



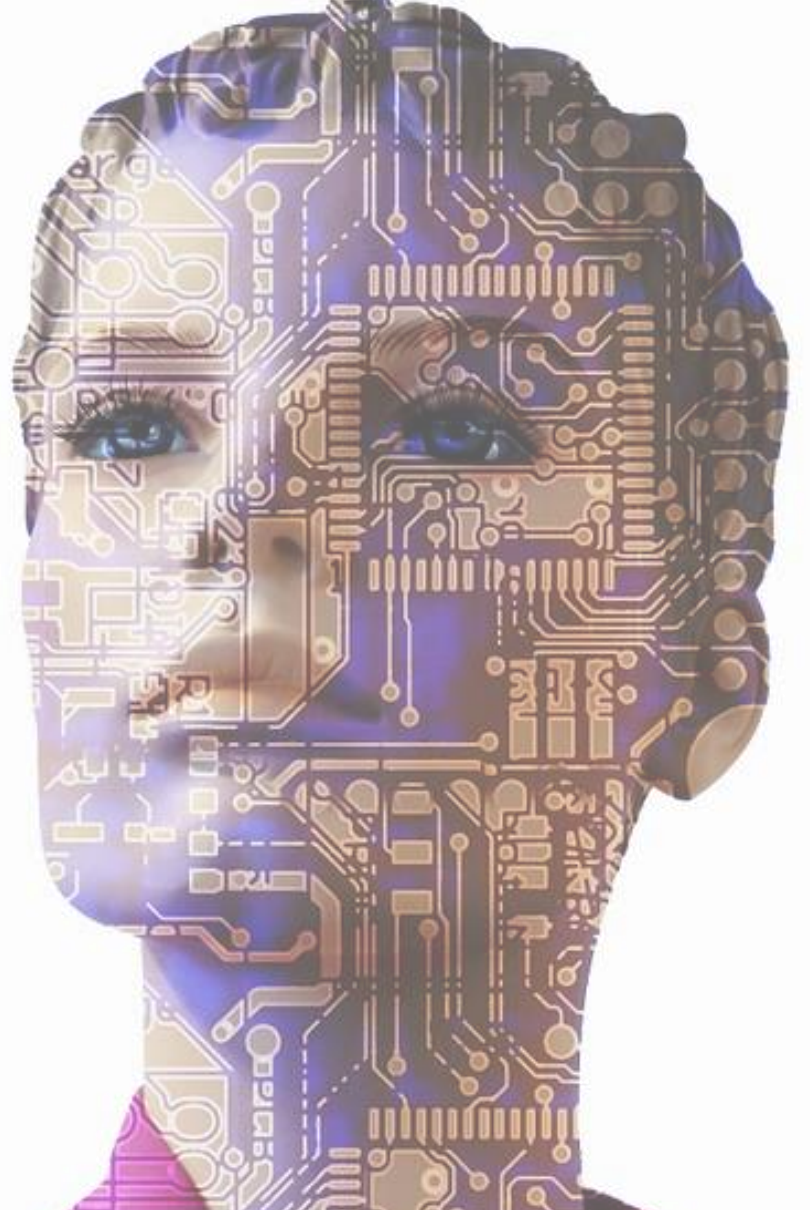
Universidade do Minho
Escola de Engenharia
Departamento de Informática

Mestrado Integrado em Engenharia Informática
Mestrado em Engenharia Informática
Agentes Inteligentes
2020/2021

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Agent UML



Unified Modeling Language (UML) applied in object-oriented software modeling (adopted by OMG in November 1997)

AUML: UML Variations and Extensions for Agent Activity Modelling

- FIPA (www.fipa.org)
- OMG_AUML Agent Group
- Interaction Protocol Representation for Agents

AUML – Agent UML

- The goal of AUML is to develop a formal specification of agent interaction protocols (AIP).
- UML sequence diagram adaptation to model agent interactions
- This was followed by the adaptation of other diagrams

UML Representation Extensions:

- “Packages”
- Templates
- Sequence Diagrams
- Collaboration Diagrams
- Activity Diagrams
- State Diagrams
- Class and Object Diagram

AUML – Agent UML

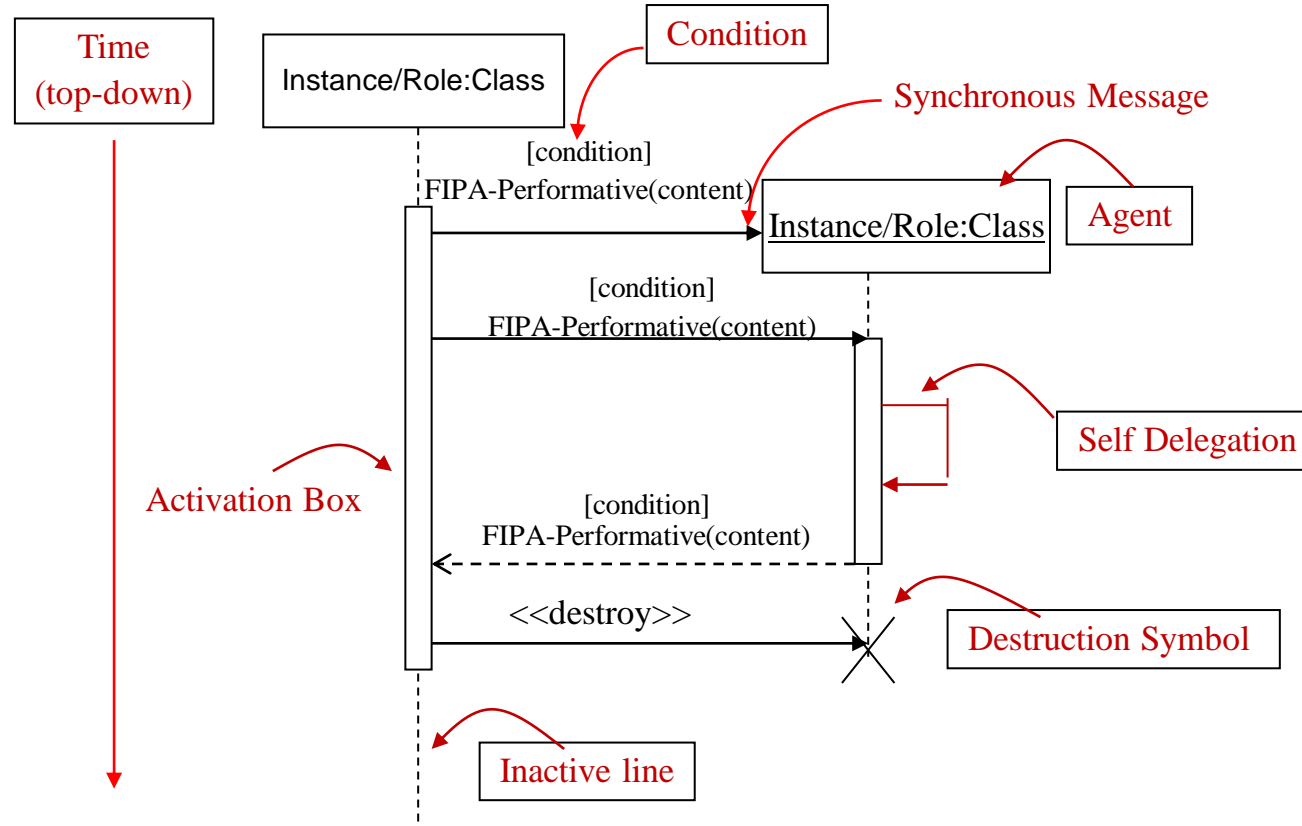
AUML models application:

- Agent Interaction Protocols (AIP) Specification
- More detailed specification of the invocation of shares
- Package Extension
- Deployment Diagram Extension

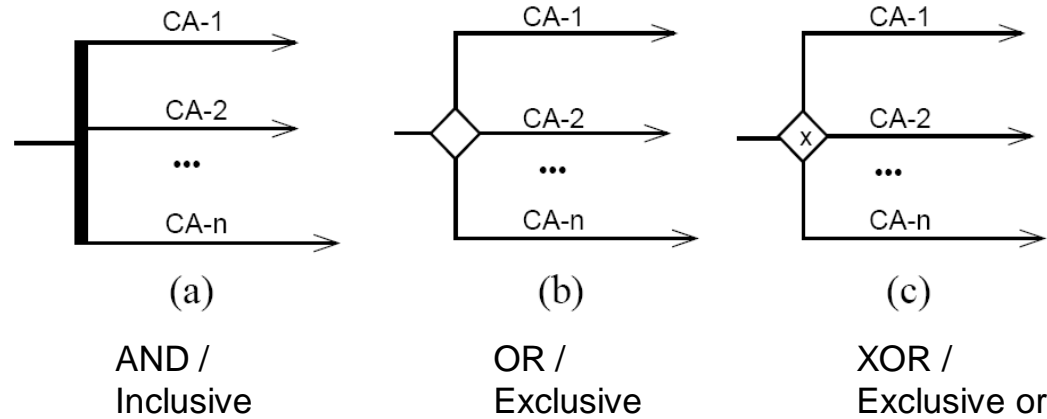
AUML takes a layered approach to protocols:

- **Level 1:** Represents the general protocol (templates, modeling diagrams)
- **Level 2:** Represent agent interactions (sequence, collaboration, activity diagrams)
- **Level 3:** Represent internal agent processing (activity diagrams and statecharts)

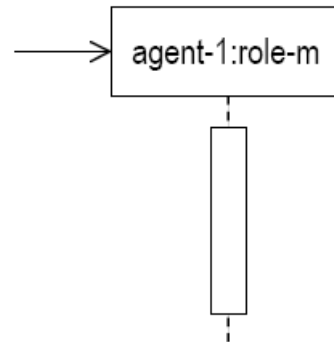
General Diagram Structure



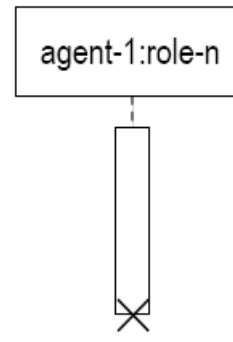
Message Transmission



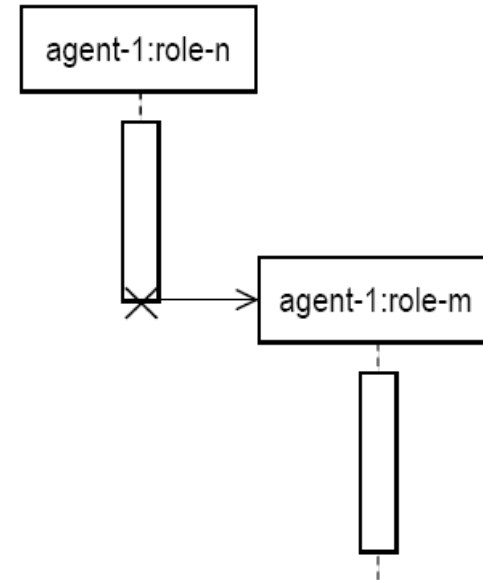
Agent States



(a) Classification

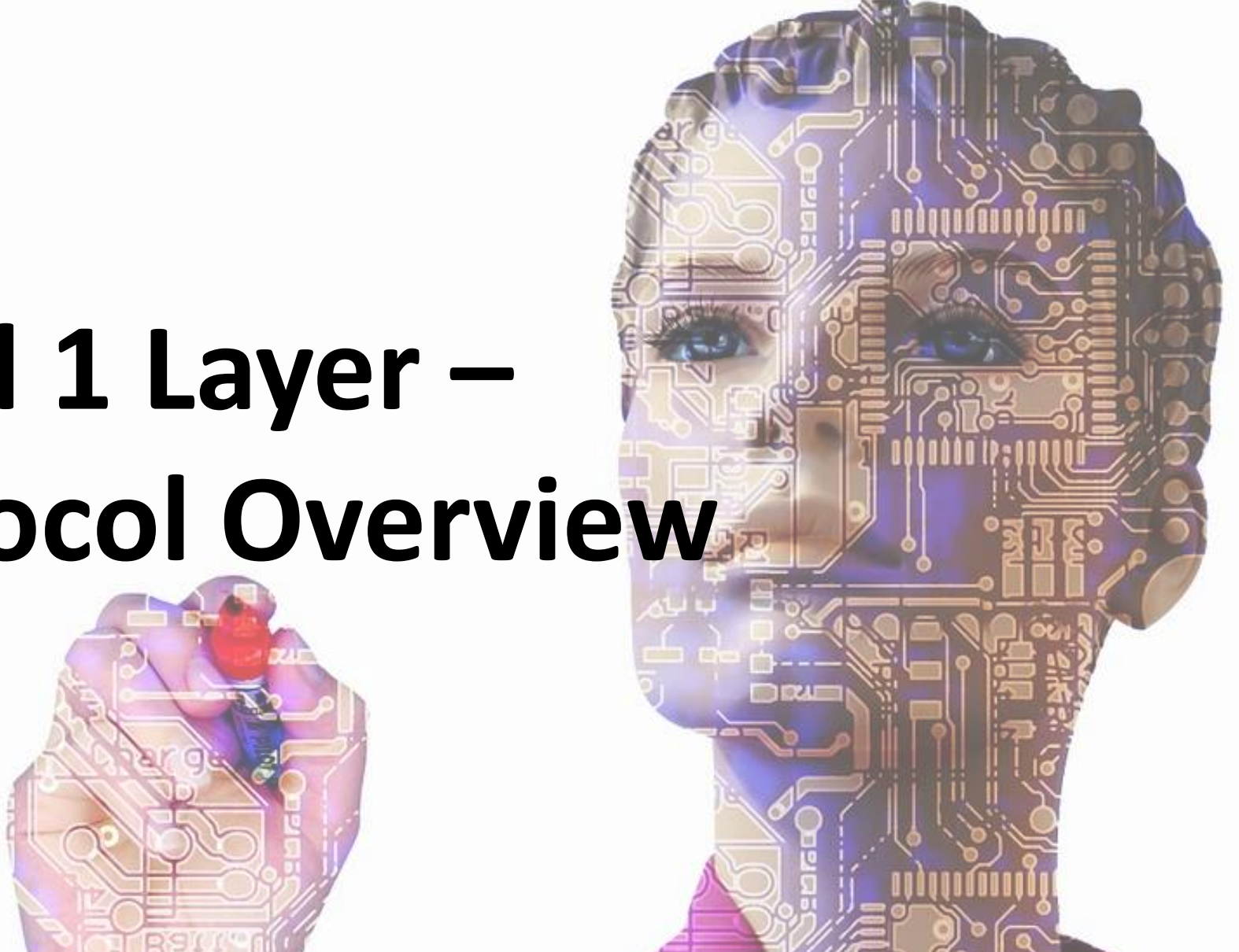


(b) Declassification



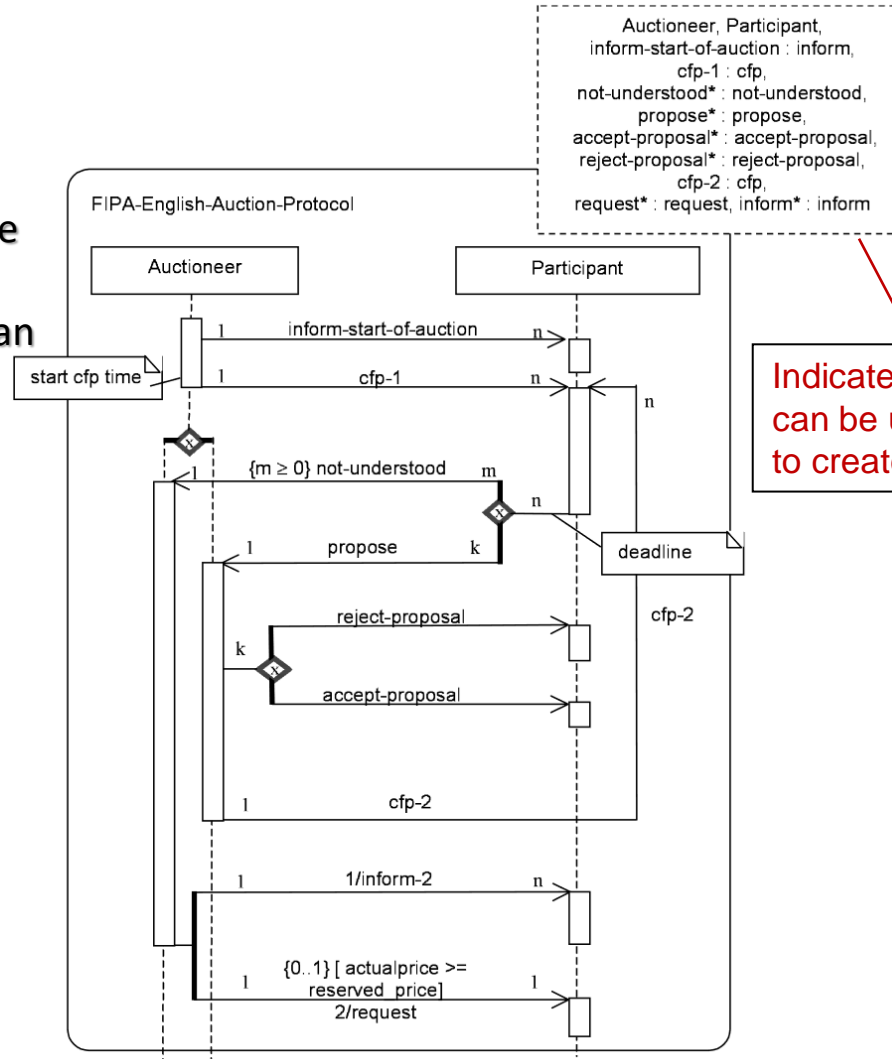
(c) Reclassification

Level 1 Layer – Protocol Overview

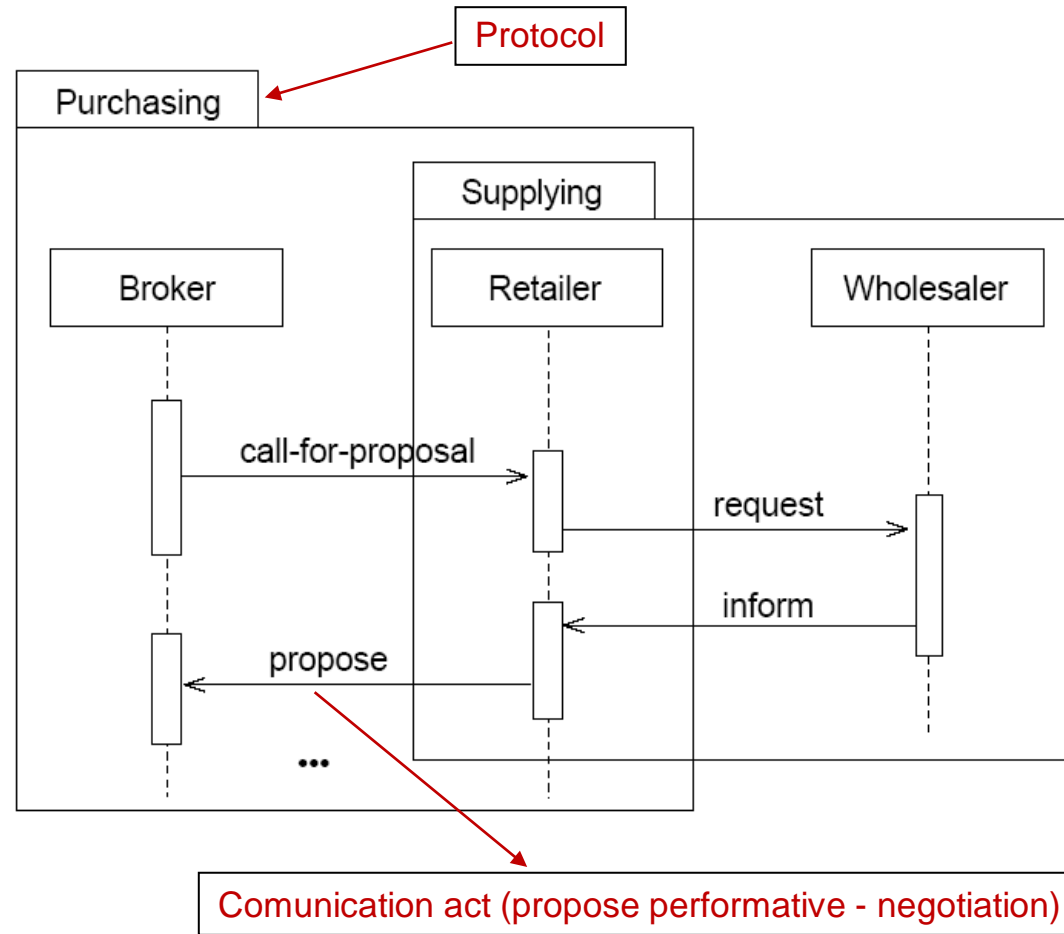


Templates Modeling

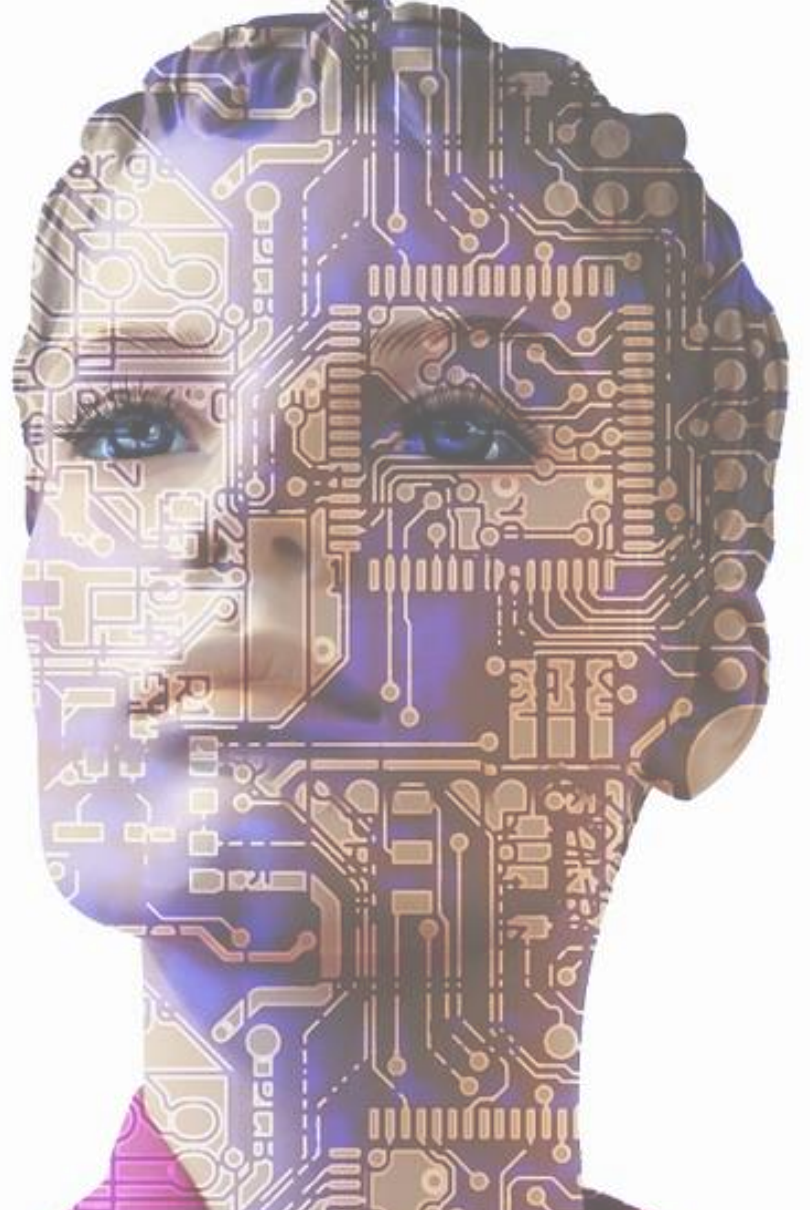
- Applied to create reusable patterns for concrete protocol instances
- The protocol can be treated as a pattern that can be customized for other problem domains



Packages Modeling

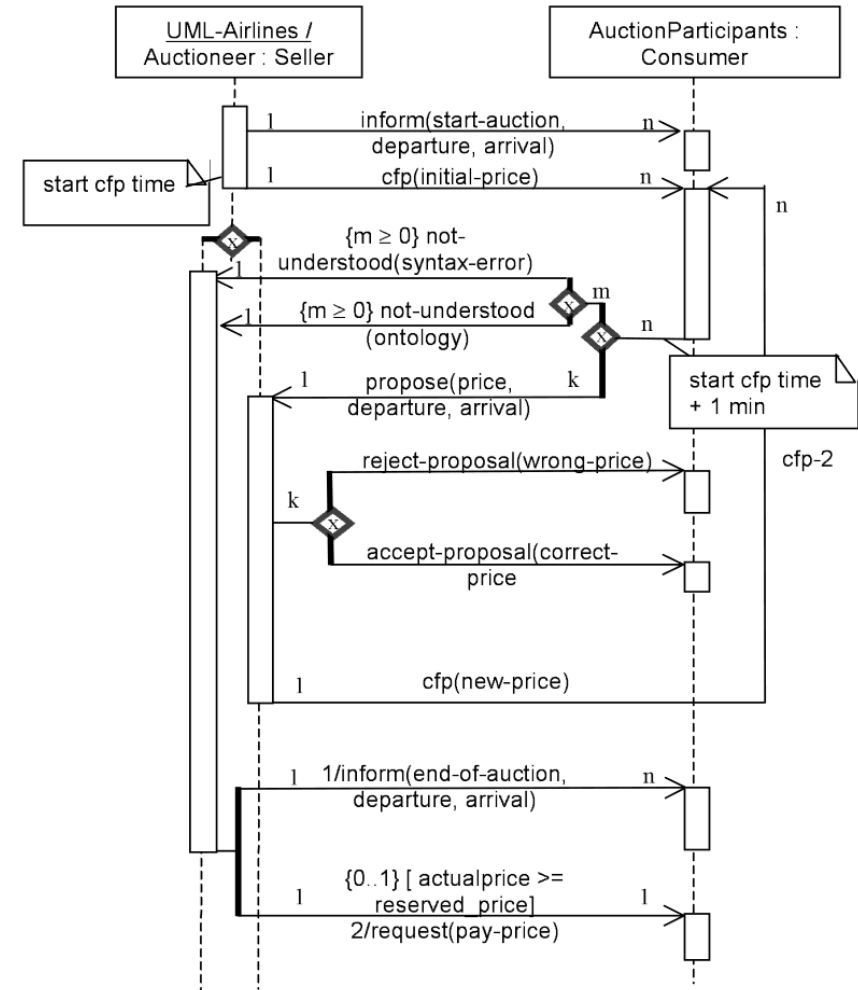


Level 2 Layer – Interaction



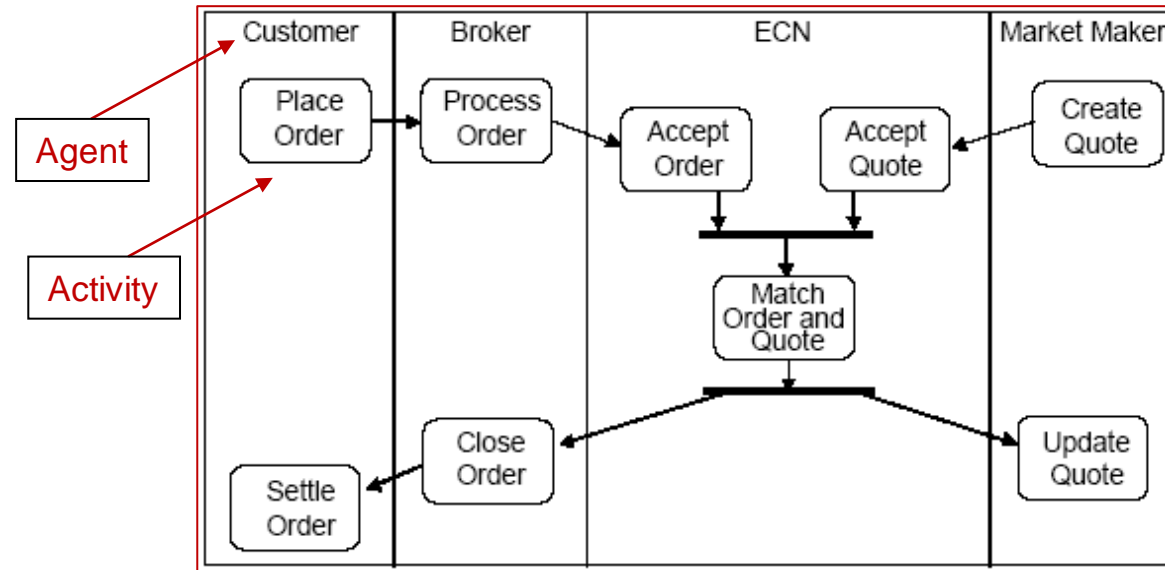
Sequence Diagram

- Defines the behaviour of object groups
- Basic interactions between objects at method invocation level
- In AUML, they enable demonstration of interactions / communications between System Agents

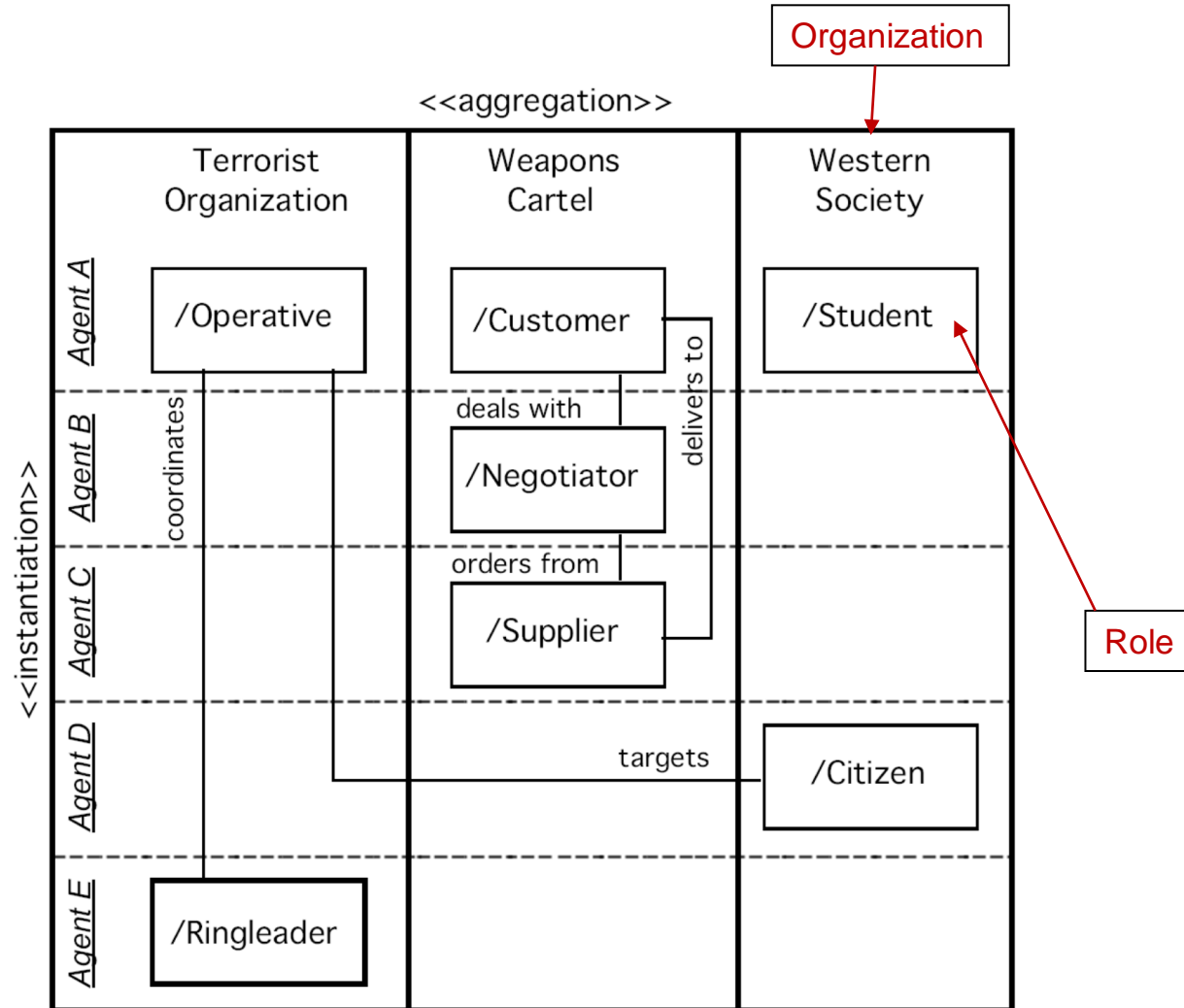


Activity Diagram

- Applied to represent the activities associated to a protocol or to an agent's activity
- Useful to plan complex interaction protocols that involve parallel processing

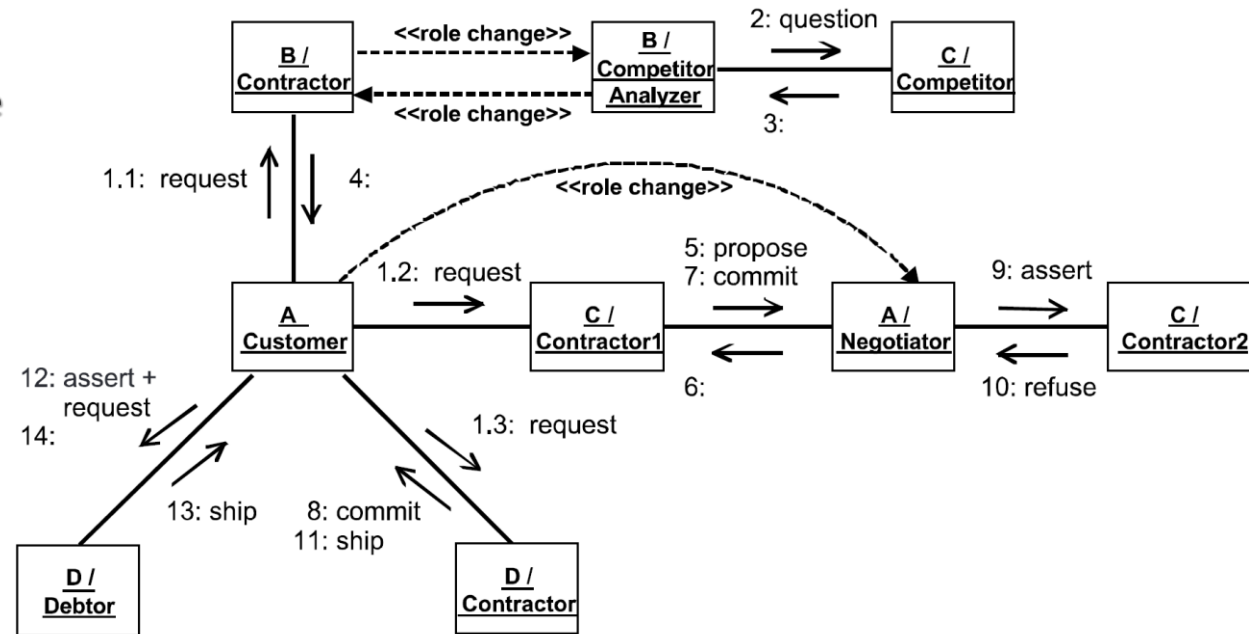


Activity Diagram



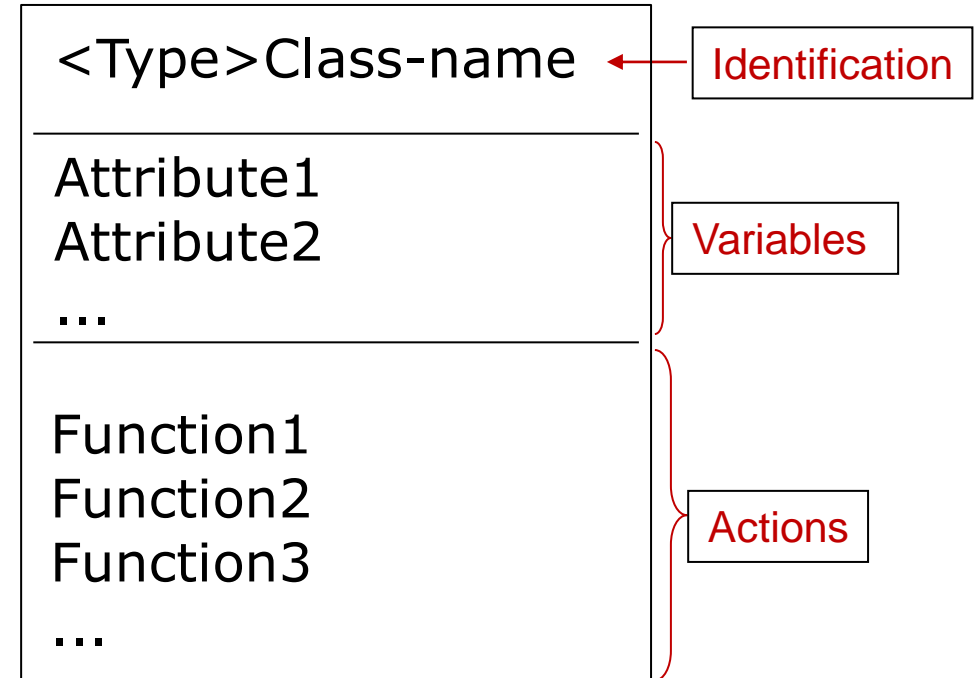
Collaboration/Communication Diagram

- Similar to sequence diagram
- Presents a clear and understandable representation of the system
- Sequence of interactions are numbered on the collaboration diagram

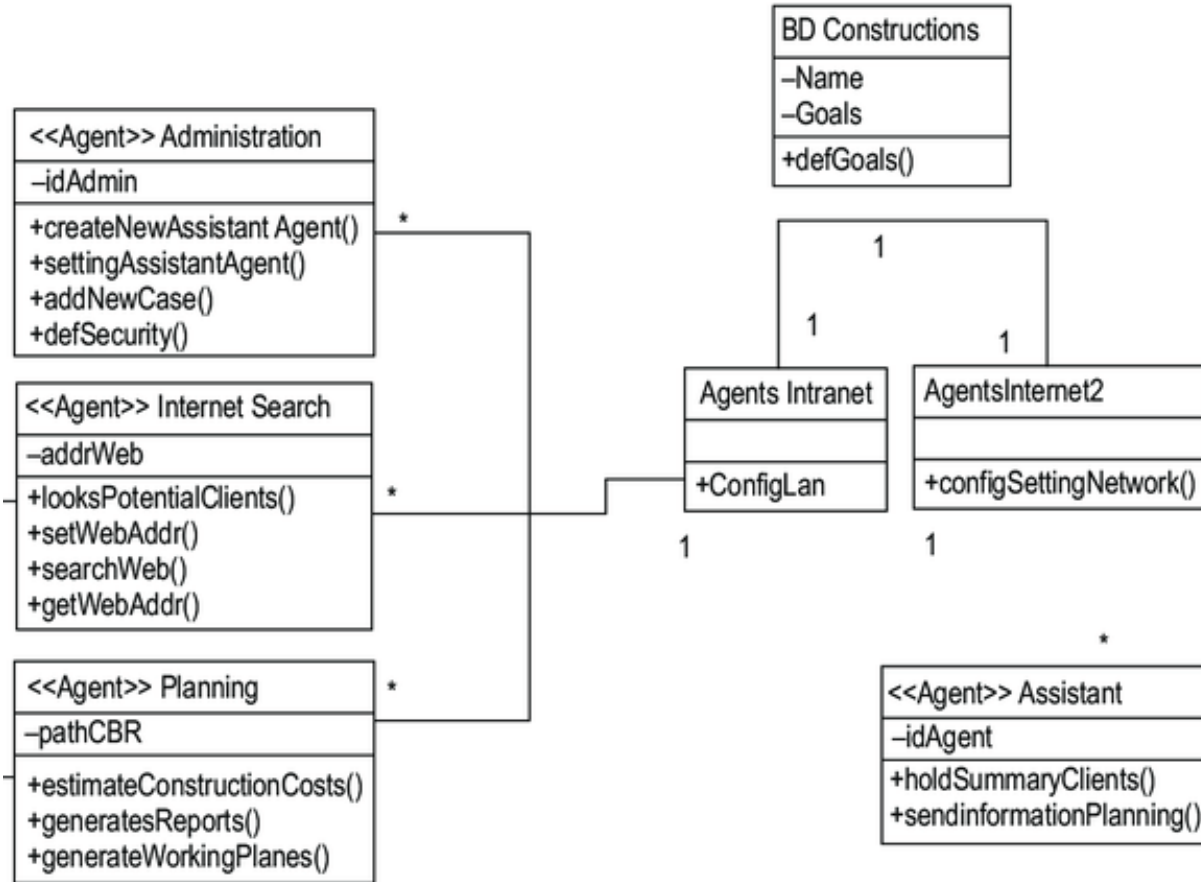


Class Diagram

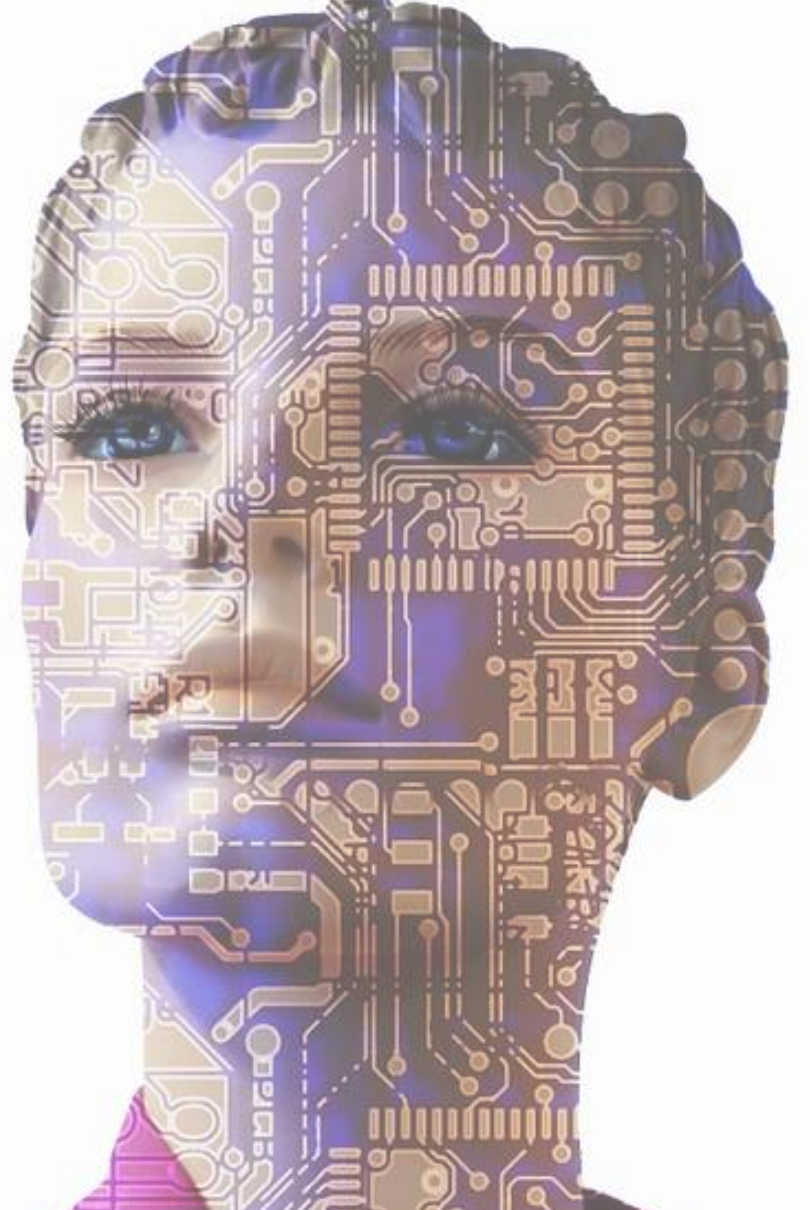
Class Diagrams are used to model the problem's dominion and agent-class implementation



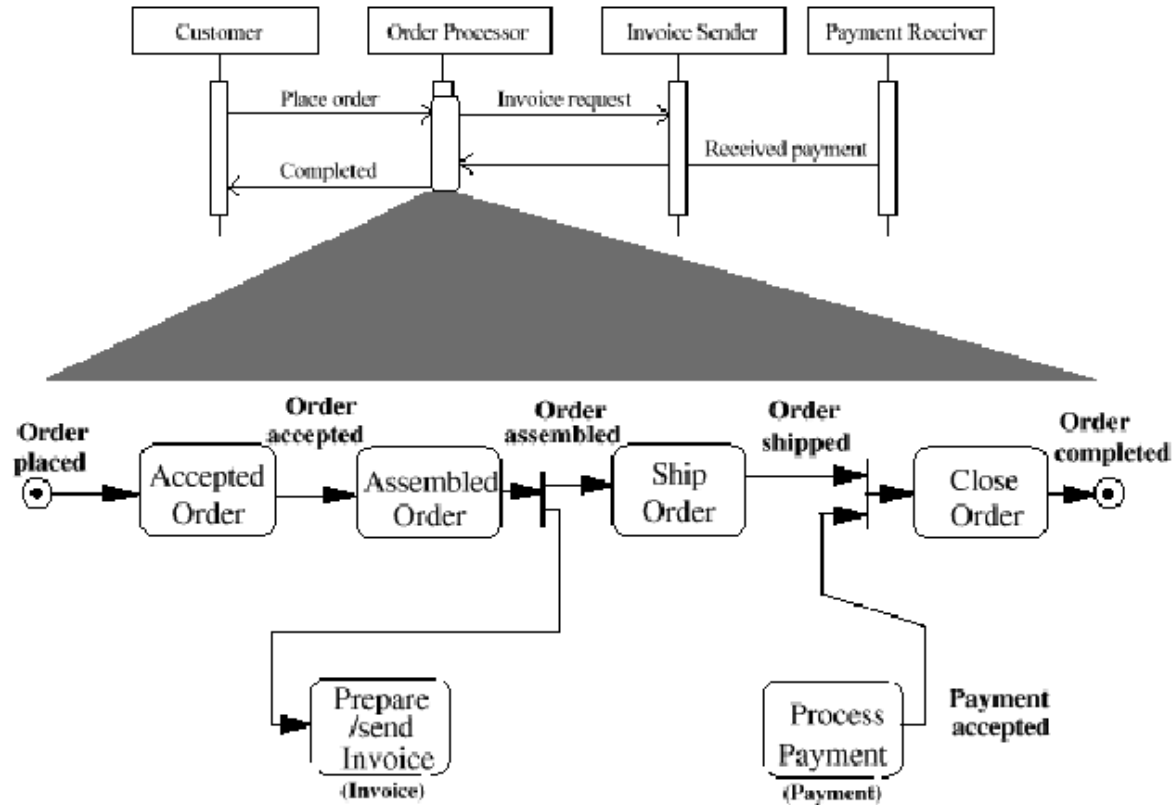
Class Diagram



Level 3 Layer – Internal Process

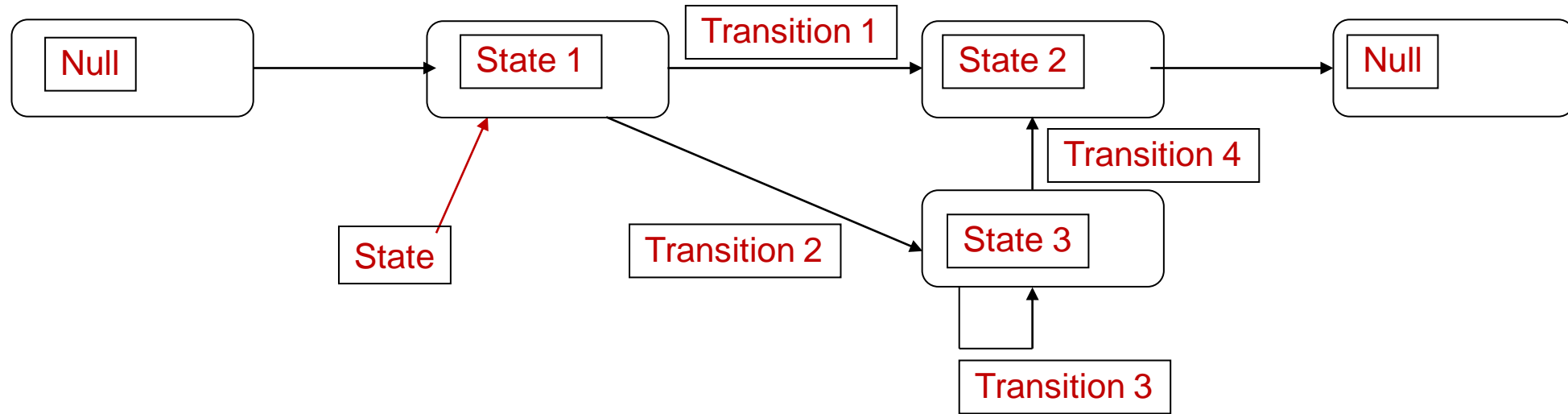


Level 3: Agent's Internal Process

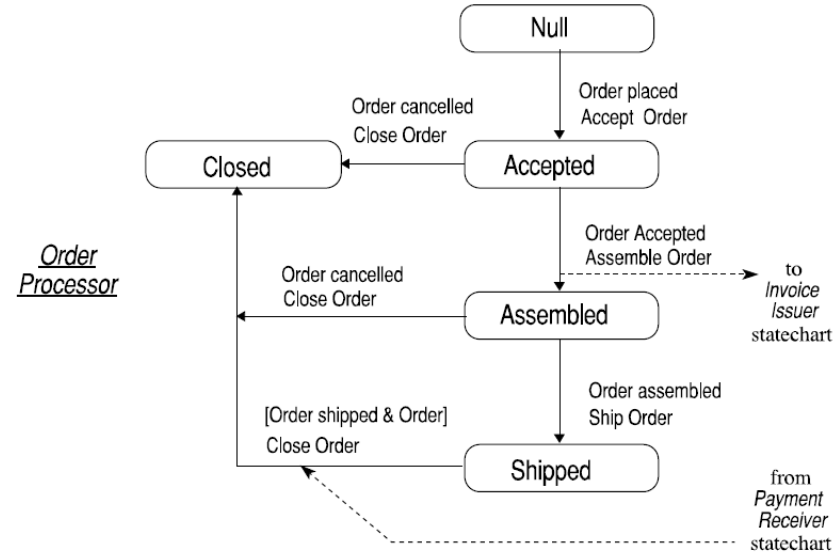


Statecharts

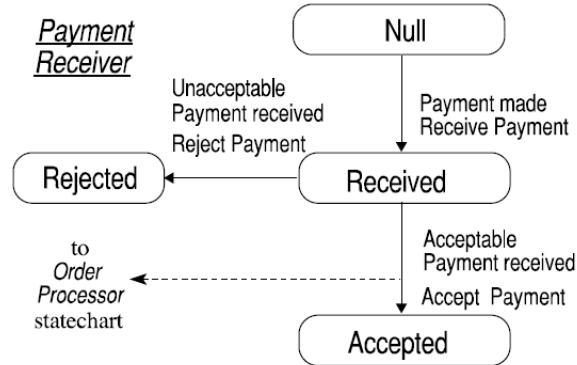
- The internal processing of a single agent can be expressed as statecharts
- Statecharts specify order processing behaviour for the different agents



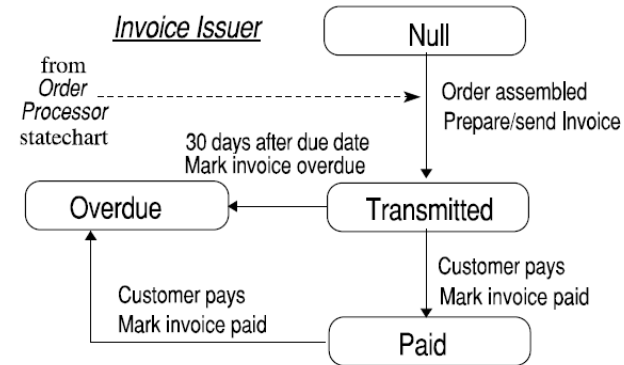
Statecharts



(a)



(b)



(c)

Conclusions

UML extension mechanisms provide formalisms to specify Agents interaction to several levels:

- Specify protocols as a whole
- Express interaction patterns between Agents
- Express the internal behaviour of an Agent
- Formalization of Agents requirements and APIs important for the development & implementation of Multi-agent Systems

▪ **Software Requirements:**

- Download and install Visual Paradigm Community Edition
 - <https://www.visual-paradigm.com/download/community.jsp>

▪ **Review:**

- AUML Manual: <http://www.jamesodell.com/ExtendingUML.pdf>
- *Buyer-Seller.vpp* project presenting the AUML diagrams regarding the first Buyer-Seller JADE exercise.

▪ **Exercise:**

- Develop the following AUML diagrams to represent the previous exercise, Taxi System:
 - Collaboration Diagram
 - Activity Diagram
 - Class Diagram



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