(364-1-1441) Foundations of Artificial Intelligence

Problem Set 1

Due: 25/12/2018

You need to submit both code and written answers. Problem 1 is a programmatic one, but there are two things there you need to submit in writing. Problems 2 and 3 only require written answers and not programming. You will submit one `q1.py` file containing your code, and one `answers.pdf` file containing your written answers (in English or Hebrew).

1 Problem 1: A Word Search

In this exercise you will build a function that checks for two words given to you if there is a chain of real words (from a dictionary given to you) such that the beginning word is one of those given to you, the final word is the other given to you, and in between, only one letter has changed from one word to another. So, for example, if you receive the words “late” and “kite”, one option would be:

```
late
lite
kite
```

Another option would be:

```
late
lite
lit
kit
kite
```

In general, shorter paths are better.

You will write a function in python called `findWordPath` that takes in 4 variables:

Starting word This is the beginning of your search. You can assume this is a word that is in the dictionary.

Goal word This is the word you wish to reach from the starting word via the process. You can assume this is a word that is in the dictionary.

Search method This will be a number. Its possible values are:

1. A hill climbing algorithm. It should be restarted 5 times (if it didn’t find the answer).
2. Simulated annealing. **You choose the temperature**. In your submitted answers, containing the answers to the questions, you will detail your temperature schedule. It should not go longer then t=100.

3. A local beam search, with the number of beams (k) being 3.
4. A genetic algorithm. The representation is just the word itself. Population size is 10.
5. An A*-heuristic search. **You choose the heuristic**. In your submitted answers, containing the answers to the questions, you will detail your heuristic.

Detail output This is a binary variable. When it is false, your output is like the text above – you give the full chain of changes of words, with a single word on each line. The first one is the *starting word*, and every next line contains a word that is in the dictionary file (see below) and different in one letter from the line before it, until the last line is the *goal word*. If no path was found, the output is `No path found`.

If the binary variable is true, for the first transformation (from the first word to your second word) you need to print out your work process, so for method:

Hill climbing No change in output.

Simulated annealing Show each word you consider.

Local beam Show your "bag" of words considered at each stage.

Genetic algorithm Print out your population

A*-heuristic search Print out the heuristic value of the word you are choosing at each point.

In order to know what is a valid word, you can use the file `dictionary.txt` downloadable from the course website. It contains a single valid word per line. **Please ignore capitalization**, so each word is legal if when you convert it to all lowercase letters.

2 Problem 2: Search

Describe a state space in which iterative deepening search performs much worst than DFS (for example, time complexity of $O(n^2)$ vs. $O(n)$).

3 Problem 3: CSP

The 4-queen problem involves 4 queens on a 4x4 board, which should not threaten each other under chess rules. Formulate the problem as a CSP, and draw its constraints graph.