Assignment 1

Theoretical questions:

1. ***What is the Turing test, and how is it conducted?***

The Turing test is a method used to determine if a computer is able to think like a human or not. During a simple Turing test, three participants are present: two humans and a computer. One human is the designated questioner, while the other human and the computer are supposed to answer the questions. If the human asking the questions is unable to determine who of the two others is the human and who is the computer, the computer is considered to have artificial intelligence and has passed the Turing test.

2. ***What is the relationship between thinking rationally and acting rationally? Is rational thinking an absolute condition for acting rationally?***

Thinking rationally can be referred to as **logic**, where one deduce truths from given rules or **axioms**. Acting rationally is to do something to achieve the best outcome or, when there is uncertainty, the best expected outcome. The relationship between these two concepts is that thinking rationally is often used to figure out which action will give the best outcome, and therefore act rationally. Rational thinking is not an absolute condition for acting rationally – in some situations there is no provable correct thing to do, also, there are ways of acting rationally without the involvement of inference: reflex actions.

3. ***What is Tarski's "theory of reference" about?***

Tarski's "theory of reference" shows how to relate the objects in a logic to objects in the real world.

4. ***Describe rationality. How is it defined?***

Rationality is an action that follows logic, and reason, also it is an action that should be based on the most optimal solution to solve a given problem or task.

5. ***Consider a robot whose task it is to cross the road. Its action portfolio looks like this: look-back, lookforward, look-left-look-right, go-forward, go-back, go-left and go-right.***

A rational agent is one that does the right thing – conceptually speaking, every entry in the table for the agent function is filled out correctly.

For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

   a. ***While crossing the road, a helicopter falls down on the robot and smashes it. Is the robot rational?***

The fact that a helicopter fell down from the sky and smashed the robot while it was crossing the road results in a bad performance measure. However, it cannot be expected that a helicopter crashing down on you is likely. Having this as a likely scenario is not rational, it is neither rational to look up in the sky to check for something falling down every time you cross the road. The robot is rational.

b. While crossing the road on a green light, a passing car crashes into the robot, preventing it from crossing. Is the robot rational?

Assuming the green light is for the cars, then the robot is most definitely not rational. However, if the green light is for the people (or robots) wanting to cross the road then it may be rational. Even though the robot has received signal that he can cross, us humans tend to check the road anyway, just in case. You never know when a speedster might come, and therefore one tends to be cautious, and look both ways before crossing.

6. Consider the vacuum cleaner world described in Chapter 2.2.1 of the textbook. Let us modify this vacuum environment so that the agent is penalized 1 point for each movement.

Assuming that the locations may become dirty again. If not, then (b) may be rational, remembering that it already cleaned one spot and does not have to go back there.

a. Can a simple reflex agent be rational for this environment? Explain your answer

Assuming the reflex agent only can perceive the location it is on, either A or B, a simple reflex agent will not be rational for this environment. So, if the agent is on one location, which is clean, it will move over to the other location, regardless of if it is dirty or not, resulting in an unnecessary movement.

b. Can a reflex agent with state be rational in this environment? Explain your answer.

The problem is kind of the same as in (a). It can't see the other location, so it won't definitively know if it is dirty or not. There, it will have to move over to the other location to check. Of course, with a state the agent may wait some time, when it remembers that the other location was clean or cleaned instead of moving there straight away, assuming that it will take some time before the other location will be dirty again. This way, it may save some points.

c. Assume now that the simple reflex agent (i.e., no internal state) can perceive the clean/dirty status of both locations at the same time. Can this agent be rational? Explain your answer. In case it can be rational, design the agent function.

Yes, this agent most definitely can be rational. It will not make unnecessary movements because, if it perceives that both locations are clean it can just wait until one of them is dirty instead of moving back and forth without cleaning.

```
def agentFunction(location, aStatus, bStatus):
    if location == a:
        if aStatus == dirty: suck( )
        else if bStatus == dirty: bMove( )
        else: wait( )
    else:
        if bStatus == dirty: suck( )
        else if aStatus == dirty: aMove( )
        else: wait( )
```

7. ***Consider the vacuum cleaner environment shown in Figure 2.3 in the textbook. Describe the environment using properties from Chapter 2.3.2, e.g. episodic/sequential, deterministic/stochastic etc. Explain selected values for properties in regards to the vacuum cleaner environment.***

The environment is:

- partially observable; the agent has limited percepts.
- Single agent: the only agent in the environment is the vacuum cleaner. or at least, no other agent is taken into consideration by the vacuum cleaner.
- Deterministic: .
- Episodic: it is a simple reflex agent, which does not take into account previous percepts.
- Dynamic: The environment may change without the intervention of the agent, also the environment does not necessarily wait for the agent to make a decision.
- Discrete: there is a finite number of states the environment may be in.
- Known: The outcomes of the agents actions are all known.

8. ***Discuss the advantages and limitations of these four basic kinds of agents:***
    a. ***Simple reflex agents***

Simple reflex agents have the property of being very simple, but they are of limited intelligence. For a simple reflex agent to work well, the whole environment needs to be observable. If just a small part of the environment is not visible, this may cause problems for a simple reflex agent.

b. Model-based reflex agents

Model-based reflex agents try to solve the problem of partially observable environments by maintaining an internal state about the environment, based on previous percepts. It is however difficult to determine the state of an environment *exactly* in partially observable environments.

c. Goal-based agents

Knowing something about the current state of the environment is not always enough to determine the right course of action. Using a **goal** an agent can decide which action will result in a desirable result. This may not be so simple, when the agent has to consider a long sequence of actions.

The Goal-based approach is less effective than the two previous mentioned approaches. However, this approach is much more flexible because the knowledge that supports its decision is represented explicitly and can be modified.

d. Utility-based agents

Goals just provide a crude binary distinction between “happy” and “unhappy”. A more general performance measure should allow the agent to see which actions will result in it being different measures of happy.

Utility-based agents are useful when there are conflicting goals and when there are multiple goals, where goal-based agents will fail.

The negatives with utility-based agents is that they are way more complex than the other agents.