

ECE 257 - LESSON 8

ELEMENT BY ELEMENT MATRIX OPERATIONS

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IN CLASS

In the last two lessons we showed how to define matrix multiplication and division for the solving of systems of linear equations. In this lesson we define what we call element by element matrix operations for applications like the calculation of

$$\frac{1}{x}$$

for each element in the vector x

INTRODUCTION TO ELEMENT BY ELEMENT CALCULATIONS

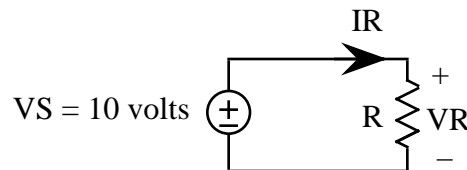
1. Multiplication, division and exponentiation

$$\begin{aligned}w &= [1 \ 2] \\x &= [3 \ 4] \\y1 &= w.*x \\y2 &= w./x \\y3 &= 1./x \\y4 &= w.^2 \\y5 &= 2.^w \\y6 &= w.^x\end{aligned}$$

- What does $.*$ do
- What does $./$ do
- What does $w.^2$ do
- What does $2.^w$ do
- What does $w.^x$ do
- How do the dimensions of matrices have to be related for element by element calculations

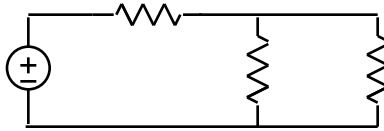
SOME APPLICATIONS OF ELEMENT BY ELEMENT CALCULATIONS

2. Finding IR in the following circuit with $V_S = 10$ volts for $R = 1K, 2K, 3K, 4K$



$$\begin{aligned}V_R &= 10; \\R &= 1000: 1000: 4000; \\I_R &= V_R./R\end{aligned}$$

- Why do we use $./$ instead of just $/$ in this program
- #### 3. Finding the powers of the resistors in the following circuit



```

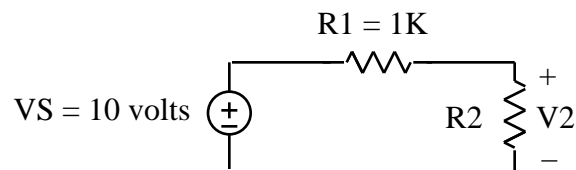
VR = [2 1 0.5];
IR = [1.5e-3 2e-3 1.8e-3];
resistor_powers = VR.*IR
total_resistor_power = sum (resistor_powers)

```

- a. Why do we use .* instead of just * in this program

MORE RESISTOR CIRCUIT EXAMPLES

4. Plotting V2 in the following circuit as a function of R2



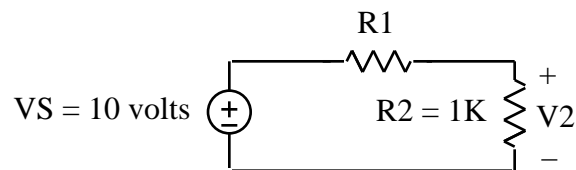
```

VS = 10;
R1 = 1e3;
R2 = linspace (0, 1e4, 100);
V2 = (R2./(R1 + R2))*VS;
plot (R2, V2)
xlabel ('R2');
ylabel ('V2');
title ('Voltage Division in a Series Circuit');

```

- a. Describe the result of this program

5. Plotting V2 in the following circuit as a function of R1



```

VS = 10;
R2 = 1e3;
R1 = linspace (0, 1e4, 100);
V2 = (R2./(R1 + R2))*VS;
plot (R1, V2)
xlabel ('R1');
ylabel ('V2');
title ('Voltage Division in a Series Circuit');

```

- a. Describe the result of this program

LOG PLOTS

6. First a linear plot

```
x = linspace (1, 1e5, 200);
y = 1000./(1000 + x.^2);
plot (x, y)
xlabel ('x');
ylabel ('y');
title ('y as a function of x');
```

- a. Describe the result of this program
- b. Why did we use ./ rather than /

7. Corresponding log plot

```
x = linspace (1, 1e5, 200);
y = 1000./(1000 + x.^2);
semilogx (x, y)
xlabel ('x - log scale');
ylabel ('y - linear scale');
title ('y on a linear axis and x on a log axis');
```

- a. How did semilogx affect the plot

8. Logspace

```
w = linspace (0, 2, 5);
y = 10.^w
x = logspace (0, 2, 5)
```

- a. Verify that $x = y$
- b. Make use of the fact that $x = y$ to explain what logspace does

9. Our log plot with logspace

```
x = logspace (1, 5, 200);
y = 1000./(1000 + x.^2);
semilogx (x, y)
xlabel ('x - log scale');
ylabel ('y - linear scale');
title ('y on a linear axis and x on a log axis');
```

- a. What's the advantage of using logspace for x. What, in particular, is the advantage of this program over the one in Problem (7)