

Project Management - From Theory to Practice
Assignment #3

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Exercise #1 – Solution

A- Priority list that uses smallest activity number as a tie-breaker.

1. LST:

-Forward Priority List:

<1,2,3,5,7,4,10,8,11,9,12>

-Backward Priority List:

<1,7,6,4,10,2,3,5,11,9,8,12>

2. LFT:

-Forward Priority List:

<1,7,2,3,10,4,5,6,8,9,11,12>

-Backward Priority List:

<1,2,3,4,5,6,7,10,11,8,9,12>

3. MSLK:

- Forward Priority List:

<1,2,3,8,5,9,7,10,11,4,6,12>

-Backward Priority List:

<1,6,4,7,10,11,5,9,2,3,8,12>

4. MTS:

- Forward Priority List:

<1,7,2,3,4,5,10,6,8,9,11,12>

-Backward Priority List:

<1,2,3,4,5,6,7,10,8,9,11,12>

5. GRPW:

- Forward Priority List:

<1,2,3,5,4,8,7,10,11,9,6,12>

-Backward Priority List:

<1,7,6,4,10,2,3,5,11,9,8,12>

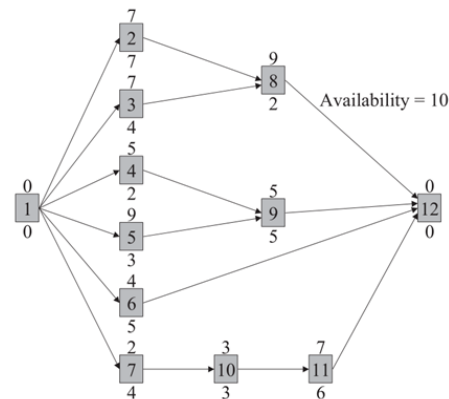
6. GRPW*:

- Forward Priority List:

<1,2,3,5,7,4,10,8,11,9,6,12>

-Backward Priority List:

<1,7,6,4,10,2,3,5,11,9,8,12>



Activity	Predecessors	Duration	Resource Use
1	-	0	0
2	1	7	2
3	1	7	4
4	1	5	2
5	1	9	3
6	1	4	5
7	1	2	4
8	2,3	9	2
9	4,5	5	5
10	7	3	3
11	10	7	6
12	6,8,9,11	0	0

7. GCUMRD:

- Forward Priority List:

<1,2,5,4,7,10,3,11,6,9,8,12>

-Backward Priority List:

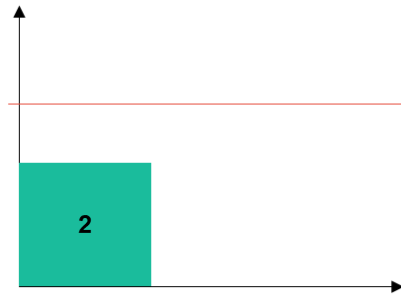
<1,4,5,3,7,6,2,10,9,8,11,12>

B- Using the priority list $\langle 1,2,3,4,5,6,7,8,9,10,11,12 \rangle$, construct a heuristic solution for this RCPSP by employing:

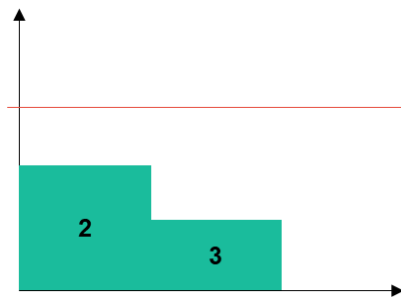
1. Forward planning with the serial scheduling scheme;

Iteration 1: $PS_1 = \{1\}$, $ED_1 = \{2, 3, 4, 5, 6, 7\}$

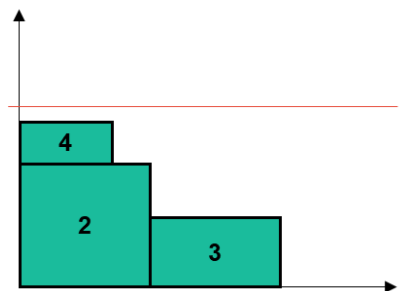
Iteration 2: $PS_2 = \{1, 2\}$, $ED_2 = \{3, 4, 5, 6, 7\}$



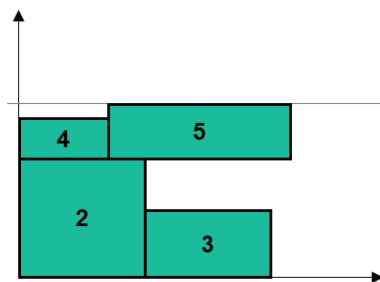
Iteration 3: $PS_3 = \{1, 2, 3\}$, $ED_3 = \{4, 5, 6, 7, 8\}$



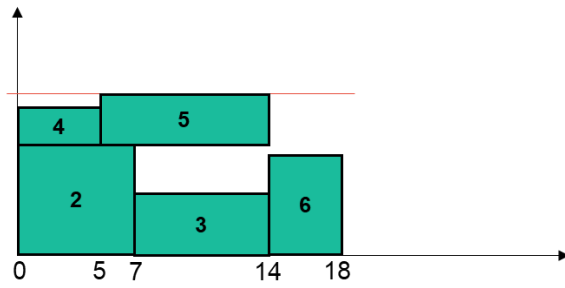
Iteration 4: $PS_4 = \{1, 2, 3, 4\}$, $ED_4 = \{5, 6, 7, 8\}$



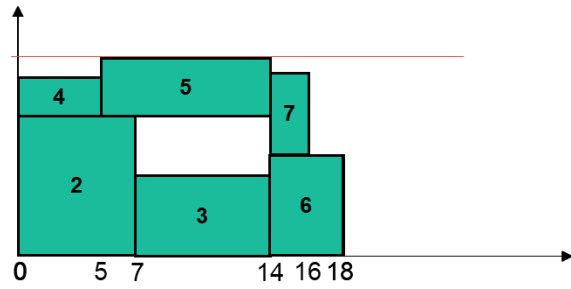
Iteration 5: $PS_5 = \{1, 2, 3, 4, 5\}$, $ED_5 = \{6, 7, 8, 9\}$



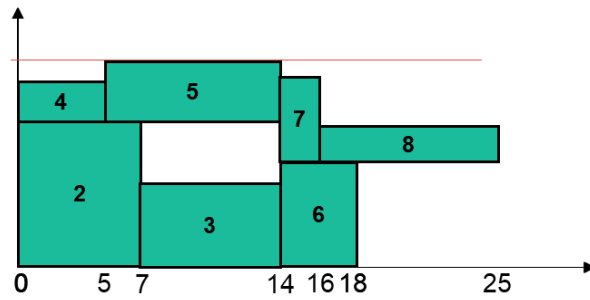
Iteration 6: $PS_6 = \{1, 2, 3, 4, 5, 6\}$, $ED_1 = \{7, 8, 9\}$



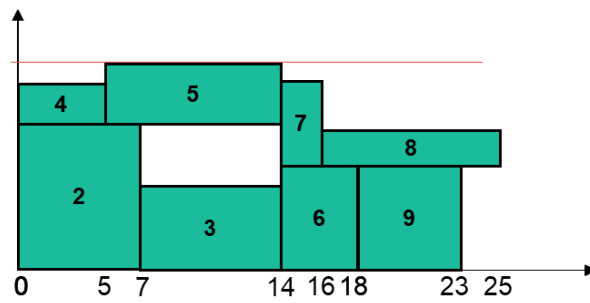
Iteration 7: $PS_7 = \{1, 2, 3, 4, 5, 6, 7\}$, $ED_1 = \{8, 9, 10\}$



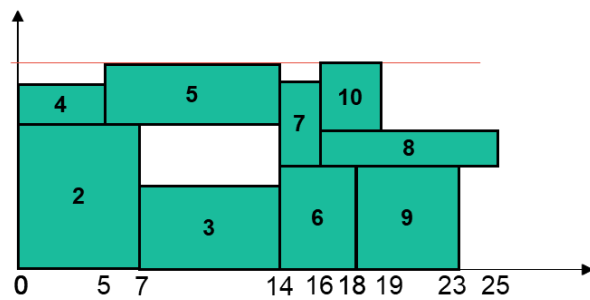
Iteration 8: $PS_8 = \{1, 2, 3, 4, 5, 6, 7, 8\}$, $ED_1 = \{9, 10, 11\}$



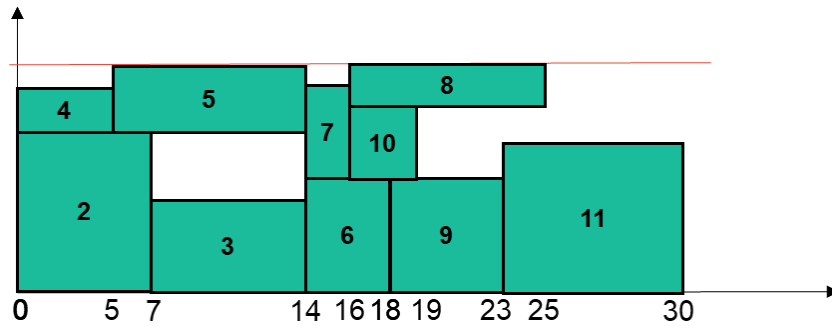
Iteration 9: $PS_9 = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $ED_1 = \{10, 11\}$



Iteration 10: $PS_{10} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $ED_1 = \{11\}$



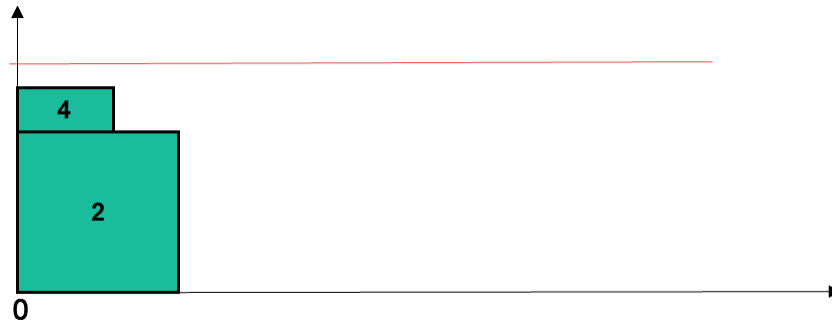
Iteration 11: $PS_{11} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11\}$, $ED_1 = \{12\}$



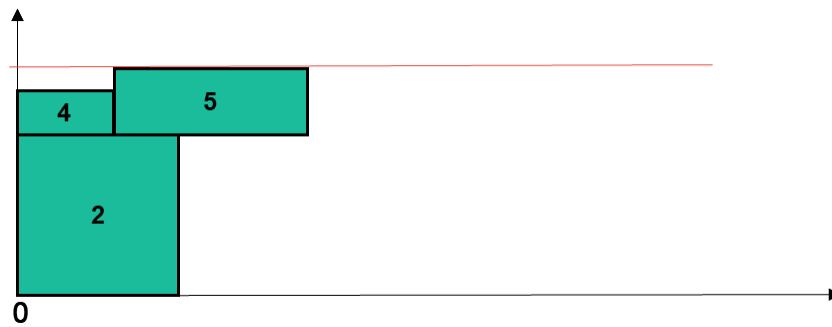
Iteration 12: $PS_{12} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$, $ED_1 = \{\}$

2. Forward planning with the parallel scheduling scheme;

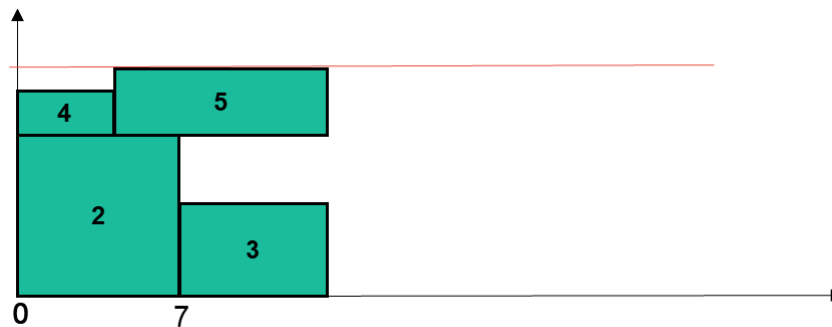
Iteration 1: $t_1 = 0$, $PS_{t_1} = \{1\}$, $AS_{t_1} = \{\}$, $ED_{t_1} = \{2, 3, 4, 5, 6, 7\}$



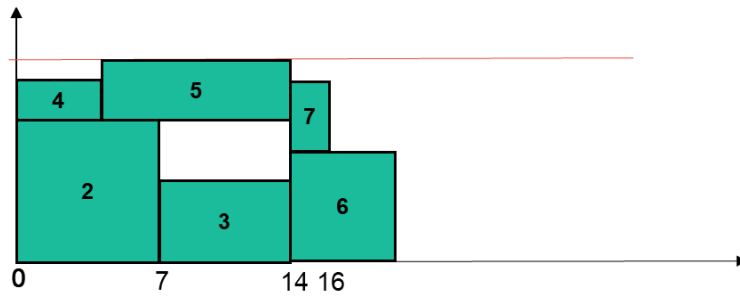
Iteration 2: $t_2 = 5$, $PS_{t_2} = \{1, 4\}$, $AS_{t_2} = \{2\}$, $ED_{t_2} = \{3, 5, 6, 7\}$



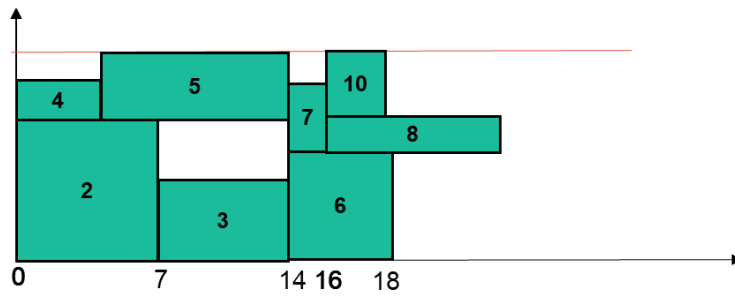
Iteration 3: $t_3 = 7$, $PS_{t_3} = \{1, 2, 4\}$, $AS_{t_3} = \{5\}$, $ED_{t_3} = \{3, 6, 7\}$



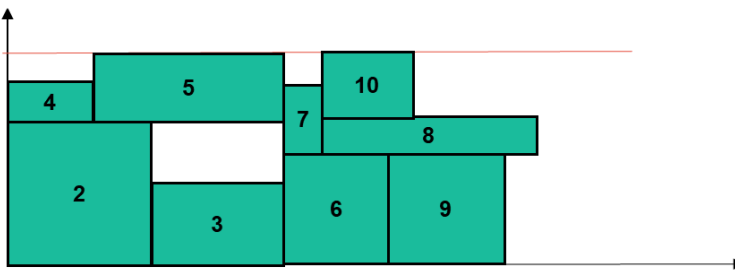
Iteration 4: $t_4 = 14, PS_{t_4} = \{1, 2, 3, 4, 5\}, AS_{t_4} = \{\}, ED_{t_4} = \{6, 7, 8, 9\}$



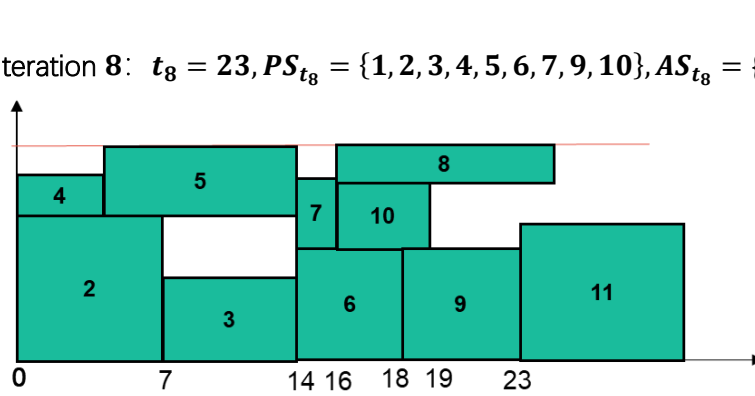
Iteration 5: $t_5 = 16, PS_{t_5} = \{1, 2, 3, 4, 5, 7\}, AS_5 = \{6\}, ED_{t_5} = \{8, 9, 10\}$



Iteration 6: $t_6 = 18, PS_{t_6} = \{1, 2, 3, 4, 5, 6, 7\}, AS_{t_6} = \{8, 10\}, ED_{t_6} = \{9\}$

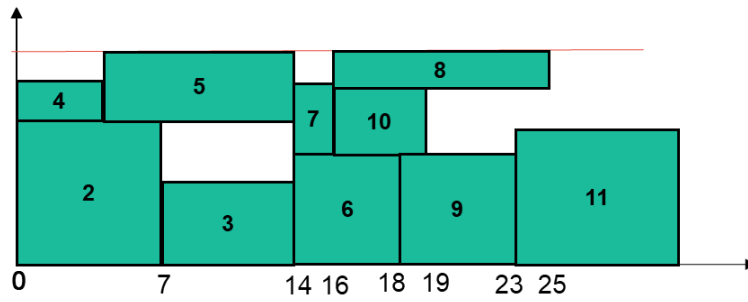


Iteration 7: $t_7 = 19, PS_{t_7} = \{1, 2, 3, 4, 5, 6, 7, 10\}, AS_{t_7} = \{8, 9\}, ED_{t_7} = \{11\}$

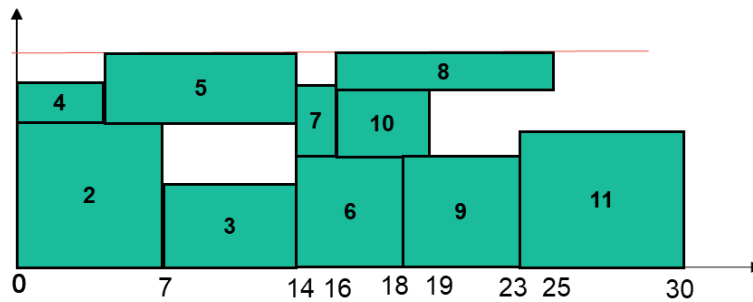


Iteration 8: $t_8 = 23, PS_{t_8} = \{1, 2, 3, 4, 5, 6, 7, 9, 10\}, AS_{t_8} = \{8\}, ED_{t_8} = \{11\}$

Iteration 9: $t_9 = 25, PS_{t_8} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}, AS_{t_8} = \{11\}, ED_{t_8} = \{12\}$



Iteration 10: $t_{10} = 25, PS_{t_8} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}, AS_{t_8} = \{11\}, ED_{t_8} = \{12\}$

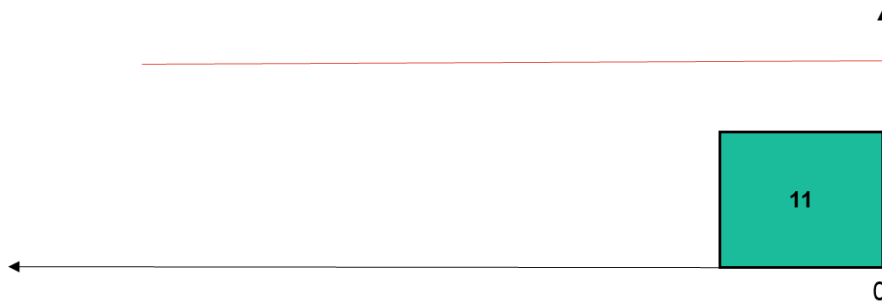


Iteration 11: $t_{11} = 30, PS_{t_{11}} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}, AS_{t_{11}} = \{\}, ED_{t_{11}} = \{\}$

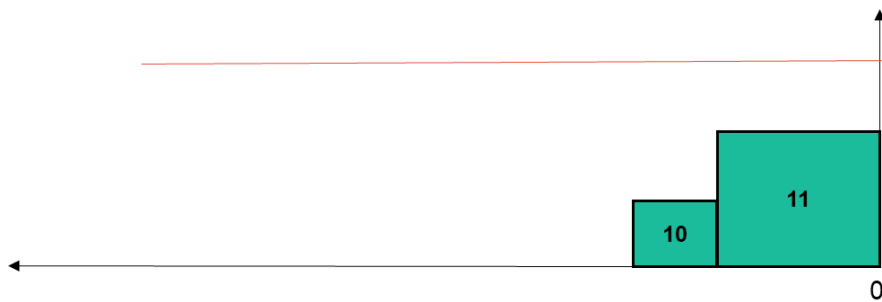
3. Backward planning with the serial scheduling scheme;

Iteration 1: $PS_1 = \{12\}, ED_1 = \{6, 8, 9, 11\}$

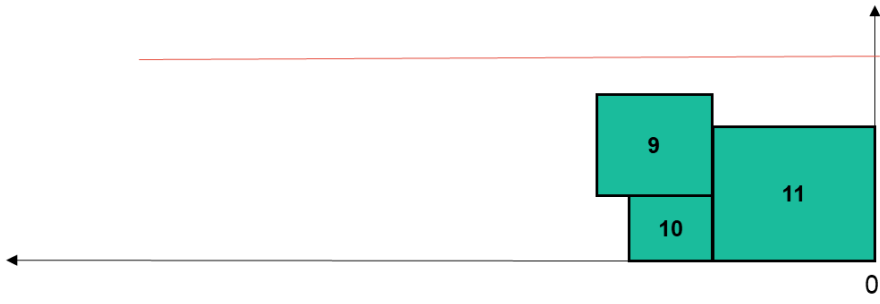
Iteration 2: $PS_2 = \{12, 11\}, ED_2 = \{6, 8, 9, 10\}$



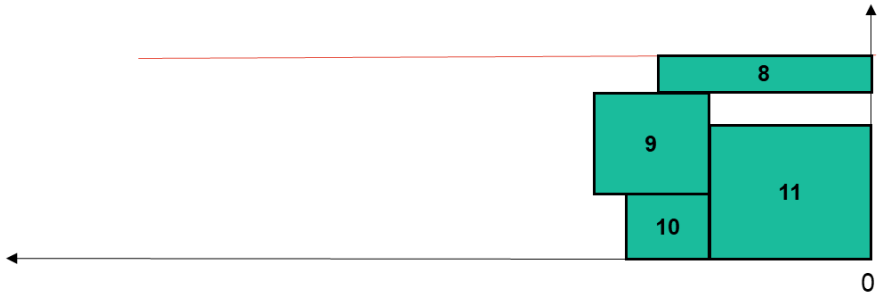
Iteration 3: $PS_3 = \{12, 11, 10\}, ED_3 = \{6, 7, 8, 9\}$



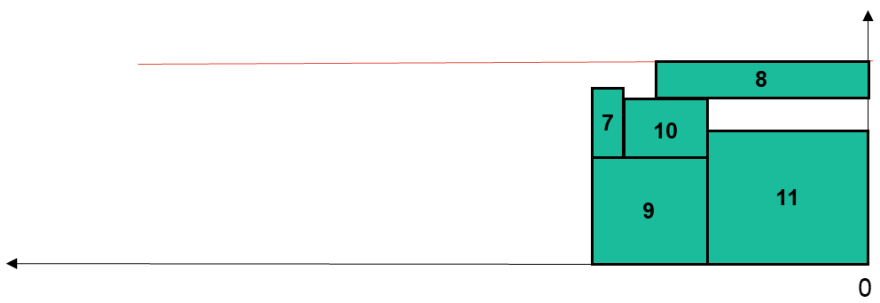
Iteration 4: $PS_4 = \{12, 11, 10, 9\}, ED_4 = \{4, 5, 6, 7, 8\}$



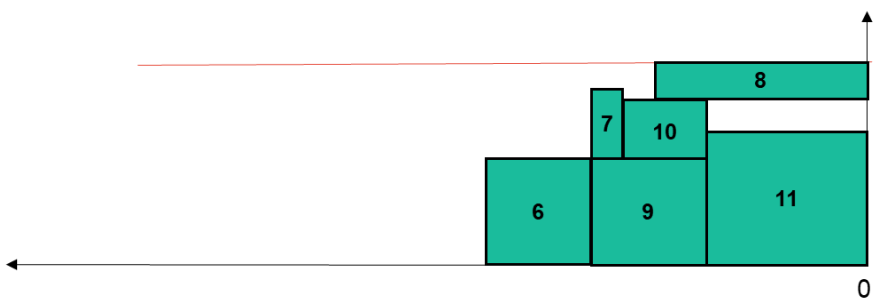
Iteration 5: $PS_5 = \{12, 11, 10, 9, 8\}$, $ED_5 = \{2, 3, 4, 5, 6, 7\}$



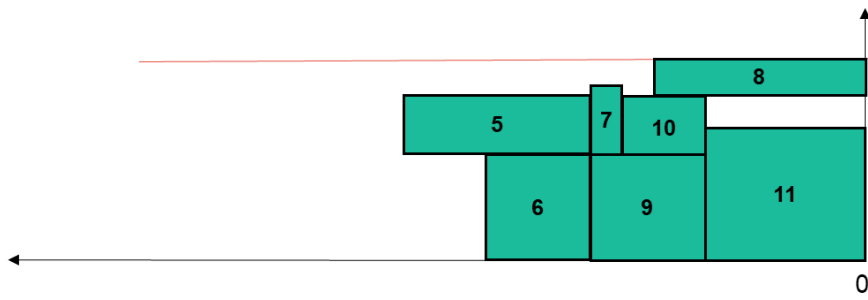
Iteration 6: $PS_6 = \{12, 11, 10, 9, 8, 7\}$, $ED_6 = \{2, 3, 4, 5, 6\}$



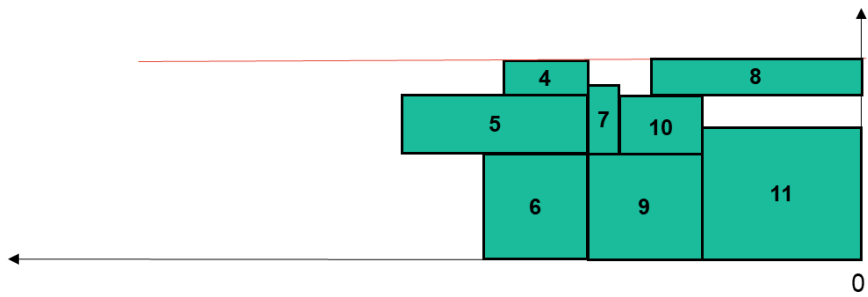
Iteration 7: $PS_7 = \{12, 11, 10, 9, 8, 7, 6\}$, $ED_7 = \{2, 3, 4, 5\}$



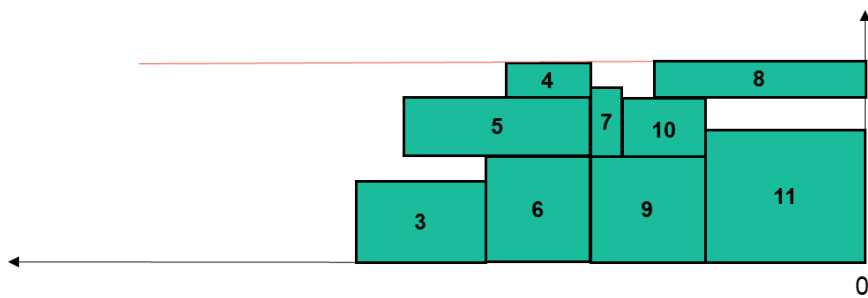
Iteration 8: $PS_8 = \{12, 11, 10, 9, 8, 7, 6, 5\}$, $ED_8 = \{2, 3, 4\}$



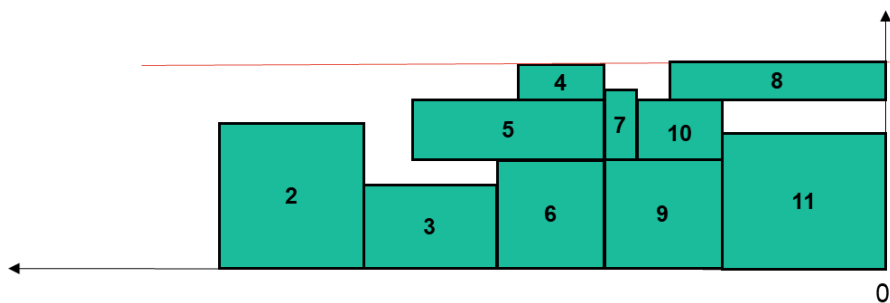
Iteration 9: $PS_9 = \{12, 11, 10, 9, 8, 7, 6, 5, 4\}$, $ED_9 = \{2, 3\}$



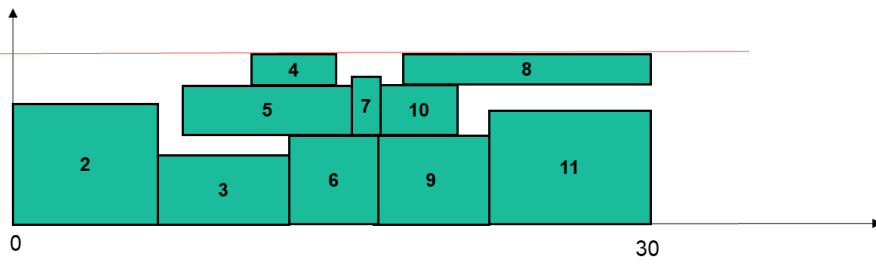
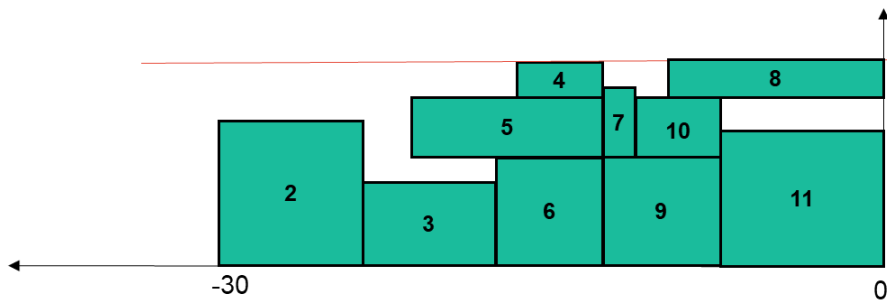
Iteration 10: $PS_{10} = \{12, 11, 10, 9, 8, 7, 6, 5, 4, 3\}$, $ED_{10} = \{2\}$



Iteration 11: $PS_{11} = \{12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2\}$, $ED_{11} = \{1\}$

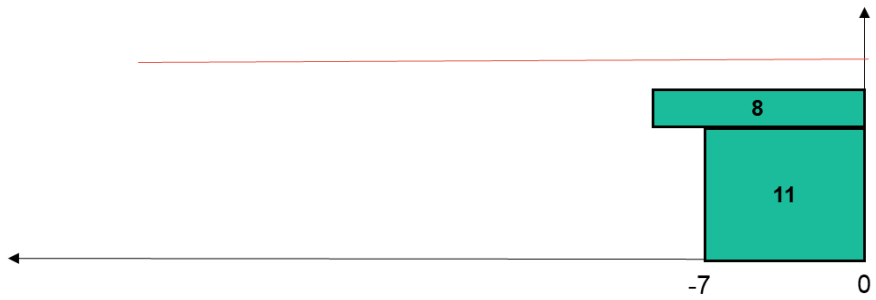


Iteration 12: $PS_{12} = \{12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1\}$, $ED_{12} = \{\}$



4. Backward planning with the parallel scheduling scheme;

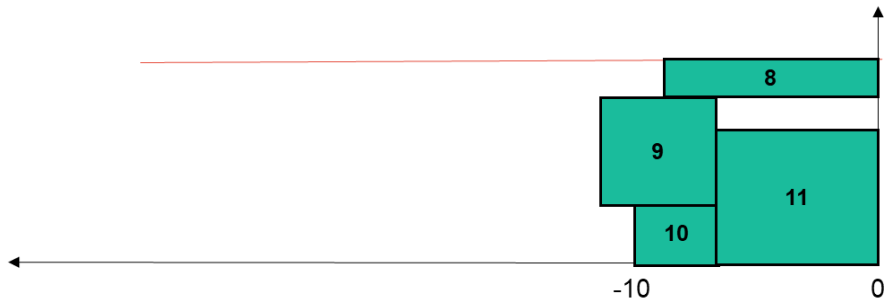
Iteration 1: $t_1 = 0$, $PS_{t_1} = \{12\}$, $AS_{t_1} = \{\}$, $ED_{t_1} = \{6, 8, 9, 11\}$



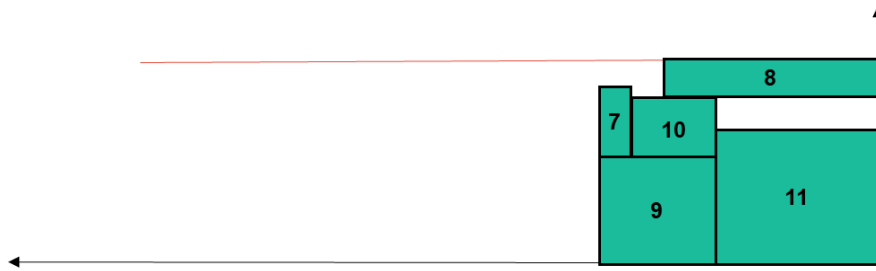
Iteration 2: $t_2 = -7$, $PS_{t_2} = \{12, 11\}$, $AS_{t_2} = \{8\}$, $ED_{t_2} = \{6, 9, 10\}$



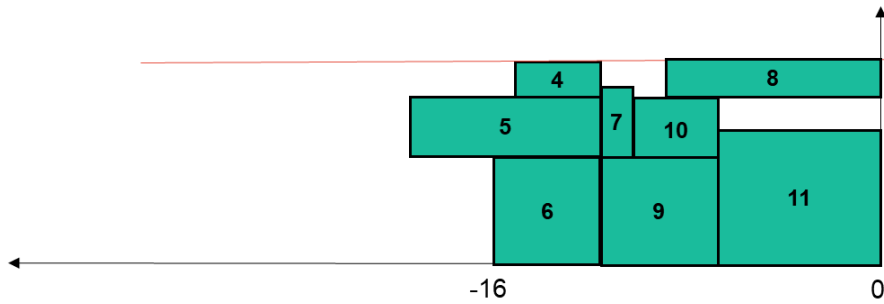
Iteration 3: $t_3 = -9, PS_{t_3} = \{12, 11, 8\}, AS_{t_3} = \{9, 10\}, ED_{t_3} = \{2, 3, 6\}$



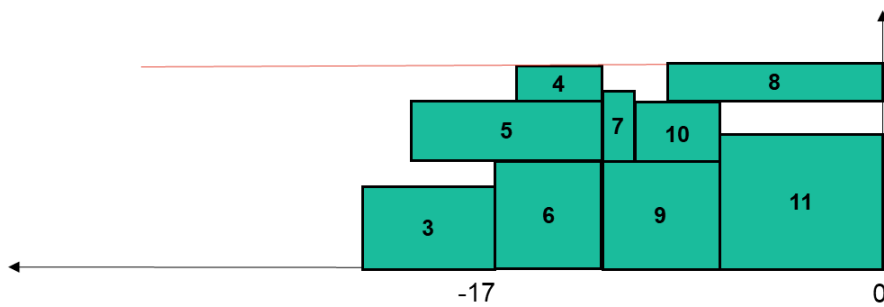
Iteration 4: $t_4 = -10, PS_{t_4} = \{12, 11, 8, 10\}, AS_{t_4} = \{9\}, ED_{t_4} = \{2, 3, 6, 7\}$



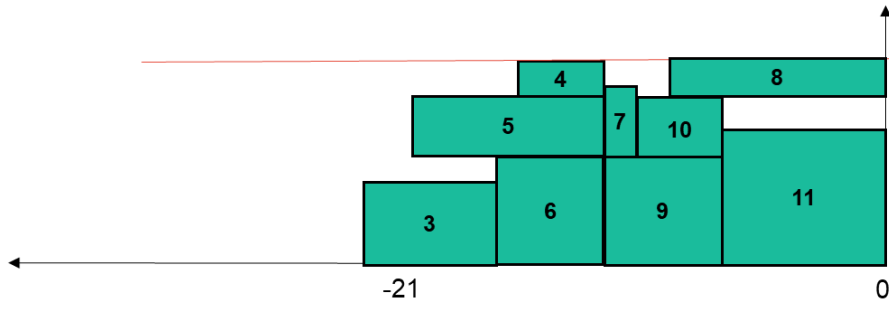
Iteration 5: $t_5 = -12, PS_{t_5} = \{12, 11, 8, 10, 9, 7\}, AS_{t_5} = \{\}, ED_{t_5} = \{2, 3, 4, 5, 6\}$



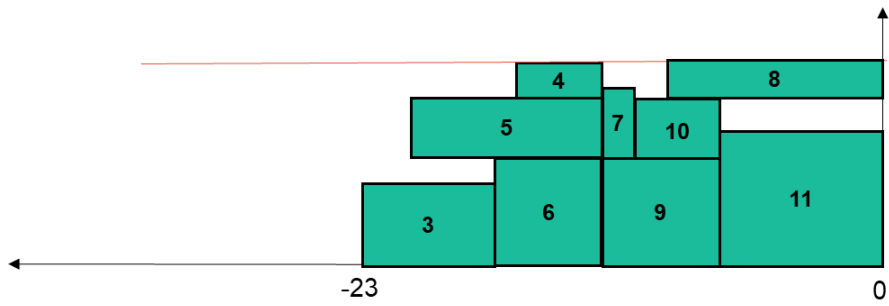
Iteration 6: $t_6 = -16, PS_{t_6} = \{12, 11, 8, 10, 9, 7, 6\}, AS_{t_6} = \{4, 5\}, ED_{t_6} = \{2, 3\}$



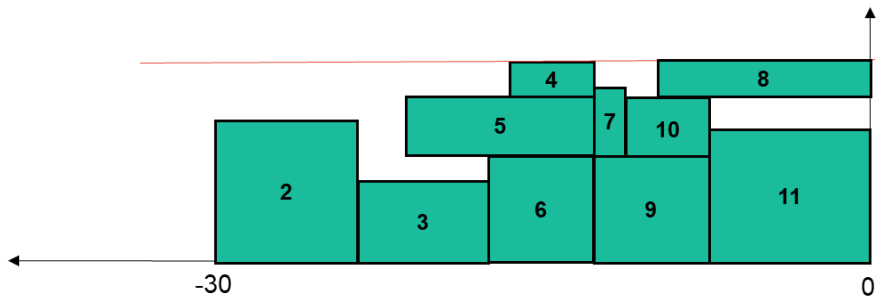
Iteration 7: $t_7 = -16, PS_{t_7} = \{12, 11, 8, 10, 9, 7, 6, 4\}, AS_{t_7} = \{5, 3\}, ED_{t_7} = \{2\}$



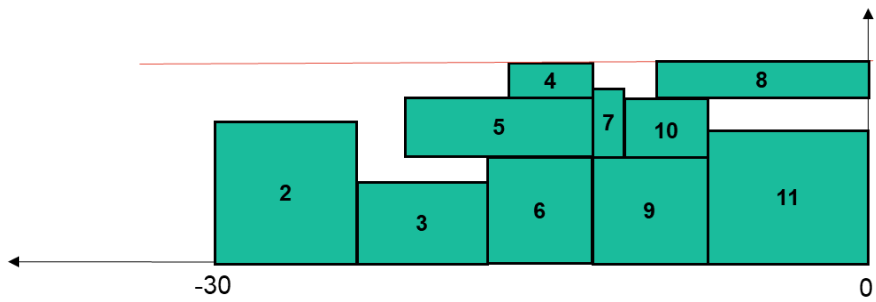
Iteration 8: $t_8 = -21$, $PS_{t_8} = \{12, 11, 8, 10, 9, 7, 6, 4, 5\}$, $AS_{t_8} = \{3\}$, $ED_{t_8} = \{2\}$



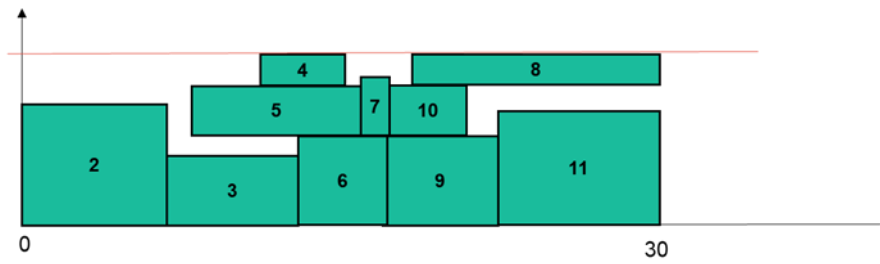
Iteration 9: $t_9 = -23$, $PS_{t_9} = \{12, 11, 8, 10, 9, 7, 6, 4, 5, 3\}$, $AS_{t_9} = \{\}$, $ED_{t_9} = \{2\}$



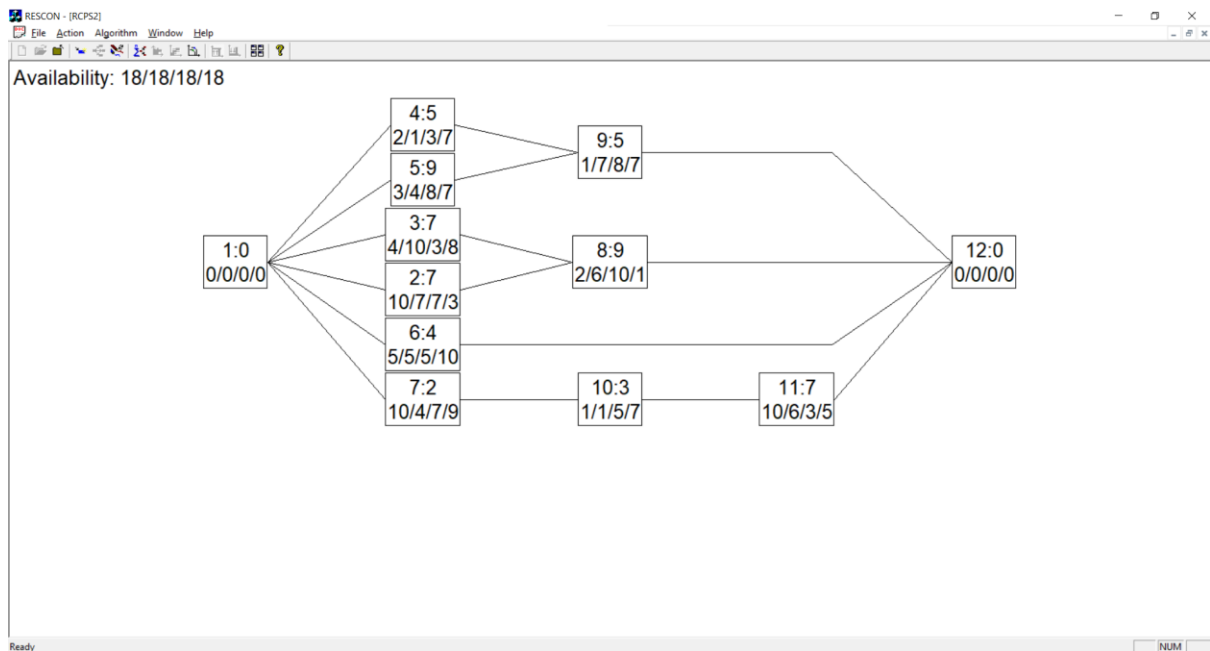
Iteration 10: $t_{10} = -30$, $PS_{t_{10}} = \{12, 11, 8, 10, 9, 7, 6, 4, 5, 3, 2\}$, $AS_{t_{10}} = \{\}$, $ED_{t_{10}} = \{1\}$



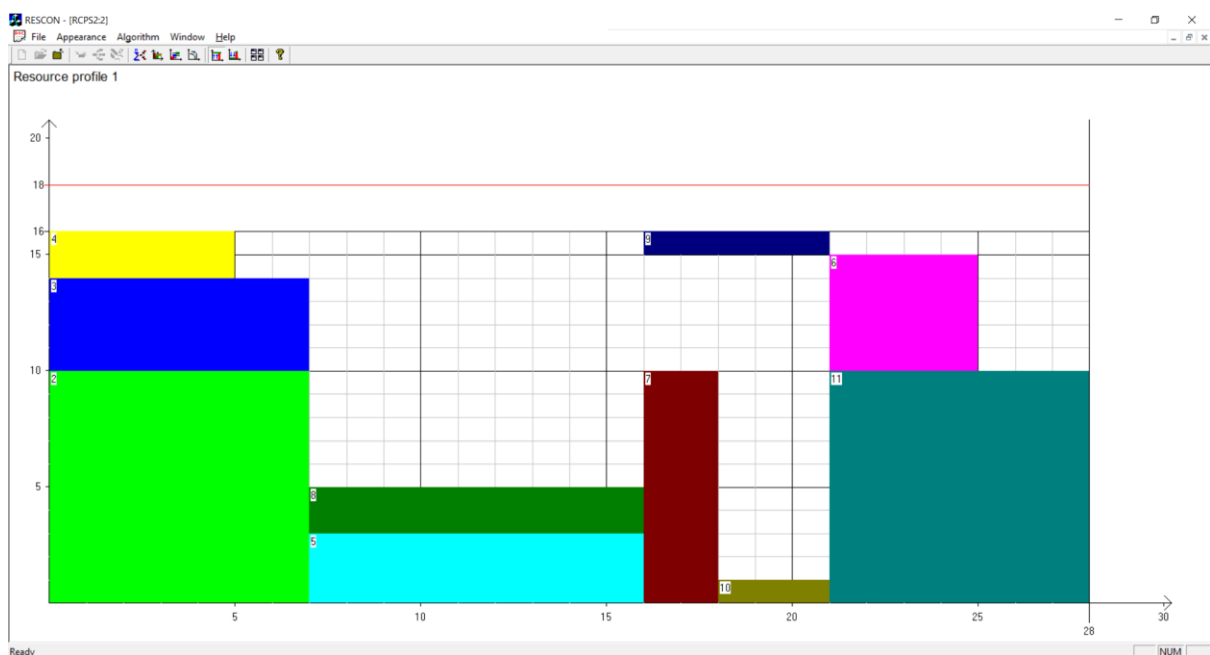
Iteration 11: $t_{11} = -30, PS_{t_{11}} = \{12, 11, 8, 10, 9, 7, 6, 4, 5, 3, 2, 1\}, AS_{t_{11}} = \{\}, ED_{t_{11}} = \{\}$

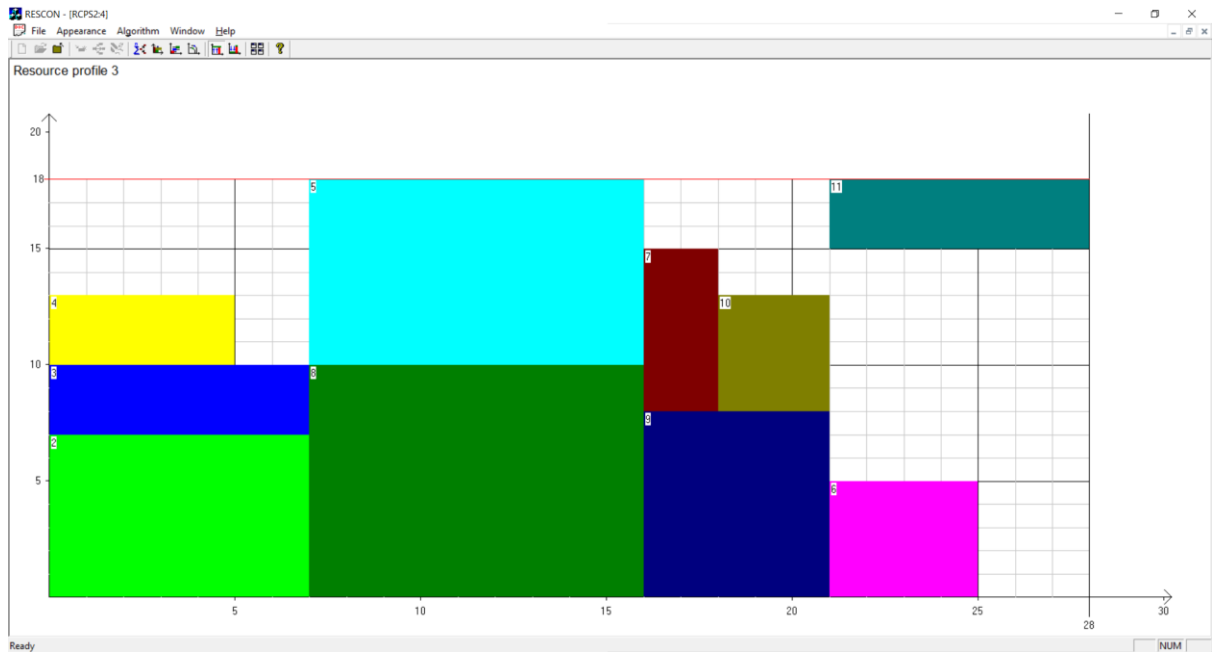
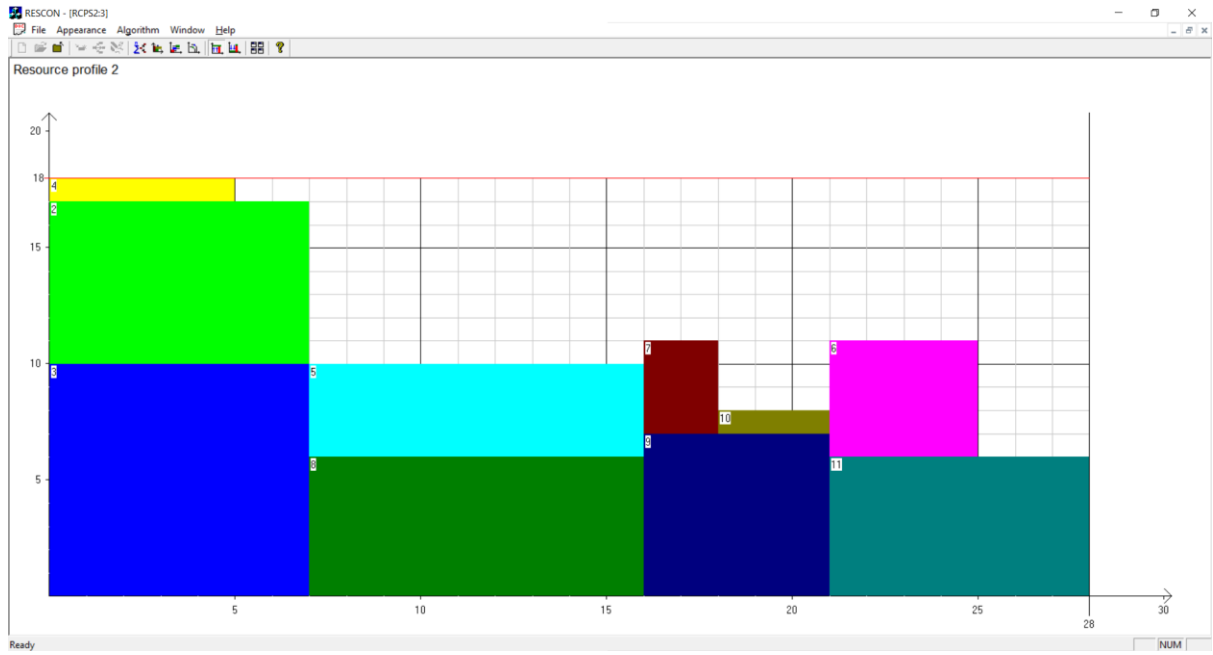


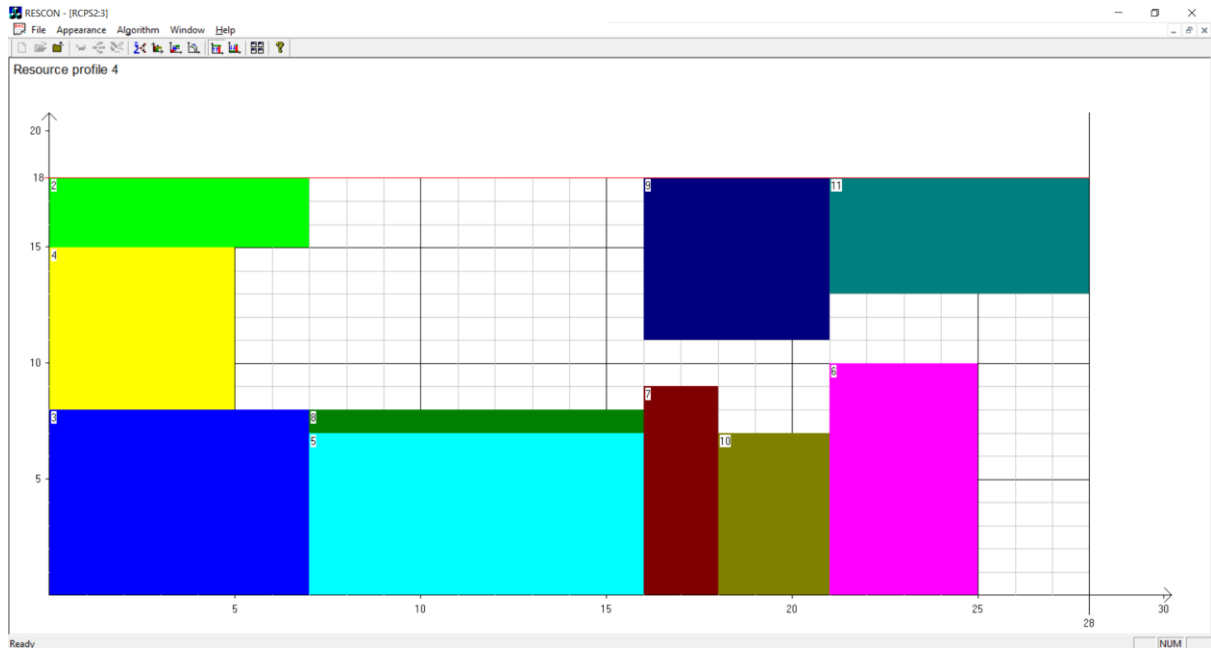
Exercise #2 – Solution Using RESCON.



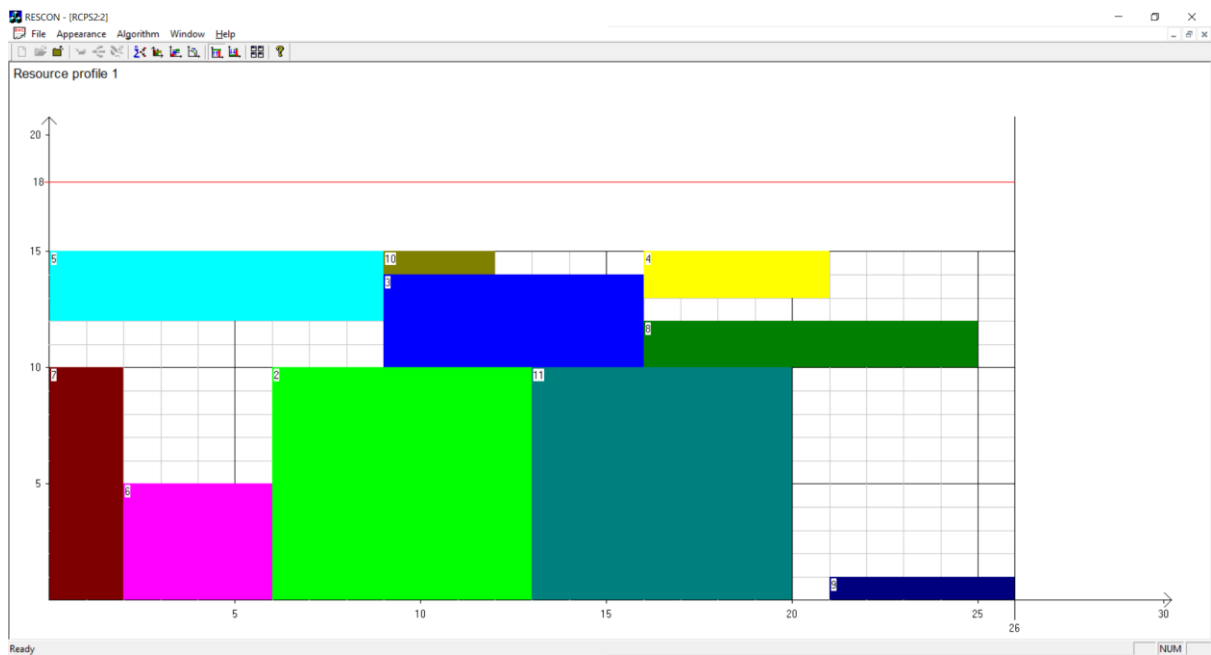
A- Serial Schedule Generation Scheme+ Forward Planning+ Min Activity Slack

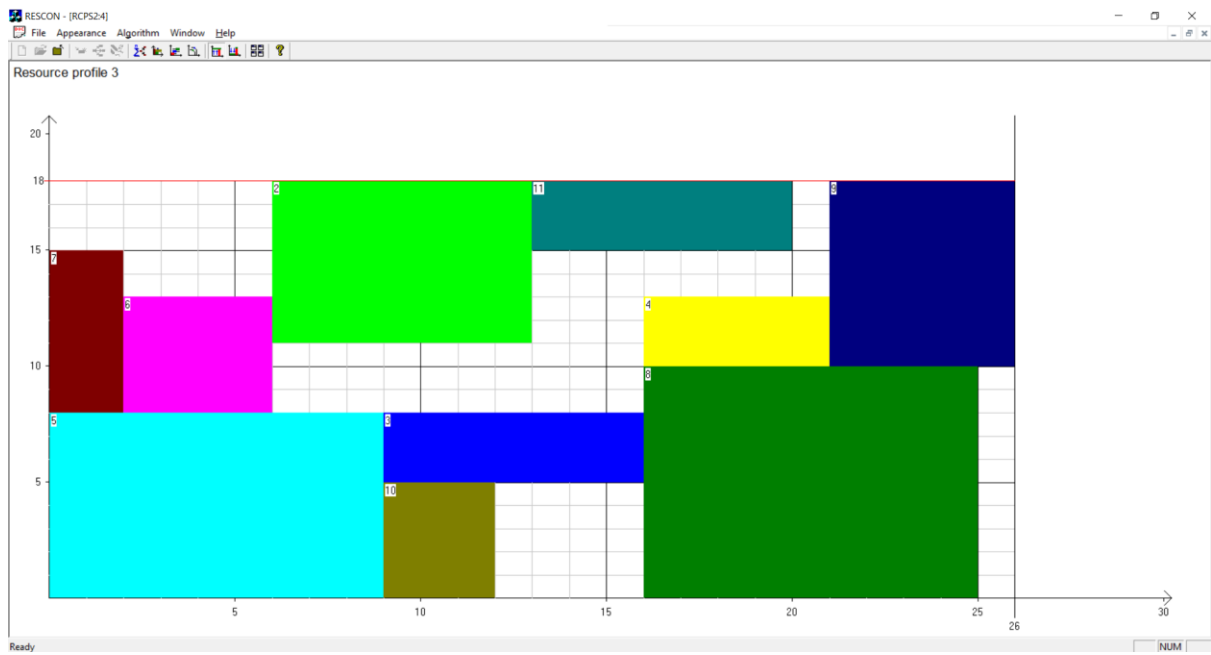
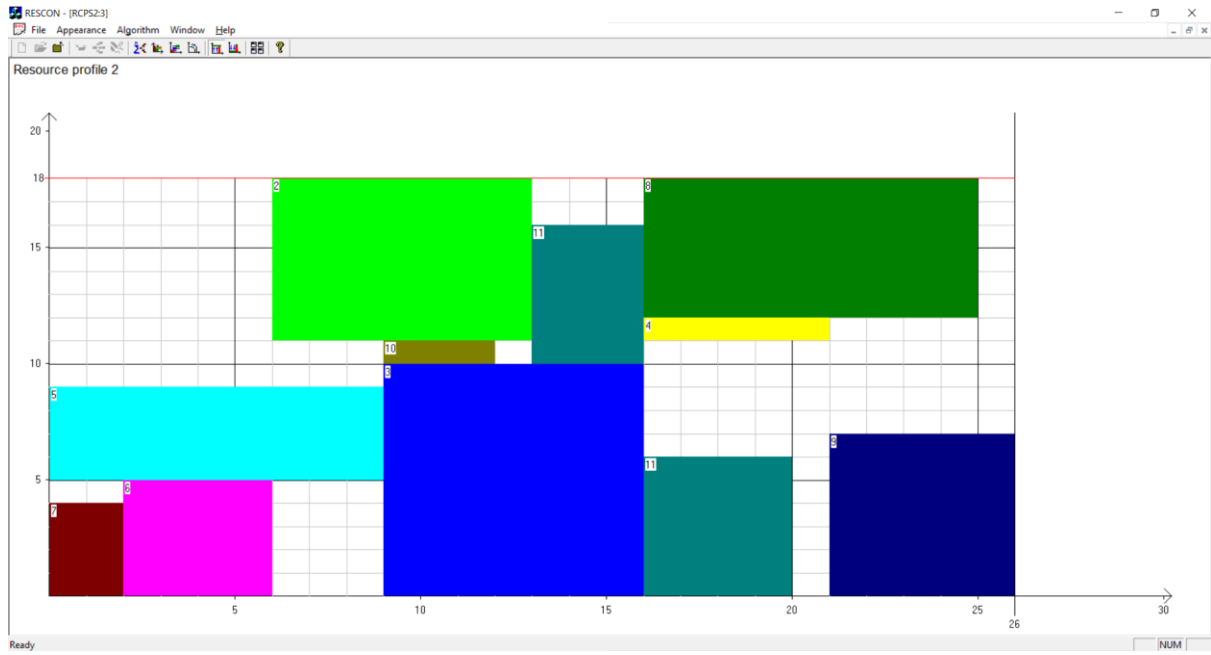


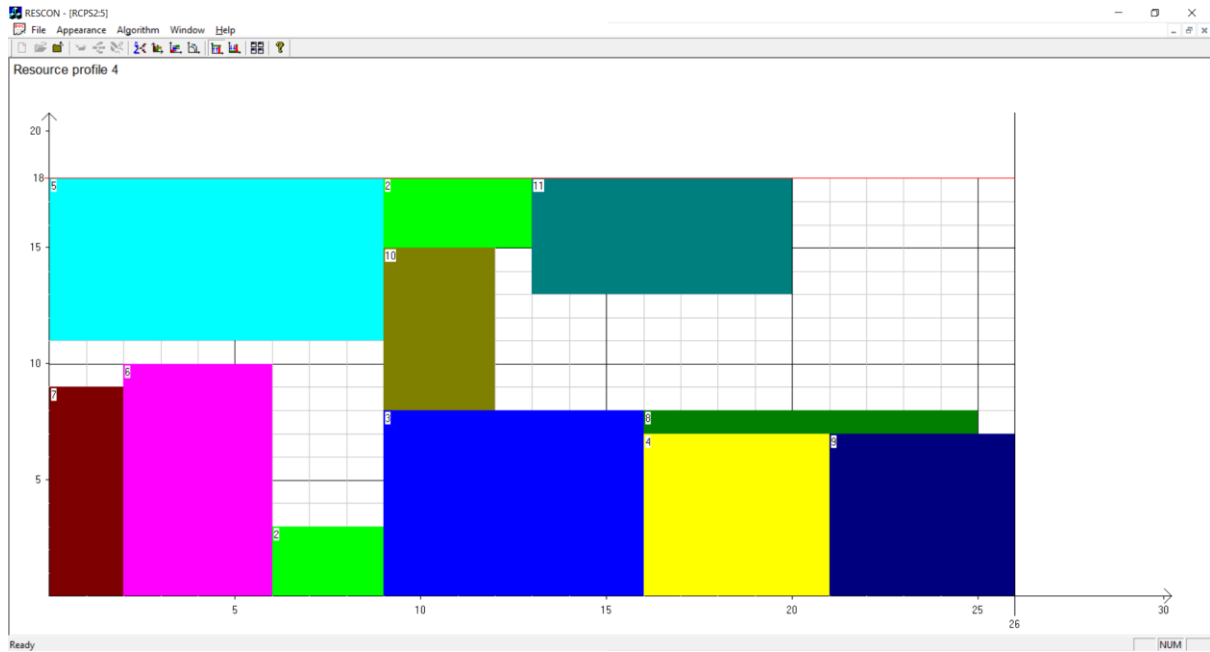




B- Parallel Schedule Generation Scheme+ Backward Planning+ Late Finishing Time

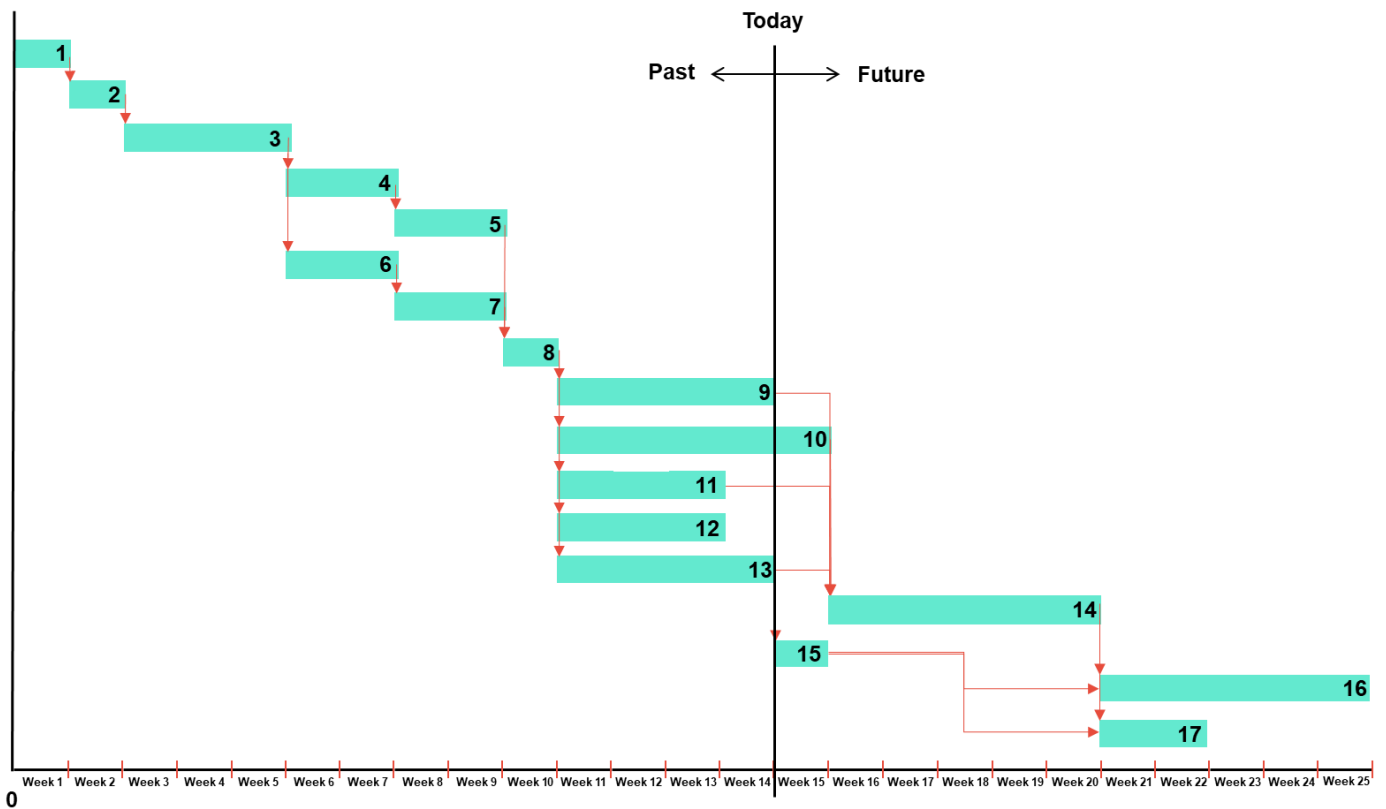






Exercise #3 – Patient Transport System Project

- Using the early start time (CPM) as the baseline schedule, and assuming that the actual time now is 14 weeks.
- Baseline Chart



✓ The Key Parameters:

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
PV	5,000	7,500	8,200	8,900	9,600	12,600	15,600	25,600	35,600	42,100	52,200	62,300	72,400	79,500
AC	5,000	7,500	10,000	10,700	11,400	13,600	14,300	20,800	32,300	48,800	59,400	60,000	69,600	79,700
EV	5,000	6,250	7,500	8,025	8,550	12,075	12,600	16,600	23,933	36,267	42,580	43,060	58,265	73,970

✓ Performance Measurement:

1. The schedule variance and schedule performance index –

$$SV = EV - PV = 73,970 - 79,500 = -5,530 < 0$$

$$SPI = EV/PV = \frac{73,970}{79,500} = 0.93 < 1 \text{ (Project Delay)}$$

2. The cost variance and cost performance index –

$$CV = EV - AC = 73,970 - 79,700 = -5,730 < 0$$

$$CPI = EV/AC = \frac{73,970}{79,700} = 0.93 < 1 \text{ (Budget Overrun)}$$

✓ Analysis:

1. **Time Performance:** The project progress is slower than expected, EV between (Week 1 and Week 14) seems to be lower than PV between in most weeks to date. Therefor there's a **Project delay**.
2. **Cost Performance:** The Actual Cost is higher than the Estimated Value so the budget seems to be exceeded at all times to date (Week 14). Therefor there's **Budget/Cost Overrun**.