Karlsruhe Institute of Technology

Automatic, Model-Based Software Performance Improvement for Component-Based Software Designs

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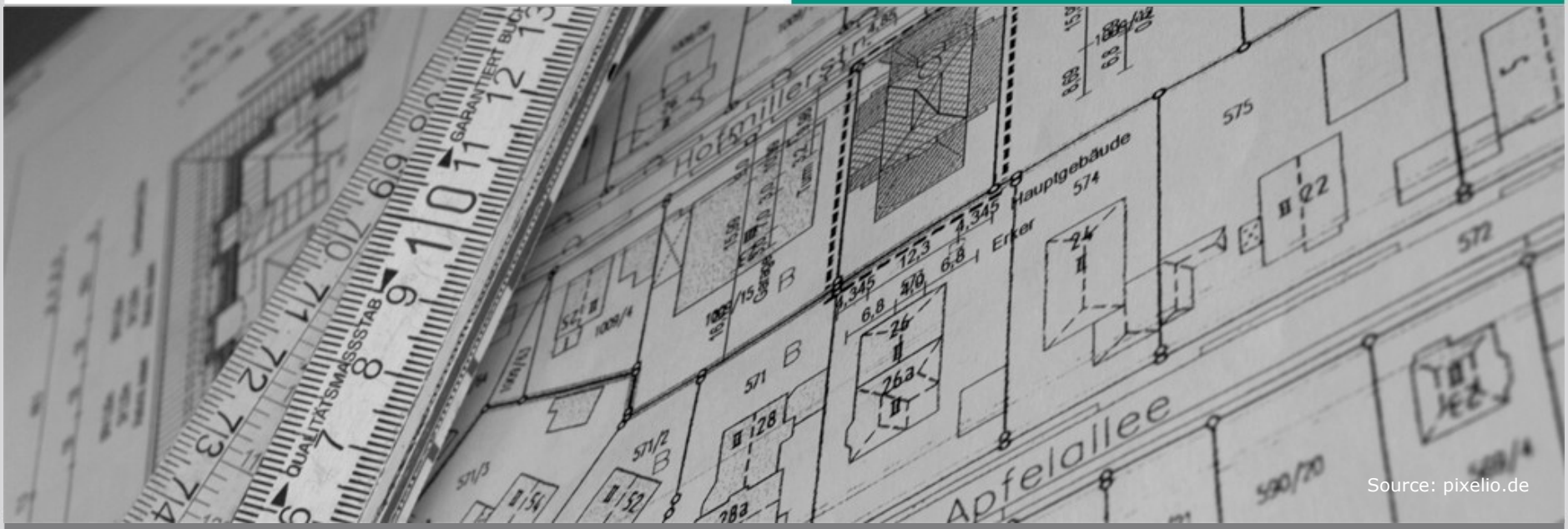
Universität Karlsruhe (TH)
Research University · founded 1825



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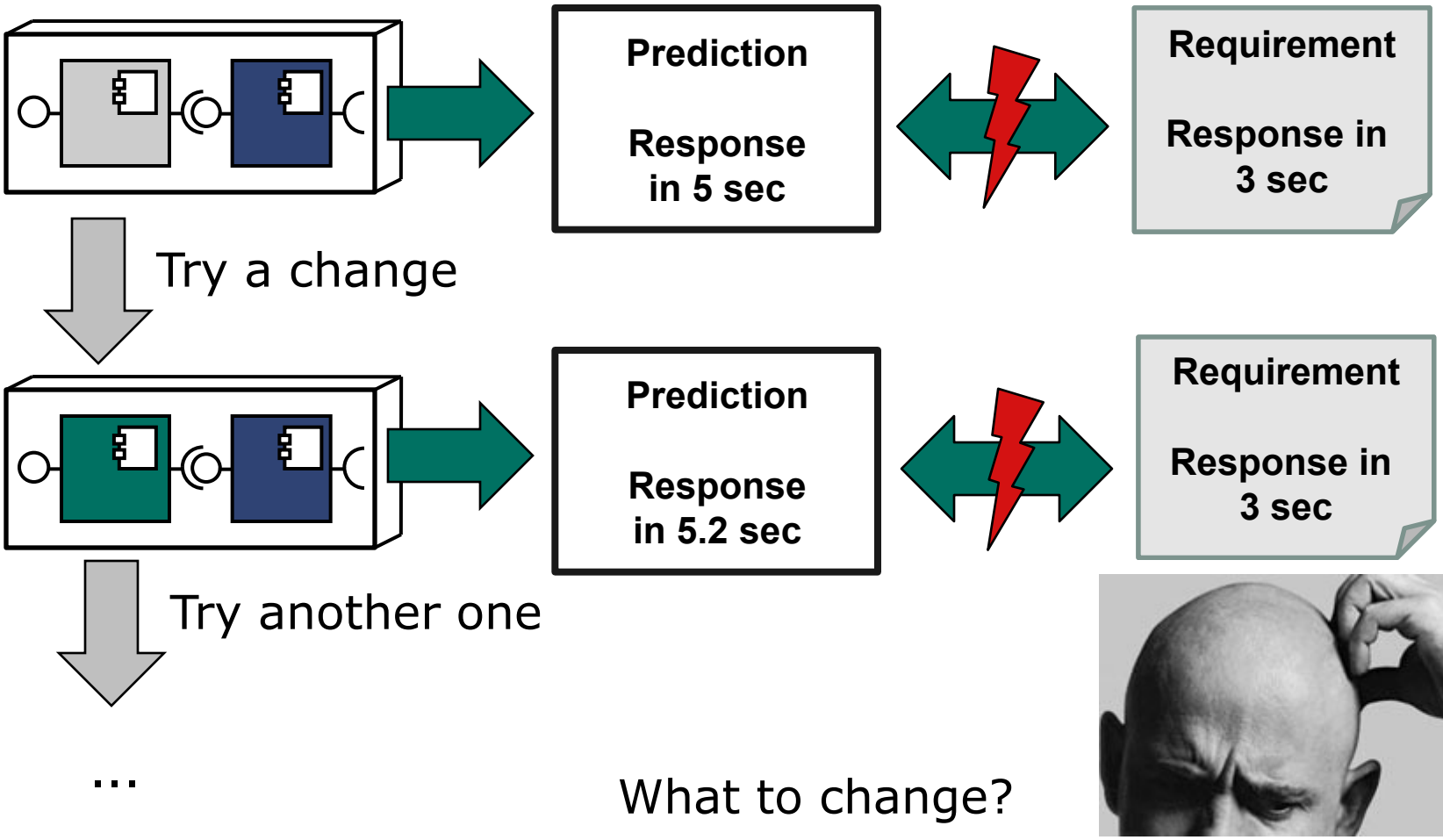
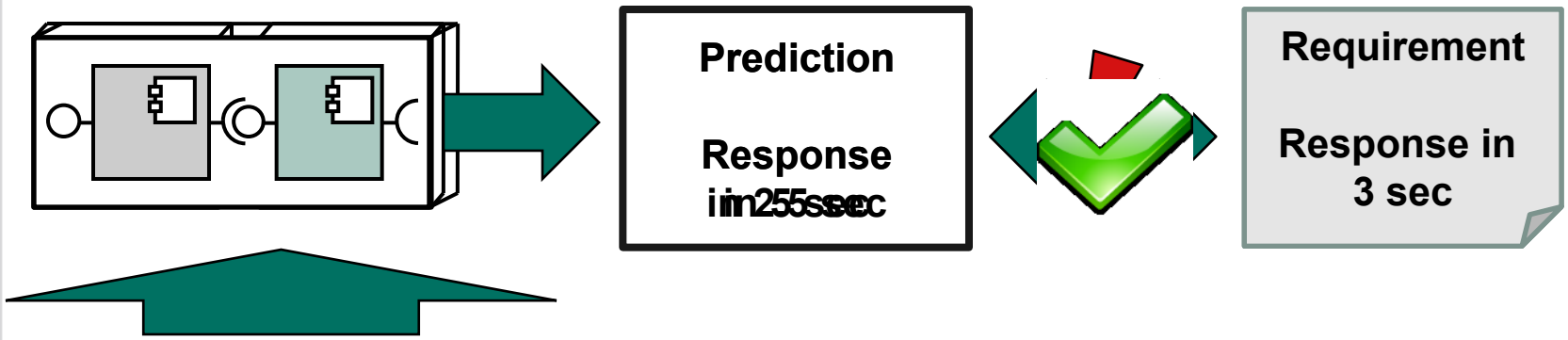
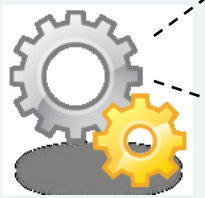
Current Software Performance Engineering



Automated Improvement

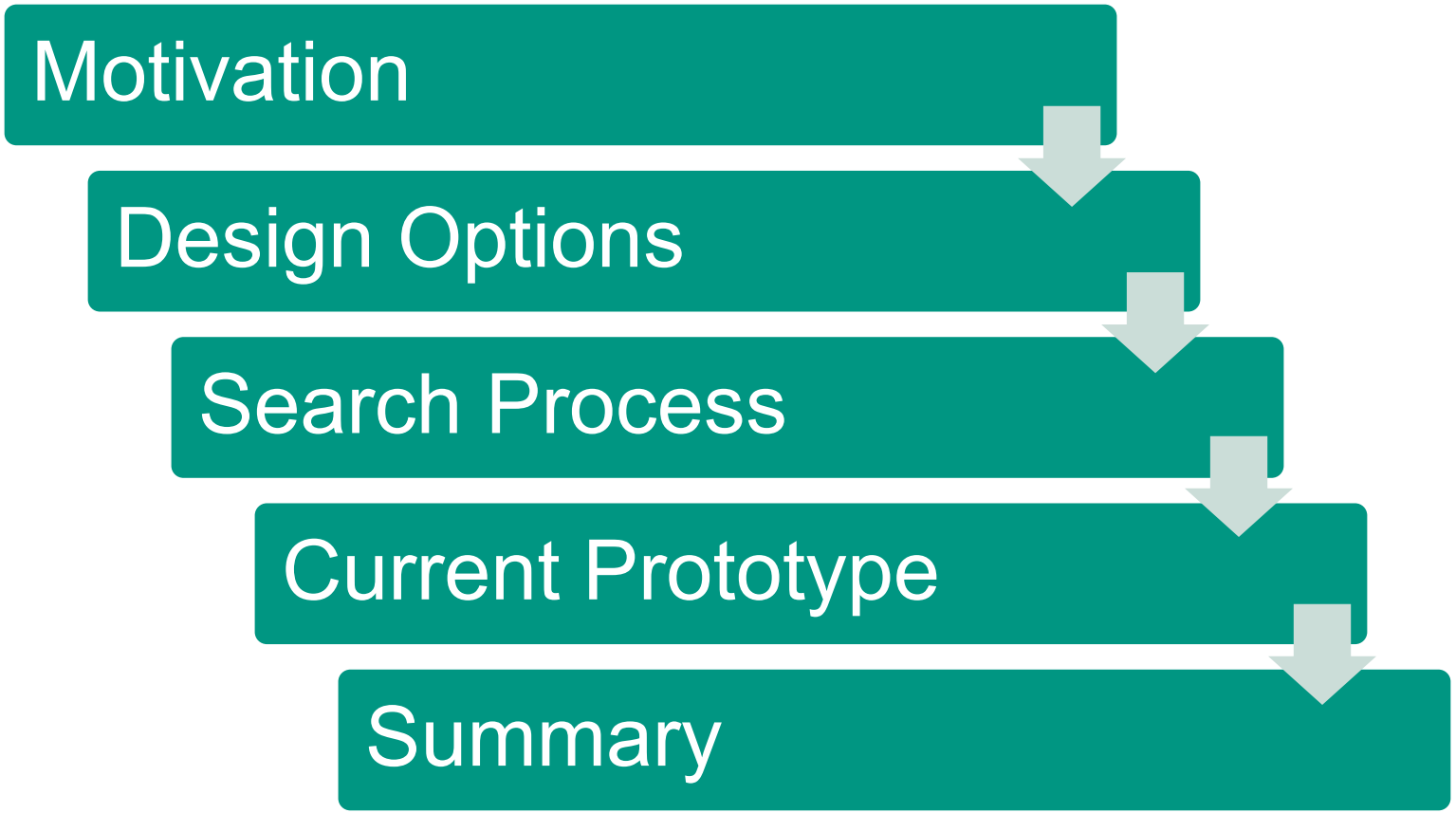


Automatically improve the design



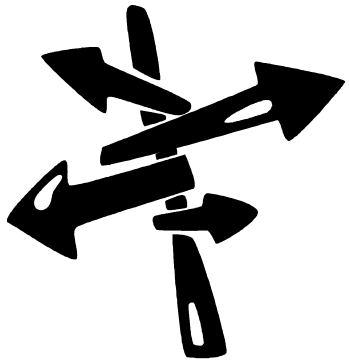
1. Generate new candidate
2. Evaluate candidate
3. Search the design space

Overview



Degrees of Freedom

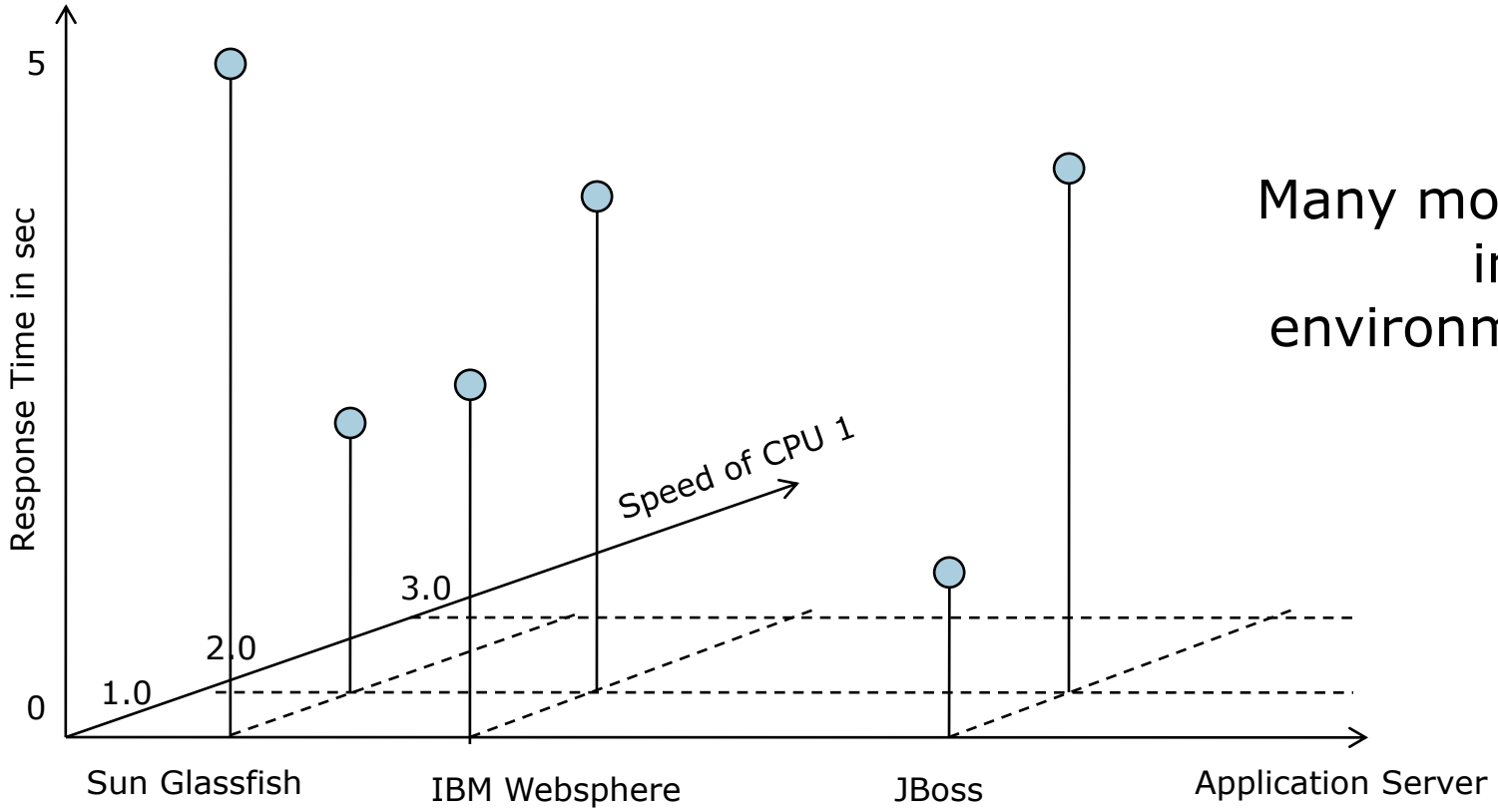
- Considered design options
  - No functional impact
  - Potential extra-functional impact
- Degrees of freedom encoded in architectural model
  - Resource environment
    - Replication, sizing, hardware choice
  - Allocation
  - Configuration as feature configs
    - Of communication, middleware, app servers,... (whatever is available in the models)
  - Selection of components



- *Design options* are instantiations for a particular system

Design Options form the Design Space

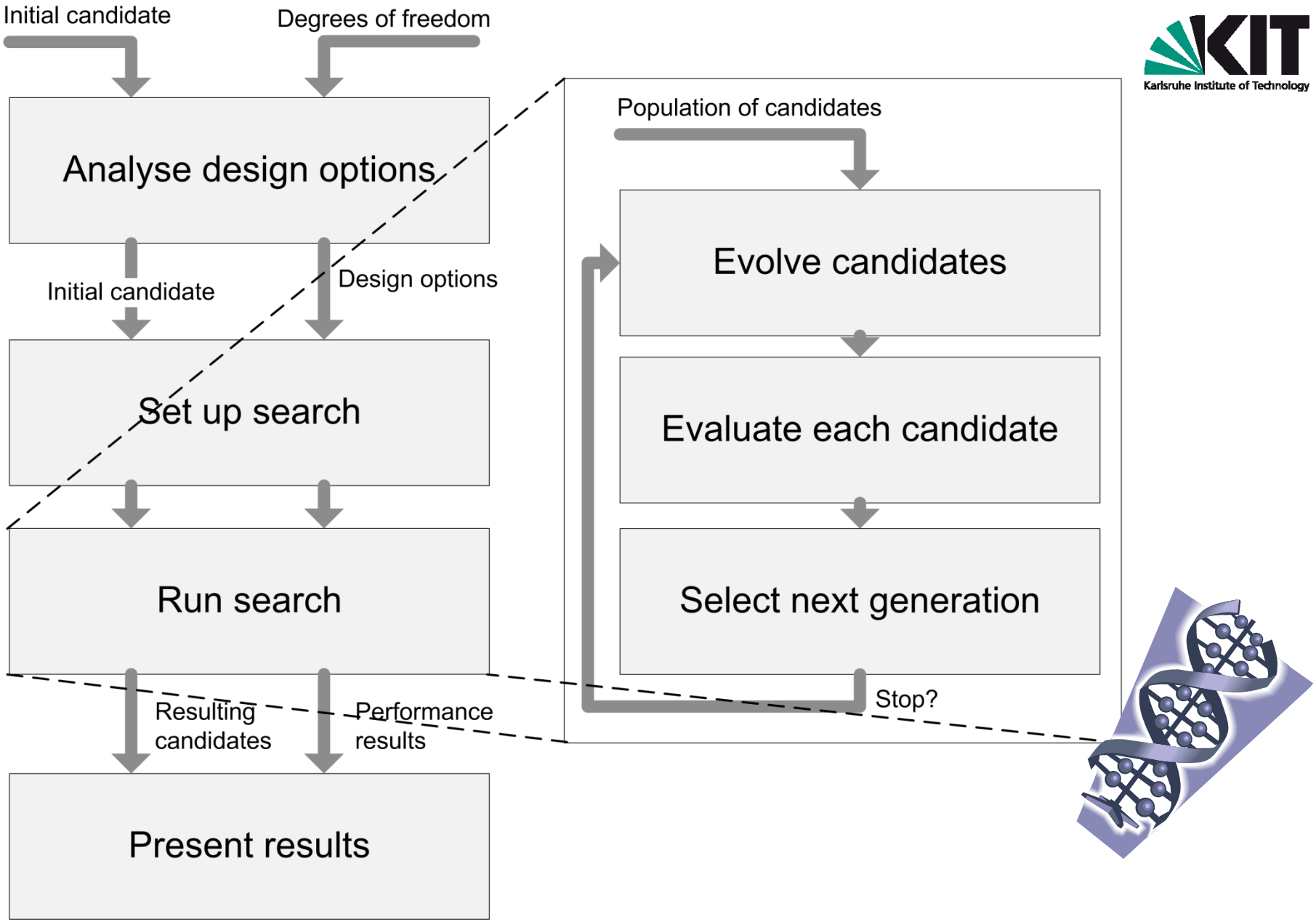
Designs options are dimensions.



Many more choices in resource environment alone

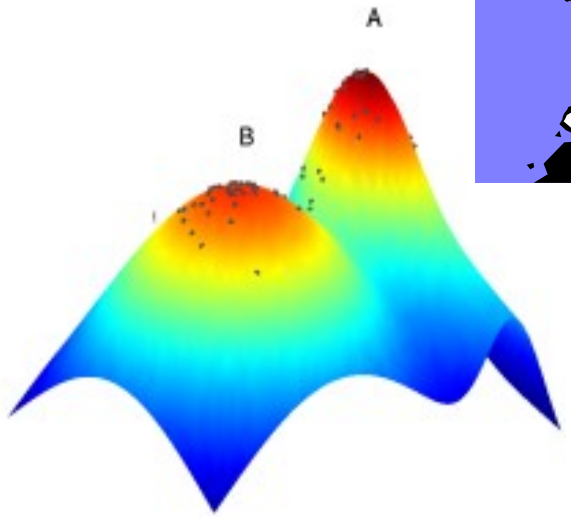
Search the Space

- No full search
  - Performance evaluation costly
  - Space too large
- Pragmatic approach: Good solution is enough
- Use metaheuristics: Intelligently search
- Use performance domain knowledge

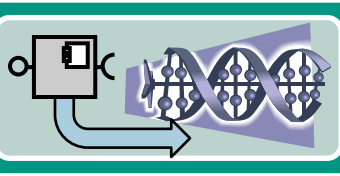


PerOpteryx Prototype

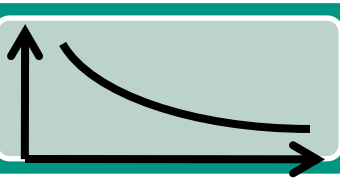
- Starting with a given PCM instance
- Limited number of operators:
  - Increase processing speed of most utilised (>70%) resource
  - Exchange functionally equivalent components
- Steepest ascent hill climbing
- Mean value of response time distribution
- Stops if
  - Requirements are met or
  - All “neighbours” are worse
- Gets stuck in local optima



Current and Future Work

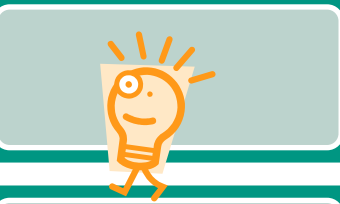


Good representation of architectural decisions in the genome



Multicriteria optimisation

Use of more domain knowledge



Learning during the search

Constraints and requirements

PerOpteryx in a Nutshell

Problem

- No support for software architects to improve their design based on prediction results

Idea

- Exploit explicit architecture model and components
- Automatically improve the design by applying metaheuristics
- Use performance domain knowledge to direct this search

Benefit

- Faster improvement of the design by automation
- Insight for software architects
- Improves applicability of performance prediction approaches