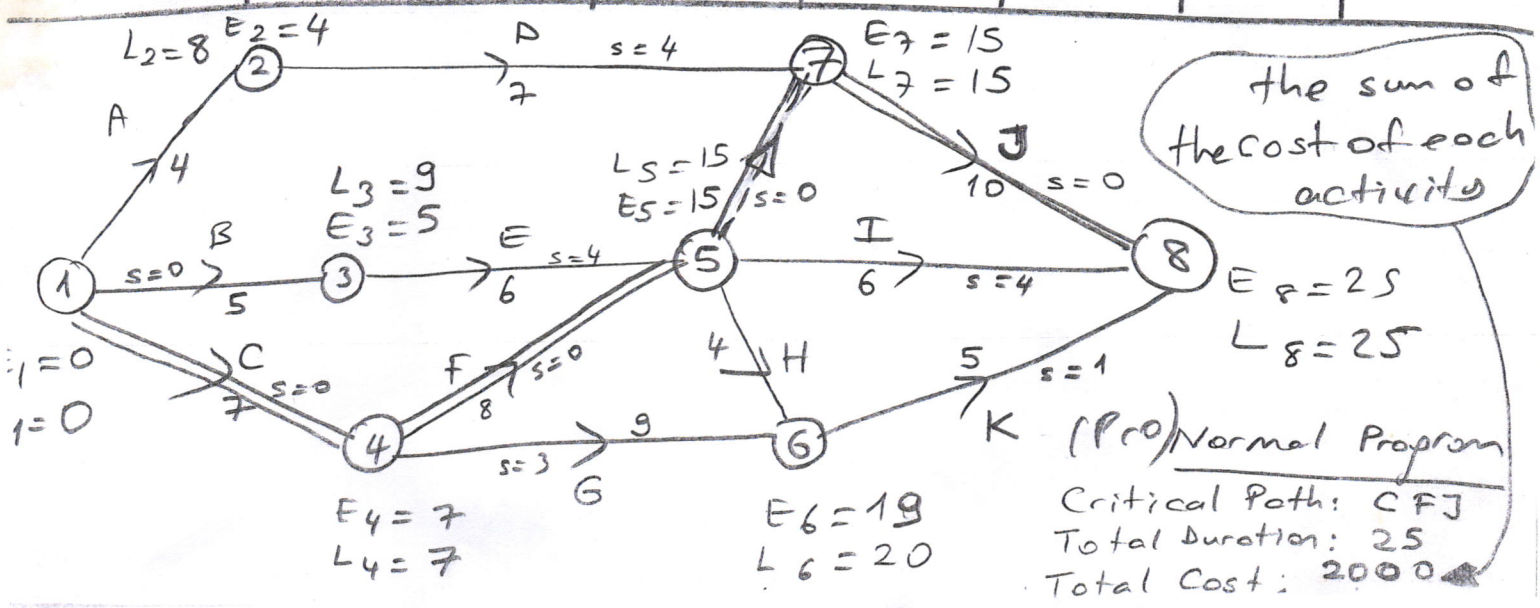
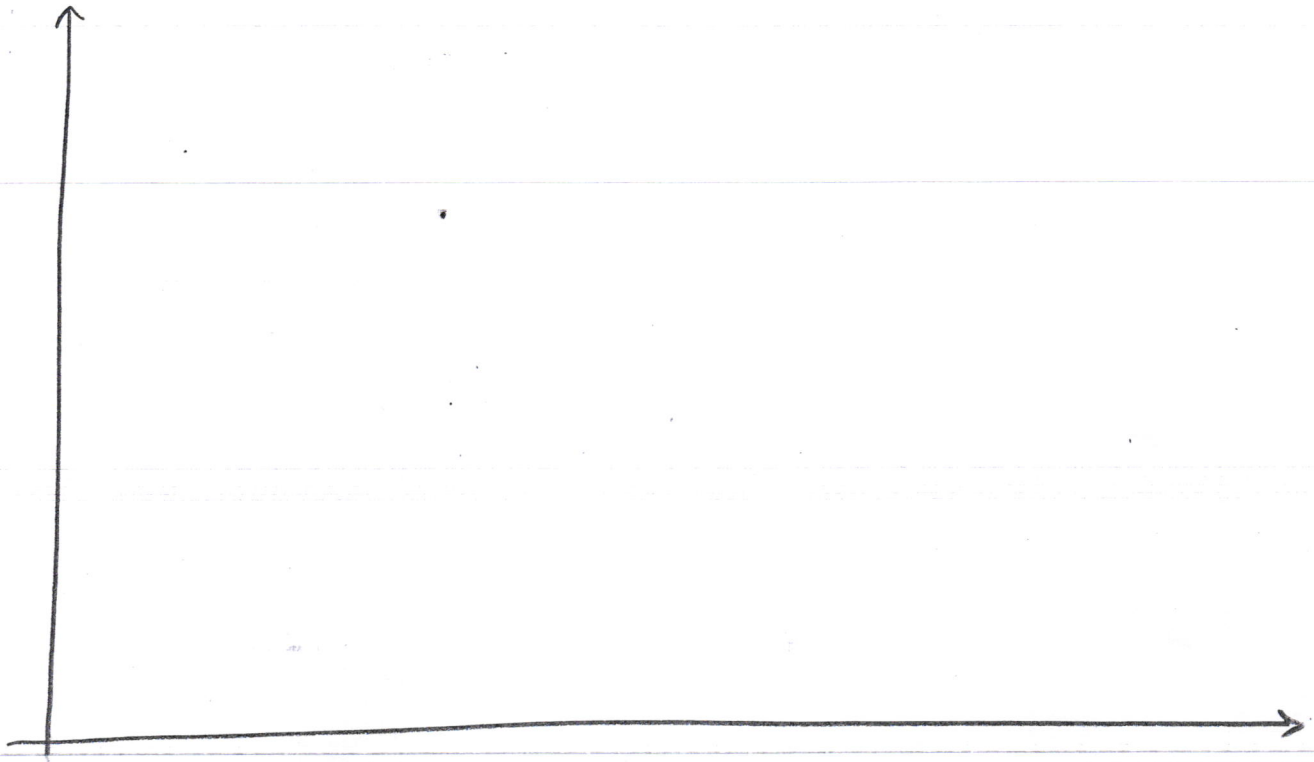
EXAMPLE Table below gives the activities of a project, their predecessor(s) and their durations. a) Draw the network for the projec
b) Determine the critical path.
c) Construct the time schedule
d)

Activity	Predecessor(s)	Duration		Cost		
		Normal	Fast	Norml	Fast	Slop
A	—	4	2	100	160	30
B	—	5	5	200	200	—
C	—	7	4	250	310	20
D	A	7	5	180	210	15
E	B	6	6	120	120	—
F	C	8	4	150	250	25
G	C	9	6	200	320	40
H	E, F	4	3	160	220	60
I	E, F	6	5	240	300	60
J	E, F, D	10	5	150	350	40
K	H, G	5	5	250	250	—



Time schedule



Critical Activities ⇒ C - F - J

Their slope ⇒ 20 - 25 - 40

Activity C has the minimal slope, thus it must be shorten. But how much??

Crashing amount = min { Maximal crashing amount of activity C , Free Floats of Alternative Noncritical paths }

Alternative non-critical paths

1) starts from the same or backward event with activity C.

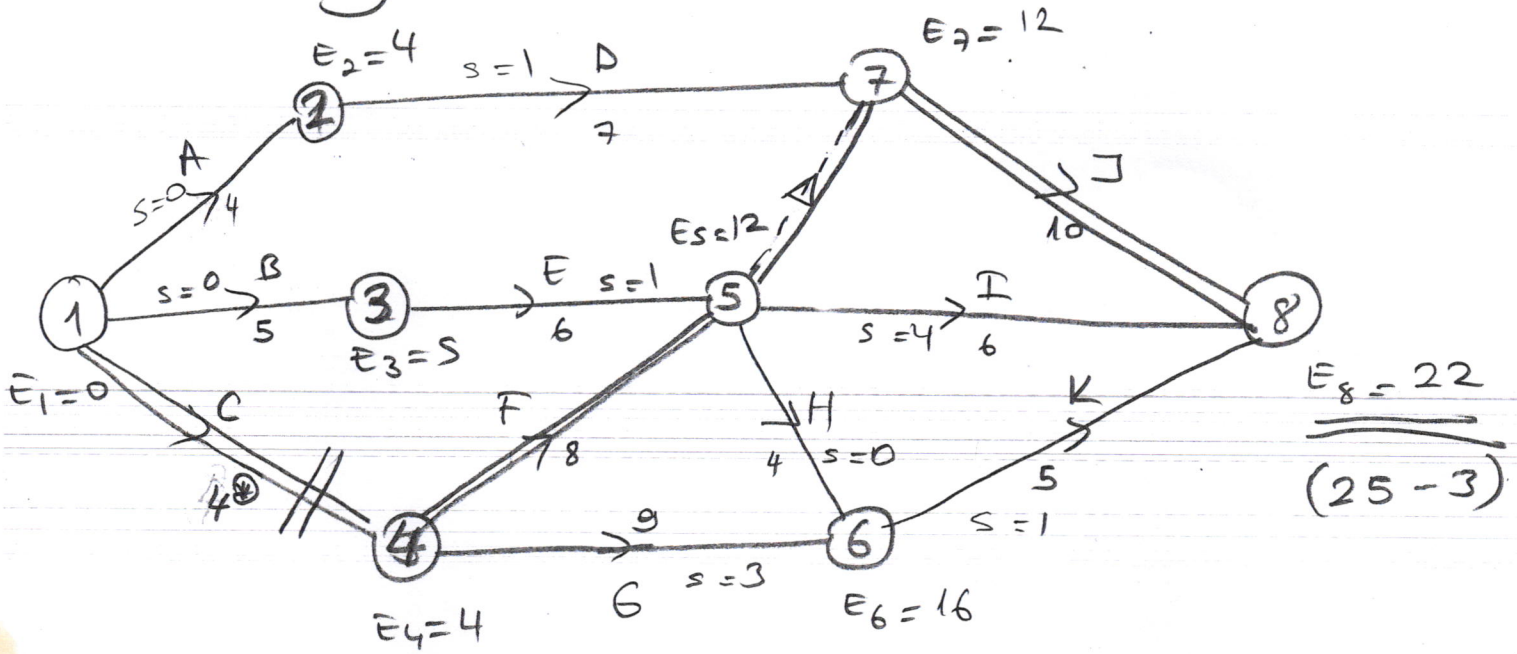
2) leads to the critical path(s).

Alternatif yollardan kritik yol oluyor mu?

C'den gitmeden başlangıçtan bitişe gidebilen yol = alternatif yol)

Crashing Amount of Activity C $= \min \left\{ \underbrace{7-4}_{3} \text{ (Crashing limit of Activity C)}, \underbrace{0+4}_{A-D}, \underbrace{0+4}_{BE} \right\} = 3$ units (5)

$\Rightarrow$ Activity C will be shorten 3 units.



(Pr 1)

Critical Paths = C - F - J

Total Duration = 22

Total Cost = $2000 + 20 \times 3 = \underline{2060}$

Activity C reached its crashing limit, thus it can not be shorten anyway. We denote this with " // " on the relevant activity.

C - F - J

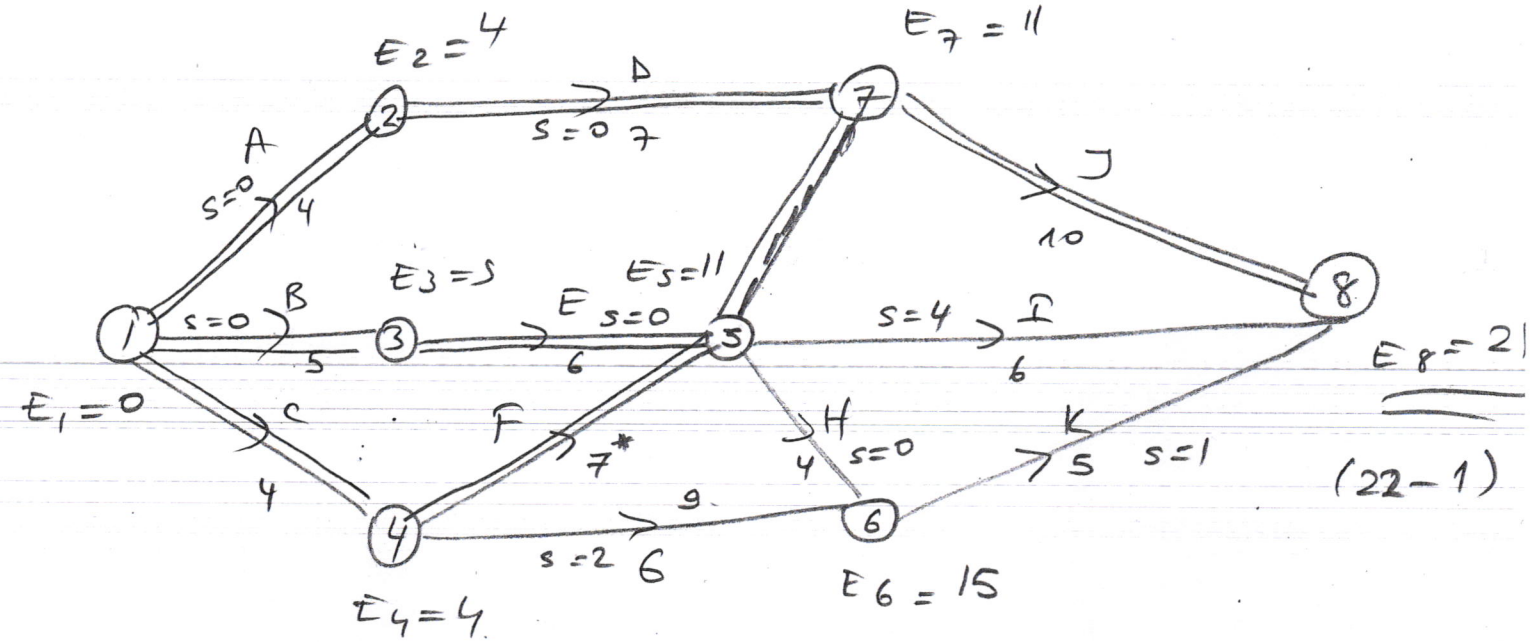
X - 25* - 40

Activity F has the minimal slope, Thus it must be shorten.

Crashing Amount of Activity F $= \min \left\{ \underset{F}{\frac{8-4}{4}}, \underset{GK}{3+1}, \underset{BE}{0+1}, \underset{AD}{0+1} \right\}$

$= 1$ unit.

$\Rightarrow$ Activity F will be shorten 1 unit.



(Pr 2)

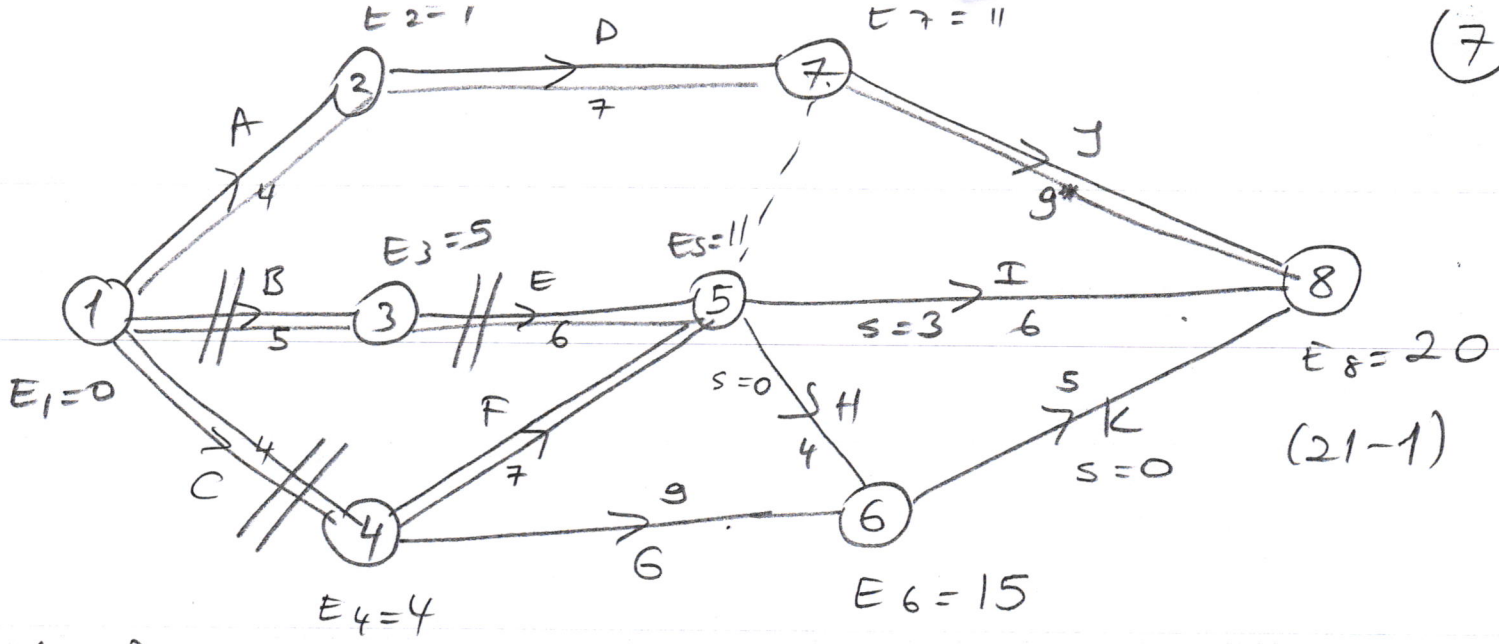
Critical Paths $= \left\{ \begin{array}{l} \cancel{A} - F - J \\ \cancel{A} - \cancel{F} - J \\ A - D - J \end{array} \right.$ Activity J will be shorter.

Total Duration $= 21$

Total Cost $= 2060 + 1 \times 25 = 2085.$

Crashing Amount $= \left\{ \underset{J}{10-5}, \underset{I}{4}, \underset{H-K}{0+1} \right\} = 1$ unit.

Activity J will be shorten 1 unit.



(Pr 3)

~~C~~ - F - J

~~B~~ - ~~E~~ - J

A - D - J

~~B~~ - ~~E~~ - H - K

~~C~~ - F - H - K

Possible crashing activities

J-H / J-K

40+60 / 40+X

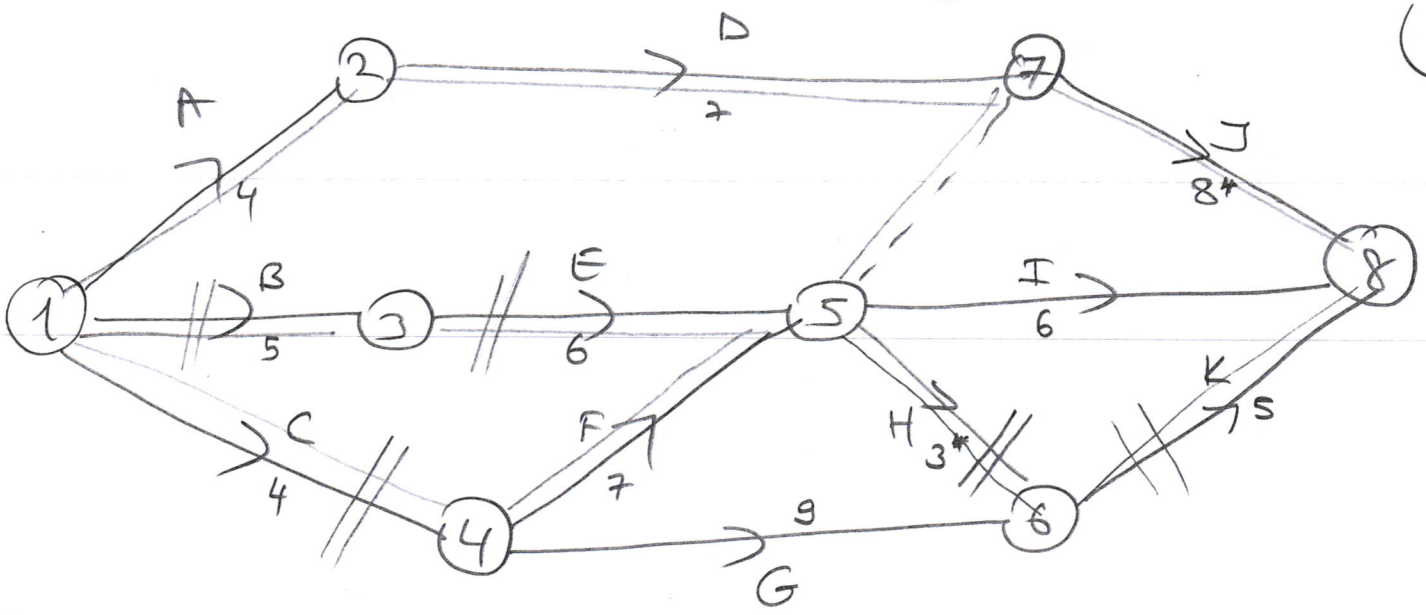
Total Duration	20	=100.

$2085 + 40 \times 1 = 2125.$

Activities J and H will be shorter.

Crashing Amount of J and H $= \min\left\{ \underbrace{9-5}_{4}\ (J),\ \underbrace{4-3}_{1}\ (H),\ 3\ (I) \right\} = 1$ unit.

Activities J and H will be shorten 1 unit



(Pr 4)

Since the critical path BEHK is reached its crashing limit, it is not possible to shorten the total project duration. Thus crashing process is over.

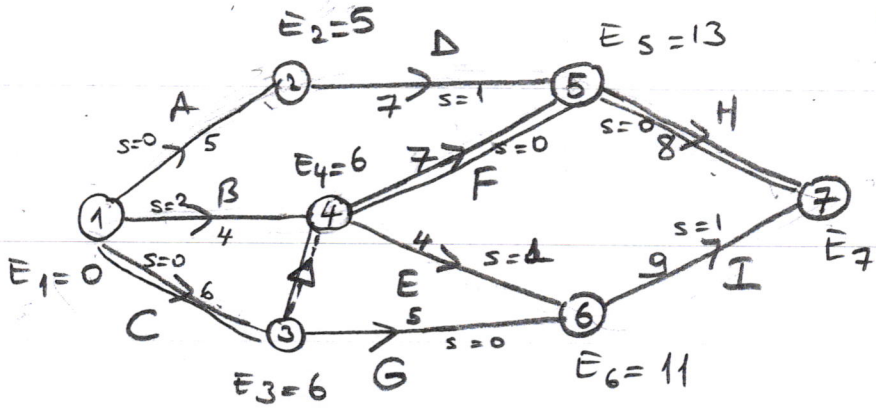
Homework (CPM-4)

Table on below gives the activities of a project, their predecessor(s), durations and costs.

a) Draw the network for the project.
b) Determine the critical path.
c) Construct the Time Schedule. → E, L.
d) Obtain programs with minimum costs.

Activities	Predecessor(s)	Durations		Costs		
		Normal	Crashed	Normal	Crashed	
A	---	5	3	100	150	25
B	---	4	2	180	200	10
C	---	6	3	170	200	10
D	A	7	5	200	260	30
E	B, C	4	4	120	120	—
F	B, C	7	7	150	150	—
G	C	5	3	180	250	35
H	D, F	8	6	200	300	50
I	E, G	9	6	100	160	20
						1400

(CPM - 4)



ADH = 20

Pr 0

CFH

21

1400 //

18

$E = \max\{E + D\}$

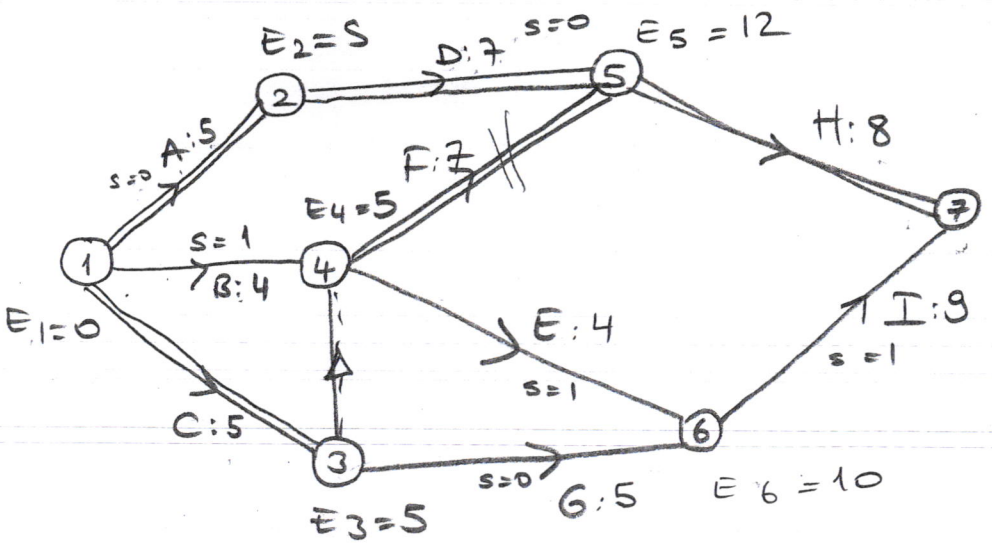
$S = FF_{ij} = E_j - E_i - D_{ij}$

C	- F	- H
1	1	1
10*	—	50

stoplamları.

Crashing amount = min { 3 → 6-3 (C) , 2 (B) , 0+1 (A-D) , B ~~E I~~ } = 1

Activity C will be shorten 1 unit.



E7 = 20

Pr 1

CFH : 20 → 18

ADH : 20 → 19

20

1400 + 10 = 1410 //

C ~~F~~ H → 2 H / C A / C D / ~~C H~~

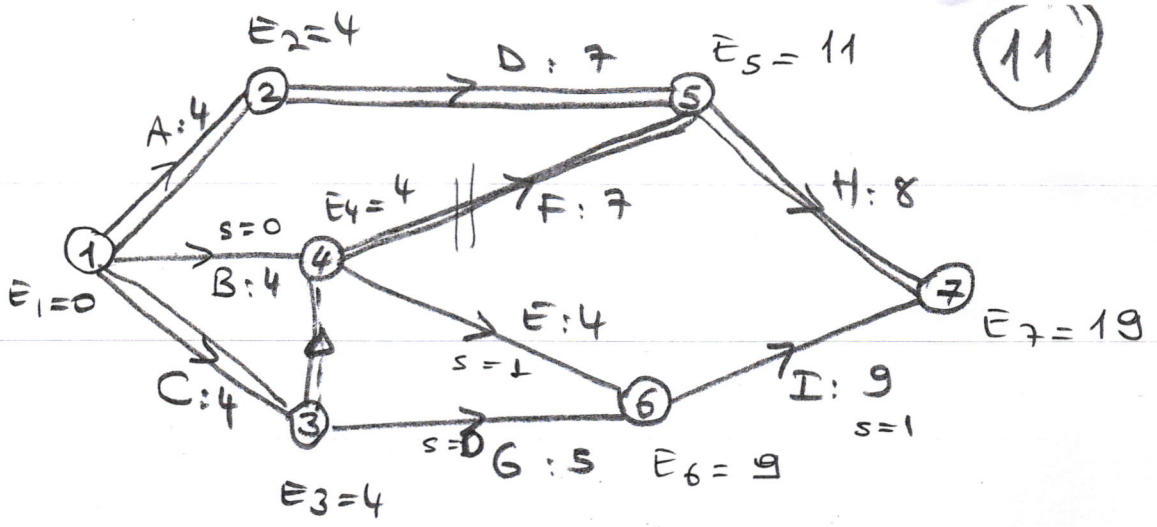
A D H → 1 50

C A: 10 + 25 = 35*

C D: 10 + 30 = 40

Crashing Amount = min { 2 (A) , 2 (C) / 1 (B) } = 1

Activities C and A will be shorten 1 unit



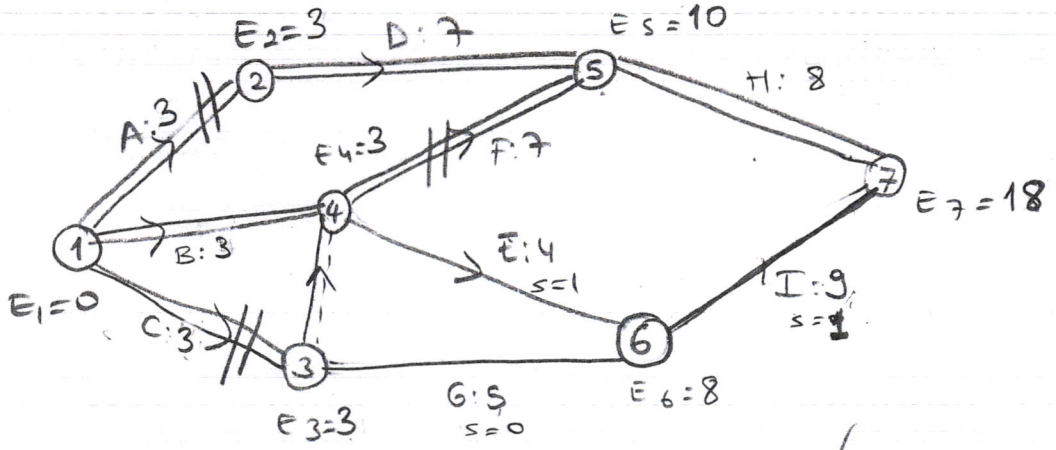
11

Pr 2

CFH
ADH
BFH
19
1410+35
=1445 //

CXH H / CAB / CDB
ADH 1
BXH 50 10+25+10 = 45 10+30+10 = 50

Crosh. Amount = min { 1 (C), 1 (A), 2 (B) } = 1.

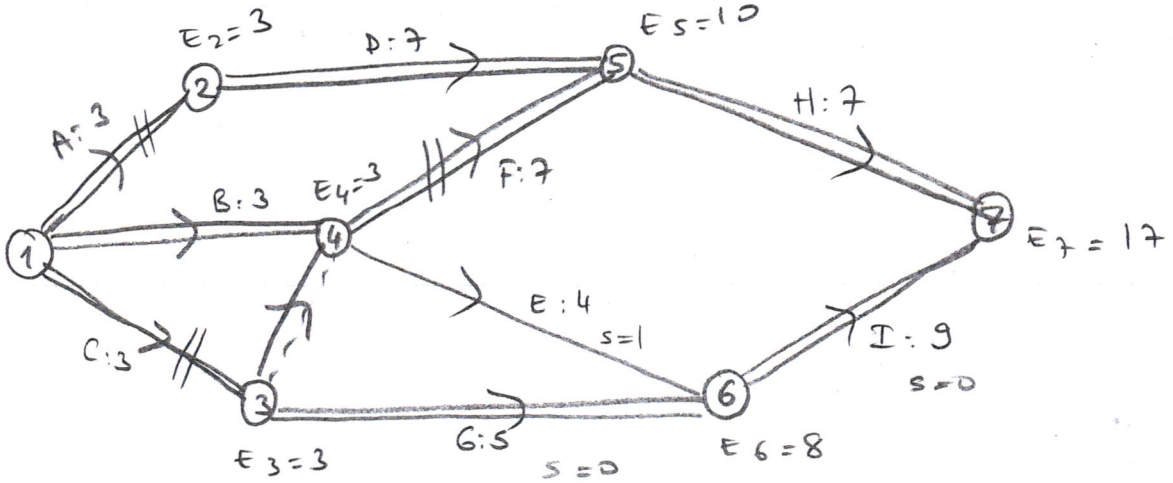


Pr 3

CFH
ADH
BFH
C
18
1445+45
=1490.

XXH
XDH
BXH
(H)

Crosh. amount = min { 2 (H) / 2 (EI), 1 (6I) } = 1.



Pr4

CFH
ADH
BFH
CGI
17
1490
+50
1540 //

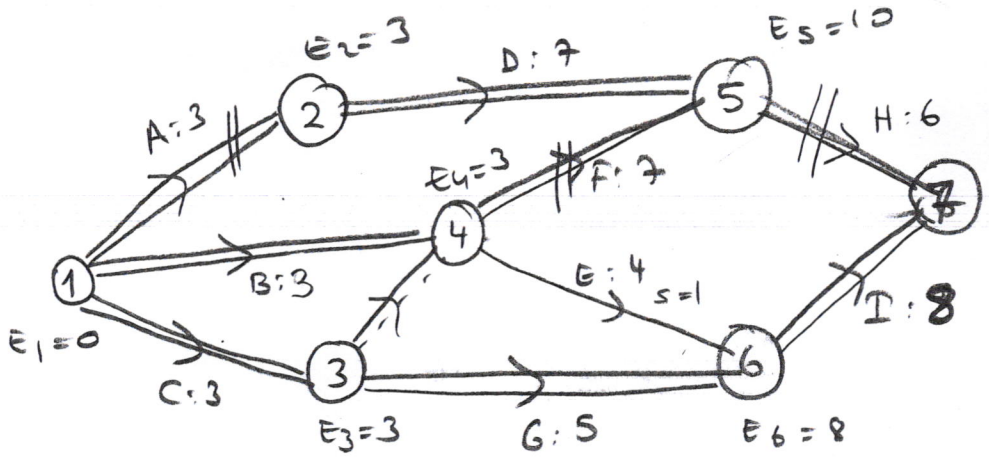
~~CFH~~
~~A~~DH
B ~~F~~H
~~C~~GI

HI / HG

50+20 = 70*

50+35 = 85

Crash. Amount = min { 1/H , 3/I , 1/E } = 1



Pr 5
CFH
ADH
BFH
CGI
16
1540+70
= 1610.

Since the activities CFH1 are reached their speedy duration, this is the final program.