Computational Skills Assignments

Class 1:

Possible Preclass assignments. (Recommend assigning one)

1. Sketch the function $f(t) = u(t-1)e^{-(t-1)^2}$ for $0 < t < 3$, where u(t) is the unit step function,
u(t) = 0 for t < 0, and u(t) = 1 otherwise.

2. Sketch the functions:
    a. u(t-1), $0 < t < 3$, where u(t) is the unit step function, u(t) = 0 for t < 0, and u(t) = 1 otherwise.
    b. $f(t) = e^{-(t-1)^2}$, for $0 < t < 3$.
    c. $f(t) = u(t-1)e^{-(t-1)^2}$, for $0 < t < 3$.

3. Sketch the functions below for $0 < t < 3$:
    a. $f(t) = t^2$ for $1 \le t \le 2$, $f(t) = 0$, otherwise.
    b. $g(t) = e^{-f(t)}$, $f(t)$ from part a.

Postclass assignments. (Recommend assigning two of these.)

Numerical Integration:
  1. Calculate the integral of the function f(t) = t sin(t) over the interval $0 < t < 2$.
  2. Calculate the integral of the function f(t) = t/(1+t).
  3. A free rolling toy car on a flat surface moves with velocity v(t) = exp(-2t).
     Compute how far the car has moved in 2 seconds using numerical integration.
  4. Water enters a reservoir at a flow rate of $q_{in}(t) = 1000 \ (1 - e^{-t})$, and flows

     out at a rate of $q_{out}(t) = 1000 \dfrac{t}{1+t}$ cubic feet per second. If the reservoir contains

     200,000 cubic feet of water at time t = 0, use numerical integration to determine
     how much water is in the reservoir after 5 seconds.

Online Help
  1. Using online help, write one or two sentence descriptions of the functions
       a. hold
       b. sum
       c. mean
       d. ones

Class 2:

Postclass assignment

1. You are given a 1024 by 1024 grayscale image, represented as a matrix, where each element is an integer from 0 to 255, 0 being white and 255 being black. You should write a program which will produce a 256 element array, indicating how many pixels are at each level. Then use the Matlab function **bar** to produce a bar chart, where the height of each bar indicates the number of pixels at that grayscale.
2. Write a step-by-step procedure for getting a glass of water to drink.

Class 3:

Postclass assignment

1. Write a Matlab function to simulate the solution to the differential equation

$$\dot{x} = -x^3 + 1$$

for $0 < t < 4$, $x(0) = 0$. Also plot x(t) versus t and provide a suitable title and x and y axis labels.

2. Write a Matlab function to simulate the solution to the differential equation

$$\dot{x} = -x(x-1)^2$$

for $0 < t < 4$. Simulate the solution for $x(0) = .5$ and $x(0) = 2$. In both cases, plot x(t) versus t, and provide a suitable title and x and y axis labels.