Solving 2D Transfer Orbits with Deep Reinforcement Learning

PHYS 416 Final Project

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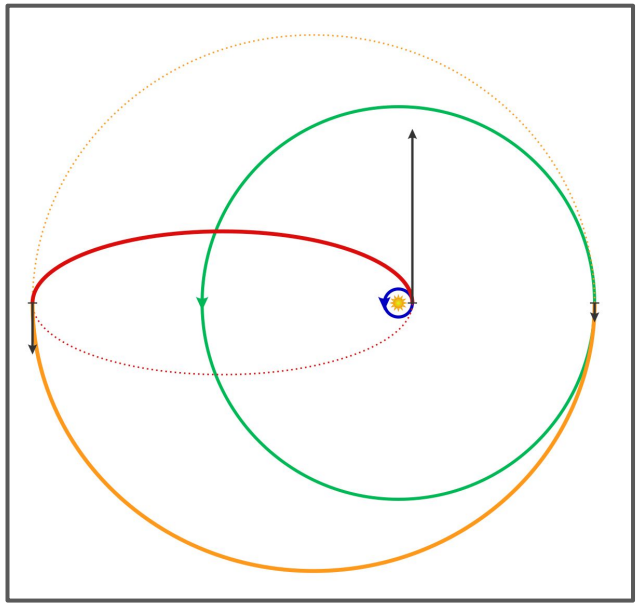
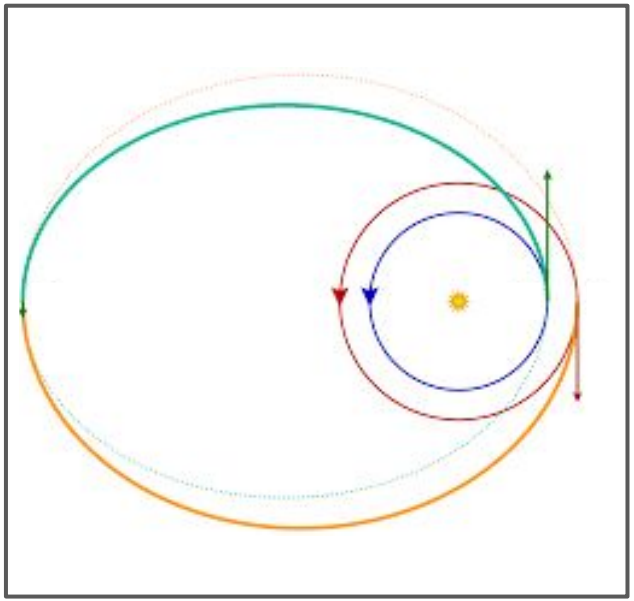
Transfer Orbits

An intermediate orbit used to transfer from one orbit to another.



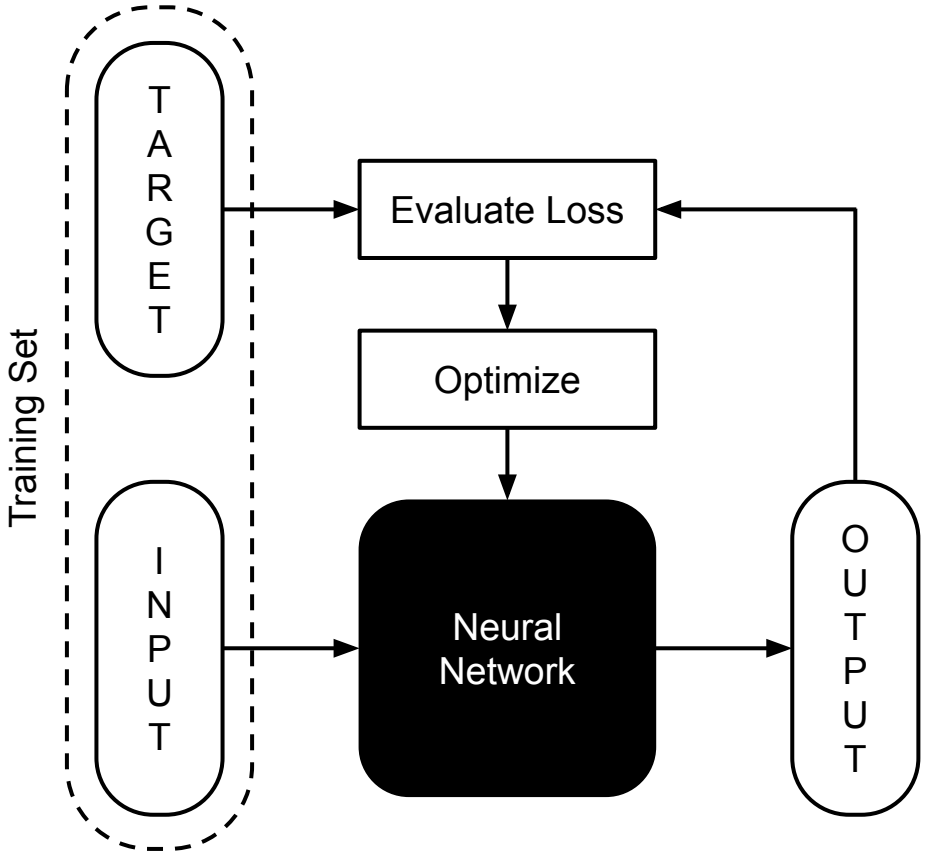
Hohmann Transfer Orbit



Bi-Elliptic Transfer Orbit

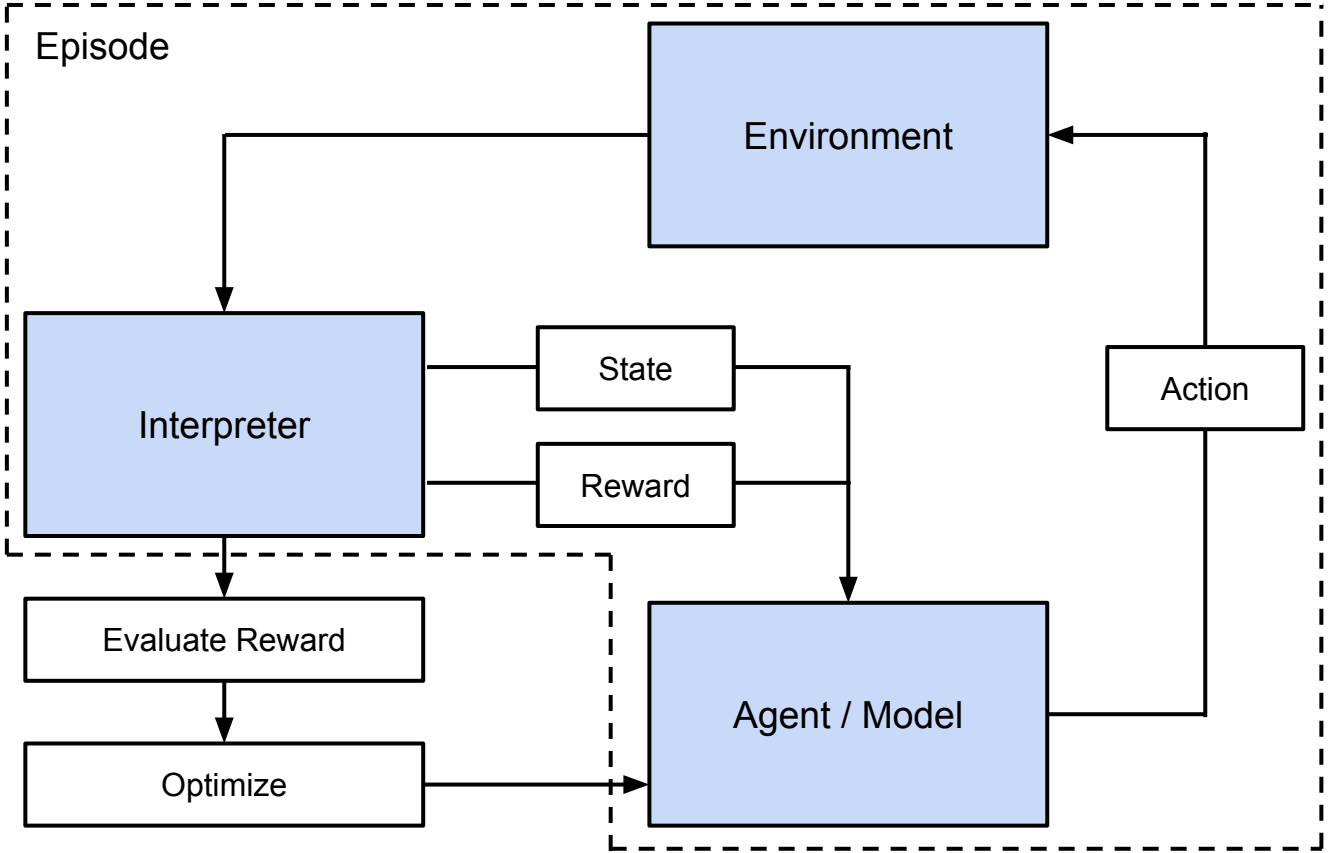
Global Trajectory Optimization Problem → No Analytic Solution

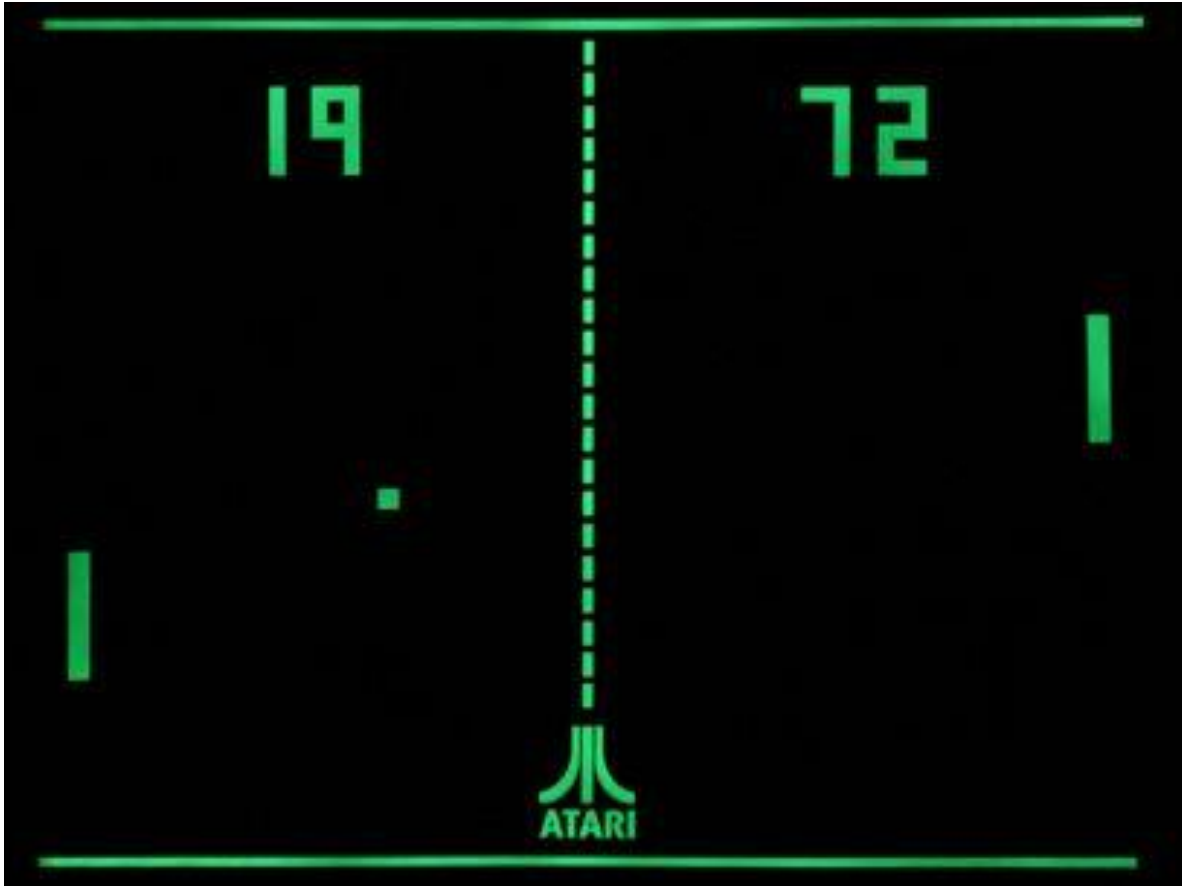
Standard Deep Learning



Deep Reinforcement Learning

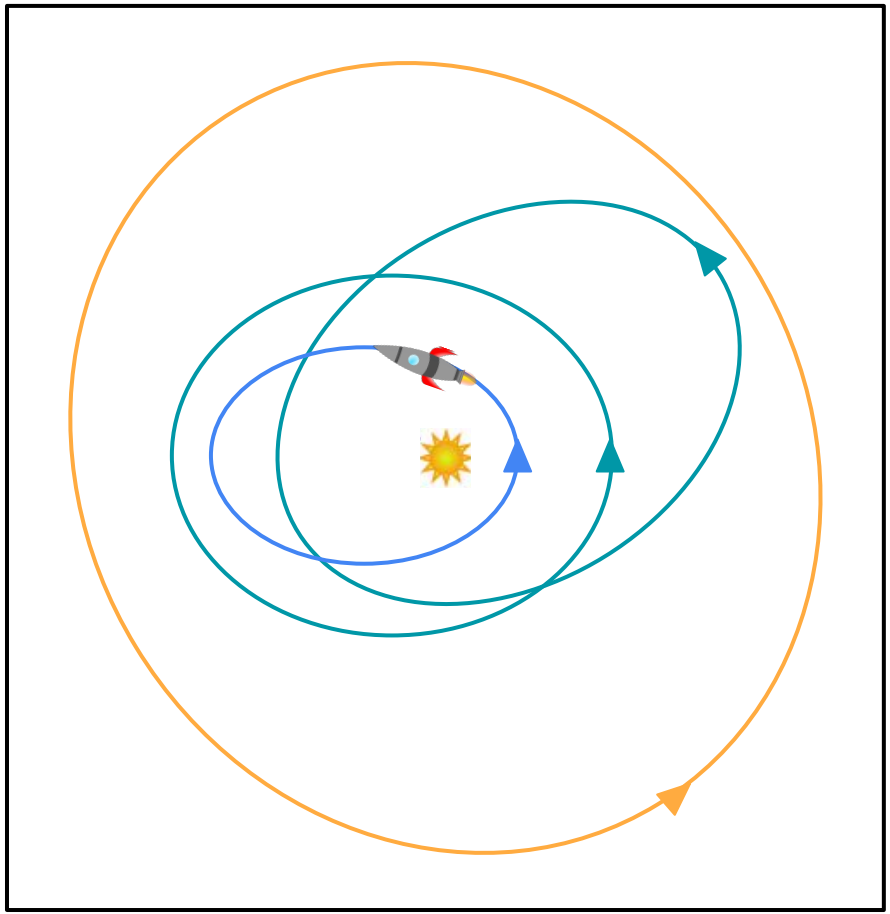
Google DeepMind


Episode
Environment
Interpreter
State
Reward
Action
Evaluate Reward
Optimize
Agent / Model



PONG®

- Episode
  - 1 Game
- State
  - Location of the ball
  - Location of my paddle
  - Location of opp. paddle
- Action
  - Up
  - Down
  - NOP
- Reward
  - Point Differential



2D Transfer Orbits with High Impulse Rocket

- Episode
  - 1 Attempt. Ends if:
    - Rocket hits target planet!
    - Rocket radius is larger than target max radius or max steps exceeded
- State
  - Rocket location and velocity
  - Source location and velocity
  - Target location and velocity
  - Other planet's locations and velocities
- Action
  - Δ Velocity (x and y comps)
  - Low-Thrust is Δ Acceleration
- Reward
  - Negative minimum separation from target minus the cumulative Δ Velocity