Relating paths in transition systems: the fall of the modal mu-calculus

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joint work with
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Motivation

In the full observation setting: Consider the ATL property

$$\langle\langle \text{Eloise} \rangle\rangle \text{F} g \text{ for "Eloise has a plan to reach goal g"}$$

that you want to model-check (and at the same time synthesize the plan, if any).

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A nice setting is to use the following roadmap:

$$\text{ATL} \rightsquigarrow \mathsf{MSO} \leftrightsquigarrow \mathsf{L}_\mu \leftrightsquigarrow \text{PT Automata}$$

[EJ91]

”Tree automata, mu-calculus and determinacy”

[Janin-Walukiewicz96]

”On the expressive completeness of the propositional mu-calculus with respect to monadic second order logic”

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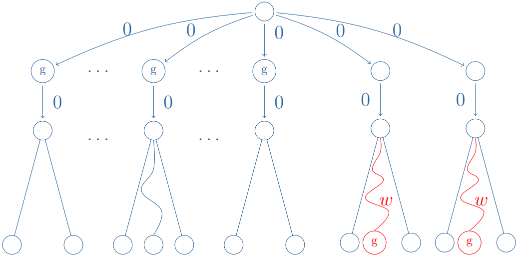
Notice that Eloise's plan has to be uniform!

$\mathcal{A}ct = \{0, 1\}$ and $w \in \mathcal{A}ct^*$



The plan $0.w$ is winning

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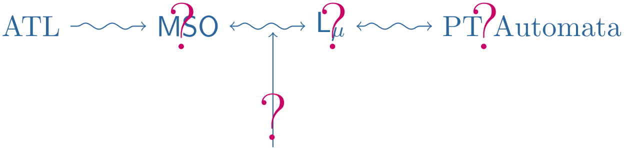
What would the roadmap look like?



What we will see

Part I : The full observation setting

- Monadic Second Order Logic MSO and the μ-calculus L_μ
- Expressive Completeness of Janin and Walukiewicz 1996 (tree automata)

$$\text{ATL} \rightsquigarrow \mathsf{MSO} \leftrightsquigarrow \mathsf{L}_\mu \leftrightsquigarrow \text{Automata}$$

What we will see

Part II : In the partial observation setting

- Transition systems with binary relations between paths
- Monadic Second Order Logic with path relations $\mathsf{MSO}^{\curvearrowright}$
- The jumping μ-calculus $\mathsf{L}_{\mu}^{\curvearrowright}$
- Jumping (Tree) Automata for $\mathsf{L}_{\mu}^{\curvearrowright}$

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- Jumping (Tree) Automata for $\mathsf{L}_{\mu}^{\smile}$
- Expressive completeness for recognizable relations (e.g. finite memory of agents)
- NON Expressive completeness for regular relations (e.g. synchronous perfect recall)
  - $\mathsf{L}_{\mu}^{\smile}$-definability of 2-player imperfect information reachability games where Eloise has a wining strategy