Department of Computer Science
UNIVERSITY OF COLORADO BOULDER

Design and Analysis of Operating Systems CSCI 3753

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These slides adapted from materials provided by the textbook authors.


COLORADO

Completely Fair Scheduler (CFS)

Completely Fair Scheduler (CFS) in Linux

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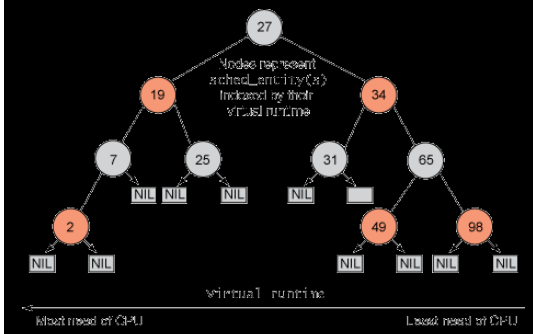

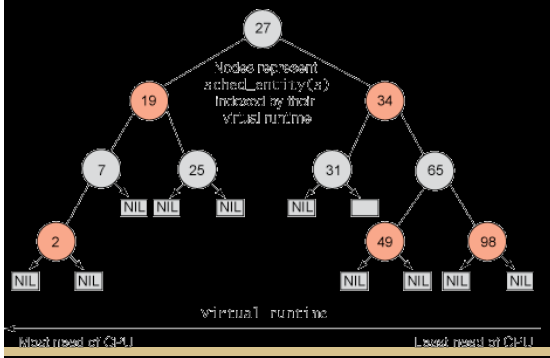

CFS' Red Black Tree

- As tasks run more, their virtual run time increases

  which causes them to migrate right in the tree

- Entries must be removed and re-inserted into the tree, but the RB tree is self-balancing

- Inserting nodes is O(logN)
  - This is viewed as acceptable overhead

- Tasks that haven't had CPU execution in a while will migrate left and eventually get service

- Eventual migration leftwards makes CFS fair

CFS Scheduler and Priorities

- All non-Real Time tasks of differing priorities are combined into one RB tree
- don't need 40 separate run queues, one for each priority - elegant!
- Higher priority tasks get larger run time slices each task has a weight that is a function of the task's niceness priority
- lower niceness => higher the priority => more run time is given on the CPU

CFS Scheduler and Priorities

- Higher priority tasks are scheduled more often

  virtual runtime += (actual CPU runtime) * NICE_0 / task's weight

- Higher priority
  - higher weight
  - less increment of vruntime
  - task is further left on the RB tree and is scheduled sooner

CFS Scheduler and Priorities

- While CFS is fair to tasks, it is not necessarily fair to applications
  - Suppose application A1 has 99 threads
    Suppose application A2 is interactive, 1 thread
  - CFS would give
    - A1 99/100 of CPU
    - A2 only 1/100 of the CPU
- Linux CFS supports fairness across groups:
  - A1 is in group 1 and A2 is in group 2
  - Groups 1 and 2 each get 50% of CPU – fair!
  - Within Group 1, 99 threads share 50% of CPU
- Multi-threaded apps don't overwhelm single thread apps

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