NPTEL MOOC, JAN-FEB 2015 Week 5, Module 3

# DESIGNAND ANALYSIS OF ALGORITHMS

**Priority queues** 

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#### Job scheduler

- \* A job scheduler maintains a list of pending jobs with their priorities.
- \* When the processor is free, the scheduler picks out the job with maximum priority in the list and schedules it.
- \* New jobs may join the list at any time.
- \* How should the scheduler maintain the list of pending jobs and their priorities?

# Priority queue

- \* Need to maintain a list of jobs with priorities to optimise the following operations
  - \* delete\_max()
    - \* Identify and remove job with highest priority
    - \* Need not be unique
  - \* insert()
    - \* Add a new job to the list

#### Linear structures

- \* Unsorted list
  - \* insert() takes O(1) time
  - \* delete\_max() takes O(n) time
- \* Sorted list
  - # delete\_max() takes O(1) time
  - \* insert() takes O(n) time
- \* Processing a sequence of n jobs requires O(n²) time

#### Two dimensional structures

First attempt

- \* Assume N processes enter/ leave the scheduler
- ★ Keep an √N x √N array
- \* Each row is maintained in sorted order

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#### Insert 11

\* Insert into first row that has free space

\* Maintain size of each row

\* Takes time O(√N)

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- \* Maximum in each row is the last element
- \* Maximum among these is to be deleted
- \* Again O(√N)

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#### Two dimensional structures

#### Summary

- \* insert() takes O(√N)
- \* delete\_max() takes O(√N)
- \* Processing N jobs takes O(N√N)

Can we do better?

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#### Trees

- \* Maintain a special kind of binary tree called a heap
  - \* Balanced: N node tree has height log N
- \* Both insert() and delete\_max() take O(log N)
  - \* Processing N jobs takes time O(N log N)
- \* Truly flexible, need not fix upper bound for N in advance