Designing adaptive systems

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VIRTUS IMPAVIDA

Software Adaptation Frameworks

Requirements-based

- Morandini et al. (2008)
- Lapouchnian and Mylopoulos (2009)
- Dalpiaz et al. (2009)
- Ali et al. (2010)
- Qureshi et al. (2010)
- Bencomo et al. (2010)
- Baresi and Pasquale (2010)
- Souza et al. (2011)

Architecture-based

- Allen et al. (1998)
- Oreizy et al. (1998)
- Dowling and Cahill (2001)
- Garlan et al. (2004)
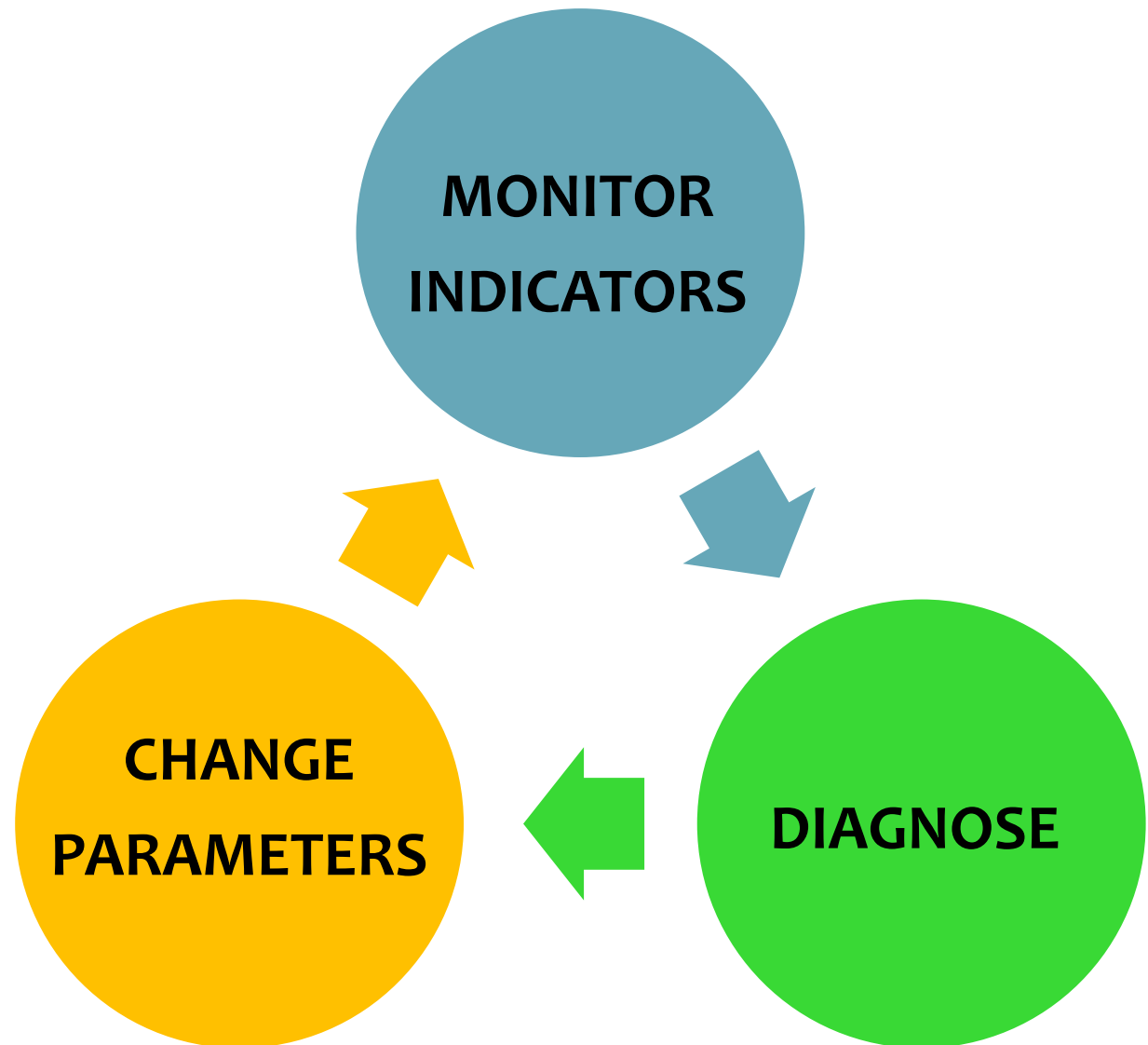- Asadollahi et al. (2009)
- Cetina et al. (2009)

Twin Peaks?

REQUIREMENTS   ARCHITECTURE
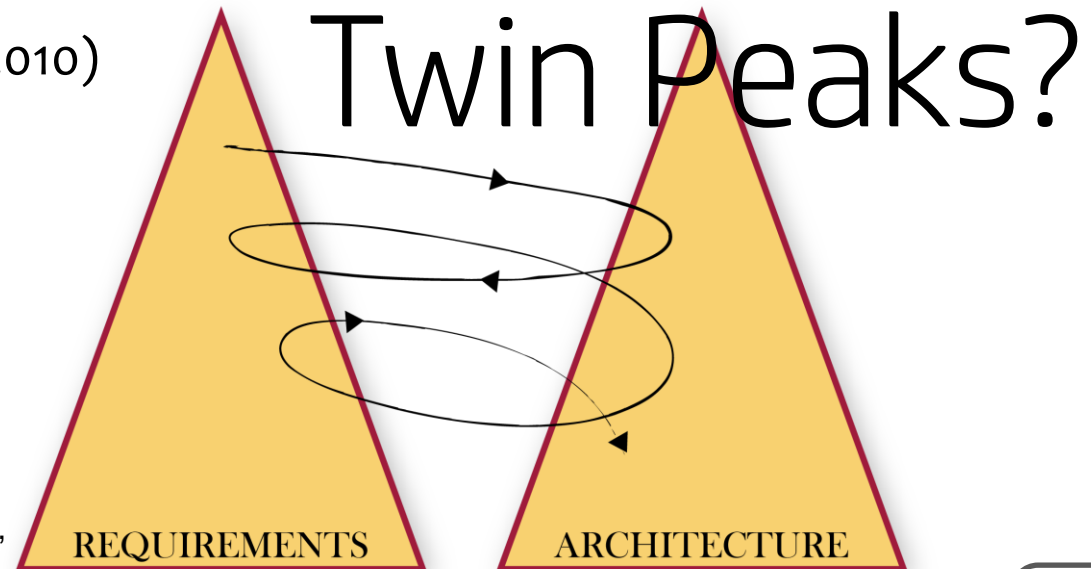
Source: Nuseibeh, B.: Weaving together requirements and architectures (Computer 34, 2001).
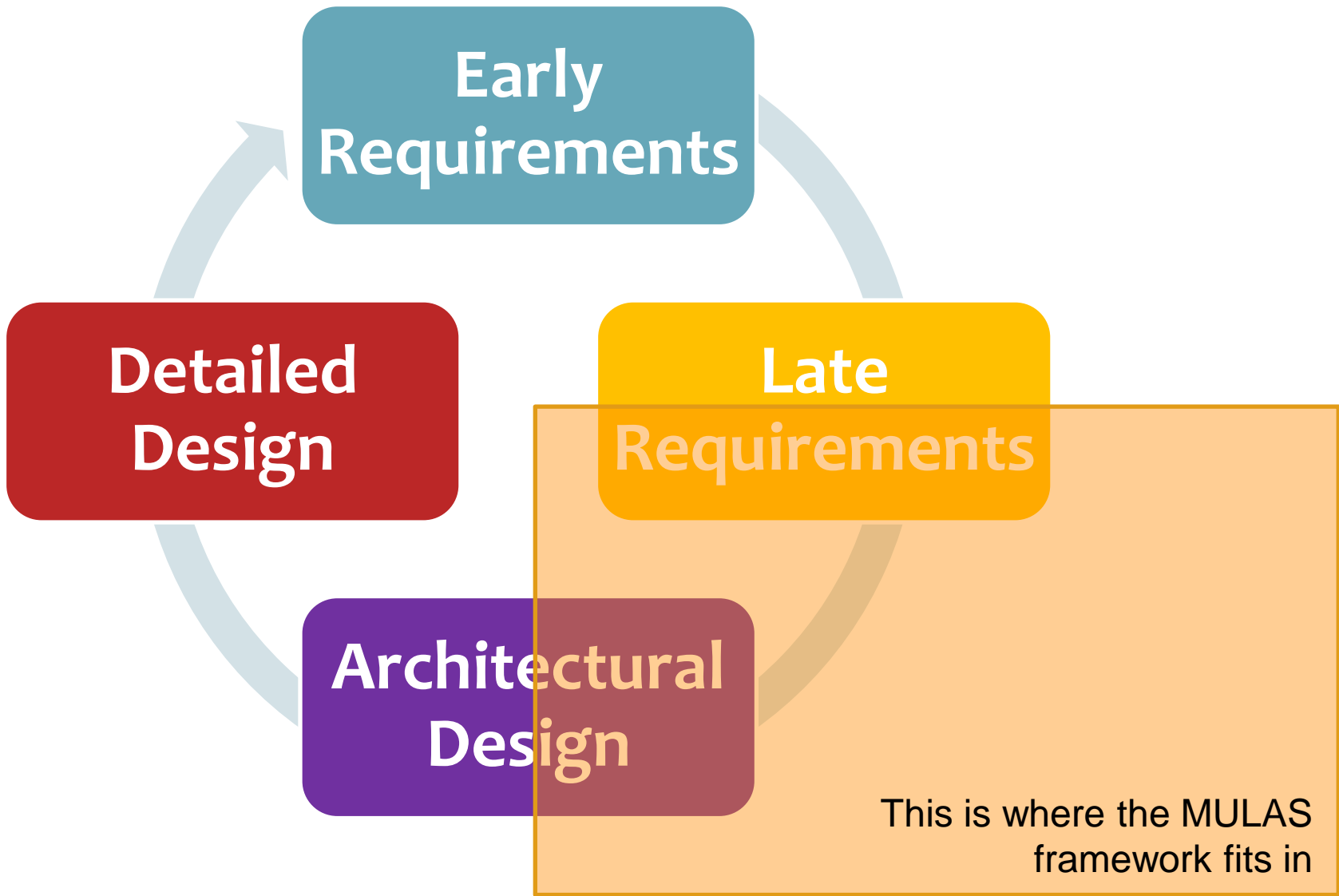
Problem statement

- Expressiveness
  - Both requirements and architectural concerns are relevant
- Only requirements: how to enact adaptation?
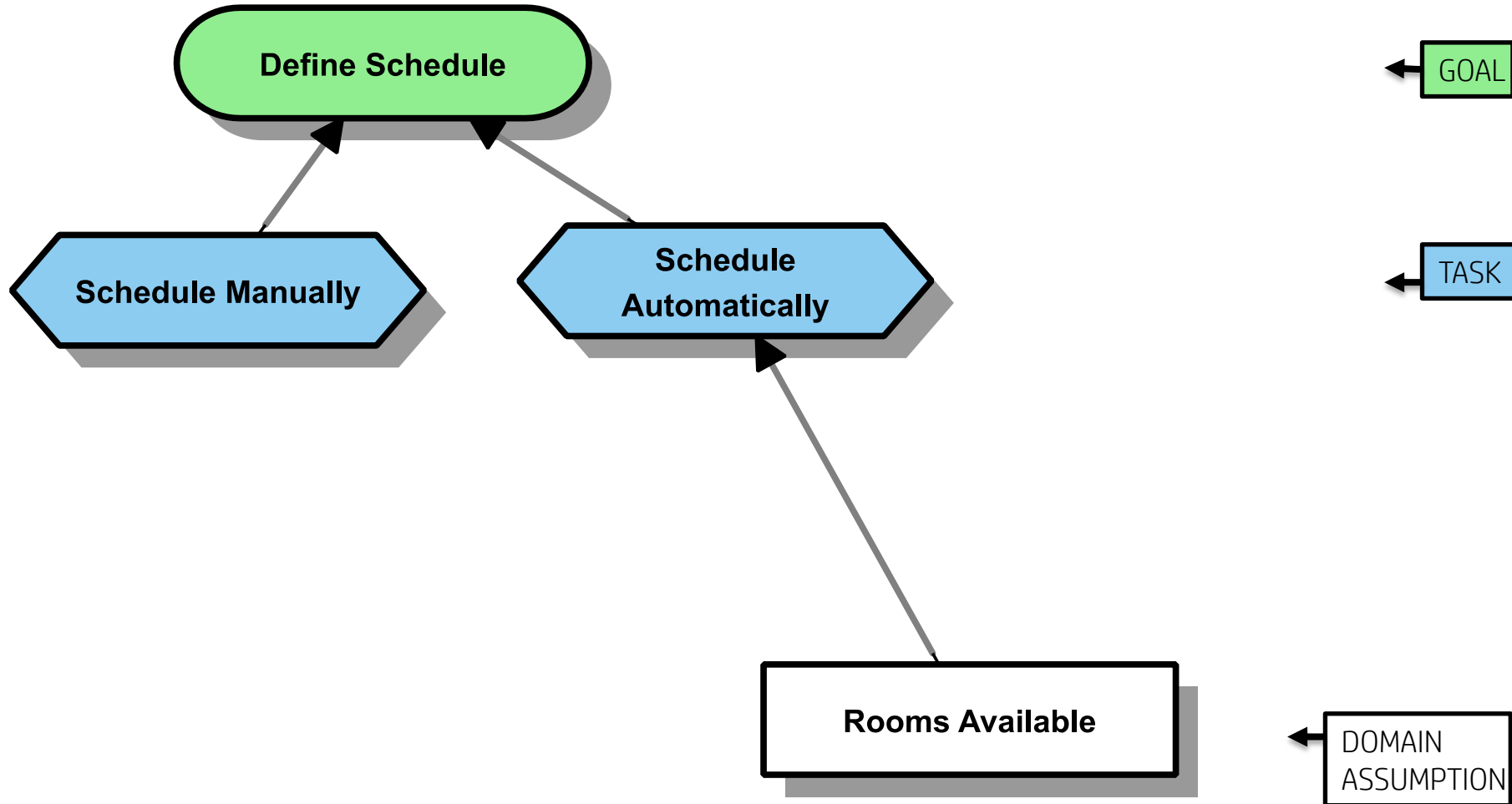- Only architecture: where does it come from?

MONITOR INDICATORS

DIAGNOSE

CHANGE PARAMETERS

feedback loop

Early Requirements

Detailed Design

Late Requirements

Architectural Design

This is where the MULAS framework fits in

Design Goal Model (DGM)

Define Schedule

Schedule Manually

Schedule Automatically

Rooms Available

GOAL

TASK

DOMAIN ASSUMPTION

Design Goal Model (DGM)
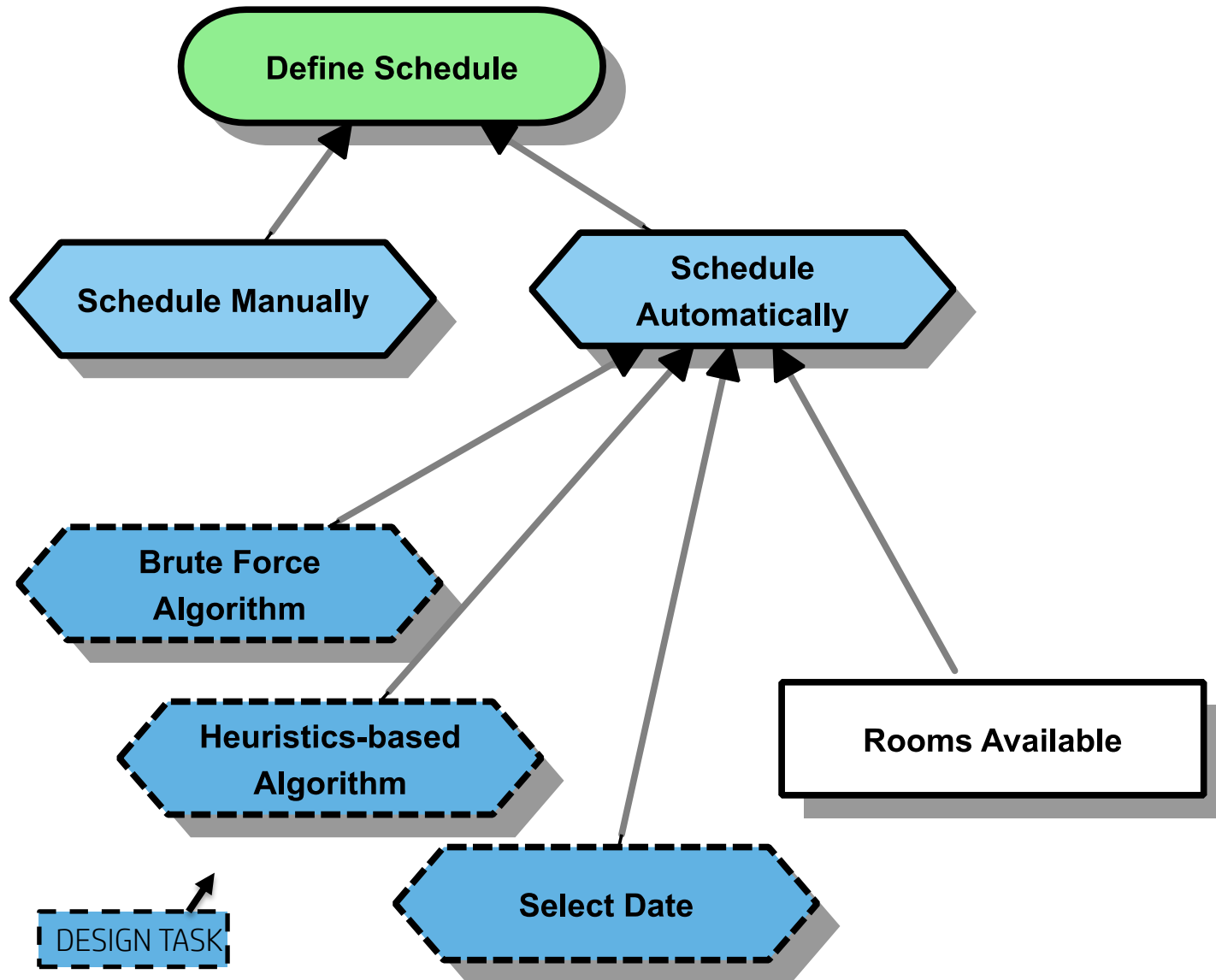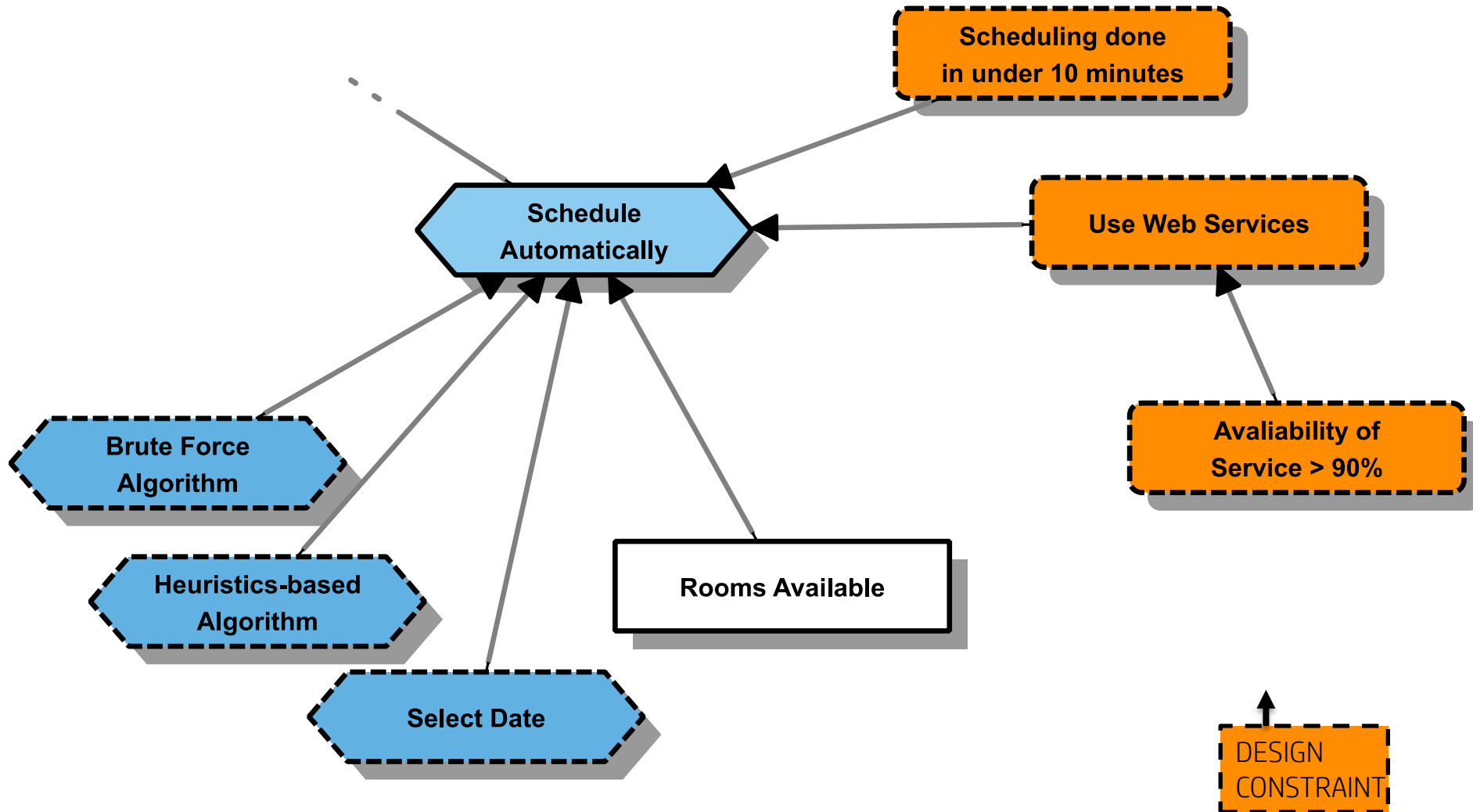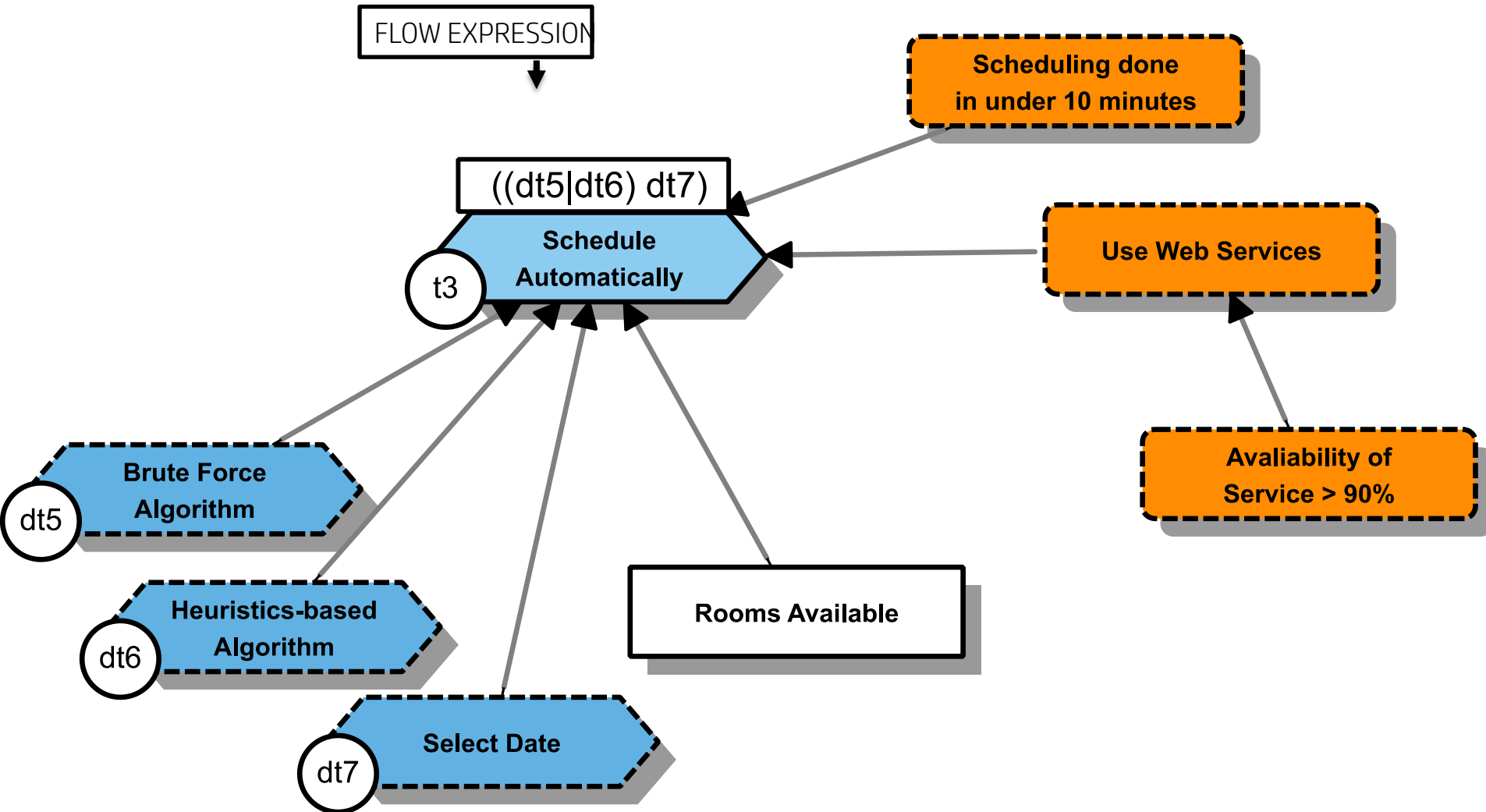
Design Goal Model (DGM)

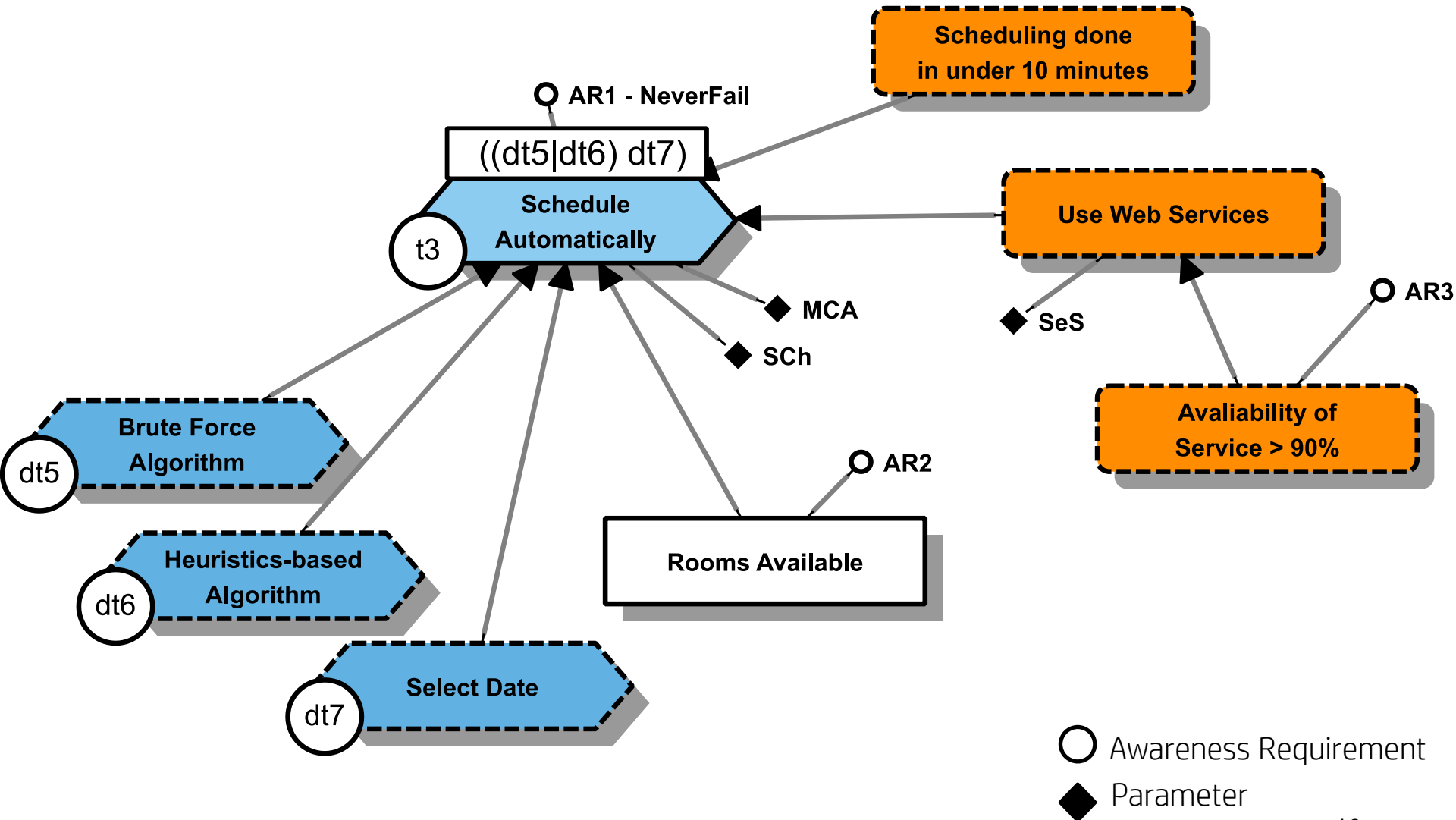# Design Goal Model (DGM)

Design Goal Model (DGM)

MULAS

Architectural Design Process

Design Goal Model

Identify design tasks, constraints, and assumptions

Assign tasks

Define basic flows

Adaptation Specification

Identify indicators, parameters, and relations

Include adaptation elements

Specify transitions

Generate base statechart

Specify adaptation strategies

Statechart

Legend

| Start event | End event | Task | Sub-process | Repeatable process/task | Sequence flow |

Tool Support

GATO

- **Demo @ RE15 (WEDNESDAY Afternoon)**
Room: FSS 4007

Web Tool for Goal Modelling and Statechart Derivation

Evaluation

Informal

- **ATM System**
  - Architectural Design process
  - Simulation
- **Robotic system**
  - Realistic
  - Architectural Design process
  - Execution

Formal

- **Automatic Derivation**
  - Random behavior
  - Performance test
- **Process use**
  - Quality of the resulting statecharts
  - Ease of use

What is the difference?

Requirements

- Stated by stakeholders (customers, users)

- Changes must be negotiated and approved by stakeholders

- The rationale is mostly domain-related

Design

- Stated by designers

- Changes are negotiated by designers

- The rationale is mostly technology-related

Benefits

- Adaptation with requirements and architectural concerns
- Enactment of requirements adaptation
- Derivation of statecharts
- Twin Peaks process

What could be better:
limitations & future work

- Expressiveness of the design goal model
- Heuristics (eg. for selecting optimal flows)
- Derivation patterns
- Modularity of the resulting statecharts
- Other enhancements for the supporting tool
- Compositional adaptation
- Further validation and improvements

Future Work

- Other enhancements for the supporting tool
- Further architectural adaptation
- Further adaptation expressiveness
- Further modeling expressiveness
- Heuristics and guidelines
- Further validation and improvements

Thanks!

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