**Exercise 2, November 5, 2015, to be handed in November 12!**

1. Plot the function $x(t) = x_0 \exp(-t/\tau)$ for one positive and for one negative value of $x_0$. You can use specific values for both $\tau$ and $x_0$ to compute a few points on the curve and then interpolate, or you can use your understanding of the curve to make a qualitative plot. In either case, mark the time axis with actual units (e.g., seconds) and choose a value for $\tau$ in those units. Mark the levels of $x_0$.

2. Compute the values of that function $x(t)$ for $t = 0$, $t = \tau$, $t = 2\tau$, $t = 3\tau$. You can do this for the abstract parameter, $x_0$, or by inserting an actual numerical value for $x_0$, whichever you find more intuitive. Now write down in a table the ratios: $x(\tau)/x(0)$; $x(2\tau)/x(\tau)$; $x(3\tau)/x(2\tau)$. State what you notice about those ratios. Interpret that observation by a kind of "theorem" that you can state about the "exponential decay" function $\exp(-t/\tau)$

3. Do another plot of the function $x(t) = x_0 \exp(-t/\tau)$, but now for two values of $\tau$. State what the significance of the parameter $\tau$ may be given how the functions vary with $\tau$.

4. Compute the derivative $\dot{x}(t)$ of this same function, $x(t) = x_0 \exp(-t/\tau)$. (If you don't know how to do that, look it up in a book or on the internet). Plot that derivative in the same way for just one value of $x_0$. Make sure the time axis has the same units as in the plots above, so you can compare across the plots of $x$ and $\dot{x}$. Form pairs of values for $x(t_i)$ and $\dot{x}(t_i)$ for a few moments in time, $t_i$, (where $i$ is 1, 2, 3, etc.) and plot these values against each other: $\dot{x}$ against $x$. State what functional relationship you are guessing. Check that by computing analytically the ratio $\dot{x}(t)/x(t)$ and write down the differential equation that now follows.