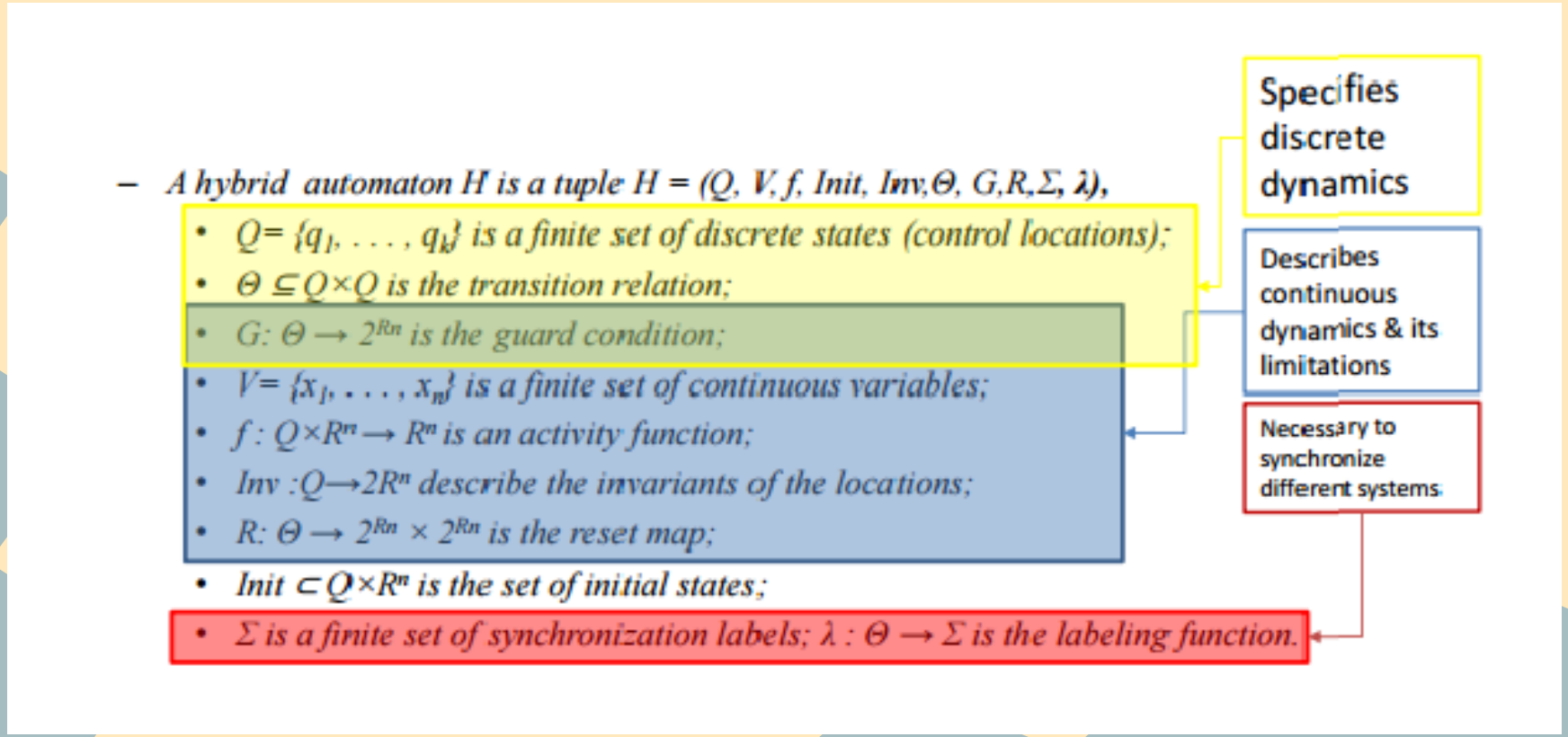
Hybrid Automata

Simulated

Definition

- Formal model of a hybrid system.
- Transition system that is extended with continuous dynamics

Tuple


– A hybrid automaton H is a tuple H = (Q, V, f, Init, Inv, Θ, G, R, Σ, λ),
• Q= {q1, . . . , qk} is a finite set of discrete states (control locations);
• Θ ⊆ Q×Q is the transition relation;
• G: Θ → 2^Rn is the guard condition;
• V= {x1, . . . , xn} is a finite set of continuous variables;
• f : Q×R^n → R^n is an activity function;
• Inv :Q→2R^n describe the invariants of the locations;
• R: Θ → 2^Rn × 2^Rn is the reset map;
• Init ⊂ Q×R^n is the set of initial states;
• Σ is a finite set of synchronization labels; λ : Θ → Σ is the labeling function.
Specifies discrete dynamics
Describes continuous dynamics & its limitations
Necessary to synchronize different systems

Thermostat (Model & Simulation)

$$f(q,x) := \begin{cases} -x+50 & q = \text{off} \\ -x+100 & q = \text{on} \end{cases}$$

$$\varphi(q,x) := \begin{cases} \text{on}, & q = \text{off}, x \leq 73 \\ \text{off} & q = \text{off}, x > 73 \\ \text{off}, & q = \text{on}, x \geq 77 \\ \text{on}, & q = \text{on}, x < 77 \end{cases}$$

Scilab vs Uppaal

Scilab

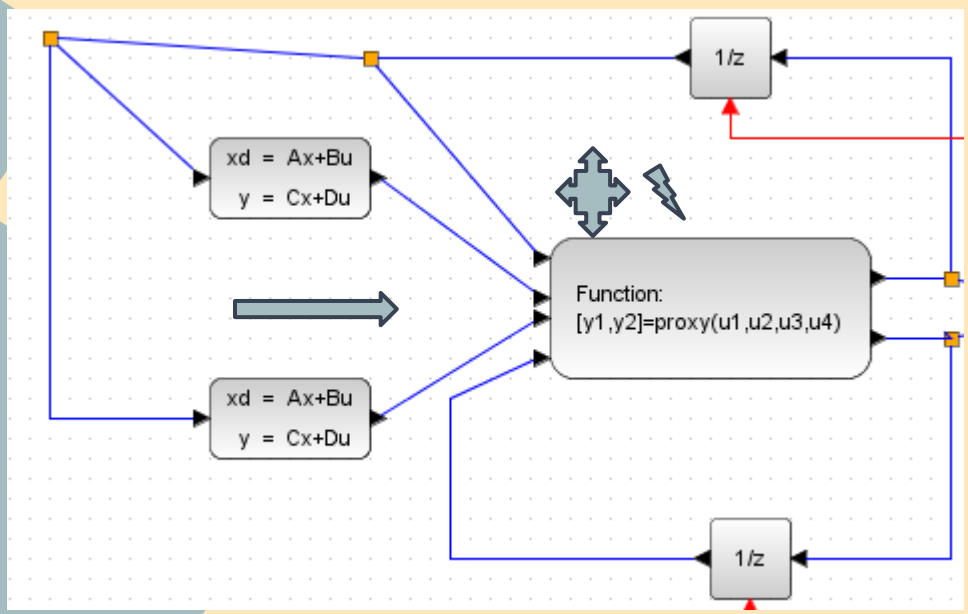
- Continuous
- Numeric Graph
- Visual Output
- Simulation

Uppaal

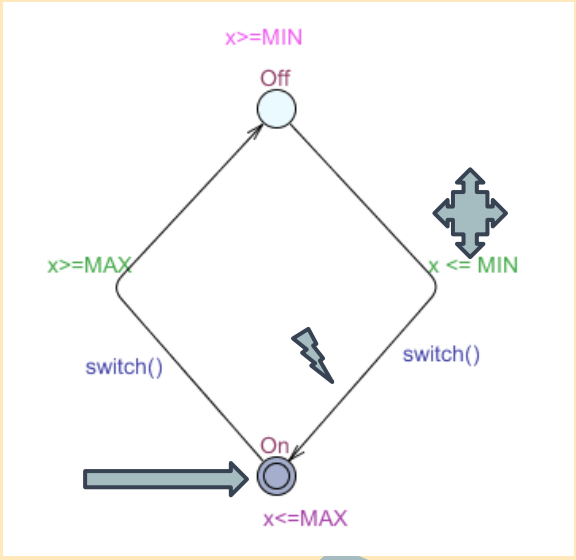
- Discrete
- Directed Graph
- Traced Query
- Verification

Discrete Dynamics

Scilab

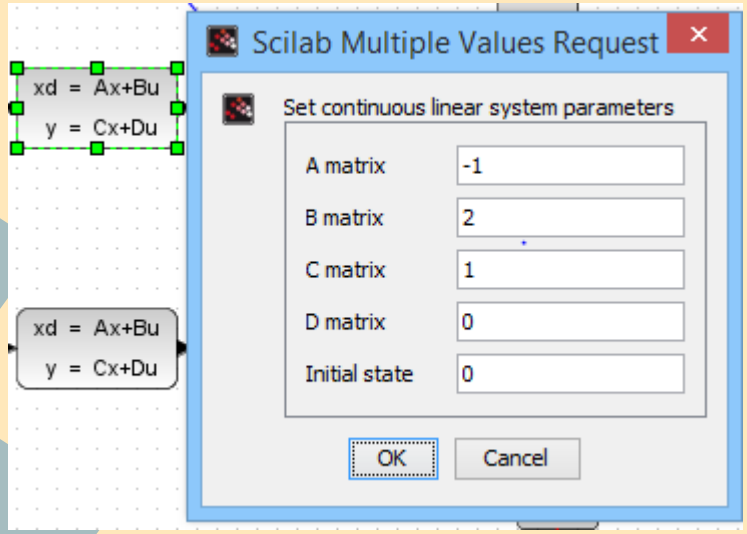


Uppaal

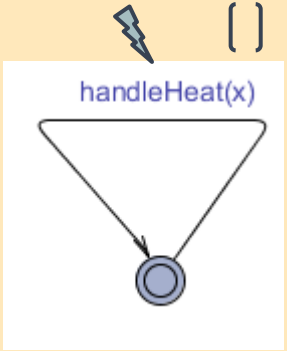


Continuous Dynamics

Scilab

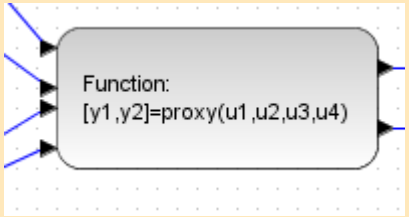


Uppaal



Invariants

Scilab



Uppaal


Blu-ray Disc
ANTONIO BANDERAS
AUTOMATA
DYLAN McDERMOTT
MELANIE GRIFFITH
BIRGITTE HJORT SØRENSEN
WITH ROBERT FORSTER

Thanks!