Laboratory of Advanced Network Technologies.

MSC & SCStudio

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Autumn 2011

Message Sequence Chart

Message Sequence Chart (MSC) is a formalism for communication description between a number of independent components.

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Standardized by ITU-T as the Z.120 recommendation

- 1993: the first version
- ...
- 2011: current version

Why?

Why should we use any formalism?

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automatic/computer processing

- model checking
- equivalence checking
- testing
- simulation
- theorem proving

MSC Components

Which components does MSC provide for the user?

- communicating processes
- message ordering
- time information
- high-level form

Advantages

What MSC is good for?

Advantages

What MSC is good for?

Both **human** and computer readable formalizm for:

- basic behaviour demonstration (use cases),
- high level system behaviour description,
- test case specification, and
- (test) log visualization.

Disadvantages

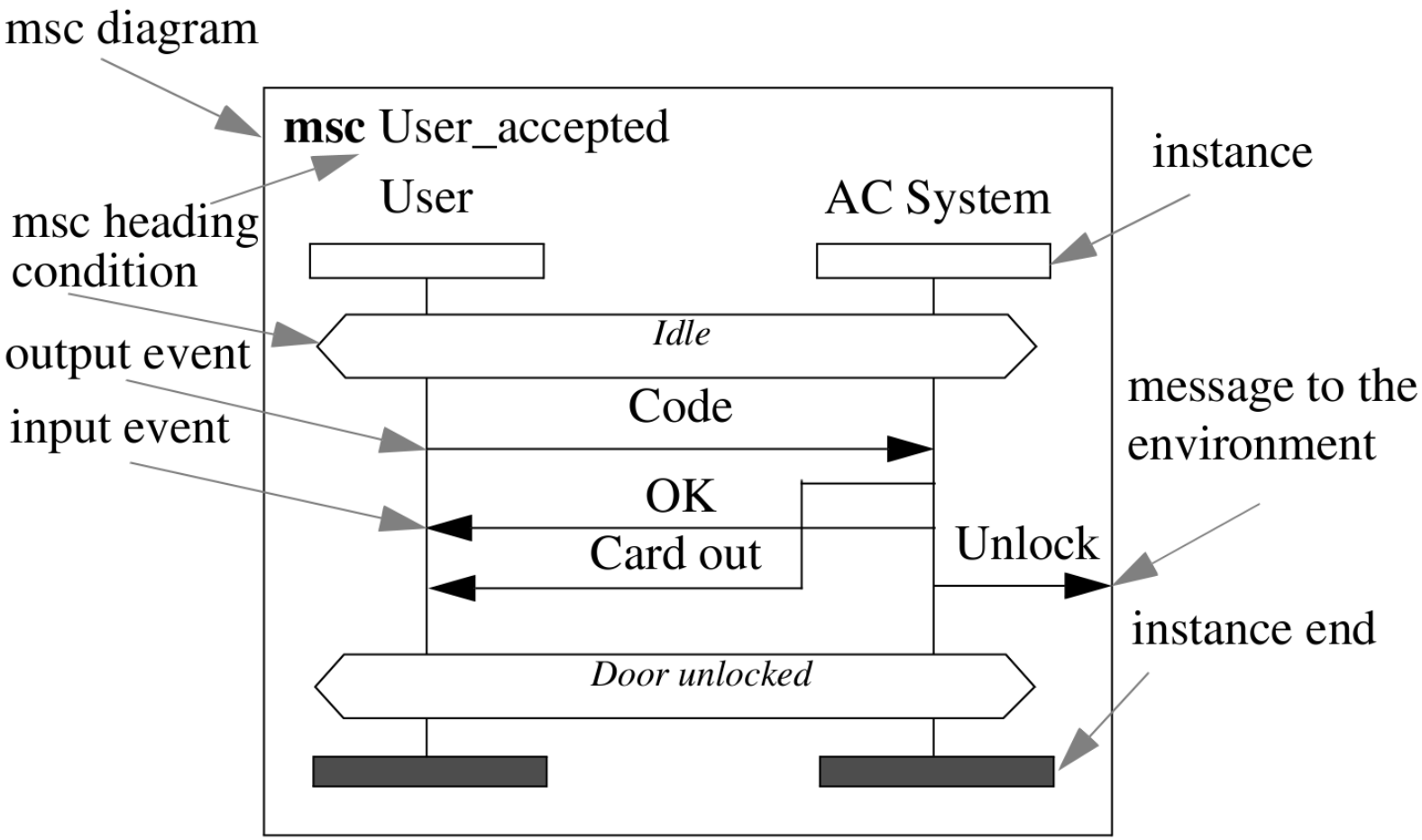
What MSC is NOT good for?

Disadvantages

What MSC is NOT good for?

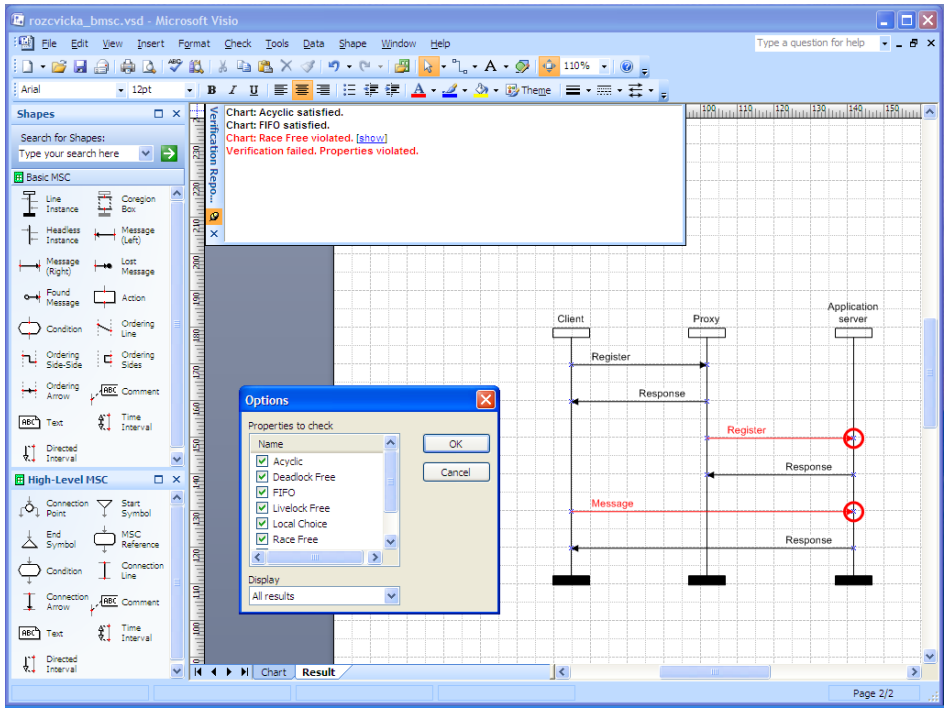
detailed specification (before implementation), hierarchical structure of communicating entities, implementation details (primitives for communication, detailed data manipulation), etc.

Message Sequence Chart (MSC)



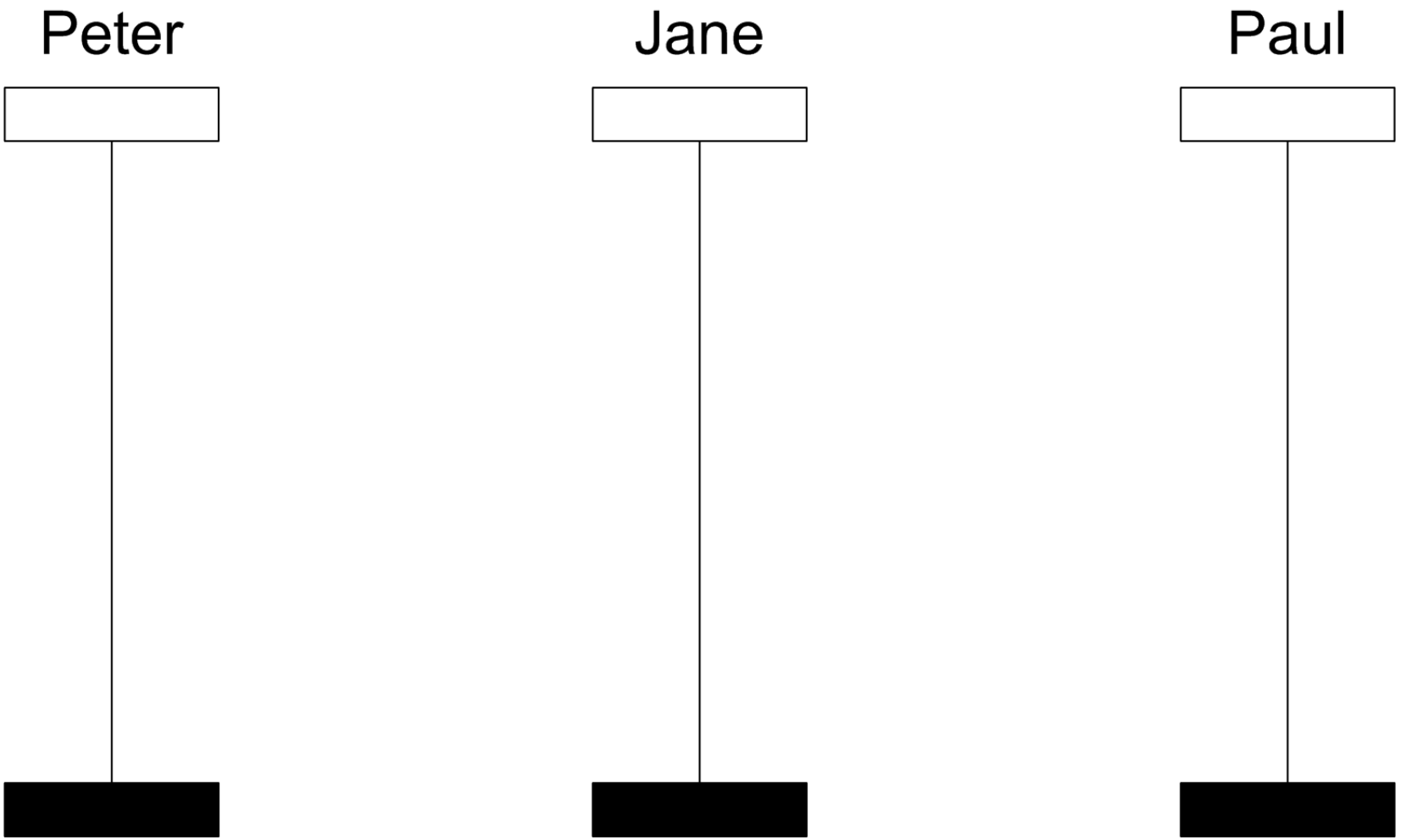
Sequence Chart Studio

MSC drawing and verification tool developed at FI MU.



http://scstudio.sourceforge.net

Message Sequence Chart (MSC) - semantics



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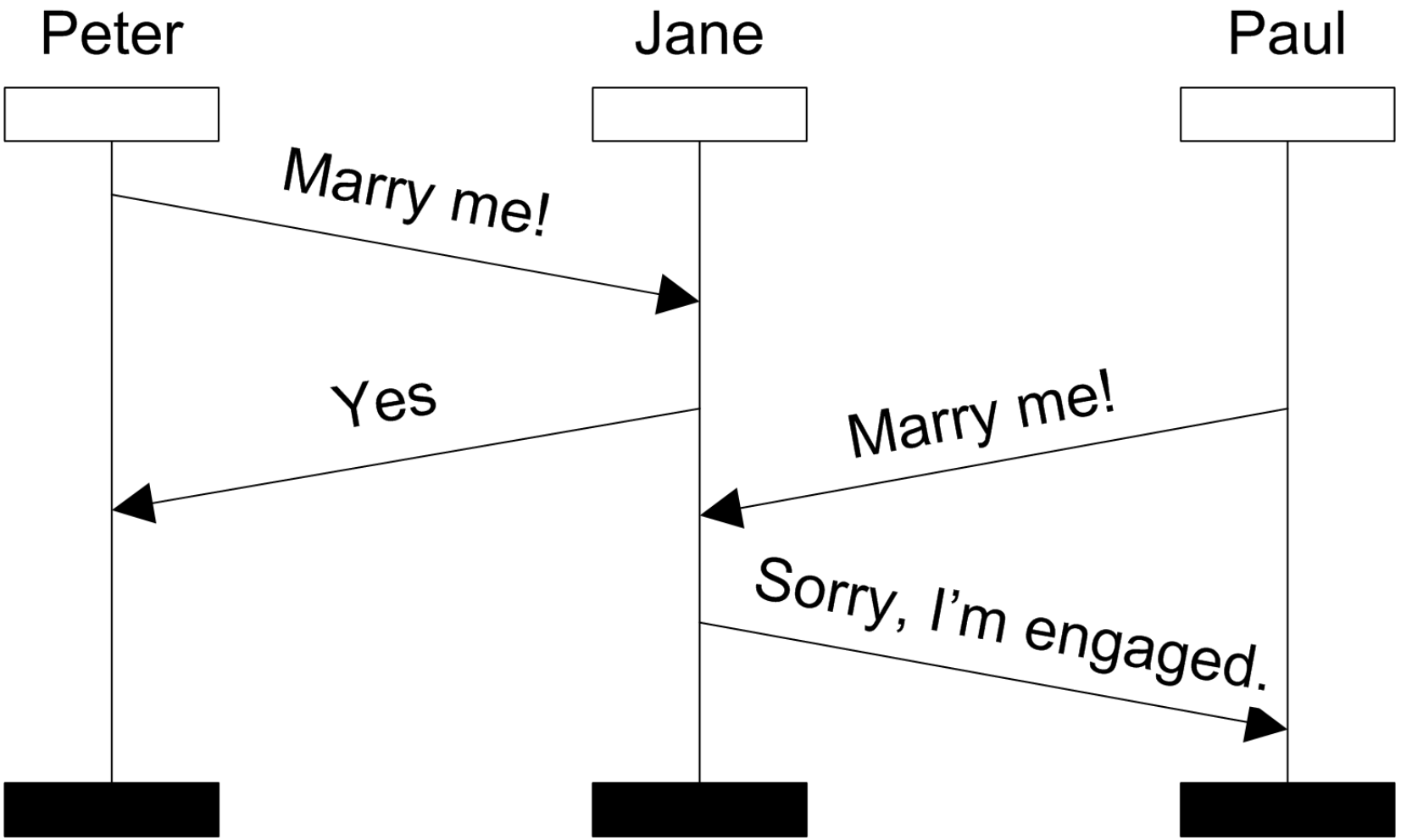

MSC Properties

What is an unwanted behaviour/property?

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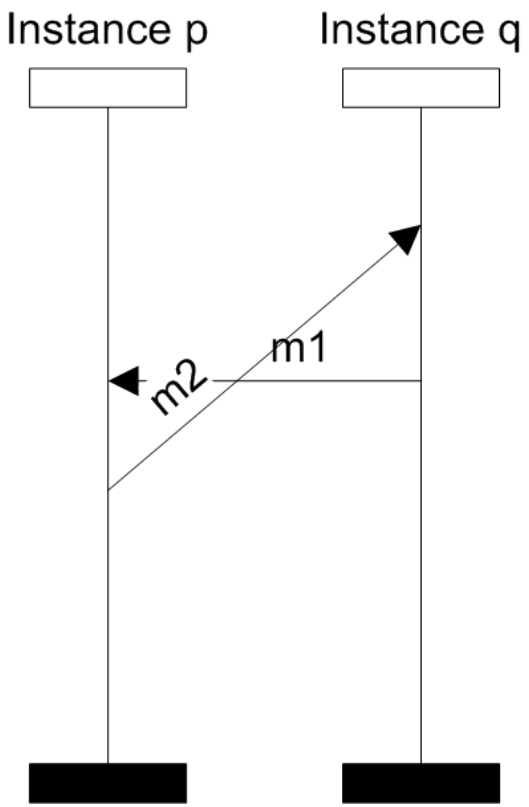
What is an unwanted behaviour/property?

Fundamental problems in the specified model, e.g. an implementation of the model does not exist in the given environment.

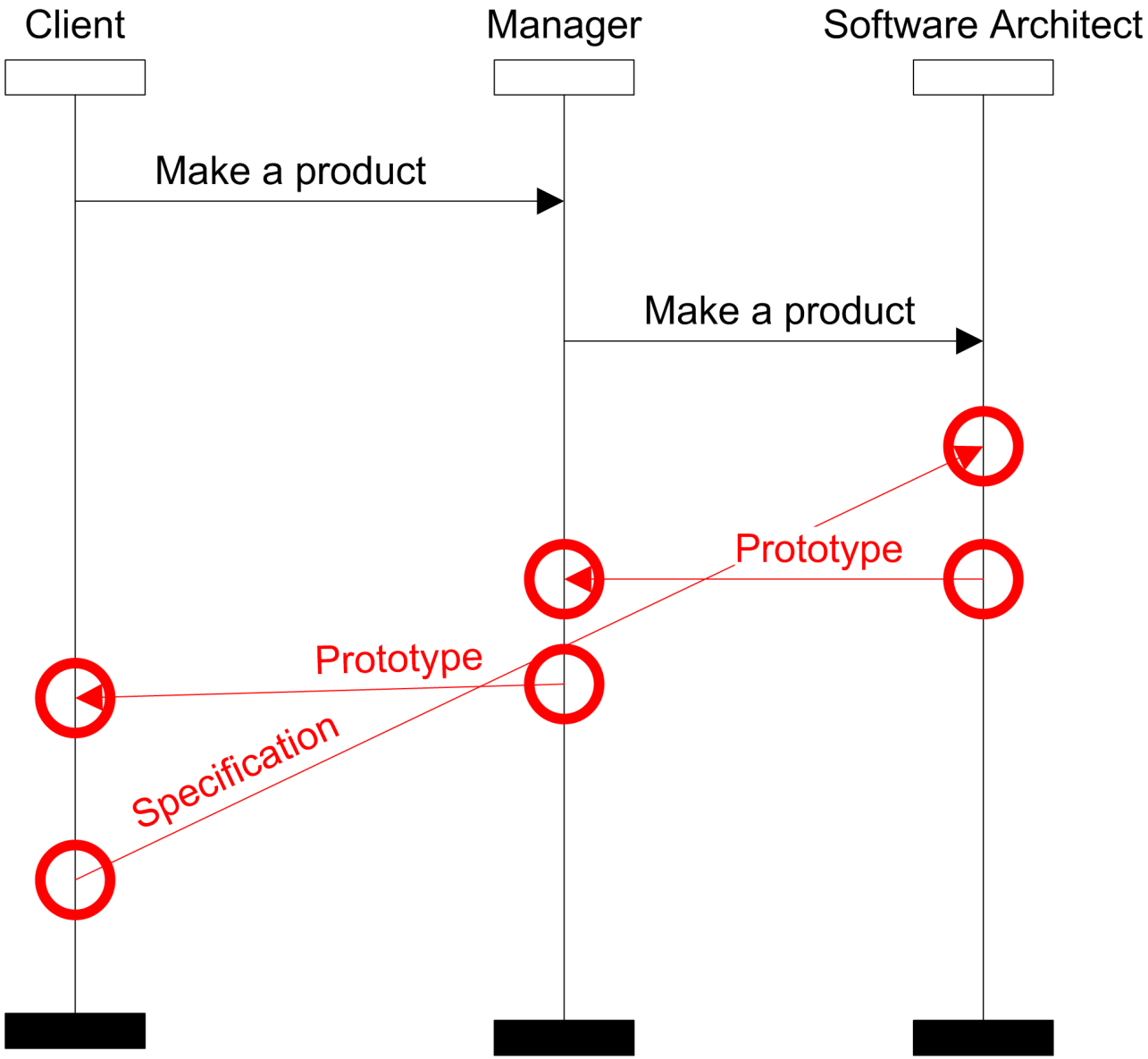
Acyclic/Cyclic property

cyclic dependency among events



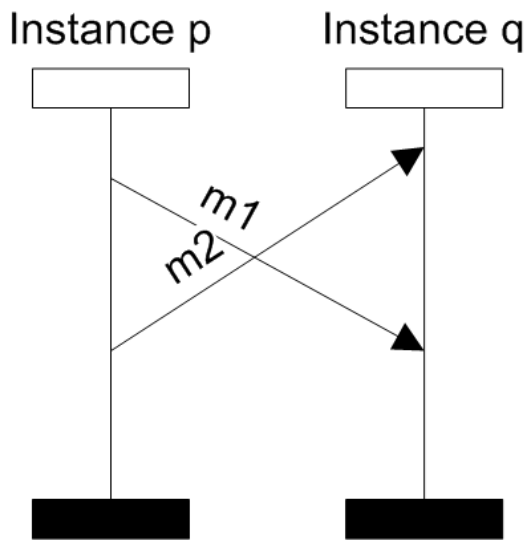
unrealizable in any environment

Acyclic/Cyclic property



FIFO/non-FIFO property

overleaping messages



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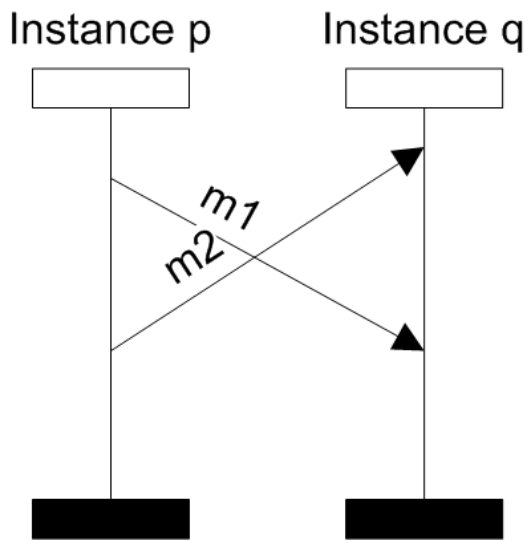

unrealizable in an environment preserving message order

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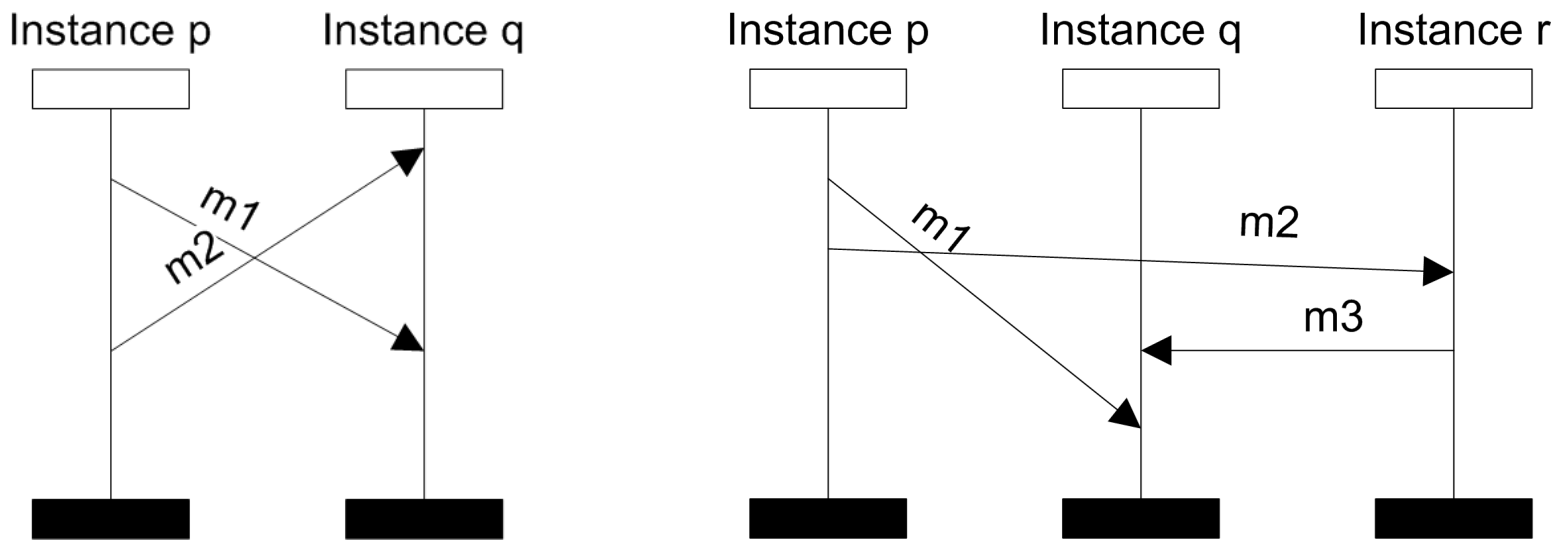

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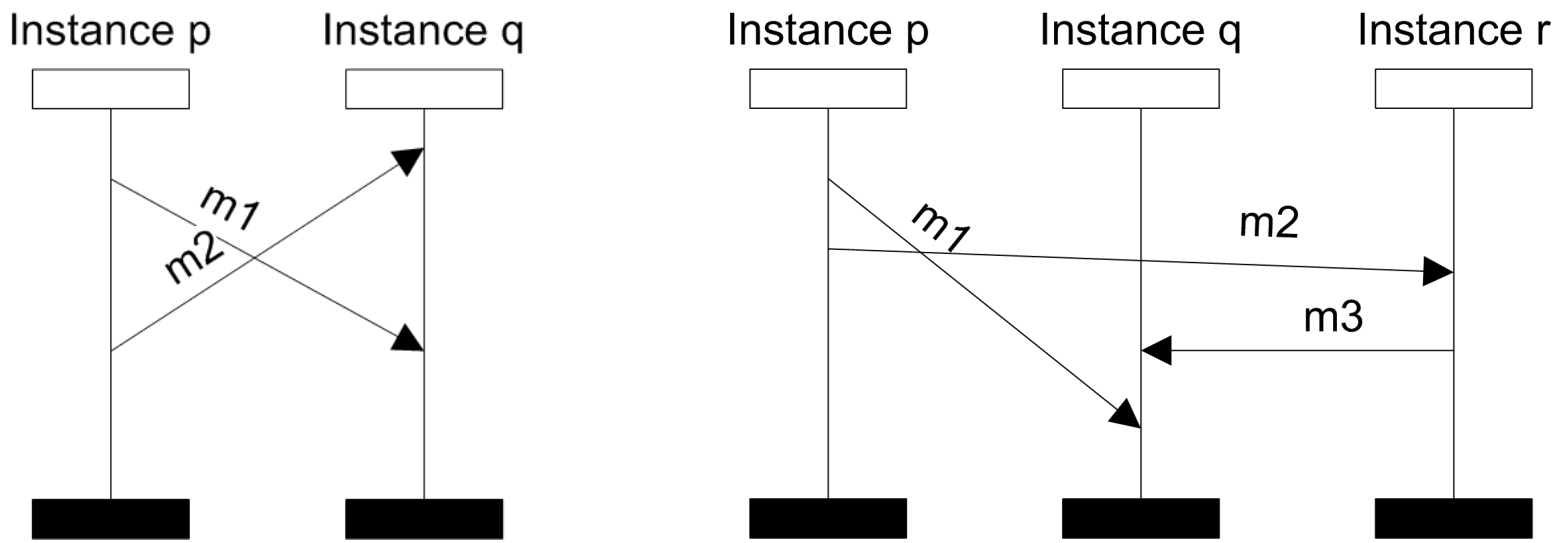
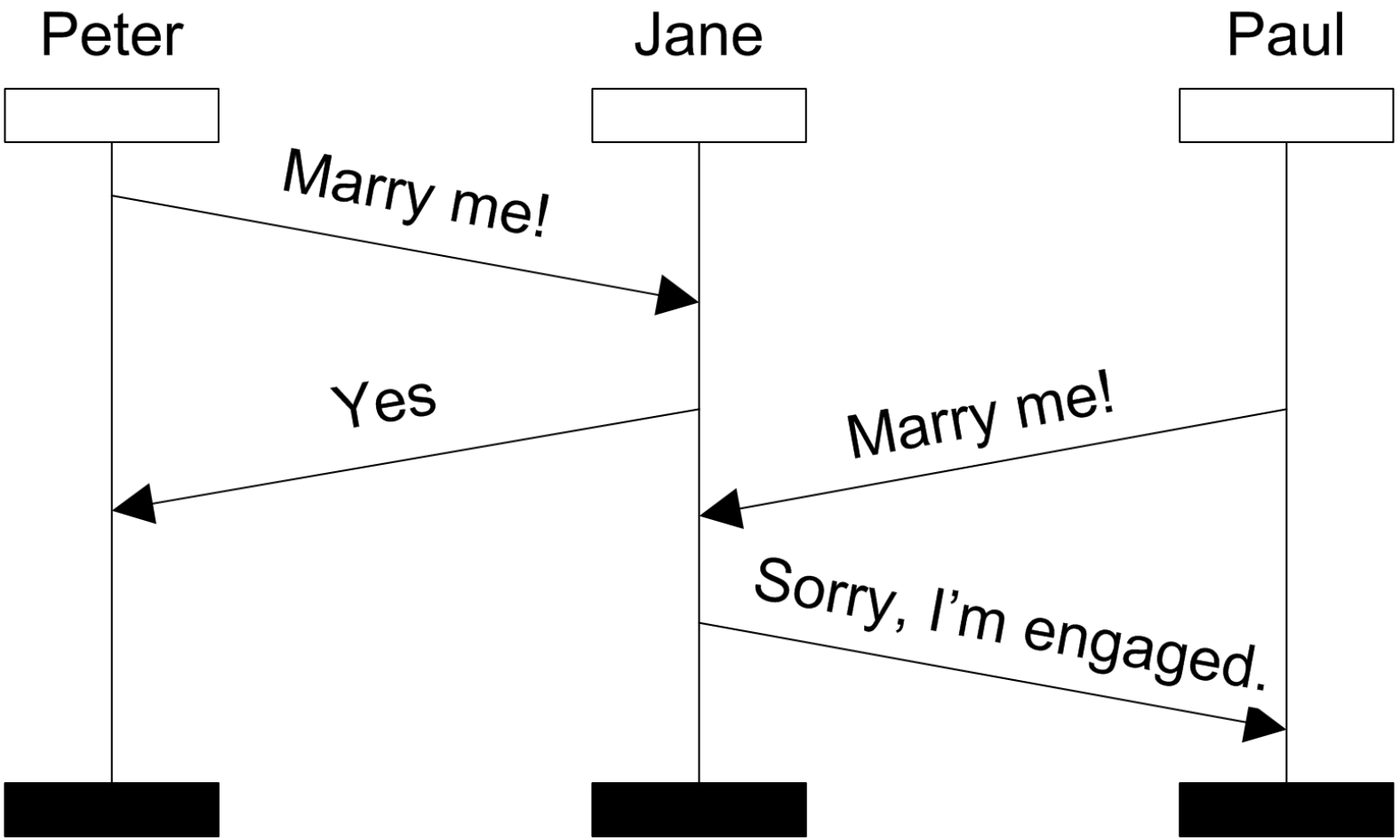


unrealizable in an environment preserving message order

realizable in an environment with P2P channel but unrealizable in case of a global channel

Race Condition



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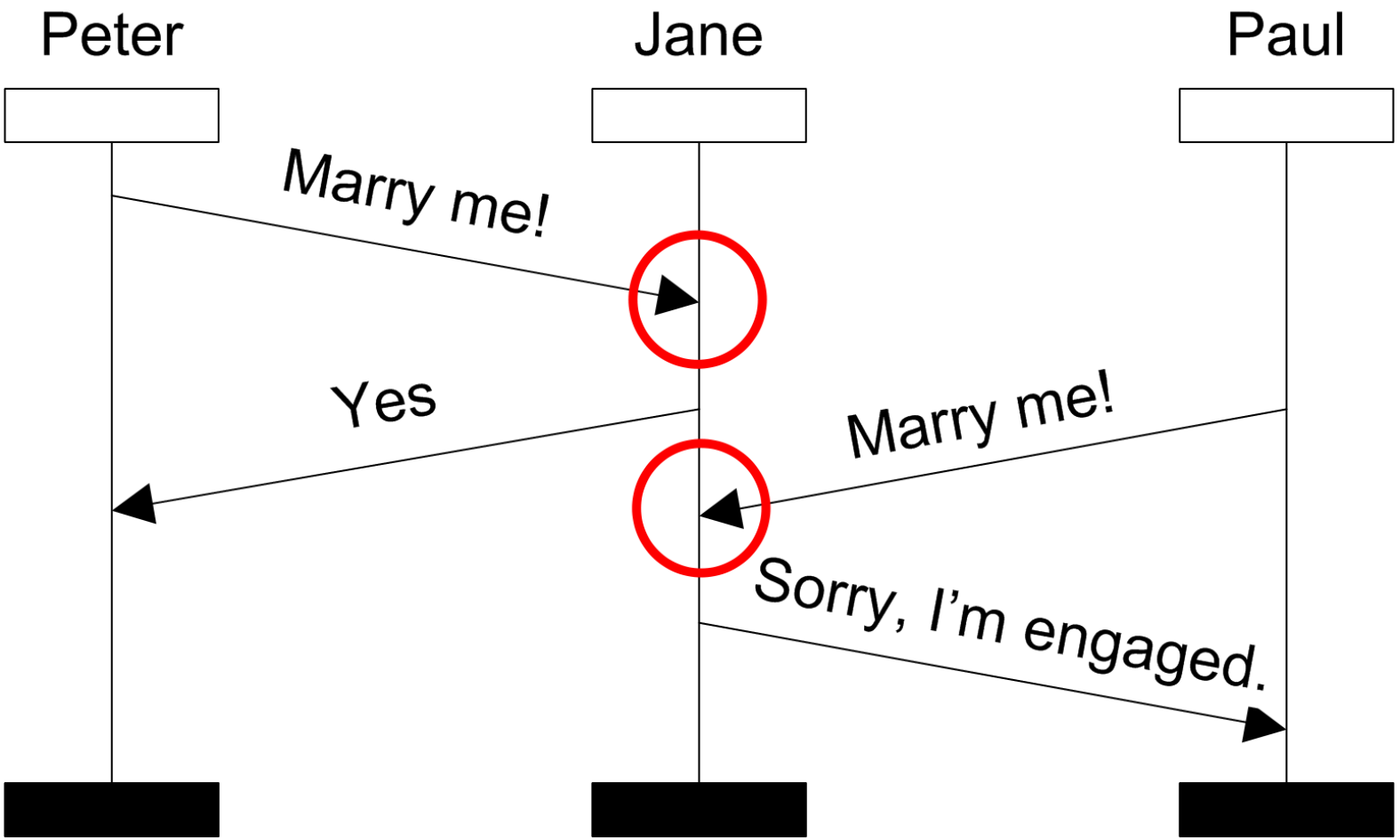

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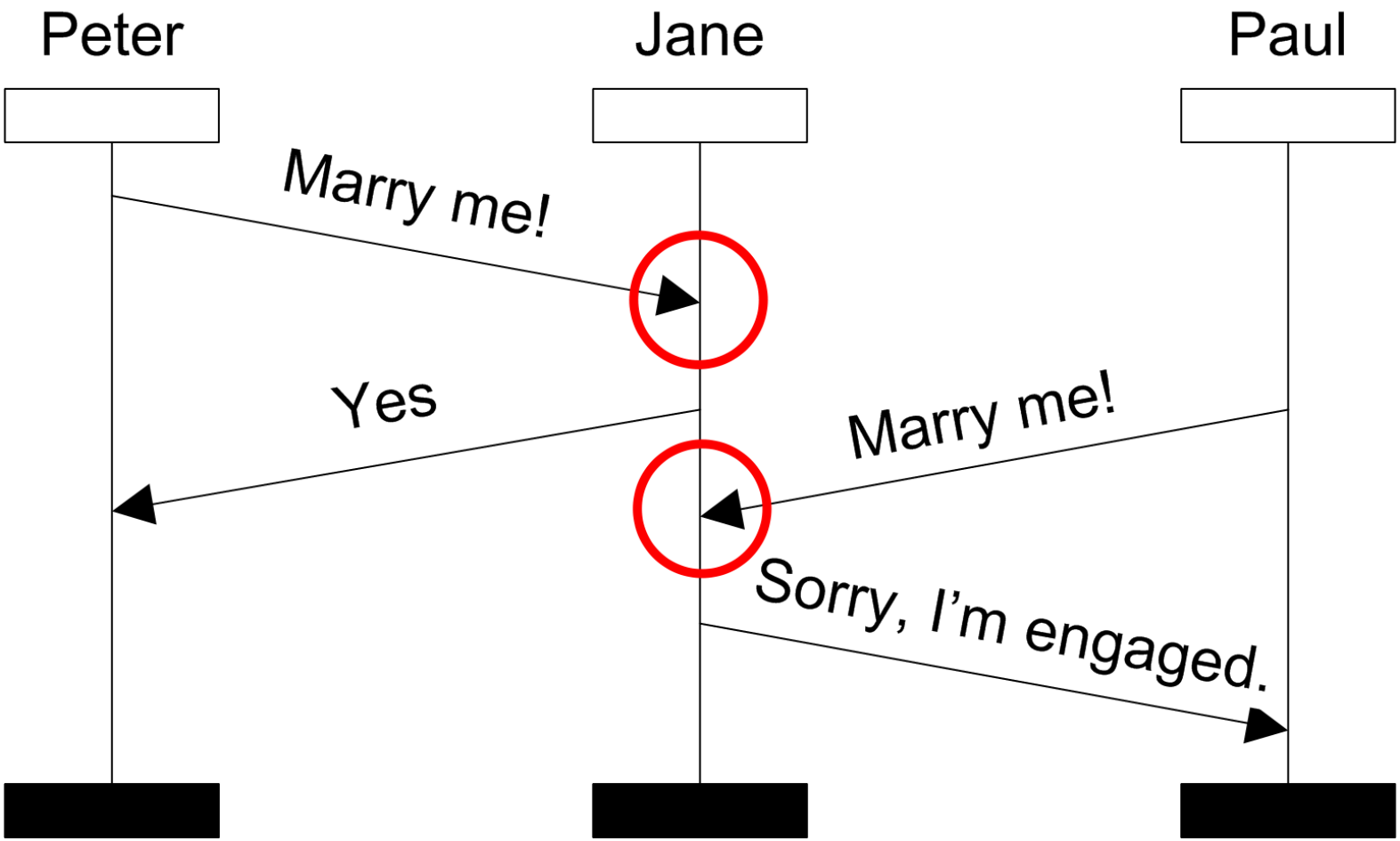

Informally, **race** is when some receive event can come earlier.

Solution #1 - Coregion Construction

Let us demonstrate that some events are not ordered.

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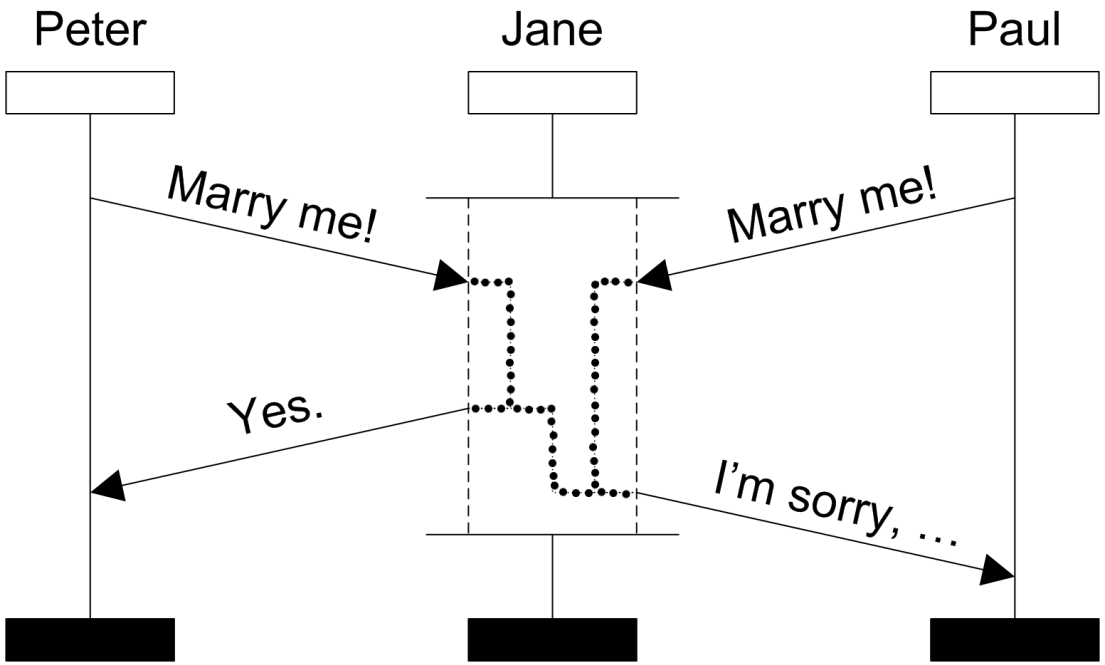

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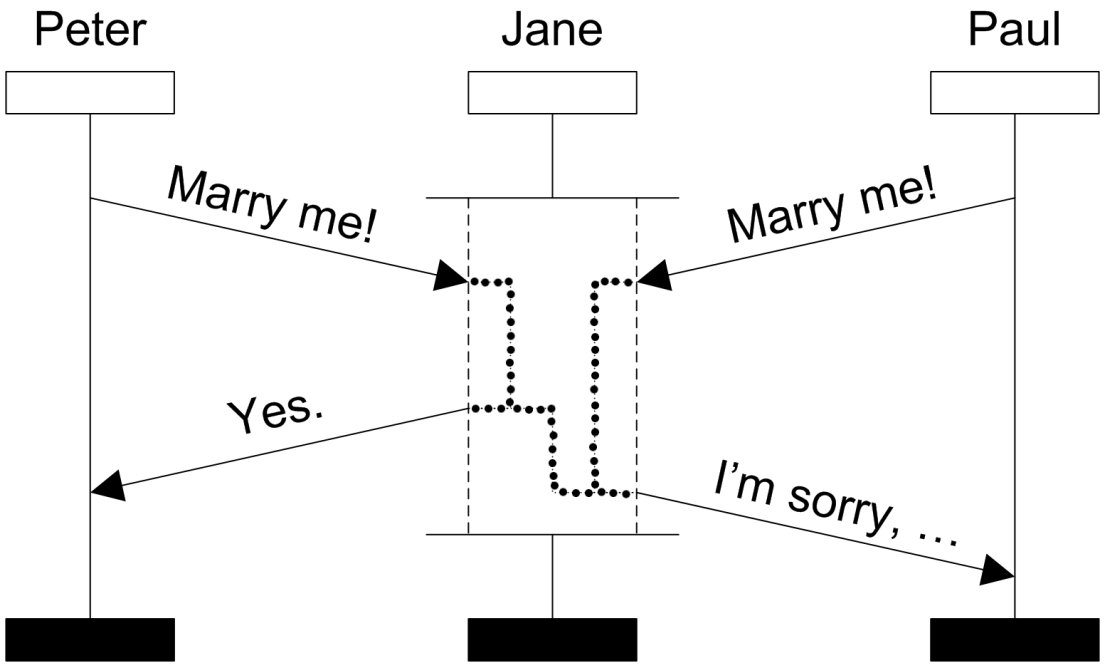
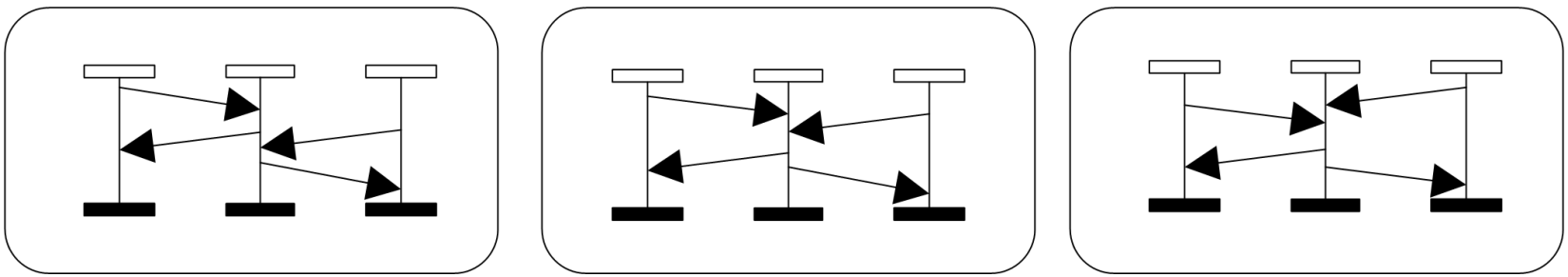
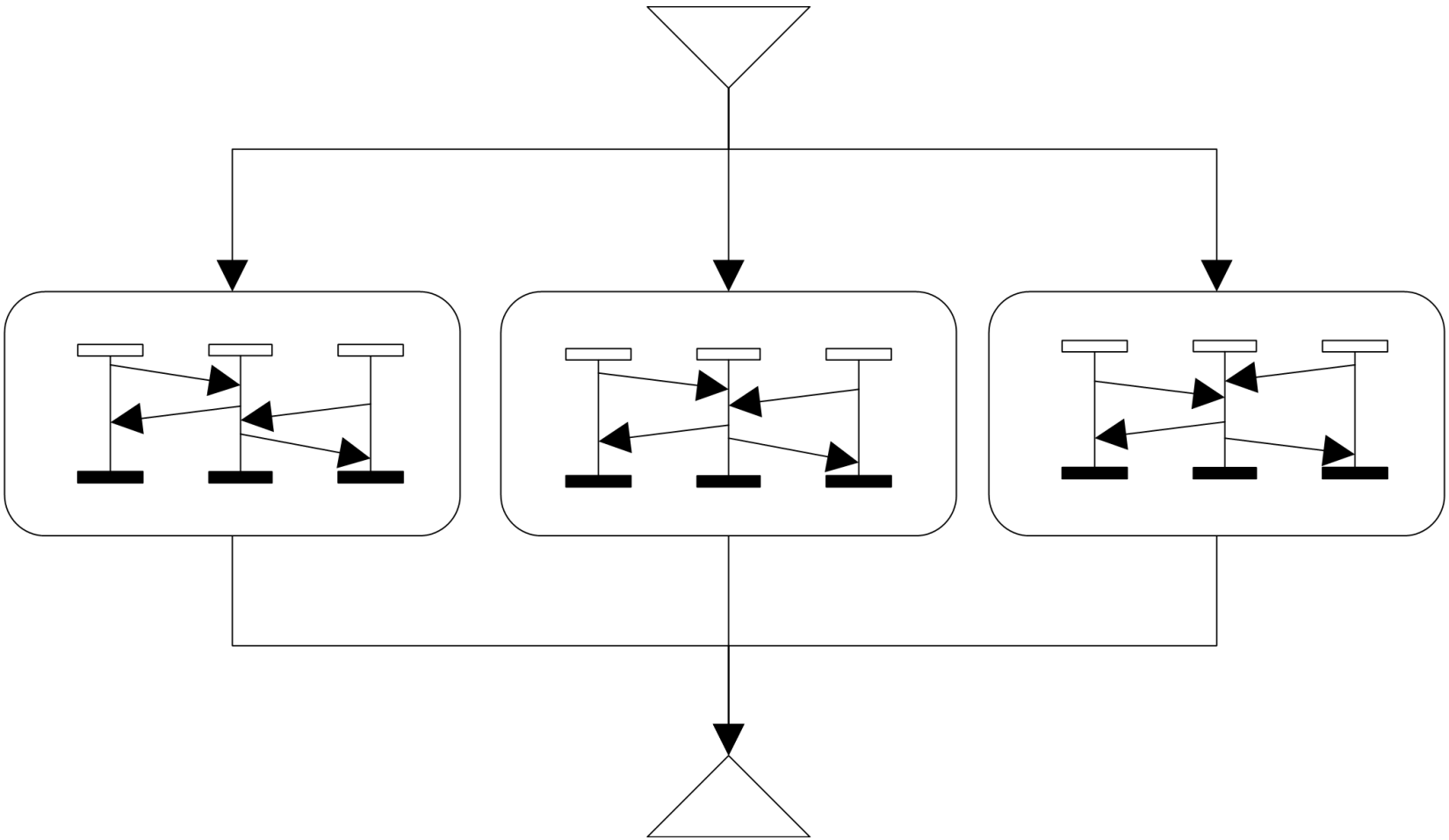


Events in a *coregion* are not ordered; except of related by *general ordering*.

Solution #2 - List/set of all possibilities



High-Level MSC (HMSC) - ITU-T Z.120



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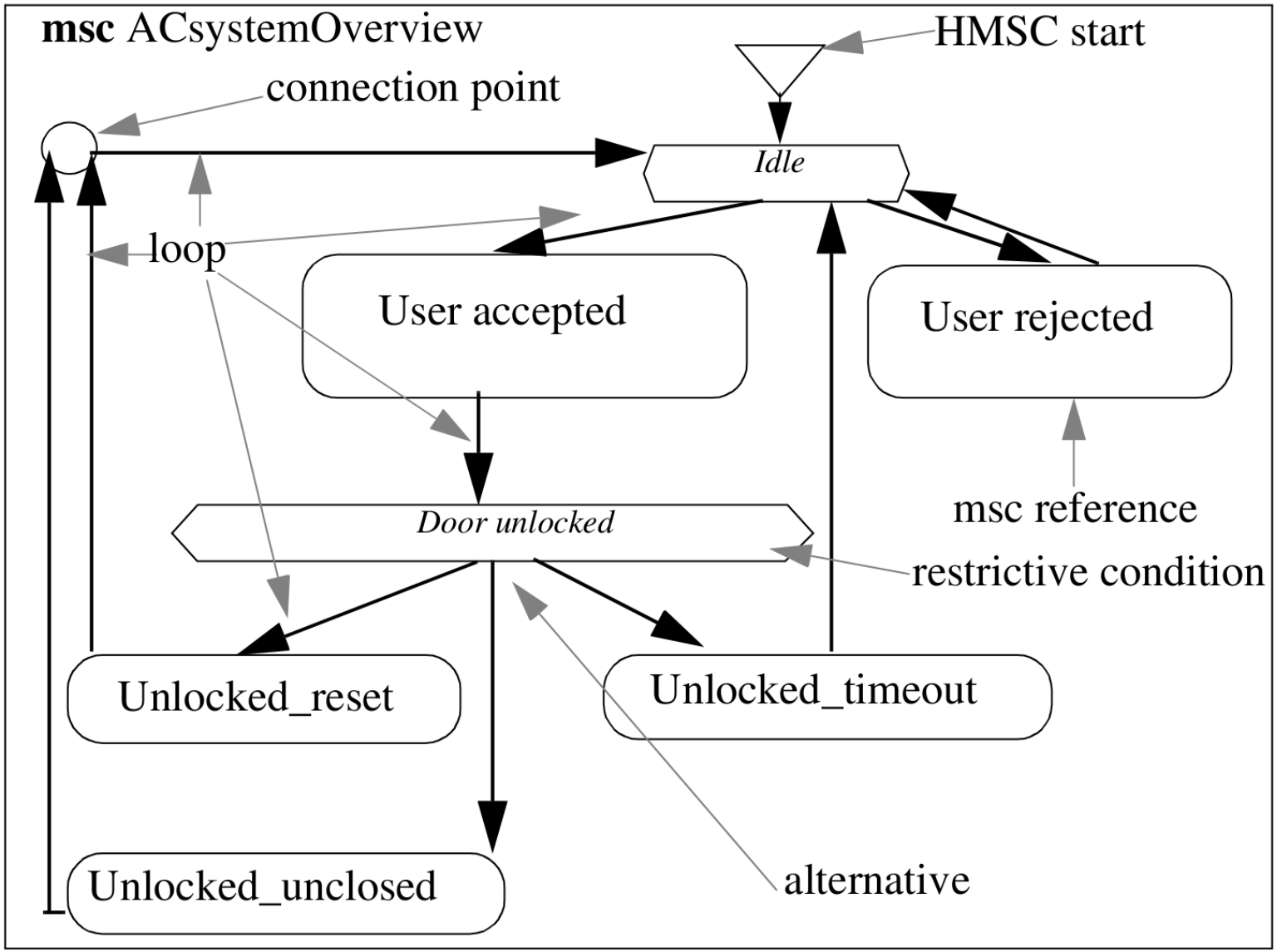

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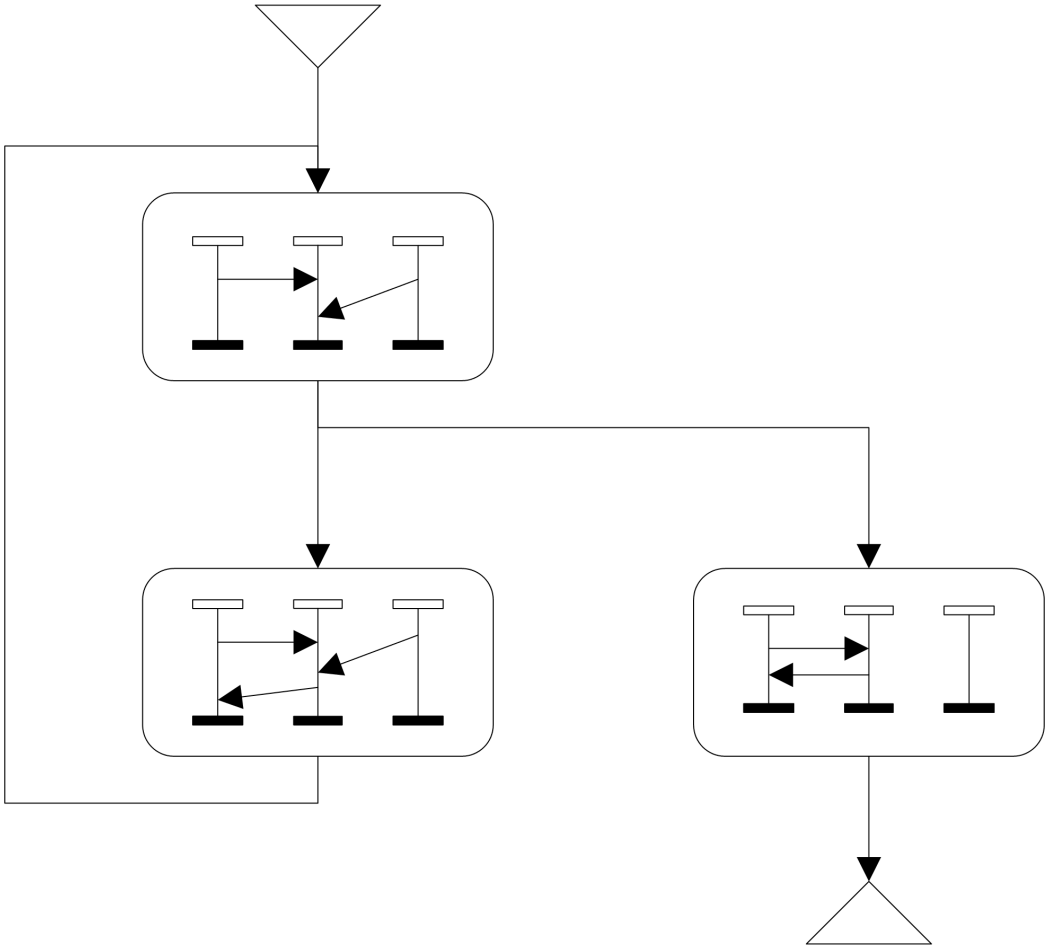

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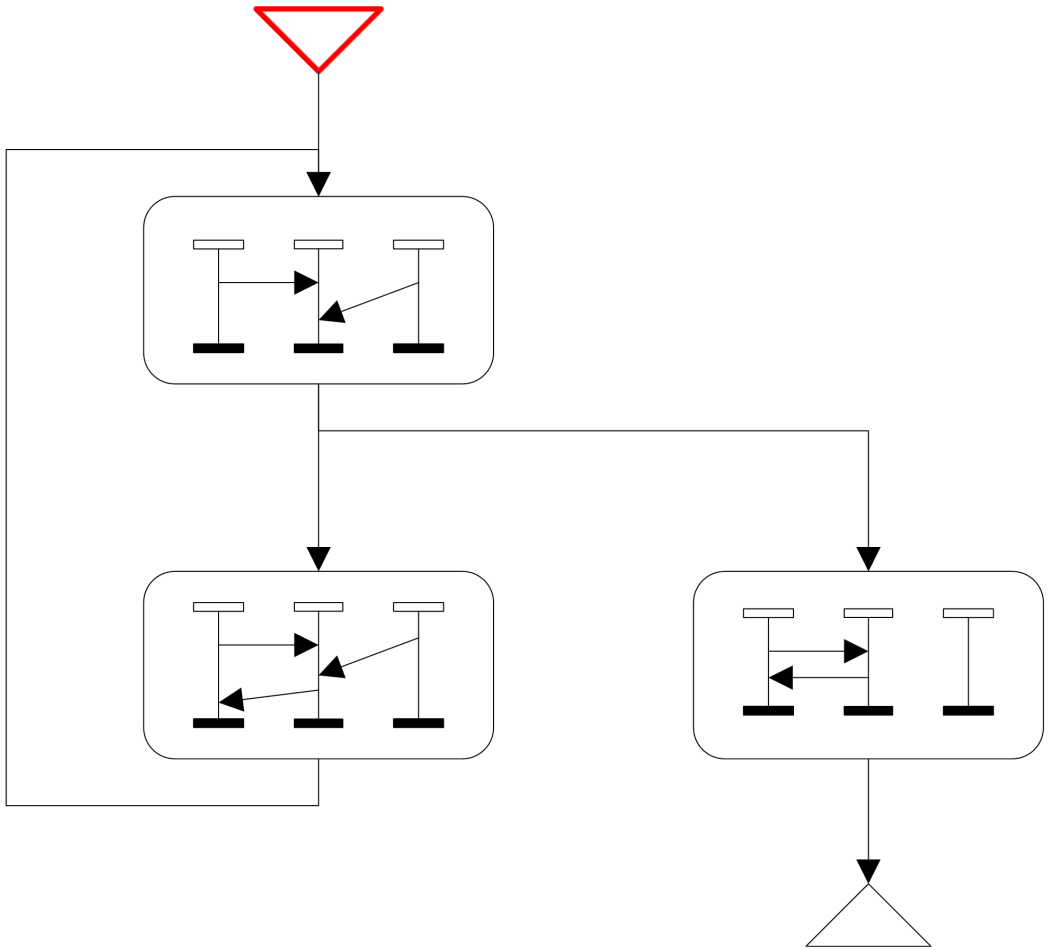

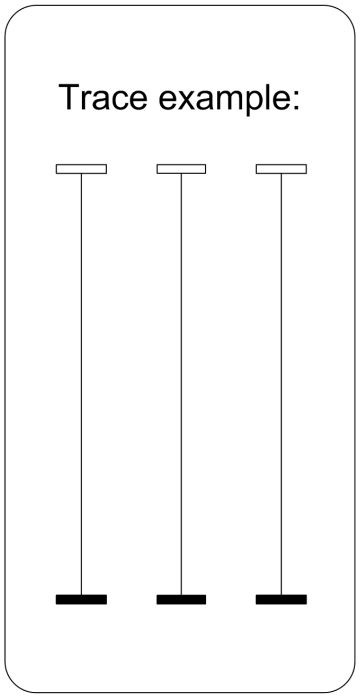

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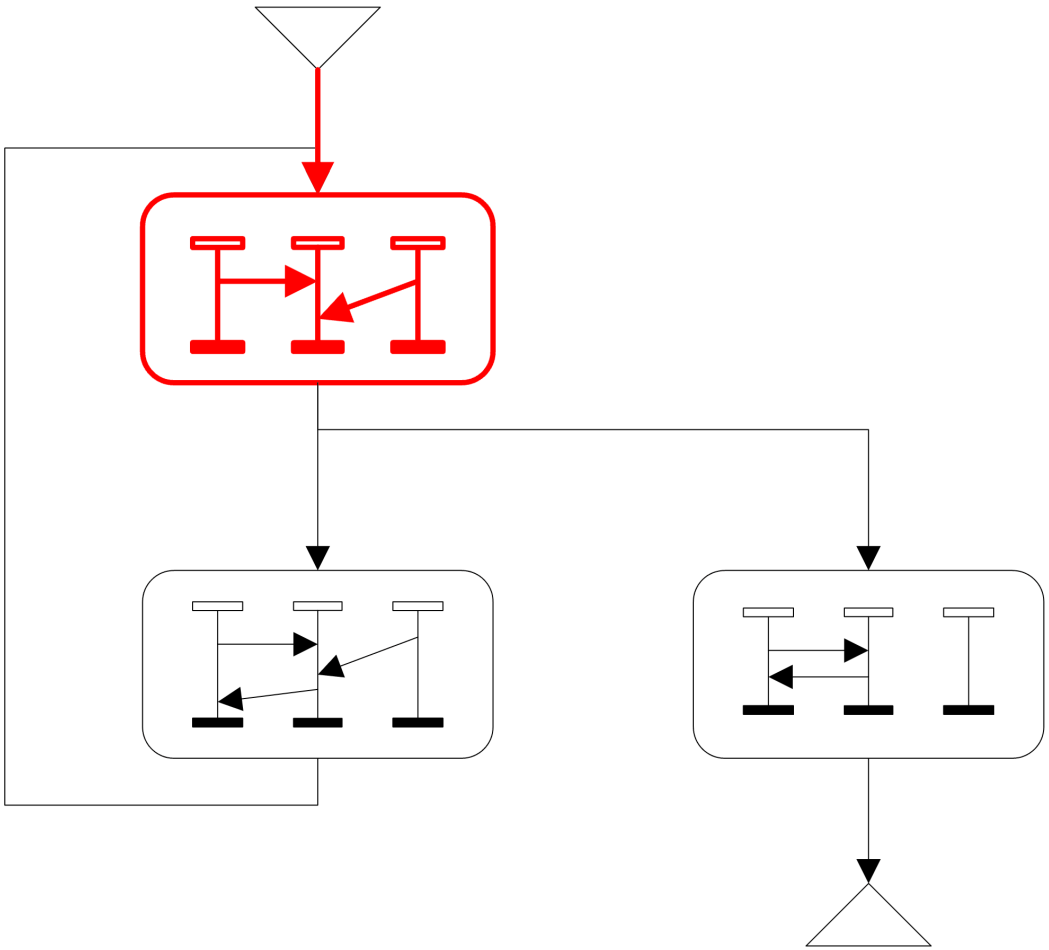

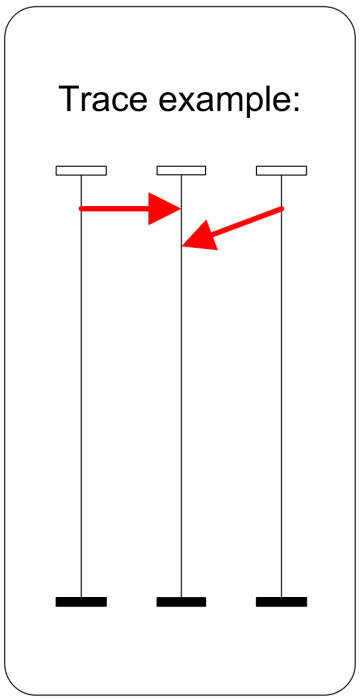

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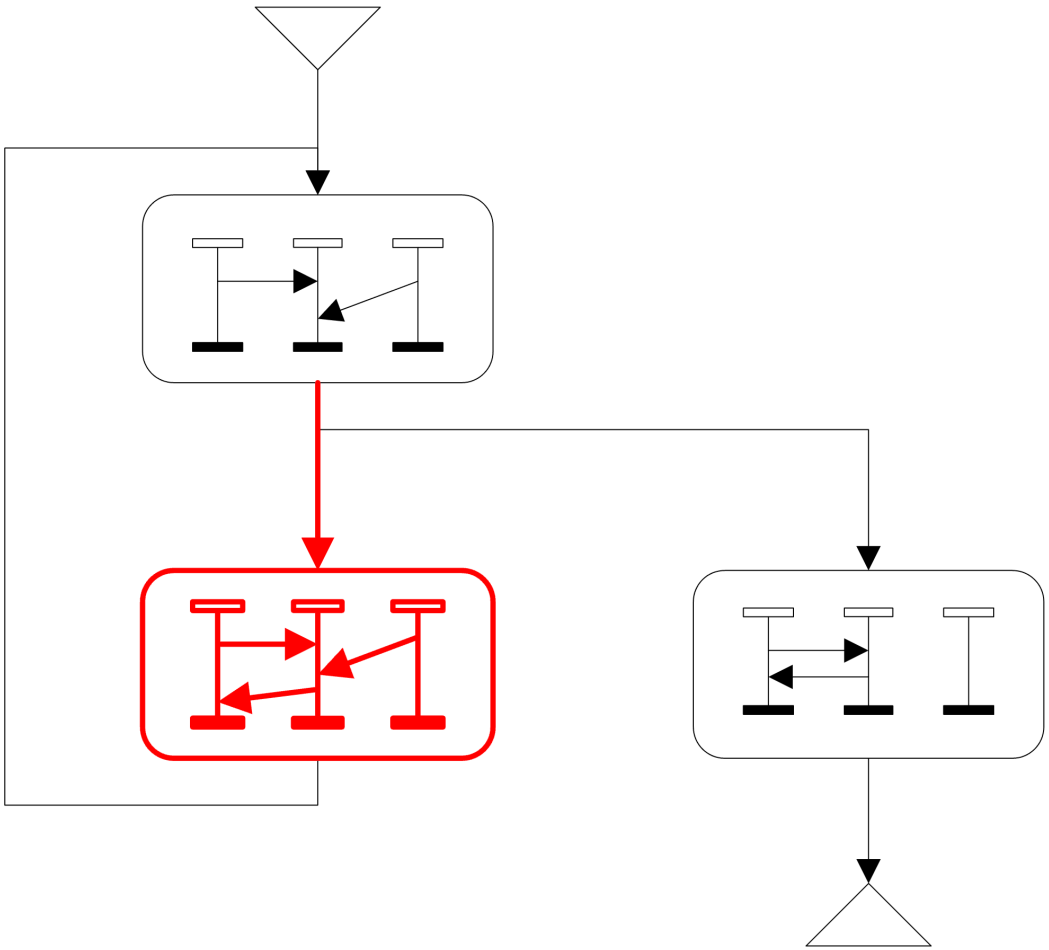

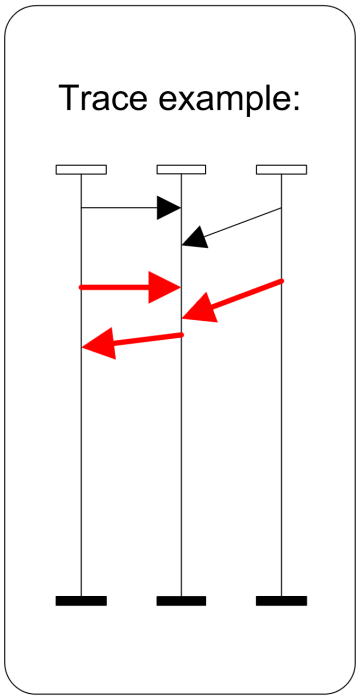

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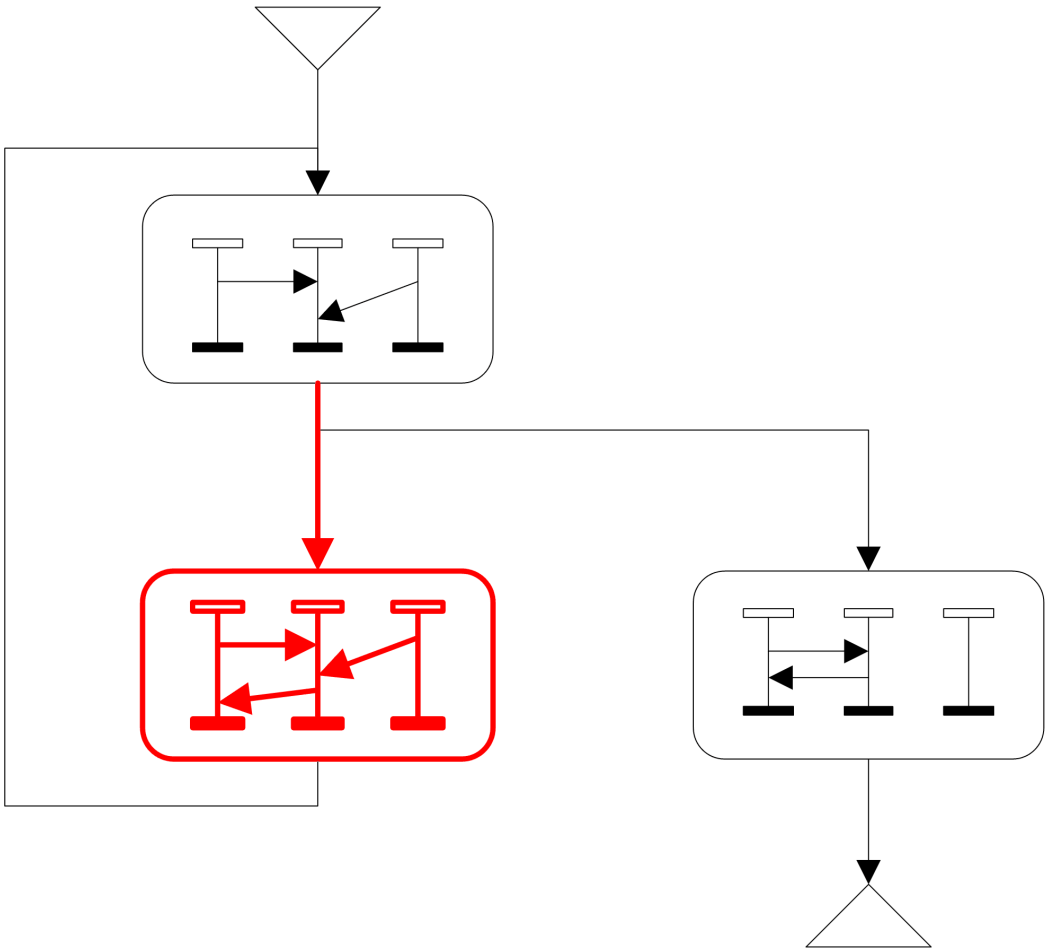

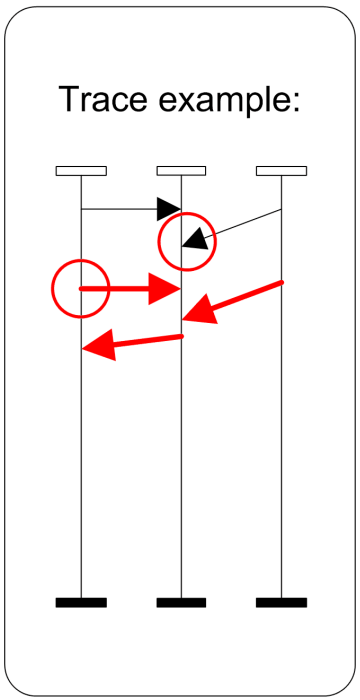

these events are not ordered!

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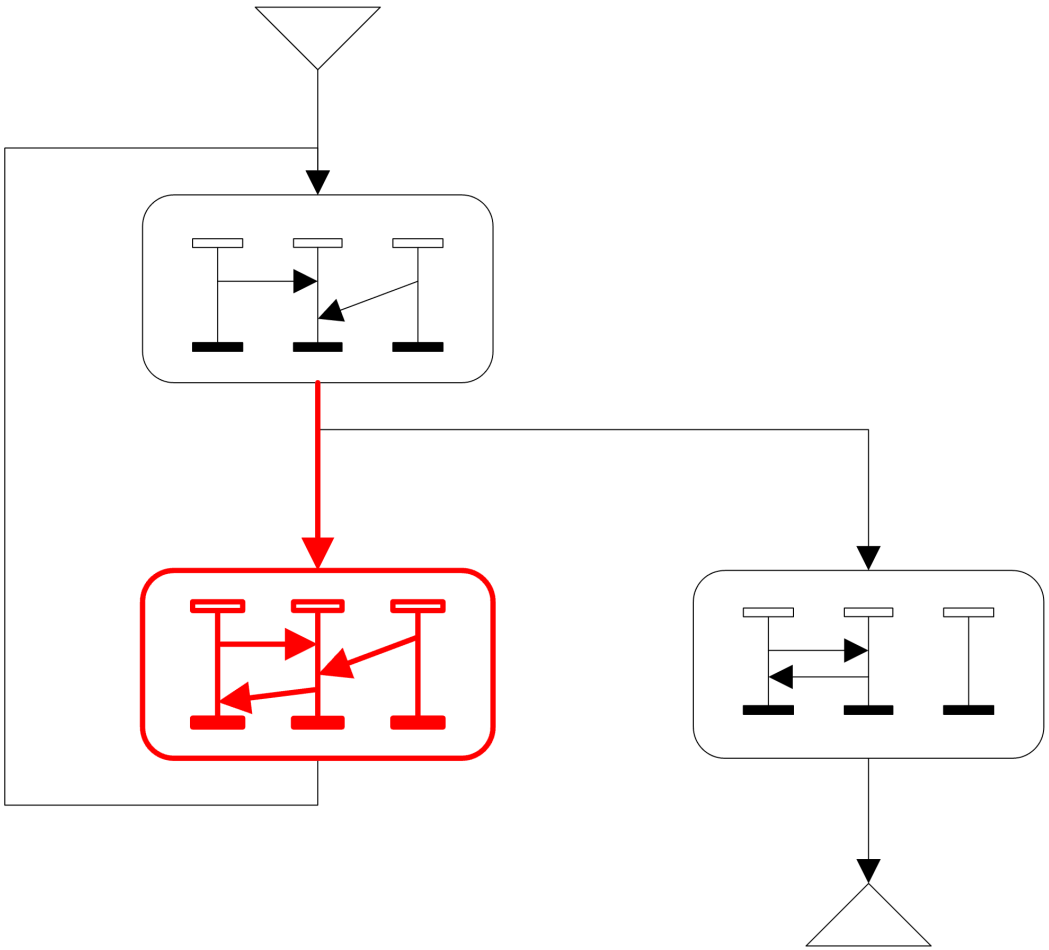

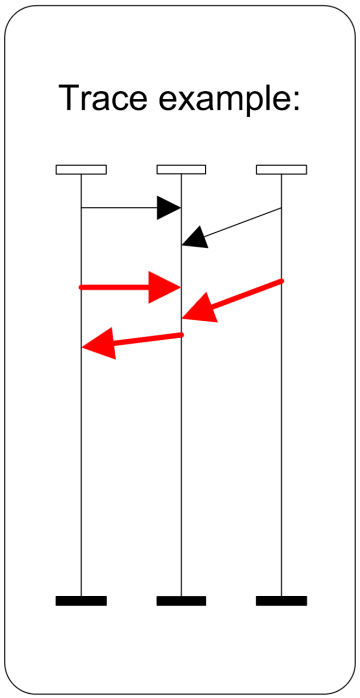

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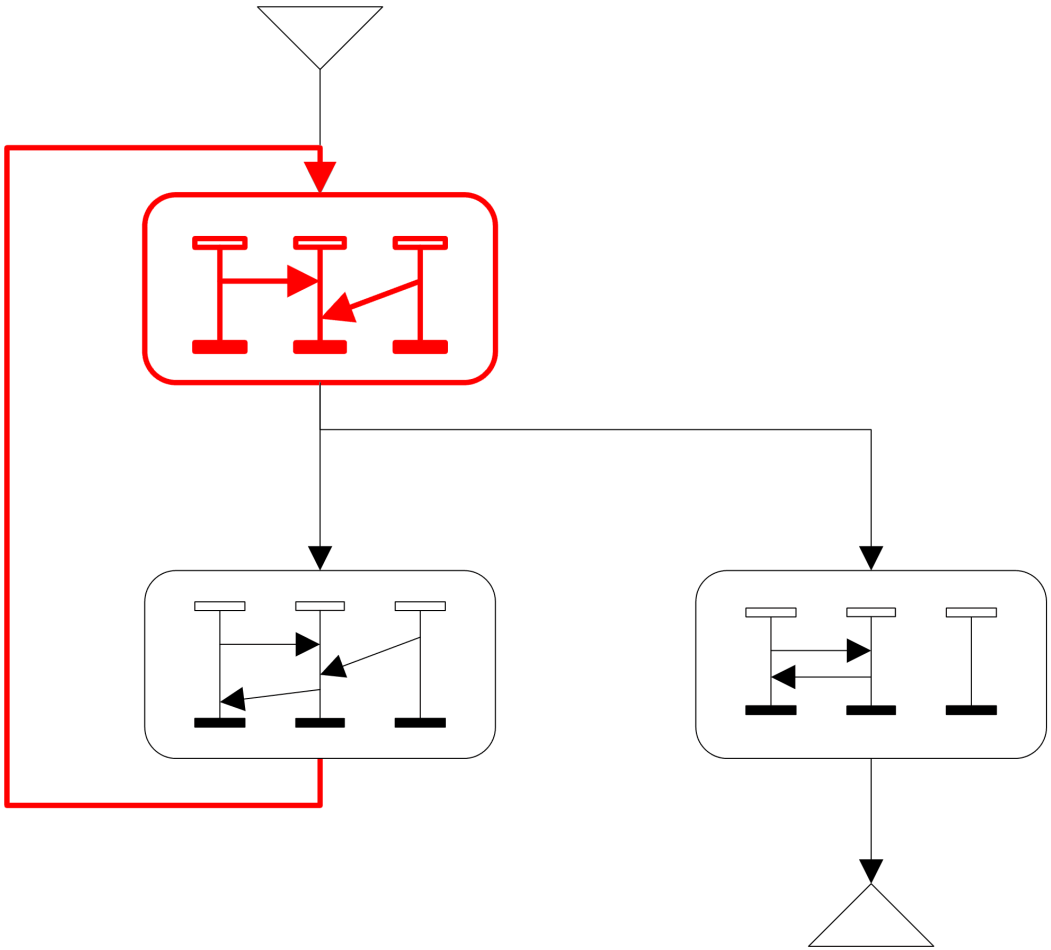

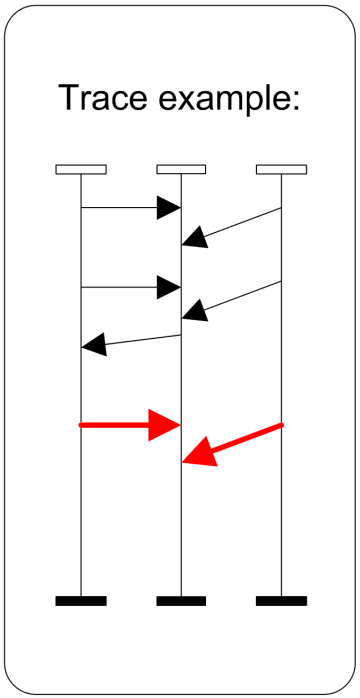

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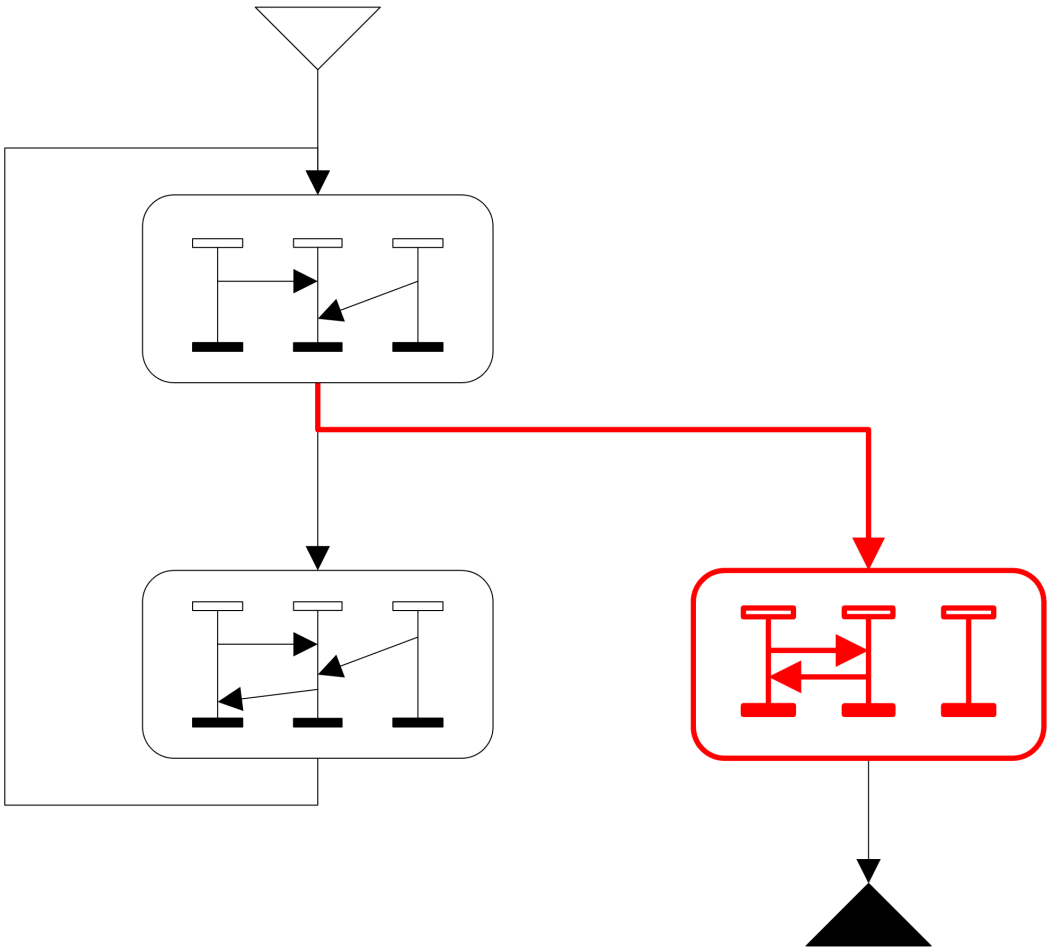

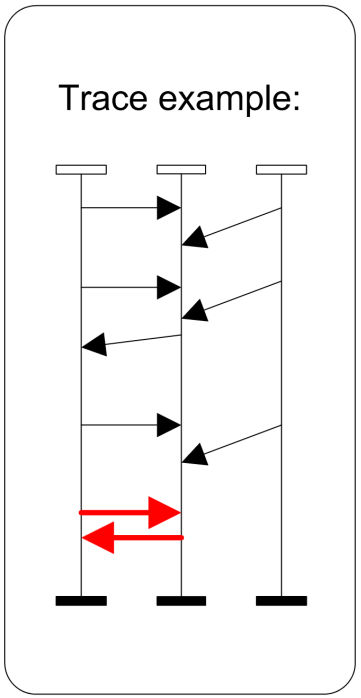

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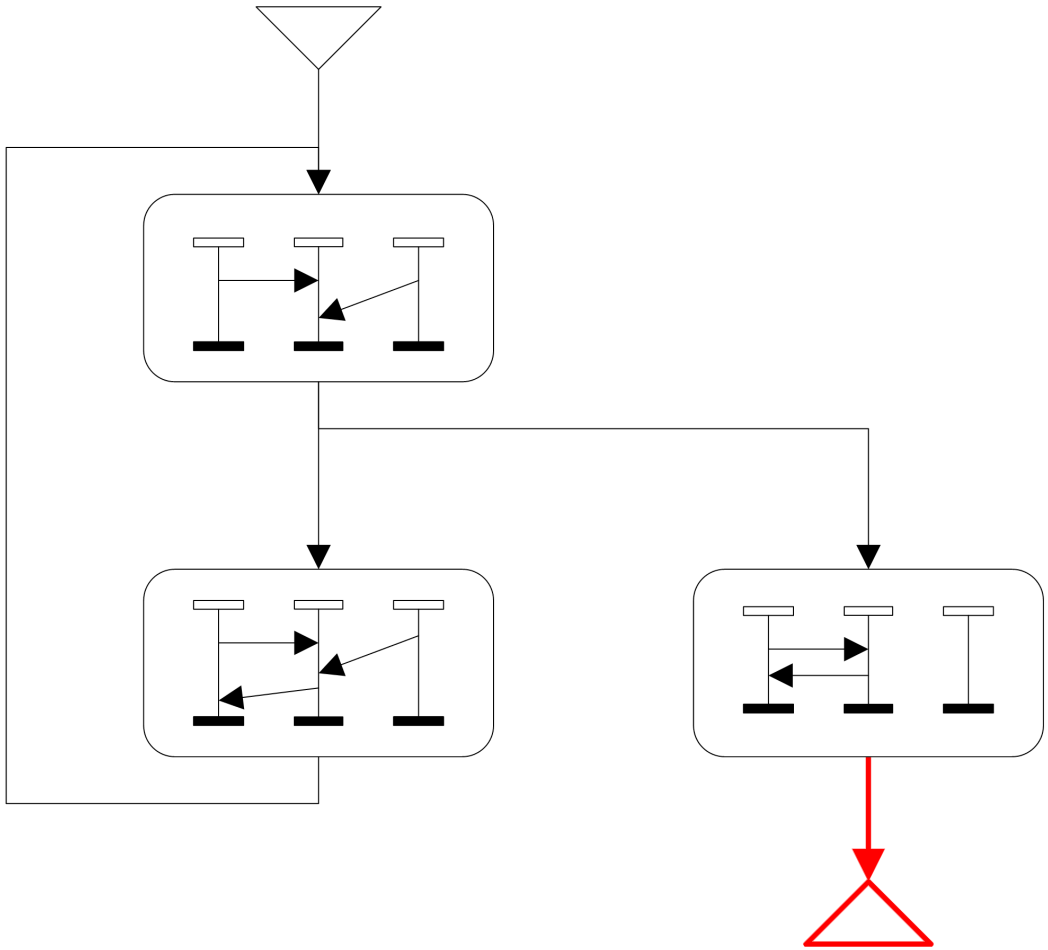

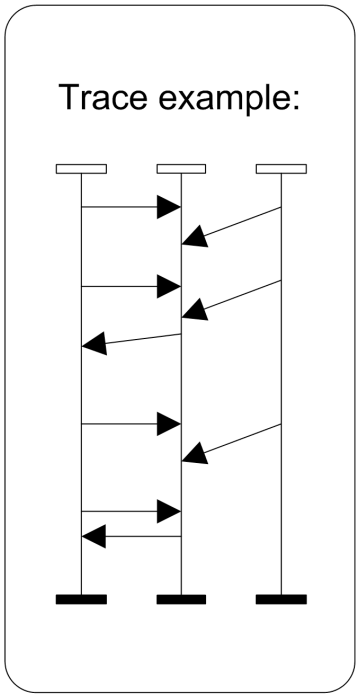

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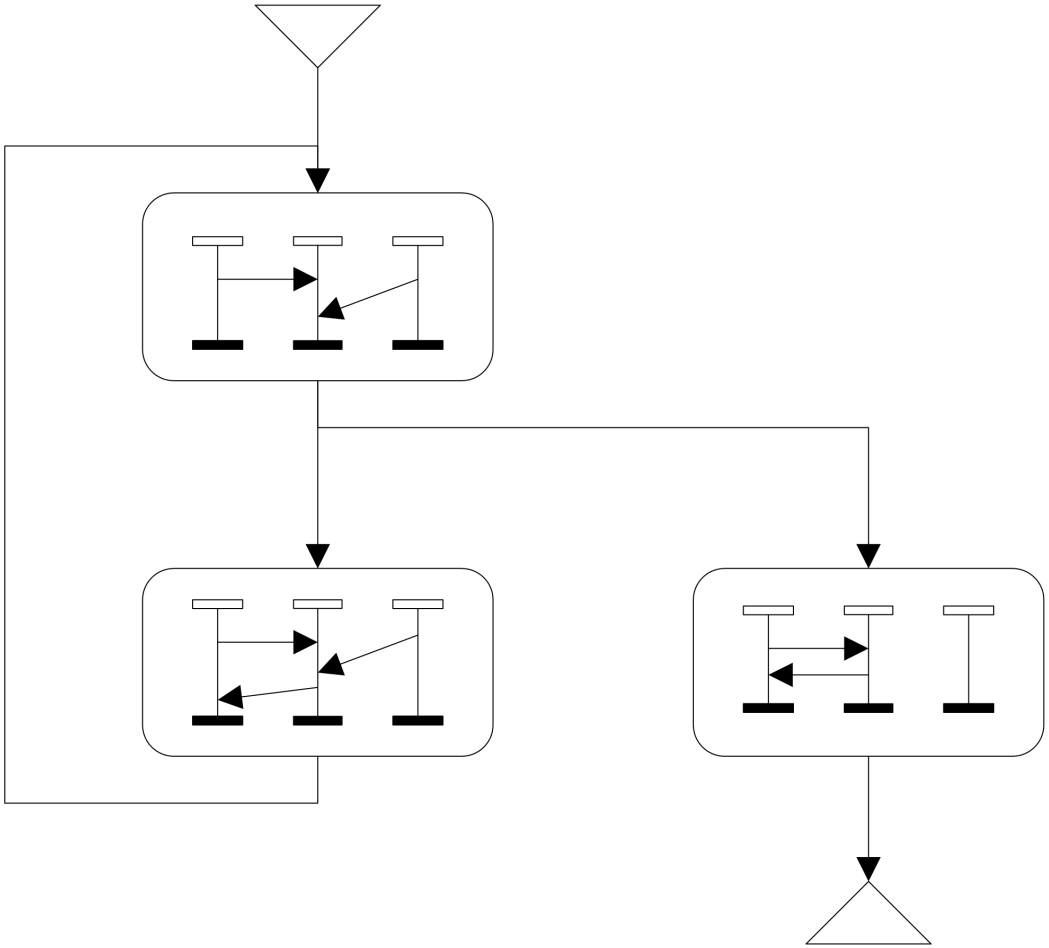
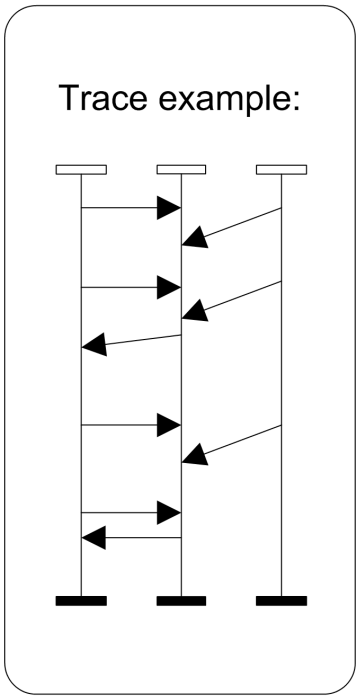
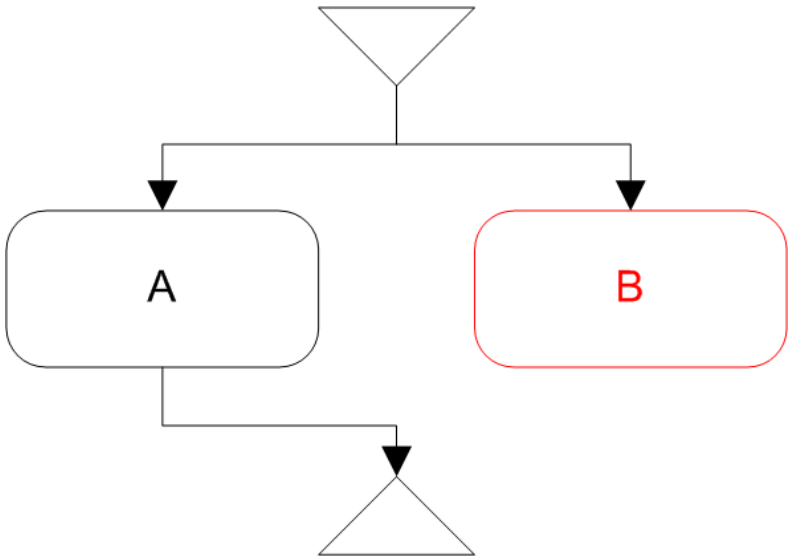
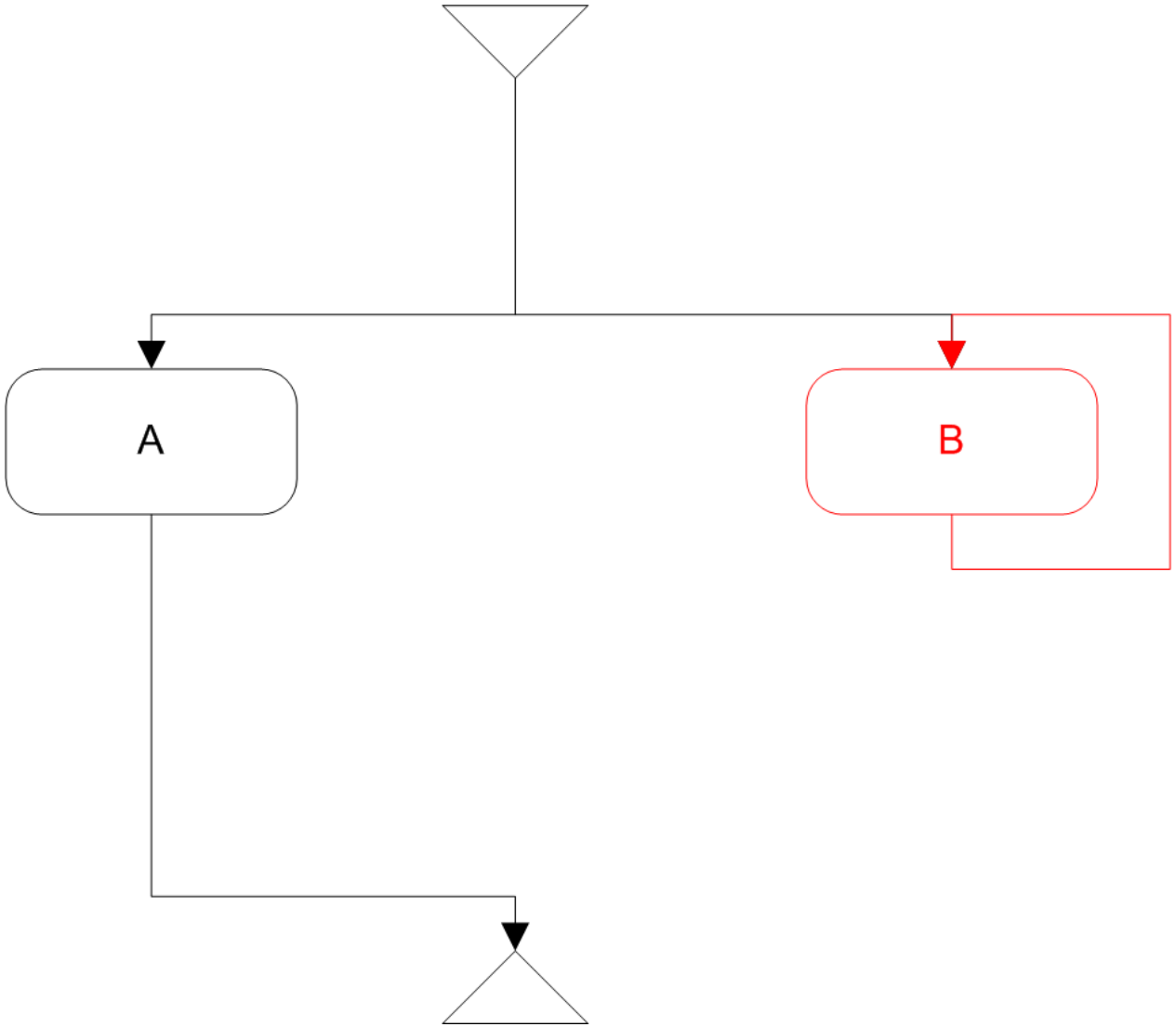




Deadlock Property



Livelock Property



Find Flow

Is a given MSC included in a given HMSC?

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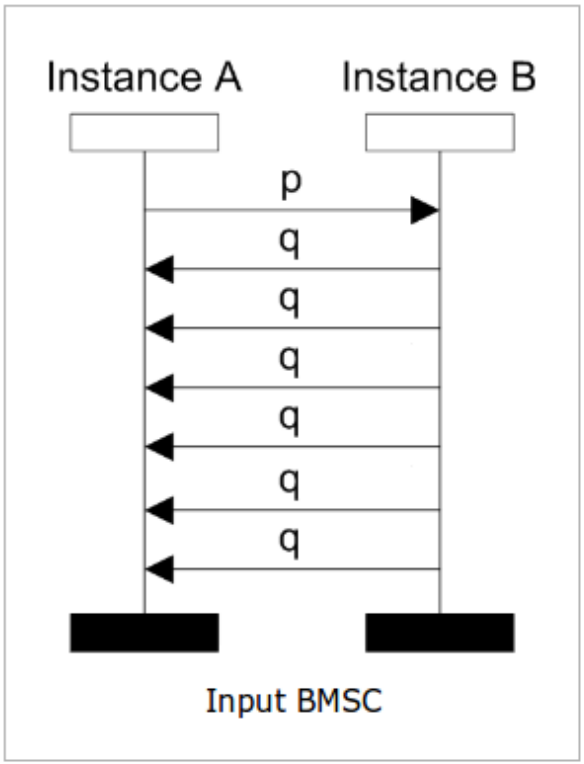
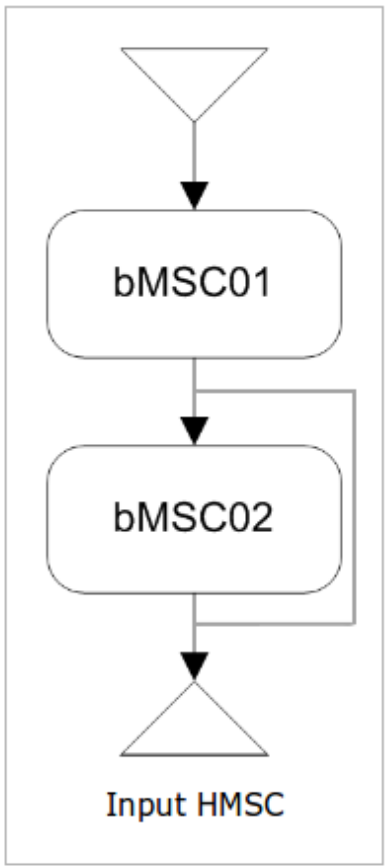
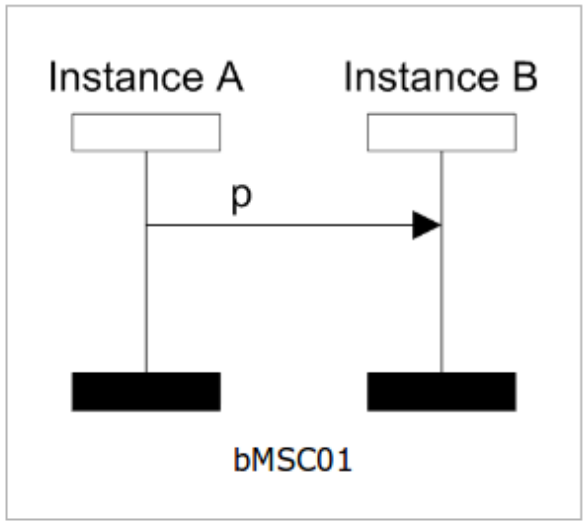
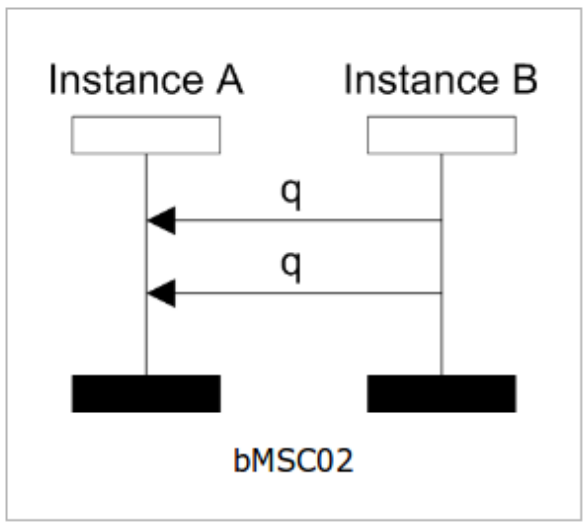


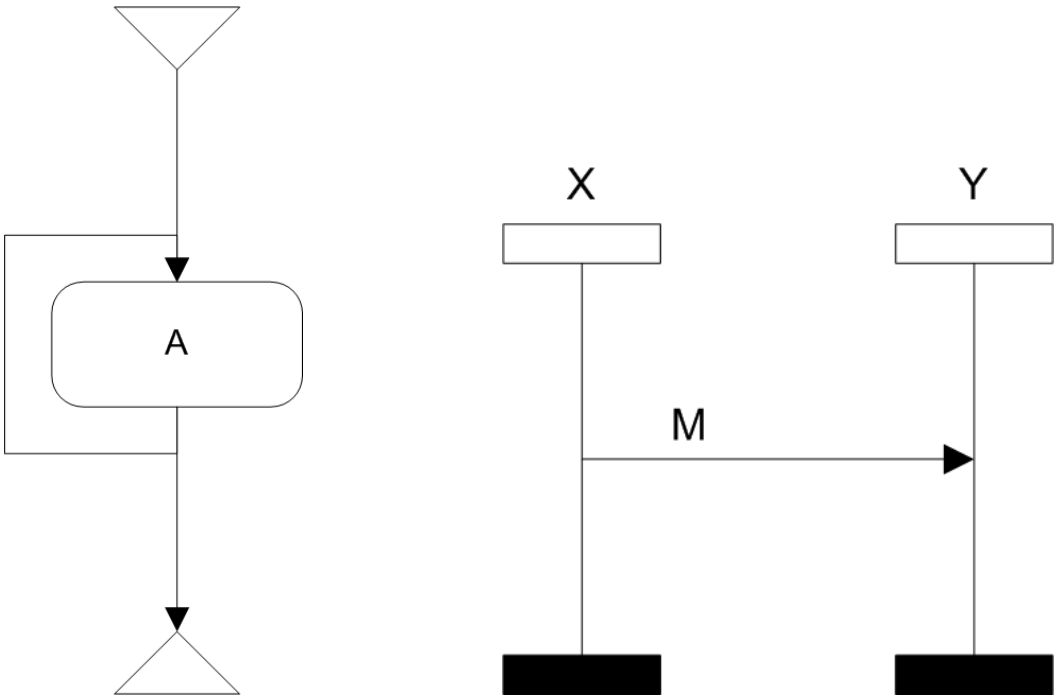






Universal Boundedness

What size of buffer is needed to be sure it will not overflow?



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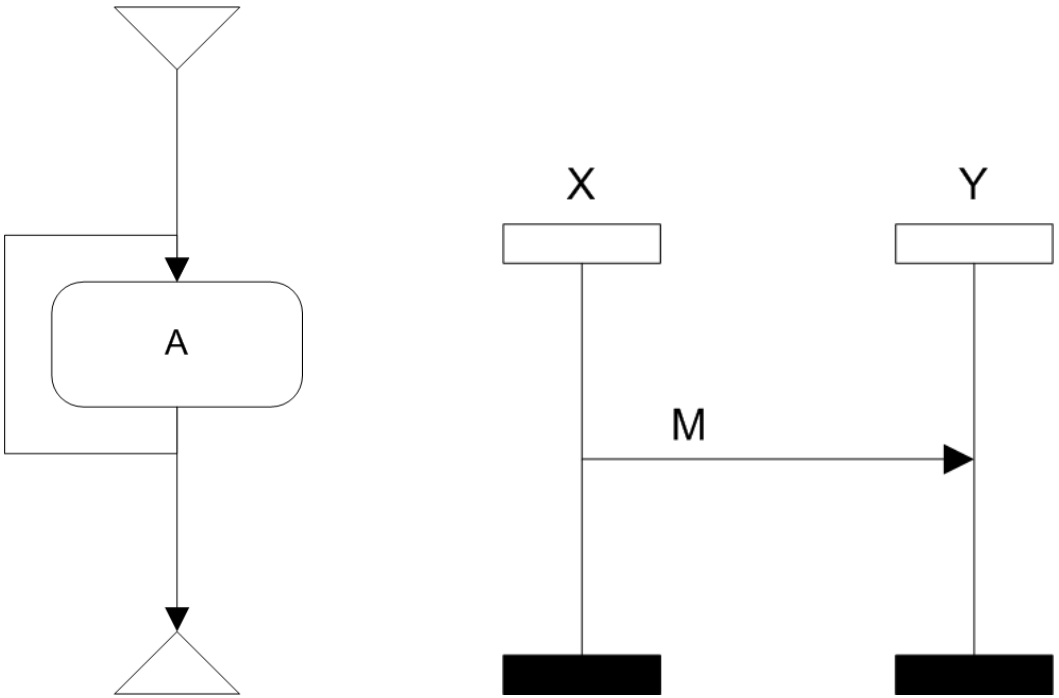

Every finite input buffer of Y can overflow.

Universal Boundedness

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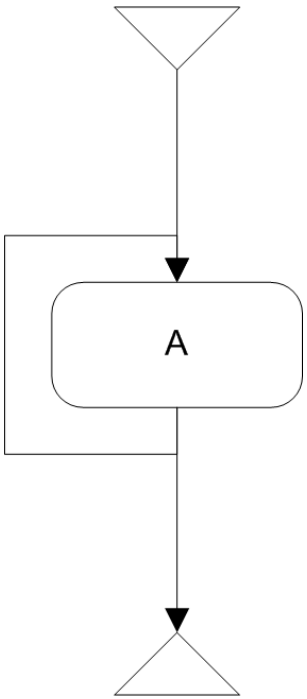

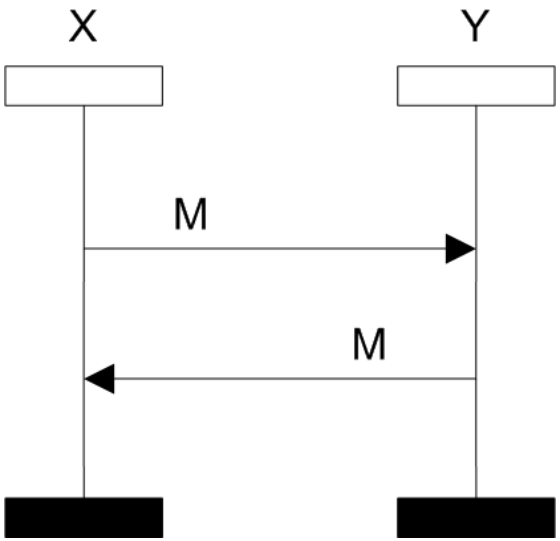

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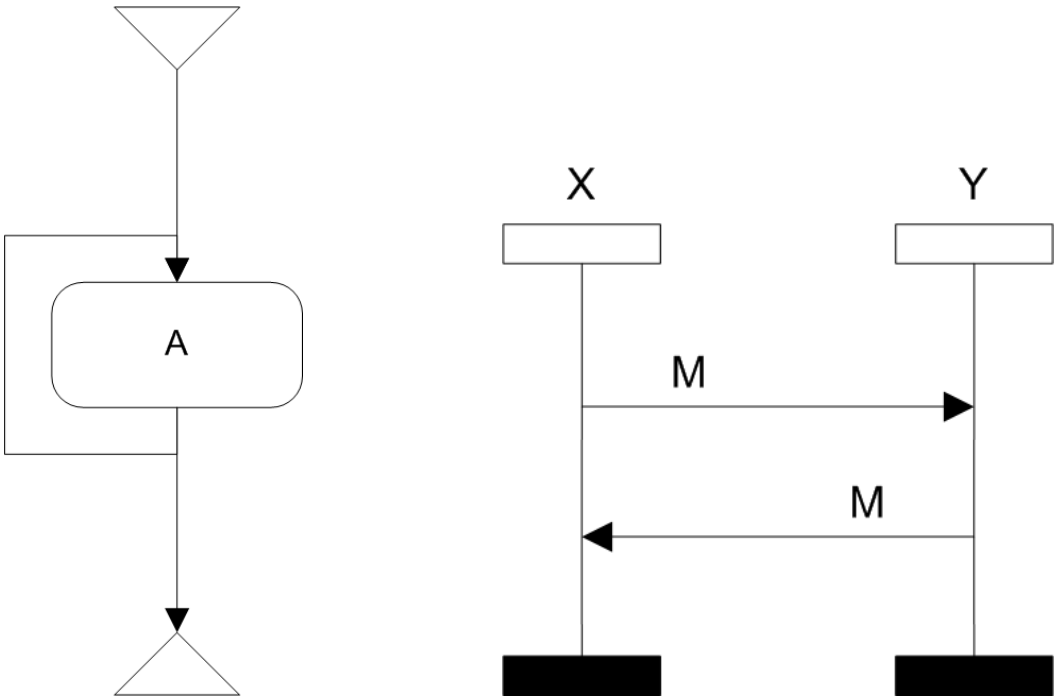
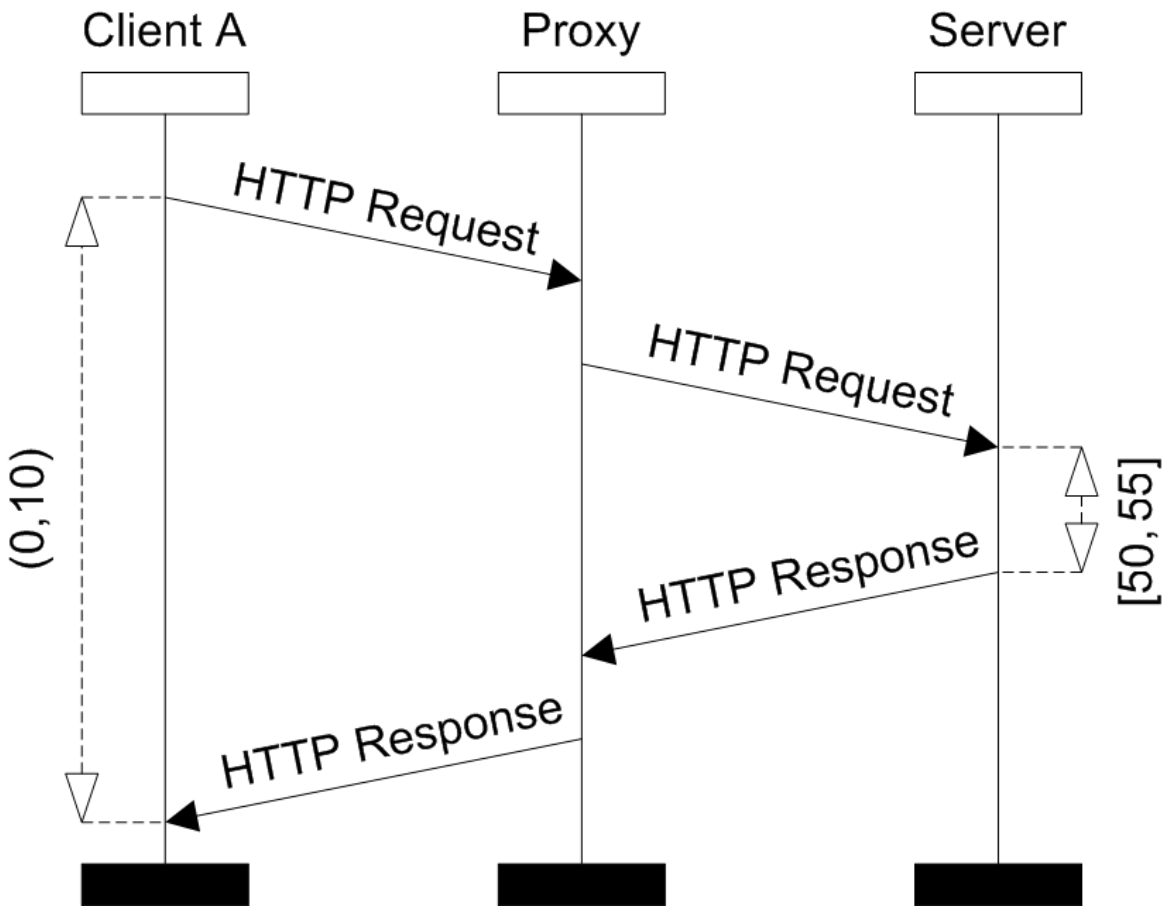


Buffers of size 1 will not overflow.

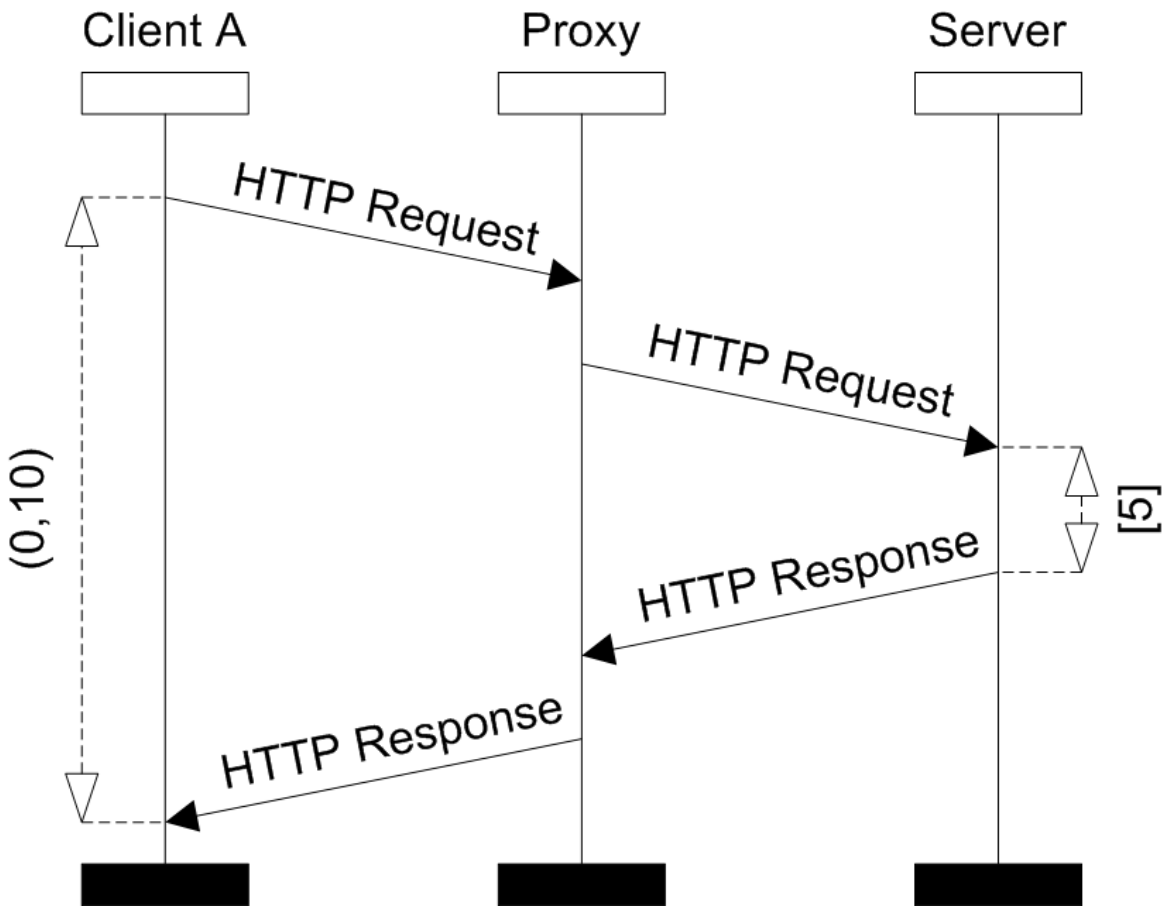
Time Consistency

Are the given time conditions consistent?



Time Tightening

Some time conditions can be tightened.



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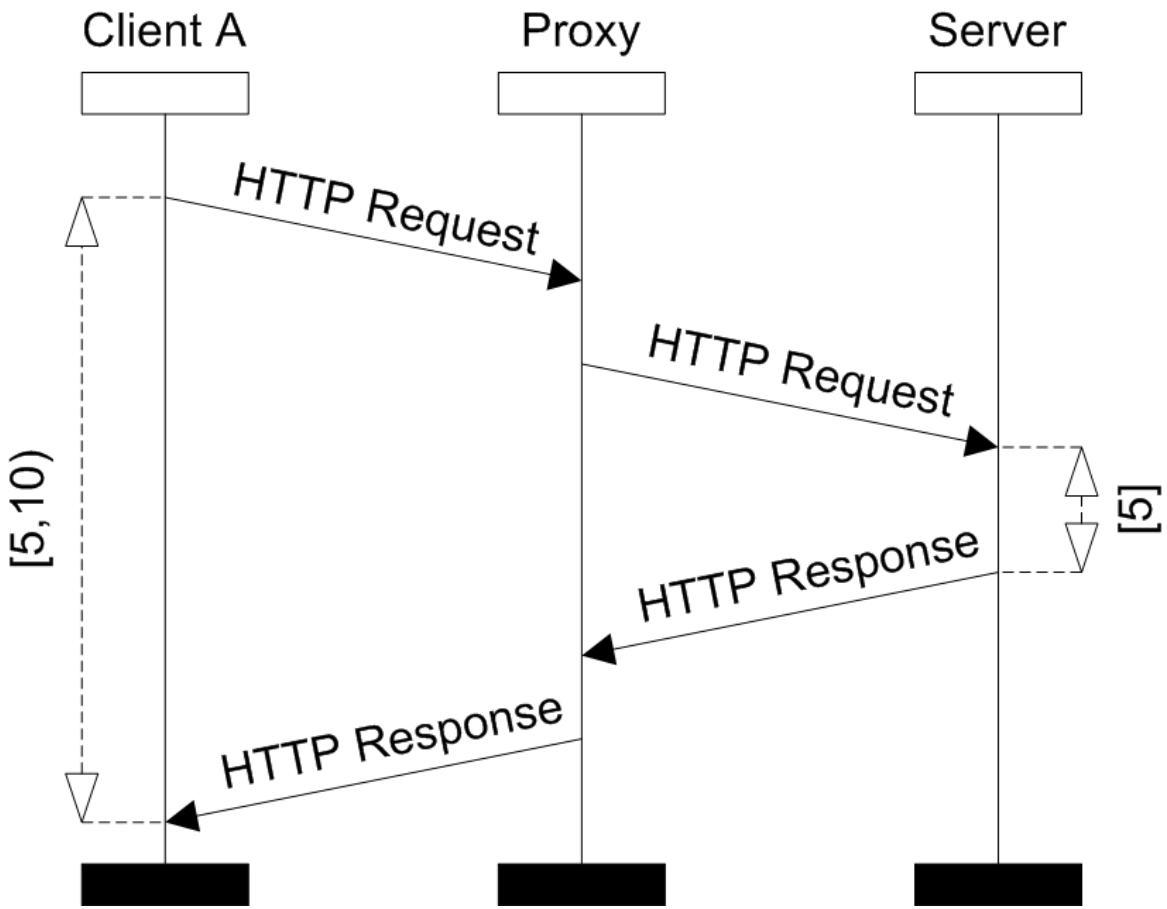

MSC - Summary

Basic MSC

- instances
- messages
- send events
- receive events
- conditions
- coregions
- general ordering
- inline expressions
- time constraints
- timers

High-level MSC (HMSC)

- start node
- end node
- reference nodes
- connection points
- lines
- conditions
- time constraints

MSC - Properties

- Acyclic property
- FIFO property
- Race Condition

- Deadlock
- Livelock
- Find Flow
- Nonlocal Choice
- Universal Boundedness
- Existential Boundedness

- Time Race Condition
- Time Consistency
- Tighten Time

MSC - Tools

IBM Rational, SanDriLa SDL, Cinderella SDL

Sequence Chart Studio (SCStudio)

- MS Visio addon
- drawing, import, export
- checkers for all the mentioned properties

MSCan

- academic tool
- only textual input
- some checkers

Mesa

- academic tool
- local choice and time checkers

TCP Demonstration

- known TCP diagram
- HMSC diagram
- detailed diagram

Thanks for your attention