Project Planning & Control

Prof. Koshy Varghese

Department of Civil Engineering

Indian Institute of Technology, Madras

Lecture - 29

Time–Cost Trade-Off: Class Exercise – 2

Now, I want you to draw this network and I am going to give you some values.

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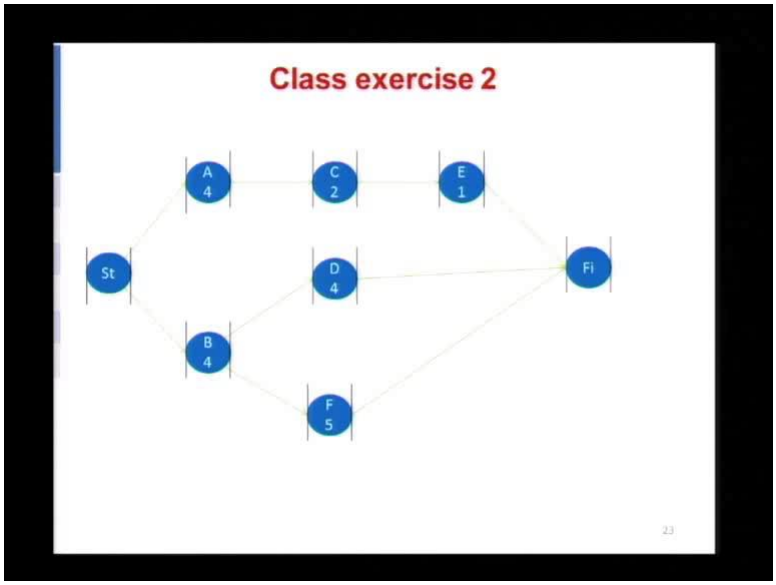

I want you to draw this network; I will give you some values to be able to practice this crashing exercise.

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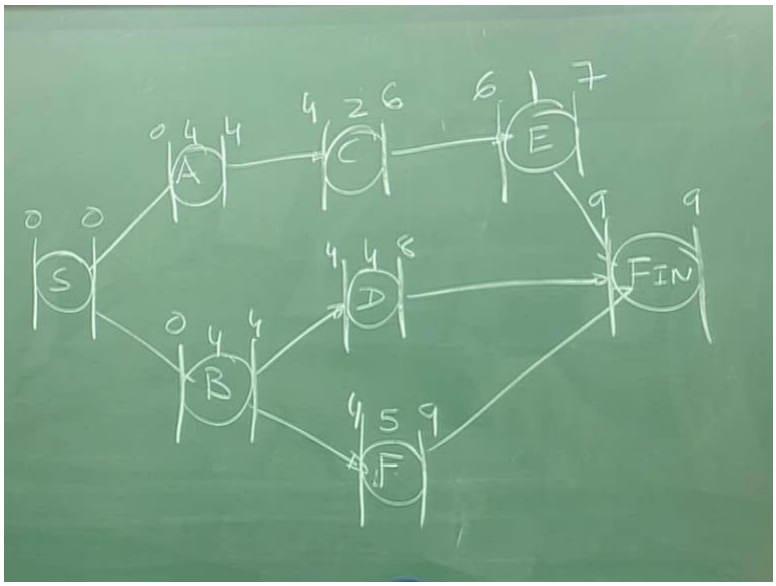

So, draw the network and then get back to this. So, I am going to now give you this as an exercise.

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Activity	Normal Duration (ND) (days)	Crash Duration (CD) (days)	Normal Cost (NC) u	Crash Cost (CC) u	Cost slope=(CC -NC)/ (ND-CD)
A	4	3	100	125	
B	4	3	250	400	
C	2	1	150	300	
D	4	1	450	900	
E	1	0.5	200	400	
F	5	2	200	350	

Assume an indirect cost of u125/day. Develop the least cost curve for the project.

So, you have to… So, here is the normal duration, the crash duration, normal cost, crash cost; you can assume an indirect cost of 125 per day and let us go through a… I mean first do the exercise for a few minutes and then we will solve it on the board. Got the values done?

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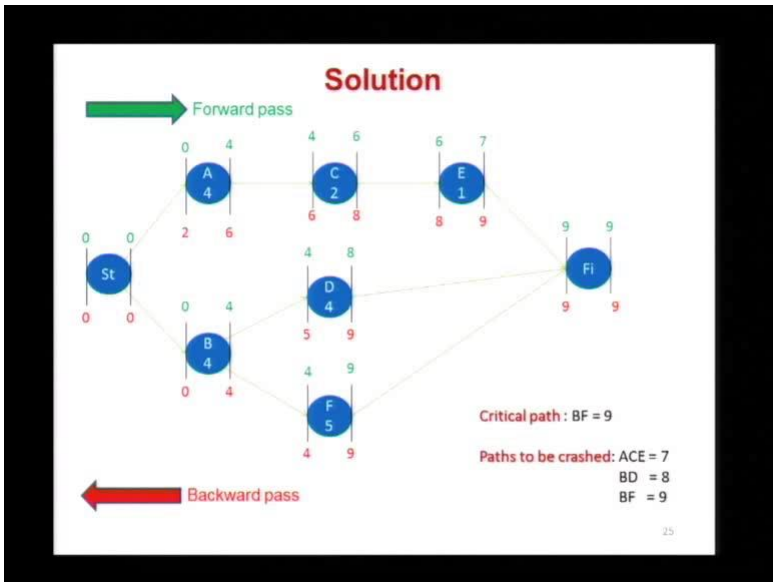

How will you find… You can find the optimum point by comparing slopes; but, why do not you crash it to the maximum. So, we can draw the cost – time curve.

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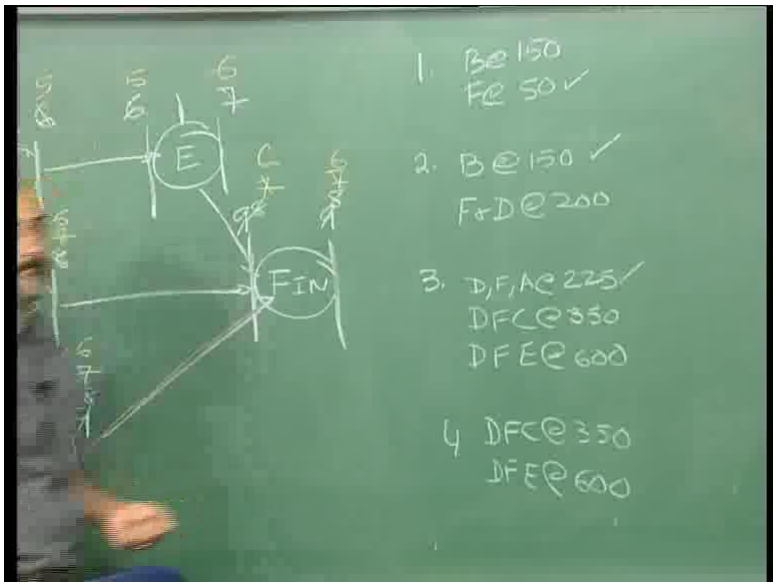

Shall we start, so that we can then solve it. So, my… I have done only the forward pass here; but, that gives us an idea; simple network – we can see where things go. And, critical path is going through B and F. So, my first step – I want to start crashing. What would be my first option? What are my options? B at 150 or F at 50; obviously, I will choose F at 50. And, how much can F… F can go all the way from 5 to 2. Let us just decrease this; we will take a stepwise again; 5 to 4, 4 to 8 goes to 8. So, my second step; again I am here. So, now, what has happened is F and D have both become critical,

because this is going through 8. So, now, my critical path is going through D also. And, what are my options?

Student: ((Refer Slide Time: 06:17))

Yeah; I have B – still B at 150 or F and D at 200. And, again B now affects both F and D. So, crash B is more economic. So, I go down to… How much can B go down to? 3. This goes to 3; I will use a different color for this step; 3. And now, this starts at 3, goes to 7, again 3, 7 and my project duration is at 7 ((Refer Slide Time: 07:11)) My third step – and now, my B has fully crashed. So, I have to crash…

Student: E is also….

Yes; now, here is sixth; here it has come to seventh. So, now, with coming to 7, you find that A, C, E has also become critical. So, I cannot crash D and F alone anymore; I have to crash combinations. What are my combinations? So, I certainly have to crash D and F; right? So, there is D, F, A – one combination – D, F, A or DFC or DFE. What are the values? DFA – 225.

Student: DFC at 350.

350

Student: DFE at 400

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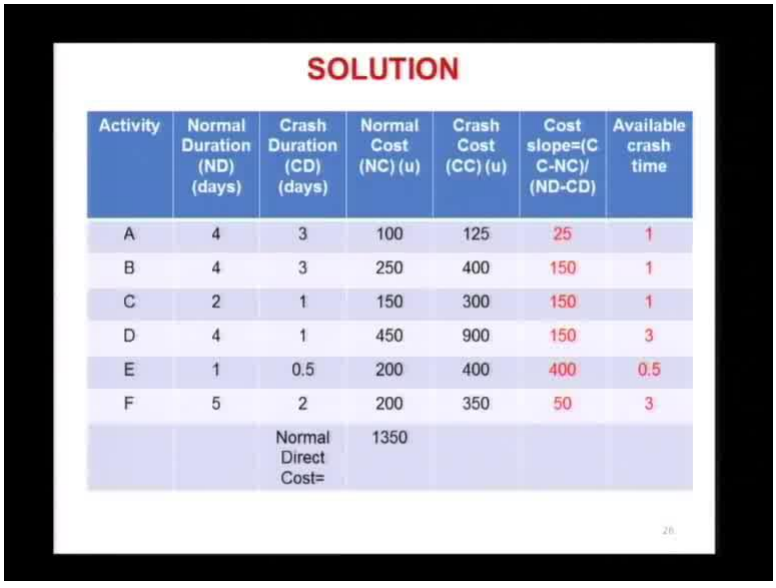

E is expensive to crash. So, D is 6 – 550 – 600. My choice would be D, F, A. And, I am going to crash it. So, now, what A can go? Only up to my… So, I am going to crash… A

goes to 3. So, this goes 0; and then, my D goes to… All are going to 3. So, this path becomes 3 – 3 to 5; 5 to 6. So, this becomes… This nothing changes; only the duration 3 to 6. Here again 3 to 6; and, this becomes 6. So, now, my A is also fully crashed, B is fully crashed. My combinations left are… Is there anything more possible?

Student: ((Refer Slide Time: 09:48))

So, now, what about D? What is that duration of D can go all the way up to 1. What about F? F can go up to 2; C can go down to 1.

Student: F and C are ((Refer Slide Time: 10:05))

F and C are limiting; I cannot. So, I can take only one more step and that will be that. So, from my – on my fourth step, I have option DFC at 350 or DFE at 600. And, I will choose DFC at 350; which means C goes to 1, 4, 5. This goes to 2 and this goes to 2. So, if… So, this would be the sequence in which we crash and we have… Let us just go through the slides again.

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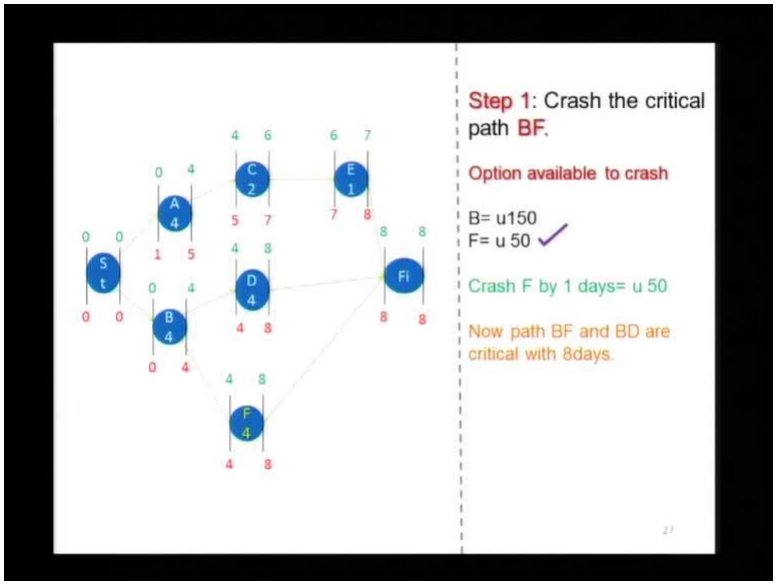

So, we can see the options for crashing; we first crashed F and then we found there is BF – BF and BD work becoming the path went through D and F.

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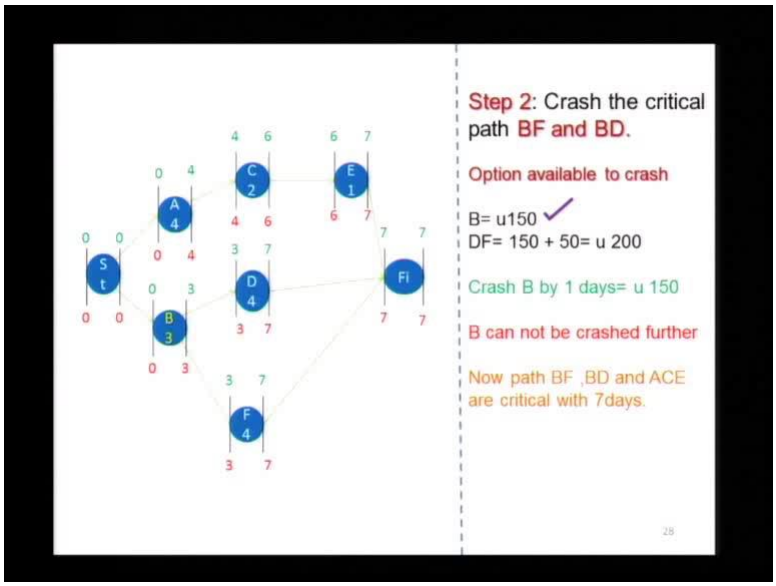

So, in the second step, we have to crash B; we crashed it to the maximum and we could not after that take B at any further.

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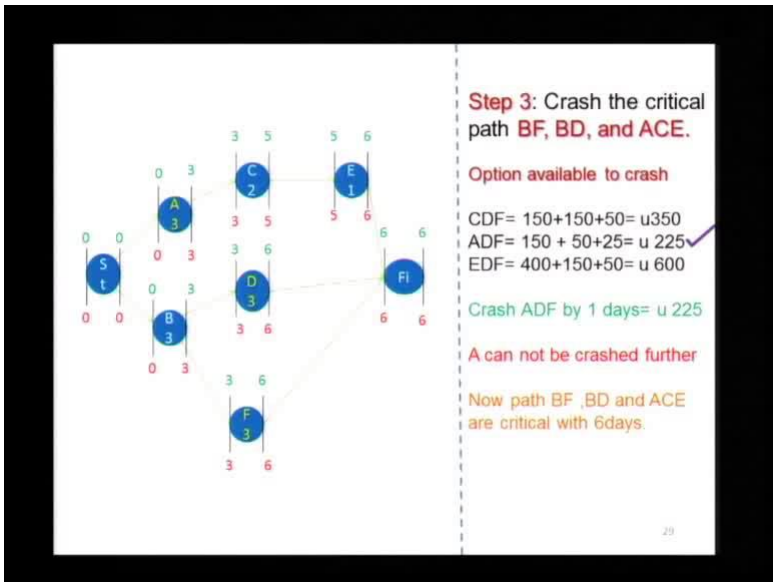

In the next step, we went on to with these options and we took the ADF option and could not be crashed.

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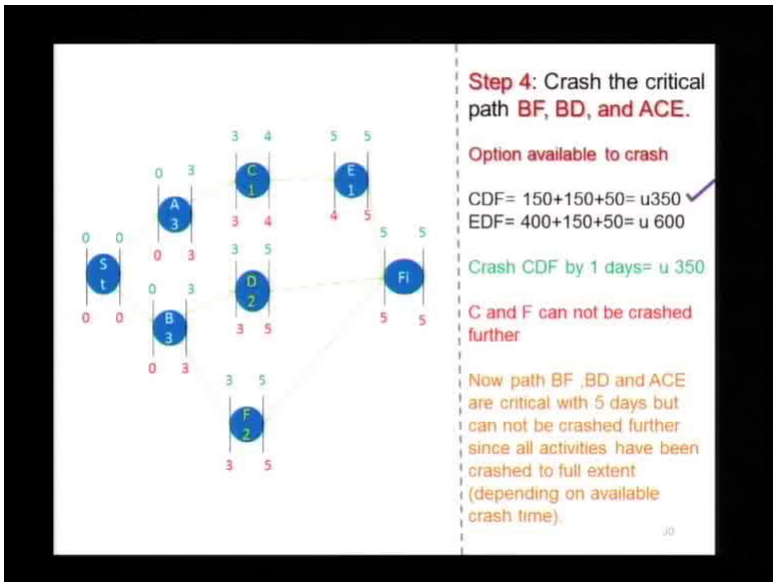

Now, we have all of it. And, in the last step, we took the CDF and we finished it in 5 days and we could not crash any more. Now, if we add the… what is the duration you got as… for minimum cost. Did you come to that computation?

Student: 5 days

No, that is the minimum duration.

Student: We have to calculate the indirect cost

You have to calculate the indirect cost.

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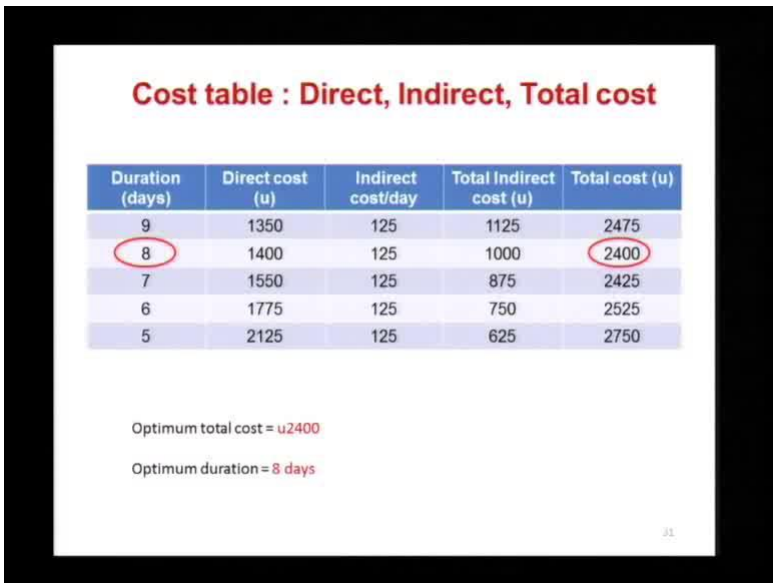

So, here we go; we have put the indirect cost per day – the total indirect cost. And, we started with 2475 as a total; comes down to 2400; then, starts increasing. And, we can see the… First cost we incurred was 50; after that it went to 150 second day. Remember – increase in cost in the second step, by bringing it down for 2 days, it went to up by 150; whereas, the slope of the first one was only 50. What is the indirect cost? 100. After that any reduction cost has more indirect cost than savings indirect cost. That is why the first step is where the savings come. And so, this is the optimum total cost and the optimum duration of 8 days; optimum in this case being minimum.

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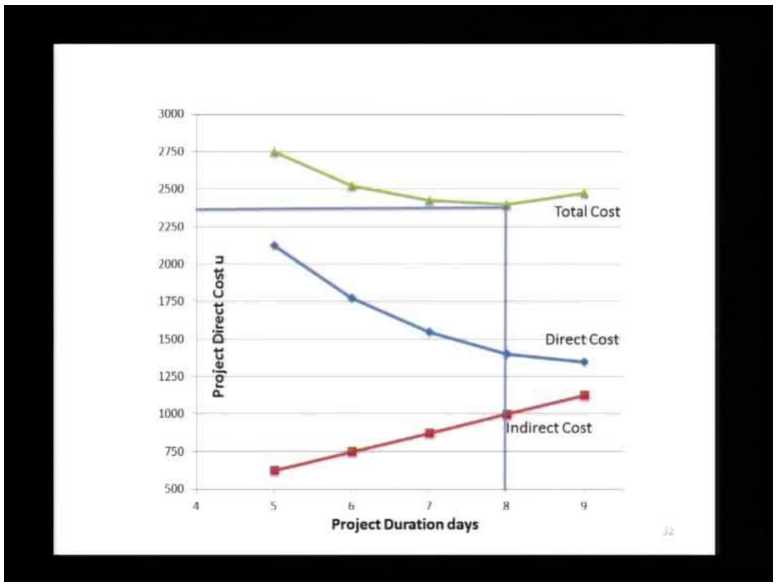

And, this is the relationship. So, if you plot the graph, you will find that, in that, this is how the trend goes. You see in the first step, I mean after we reduce it to the first here, this is where we get the optimum… Every other time we reduce the direct cost slope as higher than the indirect cost.

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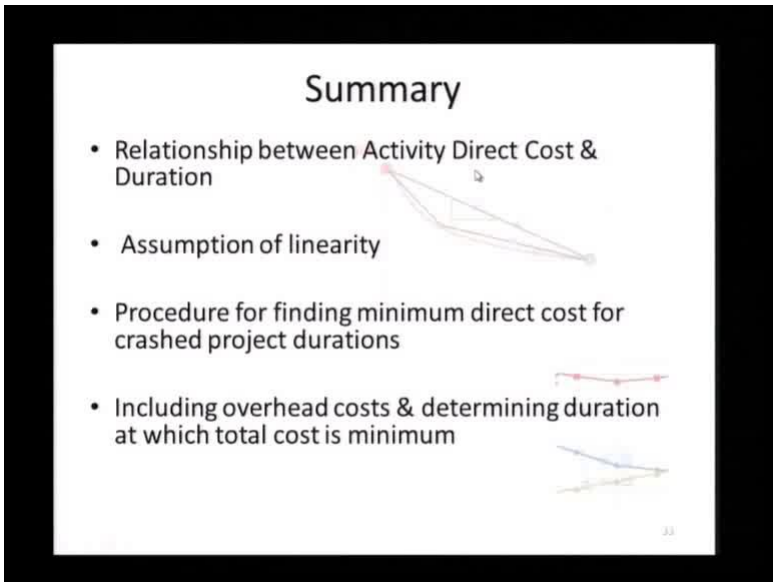

So, to summarize what we have done in this lecture, we looked at a relationship between activity direct cost and duration. We saw the assumptions that need to be made. So, if you recall, this was the graph which we showed how we make this linearity assumption. And, that really limits a lot of things, but it is only for the ease of calculation. We went through the procedure for finding minimum direct cost for crash project durations; then, we included the overhead cost and we found the duration at which total cost is a minimum. And, this is a very interesting relationship. And, we have to see how this can be applied on projects, so that we can actually find minimum overall cost. We will continue with this topic for one more lecture especially with different calculations and also various other variables like say liquidated damages, which will come and change as you change the whole equation as you start reducing duration.

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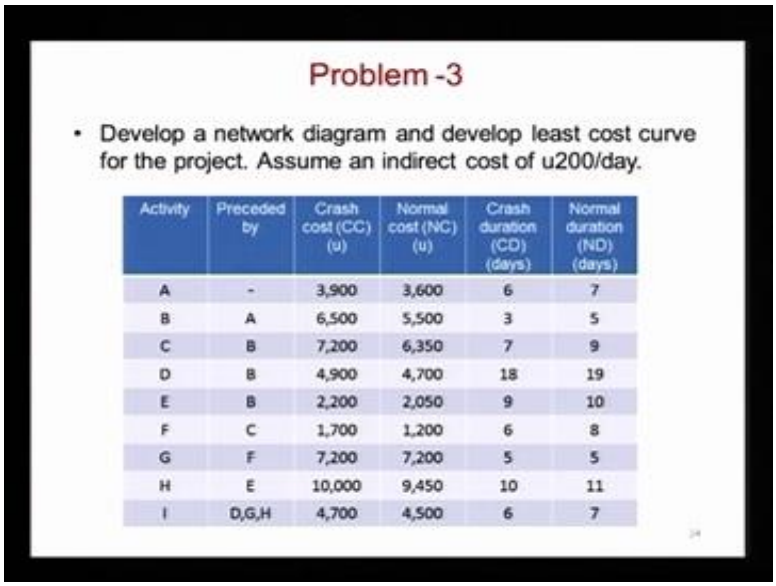

Activity	Preceded by	Crash cost (CC) (u)	Normal cost (NC) (u)	Crash duration (CD) (days)	Normal duration (ND) (days)
A	-	3,900	3,600	6	7
B	A	6,500	5,500	3	5
C	B	7,200	6,350	7	9
D	B	4,900	4,700	18	19
E	B	2,200	2,050	9	10
F	C	1,700	1,200	6	8
G	F	7,200	7,200	5	5
H	E	10,000	9,450	10	11
I	D,G,H	4,700	4,500	6	7

And, this is a problem which I am going to assign as homework. We will start out the next class with a solution to this problem.

Thank you.