

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

```
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

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

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

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

```
x = 2.3266
```

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

```
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) $r = \cos \frac{\pi}{n} \cdot \sec \left(\theta - \frac{\pi}{n} \left(2 \cdot \left\lfloor \frac{n\theta}{2\pi} \right\rfloor + 1 \right) \right)$

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

```
sec_term = -1
r = 1
```

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

```
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

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

$$V(t) = \sqrt{V_0^2 - 2V_0gt \cdot \sin A + g^2t^2}$$

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

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

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

$$x(t) = vt \cdot \cos A$$

$g = 9.81 \text{ m/s}^2$ 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.

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

$k_1 = 10^4 \text{ N/m}, k_2 = 1.5 \times 10^4 \text{ N/m}$ $d = 0.1 \text{ m}$ $x = 500 \text{ N}$ $W = 200 \text{ N}$

```
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
```