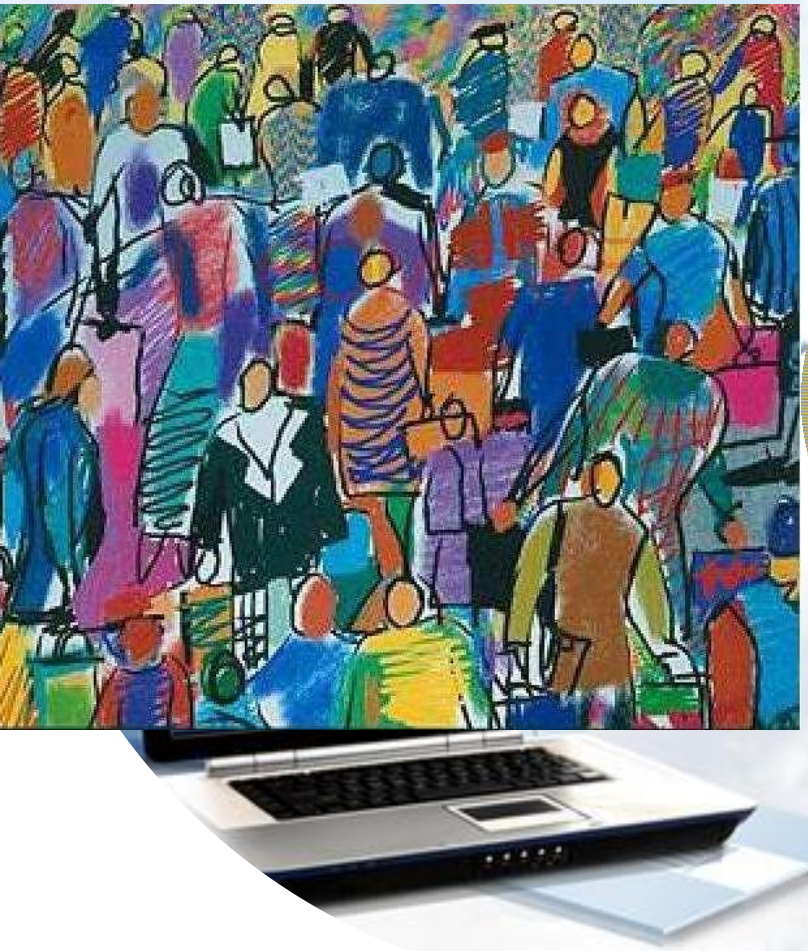
Software Project Management



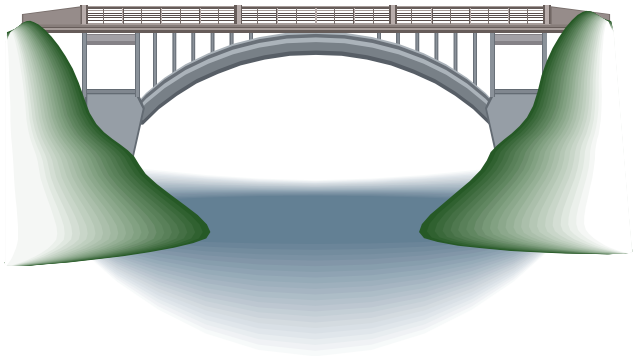
Review

Section 1.1: Project and Project Management

What is Project?

A project is a **temporary** endeavor undertaken to create a **unique** product, service, or result

---PMBOK Guide



Section 1.1: Project and Project Management

What is Project Management?

Five group progress and ten knowledge area mapping

Project management is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements

47 logically grouped project management processes, which are categorized into 5 process groups

Five process groups

Software Project Management

What?

Software Project Management is a system management method based on software project, which uses the relevant knowledge, techniques and tools for planning, organizing, advising and controlling each stage of software project cycle to achieve the project objectives.

Structure of this course

	5 process groups				
10 knowledge areas	Initiating	Planning	Executing	Monitoring & Controlling	Closing
1. Integration management					
2. Scope					
3. Time					
4. Cost					
5. Quality					
6. Human resource					
7. Communications					
8. Risk					
9. Procurement					
10. Stakeholder					

Project Management Process Group and Knowledge Area Mapping

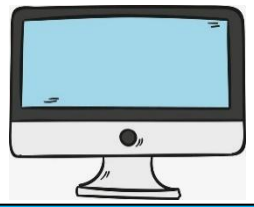
5 process groups

10 knowledge areas

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Time Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Resources 6.5 Estimate Activity Durations 6.6 Develop Schedule		6.7 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Perform Quality Assurance	8.3 Control Quality	
9. Project Human Resource Management		9.1 Plan Human Resource Management	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Control Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Control Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	12.4 Close Procurements
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Management	13.3 Manage Stakeholder Engagement	13.4 Control Stakeholder Engagement	

47 processes

47 Processes



Input → Tools & Techniques → Output

I

T&T

O

Project Management Plan

- **Project Management Plan: It is the document that describes how the project will be executed, monitored, and controlled.**
  - **It integrates and consolidates all of the subsidiary plans and baselines from the planning processes.:**

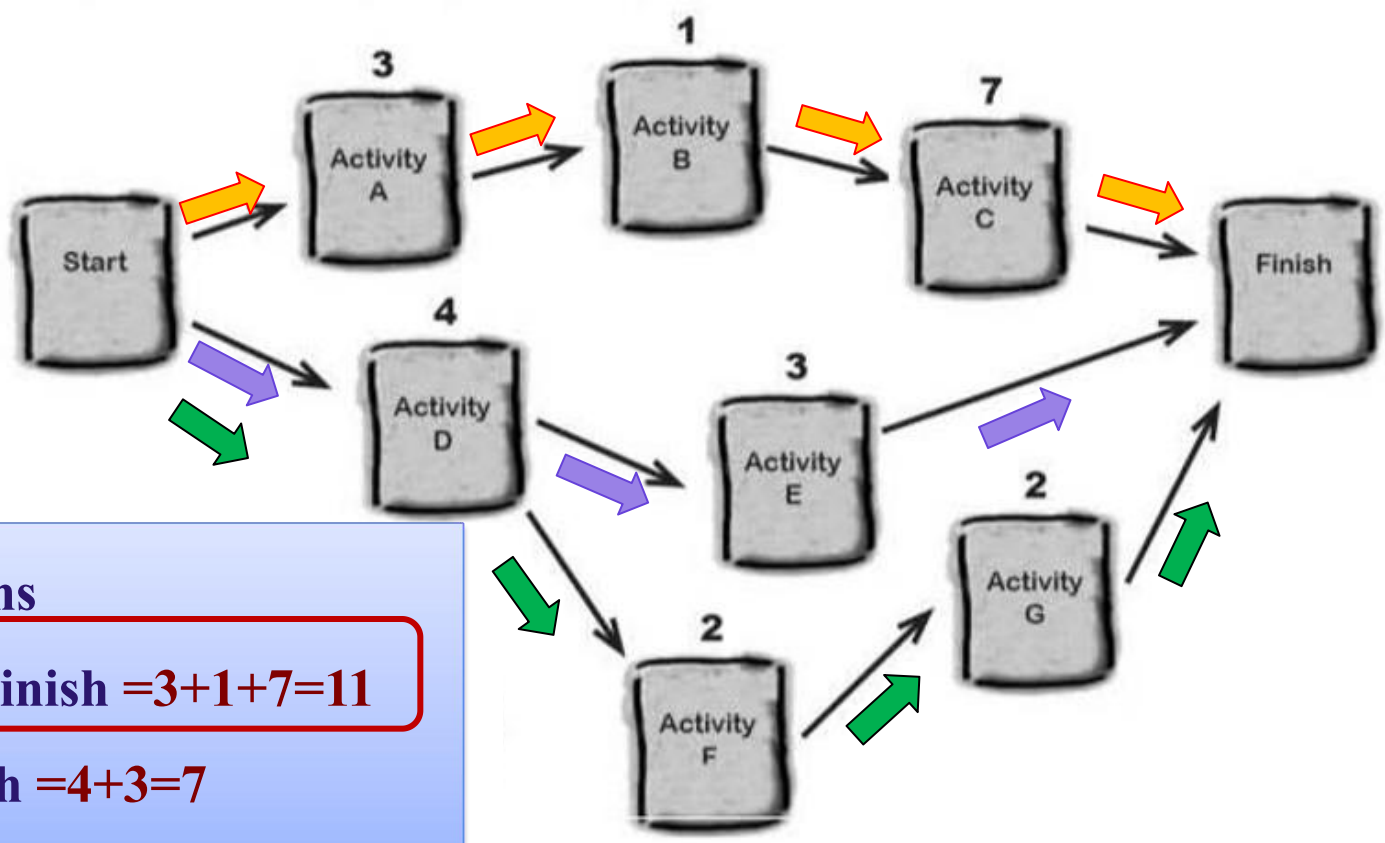
Baseline

- Scope baselines
- Schedule baselines
- Cost baselines

Subsidiary plans

- Scope management plan
- Requirements management plan
- Schedule management plan
- Cost management plan
- Quality management plan
- Process improvement plan
- Human resource management plan
- Communication management plan
- Risk management plan
- Procurement management plan
- Stakeholder management plan

Critical Path



There are three paths

Start->A->B->C->Finish =3+1+7=11

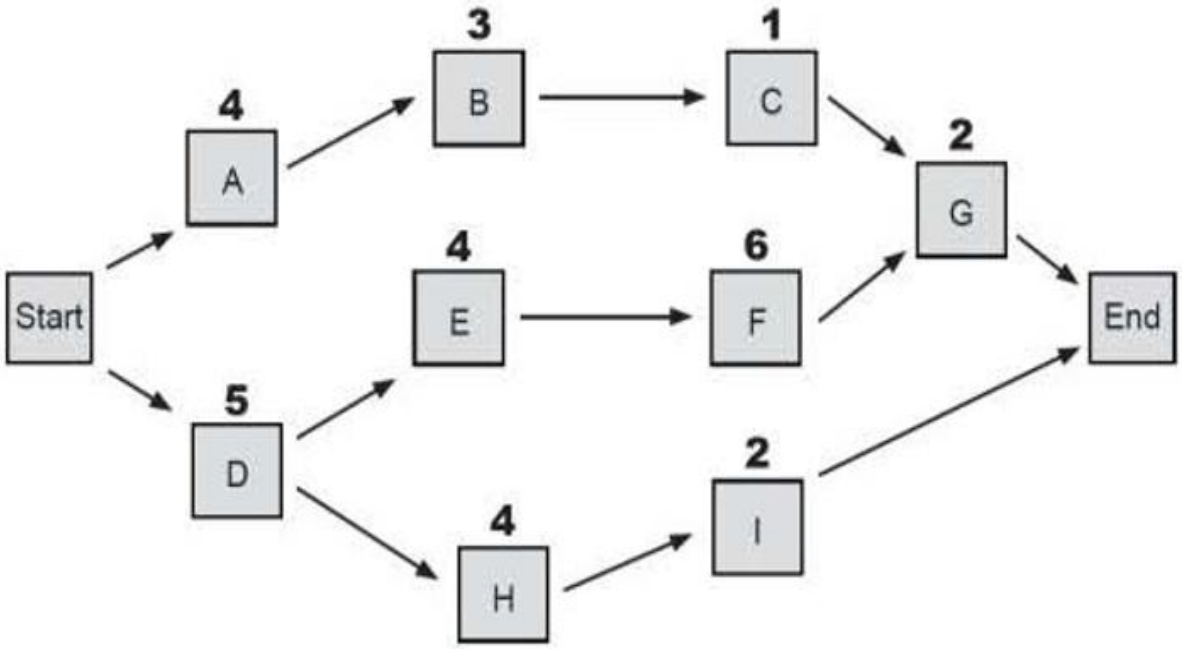
Start->D->E->Finish =4+3=7

Start->D->F-G->Finish =4+2+2=8

Duration of Critical Path=11

The critical path is the sequence of activities that represents the longest path through a project, which determines the shortest possible project duration.

Critical Path



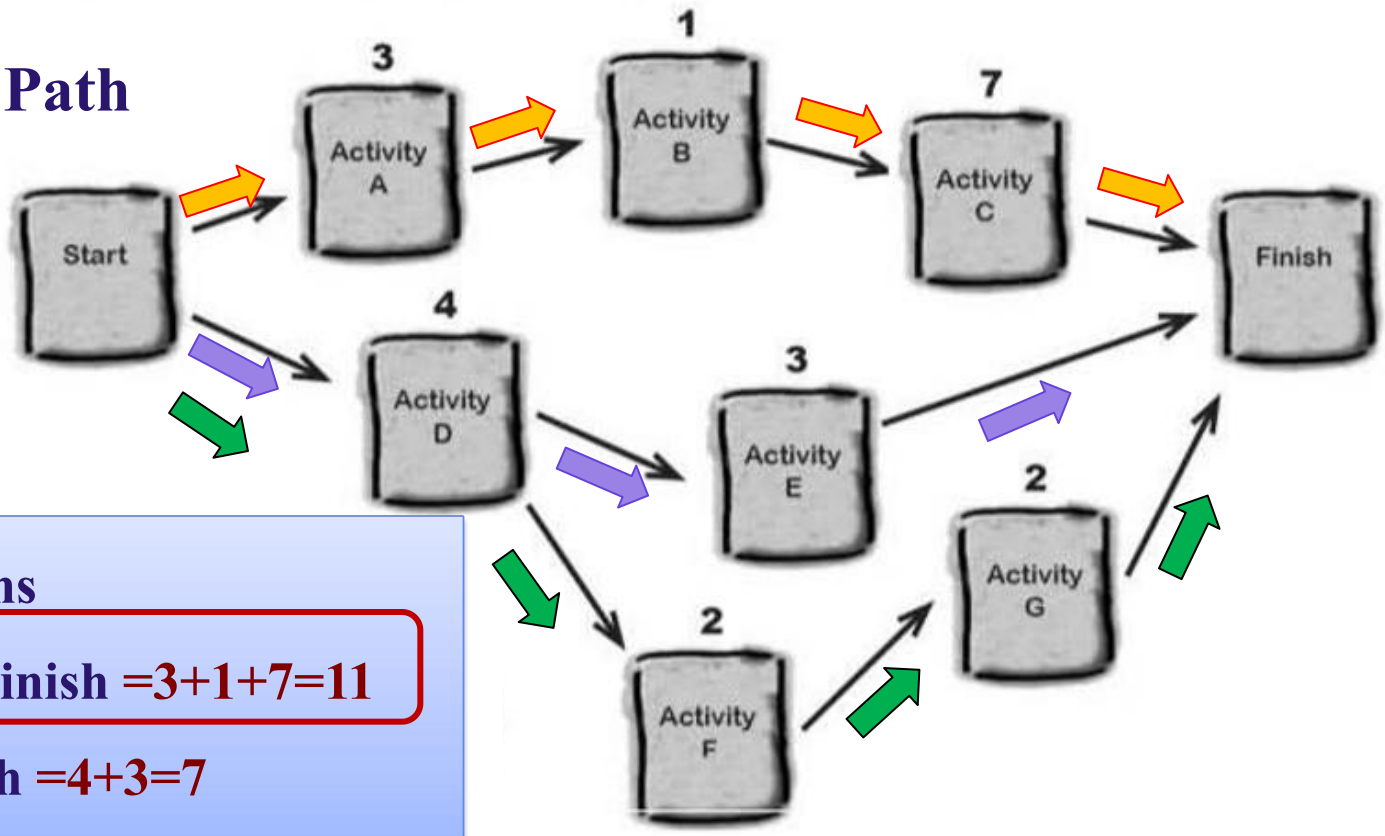
Total number of Paths 3

Critical path Start->D->E->F->G->End

Duration of Critical Path 17

Float

Critical Path



There are three paths

Start->A->B->C->Finish =3+1+7=11

Start->D->E->Finish =4+3=7

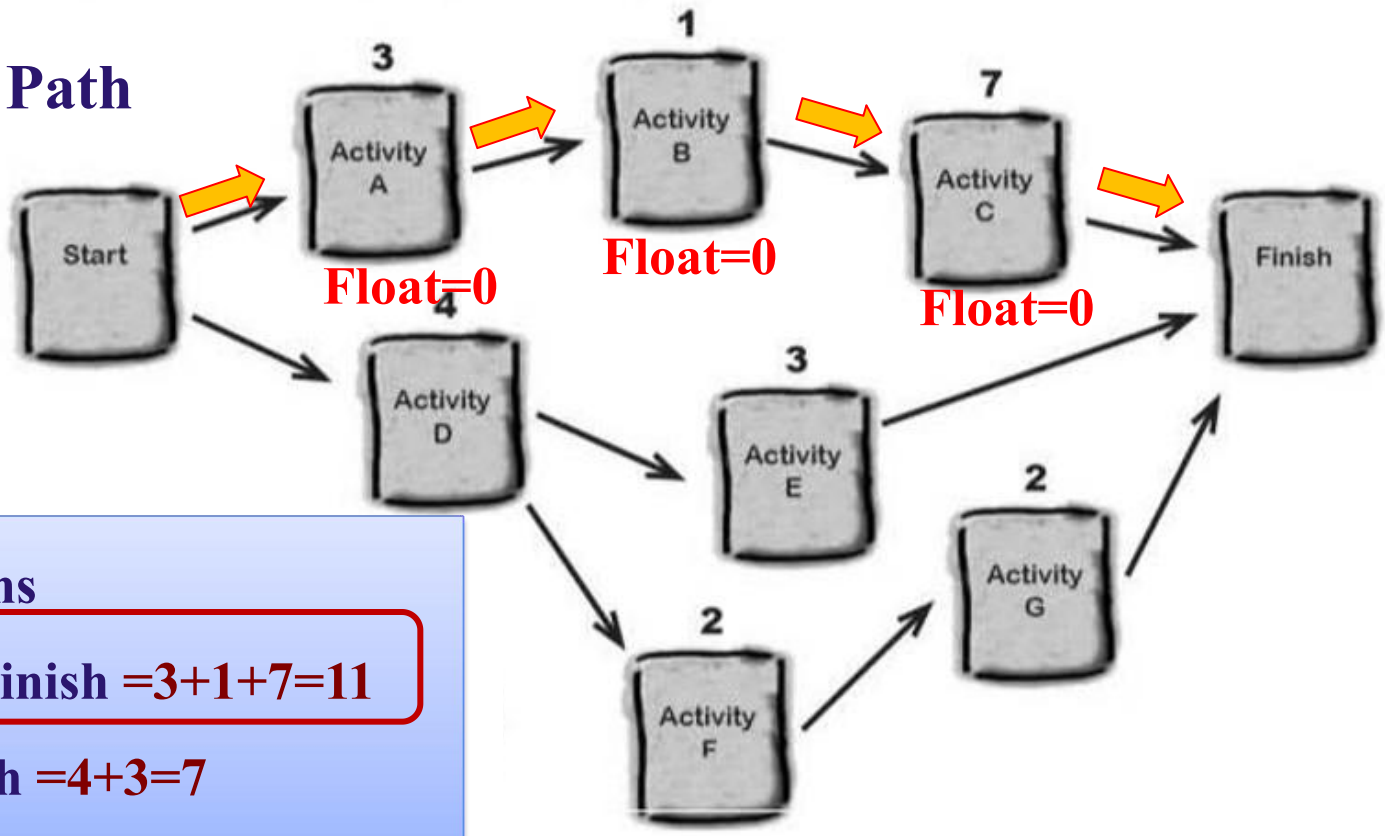
Start->D->F-G->Finish =4+2+2=8

❖ Step1: find critical path

Total float?

Float

Critical Path



There are three paths

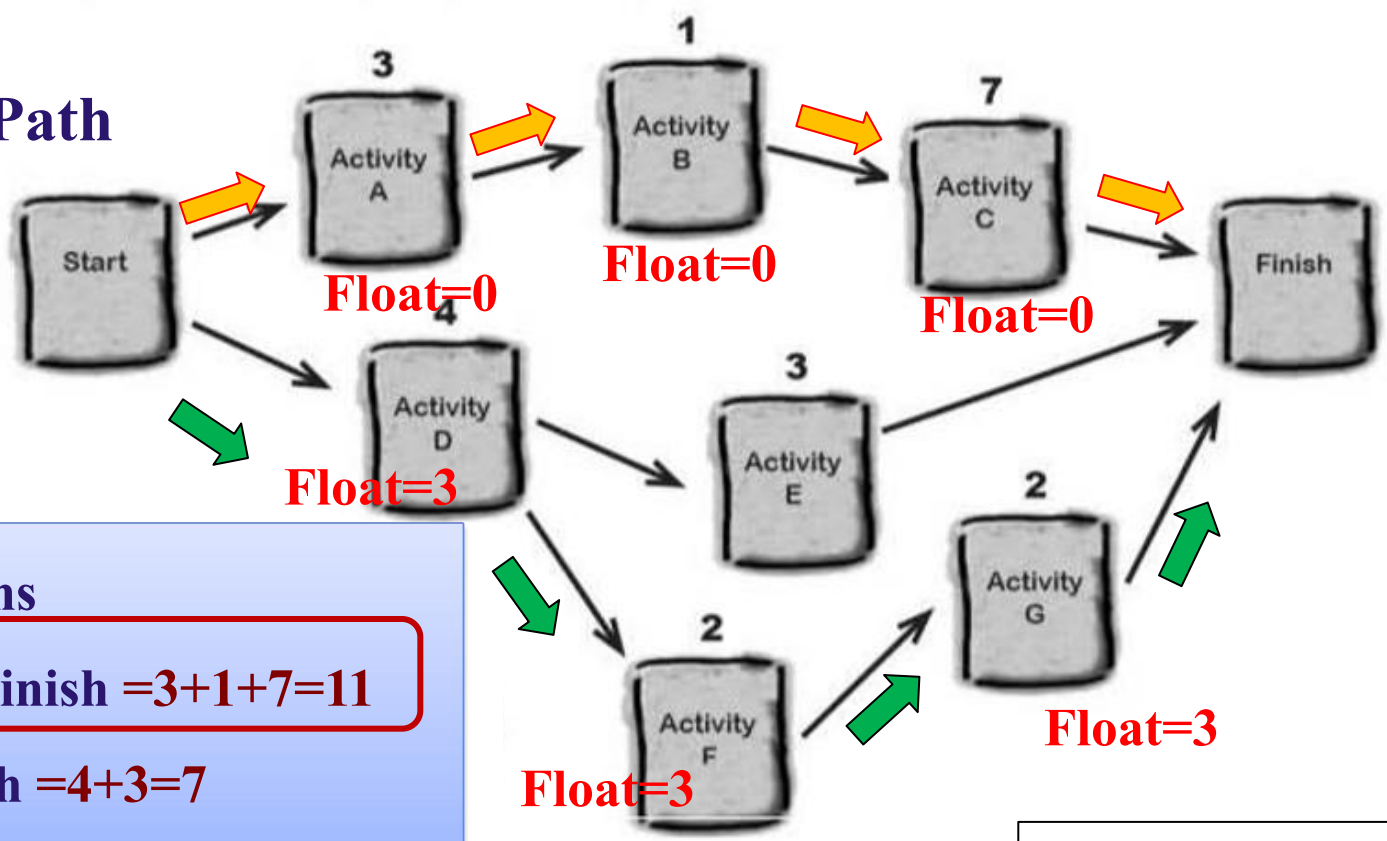
Start->A->B->C->Finish =3+1+7=11

Start->D->E->Finish =4+3=7

Start->D->F-G->Finish =4+2+2=8

❖ Step2: the float for each of the activities on the critical path is zero

Float



There are three paths

Start->A->B->C->Finish =3+1+7=11

Start->D->E->Finish =4+3=7

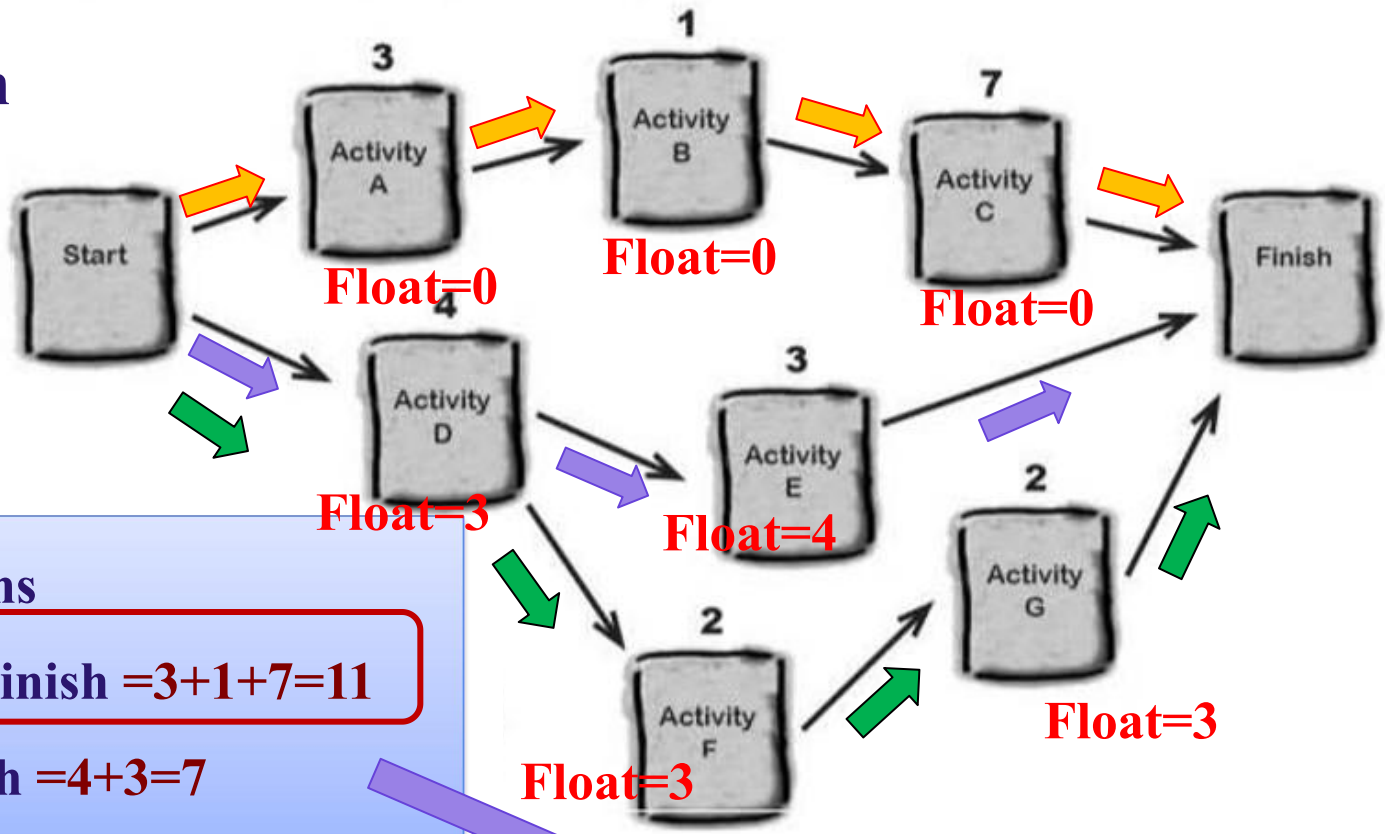
Start->D->F-G->Finish =4+2+2=8

11-8=3 DFG

- Step3: find the next longest path. Subtract its duration from the duration of the critical path, and that's the float for each activity on it.

Float

Critical Path



There are three paths

Start->A->B->C->Finish =3+1+7=11

Start->D->E->Finish =4+3=7

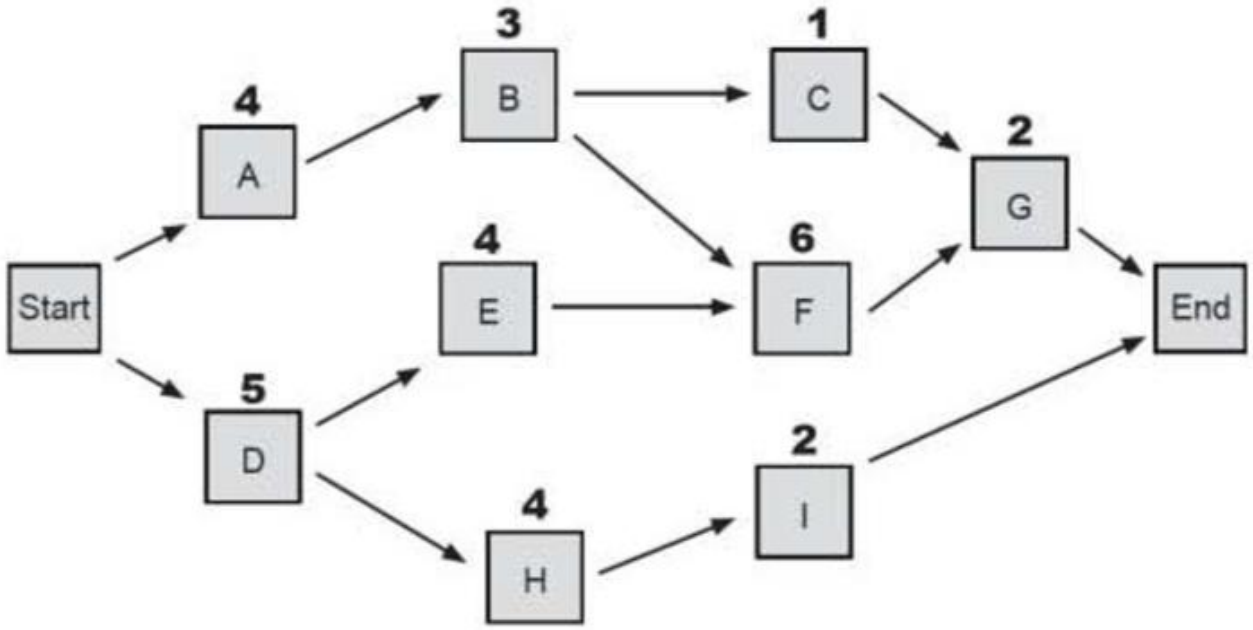
Start->D->F-G->Finish =4+2+2=8

11-7=4 E

❖ Step4: Do the same for the next longest path.

D=?

Float



How many paths _____

Critical path _____

Write down the Float for each activity:

A_____ B____ C_____ D_____ E_____

F_____ G____ H_____ I_____

ES、EF、LS、LF

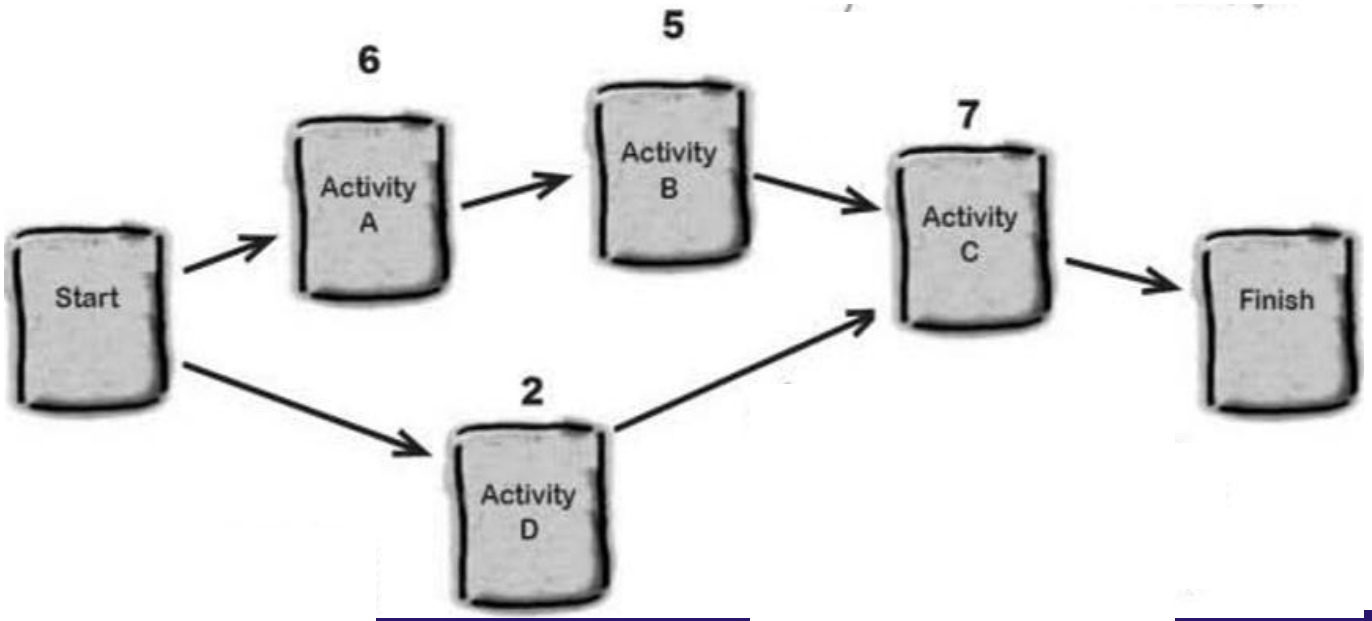
Early Start (ES)	Duration	Early Finish (EF)
Activity Name		
Late Start (LS)	Total Float	Late Finish (LF)

Forward pass:

Figure out the early start and early finish!

Backward pass:

Figure out the late start and late finish!



ES?

EF?

LS?

LF?

ES、EF、LS、LF

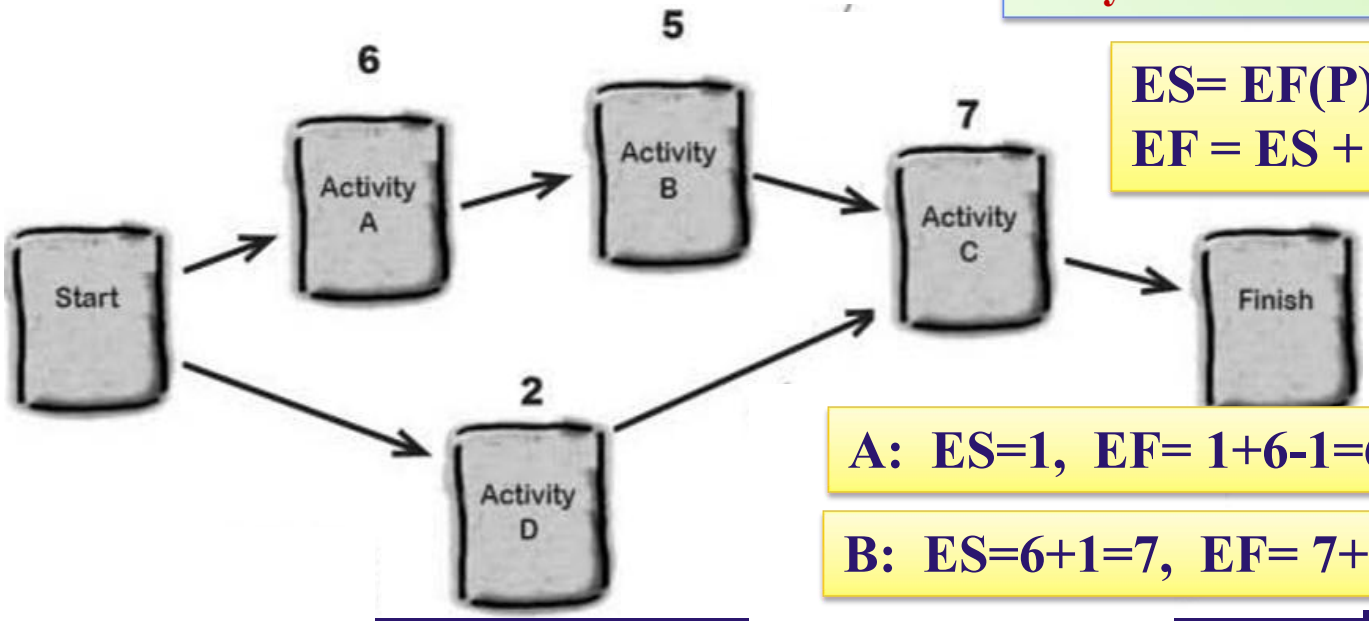
P-Predecessor Activity

S-Successor Activity

Early Start (ES)	Duration	Early Finish (EF)
Activity Name		
Late Start (LS)	Total Float	Late Finish (LF)

Take a **forward pass** through the network diagram:

Start at the **beginning** of the critical path and **move forward** through each activity. Figure out the **early start** and **early finish**!



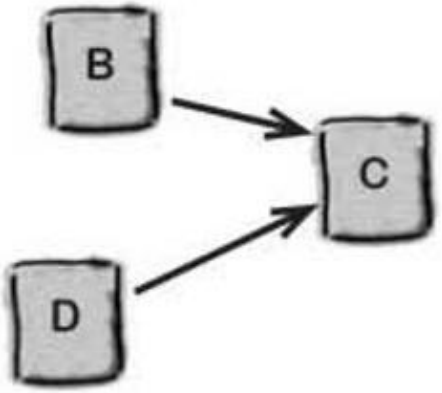
ES= EF(P)+1

EF = ES + Duration -1

A: ES=1, EF= 1+6-1=6

B: ES=6+1=7, EF= 7+5-1=11

ES、EF、LS、LF

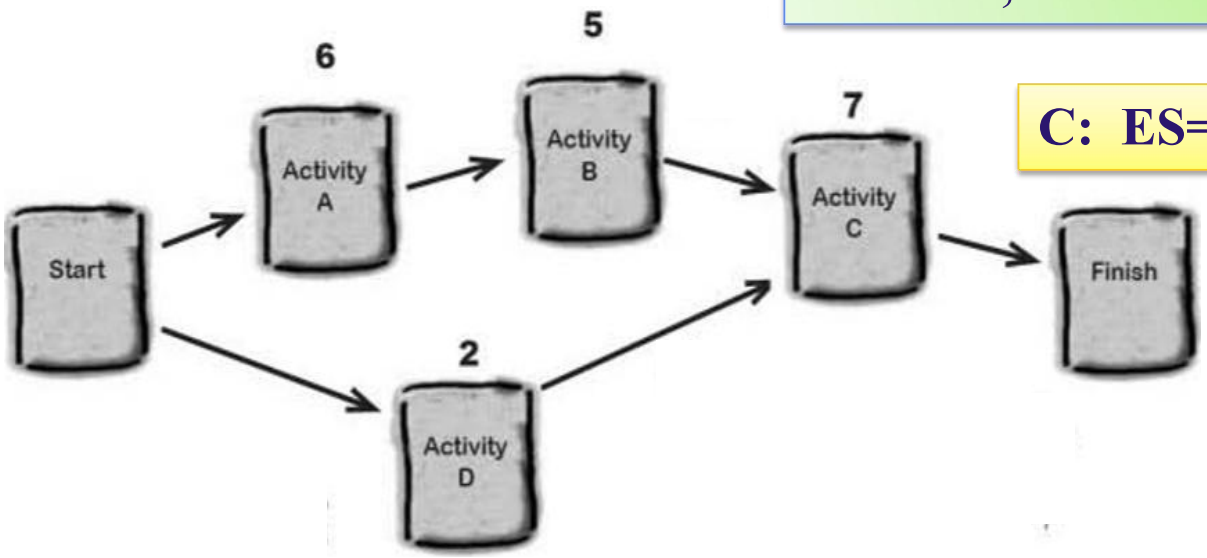


Activity C has two predecessors, which one?

B: ES=6+1=7, EF= 7+5-1=11

D: ES=1, EF= 1+2-1=2

Since C can't start until both B and D are done, use the one with latest EF

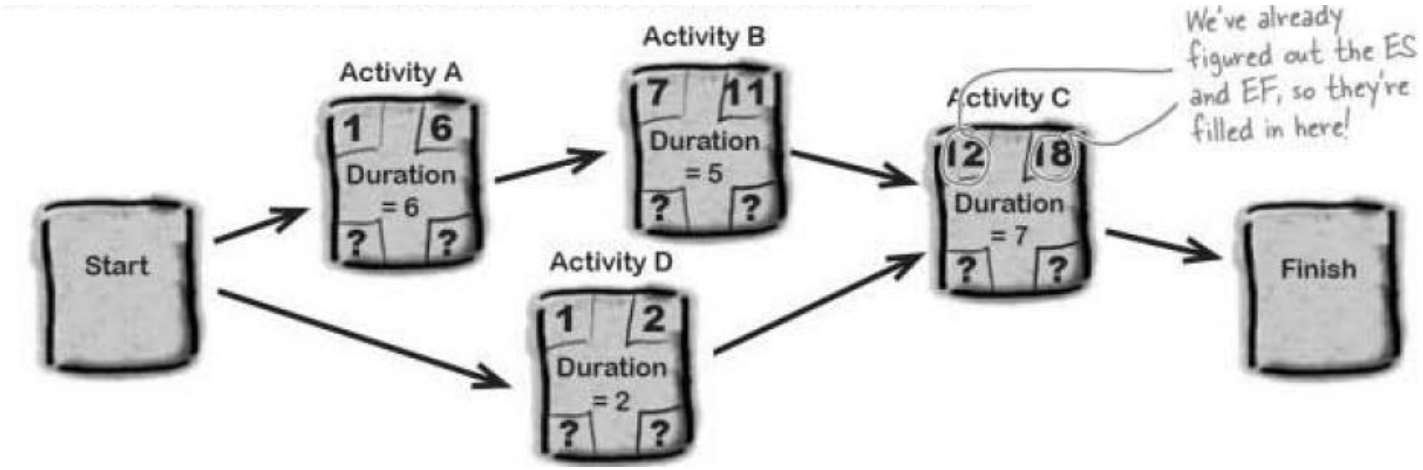


C: ES=11+1=12, EF= 12+7-1=18

ES、EF、LS、LF

Early Start (ES)	Duration	Early Finish (EF)
Activity Name		
Late Start (LS)	Total Float	Late Finish (LF)

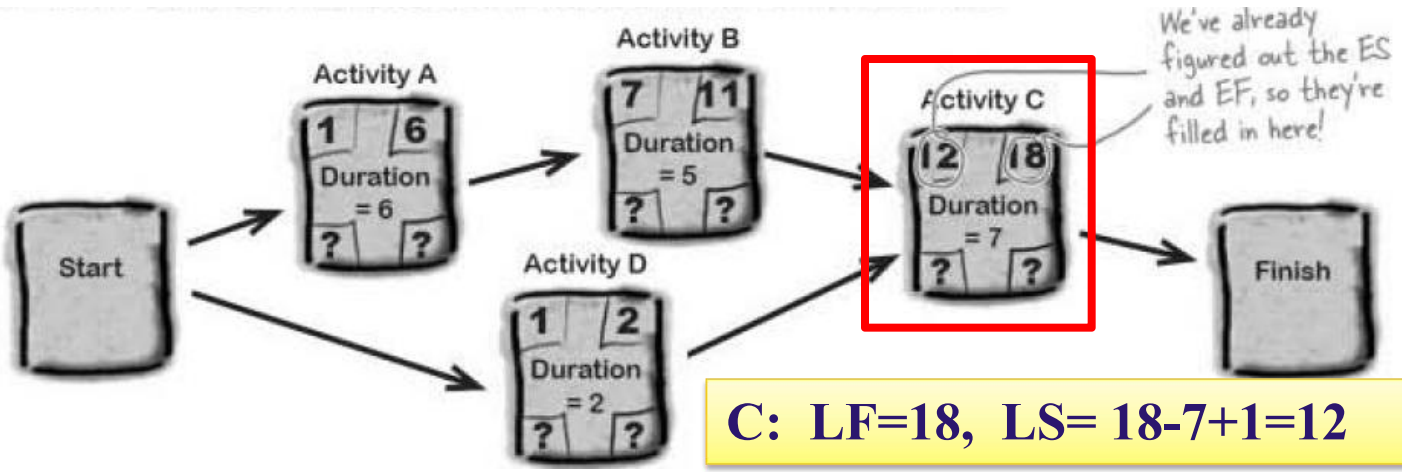
Take a **backward pass** through the network diagram: Start at the **end** of the path you just took a pass through and work your way **backward**. Figure out the **late start** and **late finish**!



ES、EF、LS、LF

P-Predecessor Activity

S-Successor Activity



C: LF=18, LS= 18-7+1=12

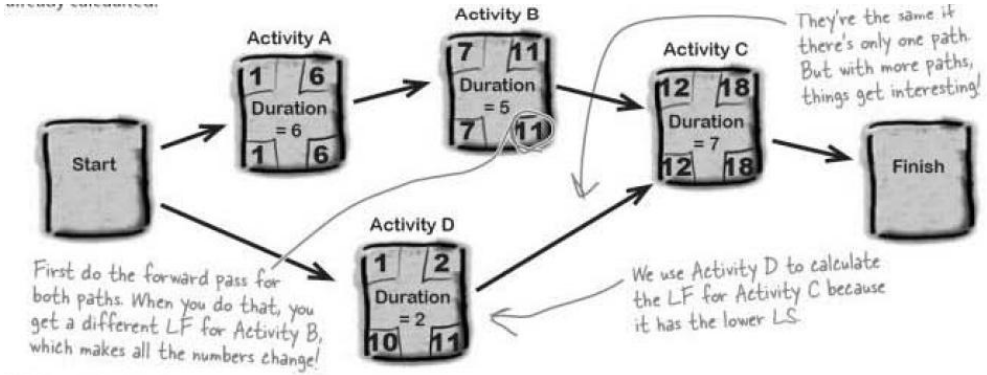
B: LF=12-1=11, LS= 11-5+1=7

A: LF=7-1=6, LS= 6-6+1=1

D: LF=12-1=11, LS= 11-2+1=10

LF= LS(S)-1

LS = LF - Duration +1

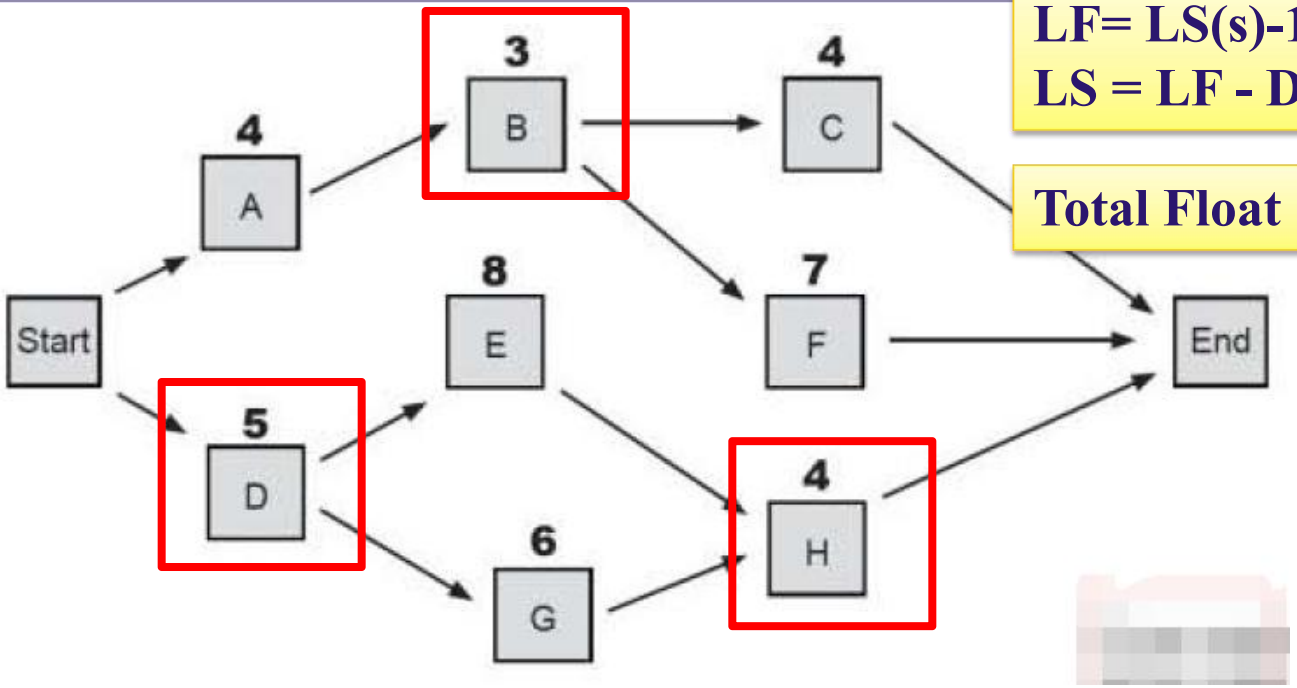


Test

ES= EF(p)+1
EF = ES + Duration -1

LF= LS(s)-1
LS = LF - Duration +1

Total Float = LF – EF = LS - ES



How many paths _____

Critical path _____

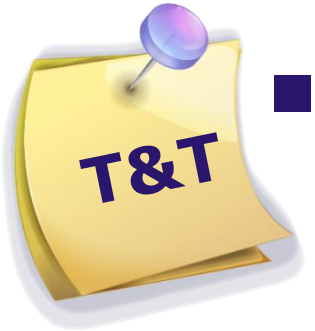
Write down the Float for each activity:

A_____ B____ C_____ D_____

E_____ F_____ G____ H_____

Calculate the ES, EF, LS, LF of each activity

FP、UFC、TCF



- 2. Function Point （FP）
  - It is not related to the language and technology used by the system to measure the size of the system.
  - Count the external and internal functions of the system. (Unadjusted Function Point Count)
  - According to the technical complexity factor, they are adjusted to produce the product scale measurement results.
- FP =UFC*TCF
  - UFC(Unadjusted Function Point Count)
  - TFC(Technical Complexity Factor)

FP、UFC、TCF

UFC's calculation method

- First, calculating feature count items, Count the following five types of elements:
  - External input: an application oriented data item entered by the user.
  - External Output: Output data items to the user.
  - External query: interactive input for system response.
  - External interface file: interface data files with other systems.
  - Internal file: internal fixation for system use.

FP、UFC、TCF

UFC's calculation method

- **Then for each function and summing the weighted count items，gained UFC。**

Feature Count items	Complexity Weight		
	simple	medium	complex
External input	3	4	6
External Output	4	5	7
External inquiry	3	4	6
External interface file	5	7	10
Internal documents	7	10	15

FP、UFC、TCF

Example

Feature Count items	**Counts**	Complexity Weight
External input	0	
External Output	1 complex	7
External inquiry	1 medium	4
External interface file	3 medium	7
Internal documents	0	

UFC=1*7+1*4+3*7=32

FP、UFC、TCF

TCF's calculation method

Technical complexity factors			
F1	Reliable backup and recovery	F2	data communication
F3	Distributed function	F4	performance
F5	Large use of configuration	F6	Online data entry
F7	Simplicity of operation	F8	Online upgrade
F9	Complex interface	F10	Complex data processing
F11	Reusability	F12	Installation simplicity
F13	Multiple Sites	F14	Easy to modify

FP、UFC、TCF

TCF's calculation method

Each technical complexity of factors affecting the range:

Value	Impact on the system
0	Does not exist or has no effect
1	No significant impact
2	Considerable influence
3	Average effect
4	Significant effect
5	Powerful influence

TCF=0.65+0.01(sum(Fi))： Fi:0-5,TCF:0.65~1.35

FP、UFC、TCF

Technical complexity factors					
F1	Reliable backup and recovery	1	F2	data communication	5
F3	Distributed function	0	F4	performance	3
F5	Large use of configuration	1	F6	On-line data entry	0
F7	Simplicity of operation	1	F8	Online upgrade	0
F9	Complex interface	1	F10	Complex data processing	4
F11	Reusability	0	F12	Installation simplicity	3
F13	Multiple Sites	0	F14	Easy to modify	3

sum(Fi)=22

FP =UFC*TCF

TCF=0.65+0.01(sum(Fi))=0.65+0.01*22=0.87

Test

- 3. Calculations
  (1)According to the tables below, please calculate the UFC, TCF and FP for this software project.
- (2) If the productivity of this project is 15 hours/FP, then please calculate the workload of this project.
- (3) If the cost for each labor hour is ¥100/hour, what is the total cost of this project.

Test

Feature Count items	counts
External input	1 medium
External Output	1 complex
External inquiry	1 simple
External interface file	1 simple, 2 medium
Internal documents	2 simple

Feature Count items	Complexity Weight		
	simple	medium	complex
External input	3	4	6
External Output	4	5	7
External inquiry	3	4	6
External interface file	5	7	10
Internal documents	7	10	15

Technical complexity factors					
F1	Reliable backup and recovery	1	F2	data communication	3
F3	Distributed function	2	F4	performance	2
F5	Large use of configuration	1	F6	On-line data entry	4
F7	Simplicity of operation	1	F8	Online upgrade	2
F9	Complex interface	1	F10	Complex data processing	3
F11	Reusability	4	F12	Installation simplicity	2
F13	Multiple Sites	2	F14	Easy to modify	3

Test

Feature Count items	counts	Complexity weight
External input	1 medium	4
External Output	1 complex	7
External inquiry	1 simple	3
External interface file	1 simple, 2 medium	5,7,7
Internal documents	2 simple	7,7

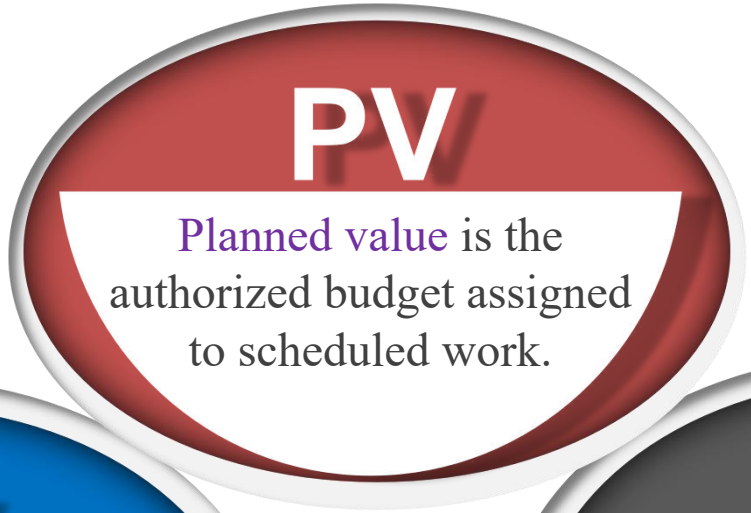
$$UFC=1*4+1*7+1*3+1*5+2*7+2*7=47$$

Test

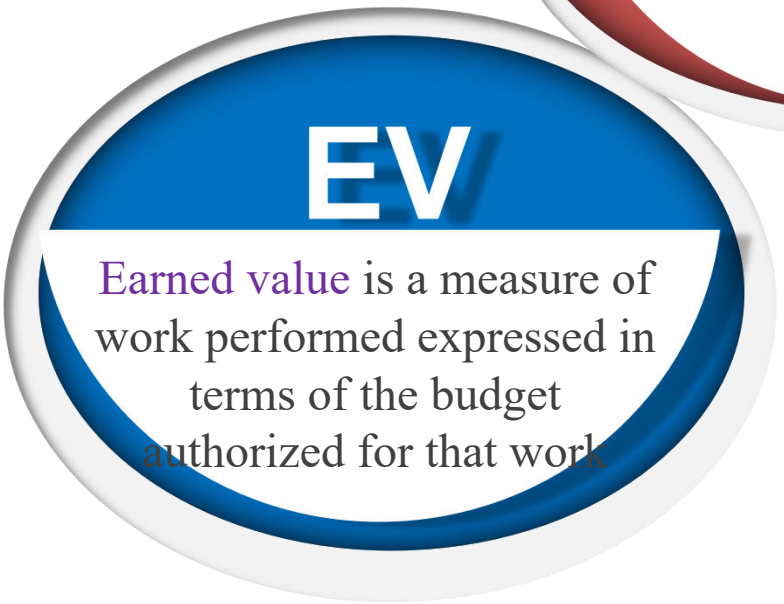
- 3. Calculations
  (1)According to the tables below, please calculate the UFC, TCF and FP for this software project.
- (2) If the productivity of this project is 15 hours/FP, then please calculate the workload of this project.
- (3) If the cost for each labor hour is ¥100/hour, what is the total cost of this project.
  - UFC=1*4+1*7+1*3+1*5+2*7+2*7=47
  - sum(Fi)=31
  - TCF=0.65+0.01(sum(Fi))=0.65+0.01*31=0.96
  - FP =UFC*TCF=45.12
  - Workload=15*45.12=676.8 hours
  - Total cost=676.8*100=67680¥

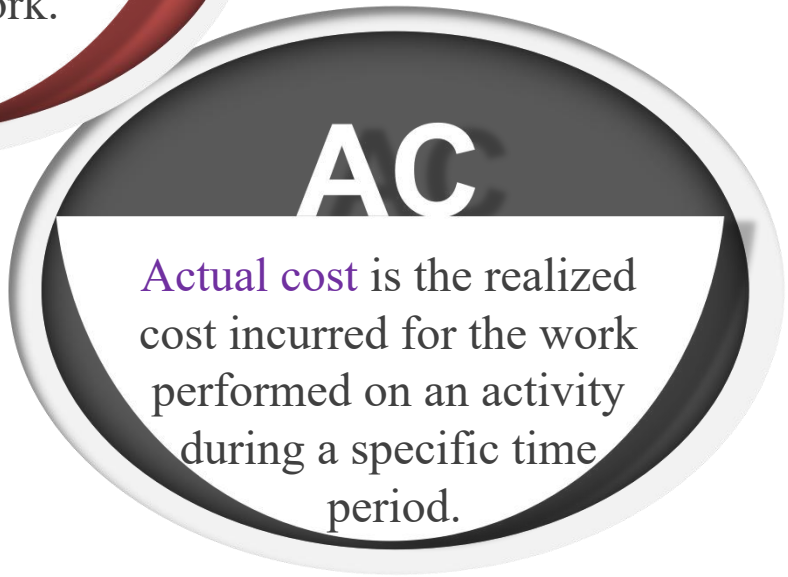
PV、EV、AC、SV、CV、SPI、CPI

The total of the PV is sometimes referred to as the performance measurement baseline (PMB)



The total planned value for the project is also known as budget at completion (BAC)





EV being measured needs to be related to the PMV
EV is often used to calculate the percent complete of a project.

AC needs to correspond in definition to what was budgeted in the PV and measured in the EV

PV、EV、AC、SV、CV、SPI、CPI

Variances from the approved baseline will also be monitored

SV

Schedule variance is a measure of schedule performance expressed as the difference between EV and PV

SV=EV-PV

A useful metric in that it indicate when a project is falling behind (sv<0) or is ahead of (sv>0) its baseline schedule

project is completed SV=0

CV

Cost variance is the amount of budget deficit or surplus at a given point in time, expressed as the difference between EV minus the AC

CV=EV-AC

CV is particularly critical because it indicates the relationship of physical performance to the costs spent.

CV<0 over budget

PV、EV、AC、SV、CV、SPI、CPI

The SV and CV values can be converted to efficiency indicators to reflect the cost and schedule performance of any project for comparison against all other projects or within a portfolio of projects.

SPI

Schedule performance index is a measure of schedule efficiency expressed as the ratio of EV to PV

SPI=EV/PV

SPI<1.0 indicates less work was completed than was planned.
SPI>1.0 more work was completed than was planned

CPI

Cost performance index is a measure of the cost efficiency of budgeted resources, expressed as a ratio of EV to AC

CPI=EV/AC

CPI<1.0 indicates a cost overrun for work completed;
CPI>1.0 indicates a cost underrun of performance to date.

Test

Your project has a total budget of $300,000. You check your records and find that you've spent $175,000 so far. The team has completed 40% of the project work, but when you check the schedule it says that they should have completed 50% of the work. Calculating the following:

BAC= $_____

AC = $_____

PV = $_____ × ___ % = $_____

EV = $_____ × ___ % = $_____

SV = $_____ − $_____ = $_____

CV = $_____ − $_____ = $_____

$$SPI = \frac{\$}{\$} = \_\_\_\_\_$$

$$CPI = \frac{\$}{\$} = \_\_\_\_\_$$

Cost overrun and schedule over budget

Test

Your project has a total budget of $300,000. You check your records and find that you've spent $175,000 so far. The team has completed 40% of the project work, but when you check the schedule it says that they should have completed 50% of the work. Calculating the following:

BAC= $ 300000

AC = $ 175000

PV = $ BAC × 50 % = $ 150000

EV = $ BAC × 40 % = $ 120000

SV = $ EV − $ PV = $ -30000

CV = $ EV − $ AC = $ -55000

$$SPI = \frac{\$\ EV}{\$\ PV} = 0.8$$

$$CPI = \frac{\$\ EV}{\$\ AC} = 0.68$$

Cost overrun and schedule over budget

BAC、EAC、ETC

As the project progresses, the project team may develop a forecast for the estimate at completion (EAC) that may differ from the BAC based on the project performance

Budget at completion (BAC) 完工预算
Estimate at completion (EAC)完工估算
Estimate to complete (ETC) 完工尚需估算

EACs are typically based on the actual costs incurred for work completed, plus an estimate to complete (ETC) the remaining work

EAC = AC + ETC

EAC

Budget at completion (BAC) 完工预算
Estimate at completion (EAC)完工估算
Estimate to complete (ETC) 完工尚需估算

EAC = AC + Bottom-Up ETC

Three commonly used methods are as follow

EAC forecast for ETC work performed at the budgeted rate

悬崖勒马

$$EAC = AC + (BAC - EV)$$

EAC forecast for ETC work performed at the present CPI

执迷不悟

$$EAC = BAC/CPI$$

EAC forecast for ETC work considering both SPI and CPI factors

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$$EAC = AC + [(BAC-EV)/(CPI \times SPI)]$$

Variance at completion (VAC = BAC – EAC)

Test

It's nine months into your project. The total budget for your project is $4,200,000. You've spent $1,650,000 so far, and you've got a CPI of 0.875. Use the Earned Value Technique formulas from forecasting to figure out where things stand.

$$EAC = \frac{\$\_\_\_\_\_}{\$\_\_\_\_\_} = \_\_\_\_\_$$

ETC = $_____ - $_____ = $_____

VAC = $_____ - $_____ = $_____

Will the project be over or under budget when it's complete?

Test

It's nine months into your project. The total budget for your project is $4,200,000. You've spent $1,650,000 so far, and you've got a CPI of 0.875. Use the Earned Value Technique formulas from forecasting to figure out where things stand.

$$EAC = \frac{\$\ 4200000}{\$\ 0.875} = 4800000$$

EAC = BAC/CPI

ETC = $4800000 - $1650000 = $3150000

EAC = AC + ETC

VAC = $4200000 - $4800000 = $-600000

VAC = BAC – EAC

Will the project be over or under budget when it's complete?

-600000 over budget