

- Previous Lecture:
 - Intro to computer programming
 - M vs. J
- Today's Lecture:
 - Anatomy of a program
 - Variables & assignment
 - Functions for input & output
 - Branching

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Formula

- Surface area of a sphere? $A = 4\pi r^2$
- Have the cosine of some angle $\theta \in [0, \pi/2]$ and want $\cos(\theta/2)$?

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

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Surface Area Increase

```
>> r = 6365;
>> delta = .000001;
>> A_plus = 4*pi*(r+delta)^2;
>> A = 4*pi*r^2;
>> Increase = A_plus - A
Increase =
    0.15996992588043
```

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A computer program

```

graph LR
    input --> computation
    computation --> output
    style computation fill:#00FF00,stroke:#000,stroke-width:1px
    
```

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Variable & assignment

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

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

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Variable & assignment

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

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

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Assignment

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


```
x= 2*3.14
y= 1+x
z= 4^2 - cos(y)
```
- Any variable on the rhs must be initialized!

Matlab 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)
```

Any variable on the rhs must be initialized!

Handwritten notes:
 Function name (pointing to cos(y))
 Argument (value) passed to the function (pointing to y)

Script execution

```
% 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

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

```
% 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);
```

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** charakter
- %s** string

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

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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

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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

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```
% 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: ');
```

- 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...

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