Digitalized
Energy Systems

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Exercise sheet 1

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1 General Notes

- Within the scope of this exercise sheet, you will
    - .. become familiar with the multi-agent framework *mango*.
    - .. implement different types of agents
    - .. design a multi-agent system
    - .. repeat some of the foundations from the lecture

- As prerequisite for the exercises we expect that ...
    - you installed python $>= 3.10$
    - you should be familiar with python and asyncio

2 Recommendations

- If you have no previous experience with Python, please work through a tutorial (e.g.
  https://www.programiz.com/python-programming or
  https://www.pythontutorial.net/ or
  https://entwickler.de/machine-learning/python-tutorial-einfuehrung)
  or work your way through a Python book (e.g. *Python 3 Crash Course: A Practical, Project-Based Programming Introduction; Mattest and Gronau; 2020; ISBN: 3864907357* or *Python 3; Steffan Kaminski; 2016; DOI: https://doi.org/10.1515/9783110473650*

- We recommend to use a virtual environment for your exercises.

- We strongly recommend getting familiar with Pythons *asyncio* library. *mango* is built on top of *asyncio* and a basic understanding of how coroutines are handled will save you many headaches from weird looking error messages.
  https://docs.python.org/3/library/asyncio.html
  https://realpython.com/async-io-python/

- Experience shows, that Windows is a difficult environment to use python on. We recommend using WSL on Windows Systems (https://learn.microsoft.com/en-us/windows/wsl/install)

3 Exercise

Exercise 1: (Optional) Work your way through the *mango* tutorial. The tutorial can be found at `https://mango-agents.readthedocs.io/en/latest/`. The *Getting started* and *Tutorial* sections should cover most of your needs for the scope of this exercise.

If you find particular difficulties or have ideas for improvement in the tutorial (and mango in general) please note them down. The feedback will then be collected by your tutor and forwarded to the *mango* development team.

Exercise 2: Explain the purpose of the separation of Agents and Containers in the mango framework. ⇒**Answer**

Exercise 3: The framework mango defines the lifecycle of an Agent (create, register, ...). Name and describe every step of this lifecycle and explain the purpose of each. Also, name the types of actions an Agent can start at every phase of its lifecycle. ⇒**Answer**

Exercise 4: In the lecture, you learned about reflexive agents and deliberative agents. Implement an example for each of these two types in mango. The differences between these types have to be visible in the implementation. ⇒**Code**

Exercise 5: Given two different problems:

1. There is a house with two solar panels and one energy storage; the owner solely wants to maximize their own energy consumption.

2. There are multiple houses with solar panels, and each wants to sell surplus energy to the energy market and maximize the profit.

Are agents a reasonable approach to these problems? And why (or why not)? ⇒**Answer**

Exercise 6: Implement a multi-agent system as a minimal showcase for one of the problems introduced in Exercise 5 (whichever you found more suitable). This showcase shall clearly show (for example, with simple print statements) how the communication/control flow could look (It is not the purpose to actually solve the problem!). Implement this showcase with a minimal amount of lines of code! ⇒**Code**

Exercise 7: In the lecture, you learned about the PEAS (performance metric, environment, actuators, and sensors) description of agents. Describe every agent of your solution for Exercise 6 following the PEAS categories. ⇒**Answer**