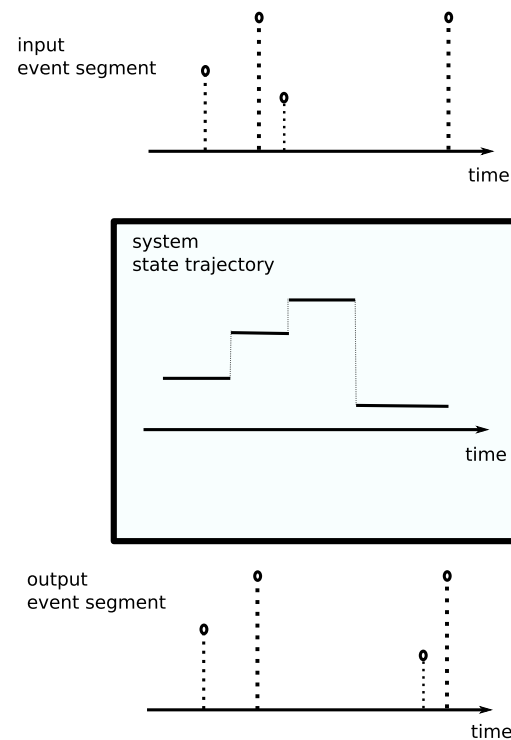# Statecharts

Used to model *behaviour* of Autonomous and Reactive Systems
(event driven, react to internal –timeouts– and external stimuli)

Statecharts

- Visual formalism yet formally and rigourously defined for

  1. documentation

  2. analysis (model checking as well as testing)

  3. simulation

  4. code synthesis

- Solves FSA problems (by combining with Higraphs):

  1. flat $\Rightarrow$ hierarchy ($\Rightarrow$ re-use)

  2. represent large number of transitions concisely

  3. represent large number of states concisely

Statecharts references

- David Harel. **Statecharts: A Visual Formalism for Complex Systems.** Science of Computer Programming. vol. 8. 1987. pp. 231 - 274.

- David Harel. **On Visual Formalisms.** Communications of the ACM. Volume 31, No. 5. 1988. pp. 514 - 530.

- David Harel and Amnon Naamad. **The STATEMATE semantics of statecharts.** ACM Transactions on Software Engineering and Methodology (TOSEM) vol. 5. Issue 4. October 1996. pp.293 - 333.

- David Harel and Hillel Kugler. **The Rhapsody Semantics of Statecharts (or, On the Executable Core of the UML).** Springer, Lecture Notes in Computer Science 3147. 2004. pp. 325 - 354.
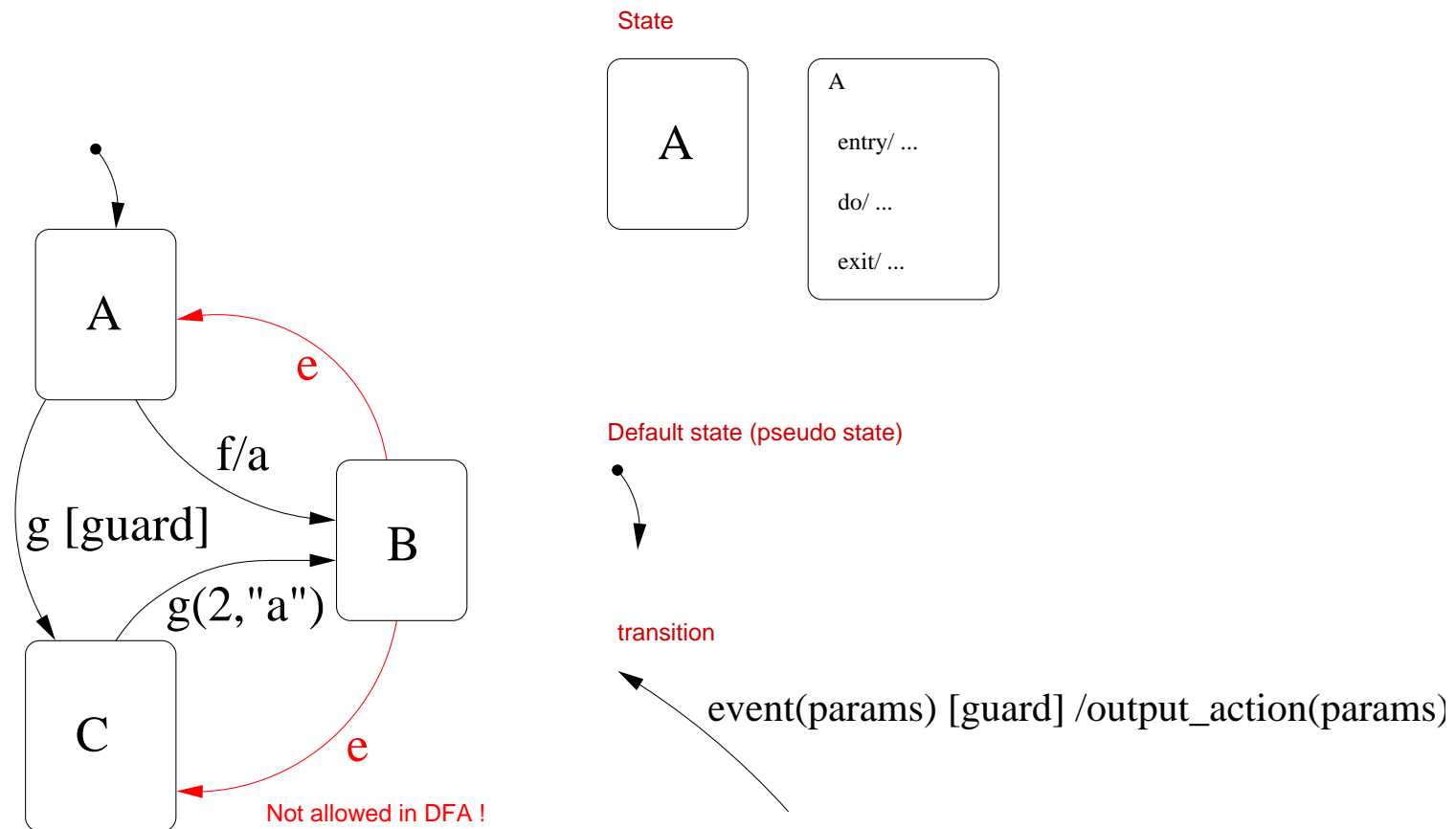
Statecharts tools

- STATEMATE [http://www.ilogix.com/products/magnum/index.cfm]

- Rhapsody [http://www.ilogix.com/products/rhapsody/rhap_inc.cfm]

- Rational Rose [http://www.rational.com]

- Stateflow [http://www.mathworks.com/products/stateflow/]

- BetterState Lite
  [http://www.windriver.com/products/html/betterstate.html]

- XJTek [http://www.xjtek.com/products/xjcharts/]

- Poseidon for UML [http://www.GentleWare.com]

- ArgoUML [http://argouml.tigris.org/]

- visualSTATE [http://www.iar.com/Products/VS/]

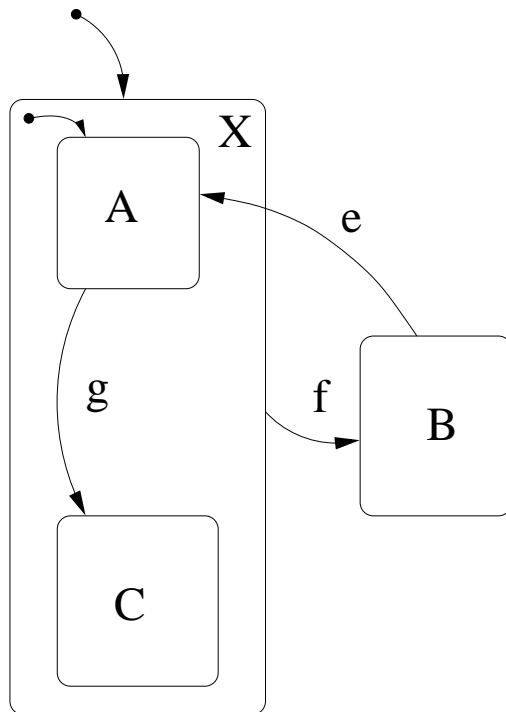- SVM [http://msdl.cs.mcgill.ca/people/tfeng/research.html]

Statecharts =

1. Deterministic Finite State Automata (FSA, DFA)

2. Depth

3. Orthogonality

4. Broadcast

5. History

6. Time

7. syntactic sugar: entry/exit actions, . . .

UML 2.0 Statecharts abstract syntax

Deterministic Finite State Automata (FSA, DFA)

State

A

A
entry/ ...
do/ ...
exit/ ...

A

f/a

g [guard]

g(2,"a")

B

e

C

e

Not allowed in DFA !

Default state (pseudo state)

transition

event(params) [guard] /output_action(params)

Depth (XOR)

Statechart with depth

give meaning
by "flattening"
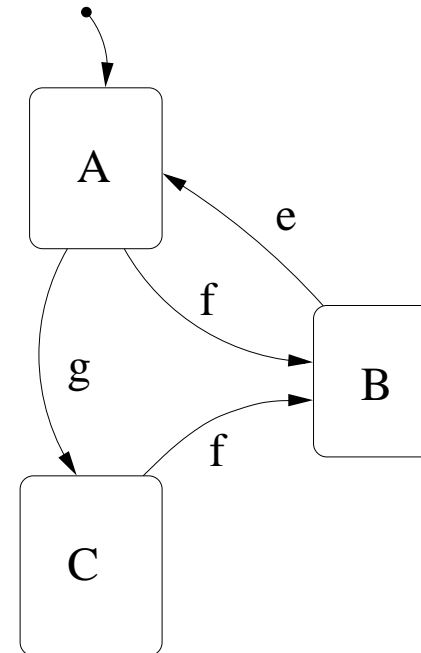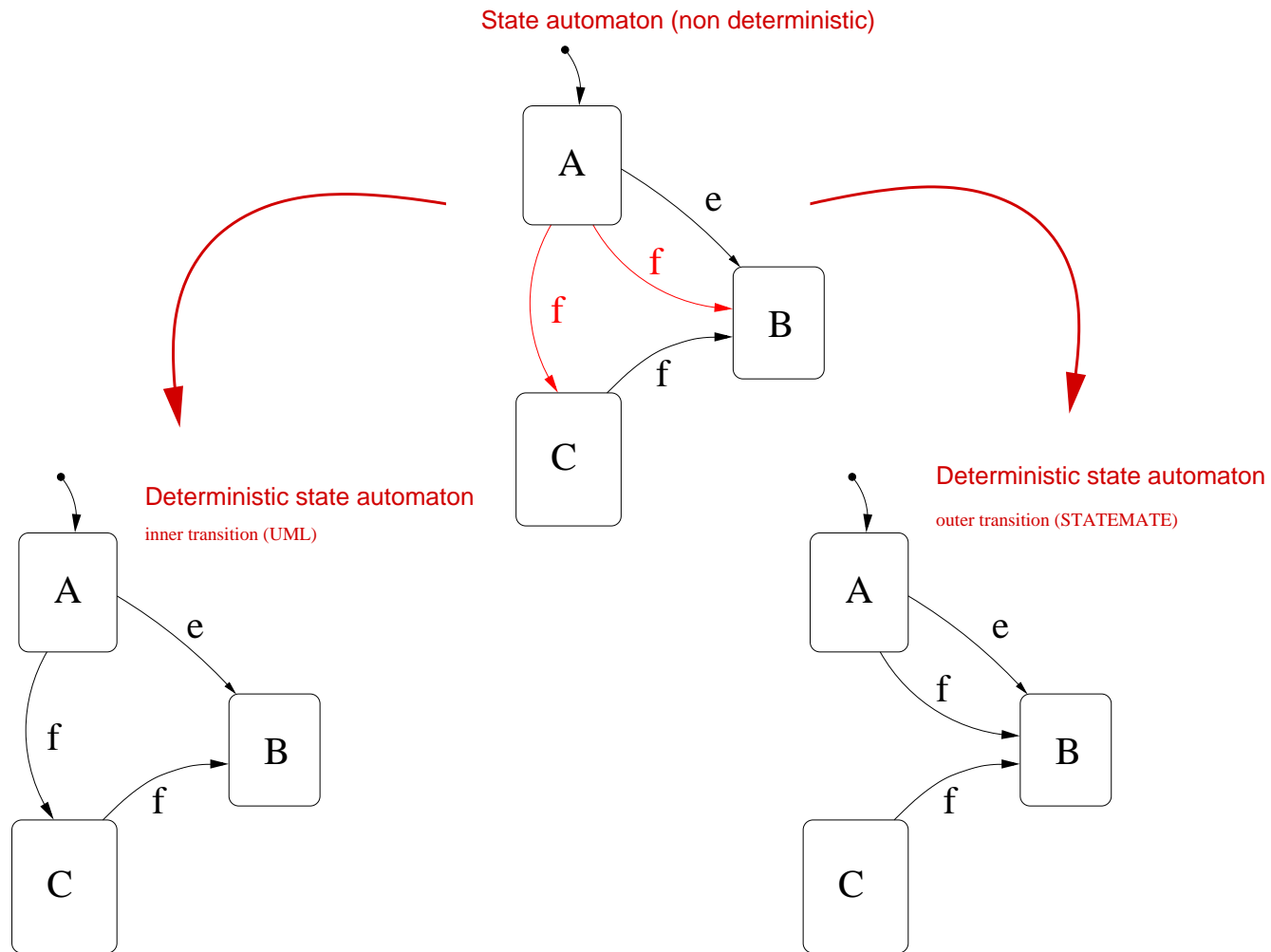
State automaton

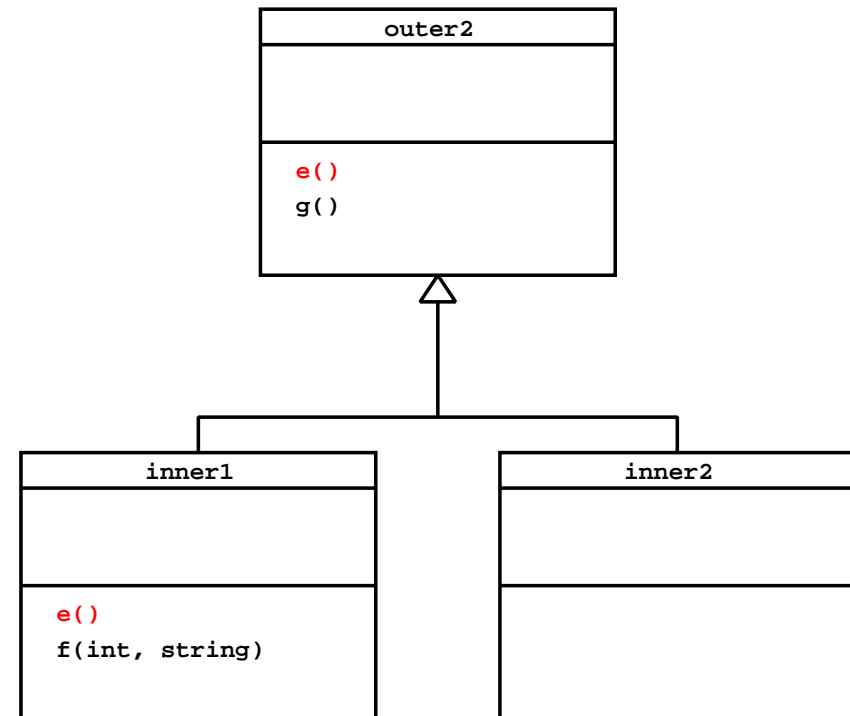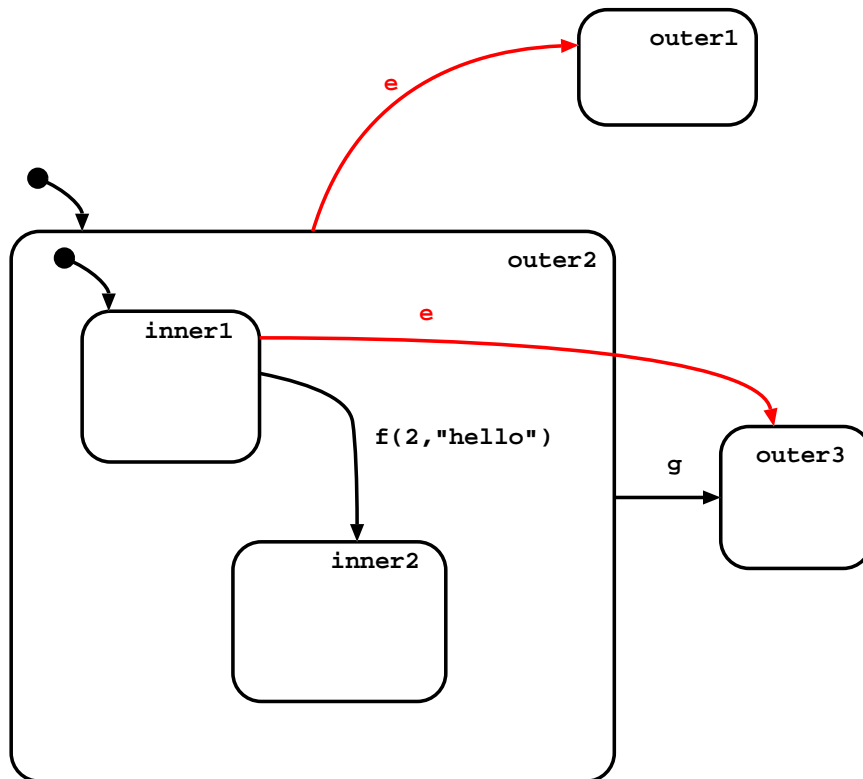# Depth and determinism

Statechart with depth
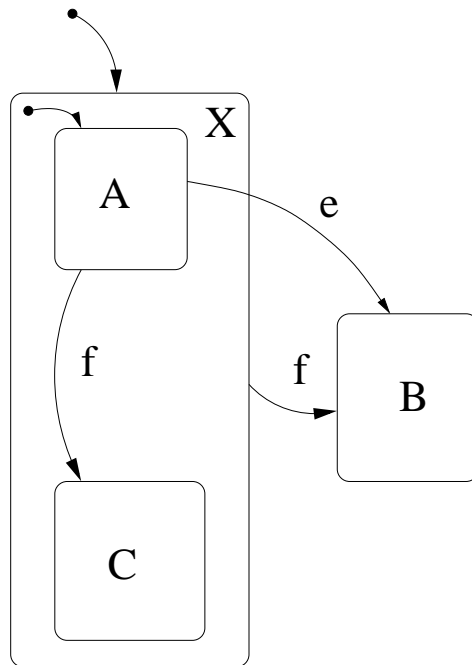
give meaning
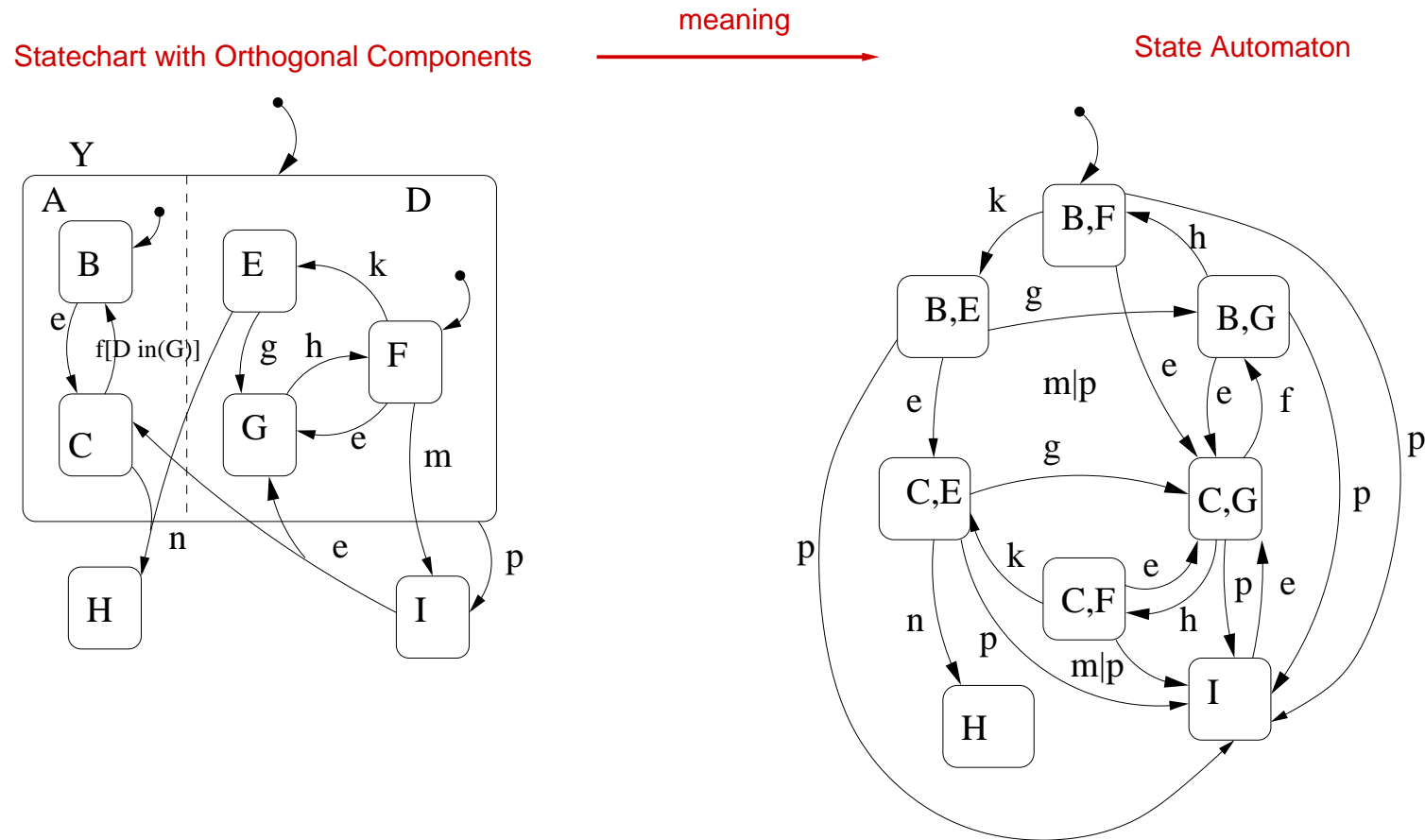by "flattening"

State automaton (non deterministic)

Depth and determinism

State automaton (non deterministic)

Deterministic state automaton
inner transition (UML)

Deterministic state automaton
outer transition (STATEMATE)
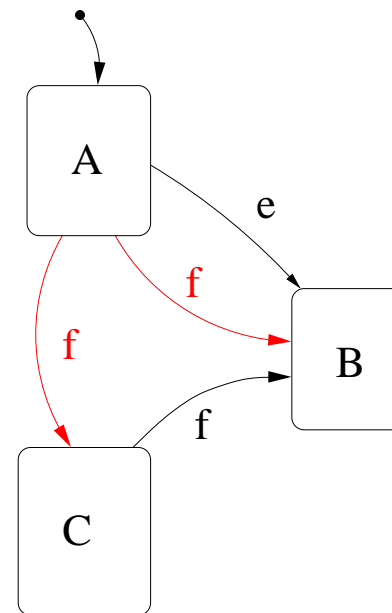
Why "inner-first" in UML Statecharts ?

Orthogonality (AND)

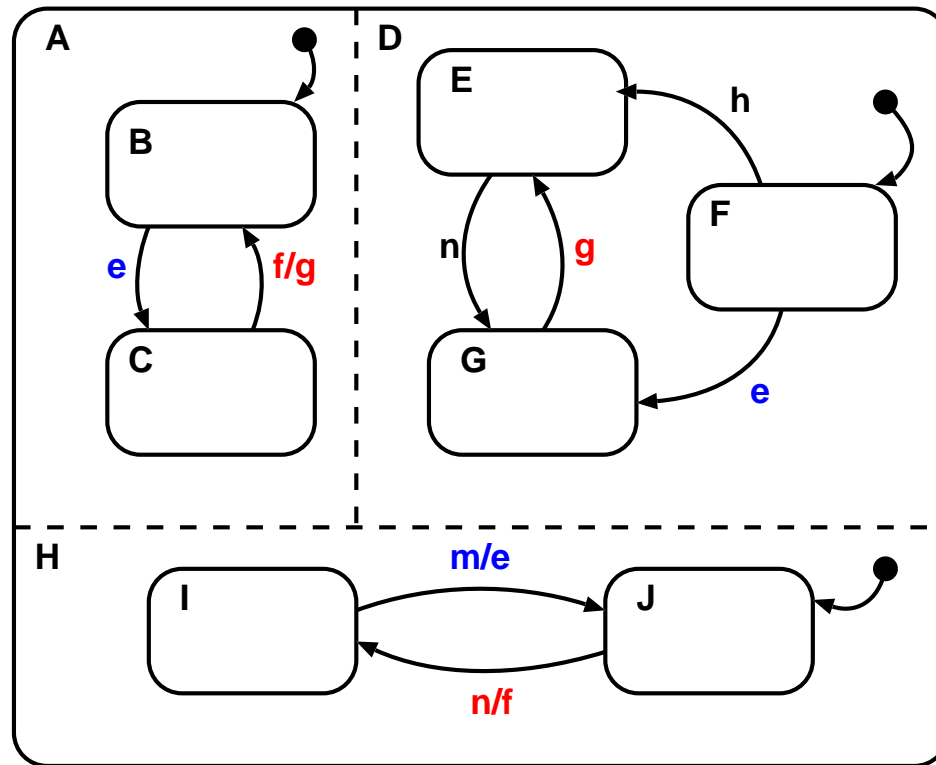Statechart with Orthogonal Components

meaning

State Automaton
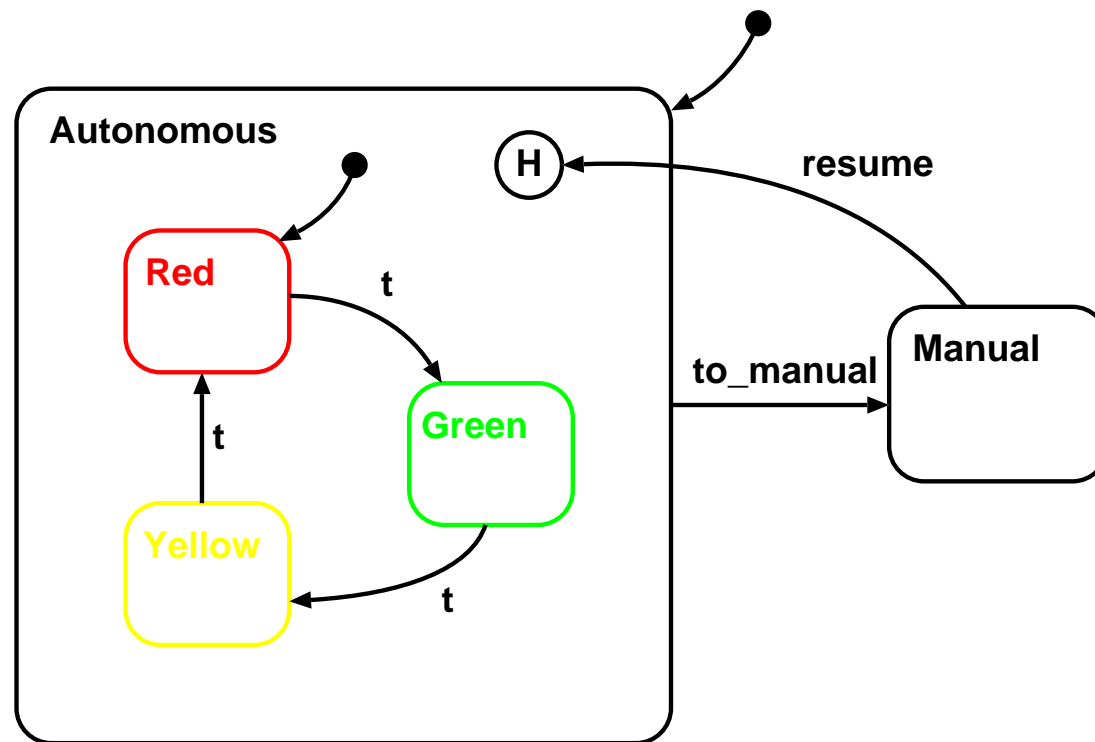
Orthogonality and synchronization
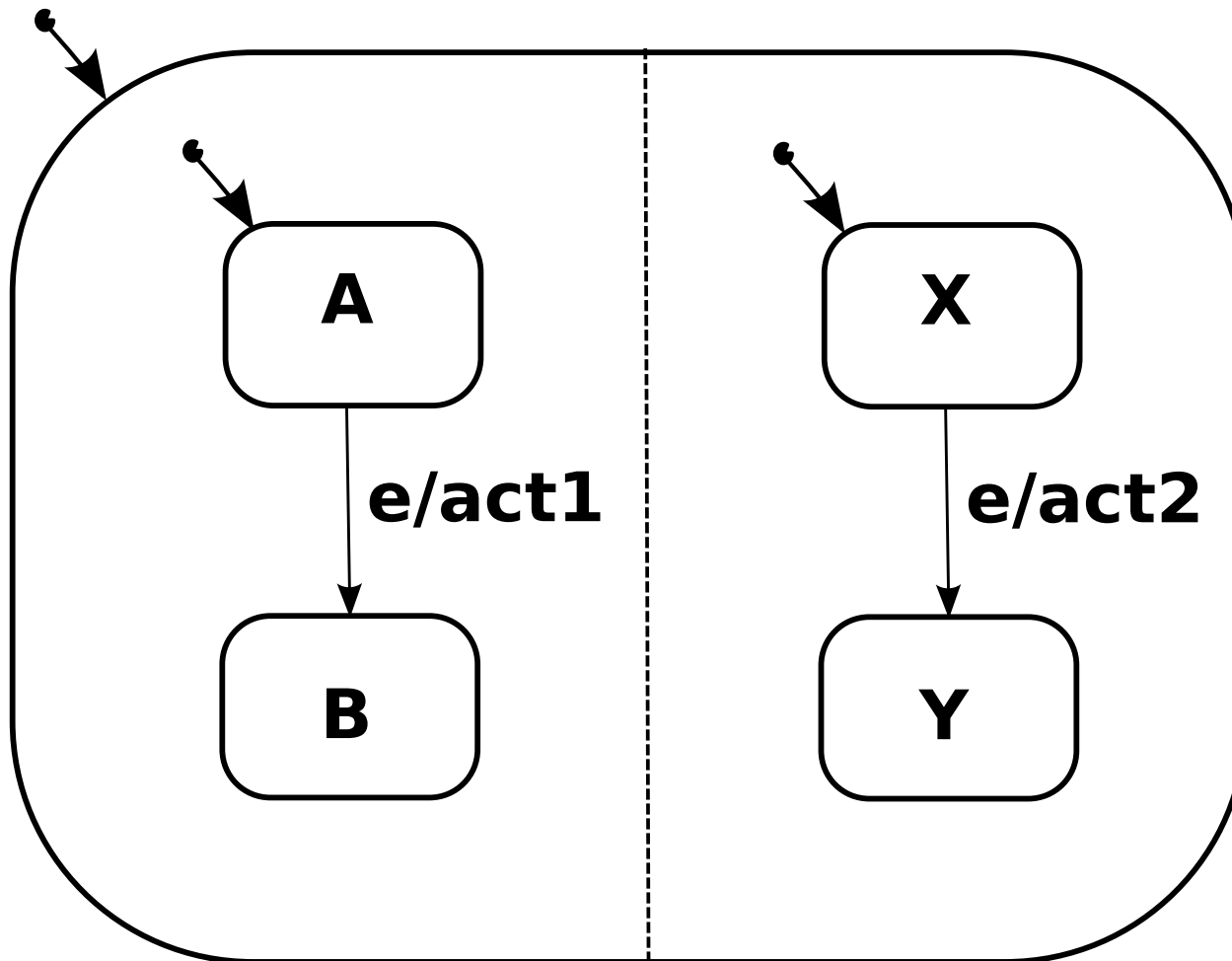
Broadcasting (output events)

Input Segment: **nmnn**

History States

Deep History