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Design approach:

First step was creating the inputs into nodes with the appropriate parameters. Some inputs had more parameters than others (EX: C 9 M=45 S=12 Q=1 and A 10 J=1 M=5 S=4 R=3 P=1, the first input has a time quantum or time slice of 1 indicated by the Q, while the second input does not but it does have a priority of 1 and a runtime indicated by the P and R.)

Next step was creating all of the queue for the new nodes that were created(waiting queues, ready queue, wait queue, run queue and submit queue).

Inside of the holding queue 1 we implemented it shortest job first (SJF) through the use of a while loop to go through all the time's of each input to look for the shortest time that matches all of the available requirements before sending it to ready queue

Inside of holding queue 2 we implemented first in first out (FIFO) by using a pointer and temp value to pull the last node in the list and it would then check if it matches all of the available requirements before sending it to the ready queue.

Next was a way to get these nodes to be in an order in which they could be run, and discard any nodes that did not meet the main memory access that was available, (the helper functions addToFront, addToEnd, and remove located in node.cpp)

After one node got finished running a function call would be made to all queues letting them know it was ok to shift every node to the next stage also it would allocate it's memory to a global memory to use when running the next node.(line 21 and 24 of runningQueueMaintenance function inside of runningQuene.cpp)

To deal with our Round Robin approach we use two variables quantum and quantumSlice. Quantum acts as our total quantum given in the configureSystem function; we then increment our quantumSlice until it equals our quantum value. Once this occurs we reset our quantumSlice to 0. We addToEnd first and second transfer then update the system for ready queue and running queue.

After when the program was finished it would print the values below:

Sample Output

Given Input

```
C 1 M=200 S=12 Q=4
A 3 J=1 M=20 S=5 R=10 P=1
A 4 J=2 M=30 S=2 R=12 P=2
A 9 J=3 M=10 S=8 R=4 P=1
Q 10 J=1 D=5
A 13 J=4 M=20 S=4 R=11 P=2
Q 14 J=3 D=2
A 24 J=5 M=20 S=10 R=9 P=1
A 25 J=6 M=20 S=4 R=12 P=2
Q 30 J=4 D=4
Q 31 J=5 D=7
L 32 J=3 D=2
D 9999
```

Output

```
Job 1's request for 5 devices denied.
Job 1 not running on the CPU.

Job 3's request for 2 devices denied.
Job 3 not running on the CPU.

Job 4's request for 4 devices denied.
Job 4 not running on the CPU.

Job 5's request for 7 devices denied.
Job 5 not running on the CPU.

Job 3 couldn't release devices.
Job 3 not running on the CPU.

This is the final system status:
Job number: 1 | Status: Completed at time 29 | Turnaround Time: 25 | Weighted Turnaround Time: 2.50
Job number: 2 | Status: Completed at time 33 | Turnaround Time: 28 | Weighted Turnaround Time: 2.33
```

Job number: 3 | Status: Completed at time 19 | Turnaround Time: 9 | Weighted Turnaround Time: 2.25
Job number: 4 | Status: Completed at time 56 | Turnaround Time: 42 | Weighted Turnaround Time: 3.82
Job number: 5 | Status: Completed at time 57 | Turnaround Time: 32 | Weighted Turnaround Time: 3.56
Job number: 6 | Status: Completed at time 61 | Turnaround Time: 35 | Weighted Turnaround Time: 2.92

This is the Submit Queue contents:
This Queue is empty.

This is the Hold Queue 1 contents:
This Queue is empty.

This is the Hold Queue 2 contents:
This Queue is empty.

This is the Ready Queue contents:
This Queue is empty.

This is Running on the CPU:
No job currently running.

This is the Wait Queue contents:
This Queue is empty.

This is the Complete Queue contents:
Place in queue: 1 | Job number: 3
Place in queue: 2 | Job number: 1
Place in queue: 3 | Job number: 2
Place in queue: 4 | Job number: 4
Place in queue: 5 | Job number: 5
Place in queue: 6 | Job number: 6

Average turnaround time: 28.50
Average weighted turnaround time: 2.90

Modified Input for Testing

C 1 M=200 S=12 Q=4
A 3 J=1 M=20 S=5 R=10 P=1
A 4 J=2 M=30 S=2 R=12 P=2

A 9 J=3 M=10 S=8 R=4 P=1
Q 10 J=1 D=5
D 12
A 13 J=4 M=20 S=4 R=11 P=2
Q 14 J=3 D=2
A 24 J=5 M=20 S=10 R=9 P=1
A 25 J=6 M=20 S=4 R=12 P=2
Q 30 J=4 D=4
D 30
Q 31 J=5 D=7
L 32 J=3 D=2
D 9999

Modified Output for Testing

Job 1's request for 5 devices denied.
Job 1 not running on the CPU.

System status at time 12:
Job number: 1 | Status: Running on the CPU | Time Remaining: 5
Job number: 2 | Status: Ready Queue | Time Remaining: 8
Job number: 3 | Status: Ready Queue | Time Remaining: 4

Submit Queue contents:
This Queue is empty.

Hold Queue 1 contents:
This Queue is empty.

Hold Queue 2 contents:
This Queue is empty.

Ready Queue contents:
Place in queue: 1 | Job number: 3
Place in queue: 2 | Job number: 2

Running on the CPU:
Job Number: 1

Wait Queue contents:
This Queue is empty.

Complete Queue contents:

This Queue is empty.

Job 3's request for 2 devices denied.
Job 3 not running on the CPU.

Job 4's request for 4 devices denied.
Job 4 not running on the CPU.

System status at time 30:
Job number: 1 | Status: Completed at time 29 | Turnaround Time: 25 | Weighted Turnaround Time: 2.50
Job number: 2 | Status: Running on the CPU | Time Remaining: 3
Job number: 3 | Status: Completed at time 19 | Turnaround Time: 9 | Weighted Turnaround Time: 2.25
Job number: 4 | Status: Ready Queue | Time Remaining: 7
Job number: 5 | Status: Ready Queue | Time Remaining: 9
Job number: 6 | Status: Ready Queue | Time Remaining: 12

Submit Queue contents:
This Queue is empty.

Hold Queue 1 contents:
This Queue is empty.

Hold Queue 2 contents:
This Queue is empty.

Ready Queue contents:
Place in queue: 1 | Job number: 5
Place in queue: 2 | Job number: 6
Place in queue: 3 | Job number: 4

Running on the CPU:
Job Number: 2

Wait Queue contents:
This Queue is empty.

Complete Queue contents:
Place in queue: 1 | Job number: 3
Place in queue: 2 | Job number: 1

Job 5's request for 7 devices denied.
Job 5 not running on the CPU.

Job 3 couldn't release devices.
Job 3 not running on the CPU.

This is the final system status:
Job number: 1 | Status: Completed at time 29 | Turnaround Time: 25 | Weighted Turnaround Time: 2.50
Job number: 2 | Status: Completed at time 33 | Turnaround Time: 28 | Weighted Turnaround Time: 2.33
Job number: 3 | Status: Completed at time 19 | Turnaround Time: 9 | Weighted Turnaround Time: 2.25
Job number: 4 | Status: Completed at time 56 | Turnaround Time: 42 | Weighted Turnaround Time: 3.82
Job number: 5 | Status: Completed at time 57 | Turnaround Time: 32 | Weighted Turnaround Time: 3.56
Job number: 6 | Status: Completed at time 61 | Turnaround Time: 35 | Weighted Turnaround Time: 2.92

This is the Submit Queue contents:
This Queue is empty.

This is the Hold Queue 1 contents:
This Queue is empty.

This is the Hold Queue 2 contents:
This Queue is empty.

This is the Ready Queue contents:
This Queue is empty.

This is Running on the CPU:
No job currently running.

This is the Wait Queue contents:
This Queue is empty.

This is the Complete Queue contents:
Place in queue: 1 | Job number: 3
Place in queue: 2 | Job number: 1
Place in queue: 3 | Job number: 2
Place in queue: 4 | Job number: 4
Place in queue: 5 | Job number: 5
Place in queue: 6 | Job number: 6

Average turnaround time: 28.50
Average weighted turnaround time: 2.90