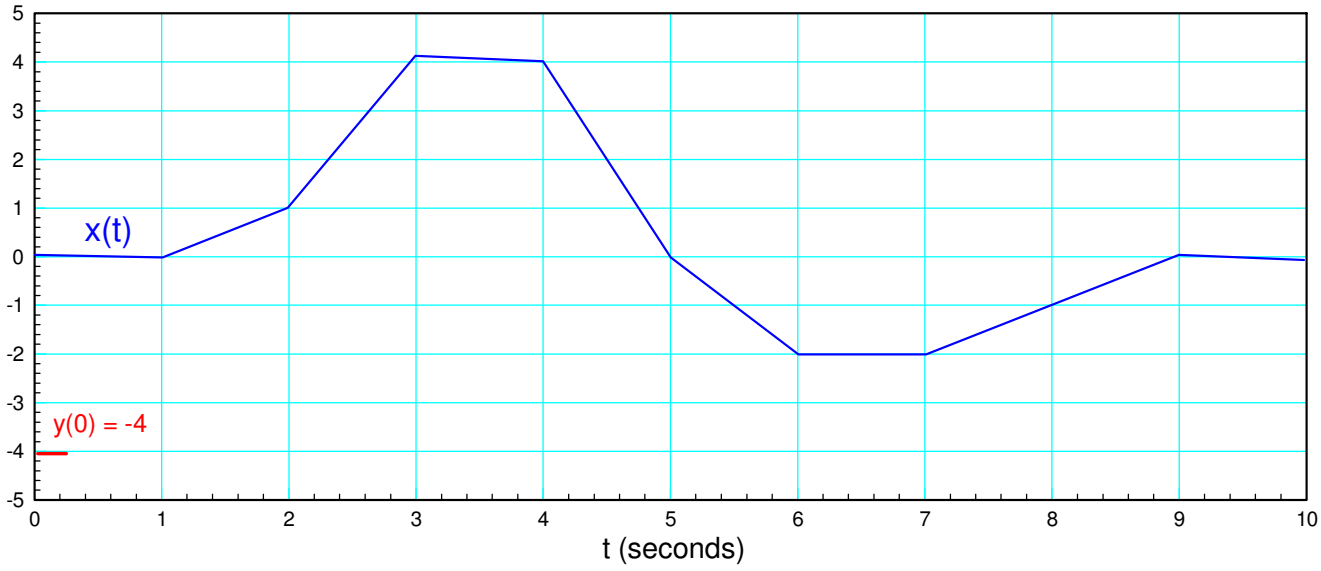
ECE 111 - Homework #7:

Math 166: Integration

1) Let y(t) be the integral of x(t)

$$y(t) = \int x(t) \cdot dt$$

Sketch y(t) assuming y(0) = -4.



If this is how much money you are depositing (positive) or withdrawing (negative) from your checking account, what is the balance at each instance?

Numerical Integration

2) Use numerical methods to determine the integral of y

$$y = \exp\left(\frac{x^2}{10} + \sin(2x)\right)$$

$$z = \int y \cdot dx$$

for -10 < x < 10. (a plot is sufficient). Assume z(-10) = 0.

3) Use numerical methods to determine the integral of y

$$y = \sin(x) + 0.1\sin(7x)$$

$$z = \int y \cdot dx$$

for -10 < x < 10. (a plot is sufficient). Assume z(-10) = 0.

Animation in Matlab with Numerical Integration

4) Calculate the position of a bouncing ball in freefall:

- The acceleration is y" = -1.625 m/s2 (gravity on the moon)
- If the ball hits the ground (y<0) the velocity becomes positive: y' = |y'|
- The initial position is (x = 0, y = 3)
- The initial velocity is (x' = +1, y' = +2)

Plot the path of the ball for two bounces

- i.e. find the x position of the ball at its 2nd bouce

5) Determine the initial velocity on x' so that the ball hits a target at (x=10, y=0) on the second bounce

- note: this is a f(x) = 0 problem

f(x) = 0: Shoot Game

- Pick a random number from 50 to 100 for your target.
- Pick a random number from 30 to 70 for your firing angle

6) Use trial and error to find the initial velocity (X) to fire a tennis ball to hit the target (result is zero)

```
>> Target = 50*rand + 50
Target =   90.7362

>> Angle = 50*rand + 20
Angle =   65.2896

>> Shoot(30, Angle, Target)
ans =   30.6515

>> Shoot(50, Angle, Target)
ans =  -28.2262
```

7) Repeat using California (or Newton's) method to find the initial velocity (X) to fire the tenis ball to hit the target

```
>> X1 = 30;
>> Y1 = Shoot(X1, Angle, Target)
Y1 =   30.6515

>> X2 = 35;
>> Y2 = Shoot(X2, Angle, Target)
Y2 =   14.5376

>> X3 = X2 - (X2-X1)/(Y2-Y1)*Y2
X3 =   39.5109

>> Y3 = Shoot(X3, Angle, Target)
Y3 =    0.5175

>> X4 = X3 - (X3-X2)/(Y3-Y2)*Y3
X4 =   39.6774

>> Y4 = Shoot(X4, Angle, Target)
Y4 =    0.0156
```