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Computer Systems B

COMS20012

Introduction to Operating Systems and Security

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MLFQ

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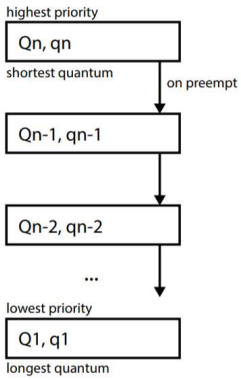
Multi-level Feedback Queue

- Widely used (Windows and Mac use a variant)
  - It was used by Linux in the past too
- **Objective:** good response time for interactive thread, non-interactive thread make as much progress as possible
  - Key idea: interactive threads are frequently blocked, waiting for user inputs, network packets etc.
- **Approach:** give higher priority to interactive thread so they run when they are ready
- **Problem:** how to identify interactive threads?

MLFQ algorithm

- **n round-robin queue** sorted by order of priority
- The higher the priority the shortest the quantum
- Select thread from the highest priority queue
  - Go down if no thread is available
  - Continue until a thread to run is found
- After a thread is preempted it is moved to a lower queue
- When a thread wake-up from waiting on I/O it is put in the highest priority queue
- Interactive threads often “block” waiting on input
  - they will live often in high priority queue
  - non interactive threads naturally fall to the bottom



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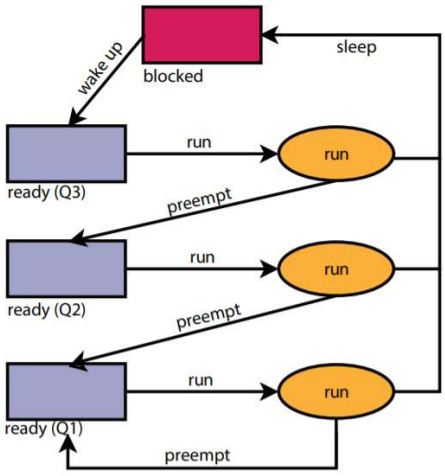
MLFQ example

- Potential starvation problem?



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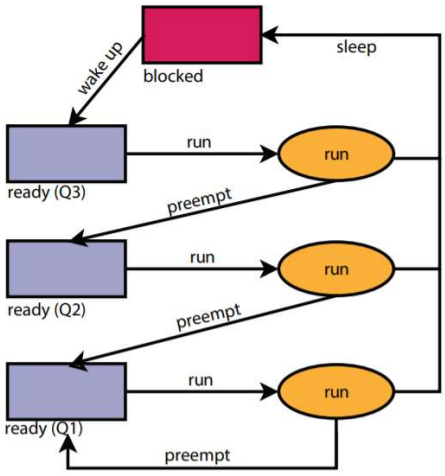
MLFQ example

- Potential starvation problem?
- Threads in Q1 cannot run if threads are continuously added to Q3



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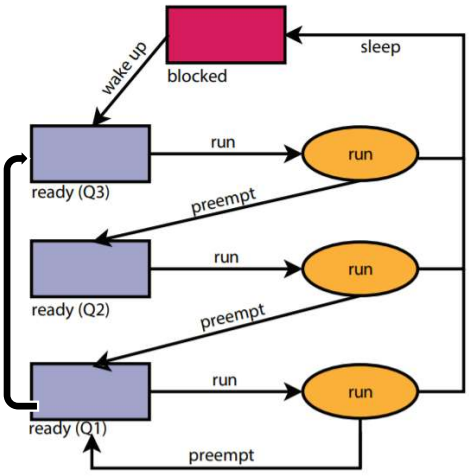
MLFQ example

- Potential starvation problem?
- Threads in Q1 cannot run if threads are continuously added to Q3
- Periodically move thread from Q1 to Q3



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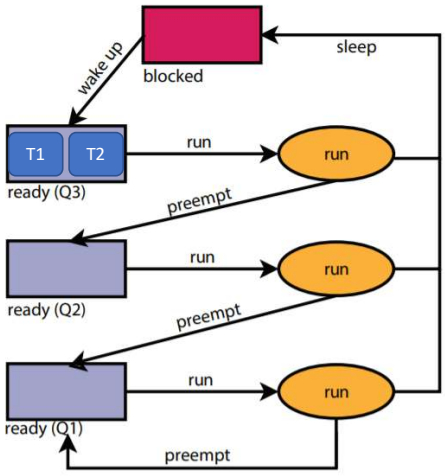
MLFQ example

- T1 and T2 start in Q3



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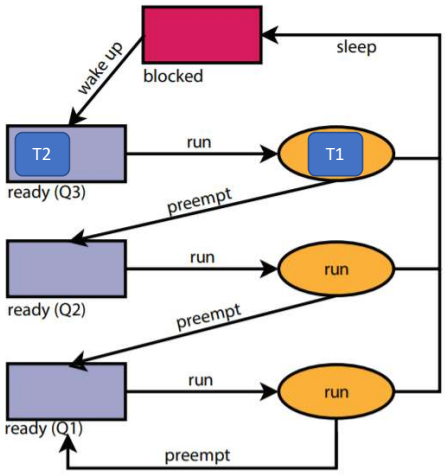
MLFQ example

- T1 is selected to run



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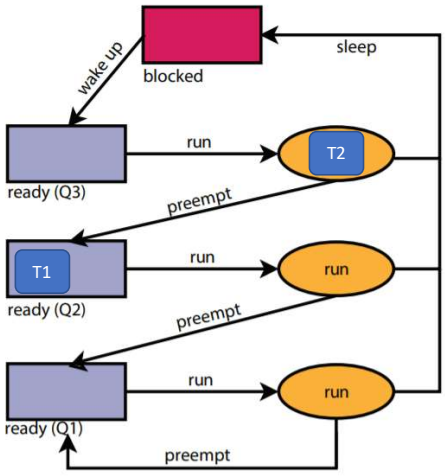
MLFQ example

- T1 is preempted
  - Pushed to Q2
- T2 is selected to run



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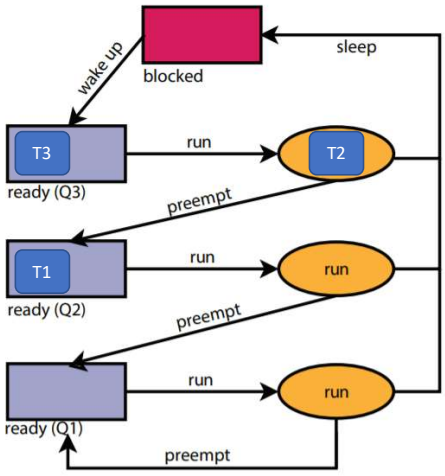
MLFQ example

- A new thread T3 is added



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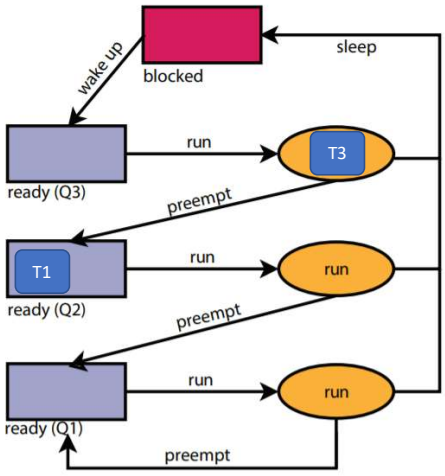
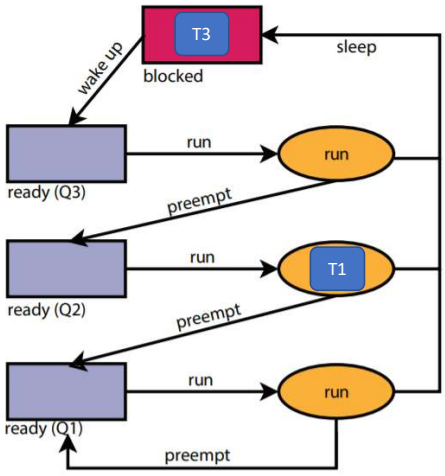
MLFQ example

- T2 terminates
- T3 is selected



MLFQ example

- T3 block
- T1 is selected



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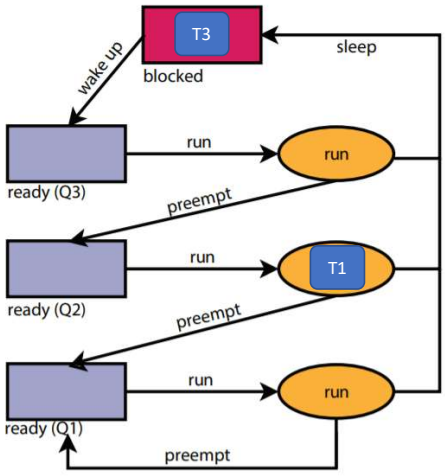
MLFQ example

- T3 is waking up what to do?



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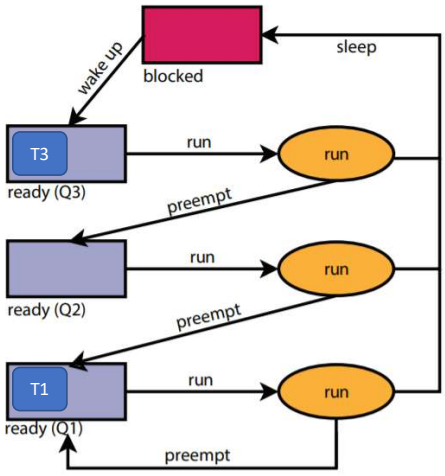
MLFQ example

- T3 is woken up
  - Pushed to Q3
- Many version of MLFQ preempt low priority threads when interactive ones wake up
- T1 is preempted
  - Pushed into Q1



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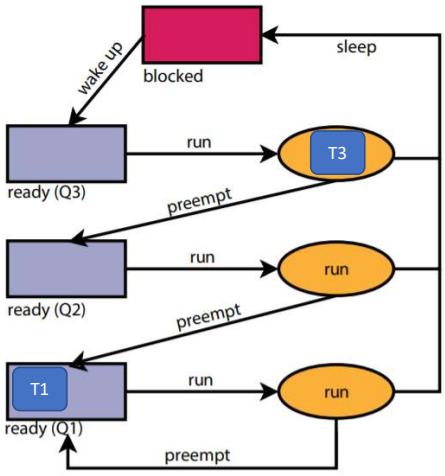
MLFQ example

- T3 is selected to run



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Note

- You've seen the building blocks for this in OS161 in previous videos
  - Preemption logic
  - Queues
  - How to set quantum
  - etc.
- You could relatively easily implement this if you wanted to

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Thank you

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