Chapter 4 Notes

One planet (Earth) orbits Sun (motion neglected), only force is gravity. Goal: calculate the position of Earth as a function of time

The Euler-Cromer method is used because this problem involves oscillatory motion

For a two-body system all three of Kepler's laws are the result of the gravitational force following an inverse-square law (the interaction of the force only depends on the distance (r) between the two bodies)

Is there anything special about the inverse-square dependence?

According to Kepler's first law, the Sun should sit at one of the foci of an elliptical orbit.

The forces of the other planets (not two-body system) can cause an elliptical orbit to rotate with time

To computationally analyze general relativity's effect on the perihelion of Mercury, calculate Fg using the inverse-square law (m1=Mercury, m2=Sun)

Set initial conditions, calculate the angle of precession as a function of time

Use the method of least squares to 'fit' straight lines

Consider a three-body problem involving the Sun, Earth, and Jupiter (simplest case)

Again, use inverse-square law but replace the Sun's mass with Jupiter's (where MJ is mass of Jupiter and REJ is distance between Earth and Jupiter

The Sun remains at Theta (EJ), distance r is still Earth-Sun (Sun's is still considered stationary at the origin)

Use Euler-Cromer to update position/velocity of both planets at each time step

After running the code, it shows that Jupiter has a negligible effect on Earth

However, if Jupiter's mass was increased 1000x, Earth's orbit would become completely unstable

So, Jupiter is too small and far from Earth to have much of an effect. Jupiter is closer to Mars so it will have a larger effect on Mars