Mission Sidequest 15.1: Ship Arming: Grand Laser

Start date: 30 September 2017
Due: 20 October 2017, 23:59

Readings:

- Textbook Section 2.5

With the sabotaging of the flagship and the likelihood of numerous upcoming battles in the near future, the ship's Chief Combat Officer, having consulted with Grandmaster Hartin, has requested for emergency augmentation of the ship's armaments. Scottie has been swiftly re-integrating several old, but powerful weapons that have previously been decommissioned, back into the ship's main weapons system. The hardware is mostly in good working condition, but Scottie is facing several problems with some of the modules in the software. Grandmaster Hartin has asked that once the numerical modules are repaired and working, spare manpower may be directed to rework the weapons modules.

Briefing Report

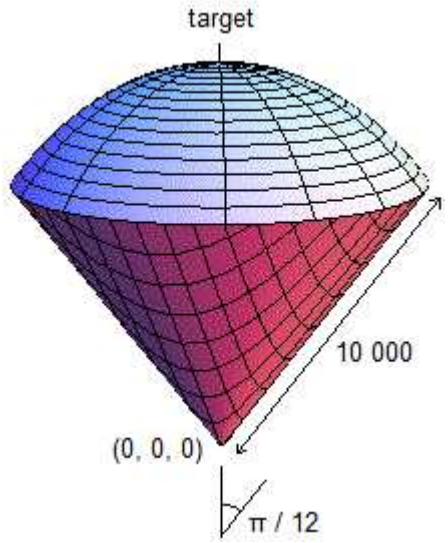
This is the briefing report for the **Grand Laser**.

The Grand Laser is a powerful superweapon with a very long range, large area-of-effect, and sheer, overwhelming destructive power. It takes three hours to charge after every use, so it cannot be fired indiscriminately. Nevertheless, prudent use of the Grand Laser has in the past been known to turn the tides of a losing war to our advantage.

Currently, our ship's radar system keeps track of the locations of all hostile and friendly ships within range of the radar, as part of the battlefield monitoring system. When the Grand Laser is fully charged and ready to fire, its control module acquires the list of ship locations from the ship's radar system. The laser's control module is then able to automatically maintain a lock-on of any hostile ship, even those out of the laser's range, as long as it is within the radar's range, and thus on the list of ship locations.

What is lacking now is the laser's optimisation module that analyses the best target to fire at. Theoretically, it may be possible to bypass the optimisation module and rely purely on human judgement instead, but in the heat of battle where seconds can make a difference between life and death, making a good judgement, even with the Source, can be very difficult without some aid.

Technical Specifications



The Grand Laser has an area-of-effect in the form of a **spherical cone**. This is the intersection of a sphere and an infinite-cone, where the sphere's centre coincides with the cone's vertex, at (0, 0, 0).

The angle between the cone's central axis and any one of its generatrices (slopes) is $\pi/12$, i.e., the cone's aperture is $\pi/6$. The laser's reach, i.e., the sphere's radius, or the cone's slope-length, is 10000.

The optimisation module should accept as input two lists (hostile ships, friendly ships), each with elements of 4-tuples (ship-ID, x-coord, y-coord, z-coord), and return as output the ship-ID of the hostile ship to target (or "none" if there is none). The targeted hostile ship always lies on the cone's central axis, and should be chosen to maximise the number of hostile ships caught in the laser's area-of-effect, subject to the precondition that no friendly ships are also hit by the laser. Use the given constants in the template and the signature:

```
function select_grand_laser_target(hostile_list, friendly_list) {
    ...
}
```

In addition, the optimisation module should also print out details of its analysis in the same format as in the example given below. Note that when the optimisation module returns the ship-ID of the optimal hostile ship to target, the Grand Laser is not immediately fired at that ship, unless the order to fire is given by the presiding Combat Officer. The printing of the analysis helps the presiding Combat Officer to decide, for example, whether it is worth firing the laser at the given moment (due to its long recharge time), and whether there are better targets to fire at as long as he orders certain friendly ships in the vicinity to evacuate the area.

Example

The command

```
select_grand_laser_target(
    list(list("TIE0001", 890, 700, 906),
         list("TIE0002", 895, 740, 912),
         list("TIE0003", -5634, -102, 8589)),
    list(list("XW0121", 862, 713, 999))
);
```

should result in the printout

```
Target: (TIE0001,890,700,906)
Hostiles in area of effect: (TIE0001,890,700,906) (TIE0002,895,740,912)
Friends in area of effect: (XW0121,862,713,999)

Target: (TIE0002,895,740,912)
Hostiles in area of effect: (TIE0001,890,700,906) (TIE0002,895,740,912)
Friends in area of effect: (XW0121,862,713,999)

Target: (TIE0003,-5634,-102,8589)
Hostiles in area of effect:
Friends in area of effect:
```

and return

```
"none"
```

End of briefing report. Please enquire on the forums if you need any further clarification.

Task 1:

Your only task is to write the optimisation module. Use the given constants and signature in the template provided.

Submission

To submit your work to the Academy, remember to click "Save", then click "Finalize Submission". Note that submission is final and that any mistakes in submission requires extra effort from a tutor or the lecturer himself to fix.