

# Logic and Modelling

— Applications of Modal Logic —

Jörg Endrullis

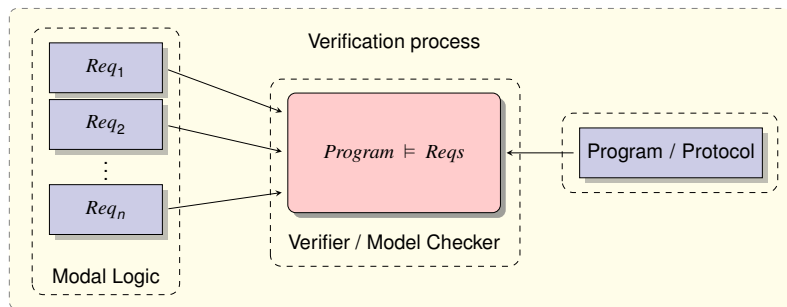
VU University Amsterdam

# Where is Modal Logic Applied?

Modal logic is applied in industry for

- ▶ **program verification,**
- ▶ **protocol validation.**

That is, to guarantee that a program / protocol is correct!



The requirements are formulated in a variant of modal logic.

# Where is Modal Logic Applied?

Variants of modal logic used in industry:

- ▶ linear time logic,
- ▶ computational tree logic,
- ▶  $\mu$ -calculus.

They typically have more modalities. For example

$G\phi \iff$  in all reachable worlds  $\phi$  is true

$F\phi \iff$  in some reachable world  $\phi$  is true

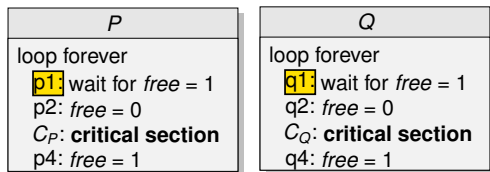
You can then formulate properties like:

- ▶ There always is a path to successful termination.
- ▶ Never two processes are in the same critical section.  
(Needed in case of shared resources.)

# Where is Modal Logic Applied?

## How does it work? The verifier...

- ▶ translates program execution into a graph (state space),
- ▶ checks the validity of the modal formulas.

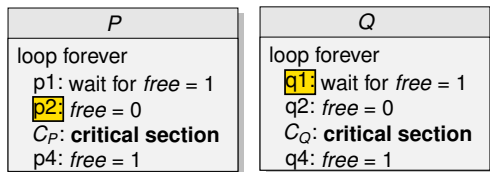


p1,q1,1

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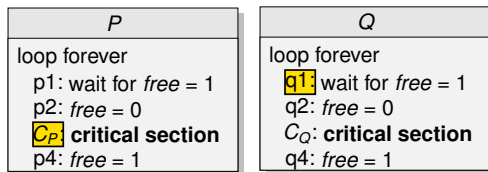


p1,q1,1 → p2,q1,1

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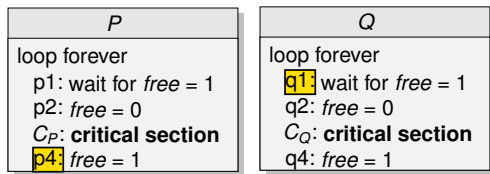
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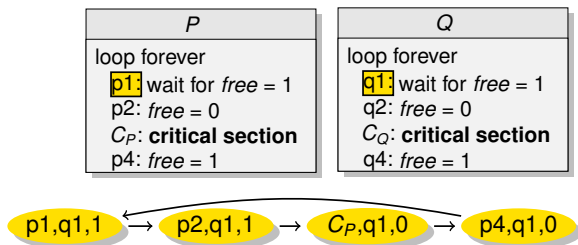
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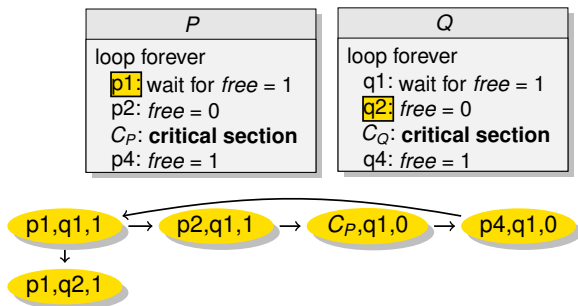




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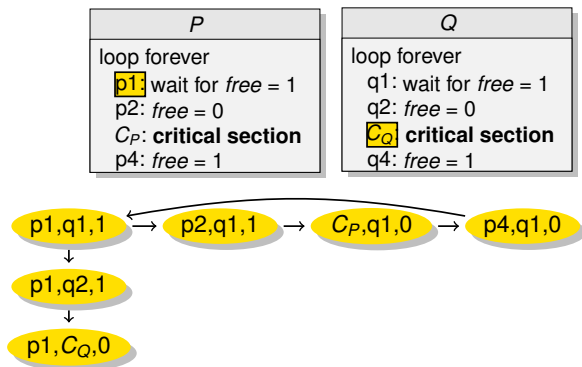
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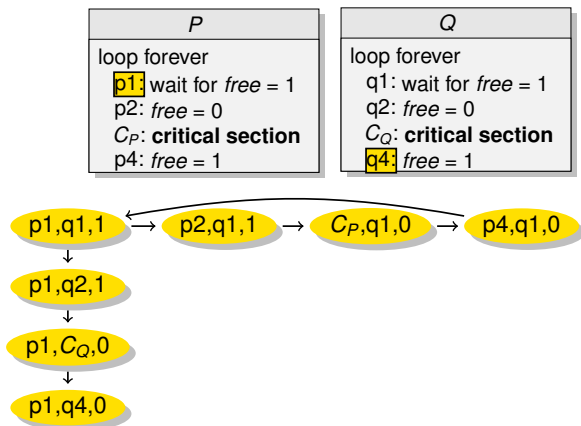
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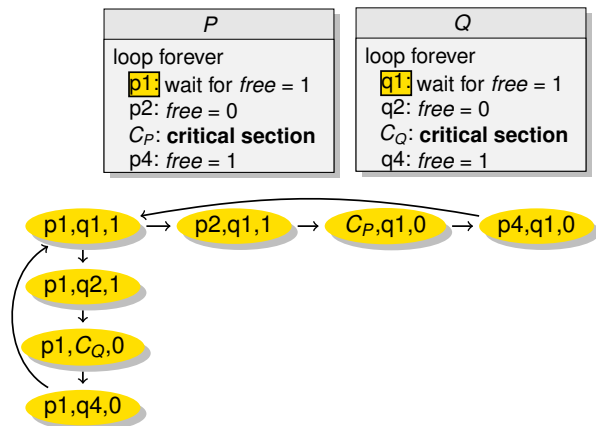
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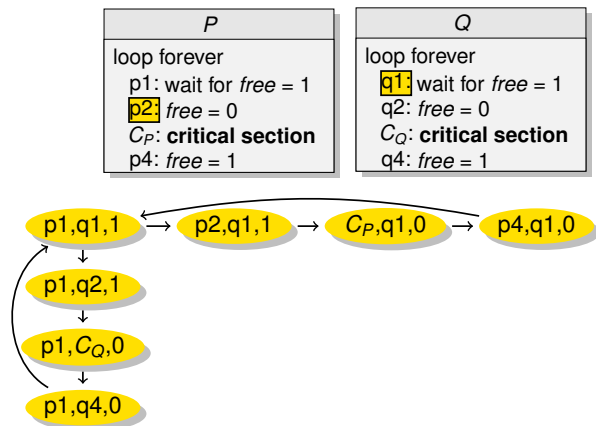
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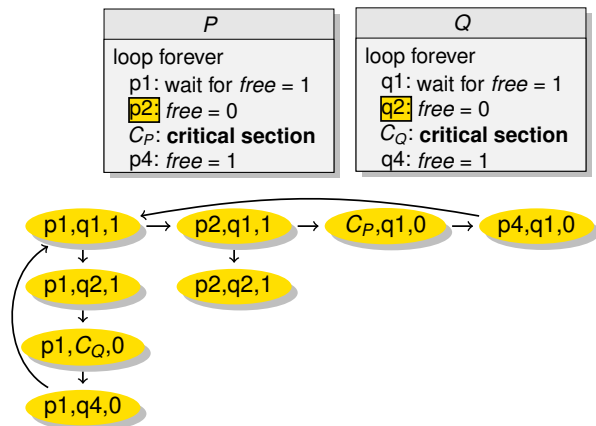
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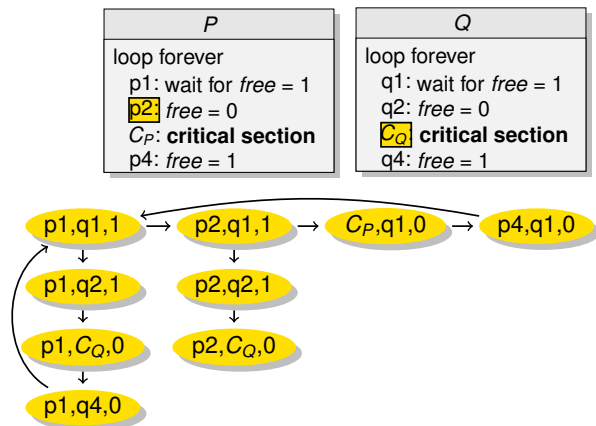
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