# Comp151 Lab8

In this lab you will write **four** applications that utilize queue. See the descriptions below:

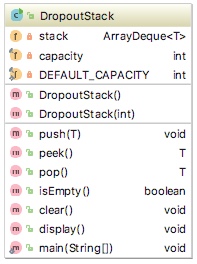
# Application #1

Using ArrayDeque class from java.util write a program that implements a special stack that has a finite size but allows an unlimited number of push operations. If the stack is full when a push occurs, the stack makes room for the new entry by deleting the entry at its bottom. A browser that maintains a limited history could use this kind of stack. Implement this stack by using a **deque** data structure implemented by ArrayDeque class.

Please note that capacity should be declared as final, DEFAULT\_CAPACITY should be set to 20. To add, remove, and retrieve elements utilize ArrayDeque methods: push, pop, peek, removeLast.

#### UML DIAGRAM:

Please note two methods added for testing: main (see the sample run) and display.



#### SAMPLE RUN:

\*\*\*\*\*\*\*\*\*\*\*\*\*\* TESTING DROPOUT STACK \*\*\*\*\*\*\*\*\*\*\*\*\*\*

----> Adding 20 items to empty stack of capacity of 20

----> The content of the stack is:

[19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0]

----> The top of the stack is: 19

----> Adding 5 more items to full stack

push 20

push 21

push 22

push 23

push 24

----> The content of the stack is:

[24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5]

----> The top of the stack is: 24

----> Removing all elements from the stack:

----> pop 24

----> pop 23

----> pop 22

----> pop 21

----> pop 20

----> pop 19

----> pop 18

----> pop 17

----> pop 16

----> pop 15

----> pop 14

----> pop 13

----> pop 12

----> pop 11

----> pop 10

----> pop 9

----> pop 8

----> pop 7

----> pop 6

----> pop 5

The stack is empty

----> The top of the stack is: null

----> Trying to pop from the empty stack

----> Got back null

----> Trying to peek at the top of the empty stack

----> Got back null

----> Adding 22 items to empty stack of capacity of 20

----> The content of the stack is:

[21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2]

----> Clearing the stack with the clear method

----> The content of the stack is:

The stack is empty

# Application #2

A Caesar cipher is a simple approach to encoding messages by shifting each letter in a message along the alphabet by a constant amount of k. For example, if k equals 3, then in an encoded message, each letter is shifted three characters forward: *a* is replaced with *d*, *b* with *e*, *c* with *f* and so on. The end of the alphabet wraps back around to the beginning. To decode the message each letter is shifted the same number of characters backwards. Julius Caesar actually used this type of cipher in some of his secret government correspondence. Unfortunately, the Caesar cipher is fairly easy to break. There are only 26 possibilities for shifting the characters, and the code can be broken by trying various key values until it works.

An improvement can be made to this encoding technique if we use a so called ***repeating key***. Instead of shifting each character by a constant amount, we can shift each character by a different amount using a list of key values. If the message is longer that the list of key values, we just start using the key over again from the beginning. For example, if the **key values** are

**3 1 7 4 2 5**

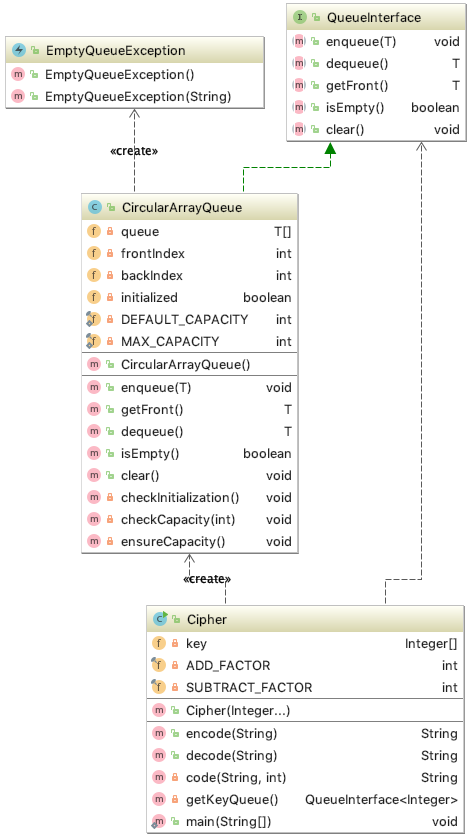
then the first character is shifted by three, the second character by one, the third character by seven, etc. After shifting the sixth character by five, we start using the key over again. The seventh character is shifted by three, the eighth by one, etc. The following table shows the message “knowledge is power” encoded using this *repeating key*:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **o** | **v** | **{** | **n** | **j** | **g** | **h** | **l** | **$** | **k** | **x** | **#** | **q** | **v** | **{** | **g** | **w** |
| 3 | 1 | 7 | 4 | 2 | 5 | 3 | 1 | 7 | 4 | 2 | 5 | 3 | 1 | 7 | 4 | 2 | 5 |
| k | n | o | w | l | e | d | g | e |  | i | s |  | p | o | w | e | r |

Notice that this encryption approach encodes the same letter into different characters, depending on where it occurs in the message and thus which key value is used to encode it.

1. Using the *QueueInterface* defined in the textbook, implement CircularArrayQueue class that uses a “circular” array with one unused location.
2. Next utilize this class to write a program(Cipher.java) that uses a *repeating key* to encode and decode a message. The keys of integer values are stored in a queue. After a key value is used, it is put back to the end of the queue so that the key continually repeats as needed for long messages. The key can use both positive and negative values. The idea is that the person encoding the message has one copy of the key, and the person decoding the message has another. Using a queue to store the *repeating key* makes it easy to repeat the key and the nature of the queue keeps the key values in the proper order.

#### UML DIAGRAM:



#### SAMPLE RUN:

\*\*\*\*\*\*\*\*\*\*\*\*\*\* TESTING THE CIPHER \*\*\*\*\*\*\*\*\*\*\*\*\*\*

--->The original message encoded is:

Fxi(gvyiufnrqo{e|g#umf…tz`krvv%bspicp\*errqzbzj$kth%mtpemvrwt3

--->The original message decoded is:

All programmers are playwrights and all computers are lousy actors.

--->The original message encoded is:

Ytbz\$su#sp%qimme~qu%ut,p}Zgouv1!^{r(\_eg#yp%^s\$~jh%tymfzj280

--->The original message decoded is:

There is no elevator to success, You have to take the stairs...

--->The original message encoded is:

Ws|wv%ev{$Xjujm}

--->The original message decoded is:

Trust but Verify

--->The original message encoded is:

ubji"hds

--->The original message decoded is:

race car

Process finished with exit code 0Application #3

Using the *Queue* interface and its implementation ArrayDeque class from java.util write a program that simulates a train route.

A train route consists of a number of stations (assume 10, represented by the variable STATIONS), starting with station 0, and ending with a FINAL\_STATION (value of STATIONS – 1). The time that the train needs to travel between a pair of consecutive stations on the route is randomly generated (number between 5 and 9, represented by the variables MIN\_TIME\_TO\_NEXT\_STATION and MAX\_TIME\_TO\_NEXT\_STATION).

Associated with **each station** is a **queue of passengers**. Random number of passengers (between 0 and 10, see variable MAX\_NUM\_OF\_PASSENGERS) is generated at each tick of the simulation clock. Each passenger is given a random entry station, and a random destination station (the entry station is always smaller than the destination station).

Trains leave a station at regular intervals (represented by the variable TRAIN\_INTERVAL) and visit the stations on the route. When a train stops at a station, all passengers for that station exit first. Then any passenger waiting in the queue at the station boards the train until either the queue is empty, or the train is full.

Once the simulation is completed the final report is printed giving the statistics from the simulation.

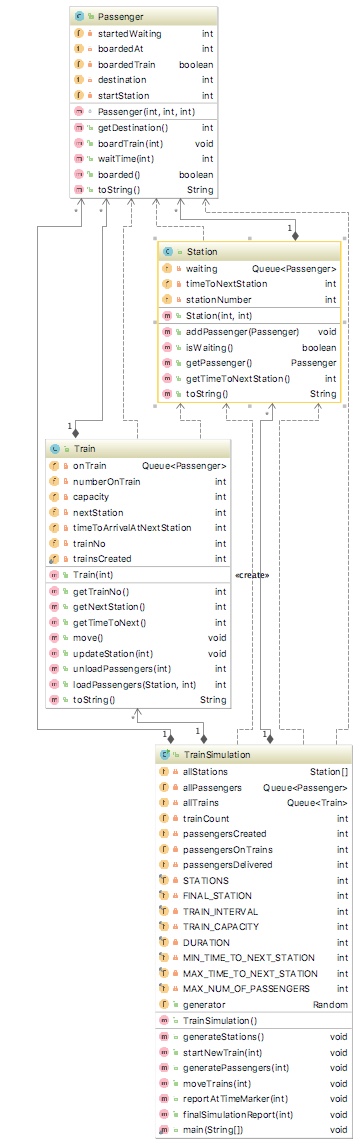
See the sample run of the application below.

Lab08.zip contains all the classes needed for implementation of this project.

TrainSimulation.java is the class that you will need to finish:

1. Make yourself familiar with all the classes provided
2. Draw a memory diagram for the application
3. Follow the steps described in the file:
   1. Step#1 – implement generateStations() method.
      * Run your application.
      * OUTCOME: 10 stations should be created with valid times to next station
   2. Step #2 – implement generatePassengers() method.
      * Run your application.
      * OUTCOME: At every time marker, between 0 and 9 passengers should be created with valid start and destination stations. Number of waiting passengers should be changed accordingly. Number of passengers on trains should be 0.
   3. Step#3 – implement startNewTrain() method.
      * Run your application.
      * OUTCOME: At every TRAIN\_INTERVAL marker a new train should be created
   4. Step #4 – implement moveTrains() method.
      * Run your application
      * OUTCOME: At every time marker you should see trains unloading and loading the appropriate number of passengers. If a train reaches the final station it should no longer be in the queue. Your produced output should be similar to the sample run below.

**UML DIAGRAM:**



#### SAMPLE RUN with seed set to 101:

# \*\*\*\*\*\*\*\*\*\*\*\*\*\* TRAIN SIMULATION \*\*\*\*\*\*\*\*\*\*\*\*\*\*

# --> Creating 10 stations:

# Station 0 has no passengers waiting; the time to next station is 5

# Station 1 has no passengers waiting; the time to next station is 5

# Station 2 has no passengers waiting; the time to next station is 8

# Station 3 has no passengers waiting; the time to next station is 9

# Station 4 has no passengers waiting; the time to next station is 5

# Station 5 has no passengers waiting; the time to next station is 5

# Station 6 has no passengers waiting; the time to next station is 9

# Station 7 has no passengers waiting; the time to next station is 8

# Station 8 has no passengers waiting; the time to next station is 7

# Station 9 has no passengers waiting; the time to next station is 6

# --> Starting the clock; duration set to 50

# Passenger arrived at time marker 0 at station 3 heading to 4

# Passenger arrived at time marker 0 at station 0 heading to 9

# Passenger arrived at time marker 0 at station 3 heading to 5

# Passenger arrived at time marker 0 at station 0 heading to 1

# New train: Train 1 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 is at station 0; unloaded 0; loaded 2 passengers; Space left 18

# Train 1 capacity of 20 arriving at station 1 in 5 minutes; currently 2 passengers on board

# -----At time marker 0 -> passengers waiting: 2 on trains: 2 active trains: 1-----

# Passenger arrived at time marker 1 at station 0 heading to 8

# Passenger arrived at time marker 1 at station 1 heading to 3

# Passenger arrived at time marker 1 at station 3 heading to 4

# Passenger arrived at time marker 1 at station 5 heading to 6

# Passenger arrived at time marker 1 at station 0 heading to 3

# Passenger arrived at time marker 1 at station 0 heading to 3

# Passenger arrived at time marker 1 at station 7 heading to 8

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 1 in 4 minutes; currently 2 passengers on board

# -----At time marker 1 -> passengers waiting: 9 on trains: 2 active trains: 1-----

# Passenger arrived at time marker 2 at station 0 heading to 2

# Passenger arrived at time marker 2 at station 0 heading to 1

# Passenger arrived at time marker 2 at station 0 heading to 1

# Passenger arrived at time marker 2 at station 8 heading to 9

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 1 in 3 minutes; currently 2 passengers on board

# -----At time marker 2 -> passengers waiting: 13 on trains: 2 active trains: 1-----

# Passenger arrived at time marker 3 at station 5 heading to 7

# Passenger arrived at time marker 3 at station 1 heading to 6

# Passenger arrived at time marker 3 at station 0 heading to 3

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 1 in 2 minutes; currently 2 passengers on board

# -----At time marker 3 -> passengers waiting: 16 on trains: 2 active trains: 1-----

# Passenger arrived at time marker 4 at station 1 heading to 7

# Passenger arrived at time marker 4 at station 4 heading to 5

# Passenger arrived at time marker 4 at station 4 heading to 7

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 1 in 1 minutes; currently 2 passengers on board

# -----At time marker 4 -> passengers waiting: 19 on trains: 2 active trains: 1-----

# Passenger arrived at time marker 5 at station 6 heading to 9

# Passenger arrived at time marker 5 at station 0 heading to 5

# Passenger arrived at time marker 5 at station 3 heading to 6

# Passenger arrived at time marker 5 at station 0 heading to 1

# Passenger arrived at time marker 5 at station 1 heading to 8

# New train: Train 2 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 is at station 1; unloaded 1; loaded 4 passengers; Space left 15

# Train 1 capacity of 20 arriving at station 2 in 5 minutes; currently 5 passengers on board

# Train 2 is at station 0; unloaded 0; loaded 9 passengers; Space left 11

# Train 2 capacity of 20 arriving at station 1 in 5 minutes; currently 9 passengers on board

# -----At time marker 5 -> passengers waiting: 11 on trains: 14 active trains: 2-----

# Passenger arrived at time marker 6 at station 0 heading to 4

# Passenger arrived at time marker 6 at station 5 heading to 6

# Passenger arrived at time marker 6 at station 3 heading to 5

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 2 in 4 minutes; currently 5 passengers on board

# Train 2 capacity of 20 arriving at station 1 in 4 minutes; currently 9 passengers on board

# -----At time marker 6 -> passengers waiting: 14 on trains: 14 active trains: 2-----

# Passenger arrived at time marker 7 at station 3 heading to 4

# Passenger arrived at time marker 7 at station 6 heading to 8

# Passenger arrived at time marker 7 at station 1 heading to 4

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 2 in 3 minutes; currently 5 passengers on board

# Train 2 capacity of 20 arriving at station 1 in 3 minutes; currently 9 passengers on board

# -----At time marker 7 -> passengers waiting: 17 on trains: 14 active trains: 2-----

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 2 in 2 minutes; currently 5 passengers on board

# Train 2 capacity of 20 arriving at station 1 in 2 minutes; currently 9 passengers on board

# -----At time marker 8 -> passengers waiting: 17 on trains: 14 active trains: 2-----

# Passenger arrived at time marker 9 at station 2 heading to 4

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 2 in 1 minutes; currently 5 passengers on board

# Train 2 capacity of 20 arriving at station 1 in 1 minutes; currently 9 passengers on board

# -----At time marker 9 -> passengers waiting: 18 on trains: 14 active trains: 2-----

# Passenger arrived at time marker 10 at station 1 heading to 3

# Passenger arrived at time marker 10 at station 1 heading to 5

# Passenger arrived at time marker 10 at station 6 heading to 7

# New train: Train 3 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 is at station 2; unloaded 0; loaded 1 passengers; Space left 14

# Train 1 capacity of 20 arriving at station 3 in 8 minutes; currently 6 passengers on board

# Train 2 is at station 1; unloaded 3; loaded 3 passengers; Space left 11

# Train 2 capacity of 20 arriving at station 2 in 5 minutes; currently 9 passengers on board

# Train 3 is at station 0; unloaded 0; loaded 1 passengers; Space left 19

# Train 3 capacity of 20 arriving at station 1 in 5 minutes; currently 1 passengers on board

# -----At time marker 10 -> passengers waiting: 16 on trains: 16 active trains: 3-----

# Passenger arrived at time marker 11 at station 0 heading to 2

# Passenger arrived at time marker 11 at station 1 heading to 4

# Passenger arrived at time marker 11 at station 2 heading to 6

# Passenger arrived at time marker 11 at station 1 heading to 2

# Passenger arrived at time marker 11 at station 1 heading to 8

# Passenger arrived at time marker 11 at station 5 heading to 6

# Passenger arrived at time marker 11 at station 1 heading to 7

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 7 minutes; currently 6 passengers on board

# Train 2 capacity of 20 arriving at station 2 in 4 minutes; currently 9 passengers on board

# Train 3 capacity of 20 arriving at station 1 in 4 minutes; currently 1 passengers on board

# -----At time marker 11 -> passengers waiting: 23 on trains: 16 active trains: 3-----

# Passenger arrived at time marker 12 at station 0 heading to 1

# Passenger arrived at time marker 12 at station 0 heading to 4

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 6 minutes; currently 6 passengers on board

# Train 2 capacity of 20 arriving at station 2 in 3 minutes; currently 9 passengers on board

# Train 3 capacity of 20 arriving at station 1 in 3 minutes; currently 1 passengers on board

# -----At time marker 12 -> passengers waiting: 25 on trains: 16 active trains: 3-----

# Passenger arrived at time marker 13 at station 3 heading to 4

# Passenger arrived at time marker 13 at station 1 heading to 2

# Passenger arrived at time marker 13 at station 3 heading to 8

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 5 minutes; currently 6 passengers on board

# Train 2 capacity of 20 arriving at station 2 in 2 minutes; currently 9 passengers on board

# Train 3 capacity of 20 arriving at station 1 in 2 minutes; currently 1 passengers on board

# -----At time marker 13 -> passengers waiting: 28 on trains: 16 active trains: 3-----

# Passenger arrived at time marker 14 at station 0 heading to 1

# Passenger arrived at time marker 14 at station 5 heading to 6

# Passenger arrived at time marker 14 at station 2 heading to 5

# Passenger arrived at time marker 14 at station 0 heading to 8

# Passenger arrived at time marker 14 at station 0 heading to 4

# Passenger arrived at time marker 14 at station 0 heading to 4

# Passenger arrived at time marker 14 at station 0 heading to 6

# Passenger arrived at time marker 14 at station 0 heading to 2

# Passenger arrived at time marker 14 at station 4 heading to 7

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 4 minutes; currently 6 passengers on board

# Train 2 capacity of 20 arriving at station 2 in 1 minutes; currently 9 passengers on board

# Train 3 capacity of 20 arriving at station 1 in 1 minutes; currently 1 passengers on board

# -----At time marker 14 -> passengers waiting: 37 on trains: 16 active trains: 3-----

# Passenger arrived at time marker 15 at station 0 heading to 1

# Passenger arrived at time marker 15 at station 4 heading to 7

# Passenger arrived at time marker 15 at station 0 heading to 5

# Passenger arrived at time marker 15 at station 0 heading to 9

# Passenger arrived at time marker 15 at station 0 heading to 6

# Passenger arrived at time marker 15 at station 1 heading to 2

# Passenger arrived at time marker 15 at station 1 heading to 2

# Passenger arrived at time marker 15 at station 0 heading to 4

# Passenger arrived at time marker 15 at station 2 heading to 6

# Passenger arrived at time marker 15 at station 1 heading to 2

# New train: Train 4 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 3 minutes; currently 6 passengers on board

# Train 2 is at station 2; unloaded 1; loaded 3 passengers; Space left 9

# Train 2 capacity of 20 arriving at station 3 in 8 minutes; currently 11 passengers on board

# Train 3 is at station 1; unloaded 0; loaded 8 passengers; Space left 11

# Train 3 capacity of 20 arriving at station 2 in 5 minutes; currently 9 passengers on board

# Train 4 is at station 0; unloaded 0; loaded 14 passengers; Space left 6

# Train 4 capacity of 20 arriving at station 1 in 5 minutes; currently 14 passengers on board

# -----At time marker 15 -> passengers waiting: 22 on trains: 40 active trains: 4-----

# Passenger arrived at time marker 16 at station 2 heading to 7

# Passenger arrived at time marker 16 at station 0 heading to 1

# Passenger arrived at time marker 16 at station 2 heading to 3

# Passenger arrived at time marker 16 at station 0 heading to 8

# Passenger arrived at time marker 16 at station 4 heading to 5

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 2 minutes; currently 6 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 7 minutes; currently 11 passengers on board

# Train 3 capacity of 20 arriving at station 2 in 4 minutes; currently 9 passengers on board

# Train 4 capacity of 20 arriving at station 1 in 4 minutes; currently 14 passengers on board

# -----At time marker 16 -> passengers waiting: 27 on trains: 40 active trains: 4-----

# Passenger arrived at time marker 17 at station 2 heading to 9

# Passenger arrived at time marker 17 at station 0 heading to 3

# Passenger arrived at time marker 17 at station 1 heading to 6

# Passenger arrived at time marker 17 at station 3 heading to 8

# Passenger arrived at time marker 17 at station 4 heading to 5

# Passenger arrived at time marker 17 at station 0 heading to 5

# Passenger arrived at time marker 17 at station 3 heading to 8

# Passenger arrived at time marker 17 at station 0 heading to 4

# Passenger arrived at time marker 17 at station 7 heading to 9

# Passenger arrived at time marker 17 at station 1 heading to 3

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 3 in 1 minutes; currently 6 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 6 minutes; currently 11 passengers on board

# Train 3 capacity of 20 arriving at station 2 in 3 minutes; currently 9 passengers on board

# Train 4 capacity of 20 arriving at station 1 in 3 minutes; currently 14 passengers on board

# -----At time marker 17 -> passengers waiting: 37 on trains: 40 active trains: 4-----

# Passenger arrived at time marker 18 at station 0 heading to 8

# Passenger arrived at time marker 18 at station 1 heading to 3

# Passenger arrived at time marker 18 at station 0 heading to 6

# Passenger arrived at time marker 18 at station 0 heading to 5

# Passenger arrived at time marker 18 at station 0 heading to 3

# >> Moving each train <<

# Train 1 is at station 3; unloaded 1; loaded 10 passengers; Space left 5

# Train 1 capacity of 20 arriving at station 4 in 9 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 5 minutes; currently 11 passengers on board

# Train 3 capacity of 20 arriving at station 2 in 2 minutes; currently 9 passengers on board

# Train 4 capacity of 20 arriving at station 1 in 2 minutes; currently 14 passengers on board

# -----At time marker 18 -> passengers waiting: 32 on trains: 49 active trains: 4-----

# Passenger arrived at time marker 19 at station 0 heading to 1

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 8 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 4 minutes; currently 11 passengers on board

# Train 3 capacity of 20 arriving at station 2 in 1 minutes; currently 9 passengers on board

# Train 4 capacity of 20 arriving at station 1 in 1 minutes; currently 14 passengers on board

# -----At time marker 19 -> passengers waiting: 33 on trains: 49 active trains: 4-----

# Passenger arrived at time marker 20 at station 0 heading to 1

# Passenger arrived at time marker 20 at station 0 heading to 1

# Passenger arrived at time marker 20 at station 3 heading to 4

# New train: Train 5 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 7 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 3 minutes; currently 11 passengers on board

# Train 3 is at station 2; unloaded 5; loaded 3 passengers; Space left 13

# Train 3 capacity of 20 arriving at station 3 in 8 minutes; currently 7 passengers on board

# Train 4 is at station 1; unloaded 3; loaded 3 passengers; Space left 6

# Train 4 capacity of 20 arriving at station 2 in 5 minutes; currently 14 passengers on board

# Train 5 is at station 0; unloaded 0; loaded 12 passengers; Space left 8

# Train 5 capacity of 20 arriving at station 1 in 5 minutes; currently 12 passengers on board

# -----At time marker 20 -> passengers waiting: 18 on trains: 59 active trains: 5-----

# Passenger arrived at time marker 21 at station 0 heading to 1

# Passenger arrived at time marker 21 at station 0 heading to 1

# Passenger arrived at time marker 21 at station 1 heading to 5

# Passenger arrived at time marker 21 at station 1 heading to 2

# Passenger arrived at time marker 21 at station 4 heading to 5

# Passenger arrived at time marker 21 at station 0 heading to 3

# Passenger arrived at time marker 21 at station 1 heading to 4

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 6 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 2 minutes; currently 11 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 7 minutes; currently 7 passengers on board

# Train 4 capacity of 20 arriving at station 2 in 4 minutes; currently 14 passengers on board

# Train 5 capacity of 20 arriving at station 1 in 4 minutes; currently 12 passengers on board

# -----At time marker 21 -> passengers waiting: 25 on trains: 59 active trains: 5-----

# Passenger arrived at time marker 22 at station 4 heading to 9

# Passenger arrived at time marker 22 at station 2 heading to 7

# Passenger arrived at time marker 22 at station 0 heading to 2

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 5 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 3 in 1 minutes; currently 11 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 6 minutes; currently 7 passengers on board

# Train 4 capacity of 20 arriving at station 2 in 3 minutes; currently 14 passengers on board

# Train 5 capacity of 20 arriving at station 1 in 3 minutes; currently 12 passengers on board

# -----At time marker 22 -> passengers waiting: 28 on trains: 59 active trains: 5-----

# Passenger arrived at time marker 23 at station 4 heading to 9

# Passenger arrived at time marker 23 at station 0 heading to 1

# Passenger arrived at time marker 23 at station 4 heading to 8

# Passenger arrived at time marker 23 at station 4 heading to 5

# Passenger arrived at time marker 23 at station 2 heading to 3

# Passenger arrived at time marker 23 at station 0 heading to 7

# Passenger arrived at time marker 23 at station 0 heading to 1

# Passenger arrived at time marker 23 at station 0 heading to 7

# Passenger arrived at time marker 23 at station 4 heading to 9

# Passenger arrived at time marker 23 at station 4 heading to 8

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 4 minutes; currently 15 passengers on board

# Train 2 is at station 3; unloaded 4; loaded 1 passengers; Space left 12

# Train 2 capacity of 20 arriving at station 4 in 9 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 5 minutes; currently 7 passengers on board

# Train 4 capacity of 20 arriving at station 2 in 2 minutes; currently 14 passengers on board

# Train 5 capacity of 20 arriving at station 1 in 2 minutes; currently 12 passengers on board

# -----At time marker 23 -> passengers waiting: 37 on trains: 56 active trains: 5-----

# Passenger arrived at time marker 24 at station 0 heading to 1

# Passenger arrived at time marker 24 at station 1 heading to 8

# Passenger arrived at time marker 24 at station 0 heading to 2

# Passenger arrived at time marker 24 at station 0 heading to 9

# Passenger arrived at time marker 24 at station 0 heading to 6

# Passenger arrived at time marker 24 at station 5 heading to 7

# Passenger arrived at time marker 24 at station 0 heading to 9

# Passenger arrived at time marker 24 at station 2 heading to 9

# Passenger arrived at time marker 24 at station 2 heading to 3

# Passenger arrived at time marker 24 at station 0 heading to 4

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 3 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 8 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 4 minutes; currently 7 passengers on board

# Train 4 capacity of 20 arriving at station 2 in 1 minutes; currently 14 passengers on board

# Train 5 capacity of 20 arriving at station 1 in 1 minutes; currently 12 passengers on board

# -----At time marker 24 -> passengers waiting: 47 on trains: 56 active trains: 5-----

# New train: Train 6 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 2 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 7 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 3 minutes; currently 7 passengers on board

# Train 4 is at station 2; unloaded 2; loaded 4 passengers; Space left 4

# Train 4 capacity of 20 arriving at station 3 in 8 minutes; currently 16 passengers on board

# Train 5 is at station 1; unloaded 4; loaded 4 passengers; Space left 8

# Train 5 capacity of 20 arriving at station 2 in 5 minutes; currently 12 passengers on board

# Train 6 is at station 0; unloaded 0; loaded 14 passengers; Space left 6

# Train 6 capacity of 20 arriving at station 1 in 5 minutes; currently 14 passengers on board

# -----At time marker 25 -> passengers waiting: 25 on trains: 72 active trains: 6-----

# Passenger arrived at time marker 26 at station 1 heading to 2

# Passenger arrived at time marker 26 at station 2 heading to 6

# Passenger arrived at time marker 26 at station 5 heading to 8

# Passenger arrived at time marker 26 at station 0 heading to 5

# Passenger arrived at time marker 26 at station 1 heading to 2

# Passenger arrived at time marker 26 at station 1 heading to 2

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 4 in 1 minutes; currently 15 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 6 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 2 minutes; currently 7 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 7 minutes; currently 16 passengers on board

# Train 5 capacity of 20 arriving at station 2 in 4 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 1 in 4 minutes; currently 14 passengers on board

# -----At time marker 26 -> passengers waiting: 31 on trains: 72 active trains: 6-----

# Passenger arrived at time marker 27 at station 1 heading to 4

# Passenger arrived at time marker 27 at station 0 heading to 6

# Passenger arrived at time marker 27 at station 1 heading to 4

# Passenger arrived at time marker 27 at station 1 heading to 4

# >> Moving each train <<

# Train 1 is at station 4; unloaded 5; loaded 10 passengers; Space left 0

# Train 1 capacity of 20 arriving at station 5 in 5 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 5 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 3 in 1 minutes; currently 7 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 6 minutes; currently 16 passengers on board

# Train 5 capacity of 20 arriving at station 2 in 3 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 1 in 3 minutes; currently 14 passengers on board

# -----At time marker 27 -> passengers waiting: 25 on trains: 77 active trains: 6-----

# Passenger arrived at time marker 28 at station 2 heading to 5

# Passenger arrived at time marker 28 at station 5 heading to 7

# Passenger arrived at time marker 28 at station 5 heading to 8

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 5 in 4 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 4 minutes; currently 8 passengers on board

# Train 3 is at station 3; unloaded 1; loaded 0 passengers; Space left 14

# Train 3 capacity of 20 arriving at station 4 in 9 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 5 minutes; currently 16 passengers on board

# Train 5 capacity of 20 arriving at station 2 in 2 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 1 in 2 minutes; currently 14 passengers on board

# -----At time marker 28 -> passengers waiting: 28 on trains: 76 active trains: 6-----

# Passenger arrived at time marker 29 at station 0 heading to 2

# Passenger arrived at time marker 29 at station 0 heading to 1

# Passenger arrived at time marker 29 at station 6 heading to 9

# Passenger arrived at time marker 29 at station 6 heading to 8

# Passenger arrived at time marker 29 at station 3 heading to 5

# Passenger arrived at time marker 29 at station 6 heading to 7

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 5 in 3 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 3 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 8 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 4 minutes; currently 16 passengers on board

# Train 5 capacity of 20 arriving at station 2 in 1 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 1 in 1 minutes; currently 14 passengers on board

# -----At time marker 29 -> passengers waiting: 34 on trains: 76 active trains: 6-----

# Passenger arrived at time marker 30 at station 0 heading to 1

# Passenger arrived at time marker 30 at station 5 heading to 6

# Passenger arrived at time marker 30 at station 1 heading to 2

# Passenger arrived at time marker 30 at station 1 heading to 2

# Passenger arrived at time marker 30 at station 6 heading to 9

# Passenger arrived at time marker 30 at station 1 heading to 4

# Passenger arrived at time marker 30 at station 2 heading to 3

# Passenger arrived at time marker 30 at station 2 heading to 3

# New train: Train 7 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 5 in 2 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 2 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 7 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 3 minutes; currently 16 passengers on board

# Train 5 is at station 2; unloaded 1; loaded 4 passengers; Space left 5

# Train 5 capacity of 20 arriving at station 3 in 8 minutes; currently 15 passengers on board

# Train 6 is at station 1; unloaded 5; loaded 9 passengers; Space left 2

# Train 6 capacity of 20 arriving at station 2 in 5 minutes; currently 18 passengers on board

# Train 7 is at station 0; unloaded 0; loaded 5 passengers; Space left 15

# Train 7 capacity of 20 arriving at station 1 in 5 minutes; currently 5 passengers on board

# -----At time marker 30 -> passengers waiting: 24 on trains: 88 active trains: 7-----

# Passenger arrived at time marker 31 at station 0 heading to 1

# Passenger arrived at time marker 31 at station 6 heading to 9

# Passenger arrived at time marker 31 at station 3 heading to 8

# Passenger arrived at time marker 31 at station 0 heading to 2

# Passenger arrived at time marker 31 at station 3 heading to 5

# Passenger arrived at time marker 31 at station 2 heading to 4

# Passenger arrived at time marker 31 at station 7 heading to 9

# Passenger arrived at time marker 31 at station 1 heading to 5

# Passenger arrived at time marker 31 at station 6 heading to 9

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 5 in 1 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 4 in 1 minutes; currently 8 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 6 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 2 minutes; currently 16 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 7 minutes; currently 15 passengers on board

# Train 6 capacity of 20 arriving at station 2 in 4 minutes; currently 18 passengers on board

# Train 7 capacity of 20 arriving at station 1 in 4 minutes; currently 5 passengers on board

# -----At time marker 31 -> passengers waiting: 33 on trains: 88 active trains: 7-----

# Passenger arrived at time marker 32 at station 5 heading to 9

# Passenger arrived at time marker 32 at station 1 heading to 9

# Passenger arrived at time marker 32 at station 4 heading to 7

# Passenger arrived at time marker 32 at station 2 heading to 3

# Passenger arrived at time marker 32 at station 5 heading to 8

# >> Moving each train <<

# Train 1 is at station 5; unloaded 6; loaded 6 passengers; Space left 0

# Train 1 capacity of 20 arriving at station 6 in 5 minutes; currently 20 passengers on board

# Train 2 is at station 4; unloaded 2; loaded 4 passengers; Space left 10

# Train 2 capacity of 20 arriving at station 5 in 5 minutes; currently 10 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 5 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 3 in 1 minutes; currently 16 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 6 minutes; currently 15 passengers on board

# Train 6 capacity of 20 arriving at station 2 in 3 minutes; currently 18 passengers on board

# Train 7 capacity of 20 arriving at station 1 in 3 minutes; currently 5 passengers on board

# -----At time marker 32 -> passengers waiting: 28 on trains: 90 active trains: 7-----

# Passenger arrived at time marker 33 at station 4 heading to 6

# Passenger arrived at time marker 33 at station 0 heading to 1

# Passenger arrived at time marker 33 at station 4 heading to 6

# Passenger arrived at time marker 33 at station 4 heading to 6

# Passenger arrived at time marker 33 at station 0 heading to 6

# Passenger arrived at time marker 33 at station 0 heading to 1

# Passenger arrived at time marker 33 at station 2 heading to 4

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 6 in 4 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 5 in 4 minutes; currently 10 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 4 minutes; currently 6 passengers on board

# Train 4 is at station 3; unloaded 4; loaded 3 passengers; Space left 5

# Train 4 capacity of 20 arriving at station 4 in 9 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 5 minutes; currently 15 passengers on board

# Train 6 capacity of 20 arriving at station 2 in 2 minutes; currently 18 passengers on board

# Train 7 capacity of 20 arriving at station 1 in 2 minutes; currently 5 passengers on board

# -----At time marker 33 -> passengers waiting: 32 on trains: 89 active trains: 7-----

# Passenger arrived at time marker 34 at station 4 heading to 9

# Passenger arrived at time marker 34 at station 1 heading to 2

# Passenger arrived at time marker 34 at station 6 heading to 7

# Passenger arrived at time marker 34 at station 0 heading to 3

# Passenger arrived at time marker 34 at station 1 heading to 4

# Passenger arrived at time marker 34 at station 0 heading to 2

# Passenger arrived at time marker 34 at station 1 heading to 6

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 6 in 3 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 5 in 3 minutes; currently 10 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 3 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 8 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 4 minutes; currently 15 passengers on board

# Train 6 capacity of 20 arriving at station 2 in 1 minutes; currently 18 passengers on board

# Train 7 capacity of 20 arriving at station 1 in 1 minutes; currently 5 passengers on board

# -----At time marker 34 -> passengers waiting: 39 on trains: 89 active trains: 7-----

# Passenger arrived at time marker 35 at station 6 heading to 9

# Passenger arrived at time marker 35 at station 6 heading to 9

# Passenger arrived at time marker 35 at station 2 heading to 5

# Passenger arrived at time marker 35 at station 1 heading to 3

# Passenger arrived at time marker 35 at station 0 heading to 8

# Passenger arrived at time marker 35 at station 2 heading to 3

# New train: Train 8 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 6 in 2 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 5 in 2 minutes; currently 10 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 2 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 7 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 3 minutes; currently 15 passengers on board

# Train 6 is at station 2; unloaded 7; loaded 5 passengers; Space left 4

# Train 6 capacity of 20 arriving at station 3 in 8 minutes; currently 16 passengers on board

# Train 7 is at station 1; unloaded 2; loaded 6 passengers; Space left 11

# Train 7 capacity of 20 arriving at station 2 in 5 minutes; currently 9 passengers on board

# Train 8 is at station 0; unloaded 0; loaded 8 passengers; Space left 12

# Train 8 capacity of 20 arriving at station 1 in 5 minutes; currently 8 passengers on board

# -----At time marker 35 -> passengers waiting: 26 on trains: 99 active trains: 8-----

# Passenger arrived at time marker 36 at station 4 heading to 7

# Passenger arrived at time marker 36 at station 0 heading to 2

# Passenger arrived at time marker 36 at station 3 heading to 4

# Passenger arrived at time marker 36 at station 0 heading to 1

# Passenger arrived at time marker 36 at station 5 heading to 6

# Passenger arrived at time marker 36 at station 1 heading to 9

# Passenger arrived at time marker 36 at station 0 heading to 2

# Passenger arrived at time marker 36 at station 4 heading to 6

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 6 in 1 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 5 in 1 minutes; currently 10 passengers on board

# Train 3 capacity of 20 arriving at station 4 in 1 minutes; currently 6 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 6 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 2 minutes; currently 15 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 7 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 2 in 4 minutes; currently 9 passengers on board

# Train 8 capacity of 20 arriving at station 1 in 4 minutes; currently 8 passengers on board

# -----At time marker 36 -> passengers waiting: 34 on trains: 99 active trains: 8-----

# Passenger arrived at time marker 37 at station 1 heading to 5

# Passenger arrived at time marker 37 at station 0 heading to 1

# Passenger arrived at time marker 37 at station 4 heading to 5

# Passenger arrived at time marker 37 at station 2 heading to 4

# Passenger arrived at time marker 37 at station 4 heading to 7

# >> Moving each train <<

# Train 1 is at station 6; unloaded 6; loaded 6 passengers; Space left 0

# Train 1 capacity of 20 arriving at station 7 in 9 minutes; currently 20 passengers on board

# Train 2 is at station 5; unloaded 4; loaded 7 passengers; Space left 7

# Train 2 capacity of 20 arriving at station 6 in 5 minutes; currently 13 passengers on board

# Train 3 is at station 4; unloaded 2; loaded 8 passengers; Space left 8

# Train 3 capacity of 20 arriving at station 5 in 5 minutes; currently 12 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 5 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 3 in 1 minutes; currently 15 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 6 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 2 in 3 minutes; currently 9 passengers on board

# Train 8 capacity of 20 arriving at station 1 in 3 minutes; currently 8 passengers on board

# -----At time marker 37 -> passengers waiting: 18 on trains: 108 active trains: 8-----

# Passenger arrived at time marker 38 at station 0 heading to 1

# Passenger arrived at time marker 38 at station 1 heading to 2

# Passenger arrived at time marker 38 at station 5 heading to 6

# Passenger arrived at time marker 38 at station 1 heading to 2

# Passenger arrived at time marker 38 at station 0 heading to 3

# Passenger arrived at time marker 38 at station 2 heading to 9

# Passenger arrived at time marker 38 at station 0 heading to 2

# Passenger arrived at time marker 38 at station 1 heading to 5

# Passenger arrived at time marker 38 at station 1 heading to 2

# Passenger arrived at time marker 38 at station 2 heading to 3

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 8 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 6 in 4 minutes; currently 13 passengers on board

# Train 3 capacity of 20 arriving at station 5 in 4 minutes; currently 12 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 4 minutes; currently 15 passengers on board

# Train 5 is at station 3; unloaded 4; loaded 1 passengers; Space left 8

# Train 5 capacity of 20 arriving at station 4 in 9 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 5 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 2 in 2 minutes; currently 9 passengers on board

# Train 8 capacity of 20 arriving at station 1 in 2 minutes; currently 8 passengers on board

# -----At time marker 38 -> passengers waiting: 27 on trains: 105 active trains: 8-----

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 7 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 6 in 3 minutes; currently 13 passengers on board

# Train 3 capacity of 20 arriving at station 5 in 3 minutes; currently 12 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 3 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 8 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 4 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 2 in 1 minutes; currently 9 passengers on board

# Train 8 capacity of 20 arriving at station 1 in 1 minutes; currently 8 passengers on board

# -----At time marker 39 -> passengers waiting: 27 on trains: 105 active trains: 8-----

# Passenger arrived at time marker 40 at station 3 heading to 8

# Passenger arrived at time marker 40 at station 4 heading to 5

# New train: Train 9 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 6 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 6 in 2 minutes; currently 13 passengers on board

# Train 3 capacity of 20 arriving at station 5 in 2 minutes; currently 12 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 2 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 7 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 3 minutes; currently 16 passengers on board

# Train 7 is at station 2; unloaded 2; loaded 3 passengers; Space left 10

# Train 7 capacity of 20 arriving at station 3 in 8 minutes; currently 10 passengers on board

# Train 8 is at station 1; unloaded 3; loaded 6 passengers; Space left 9

# Train 8 capacity of 20 arriving at station 2 in 5 minutes; currently 11 passengers on board

# Train 9 is at station 0; unloaded 0; loaded 7 passengers; Space left 13

# Train 9 capacity of 20 arriving at station 1 in 5 minutes; currently 7 passengers on board

# -----At time marker 40 -> passengers waiting: 13 on trains: 116 active trains: 9-----

# Passenger arrived at time marker 41 at station 1 heading to 2

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 5 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 6 in 1 minutes; currently 13 passengers on board

# Train 3 capacity of 20 arriving at station 5 in 1 minutes; currently 12 passengers on board

# Train 4 capacity of 20 arriving at station 4 in 1 minutes; currently 15 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 6 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 2 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 7 minutes; currently 10 passengers on board

# Train 8 capacity of 20 arriving at station 2 in 4 minutes; currently 11 passengers on board

# Train 9 capacity of 20 arriving at station 1 in 4 minutes; currently 7 passengers on board

# -----At time marker 41 -> passengers waiting: 14 on trains: 116 active trains: 9-----

# Passenger arrived at time marker 42 at station 1 heading to 7

# Passenger arrived at time marker 42 at station 3 heading to 9

# Passenger arrived at time marker 42 at station 3 heading to 4

# Passenger arrived at time marker 42 at station 5 heading to 8

# Passenger arrived at time marker 42 at station 6 heading to 9

# Passenger arrived at time marker 42 at station 1 heading to 4

# Passenger arrived at time marker 42 at station 8 heading to 9

# Passenger arrived at time marker 42 at station 5 heading to 9

# Passenger arrived at time marker 42 at station 5 heading to 6

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 4 minutes; currently 20 passengers on board

# Train 2 is at station 6; unloaded 4; loaded 7 passengers; Space left 4

# Train 2 capacity of 20 arriving at station 7 in 9 minutes; currently 16 passengers on board

# Train 3 is at station 5; unloaded 1; loaded 4 passengers; Space left 5

# Train 3 capacity of 20 arriving at station 6 in 5 minutes; currently 15 passengers on board

# Train 4 is at station 4; unloaded 4; loaded 1 passengers; Space left 8

# Train 4 capacity of 20 arriving at station 5 in 5 minutes; currently 12 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 5 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 3 in 1 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 6 minutes; currently 10 passengers on board

# Train 8 capacity of 20 arriving at station 2 in 3 minutes; currently 11 passengers on board

# Train 9 capacity of 20 arriving at station 1 in 3 minutes; currently 7 passengers on board

# -----At time marker 42 -> passengers waiting: 11 on trains: 119 active trains: 9-----

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 3 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 8 minutes; currently 16 passengers on board

# Train 3 capacity of 20 arriving at station 6 in 4 minutes; currently 15 passengers on board

# Train 4 capacity of 20 arriving at station 5 in 4 minutes; currently 12 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 4 minutes; currently 12 passengers on board

# Train 6 is at station 3; unloaded 3; loaded 3 passengers; Space left 4

# Train 6 capacity of 20 arriving at station 4 in 9 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 5 minutes; currently 10 passengers on board

# Train 8 capacity of 20 arriving at station 2 in 2 minutes; currently 11 passengers on board

# Train 9 capacity of 20 arriving at station 1 in 2 minutes; currently 7 passengers on board

# -----At time marker 43 -> passengers waiting: 8 on trains: 119 active trains: 9-----

# Passenger arrived at time marker 44 at station 6 heading to 8

# Passenger arrived at time marker 44 at station 2 heading to 6

# Passenger arrived at time marker 44 at station 0 heading to 2

# Passenger arrived at time marker 44 at station 0 heading to 2

# Passenger arrived at time marker 44 at station 0 heading to 2

# Passenger arrived at time marker 44 at station 0 heading to 2

# Passenger arrived at time marker 44 at station 1 heading to 4

# Passenger arrived at time marker 44 at station 7 heading to 8

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 2 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 7 minutes; currently 16 passengers on board

# Train 3 capacity of 20 arriving at station 6 in 3 minutes; currently 15 passengers on board

# Train 4 capacity of 20 arriving at station 5 in 3 minutes; currently 12 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 3 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 4 in 8 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 4 minutes; currently 10 passengers on board

# Train 8 capacity of 20 arriving at station 2 in 1 minutes; currently 11 passengers on board

# Train 9 capacity of 20 arriving at station 1 in 1 minutes; currently 7 passengers on board

# -----At time marker 44 -> passengers waiting: 16 on trains: 119 active trains: 9-----

# Passenger arrived at time marker 45 at station 3 heading to 5

# Passenger arrived at time marker 45 at station 3 heading to 9

# New train: Train 10 capacity of 20 arriving at station 0 in 1 minutes; currently 0 passengers on board

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 7 in 1 minutes; currently 20 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 6 minutes; currently 16 passengers on board

# Train 3 capacity of 20 arriving at station 6 in 2 minutes; currently 15 passengers on board

# Train 4 capacity of 20 arriving at station 5 in 2 minutes; currently 12 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 2 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 4 in 7 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 3 minutes; currently 10 passengers on board

# Train 8 is at station 2; unloaded 5; loaded 1 passengers; Space left 13

# Train 8 capacity of 20 arriving at station 3 in 8 minutes; currently 7 passengers on board

# Train 9 is at station 1; unloaded 3; loaded 4 passengers; Space left 12

# Train 9 capacity of 20 arriving at station 2 in 5 minutes; currently 8 passengers on board

# Train 10 is at station 0; unloaded 0; loaded 4 passengers; Space left 16

# Train 10 capacity of 20 arriving at station 1 in 5 minutes; currently 4 passengers on board

# -----At time marker 45 -> passengers waiting: 9 on trains: 120 active trains: 10-----

# Passenger arrived at time marker 46 at station 2 heading to 9

# Passenger arrived at time marker 46 at station 2 heading to 3

# Passenger arrived at time marker 46 at station 5 heading to 6

# Passenger arrived at time marker 46 at station 3 heading to 5

# Passenger arrived at time marker 46 at station 2 heading to 3

# Passenger arrived at time marker 46 at station 4 heading to 7

# Passenger arrived at time marker 46 at station 0 heading to 1

# Passenger arrived at time marker 46 at station 1 heading to 7

# >> Moving each train <<

# Train 1 is at station 7; unloaded 8; loaded 4 passengers; Space left 4

# Train 1 capacity of 20 arriving at station 8 in 8 minutes; currently 16 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 5 minutes; currently 16 passengers on board

# Train 3 capacity of 20 arriving at station 6 in 1 minutes; currently 15 passengers on board

# Train 4 capacity of 20 arriving at station 5 in 1 minutes; currently 12 passengers on board

# Train 5 capacity of 20 arriving at station 4 in 1 minutes; currently 12 passengers on board

# Train 6 capacity of 20 arriving at station 4 in 6 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 2 minutes; currently 10 passengers on board

# Train 8 capacity of 20 arriving at station 3 in 7 minutes; currently 7 passengers on board

# Train 9 capacity of 20 arriving at station 2 in 4 minutes; currently 8 passengers on board

# Train 10 capacity of 20 arriving at station 1 in 4 minutes; currently 4 passengers on board

# -----At time marker 46 -> passengers waiting: 13 on trains: 116 active trains: 10-----

# Passenger arrived at time marker 47 at station 3 heading to 6

# Passenger arrived at time marker 47 at station 4 heading to 9

# Passenger arrived at time marker 47 at station 0 heading to 1

# Passenger arrived at time marker 47 at station 1 heading to 3

# Passenger arrived at time marker 47 at station 1 heading to 2

# Passenger arrived at time marker 47 at station 1 heading to 2

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 8 in 7 minutes; currently 16 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 4 minutes; currently 16 passengers on board

# Train 3 is at station 6; unloaded 6; loaded 1 passengers; Space left 10

# Train 3 capacity of 20 arriving at station 7 in 9 minutes; currently 10 passengers on board

# Train 4 is at station 5; unloaded 4; loaded 1 passengers; Space left 11

# Train 4 capacity of 20 arriving at station 6 in 5 minutes; currently 9 passengers on board

# Train 5 is at station 4; unloaded 3; loaded 2 passengers; Space left 9

# Train 5 capacity of 20 arriving at station 5 in 5 minutes; currently 11 passengers on board

# Train 6 capacity of 20 arriving at station 4 in 5 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 3 in 1 minutes; currently 10 passengers on board

# Train 8 capacity of 20 arriving at station 3 in 6 minutes; currently 7 passengers on board

# Train 9 capacity of 20 arriving at station 2 in 3 minutes; currently 8 passengers on board

# Train 10 capacity of 20 arriving at station 1 in 3 minutes; currently 4 passengers on board

# -----At time marker 47 -> passengers waiting: 15 on trains: 107 active trains: 10-----

# Passenger arrived at time marker 48 at station 2 heading to 3

# Passenger arrived at time marker 48 at station 6 heading to 7

# Passenger arrived at time marker 48 at station 3 heading to 6

# Passenger arrived at time marker 48 at station 5 heading to 6

# Passenger arrived at time marker 48 at station 0 heading to 1

# Passenger arrived at time marker 48 at station 4 heading to 9

# Passenger arrived at time marker 48 at station 2 heading to 3

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 8 in 6 minutes; currently 16 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 3 minutes; currently 16 passengers on board

# Train 3 capacity of 20 arriving at station 7 in 8 minutes; currently 10 passengers on board

# Train 4 capacity of 20 arriving at station 6 in 4 minutes; currently 9 passengers on board

# Train 5 capacity of 20 arriving at station 5 in 4 minutes; currently 11 passengers on board

# Train 6 capacity of 20 arriving at station 4 in 4 minutes; currently 16 passengers on board

# Train 7 is at station 3; unloaded 2; loaded 5 passengers; Space left 7

# Train 7 capacity of 20 arriving at station 4 in 9 minutes; currently 13 passengers on board

# Train 8 capacity of 20 arriving at station 3 in 5 minutes; currently 7 passengers on board

# Train 9 capacity of 20 arriving at station 2 in 2 minutes; currently 8 passengers on board

# Train 10 capacity of 20 arriving at station 1 in 2 minutes; currently 4 passengers on board

# -----At time marker 48 -> passengers waiting: 17 on trains: 110 active trains: 10-----

# Passenger arrived at time marker 49 at station 0 heading to 8

# Passenger arrived at time marker 49 at station 4 heading to 8

# Passenger arrived at time marker 49 at station 0 heading to 6

# Passenger arrived at time marker 49 at station 3 heading to 4

# Passenger arrived at time marker 49 at station 1 heading to 8

# Passenger arrived at time marker 49 at station 2 heading to 4

# Passenger arrived at time marker 49 at station 6 heading to 8

# Passenger arrived at time marker 49 at station 1 heading to 2

# Passenger arrived at time marker 49 at station 5 heading to 8

# >> Moving each train <<

# Train 1 capacity of 20 arriving at station 8 in 5 minutes; currently 16 passengers on board

# Train 2 capacity of 20 arriving at station 7 in 2 minutes; currently 16 passengers on board

# Train 3 capacity of 20 arriving at station 7 in 7 minutes; currently 10 passengers on board

# Train 4 capacity of 20 arriving at station 6 in 3 minutes; currently 9 passengers on board

# Train 5 capacity of 20 arriving at station 5 in 3 minutes; currently 11 passengers on board

# Train 6 capacity of 20 arriving at station 4 in 3 minutes; currently 16 passengers on board

# Train 7 capacity of 20 arriving at station 4 in 8 minutes; currently 13 passengers on board

# Train 8 capacity of 20 arriving at station 3 in 4 minutes; currently 7 passengers on board

# Train 9 capacity of 20 arriving at station 2 in 1 minutes; currently 8 passengers on board

# Train 10 capacity of 20 arriving at station 1 in 1 minutes; currently 4 passengers on board

# -----At time marker 49 -> passengers waiting: 26 on trains: 110 active trains: 10-----

# \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Final Report \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

# The total number of passengers is 257

# The number of passengers currently on a train 110

# The number of passengers delivered is 121

# The number of passengers waiting is 26

# The average wait time for passengers that have boarded is 4.48

# Process finished with exit code 0Application #4

Using ArrayDeque and PriorityQueue classes from java.util write a program to simulate job scheduling in an operating system.

Jobs are generated at random times.

Each job is given:

* a random priority from 1 to 4, where 1 is the highest priority
* a random amount of time to complete its execution.

Jobs do not begin execution and run to completion, but instead share the processor. The operating system executes a job for a fixed unit of time called a ***time slice***. At the end of the time slice, the current job’s execution is suspended, and the job is placed back on the priority queue, where it waits for its next share of processor time. The job having the highest priority is then removed from the priority queue and executed for the time slice.

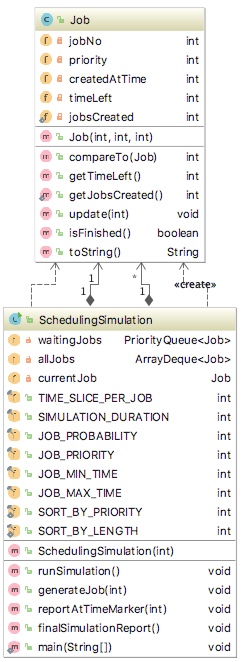
When a job is first generated, it will begin executing immediately if the processor is free. Otherwise it will be placed on the priority queue.

Since the job scheduling can be done not only by the priority but also by some other attributes add ability to run the simulation in two modes:

1. where jobs are ordered by their priority (compareTo)
2. where jobs are ordered by their timeLeft (need to implement Comparator)

SchedulingSimulation constructor would take a parameter which will indicate the priority queue ordering: SORT\_BY\_PRIORITY or SORT\_BY\_LENGTH

#### UML Diagram(\*)

(\*) – please note that :

1. Job class has implementation of compareTo method, so it must be declared as:

public class Job implements Comparable<Job>

1. With compareTo method implemented, we can create PriorityQueue that organizes entries by the natural ordering as follow:

this.waitingJobs = new PriorityQueue<Job>();

1. To create a PriorityQueue that organizes elements NOT by the natural ordering we need to implement compare method that is defined by the Comparator interface. We can create appropriate PriorityQueue utilizing *annonymous inner class* as follow:

this.waitingJobs = new PriorityQueue<Job>**(**new Comparator<Job>()

**{**

public int compare(Job job1, Job job2)

{

return job1.getTimeLeft() - job2.getTimeLeft();

}

**})**;

In the attached sample run the simulation constants were set as follow:

TIME\_SLICE\_PER\_JOB = 3;

SIMULATION\_DURATION = 100;

JOB\_PROBABILITY = 30;

JOB\_PRIORITY = 4;

JOB\_MIN\_TIME = 1;

JOB\_MAX\_TIME = 5;

#### Sample Run #1:

\*\*\*STARTING THE SIMULATION WITH PRIORITY MODE SET TO SORT\_BY\_PRIORITY\*\*\*

Time Marker 0 waiting: 0

executing: NONE

created: Job #1 priority(1) created at 0, time left 4

Time Marker 1 waiting: 0

executing: Job #1 priority(1) created at 0, time left 4

Time Marker 2 waiting: 0

executing: Job #1 priority(1) created at 0, time left 3

created: Job #2 priority(2) created at 2, time left 5

Time Marker 3 waiting: 1

executing: Job #1 priority(1) created at 0, time left 2

Time Marker 4 waiting: 1

executing: Job #1 priority(1) created at 0, time left 1

completed: Job #1 at time 4

Time Marker 5 waiting: 0

executing: Job #2 priority(2) created at 2, time left 5

created: Job #3 priority(3) created at 5, time left 2

Time Marker 6 waiting: 1

executing: Job #2 priority(2) created at 2, time left 4

created: Job #4 priority(3) created at 6, time left 2

Time Marker 7 waiting: 2

executing: Job #2 priority(2) created at 2, time left 3

Time Marker 8 waiting: 2

executing: Job #2 priority(2) created at 2, time left 2

Time Marker 9 waiting: 2

executing: Job #2 priority(2) created at 2, time left 1

completed: Job #2 at time 9

Time Marker 10 waiting: 1

executing: Job #3 priority(3) created at 5, time left 2

created: Job #5 priority(3) created at 10, time left 2

Time Marker 11 waiting: 2

executing: Job #3 priority(3) created at 5, time left 1

created: Job #6 priority(3) created at 11, time left 3

completed: Job #3 at time 11

Time Marker 12 waiting: 2

executing: Job #4 priority(3) created at 6, time left 2

Time Marker 13 waiting: 2

executing: Job #4 priority(3) created at 6, time left 1

completed: Job #4 at time 13

Time Marker 14 waiting: 1

executing: Job #6 priority(3) created at 11, time left 3

Time Marker 15 waiting: 1

executing: Job #6 priority(3) created at 11, time left 2

Time Marker 16 waiting: 1

executing: Job #6 priority(3) created at 11, time left 1

completed: Job #6 at time 16

Time Marker 17 waiting: 0

executing: Job #5 priority(3) created at 10, time left 2

Time Marker 18 waiting: 0

executing: Job #5 priority(3) created at 10, time left 1

completed: Job #5 at time 18

Time Marker 19 waiting: 0

executing: NONE

created: Job #7 priority(1) created at 19, time left 4

Time Marker 20 waiting: 0

executing: Job #7 priority(1) created at 19, time left 4

created: Job #8 priority(3) created at 20, time left 5

Time Marker 21 waiting: 1

executing: Job #7 priority(1) created at 19, time left 3

Time Marker 22 waiting: 1

executing: Job #7 priority(1) created at 19, time left 2

Time Marker 23 waiting: 1

executing: Job #7 priority(1) created at 19, time left 1

completed: Job #7 at time 23

Time Marker 24 waiting: 0

executing: Job #8 priority(3) created at 20, time left 5

created: Job #9 priority(1) created at 24, time left 2

Time Marker 25 waiting: 1

executing: Job #8 priority(3) created at 20, time left 4

Time Marker 26 waiting: 1

executing: Job #8 priority(3) created at 20, time left 3

Time Marker 27 waiting: 1

executing: Job #9 priority(1) created at 24, time left 2

Time Marker 28 waiting: 1

executing: Job #9 priority(1) created at 24, time left 1

completed: Job #9 at time 28

Time Marker 29 waiting: 0

executing: Job #8 priority(3) created at 20, time left 2

Time Marker 30 waiting: 0

executing: Job #8 priority(3) created at 20, time left 1

completed: Job #8 at time 30

Time Marker 31 waiting: 0

executing: NONE

Time Marker 32 waiting: 0

executing: NONE

Time Marker 33 waiting: 0

executing: NONE

Time Marker 34 waiting: 0

executing: NONE

created: Job #10 priority(1) created at 34, time left 3

Time Marker 35 waiting: 0

executing: Job #10 priority(1) created at 34, time left 3

created: Job #11 priority(3) created at 35, time left 2

Time Marker 36 waiting: 1

executing: Job #10 priority(1) created at 34, time left 2

Time Marker 37 waiting: 1

executing: Job #10 priority(1) created at 34, time left 1

created: Job #12 priority(4) created at 37, time left 5

completed: Job #10 at time 37

Time Marker 38 waiting: 1

executing: Job #11 priority(3) created at 35, time left 2

Time Marker 39 waiting: 1

executing: Job #11 priority(3) created at 35, time left 1

completed: Job #11 at time 39

Time Marker 40 waiting: 0

executing: Job #12 priority(4) created at 37, time left 5

Time Marker 41 waiting: 0

executing: Job #12 priority(4) created at 37, time left 4

Time Marker 42 waiting: 0

executing: Job #12 priority(4) created at 37, time left 3

created: Job #13 priority(1) created at 42, time left 3

Time Marker 43 waiting: 1

executing: Job #13 priority(1) created at 42, time left 3

Time Marker 44 waiting: 1

executing: Job #13 priority(1) created at 42, time left 2

Time Marker 45 waiting: 1

executing: Job #13 priority(1) created at 42, time left 1

created: Job #14 priority(1) created at 45, time left 4

completed: Job #13 at time 45

Time Marker 46 waiting: 1

executing: Job #14 priority(1) created at 45, time left 4

created: Job #15 priority(1) created at 46, time left 3

Time Marker 47 waiting: 2

executing: Job #14 priority(1) created at 45, time left 3

Time Marker 48 waiting: 2

executing: Job #14 priority(1) created at 45, time left 2

created: Job #16 priority(2) created at 48, time left 5

Time Marker 49 waiting: 3

executing: Job #15 priority(1) created at 46, time left 3

Time Marker 50 waiting: 3

executing: Job #15 priority(1) created at 46, time left 2

created: Job #17 priority(3) created at 50, time left 2

Time Marker 51 waiting: 4

executing: Job #15 priority(1) created at 46, time left 1

created: Job #18 priority(4) created at 51, time left 5

completed: Job #15 at time 51

Time Marker 52 waiting: 4

executing: Job #14 priority(1) created at 45, time left 1

created: Job #19 priority(1) created at 52, time left 5

completed: Job #14 at time 52

Time Marker 53 waiting: 4

executing: Job #19 priority(1) created at 52, time left 5

created: Job #20 priority(4) created at 53, time left 4

Time Marker 54 waiting: 5

executing: Job #19 priority(1) created at 52, time left 4

Time Marker 55 waiting: 5

executing: Job #19 priority(1) created at 52, time left 3

Time Marker 56 waiting: 5

executing: Job #19 priority(1) created at 52, time left 2

created: Job #21 priority(4) created at 56, time left 2

Time Marker 57 waiting: 6

executing: Job #19 priority(1) created at 52, time left 1

created: Job #22 priority(1) created at 57, time left 4

completed: Job #19 at time 57

Time Marker 58 waiting: 6

executing: Job #22 priority(1) created at 57, time left 4

created: Job #23 priority(3) created at 58, time left 3

Time Marker 59 waiting: 7

executing: Job #22 priority(1) created at 57, time left 3

created: Job #24 priority(2) created at 59, time left 3

Time Marker 60 waiting: 8

executing: Job #22 priority(1) created at 57, time left 2

created: Job #25 priority(3) created at 60, time left 5

Time Marker 61 waiting: 9

executing: Job #22 priority(1) created at 57, time left 1

completed: Job #22 at time 61

Time Marker 62 waiting: 8

executing: Job #16 priority(2) created at 48, time left 5

Time Marker 63 waiting: 8

executing: Job #16 priority(2) created at 48, time left 4

created: Job #26 priority(1) created at 63, time left 3

Time Marker 64 waiting: 9

executing: Job #16 priority(2) created at 48, time left 3

Time Marker 65 waiting: 9

executing: Job #26 priority(1) created at 63, time left 3

created: Job #27 priority(4) created at 65, time left 4

Time Marker 66 waiting: 10

executing: Job #26 priority(1) created at 63, time left 2

Time Marker 67 waiting: 10

executing: Job #26 priority(1) created at 63, time left 1

completed: Job #26 at time 67

Time Marker 68 waiting: 9

executing: Job #24 priority(2) created at 59, time left 3

Time Marker 69 waiting: 9

executing: Job #24 priority(2) created at 59, time left 2

Time Marker 70 waiting: 9

executing: Job #24 priority(2) created at 59, time left 1

completed: Job #24 at time 70

Time Marker 71 waiting: 8

executing: Job #16 priority(2) created at 48, time left 2

created: Job #28 priority(1) created at 71, time left 4

Time Marker 72 waiting: 9

executing: Job #16 priority(2) created at 48, time left 1

completed: Job #16 at time 72

Time Marker 73 waiting: 8

executing: Job #28 priority(1) created at 71, time left 4

Time Marker 74 waiting: 8

executing: Job #28 priority(1) created at 71, time left 3

created: Job #29 priority(3) created at 74, time left 5

Time Marker 75 waiting: 9

executing: Job #28 priority(1) created at 71, time left 2

Time Marker 76 waiting: 9

executing: Job #28 priority(1) created at 71, time left 1

created: Job #30 priority(3) created at 76, time left 4

completed: Job #28 at time 76

Time Marker 77 waiting: 9

executing: Job #25 priority(3) created at 60, time left 5

created: Job #31 priority(4) created at 77, time left 5

Time Marker 78 waiting: 10

executing: Job #25 priority(3) created at 60, time left 4

created: Job #32 priority(1) created at 78, time left 3

Time Marker 79 waiting: 11

executing: Job #25 priority(3) created at 60, time left 3

Time Marker 80 waiting: 11

executing: Job #32 priority(1) created at 78, time left 3

Time Marker 81 waiting: 11

executing: Job #32 priority(1) created at 78, time left 2

created: Job #33 priority(1) created at 81, time left 5

Time Marker 82 waiting: 12

executing: Job #32 priority(1) created at 78, time left 1

completed: Job #32 at time 82

Time Marker 83 waiting: 11

executing: Job #33 priority(1) created at 81, time left 5

Time Marker 84 waiting: 11

executing: Job #33 priority(1) created at 81, time left 4

Time Marker 85 waiting: 11

executing: Job #33 priority(1) created at 81, time left 3

created: Job #34 priority(4) created at 85, time left 3

Time Marker 86 waiting: 12

executing: Job #33 priority(1) created at 81, time left 2

Time Marker 87 waiting: 12

executing: Job #33 priority(1) created at 81, time left 1

completed: Job #33 at time 87

Time Marker 88 waiting: 11

executing: Job #23 priority(3) created at 58, time left 3

Time Marker 89 waiting: 11

executing: Job #23 priority(3) created at 58, time left 2

Time Marker 90 waiting: 11

executing: Job #23 priority(3) created at 58, time left 1

completed: Job #23 at time 90

Time Marker 91 waiting: 10

executing: Job #29 priority(3) created at 74, time left 5

Time Marker 92 waiting: 10

executing: Job #29 priority(3) created at 74, time left 4

created: Job #35 priority(2) created at 92, time left 3

Time Marker 93 waiting: 11

executing: Job #29 priority(3) created at 74, time left 3

Time Marker 94 waiting: 11

executing: Job #35 priority(2) created at 92, time left 3

Time Marker 95 waiting: 11

executing: Job #35 priority(2) created at 92, time left 2

Time Marker 96 waiting: 11

executing: Job #35 priority(2) created at 92, time left 1

completed: Job #35 at time 96

Time Marker 97 waiting: 10

executing: Job #29 priority(3) created at 74, time left 2

created: Job #36 priority(1) created at 97, time left 3

Time Marker 98 waiting: 11

executing: Job #29 priority(3) created at 74, time left 1

completed: Job #29 at time 98

Time Marker 99 waiting: 10

executing: Job #36 priority(1) created at 97, time left 3

created: Job #37 priority(2) created at 99, time left 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Final Report: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Active jobs:

Job #36 priority(1) created at 97, time left 2

Job #37 priority(2) created at 99, time left 4

Job #17 priority(3) created at 50, time left 2

Job #25 priority(3) created at 60, time left 2

Job #30 priority(3) created at 76, time left 4

Job #12 priority(4) created at 37, time left 2

Job #18 priority(4) created at 51, time left 5

Job #31 priority(4) created at 77, time left 5

Job #21 priority(4) created at 56, time left 2

Job #20 priority(4) created at 53, time left 4

Job #27 priority(4) created at 65, time left 4

Job #34 priority(4) created at 85, time left 3

The number of jobs currently executing is 12

The number of completed jobs is 25

The total number of jobs is 37

The average time left for unfinished jobs is 3.42

\*\*\*END OF SIMULATION\*\*\*

**Sample Run #2:**

\*\*\*STARTING THE SIMULATION WITH PRIORITY MODE SET TO SORT\_BY\_LENGTH\*\*\*

Time Marker 0 waiting: 0

executing: NONE

Time Marker 1 waiting: 0

executing: NONE

Time Marker 2 waiting: 0

executing: NONE

Time Marker 3 waiting: 0

executing: NONE

Time Marker 4 waiting: 0

executing: NONE

Time Marker 5 waiting: 0

executing: NONE

Time Marker 6 waiting: 0

executing: NONE

Time Marker 7 waiting: 0

executing: NONE

created: Job #1 priority(4) created at 7, time left 2

Time Marker 8 waiting: 0

executing: Job #1 priority(4) created at 7, time left 2

Time Marker 9 waiting: 0

executing: Job #1 priority(4) created at 7, time left 1

completed: Job #1 at time 9

Time Marker 10 waiting: 0

executing: NONE

created: Job #2 priority(1) created at 10, time left 3

Time Marker 11 waiting: 0

executing: Job #2 priority(1) created at 10, time left 3

Time Marker 12 waiting: 0

executing: Job #2 priority(1) created at 10, time left 2

Time Marker 13 waiting: 0

executing: Job #2 priority(1) created at 10, time left 1

completed: Job #2 at time 13

Time Marker 14 waiting: 0

executing: NONE

Time Marker 15 waiting: 0

executing: NONE

created: Job #3 priority(3) created at 15, time left 5

Time Marker 16 waiting: 0

executing: Job #3 priority(3) created at 15, time left 5

created: Job #4 priority(1) created at 16, time left 4

Time Marker 17 waiting: 1

executing: Job #3 priority(3) created at 15, time left 4

Time Marker 18 waiting: 1

executing: Job #3 priority(3) created at 15, time left 3

created: Job #5 priority(2) created at 18, time left 2

Time Marker 19 waiting: 2

executing: Job #5 priority(2) created at 18, time left 2

created: Job #6 priority(3) created at 19, time left 2

Time Marker 20 waiting: 3

executing: Job #5 priority(2) created at 18, time left 1

completed: Job #5 at time 20

Time Marker 21 waiting: 2

executing: Job #3 priority(3) created at 15, time left 2

Time Marker 22 waiting: 2

executing: Job #3 priority(3) created at 15, time left 1

created: Job #7 priority(1) created at 22, time left 4

completed: Job #3 at time 22

Time Marker 23 waiting: 2

executing: Job #6 priority(3) created at 19, time left 2

created: Job #8 priority(3) created at 23, time left 2

Time Marker 24 waiting: 3

executing: Job #6 priority(3) created at 19, time left 1

completed: Job #6 at time 24

Time Marker 25 waiting: 2

executing: Job #8 priority(3) created at 23, time left 2

Time Marker 26 waiting: 2

executing: Job #8 priority(3) created at 23, time left 1

completed: Job #8 at time 26

Time Marker 27 waiting: 1

executing: Job #7 priority(1) created at 22, time left 4

created: Job #9 priority(3) created at 27, time left 5

Time Marker 28 waiting: 2

executing: Job #7 priority(1) created at 22, time left 3

created: Job #10 priority(1) created at 28, time left 4

Time Marker 29 waiting: 3

executing: Job #7 priority(1) created at 22, time left 2

created: Job #11 priority(1) created at 29, time left 3

Time Marker 30 waiting: 4

executing: Job #7 priority(1) created at 22, time left 1

created: Job #12 priority(2) created at 30, time left 3

completed: Job #7 at time 30

Time Marker 31 waiting: 4

executing: Job #11 priority(1) created at 29, time left 3

Time Marker 32 waiting: 4

executing: Job #11 priority(1) created at 29, time left 2

created: Job #13 priority(2) created at 32, time left 3

Time Marker 33 waiting: 5

executing: Job #11 priority(1) created at 29, time left 1

completed: Job #11 at time 33

Time Marker 34 waiting: 4

executing: Job #12 priority(2) created at 30, time left 3

Time Marker 35 waiting: 4

executing: Job #12 priority(2) created at 30, time left 2

Time Marker 36 waiting: 4

executing: Job #12 priority(2) created at 30, time left 1

completed: Job #12 at time 36

Time Marker 37 waiting: 3

executing: Job #13 priority(2) created at 32, time left 3

Time Marker 38 waiting: 3

executing: Job #13 priority(2) created at 32, time left 2

Time Marker 39 waiting: 3

executing: Job #13 priority(2) created at 32, time left 1

completed: Job #13 at time 39

Time Marker 40 waiting: 2

executing: Job #4 priority(1) created at 16, time left 4

Time Marker 41 waiting: 2

executing: Job #4 priority(1) created at 16, time left 3

created: Job #14 priority(4) created at 41, time left 3

Time Marker 42 waiting: 3

executing: Job #4 priority(1) created at 16, time left 2

Time Marker 43 waiting: 3

executing: Job #4 priority(1) created at 16, time left 1

completed: Job #4 at time 43

Time Marker 44 waiting: 2

executing: Job #14 priority(4) created at 41, time left 3

Time Marker 45 waiting: 2

executing: Job #14 priority(4) created at 41, time left 2

created: Job #15 priority(1) created at 45, time left 2

Time Marker 46 waiting: 3

executing: Job #14 priority(4) created at 41, time left 1

completed: Job #14 at time 46

Time Marker 47 waiting: 2

executing: Job #15 priority(1) created at 45, time left 2

Time Marker 48 waiting: 2

executing: Job #15 priority(1) created at 45, time left 1

completed: Job #15 at time 48

Time Marker 49 waiting: 1

executing: Job #10 priority(1) created at 28, time left 4

Time Marker 50 waiting: 1

executing: Job #10 priority(1) created at 28, time left 3

Time Marker 51 waiting: 1

executing: Job #10 priority(1) created at 28, time left 2

created: Job #16 priority(3) created at 51, time left 3

Time Marker 52 waiting: 2

executing: Job #10 priority(1) created at 28, time left 1

completed: Job #10 at time 52

Time Marker 53 waiting: 1

executing: Job #16 priority(3) created at 51, time left 3

Time Marker 54 waiting: 1

executing: Job #16 priority(3) created at 51, time left 2

created: Job #17 priority(3) created at 54, time left 4

Time Marker 55 waiting: 2

executing: Job #16 priority(3) created at 51, time left 1

created: Job #18 priority(4) created at 55, time left 4

completed: Job #16 at time 55

Time Marker 56 waiting: 2

executing: Job #17 priority(3) created at 54, time left 4

Time Marker 57 waiting: 2

executing: Job #17 priority(3) created at 54, time left 3

Time Marker 58 waiting: 2

executing: Job #17 priority(3) created at 54, time left 2

Time Marker 59 waiting: 2

executing: Job #17 priority(3) created at 54, time left 1

created: Job #19 priority(4) created at 59, time left 2

completed: Job #17 at time 59

Time Marker 60 waiting: 2

executing: Job #19 priority(4) created at 59, time left 2

Time Marker 61 waiting: 2

executing: Job #19 priority(4) created at 59, time left 1

completed: Job #19 at time 61

Time Marker 62 waiting: 1

executing: Job #18 priority(4) created at 55, time left 4

Time Marker 63 waiting: 1

executing: Job #18 priority(4) created at 55, time left 3

Time Marker 64 waiting: 1

executing: Job #18 priority(4) created at 55, time left 2

Time Marker 65 waiting: 1

executing: Job #18 priority(4) created at 55, time left 1

completed: Job #18 at time 65

Time Marker 66 waiting: 0

executing: Job #9 priority(3) created at 27, time left 5

Time Marker 67 waiting: 0

executing: Job #9 priority(3) created at 27, time left 4

Time Marker 68 waiting: 0

executing: Job #9 priority(3) created at 27, time left 3

created: Job #20 priority(2) created at 68, time left 2

Time Marker 69 waiting: 1

executing: Job #20 priority(2) created at 68, time left 2

Time Marker 70 waiting: 1

executing: Job #20 priority(2) created at 68, time left 1

completed: Job #20 at time 70

Time Marker 71 waiting: 0

executing: Job #9 priority(3) created at 27, time left 2

Time Marker 72 waiting: 0

executing: Job #9 priority(3) created at 27, time left 1

completed: Job #9 at time 72

Time Marker 73 waiting: 0

executing: NONE

Time Marker 74 waiting: 0

executing: NONE

Time Marker 75 waiting: 0

executing: NONE

created: Job #21 priority(4) created at 75, time left 3

Time Marker 76 waiting: 0

executing: Job #21 priority(4) created at 75, time left 3

Time Marker 77 waiting: 0

executing: Job #21 priority(4) created at 75, time left 2

Time Marker 78 waiting: 0

executing: Job #21 priority(4) created at 75, time left 1

created: Job #22 priority(4) created at 78, time left 2

completed: Job #21 at time 78

Time Marker 79 waiting: 0

executing: Job #22 priority(4) created at 78, time left 2

created: Job #23 priority(1) created at 79, time left 5

Time Marker 80 waiting: 1

executing: Job #22 priority(4) created at 78, time left 1

completed: Job #22 at time 80

Time Marker 81 waiting: 0

executing: Job #23 priority(1) created at 79, time left 5

Time Marker 82 waiting: 0

executing: Job #23 priority(1) created at 79, time left 4

Time Marker 83 waiting: 0

executing: Job #23 priority(1) created at 79, time left 3

created: Job #24 priority(4) created at 83, time left 3

Time Marker 84 waiting: 1

executing: Job #23 priority(1) created at 79, time left 2

Time Marker 85 waiting: 1

executing: Job #23 priority(1) created at 79, time left 1

completed: Job #23 at time 85

Time Marker 86 waiting: 0

executing: Job #24 priority(4) created at 83, time left 3

created: Job #25 priority(3) created at 86, time left 3

Time Marker 87 waiting: 1

executing: Job #24 priority(4) created at 83, time left 2

Time Marker 88 waiting: 1

executing: Job #24 priority(4) created at 83, time left 1

completed: Job #24 at time 88

Time Marker 89 waiting: 0

executing: Job #25 priority(3) created at 86, time left 3

Time Marker 90 waiting: 0

executing: Job #25 priority(3) created at 86, time left 2

Time Marker 91 waiting: 0

executing: Job #25 priority(3) created at 86, time left 1

created: Job #26 priority(4) created at 91, time left 3

completed: Job #25 at time 91

Time Marker 92 waiting: 0

executing: Job #26 priority(4) created at 91, time left 3

created: Job #27 priority(1) created at 92, time left 5

Time Marker 93 waiting: 1

executing: Job #26 priority(4) created at 91, time left 2

created: Job #28 priority(4) created at 93, time left 4

Time Marker 94 waiting: 2

executing: Job #26 priority(4) created at 91, time left 1

completed: Job #26 at time 94

Time Marker 95 waiting: 1

executing: Job #28 priority(4) created at 93, time left 4

created: Job #29 priority(4) created at 95, time left 4

Time Marker 96 waiting: 2

executing: Job #28 priority(4) created at 93, time left 3

Time Marker 97 waiting: 2

executing: Job #28 priority(4) created at 93, time left 2

created: Job #30 priority(1) created at 97, time left 3

Time Marker 98 waiting: 3

executing: Job #28 priority(4) created at 93, time left 1

completed: Job #28 at time 98

Time Marker 99 waiting: 2

executing: Job #30 priority(1) created at 97, time left 3

created: Job #31 priority(3) created at 99, time left 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Final Report: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Active jobs:

Job #30 priority(1) created at 97, time left 2

Job #29 priority(4) created at 95, time left 4

Job #31 priority(3) created at 99, time left 5

Job #27 priority(1) created at 92, time left 5

The number of jobs currently executing is 4

The number of completed jobs is 27

The total number of jobs is 31

The average time left for unfinished jobs is 4.50

\*\*\*END OF SIMULATION\*\*\*