Model-Based Self-Adaptation from Requirements to Architectures: A Decision-Making Process

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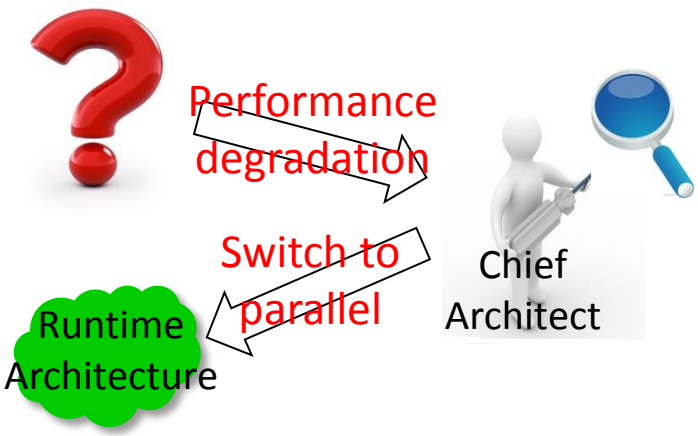
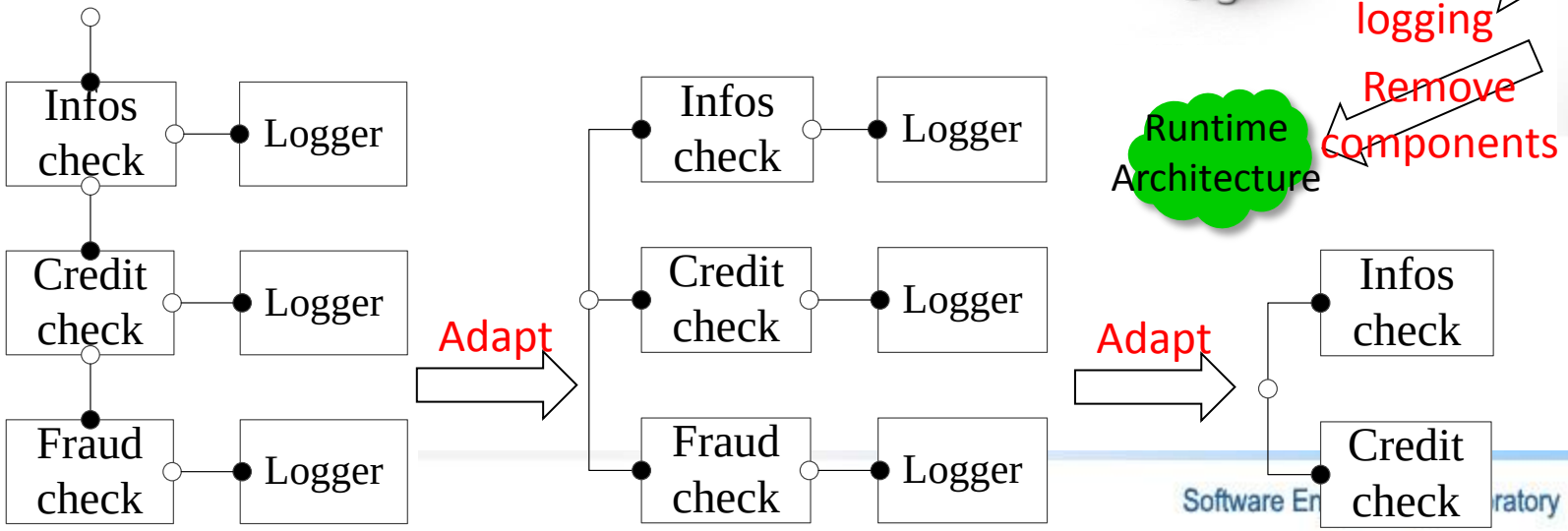
Real-Life Adaptation Scenarios

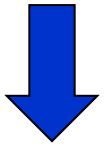
An online shopping company launches a sales promotion





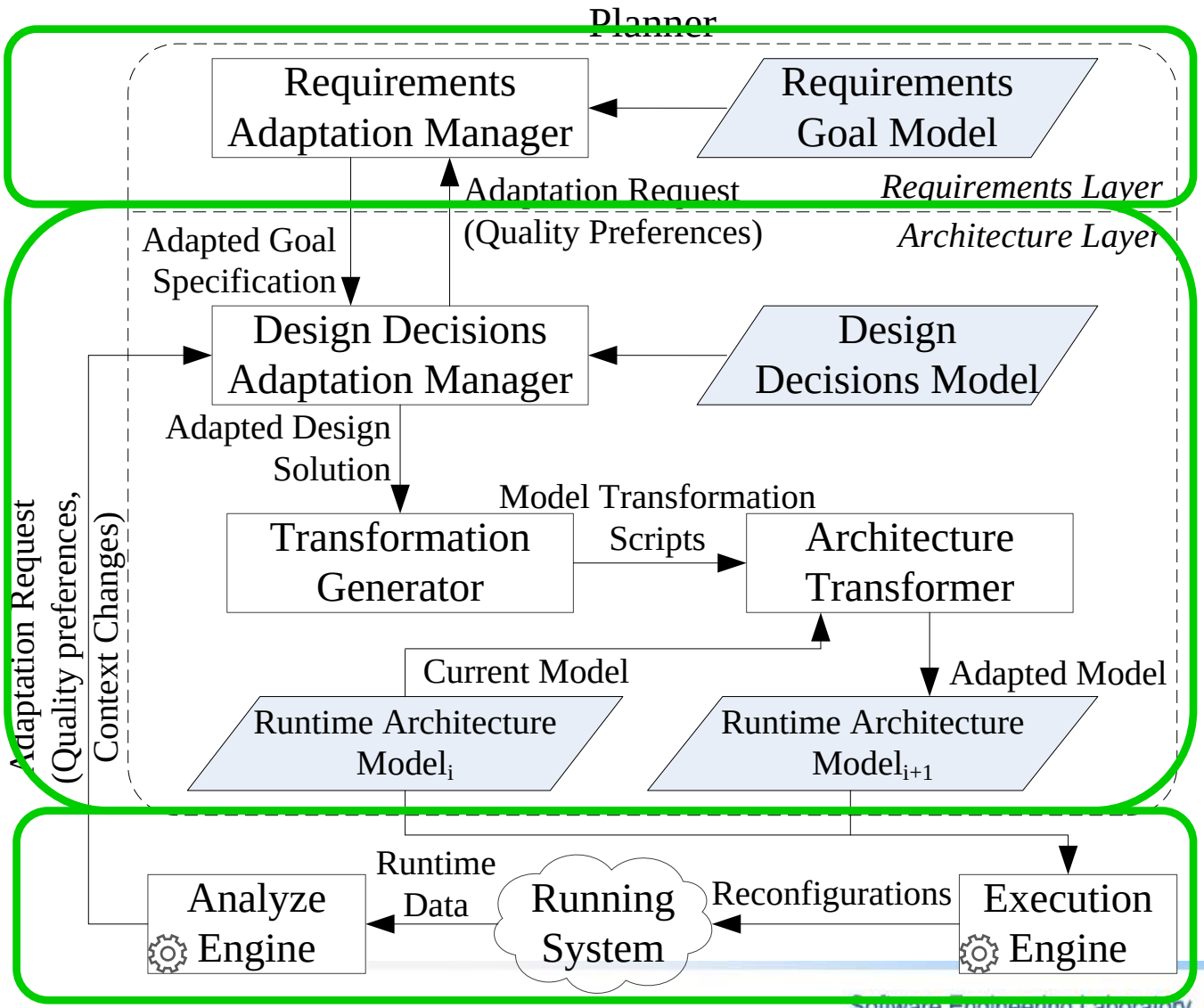
Observations

- Adaptations often involve both requirements and architectural decisions, focusing on different concerns and requiring different knowledge
- Mappings from requirements to architectural elements often involve complex traceability and the knowledge about design decisions



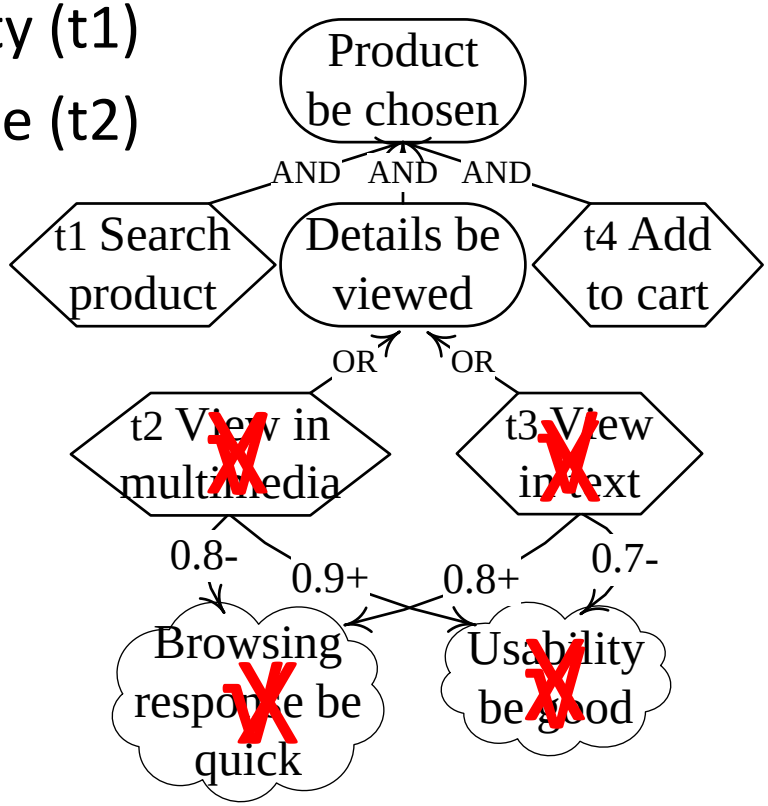
Model-based self-adaptation can be regarded as an automation of these adaptation processes at runtime

A Framework of Self-Adaptation



Requirements Layer Adaptations

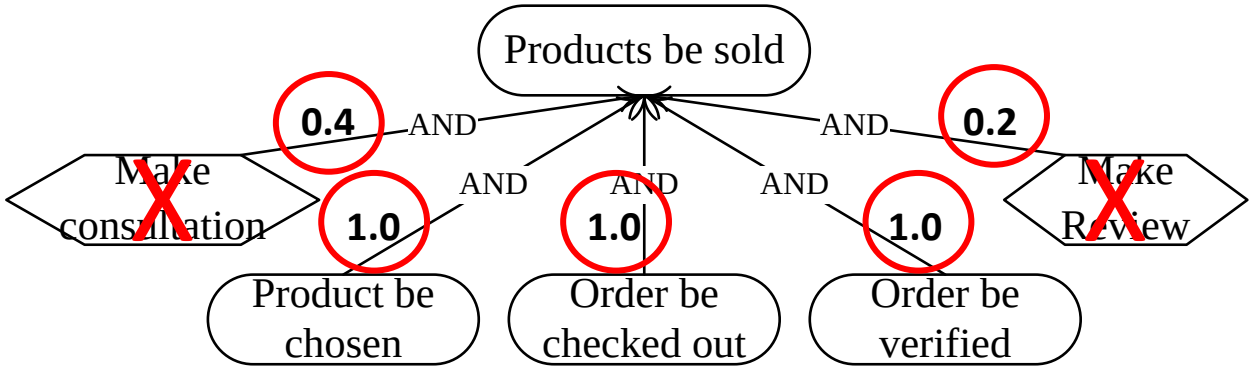
- Quality requirements tradeoffs
  - Browsing response (t1) > Usability (t1)
  - Usability (t2) > Browsing response (t2)
- Solution
  - Tune the preferences of quality requirements using a feedback controller
  - Switch among alternative goal specifications



X. Peng, B. Chen, Y. Yu, and W. Zhao, "Self-tuning of software systems through dynamic quality tradeoff and value-based feedback control loop," JSS, 2012.

Requirements Layer Adaptations

- Functional requirements tradeoffs
  - Browsing (t) > Consultation (t)

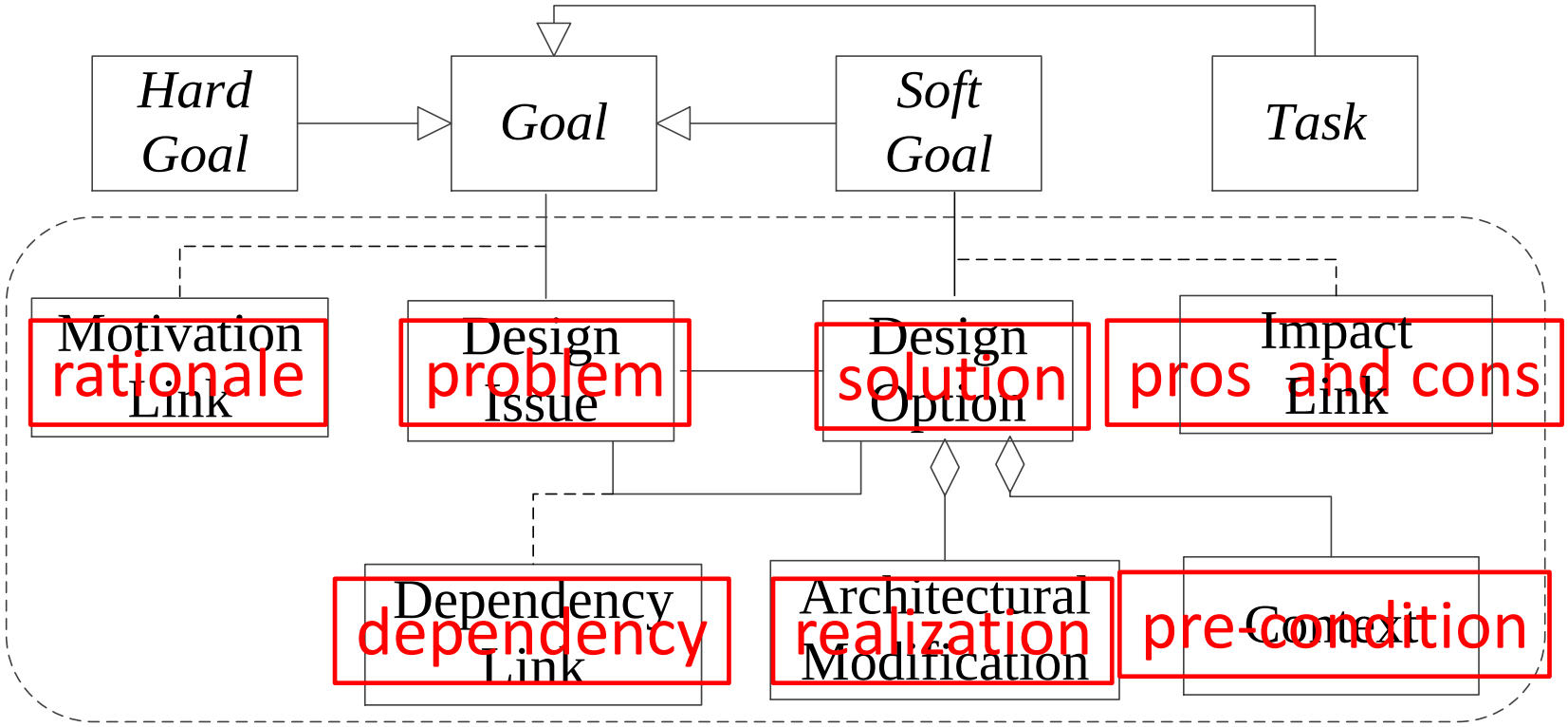


- Solution
  - Annotate a value between 0 and 1
  - Distinguish between critical goals and desired goals
  - Bind/unbind desired goals

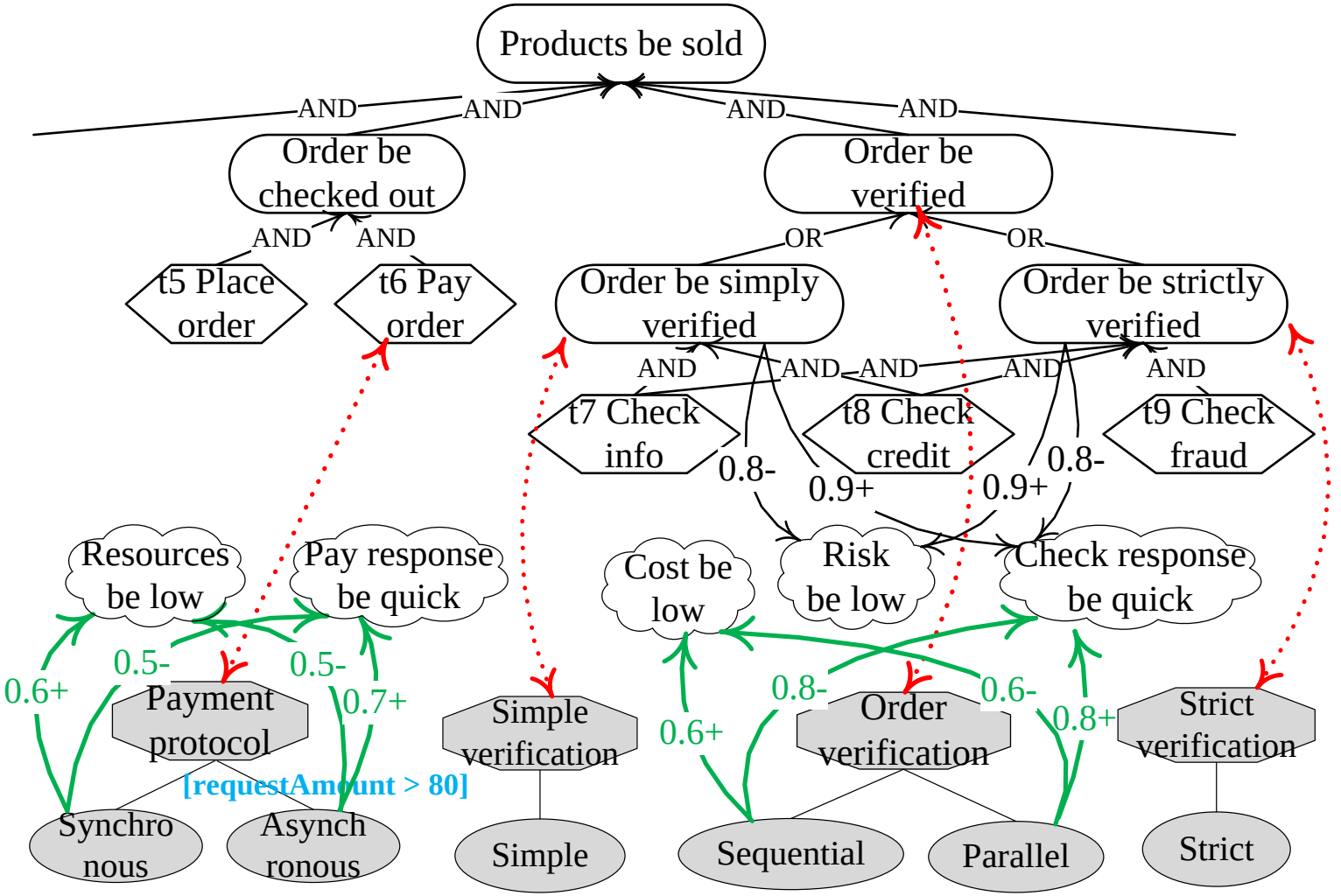
B. Chen, X. Peng, Y. Yu, and W. Zhao, "Are your sites down? Requirements-driven self-tuning for the survivability of web systems," RE, 2011.

Architecture Layer Adaptations

- Architecture: functionalities + design decisions



Architecture Layer Adaptations



Architecture Layer Adaptations

- Simple architectural adaptations
  - Adding, removing, replacing architectural elements
- Complex architectural adaptations
  - Crosscutting and restructuring architectural elements

- Achieve the model adaptations by incremental and generative model transformations
  - Architecture model $_{i}$ -> Architecture model $_{i+1}$
  - Automatically generate scripts using template engine

Conclusions

- A model-based self-adaptation approach
  - Combine requirements and architectural adaptations
  - Consider structures and behaviors of architectures by design decision models
  - Support crosscutting and restructuring architectural adaptations using incremental and generative model transformations

Thanks for your attention!