

Designing Criteria-Driven Scheduling as Integrated Service for IEEE-FIPA Compliant Multi-Agent Infrastructures

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*Dezentralität als Entwurfsprinzip: Anwendungskonzepte und
Vorgehensweisen für Dezentrale Informationssysteme*

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Outline

- 1 Introduction
- 2 Integration Approach
- 3 A Simple Example
- 4 Summary

Introduction

- Motivation:
 - Different coordination strategies
 - Focus: communication vs. multi-agent planning
 - Combine approaches
- Objective:
 - Integrate a criteria-driven scheduler with a standard compliant multi-agent framework to provide plan-based coordination.
- Means:
 - Target platform: Jade
 - Interaction/communication: FIPA
 - Representation: TÆMS and GPGP
 - Scheduler: VIE-CDS

Framework for Task Analysis, Environment Modeling, and Simulation

TÆMS [Lesser et al., 2004]

Put-Away-Dishes

Quick-And-Dirty

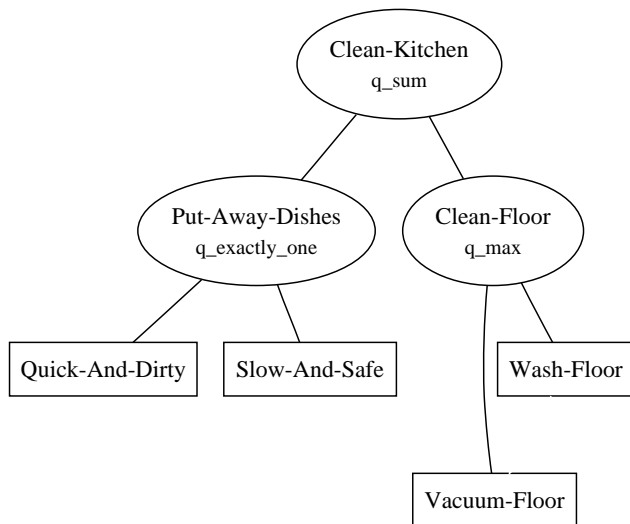
Slow-And-Safe

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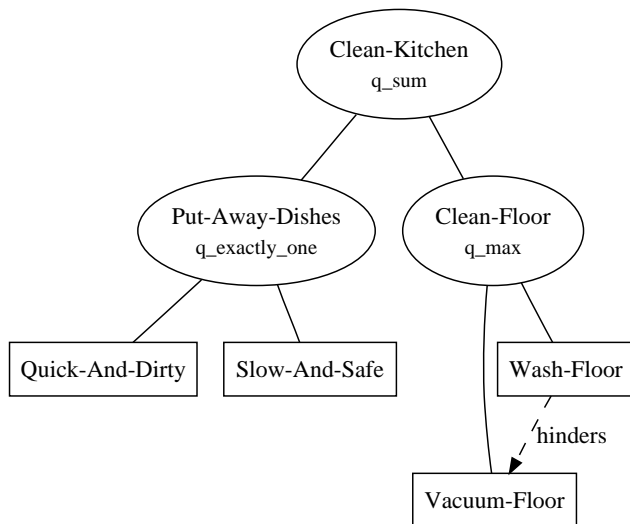
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Vienna Criteria-Driven Scheduler

DTC [Decker and Lesser, 1995] and VIE-CDS [Jung, 2003]

- Java based Design-to-Criteria scheduler
- Domain-independent approach
- Deals with uncertainty
- TÆMS based
- Scheduling criteria: relative preferences for solutions

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Design Criteria

- FIPA-compliant infrastructure
 - Already defined interaction protocols
 - Cross-platform usage
- Agent developer should not be directly bothered with communication concerning scheduled action execution
- Allow different multi-agent planning and scheduling strategies:
 - Centralised: **one** agent for planning, scheduling, and execution monitoring
 - Multi-Centric: **multiple** agents
 - Distributed: **each** agent does planning, scheduling, and execution monitoring

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System Components

- Jade agents play different/multiple roles:
 - Scheduled action execution requester (SAER)
 - Planning, scheduling, execution monitoring (PSEM)
 - TÆMS structure provider and method executor (TPME)
- Directory Facilitator (DF) provides a yellow pages service
- Domain ontologies defining the scheduling protocol vocabulary

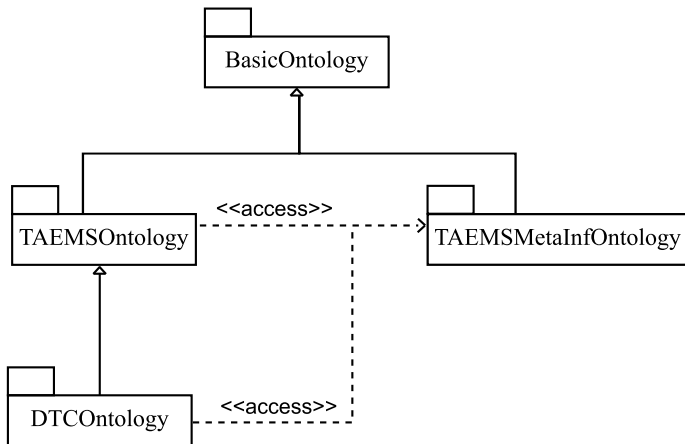
Domain Ontologies

BasicOntology: root ontology, primitive data types

TAEMSOntology: wrapper around TÆMS structures

DTCOntology: scheduled action execution requests, scheduling criteria

TAEMSMetaInf: extension point for TÆMS meta-information



5 Phases of Scheduled Action Execution

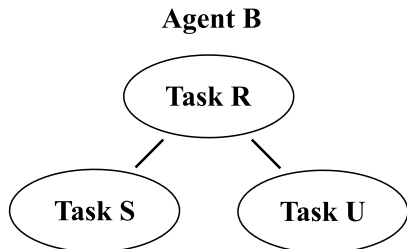
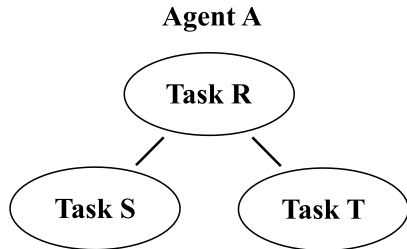
- 1 **Request scheduled action execution:** start the whole PSEM-process, Request Interaction Protocol
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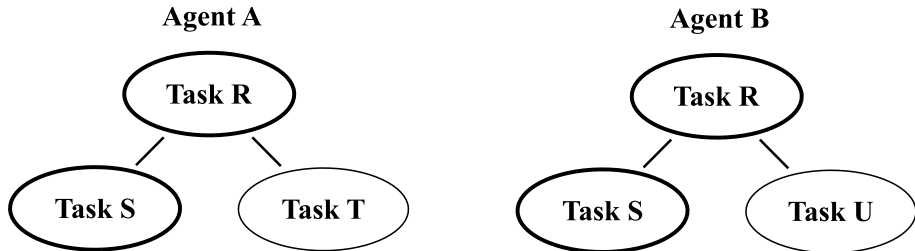
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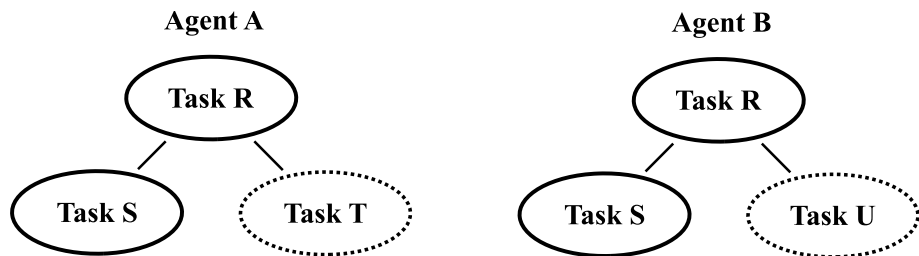
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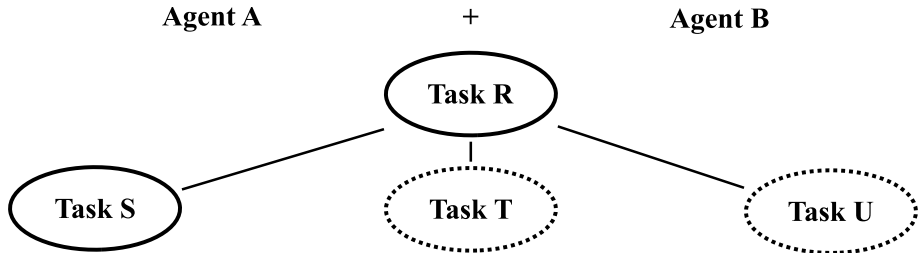
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5 Phases of Scheduled Action Execution

- 3 **Scheduling:** request commitments to methods (quality, cost, duration), run VIE-CDS obeying scheduling criteria, Query Interaction Protocol
- 4 **Schedule selection:** iterate over found schedules, query agents if commitments hold for calculated deadlines, Request Interaction Protocol
- 5 **Execution monitoring:** wait for success and execution quality messages, inform SAER about schedule execution abort or success qualities, INFORM messages

Error propagation:

- ERROR messages inside the protocol flow
- Cancel Meta-Protocol outside the protocol flow

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Scenario

Medical Care

- Optimise medical treatments in three dimensions
 - Quality
 - Cost
 - Duration
- Hospital-wide multi-agent system using Jade
- TPMEs and SAERs interfaced with staff

Workflow

- 0 Physician requests treatment
→ specific quality/cost/duration tradeoff as criteria
- 1 SAER queries DF for PSEM
- 2 PSEM queries surgeries with treatment knowledge (TPMEs)
→ partial global plan
- 3 PSEM requests commitment proposals (TPMEs) and runs VIE-CDS
- 4 PSEM selects a possible treatment plan
→ TPMEs commit to the action execution constraints
- 5 PSEM waits for treatment finish and informs SAER

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Summary

- DTC-scheduled action execution in FIPA compliant multi-agent infrastructures
- Standard protocols
- Not restricted to Jade → cross-platform usage
- Make use of engineered TÆEMS structures

Future Work


- Explicit (partial) schedule re-usage and recovery
- Tighter integration of TÆEMS into FIPA-ACL

Thank You for Your Attention!

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Questions?

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Java Agent DEvelopment Framework

Jade [Bellifemine et al., 2007]

- FIPA 2000 compliant multi-agent infrastructure
[Foundation for Intelligent Physical Agents (FIPA), 2007]
- Community-driven development
- Behaviours as action abstraction
- Communication as actions
- Agents in containers on different hosts
- Implemented in Java

Framework for Task Analysis, Environment Modeling, and Simulation

TÆMS [Horling et al., 1999]

- Models coordination issues
- Domain-independent
- Hierarchical goal (task) decomposition
- Worth-oriented domains
- Discrete probability distributions
- Interrelationships

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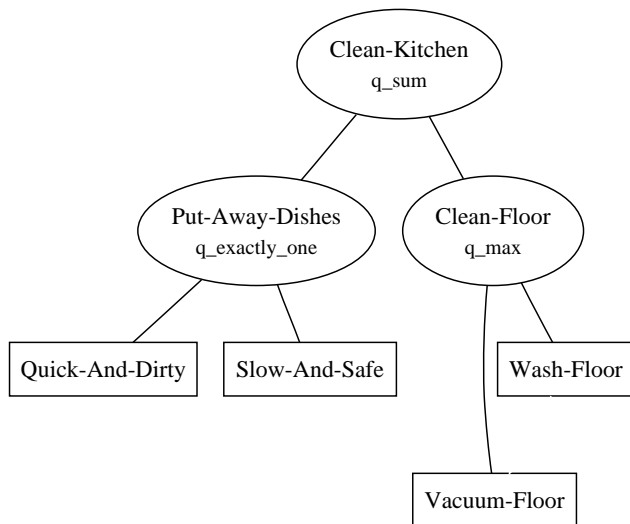
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