Tutorial Letter 201/0/2024

Software Project Management

INF3708

Year Module(s)

DEPARTMENT OF INFORMATION SYSTEMS

IMPORTANT INFORMATION

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1. INTRODUCTION

Greetings students! I officially published Assessment 2 of INF3708. Remember, Assessment 2 counts 25% towards your year mark. Assessment 2 covers Chapters 4, 6, and 7 (Schwalbe, 2019). I have written this tutorial to guide you in creating an activity-on-node diagram. The diagram that I demonstrate in this tutorial is based on Oguz (2022).

2. ACTIVITY ON NODE DIAGRAM

An activity-on-node (AoN) diagram is a tool used in project schedule management. AoN diagrams illustrate the sequence of activities (and the dependencies between them) that must be completed to finish a project (Oguz, 2022; Schwalbe, 2019).

2.1. Early start and early finish

An AoN diagram is made up of nodes. A node refers to an individual activity. Figure 1 shows Activity J connected to Activity K. As an example, activity J might represent the coding of the system and activity K testing the code. Furthermore, the link between them is a mandatory dependency, insofar as you cannot test code until after the code is written. Durations are added to a node. The AoN in Figure 1 shows the duration of activities J and K displayed below the labels. You can deduce that you must wait 6 days before you can start testing the code.

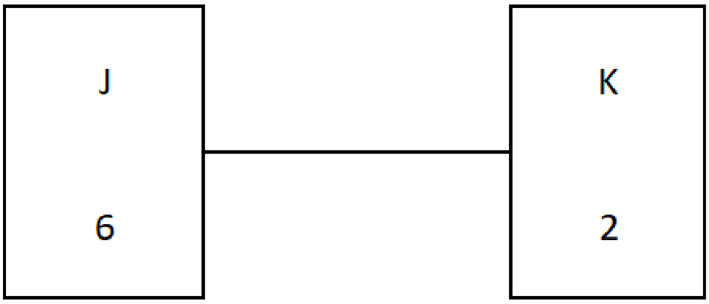

Figure 1. Two linked nodes.

The nodes also indicate the earliest possible time for an activity can begin. The earliest start time is located outside the top-left corner of the node – see Figure 2.

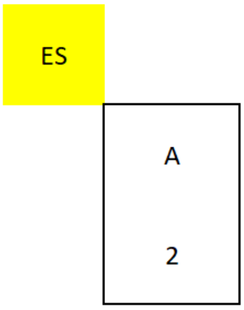

Figure 2. The earliest start (ES) start time is indicated outside the top left corner of a node.

For an activity to commence at its earliest start (ES) time, all predecessor activities must be completed. For example, Figure 3 illustrates activity A (the kickoff meeting) as the first activity of the project. The earliest start time is always zero, which indicates the start of the project. When drawing an AoN diagram, it is standard practice to insert a start node to indicate that the first activity (in this instance, Activity A) is not preceded by any other activities – the early start time of the start node is 0. The first start of the second activity and successor activities is determined by adding the predecessor activity's start time of the predecessor activity to its duration. In Figure 3, the earliest start time of Activity B is 2, therefore, the ES + duration, i.e., 0 + 2 = 2.

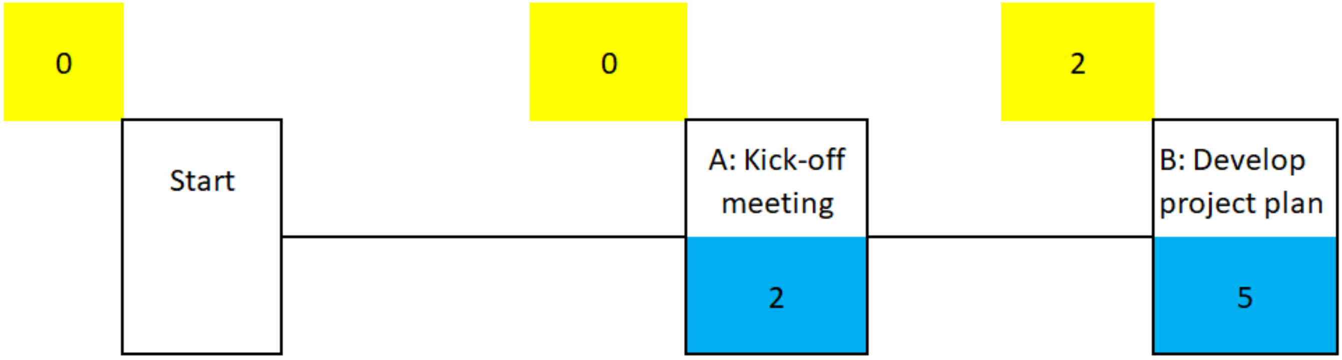

Figure 3. The earliest start time indicated on the nodes.

An activity can be preceded by two activities that started on the same day. This activity is usually in a finish-to-start dependency with one of the predecessor activities. A finish-to-start dependency refers to a relationship in which a predecessor must finish before the successor can start. As an example, consider Figure 4; You cannot train the end-users until after the training software has been installed. You scheduled the training sessions on the same day the software installation started, but you must wait until after 10 days to commence the training – 10 days is the duration of the software installation process. In such instances, the ES of the successor activity is calculated by adding the duration of the predecessor activity with the longest duration to its ES. Therefore, the ES of Activity E (train end-users) is calculated by adding the ES of Activity D (Activity D duration is longer than that of Activity C) to its duration, that is, 2 + 10 = 12.

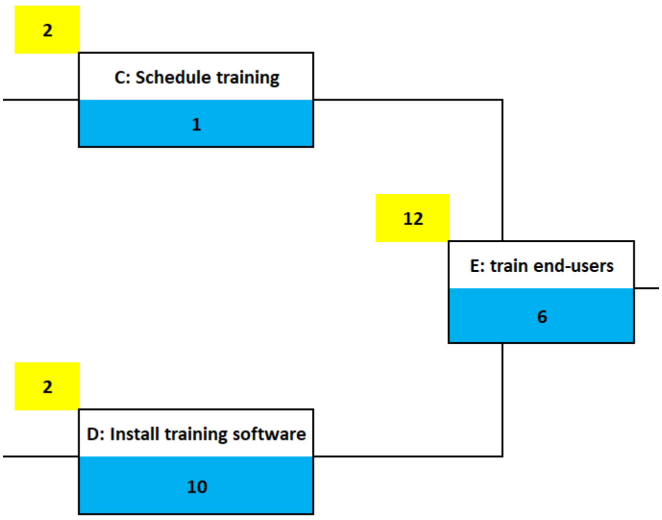

Figure 4. Activity E is in a finish-to-start dependency with activity D, that is, training cannot start until the training software is installed.

The nodes also indicate the earliest time an activity can finish, known as the early finish (EF) time. The early finish time is placed outside the top-right corner of the node; see Figure 5.

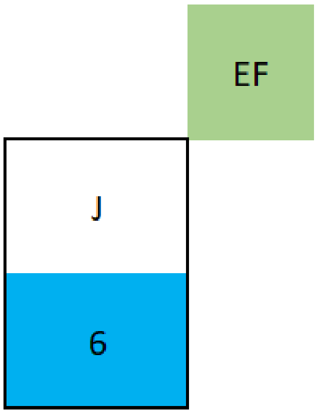

Figure 5. The earliest start (ES) start time is indicated outside the top left corner of a node.

The early finish time denotes the earliest time that an activity can finish if all the previous activity start date are not delayed. Consider Activities A and B in Figure 6; the early finish times were calculated by adding the ES to the duration. The early finish time of Activity A is 2. Therefore, the ES of Activity A (0) has been added to its duration of 2 days, that is, 0 + 2 = 2. Similarly, the early completion time of Activity B is 7. Therefore, ES (2) has been added to its duration of 5, that is, 2 + 5 = 7. Needless to state, if the kick-off meeting, for some reason or another, starts a day after its planned commencement date, the early finish times of all succeeding activities are compromised. In such a scenario, the project team can focus their gaze on late start and late finish times (discussed in the next section).

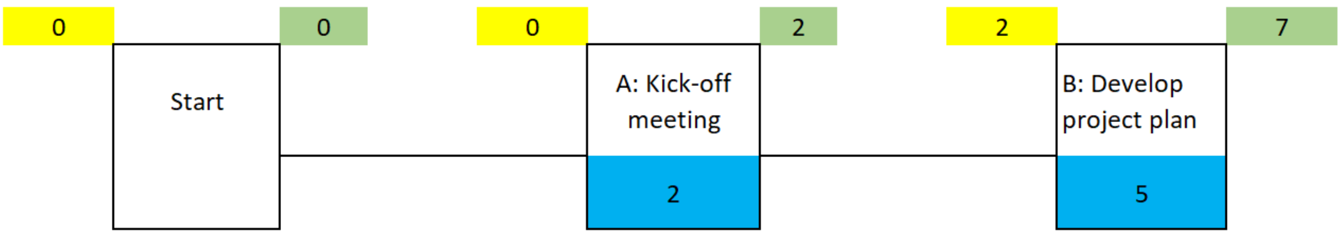

Figure 6. Early finish (EF) times (values with green background colour) are indicated outside the top right corner of the nodes.

The technique used to calculate ES and EF is known as the **forward pass** technique. The forward pass technique relies on the ES and EF of predecessor activities to calculate the ES and EF of succeeding activities.

2.2. Late finish and late start

Nodes also indicate the latest time a project can finish, known as the late finish (LF) time. The late finish time, of course, is the latest time an activity can finish without delaying the project completion time. For example, a software developer lead might indicate that a software development team may not take more than 6 days to complete the coding of an information system to avoid delaying the product launch. If it takes the team 4 days to complete the coding of the information system, 4 days is the earliest completion time. Therefore, the activity can slip with 2 days before it becomes critical; hence, the latest it can finish is day 6. The LF is located outside the bottom-right corner of the node – see Figure 7.

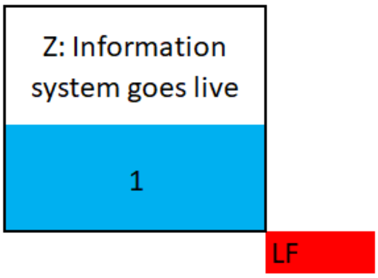

Figure 7. The LF time is positioned outside the bottom right corner of a node.

It is important to note that you can only start calculating the latest finish time when the ES and EF times of the last node (activity) have been calculated. By implication, you start by calculating the LF of the last node. Generally, the EF of the last node is considered the project completion; therefore, standard practice in project management is to replicate the EF of the last node and indicate it in the LF to emphasis project completion. It is also standard practice to add an end node after the last node/activity to indicate that no other activities succeed the last activity. Additionally, the EF of the last node is replicated to all four corners of the end node - see Figure 8.

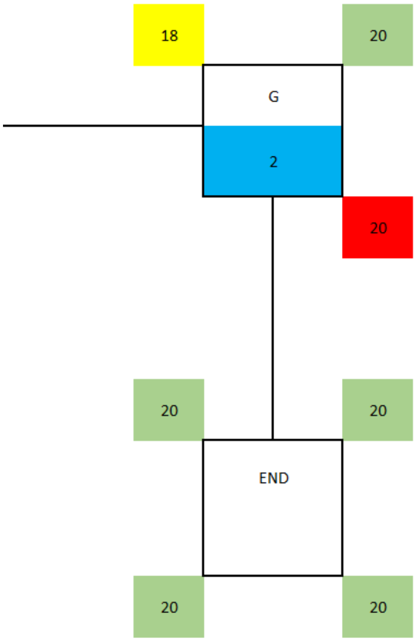

Figure 8. The ES of the last node is copied to the LF position and copied to all corners of the end node.

Finally, the node reserved the bottom left corner for the late start (LS) – see Figure 9.

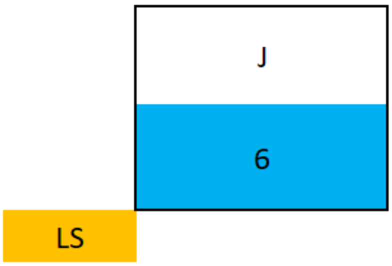

Figure 9. The LF time is positioned outside the bottom right corner of a node.

The LS allow for some delay in the activity start time -without affecting the overall project duration - if the ES is delayed. For example, a software development team may have to start with the physical design of an information system 2 days after its planned start day because of a delay in the implementation of a design model. The start of the physical information system design might have been delayed because the project team struggled to reach agreement on the design model. To calculate the LS you subtract the duration from its LF, therefore, the LS is 20 – 2 = 18

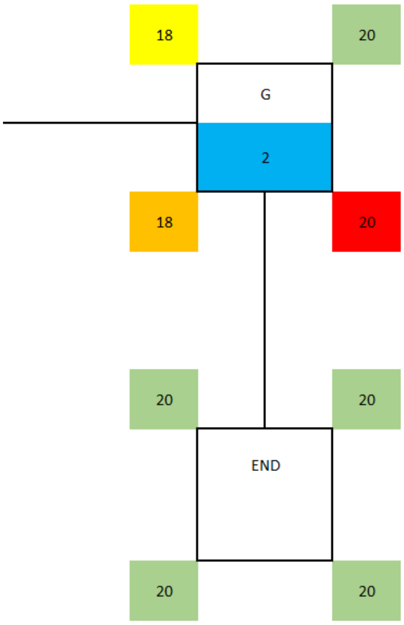

Figure 10. LS of activity G = LF – duration, i.e., 18 = 20 – 2.

I explained earlier that the LF of the last activity is derived from its EF. The LF of the last activity is the only LF that is derivative from the ES; the LS of the predecessor activities are derivative from their succeeding activities. Specifically, the LF of the activity that precedes the last activity is derivative from the LS of the final activity. Consider Activity F in Figure 11; the LF time of Activity F is 19, which was derived from the LS (19) of Activity G (the final activity). You can now calculate the LS of Activity F by subtracting its duration from its late start, which is equal to 18. In a similar vein, the LF time of Activity E – which is 18 – was derived from the LS of Activity F (Activity F LS = 18).

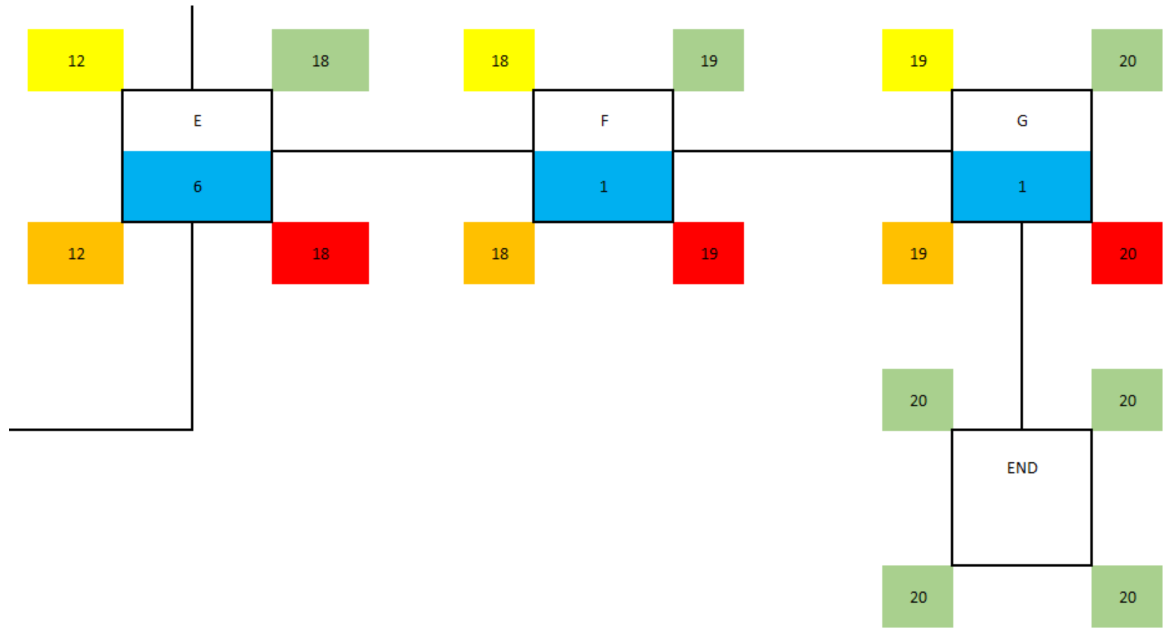

Figure 11. Except for the last node (Activity G), the LF of a predecessor node is equal to the LS of the successor node, e.g., LF of Activity E is equal to the LS of Activity F; LF of Activity F is equal to the LS of Activity G.

As mentioned earlier, an activity can be preceded by two activities that started on the same day. In such an instance, the lowest possible LS time for the successor activity is transferred to the late finish time of the predecessor activity. This is done to ensure that the successor task can still start at its earliest possible start time, even if the predecessor task starts later due to float (I discuss float in the next section). As an example, consider Figure 12; Activities C and D is the successor activities of Activity B; Activity B's LF inherits the lowest LS between the two successor activities, which is Activity D. So, Activity B's LF is 2.

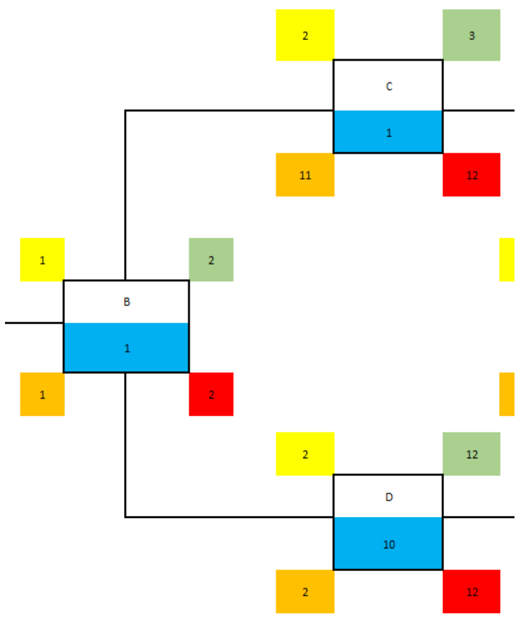

Figure 12. The lowest LS between two successor activities is transferred to the LF time of the predecessor activity.

The technique used above to calculate LF and LS is known as the **backward pass** technique. The forward pass technique relies on the EF, LF and LS of successor activities to calculate the LF and LS of predecessor activities.

2.3. Critical path and float/slack

After creating the AoN diagram, you need to determine the critical path. The critical path is referred to as the sequence of activities that will take the longest to complete. Activities are considered critical because of a delay in its completion time will delay the completion time of the entire project. To determine the critical path, you need to first determine the float or slack. Float is the amount of time that an activity can be delayed without delaying the entire project completion date. To calculate the float of an activity, you subtract the EF from the LF. As an example, consider Figure 13; I deducted the ES of 3 from the LF of 12 to indicate a slack of 9 (white numeric value in black block).

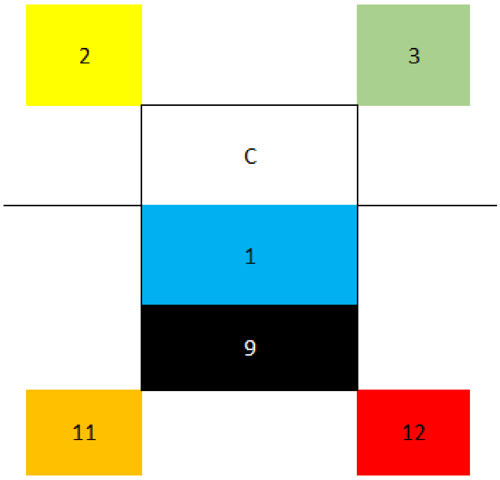

Figure 13. the slack (the value 9 displayed in the black block) was calculate by subtracting the ES (3) from the LF (12).

As I stated, to determine the critical path, you need to calculate the slack of each activity. As an example, consider Figure 14. As you can see, I calculate the slack for each activity. Activities A-C-E-F-G are not the critical path because Activity C indicates a slack of 9, which means Activity C can be delayed with 9 days without delaying the entire project completion time. Activities A-B-D-E-F-G, in contrast, are the critical path. Considering that the slack of each activity on this path amounts to 0, no activity can be delayed without delaying the entire project completion time; hence, these activities are critical.

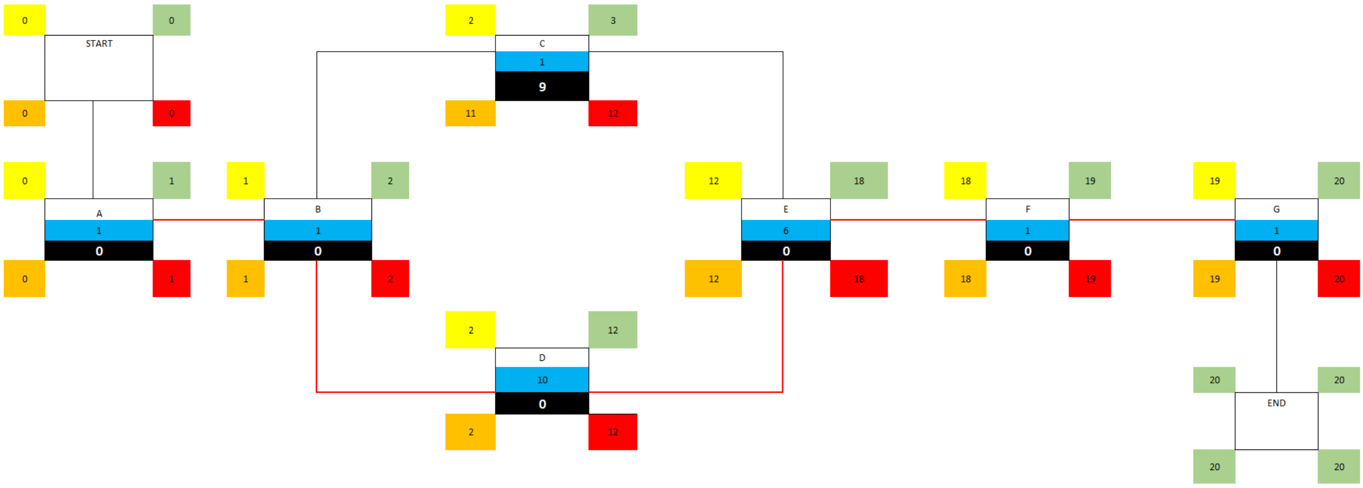

Figure 14. The red line indicates the critical path (Activities A-B-D-E-F-G).

The AoN illustrated in Figure 14 is based on the following activity list:

Activity label	Activity description	Estimated duration	Predecessor
A	Project Sponsor presents an overview of project deliverables (object, schedule, cost)	1	-
B	Project manager presents activity schedule	1	A
C	Project manager highlights risks and risk reduction techniques	1	B
D	Service manager identifies preliminary human and physical resources	10	B
E	Project manager conducts budget estimation and financial analysis	6	C, D
F	Kick-off meeting	1	E
G	Compile and publish artificial solution design model for the database system	1	F

Table 1. The label, description, duration and predecessor(s) of activities that inform the project integration knowledge area.

3. SOURCES CONSULTED

Oguz, A. (2022). *Project management: Navigating the complexity with a systematic approach*. Cleveland, Ohio: MSL Academic Endeavors. Retrieved from https://pressbooks.ulib.csuohio.edu/project-management-navigating-the-complexity/chapter/7-4-creating-an-activity-network-diagram/

Schwalbe, K. (2019). *Information technology project management* (9th ed.). Boston, USA: Cengage Learning.

4. IN CLOSING

Good luck and do not procrastinate! I will not allow anyone to submit after the due date. I will only consider late submissions in the event that you have fallen ill – in such a case, you need to produce a valid medical certificate.

Best wishes,

Emil Van Der Poll
PhD: Information Systems
Department of Information Systems
School of Computing

Enter Jiraiya's honoured sage style: Bath of boiling oil!