User Guide: Solar System Simulator

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1. Introduction

Welcome to the *Solar System Simulator*! This program is an interactive tool that simulates the motion of the planets in our solar system. It allows you to explore the orbits of the planets, view detailed statistics and information about each celestial body, and view a gallery of real-life images.

The simulator includes:

→ Real-time orbital simulation of the 8 major planets and passing comets.
→ A dynamic camera system to follow any planet.
→ A real-time calendar tracking the *Year* and *Day* of the simulation.
→ An interactive information panel with three viewing modes: *Stats*, *Info*, and *Photos*.
→ Interactive controls to zoom in and out, pause, speed up, or slow down time.
→ Interactive *Mission Mode* to launch and track interplanetary space probes.

2. Getting Started

How to Run the Program:

1. Ensure you have *DrRacket* installed on your computer.
2. Open the source file (e.g., `solar.rkt`) in *DrRacket*.
3. Click the *Run* button in the top-right corner of the window.
4. The simulation window will open automatically, centering on the Sun.

The Display - When the program starts, you will see:

→ *The Solar System:* Planets orbiting the Sun, set against a black space background. Keep an eye out for comets that occasionally streak across the screen!
→ *The Info Panel (Right Side)*: A blue and semi-transparent control panel displaying information about the currently selected object.
→ *The Legend (Bottom Left):* A quick reference guide for keyboard controls.
→ *The Heads-Up Display (Top Left):* Displays the name of the planet the camera is following, the current simulation speed, and the current Date (Year and Day).
→ *The Mission Help (Top Right):* Appears only when Mission Mode is active (by pressing *'m'*), displaying the steps required to launch a probe.

3. How to Use the Simulator

Navigation and Camera Control

- *Pan Camera:* To move the camera to a different planet, simply *click on that planet* in the view. The camera will smoothly lock onto the new target and follow it as it moves through its orbit.
- *Zoom In/Out:*
  - → Press the `UP Arrow` or '=' key to zoom in.
  - → Press the `DOWN Arrow` or '-' key to zoom out.

Controlling Time - You can control the speed of the simulation to observe planetary motion over days, months, or years.

- *Increase Speed:* Press the 'i' key to speed up time.
- *Decrease Speed:* Press the 'd' key to slow down time.
- *Pause:* Keep pressing 'd' until the speed reads *"Paused"*.
- *Reset Simulation:* Press 'r' to reset the solar system and date back to the starting point (December 11, 2025).

Using the Information Panel - The panel on the right side of the screen has three tabs that you can click to view different data about the selected planet.

1. *STATS Tab:* Displays physical data such as:
   - *Mass:* The weight of the planet.
   - *Diameter:* The size of the planet.
   - *Temperature:* The average surface temperature.
2. *INFO Tab:* Shows a brief educational description of the planet, including interesting facts about its atmosphere or history.
3. *PHOTOS Tab:* Displays a gallery of real-life images of the planet.
   - When this tab is active, *Arrow Buttons* (< and >) will appear at the bottom of the panel.
   - Click these arrows to cycle through the 3 available images for that planet.

Launching Space Missions - You can act as mission control and send probes between planets. The simulator automatically calculates the complex intercept trajectories for you.

1. *Enter Mission Mode:* Press the 'm' key. The "MISSION" help guide will appear in the top-right corner.
2. *Select Departure:* Click on the planet you want to launch from (e.g., Earth).
3. *Select Target:* Click on the destination planet (e.g., Mars).

4. *Liftoff:* A probe will immediately launch using a calculated trajectory. The mission mode will automatically close, returning you to normal view.

Note: You can press *'m'* at any time to cancel the mission setup.

4. Troubleshooting

→ *"The planets are moving too fast!"*: Press the *'d'* key multiple times until the speed is manageable.

→ *"The images aren't loading"*: Ensure that the *img* folder is in the same directory as your source code file and contains all the required *.png* files (e.g., *earth.png*).

5. Quick Reference Keys

Key:	Action:
Click Planet	Lock camera to planet
UP Arrow or '='	Zoom In
DOWN Arrow or '-'	Zoom Out
'i'	Increase Simulation Speed
'd'	Decrease Simulation Speed
'r'	Full Reset (Date & Positions)
'm'	Toggle Mission Mode
'r'	Full Reset (Date & Positions)