LECTURE 7

PRECEDENCE DIAGRAMING METHOD: Schedule Updating

OUTLINE LECTURE 5

- REVIEW LECTURE 4
- INTRODUCTION
- THE FOUR TYPES OF RELATIONSHIPS
- PROBLEM FOR FINDING THE CRITICAL PATH AND CRITICAL TIME
- **EXERCISE**

REVIEW LECTURE 4

- *Critical* - Activities, events, or paths which, IF DELAYED, WILL DELAY THE COMPLETION OF THE PROJECT.

- *Critical Path* – path with the longest total duration

- CPM is a network diagramming technique used to PREDICT TOTAL PROJECT DURATION.

Paper

- Buat contoh kasus mengenai Schedule Updating dan Project control (konstruksi dan Non Konstruksi) (kerja Praktek)

INTRODUCTION

Precedence networks (Method) are node networks that

allow for the use of four types of:

- relationships: finish to start (FS),
- start to start (SS),
- finish to finish (FF), and
- start to finish (SF).

…Cont

To understand the idea of precedence networks, consider the simple project of laying 1,000 LF (linear feet) of a utility pipe.

The logic is simple:

a. dig a trench,

b. provide a 6-inch-thick gravel sub-base (bedding),

c. lay the pipe, backfill, and

d. compact—five consecutive activities.

…Cont

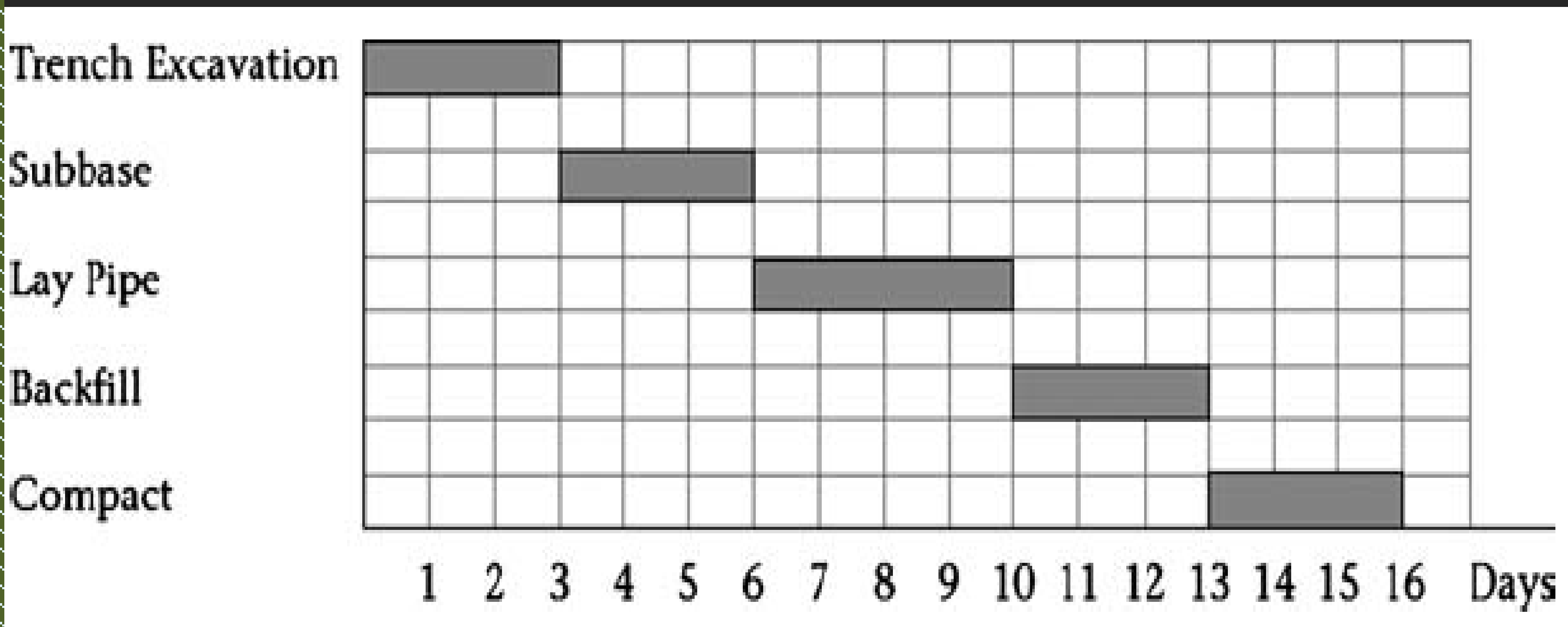
However:

- Are they actually “consecutive (berurutan)”?
- Do you need to finish excavating the entire 1,000 LF before you can start the sub-base?
- Do you need to finish the sub-base completely before you start laying the pipe?

…Cont

If the answer is yes,

your bar chart may look like the one shown in Figure below:



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Most likely, Practically:

- ✓ Once you have dug a reasonable amount, say 100 LF,
- ✓ Your second crew can start providing the sub-base,

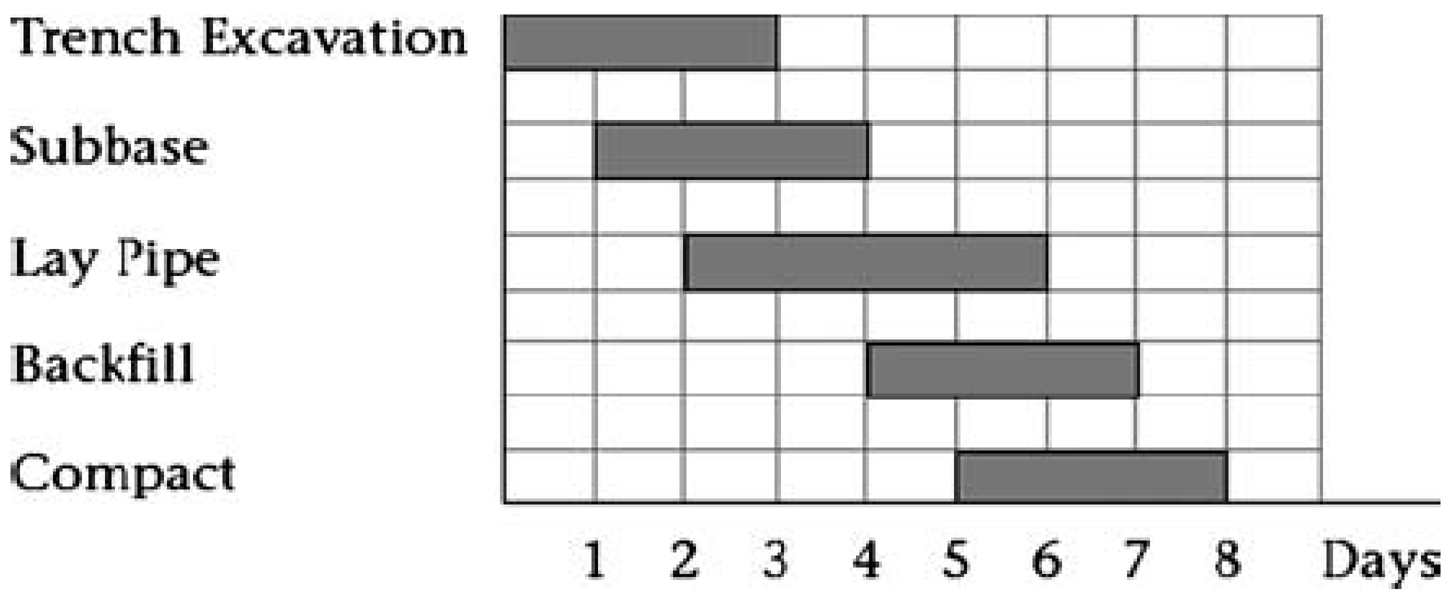
(while the first crew continues digging).

- ✓ Once digging reaches about 200 LF (say 20%),
- ✓ the sub-base is about 10% complete,
- ✓ and your third crew can start laying the pipe.

…Cont

Clearly, it is not the traditional FS relationship.

As a result, the bar chart shown in figure below.



Bar chart for five overlapping activities

THE FOUR TYPES OF RELATIONSHIPS

As mentioned previously, four types of relationships are possible in precedence networks:

1. **Finish-to-Start (FS) Relationship:** The most common type of relationship is the FS relationship. Examples of this type:

- The concrete cannot be placed (poured) until the formwork has been built.
- The doors can not be hung until door frames have been installed.

…Cont

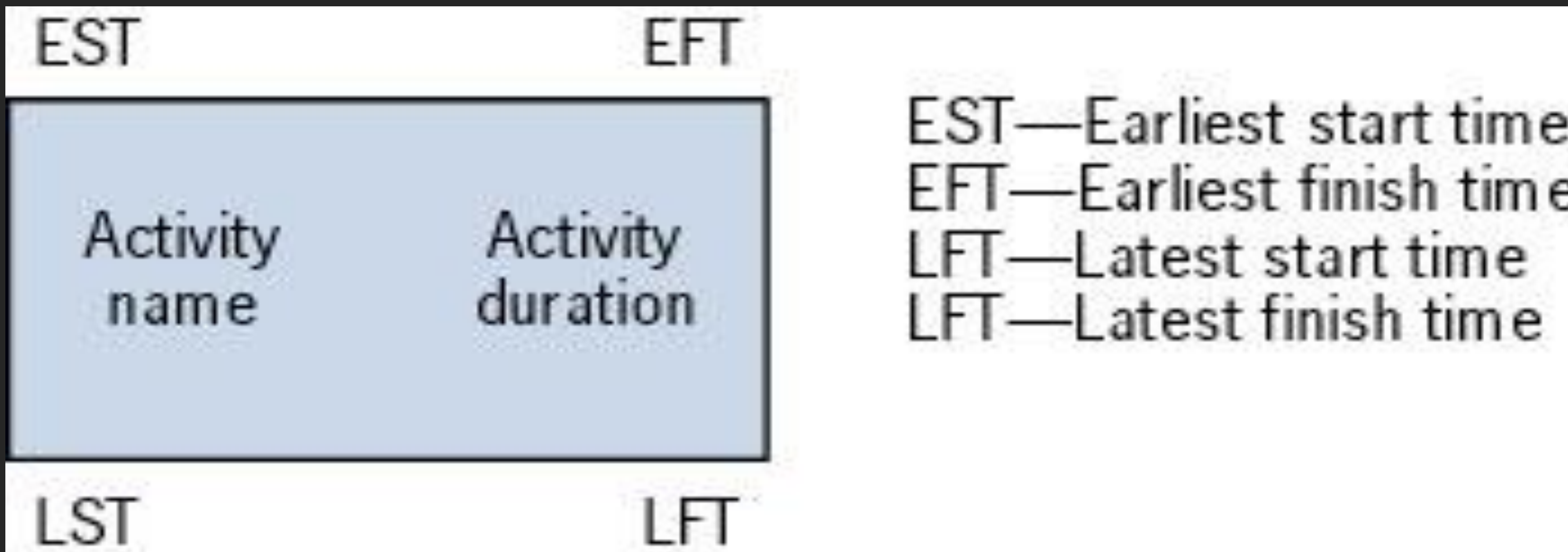
2. **Start-to-Start (SS) Relationship:** The SS relationship is common and extremely useful.

   - Excavation for the foundation can not start until clearing and grubbing begins (usually with a certain lag; i.e., a certain percentage is finished).

…Cont

3. **Finish-to-Finish (FF) Relationship**: The FF relationship is also common and useful.
   - Landscaping can not finish until the driveway is finished.
   - Backfilling a trench can not finish until the pipe in the trench has been laid.
4. **Start-to-Finish (SF) Relationship:** The SF relationship is uncommon and almost **nonexistent in construction projects**

INFORMATION CONTENTS IN AN AON NODE



ES	ID	EF
Slag		Slag
LS	Dur	LF

PROBLEM FOR FINDING THE CRITICAL PATH AND CRITICAL TIME

Project X

	Activity	Description
Manufacturing activities	A	Prototype model design
	B	Purchase of materials
	C	Manufacture of prototype model
	D	Revision of design
	E	Initial production run
Training activities	F	Staff training
	G	Staff input on prototype models
	H	Sales training
Advertising activities	I	Pre-production advertising campaign
	J	Post-redesign advertising campaign

Project X

Precedence Relationships Chart

Activity	Immediate Predecessor	Estimated Completion Time
A	None	90
B	A	15
C	B	5
D	G	20
E	D	21
F	A	25
G	C,F	14
H	D	28
I	A	30
J	D,I	45

…Cont

Question:

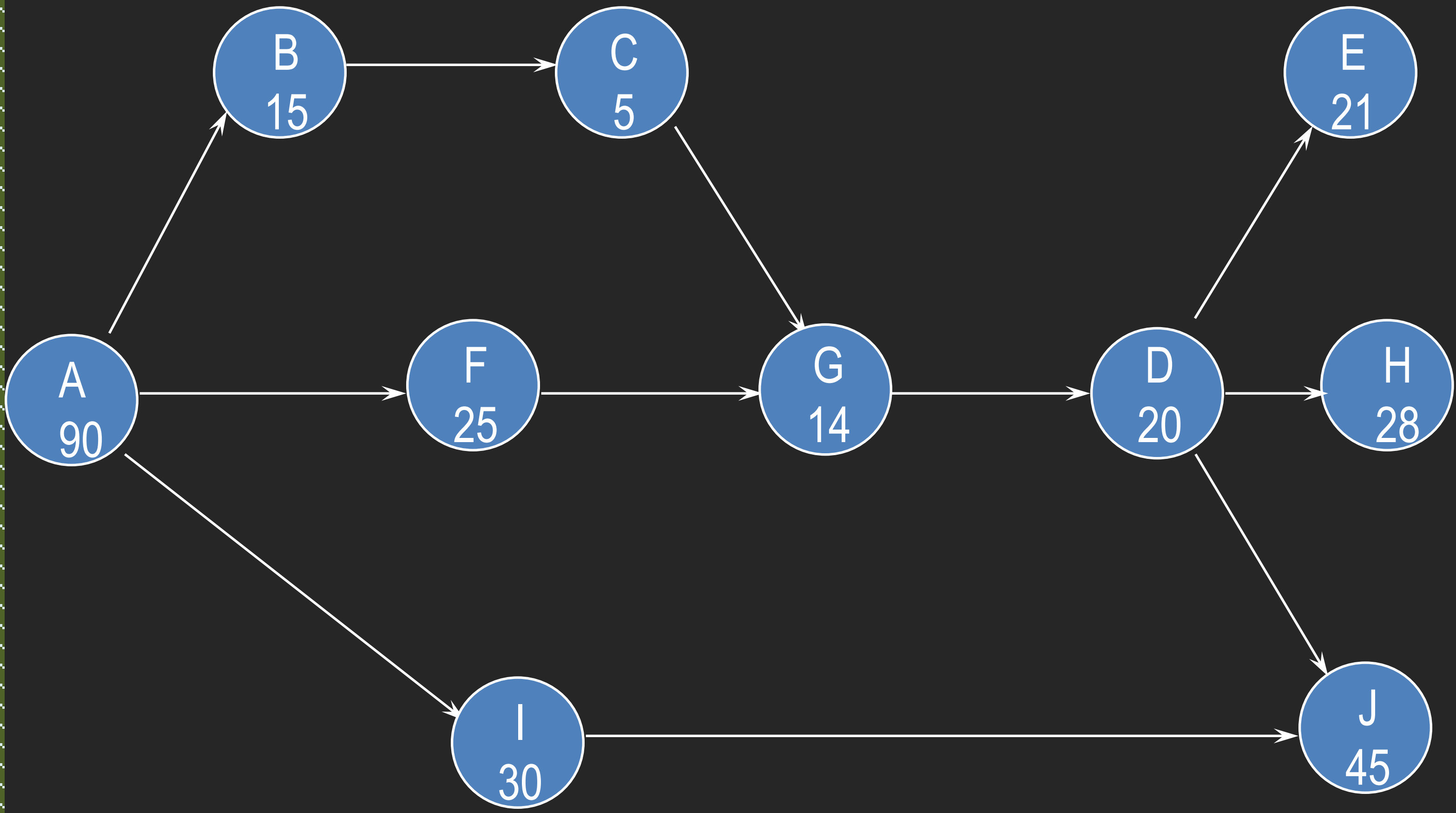
- Management would like to schedule the activities so that the project is completed in minimal time.
- Management wishes to know:
  - The earliest and latest start times for each activity which will not alter the earliest completion time of the project.
  - The earliest finish times for each activity which will not alter this date.
  - Activities with rigid schedule and activities that have slack in their schedules.

Earliest Start Time / Earliest Finish Time

- Make a forward pass through the network as follows:
  - Evaluate all the activities which have no immediate predecessors.
    - The earliest start for such an activity is zero ES = 0.
    - The earliest finish is the activity duration EF = Activity duration.
  - Evaluate the ES of all the nodes for which EF of all the immediate predecessor has been determined.
    - ES = Max EF of all its immediate predecessors.
    - EF = ES + Activity duration.
  - Repeat this process until all nodes have been evaluated
    - EF of the finish node is the earliest finish time of the project.

AON NETWORK

Activity	Immediate Predecessor	Estimated Completion Time
A	None	90
B	A	15
C	B	5
D	G	20
E	D	21
F	A	25
G	C,F	14
H	D	28
I	A	30
J	D,I	45

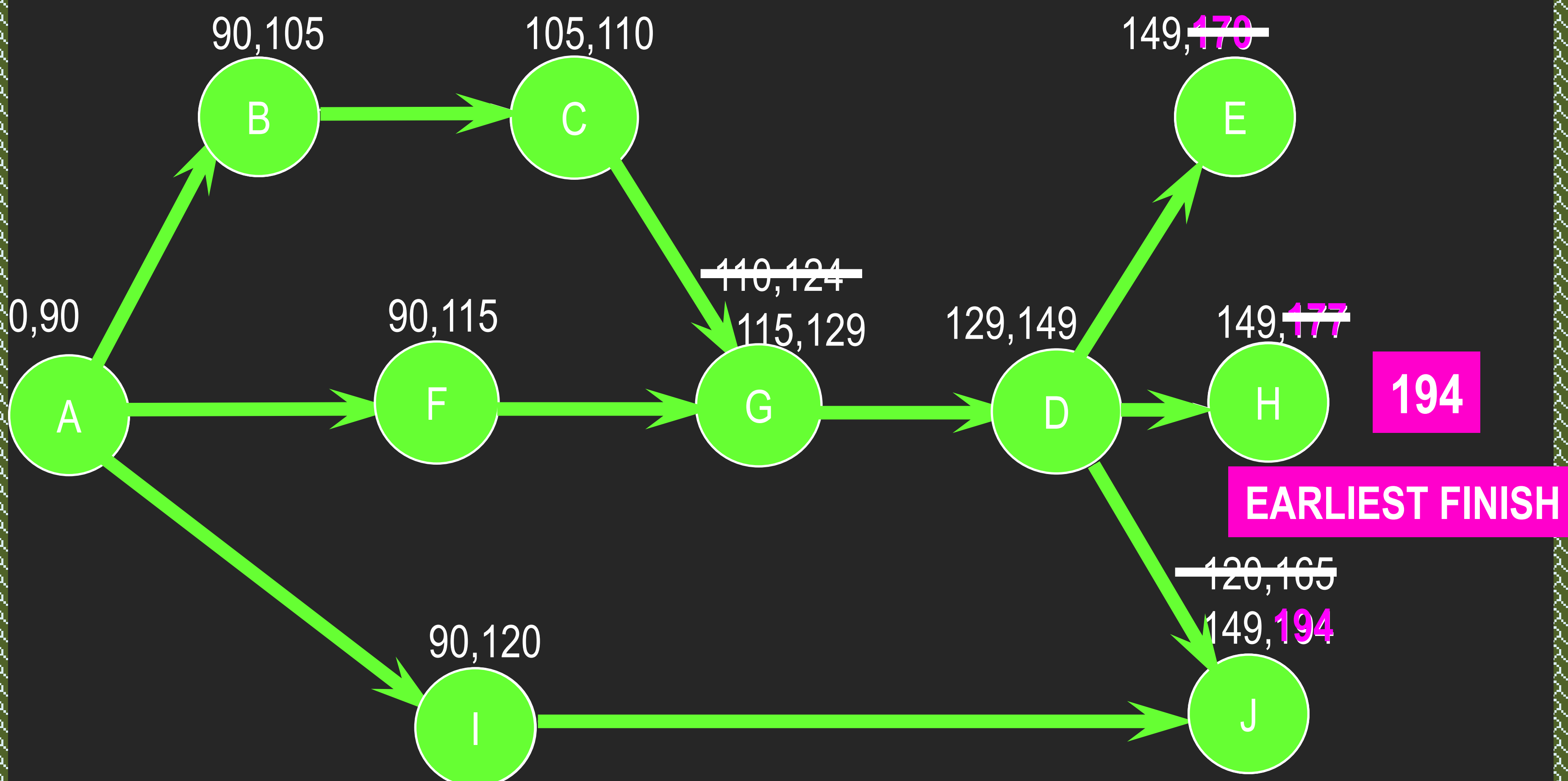


Earliest Start / Earliest Finish – Forward Pass

Activity	Immediate Predecessor	Estimated Completion Time
A	None	90
B	A	15
C	B	5
D	G	20
E	D	21
F	A	25
G	C,F	14
H	D	28
I	A	30
J	D,I	45

ES	ID	EF
Slag		
LS	Dur	LF

Always take larger number on Forward Pass



Latest start time / Latest finish time

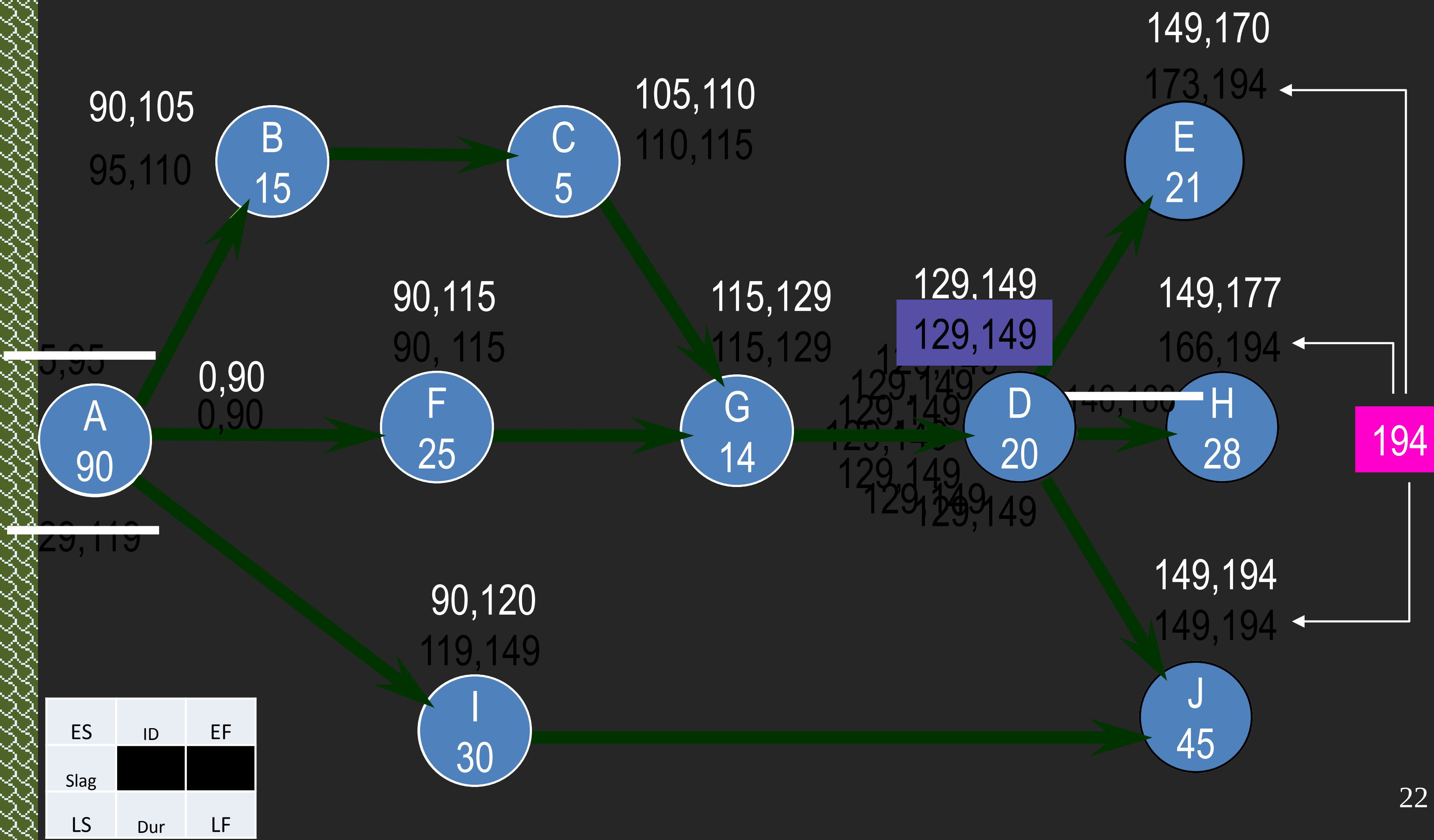
- Make a backward pass through the network as follows:
  - Evaluate all the activities that immediately precede the finish node.
    - The latest finish for such an activity is LF = minimal project completion time.
    - The latest start for such an activity is LS = LF - activity duration.
  - Evaluate the LF of all the nodes for which LS of all the immediate successors has been determined.
    - LF = Min LS of all its immediate successors.
    - LS = LF - Activity duration.
  - Repeat this process backward until all nodes have been evaluated.

Latest Start / Latest Finish – Backward Pass

Activity	Immediate Predecessor	Estimated Completion Time
A	None	90
B	A	15
C	B	5
D	G	20
E	D	21
F	A	25
G	C,F	14
H	D	28
I	A	30
J	D,I	45

Always take Smaller number on Backward Pass

Backward Pass= LF- Duration→ LS



Slack Times

- Activity start time and completion time may be delayed by planned reasons as well as by unforeseen reasons.
- Some of these delays may affect the overall completion date.
- To learn about the effects of these delays, we calculate the **slack time,** and form the **critical path**.

Slack Times

– Slack time is the amount of time an activity can be delayed without delaying the project completion date, assuming no other delays are taking place in the project.

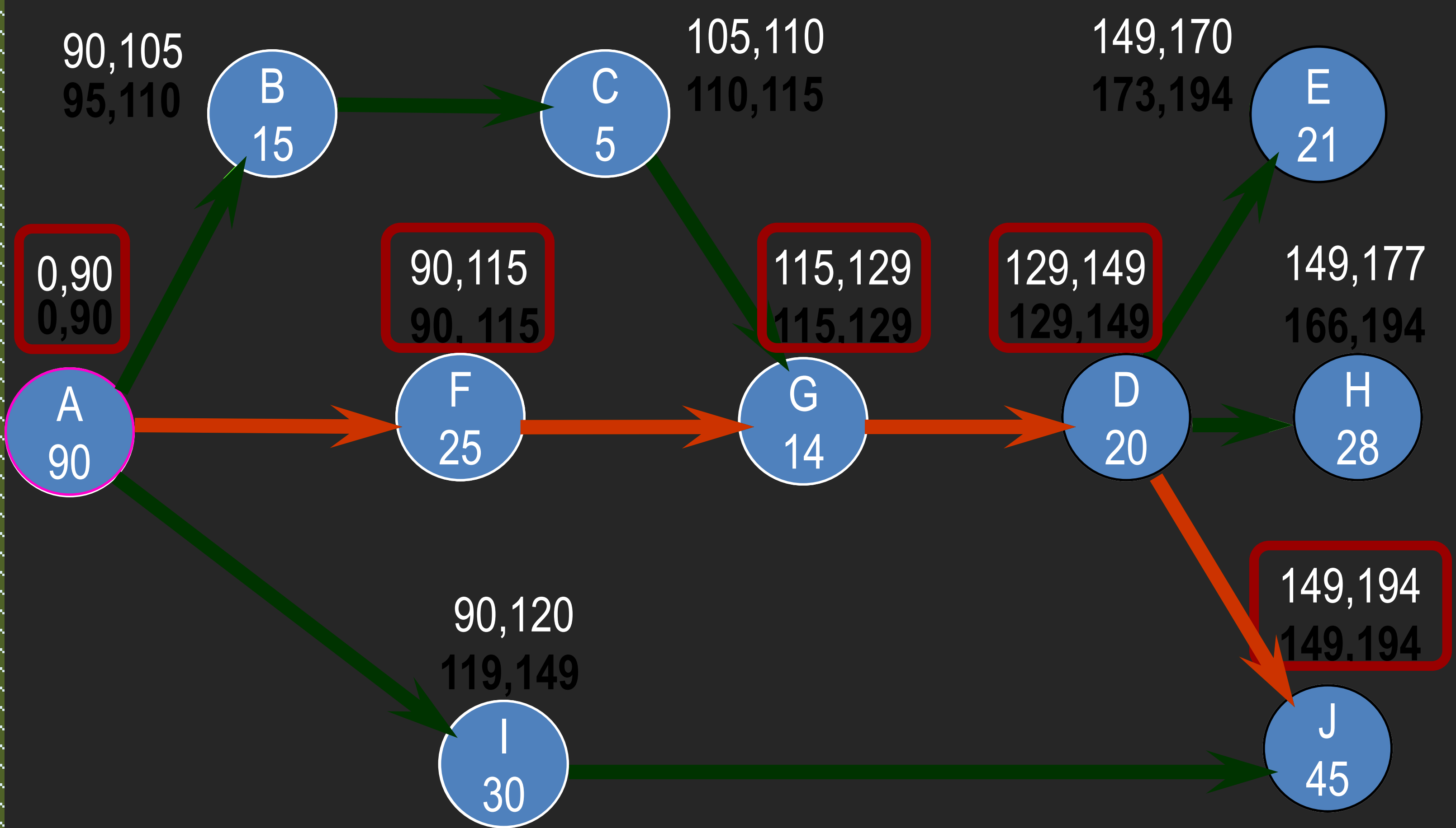
Slack Time = LS - ES

Slack time in the Project X

Activity	LS - ES	Slack
A	0 -0	0
B	95 - 90	5
C	110 - 105	5
D	119 - 119	0
E	173 - 149	24
F	90 - 90	0
G	115 - 115	0
H	166 - 149	17
I	119 - 90	29
J	149 - 149	0

Critical activities must be rigidly scheduled

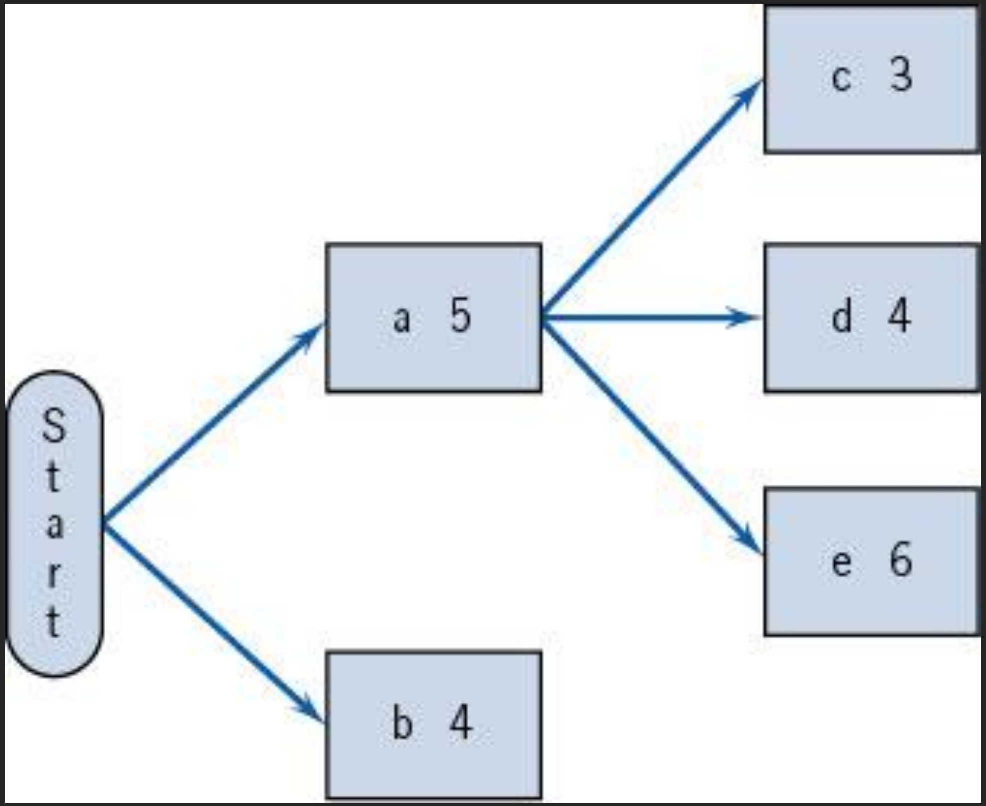
The Critical Path



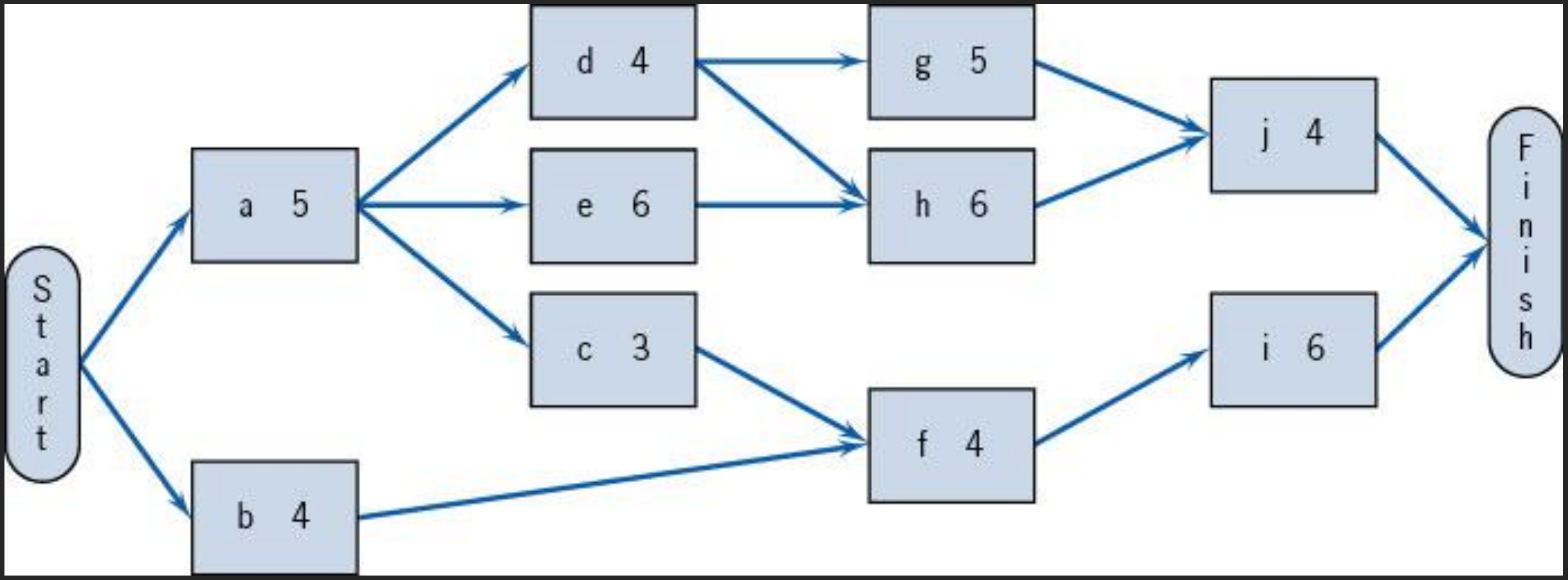
Exercise:

Activity	Predecessor	Duration
a	--	5 days
b	--	4
c	a	3
d	a	4
e	a	6
f	b, c	4
g	d	5
h	d, e	6
i	f	6
j	g, h	4

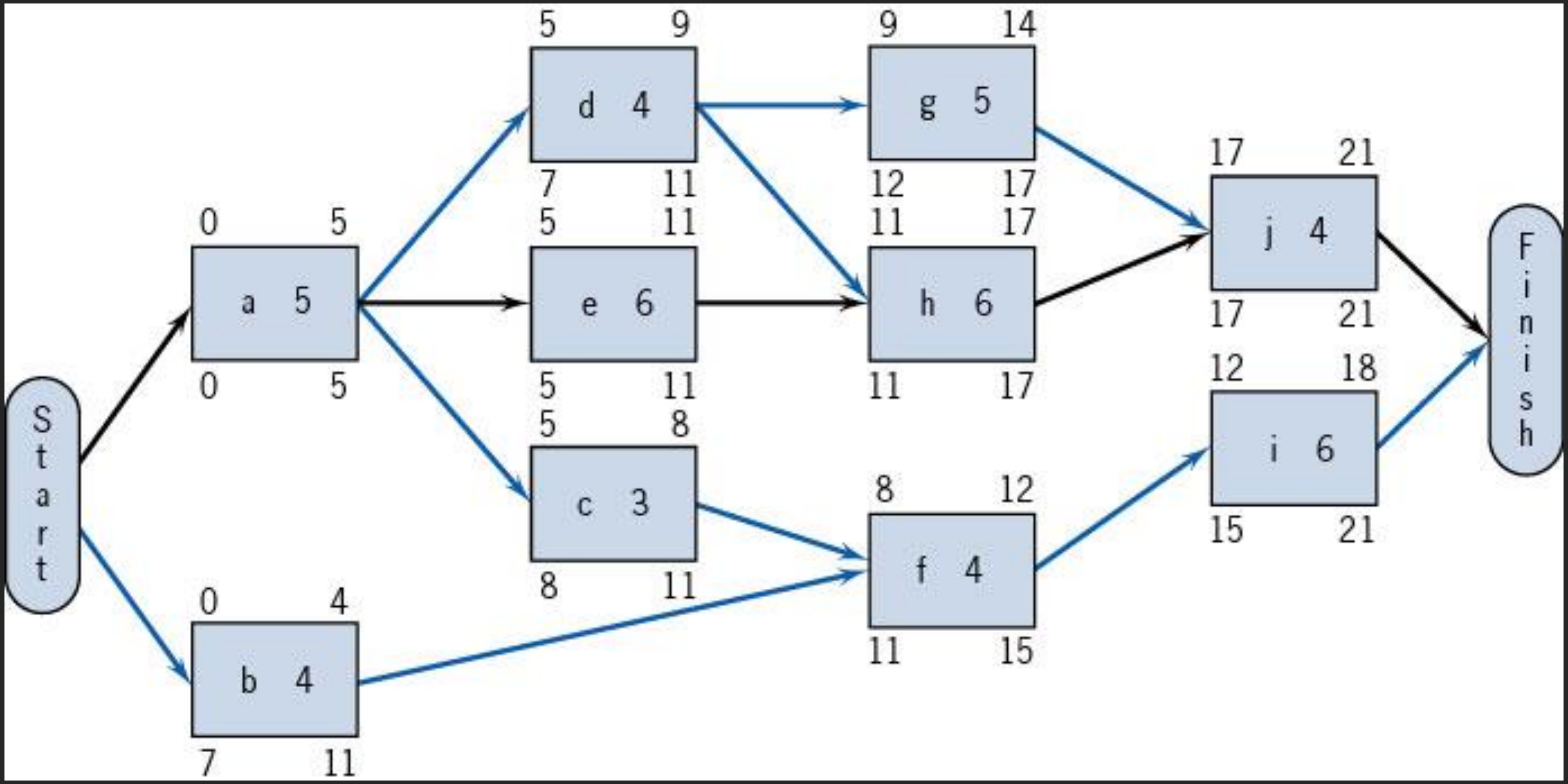
A SAMPLE NETWORK



A COMPLETE NETWORK



THE CRITICAL PATH AND TIME FOR SAMPLE PROJECT



QUESTION..????