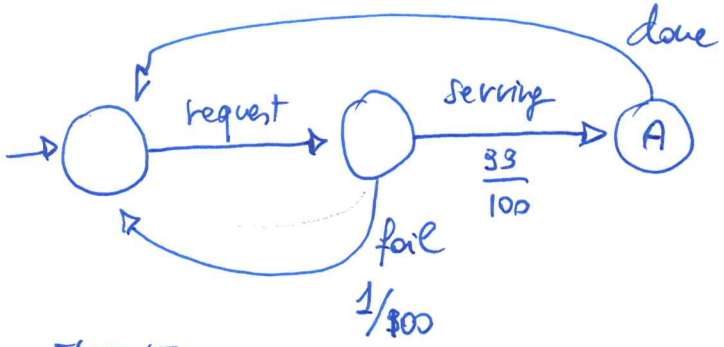
PROBABILISTIC SYSTEMS

RPSV 1/02/2017

1) AL POSTO DEL PURO NON-DETERMINISMO



$\forall \Diamond A$

$Pr(\forall \Diamond A) \approx 1$

REFINEMENT

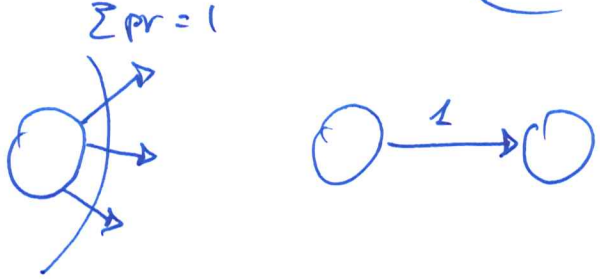
2) PERFORMANCE EVALUATION COST/REWARDS

3) RANDOMIZED ALGORITHMS

$P_{[0.5,0.7]}(c \cup^{\leq 6} b)$

PCTL

— DISCRETE TIME MARKOV CHAINS (DTMC)

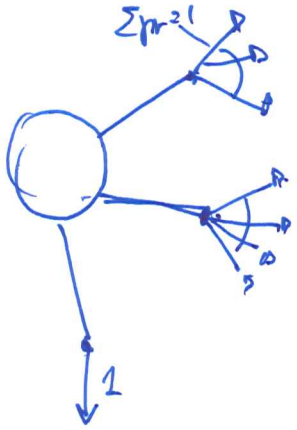


• PURA PROBABILISTA'

ABSTRACT TIME (LTS)

$P_{\geq 0.95}(\Diamond A)$ $[0.95, 1]$

— MARKOV DECISION PROCESS (MDP)



• ABSTRACT TIME

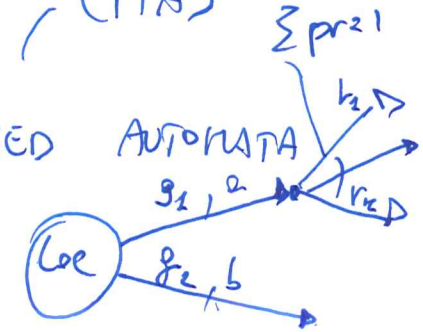
• MIX PROBABILITA + NON-DETERMINISMO

$P_{=1}(\Diamond A) \approx \forall\Diamond A$

$P_{>0}(\Diamond A) \approx \exists\Diamond A$

$[0, 1]$

(PTA)



• DETERMINISTIC @ TIME

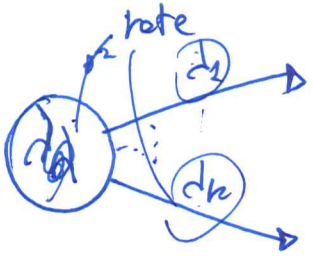
• MIX PROB + NON-DET

PTCTL — PROBABILISTIC TIMED AUTOMATA

CLOCK

CSL (Continuous Stochastic Logic)

- CONTINUOUS TIME MARKOV CHAIN (CTMC)
  - STOCHASTIC TIME
  - PROBABILITY (RACE CONDITION)



BISTRIBUZIONE ESPONENZIALE

MEMORY LESS

(3)

- ... MARKOV AUTOMATA
- ... PROB I/O AUTOMATA
- ...

TOOL

PRISM

- MC: DTMC, MDP, CTMC, PTA
  - PCTL
  - CSL
  - PTCTL
- → EXPERIMENTS
- STATISTICAL MODEL CHECKING (Simulazione + Statistica)

DTMC – (STATE-BASED)

$\langle S, i, P, AP, L \rangle$

- S set of states (COUNTABLE) ... (FINITE for VERIFICATION)
- i DISTR: $i(s)$ = prob. che s sia stato iniziale

$$i : S \longrightarrow [0,1]$$

$$\sum_{s \in S} i(s) = 1 \qquad i(s_0) = 1$$

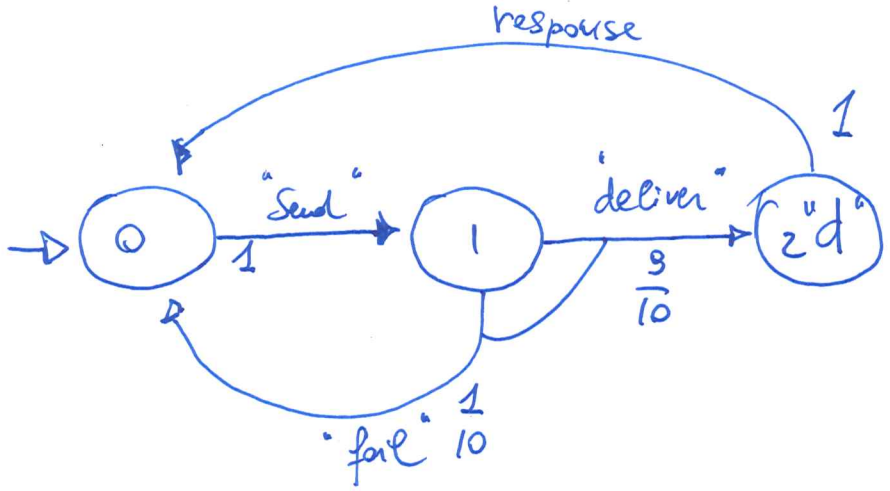
$$i(s) = 0 \quad \forall s \neq s_0$$

- $P : S \times S \longrightarrow [0,1]$ (MEMORY-LESS)

$$\forall s \in S \quad \sum_{s' \in S} P(s,s') = 1$$

$$S \begin{pmatrix} 0 & 0.5 & 0.3 & 0.2 \\ \cdots & \cdots & \cdots & \cdots \end{pmatrix}$$

- $L : S \longrightarrow 2^{AP}$ Labeling Function



"d" = delivered

(5)

- $AP = \{d\}$
- $S = \{0, 1, 2\}$

$i(0) = 1$, $i(1) = i(2) = 0$

$$P = \begin{pmatrix} 0 & 1 & 0 \\ \frac{1}{10} & 0 & \frac{9}{10} \\ 1 & 0 & 0 \end{pmatrix}$$

- $L(0) = \{\}$ $L(2) = \{d\}$
- $L(1) = \{\}$