Week 2: Steps In Problem Solving
& Some MATLAB Basics

Concepts:
- review variable assignment, structural elements of MATLAB
- identify 6 types of action involved in algorithm
- preview of arrays (link to lab 1)
- use built-in functions (link to lab 1)

Reading for next week:

For Tues: pg. 35-40 (review), 40-60, 266-267
                   there will be a quiz on the material on pages 35-60.
For lab: pg. 443-456
For Thurs: pg. 60-69

TA hours, EOS-Main 203 – make sure to note these carefully!
          Thurs (wks 3,4,5,6,8,9,10,11):   9:30am – 10:30am
          Mon (wks 7,10 **only**):   TBA

Lab due on Connect by 4pm Friday

Types of Action in Algorithm

use example from last time, maximum earthquake magnitude

1. read mag1
2. read mag2

3. Is mag2 > mag1 ?
3a.   YES: biggest = mag2
3b.   NO: biggest = mag1

4. read mag3
5. Is mag3 > biggest ?
5a.   YES: biggest = mag3
5b.   NO: don't need to update biggest

6.   Loop over 4-5b until reach end of list
7.   write out biggest

Types of Actions

➢   Input
➢   Operation
➢   Selection
➢   Repetition
➢   Output
➢   Stop

Question

Case Sensitivity: what happens when…..

```
>> if = 2;
??? if = 2;
        |
Error: The expression to the left of the equals sign is not a valid target for an assignment.
```

What went wrong? I tried to use ``if'' as a variable name, BUT
"if" is a reserved word so I cannot redefine it.

```
>> IF = 2;
```

Because MATLAB is case sensitive I AM allowed to do this.
However, it is <u>very</u> bad programming practice

Review from Lab
(1) Variable Assignment

Worshseet A: What is output in words of this code snippet?
Worksheet B: Identify variables etc

```
% radius of Earth in km
radius = 6371;
area = 4*pi*radius*radius;
% radius of Moon in km
radius = 1739;
area = 4*pi*radius*radius
```

``pi'' in MATLAB returns the value of pi

pi = 4*atan(1) and imag(log(-1))

Worksheet C & D:

Review from Lab
(2) Arrays in MATLAB (see next week)

Recall: In lab 1 you loaded a file lab1.mat that contained 2 variables:

```
>> load lab1
>> whos
  Name                Size              Bytes  Class      Attributes

  temperature       12213x1             97704  double
  time              12213x1             97704  double
```

Temperature   12213 measurements
                   this is an array, dimensions 12213 by 1

A big advantage of MATLAB is the ease of dealing with vectors and matrices

Analogy: think of a table / EXCEL file
• each VALUE in the table is defined by its POSITION (row #, col #)
• conversely each POSITION in the table (row #, col #) has associated with it a VALUE

Arrays in MATLAB

Let's look at e.g.,10 entries in a list of eq magnitudes:

```
>> clear
>> mags = [4.2; 4.1; 4.1; 4.1; 4.3; 4.2; 4.3; 4.5; 4.0; 4.7];   SEE NEXT WEEK

>> whos
  Name          Size              Bytes  Class     Attributes

  mags          10x1                 80  double

>> mags

mags =

    4.2000
    4.1000
    4.1000
    4.1000
    4.3000
    4.2000
    4.3000
    4.5000
    4.0000
    4.7000
```
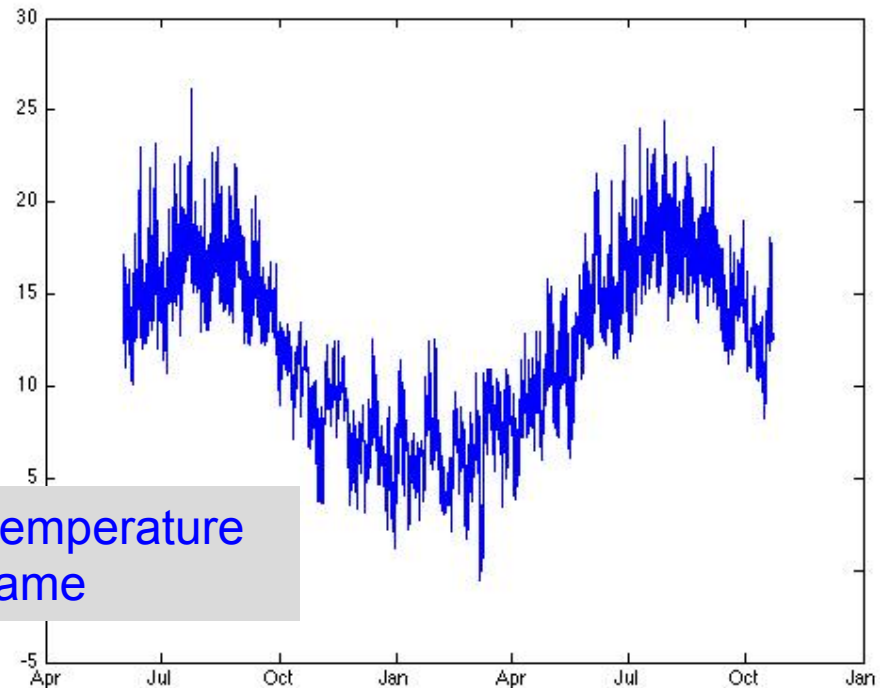
Worksheet E

Arrays and Plotting
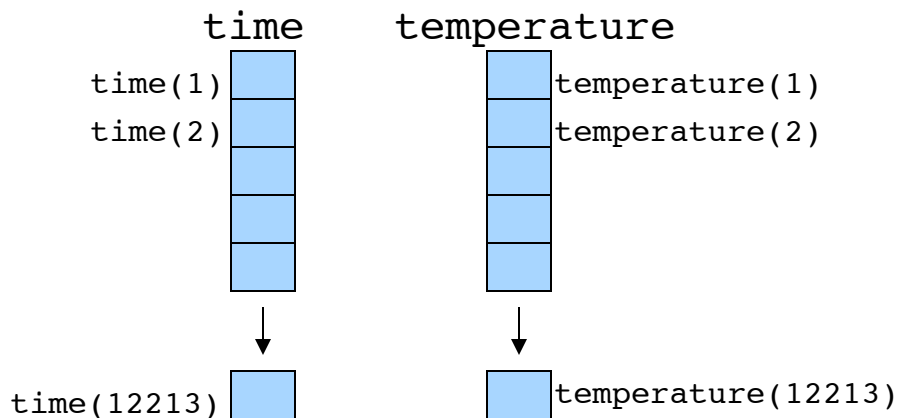


```
load lab1;
figure(1)

plot(time,temperature)
datetick('x',3)
```

# of points in time and temperature
MUST be the same

What has happened to make the plot?

time   temperature

time(1)   temperature(1)
time(2)   temperature(2)

time(12213)   temperature(12213)

Just like plotting by hand the plot
command has made a figure that
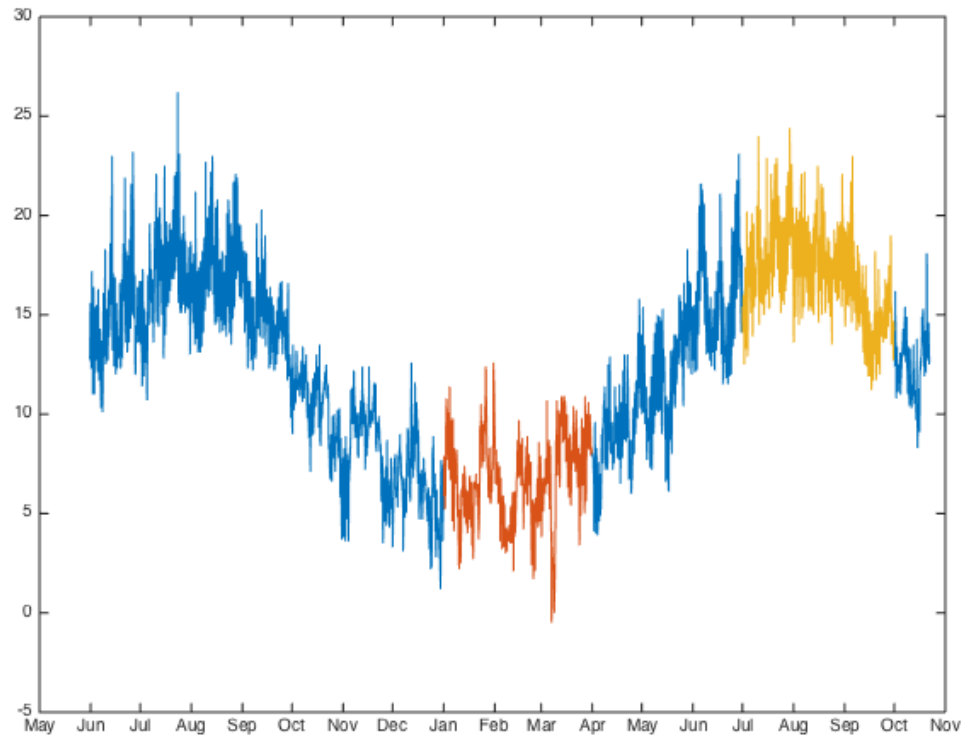consists of pairs of points

temp(1), temperature(1)
time(2), temperature(2)

time(12213), temperature(12213)

Arrays and Plotting

What does this do?

```
>> plot(time,temperature,time(5149:7308),temperature(5149:7308),....
   time(9493:11700),temperature(9493:11700)
```

Defining new arrays

```
>> plot(time,temperature,time(5149:7308),temperature(5149:7308),....
   time(9493:11700),temperature(9493:11700)
```

This is error prone if there are many commands involving the winter or summer parts of the time and temperature arrays. So we defined new arrays

```
wtime = time(5149:7308);
wtemp = temperature(5149:7308);
stime = time(9493:11700);
stemp = temperature(9493:11700);
```

Programming Style Hint:
Use variable names that are easy to understand and try to keep them short

e.g. wtemp vs. winter_temperature
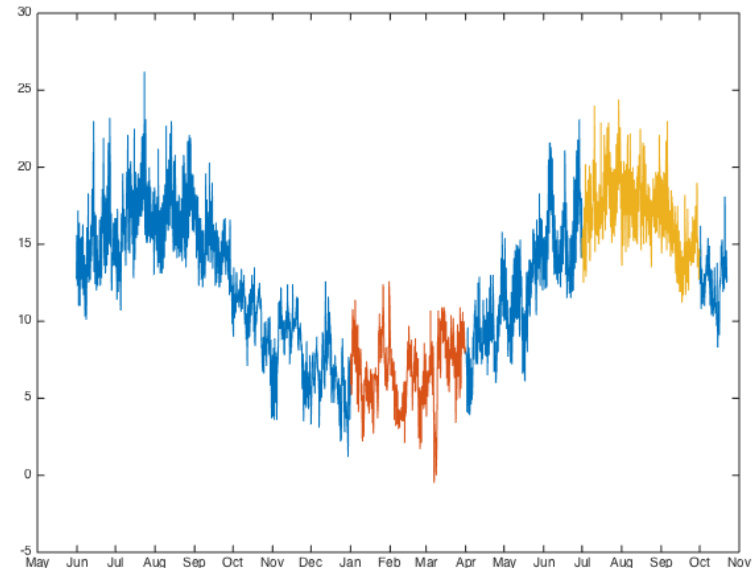
See text p. 28-29 for Programming style guidelines & common pitfalls
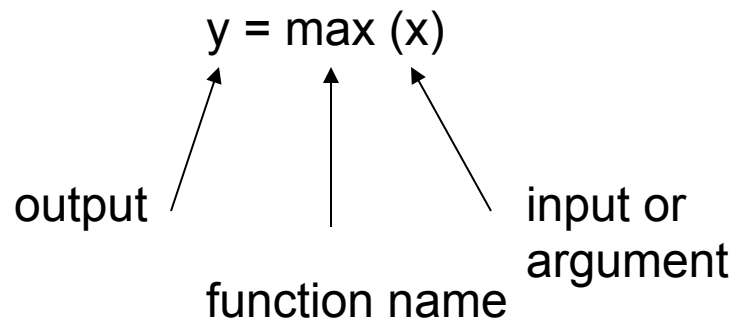
Using Built-In Functions

<u>Worksheet F:</u>

$$\texttt{y3 = max(mags(3:8))}$$

<u>Steps:</u>
1.   select a subset of mag that includes the 3rd thru 8th values
2.   calculate the maximum of these using the built-in function "max"
3.   assign the output to a variable called y3
4.   no semi-colon so echo the value of y3 to the screen

<u>General Syntax:</u>

**Advantage of MATLAB: many built-in functions**

y = max (x)

output   input or argument

function name

Why Arrays and Built-In Functions are Slick:
Finding the Largest Earthquake

my algorithm that we could code up explicitly
*   (i.e. write code that looks pretty much*
*   like this set of instructions):*

0. load data file with magnitudes
1. read mag1
2. read mag2

3. Is mag2 > mag1 ?
3a.   YES: biggest = mag2
3b.   NO: biggest = mag1

4. read mag3
5. Is mag3 > biggest ?
5a.   YES: biggest = mag3
5b.   NO: don't need to update biggest

6.   Loop over 4-5b until reach end of list
7.   write out biggest

BUT we've learned we can load arrays and use them as the input to built-in functions in MATLAB:

So this can be coded in 2 lines!
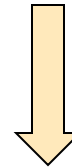
% load array of earthquake magnitudes
load mags;
% find biggest and echo to screen
biggest = max(mags)