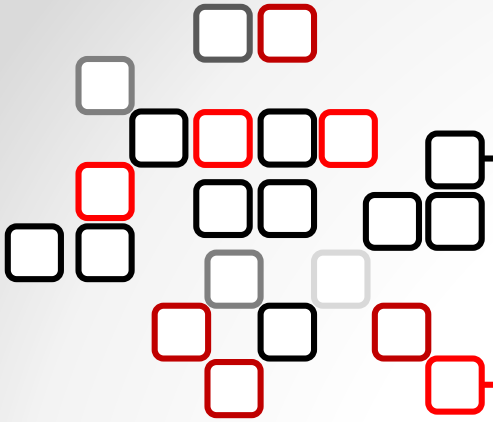
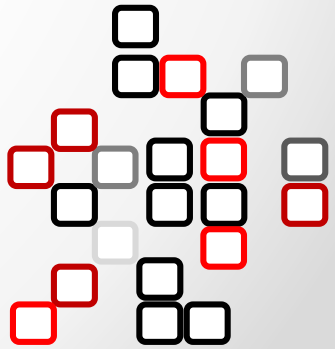


Autonomous Systems

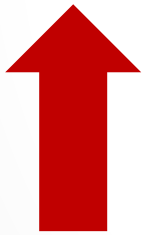
Lecture 07
Introduction into the AML
Part 01



Martina Husáková, 2017/2018

Content of the lecture

- Introduction into the AML
- StarUML
- Entity diagram
- Society diagram



Modelling architecture of MAS

The Agent Modelling Language (1)

- **The AML is used for conceptual modelling of multi-agent systems (MAS) – systems consisting of particular autonomous units – agents**
- **Main aim of the AML: „*To design and specify a semi-formal visual modeling language, called AML, for specifying, modeling and documenting systems in terms of concepts drawn from MAS theory.*“**

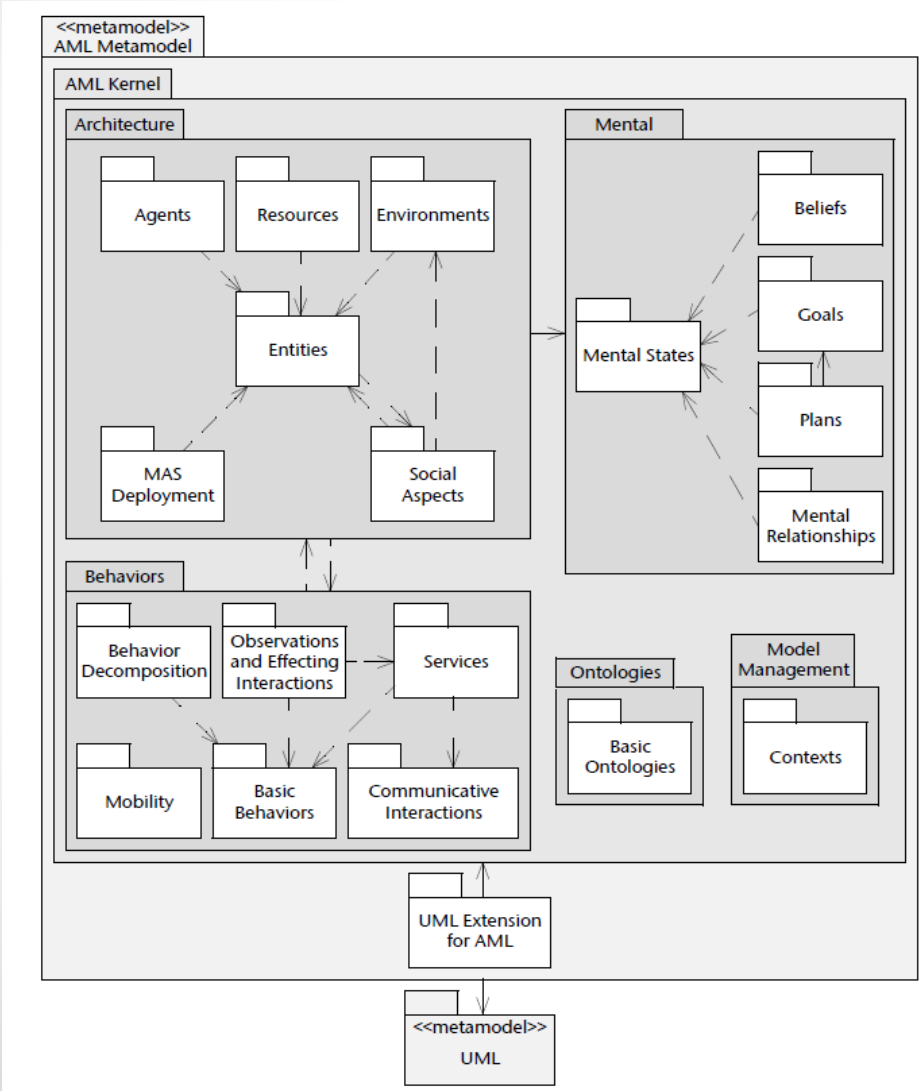
The Agent Modelling Language (2)

- **Why does the AML exist?**
  - **Traditional modelling languages used in software engineering are not enough suitable for MAS, because they do not use explicitly concept of an agent.**
- **The AML integrates the best practices of the agent-oriented software engineering and object-oriented software engineering**
- **The AML is independent on a particular theory, a development process or an implementation tool**

Suitability of the AML

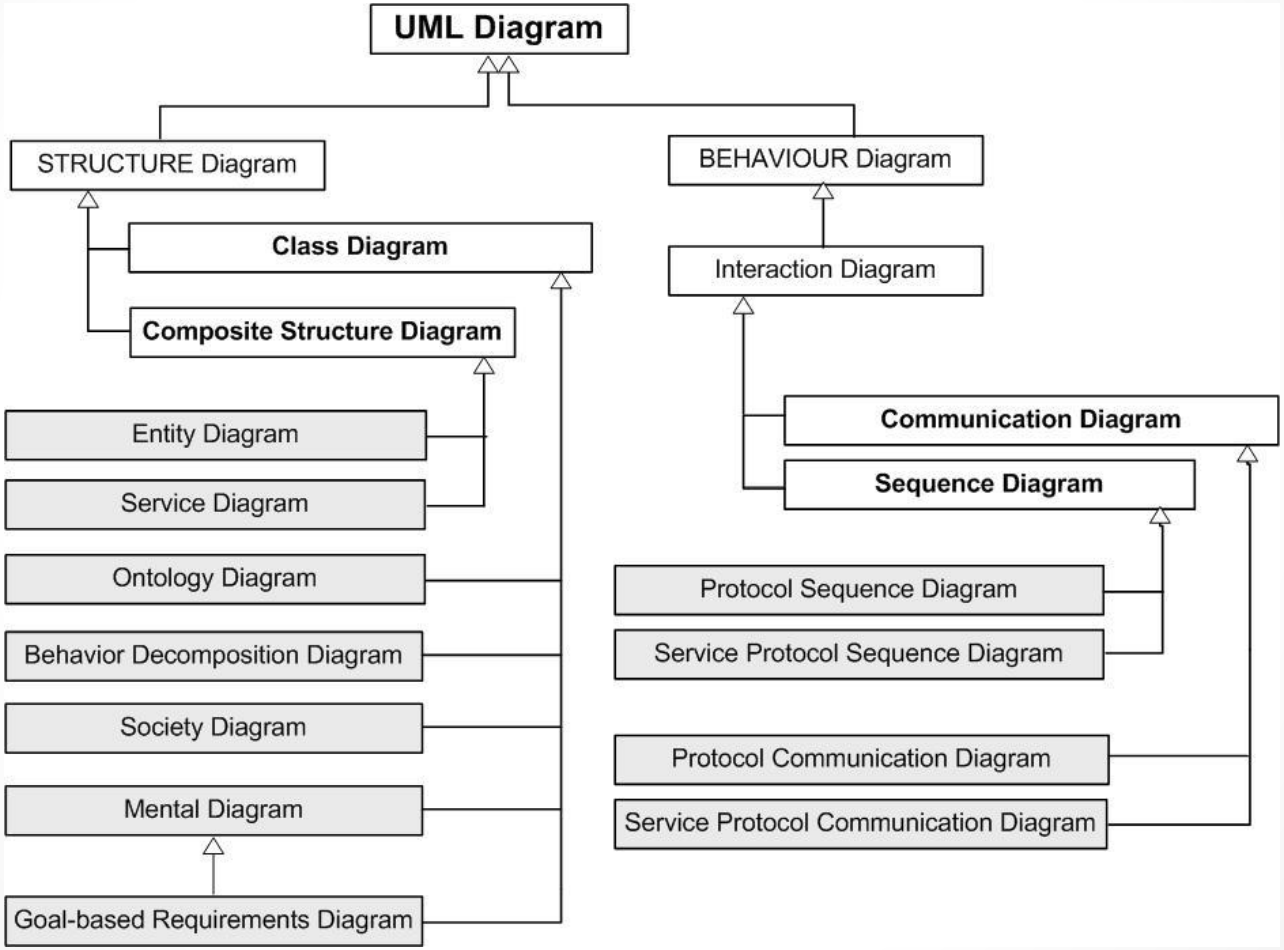
- **The AML is used for modelling systems that:**
  - **consist of several autonomous agents,**
  - **consist of entities able to (pro-actively) interact with other agents and an environment,**
  - **dispose entities able to offer or use services,**
  - **are able to follow own goals and decompose difficult problems into simpler ones,**
  - **consist of entities able to use their mental characteristics for decision making.**

Metamodel of the AML



- Architecture
- Representation of mental characteristics
- Behaviour
- Ontology
- Models management

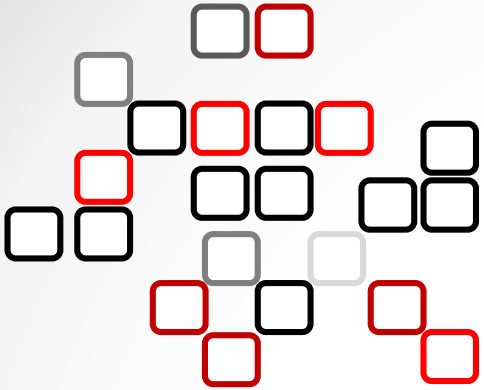
AML diagrams



Citation: Husáková, M.: Conceptual Modelling in Computational Immunology. Bruckner Publishing. Academic Series (2015)

StarUML and AML profile

- StarUML 5.0: Case tool used for analysis and design of multi-agent systems in UML 2.0
- It is extendable by the plugin-based architecture
- AML plugin is available only for the StarUML 5.0
- StarUML 2 Beta has been already publisher, but it does not support the AML language
- AML plugin does not exist for the EA tool
- Download: Ukazky\Husakova.Martina\SoftwareProVyuku\ZT1…



Modelling architecture of the multi-agent system

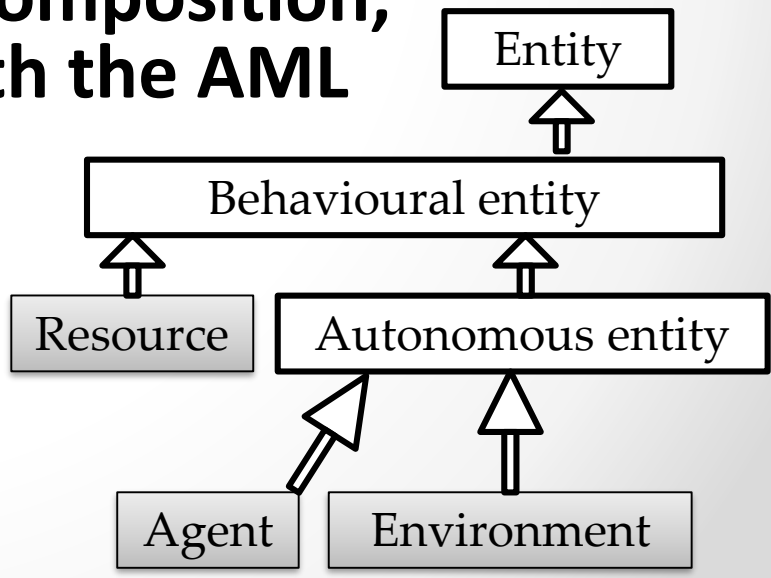
Modelling of the MAS with AML

- **Modelling architecture of the MAS**
  - **Entity diagram**
  - **Society diagram**
- **Modelling architecture of the agent**
  - **Diagram Perceptor-effector**
  - **Service diagram**
- **Modelling interactions**
  - **Sequence diagram**
  - **Communication diagram**

Entity diagram

Introduction

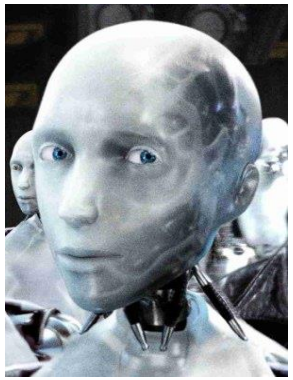
- UML Composite Structure Diagram for modelling architecture of the MAS
- Usage of the diagram:
  - External view: Modelling architecture of the MAS
  - Internal view: Modelling architecture of the agents
- The diagram combines elements of the UML (i. e. association, aggregation, composition, inheritance, UML classes) with the AML
- Entity diagram structure:
  - Agent type
  - Environment type
  - Resource type



Entity diagram
Agent type

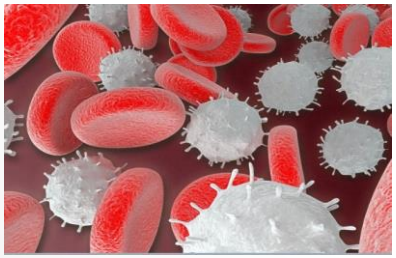
- **Agent: an autonomous unit able to complete tasks and goals**


Agent Smith


Sonny


Frank


Dron


White blood cell
Red blood cell


Vacuum cleaner

Agent: intelligent entity doing non-trivial tasks, ability to learn, make decisions, …

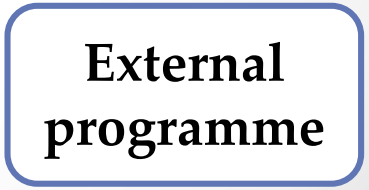
Entity diagram
Environment type

- **Environment: an autonomous unit defining conditions for the existence of agent types/resource types**

http://www.envicrack.cz/envicrack-zivotni-prostredi.html

Entity diagram
Resource type

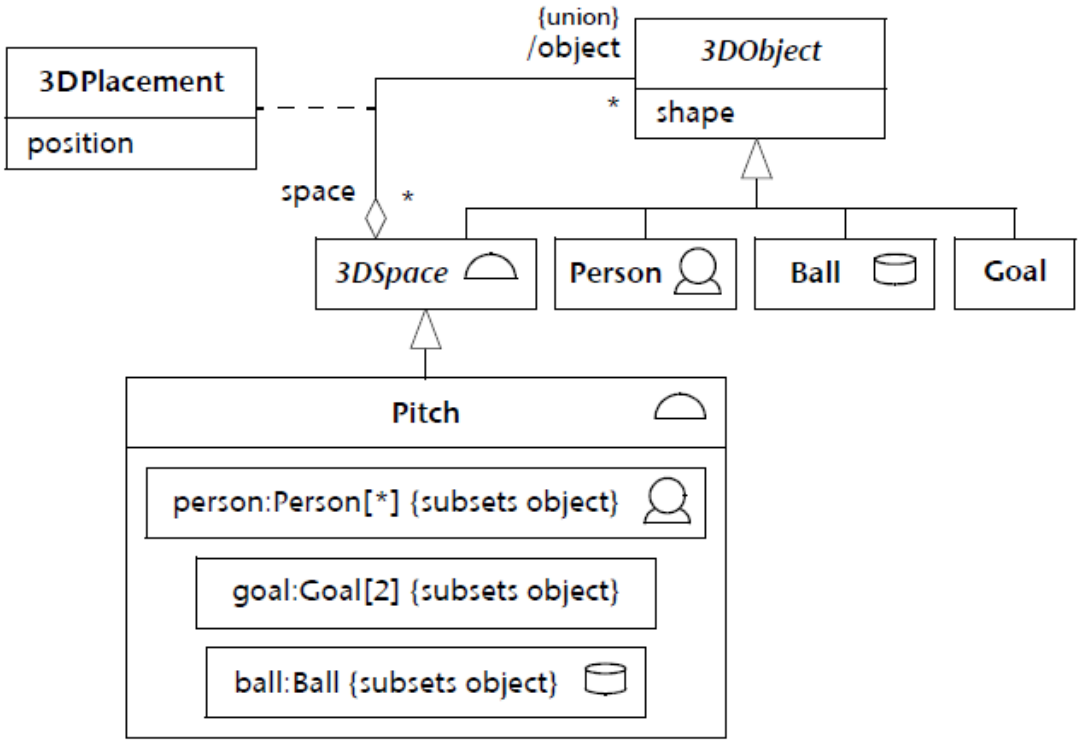
- **Physical or information non-autonomous entity that is used by agent type or environment type**
- **Main attributes:**
  - **Availability**
  - **Usage**
- **We observe an amount, accesibility rights, conditions for their usage, etc.**



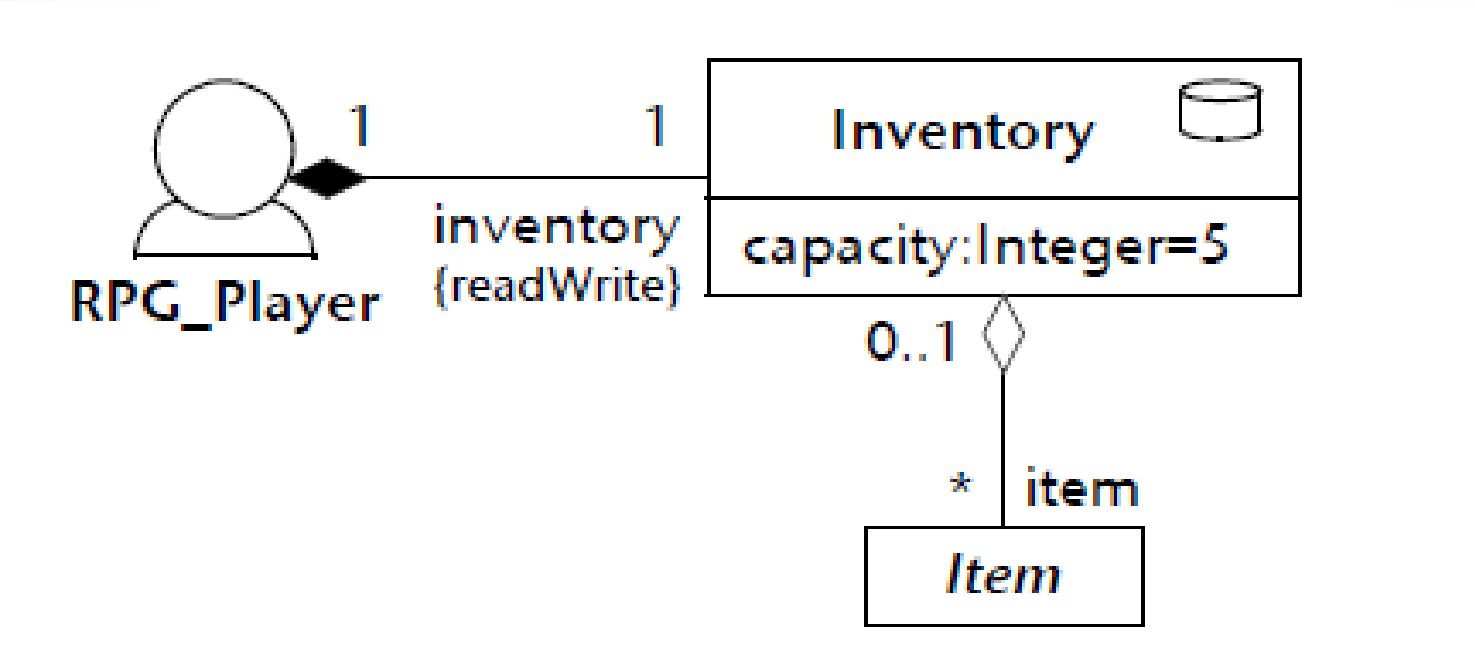
It is used by the agents for goals fulfilment or completing tasks.

Entity diagram Example 1

- Diagram combines entity types with relations between them
- All relations used in the UML can be applied also in the entity diagram



Entity diagram
Example 2



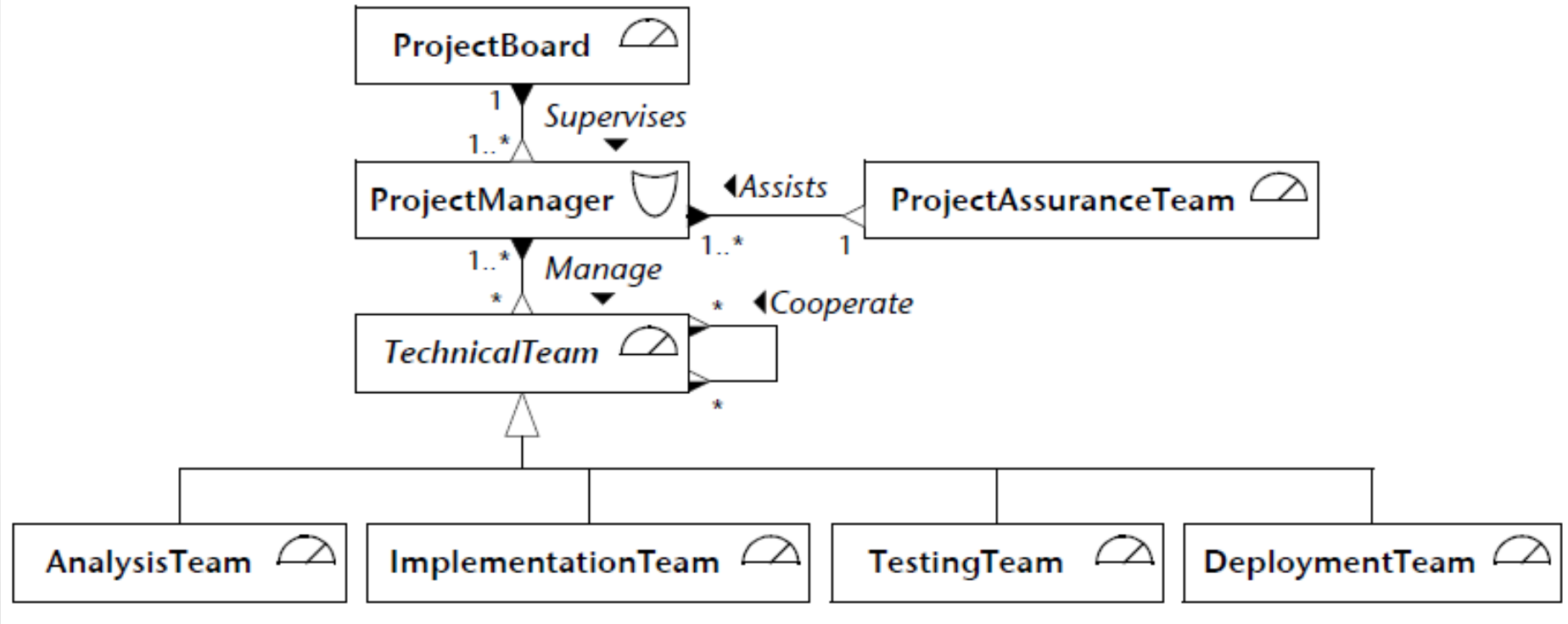
Society diagram (1)
Introduction

- The diagram is based on the UML class diagram
- It is used for modelling social aspects of the MAS
  - Social groups representation
  - Representation of social roles of entity types
  - Relation for playing social roles by entity types
  - Representation of social associations: peer-to-peer, superordinate/subordinate

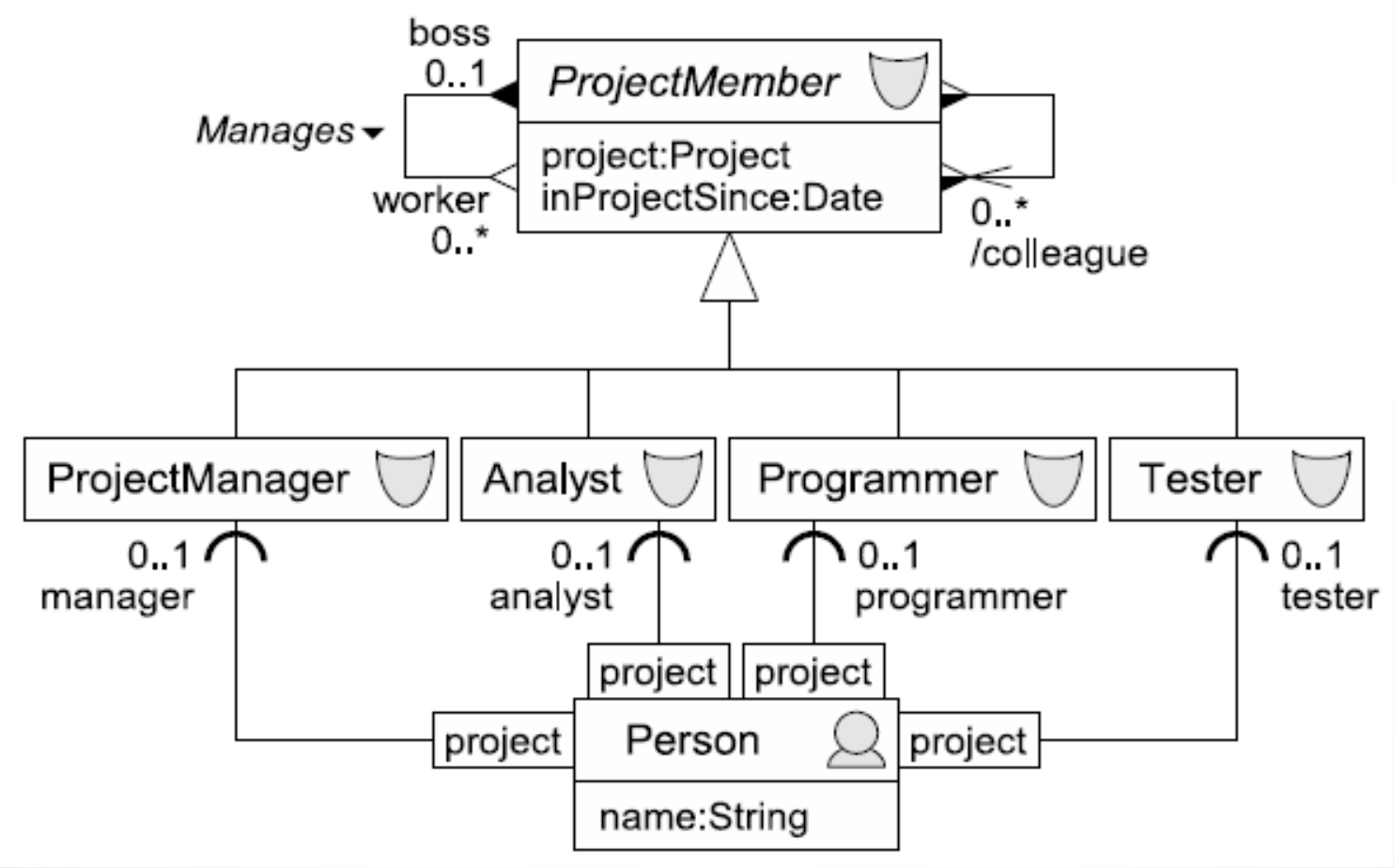
Society diagram (2)
Introduction

- **Used AML elements:**
  - **Organisation unit type: UML class (type of the environment) used for the representation of organisational units (societies)**
  - **Entiry role type: UML class representing a social role type of the entity type**
  - **Social association: UML association for representation of social relations (peer-to-peer, superordinate/subordinate)**
  - **Play association: UML association for representation the situation where entity type plays a social role in a society**

Society diagram
Example 1



Society diagram
Example 2



Literature

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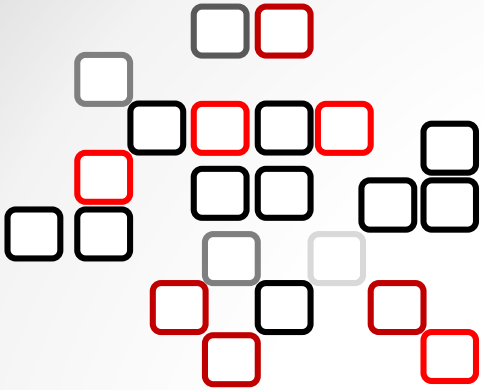

THANK YOU FOR YOUR ATTENTION!