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A Program to Find Lagrange Points for the Earth-Sun System

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ABSTRACT

I created a program that takes in user input masses to find Lagrange points for a two body system.

1. RESULTS

The program uses the bisection root finding method to find the points where the gravitational acceleration components are zero, and defines them to be the Lagrange points. We test the method with two scenarios, $m_1 = 3$ M$_\odot$, $m_2 = 1$ M$_\odot$ and $d = 1$ AU. The plots for both scenarios are shown in the figure below:

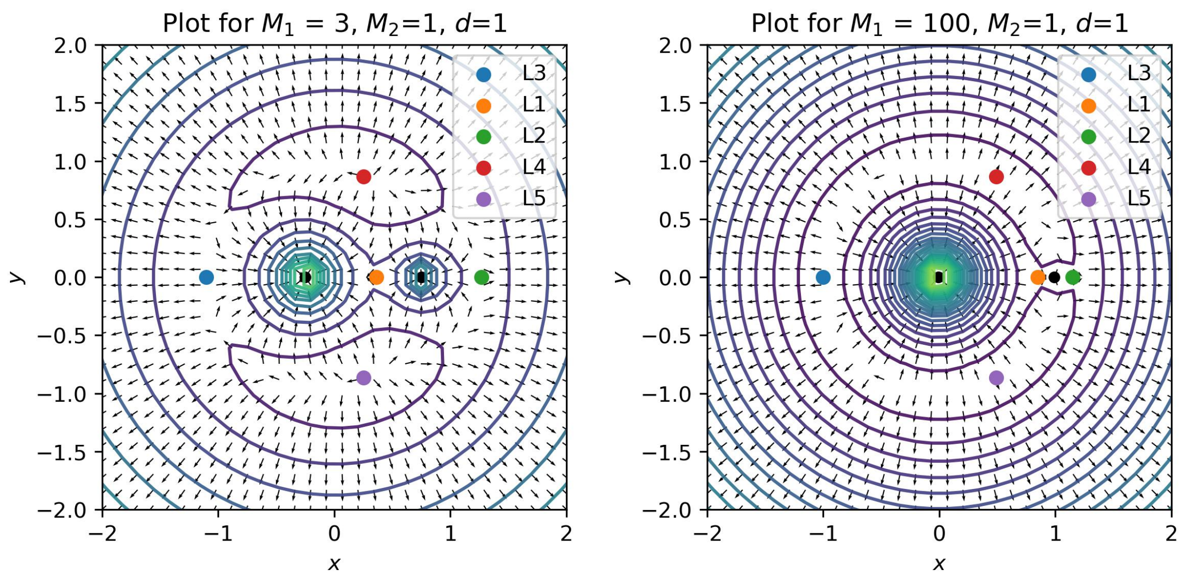

Figure 1: Vector and Contour Plots

After testing that the program works for the test cases, I ran it on the data for the Sun-Earth system, where $m_1 = 1$ M$_\odot$, $m2 = 0.0000032$ M$_\odot$ and $d = 1$ AU. This resulted in the plot below.

The Lagrange points L1 and L2 are very close to the Earth and as such I increased the point sizes of L1 and the Earth to make sure both were visible. I used this to determine that my L2 point is the optimum position for JWST and that is where it should be placed as it is completely shielded from the Sun, Earth and the Moon, which is located $1.0102 - 1 =$ **0.01 AU** from the Earth.

The Lagrange Points are given in the table below:

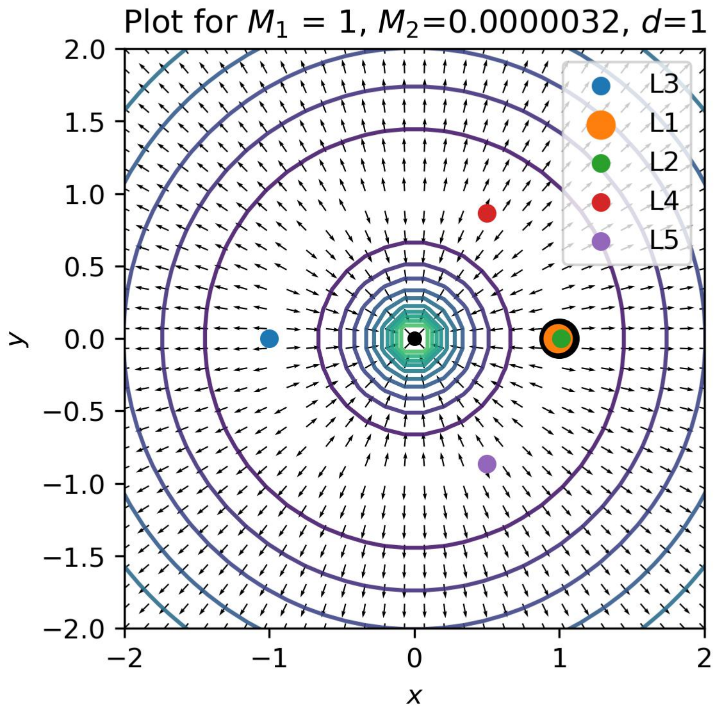

Figure 2: The Lagrange Points of the Earth-Sun System

Lagrange Point	x [AU]	y [AU]
1	0.989814195220506	0.0
2	1.0102490373301862	0.0
3	-1.0000011972736955	0.0
4	0.0	0.8660255670547485
5	0.0	-0.8660255670547485

Table 1: x and y coordinates of the Lagrange Points