MAU34601 Practical Numerical Simulations
Assignment 2 due 21/10/2022

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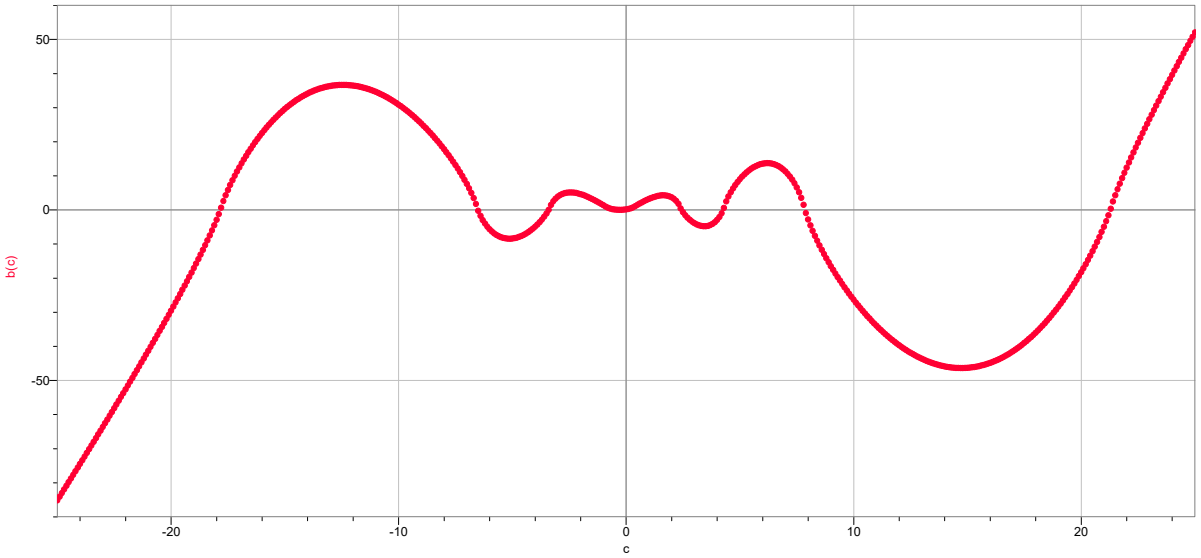
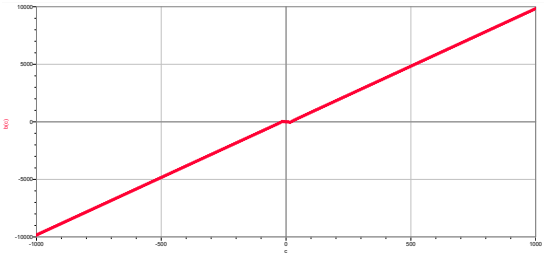
SS Theoretical Physics

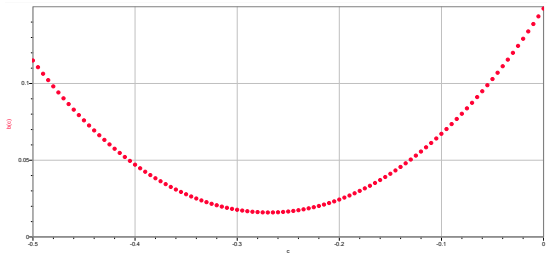
1 Shooting method



(a) $c \in [-25, 25]$.



(b) $c \in [-1000, 1000]$.



(c) $c \in [-0.5, 0]$.

Figure 1: Plots of $b(c)$.

The shooting method was used to calculate and plot $b(c)$ for a range of c values (Figure 1). The bisection method was used for these values to find the points $c^* \equiv \dot{x}(t=0)$ at which $b(c^*) = 0$, which were found to be (to 6 s.f.) $\dot{x}(t=0) = -17.8325, -6.51541, -3.40345, 2.43551, 4.26729, 7.85812, 21.2841$.

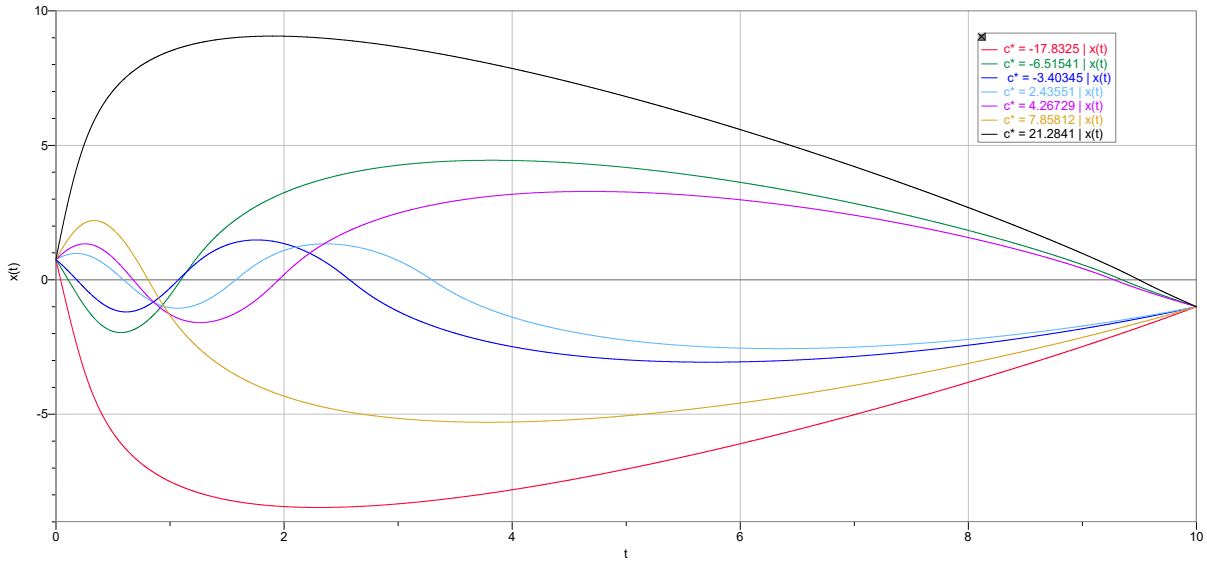


Figure 2: Plots of $x(t)$ for $t \in [0, 10]$.

Newtonian Gravity

The system of four planets was simulated using a leap-frog symplectic integrator for $N = 2^{16} = 65,536$, and their locations at $t = 5$ were calculated (Table 1).

Planet	Position
0	(-0.482, 0.345)
1	(-0.522, 0.529)
2	(-0.811, -0.684)
3	(-0.507, -0.641)

Table 1: Location of planets at $t = 5$, accurate to 3 significant figures.

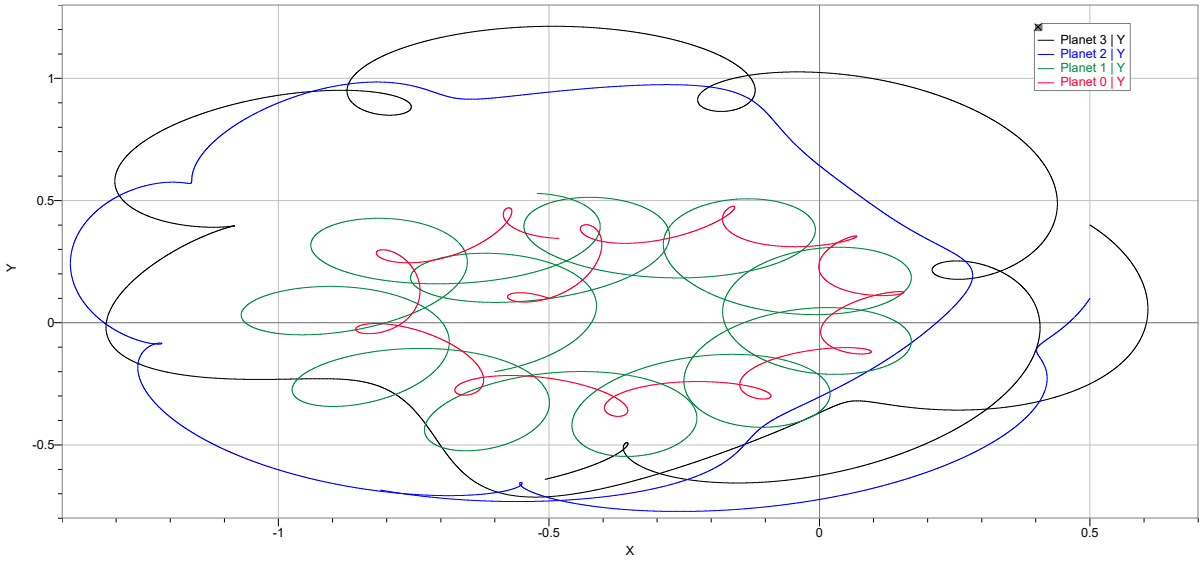


Figure 3: Plots of the evolution of the planet locations.