Habib University
CSE 351 - Artificial Intelligence
Fall' 2018
Assignment 1

Question 1 – Problem Solving via Search [35 Points]

You have to do a generic implementation of A* algorithm that can solve variety of search problems. The task is divided into following parts:

a) Framing a Problem [15 points]

An interface of Search problems is provided to you in the form of an abstract base class in python[1] which contains following functions:

- getStartState
- isGoalState
- getSuccessors
- getCostOfActions
- getHeuristic

You have to formulate the following two problems as search problems by implementing the given interface for both of them.

8-Puzzle Problem

The 8-puzzle consists of an area divided into a 3*3 grid. Each cell of the grid represents a tile numbered from 1 to 8 (in any order) with one tile being empty. A tile that is next to the empty cell can be moved into the empty space, leaving its previous position empty in turn. The aim of the puzzle is to achieve a given configuration of tiles from a given (different) configuration by sliding the individual tiles around the grid as described above.
Some supporting code for 8 puzzle is provided with this assignment.

Route Planning

You are planning a trip to Northern areas of Pakistan. There are several cities that you want to visit in a limited time and hence looking for the best route for them. Your program will take the following CSV files as inputs:

a. cities.csv - list of cities under consideration
b. connection.csv - the road network mentioning the cities that are connected to each other with their respective distances
c. heuristics.csv - aerial distance of every two cities

Given a starting and a destination city, you have to find the shortest path between these two cities.

[1] Some resources for this assignment have been taken from `http://ai.berkeley.edu`.

b) Solving a Search Problem [12 points]

Develop your search agent that takes a Search Problem and return its solution using A* algorithm. The same implementation should be used to solve both of the problems given above.

c) Knowing A* [8 Points]

d) Why is it important to have an admissible heuristic in A* to ensure Optimality?

e) Several enhancements have been proposed to A* algorithm. Discuss some variant of A* and its motivation and working. Give references for the technique discussed.

d) Bonus: Have Fun! [5 points]

Pick another interesting problem/puzzle of your choice that can be formulated as a Search Problem. Implement it as a search problem and use A* implementation done in part (b) to find its solution. Possible problems can be:

- Solving a maze
- 8-Queen
- Frog Problem
- River Crossing Problems

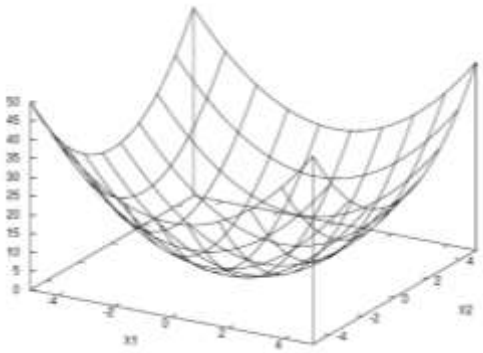
Question 2 – Optimization [15 Points]

Implement Simulated Annealing algorithm to find the global maximum/minimum of any function. The following functions can be used as examples:

The range of x and y can be seen in the plots below. Make sure that you are handling boundary values appropriately.

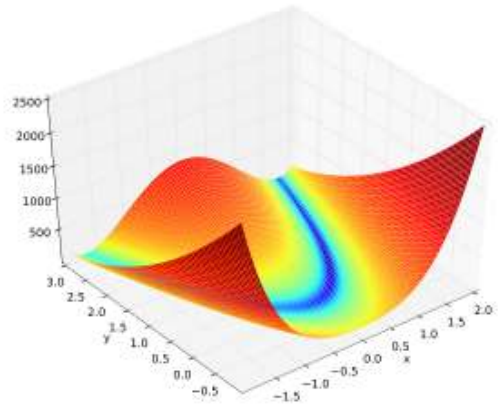
Sphere Function

$$f(x, y) = x^2 + y^2$$
$$-5 \leq x, y \leq 5$$



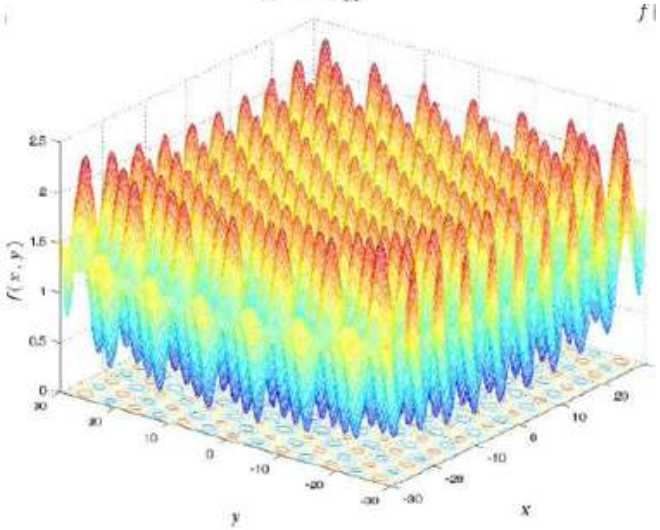
Rosenbrock Function

$$f(x, y) = 100 * (x^2 - y)^2 + (1 - x)^2$$
$$-2 \leq x \leq 2, -1 \leq y \leq 3$$



Griewank Function

$$f(x,y) = \frac{x^2+y^2}{4000} - \cos(x)\cos\left(\frac{y}{\sqrt{2}}\right) + 1$$



Submission Instructions

Submissions will be made on LMS by the due date (announced on LMS). No email submission will be accepted. The submitted file should be in the form of a ZIP file named as **<studentid>_Ass1** containing separate files/folders named Q1 and Q2 for the source code of both questions. Please submit all files (excluding CSVs) required to run your source code.