Fine-grained Variability in the Development of Families of Software Agents

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Agenda

1. Introduction
2. Buyer Agent Family Case Study
3. Lessons Learned
4. Conclusion
Introduction

- MAS in Software Engineering → Paradigm
  - Decomposition of a complex problem into autonomous agents

AOSE

- Stability
- Reuse
- Modularity
- Maintainability
- Dependability

The state-of-the-art of AOSE is insufficiently reflected in the state-of-practice in developing complex distributed systems.
Introduction

Exploratory Study of the development of a family of agents, focused on fine-grained variability. The Buyer Agent SPL.

Lessons Learned mainly related to techniques to build agent architectures that take into account SE principles.

Why a Software Product Line?

BDI Architecture Variability: beliefs, goals, plans…
The Buyer Agent Family Case Study
The Buyer Agent Family Case Study

Variability

Diagram showing the goals and plans related to the buyer agent process.
The Buyer Agent Family Case Study

Variability
- Payment Type

![Diagram showing case study structure with goals and plans, focusing on payment type variability.]
The Buyer Agent Family Case Study

Variability

- Shipping Type
The Buyer Agent Family Case Study

- Variability
  - Store Selection Strategy
The Buyer Agent Family Case Study

Variability Model Selection

Configuration Knowledge

Annotated Code

Copy Code Assets

Select Code Assets

Customize Code Assets

Save Code Assets

Automatically Deriving Buyer Agents

Customized Source Code

Compile Code Assets

Compiled Source Code

Start Buyer Agent

After the buyer finishes its execution, the resources are cleaned

MAS

Buyer enter
The Buyer Agent Family Case Study

Derivation of Specific Agents Parameterization

- Control variables
- The need of modularization techniques

```c
methodX
if (A) {
} else if (B) {
} else if (C) {
}

methodY
if (A) {
} else if (B) {
} else if (C) {
}

methodZ
if (A) {
} else if (B) {
} else if (C) {
} else if (C) {
}
```
Lessons Learned

Modeling Variability

- MAS Approaches
  - Design abstractions may not exist in the implementation platform
- MDA helps to bridge the gap between design and implementation
Goals Reuse
- Goal Diagram: Tree or Graph?
- Tropos models goals as a graph
  - Fine-grained elements
    - Complex design models

Capabilities
- Modularization and reuse
- Design first-class elements?
- Alternative: two agents?

Plan Parameterization
- Where are they in design models?

Should we strictly follow human models?
Variability Modularization

- Agents encapsulate both state and behavior
  - Lower coupling → inter-agent
- And low coupling and high cohesion between intra-agent components?
  - Capability concept

Goal decomposition and Plan Modularization

- Variants modularized in single plans
- Additionally conditional compilation
  - Capabilities
    - increase number of components
  - AOP
Lessons Learned

Modeling Variability
Lessons Learned

Variability Modularization

- SE approaches to improve software architectures
  - Reusability, maintainability, modularity, stability, dependability
  - E.g. Use of the AbstractFactory pattern to instantiate families of plans in the Buyer Agent SPL
Variability Modularization

The need of empirical studies to evaluate approaches

- Show the real effectiveness of proposed approaches
- Several MAS methodologies and processes
  - How can we ensure that their proposed models indeed improves software development?

AOSE could learn from research work that has been done in state-of-the-art SE to design and implement better software architectures.

Lessons Learned
Conclusion

- Exploratory study of the development of a family of agents
  - Fine-grained variability
- Lessons learned
  - Variability types, design and implementation

- MASs aim at developing complex, distributed systems in terms of high level abstractions

However, these models will not likely be adopted in the industry if they do not promote reduced time-to-market, lower costs and higher quality.
Questions

- Fine-grained Variability in the Development of Families of Software Agents

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