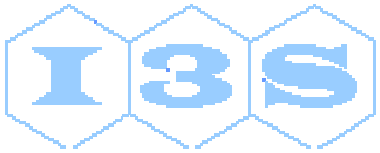
Les Objets + le Synchrone dans les systèmes temps réel

Charles André – Projet SPORTS



Le projet SPORTS

Synchronous

Programming Of

Real-Time | ReacTive

Systems

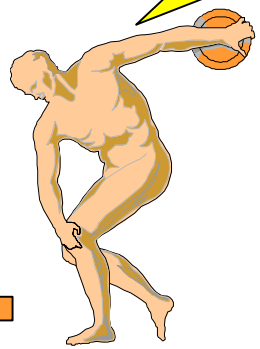
Web site: http://www.i3s.unice.fr/~map/WEBSPORTS

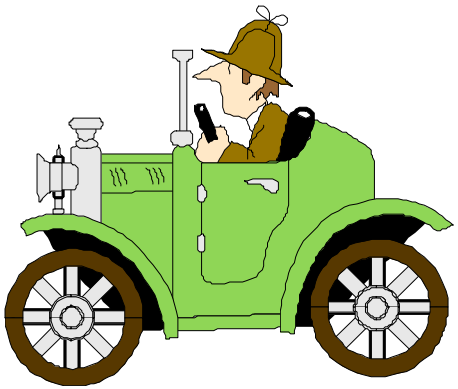
Charles André - I3S - UNSA / CNRS

Nos objectifs ...

Systèmes à contrôler
+
Comportement attendu

Modèle synchrone





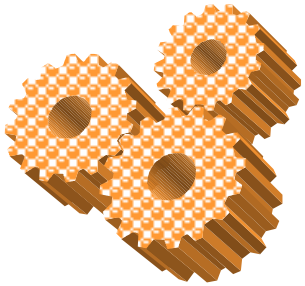
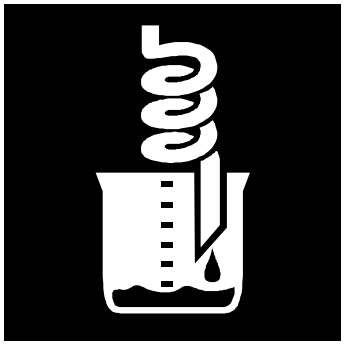


Plate-forme synchrone

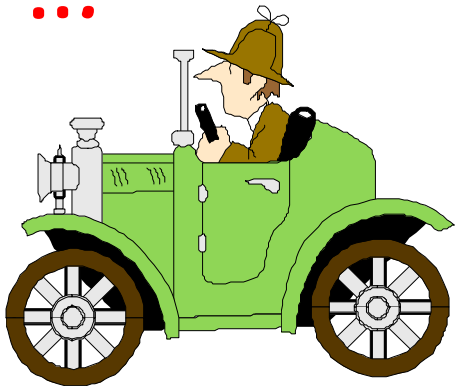


Analyse de propriétés

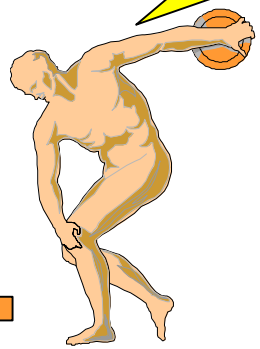
Nos contributions …

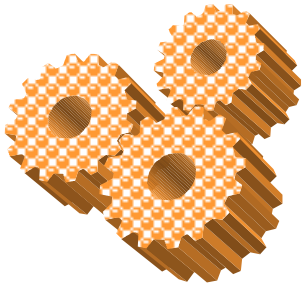
Systèmes à contrôler
+
Comportement attendu

SyncCharts
S-Grafcet
SEP, SIB

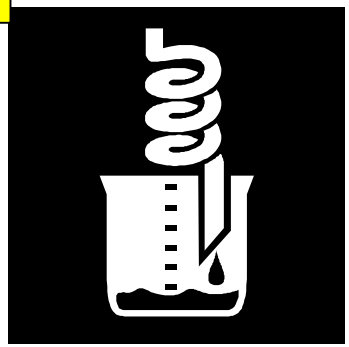


Machines d'exécution





Expression des propriétés



Garanties de propriétés

Evaluation de performance

Objets et systèmes T.R

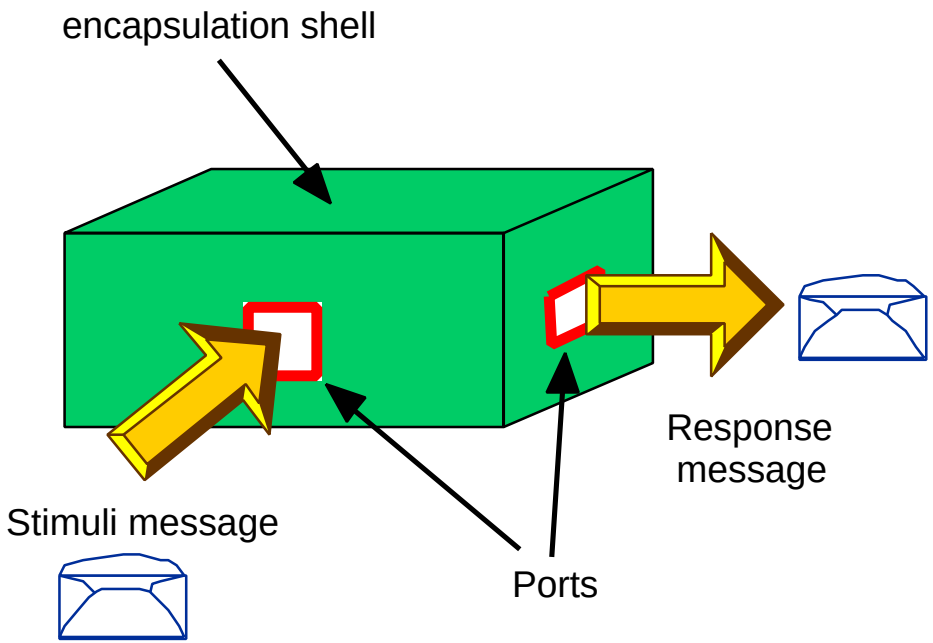
- ROOM 1994 (Real-Time Object-Oriented Modeling) B. Selic, G. Gullekson, P. Ward
- UML (Profile for concurrency and distribution) 1998 Bran Selic, Jim Rumbaugh
- Rational Rose RealTime
- ROPES (Rapid Object-oriented Process for Embedded Systems) 1999 B.P. Douglass

Objets actifs (1)

- Like passive objects they encapsulate data. However, they can also initiate control activity, which they do by having their own encapsulated thread of execution.
- To support both asynchronous and synchronous communication with other active objects, each active object has a message queue or mailbox.
- On message reception, the object executes whatever code is appropriate to process the message.

Garth Gullekson.

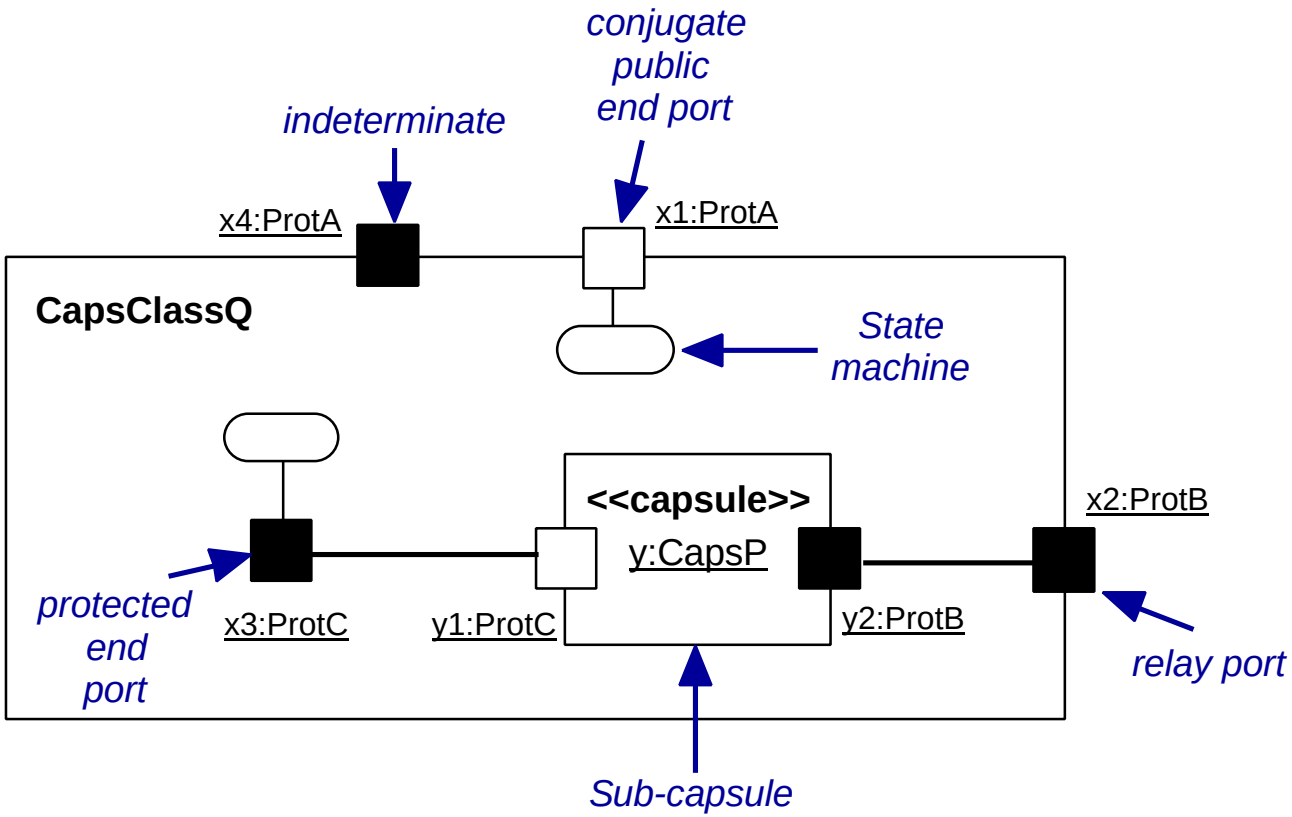
Objets actifs (2)



ROOM

- Actors → capsules = complex physical, possibly distributed architectural objects that interact with their surroundings through one or more signal-based boundary objects
- Ports = physical part of the implementation of a capsule that mediates the interaction of the capsule with the outside world. Each port plays a role in a collaboration. A protocol captures the complex semantics of these interactions.
- Bindings → Connectors = abstract views of signal-based communication channels that interconnect two or more ports.

UML stereotypes



Objets synchrones

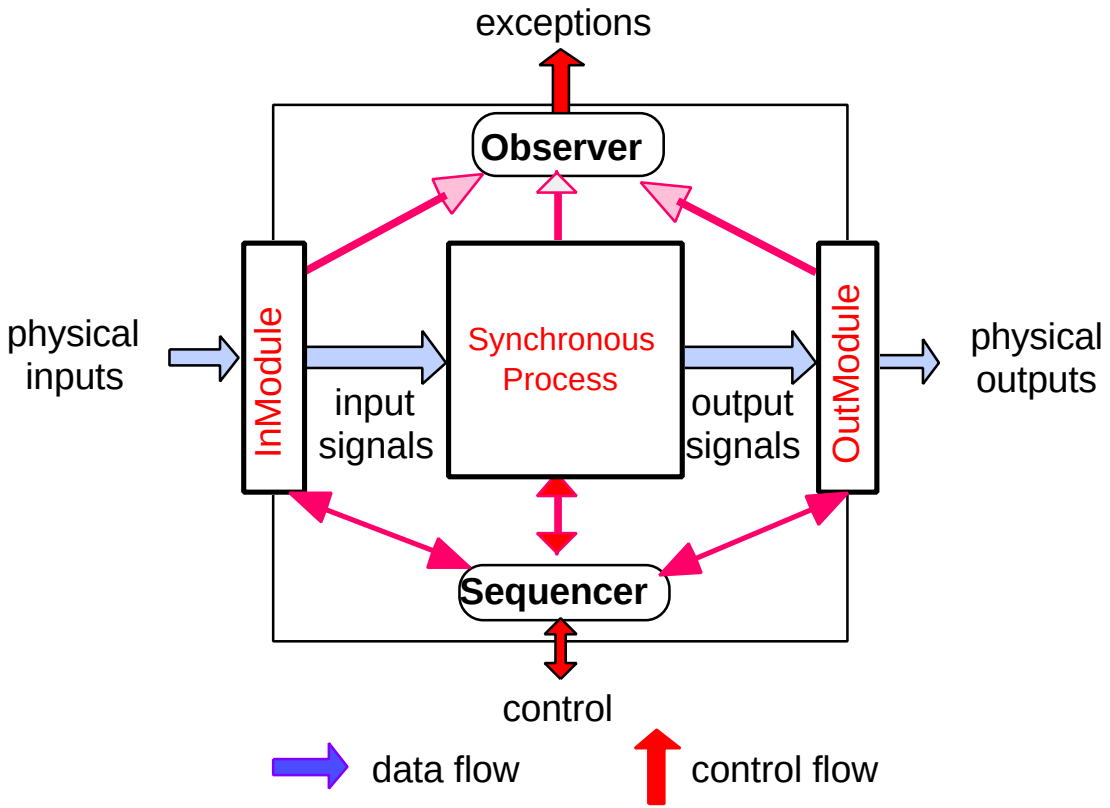
- F. Boulanger. Intégration de Modules Synchrones dans la Programmation par Objets. Paris XI, 1993.

Programmes synchrones → objets

- (Abstract) Class Reactive_Machine
- Derived: Class Synchronous
- Instances of Synchronous = Synchronous Objects
- Methods:
  - Begin_of_instant
  - Activate
  - End_of_instant
  - List_of_signals
  - …
- Class library

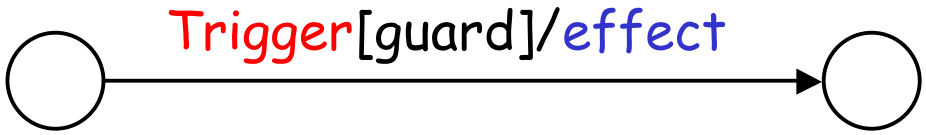
Machines d'exécution

C. André, H. Boufaïed, Execution Machine for Synchronous Languages, IDPT 2000, Dallas (TX), June, 2000

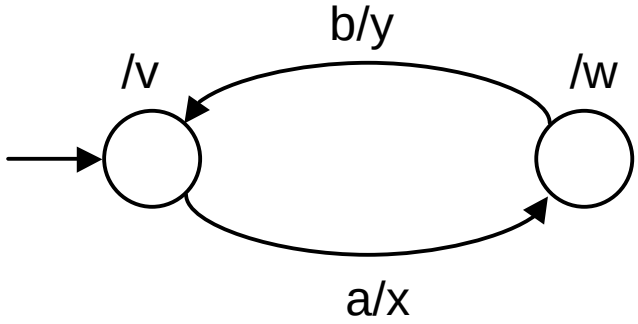


Les SyncCharts (1)

- **Representation and Analysis of Reactive Behaviors : A Synchronous Approach. C.André** IEEE-SMC, CESA'96, pp 19-29, Lille (F) July 1996
- Formalisme graphique synchrone inspiré Statecharts, compatible Esterel
- Etats/Transitions

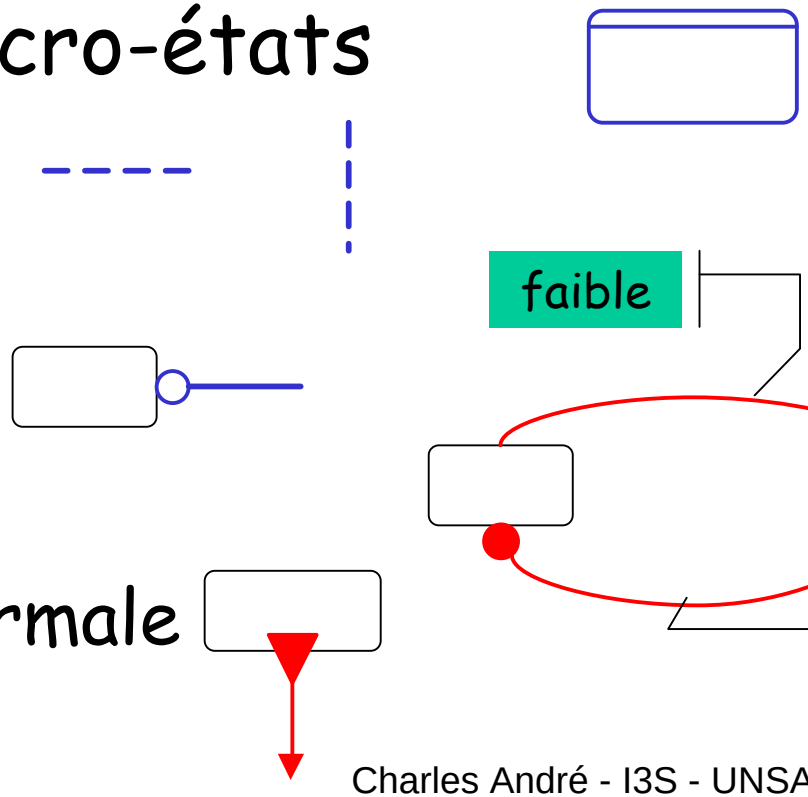


- Graphe d'états: effets associés états ou transitions



Les SyncCharts (2)

- Notion d'instant :
  - Occurrences strictement futures ou présentes (#)
  - Possibilités d'états transitoires
- Hiérarchie : macro-états
- Parallélisme :
- Préemptions :
  - Suspension
  - Avortements :
  - Terminaison normale



Les SyncCharts (3)

- Communication par diffusion instantanée
- Possibilité de cacher des signaux
- Comportement déterministe
- Sémantique : algèbre de processus synchrones entièrement compatible avec celle d'Esterel (les syncCharts supportent l'insertion de code Esterel)

Tk Button: Default Bindings

Tk automatically creates class bindings for buttons that give them default behavior:

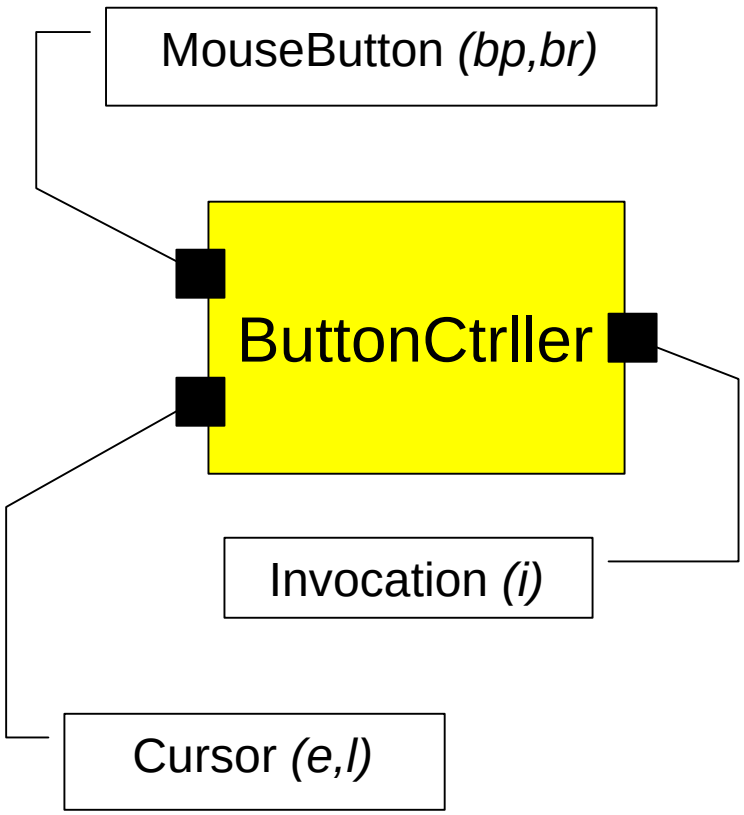
- [1] A button activates whenever the mouse passes over it and deactivates whenever the mouse leaves the button. Under Windows, this binding is only active when mouse button 1 has been pressed over the button.
- [2] A button's relief is changed to sunken whenever mouse button 1 is pressed over the button, and the relief is restored to its original value when button 1 is later released.

Tk Button (continued)

- [3] If mouse button 1 is pressed over a button and later released over the button, the button is invoked. However, if the mouse is not over the button when button 1 is released, then no invocation occurs.

- [4] When a button has the input focus, the space key causes the button to be invoked.

Contrôleur de Bouton Tk



bp: button pressed

br: button released

e: enter

l: leave

i: invoke

---

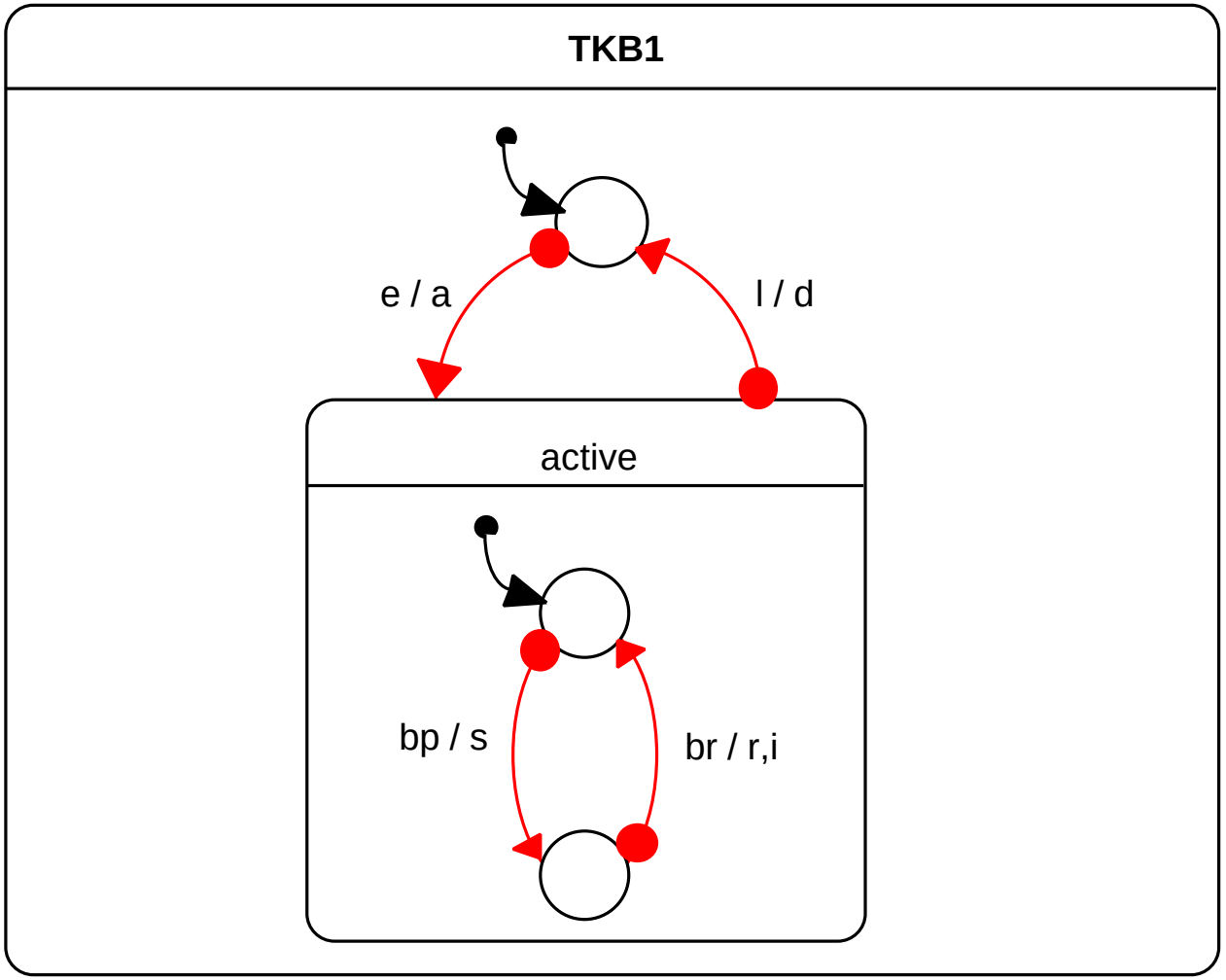
a: activate

d: de-activate

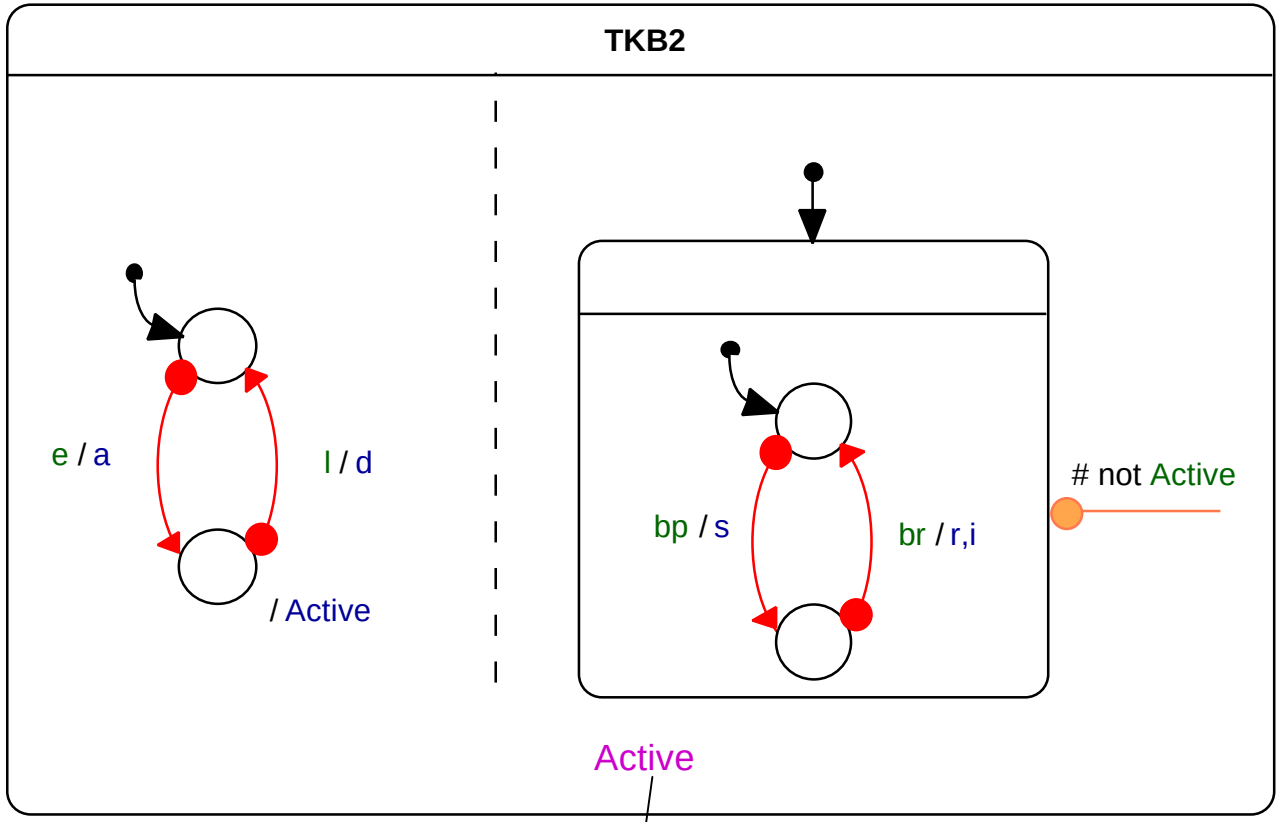
r: raise

s: sink

Solution naïve



Séparation + Histoire

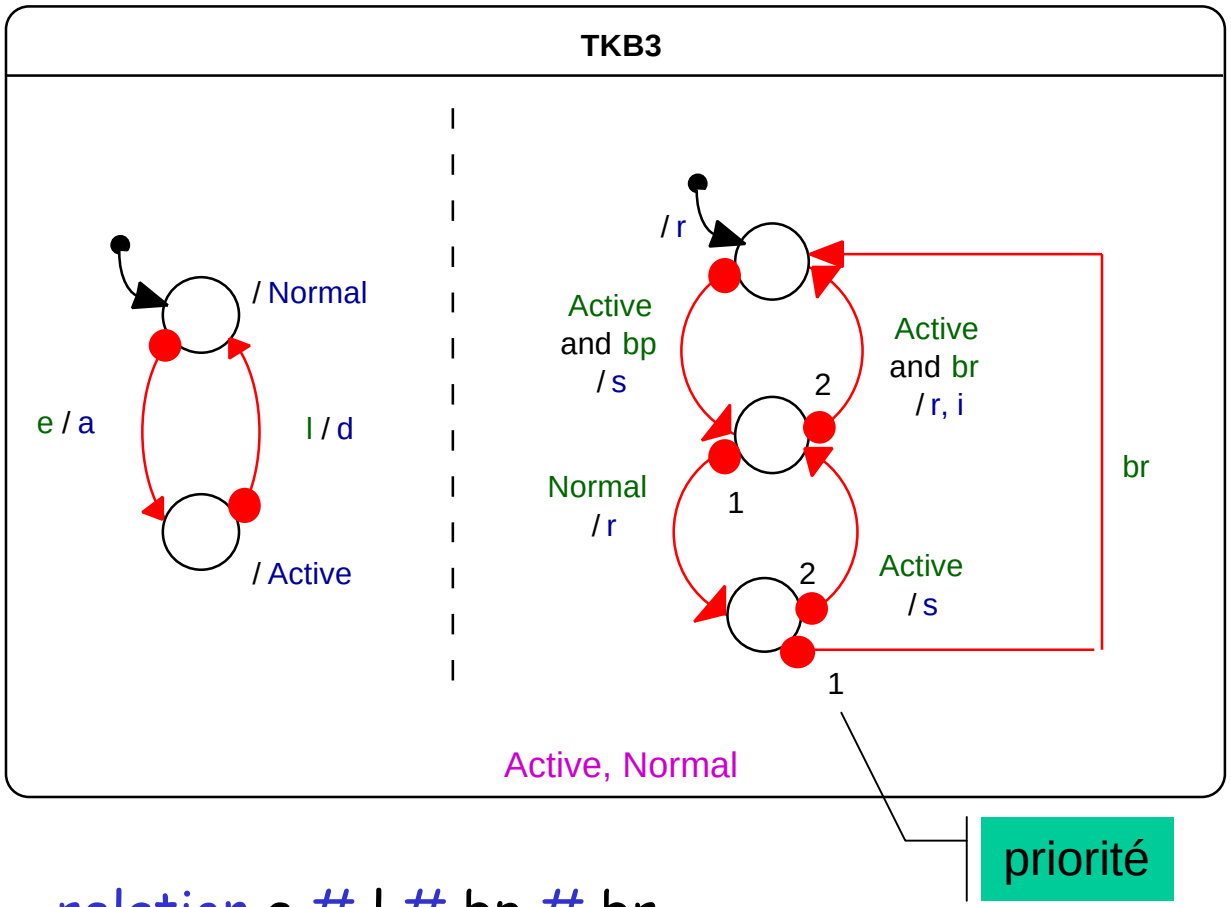


Relatif au Port Cursor

Relatif au Port MouseButton

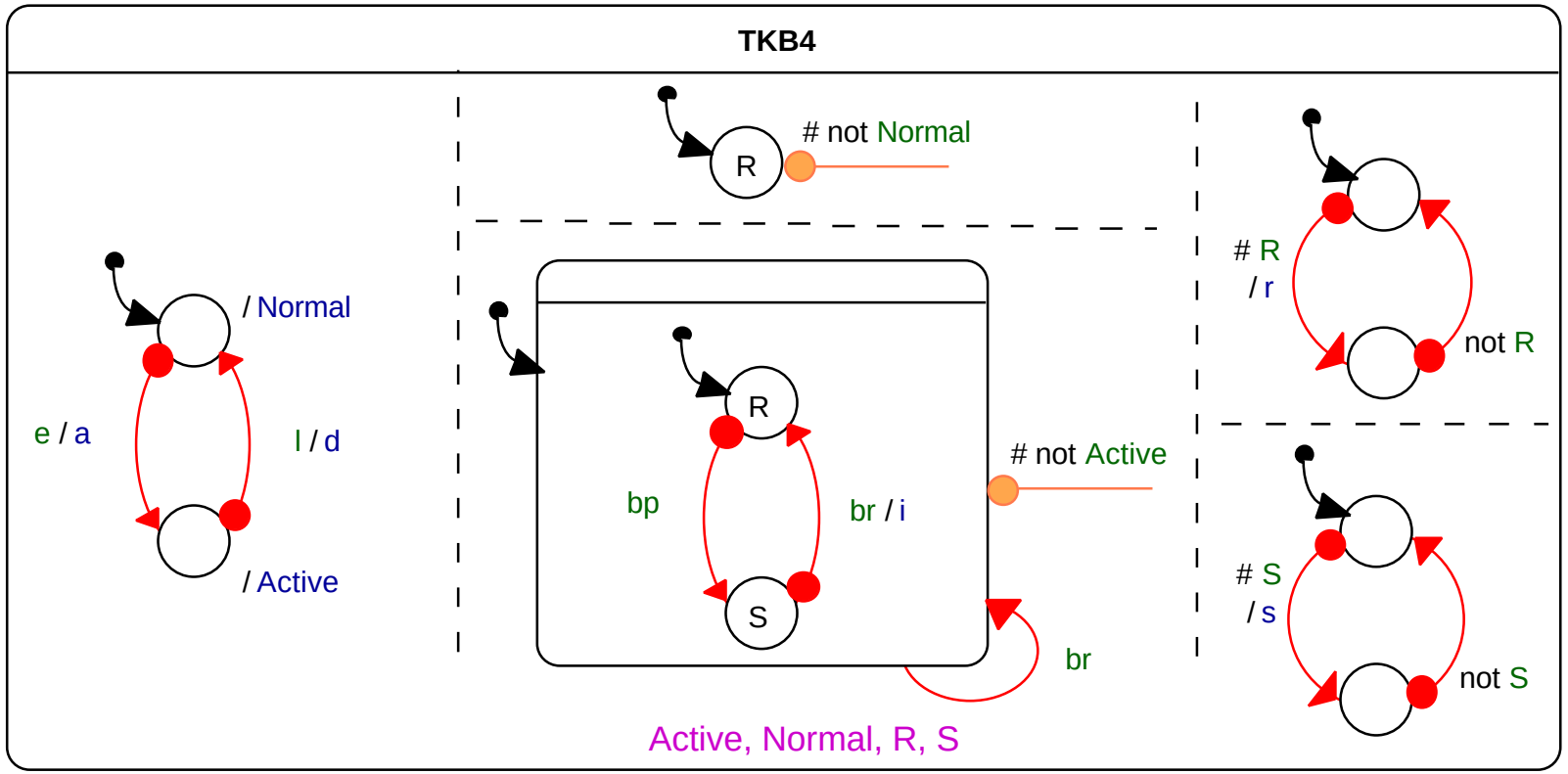
Couplage (signaux locaux)

Solution (1)



relation e # l # bp # br

Solution (2)



R = Raised; S = Sunken

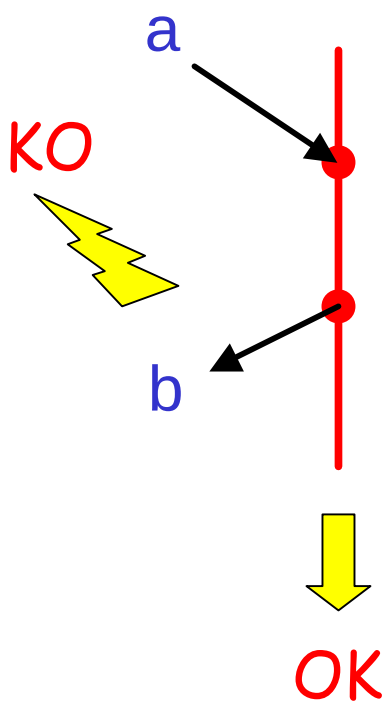
relation e # l # bp # br

S.I.B

- Synchronous Interface Behavior
  - Observed: un ensemble de signaux observés
  - Timebase: un ensemble de bases de temps
  - Une évolution attendue

- Un sib est une boîte réactive qui observe des signaux et réagit en conséquence :
  - En terminant avec OK (satisfaction)
  - En terminant avec KO (non conforme)
  - En attendant la réaction suivante (pause)

Eléments de base : Expect



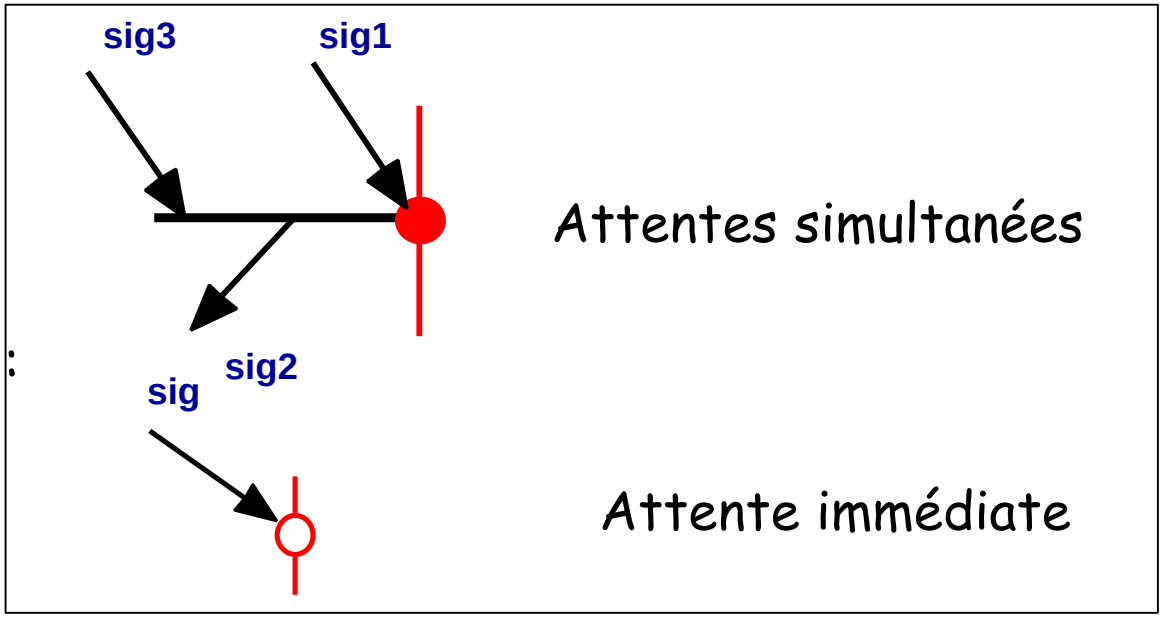
Observed = {a,b,c}

Attendre la prochaine occurrence de a (input)

puis

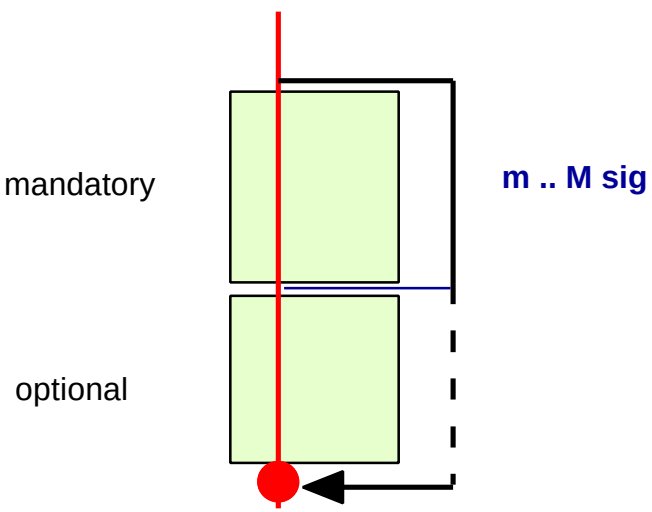
Attendre la prochaine occurrence de b (output)

Propres au synchrone :

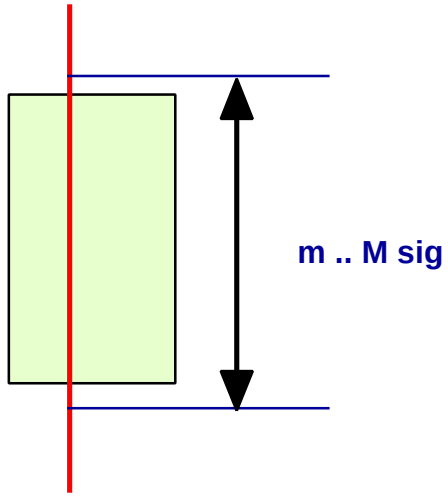


Prise en compte du temps

Temps multiforme



Before



Within

Autres blocs

- Les SIB sont inspirés des MSC (Message Sequence Charts) + synchrone
- Autres constructions :

  Parallèle, alternatives, itération bornée, et deux formes de préemption (upto, watchdog)
- Sémantique : algèbre de processus synchrones
- Introduction maîtrisée du non-déterminisme (intervalles, séquences optionnelles)

Utilisation des SIB

- Principe : 1 sib $\rightarrow$ 1 module Esterel

  Les traductions de sibs composées avec le contrôleur conçu.

- Satisfaction de scénario :
  - 1 famille de scénarii $\rightarrow$ 1 sib
  - Montrer que OK est possiblement émis
- Propriété de sûreté :
  - 1 contraposée de propriété $\rightarrow$ 1 sib
  - Montrer que OK n'est jamais émis

Perspectives

- SyncCharts :
  - Proto universitaire disponible
  - Version commerciale : Esterel Studio
- SIB :
  - Proto universitaire en développement
- UML :
  - Diagrammes de classes conservés
  - Modèle dynamique → syncCharts
  - Diagrammes de séquence → SIB
- UML + synchrone =
  - Support de description et de validation
  - A la recherche d'une méthodologie