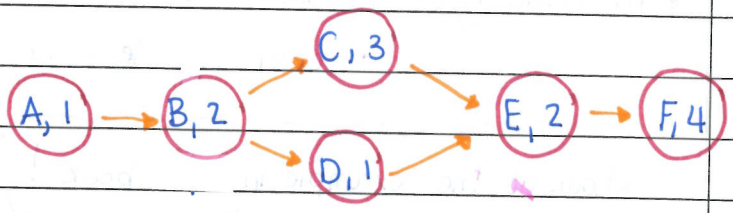
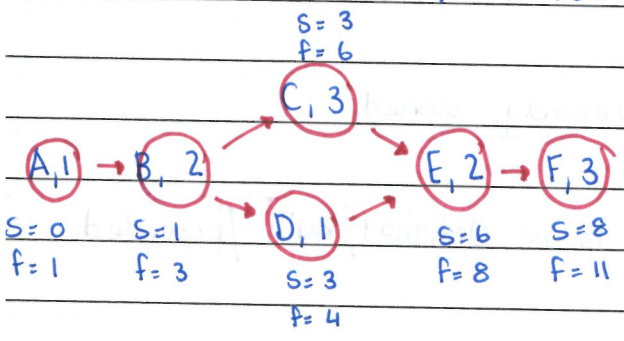
#6 Scheduling: Network Methods *

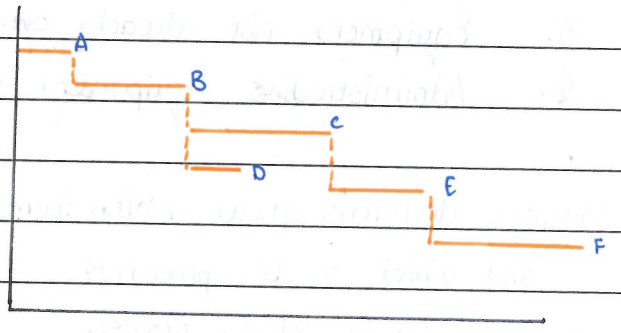
- AON → Activity on node
- Each activity / work package is represented by node
- A project is represented by a network of nodes connected with arrows in sequence.
- One start and one end node.

Activity	Predecessor	Time
A	-	1
B	A	2
C	B	3
D	B	1
E	C, D	2
F	E	3



- if an activity has multiple predecessors, must wait until all activities are finished.
- Assume for simplicity, when an activity finishes its predecessor starts immediately
- Early times: the earliest an activity can be started or finished
  - ↳ only half the time information needed for a realistic schedule.
  - ↳ do not include constraints



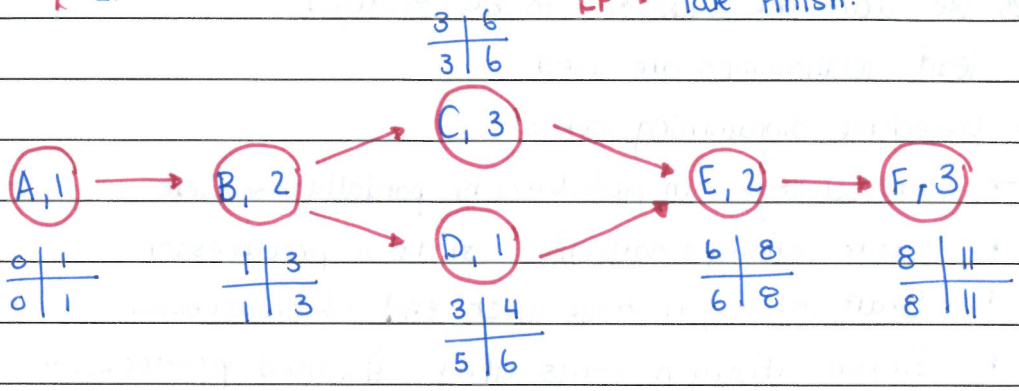


- Late time: latest time activities must be started / ended in order to complete by target date
  - ↳ specify completion and work backwards
  - ↳ late finish is based on late start for sucessor
  - ↳ more than 1 sucessor → based on the earliest sucessor

Notation.

ES	EF
LS	LF

ES = early start
EF = early finish
LS = late start
LF = late finish.



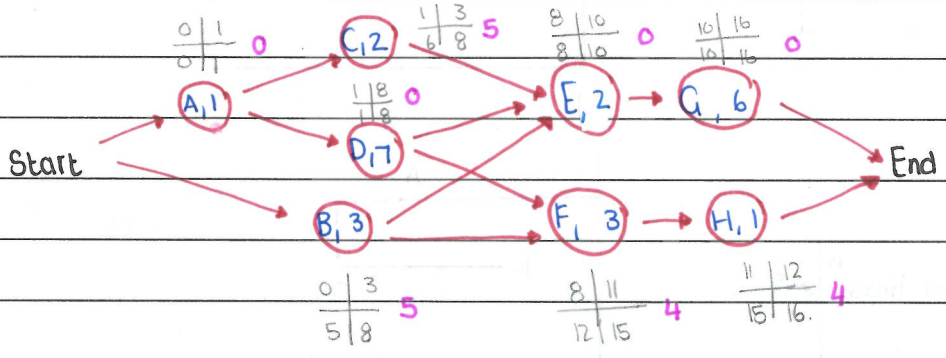
Project duration: identify the longest path through the network. 16 weeks

Slack times: difference between the early & late times

LS - ES } slack.
LF - EF }

↳ represents scheduling flexibility < possible delays exceedance of duration.

↳ with activities on the same subpath, they have a combined slack time.



Critical path:
- the path with 0 slack A, D, E, G.
- longest path i.t.o duration.
- any delay on the critical path will delay the project.

Free Slack: is the late times − early times, is the time an activity can be delayed without delaying the project - without delay in the early start of a sucessor

FS = ES (sucessor) − EF (activity)

Typo

* Precendence diagram

- Assumed a sucessor task can start as soon as all predecessor activities have been completed.
- Sometimes we want the sucessor to be delayed
- Lag & lead relationships are used

PDM: precedence digramming method

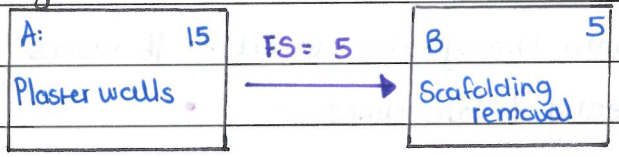
→ start activity when predecessor is partially complete

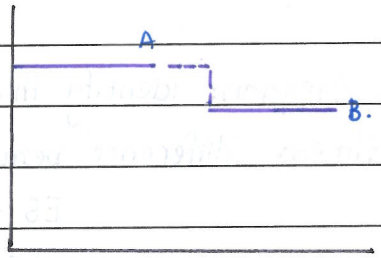
→ Start activity n days after start of predecessor

→ Start activity n days after end of predecessor

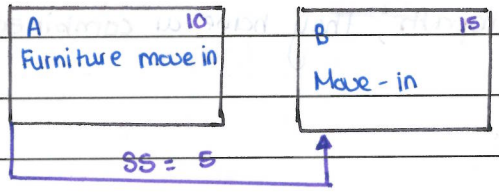
→ Finish ativity n days after finished predecessor

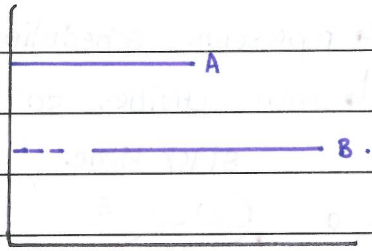
5 day lag:



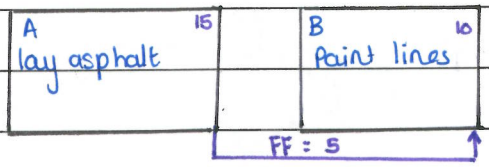


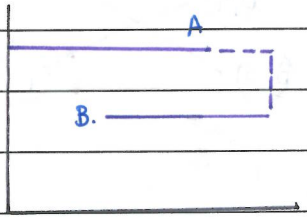
Start to start:





Finish to finish





* Scheduling Problems

- Time Constrained

→ Project must be complete by an imposed date

→ Time is fixed, resources flexible.

- Resource constrained
  - → level of resources available cannot be exceeded
  - → Resources fixed, time is flexible.
  - → Resource levelling: attempt to even out demands on resources by using slack to manage resources

Resource levelling:

PMBOK: " Any form of schedule network analysis in which schedule decisions are driven by resource constraints "

- → activities can be split (jump between activies) = negative impact
- → reducing overloading / difficult to manage fluctions of one resources leads to overloading another resource.

Network Sensitivity:

- the likelyhood that the orginal critical path will change once initiated

Function of:

- → Number of critical paths
- → Amount of slack across critical activities
- → Uncertainty of time duration of activities.

#8 Cost Estimating & Budgeting

- Estimating:
  - → process of approximating the time/cost of completing project deliverables
  - → task of balancing expectations of the stakeholders and need for control

Types:

- → Top-down: analogy, group consensus, mathematical relationship
- → Bottom-up: estimates of elements of WBS.

Methods:

- → detail cost planning on work packages – accurate but expensive
- → industrial standards
- → functional staff members
- → Three times method

$$\text{Duration} = \frac{a + b + 4m}{6}$$

Typo