Calculating orbital trajectories is an extremely complicated and time-consuming process. With the power of modern computing however, we can make the jobs of orbital dynamicists easier.

The Rich Purnell Maneuver is a fictional orbital trajectory from the book and film "The Martian". The maneuver is one of the more complex orbital trajectories ever calculated and would surely be the most complex if it were ever attempted. The maneuver starts at Mars, and begins a return journey to Earth. Then, it accelerates towards Earth and slingshots back to Mars using the Earth's gravity. It then slingshots around Mars and returns to Earth.

The author of "The Martian" developed a virtual model of a solar system to get a launch date for his fictional Mars mission. I wanted to do the same. I combined my new knowledge of orbital dynamics with my knowledge of computation to develop a simplified model of our solar system so as to determine for myself a similar trajectory while retaining the ability to plan other trajectories as well.

In order to build a calculator for an orbital dynamicist, I had to become an orbital dynamicist. What follows are the most important equations that I implemented in my calculator.

\[ \Delta v = \sqrt{\frac{2}{h_1} (\frac{\Delta E}{\Delta m} - \frac{1}{2})} \] velocity on transfer orbit at periapsis (point A)

\[ \Delta v = -\sqrt{\frac{2}{h_2} (\frac{\Delta E}{\Delta m} - \frac{1}{2})} \] velocity on transfer orbit at apoapsis (point B)

\[ \Delta v = v_{th} - v_{eo} = \frac{m_{th}}{m_{eo}} - \frac{g_{eo}}{v_{eo}} \] where

- \( v_{th} \) = initial rocket velocity relative to stationary earth,
- \( v_{eo} \) = burnout velocity; rocket velocity at moment of complete fuel expenditure
- \( \Delta v = v_{th} - v_{eo} \) = maximum vertical rocket velocity at burnout
- \( w = -(v - v_{eo}) \) = effective exhaust velocity relative to rocket nozzle, \( S' \); hence, a constant

The Hohmann transfer technique was developed by Walter Hohmann in 1925, decades before humans launched their first satellite into orbit. The technique is designed to move a vessel from a lower orbit to a higher one. It also holds for the opposite direction. It calls for two engine burns, the first, to increase the altitude of the lower orbit to that of the higher one, and second, to match the rest of the current orbit to the higher one.