



Interstellar Highway

OEC Programming 2026

Meet Our Team

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Problem Overview

- Golden Age of Space Commerce requires safe, efficient, scalable trade routes
- Merchants need optimal launch dates and trajectories across planets and stations
- **Goal:** To build a smart logistics platform that ranks routes by fuel efficiency and arrival time



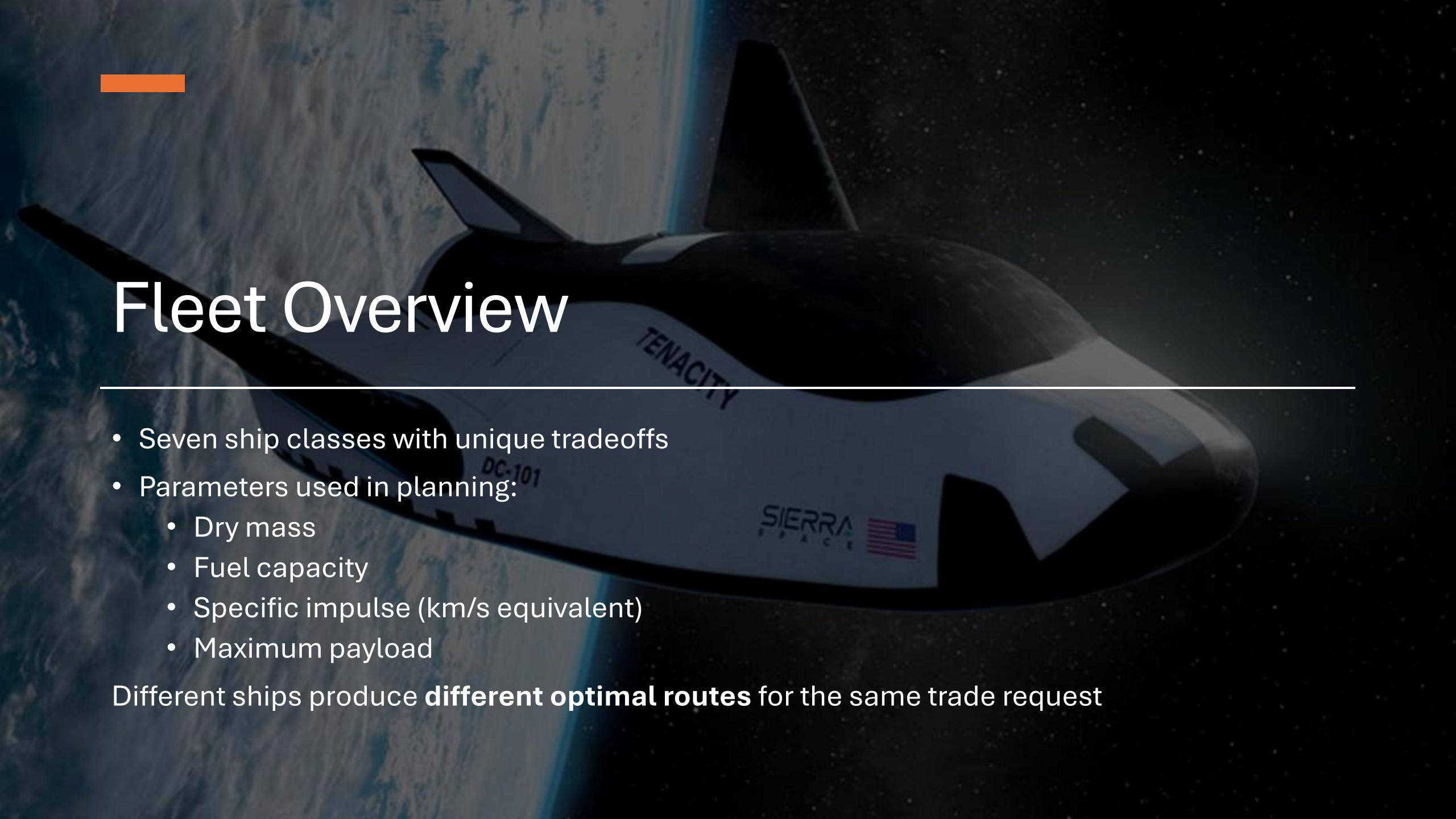
User Inputs & Outputs

User Inputs

- Departure body (planet/station)
- Destination body
- Launch window (start–end date)
- Ship type
- Payload mass

System Outputs

- Two ranked routes: Most Fuel-Efficient Flight, Soonest Arrival Flight
- Full leg-by-leg data: launch, stops, refuel, arrival
- Graphical visualization of flight paths
- JSON output via CLI



Fleet Overview

- Seven ship classes with unique tradeoffs
- Parameters used in planning:
 - Dry mass
 - Fuel capacity
 - Specific impulse (km/s equivalent)
 - Maximum payload

Different ships produce **different optimal routes** for the same trade request

Core Assumptions & Constraints

- All major bodies (8 planets + Pluto + Ceres) have refueling stations
- Stations are located at 12-hour circular parking orbits
- Launches and arrivals always occur at station orbit
- Refueling time: 1 second per kg of fuel
- Must relaunch within 3 days after refueling
- Delta-V is measured as fuel expenditure, not velocity change

Orbital Mechanics Model

- Heliocentric (Sun-centered) motion for interplanetary transfers
- Planetary motion retrieved from orbital data (ephemeris)
- Transfers computed using patched conics approximation
- Sphere of influence: $r = a\left(\frac{m}{M}\right)^{2/5}$
- Instantaneous delta-V burns assumed
- Vectors expressed in solar system ecliptic frame



Route Planning Strategy

Step 1

Candidate Route Generation

- Direct routes
- One-stop and two-stop routes using refueling bodies
- Stops limited to control complexity

Step 2

Launch Window Scanning

- Departure times sampled within user window
- Each candidate evaluated for feasibility

Step 3

Physics & Constraints Check

- Fuel feasibility based on ship + payload
- Refueling availability and timing
- 3-day relaunch constraint enforced

Optimization Objective



Fuel-Efficient Route

Minimize total fuel usage across all legs

Includes launch, capture, and relaunch burns



Soonest Arrival Route

Minimize final arrival date

Subject to fuel and refuelling constraints

If no valid solution exists → **Flight Impossible**

Equations

$$R_{fuel} = \sqrt[3]{\mu_{planet} \cdot \left(\frac{T}{2\pi}\right)^2}$$

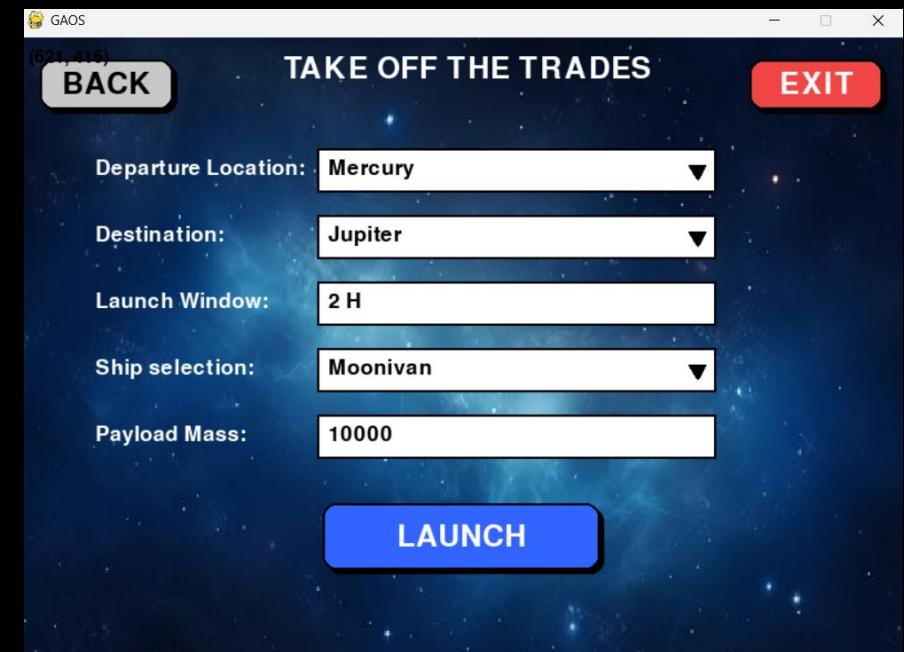
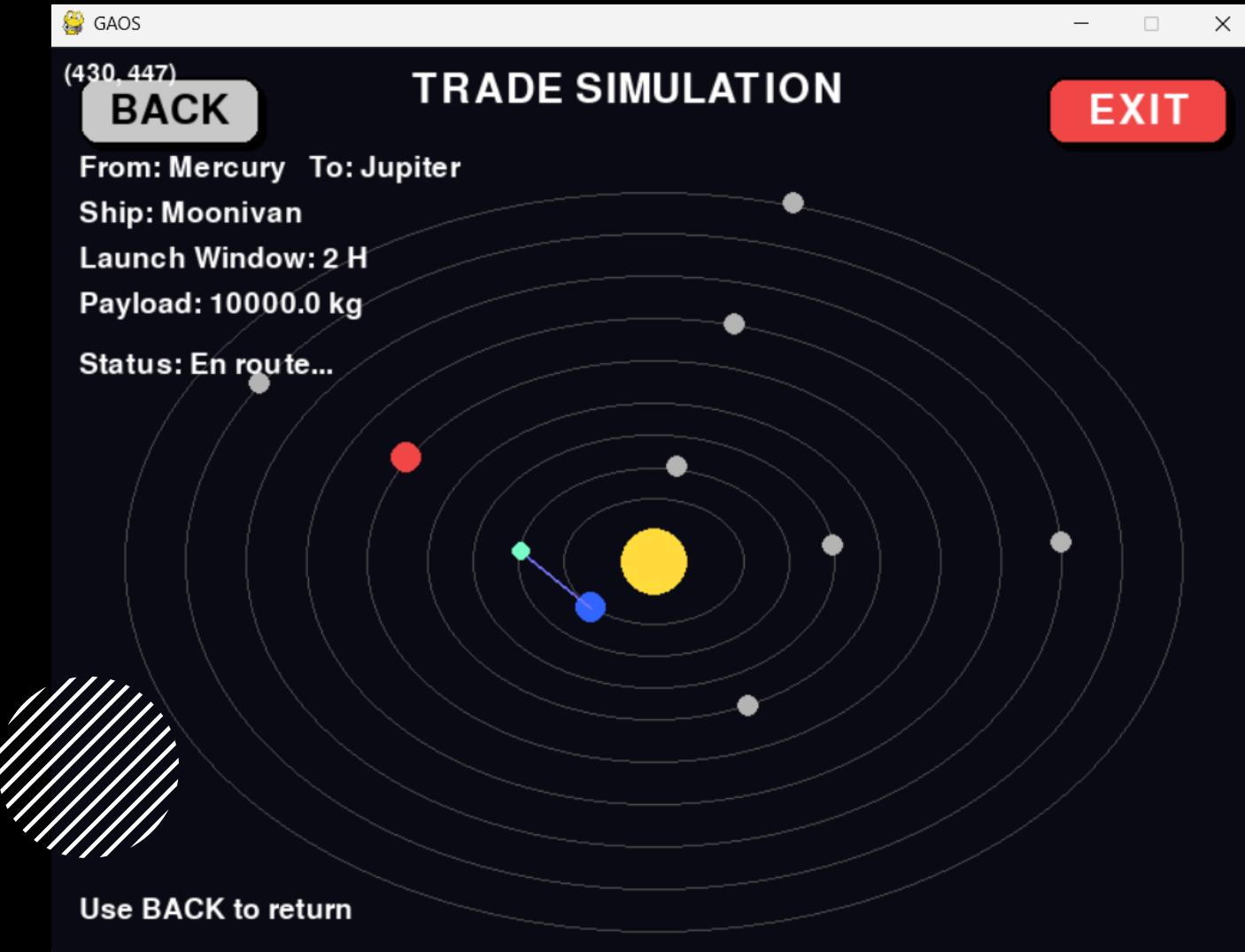
$$v_{park} = \sqrt{\frac{\mu_{planet}}{R_{fuel}}}$$

$$\Delta v_{launch} = \sqrt{|iV1|^2 + 2\frac{\mu}{r_{park}}} - v_{park}$$

- This calculates the distance (R_{fuel}) and the constant velocity (v_{park}) of the refueling station before the ship accelerates toward its destination.

- This represents the actual "kick" your engines must provide to transition from a stable parking orbit into a hyperbolic escape trajectory toward the next planet.

OUR SOLUTION



Conclusion

- Platform enables reliable interplanetary trade
- Balances realism with computational efficiency
- Scalable foundation for future space commerce
- **The ultimate spacefaring trade assistant**

