

# Project Management

The Critical Path Method

CPM

A Deterministic Approach

January 8, 2002



FOMGT 353 Introduction to  
Management Science



# Project Management

- Divide and Conquer.
- Split the Project into Phases.
- Split the Phases into Activities.
- Split the Activities into Tasks.



# Identify Tasks

- When you have identified an Activity, identify all of the tasks in the activity.
- Document the Dependencies i.e.
- "Can't do B without A being complete."
- "Can't do C without materials X,Y and Z"
- Need Materials Ordering and Receiving Tasks.....



# Use Tasks, Dependencies and Completion Time List

	Task	Estimated Completion Time (Days)	Immediate Predecessors
A	START	0	-
B	Install Ducting	3	A
C	Install Cabling	3	B
D	Unpack & Configure PCs	6	A
E	Install Netware Clients	3	D
F	Install Network Hubs	1	A
G	Connect Network Hubs	1	C, F
H	Install Netware Servers	3	D
I	Test Netware Servers	2	H
J	Test Hub	1	I, G
K	Cabling Repairs	1	I, G
L	Test Netware Clients	2	E, K, and J
M	END		L



# Use The Calendar To Coordinate Vacations

Person	Apr		May																											
	29	30	1	2	3	6	7	8	9	10	13	14	15	16	17	20	21	22	23	24	27	28	29	30	31					
The Duct Fitter.			■																											
The Network Hub Configurer.								■	■	■	■	■	■																	
The Network Cable (10BaseT) Installer.											■	■	■	■	■															
The Netware Client Installer.																														
The Netware Server Installer.																														
The PC Unpacker and Configurer.																														
The Project Manager																														

- The examples that follow will not take vacations into account as they assume the ready availability of labor.

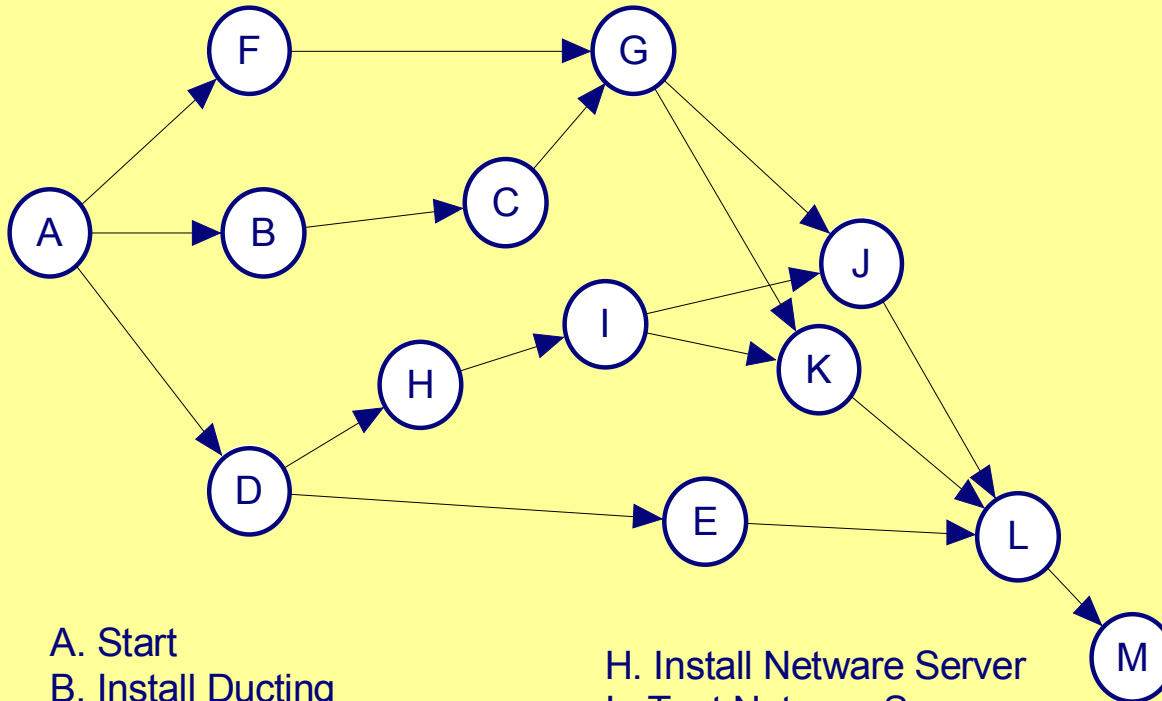


# Use The Calendar to Place Tasks in Time

Task	Apr					May												
	29	30	1	2	3	6	7	8	9	10	13	14	15	16	17	20	21	22
A																		
B	■	■		■														
C					■	■	■	■										
D	■	■	■	■	■	■												
E							■	■	■									
F	■																	
G													■					
H							■	■	■									
I										■	■							
J																■		
K																■		
L																	■	■
M																		



# Draw a Network Representation with Tasks on Nodes

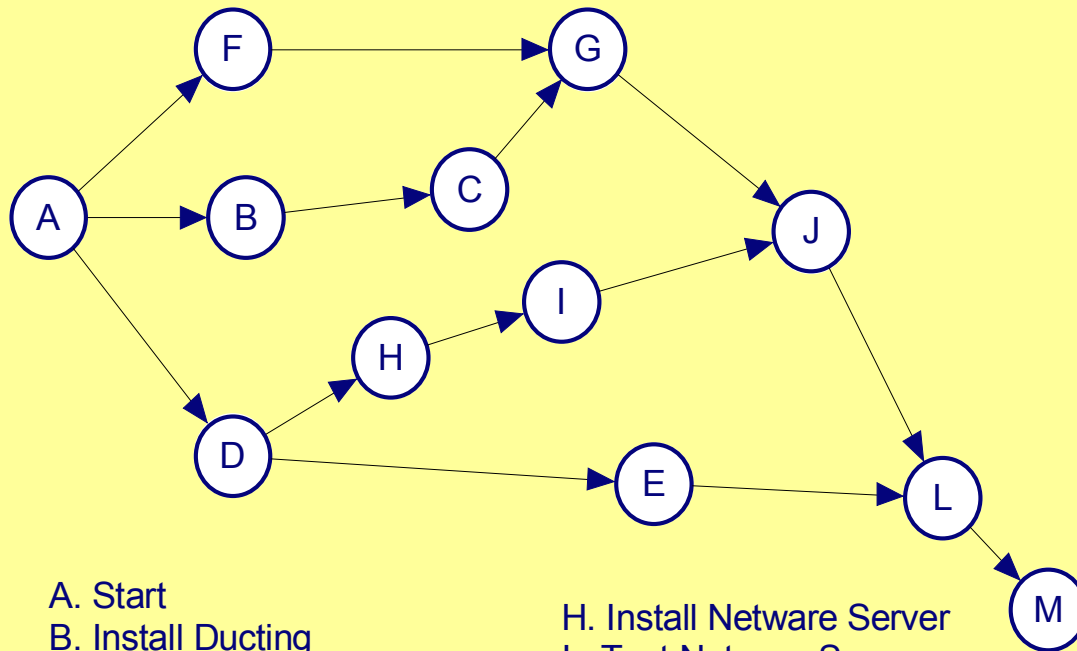


- A. Start
- B. Install Ducting
- C. Install Cabling
- D. Configure PCs
- E. Install Network Client
- F. Install Network Hub
- G. Network Hub Connection

- H. Install Network Server
- I. Test Network Server
- J. Test Hub
- K. Cabling Repairs
- L. Test Network Clients
- M. End



# J and K are One Task - For Two People



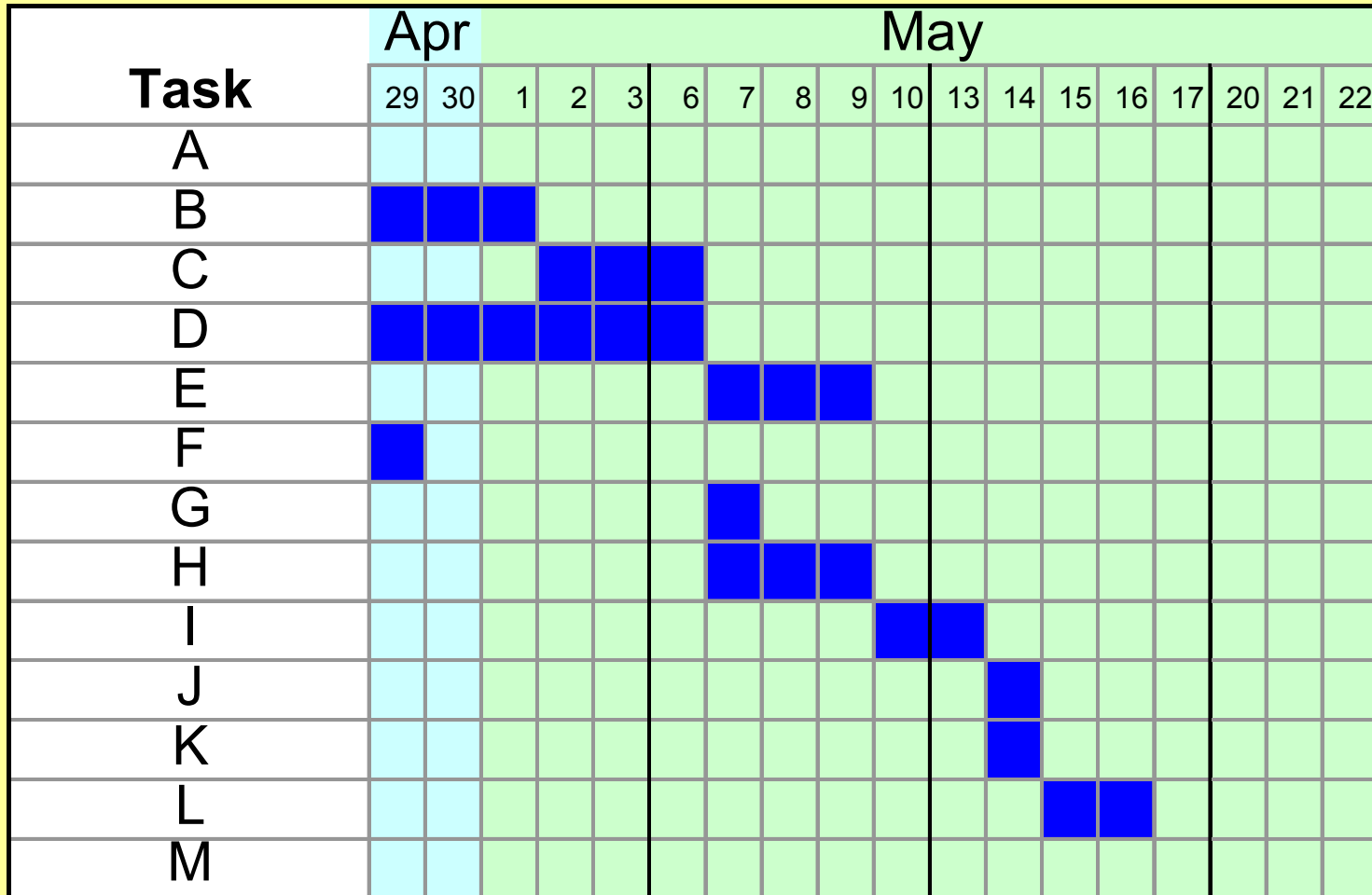
- A. Start
- B. Install Ducting
- C. Install Cabling
- D. Configure PCs
- E. Install Network Client
- F. Install Network Hub
- G. Network Hub Connection

- H. Install Network Server
- I. Test Network Server
- J. Test Hub; and  
Cabling Repairs
- L. Test Network Clients
- M. End

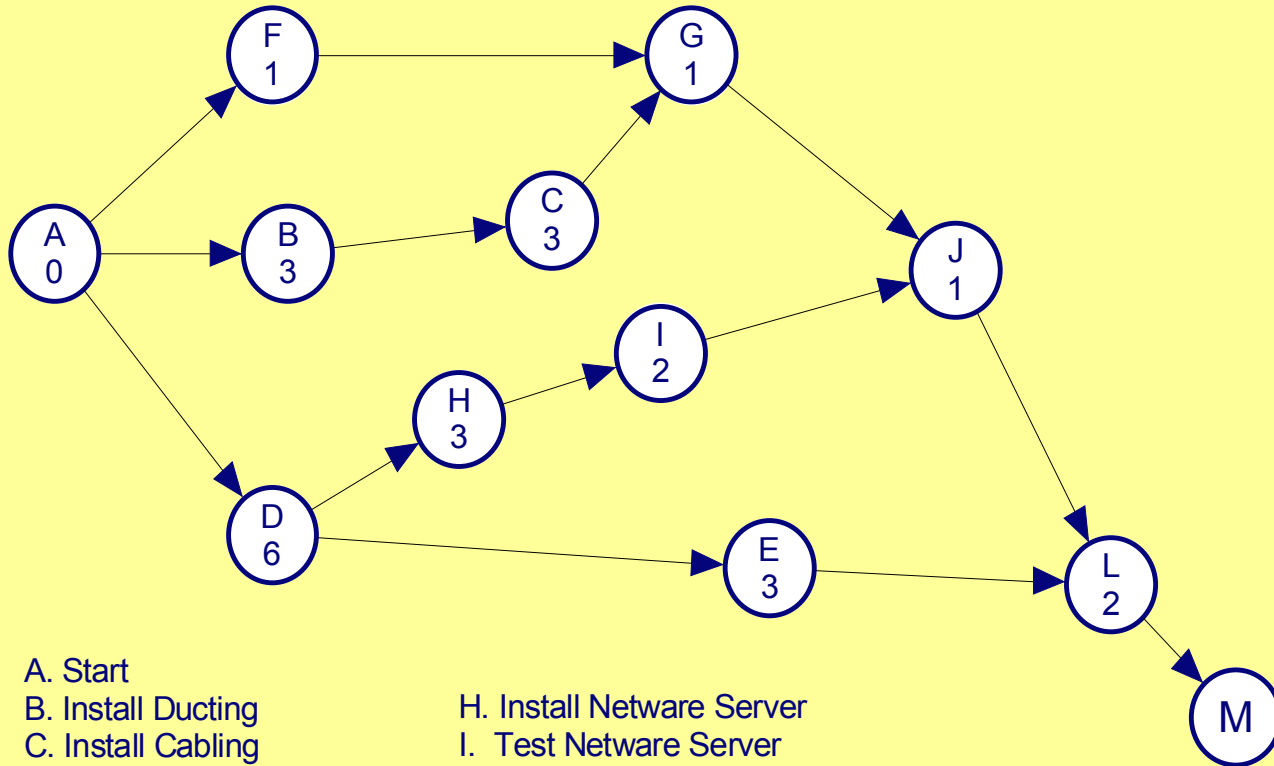




# Revised Gantt Chart



# Estimated Completion Times on the Network



- A. Start
- B. Install Ducting
- C. Install Cabling
- D. Configure PCs
- E. Install Network Client
- F. Install Network Hub
- G. Network Hub Connection
- H. Install Network Server
- I. Test Network Server
- J. Test Hub; and  
Cabling Repairs
- L. Test Network Clients
- M. End



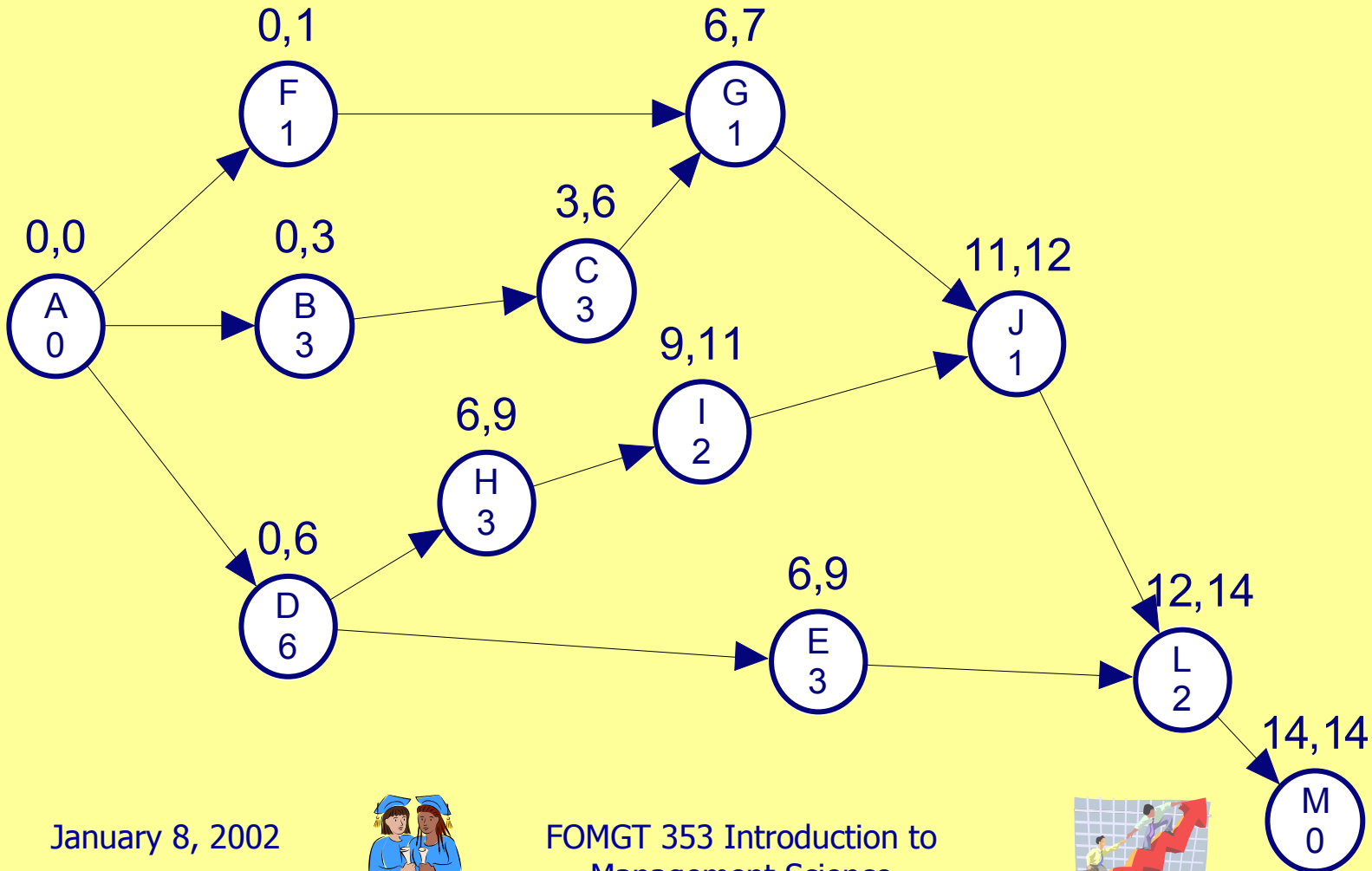
# Earliest Start and Earliest Finish Times

- A Task's Earliest Start Time (ES) is the Maximum of the Earliest Finish Times of all of its Immediate Predecessors.
- A Task's Earliest Finish Time is:
- $EF = ES + \text{Estimated Completion Time for Task}$





# Calculate ES and EF on Network

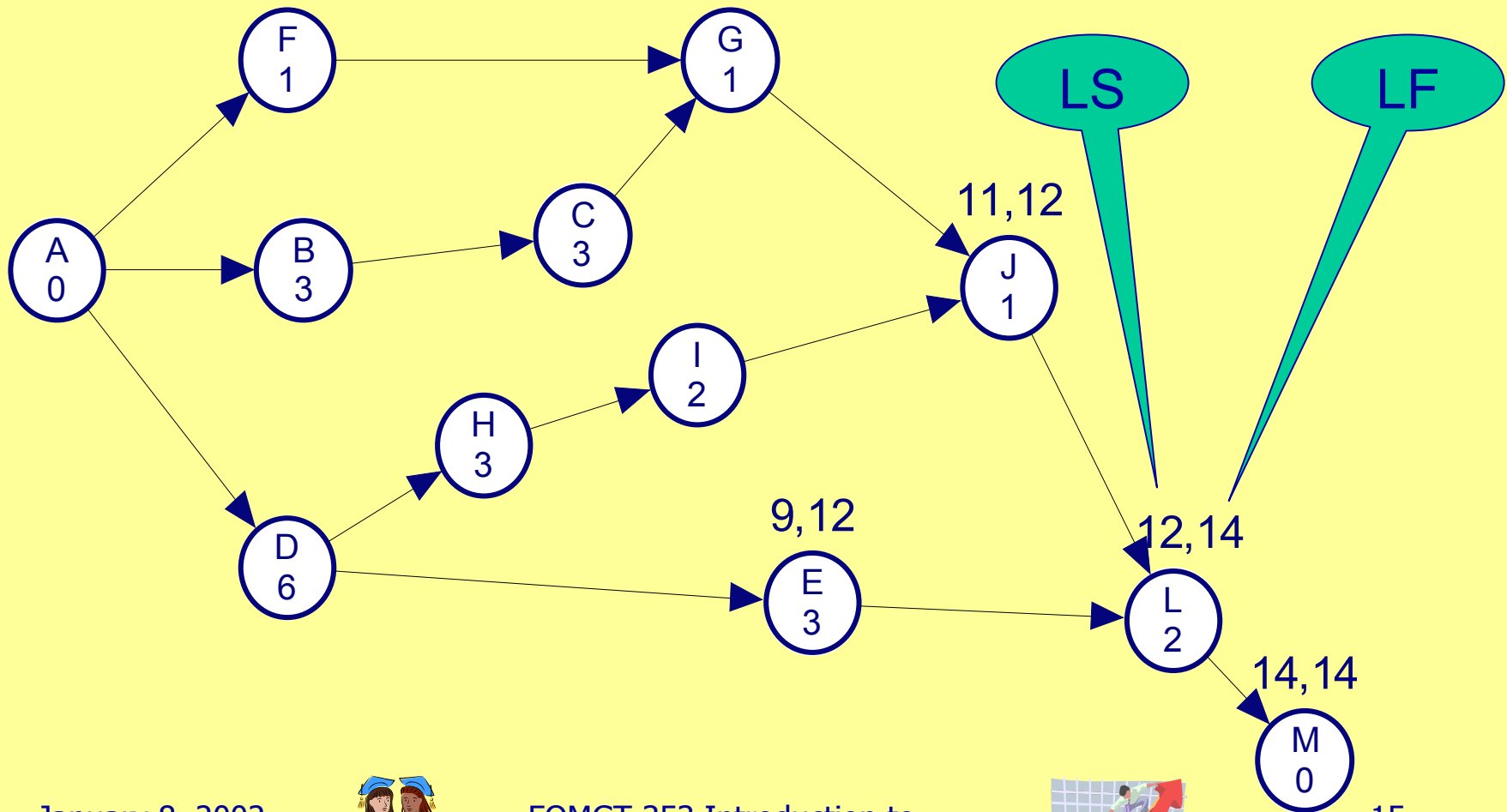


# Latest Start and Latest Finish Times

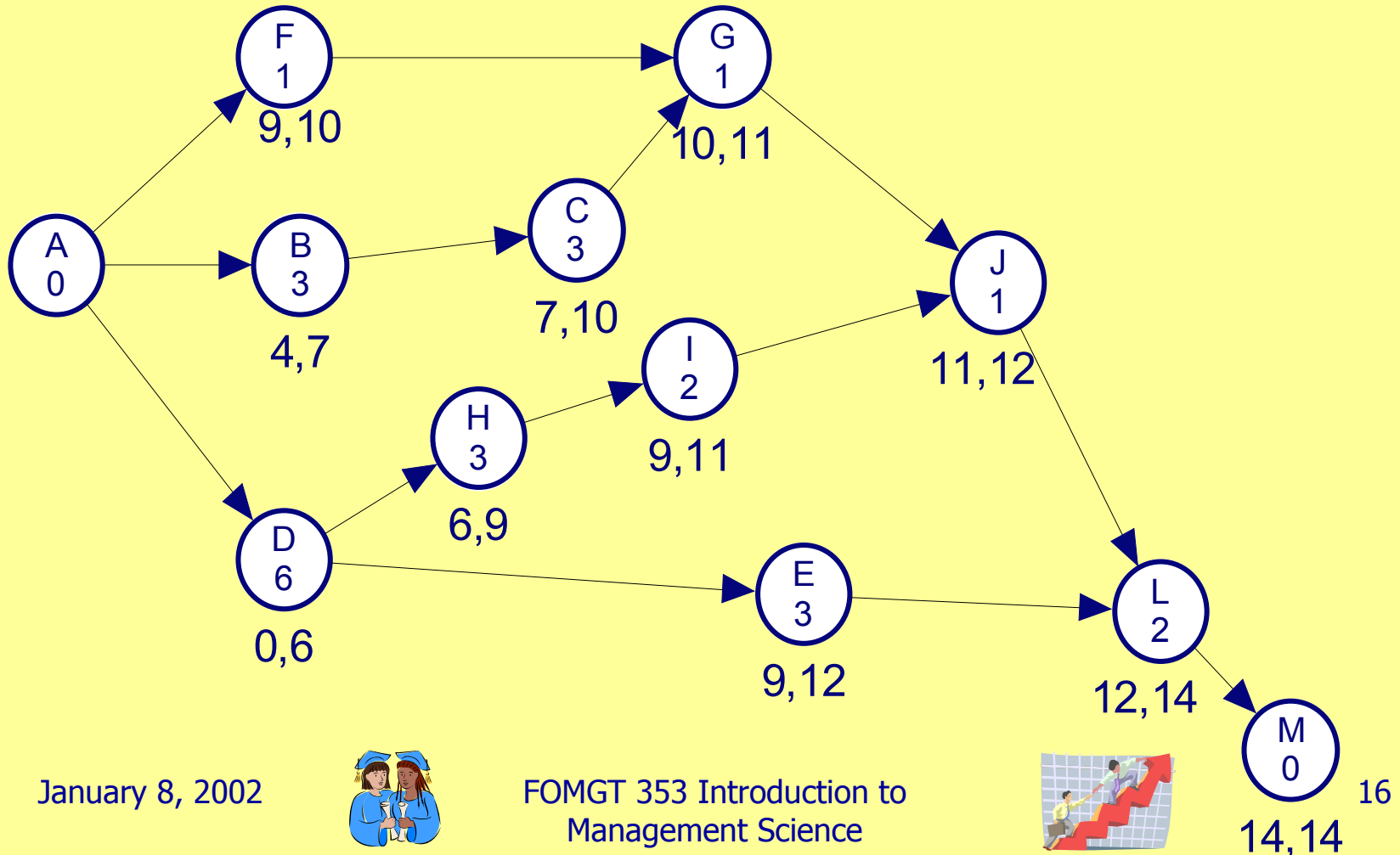
- A Task's Latest Finish Time (LF) is the Minimum of the Latest Start Times of all of its Immediate Successors.
- A Task's Latest Start Time is:
- $LS = LF - \text{Estimated Completion Time for Task}$



# Calculate LS and LF on Network



# Calculate LS and LF on Network



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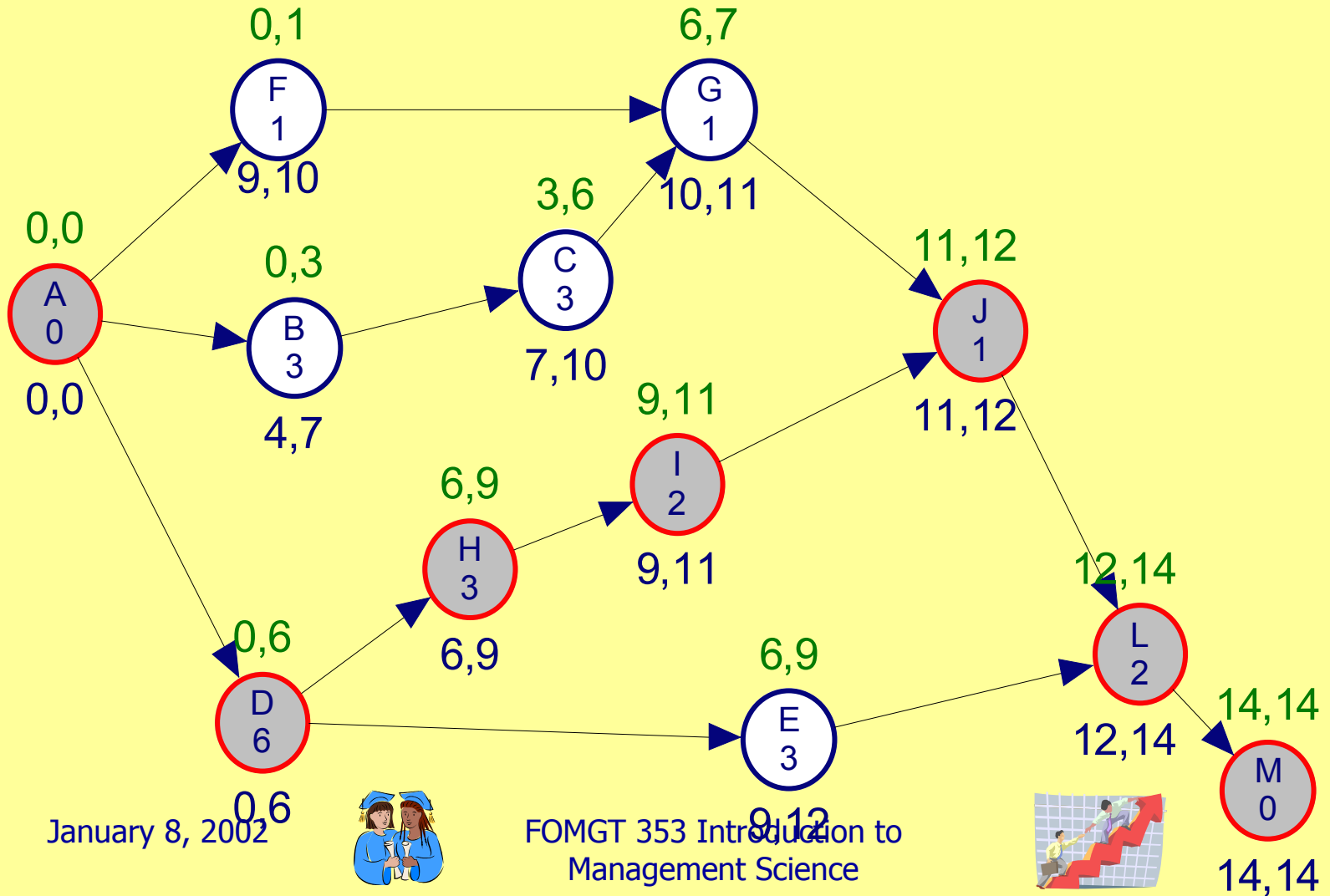
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16



# Comparing ES and LS

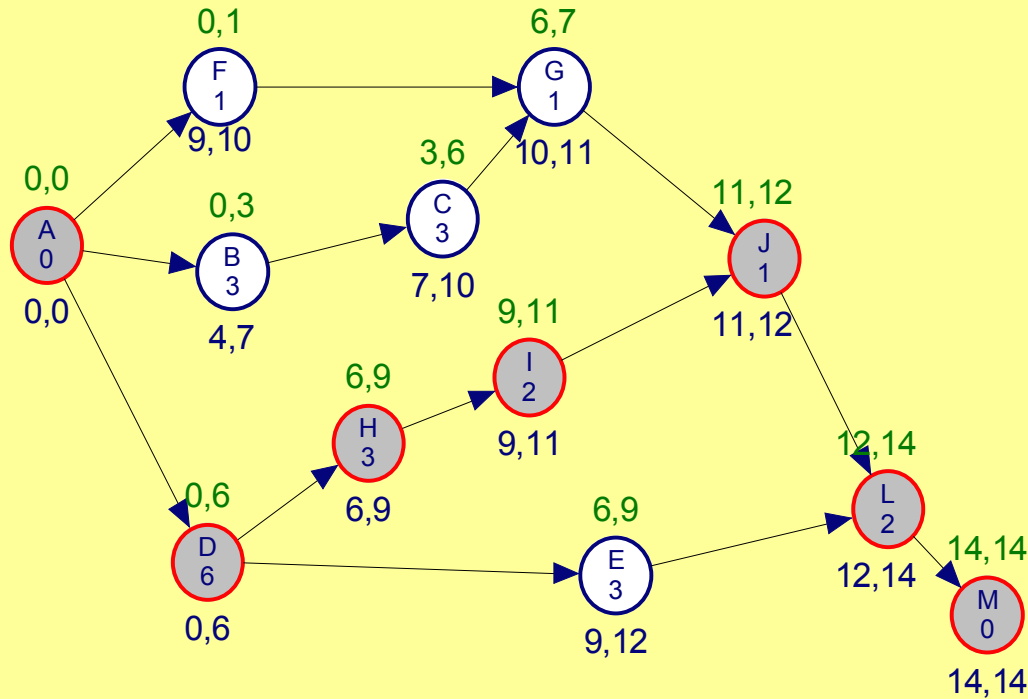


# Slack Time And Critical Path Activities

- Slack time for a task is either
  - Slack Time =  $LS - ES$ 
    - Or
  - Slack Time =  $LF - EF$
- Activities on the Critical Path have slack time = 0



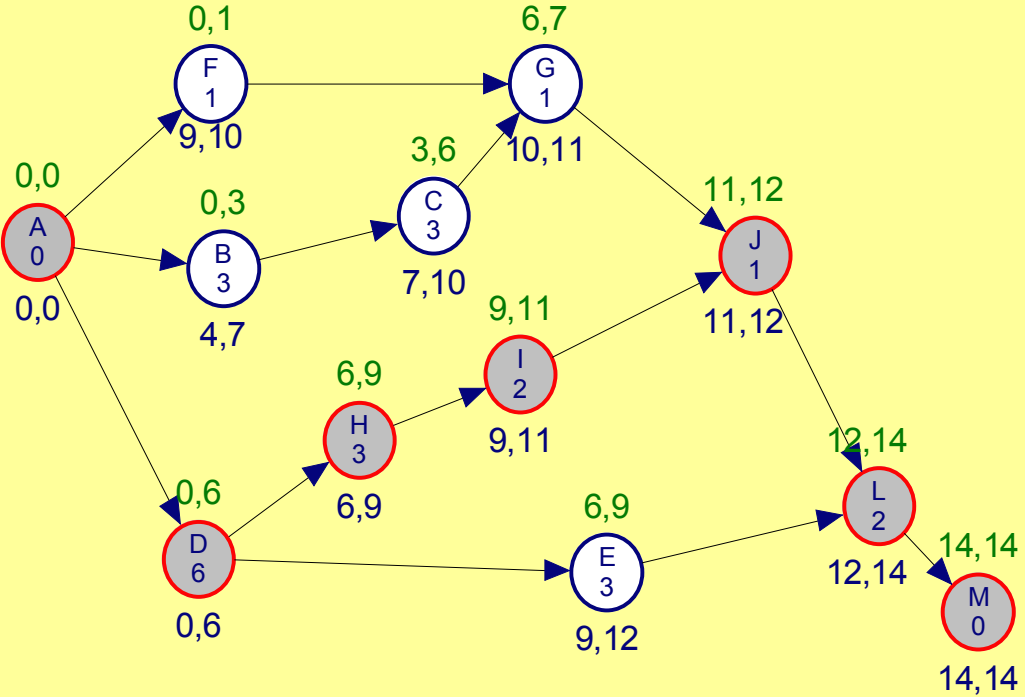
# Slack Time



Task		Slack Time
A		
B	$LS(B) - ES(B) =$	
C	$LS(C) - ES(C) =$	
D	$LS(D) - ES(D) =$	
E	$LS(E) - ES(E) =$	
F	$LS(F) - ES(F) =$	
G	$LS(G) - ES(G) =$	
H	$LS(H) - ES(H) =$	
I	$LS(I) - ES(I) =$	
J	$LS(J) - ES(J) =$	
L	$LS(L) - ES(L) =$	
M	$LS(M) - ES(M) =$	



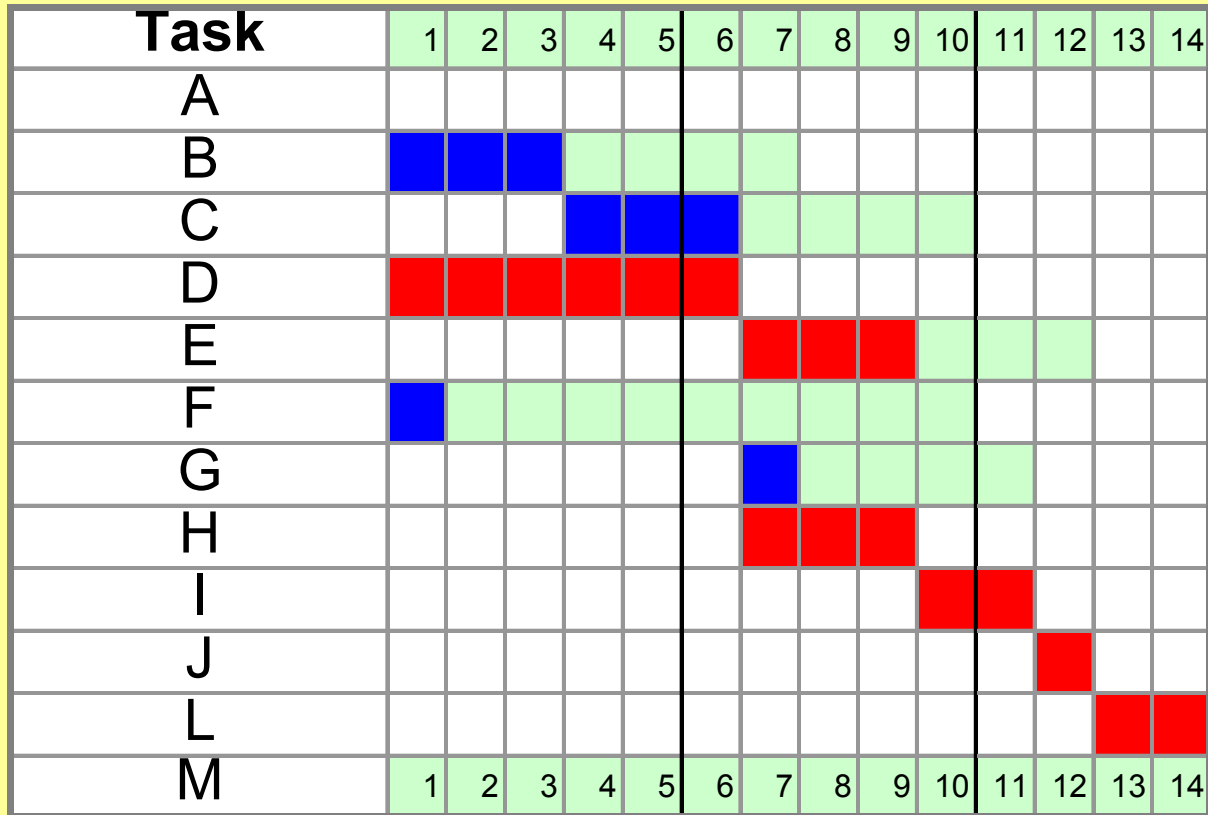
# Slack Time



Task		Slack Time
A		0
B	$LS(B) - ES(B) =$	$4 - 0 = 4$
C	$LS(C) - ES(C) =$	$7 - 3 = 4$
D	$LS(D) - ES(D) =$	$0 - 0 = 0$
E	$LS(E) - ES(E) =$	$9 - 6 = 3$
F	$LS(F) - ES(F) =$	$9 - 0 = 9$
G	$LS(G) - ES(G) =$	$10 - 6 = 4$
H	$LS(H) - ES(H) =$	$6 - 6 = 0$
I	$LS(I) - ES(I) =$	$9 - 9 = 0$
J	$LS(J) - ES(J) =$	$11 - 11 = 0$
L	$LS(L) - ES(L) =$	$12 - 12 = 0$
M	$LS(M) - ES(M) =$	$14 - 14 = 0$



# Another Look At The Gantt Chart



# Delays and Poor Estimation

- If the start of activity F is delayed by 3 days, no one will care as there is 9 days slack in this task.
- If the estimate of 6 days to complete for task D should prove to be wrong and it takes 8 days, then the project will take 16 days rather than 14 days as D is on the critical path.



# Revised Gantt Chart for Task D Estimate Error

Task	1	2	3	4	5	6	E	E	7	8	9	10	11	12	13	14
A																
B	█	█	█	█	█	█	█	█	█							
C				█	█	█	█	█	█	█	█	█				
D	█	█	█	█	█	█	█	█	█							
E									█	█	█	█	█	█		
F	█	█	█	█	█	█	█	█	█	█	█	█				
G									█	█	█	█	█			
H									█	█	█					
I												█	█			
J														█		
L															█	█
M	1	2	3	4	5	6	E	E	7	8	9	10	11	12	13	14



# Constant Communication

- You have updated your Gantt chart, but did you tell all of the people who are affected by the change?
- You need feedback from everyone involved to know that the only impact will be a delay of 2 days.





# Reading

- Read sections 5.3 to 5.10

