Exact Schedulability Test

Tarek Abdelzaher

The 4th Credit Project (Suggested: 1-2 persons per project)

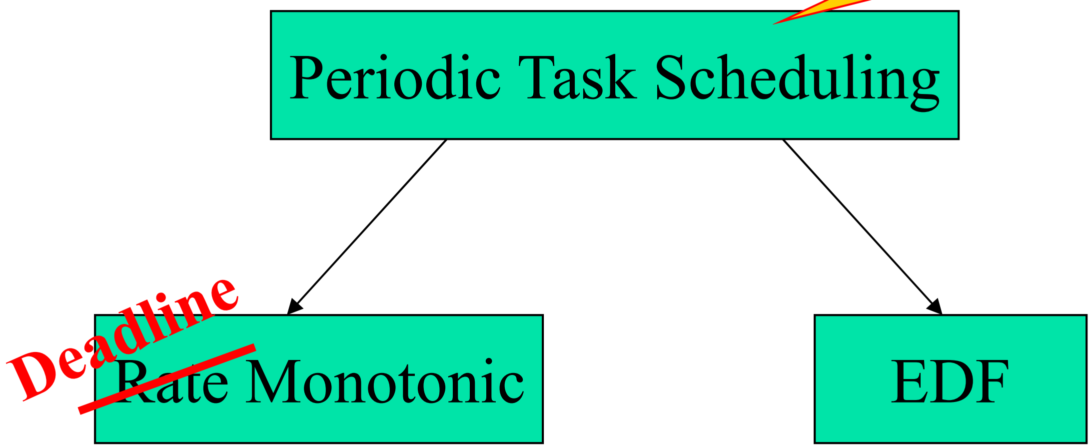
- Option 1: Develop a 30 min survey presentation on an advanced topic of your choice in real-time and embedded computing.
  - Topic name due 10/17.
  - Slides due 11/17.
  - Presentation the week of 12/2
- Example topics:
  - Self-driving cars: the state of the art and future challenges
  - Real-time AI
  - Multicore scheduling – main challenges and results
  - Embedded system security
  - Scheduling Map/Reduce workflows (with emphasis on time support)
  - Participatory and social sensing (crowd-sensing)
  - Software model checking (proving software correctness)
  - IoT market

The 4th Credit Project (Suggested: 1-2 persons per project)

- Option 2: Implement a real-time or embedded systems service
  - Service name due 10/17.
  - Slides due 11/17.
  - Presentation + Demo the week of 12/2
- Example services:
  - A real-time scheduler for "Intelligence as a Service"
  - Security and diagnostics
  - Disaster response services
  - Social sensing services
  - Your idea here…

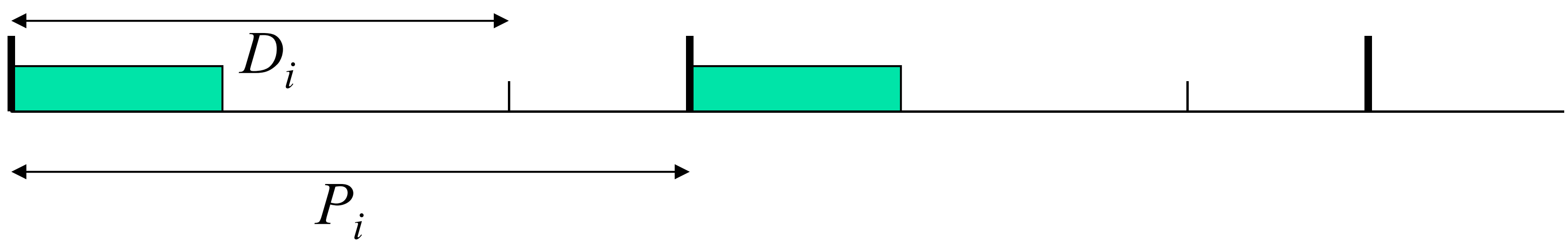
Scheduling Taxo

With
Deadline **<** Period



Deadline Monotonic Scheduling

- Consider a set of periodic tasks where each task, i, has a computation time, C_i, a period, P_i, and a relative deadline $D_i < P_i$.



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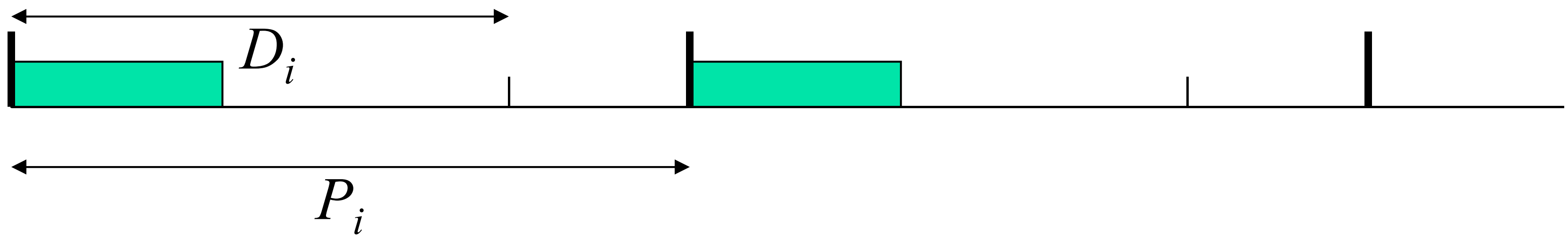

- What is the schedulability condition?

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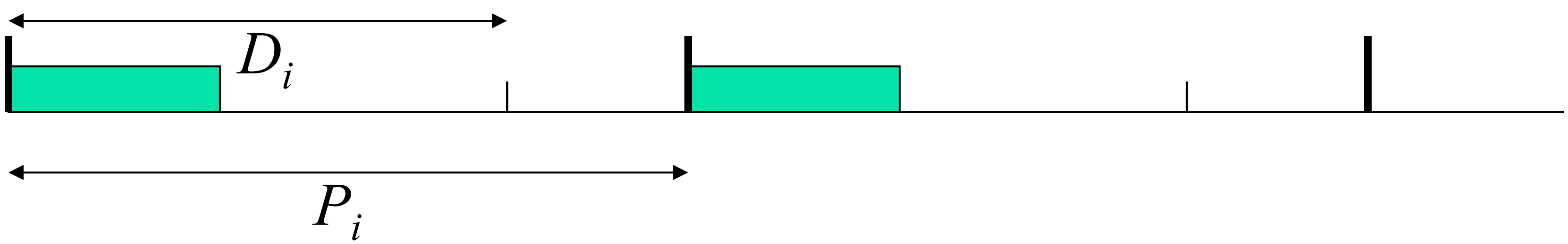

- Schedulability can't be worse than if P_i was reduced to D_i. Thus:

$$\sum_i \frac{C_i}{D_i} \leq n\left(2^{1/n} - 1\right)$$

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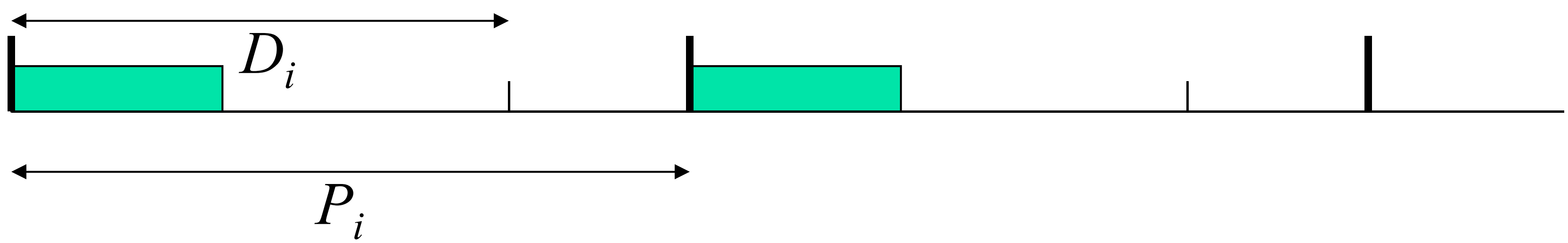

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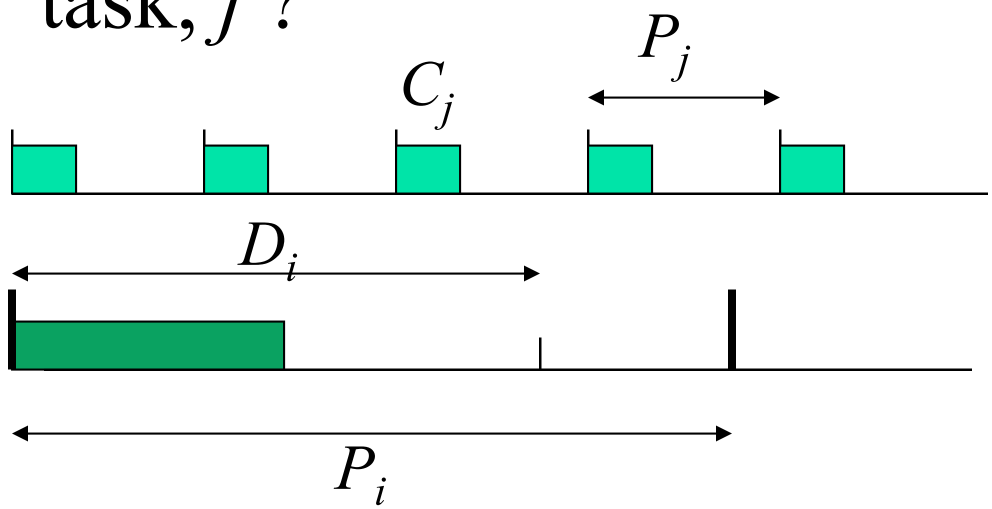
Problem?

A Better Condition

- Worst case interference from a higher priority task, j ?



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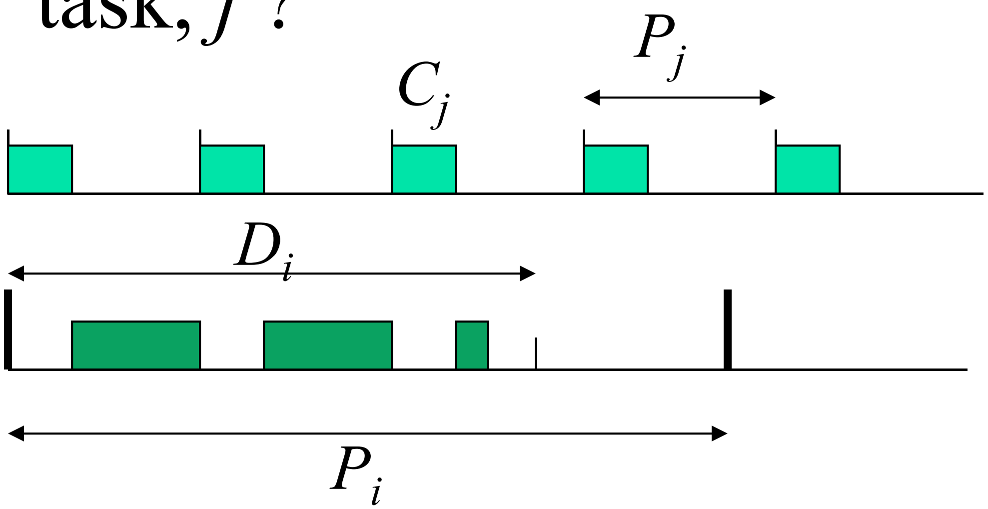

$$\left\lceil \frac{D_i}{P_j} \right\rceil C_j$$

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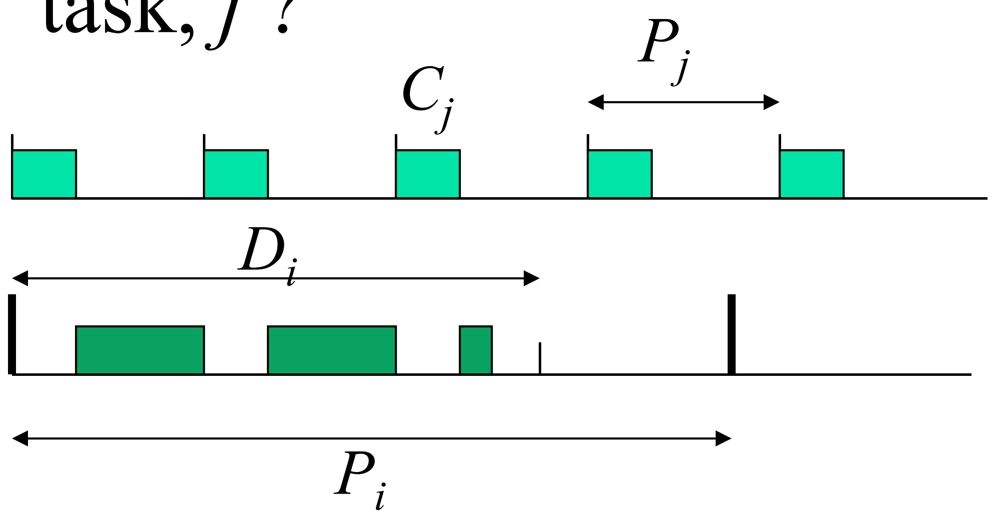

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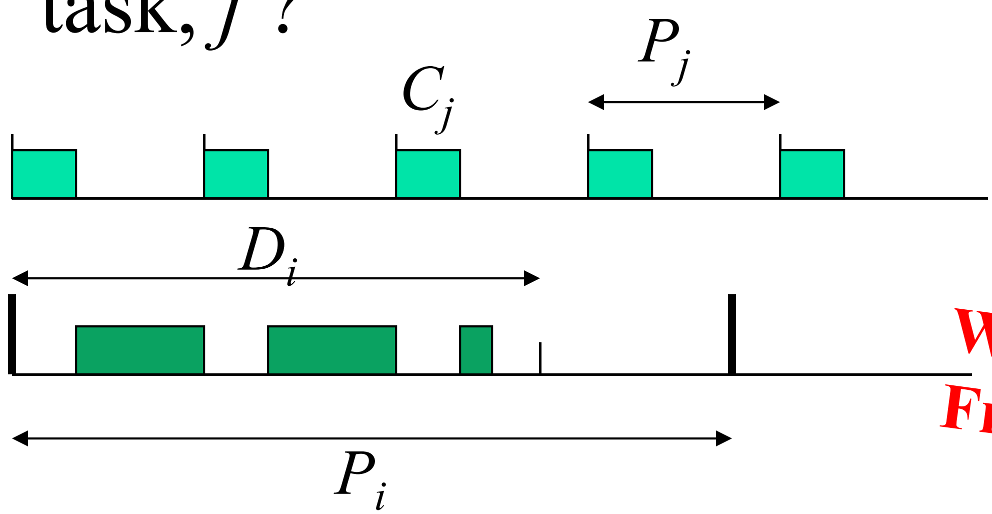

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Worst case interference, *I*,
From higher priority tasks

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My exec. time

My deadline

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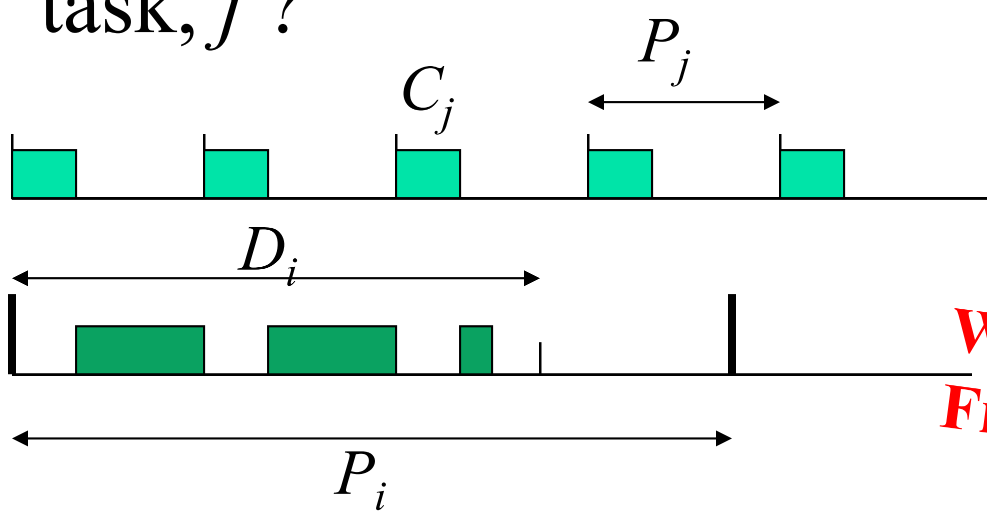

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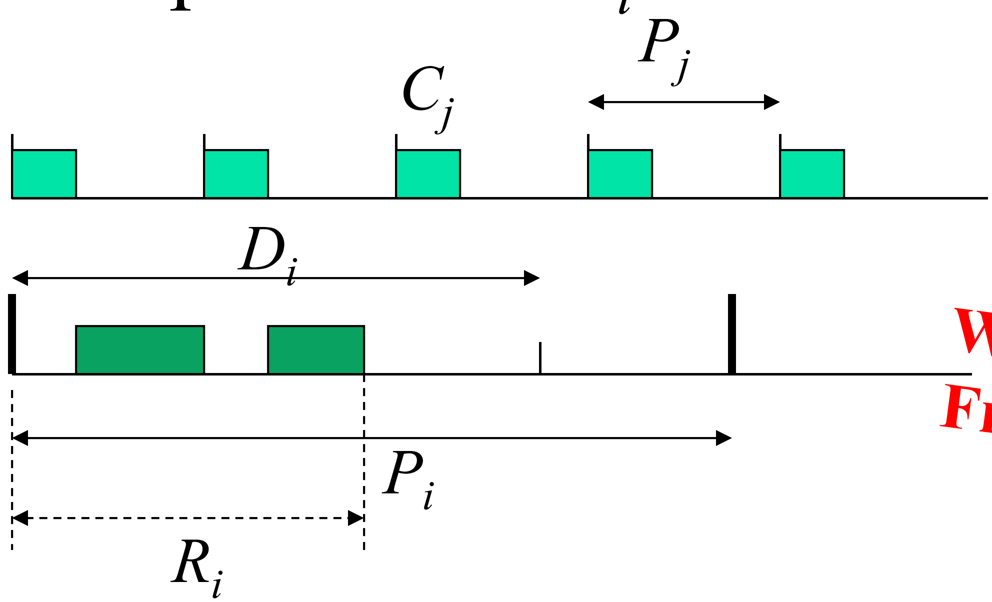
An Exact Condition

- Note: Interference exists only during the response time R_i not the entire D_i



$$I = \sum_j \left\lceil \frac{\cancel{D_i}\ R_i}{P_j} \right\rceil C_j$$

Worst case interference, *I*, From higher priority tasks

An Exact Condition

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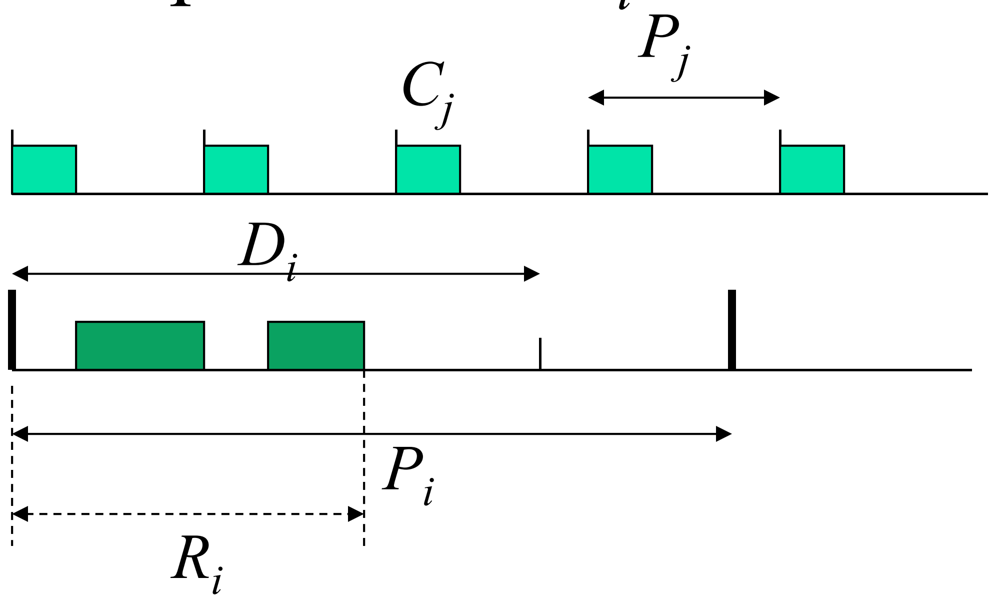

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$$R_i = I + C_i$$

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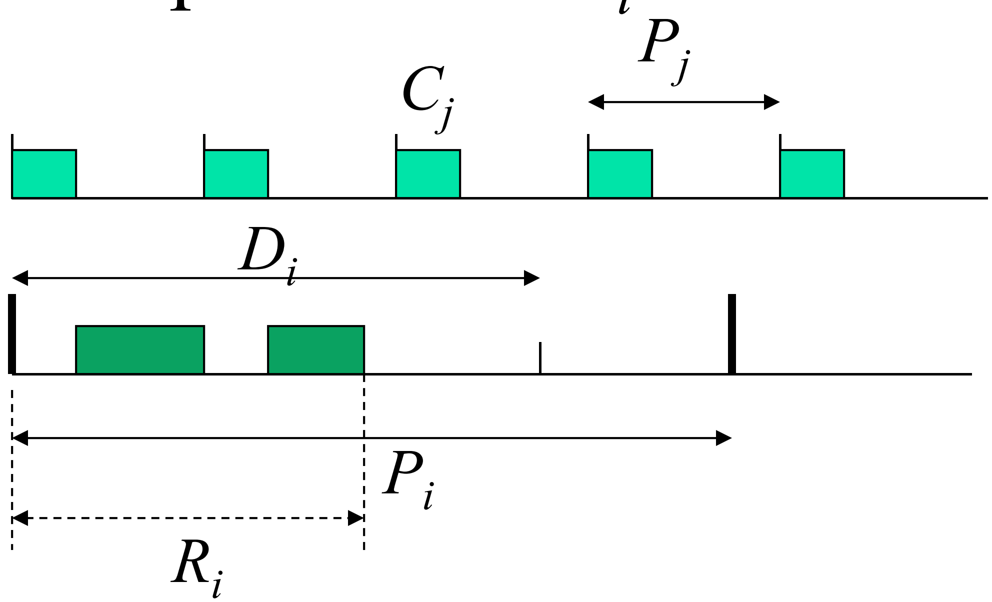

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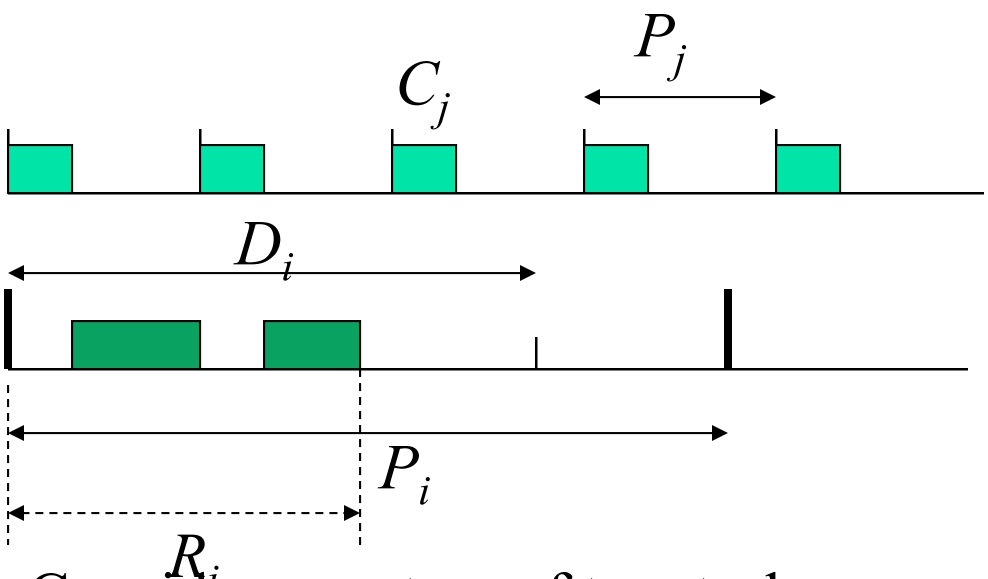
Solve iteratively for the smallest R_i that satisfies both equations

$$I = \sum_j \left\lceil \frac{R_i}{P_j} \right\rceil C_j$$

$$R_i = I + C_i$$

Example



Consider a system of two tasks:

Task 1: P_1=1.7, D_1=0.5, C_1=0.5
Task 2: P_2=8, D_2=3.2, C_2=2

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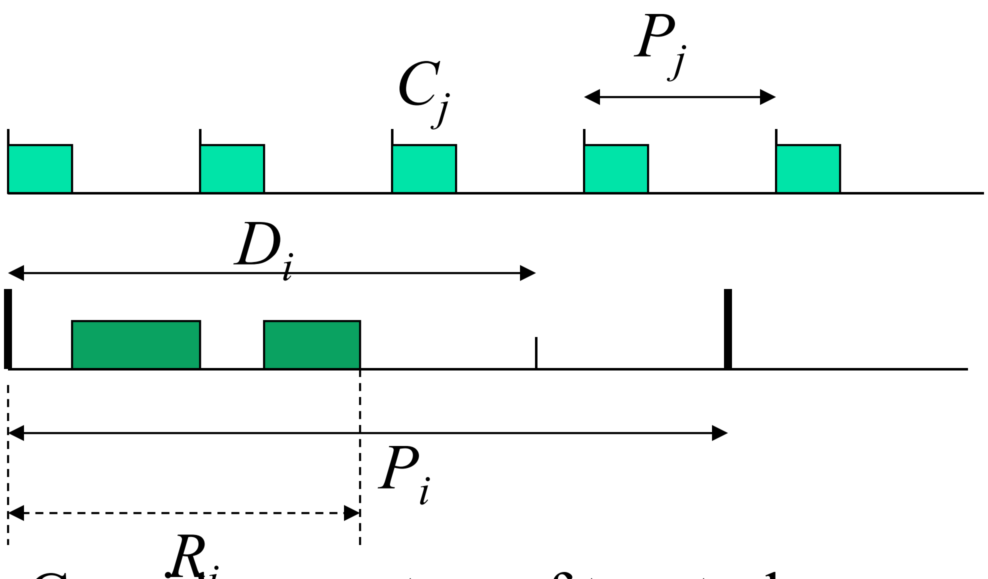

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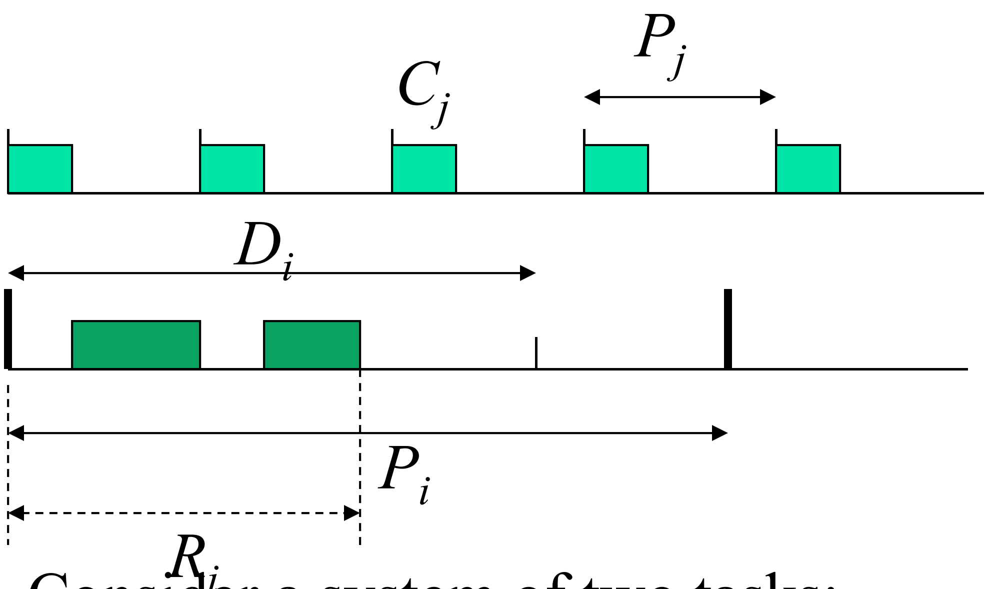

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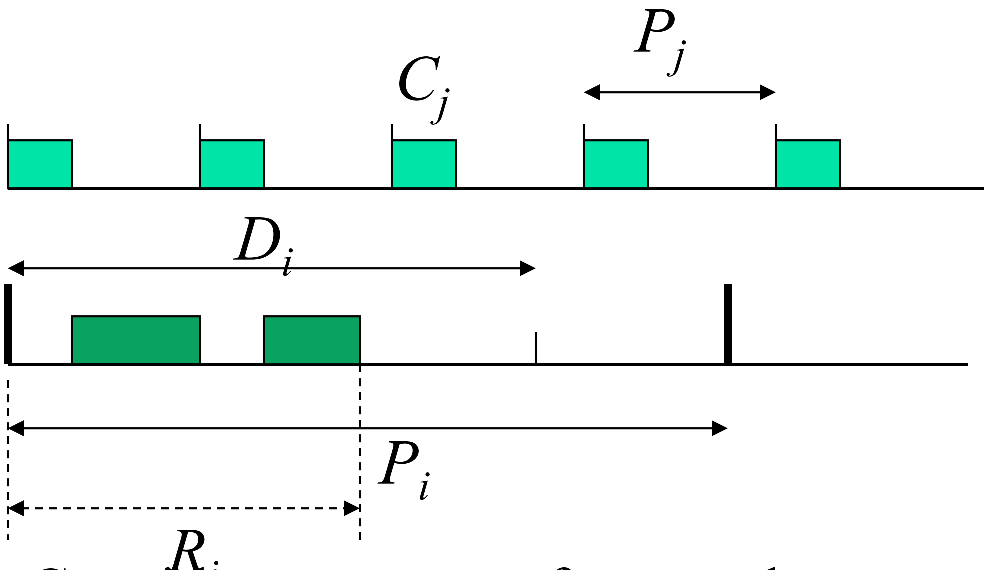

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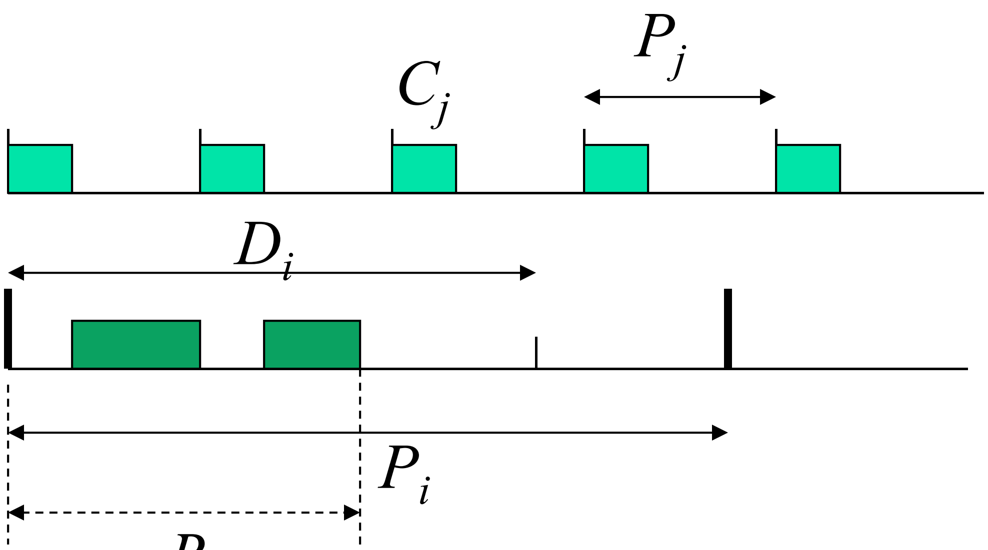

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$3 < 3.2 \rightarrow$ Ok!