CSE 4705 - Artificial Intelligence	Fall 2022
Assignment 1	Due date: Sunday, September 25, 11:59pm, EST

For full credit, please adhere to the following:

- Unsupported answers receive no credit.
- All answers can be typed or handwritten, and should be readable.
- Submit the assignment in one file (.pdf, .doc, etc.) via HuskyCT.

I encourage you to learn how to typeset documents with LATEX . You can download Texmaker at http://www.xm1math.net/texmaker/. It is available for most platforms. Another option is to use online service https://www.overleaf.com/. There is a wealth of information online on how to format documents with LATEX and you can always post a question on Moodle's Technical Forum. Leslie Lamport has authored a book that provides a nice introduction to the basic features of LATEX which you can read about here. Most scholarly articles in Mathematics and Computer Science, and even many books, are typeset with this tool.

1. (25 points) Define in your own words:
   a. Intelligence
   b. Artificial intelligence
   c. Agent
   d. Rationality
   e. Logical reasoning
   f. Agent function
   g. Agent program
   h. Autonomy

2. (10 points) Are reflex actions (such as flinching from a hot stove) rational? Are they intelligent? (For the purpose of this question, consider the "intelligent" to mean applying knowledge or applying thought and reasoning.

3. (10 points) Many of the computational models of cognitive activities that have been proposed involve quite complex mathematical operations, such as convolving an image with a Gaussian or finding a minimum of the entropy function. Most humans (an certainly all animals) never learn this kind of mathematics at all, almost no one learns it before college, and almost no one can compute the convolution of a function with a Gaussian in their head. What sense does it make to say that the "vision system" is doing this kind of mathematics whereas the actual person has no idea how to do it?

4. (10 points) Consider the following assumption regarding the vacuum-cleaner agent we discussed in class:

   - The performance measure awards one point for each clean square at each time step over a "lifetime" of 1000 time steps.
   - The "geography" of the environment is known apriori (see vacuum cleaner slide showing cells A and B, etc.) but the dirt distribution and the initial location of the agent are not. Clean squares stay clean and sucking cleans the current square. The *Left* and *Right* actions move the agent left and right except when this would take the agent outside the environment, in which case hte agent remains where it is.
   - The only available actions are *Left*, *Right*, and *Suck*. (Note, there is no *NoOp*).
   - The agent correctly perceives its location and whether that location contains dirt.

   a. Prove that the simple vacuum-cleaner agent function described in class and given the assumptions above is indeed rational.

   b. Describe a rational agent function for the case in whcih each movement costs one point. Does the corresponding agent program require internal state?

   c. Discuss possible agent designs for the cases in which clean squares can become dirty and the geography of the environment is unknown. Does it make sense for the agent to learn from its experience in these cases? If so, what should it learn? If not, why not?

5. (10 points) For each of the following activities, give a PEAS description of the task environment and characterize it in terms of the dimensions listed in class (Fully Observable vs. Partially Observable, Static vs. Dynamic, etc.)

   a. Playing soccer

   b. Exploring the subsurface of oceans of the planet, Titan

   c. Shopping for used AI books on the Internet

   d. Playing a tennis match

   e. Practicing tennis against a wall

   f. Performing a high jump

   g. Knitting a sweater

   h. Bidding on an item at an auction.

6. (25 points) Define in your own words the following terms:

   a. Reflex agent

   b. Model-based agent

c. Goal-based agent

d. Utility-based agent

e. Learning agent

7. (10 points) The vacuum environment has been considered deterministic up to this point. Discuss possible agent programs for each of the following stockastic versions:

   a. Murphy's Law: Twenty-five percent of the time, the *Suck* action fails to clean the floor if it is dirty and deposits dirt onto the floor if the floor is clean. How is your agent program affected if the sensor gives the wrong answer 10% of the time?

   b. Small Children: At each time step, each clean square has a 10% chance of becoming dirty. Can you come up with a rational agent design for this case?