Network Analysis

Network

- A network is a graphical plan consisting of a certain configuration of arrows and nodes for showing the logical sequence of various activities to be performed to achieve project objectives

What is Network analysis?

- The techniques of operations research used for planning, scheduling, and controlling large and complex projects are often referred as network analysis
- Objective-It is all about scheduling the required activities in an efficient manner so as to complete it on or before a specified time limit at a minimum cost of its completion

Techniques used in network analysis

I. PERT- PROGRAM EVALUATION REVIEW TECHNIQUE

II. CPM- CRITICAL PATH METHOD

Event

- Events in the network represents the project milestones such as
- Start or completion of an activity or activities and occur at a particular instant of time at which some specific part of the project has been or is to be achieved
- Events are commonly represented by circles (nodes) in the network diagram

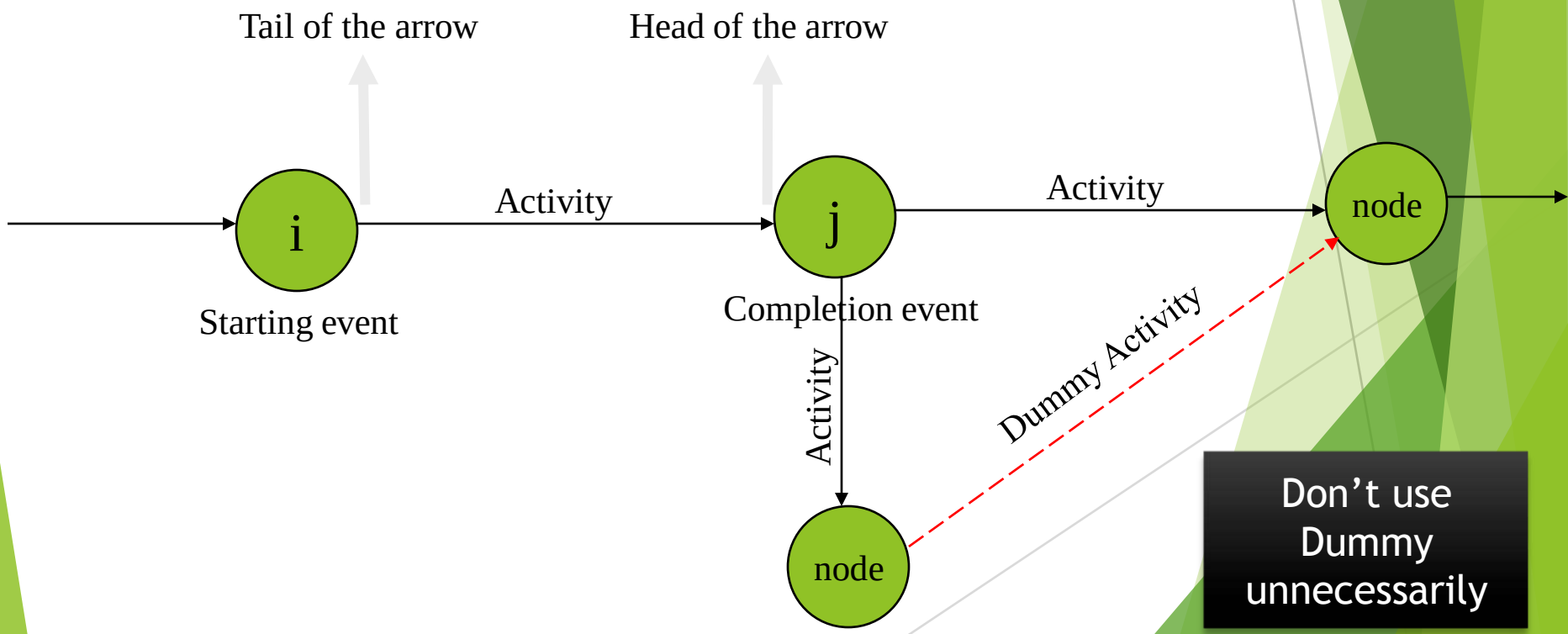
Activity

- Activities in the network diagram represent project operations or tasks to be conducted
- Note: except dummy activity each activity consumes **time** and resources and incur **cost**
- **An arrow** is used to represent the direction of the activity
- activities are identified by the numbers of their starting event and ending event

Classification of activity

- Predecessor activity-an activity which must be completed before one or more other activities start is known as predecessor activity
- Successor activity-an activity which started immediately after one or more of other activities are completed is known as successor activity
- Dummy activity-an activity which does not consume either an resources and/or time is known as dummy activity

Pictorial representation of an activity



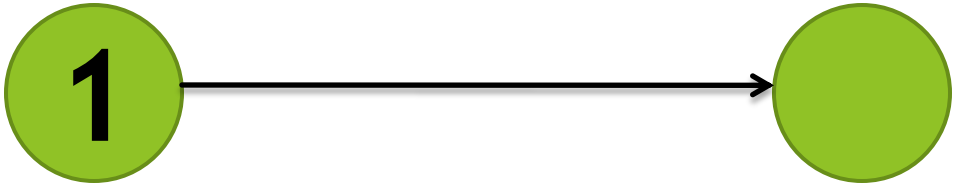
Length of arrow is of no significance

Rules for network construction

Each activity should be represented by only one arrow and must start and end in a circle called event

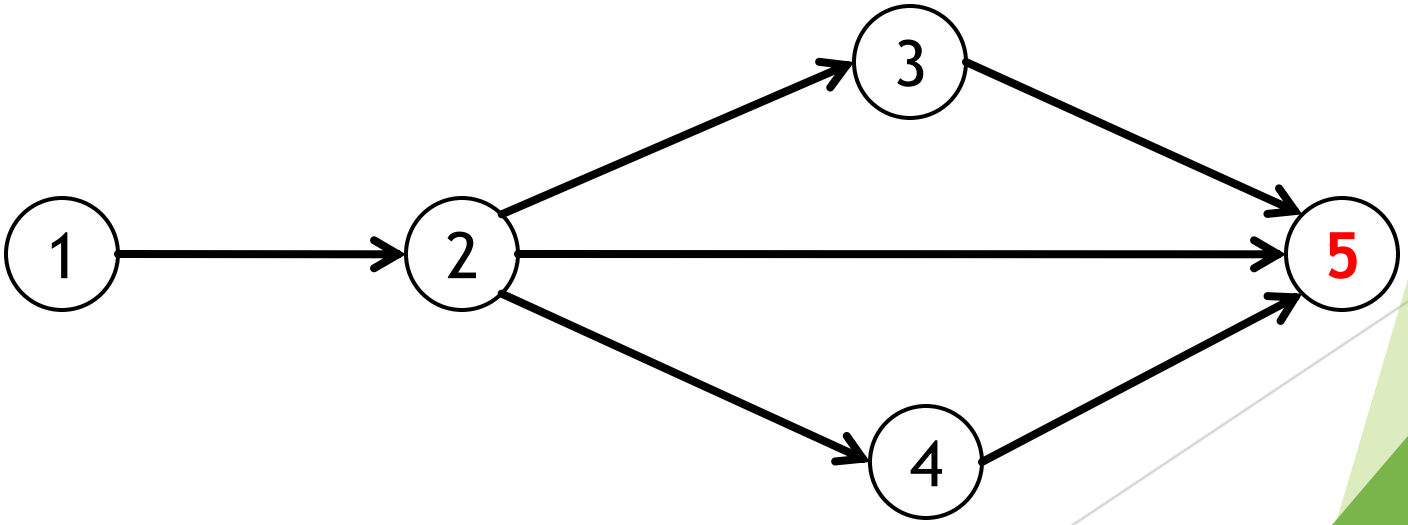
The tail of the activity represents the start and the head of the activity represents the completion of work

The event numbered 1 denotes the start of the project and is called initial event

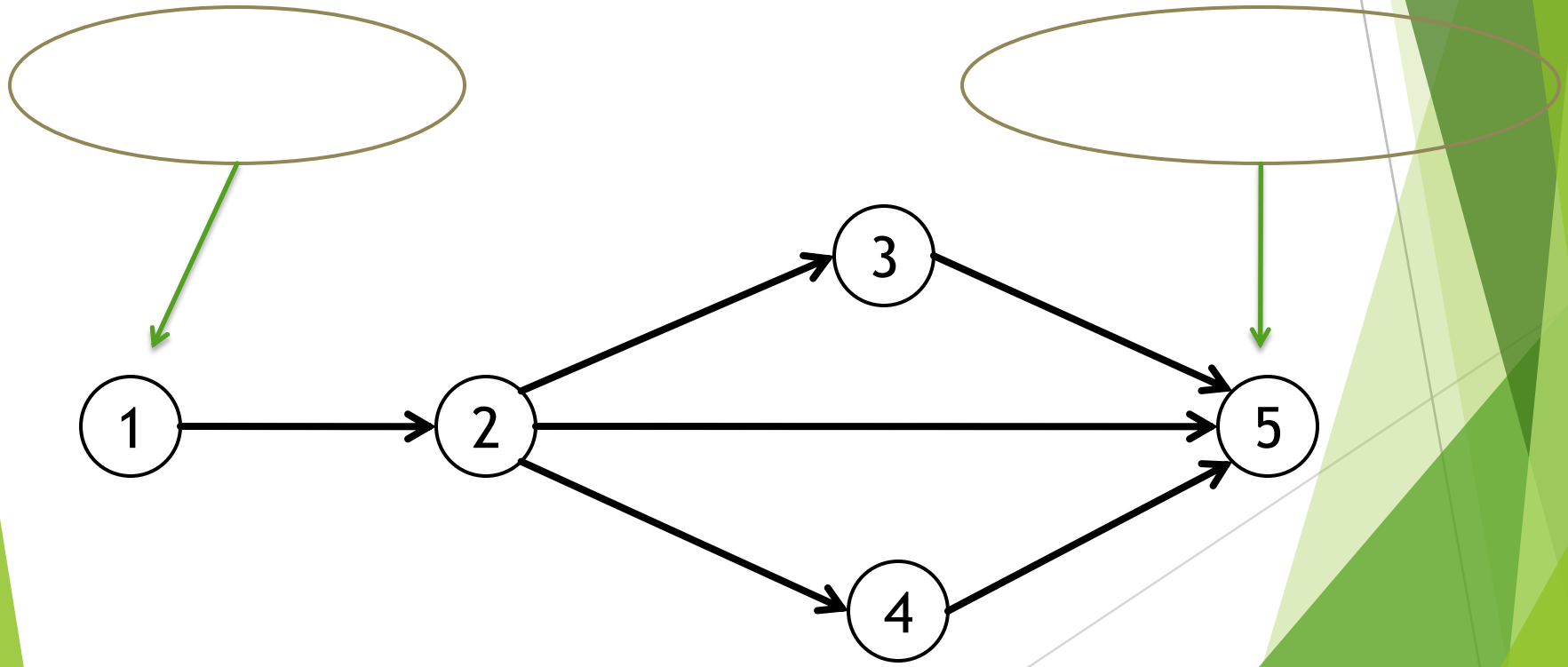


All activities emerging from event should not be preceded by any other activities

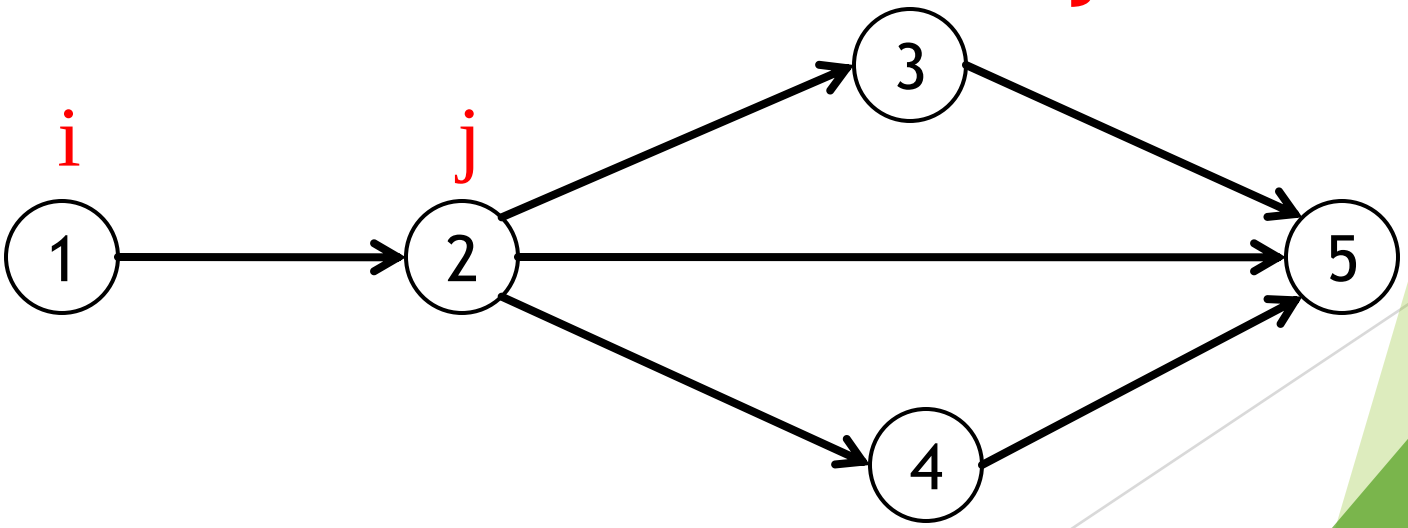
Event carrying the highest number denotes the completion of the project



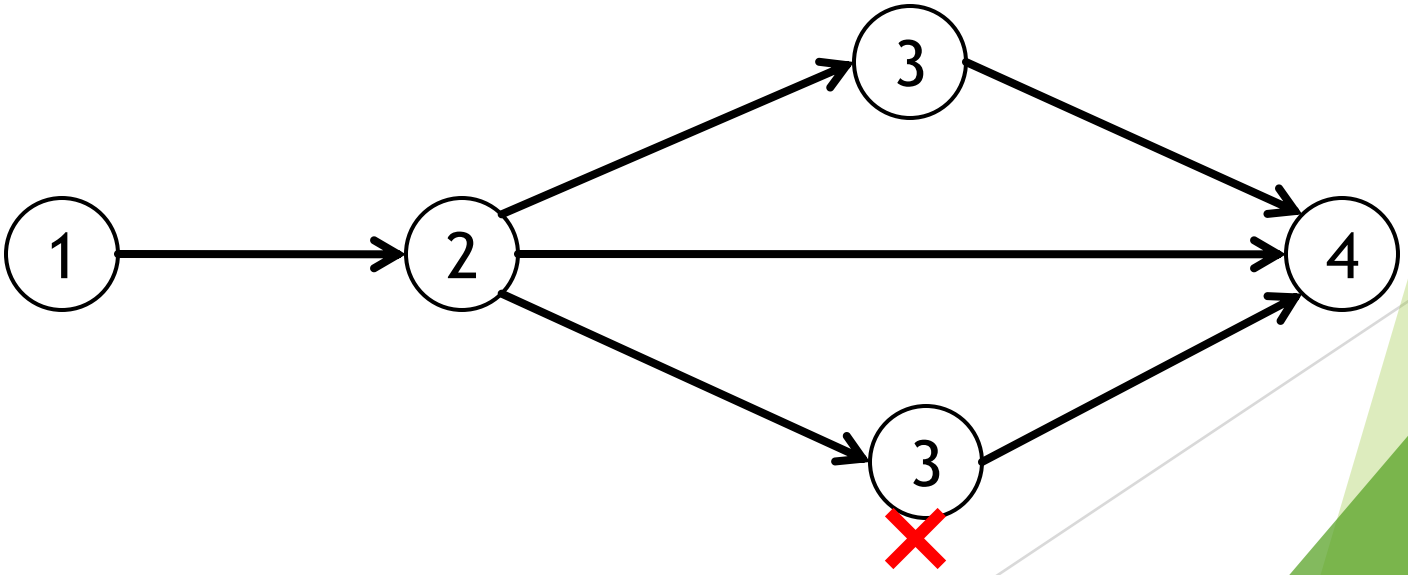
A network should have only one initial event and only one terminal event



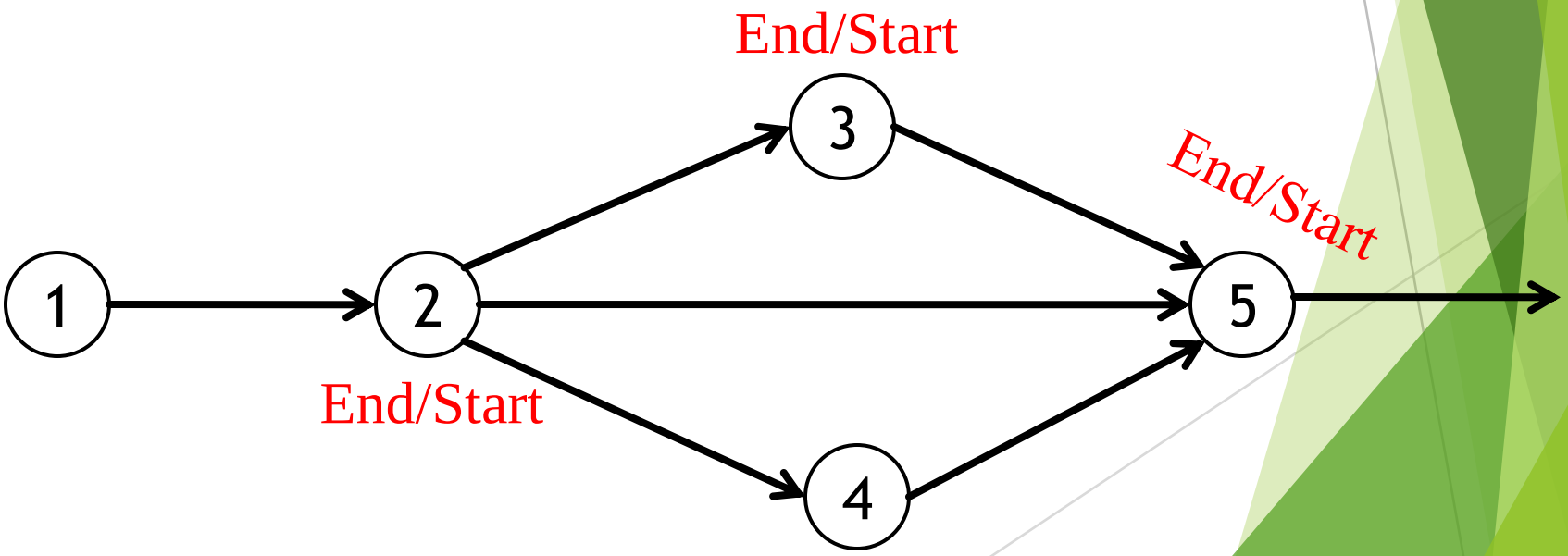
The general rule for numbering is that the head event should always be numbered larger than that at its tail i.e. i<j



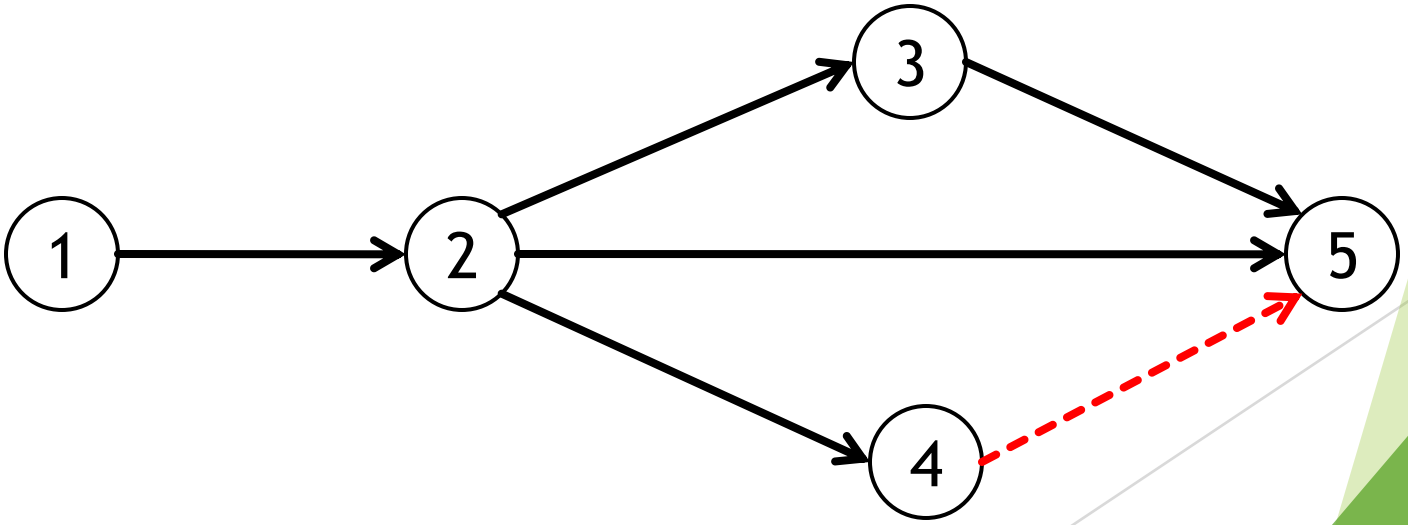
An event number should not be repeated or duplicated



An event can not occur until all the incoming activities into it have been completed



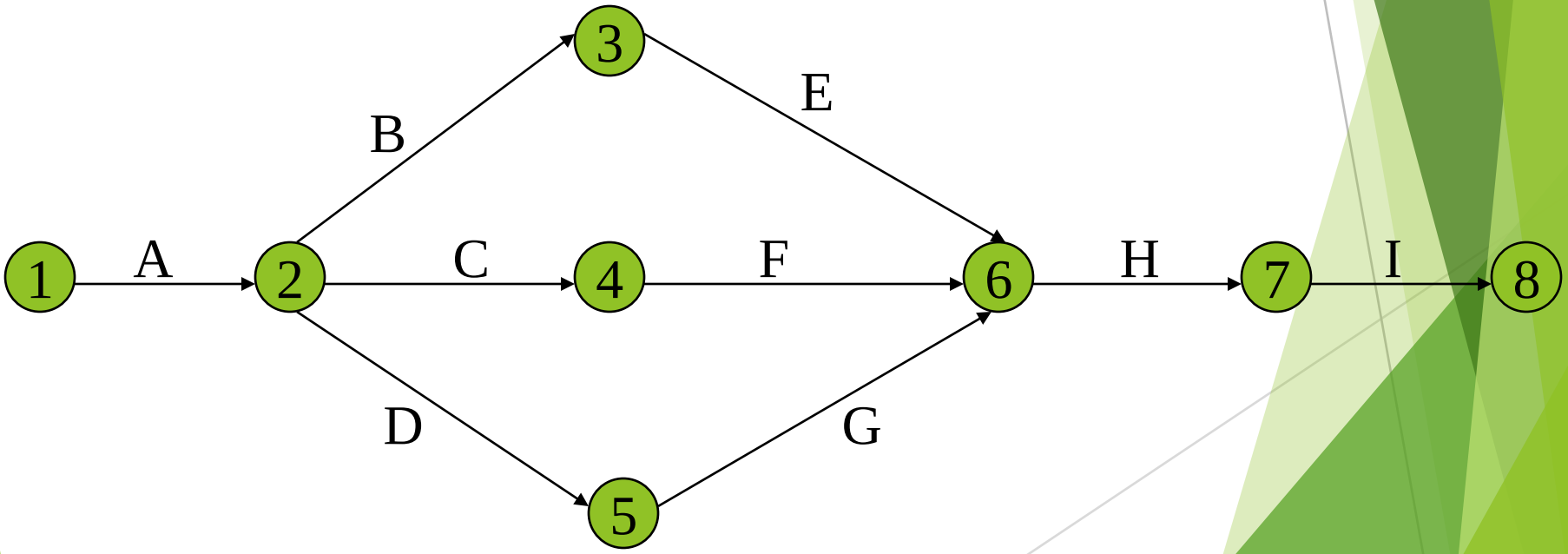
Dummy activity also should follow all the rules



e.g. for network diagram

activity	Preceding activity
A	-
B	A
C	A
D	A
E	B
F	C
G	D
H	E,F,G
I	H

Soln.



CPM(CRITICAL PATH METHOD)

- It can be found out by going through forward pass and backward pass
- Earlier start
- Earlier finish
- Latest start
- Latest finish
- Critical activities-are those activities in which E & L are same

E

L

Points to be noted

Float

- Also known as slack or free time
- Is the length of time to which a non critical activity and/or an event can be delayed or extended without delaying the total project completion time

EST, EFT, LST, LFT, Total Float & Free Float

EFT= EST + DURATION

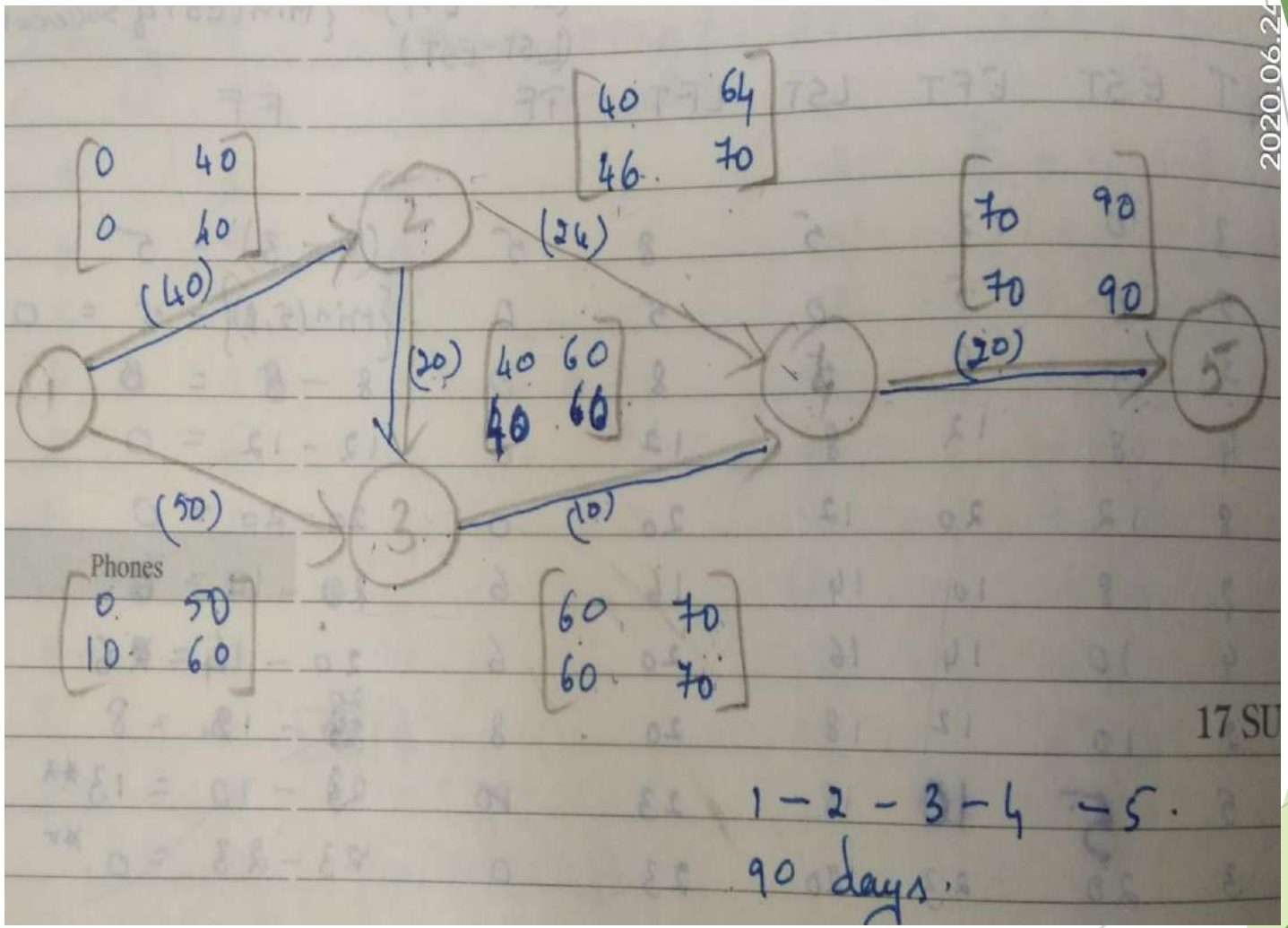
LST = LFT - DURATION

TF = LST – EST or = LFT - EFT

FF = Min {EST of successors} – EFT of current activity

Prob 4 :

Activity	Predecessor	NT
1-2	-	40
1-3	-	50
2-3	1-2	20
2-4	1-2	24
3-4	1-3, 2-3	10
4-5	2-4, 3-4	20


0 40
0 40
(40)
40 64
46 70
(24)
(20)
40 60
40 60
70 90
70 90
(20)
(50)
(10)
Phones
0 50
10 60
60 70
60 70
17 SU
1 - 2 - 3 - 4 - 5.
90 days.

8th Month

M T W T F S S M T W T F S 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

JULY 18
Monday

LST - EST
LFT - EFT

LFT - LST Work (EST) - EFT

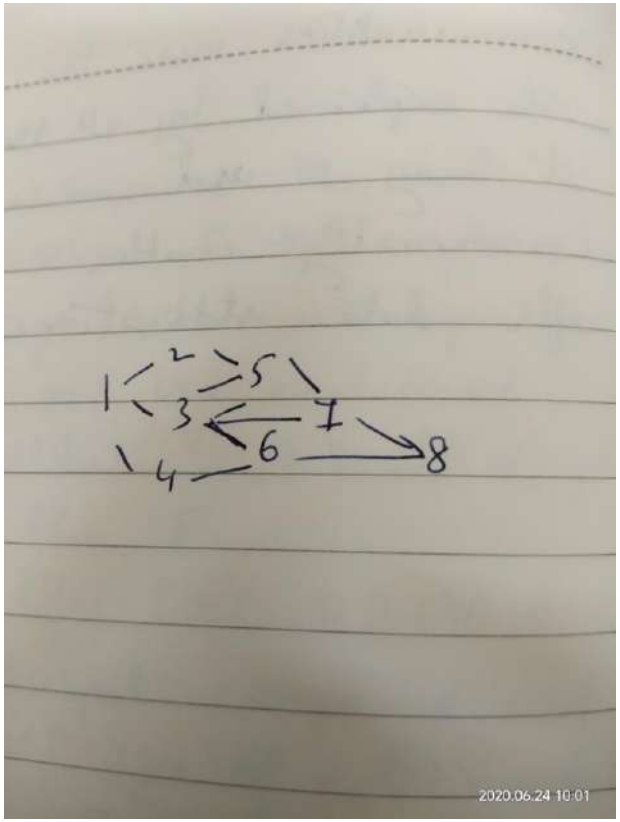
Activity	T	EST	EFT	LST	LFT	TF	FF
1-2	40	0	40	0	40	0	40-40 = 0
1-3	50	0	50	10	60	10	60-50 = 10
2-3	20	40	60	40	60	0	60-60 = 0
2-4	24	40	64	46	70	6	70-64 = 6
3-4	10	60	70	60	70	0	70-70 = 0
4-5	20	70	90	70	90	0	90-90 = 0

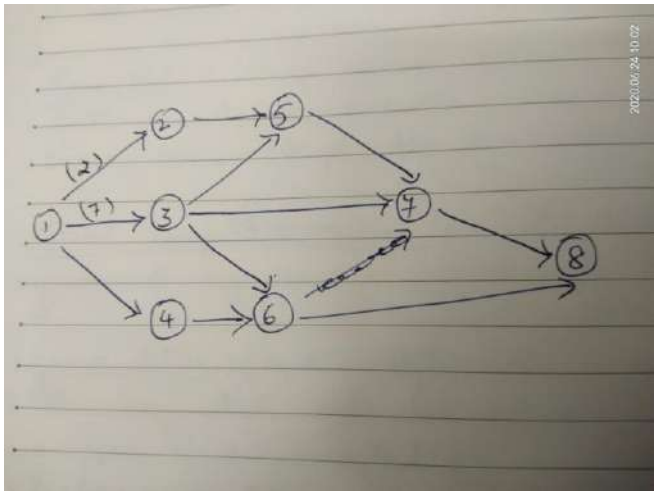
1-2-3-4-5 → CP

Appointments

Finding CPM and project completion time

ACTIVITY	DURATION(DAYS)
1-2	2
1-3	7
1-4	8
2-5	3
3-5	6
3-6	10
3-7	4
4-6	6
5-7	2
6-8	5
7-8	6


1
2
5
3
7
6
8
4
2020.06.24 10:01


(2)
(7)
1
2
5
3
7
8
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6
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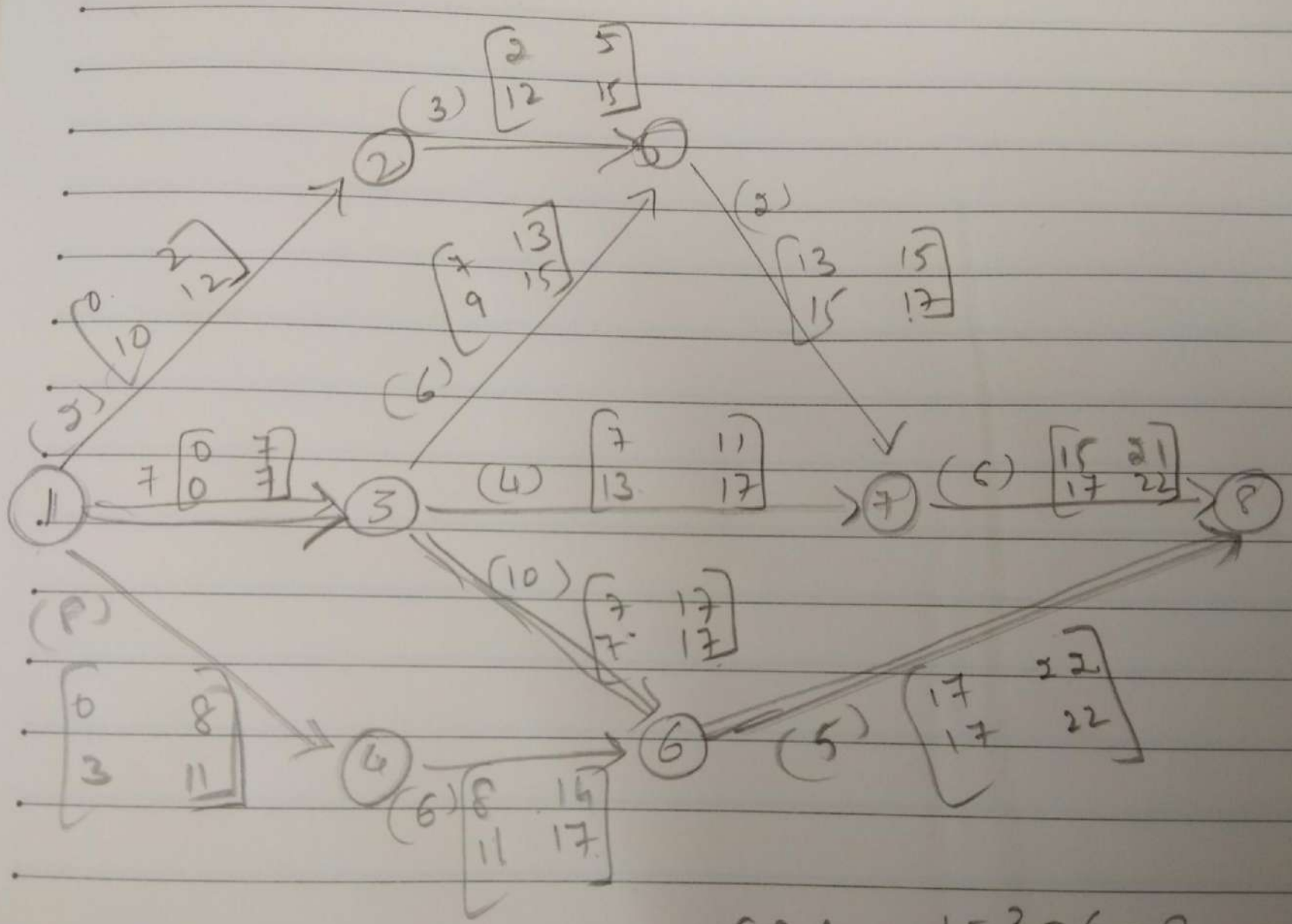

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PERT (Program Evaluation Review Technique)

Activity	t_o	t_m	t_p
1-2	4	6	8
2-3	5	7	15
2-4	4	8	12
3-6	15	20	25
3-5	10	18	26
4-6	8	9	16
5-7	4	8	12
6-7	1	2	3
7-8	6	7	8

Soln. contd.

formula

$$t_e = \frac{t_o + 4\,t_m + t_p}{6}$$

t_o = optimistic time
t_m = most likely time
t_p = pessimistic time

$$\text{variance } (\sigma^2) = \left(\frac{t_p - t_o}{6}\right)^2$$

Probability that the project will be Completed in x days

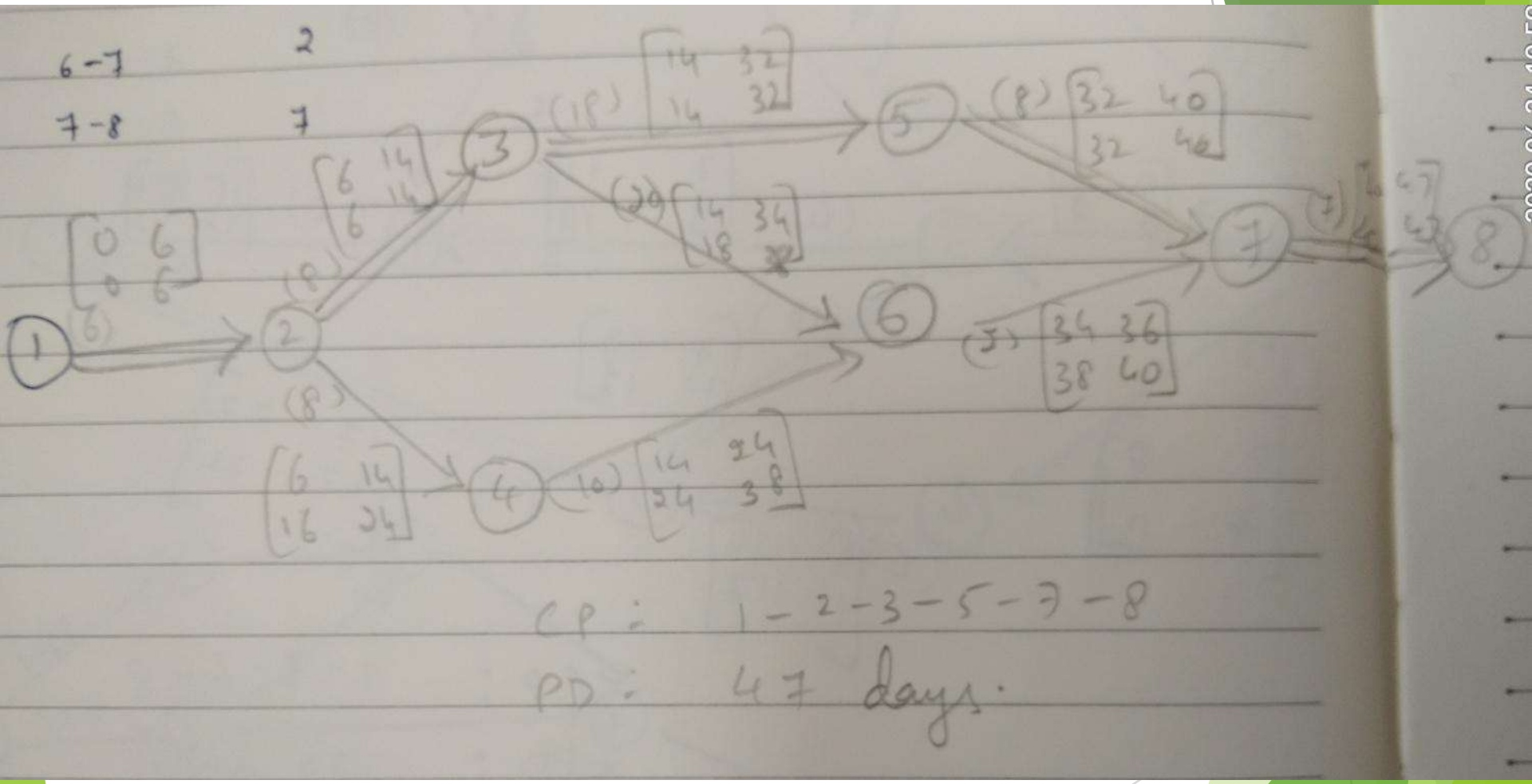
$$P(D \le X) = P\left(Z \le \frac{GT - AT}{\sigma}\right)$$

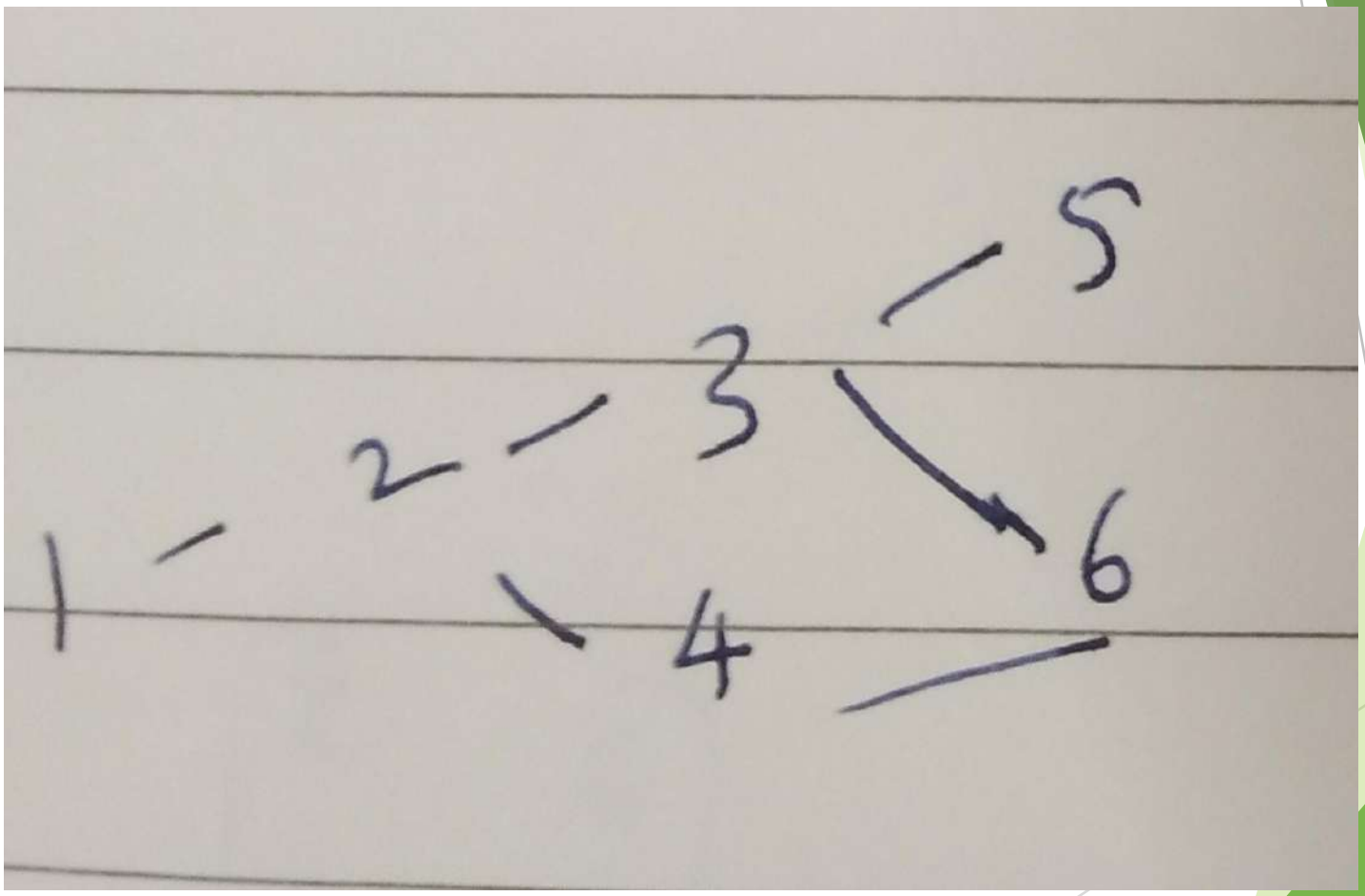
Where, Z = value under normal curve
σ = standard deviation
GT = Given Time
AT = Actual Time

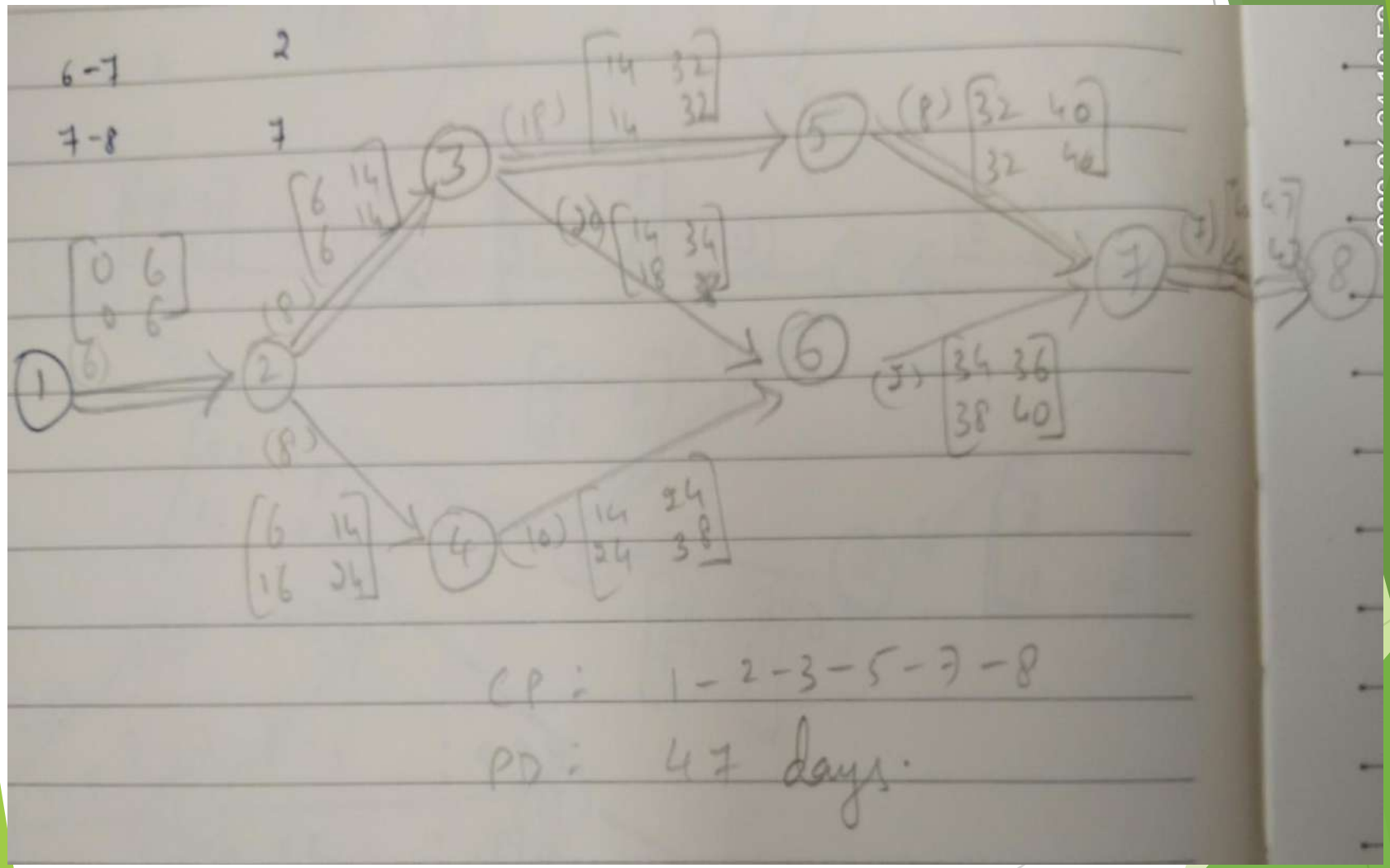
$$\text{Standard deviation} = \sqrt{\text{variance}}$$

Table for PERT

ACTIVITY	t_o	t_m	t_p	t_e	σ^2
1-2	4	6	8	6	4/9
2-3	5	7	15	8	25/9
2-4	4	8	12	8	-
3-6	15	20	25	20	-
3-5	10	18	26	18	64/9
4-6	8	9	16	10	-
5-7	4	8	12	8	16/9
6-7	1	2	3	2	-


6-7 2
7-8 7
CP : 1-2-3-5-7-8
PD : 47 days.


1
2
3
4
5
6


6-7 2
7-8 7
CP: 1-2-3-5-7-8
PD: 47 days.