MATLAB Assignment 1

ECEN-674

Prepared By,

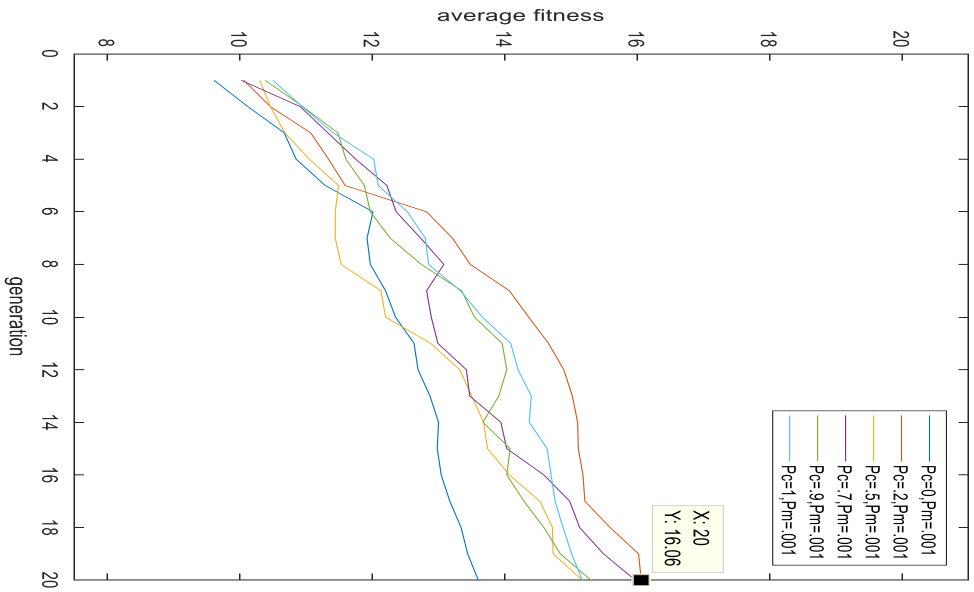
Mrinmoy Sarkar

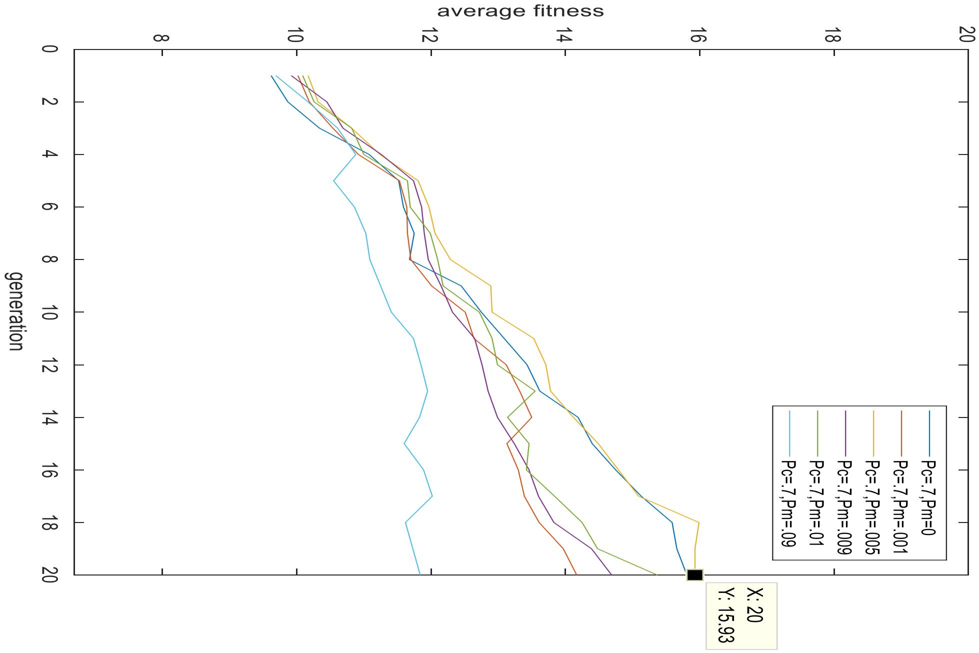
Bannar Id: 950-363-260

Date: 2/22/2018

Solution 1:

MATLAB OUTPUT:





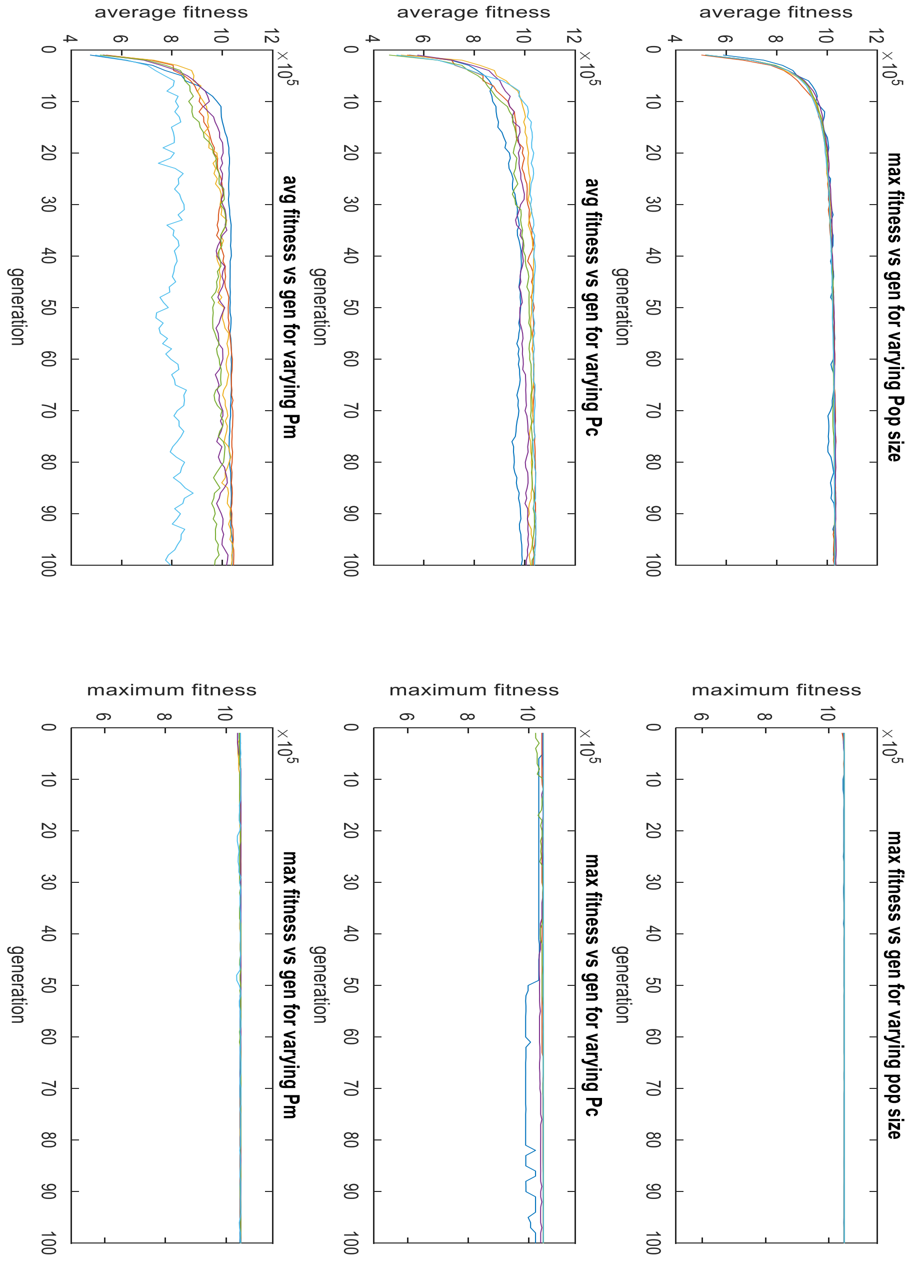
Remark: The issue concerning the relative importance of mutation and crossover can be viewed at a higher level. Mutation serves to create random diversity in the population, while crossover serves as an accelerator that promotes emergent behavior from components. The meta-issue, then, is the relative importance of diversity and construction. For the GA community, this is also related to the balance between exploration and exploitation. So, both these operations together will increase the probability of finding optimal solution.

MATLAB Code:

```
%% solution1.m
% author: Mrinmoy sarkar
% date: 2/16/2018
% email: msarkar@aggies.ncat.edu


Pcc=[0 .2 .5 .7 .9 1];
Pmm=[0 .001 .005 .009 .01 .09];
for kk=1:2
    for ii=1:length(Pcc)

        pop_size = 100;
        str_len = 20;
        pop = round(rand(pop_size,str_len));
        if kk==1
            pc = Pcc(ii);
            pm = 0.001;
        else
            pc=0.7;
            pm=Pmm(ii);
        end

        gen_no = 20;

        fit = @fitness1;

        fit_of_gen = zeros(pop_size,gen_no);

        for i=1:gen_no
            fit_of_gen(:,i)=fit(pop);
            pop = reproduction(pop,fit);
            pop =  cross(pop,pc);
            pop = mutation(pop,pm);
        end

        avg_fit = mean(fit_of_gen);
        max_fit = max(fit_of_gen);
        if kk==1
            subplot(121)
        else
            subplot(122)
        end
        plot(avg_fit)
        hold on

        %plot(max_fit)
        %hold on
        ylim([min(avg_fit)-3,max(max_fit)+3])
        %maxfit = max(avg_fit)
    end
    if kk==1
        xlabel('generation')
        ylabel('average fitness')

legend('Pc=0,Pm=.001','Pc=.2,Pm=.001','Pc=.5,Pm=.001','Pc=.7,Pm
=.001','Pc=.9,Pm=.001','Pc=1,Pm=.001')
    else
        xlabel('generation')
        ylabel('average fitness')

legend('Pc=.7,Pm=0','Pc=.7,Pm=.001','Pc=.7,Pm=.005','Pc=.7,Pm=.
009','Pc=.7,Pm=.01','Pc=.7,Pm=.09')
    end
end
```

Solution 2:

MATLAB OUTPUT:



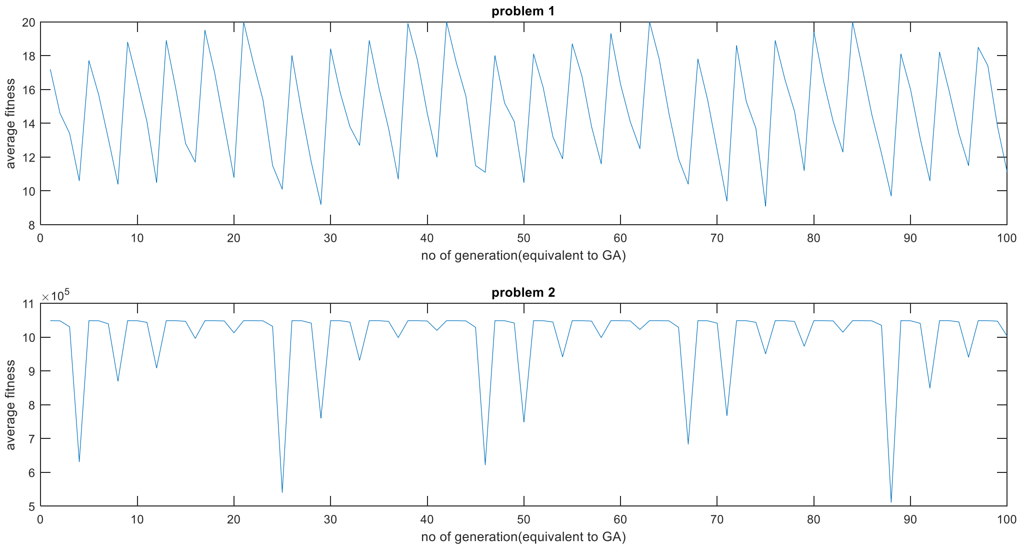
MATLAB Code:

```
%% solution2.m
% author: Mrinmoy sarkar
% date: 2/16/2018
% email: msarkar@aggies.ncat.edu

Pcc=[0 .2 .5 .7 .9 1];
Pmm=[0 .001 .005 .009 .01 .09];
popSize=[100 500 1000 1500 2000 3000];
for kk=1:3
    for ii=1:length(Pcc)
        if kk==1
            pop_size = popSize(ii);
            pc = 0.7;
            pm = 0.001;
        elseif kk==2
            pop_size = 100;
            pc = Pcc(ii);
            pm = 0.001;
        else
            pop_size = 100;
            pc = 0.7;
            pm = Pmm(ii);
        end
        str_len = 20;
        pop = round(rand(pop_size,str_len));

        gen_no = 100;

        fit = @fitness2;

        fit_of_gen = zeros(pop_size,gen_no);

        for i=1:gen_no
            fit_of_gen(:,i)=fit(pop);
            pop = reproduction(pop,fit);
            pop =  cross(pop,pc);
            pop = mutation(pop,pm);
        end

        avg_fit = mean(fit_of_gen);
        max_fit = max(fit_of_gen);
        if kk==1
            subplot(321)
            plot(avg_fit)
            xlabel('generation')
            ylabel('average fitness')
            title('max fitness vs gen for varying Pop size')
            hold on
            subplot(322)
            plot(max_fit)
            xlabel('generation')
            ylabel('maximum fitness')
            title('max fitness vs gen for varying pop size')
            hold on
        elseif kk==2
            subplot(323)
            plot(avg_fit)
            xlabel('generation')
            ylabel('average fitness')
            title('avg fitness vs gen for varying Pc')
            hold on
            subplot(324)
            plot(max_fit)
            xlabel('generation')
            ylabel('maximum fitness')
            title('max fitness vs gen for varying Pc')
            hold on
        else
            subplot(325)
            plot(avg_fit)
            xlabel('generation')
            ylabel('average fitness')
            title('avg fitness vs gen for varying Pm')
            hold on
            subplot(326)
            plot(max_fit)
            xlabel('generation')
            ylabel('maximum fitness')
            title('max fitness vs gen for varying Pm')
            hold on
        end
        ylim([min(avg_fit)-
.01*min(avg_fit),max(max_fit)+.1*max(max_fit)])
        %maxfit = max(avg_fit)
    end
end
```

Solution 3:

Next-ascent hill climbing(NAHC):

MATLAB OUTPUT:

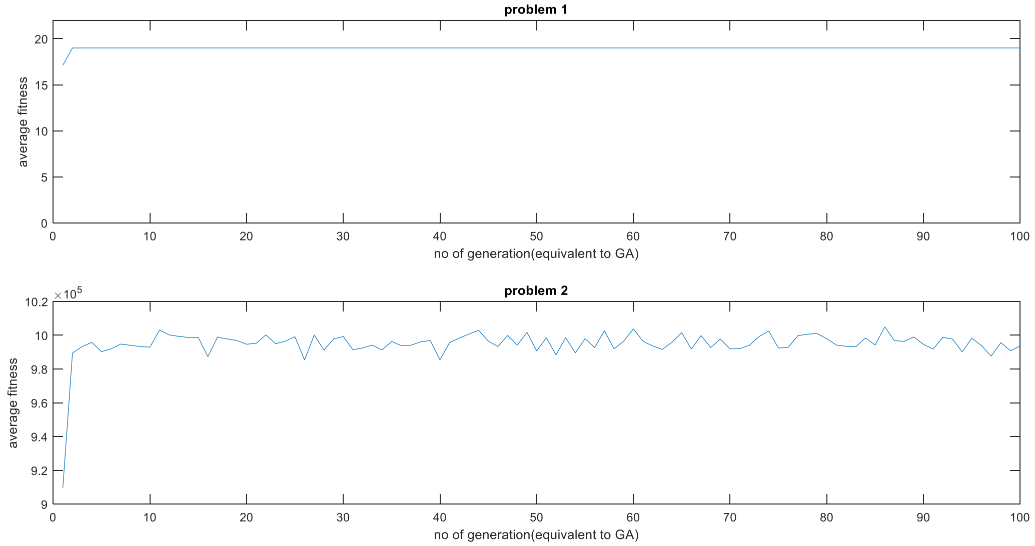


MATLAB Code:

```
%% nahc.m
% author: Mrinmoy sarkar
% date: 2/16/2018
% email: msarkar@aggies.ncat.edu

no_of_run = 10;
no_of_iteration = 10000;
pop_size = 1;
str_len = 20;
for kkk=1:2
    if kkk==1
        fit = @fitness1;
    else
        fit = @fitness2;
    end

    avg_fit = zeros(no_of_run,100);
    for r=1:no_of_run
        kk = 1;
        fit_mat=zeros(1,no_of_iteration);
        n=1;
        while 1
            pop = round(rand(pop_size,str_len));
            fit_mat(n) = fit(pop);
            if n == no_of_iteration
                break
            end
            best_fit = fit_mat(n);
            if mod(n,100) == 0
                avg_fit(r,kk) = best_fit;
                kk = kk+1;
            end
            n = n+1;
            for i = 1:str_len
                pop(i) = xor(pop(i),1);
                fit_mat(n) = fit(pop);
                if fit_mat(n)>=best_fit
                    best_fit = fit_mat(n);
                else
                    pop(i) = xor(pop(i),1);
                end
                if mod(n,100) == 0
                    avg_fit(r,kk) = best_fit;
                    kk = kk+1;
                end
                if n == no_of_iteration
                    break
                end
                n=n+1;
            end
        end
    end

    if kkk==1
        subplot(211)
        plot(mean(avg_fit))
        xlabel('no of generation(equivalent to GA)')
        ylabel('average fitness')
        title('problem 1')
    else
        subplot(212)
        plot(mean(avg_fit))
        xlabel('no of generation(equivalent to GA)')
        ylabel('average fitness')
        title('problem 2')
    end
end
```

Random-mutation hill climbing(RMHC):

MATLAB OUTPUT:



MATLAB Code:

```
%% rmhc.m
% author: Mrinmoy sarkar
% date: 2/16/2018
% email: msarkar@aggies.ncat.edu

no_of_run = 10;
no_of_iteration = 10000;
pop_size = 1;
str_len = 20;
for kkk=1:2
    if kkk==1
        fit = @fitness1;
    else
        fit = @fitness2;
    end

    avg_fit = zeros(no_of_run,100);
    for r=1:no_of_run
        pop = round(rand(pop_size,str_len));
        fit_mat=zeros(1,no_of_iteration);
        fit_mat(1) = fit(pop);
        best_fit = fit_mat(1);
        kk = 1;
        for n=2:no_of_iteration
            i = randi(str_len,1,1);
            pop(i) = xor(pop(i),1);
            fit_mat(n) = fit(pop);
            if fit_mat(n)>=best_fit
                best_fit = fit_mat(n);
            else
                pop(i) = xor(pop(i),1);
            end
            if mod(n,100) == 0
                avg_fit(r,kk) = mean(fit_mat(n-100+1:n));%
best_fit;
                kk = kk+1;
            end
        end
    end

    if kkk==1
        subplot(211)
        plot(mean(avg_fit))
        xlabel('no of generation(equivalent to GA)')
        ylabel('average fitness')
        title('problem 1')
        ylim([0,22])
    else
        subplot(212)
        plot(mean(avg_fit))
        xlabel('no of generation(equivalent to GA)')
        ylabel('average fitness')
        title('problem 2')
    end
end
```

APPENDIX:

```
function f=fitness1(pop)
f=sum(pop,2);
end
```

```
function f=fitness2(pop)
m = size(pop,1);
l = size(pop,2);
f = zeros(m,1);
for i=1:m
    for j=1:l
```

```
        f(i) = f(i)+pop(i,j)*2^(l-j);
    end
end
end
```

```
function new_pop = reproduction(pop,fit)
f = fit(pop);
f = f/sum(f);
f = cumsum(f);
m = size(pop,1);
new_pop = zeros(size(pop));
for i=1:m
    tem = find((rand<=f)==1);
    new_pop(i,:) = pop(tem(1),:);
end
```

```
function new_pop = cross(pop,pc)
n = floor(size(pop,1)/2);
l = size(pop,2);
new_pop = pop;
for i=1:n
    k = randi(l-1,1,1);
    m = size(pop,1);
    mm = 1:m;
    i1 = randi(m,1,1);
    mm(i1)=[];
    i2 = mm(randi(length(mm),1,1));
    if rand <= pc
        new_pop(i1,:) = [pop(i1,1:k) pop(i2,k+1:l)];
        new_pop(i2,:) = [pop(i2,1:k) pop(i1,k+1:l)];
    end
end
end
```

```
function new_pop = mutation(pop,pm)
m = size(pop,1);
l = size(pop,2);
new_pop = pop;
for i=1:m
    for j=1:l
        if rand <= pm
            new_pop(i,j) = xor(new_pop(i,j),1);
        end
    end
end
end
```