AMUSE assignment: Solar System

Leiden-BNU Summer School

July 2, 2019

1 Introduction

You will write your own AMUSE script to simulate the Solar System and integrate it for a few million years. You can look at the file `amuse/examples/textbook/sun_venus_earth.py` as a helpful reference.

2 Creating the script

1. Using a text editor, create a new file called `solar_system.py` and save it in the `amuse/examples/textbook` folder.
2. For your script to work, you have to import the packages `Particles`, `units`, `Huayno`, and `nbody_system` from `amuse.lab`. Write the correct import line at the top of your script.
3. We also need to import `pyplot` from `matplotlib`. Write the correct import line.

3 Creating the Sun and the planets

We will use the AMUSE `Particles` package for our Solar System. The Sun and each of the planets will be represented by a particle of the correct mass. Follow the next steps to set up your Solar System:

1. Create a set of 9 particles. The first particle (with index 0) will be the Sun, and the other 8 particles will be the planets. You can set up parameters for each particle in the following way:

```
particles = Particles(Number_of_particles)
sun = particles[0]
sun.mass = 1.0 | units.MSun
sun.radius = 1.0 | units.RSun
sun.position = (855251, -804836, -3186) |units.km
sun.velocity = (7.893, 11.894, 0.20642) | (units.m/units.s)
```

2. Use the internet to find the masses and radius of the different planets of the Solar System. Find also their distance to the Sun. Using this information, assign the corresponding values to each particle. Don't forget to use proper units.

4 Starting the gravity code

1. Initialize a converter for your gravity code (we will explain this during the session). For reference, take a look at the script `amuse/examples/textbook/sun_venus_earth.py`:

```
convert_nbody = nbody_system.nbody_to_si(particles.mass.sum(),
                                         particles[1].position.length())
```

2. Start an instance of the `Huayno` code and add your particles to it. For reference, take a look at the script `amuse/examples/textbook/sun_venus_earth.py`:

```
gravity = Huayno(convert_nbody)
gravity.particles.add_particles(particles)
venus = gravity.particles[1]
earth = gravity.particles[2]
```

5 Running the simulation

Using `amuse/examples/textbook/sun_venus_earth.py` as an example, write the function to evolve your Solar System:

```
while gravity.model_time < end_time:
    gravity.evolve_model(gravity.model_time + (1 | units.day))
    x_earth.append(earth.x)
    y_earth.append(earth.y)
    x_venus.append(venus.x)
    y_venus.append(venus.y)
gravity.stop()
return x_earth, y_earth, x_venus, y_venus
```

6 Plotting your results

Modify the function `plot_track` in `amuse/examples/textbook/sun_venus_earth.py` to plot your complete Solar System.