ECE 111 - Homework #1

Week #1: Matlab Introduction. Due Tuesday, August 29th
Please submit via email, via hard copy, or on BlackBoard

Bison Academy: Homework Sets & Solutions

1) How long does it take for a Vestas V90-2MW wind turbine to pay for itself?

- See homework #4 solutions for Spring 2023

```
3.1732 years
```

Roots to a Polynomial

2) Use the *roots()* command to find the roots to

a) $y = x^3 - x^2 - 6x + 1$

```
>> roots([1,-1,-6,1])

    2.9308
   -2.0938
    0.1630
```

b) $y = x^4 + 5x^3 + 5x^2 - 5x - 6$

```
>> roots([1,5,5,-5,-6])

   -3.0000
    1.0000
   -2.0000
   -1.0000
```

c) $y = x^5 - 5x^4 - 10x^3 + 80x^2 - 96x$

```
>> roots([1,-5,-10,80,-96,0])


         0
   -4.0000
    4.0000
    3.0000
    2.0000
```

Matlab as a Graphing Calculator: (Thermistor equations)

Assume a thermistor (temperature sensor) and voltage divider have the following relationship:

$$R = 1000 \cdot \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right)\Omega$$

$$V = \left(\frac{R}{R+1000}\right) \cdot 10V$$

3) Determine the resistance and voltage if

- T = 0 degrees C
- T = 30 degrees C

```
>> T = 0;
>> R = 1000 * exp( 3905/(T+273) - 3905/298 )

R =  3.3201e+003

>> V = R / (R + 1000) * 10

V =    7.6853

>> T = 30;
>> R = 1000 * exp( 3905/(T+273) - 3905/298 )

R =  805.5435

>> V = R / (R + 1000) * 10

V =    4.4615

>>
```

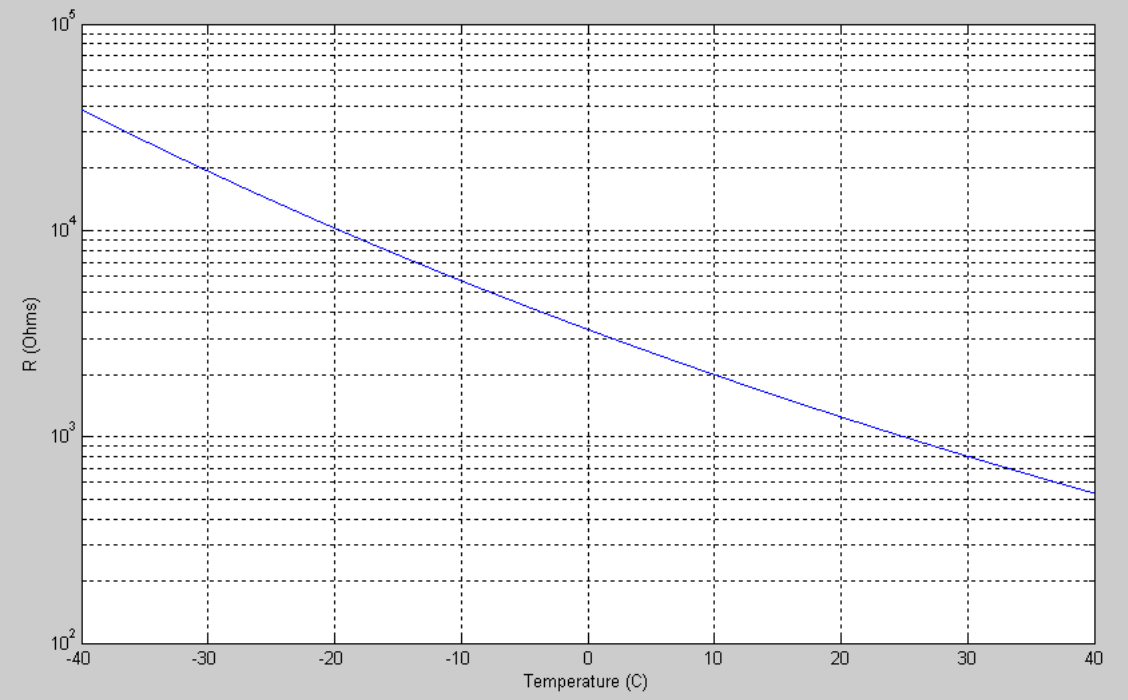
4) Plot the resistance vs. temperature for -40C < T < +40C. From the graph, determine

- The temperature if R = 2000 Ohms
- The temperature if R = 5000 Ohms

```
>> T = [-40:0.01:40]';
>> R = 1000 * exp( 3905 ./(T+273) - 3905/298 );
>> semilogy(T,R)
>> xlabel('Temperature (C)');
>> ylabel('R (Ohms)');
>> grid>>
```

From the graph,

- R = 2000 Ohms means T = 10C
- R = 5000 Ohms means T = T = -8C



5) Plot the votlage vs. temperature for -40C < T < +40C. From the graph, determine

- The temperature if V = 8.00 Volts
- The temeprature if V = 6.00 Volts

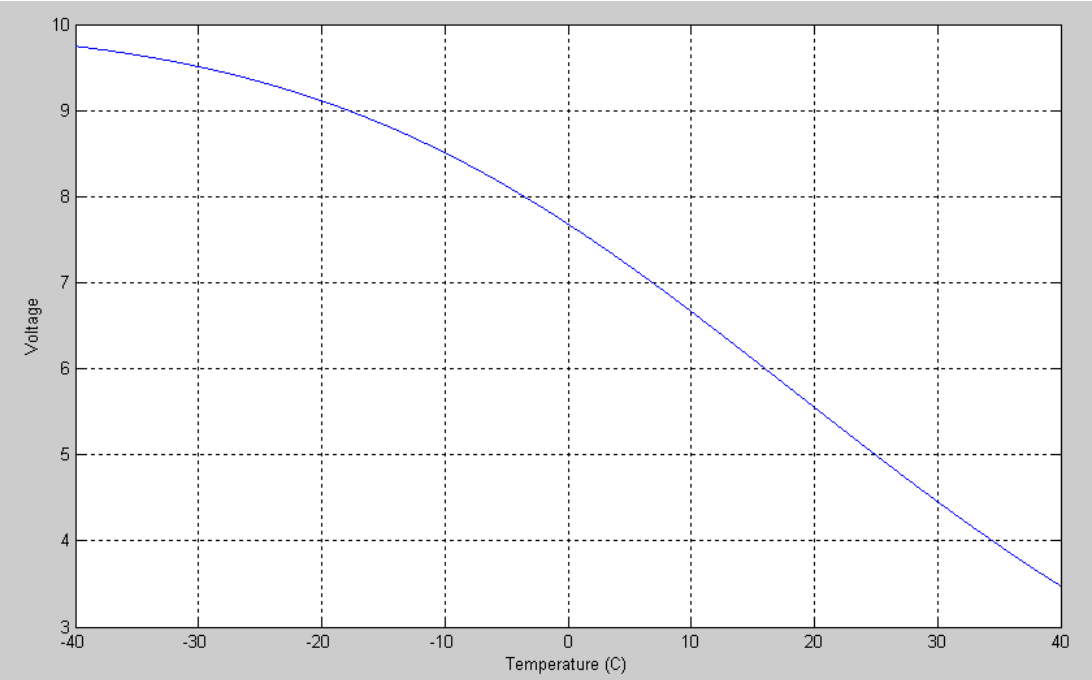
```
>> T = [-40:0.01:40]';
>> R = 1000 * exp( 3905 ./(T+273) - 3905/298 );
>> V = R ./ (R + 1000) * 10;
>> plot(T,V);
>> xlabel('Temperature (C)');
>> ylabel('Voltage');
>> grid
>>
```

V = 8.00V

- T = -3C

V = 6.00V

- T = +16C



For-Loops

6) A and B are playing a game

- A rolls three 10-sided dice and takes the sum (A = 3d10)
- B rolls four 10-sided dice and takes the sum (B = 4d10).

Whoever has the higher total wins. Determine the odds that A wins / ties / loses using a Monte-Carlo simulation with 100,000 games.

Create a Matlab script:

```
W = 0;
L = 0;
T = 0;
for n=1:1e5
    A = sum( ceil(10*rand(1,3)));
    B = sum( ceil(10*rand(1,4)));
    if(A > B)
        W = W + 1;
    elseif(A == B)
        T = T + 1;
    else
        L = L + 1;
    end
end
disp('      Wins        Ties        Loss');
disp([W,T,L]/1e5);
```

```
      Wins        Ties        Loss
      0.2189      0.0397      0.7414
```

A has

- A 21.89% chance of winning
- 3.97% chance of a tie, and
- 74.14% chance of losing

7) A and B are playing a match. For any given game,

- A has a 65% chance of winning (+1 point for A), and
- A has a 35% chance of losing (+1 point for B).

If the match consists of nine games, determine the odds that A wins the match

- A has 5 or more points

Create a Matlab script to

- Play a 9 game match,
- Repeat 100,000 times

```
Wins = 0;
for n=1:1e5
    A = 0;
    B = 0;
    for i=1:9
        if(rand < 0.65)
            A = A + 1;
        else
            B = B + 1;
        end
    end
    if(A > B)
        Wins = Wins + 1;
    end
end
Wins / 1e5


ans =    0.8295
```

Player A has an 82.95% chance of winning hte match

While-Loops

8) A and B are playing a match. For any given game,

- A has a 65% chance of winning (+1 point for A), and
- A has a 35% chance of losing (+1 point for B).

If the match continues until one player is up by 2 or more games, determine

- The odds that A wins (A has 2 or more points than B)
- Using a Monte-Carlo simulation with 100,000 matches

Write a Matlab script which

- Plays a single match (keep playing until someone is up 2 games), then
- Plays 100,000 matches

```
Wins = 0;
for n=1:1e5
    A = 0;
    B = 0;
    while(abs(A-B) < 2)
        if(rand < 0.65)
            A = A + 1;
        else
            B = B + 1;
        end
    end
    if(A > B)
        Wins = Wins + 1;
    end
end
Wins / 1e5


ans =    0.7745
```

With this format, player A has a 77.45% chance of winning the match.

9) A and B are playing a match. For any given game,

- A has a 65% chance of winning (+1 point for A), and
- A has a 35% chance of losing (+1 point for B).

If the match continues until one player

- Wins at least 5 games, and
- Is up by 3 games

Determine the odds that player A wins the match using a Monte-Carlo simulation with 100,000 matches

Write a Matlab script which

- Plays until someone wins 5 games, then
- Keeps playing until someone is up 3 games
- Then repeat 100,000 times

```
Wins = 0;
for n=1:1e5
    A = 0;
    B = 0;
    while(max(A,B) < 5)
        if(rand < 0.65)
            A = A + 1;
        else
            B = B + 1;
        end
    end
    while(abs(A-B) < 3)
        if(rand < 0.65)
            A = A + 1;
        else
            B = B + 1;
        end
    end
    if(A > B)
        Wins = Wins + 1;
    end
end
Wins / 1e5


ans =    0.8899
```

With this format, player A has an 88.99% chance of winning any given match