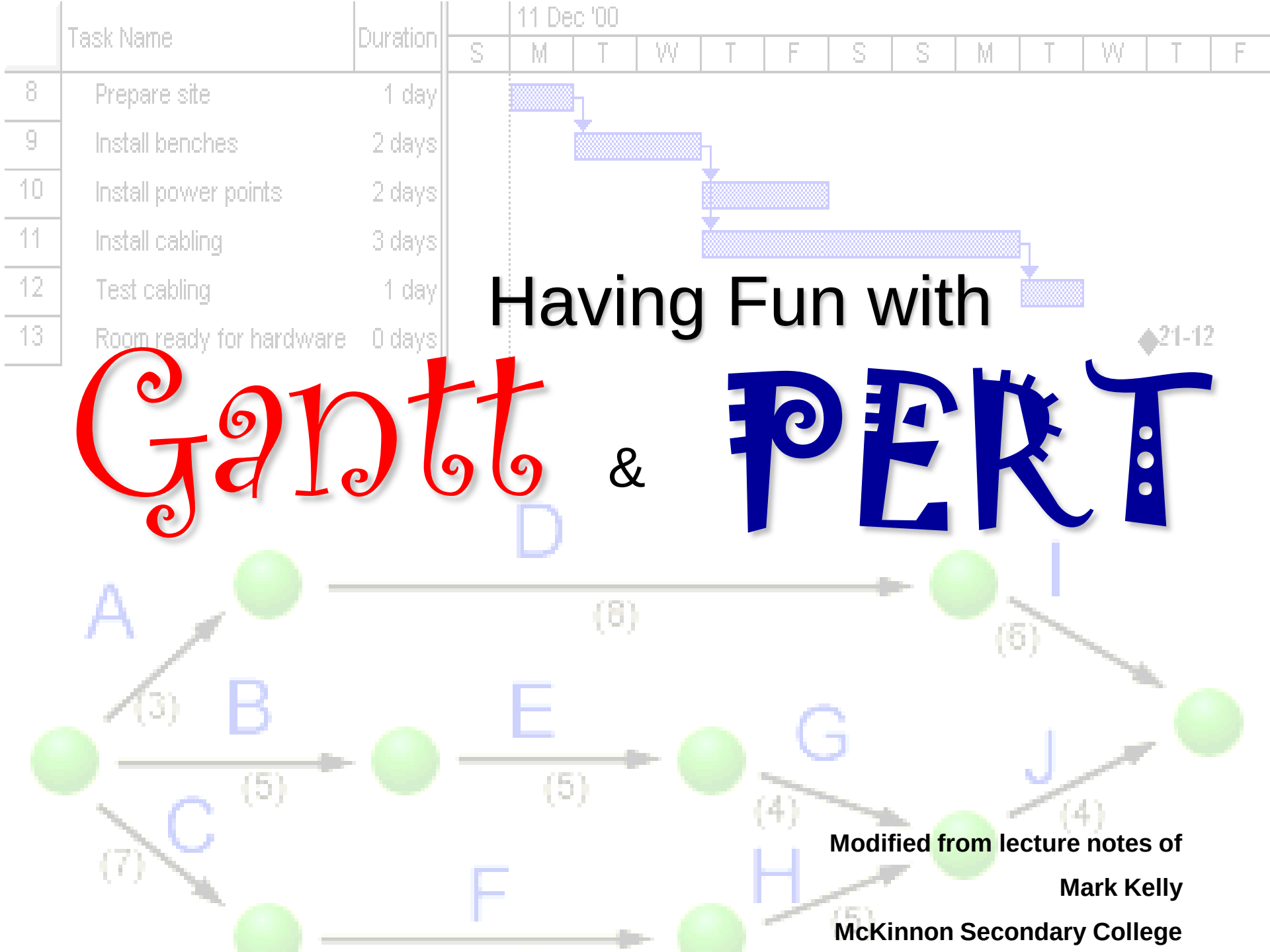


Modified from lecture notes of

Mark Kelly

McKinnon Secondary College

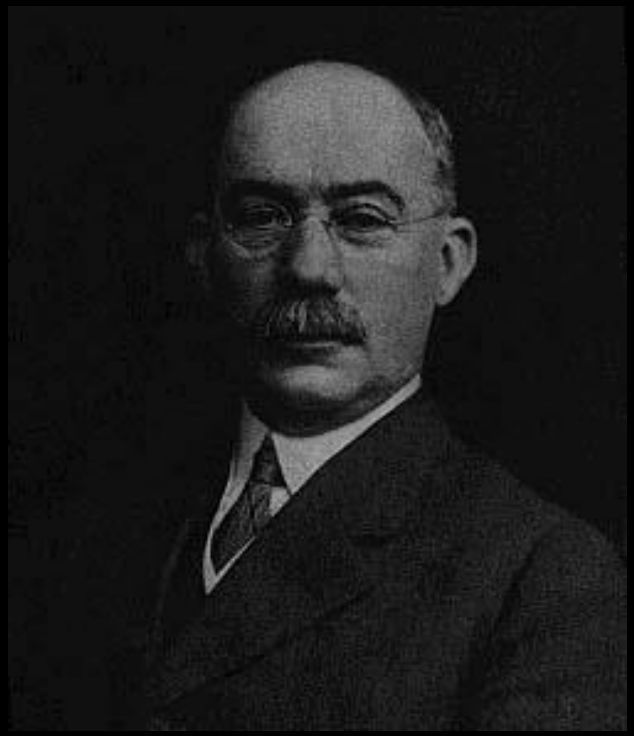
What are they?

Gantt and PERT charts are both “CPM” (Critical Path Method) tools to:

- manage the tasks involved in big and complex projects
- let project managers organise time, people, equipment and money
- ensure the right people and equipment are in the right place and the right time
- allow managers to monitor the progress of a project

Gantt Charts

Henry Laurence Gantt (1861-1919)

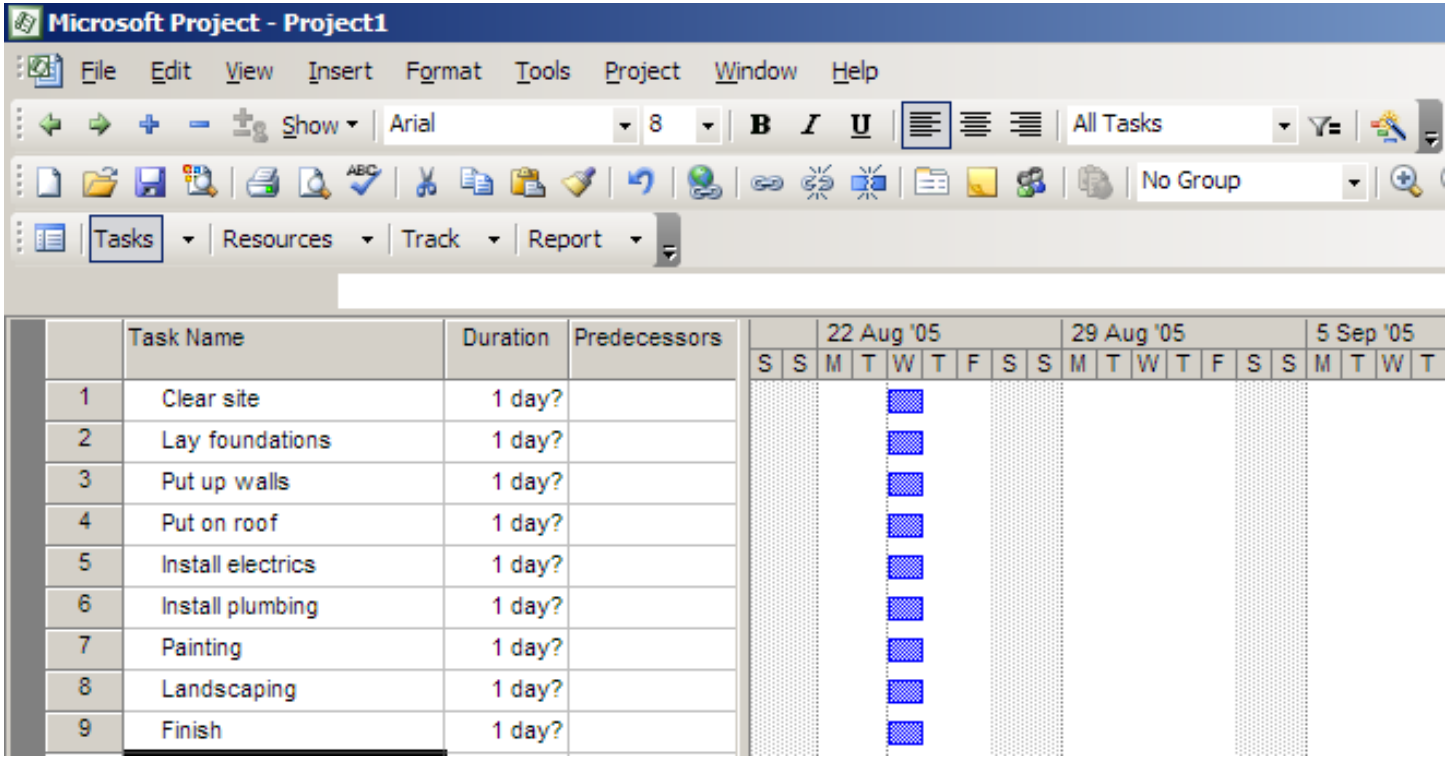


Gantt Basics

- Basically, a timeline with tasks that can be connected to each other
- Note the spelling!
- It is not all-capitals!
- Can be created with simple tools like Excel, but specialised tools like Microsoft Project make life easier

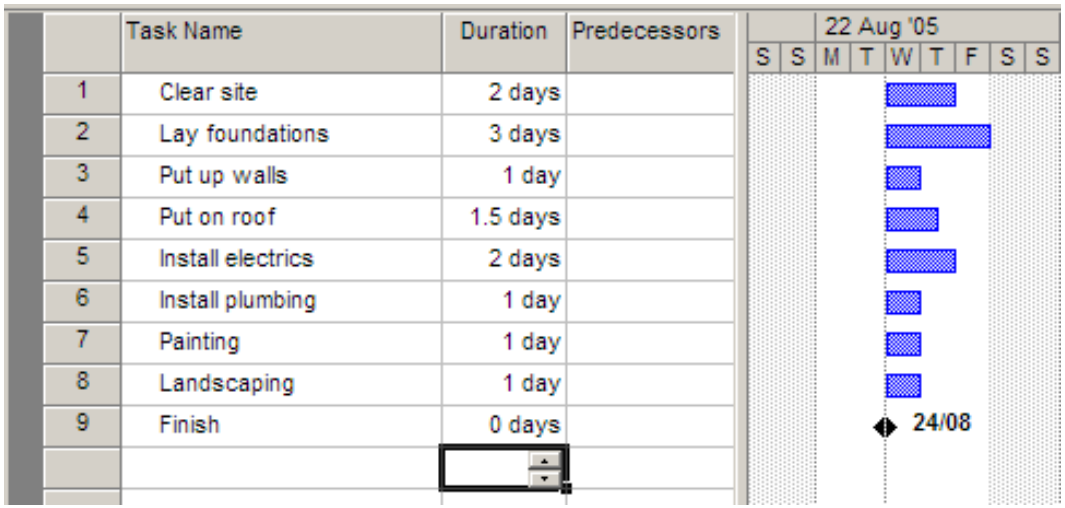
Making a Gantt chart

- Step 1 – list the tasks in the project



Making a Gantt chart

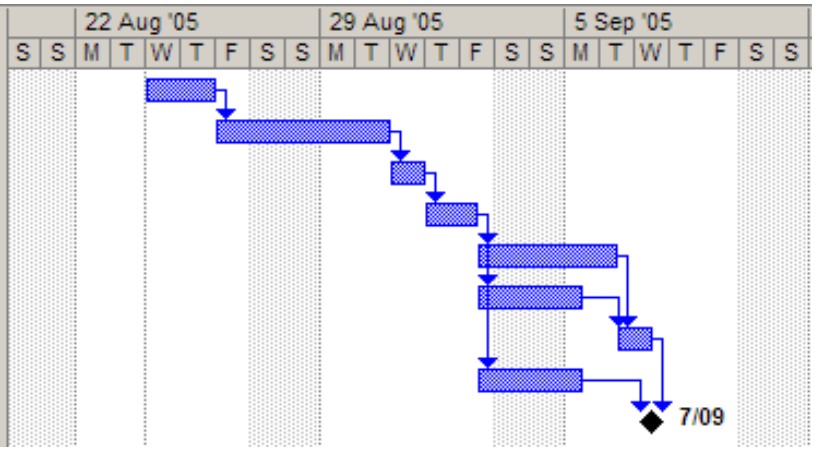
- Step 2 – add task durations



Making a Gantt chart

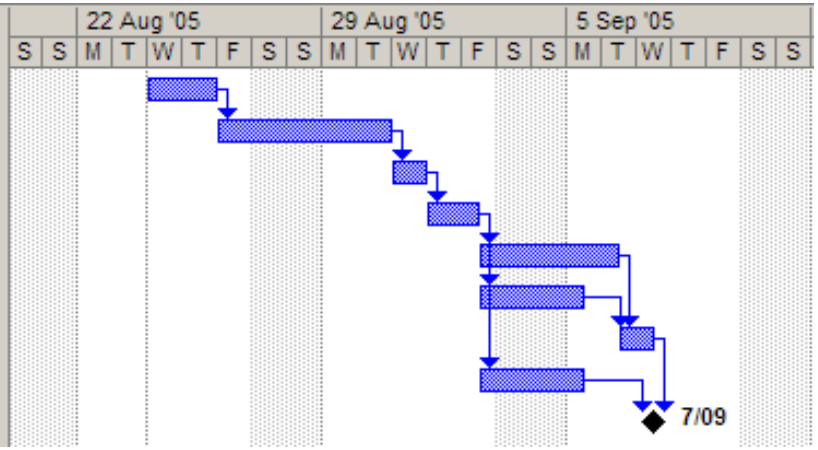
- Step 3 – add *dependencies* (which tasks cannot start before another task finishes)

	Task Name	Duration	Predecessors
1	Clear site	2 days	
2	Lay foundations	3 days	1
3	Put up walls	1 day	2
4	Put on roof	1.5 days	3
5	Install electrics	2 days	4
6	Install plumbing	1 day	4
7	Painting	1 day	5,6
8	Landscaping	1 day	4
9	Finish	0 days	8,7



Notes

	Task Name	Duration	Predecessors
1	Clear site	2 days	
2	Lay foundations	3 days	1
3	Put up walls	1 day	2
4	Put on roof	1.5 days	3
5	Install electrics	2 days	4
6	Install plumbing	1 day	4
7	Painting	1 day	5,6
8	Landscaping	1 day	4
9	Finish	0 days	8,7

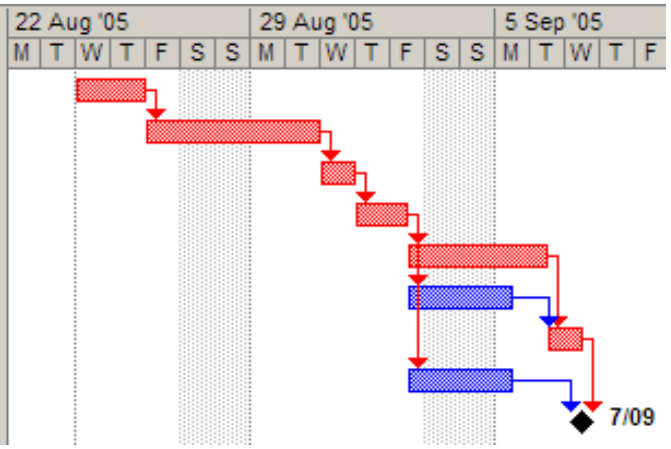


- The arrows indicate **dependencies**.
- Task 1 is a **predecessor** of task 2 – i.e. task 2 cannot start before task 1 ends.
- Task 3 is **dependent** on task 2. Task 7 is dependent on two other tasks
- Electrics, plumbing and landscaping are **concurrent** tasks and can happen at the same time, so they overlap on the chart. All 3 can start after task 4 ends.
- Painting must wait for both electrics and plumbing to be finished.
- Task 9 has zero duration, and is a **milestone**

Making a Gantt chart

- Step 4 – find the **critical path**

	Task Name	Duration	Predecessors
1	Clear site	2 days	
2	Lay foundations	3 days	1
3	Put up walls	1 day	2
4	Put on roof	1.5 days	3
5	Install electrics	2 days	4
6	Install plumbing	1 day	4
7	Painting	1 day	5,6
8	Landscaping	1 day	4
9	Finish	0 days	8,7



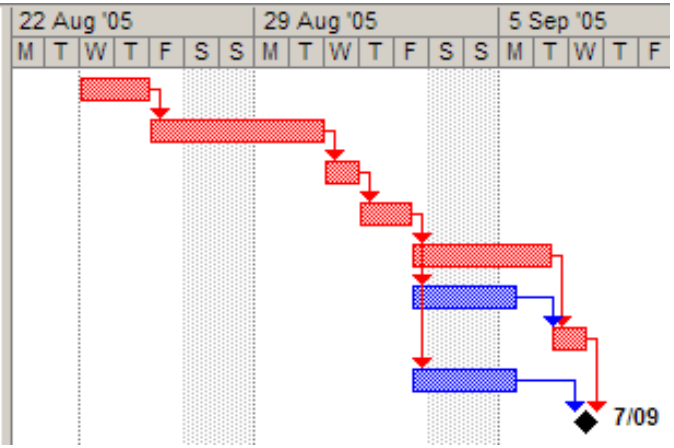
The critical path is the sequence of tasks from beginning to end that takes the **longest time** to complete.

It is also the **shortest possible time** that the project can be finished in.

Any task on the critical path is called a **critical task**.

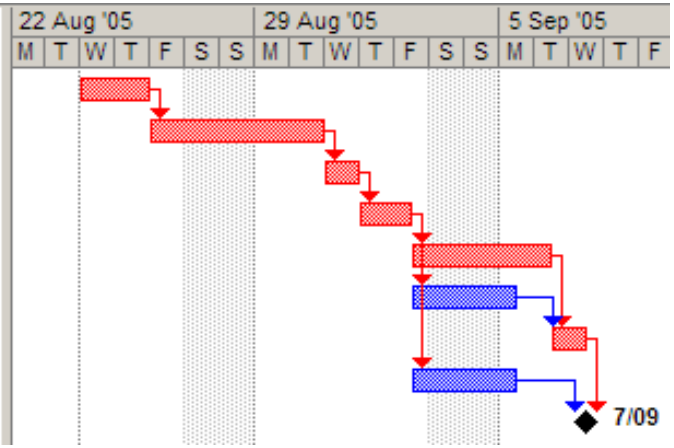
No critical task can have its duration changed without affecting the end date of the project.

	Task Name	Duration	Predecessors
1	Clear site	2 days	
2	Lay foundations	3 days	1
3	Put up walls	1 day	2
4	Put on roof	1.5 days	3
5	Install electrics	2 days	4
6	Install plumbing	1 day	4
7	Painting	1 day	5,6
8	Landscaping	1 day	4
9	Finish	0 days	8,7



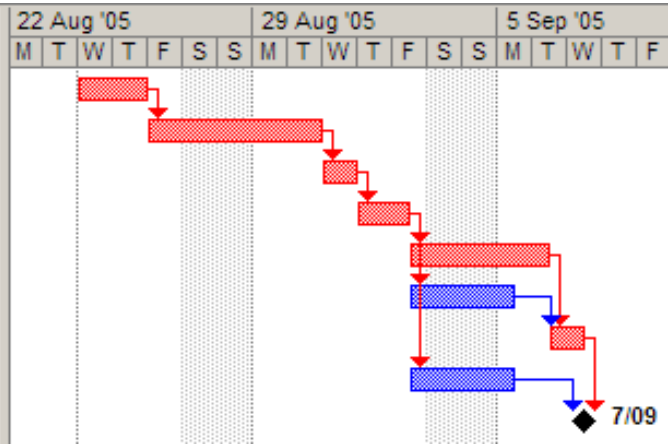
- MS Project can work out the critical path for you!
- The length of the critical path is the sum of the lengths of all critical tasks (the red tasks 1,2,3,4,5,7) which is 2+3+1+1.5+2+1 = 10.5 days.
- In other words, the minimum amount of time required to get all tasks completed is 10.5 days
- The other tasks (6,8) can each run over-time before affecting the end date of the project

	Task Name	Duration	Predecessors
1	Clear site	2 days	
2	Lay foundations	3 days	1
3	Put up walls	1 day	2
4	Put on roof	1.5 days	3
5	Install electrics	2 days	4
6	Install plumbing	1 day	4
7	Painting	1 day	5,6
8	Landscaping	1 day	4
9	Finish	0 days	8,7



- The amount of time a task can be extended before it affects other tasks is called *slack* (or *float*).
- *Float = Late Start – Early Start OR Late Finish – Early Finish*
- Task 6 can take an extra day and a half before it affects the project's end date, so each has **1.5 day's slack**.

	Task Name	Duration	Predecessors
1	Clear site	2 days	
2	Lay foundations	3 days	1
3	Put up walls	1 day	2
4	Put on roof	1.5 days	3
5	Install electrics	2 days	4
6	Install plumbing	1 day	4
7	Painting	1 day	5,6
8	Landscaping	1 day	4
9	Finish	0 days	8,7



Critical tasks, by definition, can have NO slack.

Thus if you are ever asked, "*Can the duration of a critical task be changed without affecting the end date of the project?"*, the answer is always **NO**!

PERT Charts

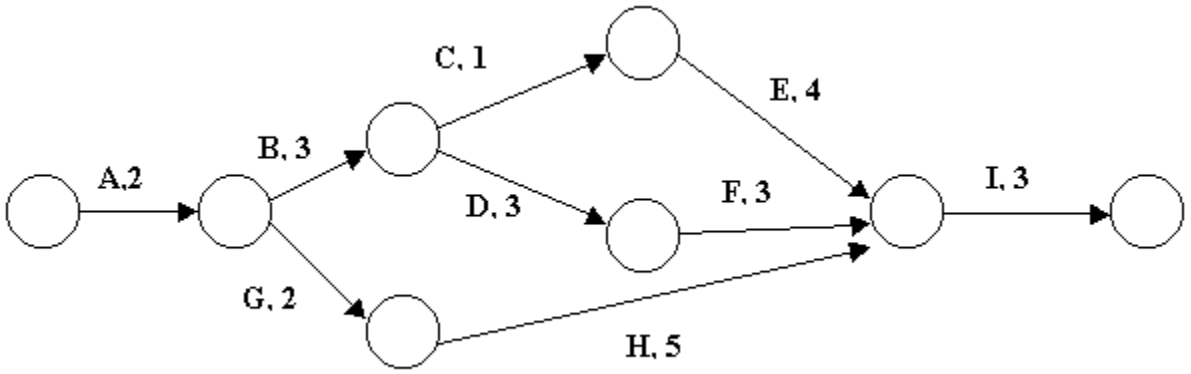
***Not* named after Mr Pert!**

Stands for Program Evaluation and Review Technique

PERT basics

- PERT is an acronym so it's in capital letters
- Gantt is a name, so only has an initial capital
- In Gantt chart, the length of a task's bar is proportional to the length of the task. This rarely applies to PERT charts.
- There are a few different "flavours" of PERT and Gantt charts…

PERT charts



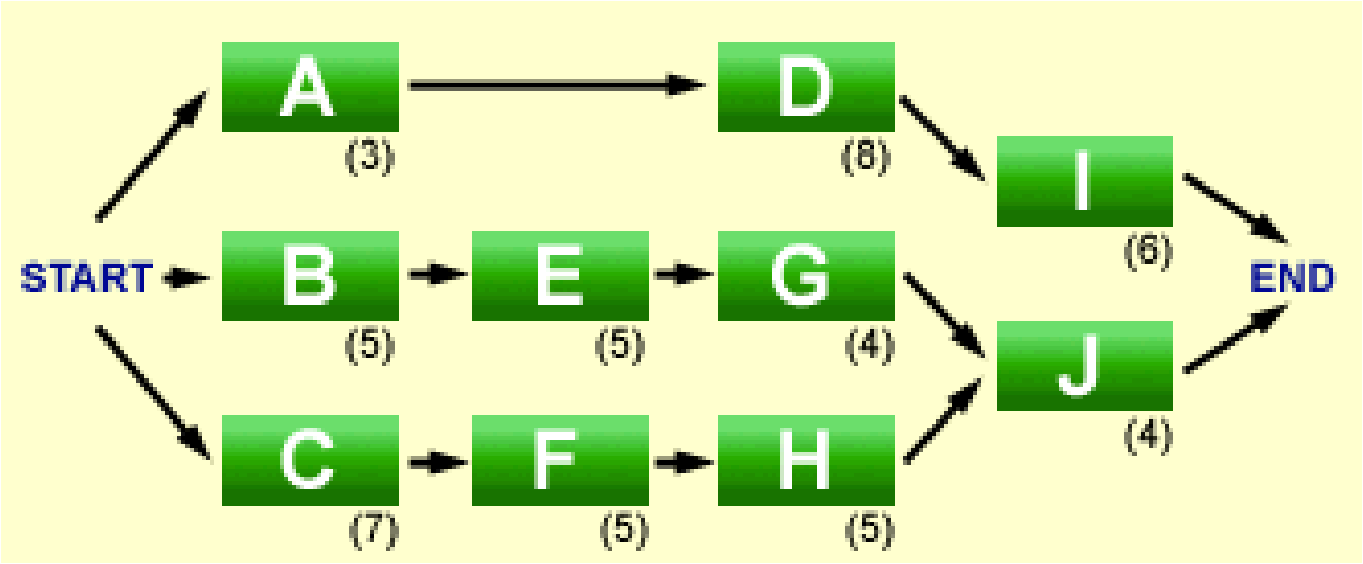
This PERT chart follows the “Activity on Arrow” style.

•The tasks are shown by **arrows**. Task name are shown by letters, in this case.

•The circles are called ***nodes***. The nodes indicate the *start* or *end* of tasks.

•Task durations are the shown by the numbers.

‘Activity on Node’ style PERT



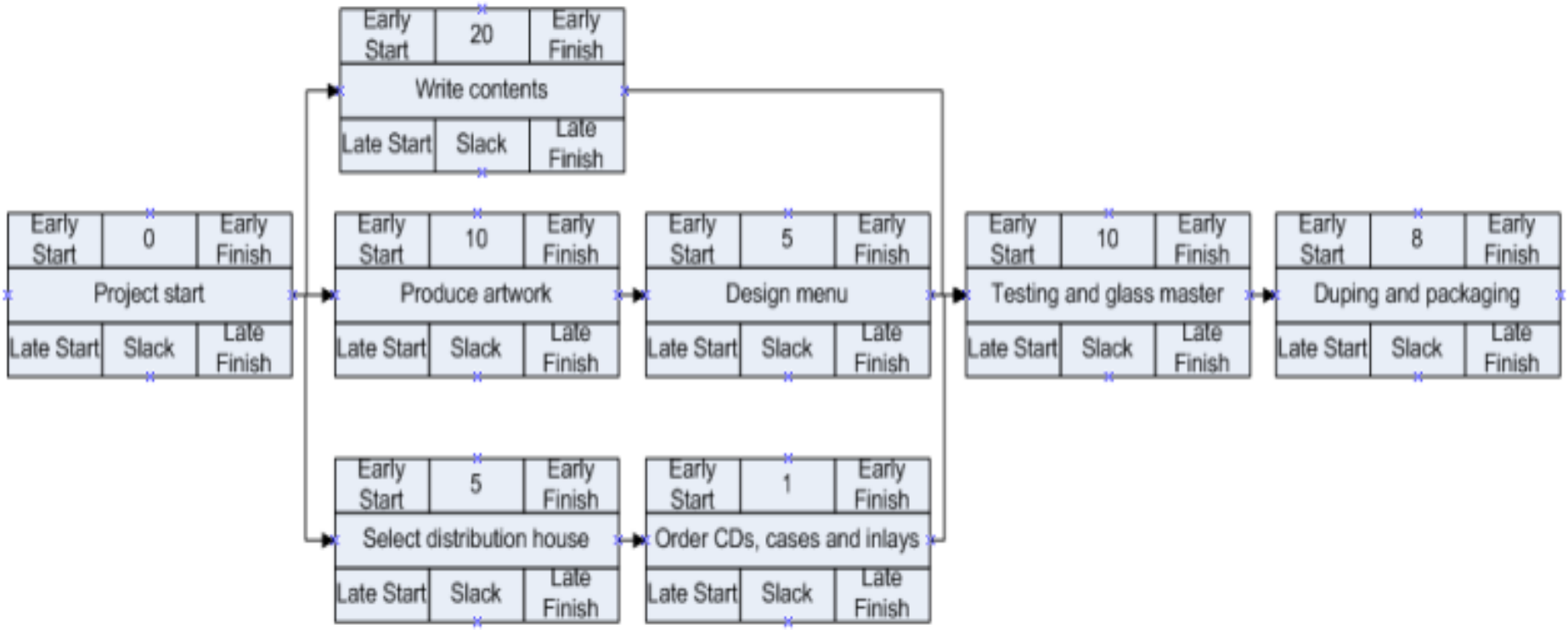
Activity on Node is a different flavour of PERT: this time the *nodes* are tasks, and the *arrows* are merely connectors. We will use *Activity on Arrows,* with the nodes merely connecting points. It’s a style issue!

Sidebar…

Activity	Predecessor	Time estimates			Expected time
		Opt. (*O*)	Normal (*M*)	Pess. (*P*)	
A	—	2	4	6	4.00
B	—	3	5	9	5.33
C	*A*	4	5	7	5.17
D	*A*	4	6	10	6.33
E	*B*, *C*	4	5	7	5.17
F	*D*	3	4	8	4.50
G	*E*	3	5	8	5.17

- *expected time* (T_E): the best estimate of the time required to accomplish a task, accounting for the fact that things don't always proceed as normal (the implication being that the expected time is the average time the task would require if the task were repeated on a number of occasions over an extended period of time).

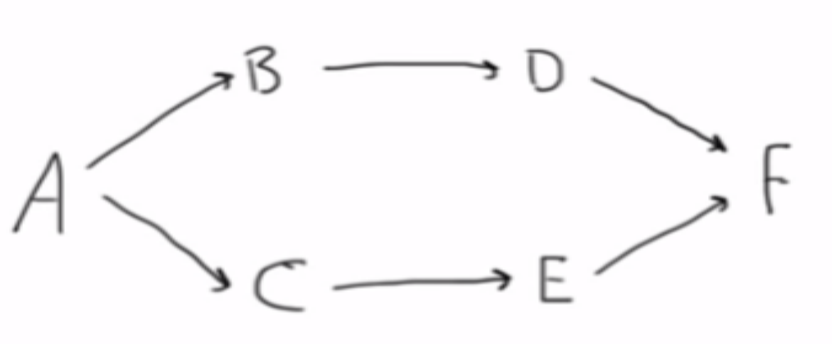
  $$T_E = (O + 4M + P) \div 6$$


Early Start
Duration
Early Finish
Task Name
Late Start
Slack
Late Finish
Early Start
20
Early Finish
Write contents
Late Start
Slack
Late Finish
Early Start
0
Early Finish
Project start
Late Start
Slack
Late Finish
Early Start
10
Early Finish
Produce artwork
Late Start
Slack
Late Finish
Early Start
5
Early Finish
Design menu
Late Start
Slack
Late Finish
Early Start
10
Early Finish
Testing and glass master
Late Start
Slack
Late Finish
Early Start
8
Early Finish
Duping and packaging
Late Start
Slack
Late Finish
Early Start
5
Early Finish
Select distribution house
Late Start
Slack
Late Finish
Early Start
1
Early Finish
Order CDs, cases and inlays
Late Start
Slack
Late Finish

- *Early Start – The earliest time that an activity can start*
- *Early Finish – The earliest time that an activity can finish*
- *Late Start – The latest time that an activity can start*
- *Late Finish – The latest time that an activity can finish*

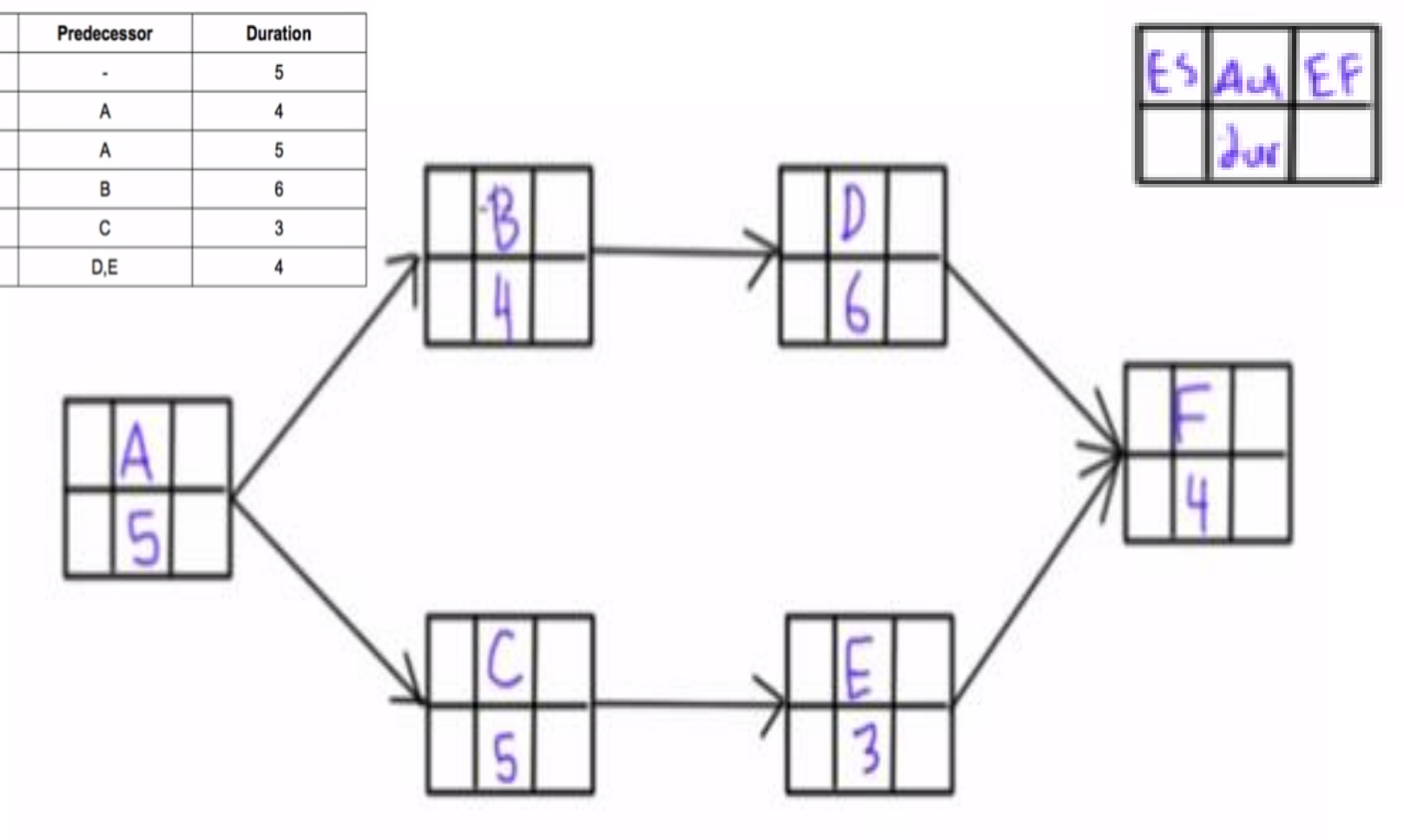
Example: Activity Network

Activity	Predecessor	Duration
A	-	5
B	A	4
C	A	5
D	B	6
E	C	3
F	D,E	4



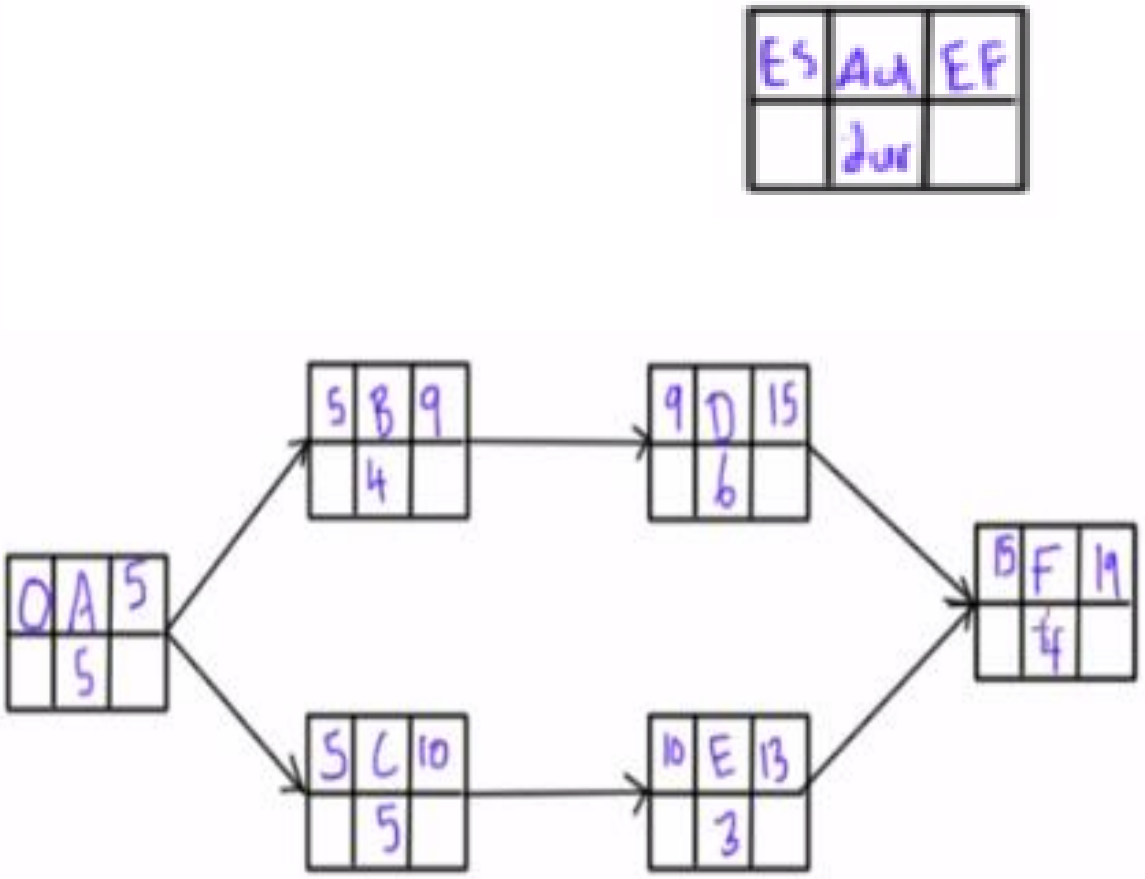
Example: Activity Network

Activity	Predecessor	Duration
A	-	5
B	A	4
C	A	5
D	B	6
E	C	3
F	D,E	4



Example: Activity Network- Early Start and Early finish

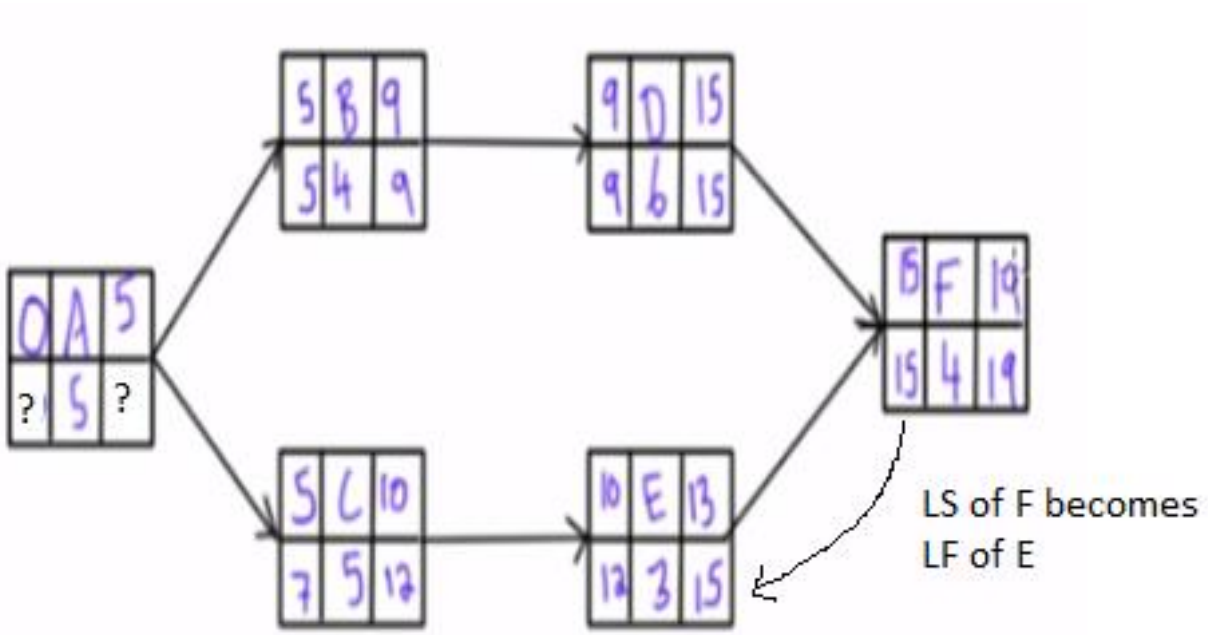
Activity	Predecessor	Duration
A	-	5
B	A	4
C	A	5
D	B	6
E	C	3
F	D,E	4



A,B,D,F = 5+4+6+4=19
A,C,E,F= 5+5+3+4= 17

Therefore, ABDF is critical path

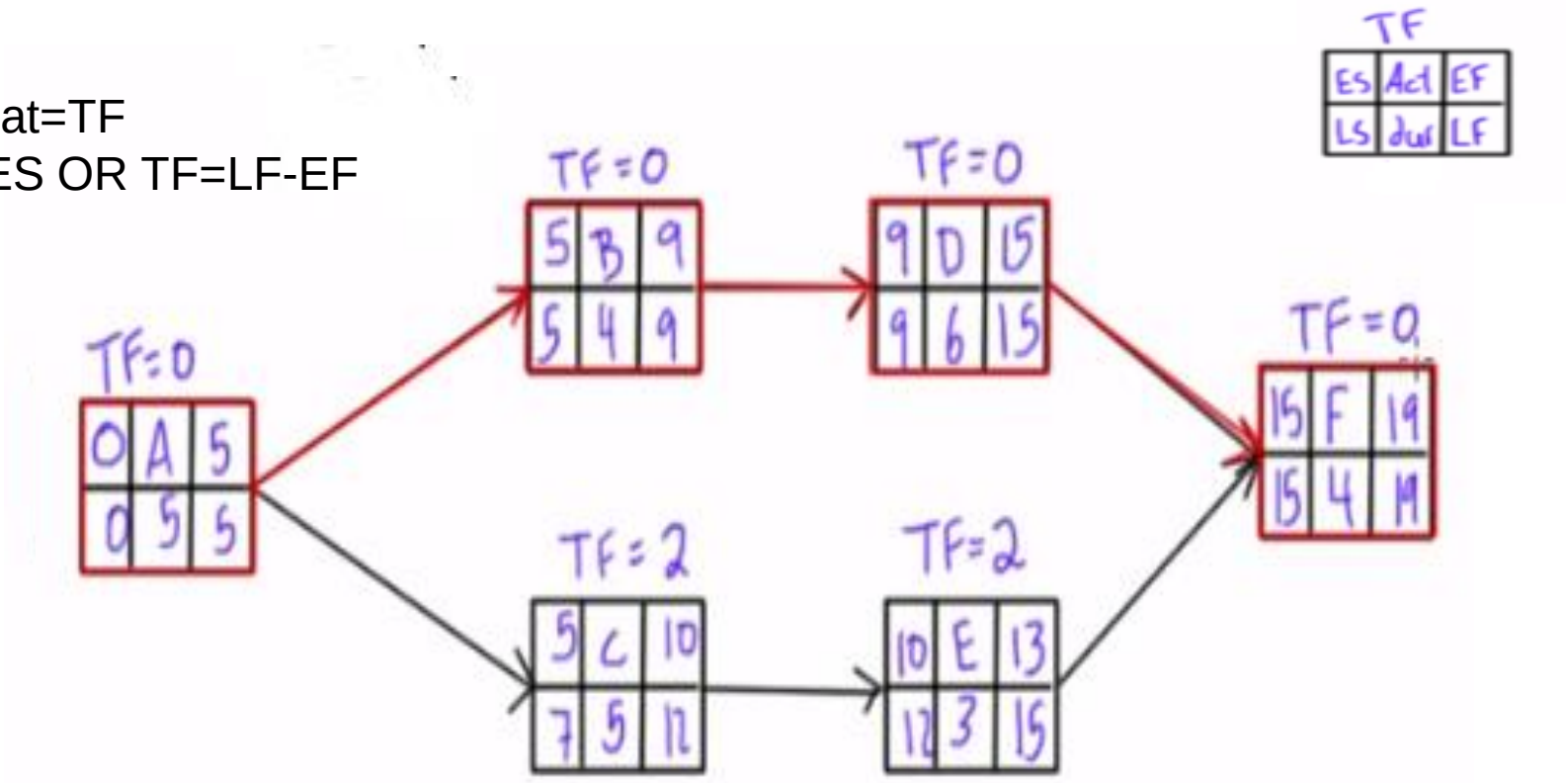
Example: Activity Network- Late Start and Late finish



Example: Activity Network- Total Float(Slack)

Total float is how long an activity can be delayed, without delaying the project completion date. On a critical path, the total float is zero.

Total Float=TF
TF=LS-ES OR TF=LF-EF



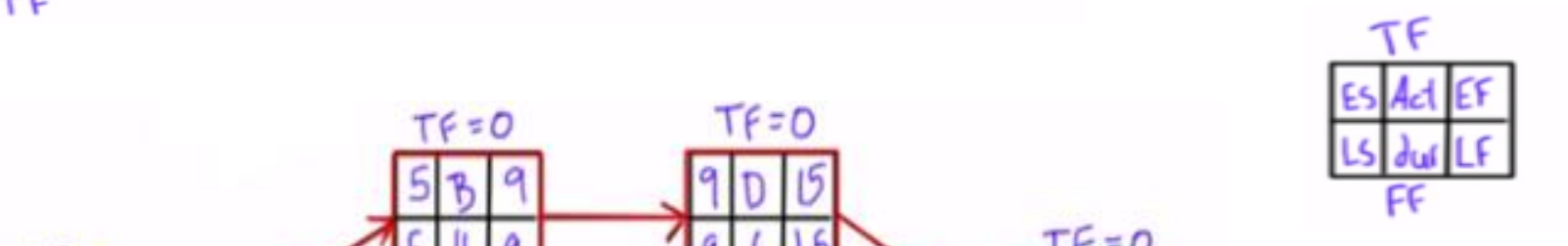
Example: Activity Network- Free Float(Slack)

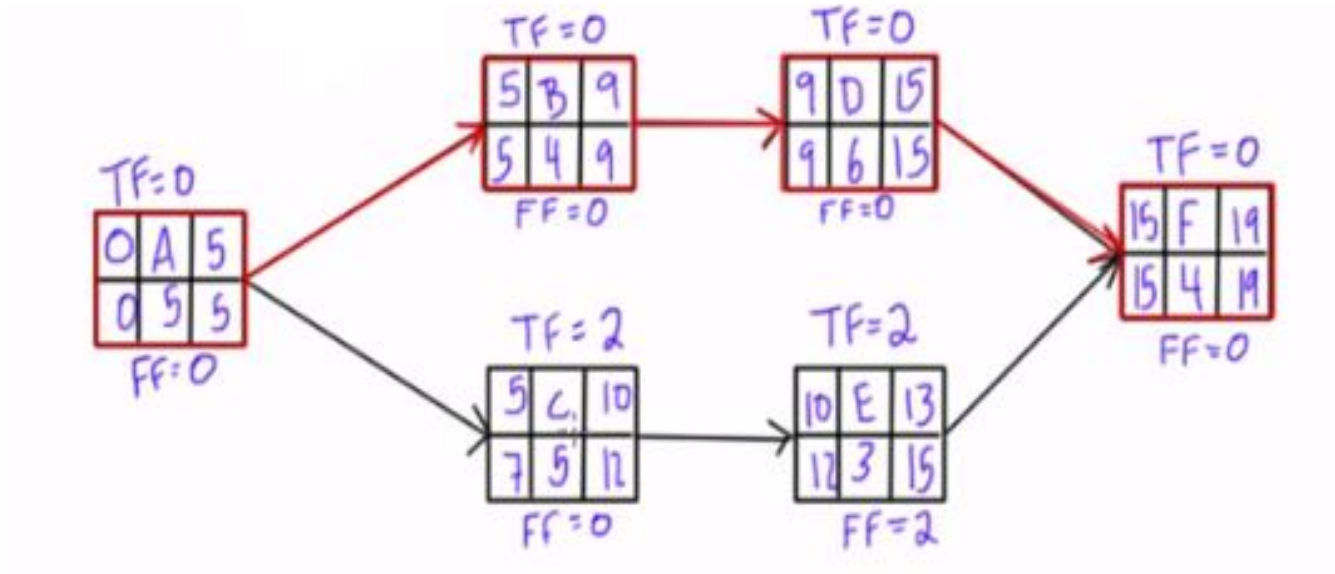
Free float is how long an activity can be delayed, without delaying the Early Start of its successor activity.

Free Float = FF = Minimum $ES_{successors}$ − $ES_{Activity}$ − $Duration_{Activity}$

FF ≤ TF

Or FF= ES(successor) – EF (activity)





Some terminologies

- Buffer also referred to as Schedule Margin, Schedule Buffer, Contingency, Reserve, etc... is an activity or period of time that is strategically placed on the Critical Path, typically prior to the agreed upon completion or delivery date.
- Lead
- The amount of time whereby a successor activity can be advanced with respect to a predecessor activity.
- Lag
- The amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.

Credits

- Mark Kelly, McKinnon Secondary College
- Lecture Notes