Python Code Algorithm

Algorithm 1 One time Calculate Initial Position function

procedure CALCULATEINITIALPOSITION

▷ Use distance to sun and eccentric anomaly to calculate initial positions x0, y0

distance = self.semiMajor * (1. - self.eccentricity)

return (distance*np.sin(self.eccentricAnomaly), -distance*np.cos(self.eccentricAnomaly))

end procedure

Algorithm 2 One time Calculate Initial Velocity function

procedure CALCULATE-INITIAL-VELOCITY

▷ Use distance to sun and eccentric anomaly to calculate initial velocity and return whenever called

velocity = np.sqrt(2./self.distanceToSun() - 1./self.semiMajor)

return (velocity * np.cos(self.eccentricAnomaly) - self.position[0]/self.distanceToSun()**3 * delta/2,velocity * np.sin(self.eccentricAnomaly) - self.position[1]/self.distanceToSun()**3 * delta/2)

end procedure

Algorithm 3 Recursive Update Position function

procedure UPDATEPOSITION(delta)

▷ Functions calculates and returns a tuple of x- and y- components of new position for every 'i' in '(x, y)' and every 'vi' in '(vx, vy)'

return tuple(i + delta * vi for i, vi in zip(self.position, self.velocity))

end procedure

Algorithm 4 Recursive Update velocity function

procedure UPDATEVELOCITY(delta)

▷ Functions calculates and returns updated velocity at every position.

return tuple(i - (delta * ri) / self.distanceToSun()**3 for i, ri in zip(self.velocity, self.position))

end procedure

Algorithm 5 Recursive Time-step

procedure TIMESTEP(delta)

▷ Time-step is the speed at which objects change in the plot or we may say change in framerate in earth days.

for planet in SolarSystemSimulation.Planets.values():

planet.position = planet.updatePosition(self.delta)

planet.velocity = planet.updateVelocity(self.delta)

end procedure

Algorithm 6 Elapsed-Time

procedure ELAPSEDTIME(delta)

▷ Elapsed time calculates the time taken by space vehical in earth years.

elapsedTimeNumber = i * gui.stepsize.get() / 365.256

info['elapsedTime'].set$_text('ElapsedTime : : .2fEarthYears'.format(elapsedTimeNumber))$

end procedure