in Generated Code”.

See Also

hasChanged | hasChangedFrom

Topics

“Detect Changes in Data Values”
“Supported Operations for Vectors and Matrices”
“Index and Assign Values to Stateflow Structures”
“Assign Values to All Elements of a Matrix”

Introduced in R2007a

in

Check state activity in Stateflow

Syntax

```
in(state_name)
```

Description

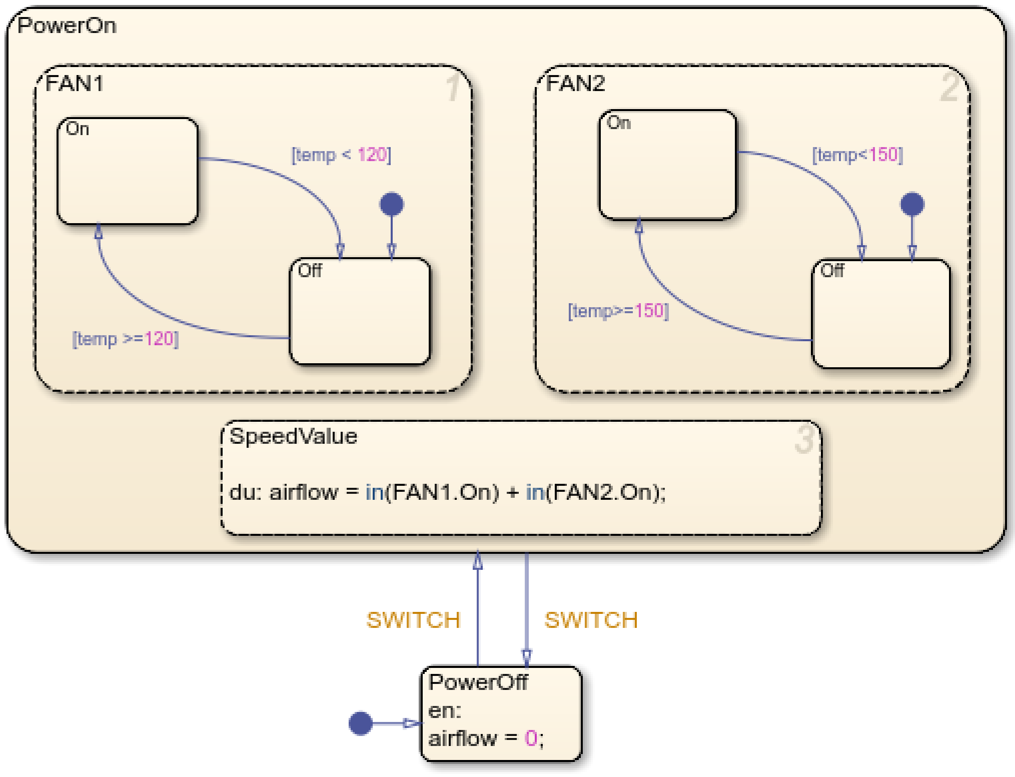
`in(state_name)` returns 1 (`true`) if the state `state_name` is active. Otherwise, the operator returns 0 (`false`).

Examples

Number of Active Subcomponents

Set the value of `airflow` to the number of fans that are turned on.

```
airflow = in(FAN1.On) + in(FAN2.On);
```



Tips

To determine the state activity, a Stateflow chart performs a localized search of the state hierarchy. The chart does not perform an exhaustive search for all states and does not stop after finding the first match. To improve the chances of finding a unique search result:

- Use dot notation to qualify the name of the state.
- Give states unique names.
- Use states and boxes as enclosures to limit the scope of the path resolution search.

Additionally, a chart cannot use the `in` condition to trigger actions based on the activity of states in other charts.

For more information, see “Resolution of State Activity”.

See Also

enter | exit

Topics

“Check State Activity by Using the in Operator”

Introduced before R2006a

isvalid

Determine if message is valid

Syntax

`isvalid(message_name)`

Description

`isvalid(message_name)` checks if an input or local message is valid. A message is valid if the chart has removed it from the queue and has not forwarded or discarded it.

Examples

Check Message in State Action

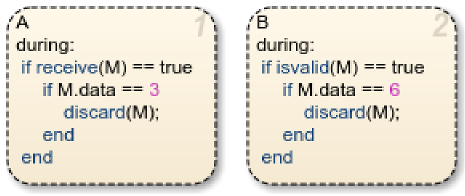
When state `A` is active, receive message `M`. If the message has a data value equal to 3, discard the message. Then, when state `B` is active, check that the message `M` is still valid. If the message is valid and has a data value equal to 6, discard the message.

In state `A`:

```
during:
   if receive(M) == true
      if M.data == 3
         discard(M);
      end
   end
```

In state `B`:

```
during:
   if isvalid(M) == true
      if M.data == 6
         discard(M);
      end
   end
```



```
during:
if receive(M) == true
   if M.data == 3
      discard(M);
   end
end
```

```
during:
if isvalid(M) == true
   if M.data == 6
      discard(M);
   end
end
```

See Also
discard | forward | receive

Topics
"Control Message Activity in Stateflow Charts"

Introduced in R2018b

length

Determine length of message queue

Syntax

```
length(message_name)
```

Description

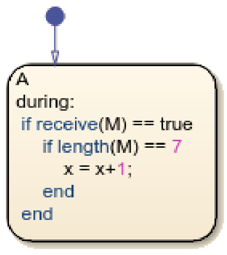
`length(message_name)` checks the number of messages in the internal receiving queue of an input or local message.

Examples

Check Queue Length in State Action

Check the queue for message `M`. If a message is present, remove it from the queue. If exactly seven messages remain in the queue, increment the value of `x`.

```
during:
   if receive(M) == true
      if length(M) == 7
         x = x+1;
      end
   end
```



```
A
during:
 if receive(M) == true
    if length(M) == 7
       x = x+1;
    end
 end
```

Tips

- The `length` operator is not supported for input messages that use external receiving queues. To use the `length` operator, enable the **Use Internal Queue** property for this message.

See Also

receive

Topics

“Control Message Activity in Stateflow Charts”

Introduced in R2018b

receive

Extract message from queue

Syntax

`receive(message_name)`

Description

`receive(message_name)` extracts an input or local message from its receiving queue. If a valid message exists, `receive` returns `true`. If a valid message does not exist but there is a message in the queue, the chart removes the message from the queue and `receive` returns `true`. If a valid message does not exist and there are no messages in the queue, `receive` returns `false`.

Examples

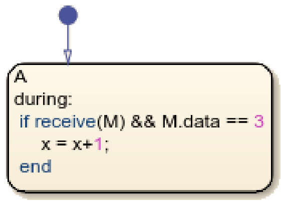
Extract Message in State Action

Check the queue for message `M` and increment the value of `x` if both of these conditions are true:

- A message is present in the queue.
- The data value of the message is equal to 3.

If a message is not present or if the data value is not equal to 3, then the value of `x` does not change. If a message is present, remove it from the queue regardless of the data value.

```
during:
   if receive(M) && M.data == 3
      x = x+1;
   end
```



```
A
during:
 if receive(M) && M.data == 3
    x = x+1;
 end
```

See Also
send

Topics
“Control Message Activity in Stateflow Charts”

Introduced in R2018b

send

Broadcast message or event

Syntax

```
send(message_name)
send(event_name)
send(local_event_name,state_name)
send(state_name.local_event_name)
```

Description

`send(message_name)` sends a local or output message.

`send(event_name)` sends a local or output event.

`send(local_event_name,state_name)` broadcasts a local event to `state_name` and any offspring of that state in the hierarchy.

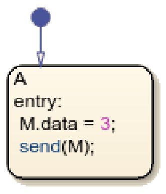
`send(state_name.local_event_name)` broadcasts a local event to its parent state `state_name` and any offspring of that state in the hierarchy.

Examples

Broadcast Message

Send a local or output message `M` with a data value of `3`.

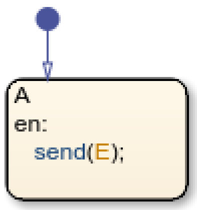
```
M.data = 3;
send(M);
```



Broadcast Output Event

Send an output event `E`.

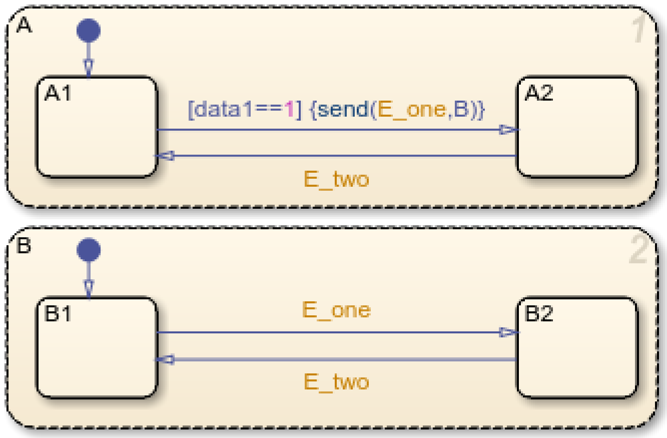
```
send(E);
```



Broadcast Directed Local Event

Send a local event E_one to state B and any of its substates.

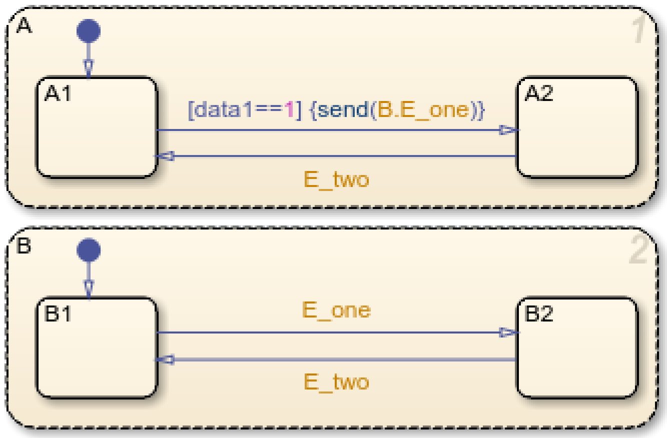
```
send(E_one,B);
```



Broadcast by Using Qualified Event Name

Send a local event E_one to its parent state B and any of its substates.

```
send(B.E_one);
```



Tips

- If a chart sends a message that exceeds the capacity of the receiving queue, a queue overflow occurs. The result of the queue overflow depends on the type of receiving queue.
  - When an overflow occurs in an internal queue, the Stateflow chart drops the new message. You can control the level of diagnostic action by setting the **Queue Overflow Diagnostic** property for the message. See “Queue Overflow Diagnostic”.
  - When an overflow occurs in an external queue, the Queue block either drops the new message or overwrites the oldest message in the queue, depending on the configuration of the block. See “Overwrite the oldest element if queue is full” (Simulink). An overflow in an external queue always results in a warning.
- Avoid using undirected local event broadcasts. Undirected local event broadcasts can cause unwanted recursive behavior in your chart. Instead, send local events by using directed broadcasts. For more information, see “Broadcast Local Events to Synchronize Parallel States”.
- Use the `send` operator to send events to the Schedule Editor. The Schedule Editor enables you to schedule the execution of aperiodic partitions. For more information on using the `send` operator with the Schedule Editor, see “Events in Schedule Editor” (Simulink).

See Also

receive

Topics

“Control Message Activity in Stateflow Charts”
“Activate a Simulink Block by Sending Output Events”
“Broadcast Local Events to Synchronize Parallel States”

Introduced in R2018b

str2ascii

Convert string to array of type `uint8`

Syntax

```
A = str2ascii(str,n)
```

Description

`A = str2ascii(str,n)` returns array of type `uint8` containing ASCII values for the first `n` characters in `str`, where `n` is a positive integer.

Use of variables or expressions for `n` is not supported.

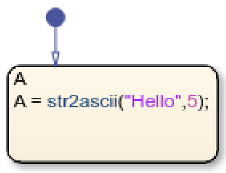
Note The operator `str2ascii` is supported only in Stateflow charts that use C as the action language.

Examples

String to ASCII Values

Return `uint8` array `{-72,101,108,108,111}`.

```
A = str2ascii("Hello",5);
```



Tips

Enclose literal strings with single or double quotes.

See Also

ascii2str

Topics

"Manage Textual Information by Using Strings"
"Share String Data with Custom C Code"

Introduced in R2018b

str2double

Convert string to double precision value

Syntax

```
X = str2double(str)
```

Description

`X = str2double(str)` converts the text in string `str` to a double-precision value.

`str` contains text that represents a number. Text that represents a number can contain:

- Digits
- A decimal point
- A leading `+` or `-` sign
- An `e` preceding a power of 10 scale factor

If `str2double` cannot convert text to a number, then it returns a `NaN` value.

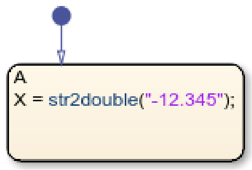
Note The operator `str2double` is supported only in Stateflow charts that use C as the action language.

Examples

String Containing Decimal Notation

Return a value of `-12.345`.

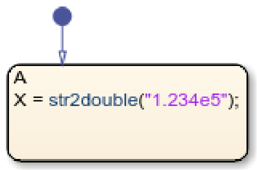
```
X = srt2double("-12.345");
```



String Containing Exponential Notation

Return a value of `123400`.

```
X = srt2double("1.234e5");
```



```
X = str2double("1.234e5");
```

Tips

Enclose literal strings with single or double quotes.

See Also

tostring

Topics

"Manage Textual Information by Using Strings"

Introduced in R2018b

strcat

Concatenate strings

Syntax

```
dest = strcat(s1,...,sN)
```

Description

`dest = strcat(s1,...,sN)` concatenates strings `s1,...,sN`.

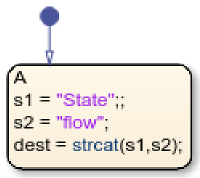
Note The operator `strcat` is supported only in Stateflow charts that use C as the action language.

Examples

Concatenation of Strings

Concatenate strings to form `"Stateflow"`.

```
s1 = "State";
s2 = "flow";
dest = strcat(s1,s2);
```



```
A
s1 = "State";;
s2 = "flow";
dest = strcat(s1,s2);
```

Tips

Enclose literal strings with single or double quotes.

See Also

strcpy | substr

Topics

“Manage Textual Information by Using Strings”

Introduced in R2018b

strcmp

Compare strings

Syntax

```
tf = strcmp(s1,s2)
s1 == s2
s1 != s2
tf = strcmp(s1,s2,n)
```

Description

`tf = strcmp(s1,s2)` compares strings `s1` and `s2`. Returns `0` if the two strings are identical. Otherwise returns a nonzero integer.

- The sign of the output value depends on the lexicographic ordering of the input strings `s1` and `s2`.
- The magnitude of the output value depends on the compiler that you use. This value can differ in simulation and generated code.

Strings are considered identical when they have the same size and content.

This operator is consistent with the C library function `strcmp` or the C++ function `string.compare`, depending on the compiler that you select for code generation. The operator behaves differently than the function `strcmp` in MATLAB.

`s1 == s2` is an alternative way to execute `strcmp(s1,s2) == 0`.

`s1 != s2` is an alternative way to execute `strcmp(s1,s2) != 0`.

`tf = strcmp(s1,s2,n)` returns `0` if the first `n` characters in `s1` and `s2` are identical.

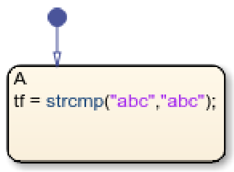
Note The operator `strcmp` is supported only in Stateflow charts that use C as the action language.

Examples

Comparison by Using `strcmp`

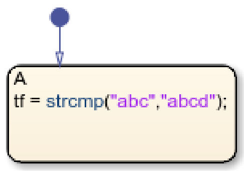
Return a value of `0` (strings are equal).

```
tf = strcmp("abc","abc");
```



Return a nonzero value (strings are not equal).

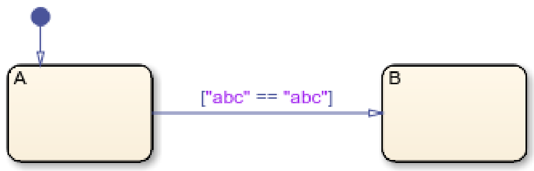
```
tf = strcmp("abc","abcd");
```



Comparison by Using ==

Return a value of `true`.

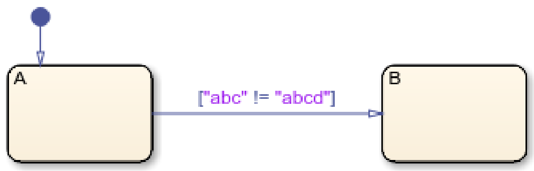
```
["abc" == "abc"]
```



Comparison by Using !=

Return a value of `true`.

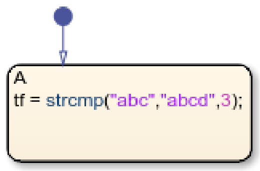
```
["abc" != "abcd"]
```



Comparison of Substrings

Return a value of `0` (substrings are equal).

```
tf = strcmp("abc","abcd",3);
```



```
tf = strcmp("abc","abcd",3);
```

Tips

Enclose literal strings with single or double quotes.

See Also

substr

Topics

“Manage Textual Information by Using Strings”

Introduced in R2018b

strcpy

Assign string value

Syntax

```
strcpy(dest,src)
dest = src
```

Description

`strcpy(dest,src)` assigns string `src` to `dest`.

`dest = src` is an alternative way to execute `strcpy(dest,src)`.

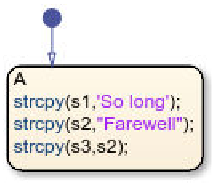
Note The operator `strcpy` is supported only in Stateflow charts that use C as the action language.

Examples

Assignment by Using `strcpy`

Assign string data to `s1`, `s2`, and `s3`.

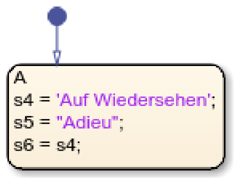
```
strcpy(s1,'So long');
strcpy(s2,"Farewell");
strcpy(s3,s2);
```



Assignment by Using =

Assign string data to `s4`, `s5`, and `s6`.

```
s4 = 'Auf Wiedersehen';
s5 = "Adieu";
s6 = s4;
```



```
A
s4 = 'Auf Wiedersehen';
s5 = "Adieu";
s6 = s4;
```

Tips

- Source and destination arguments must refer to different symbols.
- Enclose literal strings with single or double quotes.

See Also

Topics
"Manage Textual Information by Using Strings"

Introduced in R2018b

strlen

Determine length of string

Syntax

```
L = strlen(str)
```

Description

`L = strlen(str)` returns the number of characters in the string `str`.

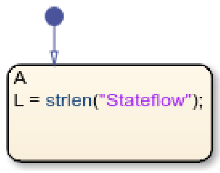
Note The operator `strlen` is supported only in Stateflow charts that use C as the action language.

Examples

Number of Characters in String

Return a value of 9.

```
L = strlen("Stateflow");
```



Tips

Enclose literal strings with single or double quotes.

See Also

Topics
“Manage Textual Information by Using Strings”

Introduced in R2018b

substr

Extract substring from string

Syntax

```
dest = substr(str,i,n)
```

Description

`dest = substr(str,i,n)` returns the substring of length `n` starting at the `i`-th character of string `str`. Use zero-based indexing.

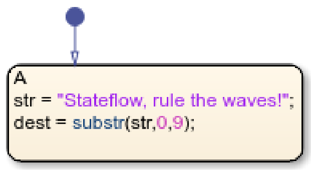
Note The operator `substr` is supported only in Stateflow charts that use C as the action language.

Examples

Extract Substring

Extract substring `"Stateflow"` from a longer string.

```
str = "Stateflow, rule the waves!";
dest = substr(str,0,9);
```



```
A
str = "Stateflow, rule the waves!";
dest = substr(str,0,9);
```

Tips

- Use zero-based indexing.
- Enclose literal strings with single or double quotes.

See Also

strcat | strcpy | strlen

Topics
“Manage Textual Information by Using Strings”

Introduced in R2018b

temporalCount

Number of events, chart executions, or time since state became active

Syntax

```
temporalCount(E)
temporalCount(tick)
temporalCount(time_unit)
```

Description

`temporalCount(E)` returns the number of occurrences of the event `E` since the associated state became active.

`temporalCount(tick)` returns the number of times that the chart has woken up since the associated state became active.

The implicit event `tick` is not supported when a Stateflow chart in a Simulink model has input events.

`temporalCount(time_unit)` returns the length of time that has elapsed since the associated state became active. Specify `time_unit` as seconds (`sec`), milliseconds (`msec`), or microseconds (`usec`).

Note Standalone Stateflow charts in MATLAB support using `temporalCount` only as an absolute-time temporal logic operator.

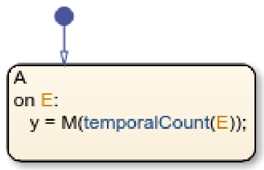
Examples

Perform Action on Event Broadcast

Access successive elements of the array `M` each time that the chart processes a broadcast of the event `E`.

In charts in a Simulink model, enter:

```
on E:
   y = M(temporalCount(E));
```



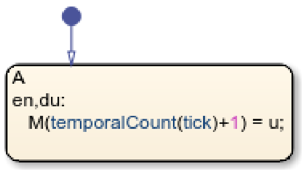
Using `temporalCount` as an event-based temporal logic operator is not supported in standalone charts in MATLAB.

Perform Action on Chart Execution

Store the value of the input data `u` in successive elements of the array `M`.

In charts in a Simulink model, enter:

```
en,du:
   M(temporalCount(tick)+1) = u;
```

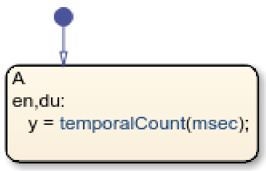


Using `temporalCount` as an event-based temporal logic operator is not supported in standalone charts in MATLAB.

Determine Time of State Activity

Store the number of milliseconds since the state became active.

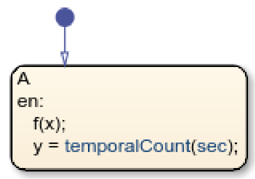
```
en,du:
   y = temporalCount(msec);
```



Tips

- You can use quotation marks to enclose the keywords `'tick'`, `'sec'`, `'msec'`, and `'usec'`. For example, `temporalCount('tick')` is equivalent to `temporalCount(tick)`.
- The Stateflow chart resets the counter used by the `temporalCount` operator each time the associated state reactivates.
- The timing for absolute-time temporal logic operators depends on the type of Stateflow chart:
  - Charts in a Simulink model define temporal logic in terms of simulation time.
  - Standalone charts in MATLAB define temporal logic in terms of wall-clock time.

  The difference in timing can affect the behavior of a chart. For example, suppose that this chart is executing the `entry` action of state `A`.



- In a Simulink model, the function call to `f` executes in a single time step and does not contribute to the simulation time. After calling the function `f`, the chart assigns a value of zero to `y`.
- In a standalone chart, the function call to `f` can take several seconds of wall-clock time to complete. After calling the function `f`, the chart assigns the nonzero time that has elapsed since state `A` became active to `y`.

See Also

count | duration | elapsed

Topics

“Control Chart Execution by Using Temporal Logic”
“Count Events by Using the temporalCount Operator”

Introduced in R2008a

this

Access chart data during simulation

Syntax

`this`

Description

`this` provides external MATLAB code, such as functions and apps, access to chart data during simulation.

- For charts in Simulink models, external MATLAB code can access inputs, outputs, and local data.
- For standalone charts in MATLAB, external MATLAB code can access local data and call `step`, input event functions, and graphical and MATLAB functions in the chart. For more information, see “Execute a Standalone Chart”.

Note In charts in Simulink models, the keyword `this` is supported only as an argument to external MATLAB code. Any other use of the keyword in the chart results in a compile-time error.

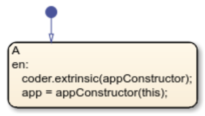
Examples

Connect Chart to MATLAB App

Create a bidirectional connection between a Stateflow chart and a MATLAB app created in App Designer. Call the app as an extrinsic function using `this` as an argument to the constructor. In the app, create a custom property to interface with the chart during simulation. In the chart, store the value returned by the function call to the app as a local data object.

In a chart that uses MATLAB as the action language, enter:

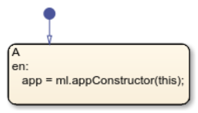
```
coder.extrinsic(appConstructor);
app = appConstructor(this);
```



```
A
en:
  coder.extrinsic(appConstructor);
  app = appConstructor(this);
```

In a chart that uses C as the action language, enter:

```
app = ml.appConstructor(this);
```



```
A
en:
  app = ml.appConstructor(this);
```

For additional examples that illustrate this workflow, see “Model a Power Window Controller” and “Simulate a Media Player”.

Change Data Value While Debugging Standalone Chart

Modify the value of the local data `x` while debugging a standalone Stateflow chart in MATLAB.

At the debugging prompt, enter:

```
this.x = 7
```

For more information, see “Examine and Change Values of Chart Data”.

Note When debugging a chart in a Simulink model, you can access all Stateflow data directly at the debugging prompt. For more information, see “View and Modify Data in the MATLAB Command Window”.

Tips

- Do not use the keyword `this` to access chart data after simulation has stopped.
- Calling an external function named `this` from a chart disables the keyword `this` throughout the chart. To use the keyword, rename the extrinsic function.

See Also

`coder.extrinsic`

Topics
“Model a Power Window Controller”
“Simulate a Media Player”
“Model a Fitness Tracker”
“Call Extrinsic MATLAB Functions in Stateflow Charts”
“Access MATLAB Functions and Workspace Data in C Charts”
“Debug a Standalone Stateflow Chart”

Introduced in R2020b

tostring

Convert numeric value to string

Syntax

```
dest = tostring(X)
```

Description

`dest = tostring(X)` converts numeric, Boolean, or enumerated data X to a string.

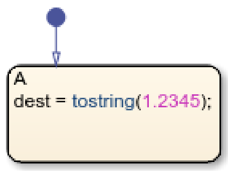
Note The operator `tostring` is supported only in Stateflow charts that use C as the action language.

Examples

Numeric Value to String

Convert numeric value to string `"1.2345"`.

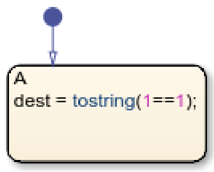
```
dest = tostring(1.2345);
```



Boolean Value to String

Convert Boolean value to string `"true"`.

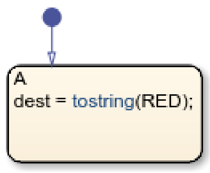
```
dest = tostring(1==1);
```



Enumerated Value to String

Convert enumerated value to string `"RED"`.

```
dest = tostring(RED);
```



See Also

str2double | strcpy

Topics

“Manage Textual Information by Using Strings”

Introduced in R2018b

Objects

Stateflow.SimulationData.Data

Data values during simulation

Description

Use `Stateflow.SimulationData.Data` to log the values of local and output data during simulation.

Creation

1 In the Symbols pane, select a local or output data object.
2 In the Property Inspector, under **Logging**, select the **Log signal data** check box.

Properties

Name — Logging name of data object
character array

Logging name of the data object, specified as a character array. By default, the logging name for a data object is the name of the data object. To assign another name to the data object, in the Property Inspector, under **Logging Name**, select `Custom` and enter a custom logging name.

Data Types: `char`

`BlockPath` — Block path for source block
`Simulink.SimulationData.BlockPath`

Block path for the source block, specified as a `Simulink.SimulationData.BlockPath` object.

Data Types: `Simulink.SimulationData.BlockPath`

`Values` — Logged data and time
`timeseries`

Logged data and time, specified as a `timeseries` object.

Data Types: `timeseries`

Object Functions

plot	Plot simulation output data in the Simulation Data Inspector

Examples

Access Logged Data

1 Open the `sf_semantics_hotel_checkin` model.

2 Open the `Hotel` chart.
3 Open the Symbols pane. In the **Simulation** tab, in **Prepare**, click **Symbols Pane**.
4 Open the Property Inspector. In the **Simulation** tab, in **Prepare**, click **Property Inspector**.
5 Configure the `service` local data for logging.

   - In the Symbols pane, select `service`.
   - In the Property Inspector, on the **Logging** tab, select the **Log signal data** check box.

6 Return to the Simulink model.
7 Simulate the model. After starting the simulation, check into the hotel by toggling the first switch and order room service multiple times by toggling the second switch. During simulation, Stateflow saves logged data in a `Simulink.SimulationData.Dataset` signal logging object. The default name of the signal logging object is `logsout`. For more information, see "Export Signal Data Using Signal Logging" (Simulink).
8 Stop the simulation.
9 To access the signal logging object, at the MATLAB command prompt, enter:

```
logsout = out.logsout
```

```
logsout = 

Simulink.SimulationData.Dataset 'logsout' with 1 element

                        Name         BlockPath                       
                        ___________  ________________________________
    1  [1x1 Data ]      service      sf_semantics_hotel_checkin/Hotel
```

10 To access logged element, use the `get` method.

```
serviceLog = logsout.get('service')
```

```
serviceLog = 

  Stateflow.SimulationData.Data
  Package: Stateflow.SimulationData

  Properties:
         Name: 'service'
    BlockPath: [1×1 Simulink.SimulationData.BlockPath]
       Values: [1×1 timeseries]
```

11 To access the logged data and time of each logged element, use the `Values.Data` and `Values.Time` properties. For example, arrange logged data in tabular form by using the `table` function.

```
Tbl = table(serviceLog.Values.Time,serviceLog.Values.Data);
Tbl.Properties.VariableNames = {'Time','Data'}
```

```
Tbl =

  6×2 table

       Time       Data
    __________    ____
    1.7076e+06     0  
    1.8607e+06     1  
    1.9653e+06     2  
    1.9653e+06     3  
    1.9653e+06     4  
    2.2912e+06     5  
```

See Also

`Simulink.SimulationData.BlockPath` | `Stateflow.SimulationData.State` | `plot` | `timeseries`

Topics

"Log Simulation Output for States and Data"
"Export Signal Data Using Signal Logging" (Simulink)

Introduced in R2017b

Stateflow.SimulationData.State

State activity during simulation

Description

Use `Stateflow.SimulationData.State` to log the activity of a state during simulation.

Creation

1. In the Stateflow Editor, select a state.
2. In the **Simulation** tab, in **Prepare**, select **Log Self Activity**. Alternatively, in the Property Inspector,under **Logging**, select the **Log self activity** check box.

Properties

`Name` — Logging name of state
character array

Logging name of the state, specified as a character array. By default, the logging name for a state is the hierarchical name using a period (`.`) to separate each level in the hierarchy of states. To assign a shorter name to the state, in the Property Inspector, set **Logging Name** to `Custom` and enter a custom logging name.

Data Types: `char`

`BlockPath` — Block path for source block
`Simulink.SimulationData.BlockPath`

Block path for the source block, specified as a `Simulink.SimulationData.BlockPath` object.

Data Types: `Simulink.SimulationData.BlockPath`

`Values` — State activity
`timeseries`

State activity, specified as a `timeseries` object. Data values represent whether the state is active (`1`) or not active (`0`). Time values correspond to simulation time.

Data Types: `timeseries`

Object Functions

plot	Plot simulation output data in the Simulation Data Inspector

Examples

Access Logged State Activity

1. Open the `sf_semantics_hotel_checkin` model.
2. Open the `Hotel` chart.
3. Open the Symbols pane. In the **Simulation** tab, in **Prepare**, click **Symbols Pane**.
4. Configure the `Dining_area` state for logging.

   - In the Stateflow Editor, select the `Dining_area` state.
   - In the **Simulation** tab, under **Prepare**, select **Log Self Activity**.

     In the Property Inspector, under **Logging**, select the **Log self activity** check box.
   - By default, the logging name for this state is the hierarchical signal name `Check_in.Checked_in.Executive_suite.Dining_area`. To assign a shorter name to the state, set **Logging Name** to `Custom` and enter `Dining Room`.
5. Return to the Simulink model.
6. Simulate the model. After starting the simulation, check into the hotel by toggling the first switch and order room service multiple times by toggling the second switch. During simulation, Stateflow saves logged data in a `Simulink.SimulationData.Dataset` signal logging object. The default name of the signal logging object is `logsout`. For more information, see “Export Signal Data Using Signal Logging” (Simulink).
7. Stop the simulation.
8. To access the signal logging object, at the MATLAB command prompt, enter:

   ```
   logsout = out.logsout
   ```

   ```
   logsout = 

   Simulink.SimulationData.Dataset 'logsout' with 1 element

                           Name         BlockPath                       
                           ___________  ________________________________
       1  [1x1 State]      Dining Room  sf_semantics_hotel_checkin/Hotel
   ```
9. To access logged elements, use the `get` method.

   ```
   diningLog = logsout.get('Dining Room')
   ```

   ```
   diningLog = 

     Stateflow.SimulationData.State
     Package: Stateflow.SimulationData

     Properties:
            Name: 'Dining Room'
       BlockPath: [1×1 Simulink.SimulationData.BlockPath]
          Values: [1×1 timeseries]
   ```
10. To access the logged data and time of each logged element, use the `Values.Data` and `Values.Time` properties. For example, arrange logged data in tabular form by using the `table` function.

    ```
    Tbl = table(diningLog.Values.Time,diningLog.Values.Data);
    Tbl.Properties.VariableNames = {'Time','Data'}
    ```

    ```
    Tbl =

      6×2 table
    ```

```
       Time       Data
    __________    ____

             0     0  
    1.8607e+06     1  
    1.9653e+06     0  
    1.9653e+06     1  
    1.9653e+06     0  
    2.2912e+06     1  
```

See Also

`Simulink.SimulationData.BlockPath` | `Stateflow.SimulationData.Data` | `plot` | `timeseries`

Topics

"Log Simulation Output for States and Data"
"Export Signal Data Using Signal Logging" (Simulink)

Introduced in R2017b

5

Tools

Sequence Viewer

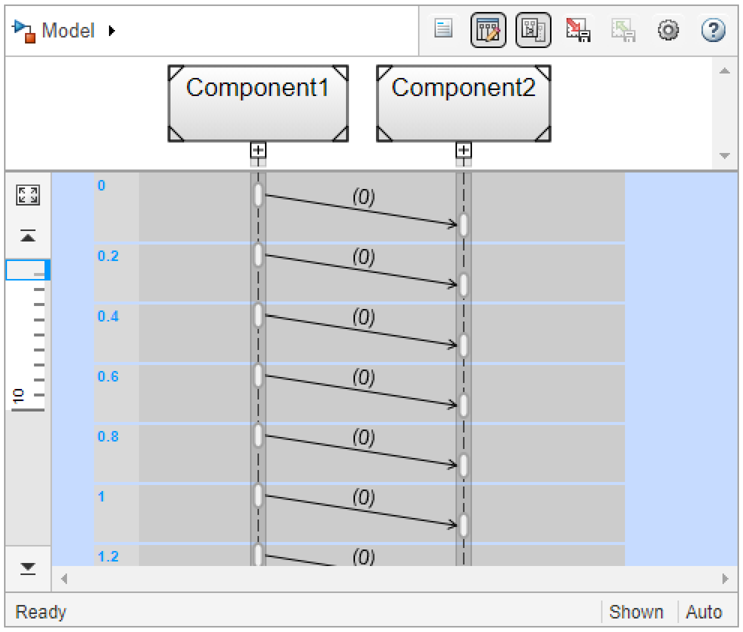
Visualize messages, events, states, transitions, and functions

Description

The Sequence Viewer visualizes message flow, function calls, and state transitions.

Use the Sequence Viewer to see the interchange of messages, events, function calls in Simulink models, Simulink behavior models in System Composer™ and between Stateflow charts in Simulink models.

In the Sequence Viewer window, you can view event data related to Stateflow chart execution and the exchange of messages between Stateflow charts. The Sequence Viewer window shows messages as they are created, sent, forwarded, received, and destroyed at different times during model execution. The Sequence Viewer window also displays state activity, transitions, and function calls to Stateflow graphical functions, Simulink functions, and MATLAB functions. For more information, see “Use the Sequence Viewer to Visualize Messages, Events, and Entities” (Simulink).



Open the Sequence Viewer

- Simulink Toolstrip: On the **Simulation** tab, in the **Review Results** section, click **Sequence Viewer**.

Examples

Using the Sequence Viewer Tool

1. To activate logging events, in the Simulink Toolstrip, under the **Simulation** tab, in the **Prepare** section, click **Log Events**.
2. Simulate your model.
3. To open the tool, in the Simulink Toolstrip, under the **Simulation** tab, in the **Review Results** section, click **Sequence Viewer**.

- "Use the Sequence Viewer to Visualize Messages, Events, and Entities" (Simulink)
- "Simulink Messages Overview" (Simulink)

Parameters

`Time Precision for Variable Step` — Digits for time increment precision

`3` (default) | scalar

Number of digits for time increment precision. When using a variable step solver, change this parameter to adjust the time precision for the sequence viewer. By default the block supports `3` digits of precision. Minimum and maximum precision are `1` and `16`, respectively.

Suppose the block displays two events that occur at times `0.1215` and `0.1219`. Displaying these two events precisely requires `4` digits of precision. If the precision is `3`, then the block displays two events at time `0.121`.

Programmatic Use
Block Parameter: `SequenceViewerTimePrecision`
Type: character vector
Values: `'3'` | scalar
Default: `'3'`

`History` — Maximum number of previous events to display

`1000` (default) | scalar

Total number of events before the last event to display. Minimum and maximum number of events are `0` and `25000`, respectively.

For example, if **History** is `5` and there are `10` events in your simulation, then the block displays `6` events, including the last event and the five events prior the last event. Earlier events are not displayed. The time ruler is greyed to indicate the time between the beginning of the simulation and the time of the first displayed event.

Each send, receive, drop, or function call event is counted as one event, even if they occur at the same simulation time.

Programmatic Use
Block Parameter: `SequenceViewerHistory`
Type: character vector
Values: `'1000'` | scalar
Default: `'1000'`

See Also

Topics
“Use the Sequence Viewer to Visualize Messages, Events, and Entities” (Simulink)
“Simulink Messages Overview” (Simulink)

Introduced in R2020b

Simulation Data Inspector

Inspect and compare data and simulation results to validate and iterate model designs

Description

The Simulation Data Inspector visualizes and compares multiple kinds of data.

Using the Simulation Data Inspector, you can inspect and compare time series data at multiple stages of your workflow. This example workflow shows how the Simulation Data Inspector supports all stages of the design cycle:

1. "View Data in the Simulation Data Inspector" (Simulink).

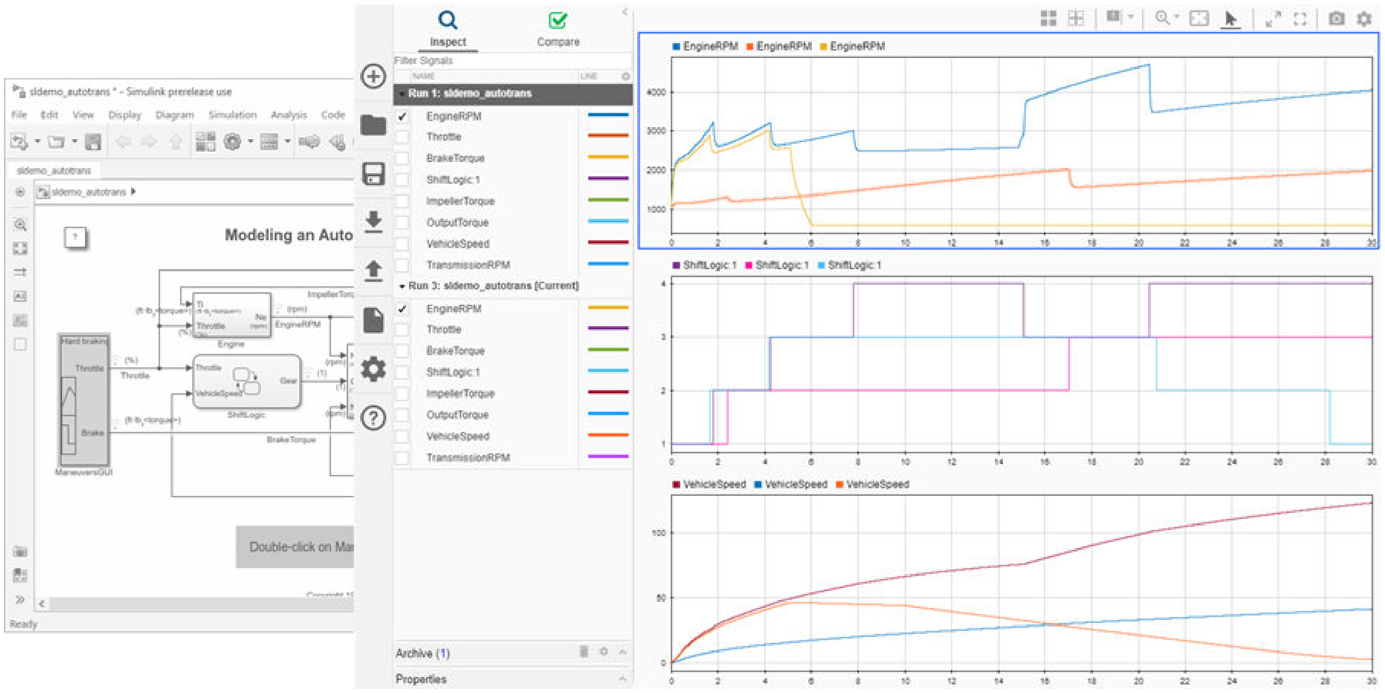
   Run a simulation in a model configured to log data to the Simulation Data Inspector, or import data from the workspace or a MAT-file. You can view and verify model input data or inspect logged simulation data while iteratively modifying your model diagram, parameter values, or model configuration.
2. "Inspect Simulation Data" (Simulink).

   Plot signals on multiple subplots, zoom in and out on specified plot axes, and use data cursors to understand and evaluate the data. "Create Plots Using the Simulation Data Inspector" (Simulink) to tell your story.
3. "Compare Simulation Data" (Simulink)

   Compare individual signals or simulation runs and analyze your comparison results with relative, absolute, and time tolerances. The compare tools in the Simulation Data Inspector facilitate iterative design and allow you to highlight signals that do not meet your tolerance requirements. For more information about the comparison operation, see "How the Simulation Data Inspector Compares Data" (Simulink).
4. "Save and Share Simulation Data Inspector Data and Views" (Simulink).

   Share your findings with others by saving Simulation Data Inspector data and views.

You can also harness the capabilities of the Simulation Data Inspector from the command line. For more information, see "Inspect and Compare Data Programmatically" (Simulink).



Open the Simulation Data Inspector

- Simulink Toolstrip: On the **Simulation** tab, under **Review Results**, click **Data Inspector**.
- Click the streaming badge on a signal to open the Simulation Data Inspector and plot the signal.
- MATLAB command prompt: Enter `Simulink.sdi.view`.

Examples

Apply a Tolerance to a Signal in Multiple Runs

You can use the Simulation Data Inspector programmatic interface to modify a parameter for the same signal in multiple runs. This example adds an absolute tolerance of `0.1` to a signal in all four runs of data.

First, clear the workspace and load the Simulation Data Inspector session with the data. The session includes logged data from four simulations of a Simulink® model of a longitudinal controller for an aircraft.

```
Simulink.sdi.clear
Simulink.sdi.load('AircraftExample.mldatx');
```

Use the `Simulink.sdi.getRunCount` function to get the number of runs in the Simulation Data Inspector. You can use this number as the index for a for loop that operates on each run.

```
count = Simulink.sdi.getRunCount;
```

Then, use a for loop to assign the absolute tolerance of `0.1` to the first signal in each run.

```
for a = 1:count
    runID = Simulink.sdi.getRunIDByIndex(a);
    aircraftRun = Simulink.sdi.getRun(runID);
    sig = getSignalByIndex(aircraftRun,1);
    sig.AbsTol = 0.1;
end
```

- "View Data in the Simulation Data Inspector" (Simulink)
- "Inspect Simulation Data" (Simulink)
- "Compare Simulation Data" (Simulink)
- "Iterate Model Design Using the Simulation Data Inspector" (Simulink)

Programmatic Use

`Simulink.sdi.view` opens the Simulation Data Inspector from the MATLAB command line.

See Also

Functions
`Simulink.sdi.clear` | `Simulink.sdi.clearPreferences` | `Simulink.sdi.snapshot`

Topics
"View Data in the Simulation Data Inspector" (Simulink)
"Inspect Simulation Data" (Simulink)
"Compare Simulation Data" (Simulink)
"Iterate Model Design Using the Simulation Data Inspector" (Simulink)

Introduced in R2010b