Ayush Gaggar HOMEWORK 4 11/5/20

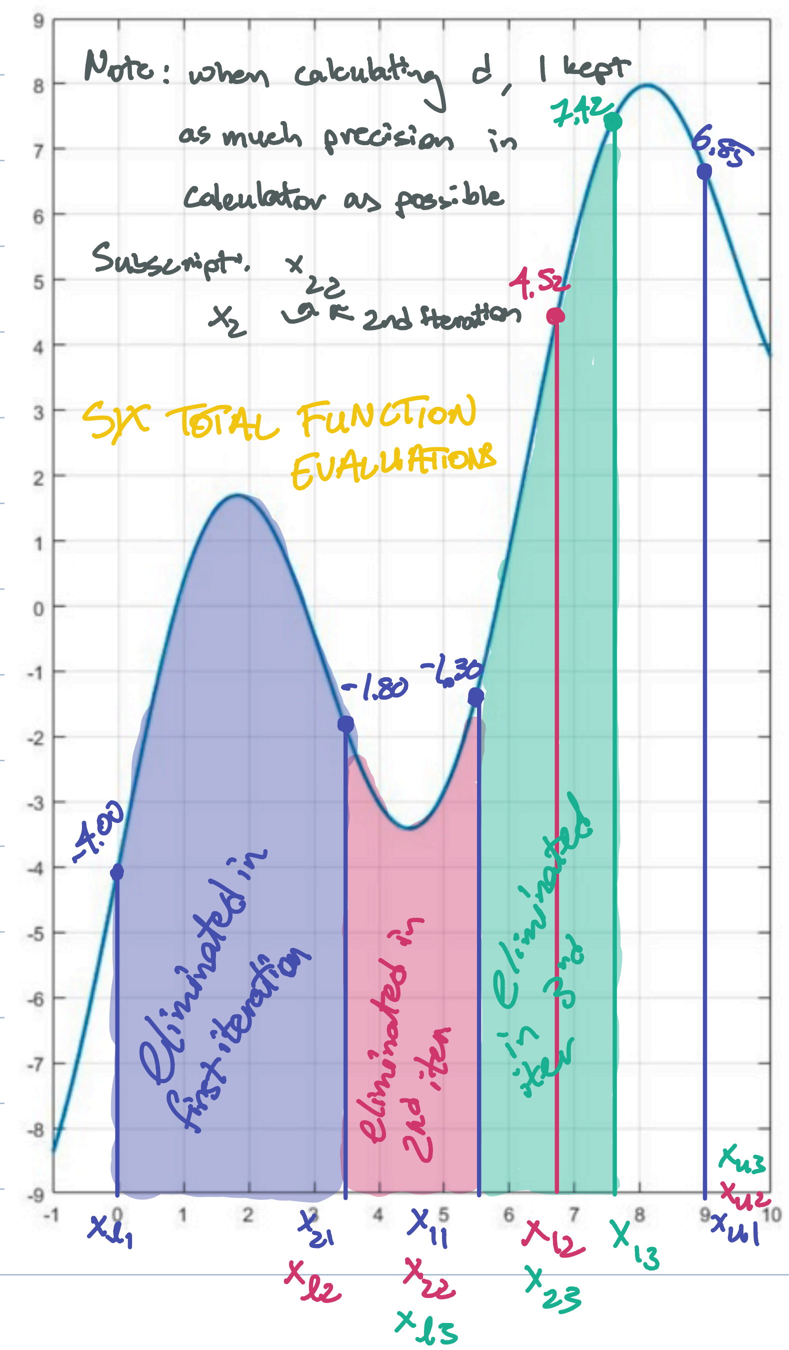
1\. a) $-\rho_1\cos\theta_2 + \rho_3 = \cos(\theta_2-\theta_4) - \rho_2\cos\theta_4$

$$\cos^{-1}\left(\frac{\rho_1\cos\theta_2 - \rho_3 + \cos(\theta_2-\theta_4)}{\rho_2}\right) = \theta_4$$

2\. a) $f(\theta_4)=0$: $\cos(\theta_2-\theta_4) + \rho_1\cos\theta_2 - \rho_3 - \rho_2\cos\theta_4 = 0$

b) $$\frac{df}{d\theta_4} = \sin(\theta_2-\theta_4) + \rho_2\sin\theta_4$$

3\.



– First iteration: 4 function eval

$d_1 = R(x_u - x_l) = \frac{1}{2}(\sqrt{5}-1)(9-0)$

$= 5.562306$

$x_{11} = 0 + d = 5.56$

$x_{21} = 9 - d = 3.44$; $f(x_{11}) > f(x_{21})$

– 2nd iteration: 1 new function eval

$x_{l2} = x_{21} = 3.44$; $x_{u2} = x_{u1}$

$d_2 = \frac{1}{2}(\sqrt{5}-1)(9-3.44) = 3.43769$

$x_{12} = 3.44 + 3.44 = 6.875$

$x_{22} = 9 - 3.44 = 5.562$

$f(x_{12}) > f(x_{22})$

– 3rd iteration: $x_{l3} = x_{22}$, $x_{u3} = x_{u1}$

$d_3 = \frac{1}{2}(\sqrt{5}-1)(9-5.562) = 2.125$

$x_{13} = 5.562 + 2.12 = 7.687$ ← 1 new function eval

$x_{23} = 9 - 2.12 = 6.875$

$f(x_{13}) > f(x_{23})$

Assignment 4

Table of Contents

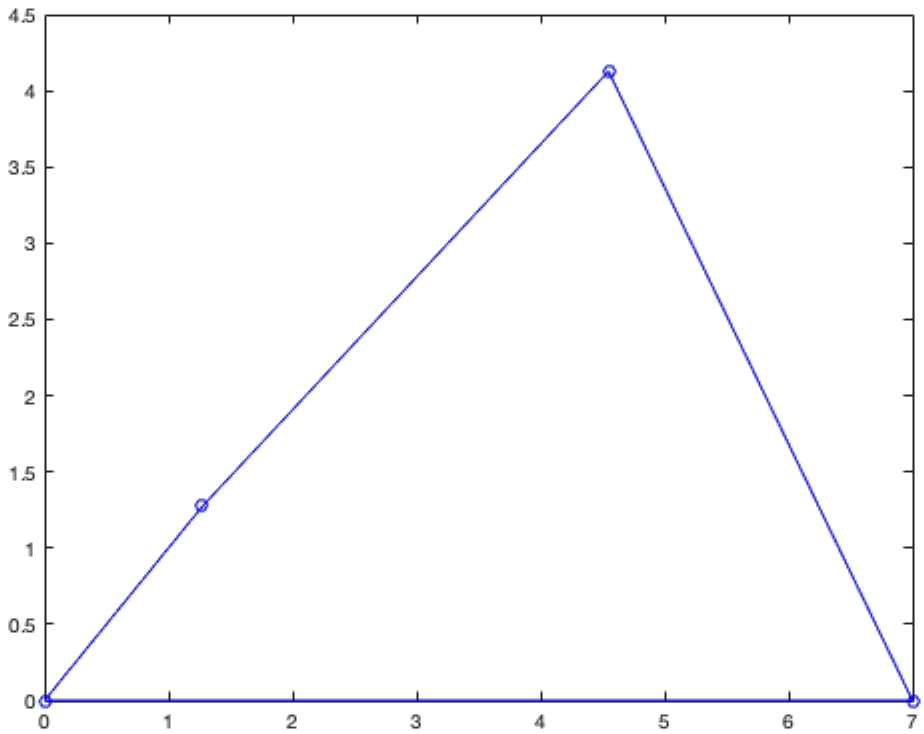
Problem 1: Fixed Point Iteration

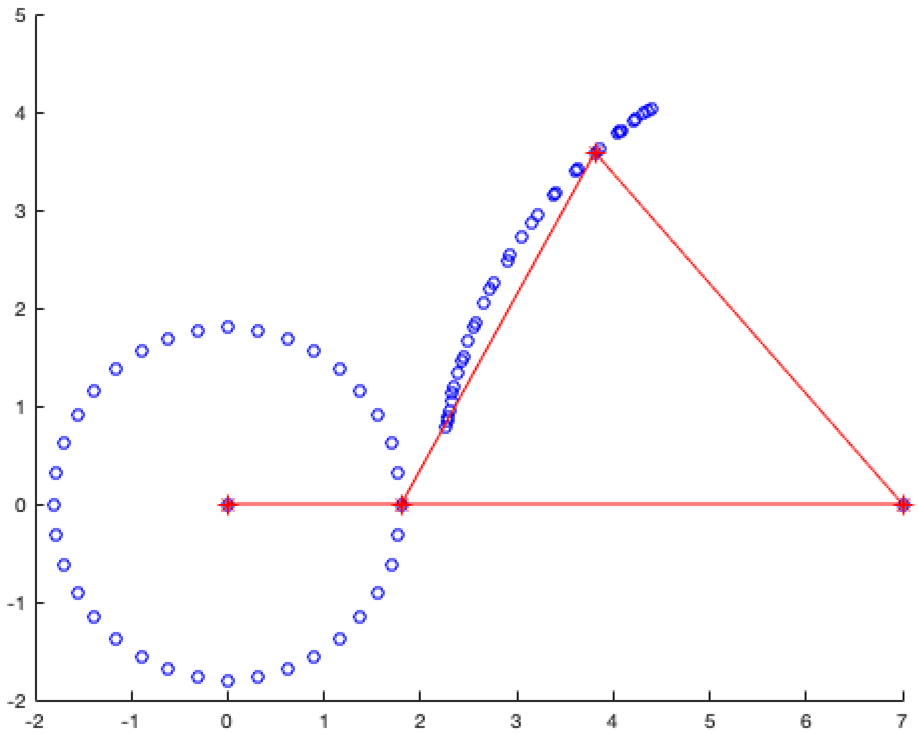
Part a done on paper Part b

```
clc; clear all; close all;
l1 = 7; l2 = 1.8; l3 = 4.2; l4 = 4.8;
p1 = l1/l4; p2 = l1/l2; p3 = (l1^2 + l2^2 + l4^2 - l3^2)/(2*l2*l4);
theta2 = 45; xi = 100; ea_goal = 0.1; ea = 10000; i = 0;
fpi = @(x) acosd((p1*cosd(theta2) - p3 + cosd(theta2 - x))/p2);

while ea > ea_goal
    i = i + 1;
    xi1 = fpi(xi);
    ea = abs((xi1 - xi)/xi1);
    xi = xi1;
end
theta4a = xi;
theta4 = xi;
fprintf('Using fixed point iteration: \n');
fprintf('After %d iterations, theta 4 is %f\n', i, theta4a);

% Part c
x = [0, l2*cosd(theta2), l1 + l4*cosd(theta4), l1, 0];
y = [0, l2*sind(theta2), l4*sind(theta4), 0, 0];
% First figure is for part c
figure(1);
plot(x, y, '-ob');

% Part d: Add a for loop
for theta2 = 0:10:360
    ea = 10000;
    fpi = @(x) acosd((p1*cosd(theta2) - p3 + cosd(theta2 - x))/p2);
    while ea > ea_goal
        i = i + 1;
        xi1 = fpi(xi);
        ea = abs((xi1 - xi)/xi1);
        xi = xi1;
    end
    theta4 = xi;
```

```
    x = [0, l2*cosd(theta2), l1 + l4*cosd(theta4), l1, 0];
    y = [0, l2*sind(theta2), l4*sind(theta4), 0, 0];
    figure(2);
    scatter(x, y, 'ob');
    hold on
end
plot(x, y, '-*r');
% Second figure is for part d
```

Using fixed point iteration:
After 2 iterations, theta 4 is 120.708904





Problem 2: Newton Rhapson

```
close all;
theta2 = 45; ea = 10000; i = 0; xi = theta4a;
nri = @(x) cosd(theta2 - x) + p1*cosd(theta2) - p3 -p2*cosd(x);
nri1 = @(x) sind(theta2 - x) + p2*sind(x);

while ea > ea_goal
    i = i + 1;
    xi1 = xi - nri(xi)/nri1(xi);
    ea = abs((xi1 - xi)/xi1);
    xi = xi1;
end
theta4 = xi;
fprintf('Using Newton-Raphson Method: \n');
fprintf('After %d iterations, theta 4 is %f\n', i, theta4);

Using Newton-Raphson Method:
After 1 iterations, theta 4 is 120.739074
```

Problem 3

Work done on paper

Problem 4

```
clc; close all; clear all;
max = -10000000; xmax = -100000; ymax = -1000000; z = -1000000;
for i = 1:1000
   x = -2 + 4*rand;
   y = -2 + 4*rand;
   z = opt(x, y);
   if z > max
       max = z;
       xmax = x;
       ymax = y;
   end
end

fprintf('\nUsing 2D Optimization: \n');
fprintf('The x value is: %f\n The y value is: %f\n The optimum value
 is: %f\n', xmax, ymax, max);

function z = opt(x, y)
z = sin(4*x + 3*y + 2*x^2 - x^4 - 3*x*y - 2*y^2);
end
```

```
Using 2D Optimization:
The x value is: 0.551037
 The y value is: 1.166155
 The optimum value is: 1.000000
```

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