# AUTONOMOUS SYSTEMS

# ASSIGNMENT OF THE SEMINAR PROJECT

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| Name, surname |  |
| Login |  |
| Branch of study |  |
| Academic year |  |

**Information for the analysis and the design of the multi-agent system**

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| Name of the topic |  |

## PART 01: Analysis of the multi-agent system

Create the conceptual design of the multi-agent system (MAS). The MAS has to be designed for a particular task. The assignment should be meaningful. The system should have rational purpose. The MAS should not be too complex, but on the other hand it should not have trivial structure or solve trivial problem(s). The MAS is not going to be directly programmed during the subject aAUTS. It is going to be deeply designed and described. The implementation of the MAS will be realised during the next related subjects, e. g. Complex Systems.

## Literature research – the state of the art preparation

Preparation of the review of the literature is the first part of the analysis of the MAS. Review of the literature should offer the aggregate overview of the actual state (state-of-the-art) of the application domain. For more information about the review of the literature, please see the following sources: <http://library.bcu.ac.uk/learner/writingguides/1.04.htm>, <http://writing.wisc.edu/Handbook/ReviewofLiterature.html>. Five citations (information sources) should be mentioned at least. Use the following scientific libraries as the information sources for your projects (Only these ones are acceptable.):

* [www.springerlink.com](http://www.springerlink.com)
* [www.sciencedirect.com](http://www.sciencedirect.com)
* Any information source that can be received from the university web page: https://www.uhk.cz/cs-CZ/UHK/Centralni-pracoviste/Univerzitni-knihovna/Databaze#UHK-Article
* The sources have to actual (2010 or later).
* Personal webpages, comments, discussions are not acceptable as the information sources for the project.

Length of the review should be 2 pages (A4) at least. Use the Harvard style of citations formatting in the end of the review of the literature (examples: https://www.staffs.ac.uk/assets/harvard\_quick\_guide\_tcm44-47797.pdf). All used information sources (citations) have to be mentioned directly in the review of the literature and in the table below the text. Include 5 research studies in your literature research at least.

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| *(input the review of the literature in the scope - 1-2x A4, font Calibri, 11b, line spacing 1)* |

Mention the used literature sources in the Harvard style into the table below. Book chapters or journals can be cited in the same way. For simplicity, these citations will not be distinguished:

|  |  |
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| # | Examples |
| 1 | SURNAME, J. (year). Name of the paper. Place of publishing: Publisher. ISBN. |
| 2 | Neumann, J. (2013). Information ethics: syllabus for bachelor study of information science. Brno: Masaryk University. ISBN 80-2102-981-1. |

Input your own citation (information sources) into the table below.

|  |  |
| --- | --- |
| # | Citations |
| **1** |  |
| **2** |  |
| **3** |  |
| **4** |  |
| **5** |  |
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| 7 |  |
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## Mind mapping

Create the mind map in the Cmap tool. Map will graphically visualise structure of your state of the art (literature research). Follow the guidelines for mind mapping preparation, see the seminar 3. Main facts of the research papers (books) which should occur in the mind map: authors, year of publication, place of publication (e. g. journal), number of pages, name of the paper (book), summarisation of its content. Additional parameters can be added, e. g. ISBN, etc.

*(Input the structure of your map that you created in the Cmap tool.)*

## PEAS specification

The abbreviation PEAS represents the four key words: Performance, Environment, Actuators, Sensors. It is the basic determination of the application domain – task environment of the MAS. Describe briefly the particular attributes below into the blank spaces.

**Performance** – mention the textual description how the performance of the MAS will be measured. It should be obvious which main tasks will be solved by the MAS (max. 10 rows).

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**Environment** – mention the brief description of the environment where the intelligent agents will be located. Focus on the key characteristics and what is the most important. Description cannot be exhaustive, but it should be possible to make clear notation of the environment in which the MAS will work (max. 10 rows).

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**Actuators** – describe the actions that the intelligent agents will realise and actuators that will be used by these agents. If you design more intelligent agents, mention the actions and actuators for all of them. 5 rows of description for each of the agent (max.).

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**Sensors** – describe the perceptions that the agents will be able to perceive and sensors that will be used by these agents for perception. . If you design more intelligent agents, mention the perceptions and sensors for all of them. 5 rows of description for each of the agent (max.).

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## Annotation of the multi-agent system

Mention the brief framework of working of the designed MAS. Description should answer on the following questions: “What will be a part of the MAS and what will not be a part of the MAS, i. e. where you will use the abstraction? What will be the purpose of the system? What is going to be solved by the MAS? For which target group of people the MAS will be used?

Annotation of the project – a brief description of the MAS behaviour (max. 15 rows)

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Characterise the organisation or the user that will use the MAS (max. 10 rows) (note: Fill only, if the MAS is intended for particular organisation or a group of people).

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Notes – You can add some additional notes (comments) that specify the part 2 and 3 of the project (max. 10 rows)

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## ODD+D protocol

Fill the particular parts of the ODD+D protocol, see table below. The protocol is quite general. If some part of the protocol cannot be filled, explain why it is not possible. Use the new line (below the filed/question) for description because of the clarity.

| ITEM | | QUESTION |
| --- | --- | --- |
| 1 Overview | 1.1 | 1.1.1 What is the purpose of the study? |
| 1.1.2 For whom is the model designed? |
| 1.2 | 1.2.1 What kinds of entities (resources, agents, environments) are in the model? |
| 1.2.2 By what attributes (i.e., state variables and parameters) are these entities characterised? |
| 1.2.3 What are the exogenous factors / drivers of the model?  (Note: Exogenous factor – external influence that has the influence on the behaviour of the model)   |  | | --- | |  | |
| 1.2.4If applicable, how is space included in the model? |
| 1.2.5 What are the temporal and spatial resolutions and extents of the model? |
| 1.3 | 1.3.1 What entity does what, and in what order? |
| 2 Design Concepts | 2.1 | 2.1.2 On what assumptions is/are the agents’ decision model(s) based (What is necessary for decisions realisation)? |
| 2.1.4 If the model / submodel (e.g., the decision model) is based on empirical data, where do the data come from? |
| 2.2 | 2.2.1 What are the subjects and objects of the decision-making? |
| 2.2.2 What is the basic rationality behind agent decision-making in the model? Do agents pursue an explicit objective or have other success criteria? |
| 2.2.3 How do agents make their decisions? |
| 2.2.4 Do the agents adapt their behaviour to changing endogenous and exogenous state variables? And if yes, how? |
| 2.2.5 Do social norms or cultural values play a role in the decision-making process? |
| 2.2.6 Do spatial aspects play a role in the decision process? |
| 2.2.7 Do temporal aspects play a role in the decision process? |
| 2.2.8 To which extent and how is uncertainty included in the agents’ decision rules? |
| 2.3 | 2.3.1 Is individual learning included in the decision process? How do individuals change their decision rules over time as consequence of their experience? |
| 2.3.2 Is collective learning implemented in the model? |
| 2.4 | 2.4.1 What endogenous and exogenous state variables are individuals assumed to sense and consider in their decisions? Is the sensing process erroneous? |
| 2.4.2 What state variables of which other individuals can an individual perceive? Is the sensing process erroneous? |
| 2.4.3 What is the spatial scale of sensing? |
| 2.4.4 Are the mechanisms by which agents obtain information modelled explicitly, or are individuals simply assumed to know these variables? |
| 2.5 | 2.5.1 Which data do the agents use to predict future conditions? |
| 2.5.3 Might agents be erroneous in the prediction process, and how is it implemented? |
| 2.6 | 2.6.1 Are interactions among agents and entities assumed as direct or indirect? |
| 2.6.2 On what do the interactions depend? |
| 2.6.3 If the interactions involve communication, how are such communications represented? |
| 2.6.4 If a coordination network exists, how does it affect the agent behaviour? Is the structure of the network imposed or emergent? |
| 2.7 | 2.7.1 Do the individuals form or belong to aggregations that affect and are affected by the individuals? Are these aggregations imposed by the modeller or do they emerge during the simulation? |
| 2.7.2 How are collectives represented? |
| 2.8 | 2.8.1 Are the agents heterogeneous? If yes, which state variables and/or processes differ between the agents? |
| 2.8.2 Are the agents heterogeneous in their decision-making? If yes, which decision models or decision objects differ between the agents? |
| 2.9 | 2.9.1  What processes (including initialisation) are modelled by assuming they are random or partly random? |
| 2.10 | 2.10.1 What data are collected from the ABM for testing, understanding and analysing it, and how and when are they collected? |
| 2.10.2 What key results, outputs or characteristics of the model are emerging from the individuals? (Emergence) |
| 3 Details | 3.1 | 3.1.1 How has the model been implemented? |
| 3.1.2 Is the model accessible, and if so where? |
| 3.2 | 3.2.1 What is the initial state of the model world, i.e. at time t = 0 of a simulation run? |
| 3.2.2 Is the initialisation always the same, or is it allowed to vary among simulations? |
| 3.2.3 Are the initial values chosen arbitrarily or based on data? |
| 3.3 | 3.3.1 Does the model use input from external sources such as data files or other models to represent processes that change over time? |

## PART 02: Design of the multi-agent system with AML

## Entity diagram

Mention the entity types into the following table together with the explanation of their roles in the MAS in the “Comment” part. Use the following minimum counts of entity types:

* the environment type (1x),
* the agent type[[1]](#footnote-1) (2x),
* the resource type (1x).

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| Entity type | Name of the entity type | Comment |
| Environment type |  |  |
| Agent type |  |  |
| Agent type |  |  |
| Resource type |  |  |

Input the brief description of the AML-based diagram in the view of relations between entity types into the following blank field. If you create more diagrams, each one has to have a comment.

*(input the description of the AML-based diagram – ENTITY DIAGRAM; if you have more entity diagrams, copy this box several times accounting to the amount of diagrams)*

Input the AML-based diagram – ENTITY DIAGRAM into the following blank field. If you need to separate the diagram into several parts, input these several divided parts under each other. Diagram has to be readable in the protocol.

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| *(input the AML-based diagram – ENTITY DIAGRAM)* |

## Society diagram / Service diagram / Perceptor-effector diagram

Choose two of the following AML-based diagrams:

* Society Diagram
* Services Diagram
* Perceptor-effector Diagram

Input the used elements into the table below according to the chosen AML-based diagram. Do not forget to include the description (purpose) of these elements in the section Comments.

Society diagram should include the following types of elements with the minimal amount:

* organisation type (1x),
* role type (2x),
* social associations (4x),
* play association (optional element).

Service diagram should include the following types of elements with the minimal amount:

* service specification (2x),
* service provision (dependency relationship) (2x),
* service usage (dependency relationship) (2x).

Perceptor-effector diagram should include the following types of elements with the minimal amount:

* perceptor type (1x),
* effector type (1x),
* the sensor (1x),
* the actuator (1x),
* perceives (2x),
* effects (2x).

**Diagram 1**

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| Type of the element | Name of the element | Comments |
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Input the brief description of the selected AML-based diagram in the view of relations between types of elements into the following blank field. If you create more diagrams, each one has to have a comment.

*(input the description(s) of the selected AML-based diagram(s))*

Input the selected AML-based diagram(s) into the following blank field. If you need to separate the diagram into several parts, input these several divided parts under each other. Diagram has to be readable in the protocol.

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| *(input the selected AML-based diagram(s))* |

**Diagram 2**

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| Type of the element | Name of the element | Comments |
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Input the brief description of the selected AML-based diagram in the view of relations between types of elements into the following blank field. If you create more diagrams, each one has to have a comment.

*(input the description(s) of the selected AML-based diagram(s))*

Input the selected AML-based diagram(s) into the following blank field. If you need to separate the diagram into several parts, input these several divided parts under each other. Diagram has to be readable in the protocol.

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| *(input the selected AML-based diagram(s))* |

1. Not instances! [↑](#footnote-ref-1)