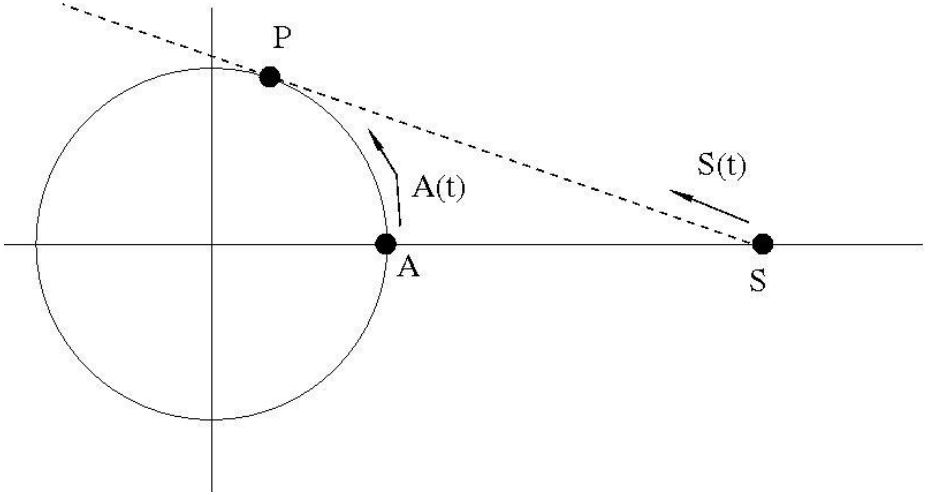
Closing Mon: 10.1

Closing Fri: 2.1, 2.2, 2.3

Warning: Expect a lot of work.

Visit the MSC! *Check newsletter hints.*

Entry Task (directly from HW):



An ant is walking around the unit circle such that: $x = \cos(\pi t)$, $y = \sin(\pi t)$.

Starting at the same time, a spider walks from (4,0) along a line tangent to the circle, as shown.

1. Find the point P.

2. When will the ant first get to point P? Second time?

3. Give the parametric linear equations for the spider in order for it to get the point P at this second time.

Linear Motion: $x = x_0 + v_x t$

$y = y_0 + v_y t$

$(x_0, y_0) =$ initial location

$v_x =$ horizontal velocity $= \frac{\Delta x}{\Delta t}$

$v_y =$ vertical velocity $= \frac{\Delta y}{\Delta t}$

Example: $x = 1 + 2t$

$y = 5 - 3t$

Circular: $x = x_c + r\cos(\theta_0 + \omega t)$

$y = y_c + r\sin(\theta_0 + \omega t)$

$(x_c, y_c) =$ center of circle

r = radius of circle

θ_0 = initial angle

ω = angular speed = $\Delta\theta/\Delta$t

Example: $x = 2\cos\left(\frac{3\pi}{2} + \frac{\pi}{2}t\right)$

$y = 3 + 2\sin\left(\frac{3\pi}{2} + \frac{\pi}{2}t\right)$

Example:
A bug follows a circular path with radius 8 inches. It starts at the west-most edge. It rotates counterclockwise at a constant 10 revolutions per minute.

Give the equations for motion in terms of time *t*.

r = ??

θ_0 = ?? (give in radians)

w = ?? (give in radians/min)

Ch. 2 Limits and Derivatives

2.1 Motivation

Calculus is primarily about "rates".

$$\text{rate} = \frac{\text{change in quantity}}{\text{change in time}}$$

We will find *instantaneous* rates, by building a limiting process of better and better approximations.

Example: The distance traveled by an object is recorded at various times:

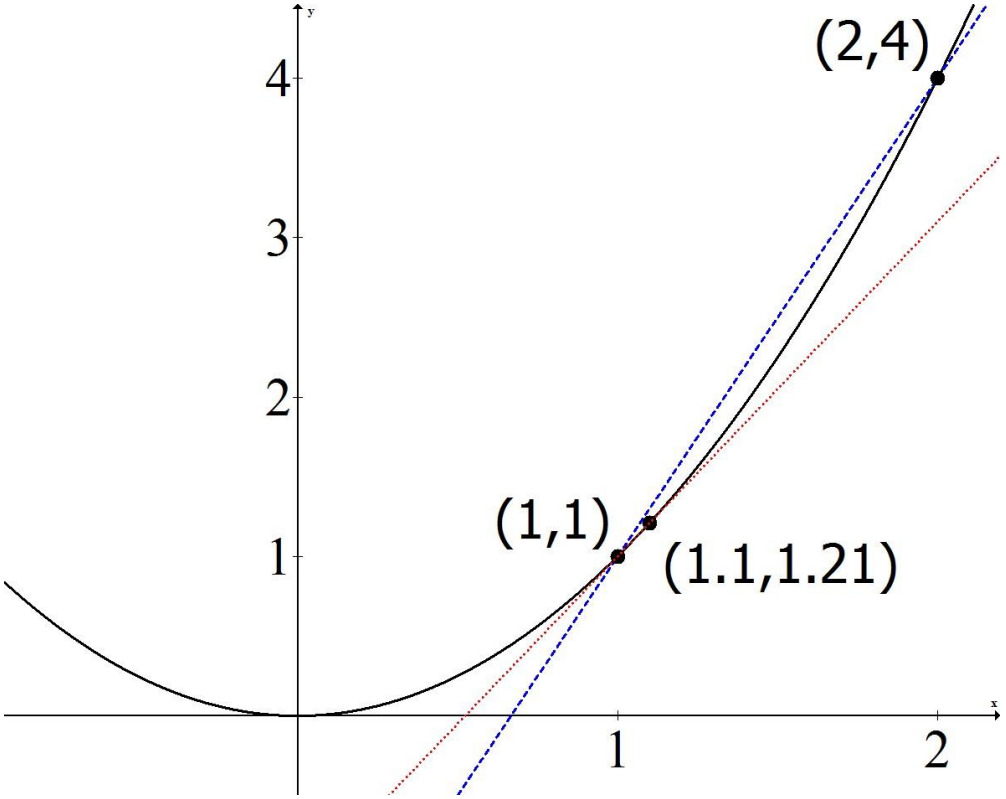
t (seconds)	0	1	2	3
Dist (meters)	0	1.2	4.5	10.4

1. What is the average velocity
   … from t = 0 to t = 3?
   … from t = 1 to t = 3?
   … from t = 2 to t = 3?
2. What is the instantaneous velocity at t = 3?

Example:

Consider the function: $f(x) = x^2$

1. Find the slope of the *secant* line from x = 1 to x = 2.
2. Find the slope of the secant line from x = 1 to x = 1.1.



In this course we will find

f'(1) = `slope of the tangent at *x=1*'

$$= \lim_{h \to 0} \frac{f(1+h) - f(1)}{h}$$