CSIT9000F 2017 Fall Semester Assignment #1

Date assigned: Saturday, Sep 16

Due time: 23:59pm on Tuesday, Sep 26

How to submit it: Submit it as a pdf file on canvas.ust.hk

Penalties on late papers: 20% off each day (anytime after the due time is considered late by one day)

Problem 1. (30%) Consider a 10x10 grid without any obstacles, and a robot with the same specification as our boundary following robot: eight sensors and four actions.

- Design a reactive production system to control the robot to go to one of the four corners, wherever its initial position is.
- Show that it is not possible to have a reactive production system to make the robot visit every cell in the grid.
- Design a state machine to achieve the above task. In addition to having memory about previous action taken and previous sensory input, you can have internal variables (mental states) and actions to change the values of these variables.

Problem 2. (10%) Which boolean function does the following TLU implement? The TLU has five inputs. Its weight vector is $(1.1, 3.1, -1, -2, 0.5)$, and threshold is 1.

Problem 3. (20%) Consider the problem of training a TLU to do logical disjunction (logical "or") using the error-correction procedure that we talked about in class. Suppose that we start with the initial weights all equal to 0, and learning rate $c = 1$. Find a *minimal* set of training instances that will correctly train the TLU according to the procedure. Here a training set is minimal if removing any instance in it will not produce a TLU for the logical disjunction. Please show the details of your work inlcuding the converging sequence of the weights.

Problem 4. (Adapted from Ex 4.1 of Nilsson) (20%) Specify fitness functions for use in evolving agents that

1. Control an elevator
2. Control traffic lights at the intersection of a city main street and a city side street.

Try to come up with as many as possible fitness functions, and discuss their relative merits.

Problem 5. (Exercise 5.4 of Nilsson) (20%) The female solitary wasp, Sphex, lays her eggs in a cricket that she has paralyzed and brought to her burrow nest. The wasp grubs hatch and then feed on this cricket. According to [Wooldridge 1968, p. 70], the wasp exhibits the following interesting behavior:

> . . . the wasp's routine is to bring the paralyzed cricket to the burrow, leave it on the threshold, go inside to see that all is well, emerge, and then drag the cricket in. If the cricket is moved a few inches away while the wasp is inside making her preliminary inspection, the wasp, on emerging from the burrow, will bring the cricket back to the threshold, but not inside, and will then repeat the preparatory procedure of entering the burrow to see that everything is all right. If again the cricket is removed a few inches while the wasp is inside, once again she will move the cricket up to the threshold and reenter the burrow for a final check. . . . On one occasion this procedure was repeated forty times, always with the same result.

Invent features, actions, and a production system that this wasp might be using in behaving this way. Design this wasp as a stimulus-response agent, except that she can have a mental state (like an "ok" bit) that she can manipulate with an internal action (like set "ok" to 0 or 1).