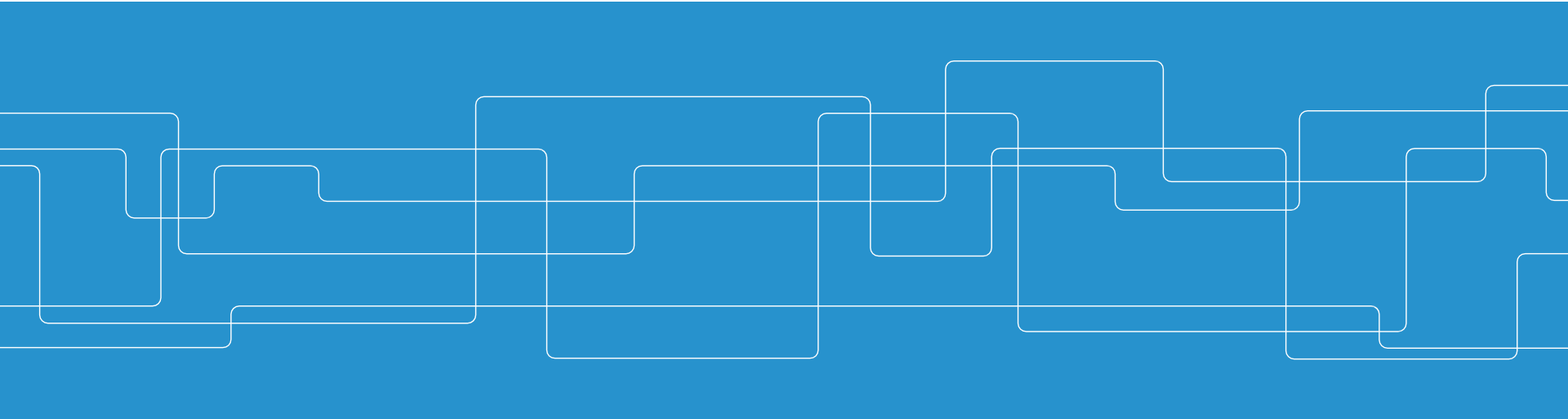
ID2209 Distributed Artifical Intelligence and Intelligent Agents

Project Description



Project Introduction

- Topics covered in this session:
  - Agent Oriented Software Engineering (AOSE)
    - Using GAIA AOSE model
  - Reusing concepts learned throughout homeworks so far

Materials needed

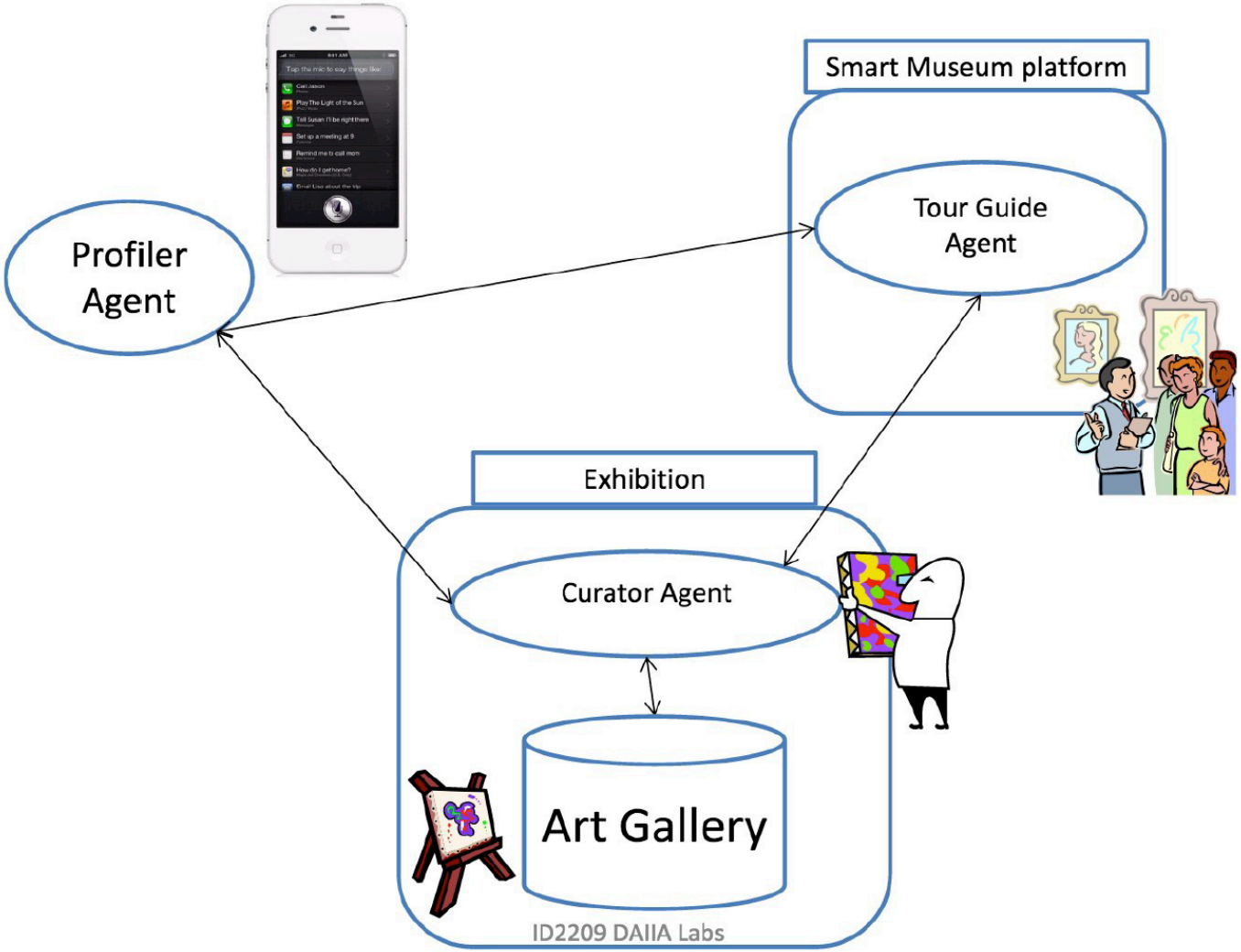
- **You can download them from Canvas – Modules/Project:**

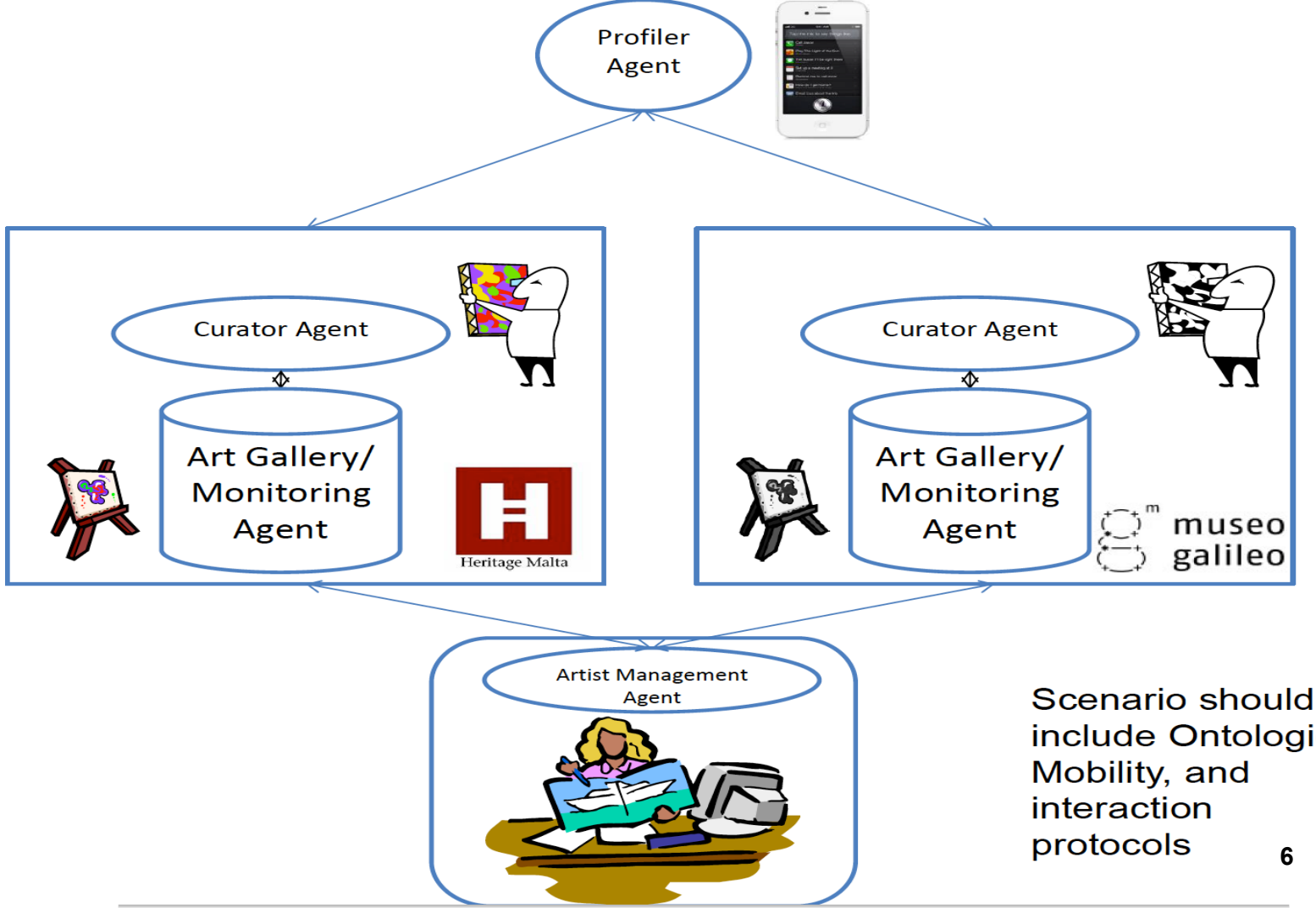
1. "*Representing Agent Interaction Protocols in UML*"
2. "*UML Class Diagrams Revisited in the Context of Agent-based Systems*"
3. "*ROMAS: a role-based modeling method for multi-agent system* "
4. "The Gaia Methodology for Agent-Oriented Analysis and Design"
5. "From m-GAIA To Grasshopper: Engineering Mobile Agent ApplicaQons"

1. Reference materials:
    - Course Book + Slides of "Agent Oriented Software Engineering"

Goal

Objective of the project is to model the following Smart Museum scenario using GAIA AOSE.


Smart Museum platform
Profiler Agent
Tour Guide Agent
Exhibition
Curator Agent
Art Gallery
ID2209 DAIIA Labs



Scenario should include Ontologies, Mobility, and interaction protocols

Task 1

- Task 1. Model your system via GAIA AOSE Methodology

Check the following two references uploaded in Canvas:

1. GAIA

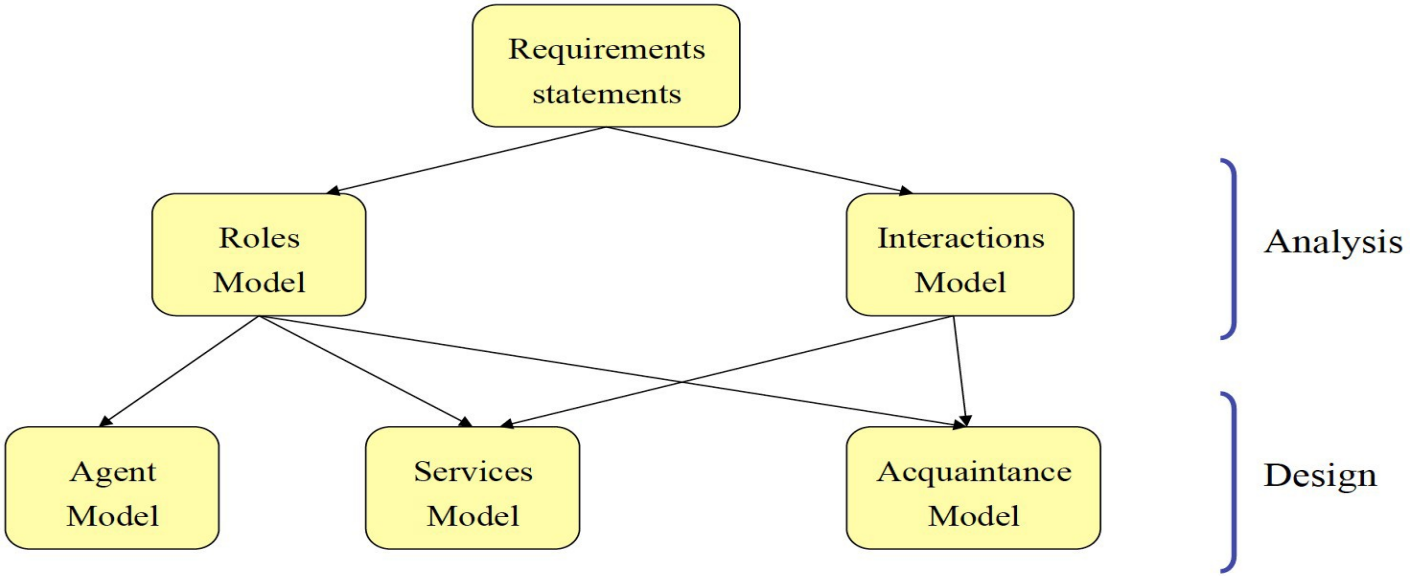
And for the “Mobility Model” refer to:

2. Mobile GAIA

Task 1

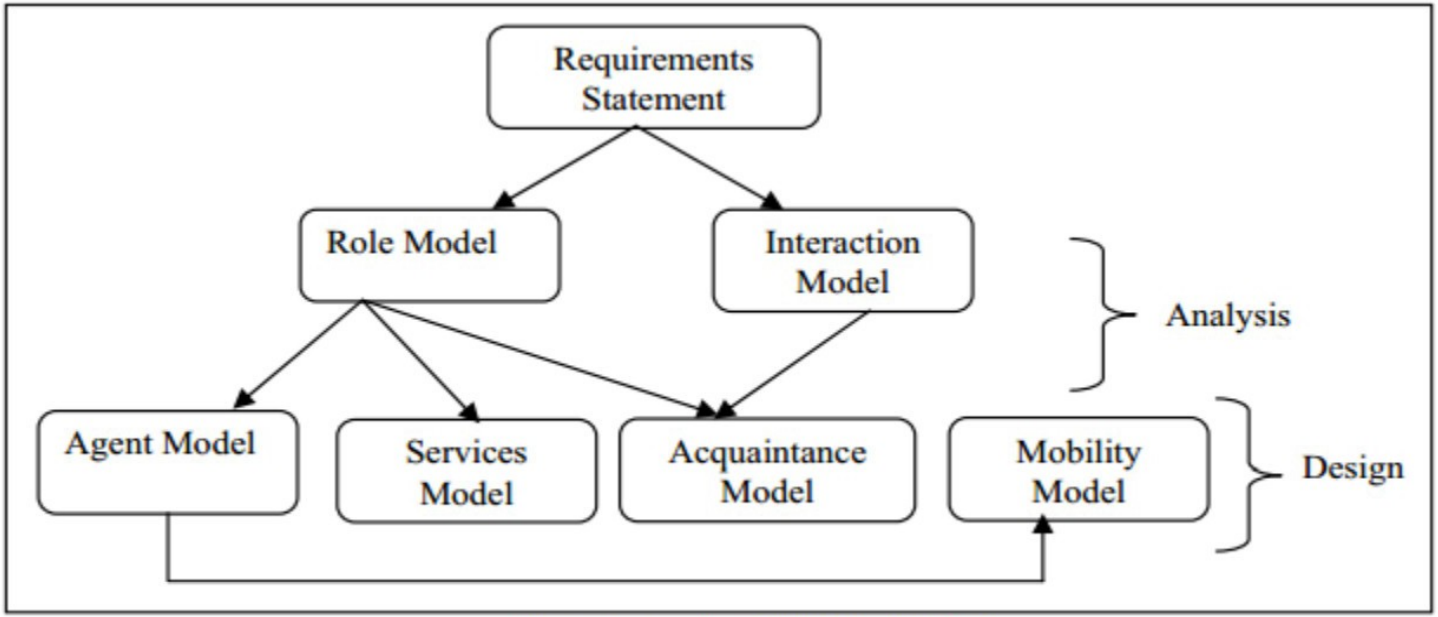
Gaia Methodology

Relationships between Gaia Models



Mobile GAIA

The mobility scenarios are supported in the extended model m-GAIA (mobile GAIA), which includes the mobility model, **that identifies the movement and travel path of each mobile agent.**



Structure of m-GAIA's Models

Task 1

Expected Output:

1. **Requirements Statement** (Use your knowledge from previous homeworks – the previous scenarios supported interaction and mobility between agents).

   virtual tour, Dutch auction, intra-platform auctions

   Expected: one (long) or two paragraphs describing the virtual tour, Dutch auction, and mobility in the context of multi-agent systems.

Task 1

1. Roles Model

Check the “GAIA” reference in Canvas

Role Schema:	*name of role*
Description	*short English description of the role*
Protocols and Activities	*protocols and activities in which the role plays a part*
Permissions	*“rights” associated with the role*
Responsibilities	
Liveness	*liveness responsibilities*
Safety	*safety responsibilities*

Task 1

Example for a Role Schema:

Role Schema: AUCTIONEER - ***system***

Description:
Responsible for initiating an auction, processing proposals, modifying quote price, and terminating the auction either by accepting the best bid or by informing participants of no suitable bids when exceeding reserve price.

Protocols and Activities:
GeneratePriceService, InformStartAuction, RequestForProposals, AwaitBids, ReplyToBids, InformNoBids, InformSuccessfulBid

Permissions:

reads	**supplied** bidderProposal
generates	quotePrice

Responsibilities:

Liveness:

AUCTIONEER = AuctionProcess
AUCTIONPROCESS = GeneratePriceService . InformStart. GenerateProposalResult
GENERATEPROPOSALRESULT = (RunProposalCycle)+ . InformSuccessfulBid |
(RunProposalCycle)+ . InformNoBids
RUNPROPOSALCYCLE = (RequestForProposals . AwaitBids . ReplyToBids)

Safety:

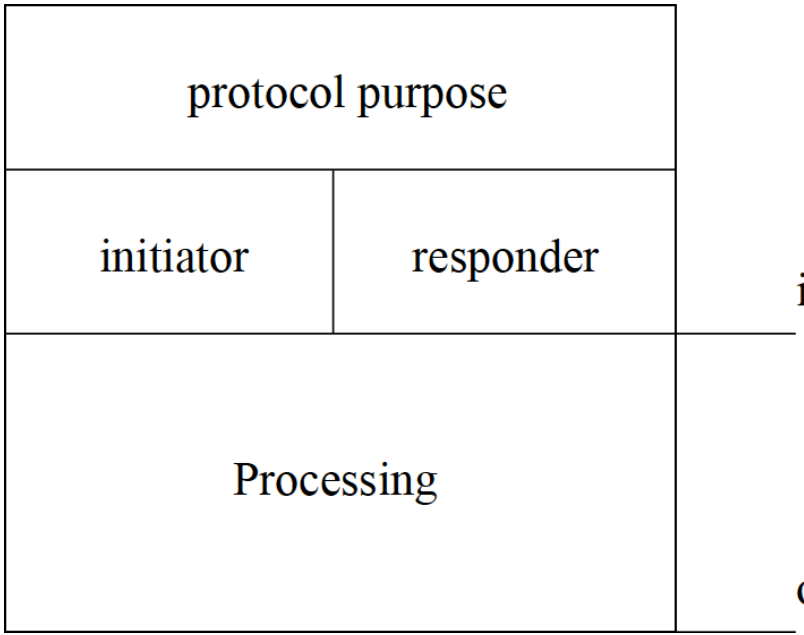
- quotePrice < reservePrice => auctionStatus = Terminated
- proposalPrice < quotePrice => proposalAcceptance = false

Schema for role AUCTIONEER

Task 1

3. Interaction Model

Example of protocol definition:



Purpose: description of the nature of interaction

Initiator: the role that starts the protocol

Responder: the role with which the initiator interacts

Inputs: information used by the initiator while performing the protocol

Outputs: information supplied by/to the protocol responder during the interaction

Processing: description of activities performed during the interaction

Task 1

Example - **Interaction Model**

RequestForProposal		
Auctioneer	Bidder	price Participating bidders' addresses
Request for proposals for a product with certain price		Request message

ReceiveProposals		
Bidder	Auctioneer	Request for proposal price
Receive request, check their values and compare with the expected quote price and replies with a proposal		propose message

Analysis Process

Objective: to develop an understanding of the system and its structure.

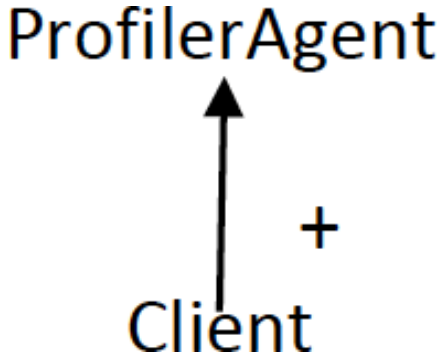
Steps	Output
1. Identify roles	Roles model
2. For each role, identify associated protocols	Interaction model
3. Using the protocol/interaction model as basis, elaborate role model	Fully elaborated roles model (with permissions, responsibilities, etc.)

Task 1

4. Agent Model

Identification of the agent types that will be used in the system, and the agent instances that will realise these agent types at run-time

Example:



+ ➔one or more instances at run time

Task 1

5. Service Model

For each protocol, you identify the services, and for each service: input, output, precondintions , and postconditions

Example of one service for this protocol:

Auctioneer protocol services:

Service	Input	Output	Preconditions	Postconditions
Send inform start of auction message	Bidders' addresses	Inform message	Bidders registered at the DF	Bidders informed of start of auction

Task 1

6. **Acquaintance Model**

Show the communication links between the agents: profiler, curator, tour-guide and artist manager

Expected output: one single graph showing which agents can communicate with each other

Design Process

Step	Output
1. Create agent model	Agent model *(identifies agent types)*
2. Develop service model	Service model *(identifies main services required to realise agent's role)*
3. Develop acquaintance model from interaction model and agent model.	Acquaintance model *(documents the lines of communication between the agents)*

Task 1

7. Mobility Model

Please check "mobile GAIA" reference in Canvas:

a. Identification of place types (example: Museo Galileo Museum).

Example:

Place Type	Description	Instances
Heritage Malta Container	A container where curator agents can reside and get cloned	3 mobile agents (*on assumption that we will clone two participants from the curator agent and one from the artist management*)

Task 1

b. Identification of relationships between agent types and place types

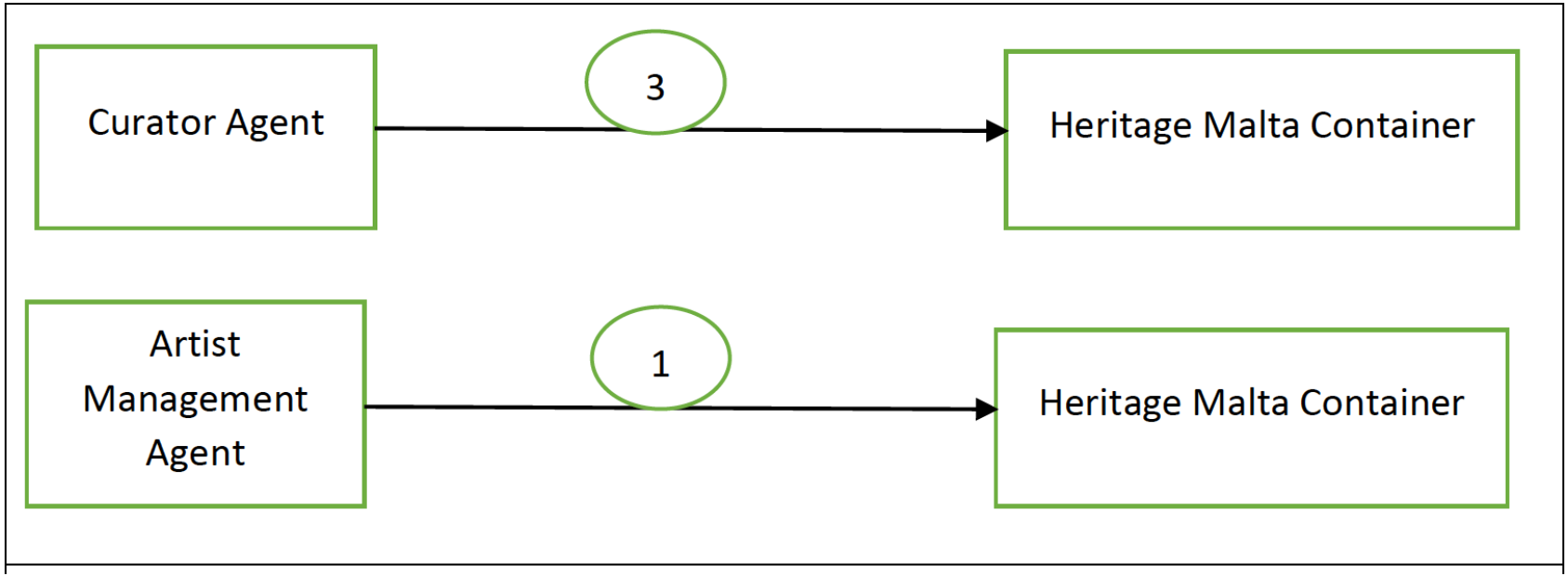
Example:

Agent Type	Mobile	Place Type	Constraints
CuratorAgent	Yes	Heritage Malta Container, Museo galileo Container	

Task 1

c. Definition of the cardinality between agent types and place types

Example:



Task 1

d. Identification of the travel path of each mobile agent

Agent Type	CuratorAgent
Description:	This agent will be cloned to participate in the auction
Origin:	*Heritage Malta container* *Or* *Museo galileo container*
Final Destination:	Same as its origin
List of atomic movement:	*Heritage Malta container* — Cloned in this container *Museo galileo container* — Cloned in this container
Paths:	Cloned in the same container, no paths

Travel schema for Curator agent

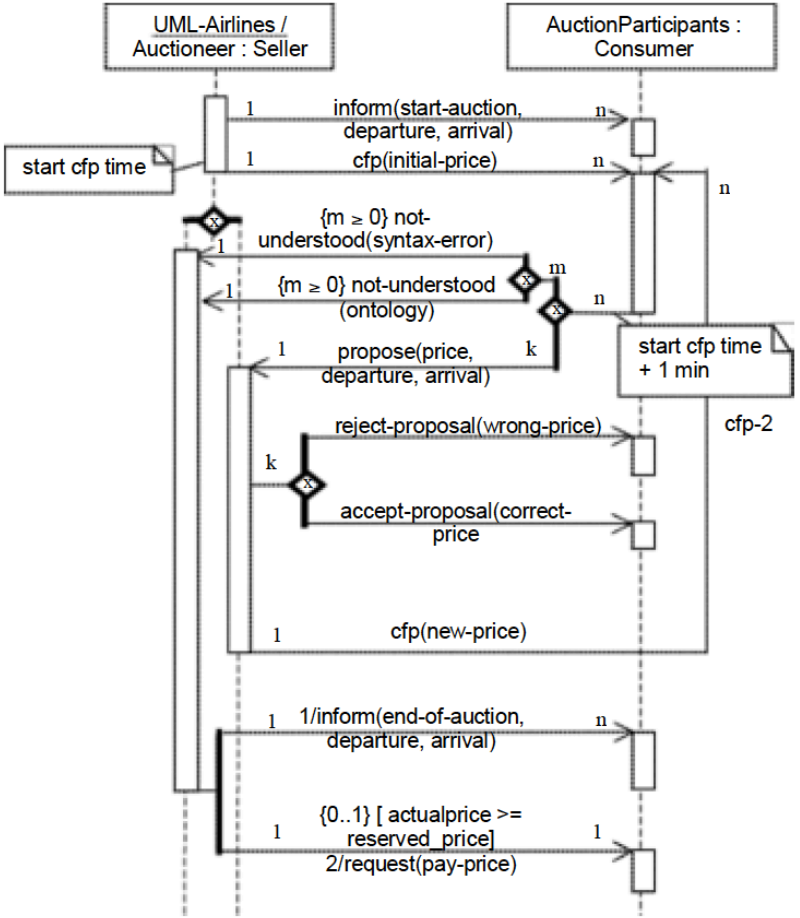
Task 2

- Task 2. Model interactions among agents in AgentUML

Check this reference from Canvas:

Representing Agent Interaction Protocols in UML

Example of a protocol diagram modeled using Agent UML



Task 2

Expected Output:

Application of the following:

- **Level 1: Representing the overall protocol**

Output: Detailed package and template diagrams + brief description

- **Level 2: Representing interactions among agents**

Output: Sequence diagrams + brief description

- **Level 3: Representing internal agent processing**

Output: State chart diagrams + brief description

Task 3

- Task 3. Use UML Class diagrams to design behavior of your agents.

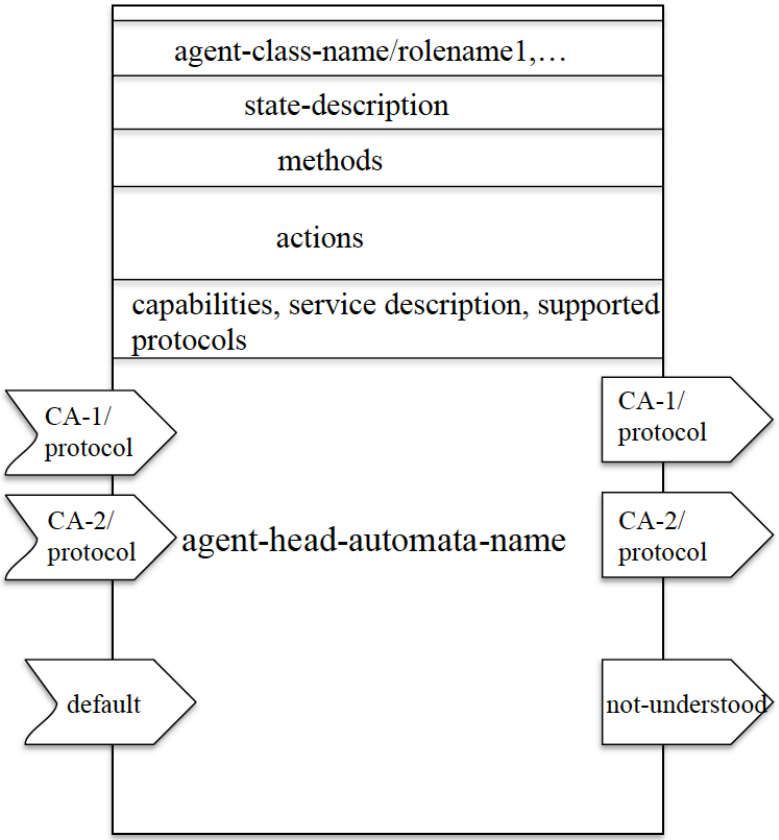
Check this reference from Canvas:

UML Class Diagrams Revisited in the Context of Agent -Based Systems

Expected Output:

UML class diagrams according to the descriptions found in the reference

Agent Class Diagrams



Task 4

- Task 4. Model your system using Role based modeling approach

Check this reference from Canvas:

ROMAS: a role-based method for multi-agent system

RoMAS: Role Based Modeling Method for Multi-Agent Systems

The main development process is as follows:

(1) Capture use cases;

(2) Identify roles from use cases;

(3) Construct role organization;

(4) For each role, if the appropriate agent does not exist, then go to (5); else

I. Bind roles to agents

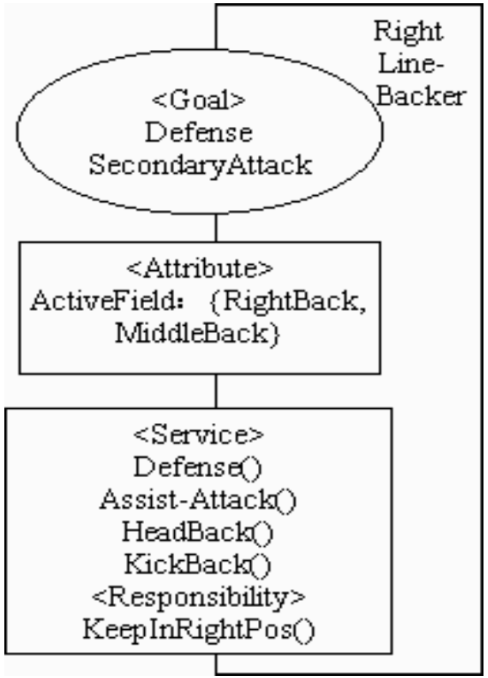
II. Describe dynamic properties of bind relation between agents and roles

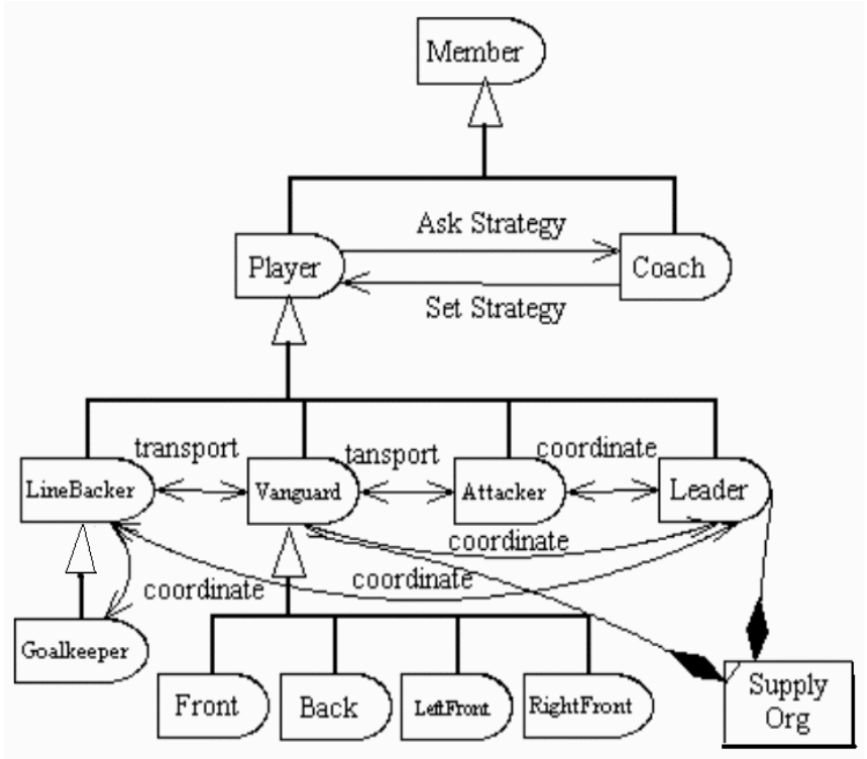
III. Go to (6)

(5) Generate agents according to roles; Go to(4).I.

(6) Generate codes for agents with roles bound;

Some Examples





Role organizations

Task 4

- Task 4.1 Perform **role-based modeling** using RoMAS for the initial task.
- Task 4.2 Comment on differences in resulting designs of 4.1 and GAIA (from Task 1).
  - (i.e. Analysis phase of GAIA against performing role-based modeling as first step to GAIA analysis)

Task 5 JADE and (Other Agent Platforms)

- There are number of implementations of agent platforms which conform to the FIPA Specifications. Perform a comparison of at least 02 other Agent Platforms with JADE.
- Your comparison should comprise of
  - i). Architecture of Platform
  - ii). Services provided by Platform
  - iii). Comparison of implementation of a simple scenario same as Question 2 (i.e. Service Implementation, Service Registration, and Service Discovery)
  - iv). List some notable projects which used that platform.
  - v). your personnel opinion/judgment about the platform as compared to JADE. You can take part iii) as your starting point, and explain the architecture and services the platform provides from a practical point of view.

Task 5 JADE and (Other Agent Platforms)

- Agent Development Kit, FIPA-OS, JACK Intelligent Agents, ZEUS, SAGE … just to name a few other FIPA Complaint implementaBons. (Feel free to use some other FIPA Complaint ImplementaBon)

Deliverables

- Upload Documented Reports in Canvas