Homework 4 - Critical Path Method (CPM), Project Crashing

MGCR 472 - Operations Management

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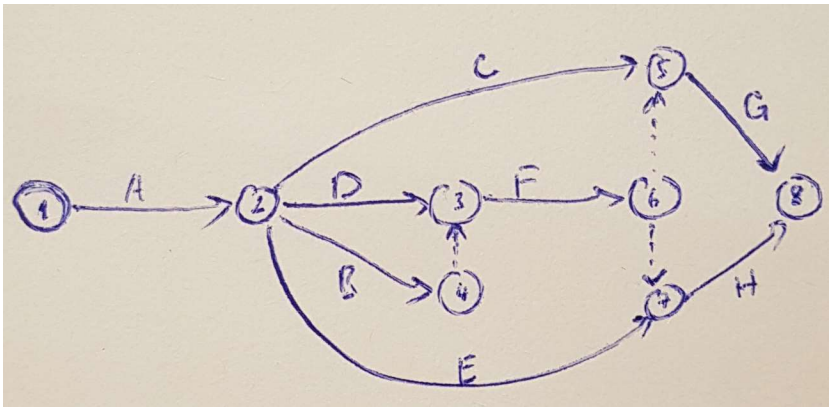
Question 1

Fix-Em-Up Industries restores classic cars. Their chairman wants to create a project network diagram to plan future restoration jobs. The following activities are required to restore a car. First, workers must disassemble the car and catalog the parts. Next, they must reupholster the seats, rechrome the bumpers, paint the body panels and rebuild the engine. Each of these activities may begin once the car has been disassembled and the parts have been cataloged. After the workers have finished rechroming the bumpers and painting the body panels, they can reassemble the body. After the seats are reupholstered and the body has been reassembled, they can install the reupholstered seats. After the engine is rebuilt and the body has been reassembled, the rebuilt engine can be installed. The list of activities is given below. Construct the network diagram for Fix-Em-Up Industries using the Activity-on-Arc method discussed in class.

Activity	Description
A	Disassemble car & catalog parts
B	Paint Body Panels
C	Rebuild Engine
D	Rechrome Bumpers
E	Reupholster seats
F	Reassemble body
G	Install reupholstered seats
H	Install rebuilt engine

Solution



Question 2

NYC Real Estate is purchasing an old office building in order to renovate it. The renovation project consists of 7 activities which are given below. The duration of each activity is given in weeks and the precedence relationships among the activities are given as well.

Activity	Description	Immediate Predecessors	Duration (weeks)
A	Secure Financing	–	3
B	Hire Employees	–	9
C	Buy Materials	A	7
D	Purchase Property	A	2
E	Clean Old Building	D	2
F	Perform Renovation	B,C,E	5
G	Sign Tenants	D	8

a. Draw the precedence diagram for this project.

b. Using the critical path method learned in class, determine the earliest start, earliest finish, latest start, and latest finish times of each activity. In addition, compute the slack of each activity.

c. What is the minimum amount of time needed to complete the renovation project? Also, what are the critical activities and the critical path(s) of the project?

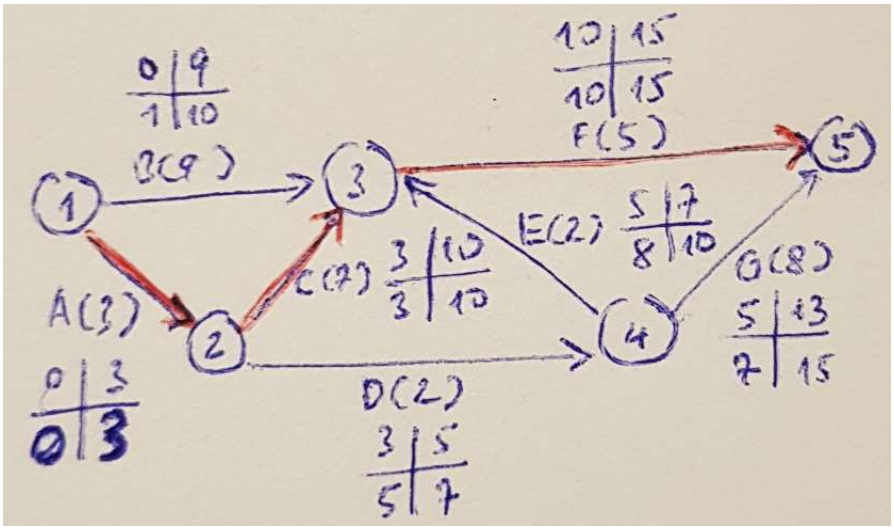
d. Suppose that due to market competition, NYC Real Estate would like to complete its renovation project within the next 12 weeks. For each week beyond the 12 weeks deadline, it faces a $800 penalty. The following table details NYC Real Estate's project crashing options.

Activity	Immediate Predecessors	Normal Duration (weeks)	Crash Duration (weeks)	Normal Cost	Crash Cost	Crash Cost per Week
A	–	3	2	$1,300	$1,800	$500
B	–	9	6	$800	$2,150	$450
C	A	7	2	$2,000	$3,500	$300
D	A	2	2	$1,600	$1,600	–
E	D	2	1	$1,500	$1,750	$250
F	B,C,E	5	2	$1,000	$2,500	$500
G	D	8	4	$2,200	$3,800	$400

Using the greedy method learned in class, crash NYC Real Estate's renovation project for as many weeks as it is profitable to do so. For each week of crashing, identify the activities to be crashed, the cost of crashing, and the resulting critical path(s) after performing the crashing. If it becomes no longer profitable to crash the project, then clearly explain why.

Solution

a. b.



Slack of activity (= LS - ES = LF - EF)

- A: 0
- B: 1
- C: 0
- D: 2
- E: 3
- F: 0
- G: 2

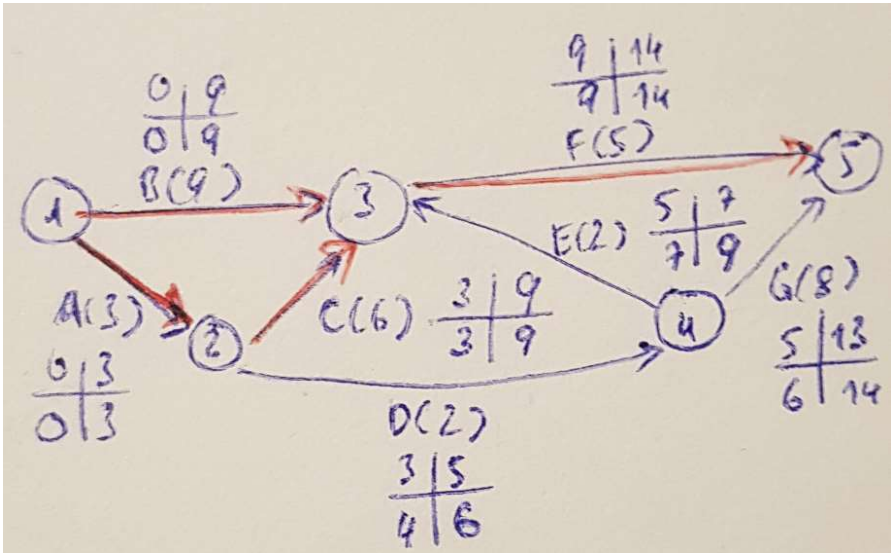
c. The project needs at least 15 weeks to be complete.

The critical activities are A, C, and F.

The critical path is: A-C-F.

d. **Crashing to 14 weeks:**

Crash C, costing 300



New critical paths:

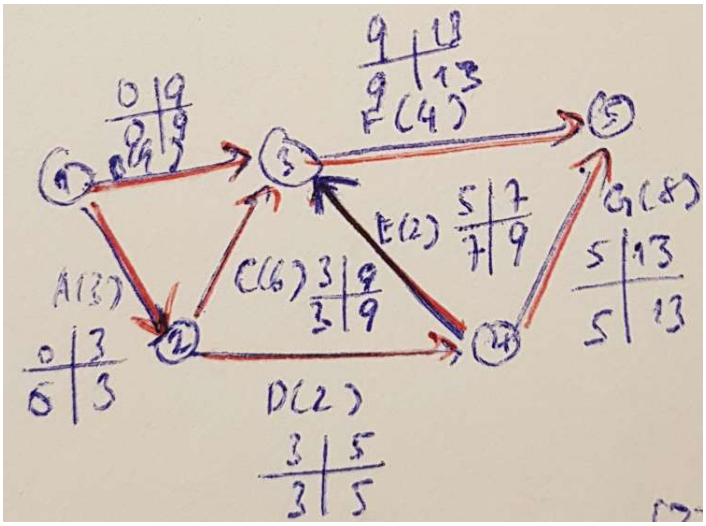
- B-F
- A-C-F

Crashing to 13 weeks:

Possible crashes and their cost:

- F: 500
- B, C: 450 + 300 = 750
- B, A: 450 + 500 = 950

Therefore, crash F, costing 500



New critical paths:

- B-F
- A-C-F
- A-D-G

Crashing to 12 weeks:

Possible crashes and their cost:

- F, G: 500 + 400 = 900
- A, F: 500 + 500 = 1000
- A, B: 500 + 450 = 950
- C, B, G: 300 + 450 + 400 = 1150

The $800 penalty is lower than the cost of any crashing option. Therefore, it is no longer profitable to crash the project.