# Advanced Algorithm
# Assignment 2
# Load Balancing Problem

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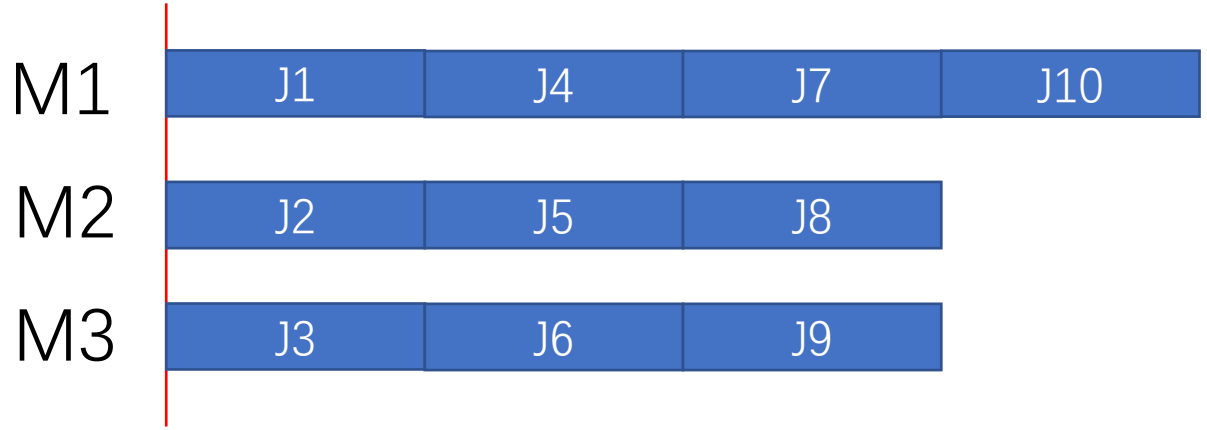
# context

- **Exercise 1**
- **Exercise 2**
- **Exercise 3**

# Exercise 1

We assume that there are three machines and ten tasks and each task's process time is 4.




T1 = 16

T2 = 12

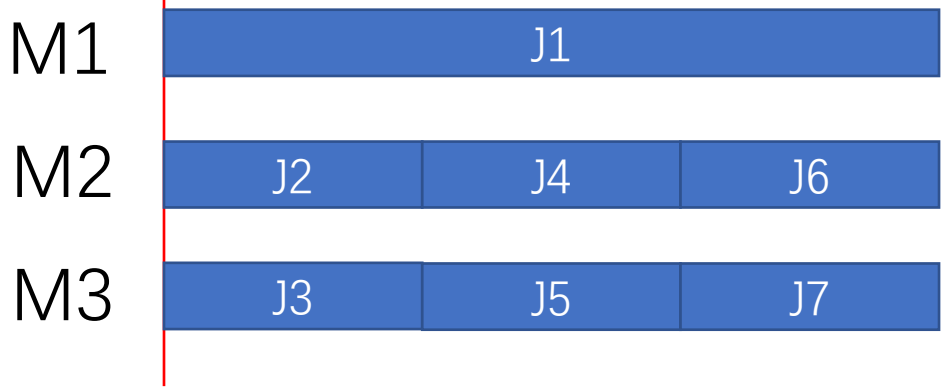
T3 = 12

$T^*$ is always the same as the T1.

# Exercise 2

We assume that there are three machines and seven task with each processing time(2,2,2,2,2,2,6).

In the optimal case, the order of jobs is (6,2,2,2,2,2,2), and the tasks distribution is as follows:




T1 = 6

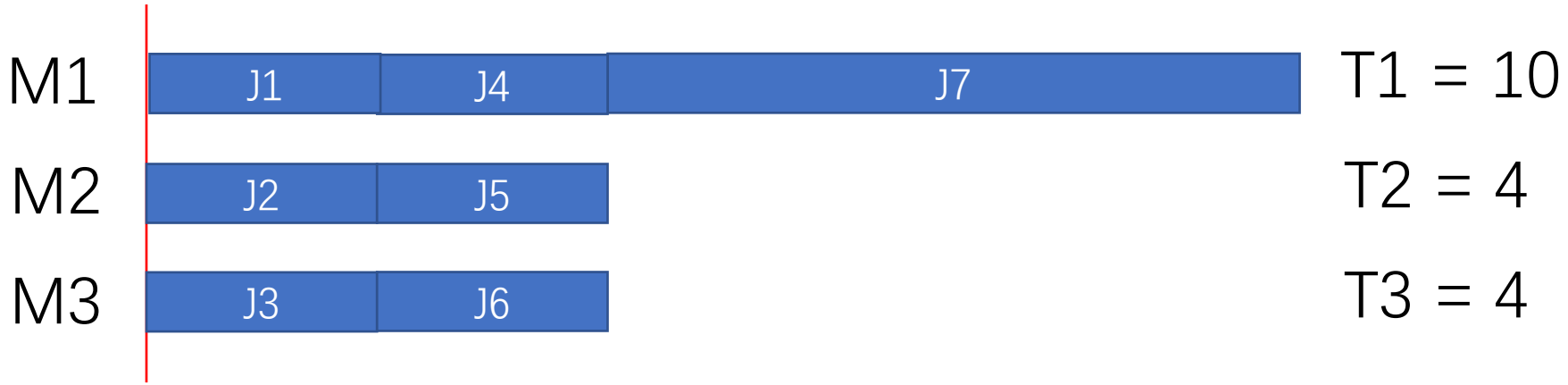
T2 = 6

T3 = 6

$T^* = 6$

# Exercise 2

In normal conditions, such as the order is (2,2,2,2,2,2,6), the tasks distribution will be as follows:




$T_{max} = 10$ $\frac{T_{max}}{2T^*} = 0.833$

# Exercise 2

Actually we can assume that we have m machines and $m(m-1)+1$ jobs, and only one of the jobs($j_{m(m-1)+1}$) consumes m times as long as the rest.

In the optimal condition,one machine only deal with the $j_{m(m-1)+1}$, we have $T^* = m$.

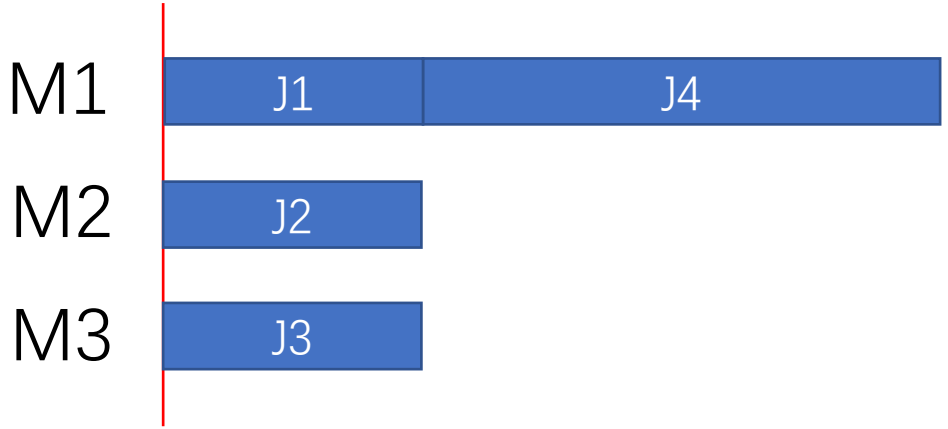
While in the worst case, every machine first deal with (m-1) jobs,and one of them deal with the $j_{m(m-1)+1}$,$T_{\max} = (m-1) + m = 2m-1$

$$\lim_{m\to\infty} \frac{T_{\max}}{2T^*} = \lim_{m\to\infty} \frac{2m-1}{2m} = 1$$

# Exercise 3

Assume that we have three machines and 4 jobs with processing time(8,2,2,2).

In the worst order(2,2,2,8), the machine execution process is as follows:




T1 = 6

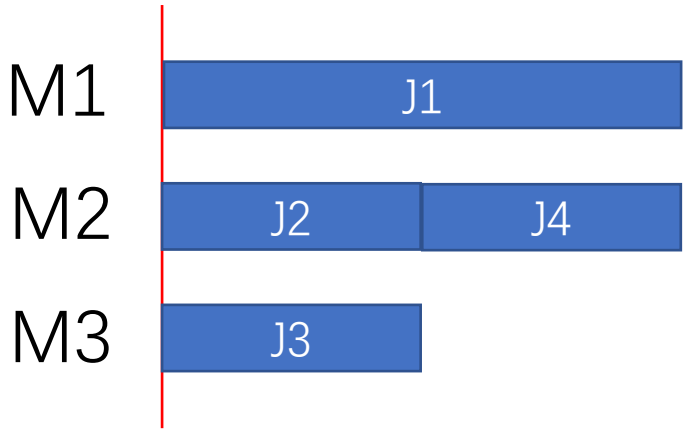
T2 = 2

T3 = 2

$T_{max} = 6$

# Exercise 3

While in general case, like (4,2,2,2), we can obtain the $T = T^* = 4$.




T1 = 4

T2 = 2

T3 = 2

$$T_{max} = 10$$

$$\frac{T_{\max}}{T^*} = \frac{6}{4} = 1.5$$

In this case, one particular order consumes 1.5 times than general case/

# Thank you