



JOHNS HOPKINS

WHITING SCHOOL  
of ENGINEERING

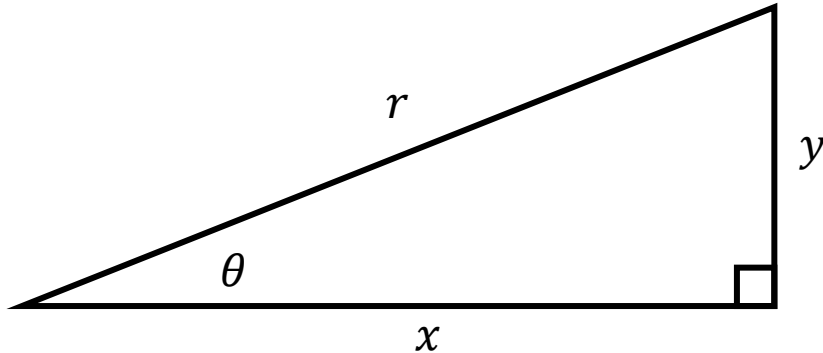
# Signals & Systems

Mathematics of Signals & Systems

A. Trigonometry Basics

# Basic Trigonometric Functions

- The **sine** and **cosine** functions are frequently used to describe signals encountered in practice.
- The **sine** and **cosine** functions will also be used to characterize the behavior of systems



$$\sin \theta = \frac{y}{r}$$

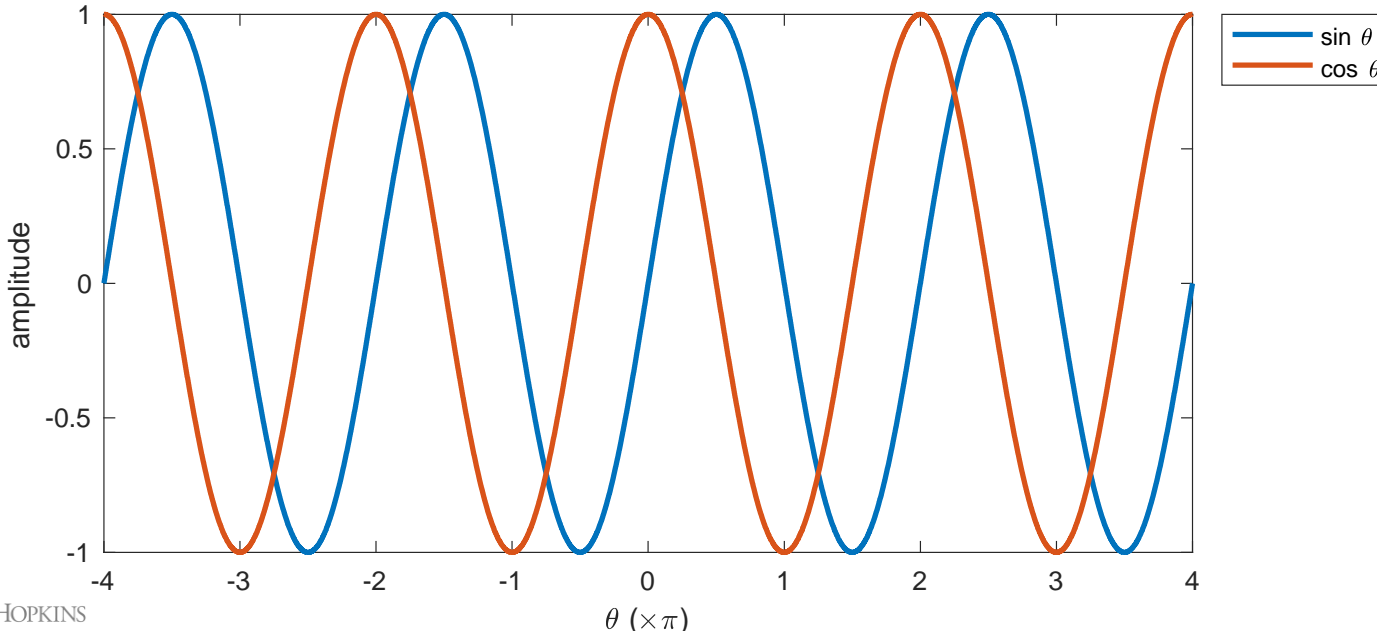
$$\cos \theta = \frac{x}{r}$$

$$\tan \theta = \frac{y}{x} = \frac{\sin \theta}{\cos \theta}$$

Note that  $r^2 = x^2 + y^2$

# Basic Trigonometric Functions Continued

- Plots of **sine** and **cosine** as functions of the angle  $\theta$



# MATLAB Plotting Commands

```
f = -4:0.001:4;
```

```
theta = f*pi;
```

```
plot(f,sin(theta),'linewidth',2); hold on  
plot(f,cos(theta),'linewidth',2); grid on
```

```
legend('sin \theta','cos \theta','Location','NorthEastOutside')
```

```
xlabel('\theta (\times\pi)')  
ylabel('amplitude')
```

# Some Trigonometric Identities

$$\sin(\theta \pm 2\pi) = \sin \theta$$

$$\cos(\theta \pm 2\pi) = \cos \theta$$

$$\sin\left(\theta \pm \frac{\pi}{2}\right) = \pm \cos \theta$$

$$\cos\left(\theta \pm \frac{\pi}{2}\right) = \mp \sin \theta$$

$$\cos^2(\theta) + \sin^2(\theta) = 1$$