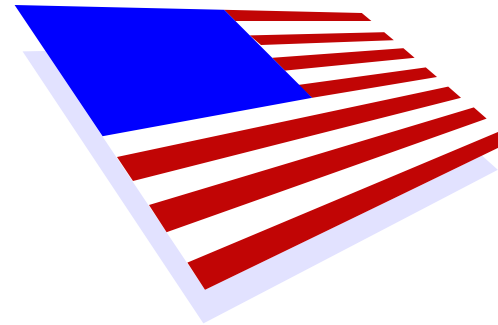
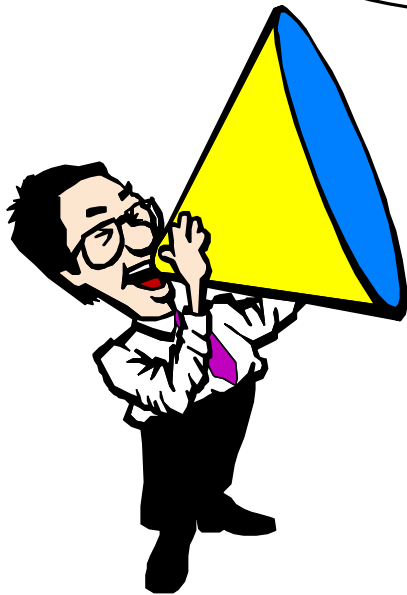
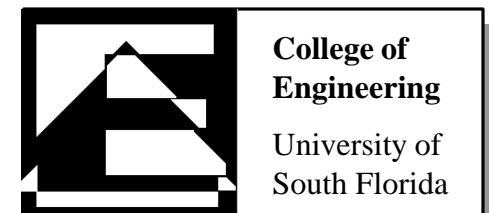


Lecture #2 for *Computer Tools for Engineers*



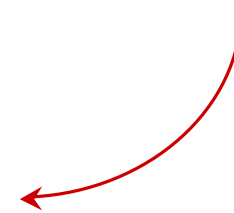
**University of
South Florida**
USF



Today's agenda:

- Review from last lecture
- Miscellaneous
- Mathcad
 - Variables (including index variables)
 - Basic calculations and functions
 - Vectors and matrices
 - Graphing
 - Solve blocks and root finding
 - Symbolic math
- Problem solving with Mathcad
 - Generating random numbers
 - Graphing one vector against another
 - Break-even analysis for economic modeling
 - Least-squares fit for trend analysis
 - Calculus - derivatives and integrals

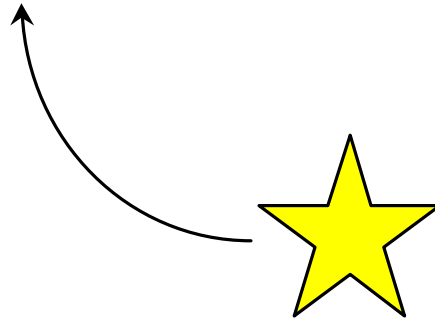
Assignment #1 problems



Review from last week:

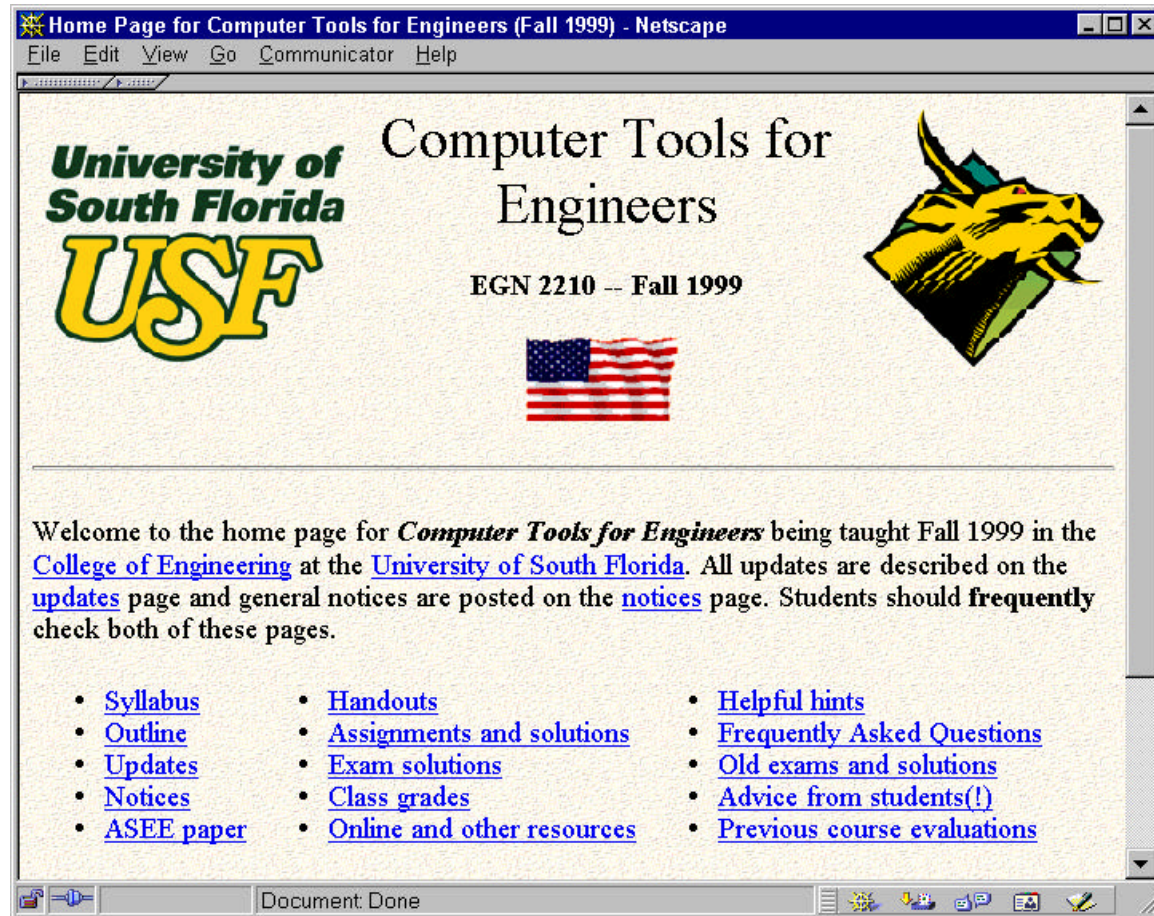
- I assume that EVERONE...
 - Has read the ASEE paper on the class homepage
 - Has worked, or is working, through the Mathcad tutorial
 - Can access material posted on the class homepage
- If any of the above is not true
 - **SEE ME OR A TA !!!**

} Right?



Review from last week: (continued)

- URL: *http://www.csee.usf.edu/~christen/class7/class7.html*



Review from last week: (continued)

- The goal of this course is _____
- To achieve this goal, you will learn
 - _____ for _____ crunching
 - _____ for _____ crunching
 - _____ for _____ solving
 - _____ for _____ problems
- Over a 10 year career, about how much more money will an engineer make over a business major?
 - _____
- For repetitive calculations, _____ is a good tool to use
- Not being able to use common tools makes you _____

Review from last week: (continued)

- A DOS directory is the same things as a Windows _____
- The DOS **md** command is used to _____
- The DOS **cd** command is used to _____
- The “\” directory is the _____ directory
- “**c:**” refers to the _____
- “**copy c:\test\x.dat c:\usf\y.txt**” does _____
- To generate or change a text file, one can use _____
- To “unzip” a **.zip** file use _____

Review from last week: (continued)

- Student exercise #1

Create two directories named usf1 and usf2 on floppy disk. Copy autoexec.bat (found on the root directory of the hard drive) to each of the two created directories. Change to the usf1 directory and list the contents of this directory.

Review from last week: (continued)

- Solution to student exercise #1

```
md a:\usf1
```

```
md a:\usf2
```

```
copy c:\autoexec.bat a:\usf1\autoexec.bat
```

```
copy c:\autoexec.bat a:\usf2\autoexec.bat
```

```
cd a:\usf1
```

```
dir
```

Miscellaneous:

- Quiz #1 is next week
 - Two randomly chosen problems directly from assignment #1
 - Quiz given in lab sections and is “hands on”
 - Closed book (only Mathcad may be open)
- Everyone knows where to find assignment #1, **right!?!?!?!?**
- You will need to bring
 - Diskette (label with your name!)
 - Big envelope to submit diskette } **+2 pts on quiz #1 for doing this!**

Miscellaneous: (continued)

My Fall 1999 office hours are **Monday** through **Thursday** **4:00pm** to **5:00pm**. Appointments are always possible.
I am best reach via email at *christen@csee.usf.edu*.



TA OFFICE HOURS

Li Zhou - MW 5:30 to 6:30, TH - 5:40 to 6:40

Sujit Vaidya - F 11:00 to 2:00

Miscellaneous: (continued)

- How should I take notes?
 - Most important is to pay attention and understand in “real time”. You can take notes by overhead # (upper right corner) and then later refer to a print-out of the class overheads.
- How should I best prepare for this class?
 - The best advice is to **STAY AHEAD** of the curve. Your class and lab time will be much more productive. One hour of “stay ahead” is worth two to ten hours of “catch-up”. *Think about it!*
- Why do you make this class so hard?
 - I work very hard to make this class **EASY**. Please tell me what I can do to make your learning easier... anything except dropping content (“dumbing down”), which is not fair to you, me, or your future employer or graduate school.

Mathcad:

- Mathcad is...
 - A mathematics package by Mathsoft (www.mathsoft.com)
 - Current version is 8.0 and we have 8.0 in the labs!
 - » Cost is about \$130.00
 - Hardest thing to learn is “what to type”

Mathcad: (continued)

- Variables
 - Regular variable (e.g., x, y)
 - Range variable (e.g., i, j)
 - Vector (e.g., year_i)

Examples:

x := 3

y := x

i := 1 ... x

j := 1, 1.1 ... y

year_i := i * 2

Type := to get :=

Type ; to get ...

Step size of 0.1

Type [to get subscript



Mathcad: (continued)

- Basic calculations
 - +, -, *, /, ^
 - Sum and product of a vector (subscripted variable)
 - Square root, etc. from calculator pallet
 - Integrate and differentiate from calculus pallet

Examples:

$$x := 3$$

$$y := x + 6$$

$$y := y + \sqrt{y}$$

$$y = 12$$

$$i := 1 \dots 5$$

$$\sum_i i = 15$$

Two kinds of equal used here, := for assignment and = for “show result”

Mathcad: (continued)

- Functions
 - Lots of built-in functions
 - Or write your own, $f(x)$ = calculations in terms of x

Examples:

$$f(x) := 2 * x$$

$$y := 3$$

$$f(4) = 8$$

$$f(y) = 6$$

$$\log(1000) = 3$$

Note x used here,
but “invoked” with y
here... this is how a
function works!

Mathcad: (continued)

- Functions
 - Access built-in functions via *Insert / Choose function* menu option
 - Can also use HELP to find a function

Example:

How to generate a random number? Use help!

Mathcad: (continued)

- Vectors and matrices
 - A vector is a one-dimensional array
 - A matrix is a two dimensional array

Examples:

$$i := 0 \dots 3$$
$$j := 0 \dots 2$$
$$x_i := i * 2$$
$$z_{i,j} := i + j$$

This is a vector



And, this is a matrix



Mathcad: (continued)

- Vectors and matrices
 - Can also enter via *Math / matrices* menu option

Mathcad: (continued)

- Graphing
 - Can graph a function
 - Can graph a vector (or a matrix for a 3D graph)
 - Can graph a vector against another vector

- Procedure for graphing
 - Define a function or vector
 - Define a range variable
 - Select *Graphics / Create X-Y Plot* from menu options
 - Put range variable on x-axis
 - Put function or vector on y-axis
 - Poof... you have a graph 😊

Mathcad: (continued)

- Solve blocks
 - Can solve for N unknowns in N equations

Example:

$$x := 1 \quad y := 1$$

Given

$$2*x + 3*y = 7$$

$$3*x - y = 5$$

$$\text{Find}(x,y) = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

A “guess” (this is needed!)

Given and Find pair

Note use of constrained equals (Ctrl =)

Mathcad: (continued)

- Root finding
 - Can find roots of an equation in (at least) 3 ways
 - > By symbolic factoring
 - > Using the root function
 - > Graphing to visually find the roots

Example:

$$f(x) := x^2 - 7x + 12$$

$$\text{root}(x, f(x)) = 3$$

But, what about the other root?



Mathcad: (continued)

- Symbolic math (math without numbers)

- Evaluate
- Simplify
- Expand
- Factor
- Differentiate
- Integrate
- Solve for variable
- Matrix operations
- Transforms (FFT, etc.)

Wow!

Mathcad: (continued)

- Symbolic math

Examples:

$$f(x) := x^2 - 7x + 12$$

$$f(x) = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$$

Solve for variable

Problem Solving using Mathcad:

- General strategy
 - Define the problem (define the *inputs* and *outputs*)
 - Gather information (the inputs)
 - Generate and evaluate potential solutions (“method”)
 - Refine and implement the solution
 - Verify the solution through testing



USE THE RIGHT TOOL

Mathcad Problem #1:

- Create a vector that contains 1000 random integers between -5 and 5
 - Find min, max, and mean of the numbers

Mathcad Problem #2:

- Combine two electrical signals on an XY plot
 - This is an example of how a TV works
- The signals are:
 - $X_i = \sin(\pi i/25), i = 0 \dots 1000$
 - $Y_i = \cos(\pi i/15), i = 0 \dots 1000$

Mathcad Problem #3:

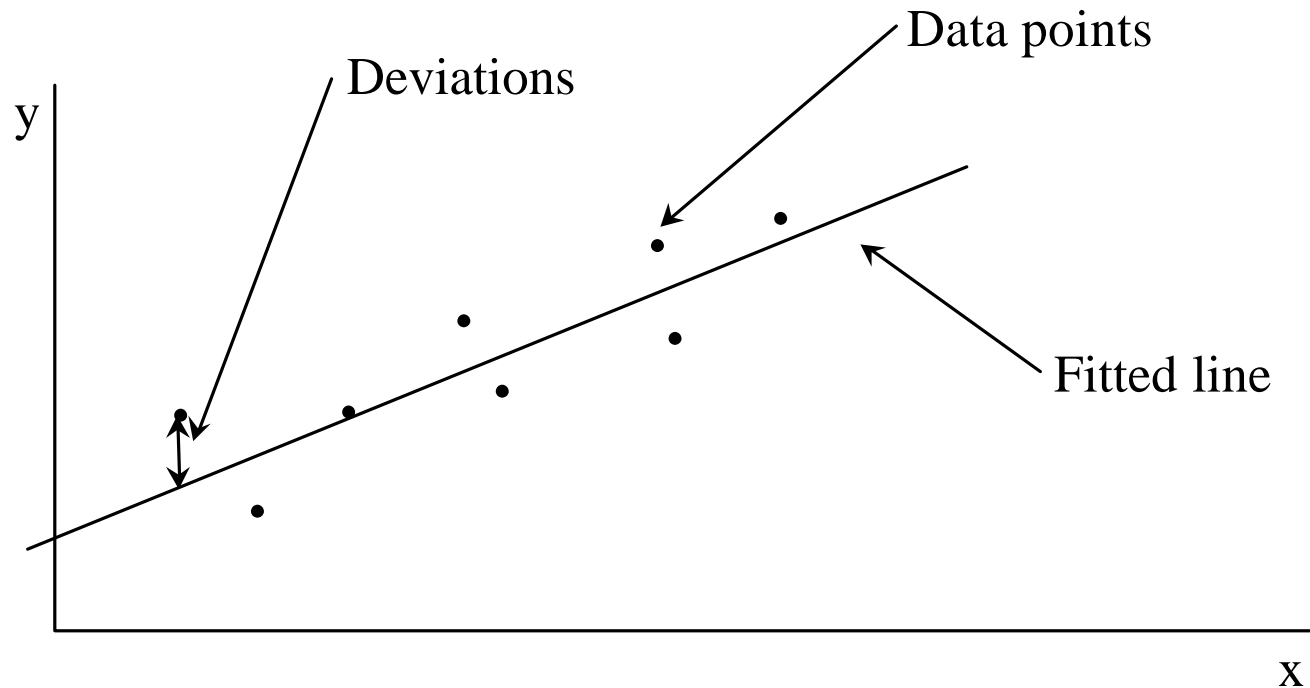
- Break-even analysis
 - Break-even occurs where costs equals revenues
 - Assume cost to produce a bird house is $\$1500 + \$6.00*b$
 - Assume price (revenue) of a bird house is $\$8.00$
 - How many bird houses must we sell to break-even?

Mathcad Problem #4:

- Least-squares fit for trend analysis
 - Average daily oil production for 12 months is...
70, 64, 65, 60, 68, 58, 54, 54, 58, 48, 49, 53
 - What is the trend and (if negative) when will the oil run out?

Mathcad Problem #4: (continued)

- What is a least-squares fit?
 - Fitting a line to data such that deviations are as small as possible



Mathcad Problem #5:

- Calculus - derivatives
 - Evaluating a derivative at a point

$$f(x) = x^3 + e^x \text{ what is } df(x)/dx \text{ at } x = 3?$$

- Symbolic differentiation

What is $df(x)/dx$ (the derivative function)?

Mathcad Problem #5: (continued)

- Calculus - integrals
- Solve for (indefinite integral) ...

$$\int x \cdot e^x dx$$

- Determine the distance in feet that a free-falling object falls in 5 sec
 - acceleration due to gravity... $g = 32.2 \text{ ft/sec}^2$
 - velocity... $v(t) = g \cdot t$
 - distance... $d = \text{integral of } v(t)$

End-of-Mathcad

- Mathcad lab is this week
- Mathcad quiz *is next week*
 - *Exactly 60 minutes to complete two problems*
- No lecture next week (Labor Day holiday)
 - Excel spreadsheet begins in two weeks