# Tutorial 11 : Production planning

Graph theory, 1st semester.

2022

**Exercise 1 — *Build a house***

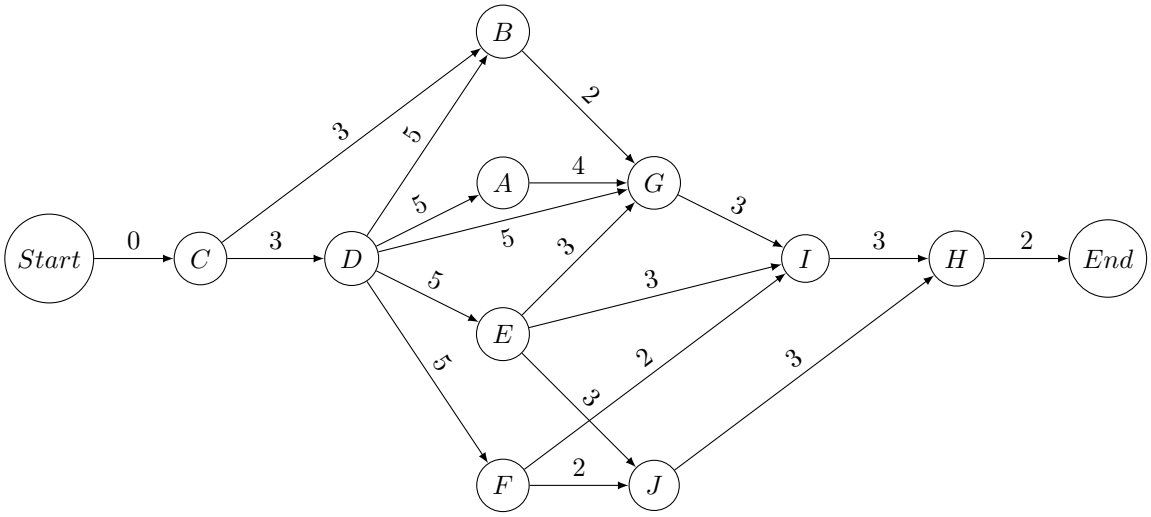
The following table describes a project to build a house, for each task, the table specifies the duration and the required tasks (the tasks that need to be done before).

| | | Duration (weeks) | Required tasks |
|---|---|---|---|
| A | Cables laying | 4 | D |
| B | Plumbing | 2 | C,D |
| C | Foundations | 3 | - |
| D | Build the frame | 5 | C |
| E | Brickwork | 3 | D |
| F | Cover the roof | 2 | D |
| G | Cover the walls | 3 | A,B,D,E |
| H | General inspection | 2 | I,J |
| I | Inside adjustments | 3 | E,F,G |
| J | Outside adjustments | 3 | E,F |

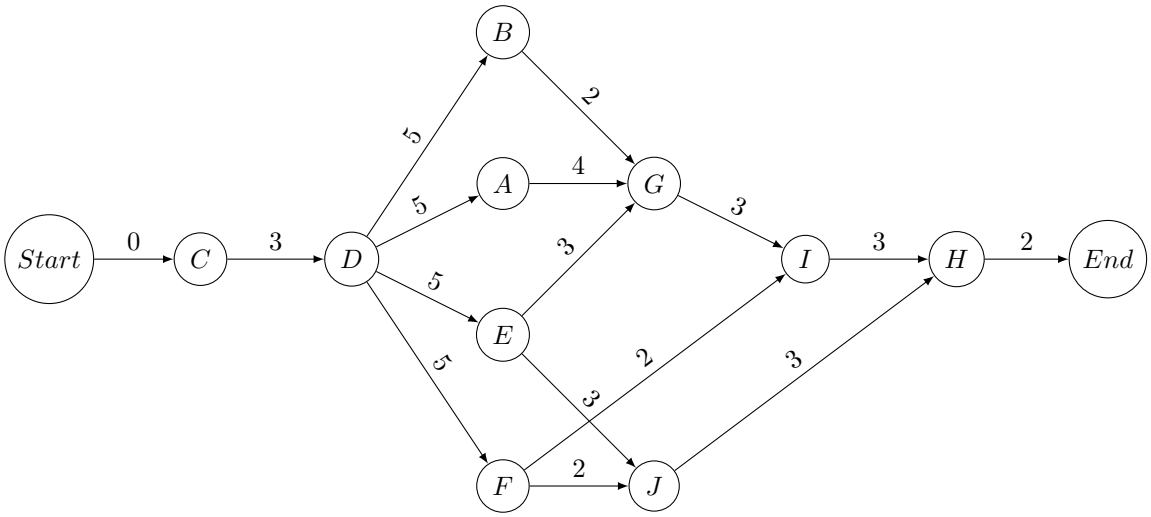
1. Draw the MPM diagram corresponding to that project.
2. Some of the required taks are redundant. Delete them.
3. Compute the optimistic and pessimistic times $t_i$ and $T_i$ of each task $i$.
4. What are the critical paths ?
5. Compute the free float $m_i$ and the total float $M_i$ of each task $i$.

▶ **Correction**

1. Potnetiel tache



2. Tous les arcs $(u, v)$ où dans le potentiel tâche, il existe un chemin de $u$ à $v$ peuvent être retirés :
   $(C, B)$ $(D, G)$ $(E, I)$




3. Temps au plus tôt : $t_{START} = 0$ et $t_i = \max_{(j,i)} t_j + d_{ij}$
   Temps au plus tard : $T_{END} = t_{END}$ et $T_i = \min_{(i,j)} T_j - d_{ij}$

| | START | A | B | C | D | E | F | G | H | I | J | END |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t_i$ | 0 | 8 | 8 | 0 | 3 | 8 | 8 | 12 | 18 | 15 | 11 | 20 |
| $T_i$ | 0 | 8 | 10 | 0 | 3 | 9 | 13 | 12 | 18 | 15 | 15 | 20 |

4. Chemin critique : START, C, D, A, G, I, H, END
5. Marge libre : $\min_{(i,j)} t_j - d_{ij} - t_i$
   Marge totale : $T_i - t_i$

| | START | A | B | C | D | E | F | G | H | I | J | END |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $m_i$ | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 0 |
| $M_i$ | 0 | 0 | 2 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 4 | 0 |

**Exercise 2 — *Movie production***

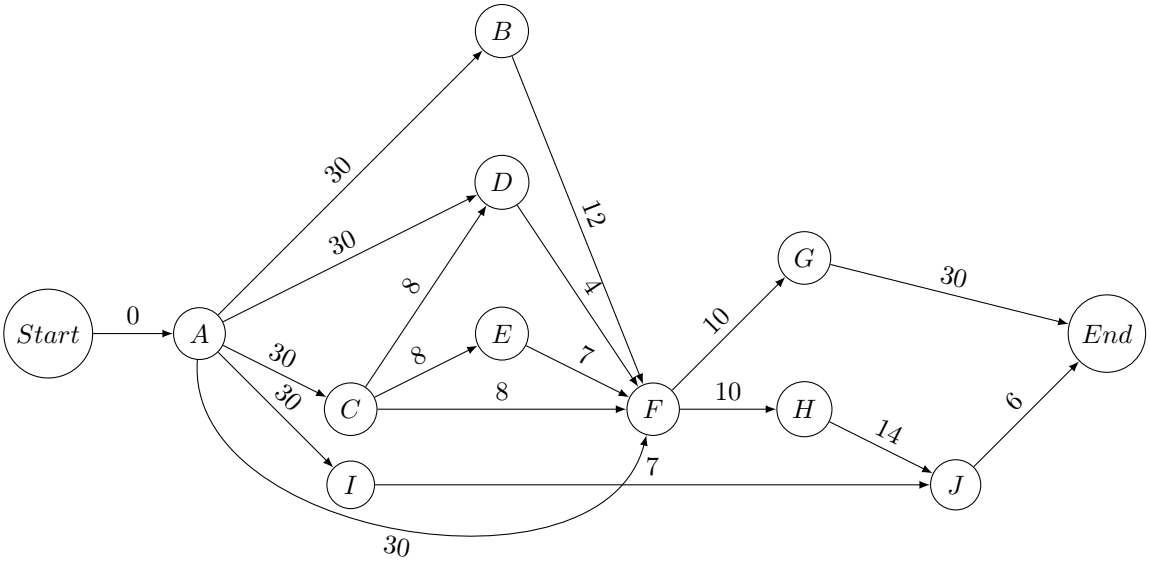
The following table describes a project to product a movie, for each task, the table specifies the duration and the required tasks (the tasks that need to be done before).

| | | Duration (days) | Required tasks |
|---|---|---|---|
| A | Write the script | 30 | |
| B | Hire the actors | 12 | A |
| C | Choose the location of the shooting | 8 | A |
| D | Storyboard | 4 | A,C |
| E | Build the sets | 7 | C |
| F | Shooting | 10 | A,B,C,D,E |
| G | Marketing | 30 | F |
| H | Editing | 14 | F |
| I | Music and sound composition | 7 | A |
| J | Mixing | 6 | H, I |

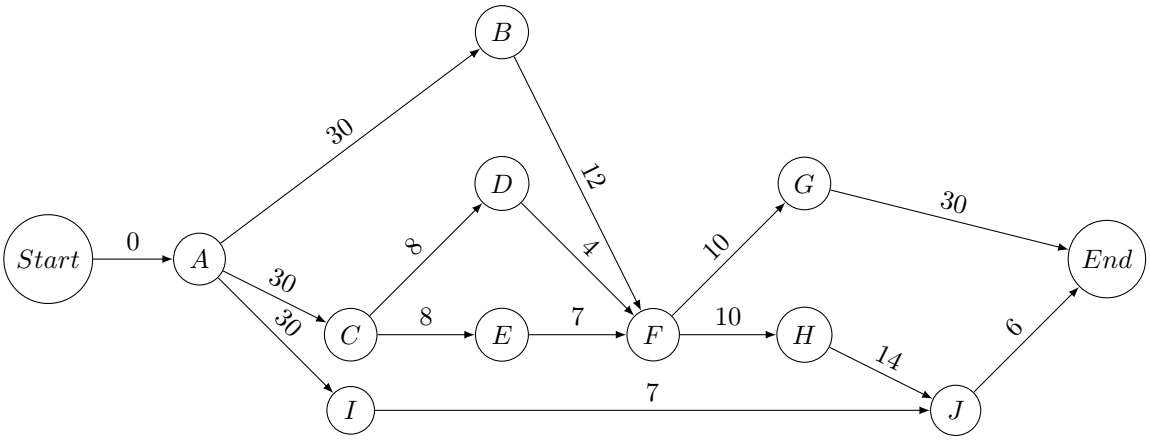
1. Draw simultaneously a MPM and a PERT diagram corresponding to that project.
2. Some of the required taks are redundant. Delete them.
3. Compute the optimistic and pessimistic times $t_i$ and $T_i$ of each task $i$.
4. What are the critical paths ?
5. Compute the free float $m_i$ and the total float $M_i$ of each task $i$.

▶ **Correction**

1. Potentiel tache :




2. (C,F), (A,F), (A,D)




3. Temps au plus tôt : $t_{START} = 0$ et $t_i = \max_{(j,i)} t_j + d_{ij}$
   Temps au plus tard : $T_{END} = t_{END}$ et $T_i = \min_{(i,j)} T_j - d_{ij}$

| | START | A | B | C | D | E | F | G | H | I | J | END |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t_i$ | 0 | 0 | 30 | 30 | 38 | 38 | 45 | 55 | 55 | 30 | 69 | 85 |
| $T_i$ | 0 | 0 | 33 | 30 | 41 | 38 | 45 | 55 | 65 | 72 | 79 | 85 |

4. Chemin critique : START, A, C, E, F, G, END
5. Marge libre : $\min_{(i,j)} t_j - d_{ij} - t_i$
   Marge totale : $T_i - t_i$

| | START | A | B | C | D | E | F | G | H | I | J | END |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t_i$ | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 32 | 10 | 0 |
| $T_i$ | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 10 | 42 | 10 | 0 |