Concordia University
Department of Computer Science and Software Engineering

COMP 472/6721: Introduction to Artificial Intelligence

Winter 2017

Assignment #3

Deadline:	**April, 14, 2017 @ 23:59**
Late submission: **Email submission:**	**Not accepted** **Not accepted**
Type of submission	**Electronic submission using EAS**
Evaluation:	**5% of final mark**

Important note: This assignment can be done individually or in a team of maximum four (4) students. In case of team formation, each team provides only one report/solution for this assignment submitted by the leader of the team. Report of this assignment, including all your solutions and answers, and your programming source codes must be submitted electronically using EAS submission system before the due date.

For this assignment, you are allowed to use any resources including those tools, pseudo-codes, codes, and/or implementation of Genetic algorithms currently exist in textbooks, on the Internet, etc. However, you should avoid plagiarism, and you have to accurately cite and acknowledging all the original sources you have used for your assignments/projects.

Question on Genetic Algorithm:
In this question you will design a Genetic Algorithm (GA) in order to optimize a function and you will see different aspects of the designing and applying a Simple GA (SGA) on an optimization problem.

We are going to maximize the function f(x) as follows on the integer domain of x's from 0 to 1023.

$$x \in [0..1023]$$

$$y = f(x) = -\frac{1}{10000} * x * (x - 1023) + 5 * \sin(x/8) * \cos(x/19)$$

The graph of this function is shown on the Figure 1. As you can see, there are several local minima and maxima on this figure. Our goal is to find the location of the global maximum of f(x) in the integer domain of x in the range of [0..1023].

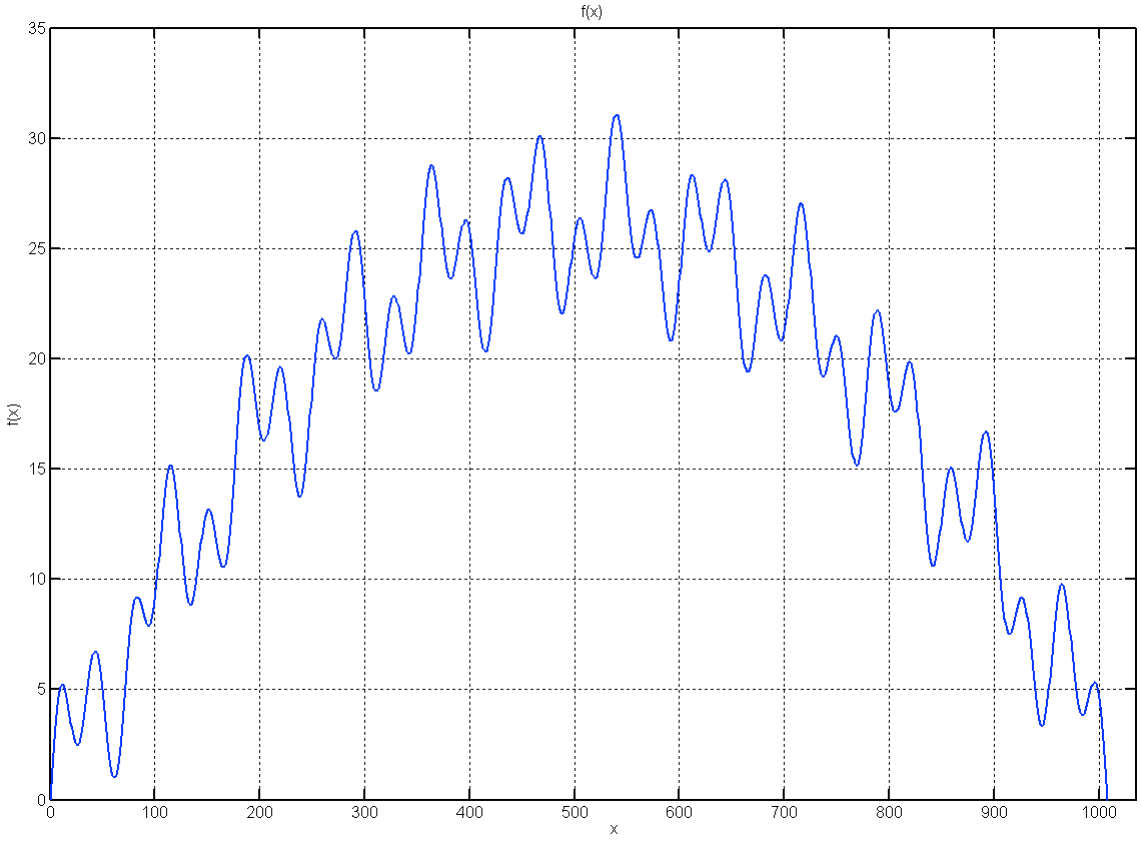

Figure 1: The function f(x) has been plotted for all real values of x from [0, 1023], however in this question you only will consider f(x) on integer values of x.

a) Design a Genetic Algorithm that can maximize this function. Explain your coding scheme for the chromosomes. Consider different values for Pc (probability of cross over) and Pm (probability of mutation), and compare the performance and the number of generations that GA requires in order to find the global maximum. What is your conclusion?

b) Consider different population sizes such as (N= 10, 20, 40,…) chromosomes, and compare the performance and running time of your algorithm, in each case.

c) Consider different number of stopping criterions such as maximum number of generations (M=10, 100, 200,…), and the performance of the algorithm for finding the best maximum of this function.

d) What is the true value(s) of maximum of f_max, x_max for this function? (note your domain is integer, so x_max must be integer). In which cases of (a), (b) and (c) your algorithm was able to find the maximum.

(e) In the all cases of (a), (b), (c), (d), plot the average fitness, and best fitness, and the worst fitness of the populations in each generation. Write your general conclusions about using GA for solving this problem.

Evaluation of this assignment:

All the questions (a), (b) , (c), (d) , (e) have equal marks: 5 * 20% = 100%

CEAB Graduate Attributes:

This assignment is evaluating all the five graduate attributes mentioned in the course outline.

Submission Criteria/Format & Deliverables

Your submission must include information of all the members of your team, plus a README.txt file that includes the following information:

- Team leader's name (The student who submitted the assignment)
- Students Full Names (for all members of the team)
- Students IDs (for all members of the team)
- Students emails (for all members of the team)
- Difficulties (outlining difficulties will help the TA's/Markers focus on repairing weaknesses)
- Additional comments (anything deemed important for marking purposes)

Please give meaningful names to each of your files, folders to make the feedback or correction process easier. For example, for the first assignment, student 123456 should name his/her PDF file as a1_123456.pdf. Please submit a zip file containing all the files and folders related to this assignment named a1_123456.zip, **and submit it through ENCS Electronic Assignment Submission system (EAS) under the category of "Theoretical Assignment #3".**

Please note that the marker(s) reserve the right to deduct marks or reject the submission if the submission format is not followed as specified. Late submissions are not accepted; penalty for late submission will be 100% (Assignments submitted after the due date will receive a mark of 0). Also,

email submission of assignments will not be accepted under any condition.

Important note: Academic integrity

Students are encouraged to study and share their knowledge with each other. However, students/teams should submit their own works. Copying is strictly prohibited and all assignments to be copied would not receive any marks. Also, those students who are found copying will face severe consequences. Students should be aware and observe the academic integrity & the university's code of conduct. For more information please