Scheduling and Digraphs

Lecture 34
Sections 8.1, 8.2

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Outline

Introduction

- To plan a meeting with several invited speakers involves a number of tasks:
  - (A) Locate appropriate speakers.
  - (B) Invite them to speak.
  - (C) Send out announcements of the meeting.
  - (D) Build a website to register attendees.
  - (E) Plan a banquet menu.
  - (F) Retain a caterer.
  - (G) Determine the registration fee.
  - (H) Reserve a room for the banquet.
  - (I) Update website with info.

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  - Determine the registration fee.
  - Build a website to register attendees.
- If we know how long each task will take and if we know the "dependencies," then we can figure out how long the entire project will take.

Outline

Definitions

Definition (Task)

A task is a unit of work that cannot be broken down into smaller units.

Definition (Processor)

A processor is a person or a machine that carries out a task.

- Because a task cannot be broken down into parts, each task must be done by a single processor.

Definitions

Definition (Processing Times)

The processing time of a task is the time necessary to complete the task.

Definition (Precedence Relations)

Given two tasks, a precedence relation states that one of them must be *completed* before the other one can be *started*.

Outline

Example

- Assume the following processor times.
  - (A) Locate appropriate speakers – 3 days.
  - (B) Invite them to speak (and get confirmation) – 4 days.
  - (C) Send out announcements of the meeting – 1 day.
  - (D) Build a website to register attendees – 3 days.
  - (E) Plan a banquet menu – 1 day.
  - (F) Retain a caterer – 2 days.
  - (G) Determine the registration fee – 1 day.
  - (H) Reserve a room for the banquet – 1 day.
  - (I) Update website with info – 1 day.

Example

- We have the following times and precedence relations.

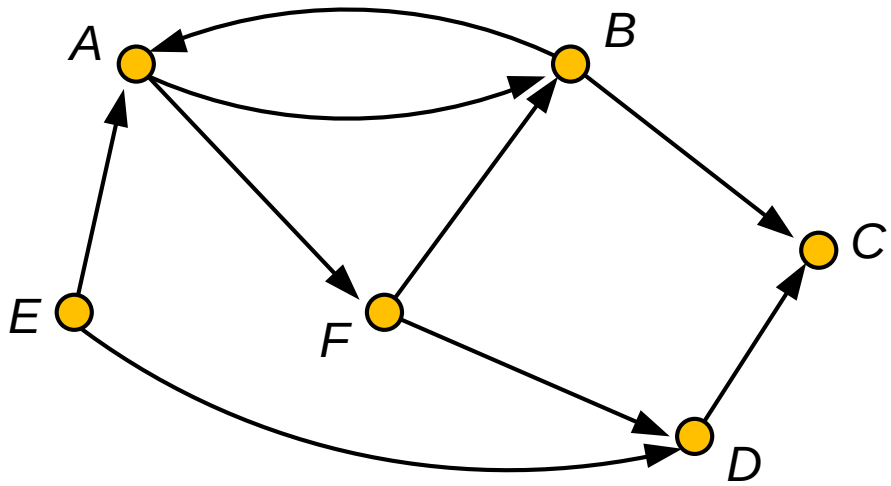
	Task	Time	Precedent Tasks
(A)	Locate speakers	3	
(B)	Confirm speakers	4	A
(C)	Send announcements	1	B, D, E, G
(D)	Build website	3	
(E)	Plan menu	1	F
(F)	Retain caterer	2	
(G)	Registration fee	1	E
(H)	Banquet room	1	
(I)	Update website	1	B, D, E, G

Outline

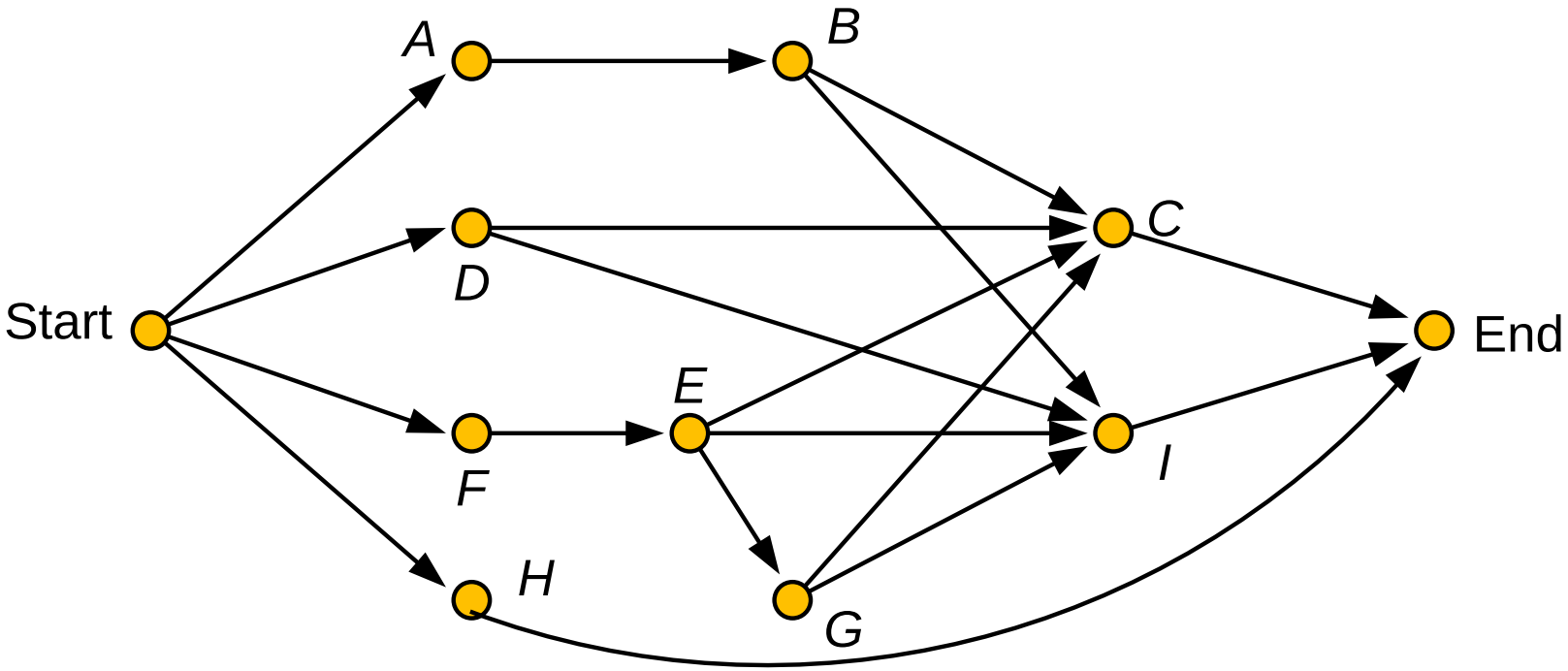
Definitions

Definition (Digraph)

A digraph is a “directed” graph. That is, each edge is given a direction, indicated by an arrowhead.

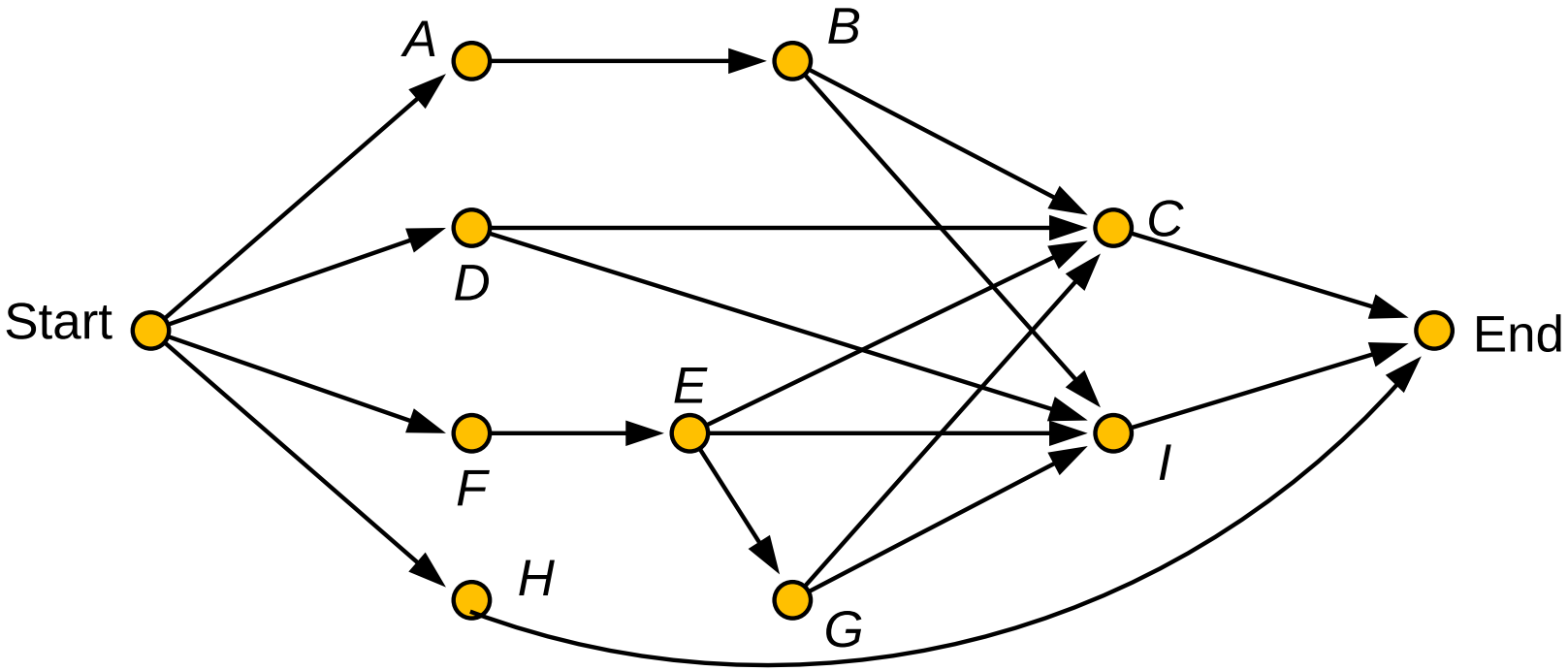


Example



- This digraph shows the precedence relations of our example.

Example



- This digraph shows the precedence relations of our example.
- Note the two additional vertices Start and End.

Outline

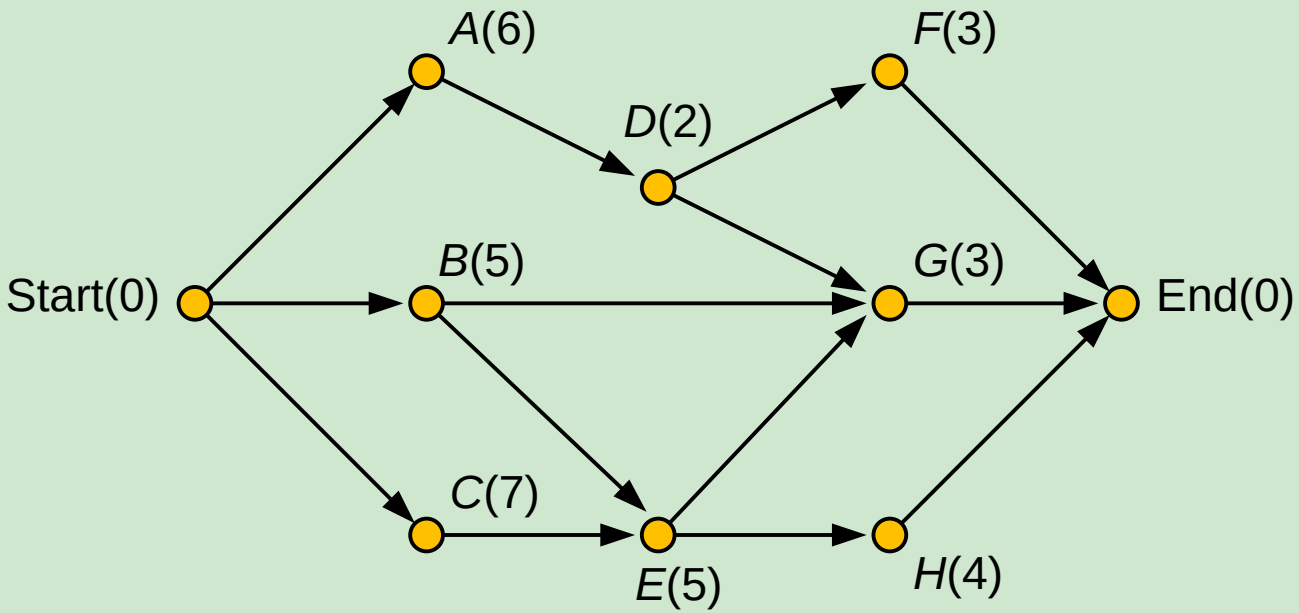
Project Digraphs

Definition (Project Digraph)

A project digraph is a digraph that displays the precedence relations among the tasks of a project as well as the process times for each task, and START and END vertices.

Example

Example (Project Digraph)



- The diagram shows the precedence relations.
- Some of the precedence relations are *implied* (not shown) by the graph.

Outline

Priority Lists

Definition (Priority List)

A priority list is a list of the tasks of a project, listed in the order in which we *prefer* to execute them. (But not necessarily in the order in which we *will* execute them.)

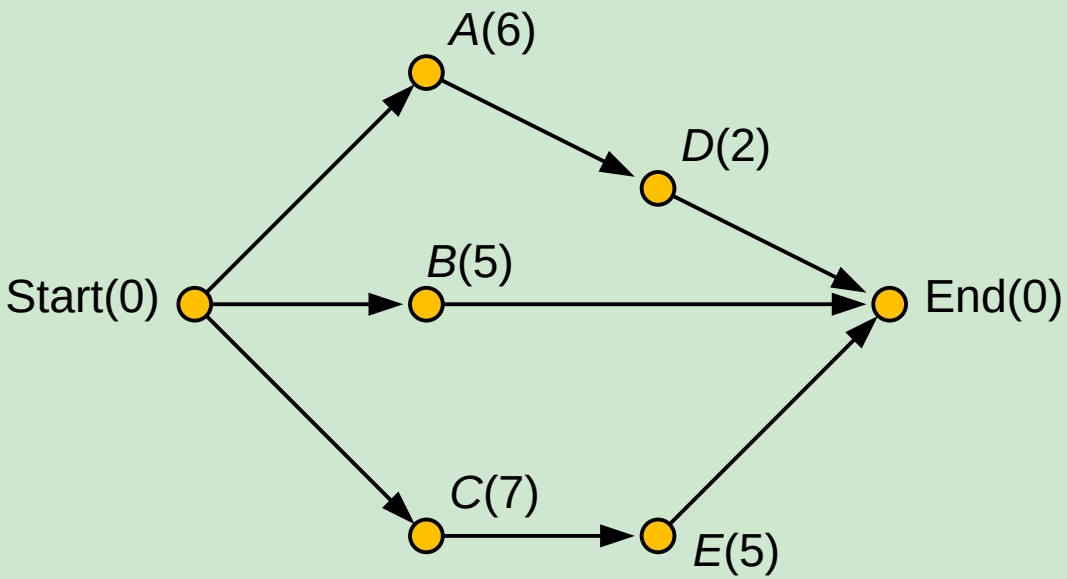
Definition (Priority List Model)

The priority list model uses a priority list to schedule the tasks. Whenever a processor is available, the model chooses the next task in the list that is ready to be processed. (To be ready, all precedent tasks must have been completed.)

- If there are M tasks, then there are $M!$ possible priority lists.
- It is not practical to try them all.

Example

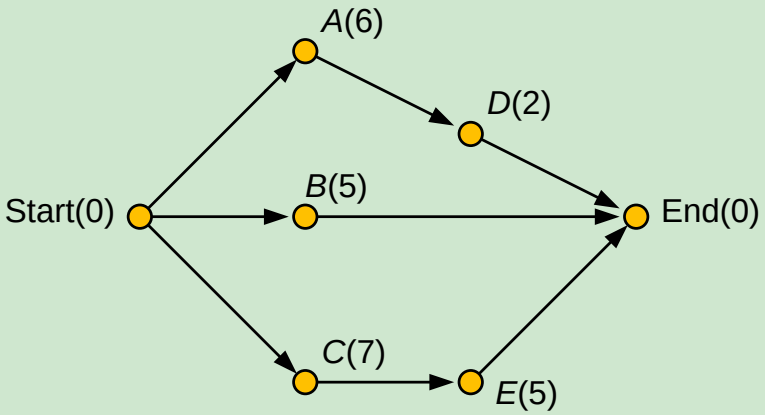
Example (Priority-List Scheduling)

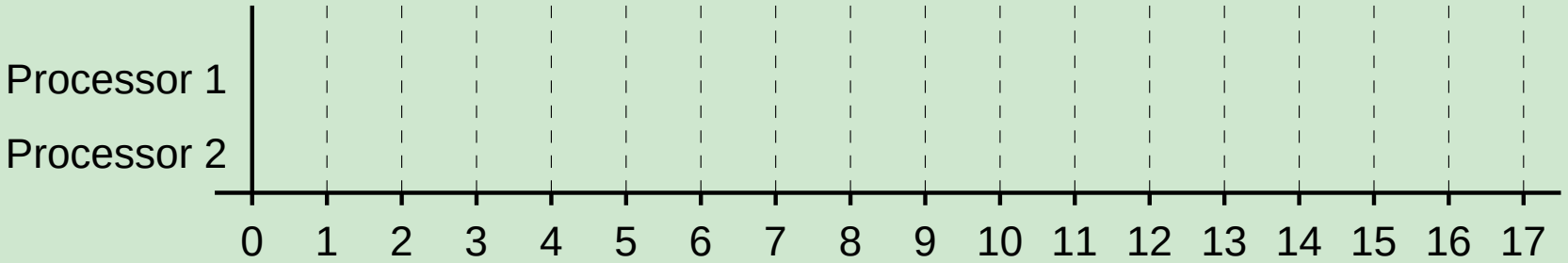


- Suppose the priority list is A, B, C, D, E and that there are only 2 processors.
- What is the resulting schedule?

Example

Example (Priority-List Scheduling)





Example

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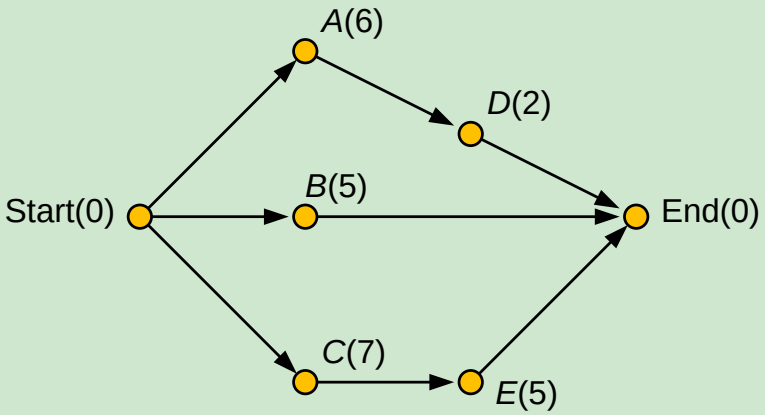

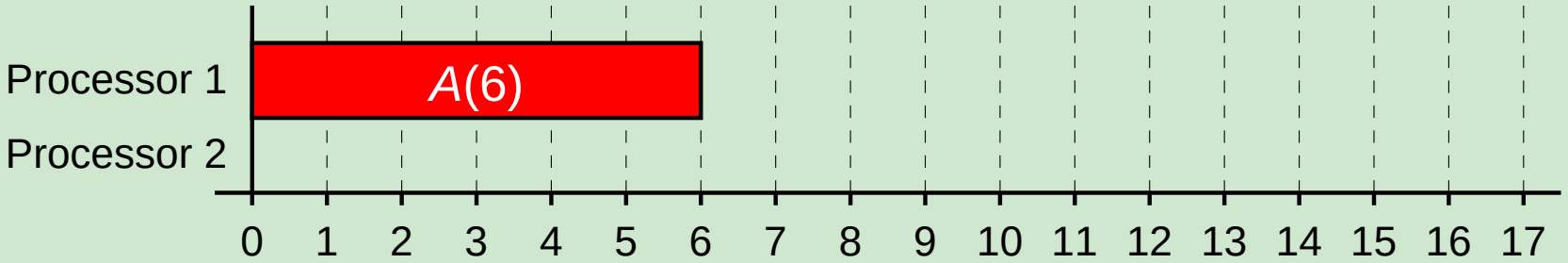

Example

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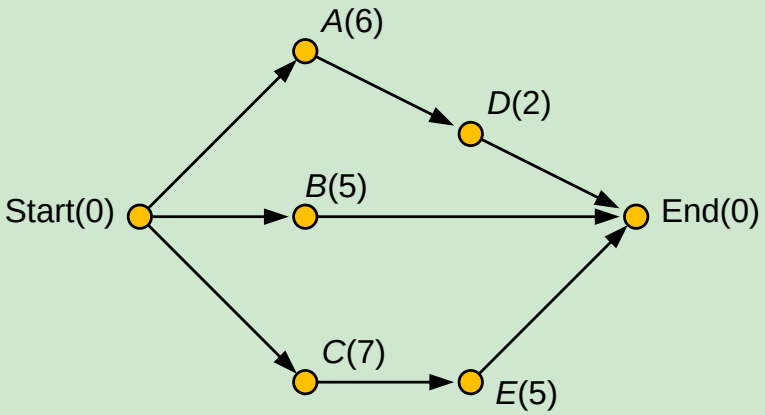

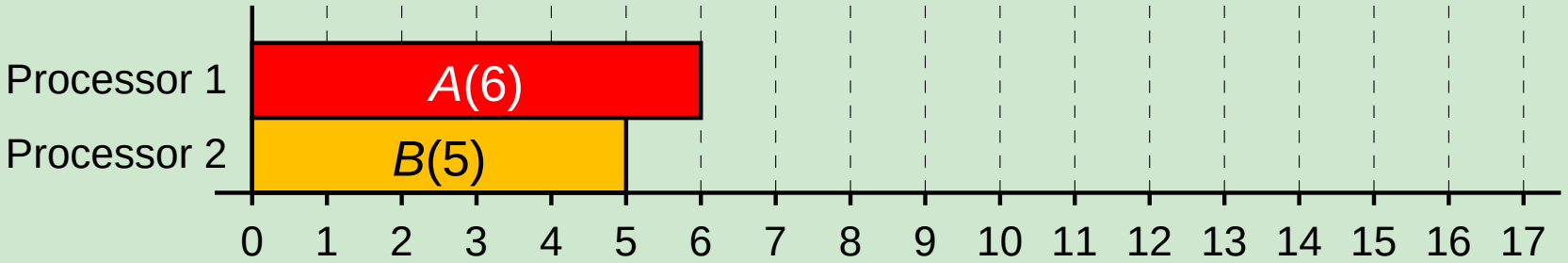

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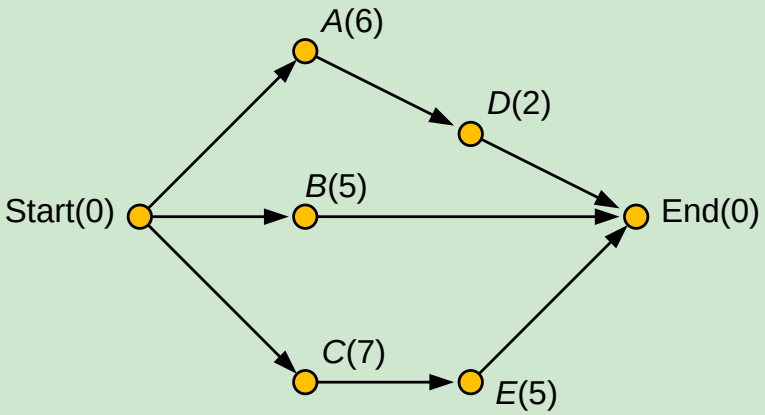

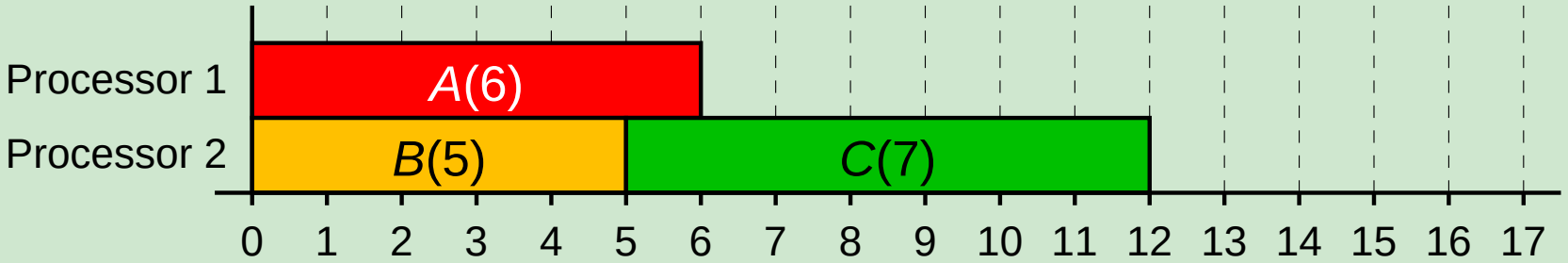

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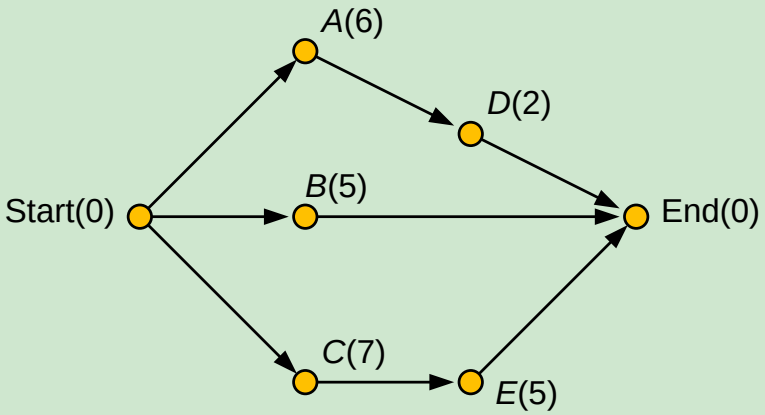

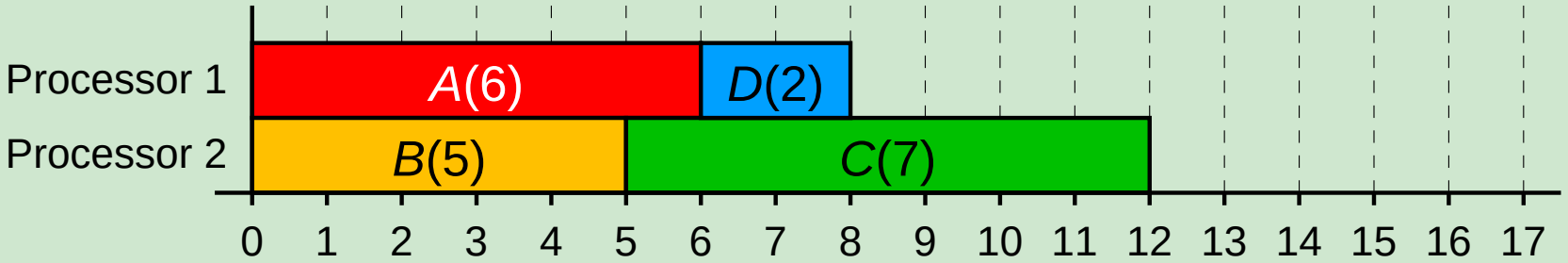

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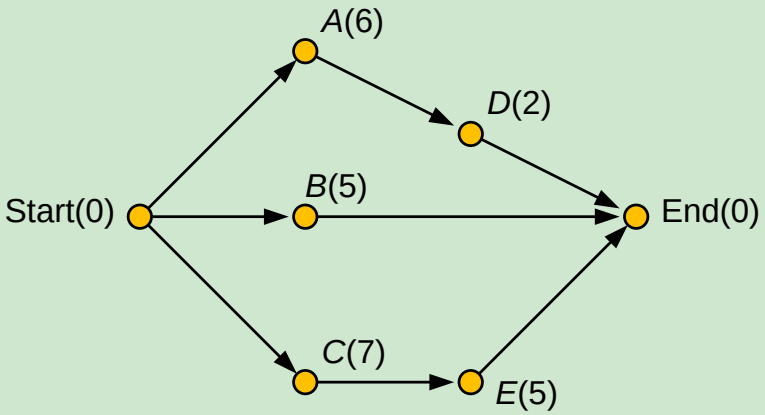

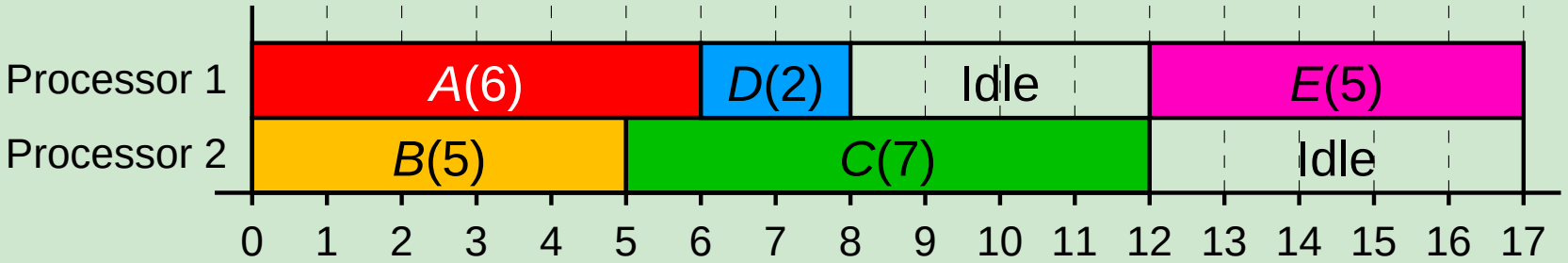

Example

Example (Priority-List Scheduling)

- What if there had been 3 processors?
- What if the priority list had been A, C, D, E, B?
- What if the priority list had been E, D, C, B, A?

Another Example

Example (Priority-List Scheduling)

	Task	Precedent Tasks	Time
(A)	Locate speakers		5
(B)	Confirm speakers	C, D	2
(C)	Send announcements		4
(D)	Build website		6
(E)	Plan menu	A, C, F	3
(F)	Retain caterer	A, B	1
(G)	Registration fee	F	4

- Schedule the tasks with priority list A, B, C, D, E, F, G with 2 processors.

Outline

Assignment

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- Chapter 8 Exercises 4, 12, 13, 14, 16, 19, 20.