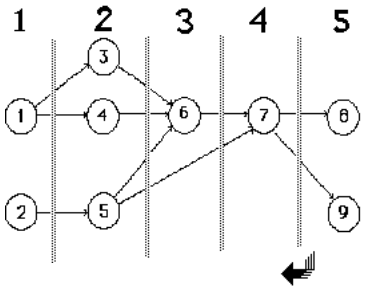
The Kilbridge & Wester Heuristic

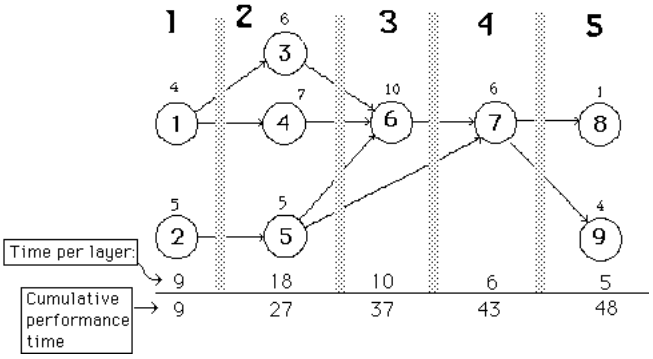
First, the "layers" are identified in the precedence diagram:



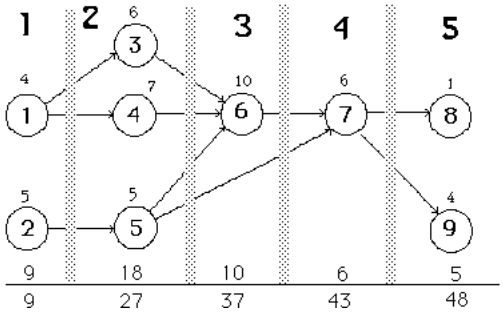
Tasks with NO predecessors are in the first layer.

Tasks that are preceded directly by tasks in layer #i are placed in layer # i+1, etc.

Compute the cumulative performance times by layer:

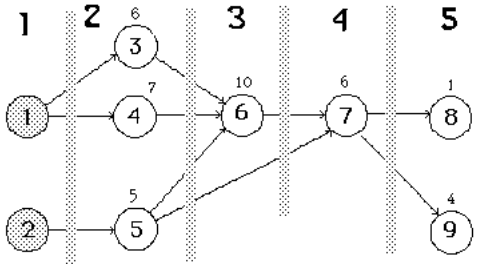


Let's find a balance with cycle time c=16



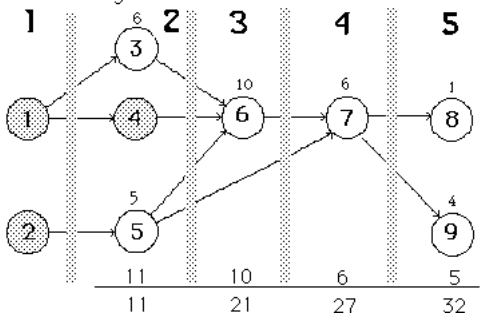
All tasks in the first layer can be assigned to station #1

Only 16-9= 7 minutes remain idle at station #1, which is not enough to perform all the tasks of layer #2. Find a subset of tasks in layer #2 with total performance time as near as possible to 7:



Task #4 is next assigned to station #1

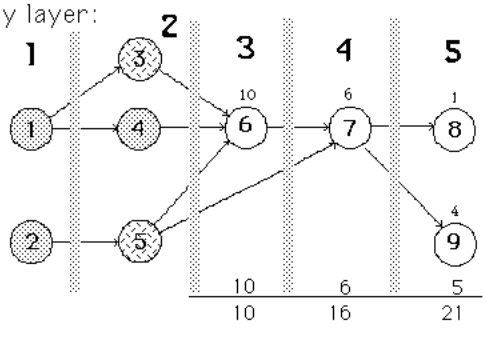
Recompute the cumulative performance time of the unassigned tasks:



Assign both remaining tasks of layer 2 to station 2, leaving 5 idle minutes at station #2.

No task of layer #3 can be added to the station

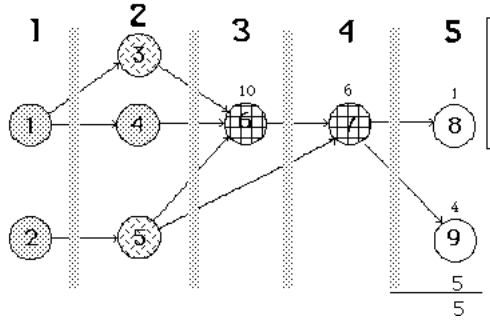
Recompute the cumulative times for unassigned tasks by layer:



Assign the task in layer #3 to station #3, leaving 6 minutes of idle time.

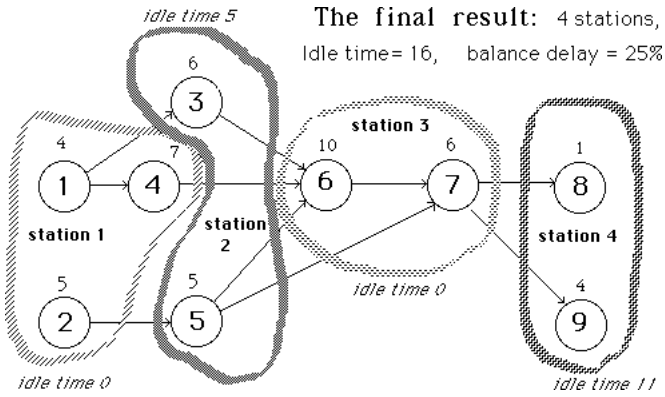
Assign the task in layer #4 to station #3, leaving 0 minutes of idle time.

Recompute cumulative times of unassigned tasks:

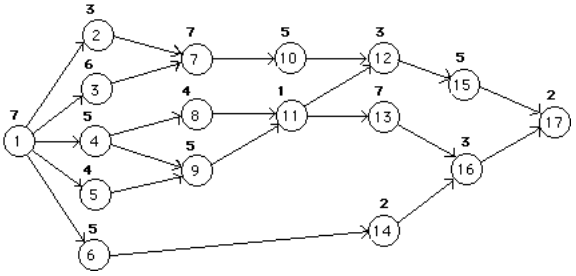


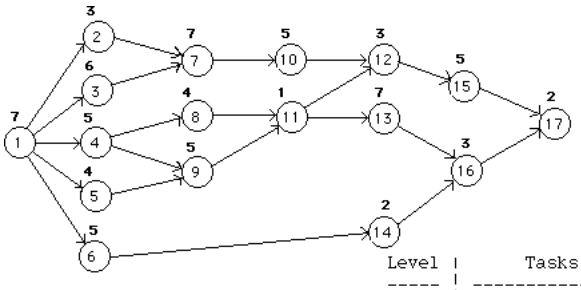
Both tasks of layer #5 can be assigned to station # 4

The final result: 4 stations, Idle time= 16, balance delay = 25%



Another example: cycle time = 15 minutes





Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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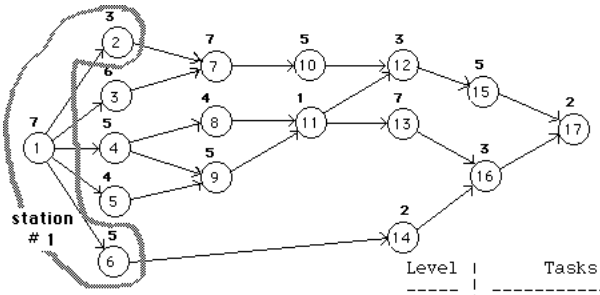
Kilbridge and Wester's
Heuristic Method

Station 1

```
Cumulative P of unassigned tasks by level:
                Level 1  2  3  4  5  6  7
                Cum P 7 30 48 54 64 72 74
Assign task(s) 1 to station 1
Idle time at Station 1 is now 8
Candidates from level 2 for adding to station 1 are 2 3 4 5 6
Add task(s) 2 6 with total processing time 8
```



Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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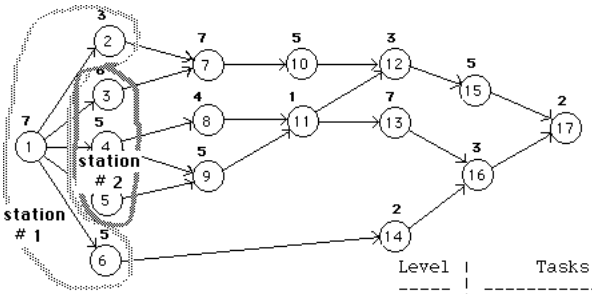
Kilbridge and Wester's
Heuristic Method

Station 2

```
Cumulative P of unassigned tasks by level:
                Level 1  2  3  4  5  6  7
                Cum P 0 15 33 39 49 57 59
Assign task(s) 3 4 5 to station 2
Idle time at Station 2 is now 0
Candidates from level 3 for adding to station 2 are 7 8 9 14
Add task(s) <none> with total processing time 0
```



Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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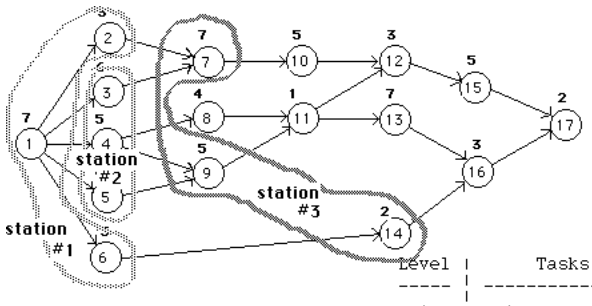
Kilbridge and Wester's
Heuristic Method

Station 3

```
Cumulative P of unassigned tasks by level:
                Level 1 2  3  4  5  6  7
                Cum P 0 0 18 24 34 42 44
Candidates from level 3 for adding to station 3 are 7 8 9 14
Add task(s) 7 9 14 with total processing time 14
```



Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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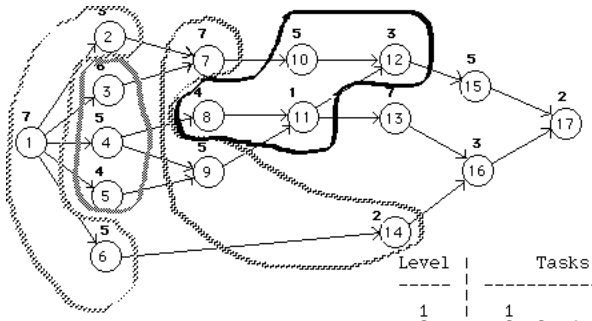
Heuristic Method

Station 4

Cumulative P of unassigned tasks by level:

Level	1	2	3	4	5	6	7
Cum P	0	0	4	10	20	28	30

Assign task(s) 8 10 11 to station 4
Idle time at Station 4 is now 5
Candidates from level 5 for adding to station 4 are 12 13
Add task(s) 12 with total processing time 3



Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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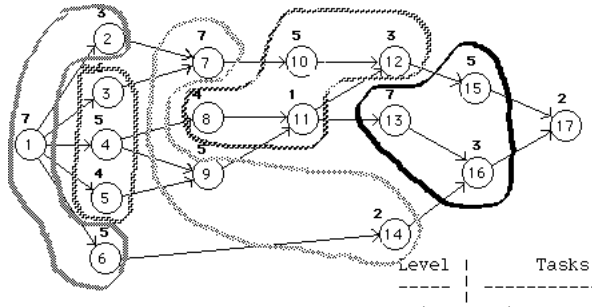
Heuristic Method

Station 5

Cumulative P of unassigned tasks by level:

Level	1	2	3	4	5	6	7
Cum P	0	0	0	0	7	15	17

Assign task(s) 13 15 16 to station 5
Idle time at Station 5 is now 0
Candidates from level 7 for adding to station 5 are 17
Add task(s) <none> with total processing time 0



Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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Heuristic Method

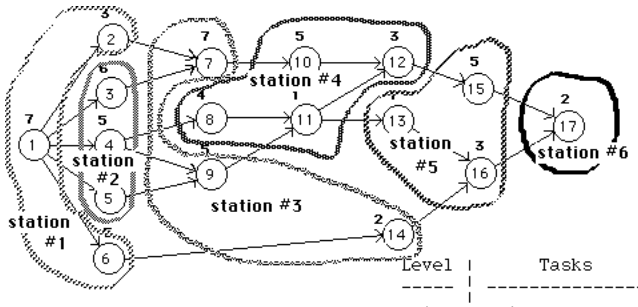
Station 6

Cumulative P of unassigned tasks by level:

Level	1	2	3	4	5	6	7
Cum P	0	0	0	0	0	0	2

Assign task(s) 17 to station 6
Idle time at Station 6 is now 13
Candidates from level 8 for adding to station 6 are
Add task(s) <none> with total processing time 0

Done



Level	Tasks
1	1
2	2 3 4 5 6
3	7 8 9 14
4	10 11
5	12 13
6	15 16
7	17

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Solution

17-task Line-Balancing Problem

Number of Stations: 6

Station	Idle time	Tasks
1	0	1 2 6
2	0	3 4 5
3	1	7 9 14
4	2	8 10 11 12
5	0	13 15 16
6	13	17

Balance delay: 0.177778