Exercise week1

December 21, 2017

Week 1

0.0.1 1. $f(x) = 3x - 2$ x -10, -5, 0, 5 10

```
In [3]: x = [-10:5:10]
        fx1 = 3*x-2

x =

  -10   -5    0    5   10

fx =

  -32  -17   -2   13   28
```

0.0.2 2. $f(x) = \frac{2x^2+1}{x^2-3}$ x -5i, -5, 0, 5 5i

$$i = \sqrt{-1}$$

```
In [9]: x2 = [-5i, -5, 0, 5i]
        fx2 = (2*x2.^2 + 1)./(x2.^2 - 3)

x2 =

  -0 - 5i  -5 + 0i   0 + 0i   0 + 5i

fx2 =

   1.75000   2.31818  -0.33333   1.75000
```

0.0.3 3. f(x) x = -2i, -2, 0, 2, 2i

a) $f(x) = \sqrt{x^3 - 2x} + \log 10(|3x - 5|)$

```
In [19]: x3 = [-2i, -2, 0, 2, 2i]
         term1 = sqrt( x3.^3 - 2*x3 );
         term2 = log10(abs(3*x3 - 5));
         fx31 = term1 + term2
```

```
x3 =

  -0 - 2i  -2 + 0i   0 + 0i   2 + 0i   0 + 2i

fx31 =

 Columns 1 through 3:

   3.34215 + 2.44949i   1.04139 + 2.00000i   0.69897 + 0.00000i

 Columns 4 and 5:

   2.00000 + 0.00000i   3.34215 - 2.44949i
```

b) $f(x) = 3e^{x+3} + ln(\frac{e^x+e^{-x}}{2})$

```
In [27]: term1 = 3*exp(x3 + 3);
         term2 = log( (exp(x)+exp(-x))/2 );
         fx32 = term1 + term2
```

```
fx32 =

 Columns 1 through 3:

   -15.769 -  54.791i    12.462 +   0.000i    60.257 +   0.000i

 Columns 4 and 5:

   449.546 +   0.000i   -15.769 +  54.791i
```

0.0.4 4. Matlab

$R = 5, r = 3, r_0 = 0.1 \cdot x_{max}, a = 0.81, b = 0.14, c = 1, d = 5, \theta = 45°, t = 1,$ \$ n = 1\$

```
In [30]: R = 5; r = 3; a = 0.81; b = 0.14; c = 1; d = 5; theta = 45; t = 1; n = 1;
```

a) $x_{max} = \sqrt{-\frac{1}{b^2}\log(2e^{-a^2} - 1)}$

```
In [34]: log_term = log10(2*exp(-a^2)-1);
         x_max = sqrt(-b^-2*log_term)
         r_0 = 0.1*x_max
```

```
x_max =  8.5212
r_0 =  0.85212
```

b) $x = x_{max} \cdot sin((\theta - \frac{\pi}{2}) \cdot \frac{n}{2})$

```
In [38]: sin_term = sin((theta - pi/2)*n/2);
         x = x_max*sin_term

x =  2.3266
```

c) $x = (R - r) \cdot cos(\theta) + d \cdot cos(\frac{R-r}{r} \cdot \theta)$

```
In [39]: cos_term = cos(((R-r)/r)*theta);
         x = (R-r)*cos(theta)+d*cos_term

x =  1.8219
```

d) $r = r_0 + \frac{1}{c}\sqrt{-\log\left[2e^{-a^2} - e^{-b^2 x_{max}^2 sin^2\left(\left(\theta - \frac{\pi}{2}\right) \cdot \frac{n}{2}\right)}\right]}$

```
In [44]: log_term1 = -log10(2*exp(-a^2)-exp(-b^2*x_max^2*sin((theta-pi/2)*n/2)^2))
         r = r_0 + c^-1*(sqrt(log_term1))

log_term1 =  0.85885
r =  1.7789
```

e) $r = cos\frac{\pi}{n} \cdot sec\left(\theta - \frac{\pi}{n}\left(2 \cdot \left[\frac{n\theta}{2\pi}\right] + 1\right)\right)$

```
In [47]: sec_term = sec(theta-(pi/n)*((n*theta/pi)+1))
         r = cos(pi/n)*sec_term

sec_term = -1
r =  1
```

f) $r = 2 \cdot cos\left(\frac{\pi}{2n}\right) \cdot sin\left(\frac{1}{2} \cdot \left(t + \frac{\pi}{n} \cdot \left(2 \cdot \left[\frac{nt}{2\pi}\right] + 1\right)\right)\right) - sin\left(\frac{\pi}{n}\left(2 \cdot \left[\frac{nt}{2\pi}\right] + 1\right)\right)$

```
In [50]: n_term = (pi/n)*((n*t/pi) + 1)
         r = 2*cos(pi/2*n)*sin(0.5*(t+n_term))-sin(n_term)

n_term =  4.1416
r =  0.84147
```

0.0.5 5. A V_0

$$h(t) = V_0 t \cdot sinA - 0.5gt^2$$

$$V(t) = \sqrt{V_0^2 - 2V_0 gt \cdot sinA + g^2t^2}$$

g h(t) = 0 $t_{hit} = \frac{2V_0}{g} sinA$ $A = 30°, V_0 = 40m/s$ $g = 9.81m/s^2$

```
In [54]: v_0 = 40; A = 30; g = 9.81; t_hit = 2*v_0*sind(A)/g;
```

i. 15

```
In [65]: t_possible = [0:1:t_hit]
         h_higher15 = v_0.*t_possible*sind(A) - 0.5*g.*t_possible.^2
         t_ans = [1 2 3]

t_possible =

   0   1   2   3   4

h_higher15 =

    0.00000   15.09500   20.38000   15.85500    1.52000

t_ans =

   1   2   3
```

ii. 15 3

```
In [71]: t_possible
         h_higher15
         v_test = sqrt(v_0^2 - 2*v_0*g.*t_possible*sind(A)+g^2.*t_possible.^2)
         t_ans = [1 2]

t_possible =

   0   1   2   3   4

h_higher15 =

    0.00000   15.09500   20.38000   15.85500    1.52000

v_test =

   40.000   36.109   34.643   35.902   39.625

t_ans =
```

```
   1    2
```

iii. 5 35 m/s

```
In [72]: t_ans = [ 0 1 3 4 ]

t_ans =

   0    1    3    4
```

0.0.6 6. h(t) x(t) A v

$$h(t) = vt \cdot sinA - \frac{1}{2}gt^2$$

$$x(t) = vt \cdot cosA$$

g = 9.81 $ m/s^2 $ h(t) x(t) v = 10 m/s A = 35°

```
In [74]: v = 10; A = 35; g = 9.81;

In [94]: t = [0:0.1:1.2]
         h_t = v.*t*sind(A)-0.5*g.*t.^2
         x_t = v.*t*cosd(A)

         t_hit = 1.1

t =

 Columns 1 through 8:

   0.00000   0.10000   0.20000   0.30000   0.40000   0.50000   0.60000   0.70000

 Columns 9 through 13:

   0.80000   0.90000   1.00000   1.10000   1.20000

h_t =

 Columns 1 through 8:

   0.00000   0.52453   0.95095   1.27928   1.50951   1.64163   1.67566   1.61159

 Columns 9 through 13:
```

```
   1.44941   1.18914   0.83076   0.37429  -0.18028

x_t =

 Columns 1 through 8:

   0.00000   0.81915   1.63830   2.45746   3.27661   4.09576   4.91491   5.73406

 Columns 9 through 13:

   6.55322   7.37237   8.19152   9.01067   9.82982

t_hit =  1.1000
```

0.0.7 7.

$$W = k_1 x + 2k_2(x - d)$$

$k_1 = 10^4 N/m, k_2 = 1.5x10^4 N/m$ $d = 0.1m$ x W = 500N W = 200N

```
In [99]: k1 = 10^4; k2 = 1.5*10^4; d = 0.1;
         W = [500 200];
```

$$x = \frac{w + 2k_2 d}{k_1 + 2k_2}$$

```
In [102]: upper = W + 2*k2*d;
          lower = k1 + 2*k2;
          x = upper/lower
```

```
x =

   0.087500   0.080000
```