Remember:

Screen-free zone

- Previous Lecture:
  - Intro to the course
  - “Computational senses”
  - Running a program in Matlab
- Today, Lecture 2:
  - Anatomy of a program
  - Variables, assignment, mathematical operations
  - Functions for input & output
  - Writing a program—systematic problem solving
- Announcements:
  - Set up folders (directories) on your laptop, flash drive, or cloud storage to store course files (see website announcement)
  - Register your clicker or clicker app (see links in Syllabus)
  - See website for office hours and consulting hours
  - First project will be posted after Tue lecture

Pick up a handout

Formula

- Surface area of a sphere?

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$$A = 4\pi r^2$$

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$$\cos(\theta/2) = \sqrt{\frac{1+\cos(\theta)}{2}}$$

Interactive computation in *Command Window*

```
>> r= 6
r =
     6
>> a= 4*pi*r^2
a =
  452.3893
>> v= 4/3*pi*r^3
v =
  904.7787
```

```
% Example 1_1:  Surface area of a sphere
% r: radius of the sphere [unit]
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r= input('Enter the radius: ');
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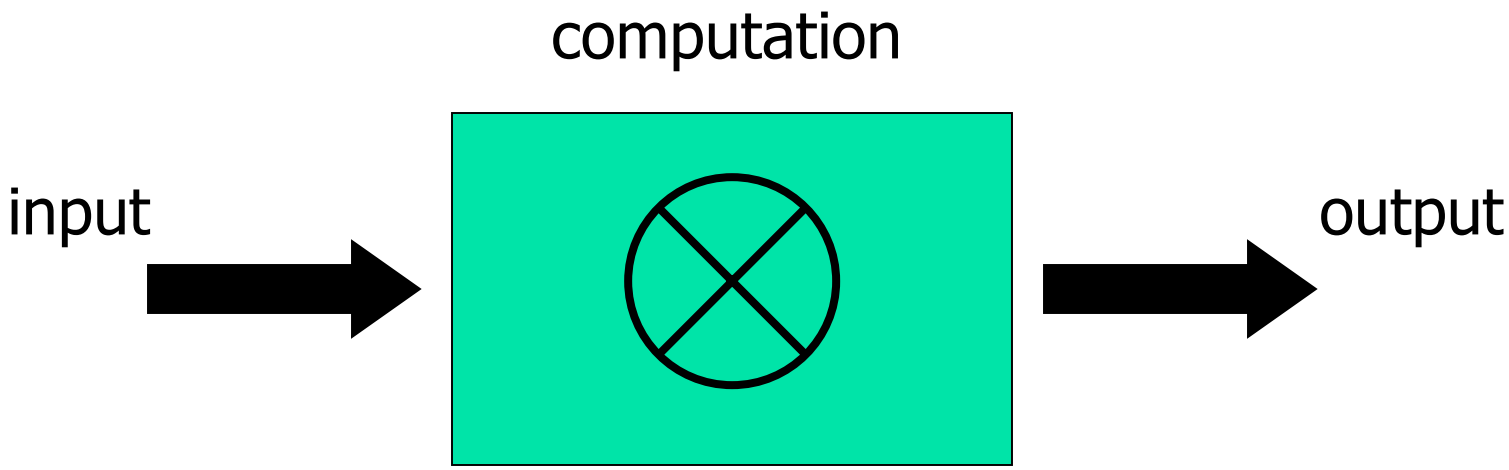
fprintf('Surface area is %f units^2!\n', A)
```

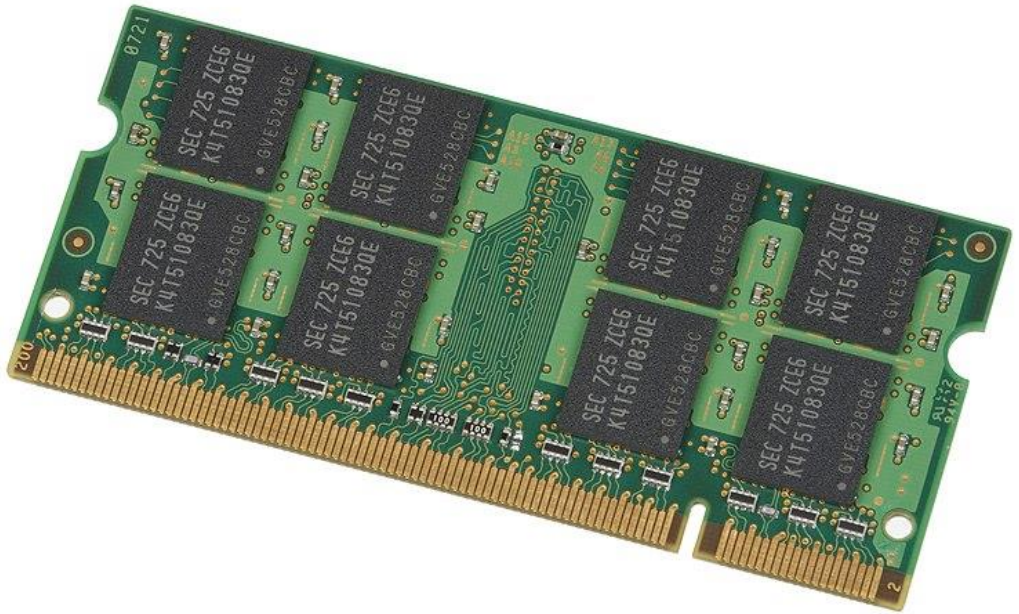
A computer program



Where does computation happen?

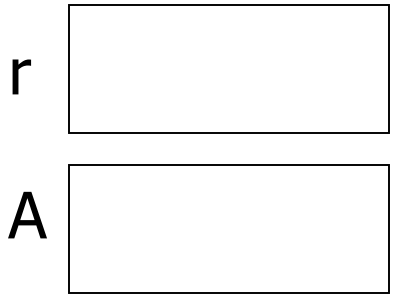
- Code lives on a disk (hard drive)
  - Matlab: Folder pane

- Variables live in memory (RAM)
  - Matlab: Workspace pane



Variable & assignment

- Variable: a named computer memory space for storing a value



Variable & assignment

- Variable: a named computer memory space for storing a value

- Valid names start with a letter, can contain digits
- Use meaningful variable names!
- Create a variable by assigning a value to it
- By default, a number has the type (class) double, for “double precision floating point number”

Variable & assignment

- Variable: a named space for storing a value

- Assignment: putting a value into a variable
- Assignment operator: =
- An assignment statement, e.g., `r= 2*4.5`
- Expression on right-hand-side (rhs) is evaluated before the assignment operation
- Update variable's value with another assignment statement, e.g., `r= 7`

Assignment

- Expression on rhs is evaluated before the assignment operation
- Examples:

```
x= 2*3.14
y= 1 + x
z= 4^2 - cos(y)
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Statements in a program are executed in sequence

```
% A program fragment ...
x= 2*3.14
y= 1 + x
x= 5
% What is y now?
```

A: 6 | B: 7.28 | C: *some other value* | D: *error*

Script execution

(A script is a sequence of statements, an “m-file”)

```
% Quad1
% Solves x^2 + 5x + 6 = 0


  a  = 1;
  b  = 5;
  c  = 6;
  d  = sqrt(b^2 - 4*a*c);
  r1 = (-b - d)/(2*a)
  r2 = (-b + d)/(2*a)
```

Memory space

a	1
b	5
c	6
d	1
r1	-3
r2	-2

```
% Example 1_1:  Surface area of a sphere
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r= input('Enter the radius: ');
A= 4*pi*r^2;
fprintf('Surface area is %f units^2!\n', A)
```

Input & output

- *variable* = **`input`**`('`*prompt*`');`

- **`fprintf`**`('`*message to print*`')`

Input & output

- *variable* = **input** ('*prompt* ')

```
r= input('Enter radius: ')
```

- **fprintf** ('*message to print* ')

```
fprintf('Increase ')
fprintf('is %f inches\n', x)
fprintf('Position (%d,%d)\n', x, y)
```

Substitution sequences (conversion specifications)

`%f`	fixed point (or floating point)
`%d`	decimal—whole number
`%e`	exponential
`%g`	general—Matlab chooses a format
`%c`	character
`%s`	string

During discussion: Find out how to control the number of decimal places shown with `%f`

```
% Example 1_1:  Surface area of a sphere
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r= input('Enter the radius: ');
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fprintf('Surface area is %f!\n', A)
```

Symbol to indicate that the rest of the line is a comment—not to be executed as code

Comments

- For readability!
- A comment starts with % and goes to the end of the line
- Start each program (script) with a concise description of what it does
- Define each important variable/constant
  - Units, assumptions/constraints
- Top a block of code for a specific task with a concise comment
  - Comment: "What we are trying to do"
  - Code: "How we are doing it"

Example

Modify the previous program to calculate the increase in surface area given an increase in the radius of a sphere.

Note: 1 mile = 5280 feet

```
% Example 1_2: Print surface area increase in
% miles^2 given an increase in the radius

r= input('Enter radius r in miles: ');
delta= input('Enter delta r in inches: ');
```

1 mile = 5280 feet

Tips for writing a program

- Check that you know what is given (or is input, or is assumed)
- Be goal-oriented: start by writing the last statement(s) for the program output
  - What is the program supposed to produce? *You know this from the problem statement*
  - Allows you to work backwards from the results
- Name as a variable what you don't know
  - Helps you break down the steps
  - Allows you to temporarily skip over any part that you don't know yet how to do

What's next?

- So far, all the statements in our scripts are executed in order
- We do not have a way to specify that some statements should be executed only under some condition
- We need a new language construct…