Mathematics for Robotics Assignment 5

Generic Algorithm

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1 Task 1

1.1 a),b),c)

Individual No	X Value	Equivalent Binary	Fitness f(x)	Probability p
1	6	0 0 1 1 0	-66	0.0014
2	8	0 1 0 0 0	-248	0.0053
3	15	0 1 1 1 1	-2460	0.0521
4	19	1 0 0 1 1	-5396	0.1144
5	25	1 1 0 0 1	-13100	0.2776
6	31	1 1 1 1 1	-25916	0.5492

Table 1: Probability Table

1.2 d)

Highest probability on individual 5 and 6. Therefore, make two offsprings from them (K=2):

$$
\begin{aligned}
&p_1\ 11001\\
&p_2\ 11111\\
&=\\
&o_1\ 11111 = 31\\
&o_2\ 11001 = 25
\end{aligned}
$$

Second-highest probability on individual 3 and 4. Therefore, make two offsprings from them (K=2):

$$
\begin{aligned}
&p_3\ 01111\\
&p_4\ 10011\\
&=\\
&o_3\ 01011 = 11\\
&o_4\ 10111 = 23
\end{aligned}
$$

1.3 e)

Repeat the step with the offsets as parents:

$$
\begin{aligned}
&p_1\ 11111\\
&p_2\ 11001\\
&=\\
&o_1\ 11001 = 25\\
&o_2\ 11111 = 31
\end{aligned}
$$

p_3 01111
p_4 10011
=
o_3 01011 = 11
o_4 10111 = 23

```
clear; close all; clc;

% Given Function
xList = 0:0.1:31;
y = 4.*xList.^2-xList.^3+xList;
plot(xList,y)

% Function to convert binary to decimal
binaryToDecimal = @(binary) sum(binary .* 2.^(numel(binary)-1:-1:0));

% Parameters
num_individuals = 4;
num_bits = 5;
lower_limit = 0;
upper_limit = 31;

% a) Create population
population = [ 6;8;15;19;25;31];
f_x = 4.*population.^2-population.^3+population;
% b) Binary encoding
binary_population = arrayfun(@(x) decimalToBinary(x, num_bits), ...
    population, 'UniformOutput', false);

% Display the results
disp('Original Values:');
disp(population);
disp('Binary Encoding:');
disp(binary_population);

%c), calculate p based on fitness values.
% Formula from lecture: fi/sum(fi)
for i =1 :length(f_x)
p(i) = f_x(i)/sum(f_x)
end

sum(p)

%Task d)
%Offsprings from parent 6,5,4,3:
o1 = [1 1 1 1 1];
o2 = [1 1 0 0 1];
o3 = [0 1 0 1 1];
o4 = [1 0 1 1 1];
O1 = binaryToDecimal(o1)
O2 = binaryToDecimal(o2)
O3 = binaryToDecimal(o3)
O4 = binaryToDecimal(o4)

%Task e)
o1 = [1 1 0 0 1];
o2 = [1 1 1 1 1];
```

```
o3 = [0 1 0 1 1];
o4 = [1 0 1 1 1];
O1 = binaryToDecimal(o1)
O2 = binaryToDecimal(o2)
O3 = binaryToDecimal(o3)
O4 = binaryToDecimal(o4)
```

2 Task 2

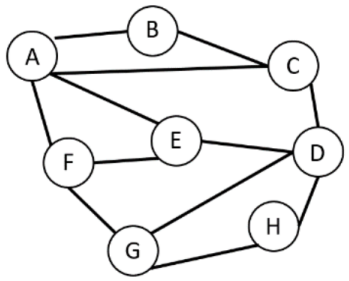

Figure 1: Traveling Salesmann Given Problem

City	Connectivity
A	B, C, E, F
B	A, C
C	A, B, D
D	C, E, G, H
E	A, D, F
F	E, A, G

Table 2: Connectivity Table

Possible routes: A - B - C - D - E - F - G - H and B - C - A - E - F - G - H - D etc.

3 Task 3

```
clear; clc
P_original = 11.4;
r = 0.2;
q = 2;
Delta = 1.5;
delta = 1-(2*(1-r))^(1/(q+1))
Pmutated = P_original*delta*Delta % = -2.9003

% r2
%r1
clear;
P_original = 11.4;
r = 0.7;
q = 2;
Delta = 1.5;
delta = 1-(2*(1-r))^(1/(q+1))
Pmutated = P_original*delta*Delta % = 2.6773
```