

Introduction to MATLAB

Workshop on Fundamental Engineering Skills

American Society for Engineering Education (ASEE)
Student Chapter at the University of Michigan

What we'll cover today...

- Matrix definition and manipulation
- Script file generation and execution
- Basic plotting
- Programming

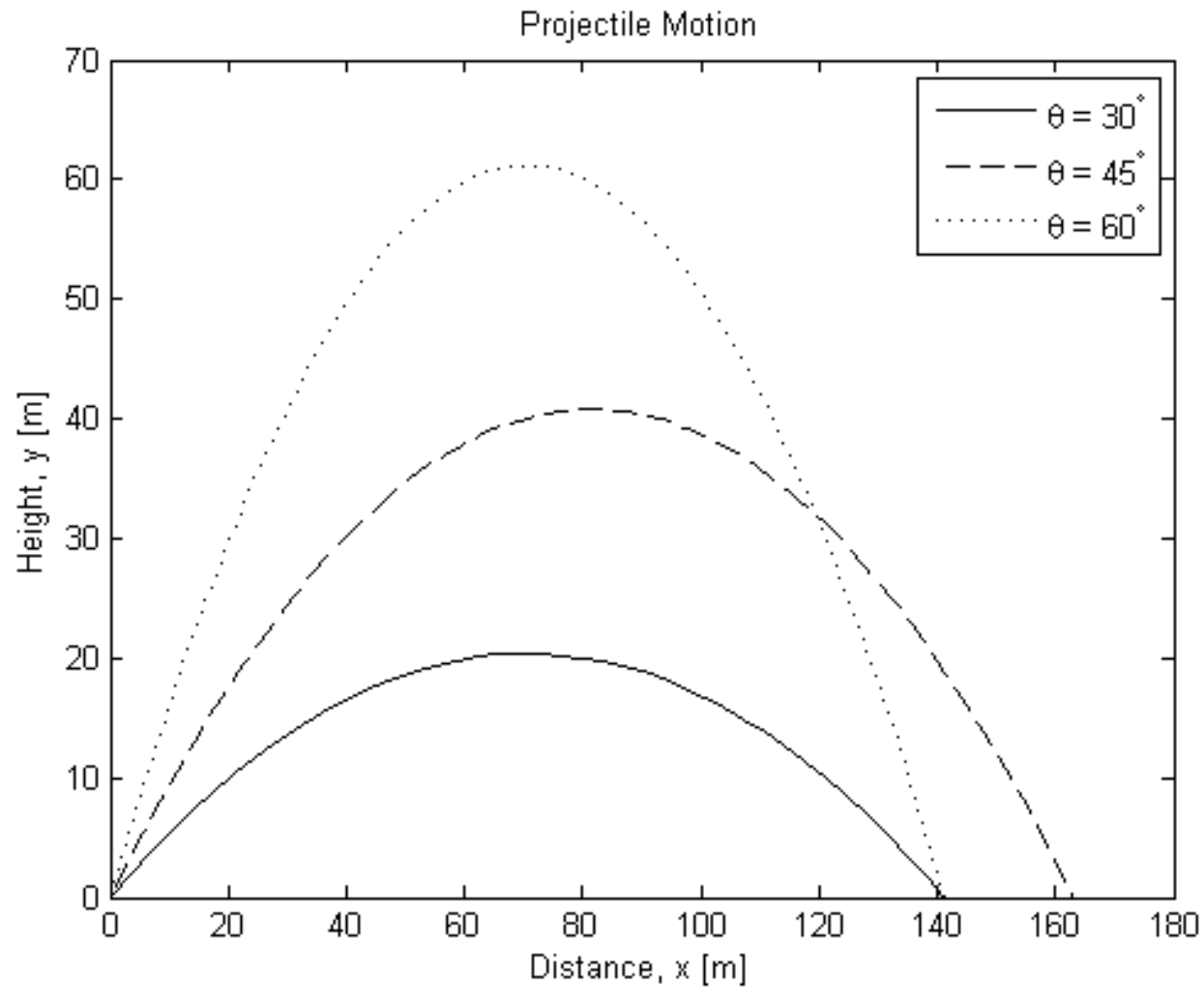
MATLAB stands for MATrix LABoratory

Everything is represented as a matrix

Why use MATLAB?

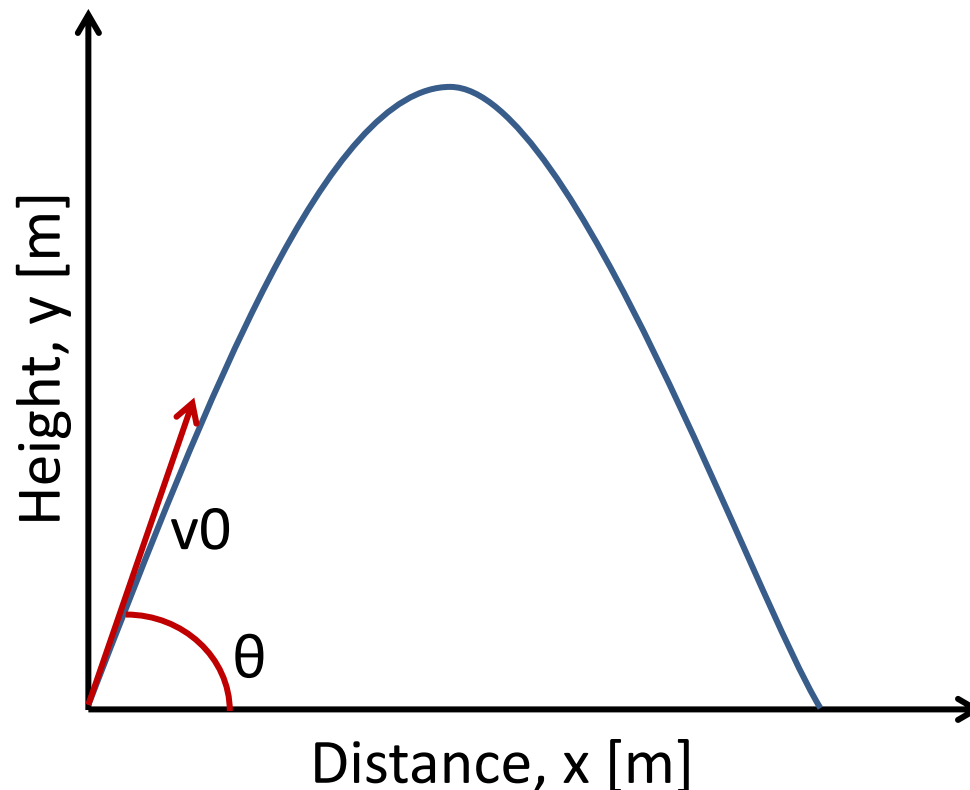
- Widely used by scientists and engineers
- Well-suited for problems in linear algebra and differential equations
- Beginner-friendly
 - No variable definition or memory allocation required
 - Excellent *Help* menu and function
 - Vector and matrix definition similar to scientific calculator

End Goal



Example 1: Projectile Motion

- Plot the trajectory of a projectile
 - Initial velocity, $v_0 = 40 \text{ m/s}$
 - Launch angle, $\theta = 45^\circ$



Example 1: Projectile Motion

- Equations of motion

$$x(t) = v_0 \cdot t \cdot \cos(\theta)$$

$$y(t) = v_0 \cdot t \cdot \sin(\theta) - \frac{1}{2} \cdot g \cdot t^2$$

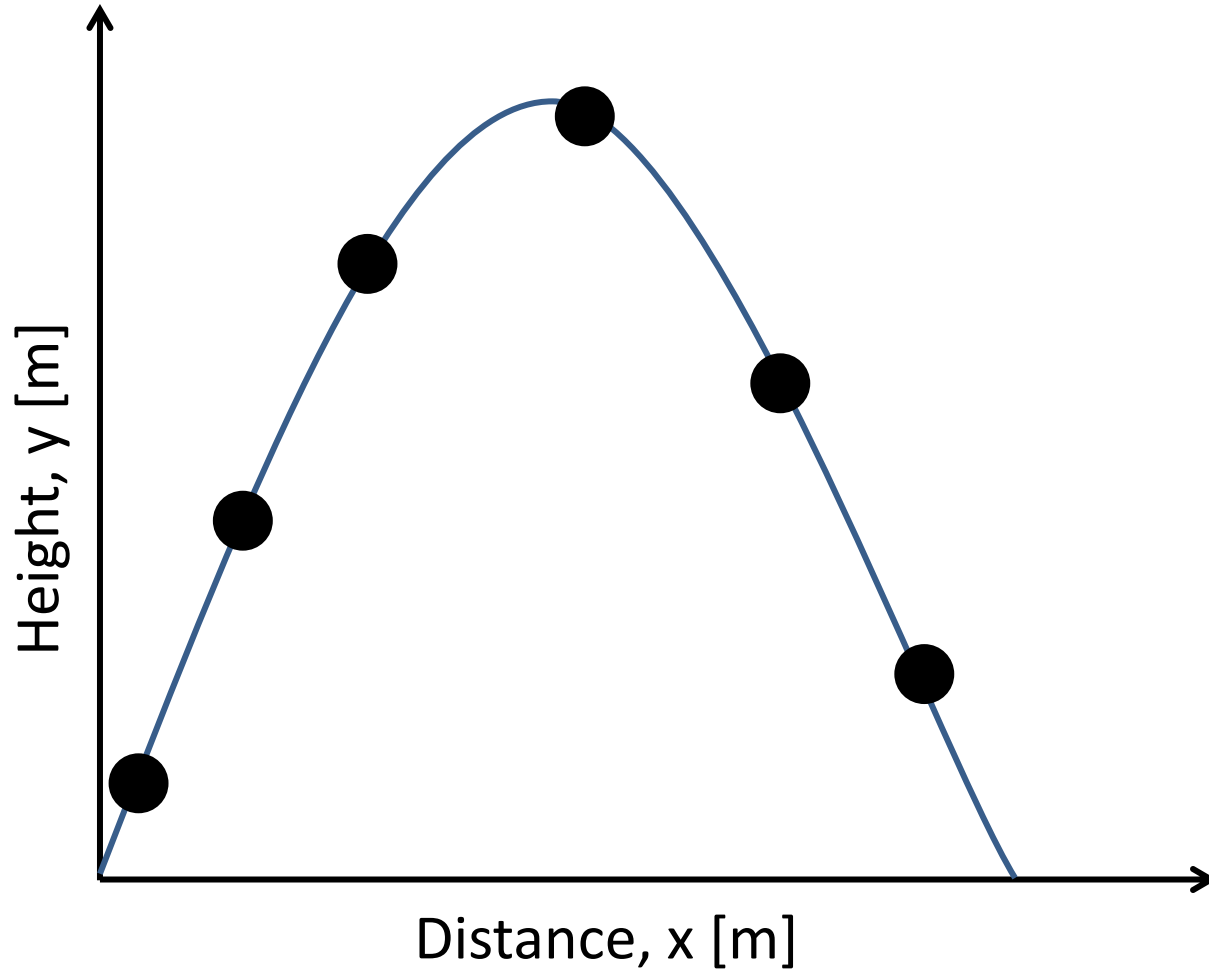


$$t = [t(1) \quad t(2) \quad t(3) \quad \dots]$$

$$x = [x(1) \quad x(2) \quad x(3) \quad \dots]$$

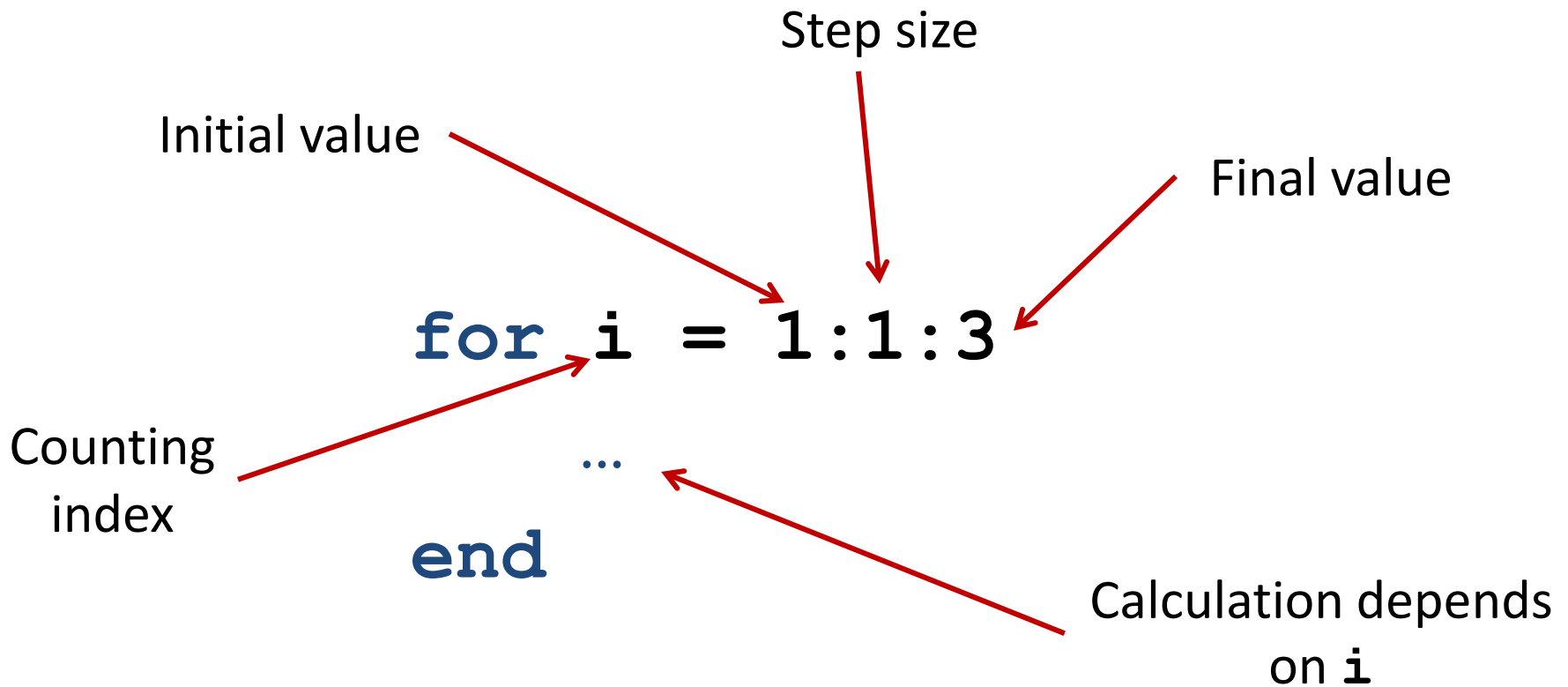
$$y = [y(1) \quad y(2) \quad y(3) \quad \dots]$$

Example 1: Projectile Motion



Example 2: Varying Launch Angle

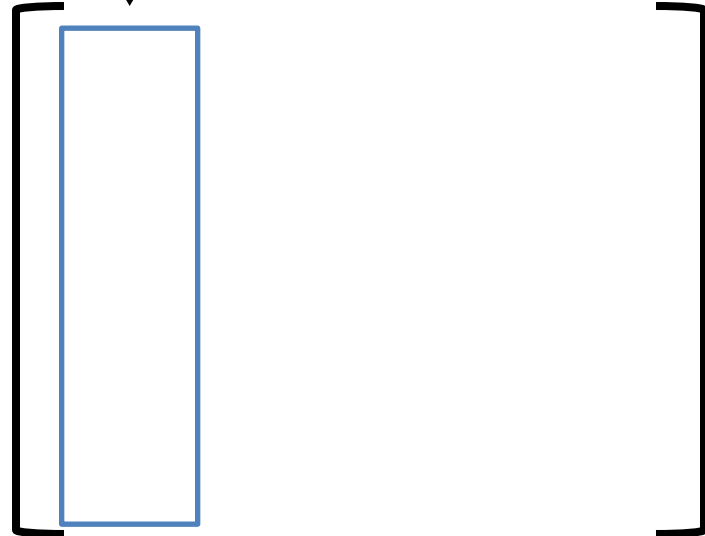
- Plot the trajectories of a projectile for various θ
 - $\theta = [\pi/6 \ \pi/4 \ \pi/3]$



Example 2: Varying Launch Angle

$$x(\theta_1) = \begin{bmatrix} x(1) & x(2) & \dots \end{bmatrix}$$

xPlot =

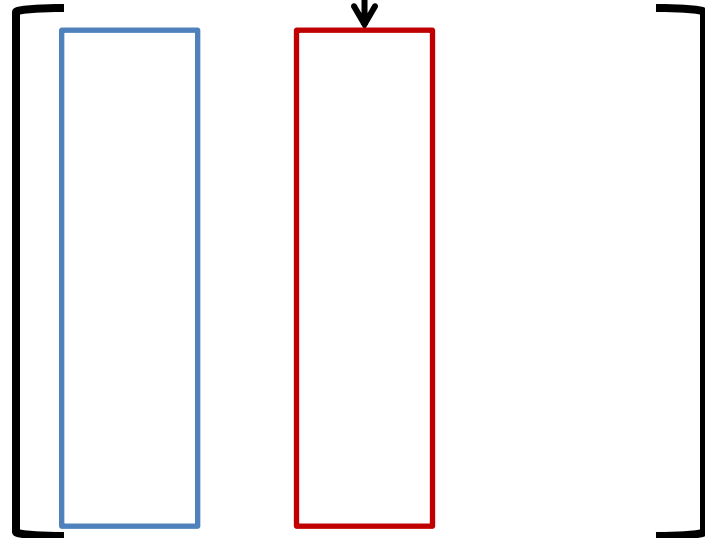


Example 2: Varying Launch Angle

$$x(\theta_1) = \begin{bmatrix} x(1) & x(2) & \dots \end{bmatrix}$$

$$x(\theta_2) = \begin{bmatrix} x(1) & x(2) & \dots \end{bmatrix}$$

xPlot =



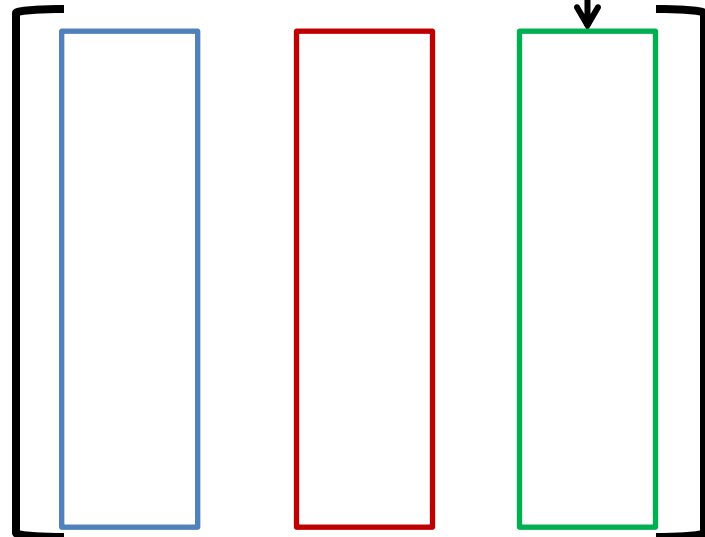
Example 2: Varying Launch Angle

$$x(\theta_1) = \begin{bmatrix} x(1) & x(2) & \dots \end{bmatrix}$$

$$x(\theta_2) = \begin{bmatrix} x(1) & x(2) & \dots \end{bmatrix}$$

$$x(\theta_3) = \begin{bmatrix} x(1) & x(2) & \dots \end{bmatrix}$$

xPlot =



Example 3: Only Calculate When $y \geq 0$

- Plot the trajectory of a projectile
 - Only calculate this trajectory when projectile is above ground

Initialize y

$y = 0$

while ($y \geq 0$)

...

end

Known constraint,
unknown # of
iterations

Calculation updates

y

Example 4: Combine Examples 2 & 3

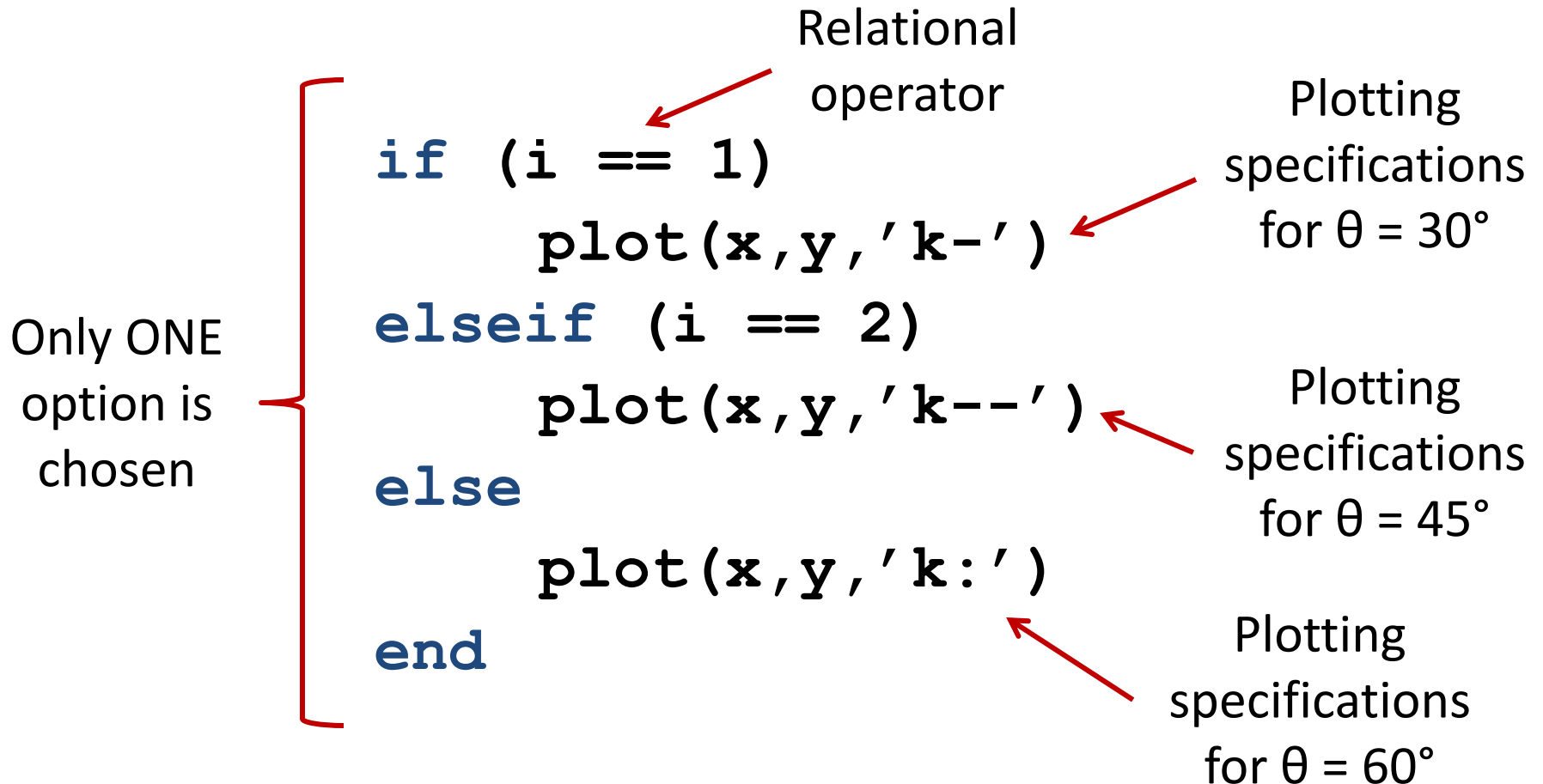
- Plot the trajectory of a projectile
 - Plot results for varying launch angle
 - Only calculate this trajectory when projectile is above ground

```
for i = 1:1:3
    y = 0
    while (y >= 0)
        ...
    end
end
```



“Nested” loops

Example 4: Combine Examples 2 & 3



Check out our website
(<http://asee.engin.umich.edu/>)

for upcoming

Workshops on Fundamental Engineering Skills:

- Advanced Plotting in MATLAB
- Introduction to Mathematica
- SolidWorks
- Photoshop
- Illustrator