## Exercise Problems — Part 3

(Due Date: Tuesday, 13.10.15, *before* the lecture. You can also put the solutions in the red box outside office FY277. )

### 1. Warm Up

This we are going to perform together in the computer room YL124. Download the IDL routines from the NOPPA page of the course. This is a gzipped tarfile. Put it in your directory on the linux computer, open a shell, and unpack it from the command line as

`prompt> tar xvfz Exercise3IDLFiles.tgz`

Open the file `HarmOscillator.pro` in an editor of your choice, e.g.

`prompt> emacs HarmOscillator.pro &`

(the ampersand & shifts this process to the background, so you can continue using your current shell). Then open IDL from the command shell

`prompt> IDL`

and press `return`. Then from the IDL prompt you can compile and run the program as

`IDL> .rnew HarmOscillator`

`IDL> HarmOscillator`

We will go through this together.

### 2. Orbital Decay of Semi-Major Axis and Atmospheric Densities and Temperatures of the Earth

(a) Make a copy of the routine `HarmOscillator.pro` and modify it to produce a numerical solution of the simplified equation for the orbital decay of the (normalized) semi-major axis, as we had it in exercise 2

$$\frac{\mathrm{d}\alpha}{\mathrm{dt}} = -\sqrt{\alpha}\,.$$

Also overplot the analytical solution we had obtained

$$\alpha = \left(1 - \frac{\tau}{2}\right)^2\,.$$

Return the plot to me as a screenshot. (*Hint:* You should define the (scaled) time $\tau$ in the range from 0 to 2.)

(b) *Advanced*: **Atmospheric Densities and Temperatures**

Use the program `NRLMSISE.pro` to reproduce the plot on terrestrial atmospheric density vs height we had in the previous exercise. Then go to the webpage for this model `http://ccmc.gsfc.nasa.gov/modelweb/` and download the corresponding data for temperature vs height. Modify the routine to plot this data. Return the plot to me as a screenshot.