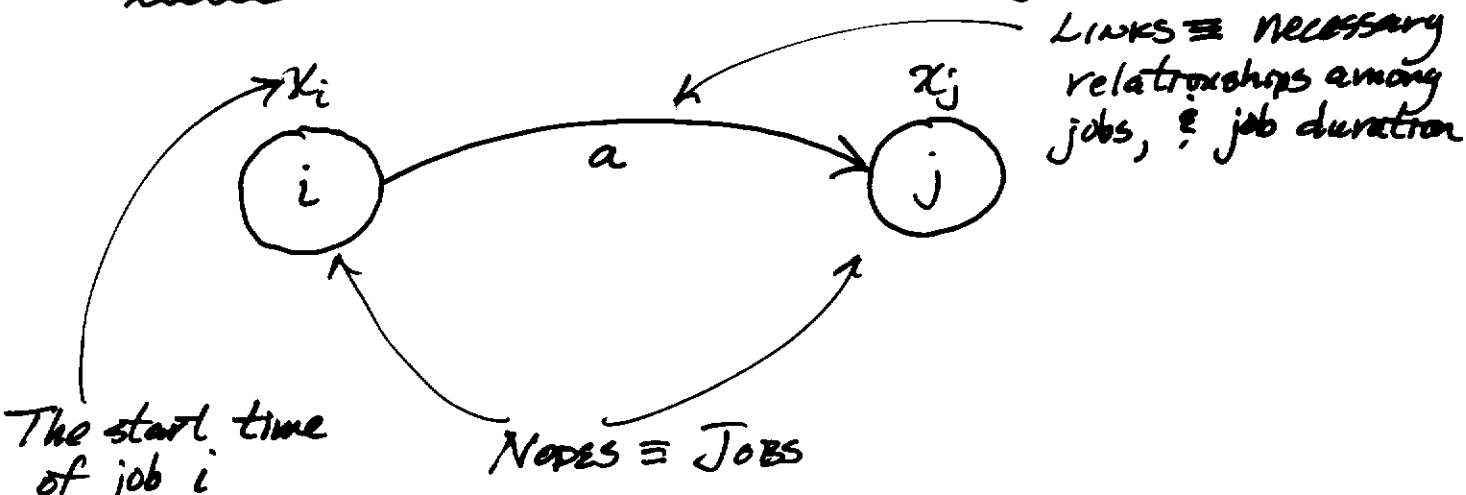
Example 2.17

Consider the scheduling of construction activities for a small commercial establishment:

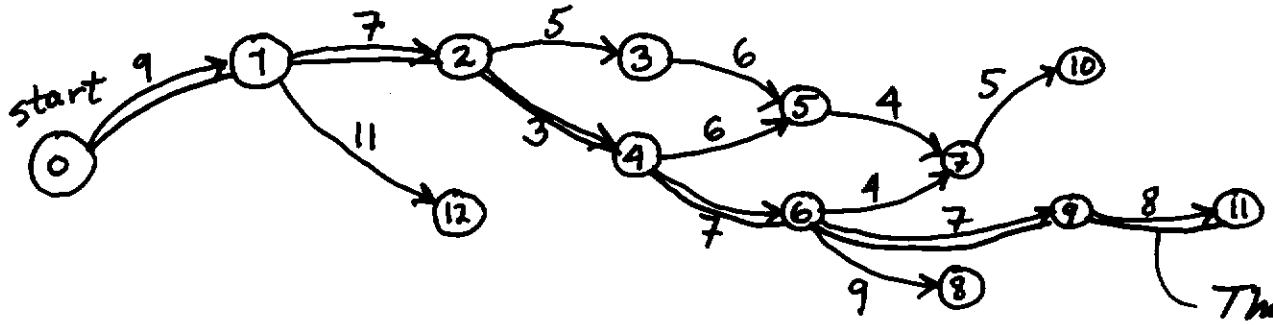
Job	Description	Duration	Must follow
1	Land preparation.	9	—
2	foundation	7	1
3	basement support structure	5	2
4	floor joists	3	2
5	exterior walls	6	3, 4
6	walls & flooring	7	4
7	ceiling / roof superstructure	4	5, 6
8	Electrical / mech / plumbing	9	6
9	rough finish interior	7	6
10	roofing material	5	7
11	interior finish	8	9
12	landscaping.	11	1

Create a linear programming model formulation that will schedule the above jobs such that sequencing is obeyed, and total construction time is a minimum.

A network view of the above scheduling data:



"Job j must start after completion of job i, and takes a days to complete."



The "Critical Path" (41 days).

The critical path includes only those activities that, if delayed, would affect the total (minimum) project duration.

Let x_i = start time (days) of activity i.

y = maximum time to complete an activity, over all activities.

Minimize Z = total Construction time

$\{x, y\}$

$$Z = y$$

subject to: Activity sequencing constraints:

$$x_1 \geq 0$$
$$x_2 \geq x_1 + 9$$
$$x_3 \geq x_2 + 7$$
$$x_4 \geq x_2 + 7$$
$$x_5 \geq x_3 + 5$$
$$x_5 \geq x_4 + 3$$
$$x_6 \geq x_4 + 3$$
$$x_7 \geq x_5 + 6$$
$$x_7 \geq x_6 + 7$$
$$x_8 \geq x_6 + 7$$
$$x_9 \geq x_6 + 7$$
$$x_{10} \geq x_4 + 4$$
$$x_{11} \geq x_9 + 7$$
$$x_{12} \geq x_1 + 9$$

Definition of y:

$$y \geq x_1 + 9$$
$$y \geq x_2 + 7$$
$$y \geq x_3 + 6$$
$$y \geq x_4 + 3$$
$$y \geq x_5 + 6$$
$$y \geq x_6 + 7$$
$$y \geq x_7 + 4$$
$$y \geq x_8 + 9$$
$$y \geq x_9 + 7$$
$$y \geq x_{10} + 5$$
$$y \geq x_{11} + 8$$
$$y \geq x_{12} + 11$$

Will y^* always equal the minimum construction time? Why? Is this true for any feasible solution?