Digitalized Energy Systems

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Exercise sheet 2

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Background

We consider a (overlay) topology being defined via enumeration of neighborhoods, i.e. for each agent the set of agents with which it can communicate directly. There are several topologies, which we generally will describe as graph: i.e. fully-meshed (every agent is connected to every other agent), ring topology (every agent has exactly two neighbors and every agent is reachable), small-word topology, etc..

The small word topology can be characterized as a graph in which the average path between each pair of nodes is generally short and the nodes tend to cluster together. A typical way to construct small world topologies is:

1. Create a ring topology with n nodes
2. For every node: Add additional connections to other nodes with a distance $\leq k$, k being a choosable constant > 1.
3. Add additional connections with a predefined probability

For further reference please consult the slides of the lecture 5, slides 15-20.

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Exercise 1: Implement the following multi-agent system.

1. 10 agents to be able to..
   - ..accept a message from a topology agent telling them their neighborhood.
   - ..send a message to all agents in their neighborhood to inform them about their neighborhood.
2. A topology agent that...
   - ..knows the unique IDs (addresses) of all agents and should develop an overlay topology for them.
   - ..can communicate the resulting neighborhood to all agents.
   - ..establishes a ring structure by sending a message to all other agents informing them of their neighborhood, i.e. the agents with which the respective agent can communicate directly.
3. Have the agents communicate according to the following rule:
   - When an agent has received its neighborhood, it sends an information to all agents of its neighborhood with its ID.
   - An agent that has received a message from another agent stores the received information as `received_ids`.

⇒**Code**

Exercise 2: In which data structure do the agents store the neighborhood?
⇒**Answer**

Exercise 3: Add additional connections to the ring so that you achieve a highly simplified Small World, e.g. with $k = 2$ and no additional connections (random factor would then be 0).
⇒**Code**

Exercise 4: Do the `received_ids` data structures and the neighborhood contain the same IDs? In which case is this the case?
⇒**Answer**

Exercise 5: Have the topology agent create and distribute another topology. Log the number of messages and compare. How many messages are sent with which topology?
⇒**Answer**

Exercise 6: How would we have to change the system shown above so that all agents know the IDs of all other agents in the system?
⇒**Answer**

Exercise 7: Imagine you want to solve the n-Queens problem using agents. Every queen is represented by one agent, the so-called QueenAgent. How would you characterize the task environment of these agents?
⇒**Answer**

Exercise 8: Concisely describe a possible strategy of the QueenAgent to solve the n-Queens problem.
⇒**Answer**

Exercise 9: **(Optional)** What are the key differences of the topology agent approach in Exercise 1 to the built-in topology feature (`https://mango-agents.readthedocs.io/en/latest/topology.html`)? In which situations would you prefer one above the other?
⇒**Answer**