A Formal Framework for the Analysis of Human-Machine Interactions

PhD Public Defence

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UCL Université catholique de Louvain

Automated interactive systems

People are interacting with technology everyday!

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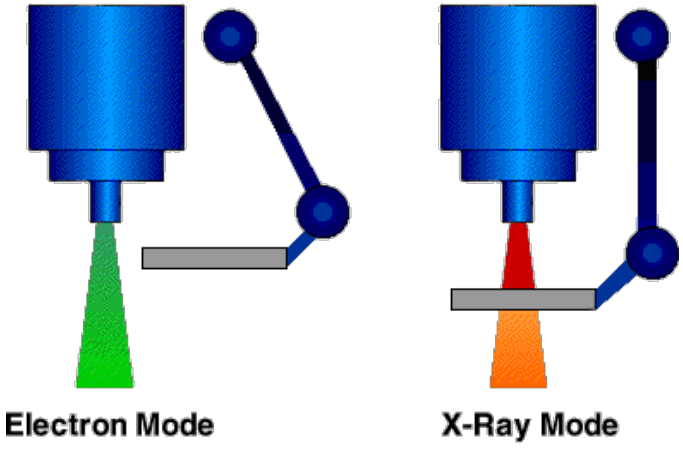
Automation surprise

Therac-25

1985–1987



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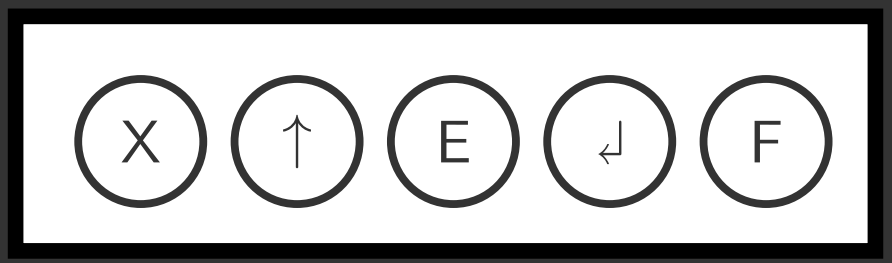

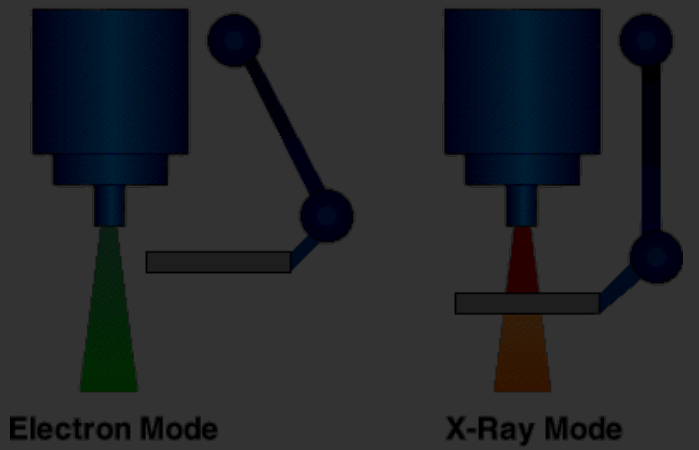

Did you said bug?

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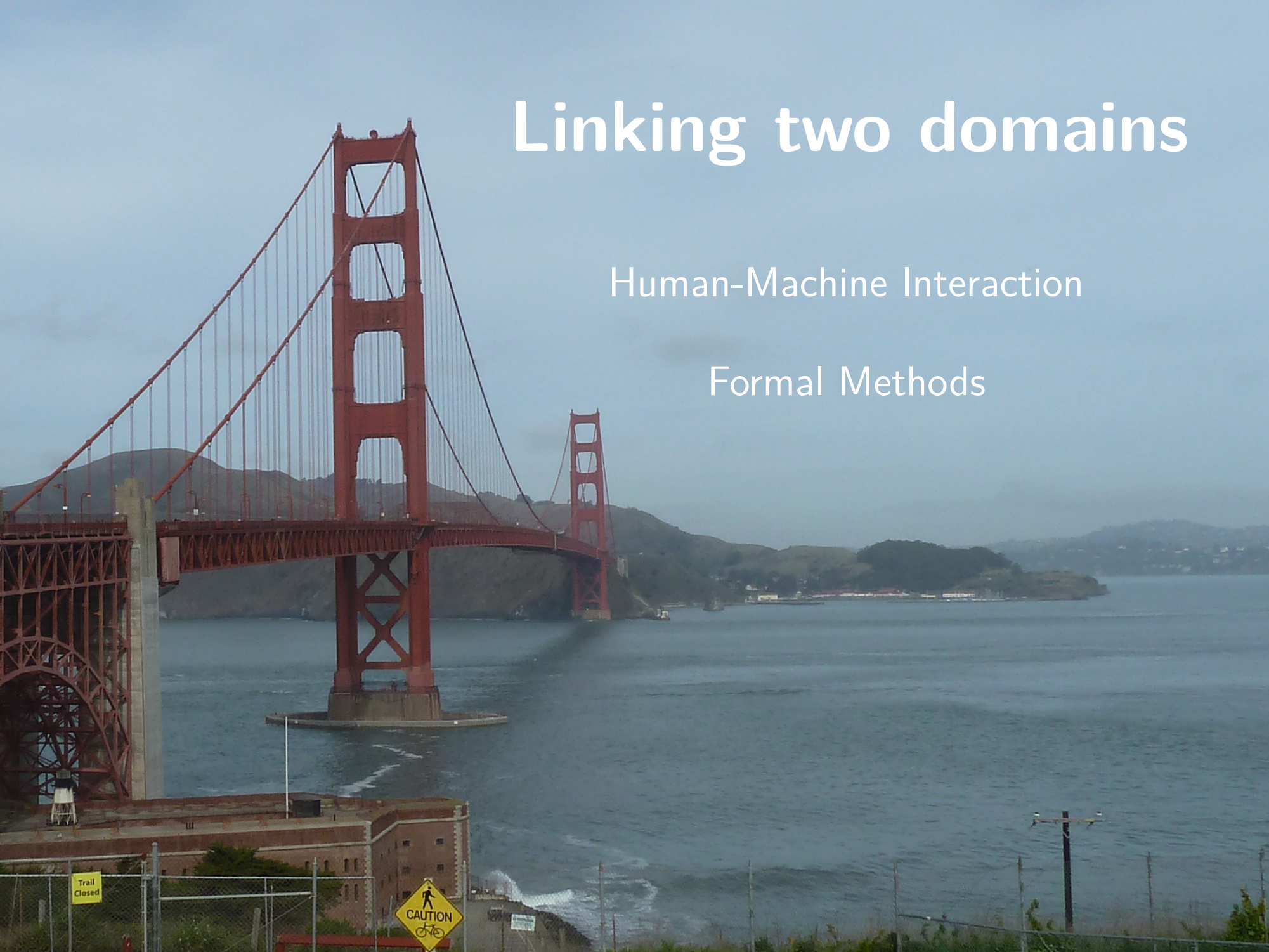
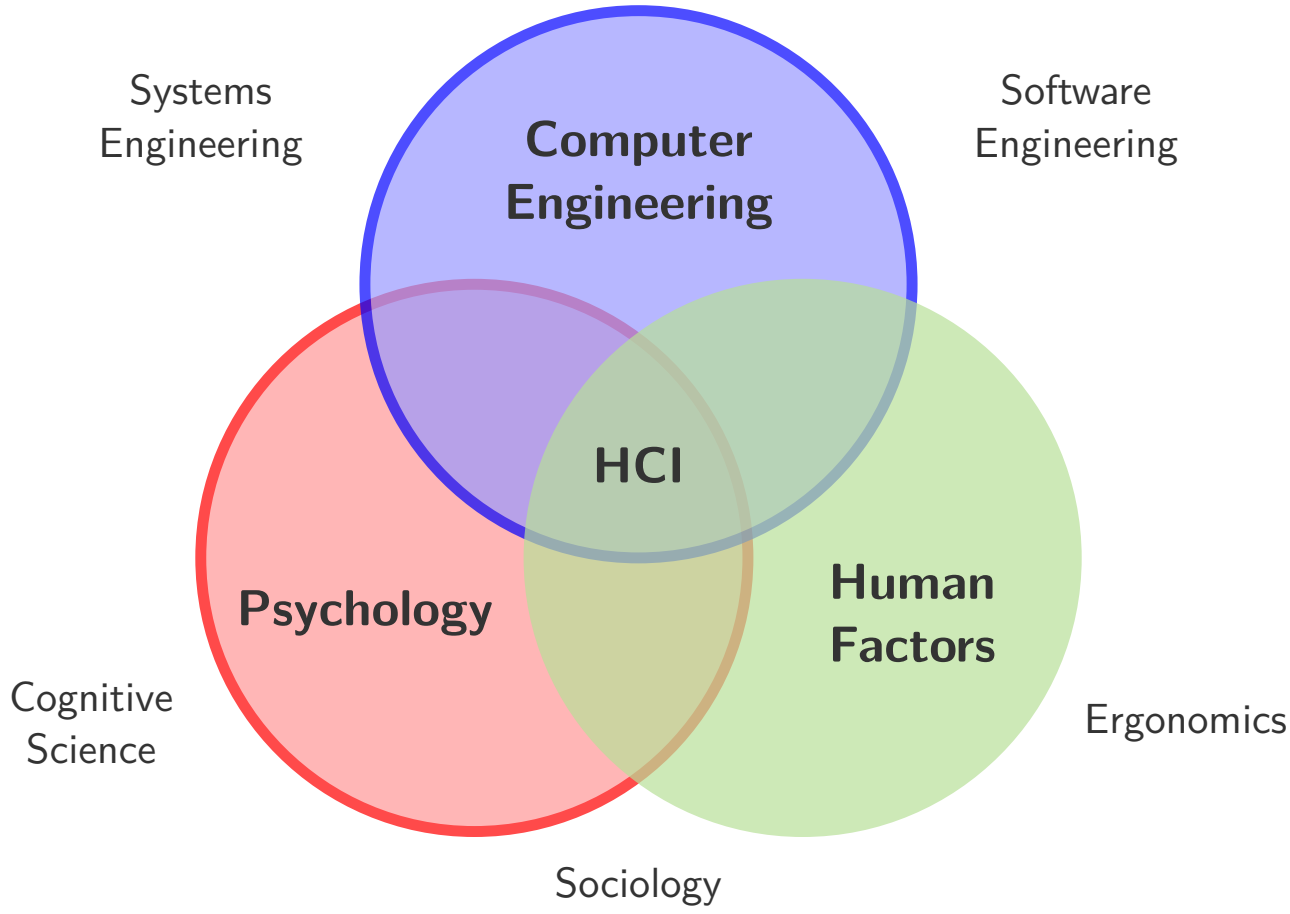


Linking two domains

Human-Machine Interaction

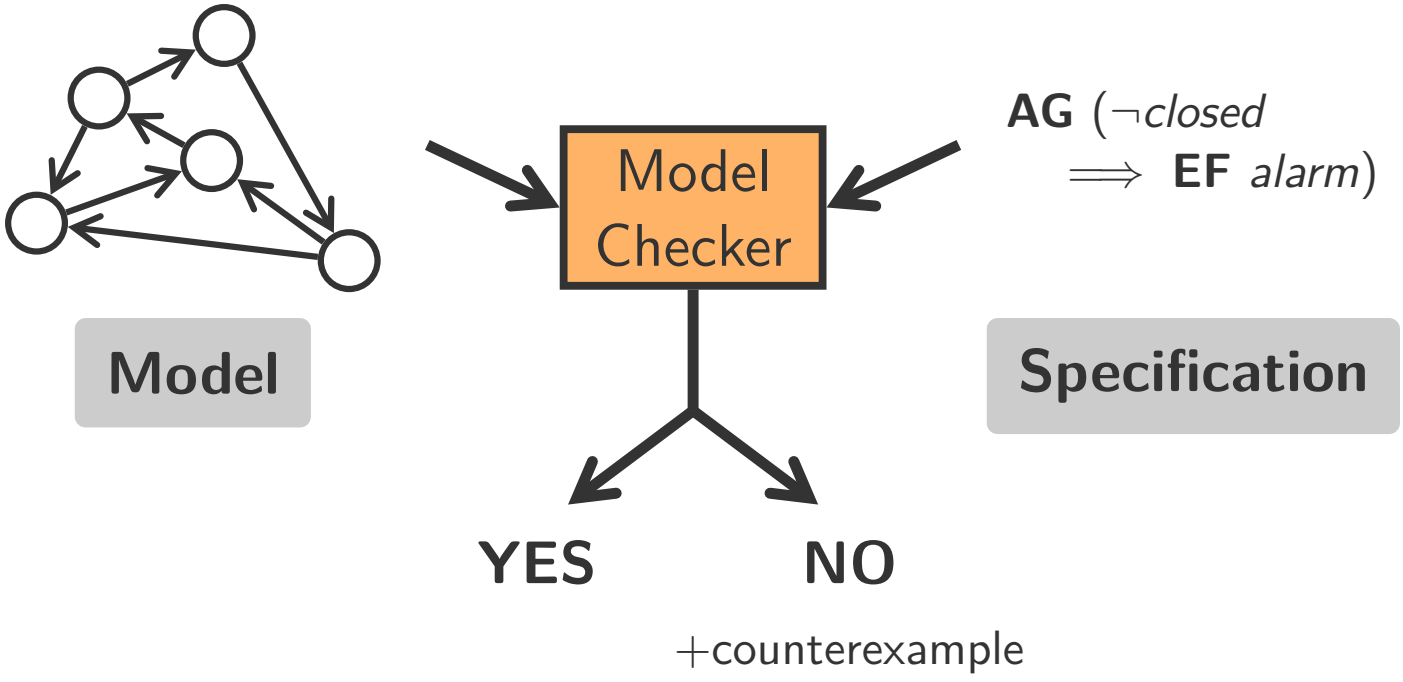
Formal Methods

Human-computer interaction



Design, evaluation and implementation of interactive computing systems for human use

Formal methods



Specification, development and verification of hardware and software systems using mathematical techniques

Modelling the world around us

Simplification of the analyses

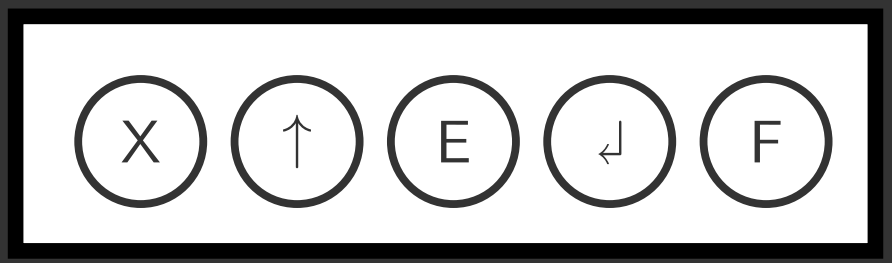
Validation of models

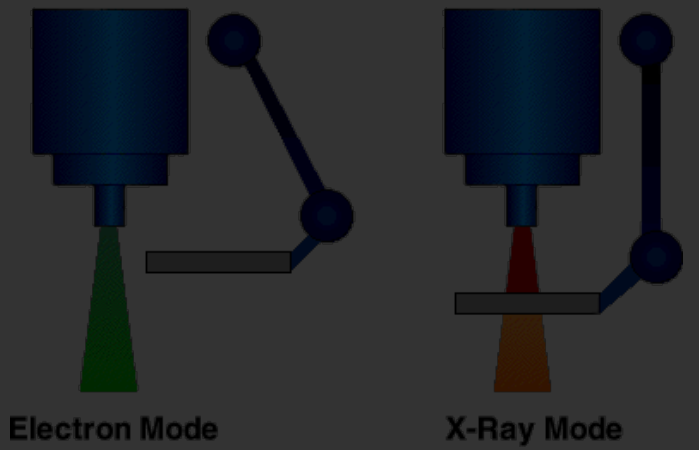
False positives and negatives

Automation surprise

Therac-25

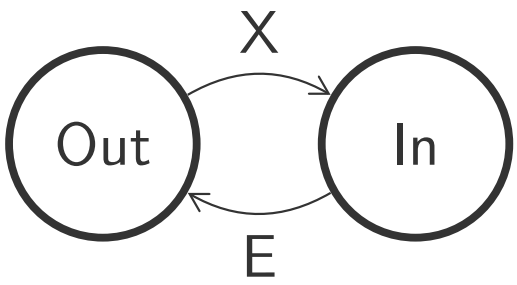
1985–1987



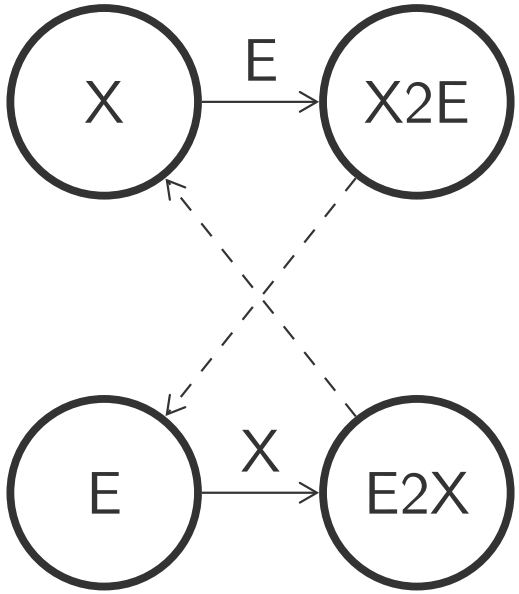


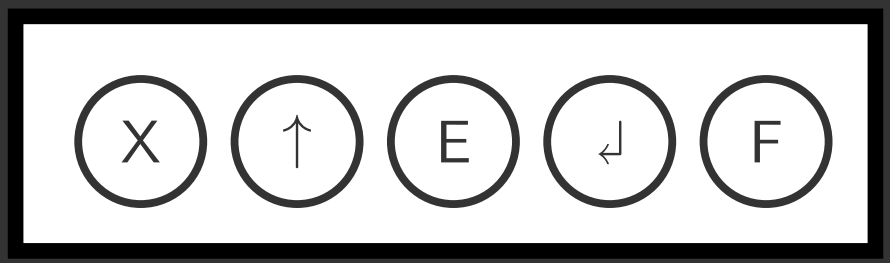
Automation surprise

Spreader



BeamLevel





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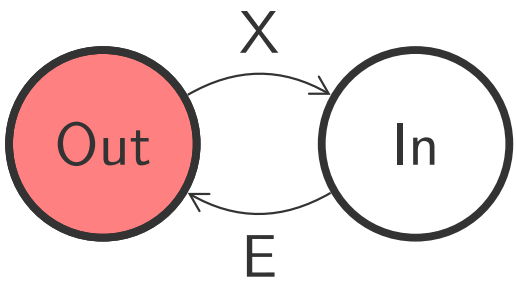

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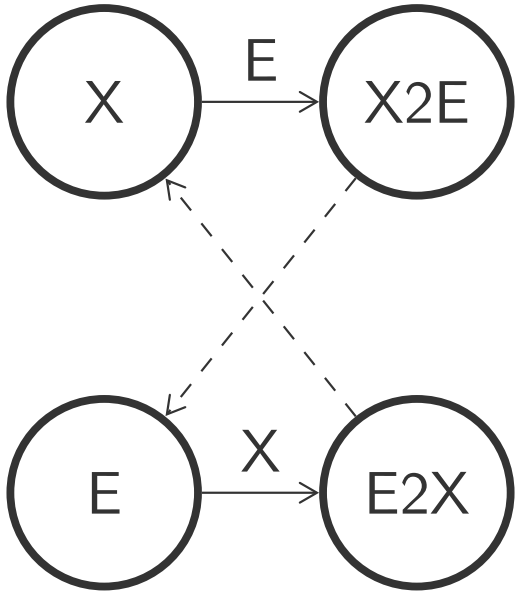

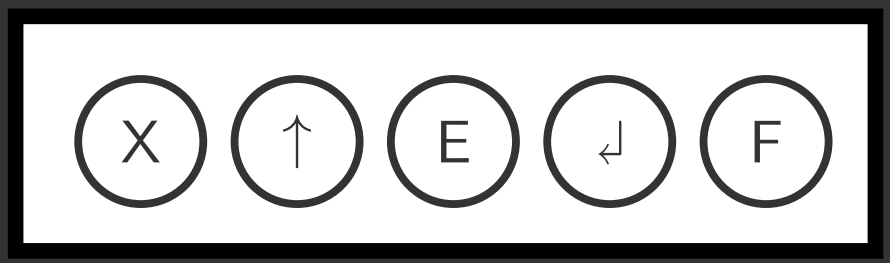

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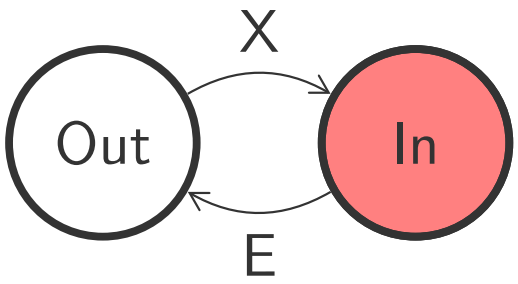

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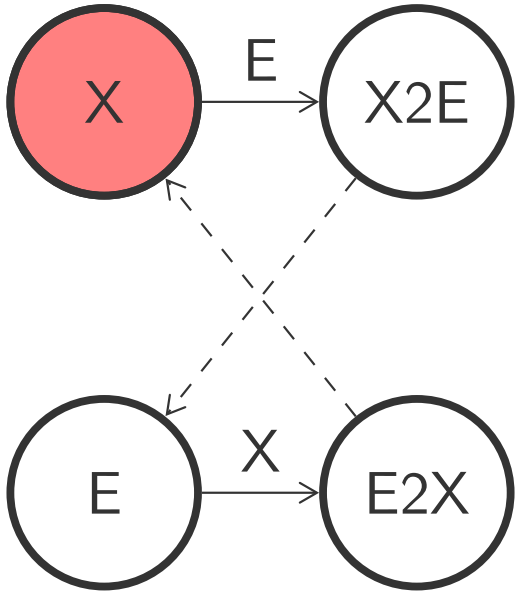

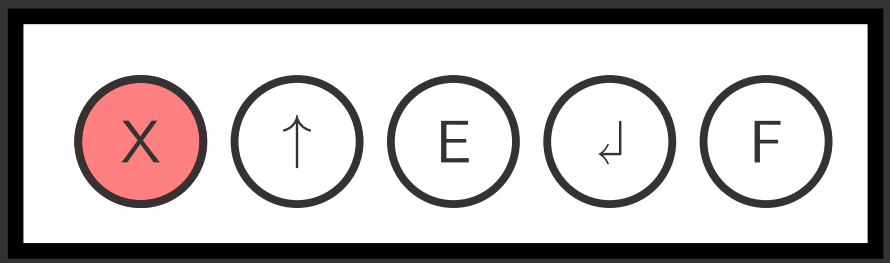

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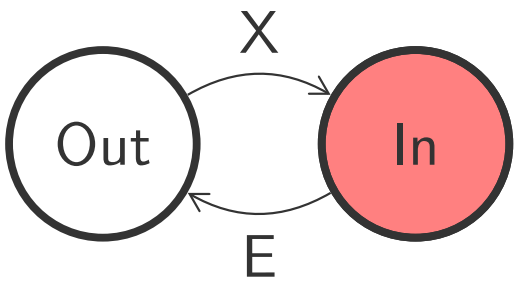

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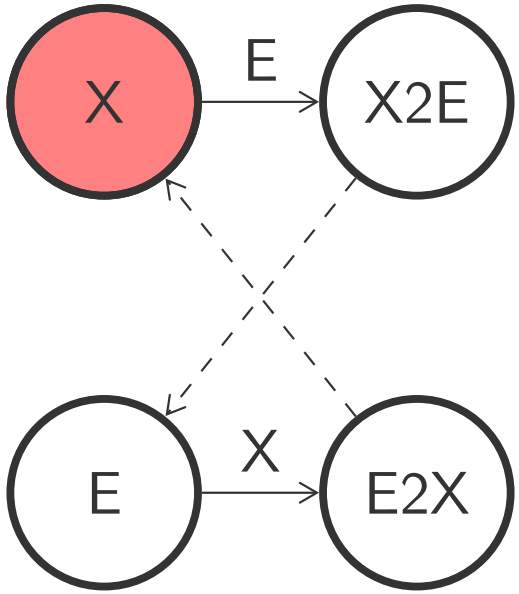

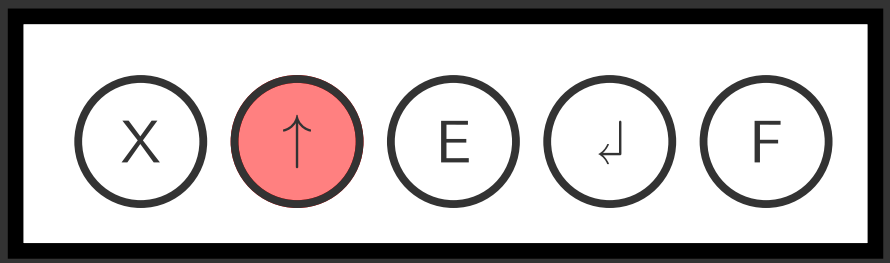

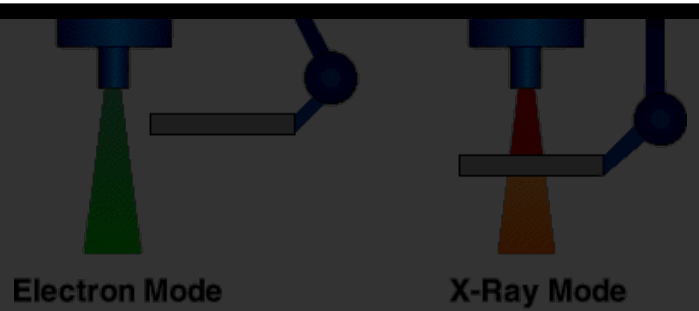

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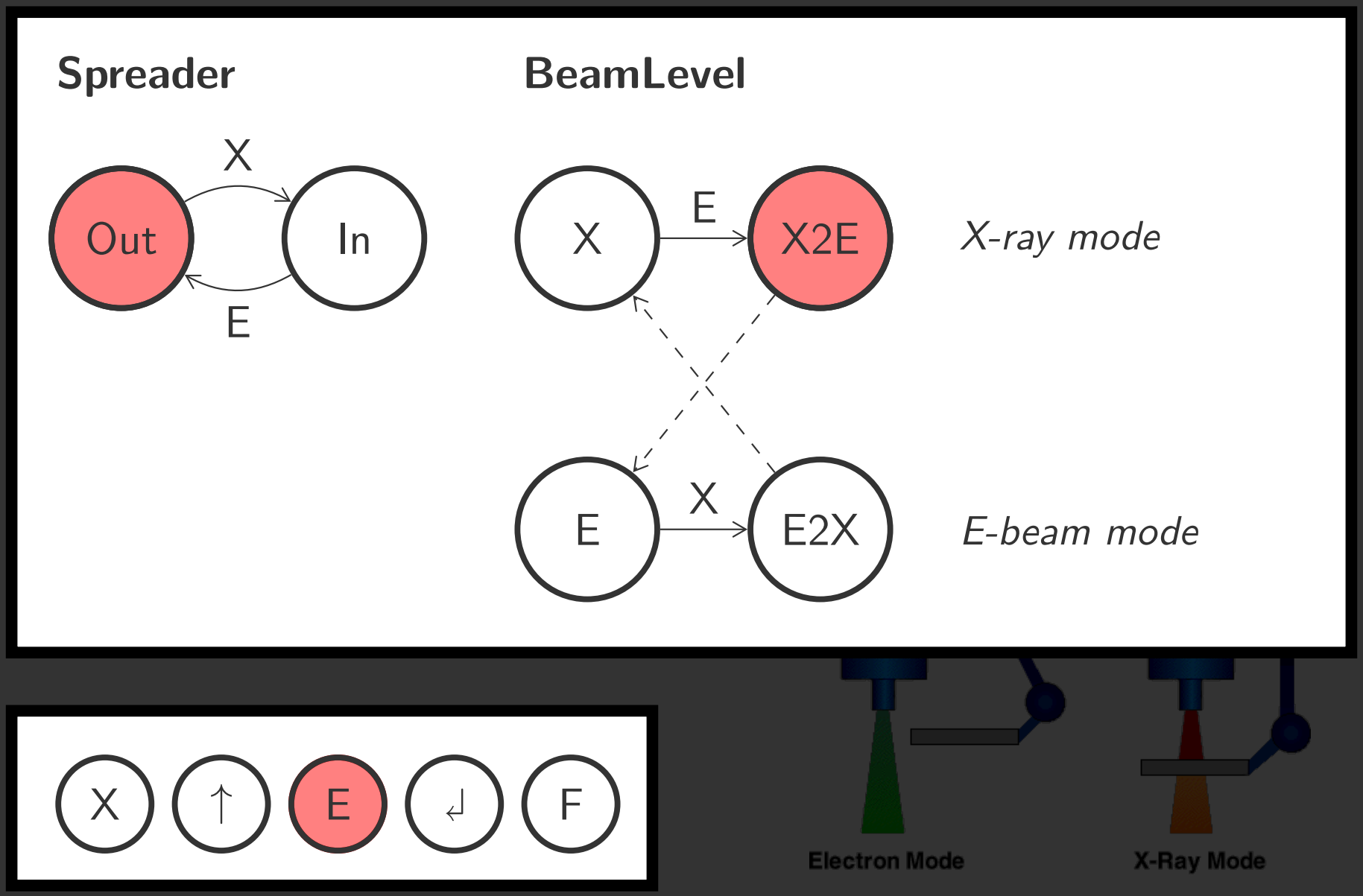

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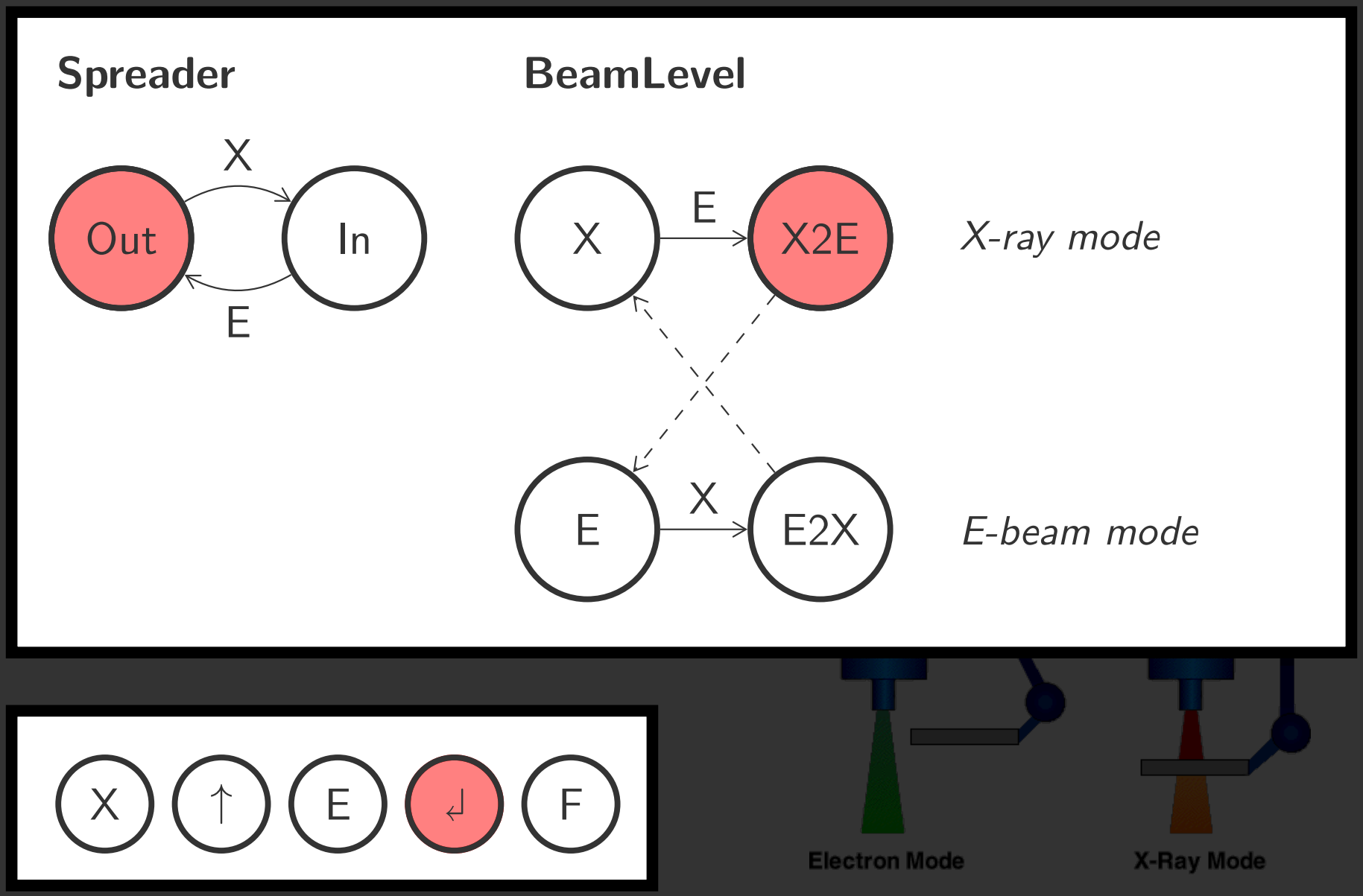

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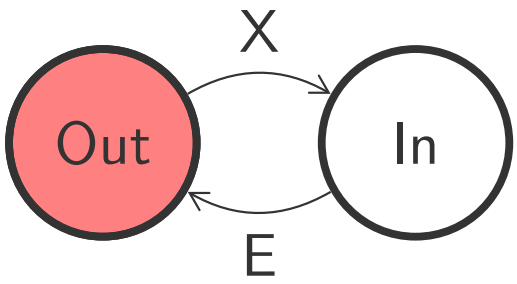
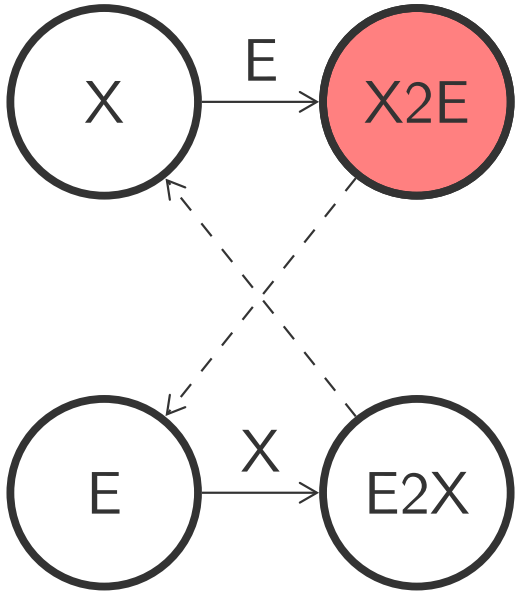
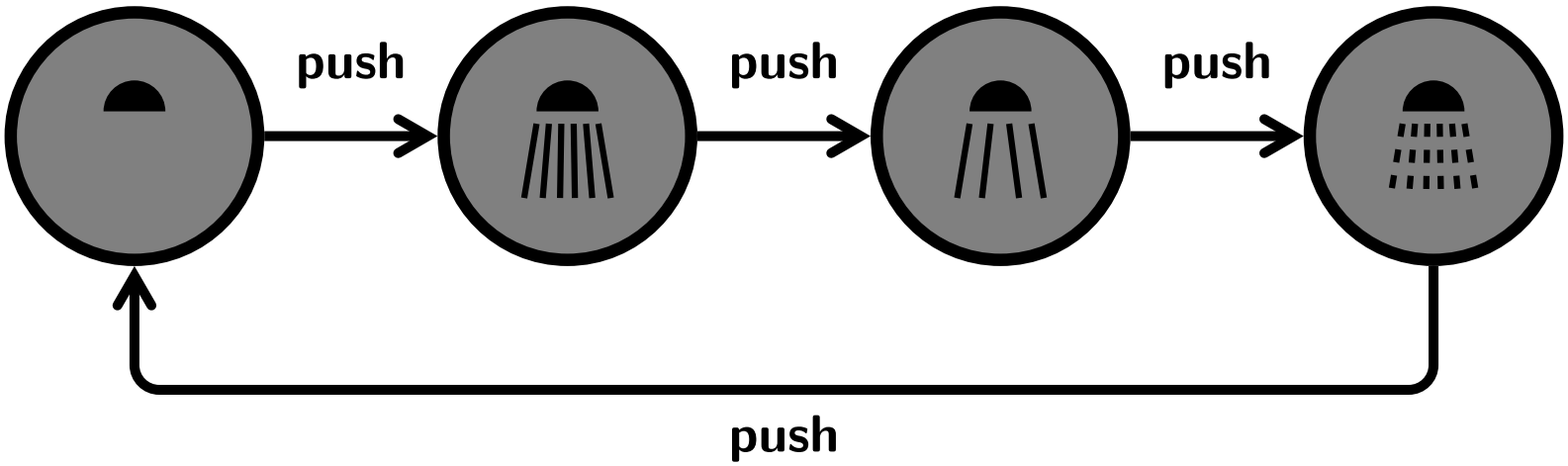


BeamLevel

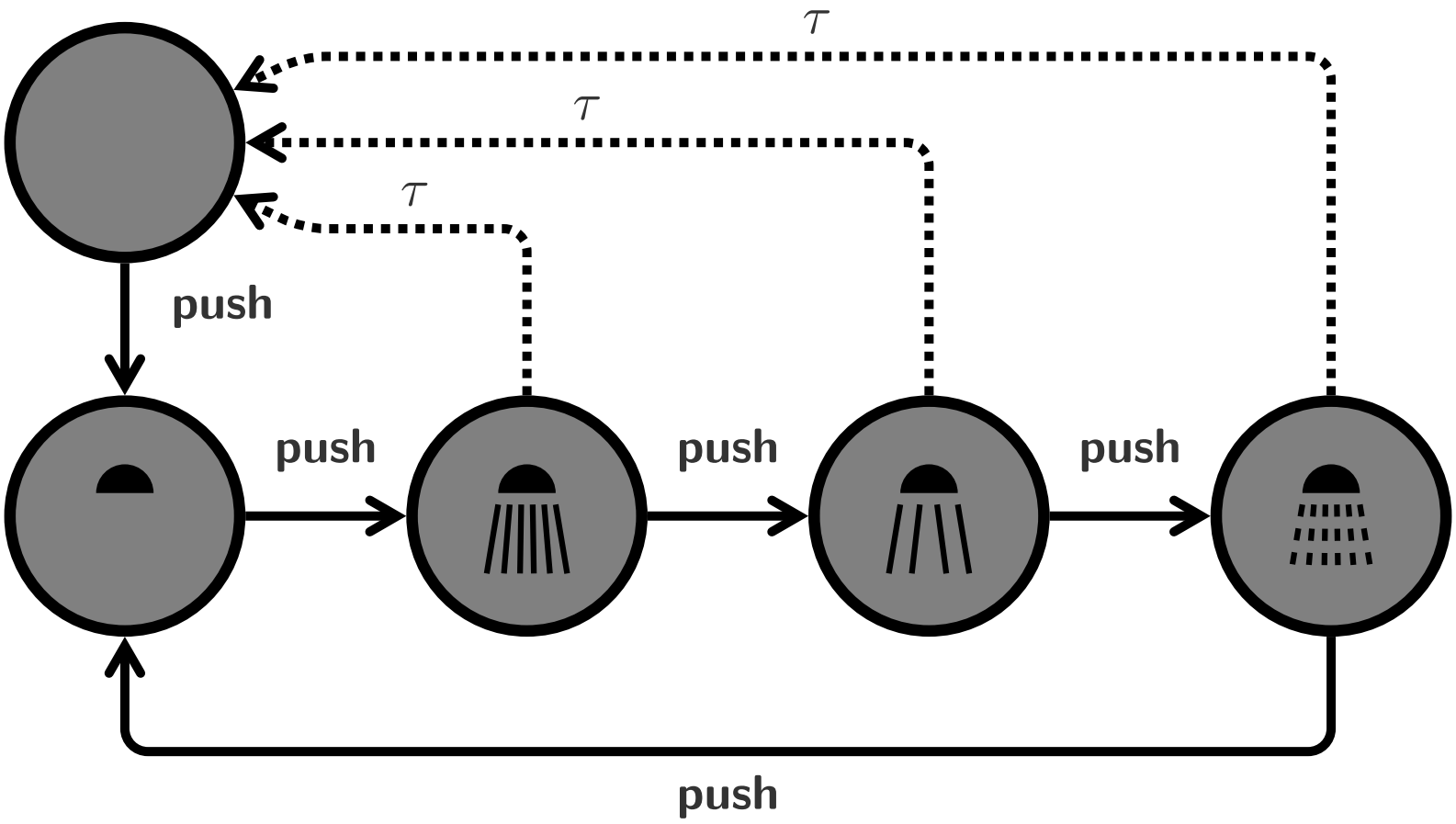


Model of the system

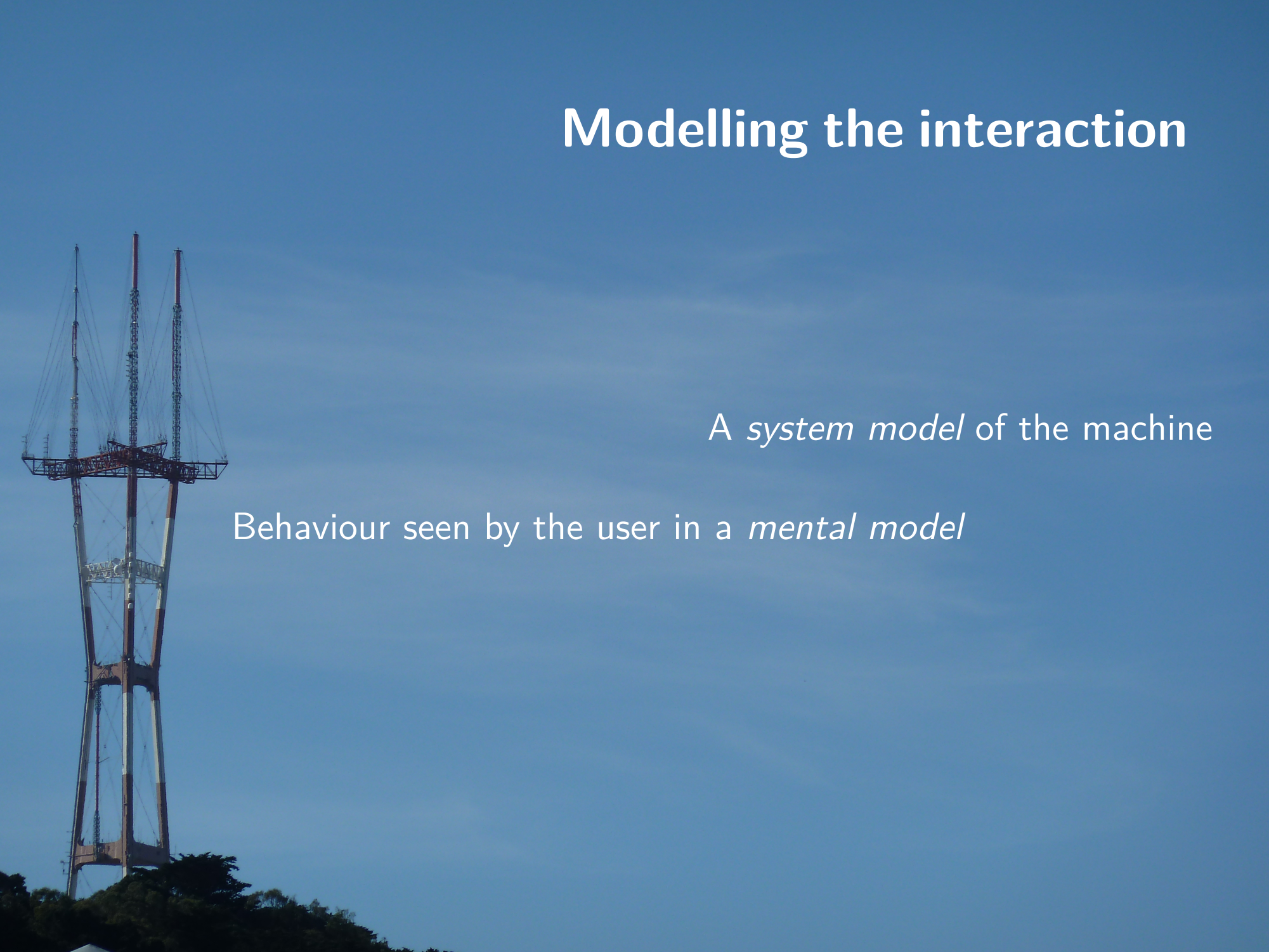


That model do NOT reflect the actual behaviour of the system!

Actual model of the system



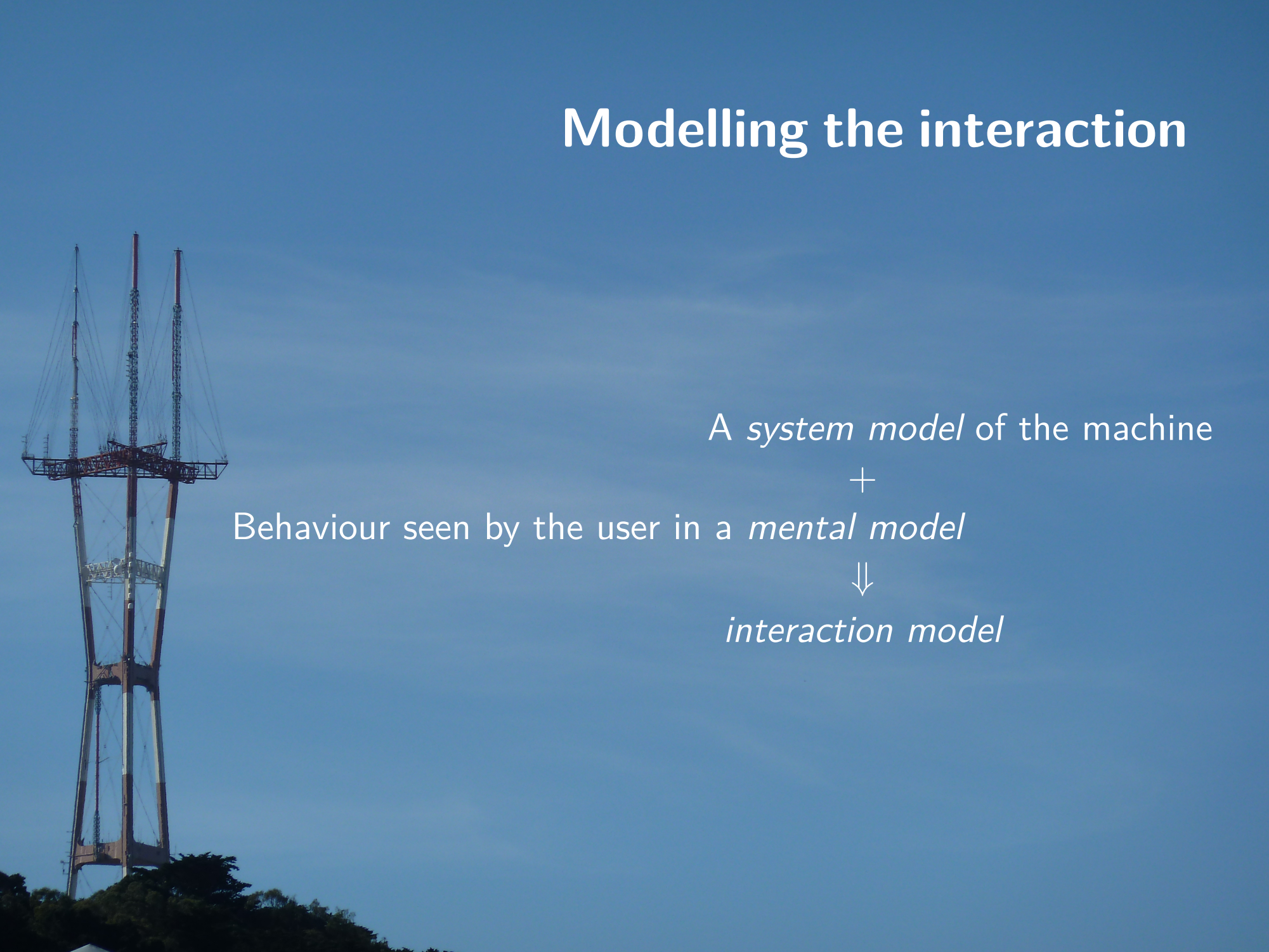
Internal changes are occurring autonomously in the system!



Modelling the interaction

A *system model* of the machine

Behaviour seen by the user in a *mental model*



Modelling the interaction

A *system model* of the machine

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Behaviour seen by the user in a *mental model*

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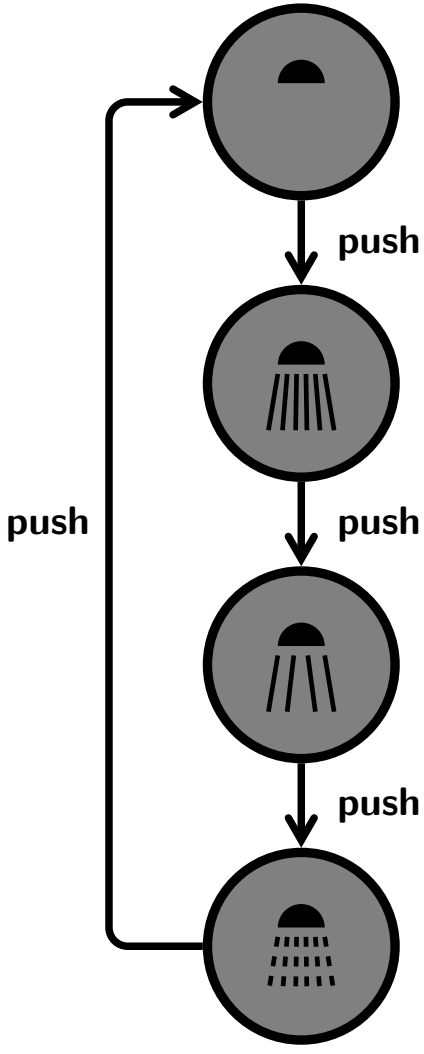
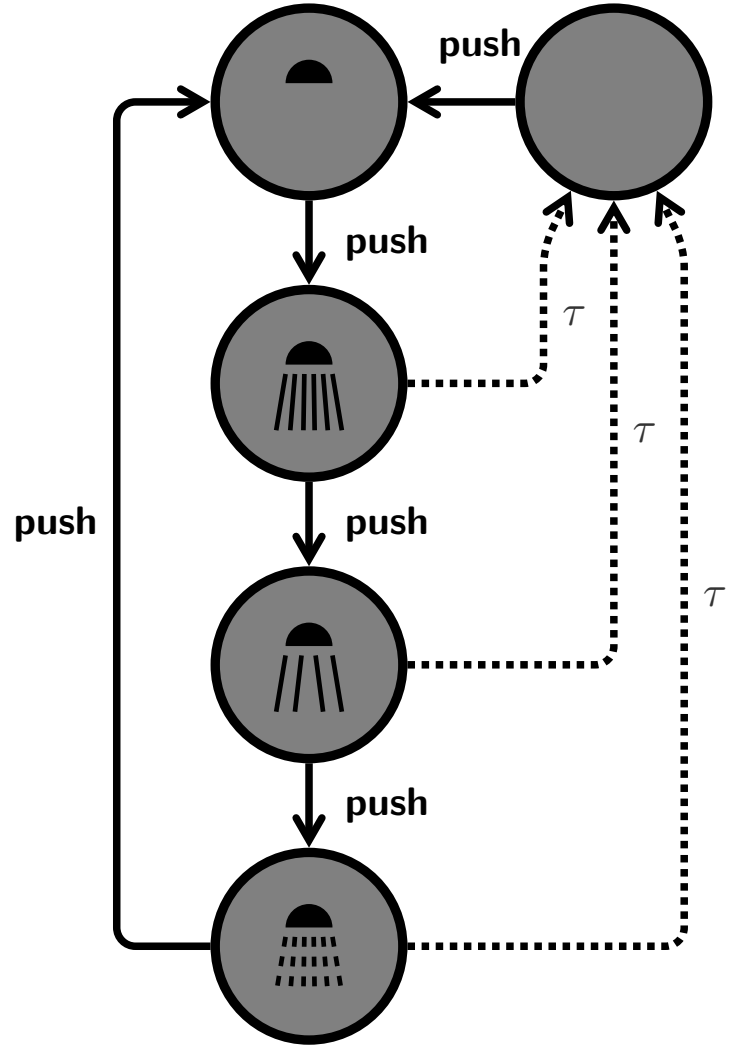
interaction model

Interaction model

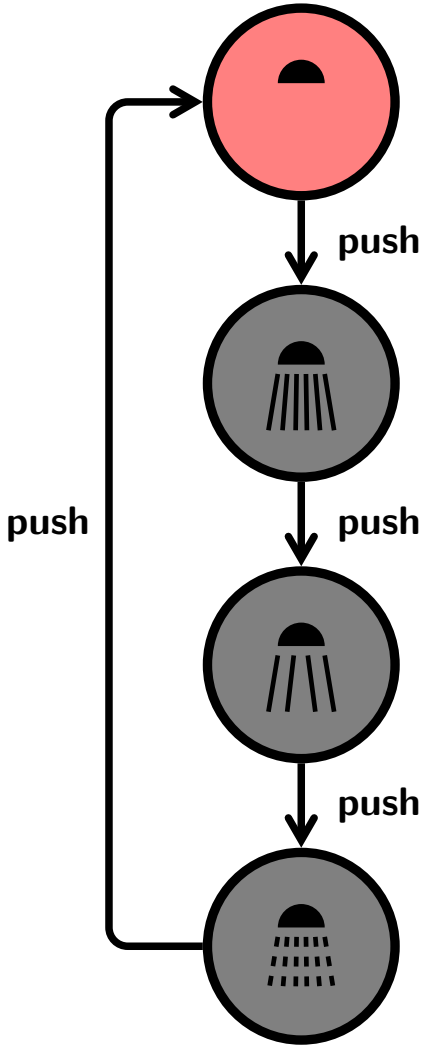


Mental model

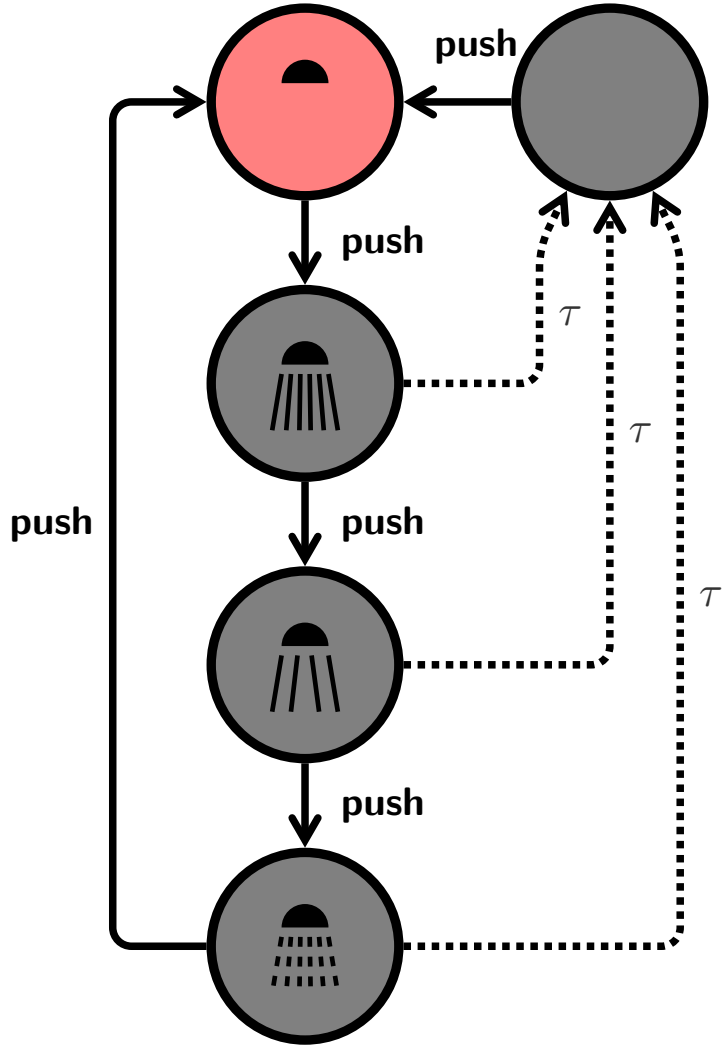


System model

Interaction model

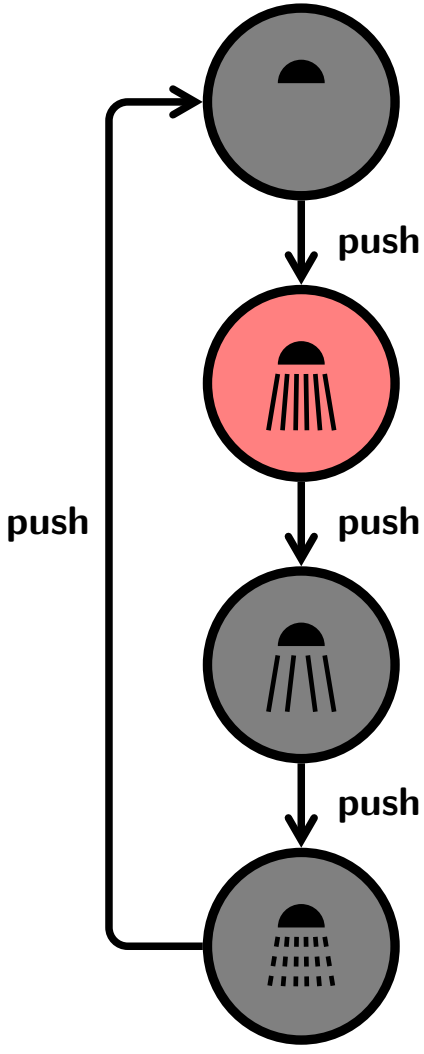


Mental model

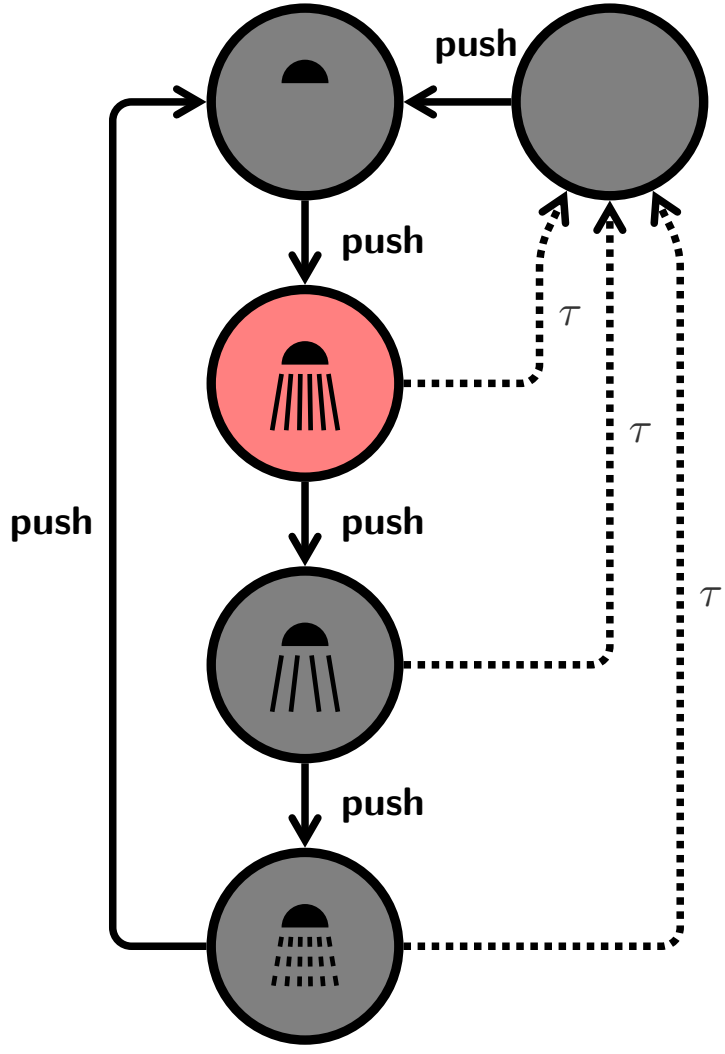


System model

Interaction model

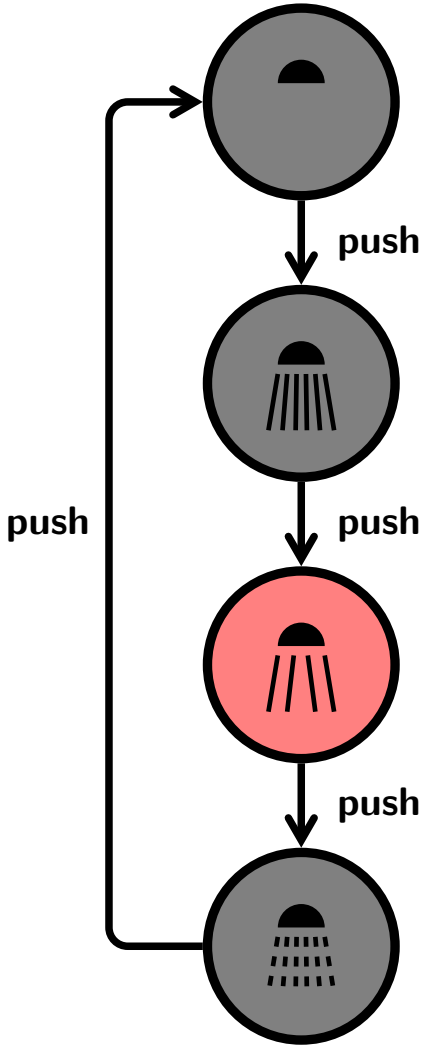


Mental model

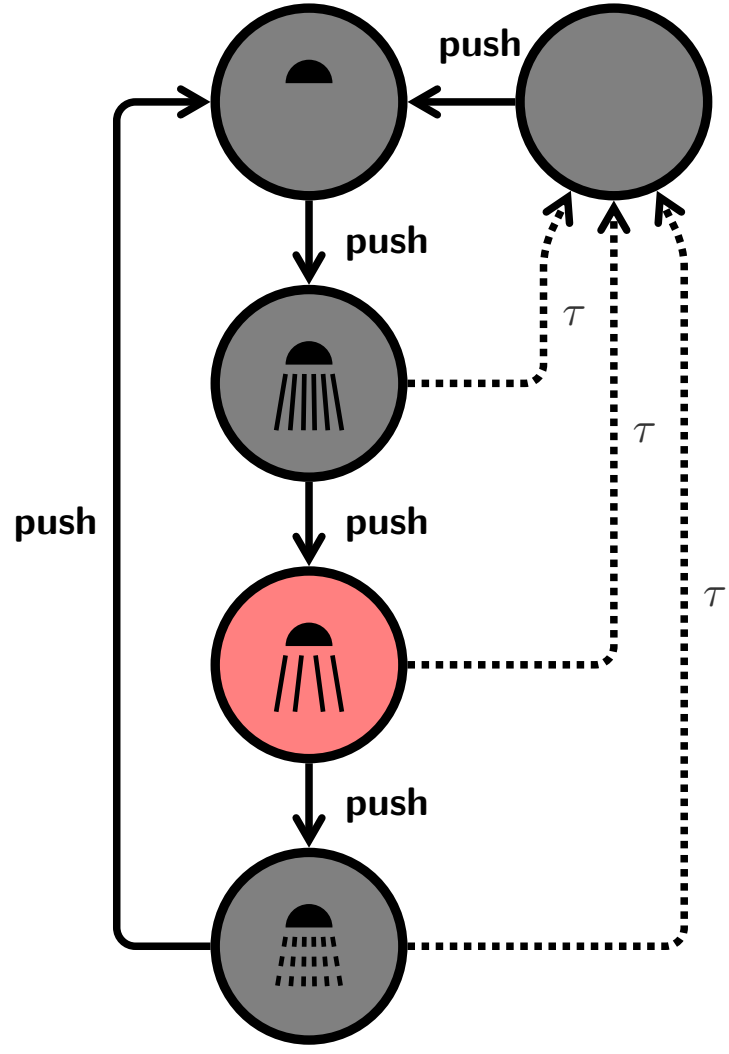


System model

Interaction model

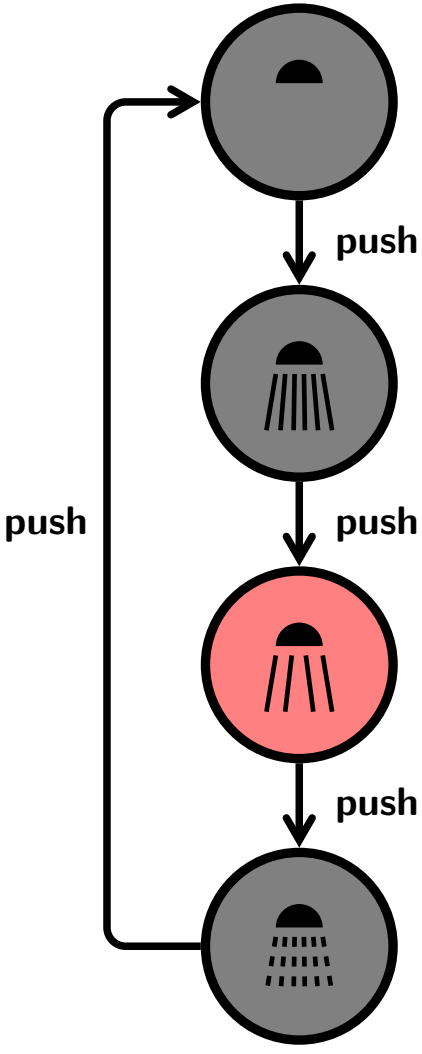


Mental model



System model

Interaction model



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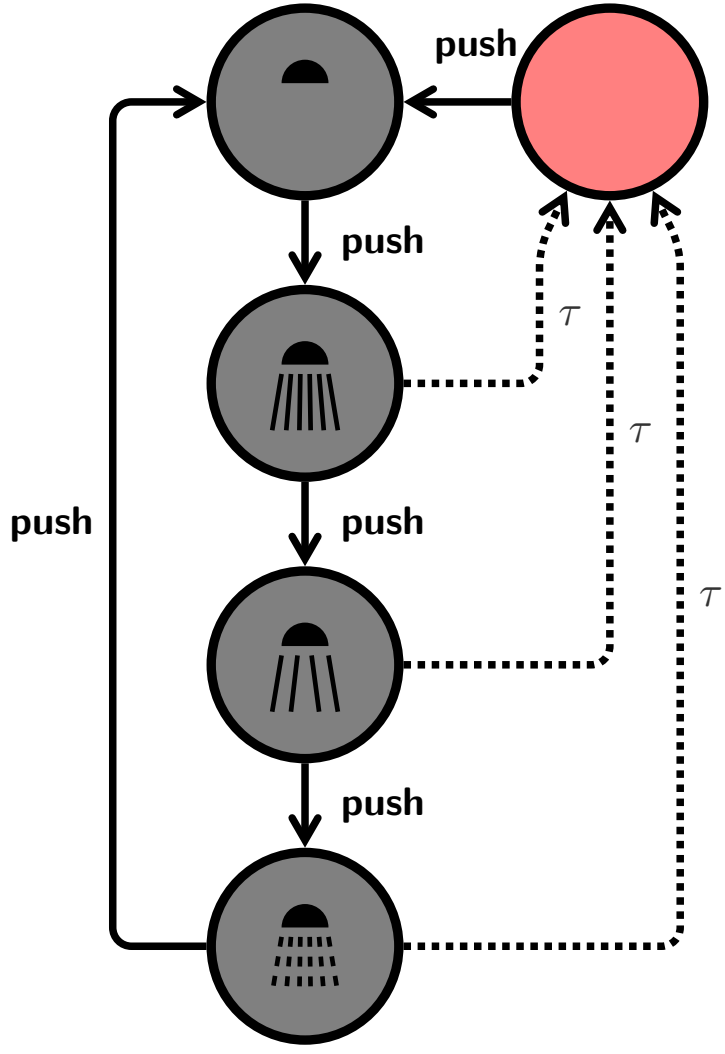
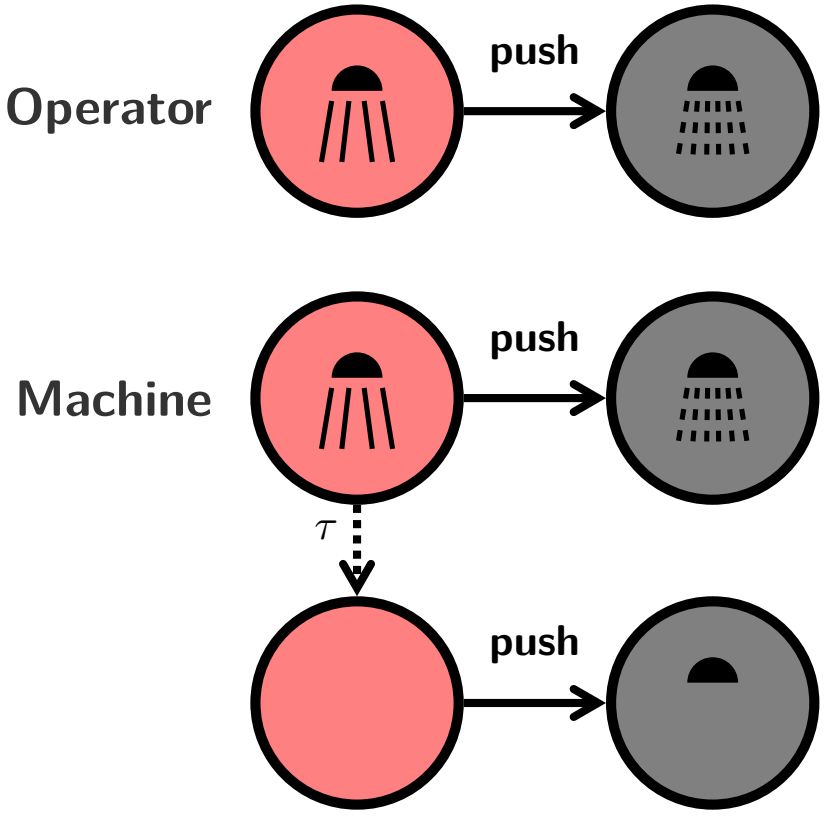
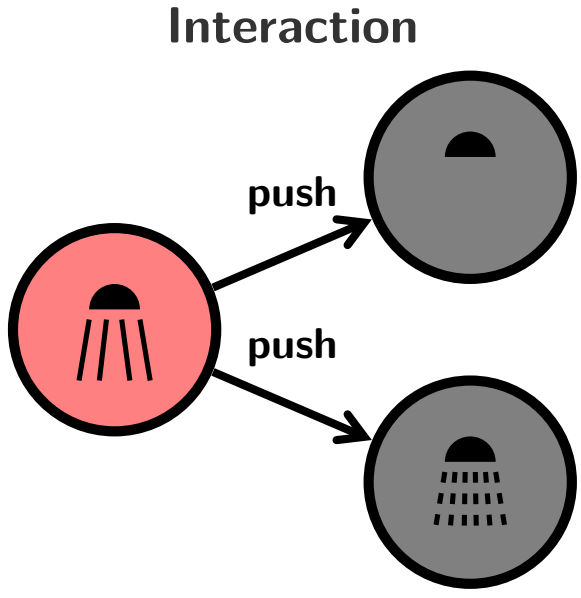


System model

Mode confusion



Mode confusion



The operator does NOT understand the machine anymore!

This thesis

Choosing models for systems and humans

Defining and characterising full-control

Implementing generation algorithms

Evaluating the approach on case studies