HOMEWORK #5:

Battle beyond the stars

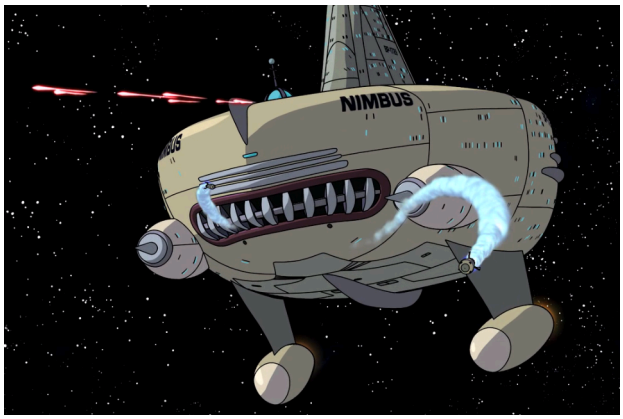
Due Monday, April the 10th, 11:59pm

For this assignment, your '`main()`' function should be in a C++ file called '`spacebattle.cpp`'.

Remember to put your name and section at the top of your program file.
Your program should expect all input to come from '`cin`', and all your output should be to '`cout`'.

Problem

The threat of the Annihilation Planet has been averted without firing a single shot!. The Annihilation Planet was very careful to cover all exhaust ports, but then they exploded due to a buildup of internal pressure.
Now, President of Earth Richard Nixon does not knows what to do with all the new ships that were built and equipped in preparation to the attack on the Annihilation Planet. Somehow he has to justify the expense of a terazillion dollars to the taxpayers or Earth.
So, one of his loyal advisors, the headless body of Spiro Agnew, has suggested to hold a "Battle Royale", a grand space warfare tournament between the spaceships, for show, fun and profit. Of course, there is no fun unless there is some profit to be made. Knowing the battle policy of each class of ship, President Nixon wants you to create a simulator program that will predict the winner beforehand, and then make a profit on the black sports betting markets.



"They said joining the Space Navy would be fun".

The Tournament will follow simple rules. First, all the participating ships will be put in a queue. The first two spaceships in the queue are made to fire at each other until only one of them is left alive. Then the surviving ship is placed *in the back* of the queue. This process continues until

only one ship is left.
When two ships are matched against each other, the ships will take turns firing at each other. **One shot fired per turn**. The spaceship picked first from the queue will fire first. As mentioned before, the ships will keep taking turns firing at each other until one of them is destroyed.

Weaponry

Spaceships are equipped with one or more kinds of weaponry. There are 3 kinds of weapons: Lasers, Missiles, and Plasma. Spaceships equipped with missiles have a limited supply of them. Lasers and Plasma volts are energy weapons, driven by the ship's engines, so they can be fired an unlimited number of times as long as the ship is alive. Plasma volts, however, have a nasty side effect on the firing ship. When a spaceship equipped with shields fires a plasma its shield level is reduced by **half** the plasma volt's power.

Earth Space Navy Ship Armament and Firing policy:

As you know, Earth Space Navy ships come in 5 different classes. Each class has different armament. and when there is their turn to fire, they have a different policy to decide which weapon to fire.

- Frigate: Equipped only with lasers, a frigate will fire lasers in every turn.

- Destroyer: Equipped with missiles and lasers. A Destroyer will fire a missile if available, else it will fire its lasers.

- Battlecruiser: Equipped with lasers and plasma volts. As longs as its shields are up and the hull strength is over 10, a Battlecruiser will fire its lasers. If its shields are down or its hull strength is below 10 a Battlecruiser will enter panic mode and fire plasma volts.

- Dreadnought: Aggressive to the core, dreadnought class ships are equipped with lasers, missiles **and** plasma volts. A dreadnought will first prefer to spend its supply of missiles. Once out of missiles, it will resort to use plasma volts, as long as its shields are above power 15. (Notice that a dreadnought will actually **lose** shield power by firing its plasma gun) If a dreadnought is out of missiles and its shields are below power 15, then it will fire its lasers.

- Dropship:. Equipped only with missiles. As long as it has missiles, a dropship will fire them. Once out of missiles, the dropship is a lame duck and will skip its turns.

“I’m not a crook”.

Input

The first line of the input gives the number of ships in the tournament **S**.
The first line of each ship is an integer stating the ship class, followed by a string stating the ship’s name, followed by an integer stating the ships hull strength.

Then, according to the class of the ship, integers stating:

- For Frigates:
  - the power of its laser guns.

- For Destroyers:
  - the armor strength,
  - the power of its laser guns,
  - the number of missiles, and
  - the power level of the missiles

- For Battlecruisers:
  - the shield strength,
  - the power of its laser guns, and
  - the power of its plasma volts.

- For Dreadnaughts:
  - the armor strength,
  - the shield strength,
  - the power of its laser guns,
  - the number of missiles,
  - the power level of the missiles, and
  - the power of its plasma volts.

- For Dropships:
    - the armor strength,
    - the number of personnel on board,
    - the number of missiles, and
    - the power level of the missiles.

As a reminder, the ship class numbers are:

0 - Frigate 1 - Destroyer 2 - Battlecruiser 3 - Dreadnaught 4 - Dropship

Output

Before each match, output one line containing "`Battle #`*x*" (starting from 1).
Then, output the **winner** of the match, and the **status** of the winner following the format provided in the sample output. For the status of missiles, the first number states the number of missiles left, while the second number states the power of the missiles.
NOTE: The status should be printed in a single line. Due to space constraints the line wraps around in this document's sample output.

Implementation : The AbstractQueue Class

Notice that the battle order is organized in a **queue**, the Abstract Data Type seen in class.
For this assignment, you will create your own implementation of a queue data structure.

- Your queue implementation should be a subclass of the provided "`AbstractQueue`" class.
- Implement and **test** your queue implementation **before** you code the simulation.

Implementation : The Space Battle Simulation

- You are provided with an **updated** abstract base class 'Spaceship', please download the latest version.
- Use derived classes for each different kind of ship. Consider what functionality is needed for each kind.
- Do not use any public member variables. (respect the privacy of the ships).
- Use **const** for the necessary constants.
- The names of the ships will **not** contain spaces.

SpaceBattle Algorithm Draft:

```
WHILE queue is of size greater than 1

    player1 = front of queue
    dequeue
    player2 = front of queue
    dequeue

    while both ships are alive
       player1.fire(w,p)
       player2.hit(w,p)
       if player2 is dead
          winner = player1
       else
          player2.fire(w,p)
          player1.hit(w,p)
          if player1 is dead
             winner = player2

    enqueue winner
```

Sample 1:

Input
3 2 Stroustrup 30 30 10 25 3 Dijkstra 49 50 50 7 5 12 30 2 Wirth 20 100 15 25

NOTE: The status should be printed in a single line. Due to space constraints the line wraps around in this document's sample output.

Output

```
Battle #1 : Stroustrup vs. Dijkstra.
Winner! : Dijkstra.
Dijkstra : hull = 37, shield = 19, armor = 50 : laser = 7 missiles
= 2,12 plasma = 30.

Battle #2 : Wirth vs. Dijkstra.
Winner! : Dijkstra.
Dijkstra : hull = 25, shield = 0, armor = 50 : laser = 7 missiles =
0,12 plasma = 30.

*** CHAMPION!!! : Dijkstra.
Dijkstra : hull = 25, shield = 0, armor = 50 : laser = 7 missiles =
0,12 plasma = 30.
```

Notes on Sample 1:

Although you are only asked for the final status of the winning ship after a battle, tracing the battle step-by-step may be useful to understand the problem. For example:

Battle #1 : Stroustrup vs. Dijkstra.

Stroustrup fires laser power 10 to Dijkstra
    Dijkstra : hull = 49, shield = 47, armor = 50 : laser = 7 missiles = 5,12 plasma = 30.
Dijkstra fires missile power 12 to Stroustrup
    Stroustrup : hull = 18, shield = 30 : laser = 10 plasma = 25.
Stroustrup fires laser power 10 to Dijkstra
    Dijkstra : hull = 49, shield = 44, armor = 50 : laser = 7 missiles = 4,12 plasma = 30.
Dijkstra fires missile power 12 to Stroustrup
    Stroustrup : hull = 6, shield = 30 : laser = 10 plasma = 25.
Stroustrup fires plasma power 25 to Dijkstra
    Dijkstra : hull = 37, shield = 19, armor = 50 : laser = 7 missiles = 3,12 plasma = 30.
Dijkstra fires missile power 12 to Stroustrup
    Stroustrup : hull = 0, shield = 30 : laser = 10 plasma = 25.
Winner! : Dijkstra.
    Dijkstra : hull = 37, shield = 19, armor = 50 : laser = 7 missiles = 2,12 plasma = 30.

Battle #2 : Wirth vs. Dijkstra.

Wirth fires laser power 15 to Dijkstra
    Wirth : hull = 20, shield = 100 : laser = 15 plasma = 25.
    Dijkstra : hull = 37, shield = 14, armor = 50 : laser = 7 missiles = 2,12 plasma = 30.
Dijkstra fires missile power 12 to Wirth
    Wirth : hull = 8, shield = 100 : laser = 15 plasma = 25.
    Dijkstra : hull = 37, shield = 14, armor = 50 : laser = 7 missiles = 1,12 plasma = 30.
Wirth fires plasma power 25 to Dijkstra
    Wirth : hull = 8, shield = 88 : laser = 15 plasma = 25.
    Dijkstra : hull = 25, shield = 0, armor = 50 : laser = 7 missiles = 1,12 plasma = 30.
Dijkstra fires missile power 12 to Wirth
    Wirth : hull = -4, shield = 88 : laser = 15 plasma = 25.
    Dijkstra : hull = 25, shield = 0, armor = 50 : laser = 7 missiles = 0,12 plasma = 30.
Winner! : Dijkstra.
    Dijkstra : hull = 25, shield = 0, armor = 50 : laser = 7 missiles = 0,12 plasma = 30.

Sample 2:

Input

```
10
0 Nostromo           15          2
1 AluminiumFalcon    36  30      4 5 10
2 Hyperion           49  57      10 15
3 Nimbus             63  50 50   7 10 10 20
4 Titan              45  20 174  5 15
0 PurplePearl        13          13
1 Serenity           18  50      7   7 12
2 Deadalus           10  100     10  33
3 Executor           80  10 10   10  10 16  10
4 Sulacco            26  66 666  20 7
```

Output

```
Battle #1 : Nostromo vs. AluminiumFalcon.
Winner! : AluminiumFalcon.
AluminiumFalcon : hull = 32, armor = 30 : laser = 4 missiles =
3,10.

Battle #2 : Hyperion vs. Nimbus.
Winner! : Nimbus.
Nimbus : hull = 56, shield = 23, armor = 50 : laser = 7 missiles =
5,10 plasma = 20.

Battle #3 : Titan vs. PurplePearl.
Winner! : Titan
Titan : hull = 45, armor = 20, personnel = 174 :  missiles = 4,15.

Battle #4 : Serenity vs. Deadalus.
Winner! : Serenity
Serenity : hull = 18, armor = 50 : laser = 7 missiles = 6,12.

Battle #5 : Executor vs. Sulacco.
Winner! : Executor
Executor : hull = 38, shield = 10, armor = 0 : laser = 10 missiles
= 0,16 plasma = 10.

Battle #6 : AluminiumFalcon vs. Nimbus.
Winner! : Nimbus.
Nimbus : hull = 56, shield = 8, armor = 35 : laser = 7 missiles =
0,10 plasma = 20.

Battle #7 : Titan vs. Serenity.
Winner! : Serenity.
Serenity : hull = 18, armor = 22 : laser = 7 missiles = 0,12.

.....
```

NOTE: The output for sample 2 is incomplete, in order to not reveal the champion!.

Battle #6 : AluminiumFalcon vs. Nimbus.
Initially:
AluminiumFalcon : hull = 32, armor = 30 : laser = 4 missiles = 3,10.
Nimbus : hull = 56, shield = 23, armor = 50 : laser = 7 missiles = 5,10 plasma = 20.

AluminiumFalcon fires missile power 10 to Nimbus
AluminiumFalcon : hull = 32, armor = 30 : laser = 4 missiles = 2,10.
Nimbus : hull = 56, shield = 23, armor = 45 : laser = 7 missiles = 5,10 plasma = 20.

Nimbus fires missile power 10 to AluminiumFalcon
AluminiumFalcon : hull = 32, armor = 25 : laser = 4 missiles = 2,10.
Nimbus : hull = 56, shield = 23, armor = 45 : laser = 7 missiles = 4,10 plasma = 20.
AluminiumFalcon fires missile power 10 to Nimbus
AluminiumFalcon : hull = 32, armor = 25 : laser = 4 missiles = 1,10.
Nimbus : hull = 56, shield = 23, armor = 40 : laser = 7 missiles = 4,10 plasma = 20.
Nimbus fires missile power 10 to AluminiumFalcon
AluminiumFalcon : hull = 32, armor = 20 : laser = 4 missiles = 1,10.
Nimbus : hull = 56, shield = 23, armor = 40 : laser = 7 missiles = 3,10 plasma = 20.
AluminiumFalcon fires missile power 10 to Nimbus
AluminiumFalcon : hull = 32, armor = 20 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 23, armor = 35 : laser = 7 missiles = 3,10 plasma = 20.
Nimbus fires missile power 10 to AluminiumFalcon
AluminiumFalcon : hull = 32, armor = 15 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 23, armor = 35 : laser = 7 missiles = 2,10 plasma = 20.
AluminiumFalcon fires laser power 4 to Nimbus
AluminiumFalcon : hull = 32, armor = 15 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 22, armor = 35 : laser = 7 missiles = 2,10 plasma = 20.
Nimbus fires missile power 10 to AluminiumFalcon
AluminiumFalcon : hull = 32, armor = 10 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 22, armor = 35 : laser = 7 missiles = 1,10 plasma = 20.
AluminiumFalcon fires laser power 4 to Nimbus
AluminiumFalcon : hull = 32, armor = 10 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 21, armor = 35 : laser = 7 missiles = 1,10 plasma = 20.
Nimbus fires missile power 10 to AluminiumFalcon
AluminiumFalcon : hull = 32, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 21, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
AluminiumFalcon fires laser power 4 to Nimbus
AluminiumFalcon : hull = 32, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 20, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
Nimbus fires plasma power 20 to AluminiumFalcon
AluminiumFalcon : hull = 12, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 10, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
AluminiumFalcon fires laser power 4 to Nimbus
AluminiumFalcon : hull = 12, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 9, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
Nimbus fires laser power 7 to AluminiumFalcon
AluminiumFalcon : hull = 5, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 9, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
AluminiumFalcon fires laser power 4 to Nimbus
AluminiumFalcon : hull = 5, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 8, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
Nimbus fires laser power 7 to AluminiumFalcon

AluminiumFalcon : hull = -2, armor = 5 : laser = 4 missiles = 0,10.
Nimbus : hull = 56, shield = 8, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.
Winner! : Nimbus.
Nimbus : hull = 56, shield = 8, armor = 35 : laser = 7 missiles = 0,10 plasma = 20.