Lab# 09

Identifying the Task Dependencies and Activity on Node

Construction for the Software Project

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9.1 Objectives

The lab objective is to introduce the students to the activity networks for the Software Project.

9.2 Scope

The lab focuses on introducing the students to

- Activity on Arrow (AOA) Network.
- Activity on Node (AON) Network

9.3 Useful Concepts

Drawing Project Network

Network -A diagram to represent the relationship of activities to complete the project. Before drawing the network, it is necessary to ensure that:

- The project has a unified starting and ending point.
- Networks should be continuous (i.e., each activity except the first and the last has both preceding and succeeding activities).

There are two ways that are commonly used to draw a network diagram for a project:

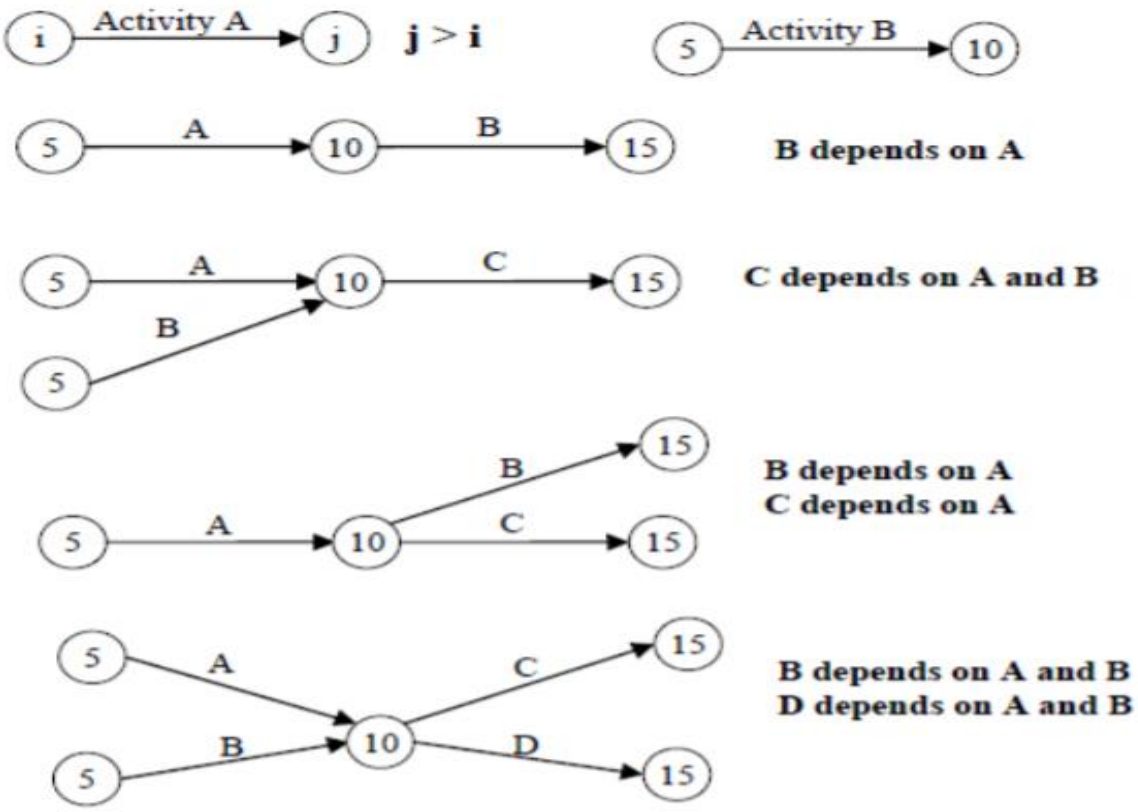
1. Activity on Arrow (AOA) representation.
2. Activity on Node (AON) representation.

Activity on arrow network (AOA)

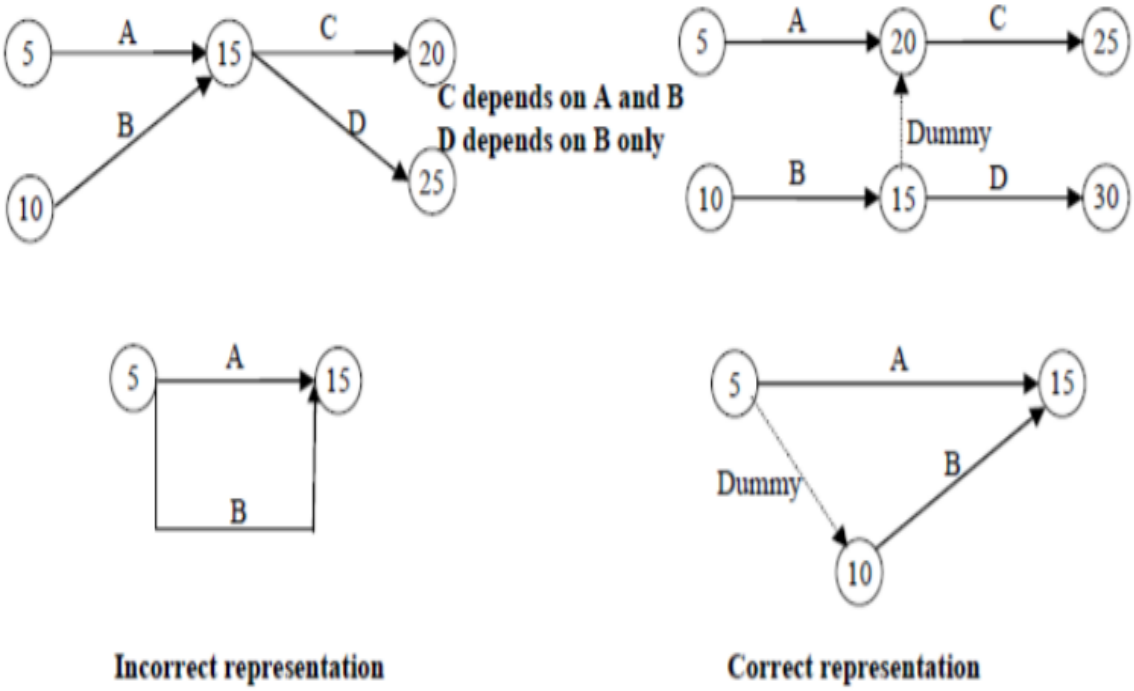
In this method, the arrows represent activities while the nodes represent the start and the end of an activity (usually named as events). The length of the arrow connecting the nodes has no significance and may be straight, curved, or bent. When one activity depends upon another, both appear on the diagram as two arrows having a common node.

The following are some rules that need to be followed when constructing an AOA network diagram:

- Each activity must have a unique i – j numbers, where i (the number at the tail of the arrow) is smaller than j (the number at the head of the arrow).
- It is recommended to have a gap between numbers (i.e., 5, 10, 15, etc.). This will allow for accommodation of missed activities.
- Avoid back arrows.

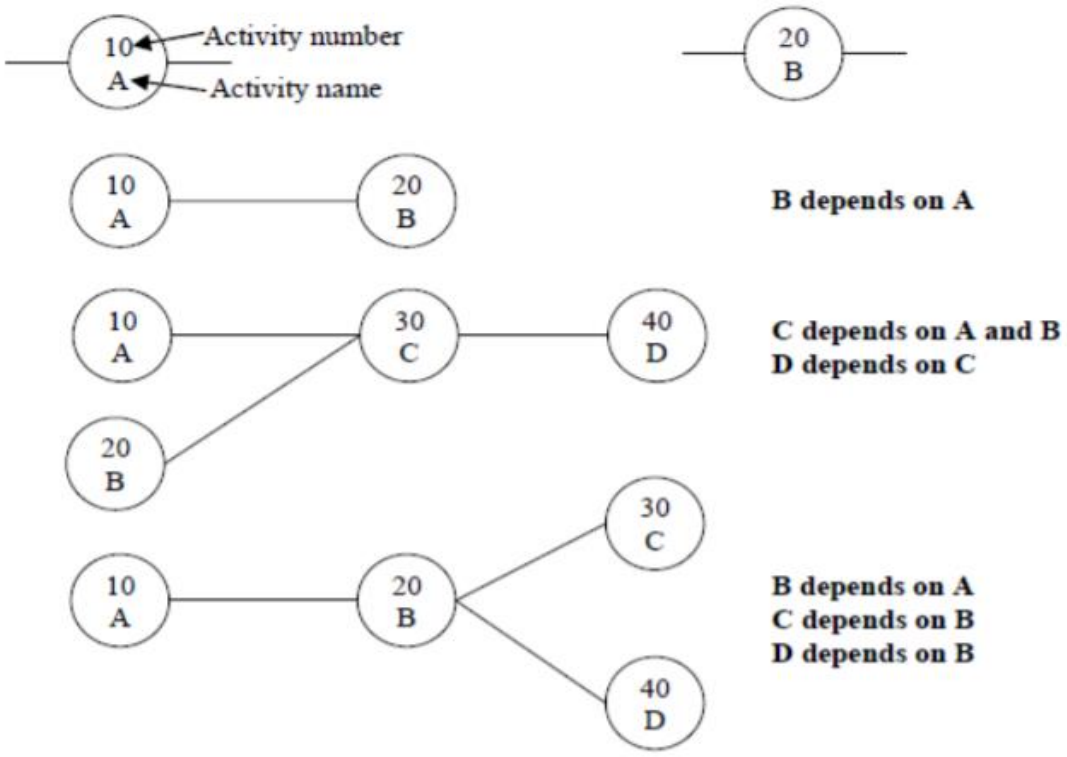


- **Dummy Activity** -An activity (represented by a dotted line on the arrow network diagram) that indicates that any activity following the dummy cannot be started until the activity or activities preceding the dummy are completed. The dummy does not require any time except the following:
- When more than one arrow leaves the same node and arrives at another node.
- When one activity depends upon two preceding activities and another activity depends only upon one of these two preceding activities as shown in the figure.



Activity on node network (AON)

This method is also called the precedence diagram method. In this method, the nodes represent activities, and the arrows represent logical relationships among the activities. If the arrow starts from the end side of an activity (activity A) and ends at the start side of another activity (activity B), then A is a predecessor of B. AON representation allows the overlap or lag representation on the relationship arrows connecting activities.



Although both methods achieve the same results, most project managers prefer the AON method because it does not require the use of dummy activities. The AON method can also provide the start-to-start, finish to- finish, start-to-finish, and finish-to-start relationship of activities, which can significantly reduce the number of activities that are required in a network diagram. AON allows for overlap/lag representation. However, many individuals prefer to not use these relationships because of potential confusion in the network scheduling. In AOA, an activity can only start when all its predecessors have finished.

Estimating Activity Duration and Direct Cost

Each work activity has associated time duration. These durations are used in preparing a schedule.

- **Duration (D)** -The estimated time required to perform an activity. The time should include all resources that are assigned to the activity. For example, suppose that the durations shown in Table were estimated for a project. The entire set of activities would then require at least 3 days, since the activities follow one another directly and require a total of 1.0 + 0.5 + 0.5 + 1.0 = 3 days.

Durations and predecessors for a four-activity project

Activity	Predecessor	Duration (Days)
Excavate trench	---	1.0
Place formwork	Excavate trench	0.5
Place reinforcing	Place formwork	0.5
Pour concrete	Place reinforcing	1.0

Since the scope of activities is unlikely to be identical between different projects, unit productivity rates are typically employed for this purpose. The duration of an activity may be estimated as:

Activity duration = quantity of work / number of crews * resource output

- The quantity of work is determined from engineering drawings of a specific project.
- The number of crews working is decided by the planner.
- In many cases, the number or number of resources applied to particular activities may be modified in light of the resulting project plan and schedule.
- Some estimate of the expected work productivity must be provided.
- Historical records in a firm can also provide data for estimation of productivities.

Note: The three elements of an activity: duration, cost, and resources form what is called construction method. Some activities can be performed using different construction methods. Then it is simple to estimate the activity direct cost.

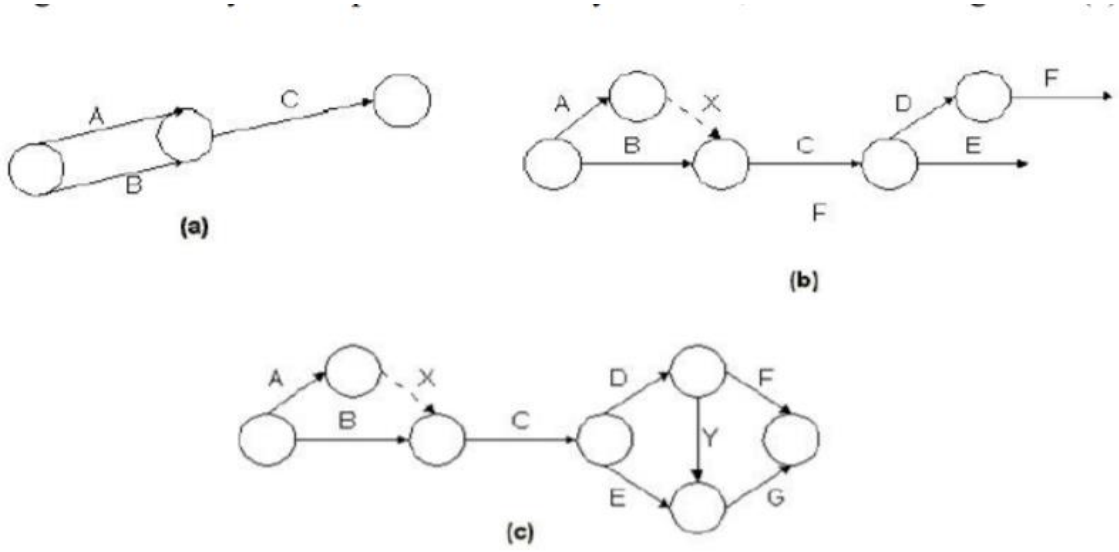
9.4 Solved Problems

Construct an AOA and AON networks for the activities listed in the following table

Activity	Predecessors
A	-
B	-
C	A, B
D	C
E	C
F	D
G	D, E

Solution:

Forming an AOA network for this set of activities might begin be drawing activities A, B and C as shown in Fig. (a). At this point, we note that two activities (A and B) lie between the same two event nodes; for clarity, we insert a dummy activity X and continue to place other activities as in Fig. Placing activity G in the figure presents a problem, however, since we wish both activity D and activity E to be predecessors. Inserting an additional dummy activity Y along with activity G completes the activity network, as shown in Fig. (c).

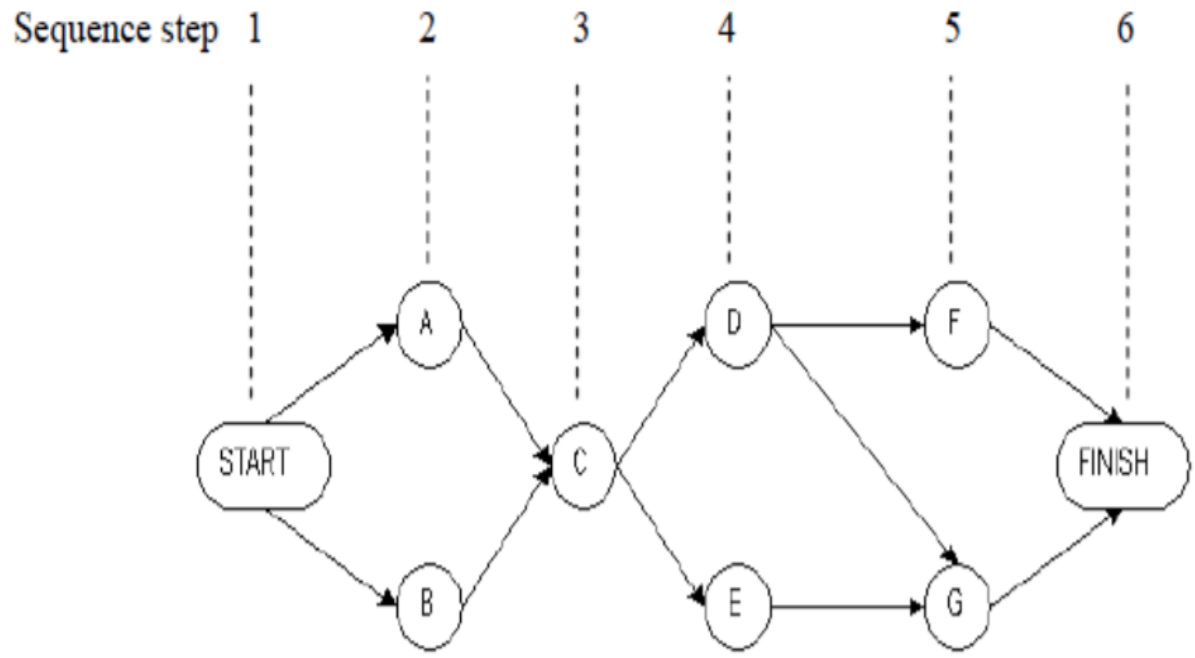


To understand the drawing of the AON, some ordering for the activities may be necessary. A sequence step may be defined as the earliest logical position in the network that an activity can occupy while maintaining the logical relationships. In this example, as there are two activities (activities A and B) has no predecessor, then a start activity is added to have one unified start activity (Start) for the project. Also, a finish activity (Finish) is added as there are two activities without successors (activities F and G). Considering the data given in Table, sequence step 1 is

assigned to the Start activity. Then, we take all activities on the list one by one and look at their immediate predecessors and then assign a sequence step that equals the highest sequence step of all immediate predecessors plus one as given in Table After all sequence step numbers have been assigned, the AON diagram can be drawn.

Activity	Predecessors	Sequence step (SS)
Start	-	SS(Start)=1
A	Start	2=SS(Start)+1
B	Start	2=SS(Start)+1
C	A, B	3=Highest of [SS(B), SS(A)]
D	C	4=SS(C)+1
E	C	4=SS(C)+1
F	D	5=SS(D)+1
G	D, E	5=Highest of [SS(D), SS(E)]
Finish	F, G	6= Highest of [SS(F), SS(G)]

AON representation is shown in Fig, including project start and finish nodes. Note that dummy activities are not required for expressing precedence relationships in activity-on-node networks.



9.5 Exercises for Lab

- Draw the AOA and AON networks for the project given

Activity	Predecessors
Start	-
A	Start
B	Start
C	Start
D	A
E	B
F	B
G	C
H	D
I	E
J	F, G
K	H, I
Finish	J, K