The Dynamic Turn in Strategy Logics

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Strategy Logics

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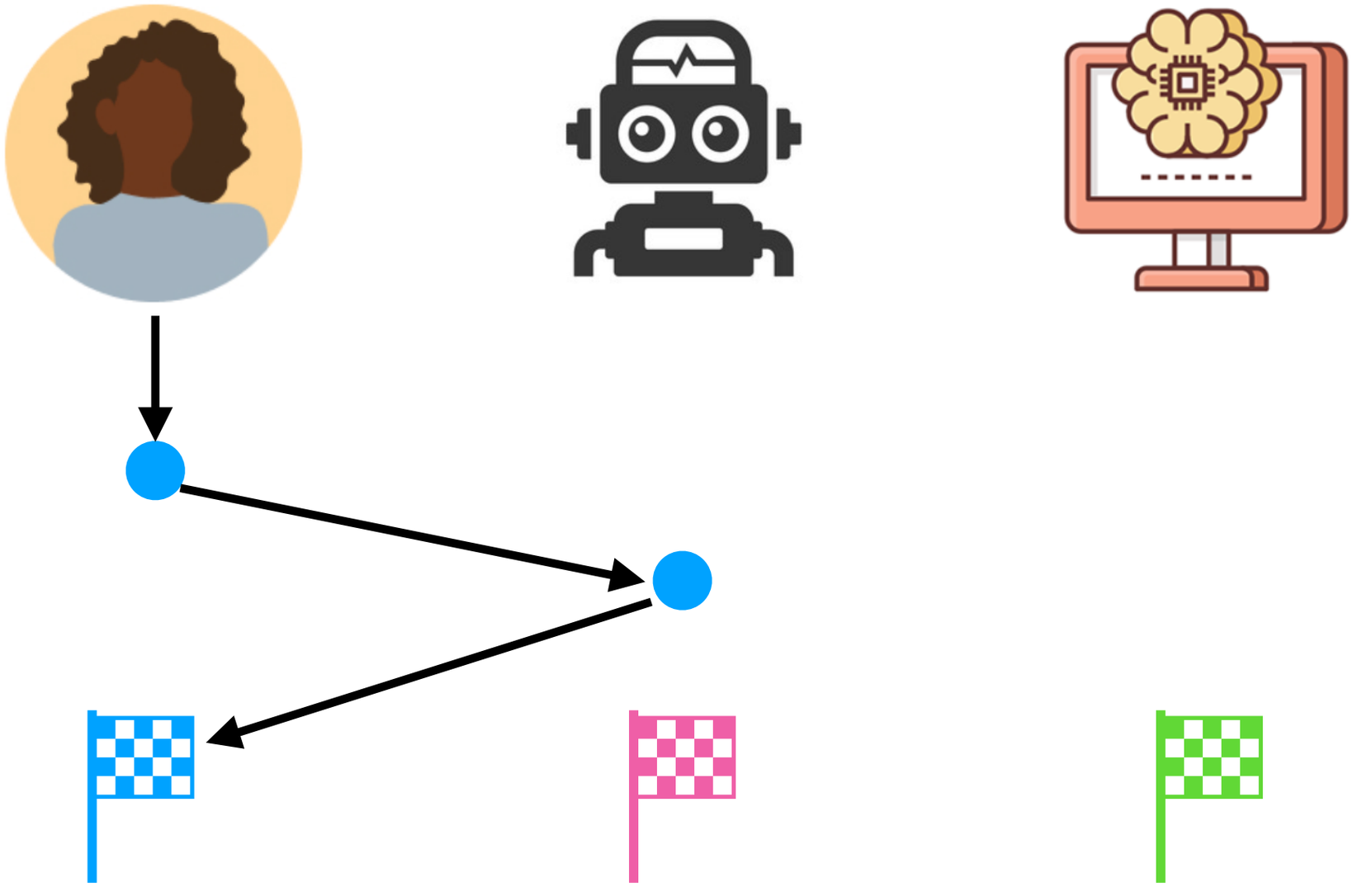
Strategy logics (SLs) is a family of formal frameworks devised for specification and verification of multi-agent systems



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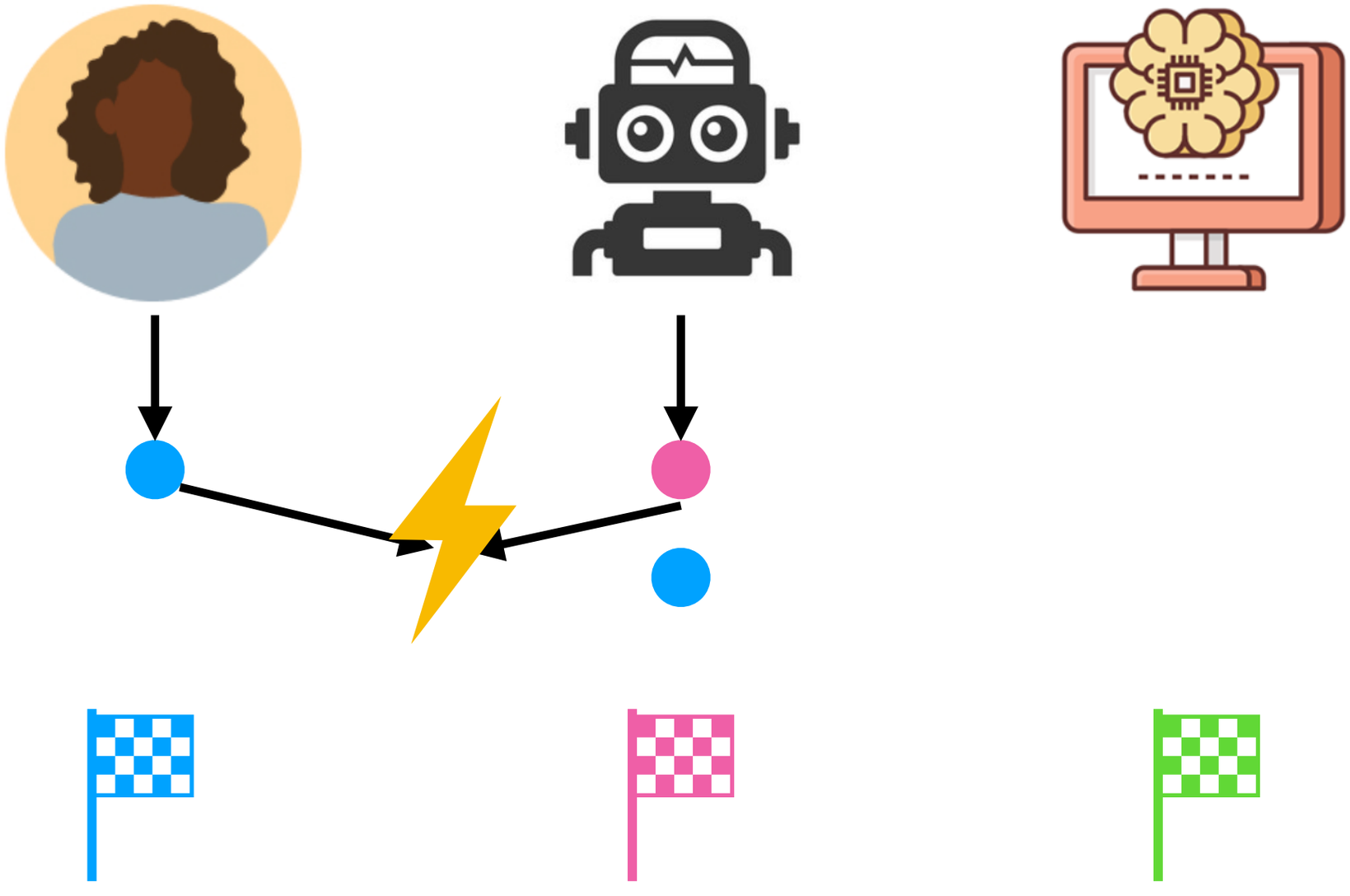

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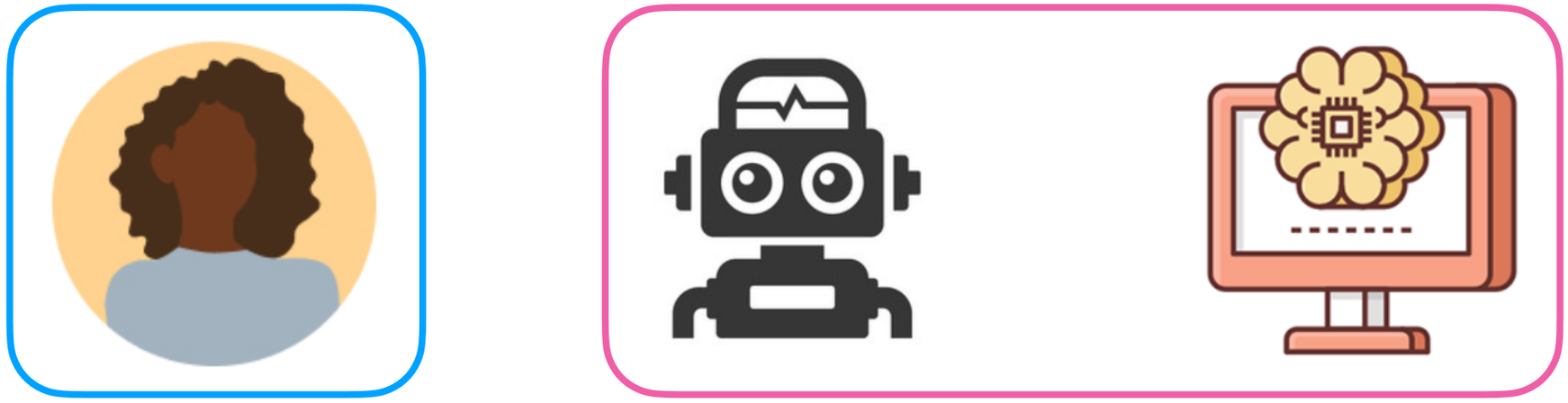
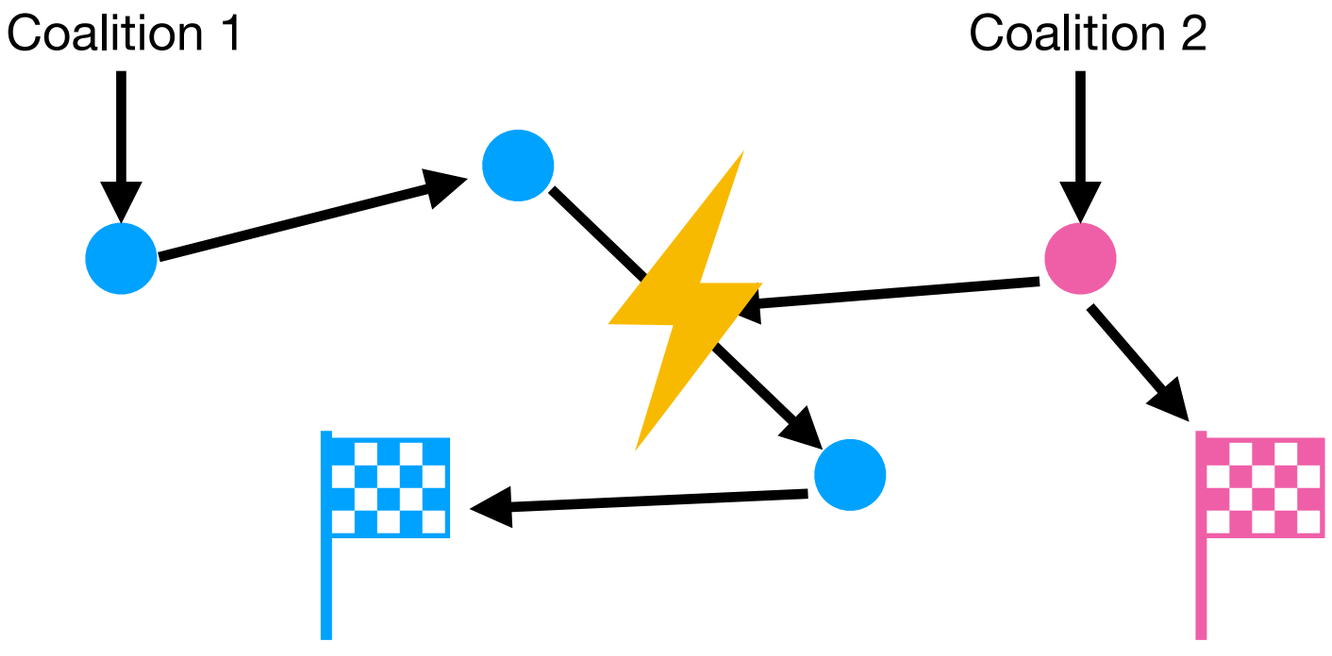
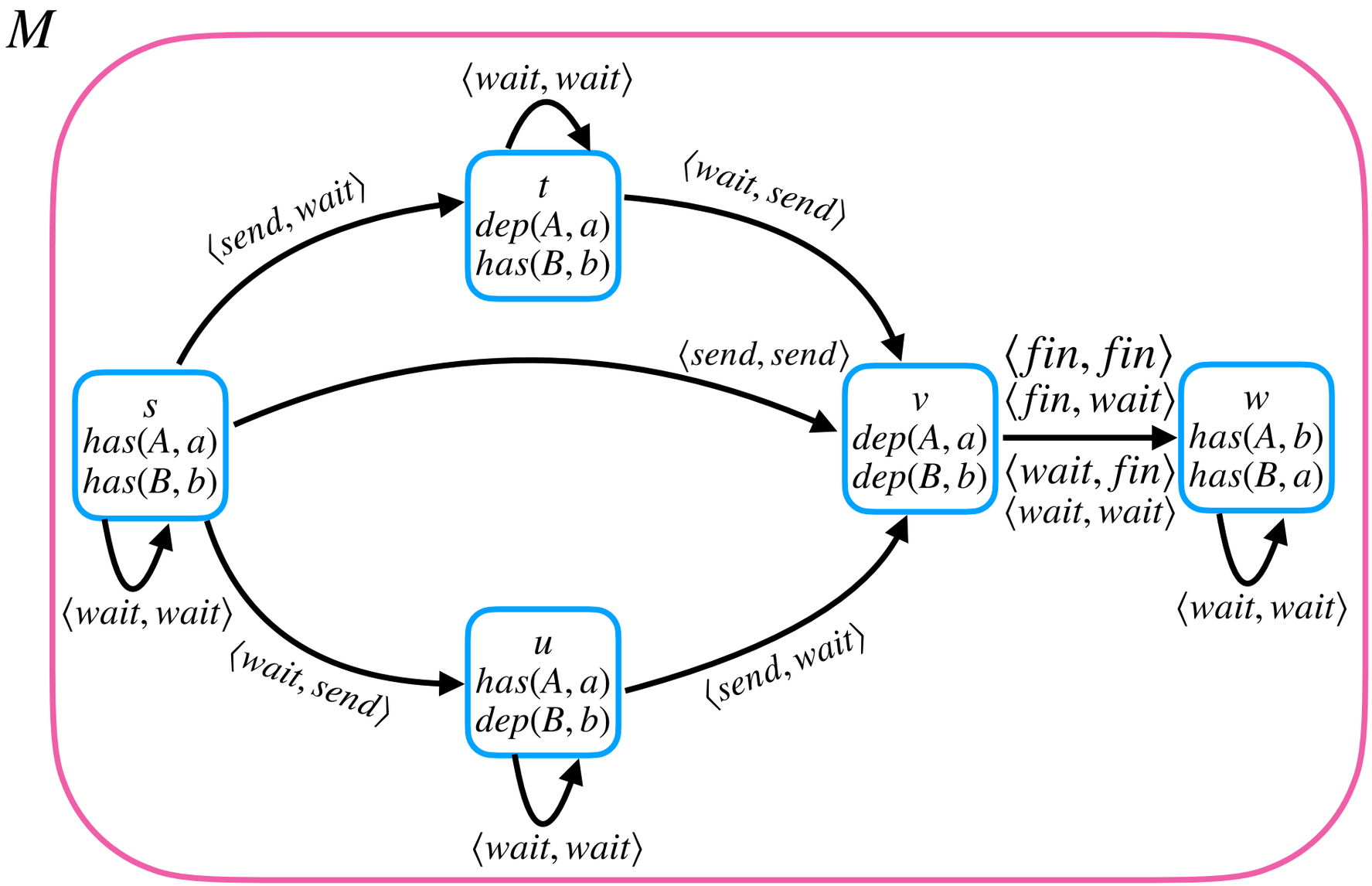




Strategy Logics

We focus on logics interpreted on Concurrent Game Models (CGMs) like Coalition Logic, ATL, etc



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$\langle\langle C \rangle\rangle \varphi$: coalition C **has** a strategy to ensure φ **no matter what** agents outside of the coalition do

$[\![C]\!] \varphi$: **whatever** coalition C does, agents outside of the coalition **have** a strategy to ensure φ

Functionality. Authorised or honest agents can achieve their goals

Security. Unauthorised or malicious agents can not achieve undesirable results

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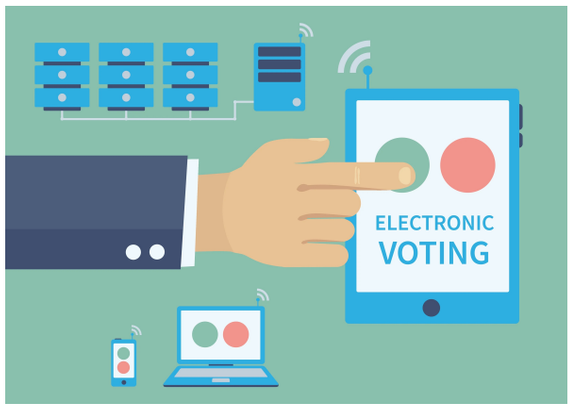
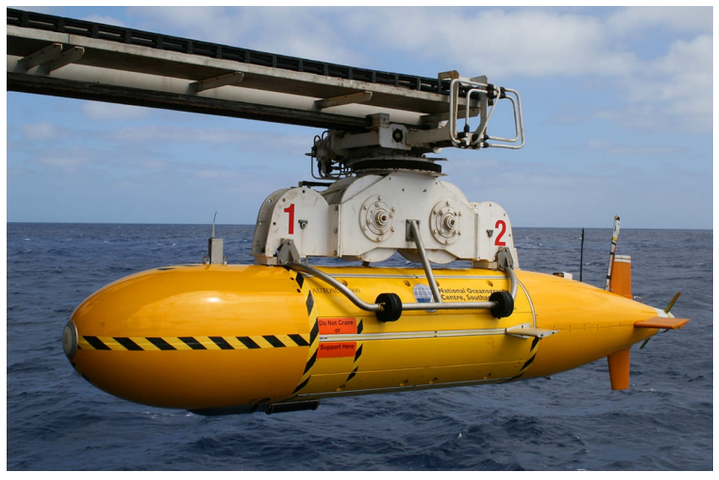


SELENE e-voting



National Oceanography Centre

Ezeikiel et al. *Verifying fault tolerance and self-diagnosability of an autonomous underwater vehicle*. 2011

Jamroga et al. *Model Checking the SELENE E-Voting Protocol in Multi-agent Logics*. 2018

The Dynamic Turn

(dynamics as in model transformations)

Dynamics in MAS

Normative reasoning: the set of actions is divided into desirable\undesirable

Obstruction logics: a special agent (Demon) can switch off some transitions to prevent an attacker reaching crucial points of a system

Our goal: unifying general approach to reasoning about dynamic phenomena in MAS

$$[U]\varphi$$

‘After implementing update\upgrade\change U, φ will hold in the resulting updated\upgraded\changed model’

Dynamics in MAS

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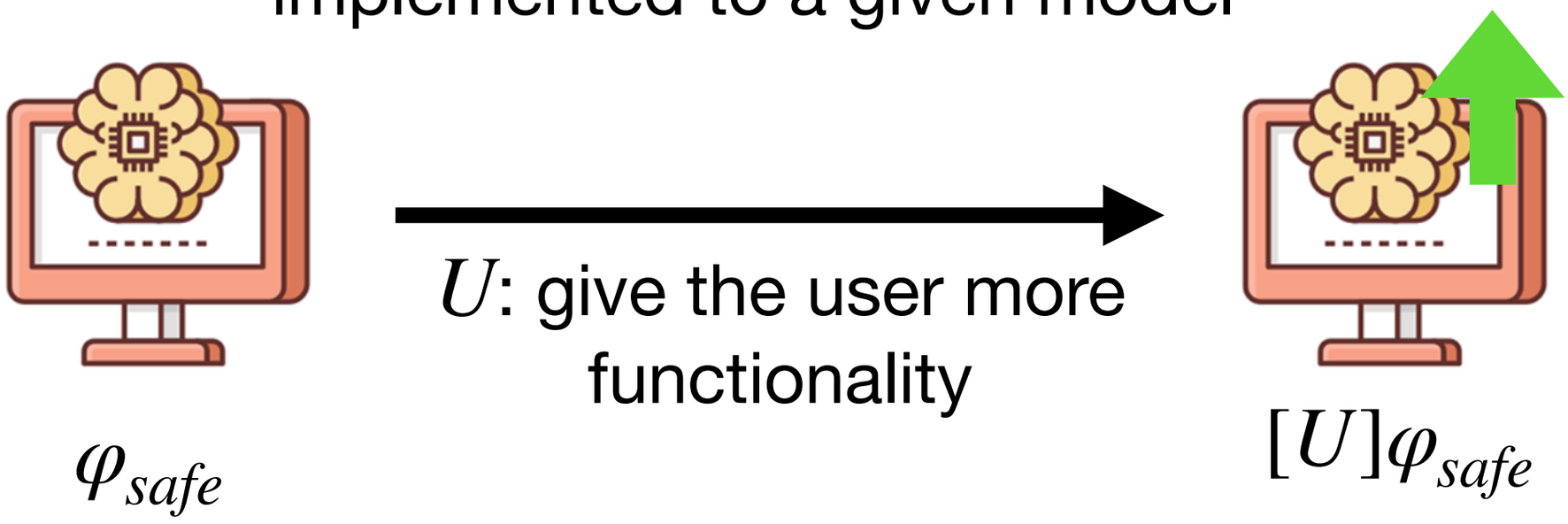
U is a part of a language, and encapsulates changes to be implemented to a given model



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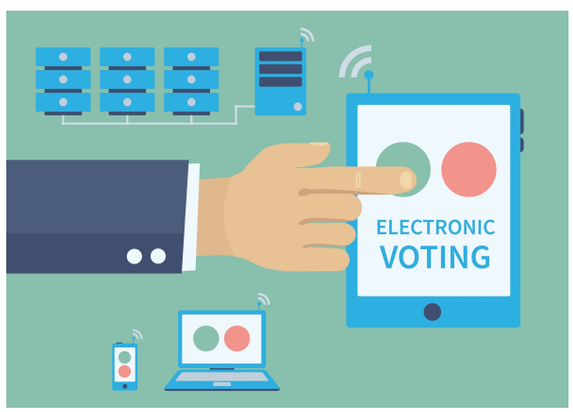
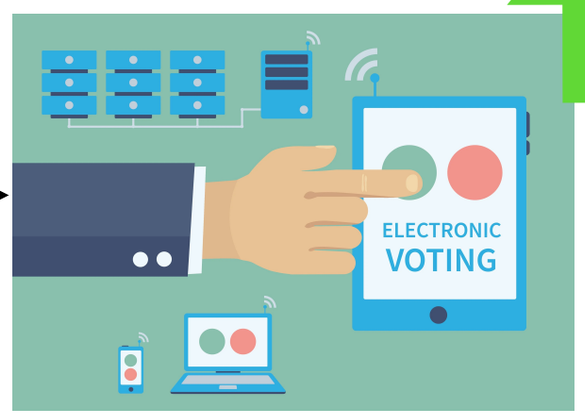


$\varphi_{no\_coercion}$

U: switch from single-winner to multiple-winner



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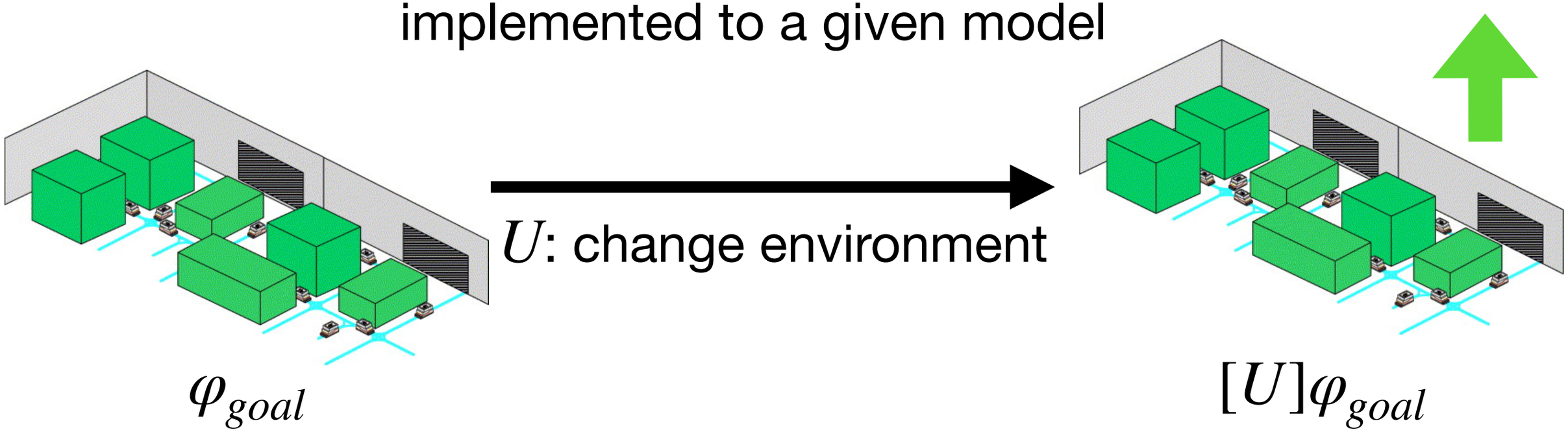

Why?

$$[U]\varphi$$

High-level description of changes: as updates U are part of a language, they represent a succinct high-level representation of an update, as opposed to a low-level description of particular changes in a model

Universality: updates, as logical formulas, are model agnostic (for the same class of models)

Automated checking: checking whether φ holds after U can be done automatically on a computer, instead of implementing all changes in a model by hand

Challenges

Reasoning about the dynamics of ability: propose meaningful and succinct ways of updating models (changing strategies, environment, abilities, etc); study expressivity and computational properties of new formalisms; add quantification over updates

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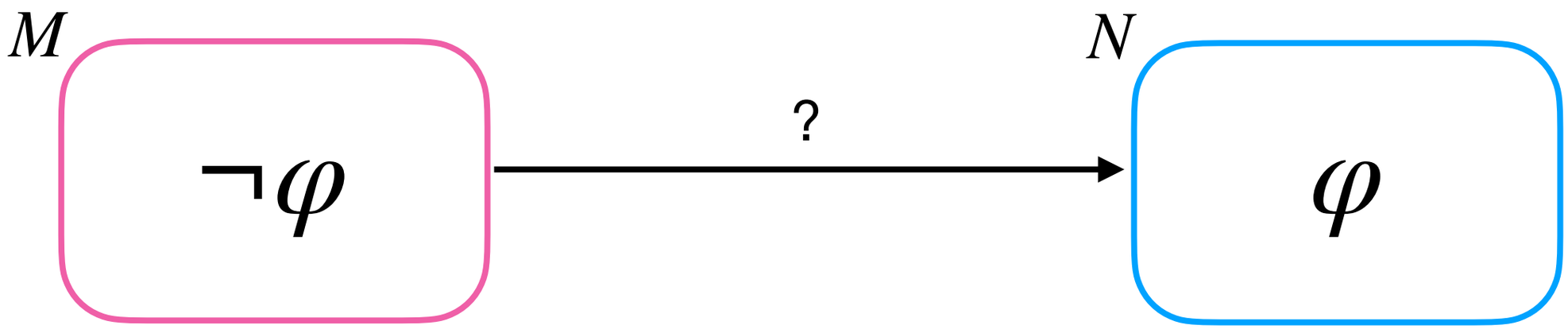
Automated synthesis\Model repair: given a starting model and a target property φ, construct an update that transforms the model so that the target formula is satisfied; provide minimal synthesis disrupting a model as little as possible



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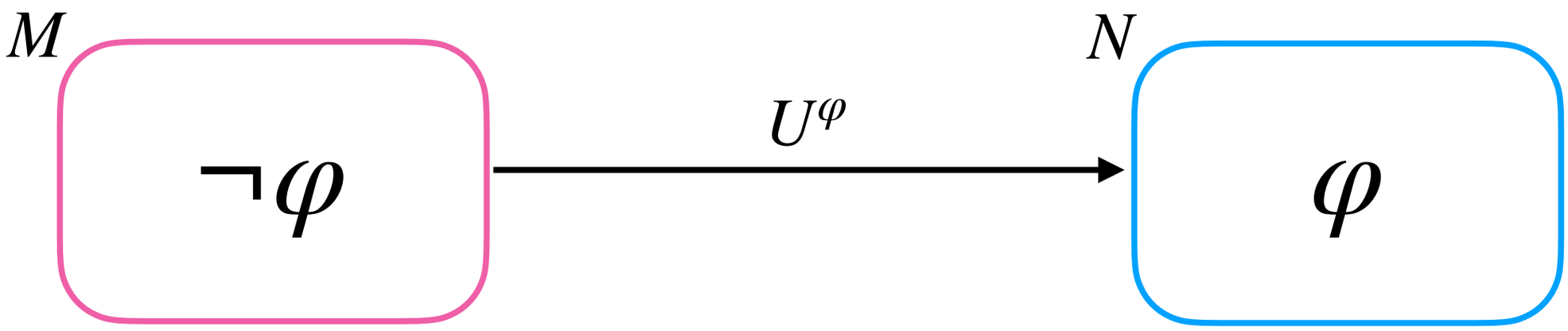

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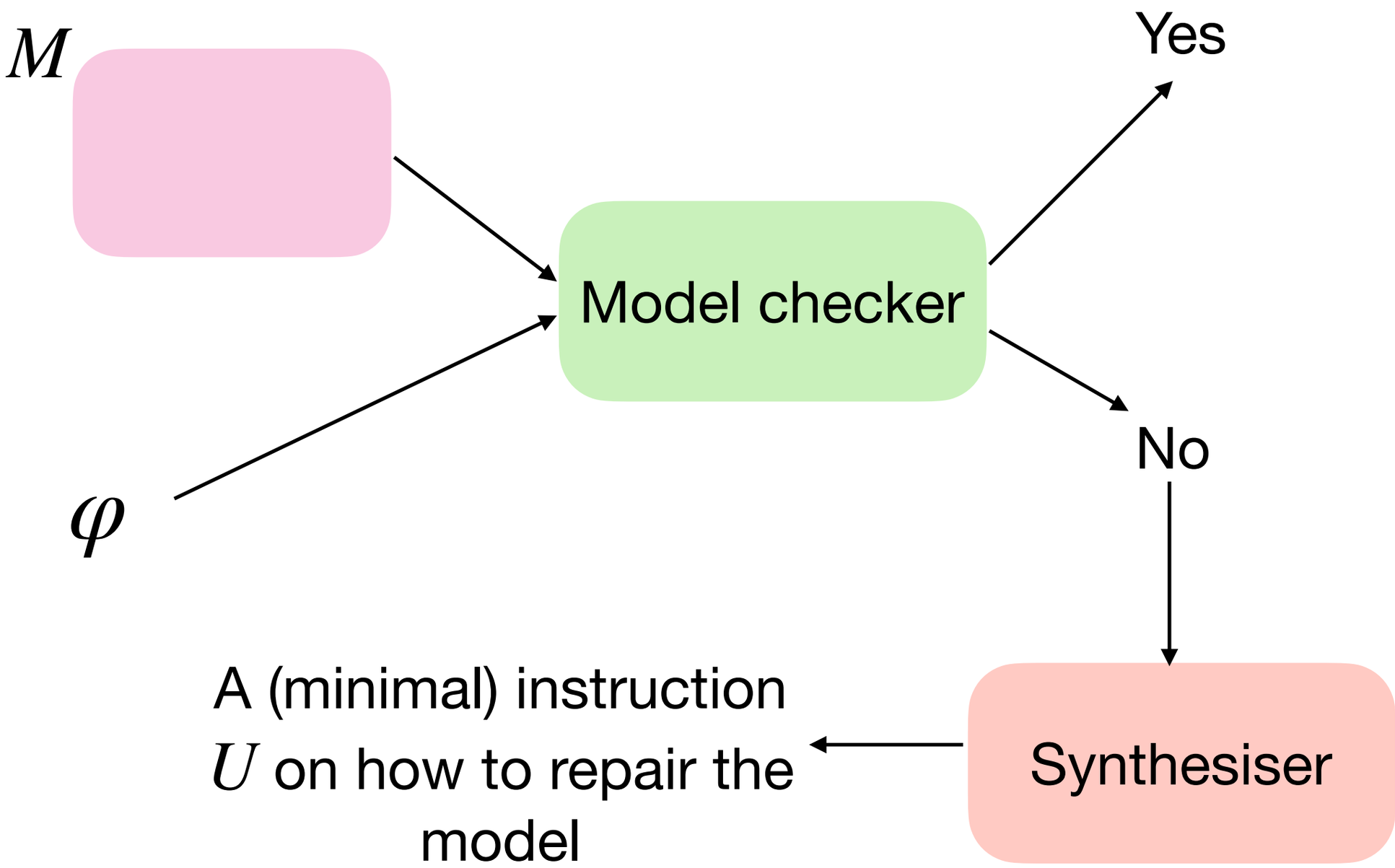
Tools for Verification and Synthesis: create extensions of established model checkers (MCMAS, STV, VITAMIN) for new logics; incorporate automated synthesis



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