Lab 2: Basic Plotting of Signals

Using MATLAB, make plots of the signals below. Put your code in a Matlab *script* file so you can rerun it from the Matlab command after you make revisions to your file.
Use the subplot command to put several plots on the same page. Print out the plots and turn them in with your code. Use `help subplot` to find out how to use the command.
Use the `plot` command to plot continuous-time signals. Use the `stem` command to plot discrete-time signals. Use `help plot` and `help stem` to find out how to use these commands. Our convention is that $f(t)$ denotes a continuous-time signal, and that $f(n)$ denotes a discrete-time signal.

1. **Plotting Continuous-Time Signals**

   For the following: Run the following three lines and explain why the plots are different.

   ```
   t = 0:2*pi; plot(t,sin(t))
   ```

   ```
   t = 0:0.2:2*pi; plot(t,sin(t))
   ```

   ```
   t = 0:0.02:2*pi; plot(t,sin(t))
   ```

   For the last graph, add a title and axis labels with:

   ```
   title('My Favorite Function')
   ```

   ```
   xlabel('t (Seconds)')
   ```

   ```
   ylabel('y(t)')
   ```

   Change the axis with:

   ```
   axis([0 2*pi -1.2 1.2])
   ```

   Put two plots on the same axis:

   ```
   t = 0:0.2:2*pi; plot(t,sin(t),t,sin(2*t))
   ```

   Produce a plot with out connecting the points:

   ```
   t = 0:0.2:2*pi; plot(t,sin(t),'.')
   ```

   Try the following command:

   ```
   t = 0:0.2:2*pi; plot(t,sin(t),t,sin(t),'r.')
   ```

   What does the `r` do?

2. **Plotting Discrete-Time Signals**

   Use `stem` to plot the discrete-time step-function:

   ```
   n = -10:10;

   f = n >= 0;

   stem(n,f)
   ```

   Make stem plots of the following signals. Decide for yourself what the range of n should be.

$$
\begin{aligned}
f(n) &= u(n) - u(n-4) \\
g(n) &= n \cdot u(n) - 2\,(n-4) \cdot u(n-4) + (n-8) \cdot u(n-8) \\
x(n) &= \delta(n) - 2\,\delta(n-4) \\
y(n) &= (0.9)^n\,(u(n) - u(n-20)) \\
v(n) &= \cos(0.12\,\pi n)\,u(n)
\end{aligned}
$$

3. **The `conv` Command**

   Use `help conv` to find out how to use the `conv` command.

   Let

$$
\begin{aligned}
f(n) &= u(n) - u(n-4) \\
g(n) &= n \cdot u(n) - 2\,(n-4) \cdot u(n-4) + (n-8) \cdot u(n-8).
\end{aligned}
$$

   Make stem plots of the following convolutions. Use the MATLAB `conv` command to compute the convolutions.

   (a) $f(n) * f(n)$

   (b) $f(n) * f(n) * f(n)$

   (c) $f(n) * g(n)$

   (d) $g(n) * \delta(n)$

   (e) $g(n) * g(n)$

   Comment on your observations: Do you see any relationship between $f(n) * f(n)$ and $g(n)$? Compare $f(n)$ with $f(n) * f(n)$ and with $f(n) * f(n) * f(n)$. What happens as you repeatedly convolve this signal with itself?

   Use the commands `title`, `xlabel`, `ylabel` to label the axes of your plots.

4. **Plotting a Sampled-Signal.**

Suppose the continuous-time signal $x(t)$ is sampled with a sampling period of 0.3 seconds between each sample. Suppose also that the first sample is at $t = 0$ and that a total of 12 samples are collected. The table below lists the samples of $x(t)$ that were collected.

sample number	$x(t)$
0	6.0
1	-1.3
2	-8.0
3	-11.7
4	-11.0
5	-6.0
6	1.3
7	8.0
8	11.7
9	11.0
10	6.0
11	-1.3

Using the `plot` command, make a plot of this signal. The horizontal axis should be labeled: `TIME (SECONDS)`. Make sure that horizontal time axis shows the correct time for each sample: $0, 0.3, 0.6, \ldots, 3.3$.