**COMP 150 Assignment [10 points]**

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**IMPORTANT:** The on-paper project description said to choose a car or airplane, but in class you talked about using other vehicles instead. If my choice (a spaceship) is too far off from what you had in mind, just let me know and I’ll change to doing an airplane instead (resubmitting this proposal if necessary).

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| --- | --- | --- |
|  | Manufacturer, car type, name, specification | Specifications |
| example | [Project Orion](https://en.wikipedia.org/wiki/Project_Orion_(nuclear_propulsion))  (speculative interplanetary spacecraft) |  |
| Ship 1 | Rubin Class Exploration Vessel | Dry Mass: 30 million kg  Max  Acceleration: 2g  Crew Capacity: 10 |
| Ship 2 | Underhill Class Unmanned Test and Research Vessel | Dry Mass: 10 million kg  Max Acceleration: 8g  Crew Capacity: 0 |
| Ship 3 | Chandrasekhar Class Colony Ship | Dry Mass: 600 million kg  Max Acceleration: 1g  Crew Capacity : 150 |

1. City information (minimum 3): names, countries, and road conditions. Use Google map and Wikipedia to find out the layout of each city (street, blocks, neighbors, business district, park, density etc.). To roughly estimate the number of traffic lights and stop signs, please add screen capture of each city and paste it on this/next page, and briefly describe about it.

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|  | Google map image capture (<https://www.google.ca/maps> ) | description |
| Example |  |  |
| Destination 1 | [Proxima Centauri:](https://en.wikipedia.org/wiki/Proxima_Centauri) | Distance:  4 lightyears  Density of nearby space:  low |
| Destination 2 | [Cygnus X-1:](https://en.wikipedia.org/wiki/Cygnus_X-1) | Distance:  7200  Lightyears  Density of nearby space:  moderate |
| Destination 3 | [Galactic Center:](https://en.wikipedia.org/wiki/Galactic_Center) | Distance:  25,000  Lightyears  Density of nearby space:  high |

1. List all factors (minimum 7; including your own finding/invention) associated with gas consumption, and briefly explain about how it affects gas mileage.
   1. Factor 1: Distance Travelled. This doesn’t technically affect fuel efficiency (it’s possible to go arbitrary distances in space on a fixed amount of fuel) but if affects the trip time. If you want to go a larger distance while keeping your trip time short, you must expend more fuel.
   2. Factor 2: Desired Subjective Trip Time. How long the trip will take (from the perspective of those in the spacecraft). Shortening the trip requires burning more fuel both accelerating and decelerating.
   3. Factor 3: Maximum Safe Acceleration. Different equipment (and humans) can tolerate different amounts of acceleration. Higher accelerations mean shorter trips, both because the craft spends less of the trip accelerating/decelerating and because the ship spends more time at a higher Lorentz factor (i.e. subjective time slows down for more of the trip).
   4. Factor 4: Ship “dry” mass. When accelerating the ship, enough energy must be provided to accelerate both the craft itself and any fuel its carrying. How much fuel is necessary depends on the details of the trip, but also the “dry” mass of the ship (that is, the mass of everything but the fuel).
   5. Factor 5: Reserve Fuel. You can calculate how much fuel is necessary based on the details of the trip and the craft. But it’s wise to carry some extra in case of unforeseen circumstances (see below). Unfortunately, carrying extra fuel also makes the craft less fuel efficient: the reserve fuel will be added to the dry mass.
   6. Factor 6: Launch velocity. One way to save fuel is to use stationary launch facilities (or gravity assists) to launch the craft at some initial velocity.
   7. Factor 7: Course corrections. If you discover you need to change course during the trip (either to avoid an obstacle or correct your flight path) you need to spend extra fuel to change your heading.
   8. Factor 8: Drag Zones. Interstellar space is mostly very empty, will little material to cause drag on a spaceship. However, if the flight path intersects concentrations of gas or dust they could cause significant drag on a fast-moving spaceship. This could cost the spacecraft some fuel (as it needs thrust to counteract the drag) or save fuel by decelerating the craft “for free,” at the expense of making the trip take longer.
2. Your design strategy to simulate number of random traffic lights and stop signs in certain cities.

The two factors that will impact efficiency that will be randomize (as they are not known ahead of the flight) will be Course Corrections and Drag Zones (2.7 and 2.8 above). The incidence and severity of both of these factors will be determined randomly, but the likelihood will depend on the destination of the trip. Longer trips are naturally more likely to run into obstacles. In addition, navigating regions of space that have a lot of stars and other matter are more likely to require both course corrections and dealing with drag. Towards this end, each destination will be assigned a “density coefficient” that determines the likelihood of each sort of event for each unit of distance travelled.

Course corrections will be randomly generated as a small number of degrees. The amount of fuel needed for the course correction will be calculated based on this number as well as the craft’s current speed and total mass.

Drag Zones will be modelled by generating a random coefficient which is multiplied by the current speed of the ship to determine how much kinetic energy the ship loses, which will in turn determine the decrease in speed. If the ship has sufficient reserve fuel to compensate for that decrease, it will. If there is insufficient reserve fuel then it will simply lose speed, and the total trip time will be increased accordingly.