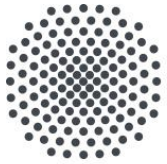
Understanding Real-World AI Planning Domains: A Conceptual Framework



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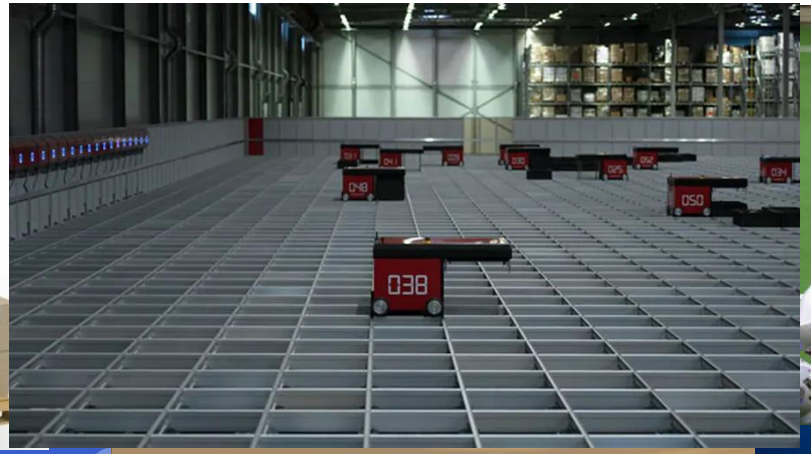
Service Computing

AI Planning

AI planning is a subfield of AI that focuses on researching and developing planning systems that aim to find, organise and execute a course of action, i.e., a plan, in order to achieve some designated goal.

- classical planning
- probabilistic planning
- Hierarchical Task Network (HTN) planning
- temporal planning
- ⋮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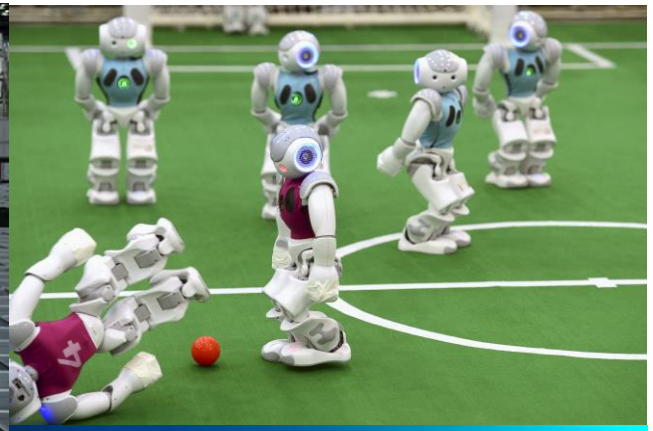
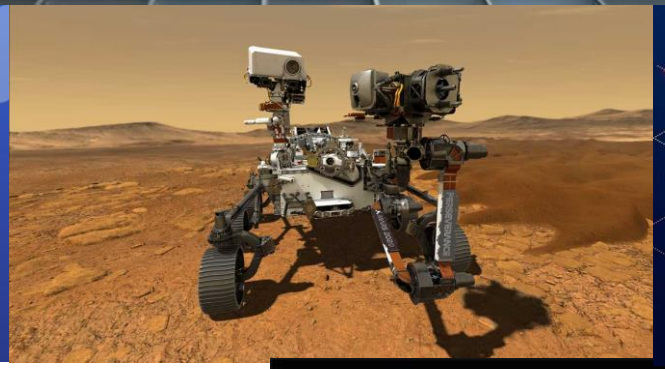
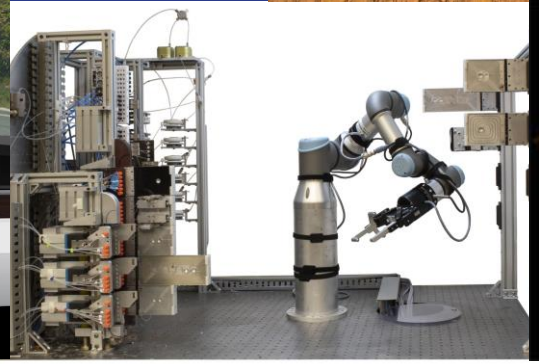
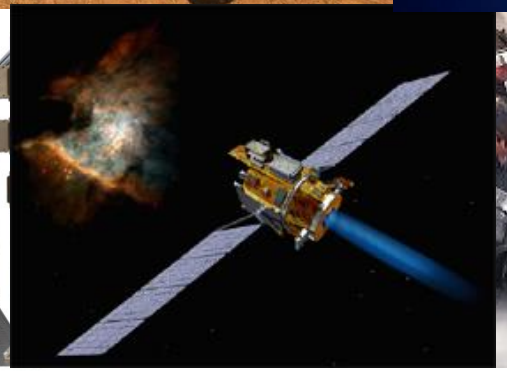
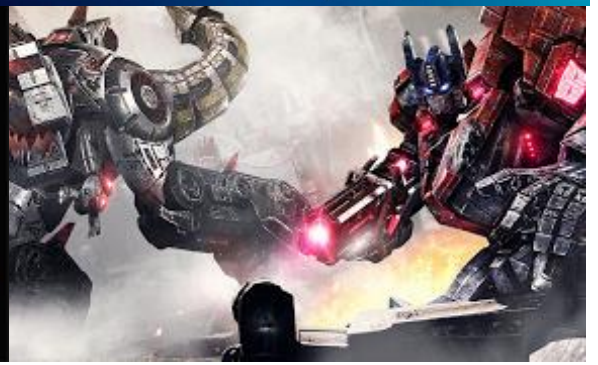


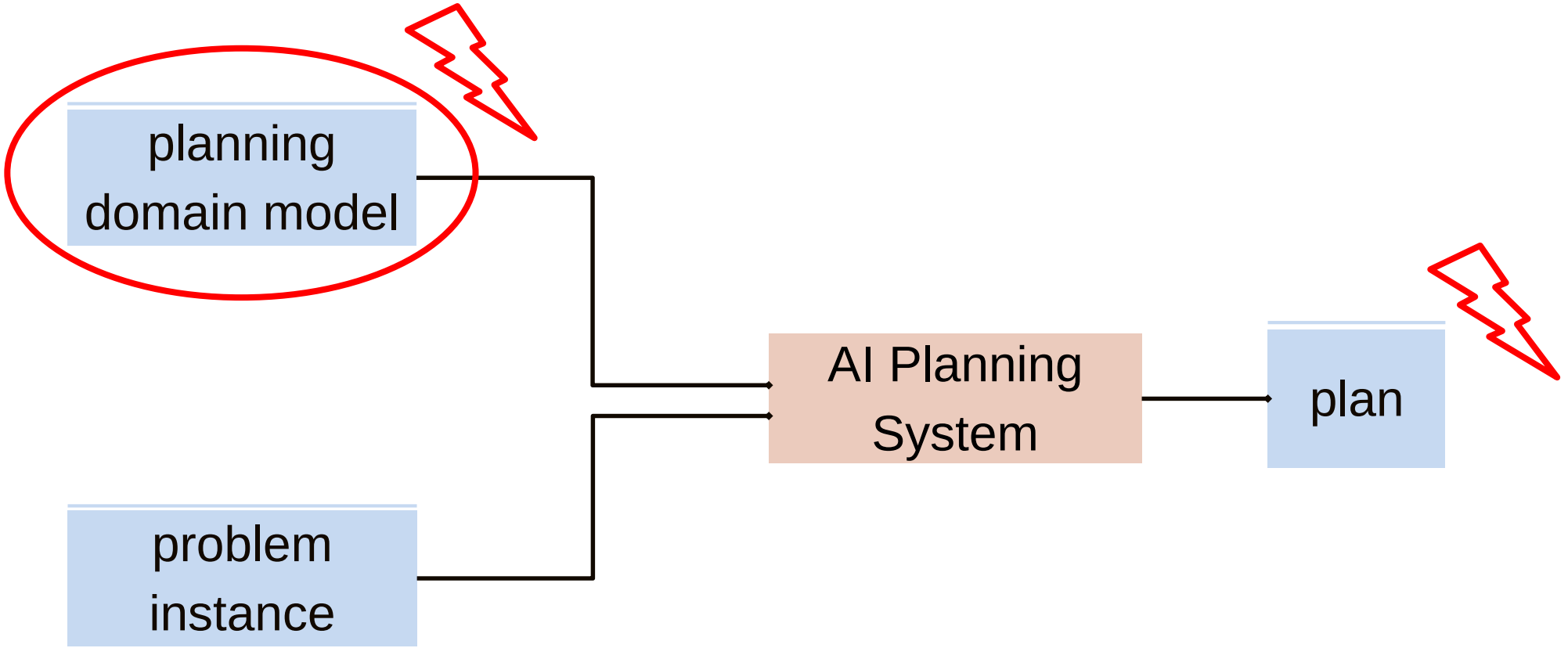


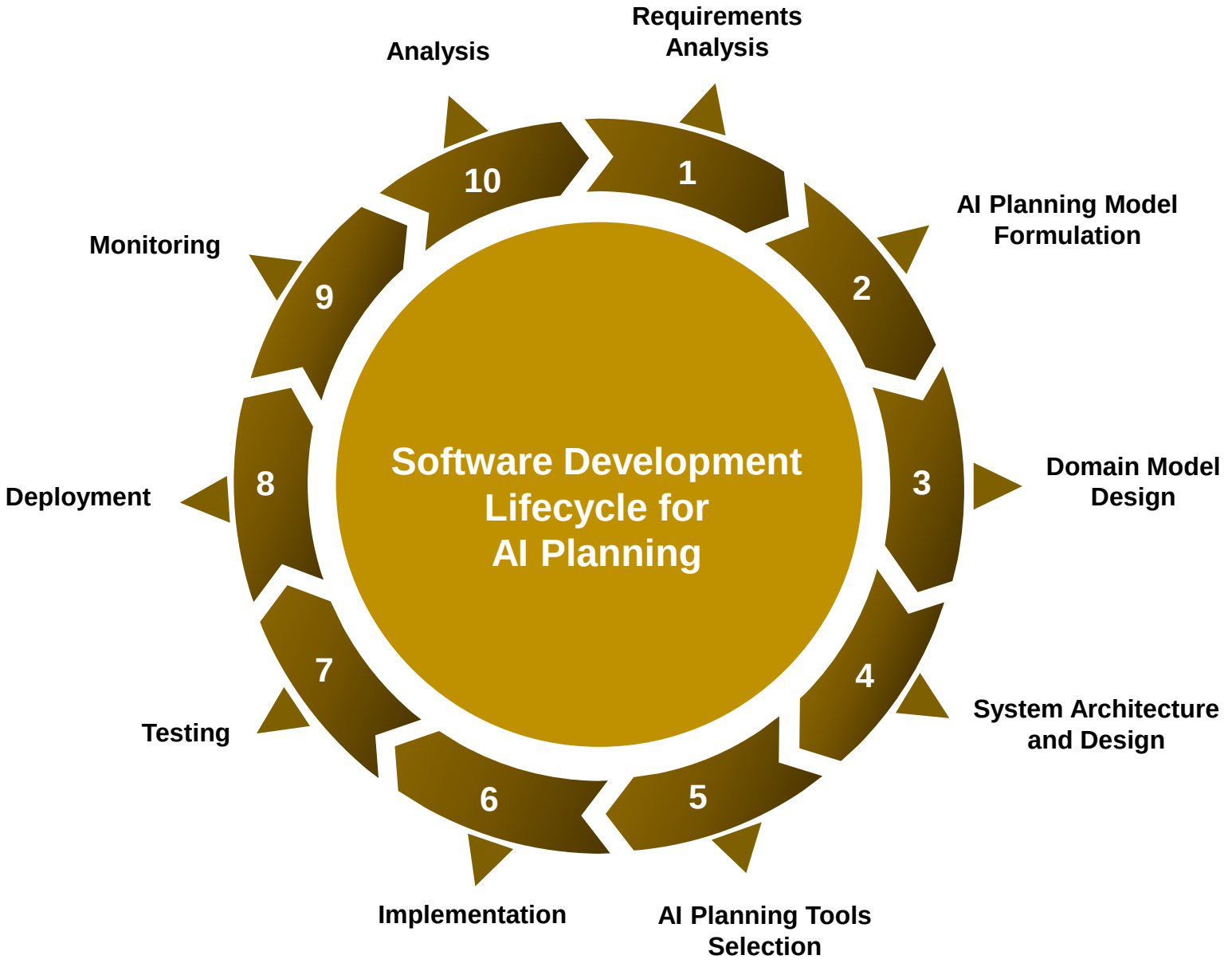






AI Planning


planning
domain model
problem
instance
AI Planning
System
plan


Software Development Lifecycle for AI Planning
1
Requirements Analysis
2
AI Planning Model Formulation
3
Domain Model Design
4
System Architecture and Design
5
AI Planning Tools Selection
6
Implementation
7
Testing
8
Deployment
9
Monitoring
10
Analysis

Problem Statement

There is currently **no support for software engineers and knowledge engineers** in the process of identifying relevant and **realistic aspects** of real-world planning domains necessary **for the development of essential planning elements** (i.e., requirements, planning types, planning domain models, planning system design)

Research Question

What are the **realistic aspects** that should be considered in the process of **developing AI planning services** for real-world domains and how can those aspects be meaningfully **organised**?

Contributions

Main Contribution

Developing a conceptual framework of realistic aspects for planning domain knowledge

Realistic-Aspects Framework

Guidelines for planning and software engineers

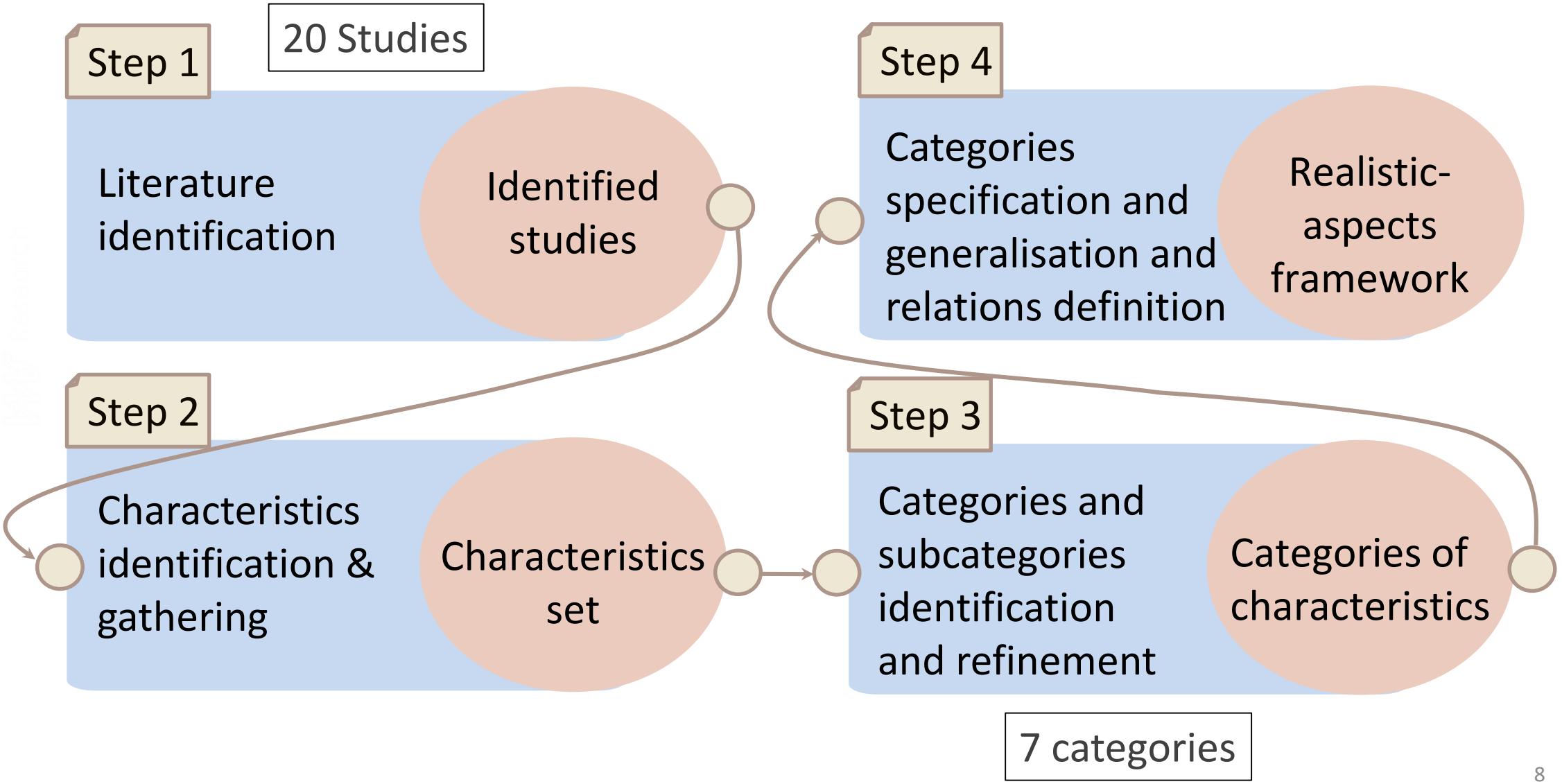
Common and inclusive notion of AI domain models realism

Drives the development of AI planning techniques and services

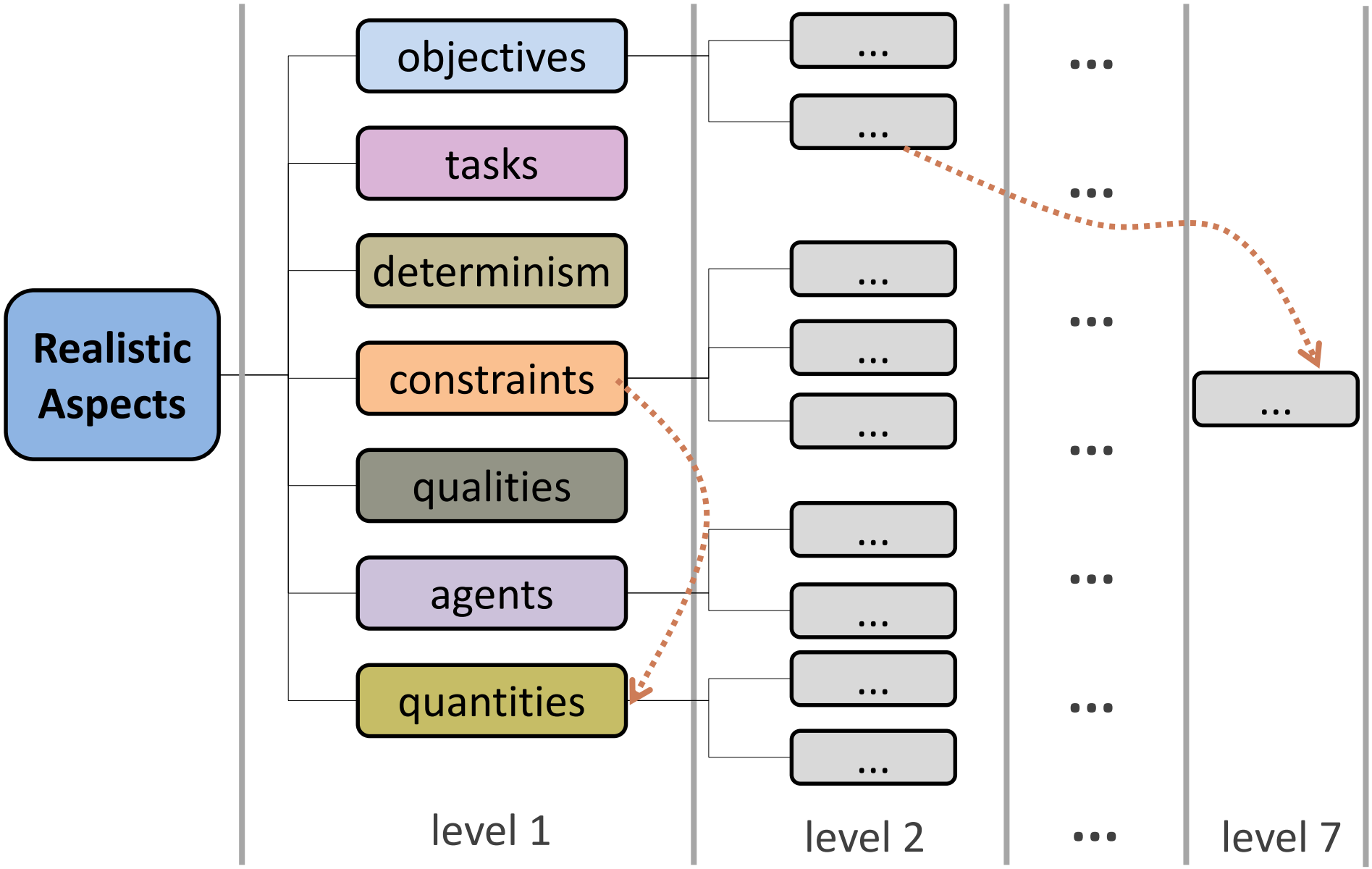
May improve the applicability of AI planning

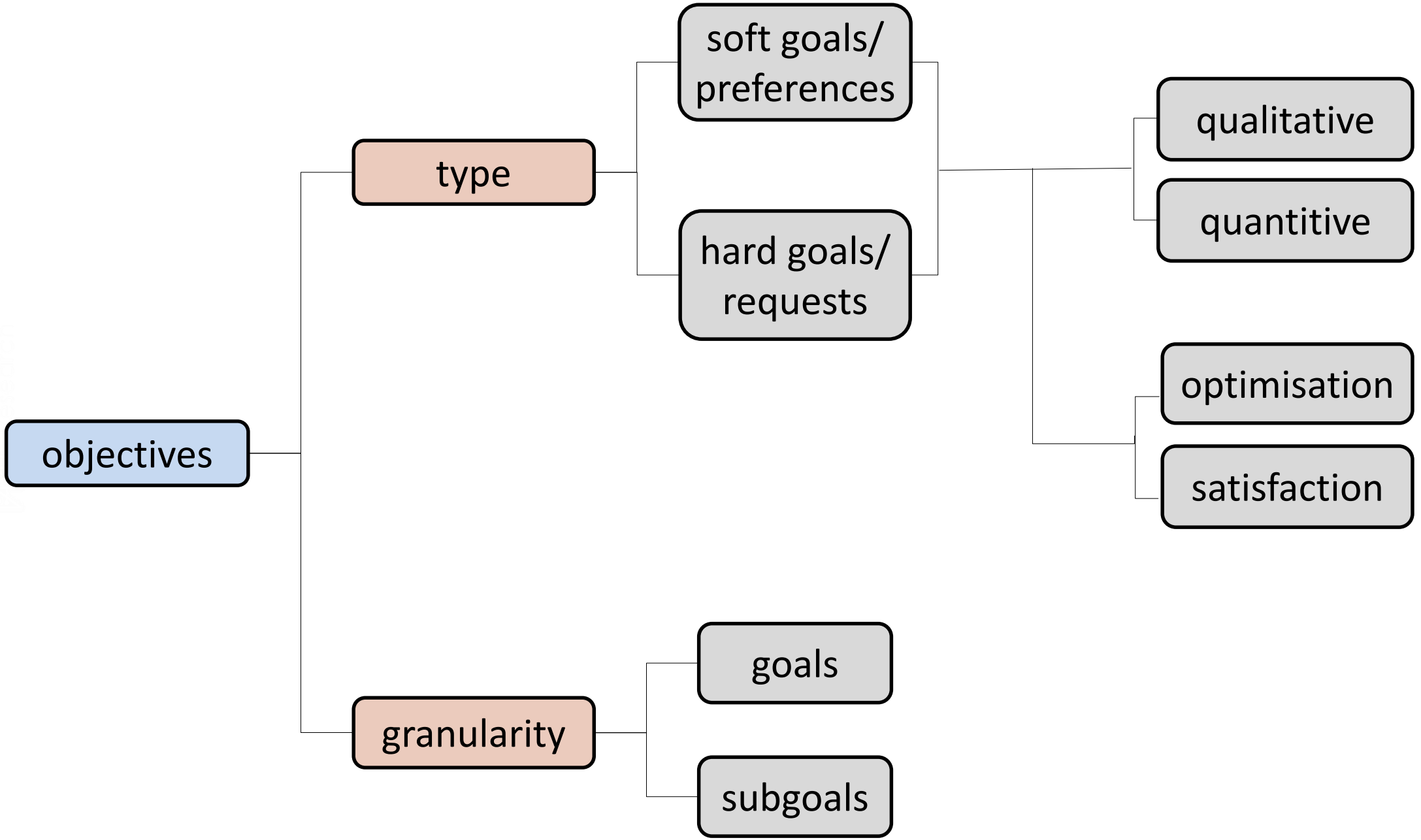
Provides means for comparing different AI planning systems

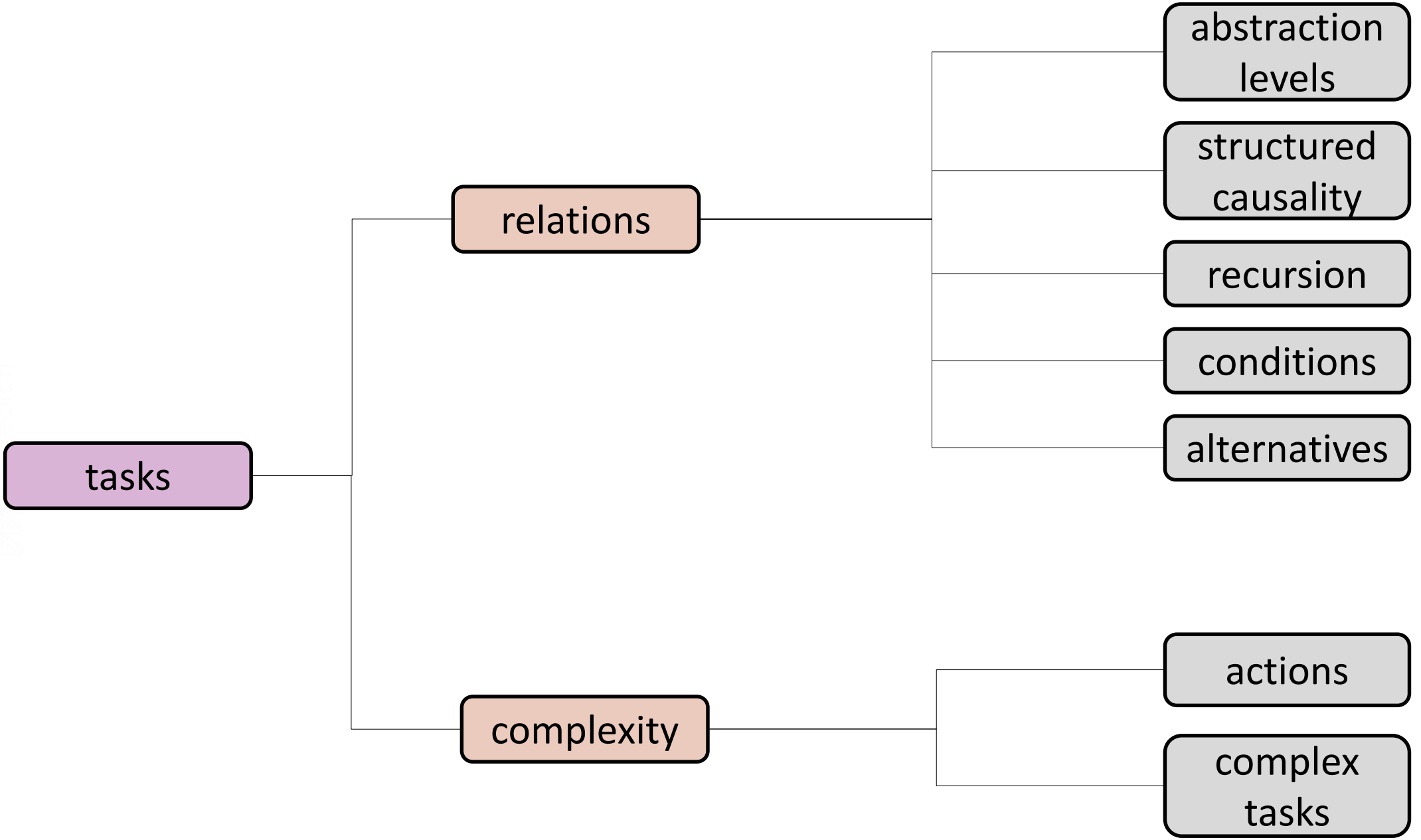
Approach

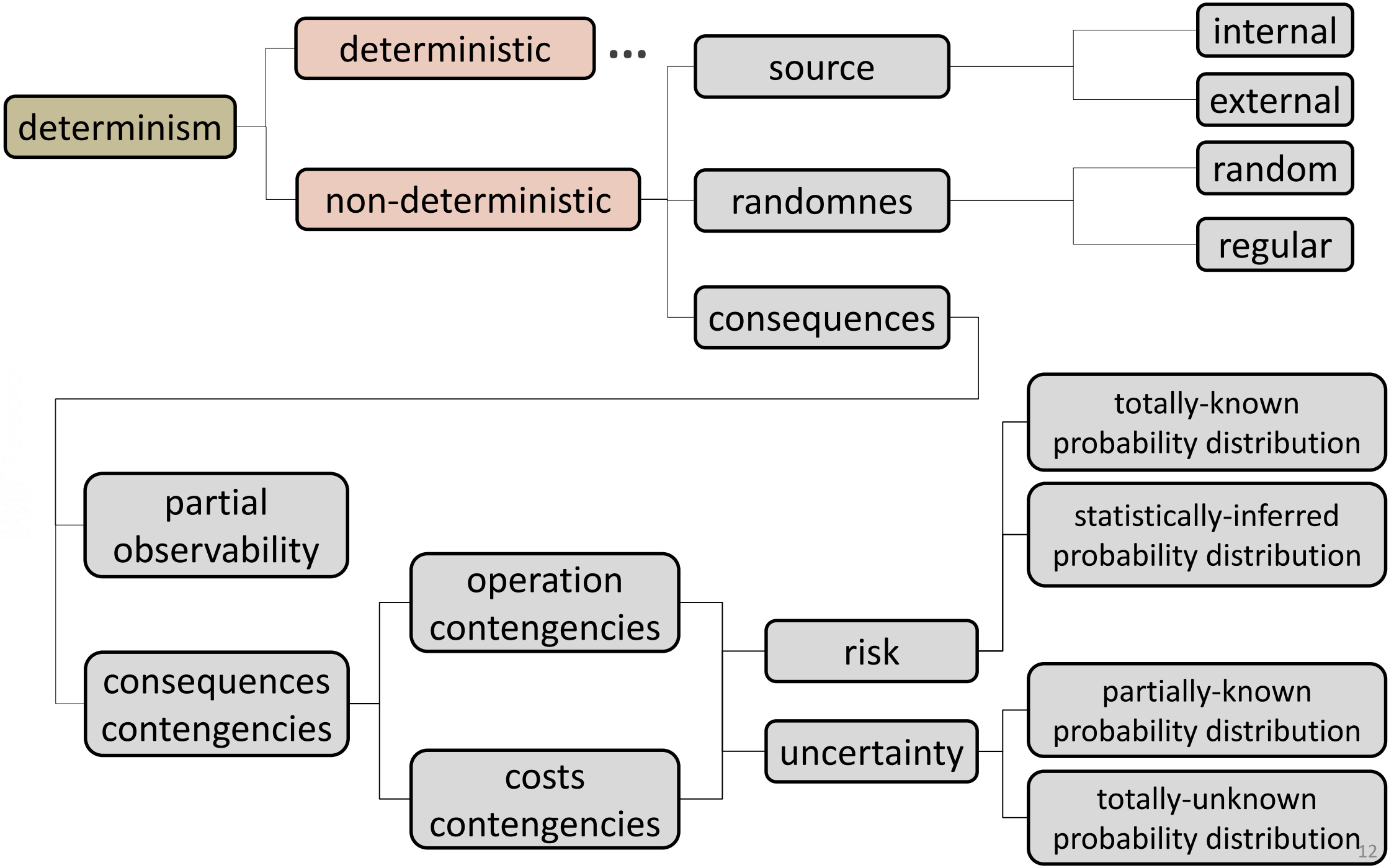

20 Studies
Step 1
Literature identification
Identified studies
Step 2
Characteristics identification & gathering
Characteristics set
Step 3
Categories and subcategories identification and refinement
Categories of characteristics
7 categories
Step 4
Categories specification and generalisation and relations definition
Realistic-aspects framework

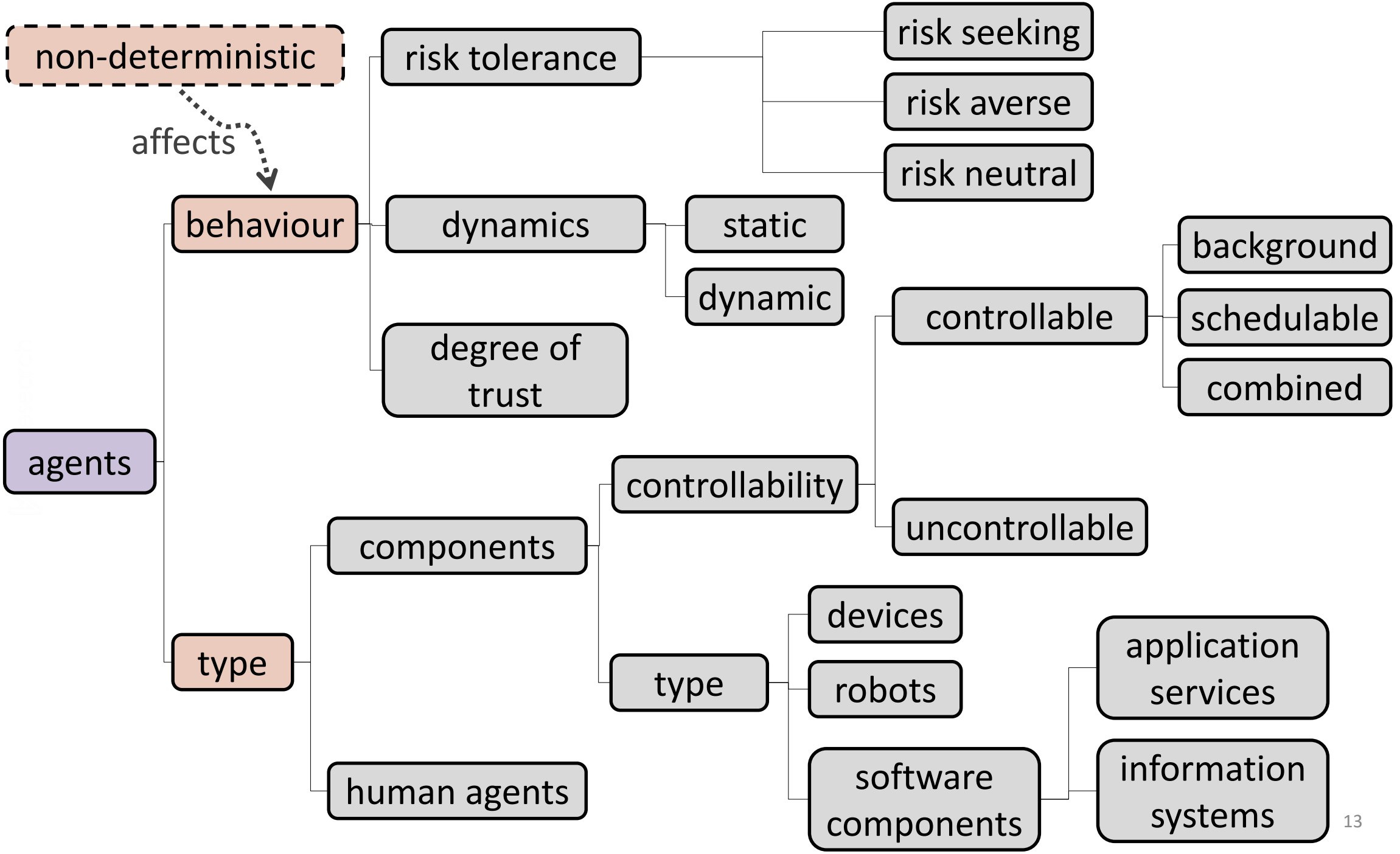
Realistic-Aspects Framework

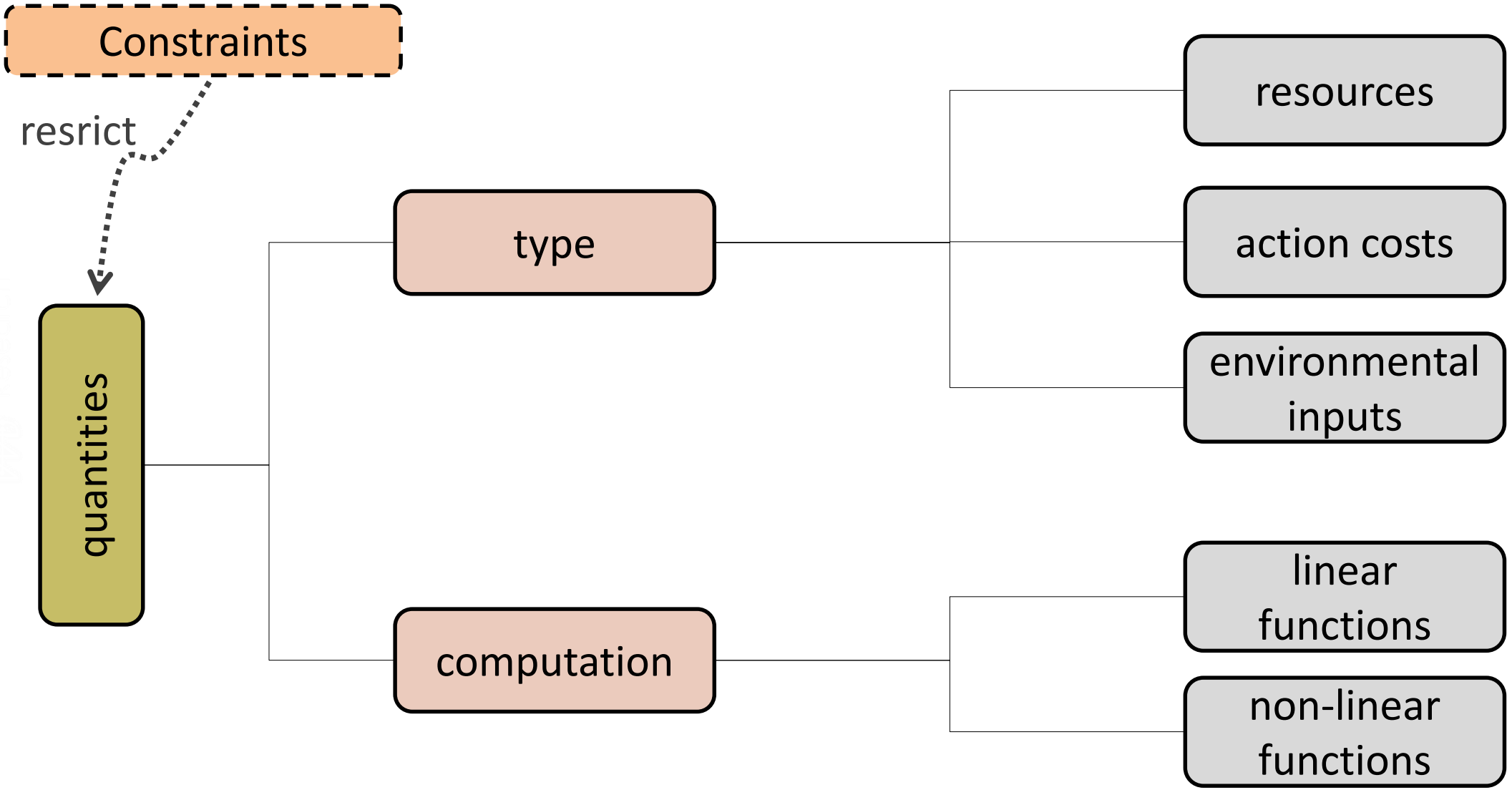



objectives
type
soft goals/ preferences
hard goals/ requests
qualitative
quantitive
optimisation
satisfaction
granularity
goals
subgoals

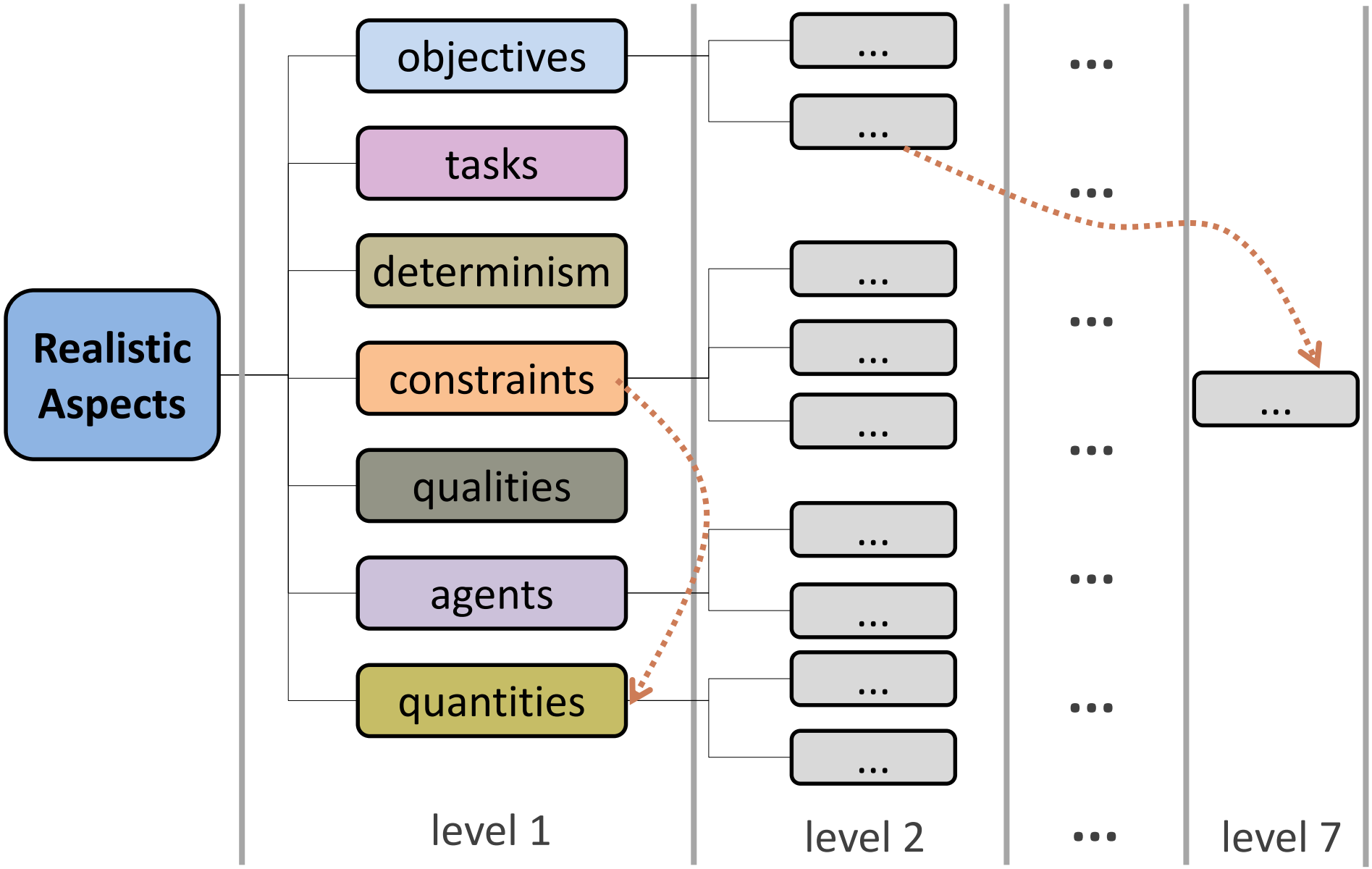

tasks
relations
abstraction levels
structured causality
recursion
conditions
alternatives
complexity
actions
complex tasks


determinism
deterministic
...
non-deterministic
source
internal
external
randomnes
random
regular
consequences
partial observability
consequences contengencies
operation contengencies
costs contengencies
risk
uncertainty
totally-known probability distribution
statistically-inferred probability distribution
partially-known probability distribution
totally-unknown probability distribution


non-deterministic
affects
agents
behaviour
risk tolerance
risk seeking
risk averse
risk neutral
dynamics
static
dynamic
degree of trust
type
components
controllability
controllable
background
schedulable
combined
uncontrollable
type
devices
robots
software components
application services
information systems
human agents


Constraints
resrict
quantities
type
computation
resources
action costs
environmental inputs
linear functions
non-linear functions

Realistic-Aspects Framework



Conclusion

Applicability of AI planning systems

- Broad range of aspects of planning domains
- Lack of unified notions of what makes a planning domain realistic

Support for knowledge and software engineers

- Knowledge engineers and software engineers should be Supported in making informed choices

Conceptual framework

- Conceptualises the notion of planning domains' realism
- Drives the development of service-oriented AI planning systems
- Offers means for comparing different planning systems
- Highlights some aspects that are simplified or neglected

Future Work

Metrics

Synthesise metrics that can quantitatively evaluate the realism of planning domains

Verification and Validation

Empirically verify and validate the conceptual framework on realistic application domains

Usability

Explore the usability of the framework for the design of service-oriented AI planning system

Thank you ☺