CAIRO UNIVERSITY
FACULTY OF COMPUTERS AND ARTIFICIAL INTELLIGENCE
Quiz (A)

Examiner : Dr. Mustafa M. Shiple
Subject: Autonomous Multiagent Systems (AI 314)
Score: 10 Marks

Term: Spring 2023
Exam Time:60 min

Instructions:

- Use the space provided to write your answers.
- Ask in case of doubt.

ANSWER THE FOLLOWING QUESTIONS:

1. Fill in the spaces [5 marks]
   (a) Genetic Algorithms (GA) use principles of natural evolution. There are five important features of GA .....
   (b) Mutation is a technique that .....
   (c) IF environment is nondeterministic, the agent doesn't know what is ....state after .....
   (d) In games theory, Zero-sum means .....
   (e) Monte Carlo methods rely on .....sampling to obtain numerical results.

Solution:

(a) Initial Population, Fitness Function, Selection, Crossover, Mutation.

(b) flips a randomly selected gene in a chromosome.

(c) next , taking an action

(d) one players loss is the others gain.

(e) repeated random .

2. Suppose a genetic algorithm uses chromosomes of the form x = abcdefgh with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as:

$$f(x) = (a + b)(c + d) + (e + f)(g + h),$$

and let the initial population consist of four individuals with the following chromosomes:

x1 = 2 3 9 2 1 2 8 5
x2 = 6 5 4 1 3 5 3 2
x3 = 8 7 1 2 6 6 0 1
x4 = 4 1 8 5 2 0 9 4

if individual operations are defined as:-

- Cross operation: a onepoint crossover at the middle point.
- Mutation operation: third digit only in last generated offspring.
- Roulette wheel : when it rotated the outcome will be $\{3, 1, 4, 2, 1, 2, 4, 3, 4, 1, 4, 5, 1, 3, 2, 6, 4, 2, 3, 5\}$

(a) Perform two complete cycles of genetic algorithm, each generation consists of **6 chromosomes** .

[Total Marks is 10]

Good Luck

[5 marks]

Solution:

$$f(x1) = (2+3)(9+2) + (1+2)(8+5) = -16$$
$$f(x2) = (6+5)(4+1) + (3+5)(3+2) = 9$$
$$f(x3) = (8+7)(1+2) + (6+6)(0+1) = 23$$
$$f(x4) = (4+1)(8+5) + (2+0)(9+4) = -19$$

order: x3-x2-x1-x4
Due to roulette wheel and cross operation the pairs are :

$$(x1, x3) = x5 = 23926601 = (2+3)(9+2) + (6+6)(0+1) = 5$$
$$(x4, x2) = x6 = 41853532 = (4+1)(8+5) + (3+5)(3+2) = -5$$
$$(x3, x2) = x7 = 87123532 = (8+7)(1+2) + (3+5)(3+2) = 15$$
$$(x1, x4) = x8 = 23922094 = (2+3)(9+2) + (4+1)(8+5) = -17$$
$$(x4, x1) = x9 = 41851285 = (4+1)(8+5) + (1+2)(8+5) = -18$$
$$x3 = 87126601 = 23$$

Mutation : x9 = 4 1 **1** 5 1 2 8 5 = -11

first generation :

$$1x3 = 87126601 = 23$$
$$2x7 = 87123532 = 15$$
$$3x5 = 23926601 = 5$$
$$4x6 = 41853532 = -5$$
$$5x9 = 41851285 = -11$$
$$6x8 = 23922094 = -18$$

Due to roulette wheel and cross operation the pairs are :

$$(x6, x9) = x10 = 41851285 = (2+3)(9+2) + (6+6)(0+1) = -17$$
$$(x3, x5) = x11 = 87126601 = (4+1)(8+5) + (3+5)(3+2) = 23$$
$$(x7, x8) = x12 = 87122094 = (8+7)(1+2) + (3+5)(3+2) = 1$$
$$(x6, x7) = x13 = 41853532 = (2+3)(9+2) + (4+1)(8+5) = -5$$
$$(x3, x9) = x14 = 87121285 = (4+1)(8+5) + (1+2)(8+5) = 2$$
$$x3 = 87126601 = 23$$

Mutation : x 14 = 8 7 **0** 2 1 2 8 5= 3 Second offspring :

$$x10 = 41851285$$
$$x11 = 87126601$$
$$x12 = 87122094$$
$$x13 = 41853532$$
$$x14 = 87121285$$
$$x3 = 87126601 = 23$$