05.05.2025 Week 11 exercises: Scheduling in the Cloud

Solutions will be released on 08.05.2025 (Thursday) and discussed on 12.05.2025 (following Monday).

Scheduling

Exercise 1:

Suppose we have n jobs that appear in some specific order on a single machine. Each job takes t_i to complete its execution, with $i = 1 \ldots n$. The metric that we want to minimize is the sum of all the completion times of the jobs. For instance, if we have two jobs that take $t_1 = 100$ and $t_2 = 50$ and are executed in this order, our metric gives $100 + 150 = 250$.
What is the most efficient way to schedule the jobs in order to minimize such a metric?

Exercise 2:

Now we want to create a schedule for a classroom, given that we have n courses. Every course c_i has a starting time s_i and an ending time e_i.
Describe a strategy to select which courses will take place in this classroom given that they do not overlap and that you maximize the number of courses that will take place in this room.

Resource allocation

Exercise 3:

Compute the max–min fair allocation for a set of four users with demands 4, 5.2, 8, 10 of a shared resource with a capacity of 20.

Exercise 4:

Compute the max–min allocation for a set of four users with demands 12, 6, 30, 12 and weights 2.5, 4, 0.5, 1 of a shared resource with a capacity of 48.

Exam question: Spring 2022

Exercise 5 ([10 points] Multi–resource scheduling):

Calculate the number of tasks of Job A and Job B that can be scheduled on a cluster under the Dominant Resource Fairness (DRF) strategy. The cluster has a total of 20 GiB of RAM, 50 Gbps of network bandwidth and 18 CPU units to allocate. The tasks of Job A are network–intensive and require (2 GiB RAM, 10 Gbps network, 2 CPU units) while the tasks of Job B are memory–intensive and require (4 GiB RAM, 5 Gbps network, 1 CPU unit) per task.

(1) [6 points] Total tasks allocated:

Job A	Job B

(2) [2 points] Total resource usage in percentage after allocation:

RAM	Network	CPU

(3) [2 points] Is some resource still significantly available after the allocation? Briefly explain why this matches the goal of DRF strategy.