ENG ME 404: Activity 1: Black box or: what in the world is this system?

Goal: To develop intuition about and explore what it means for a system to be linear, nonlinear, or other.

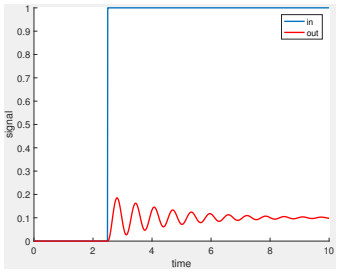
Description: The m-file `blackBox.m` has five different system models coded in it. It accepts an input and shows a plot of the output (call `help blackbox` for details). Your job is to determine the model types of each system. Possible model types in the file are:

- Linear, Time-Invariant (LTI) or Time-Varying (LTV)
- Nonlinear, time-invariant (also known as *autonomous*) or time-varying (also known as *non-autonomous*)
- Hybrid, time-invariant or time-varying

Note: Do not open blackbox.m since that will tell you exactly what each model is!

All together:

1. Grab the blackBoxActivity.zip file from Slack and expand it.
2. Open Matlab on your computer and move to the directory with the files you just expanded.
3. Type help blackBox and read through the text, following all instructions.
4. Open the file testSystems.m. Modify this file to create a time vector (t) that goes from 0-10 seconds in steps of 0.05 seconds (it should be 201 elements long). Then create an input vector (u) of the same length that is zeros for the first 25% and ones for the rest.
5. Run blackBox on model 1 using your time and input vectors. The resulting figure should look like:



6. Let's discuss the following: what can we say, if anything, about the kind of system this is?

With your group:

7. **Before doing anything in Matlab**, discuss what you think the properties of the different types of systems are. What distinguishes a linear system? A nonlinear system? A time-invariant system? **Be sure to take good notes on your discussion- you will need them for your homework.**
8. Discuss what kinds of inputs you will put in to the black box and what you expect to see for the different model types. Try to think of the simplest input that would help you differentiate. Again, take good notes.
9. Using the ideas you discussed, design some inputs and insert them into the system to determine what the first two systems are.