Al- Mustaqbal University College
Chem. Eng. Petr. Ind. Dept.
4th stage

Industrial Management and Ethics

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Project Management Techniques: PERT and CPM

Lecture 5

2020-2021

Program evaluation and review technique (PERT) and the critical path method (CPM) were both developed in the 1950s to help managers schedule, monitor, and control large and complex projects.

CPM arrived first, as a tool developed to assist in the building and maintenance of chemical plants. Independently, PERT was developed in 1958 for the U.S. Navy.

Critical path method (CPM)
A project management technique that uses only one-time factor per activity.

Critical path
The computed longest path through a network

Program evaluation and review technique (PERT)
A project management technique that employs three time estimates for each activity.

Project Management Techniques: PERT and CPM

Program evaluation and review technique (PERT) and the critical path method (CPM)

The Framework of PERT and CPM

PERT and CPM both follow six basic steps:

1. Define the project and prepare the work breakdown structure.

2. Develop the relationships among the activities. Decide which activities must precede and which must follow others.

3. Draw the network connecting all the activities.

4. Assign time and/or cost estimates to each activity.

5. Compute the *longest* time path through the network. This is called the critical path .

6. Use the network to help plan, schedule, monitor, and control the project.

Step 5, finding the critical path, is a major part of controlling a project. The activities on the critical path represent tasks that will delay the entire project if they are not completed on time.

Although PERT and CPM differ to some extent in terminology and in the construction of the network, their objectives are the same. Furthermore, the analysis used in both techniques is very similar. The major difference is that PERT employs three time estimates for each activity

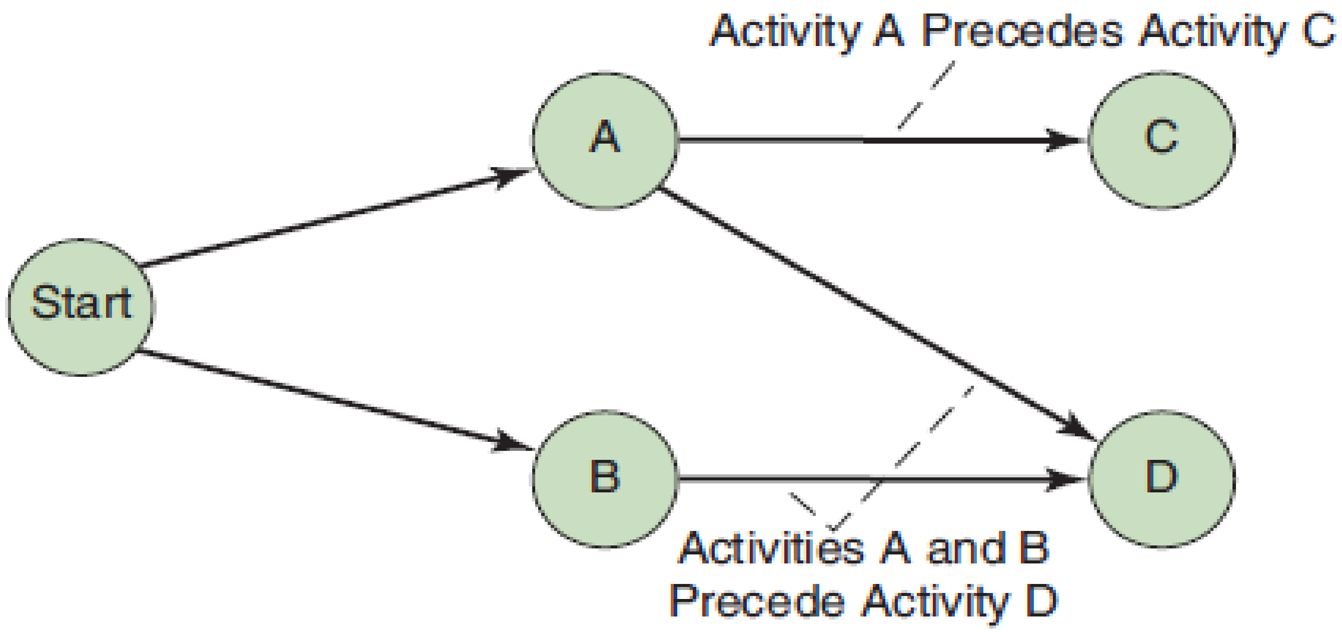


TABLE 3.1 Milwaukee Paper Manufacturing's Activities and Predecessors

ACTIVITY	DESCRIPTION	IMMEDIATE PREDECESSORS
A	Build internal components	—
B	Modify roof and floor	—
C	Construct collection stack	A
D	Pour concrete and install frame	A, B
E	Build high-temperature burner	C
F	Install pollution control system	C
G	Install air pollution device	D, E
H	Inspect and test	F, G

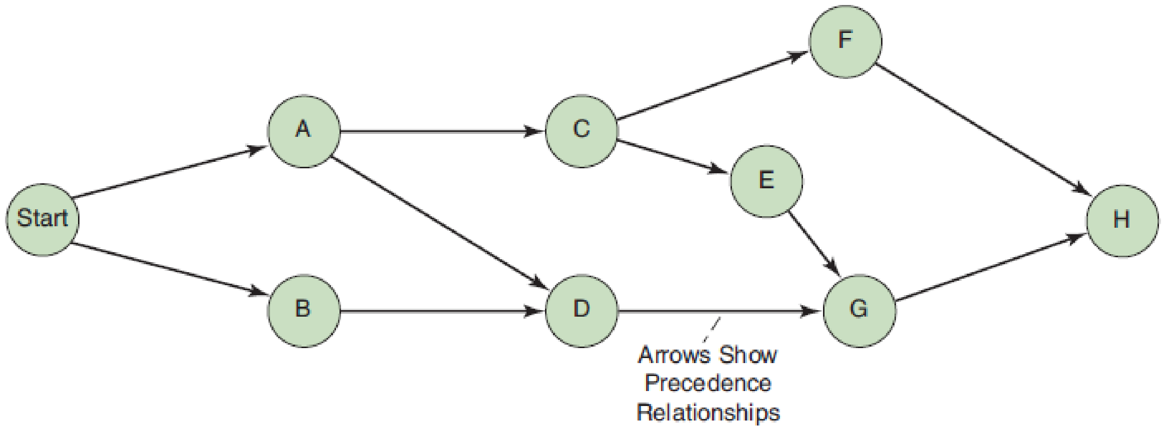


TABLE 3.2 Time Estimates for Milwaukee Paper Manufacturing

ACTIVITY	DESCRIPTION	TIME (WEEKS)
A	Build internal components	2
B	Modify roof and floor	3
C	Construct collection stack	2
D	Pour concrete and install frame	4
E	Build high-temperature burner	4
F	Install pollution control system	3
G	Install air pollution device	5
H	Inspect and test	2
	Total time (weeks)	25

Ist method for calculating CPM

Milwaukee Paper Co. Activities		
ACTIVITY	TIME (WKS)	PREDE-CESSORS
A	2	—
B	3	—
C	2	A
D	4	A, B
E	4	C
F	3	C
G	5	D, E
H	2	F, G

A , C ,F, H =2+2+3+2=9
A, C, E, G, H= 2+2+4+5+2=15
A,D,G,H=2+4+5+2=13
B,D,G,H= 3+4+5+2=14

CPM=15 weeks
This is the project time to be completed
This time is critical because the processes on this path should not be delayed.

Second method

As mentioned earlier, the critical path is the *longest* time path through the network. To find the critical path, we calculate two distinct starting and ending times for each activity. These are defined as follows:

Earliest start (ES) = earliest time at which an activity can start, assuming all predecessors have been completed

Earliest finish (EF) = earliest time at which an activity can be finished

Earliest Start Time Rule Before an activity can start; all its immediate predecessors must be finished:

◆ If an activity has only a single immediate predecessor, its ES equals the EF of the predecessor.

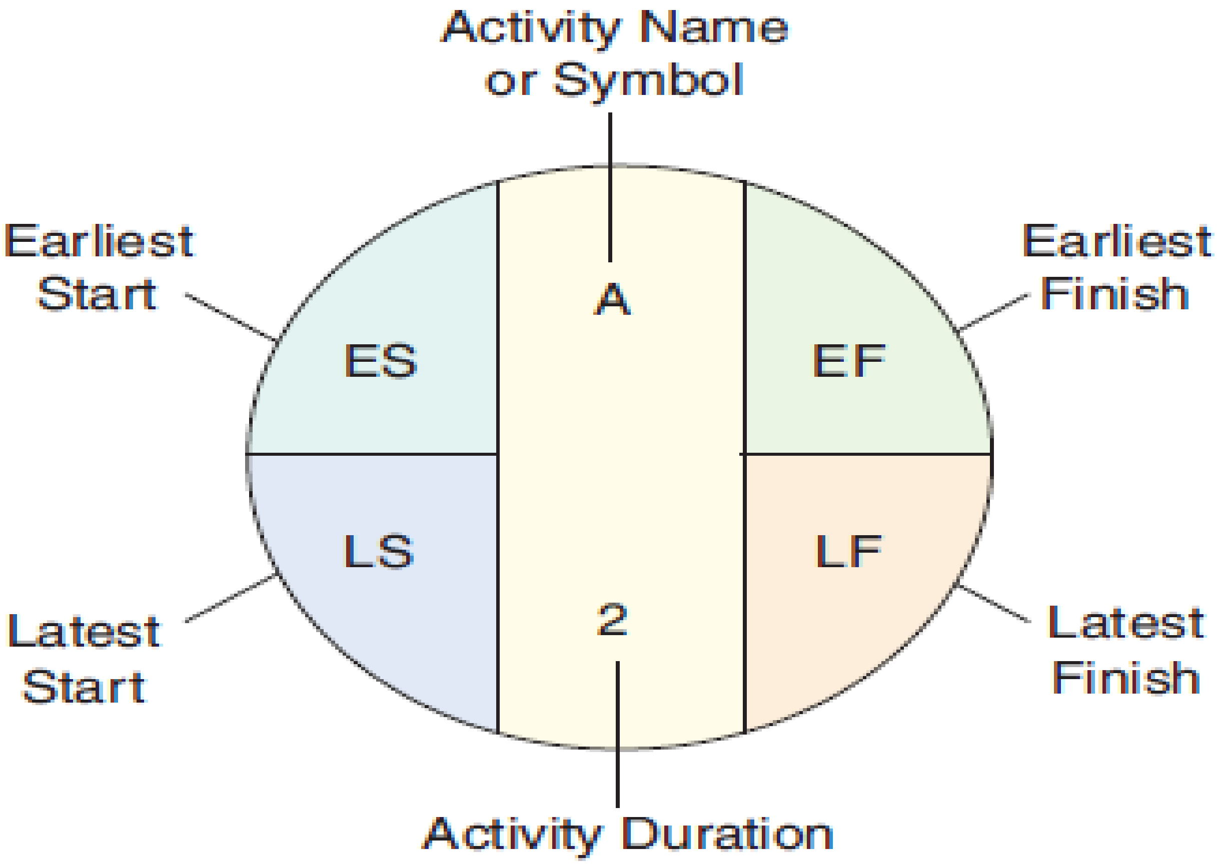
◆ If an activity has multiple immediate predecessors, its ES is the maximum of all EF values of its predecessors. That is:

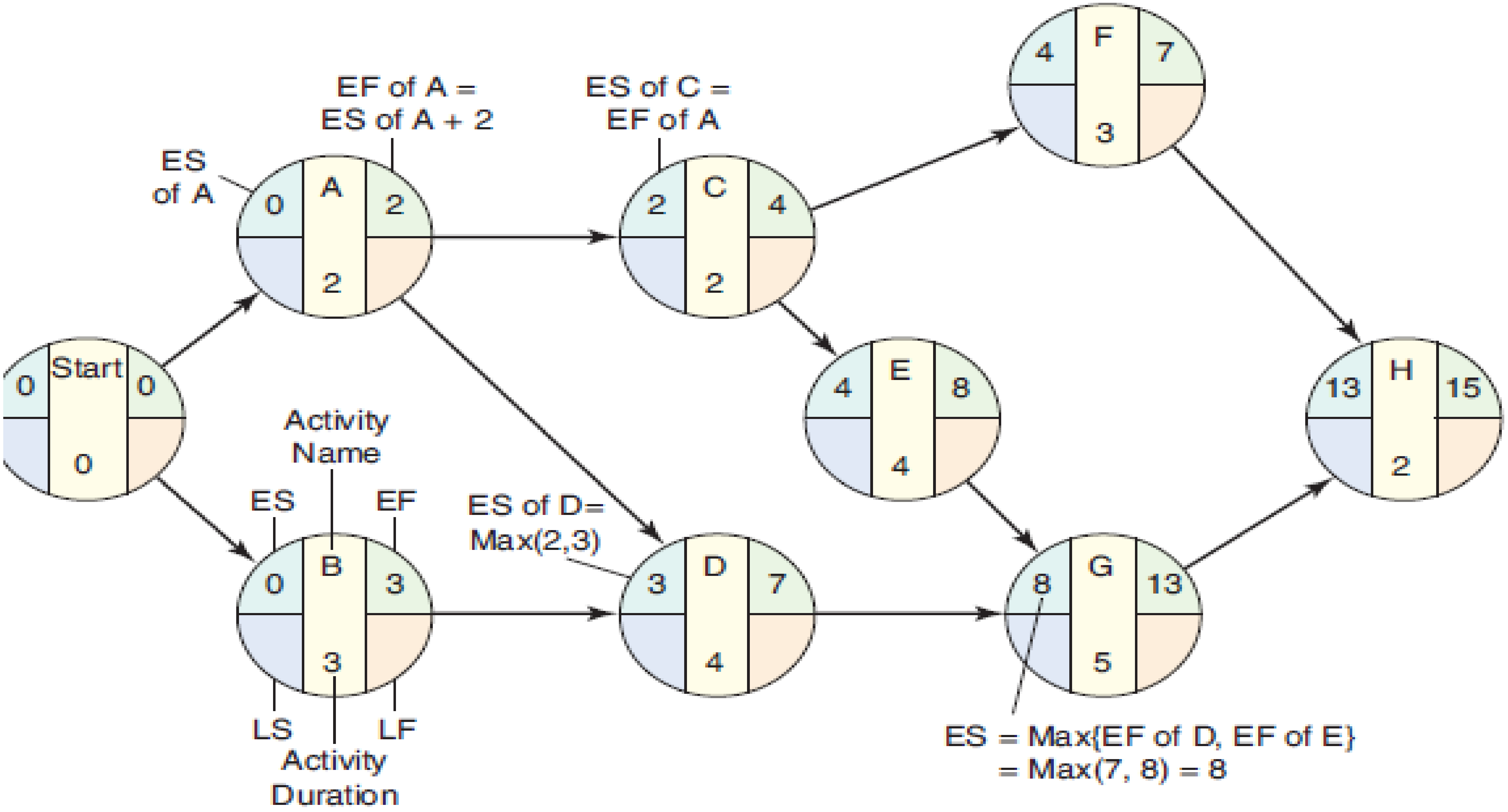
ES = Max {EF of all immediate predecessors} (3-1)

Earliest Finish Time Rule

The earliest finish time (EF) of an activity is the sum of its earliest start time (ES) and its activity time. That is:

EF = ES + Activity time (3-2)


Activity Name
or Symbol
Earliest
Start
A
Earliest
Finish
ES
EF
LS
LF
Latest
Start
2
Latest
Finish
Activity Duration

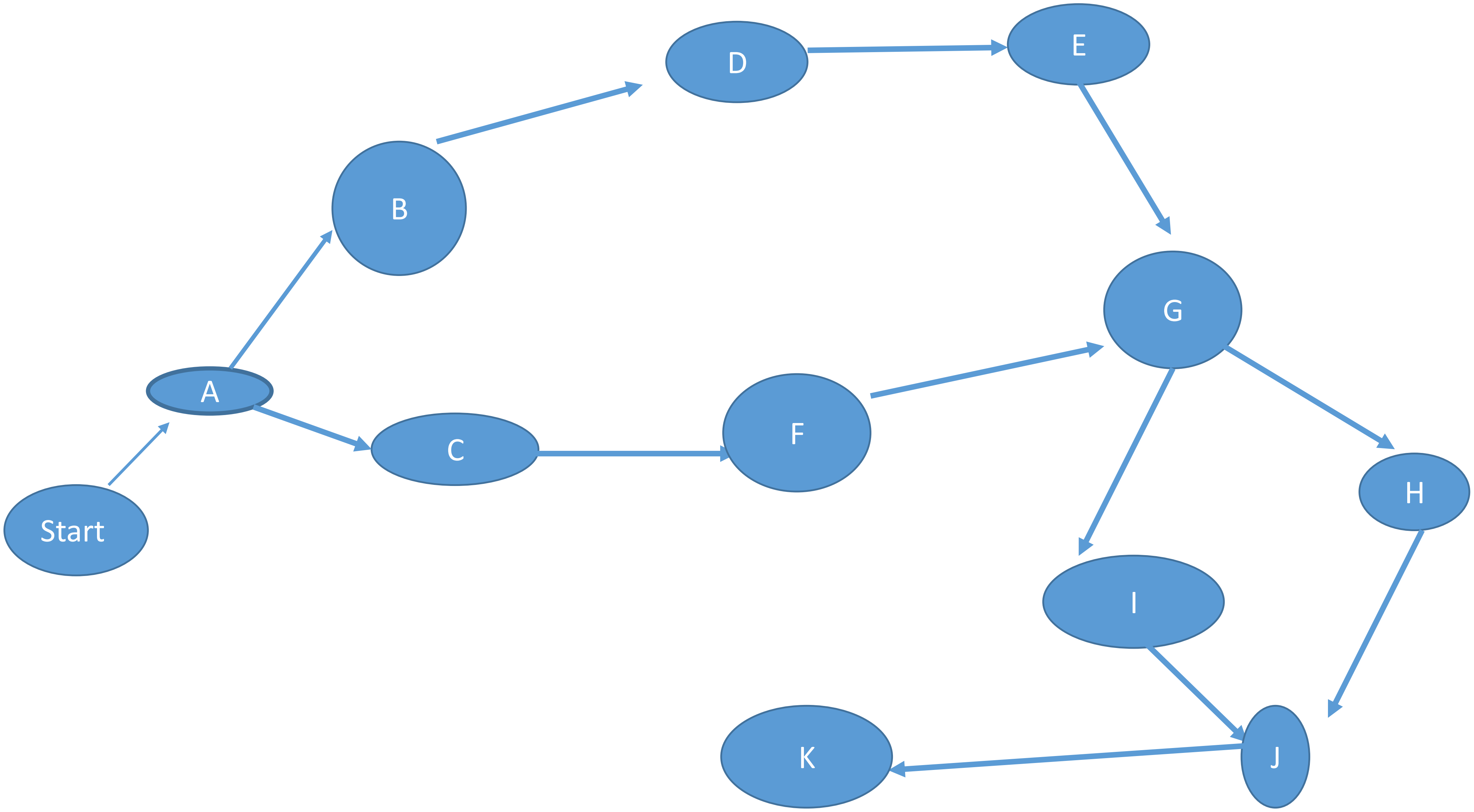

EF of A =
ES of A + 2
ES of C =
EF of A
ES
of A
0
A
2
2
2
C
4
2
4
F
7
3
0
Start
0
0
4
E
8
4
13
H
15
2
Activity
Name
ES
EF
ES of D=
Max(2,3)
0
B
3
3
3
D
7
4
8
G
13
5
LS
LF
Activity
Duration
ES = Max{EF of D, EF of E}
= Max(7, 8) = 8

Because H is the last activity in the project, this also implies that the earliest time in which the entire project can be completed is 15 weeks.

Classwork

Table below shows the activities, immediate predecessors and activity durations of a project. Draw the AON project network. How long would it take to complete this project? What is the length of the critical path?

ACTIVITY	IMMEDIATE PREDECESSOR(S)	TIME (DAYS)
A	—	2
B	A	4
C	A	4
D	B	6
E	D	9
F	C	8
G	E, F	2
H	G	2
I	G	3
J	H, I	4
K	J	4


Start
A
B
C
D
E
F
G
H
I
J
K

Homework

Jim Gilbert would like to determine the critical path for the project as well as the expected completion time for the total project. In addition, he would like to determine the earliest start and finish times for all activities.

Activity	WEEK	PREDESESSORS
A	2	--
B	1	--
C	3	A
D	3	B
E	4	C,D
F	6	D
G	3	E