MINIMIZING TOTAL TARDINESS

OF ‘N’ JOBS ON A SINGLE MACHINE WITH RELEASE TIME AND DEADLINE

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Considering a set of ‘n’ jobs with

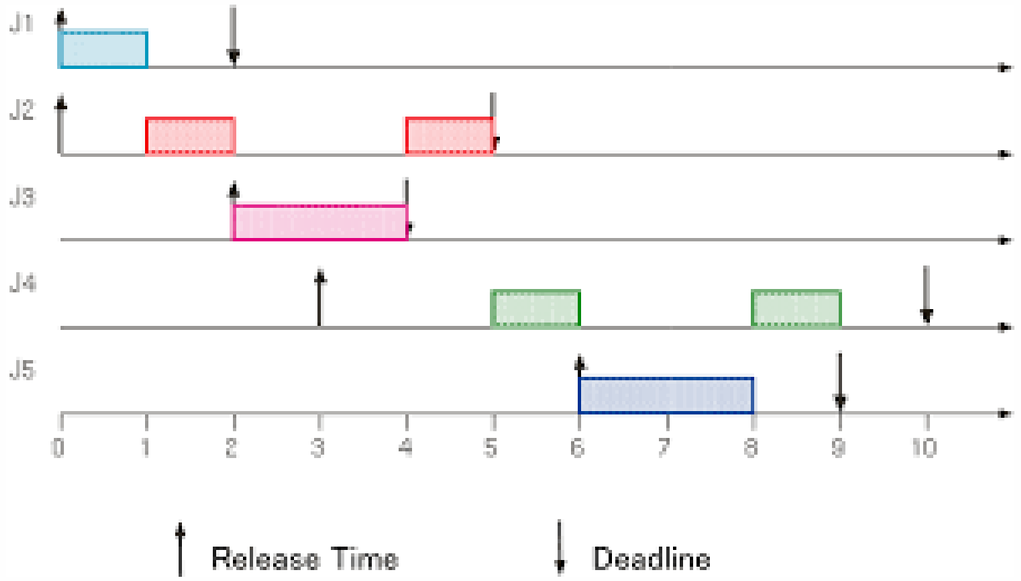
- **Processing Time (p_i)**:
  p_i represents the time required to process job

- **Release Times (r_i)**:
  r_i is the earliest time at which job ‘i’ can start processing

- **Deadlines (d_i)**:
  d_i is the latest time by which job i should be completed

Objective

The goal is to schedule these jobs on a single machine in a way that **minimizes** the total tardiness/penalty, where the penalty is incurred for each job that is completed after its deadline.



Objective

- Let C_i be the completion time after each job i and T_i be the tardiness of each job i given by $T_i = \max(0, C_i - d_i)$
- The Total Penalty is given by-

$$\sum_{i=1}^{n} T_i$$

- So our objective is to

$$\text{Minimize} \quad \sum_{i=1}^{n} T_i$$

Palmer's Heuristic

- Calculate a **Priority Index (P_i)** for each job:

$$P_i = \frac{(\text{Deadline - Release Time})}{(\text{Processing Time})}$$

- **Sort** the jobs based on their Priority Index in descending order.
- Initialize the schedule with first job in sorted order at its release time
- For each remaining job
  - if $C < r_i$, Schedule job at r_i
  - else Schedule job at C

Calculating Total Tardiness

- For each scheduled job compute completion time & tardiness.

  $Tardiness(T_i) = max(0, Completion\_Time(C_i) - Deadline(d_i))$

- Repeat until all jobs are scheduled.

Example

Jobs	r_i	p_i	d_i
A	0	3	10
B	2	2	8
C	1	4	12
D	3	1	6
E	0	5	15

Calculating Priority Indexes-

- PI(A) = (10 - 0) / 3 = **3.33**
- PI(B) = (8 - 2) / 2 = **3**
- PI(C) = (12 - 1) / 4 = **2.75**
- PI(D) = (6 - 3) / 1 = **3**
- PI(E) = (15 - 0) / 5 = **3**

Final Schedule : A -> B -> D -> E -> C

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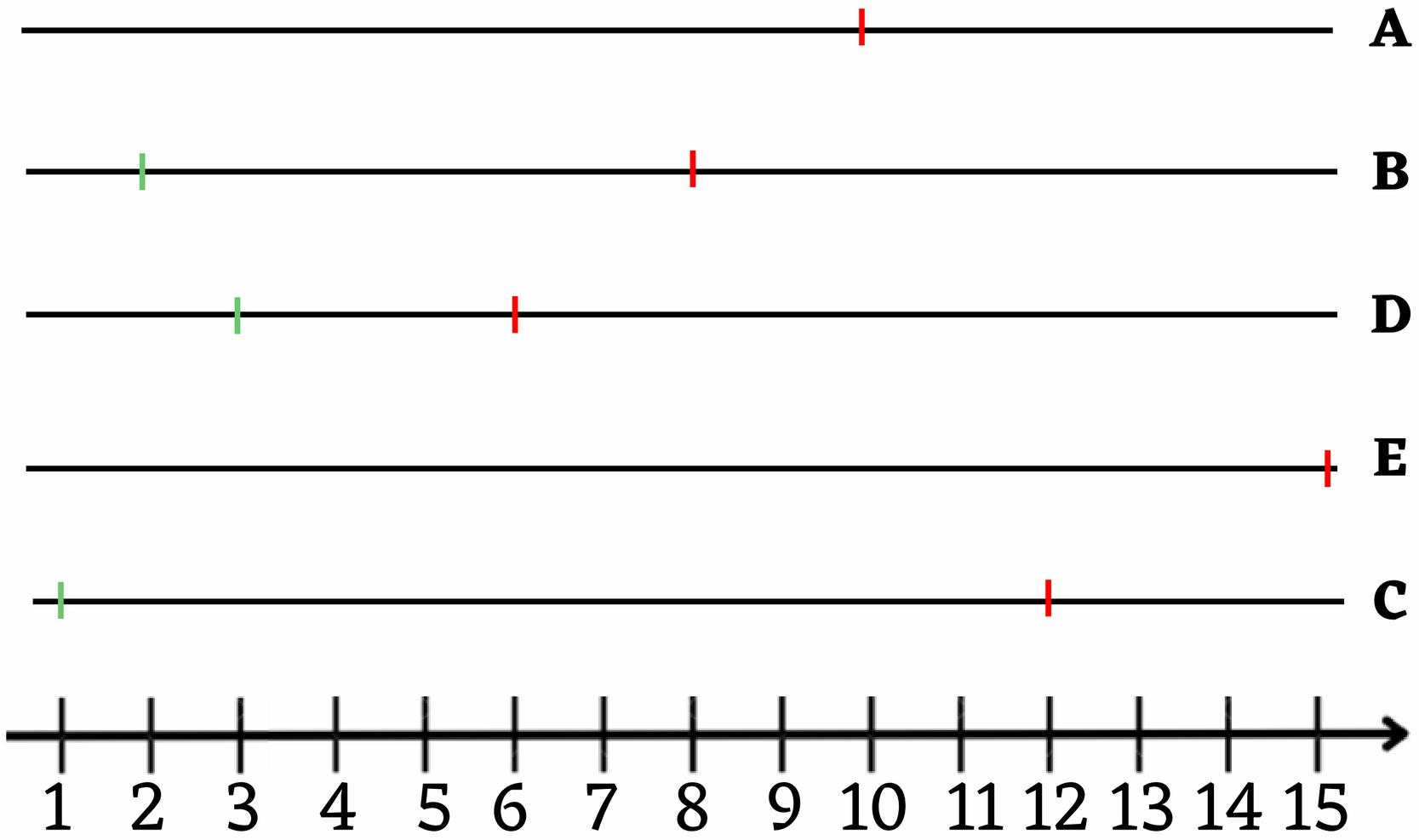

Calculating Total Tardiness

- Tardiness(A) = max(0,) =
- Tardiness(B) = max(0,) =
- Tardiness(D) = max(0,) =
- Tardiness(E) = max(0,) =
- Tardiness(C) = max(0,) =

Total Tardiness = + + + + =

Time Complexity

- Calculating PI (Priority Index)
- Sorting Jobs
- Selecting each job

Total Complexity =

THANK YOU

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