

- Previous Lecture:
 - Intro to the course, “Computational senses”
 - Running a program in Matlab

- Today’s Lecture:
 - Anatomy of a program
 - Variables, assignment, mathematical operations
 - Functions for input & output

- Announcements
 - Due to the fixed lab capacity, you **must attend the discussion section in which you are enrolled**
 - Consulting begins Wednesday in ACCEL Green Room (Carpenter Hall)

Formula

- Surface area of a sphere?

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

- Have the cosine of some angle and want $\cos(\theta/2)$?

$$\theta \in \left[0, \frac{\pi}{2}\right]$$

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

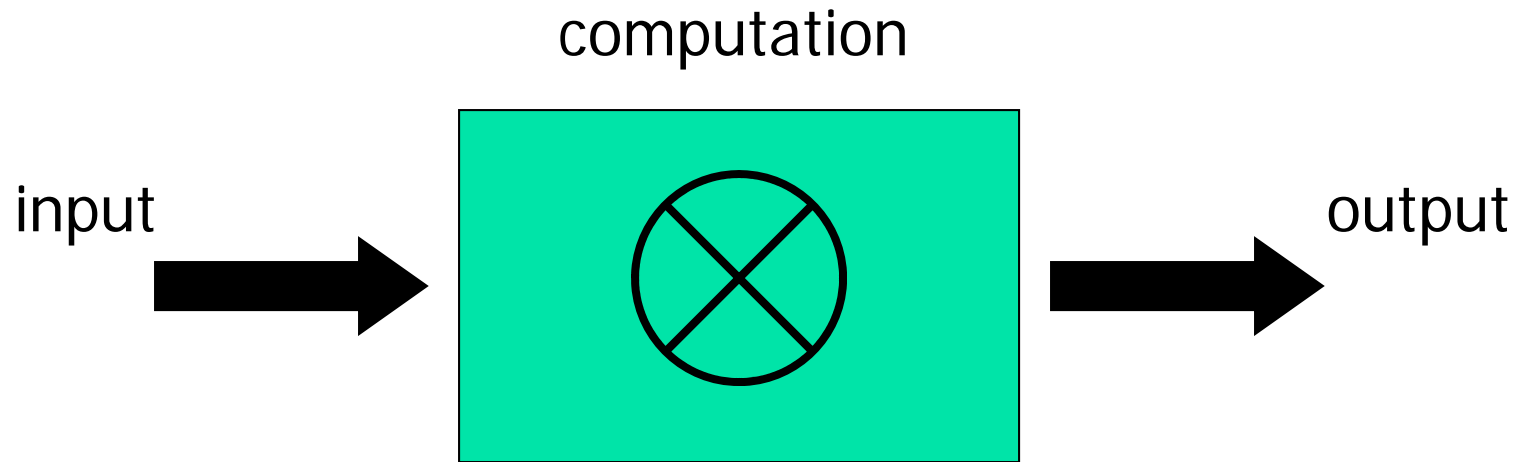
```
% Example 1_1: Surface area of a sphere
% A: surface area of the sphere
% r: radius of the sphere

r= input('Enter the radius: ');
A= 4*3.14159*r*r;
fprintf('Surface area is %f!\n', A)
```

```
% Example 1_1: Surface area of a sphere
% A: surface area of the sphere
% r: radius of the sphere

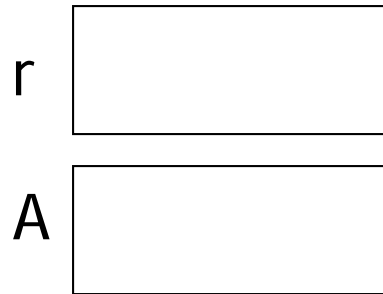
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A= 4*pi*r*r;
fprintf('Surface area is %f!\n', A)
```

A computer program



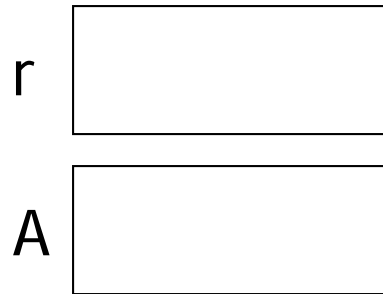
Variable & assignment

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



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- Valid names start with a letter, can contain digits
- **Use meaningful variable names!**

Variable & assignment

- **Variable**: a named space for storing a value



- **Assignment**: putting a value into a variable
- Assignment operator: =
- An assignment statement: $r = 2 * 4.5$
- **Expression** on **right-hand-side (rhs)** is evaluated before the assignment operation

Assignment

- **Expression** on **rhs** is evaluated before the assignment operation

- **Examples:**

`x = 2 * 3.14`

`y = 1 + x`

`z = 4 ^ 2 - cos(y)`

Assignment

- **Expression** on **rhs** is evaluated before the assignment operation
- Examples:
`x= 2*3.14`
`y= 1+x`
`z= 4^2 - cos(y)`
- Question: can we reverse the order of the 3 statements above?

Assignment

- **Expression** on **rhs** is evaluated before the assignment operation
- Examples:
`x = 2 * 3.14`
`y = 1 + x`
`z = 4 ^ 2 - cos(y)`
- Question: can we reverse the order of the 3 statements above?
- **NO!** Any variable on the rhs must be initialized.

Matlab's built-in functions

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

```
x= 2*3.14  
y= 1+x  
z= 4^2 - cos(y)
```

Function name (handwritten red text with arrow pointing to `cos`)

Argument passed to the function (handwritten red text with arrow pointing to `y`)
- Question: can we reverse the order of the 3 statements above?
- NO! Any variable on the rhs must be initialized.

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

Script execution

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```

Memory space

a 1

b 5

c 6

d 1

r1 -3

r2 -2

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, or error*

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	<u>f</u>ixed point (or floating point)
%d	<u>d</u>ecimal—whole number
%e	<u>e</u>xponential
%g	general—Matlab chooses a format
%c	<u>c</u>haracter
%s	<u>s</u>tring

Examples: **%f** **%15.2f**

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
- Top a block of code for a specific task with a **concise** comment

Example

Modify the previous program to calculate the increase in surface area (mile²) given an increase in the radius of a sphere.

Note: 1 mile = 5280 feet

```
% Example 1_2:  Surface area increase
% given an increase in the radius

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

```
% Example 1_2:  Surface area increase
% given an increase in the radius

r= input('Enter radius r in miles: ');
delta= input('Enter delta r in inches: ');
newr= r + ((delta/12)/5280);
A= 4*pi*r^2;
newA= 4*pi*newr^2;
incr= newA - A;
fprintf('Increase in mile^2 is %f.\n', incr)
```