Computational Physics ps-7 Report

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https://github.com/TZW56203/phys-ga2000

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1 Problem 1

1.1 Part (a)

By the Newton's second law we have

$$\frac{GMm_s}{r^2} - \frac{Gmm_s}{(R-r)^2} = m_s\omega^2 r. \tag{1}$$

Simplifying, we get the required expression

$$\frac{GM}{r^2} - \frac{Gm}{(R-r)^2} = \omega^2 r. \tag{2}$$

Since the satellite have the same angular velocity as the moon, we also have

$$\frac{GMm}{R^2} = m\omega^2 R, \tag{3}$$

which gives

$$\omega^2 = \frac{GM}{R^3}. \tag{4}$$

Plugging this in to (2), we get

$$\frac{GM}{r^2} - \frac{Gm}{(R-r)^2} = \frac{GMr}{R^3}. \tag{5}$$

Simplifying and taking $m' = m/M$ and $r' = r/R$, we get

$$1 - r'^3 - m'\left(\frac{r'}{1-r'}\right)^2 = 0. \tag{6}$$

1.2 Part (b)

Listing 1 shows the Lagrange points in the following cases.

Listing 1: Lagrange points.

```
Moon Earth
iteration: 8
dist to the smaller mass: 58173.37021396068 km
dist to the larger mass: 326826.6297860393 km

Earth Sun
iteration: 18
dist to the smaller mass: 1491392.0145535602 km
dist to the larger mass: 148106630.98544645 km

Jupiter at Earth dist Sun
iteration: 11
dist to the smaller mass: 9974410.89615033 km
dist to the larger mass: 139623612.10384968 km
```

2 Problem 2

Listing 2 shows the computed point at which the function $y = (x - 0.3)^2 \exp(x)$ takes minimum. The self-written Brent's method gives a result close to that of `scipy.optimize.brent` and the true value 0.3.

Listing 2: Minimization.

```
MyMin: 0.29999962375665
scipyMin: 0.300000000023735
MyMin - scipyMin: -3.762670849893901e-07
```