

Project Planning and Control Methods

Lecture #6

Schedule Presentation

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Outline

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- Network Presentation
- Activity on arrow (AOA) network
- Bar-chart (Gantt-chart)
- Working time

Network presentation

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- A network is a logical and chronological graphic representation of the activities (and events) composing a project.
- At their minimum level, project networks present activity dependencies, but they can also represent additional information such as early and late start time, early and late finish time, slack, resources, etc.
- Networks are used for both presentation and calculations of the project schedules. Many schedule optimization methods use network concepts.
- Schedule network diagrams are in two types: Activity on Arrow (AOA) networks and Activity on Node (AON) networks.

Network presentation

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- AOA networks were more popular in the 1960s and 1970s, but because of their limitations they are now mainly replaced with AON networks (as we used them in our CPM scheduling)
- Network scheduling has revolutionized the management of construction projects. It has provided management with a more objective and scientific methodology than simply relying completely on the project manager's personal skills.

Activity on arrow (AOA) network

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- AOA networks are also called the arrow networks, the arrow diagramming method (ADM) or the I–J method (because activities are defined by from node I and to node J).
- Example 1: Let's start with a simple AOA networks example:

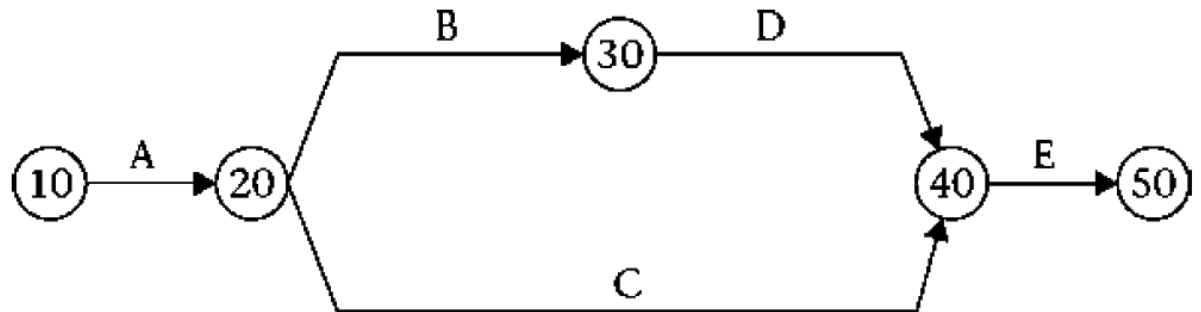
Activity	Predecessor
A	–
B	A
C	A
D	B
E	C, D

Activity on arrow (AOA) network

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- Example 1: Let's start with a simple AOA networks example:

Activity	Predecessor
A	–
B	A
C	A
D	B
E	C, D



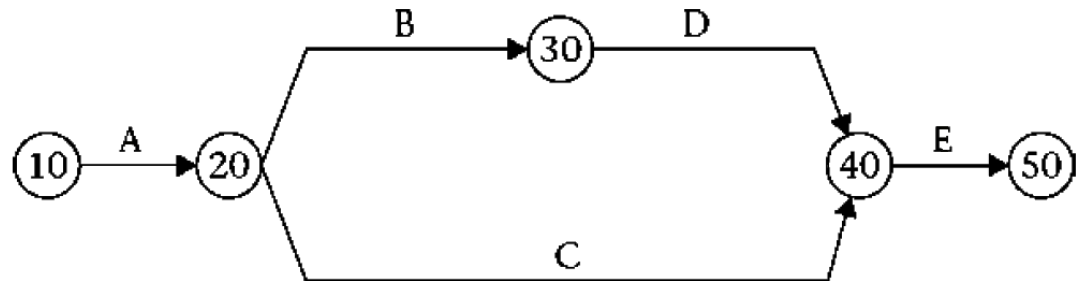
- Nodes represent events in the AOA networks, i.e., start of the activities and end of the activities.

Activity on arrow (AOA) network

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- In the network calculation in order to address activities (arrows) we need to know activity start and finish nodes.

Activity	Network representation
A	10-20
B	20-30
C	20-40
D	30-40
E	40-50

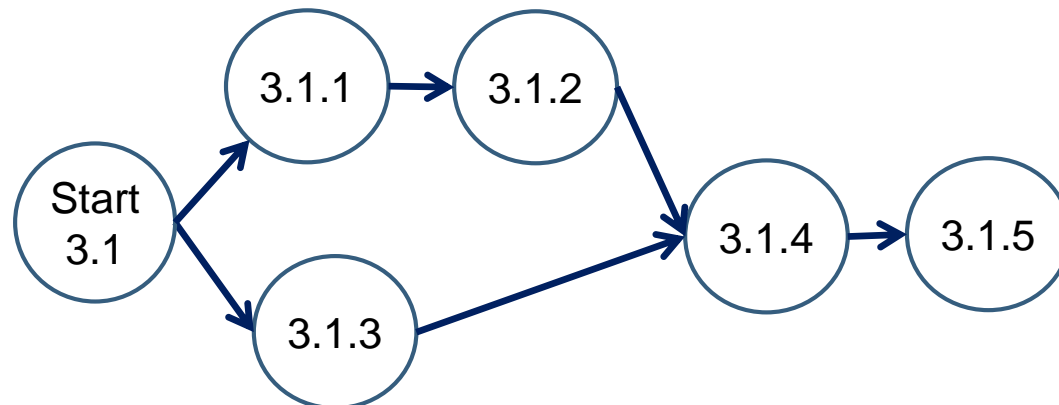


🔊 One *weakness* of AOA networks is that they can not represent other types of dependencies than FS.

Activity on arrow (AOA) network

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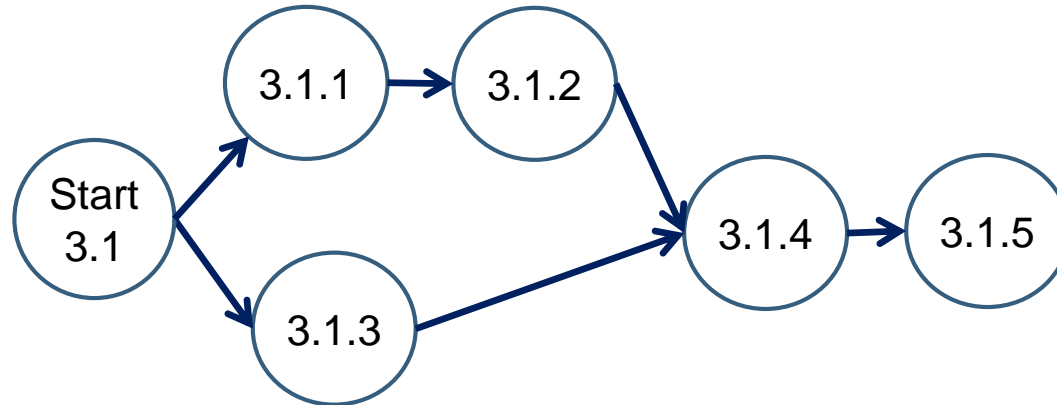
- Example 2: Show our “3.1. Prepare foundation form work “ example on AOA network.
 - 1) Extract foundation sizes from drawings
 - 2) Order form sheets
 - 3) Hire two form-workers for the job
 - 4) Size form sheets
 - 5) Install form sheets in place



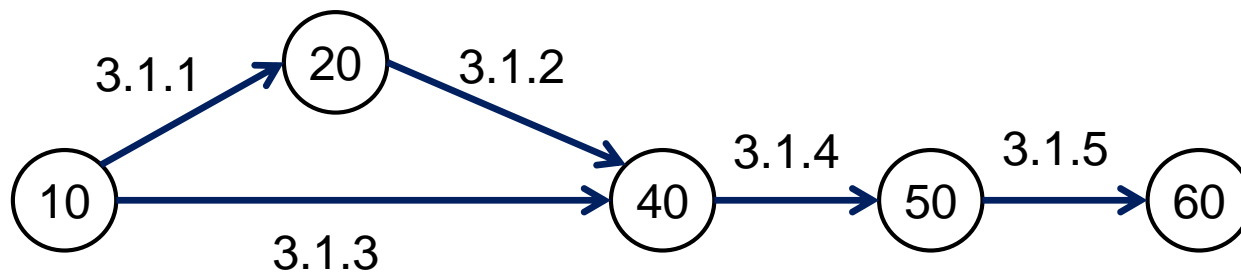
Previously developed AON network

Activity on arrow (AOA) network

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Previously developed AON network



AOA network of "prepare foundation form-work"

Activity on arrow (AOA) network

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- Example3: Draw AOA network for the activities with dependencies in table below:

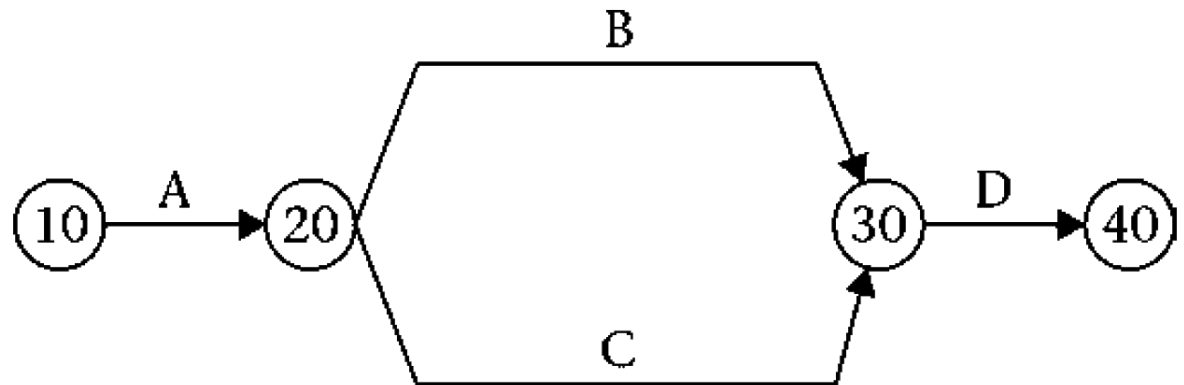
Activity	IPA
A	–
B	A
C	A
D	B, C

Activity on arrow (AOA) network

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- Example 3: Draw AOA network for the activities with dependencies in table below:

Activity	IPA
A	-
B	A
C	A
D	B, C

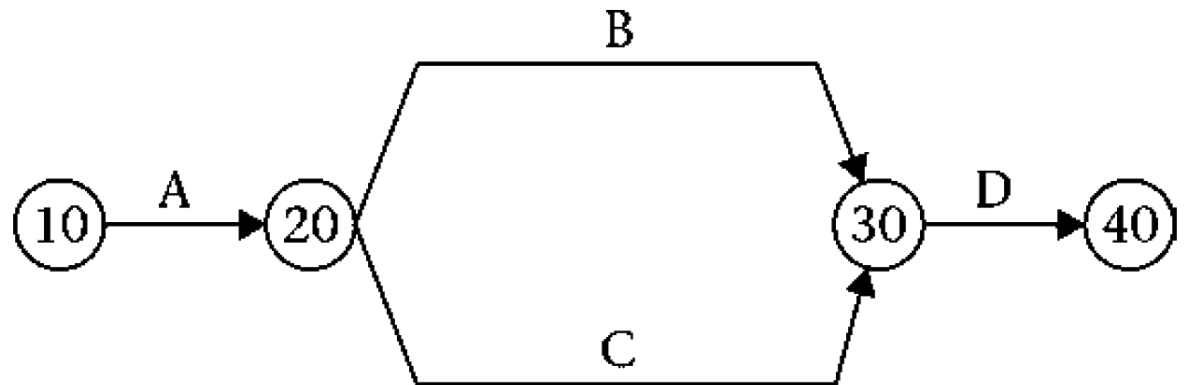


Activity on arrow (AOA) network

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- Example 3: Draw AOA network for the activities with dependencies in table below:

Activity	IPA
A	-
B	A
C	A
D	B, C



Activity	Network representation
A	10-20
B	20-30
C	20-30
D	30-40

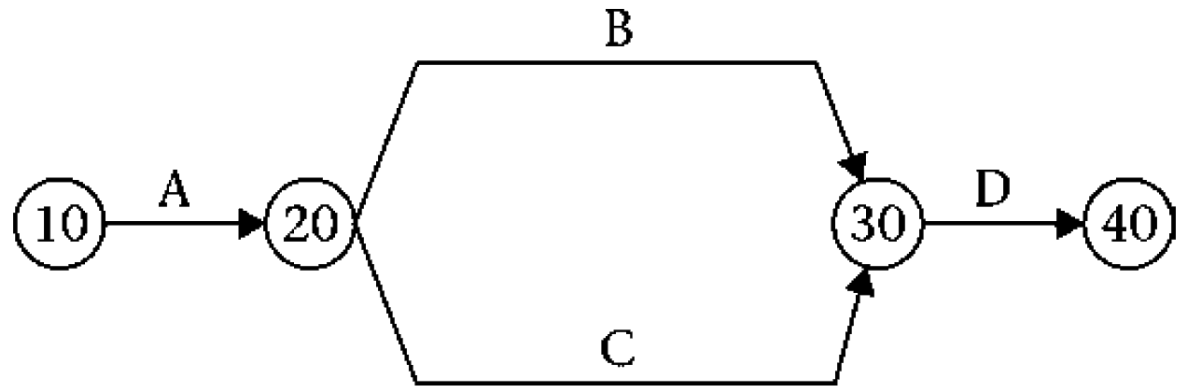
- We need to remove identical network representation for different activities!

Activity on arrow (AOA) network

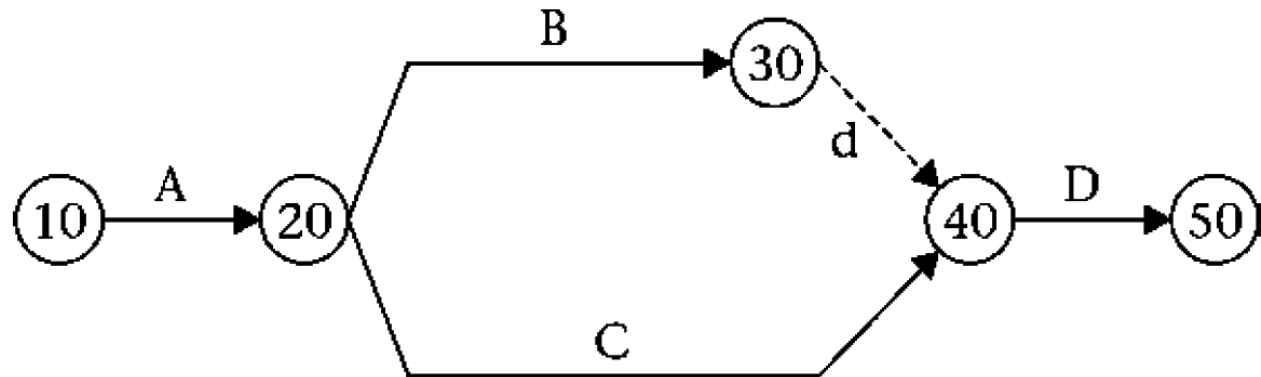
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- Example 3: Draw AOA network for the activities with dependencies in table below:

Activity	IPA
A	-
B	A
C	A
D	B, C



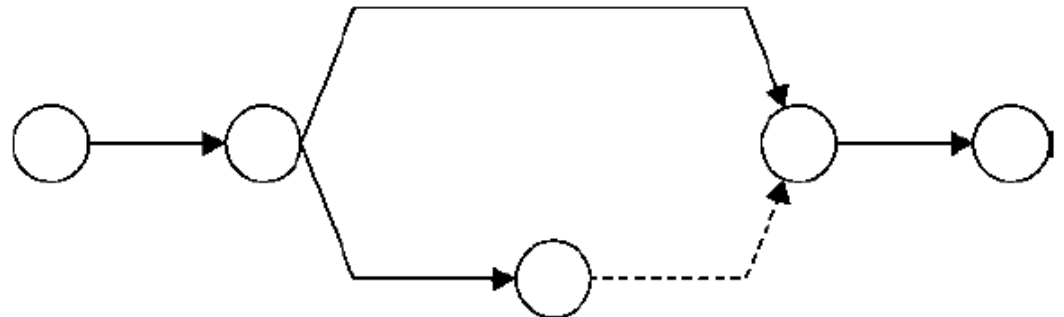
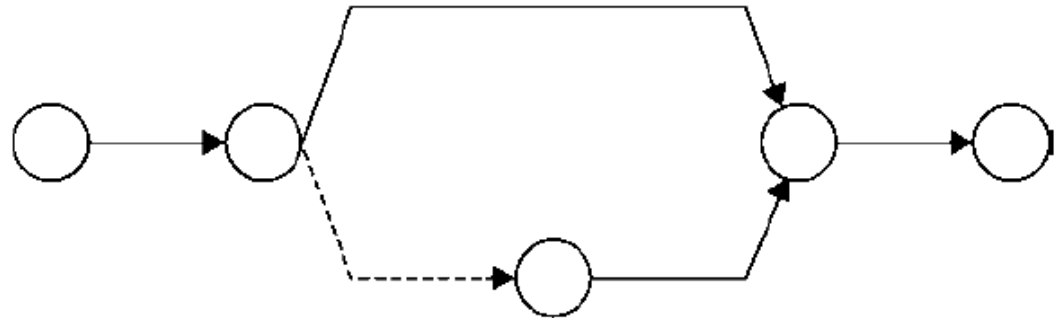
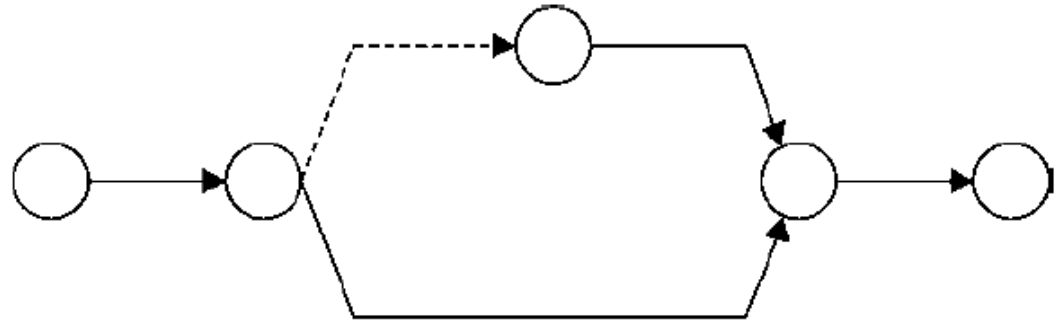
Use a **dummy** activity to remove identical network representation issue!



Activity on arrow (AOA) network

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- Example3 (Cont'd): Other solutions:
We can place the dummy activity in different network locations to prevent the identical network representation issue!



Activity on arrow (AOA) network

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- Example4: Draw AOA network for the activities with dependencies in table below:

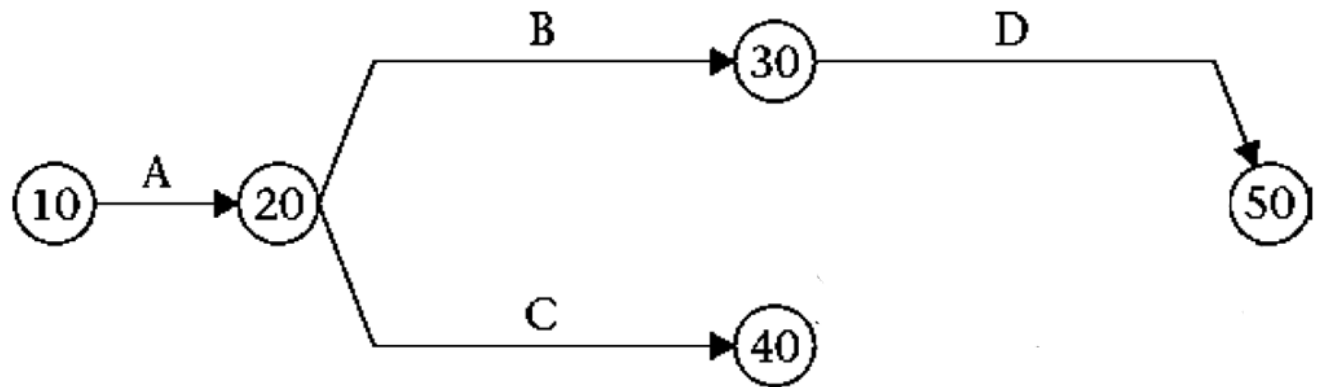
Activity	IPA
A	—
B	A
C	A
D	B
E	B, C
F	C

Activity on arrow (AOA) network

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- Example 4: Draw AOA network for the activities with dependencies in table below:

Activity	IPA
A	-
B	A
C	A
D	B
<u>E</u>	<u>B, C</u>
F	C



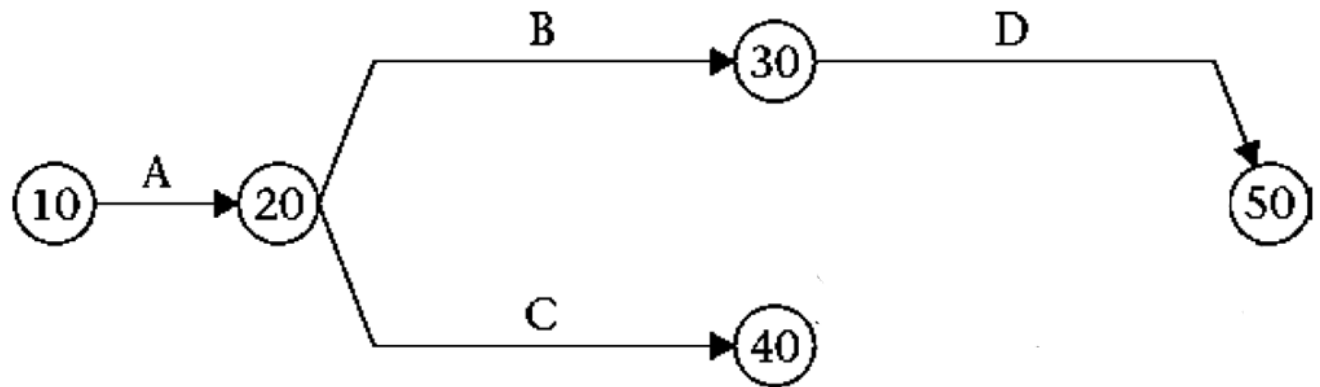
Question: How can we represent activity “E” considering its “B, C” dependencies on the network?

Activity on arrow (AOA) network

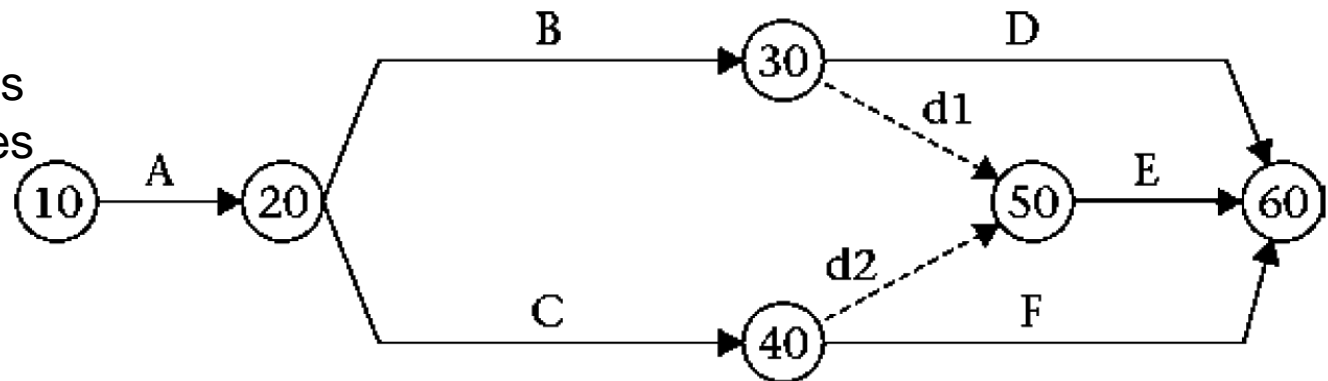
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- Example 4: Draw AOA network for the activities with dependencies in table below:

Activity	IPA
A	-
B	A
C	A
D	B
<u>E</u>	<u>B, C</u>
F	C



Question: How can we represent activity "E" considering its "B, C" dependencies on the network?



Use **dummy** activities to show dependencies in the AOA network when required!

AOA network - In class exercise 1


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 Draw AOA network for the activities with dependencies in table below:

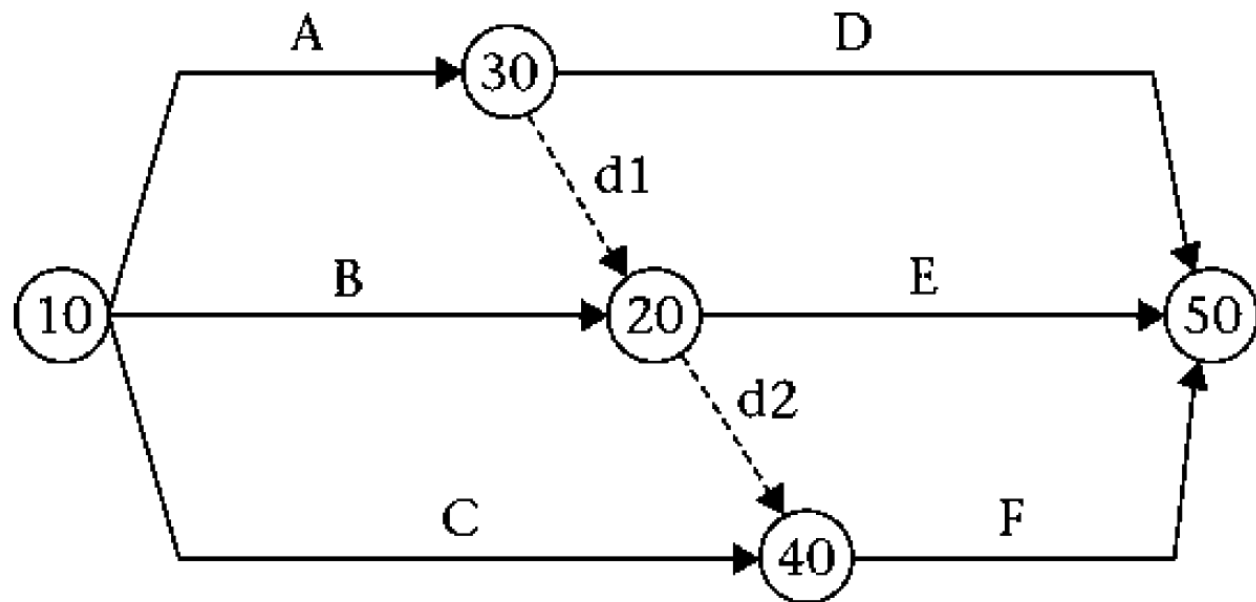
Activity	IPA
A	—
B	—
C	—
D	A
E	A, B
F	A, B, C

AOA network - In class exercise 1

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 Draw AOA network for the activities with dependencies in table below:

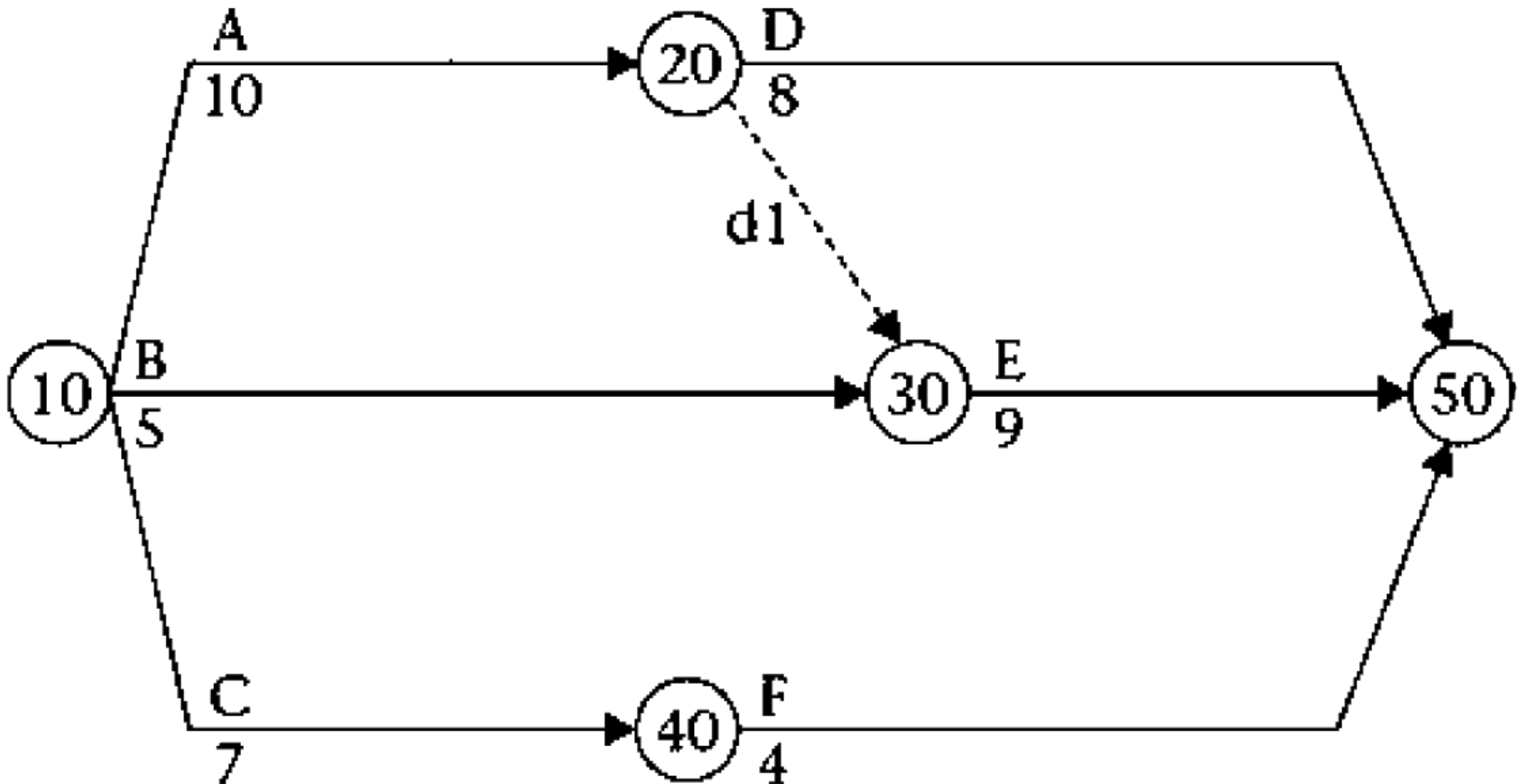
Activity	IPA
A	-
B	-
C	-
D	A
E	A, B
F	A, B, C



AOA network – CPM calculation

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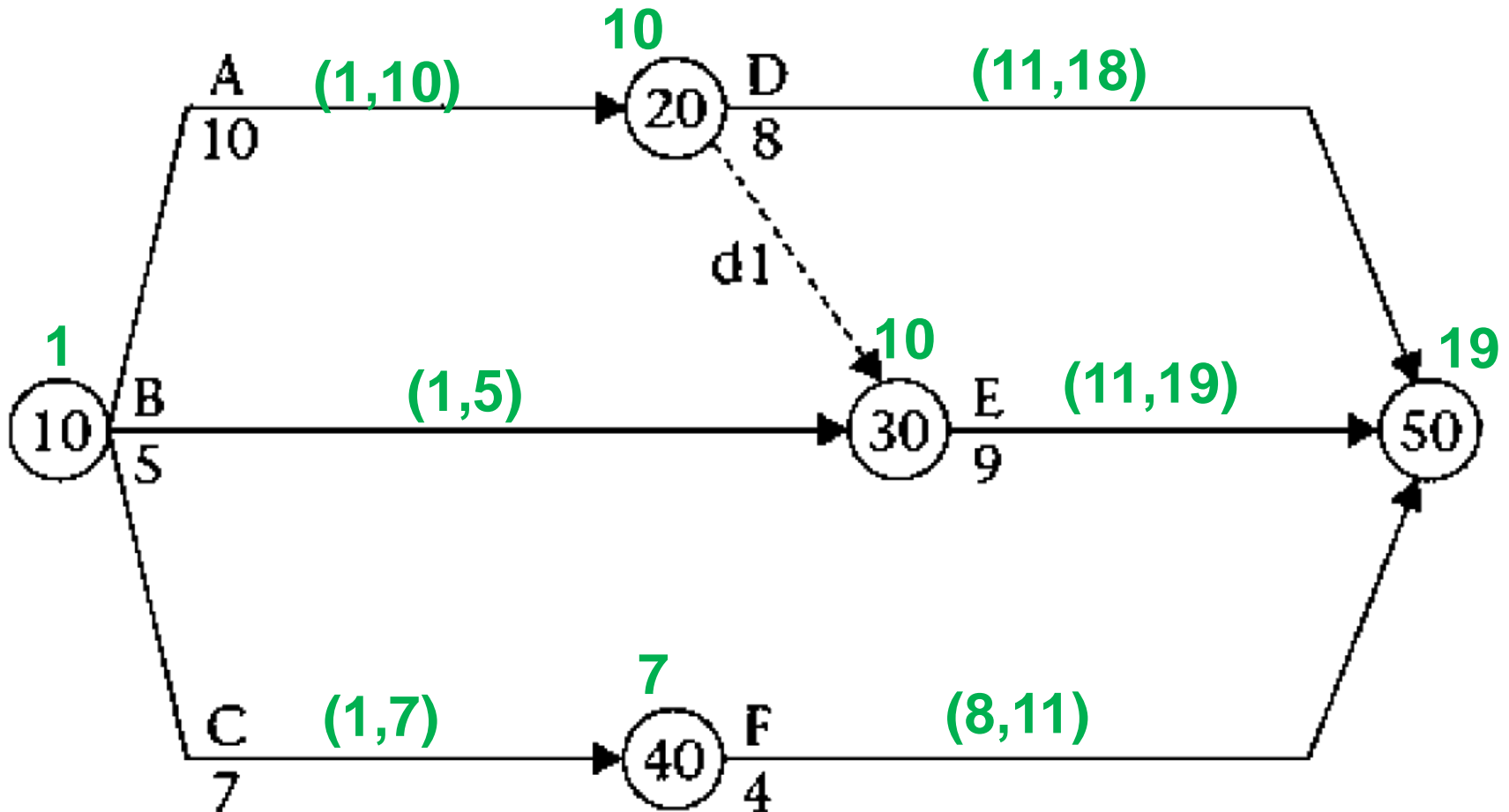
- Similar CPM calculations we did on AON network can be done in AOA network:



AOA network – CPM calculation

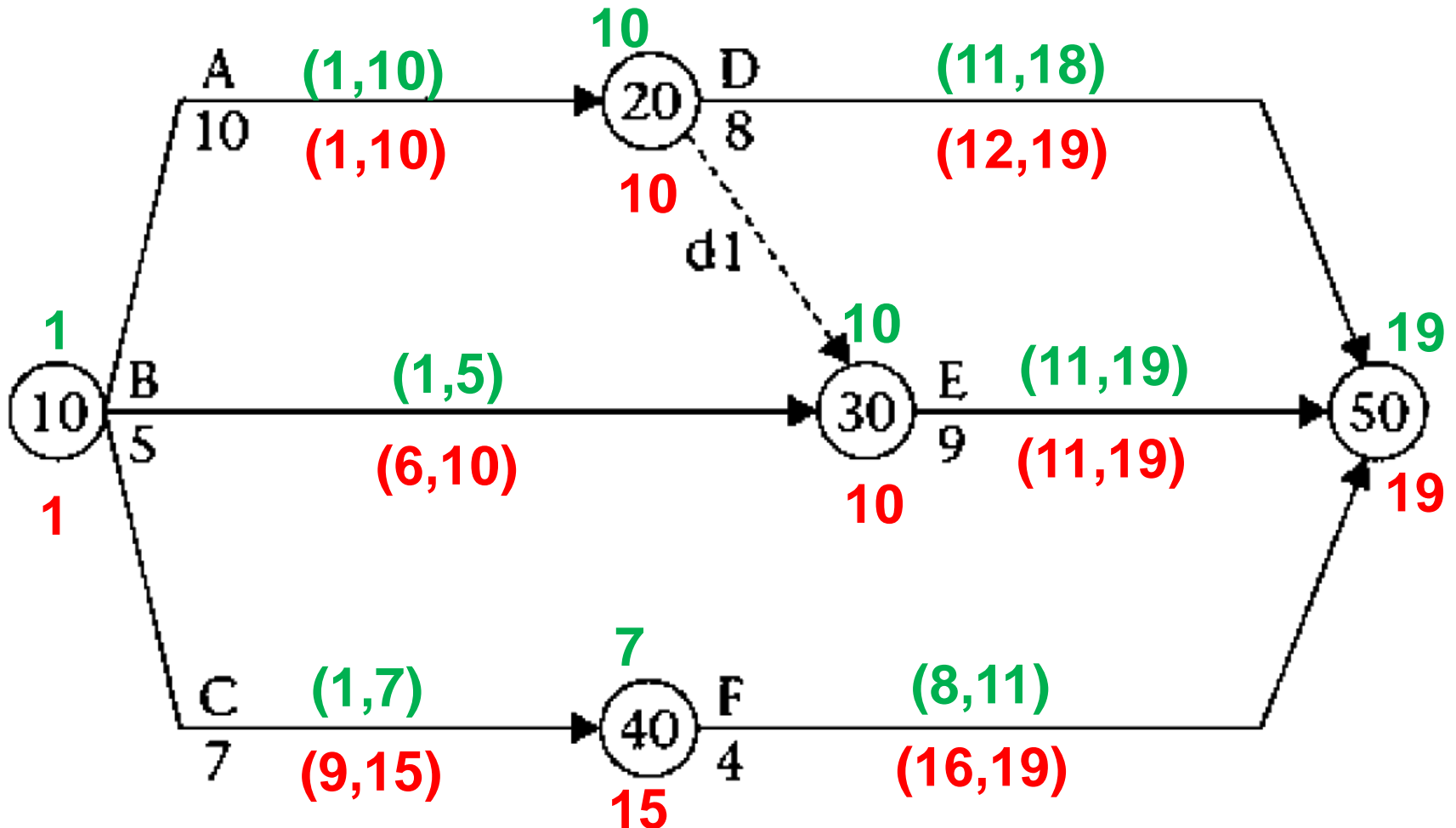
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- Calculate schedule for the below AOA network with the given activity duration:



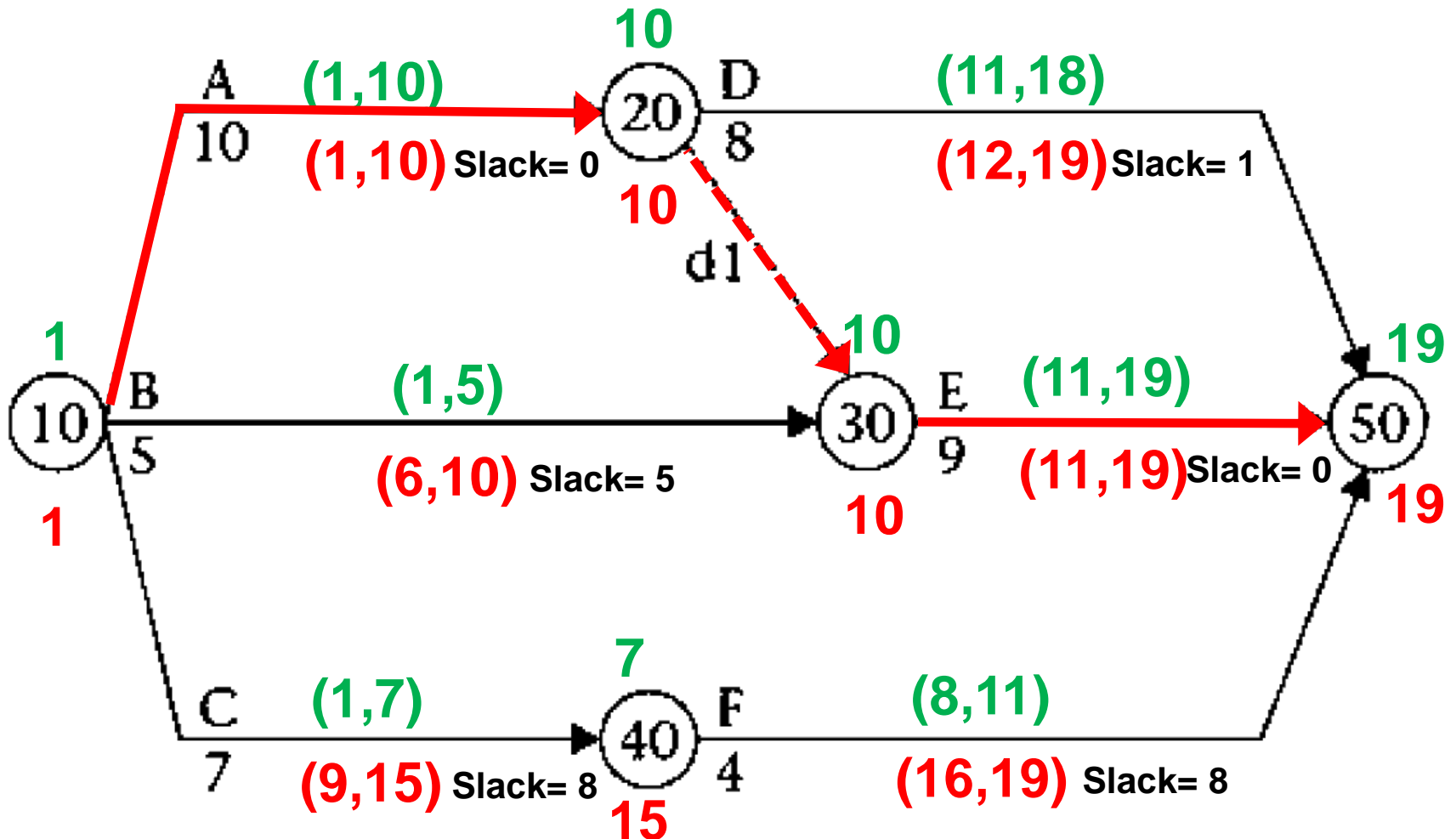
AOA network – CPM calculation

- Calculate schedule for the below AOA network with the given activity duration:



AOA network – CPM calculation

- Calculate schedule for the below AOA network with the given activity duration:

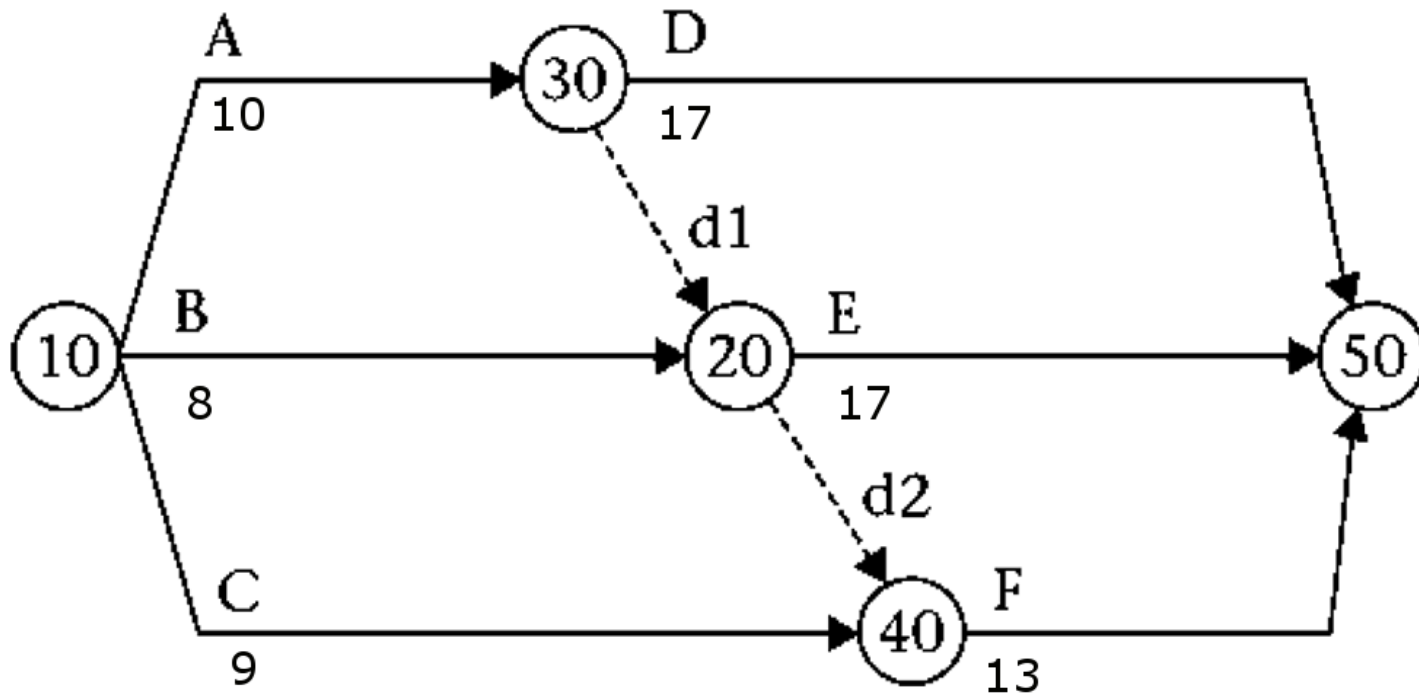


AOA network - In class exercise 2

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Calculate schedule for the AOA network in below and show the critical chain :

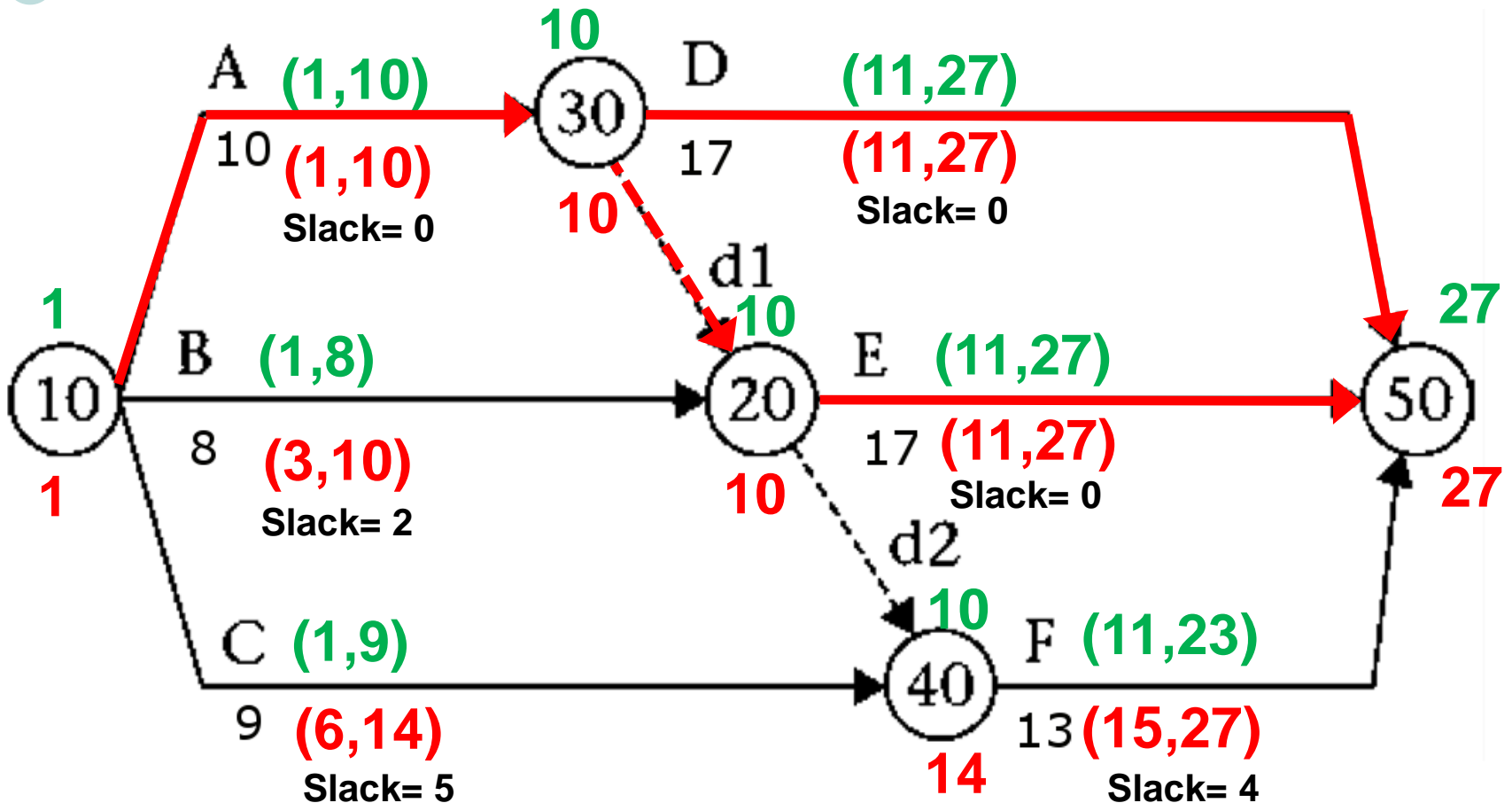


AOA network - In class exercise 2

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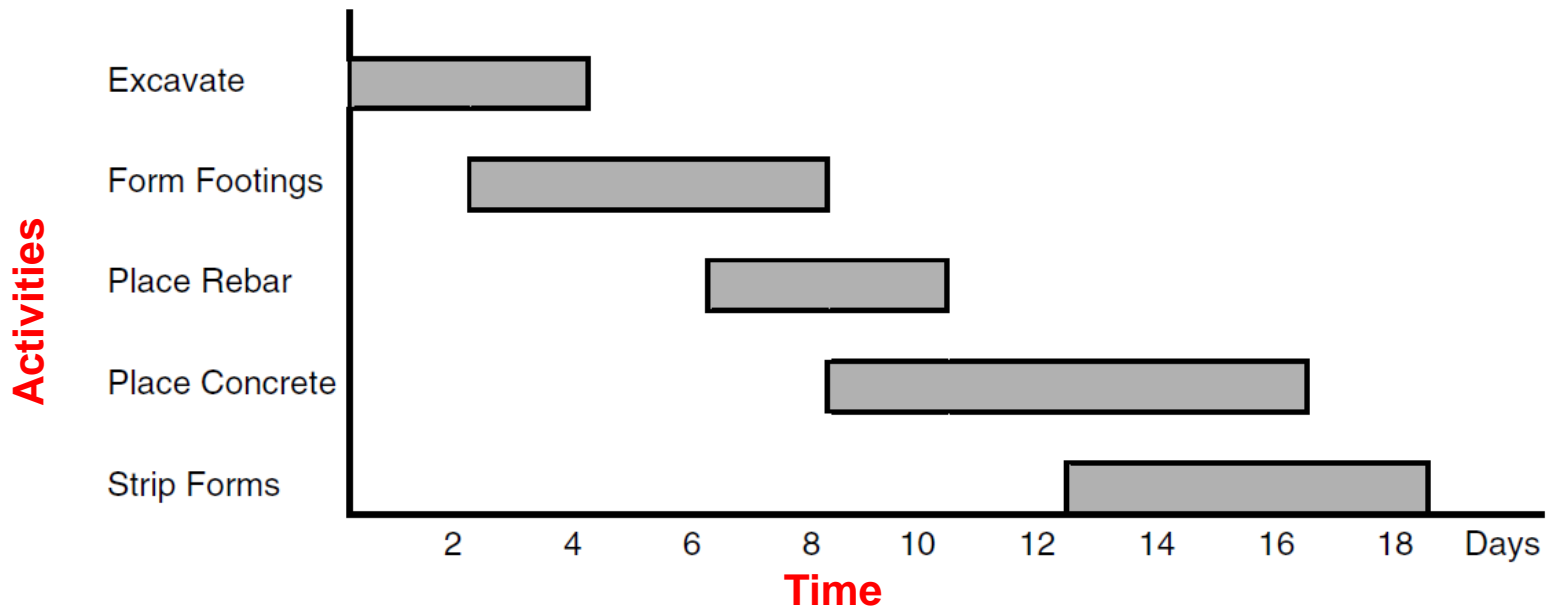
Calculate schedule for the AOA network in below and show the critical chain :



Bar-chart (Gantt-chart)

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- A bar chart is a graphic representation of project activities, presented in a time-scaled bar.
- The bar chart was originally developed by Henry L. Gantt in 1917 and is alternatively called a Gantt chart.

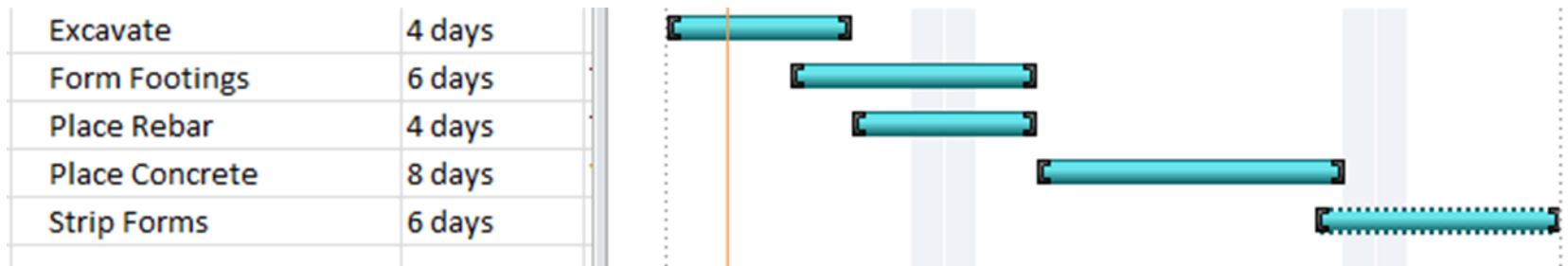


Example 1. A Gantt-chart for a foundation work

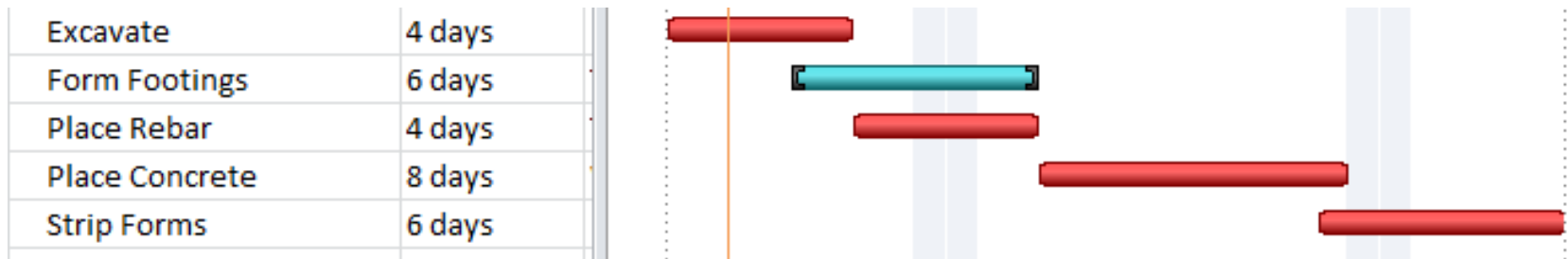
Bar-chart (Gantt-chart)

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- Simplicity of Gantt-chart has made it one of the most popular methods for the project schedule presentation.



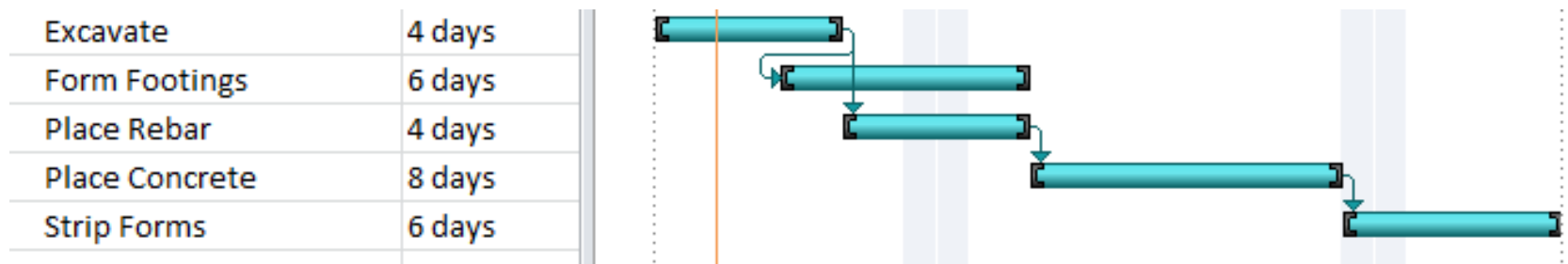
- Different colour can be used for presenting critical chains in the Gantt-chart.




Bar-chart (Gantt-chart)

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- Dependencies can be shown in Gantt-chart by linking bars with arrows.



 **Question:** With the arrows representing dependencies in the Gantt-chart, what kind of network it is look like? (AOA or AON)

Working time

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- Actual duration of projects usually is longer than what we calculate in our CPM calculations because of Working Time (Calendar) regulation (weekend, holidays, labour-code)!

Change Working Time

For calendar: Standard (Project Calendar)

Calendar 'Standard':
24 Hours
Night Shift
Standard (Project Calendar)

Legend:

- Working
- Nonworking
- 31** Edited working hours

On this calendar:

- 31** Exception day
- 31** Nondefault work week

March 2013

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Working times for 29 March 2013:

- 8:00 AM to 12:00 PM
- 1:00 PM to 5:00 PM

Based on:
Default work week on calendar 'Standard'.

Create New Calendar ...

Working time

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Task Name	Duratic	Start	Finish	31 Mar '13							07 Apr '13							14 Ap	
				F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
Excavate	4 days	Fri 29/03/13	Wed 03/04/13	[Bar]															
Form Footings	6 days	Tue 02/04/13	Tue 09/04/13								[Bar]								
Place Rebar	4 days	Thu 04/04/13	Tue 09/04/13								[Bar]								
Place Concrete	8 days	Wed 10/04/13	Fri 19/04/13								[Bar]								
Strip Forms	6 days	Mon 22/04/13	Mon 29/04/13								[Bar]								

2 days off

$9/4/2013 - 2/4/2013 = 8 \text{ days} = 6 \text{ working days} + 2 \text{ days off}$

Home assignment - CPM

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Present following activities in AON and AOA network. Use CPM calculation on AOA network to calculate the schedule. Present the schedule on a Gantt-chart view of MSP using standard working hours (Saturday through Wednesday-8 hours a day)! Project starts on Meh 2nd, 1401. Consider Statutory holidays in the country!

Activity	Predecessor	Lag	Resource	Duration
A	-		1 Engineer	5 days
B	A		2 Engineers	7 days
C	A,B		2 Loaders, 2 operators	4 days
D	A	3 days	2 Operators	7 days
E	D		1 Operator	25 hours
F	C,D,E		1 Operator	16 hours



Thank you!