Network Analysis for Mines and Mineral Engineering
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Lecture – 04
Introduction to activity on node diagram and comparison with arrow diagram

Let me welcome you to the 4th lecture of a Swayam NPTEL online certification course; Network Analysis for Mining and Mineral Engineering. So, in this lecture 4 we will discuss Introduction to activity on node diagram and comparison with arrow diagram.

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In class we have discussed how to construct a project graph in using the arrows; that means, how a network which is basically comprising a number of activities of job can be framed or can be show in form of a network using the arrow diagram; where arrow diagram where the jobs are denoted on the arrow by its name and duration.

So, this is the way we represent a job or activity in terms of arrow. And in the last lecture we have seen while we have tried to use this arrow for framing a network, which basically gives the complete activities or schedule. But we faced a number of problem where the complex relationships of the precedence and suceedence of the jobs are there and restrict the user to construct the network very easily using this arrow diagram.

So, the user is forced to use a number of dummy activities to complete the network which is nothing, but the dotted line represent as the dotted arrows in the network and essentially those are of 0 length sorry which is having 0 length and 0 costing. So, basically the 0 duration, 0 costing, dummy networks, pseudo net pseudo jobs are added to show the precedence of the jobs for completing the network which are not actually existing.

So, basically it has been found it is very difficult for a new user to foresee where the dummy activities should be added where not be, but dependence are there. So, that is why it is for the new user it is very difficult to find out the position, where the dummy activities can be added to define the complete network. So, that is why there must be some different types of system where it can be easily, the network may be framed even if a new person can do it very easily.

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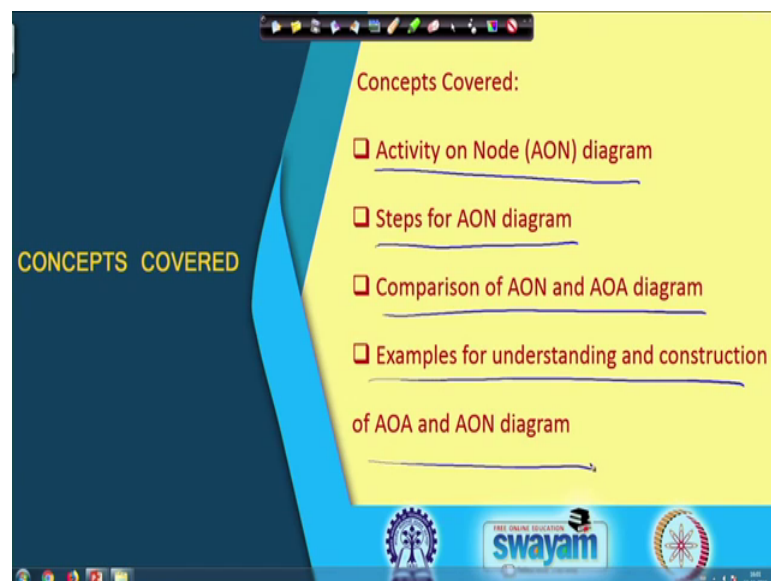
So, basically in this lecture; in this lecture we are trying to; we are trying to address this where we will discuss the activity on node diagram which is basically avoiding this. How what are the steps of this activity a on node diagram, then we will compare activity on node diagram with activity on arrow diagram that is the arrow diagram.

And we will understand some examples of mining and construction with some example we will understand constructional difference of activity on arrow and activity of node diagram. So, this lecture is another very simple lecture.

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Say activity on node diagram is constructed; so, that the jobs are mentioned in the node and the immediate predecessor relationship between two jobs is shown by an arrow connecting two nodes. That means, while the arrow diagram we are mentioning the job is a of length t which is started from node 1 to 2. In this case we representing a circle which is the node where we mention the job and its duration within the node.

That means, if a is preceded by x then the arrow x arrow is coming into the node 1 which gives the idea that x must be completed for prior to start up a. And node 2 the point where the arrow is being ended after that it is the job b is there; that means, b is the successors of the a. But in this case as it is represented in the node; that means, the preceded node preceded job again which is also mentioned in the node has to be shown in this way. So, that the precedence and success successor of that job particular job can be mentioned.

So, the nodes A, B, C are basically representing the activity of the job connected to that and arrows are basically shows the precedence predecessors and the successors of that job of that particular job. So, basically this is a different kind of diagram where the activities are placed in the node and that is why it is easier for anyone to draw this diagram.

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That means, a person can write the all the jobs and just name of jobs circle them then the jobs are mentioned in the network. Now, to show the predecessors precedence and the suceedence just the arrow has to be placed. So, like this way arrow can be made so; that means, it is very easy for a person to understand that these are the jobs required for the as the predecessors of that job and these are the jobs that are the successor of that particular job.

So, c and e are the predecessors of a b and d are the predecessors of a successors of a, but this actually a wrong diagram where we will find out some problem related to the cyclic mode of the not a network, but the giving the precedence and suceedence of a job is very easy while you are presenting the job on the network. Only by giving the arrow connecting to that network or ending at that network shows the precedence of that job and the suceedence is shown which are the arrows coming out from that node is showing the suceedence.

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So, basically the construction; construction of the network is very very important or very very easy in this activity on node diagram. Now let us see how we can construct a activity on net node diagram. So, this is activity on arrow diagram this is activity on node diagram you can see this is a little bit lengthier one, this is a smaller one. And this representing the 2 successive activities; AB using the activity on arrow and activity on node diagram. And if you see it is found in the previous arrow diagram that addition of dummy jobs is a cumbersome procedure.

Because, calculation to perform critical path or pert scheduling make use of all jobs and hence are lengthened the calculation part in the system so; that means, the moment we are using a dummy job we are lengthening the calculation process and creating the problems. So, that is without the dummy job it is very easy for a person to calculate it or the computer calculation time may be reduced as the number of jobs are getting reduced.

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So, using a an activity on node diagram we can eliminate the dummy job and you can see with this example where you can see activity on arrow diagram this dummy job is this dummy job is required for this example which you have already discussed in the previous class. So, this dummy activity is required so, that we can construct this network in the activity on node diagram activity on arrow diagram.
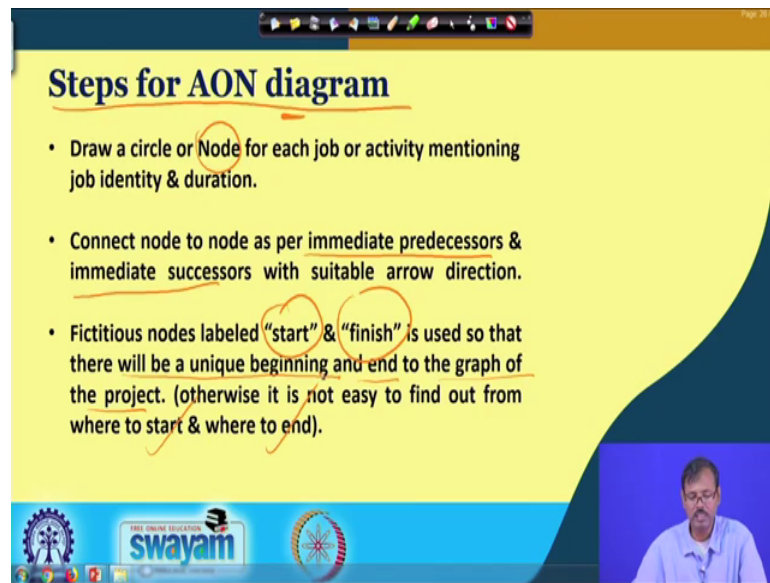
But if you try to present it; to present it in a activity on node diagram then you can easily find out there must be starting node from that the first two jobs which are a and a dot let me clear it once a a dot these two jobs are the starting job which does not need any predecessors. Then we are having job b which is having both a and a dot as the predecessors we are having job c which has only a as predecessor.

We are having job d which only sees the predecessors and we are having job e which both b and d are the predecessors then we have to end the network by providing. A predecessors at this point. So, basically so, basically what we are doing we are we are forming the precedence and suceedence while we are placing the jobs on the node and only the arrows are given for showing the precedence and succedence and that is why we do not need a dummy activities which we are required at this position. So, this is very easy to construct the network in activity on node diagram where we do not need to use the dummy jobs.

Now, let us see the steps of the steps for constructing the AON diagram. So, we have to draw a circle or node for each job and activities then connect the node as per the immediate predecessors and immediate successors and there must be two nodes for start and finish. So, that it will be a unique beginning and end for the project graph otherwise it is no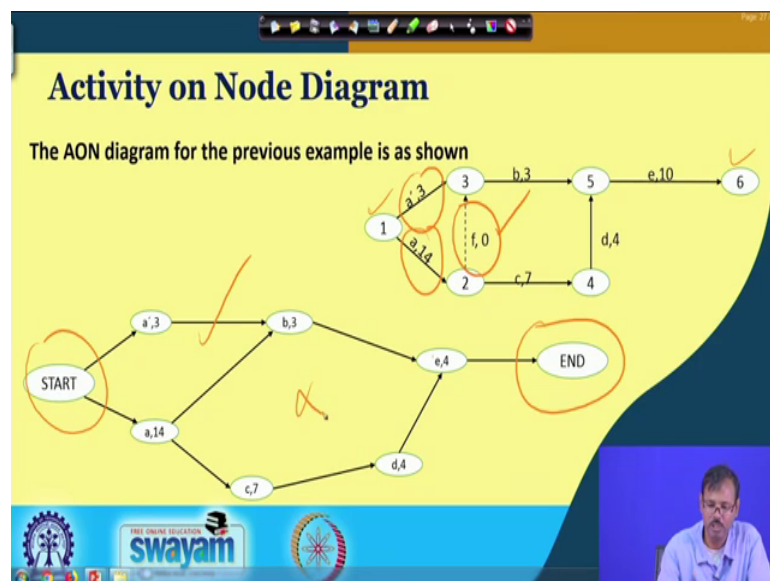t easy to find out from where it is start and where it ends. So, this is essential steps which are required for the activity on node diagram and by this way you can construct the activity on node diagram.

Now, let us see some of the activity on node diagram which are previously shown you in the last class. Now, you can see this is the example which we have discussed where this dependences are defined by this defined using this dummy activities which are which is eliminated here ok. So, you can see this is the c d e ends. So, these two start and end are required for terminating this projects, but here these are not required, but here dummy jobs are required here dummy jobs are not required.

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So, now let us compare between the activity on node diagram and arrow diagram. So, this comparison is very interesting you can see arrow AON diagram is simpler and having some advantages during the construction over arrow diagram. And it is it is for the new person also it is very easy to explain their dependency, it is very easy to understand also where for arrow diagram because of the dummy job it is little bit difficult.

But the problems the benefit arrow diagram is having while we are carrying out computerized analysis for the complete network especially for the optimization. And we go for frequent changing of the costing and time scheduling part for the critical path method analysis and for the program evolution review technique analysis that time arrow diagram is much much better.

Because they represent by a node in an arrow diagram and that is why it takes for a long computerized system arrow diagram present representation needs lesser memory

because, that can be explained in arrow of starting node and ending node. But for the activity on node diagram the activity will be defined in the computerized system with its predecessors and the successors. So, it is arrow requirement is much much higher that is why the memory requirement will be more for a complex project while we are carrying out for the activity on node diagram in compared to arrow diagram.

So, though dummy jobs are there and it is difficult to place those dummy jobs personally when it is carried out, but if it is carried out then the analysis in a computerized system is easier for the arrow diagram than the AON diagram.

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Arrow diagram for computer based calculation in PERT CPM scheduling is superior because, two number from job identifications and automatically able to read the immediately predecessors are and successors. So, that is easy for the arrow diagram and AON diagram list each jobs immediate predecessors successors.

So, which is difficult data base or string has to be provided which is insignificant in the advance computer because, it is taking much much memory for those things. So, we have already discussed these things.

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Now, let us discuss few examples we will discuss two example from the mining industry one for the open cost mine one for the underground mine. Then we will I will show you one example for the construction industry your job is to practice that construction because that is a very big network, you have to practice that in your house. So, that on your or in your hostel so, that you can understand or check whether you are able to solve that one or not.

So, let us consider this one where drilling of over burden drilling, charging of over burden drilling in coal, charging in coal, then blasting will be carried out both together, then mucking in coal, mucking in over burden, secondary drilling in over burden is required coal we do not expect a larger size bolter, then face preparation and OB and coal is required. And, based on that our expert systems are showing that we have to carry out drilling before charging; so, that is essentially required that b is having a as the predecessors we must charge the hole first before blasting.

So, b and d is required before we are carrying out the blasting e. Similarly blasting must be completed prior to marking in f and g and secondary drilling can be carried out only after marking; that means, the when the (Refer Time: 19:49) sorted out the big bolder after that only the secondary drilling will be carried out here. So, the secondary drilling will be carried out here. So, the secondary drilling ob will be carried out after the mucking in OB.

And the face will prepared for the next blast after those h and f; that means, secondary drilling and blasting at OB and mucking at for the for this case mucking at coal. So, this is the very simple network and very very easy for a mining engineer to understand that how drilling charging then blasting has to be carried out. Then the mucking will be carried out big boulders will be sorted then the secondary drilling and blasting actually this secondary plus blasting will be carried out in the secondary boulder big boulders then the face will be prepared for the over burden and coal for the next round of operation.

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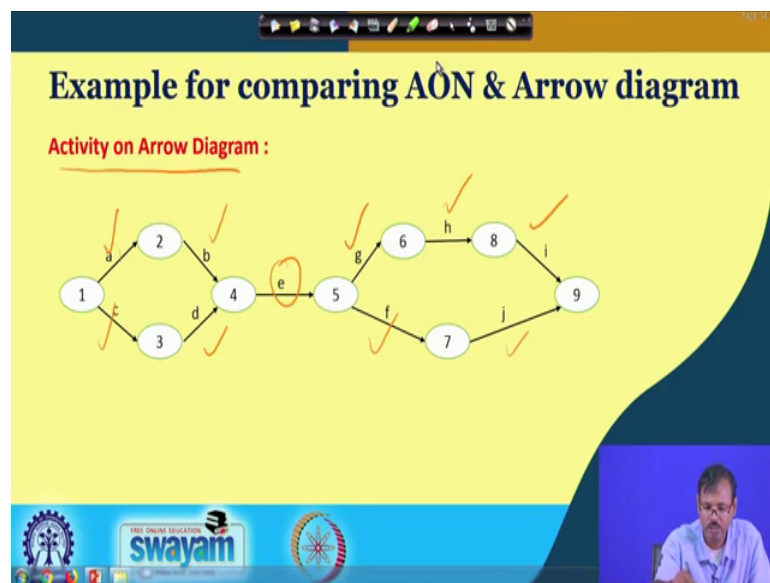
So, this is very easy to understood let us see if we. So, the network activity on node network will represent like this sorry activity on arrow diagram is being represented like this actually the durations are not given you can add the duration at this position. So, these are first job drilling then charging then the blasting will be carried out only after completion of this one then this one is for over burden. So, you have to carry out mucking, then mucking then, secondary drilling blasting, then face preparation, then face preparation. So, this is very easier way to represent this one if you try to represent this one in terms of activity or node diagram.

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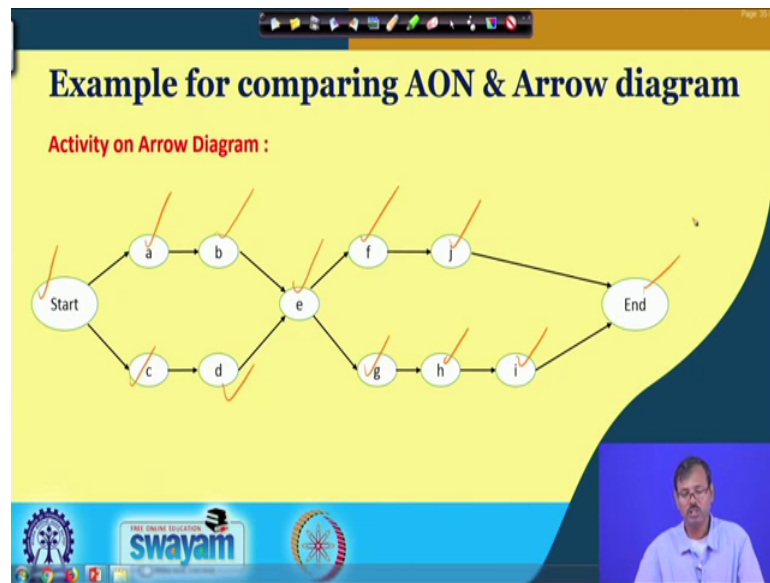
So, it can be represented in activity or node diagram this is the starting then the drilling overburden and coal charging overburden and coal then blasting, then mucking, then secondary drilling blasting, then face preparation that ends. So, this construction was very easy for both the cases because we need not to have we need not to have any dummy job in this case.

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So, this is another underground requirement where face drilling is carried out fast then the charging which is having the drilling requirement, then the blasting which is having

the charging requirement, fume clearance which is having the blasting requirement, then scaling only man can enter into the face after the fume is clear. So, scaling can be done by the human being. So, that is why fume clearance must be essential to carry out the scaling in the roof. Then the light cable will be reinstalled during the scaling itself you can carry out the extension of the light electrical cables.

So, fume clearance is the precedence of the light cable extension. Then mucking will be carried out and then will be carried out if it is scaling is already carried out and the sufficient lights are there then will allow for the mucking. Then after mucking we will provide the support as a you are closing to the unsupported span your supported span is extending. So, that is why you will go for the supporting in terms of roof bolting etcetera then you can extend image along with the supporting system you can extend the drainage along with the supporting system.

So, this job can be done together and that required the completion of the mucking only because the top movement and others will be there or (Refer Time: 23:49) movements maybe there or maybe the LHD movements are there. So, that will prevent the operation of these where human man powers are involved so, but completion of the network is allowed the man power engagement in this three activities. And finally, after completion of all this the supervisor will come or the foreman will come or the over man will come to mark the face again for the next round of drilling.

So, this is one circle cycle of operation carried out in a face of drift or in a face of coal mines or may be even metal metallic (Refer Time: 24:27) mines where ever it is used.

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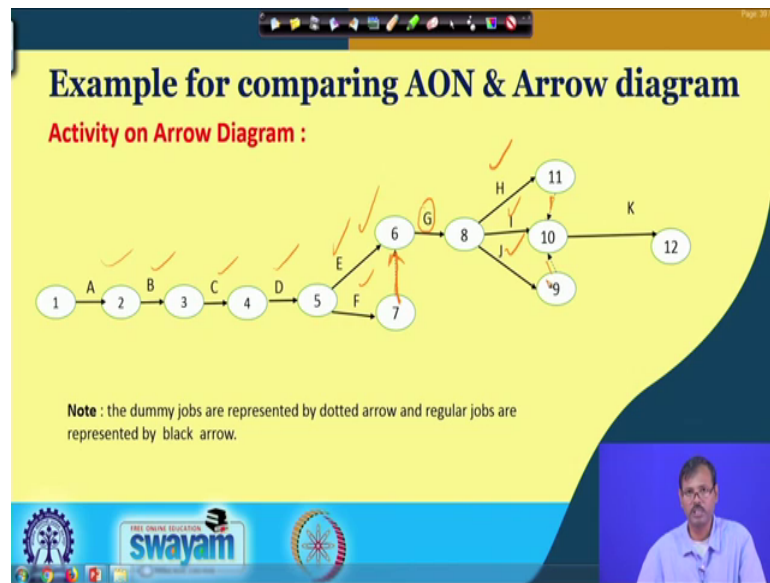
So, this one cycle of operation and if you try to construct a network it may look like this actually it is basically wrong one this will be direct arrow. So, this is the dependency showing A is A to B B to C C to D then E and F will be carried out together and G will be carried out only after completion of lighting and scaling. So, lighting and scaling has to be completed prior to start of mucking.

But, after mucking simultaneously you can carry out these three operations and the face will be marked after the completion of these three operations that is why the dependence of this one is being shown here using these two dummy jobs. So, now, this is activity on arrow diagram which is presenting the cyclic operation of one underground mine face.

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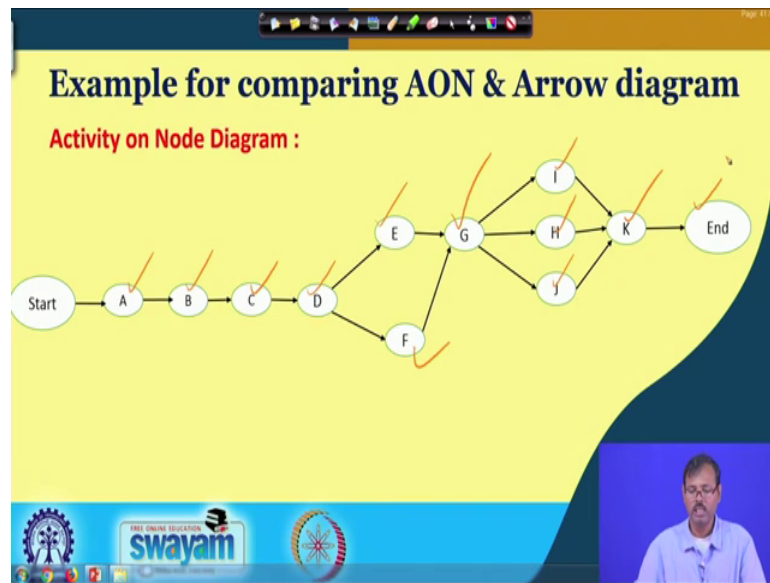
Now, if we see the activity on node diagram of the same you can see this is the drilling, charging, blasting, fume clearance, then it is some scaling and extension of electrical cable. Then mucking, then the three support drainage duct extension operation then the finally, the marking of the face and this is the end of the procedure.

So, this is simple one for the underground, but in activity on arrow that diagram requires two dummy jobs to be defined there for the completion of the network, but which is eliminated in this activity on node diagram. So, let us give you one example for the construction industry as it is available to you now.

Example for comparing AON & Arrow diagram

Assignment : Draw AON and AOA diagram

Events	Description	Immediate Predecessor	Time
a	Excavation	-	4
b	Foundation	a	2
c	Frame correction	b	4
d	Brick Work	c	6
e	Drainage	b	1
f	Basement flooring	e	2
g	Rough plumbing	e	3
h	Rough wiring	c	2
i	Air conditioning	c,f	4
j	Plastering	g,h,i	10
k	Finished flooring	j	3
l	Finished Kitchen	k	1
m	Finished Plumbing	k	2
n	Finished carpentry	k	3
o	Finished roofing	d	2
p	Fasten gutters	o	1
q	Lay storm drain	b	1
r	Tile fitting	n,s	2
s	Paints	l,m	3
t	Electrical fittings	s	1
u	Door steps & grading	p,q	2
v	Pour walks and lands cape	U	5

This is a very long you can say a to a, a b c d up to v is there and those jobs and duration are there and you have you complete this one by your house you can say this your home assignment. I can show you one glance one glance of this one, but do not see this just only one glance I want that you must complete the activity on arrow diagram of this one and activity on node diagram of this one.

And if you are able to complete this one by your own then you can consider yourself or gathering or acquiring the sufficient knowledge for the construction of the network. So, basically this ends this lecture my expectation is that with this lecture you now think that you are able to construct any network or you can practice a number of construction of; a number of network.

Only from the table given in the different texts book or available in the internet or etcetera by the predecessors jobs or the successors jobs do not follow the alternative if alternate is given; that means, already the network is constructed. So, you have to construct the network by getting only the name of the predecessors and the successors of the job if you are you carry out n number of examples. If you are able to complete those by your own without seeing the solutions then you can think that you are now expert for the network construction ok.

Thank you.