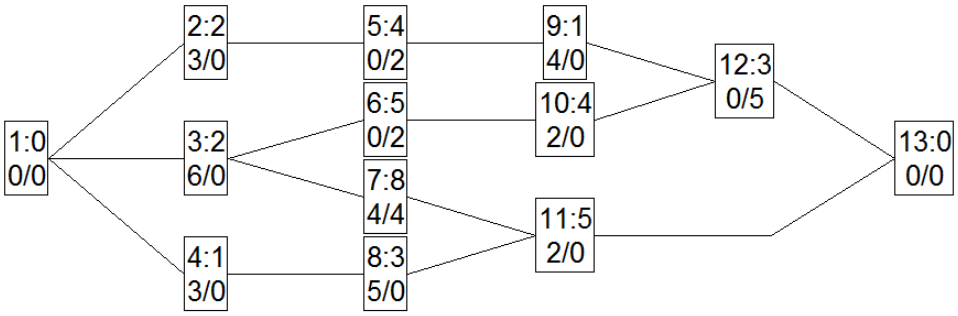
Homework 2

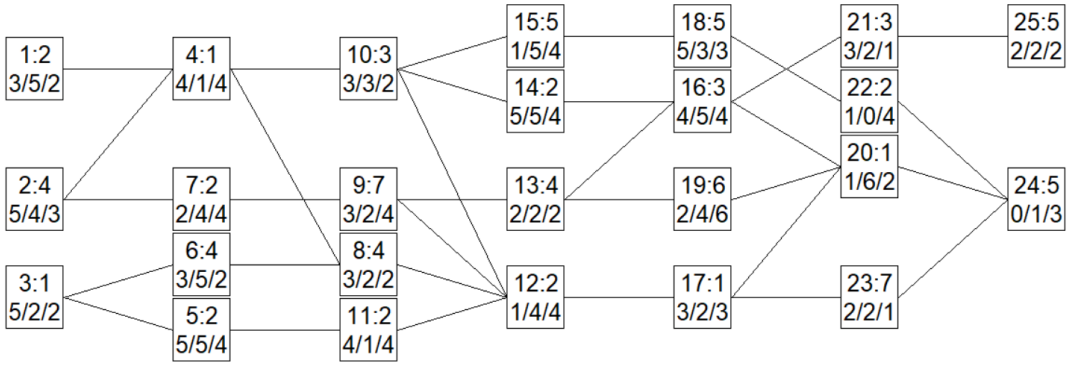
1. Consider the following project network in activity-on-the-node representation:



Apply the Burgess and Killebrew heuristic in order to find the most leveled resource usage given a deadline on the project of 15. Do not stop after completing one planning cycle!

2. Using the RESCON software, find the cheapest resource assignment for problem "Pat100.rcp" (to be found on Toledo) given a project deadline of 42 when the unit costs for the different resource availabilities are $c_1 = 4$, $c_2 = 3$ and $c_3 = 2$. Below you can find the representation of the network as well as some tables that represent the optimal makespan given the corresponding resource availabilities for the three resource types (the rows represent the availability of resource type 2, while the columns represent the availability of resource type 3). For your information: you can use a resource availability of 12 if you want to consider an infinite resource availability for a certain resource type.

Availability: 10/10/10



$a_1 = 5$	6	7	8	9	10	11	12
6	67	63	61	61	61	61	61
7	63	57	57	57	57	57	57
8	62	57	56	56	55	55	55
9	62	57	55	54	54	54	54
10	61	56	54	54	54	54	54
11	61	56	54	54	54	54	54
12	61	56	54	54	54	54	54

$a_1 = 6$	6	7	8	9	10	11	12
6	62	57	56	56	56	56	56
7	55	50	49	49	49	49	49
8	54	50	48	48	48	48	48
9	52	49	46	46	46	46	46
10	52	49	46	46	45	45	45
11	52	49	46	46	45	45	45
12	52	49	46	46	45	45	45

$a_1 = 7$	6	7	8	9	10	11	12
6	55	52	52	52	52	52	52
7	50	47	46	45	45	45	45
8	50	46	44	44	44	44	44
9	50	46	43	41	41	41	41
10	50	46	42	41	40	40	40
11	50	46	42	41	40	40	40
12	50	46	42	41	40	40	40

$a_1 = 8$	6	7	8	9	10	11	12
6	55	52	52	52	52	52	52
7	49	46	44	44	44	44	44
8	49	46	43	42	41	41	41
9	49	44	39	38	37	37	37
10	49	43	39	38	37	37	37
11	49	43	39	38	37	35	34
12	49	43	39	38	37	35	34

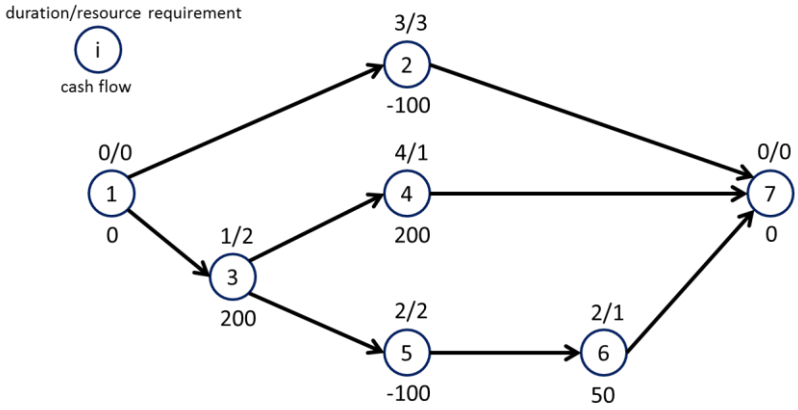
$a_1 = 9$	6	7	8	9	10	11	12
6	55	52	52	52	52	52	52
7	49	46	44	43	43	43	43
8	49	45	42	41	41	41	41
9	49	44	38	37	35	35	35
10	49	43	38	37	34	34	34
11	49	43	38	37	34	34	33
12	49	43	38	37	34	33	32

$a_1 = 10$	6	7	8	9	10	11	12
6	55	52	52	52	52	52	52
7	49	46	44	43	43	43	43
8	49	44	42	41	41	40	40
9	49	41	37	37	34	34	34
10	49	41	37	36	33	33	32
11	49	41	37	36	32	32	31
12	49	41	37	36	32	31	31

$a_1 = 11$	6	7	8	9	10	11	12
6	55	52	52	52	52	52	52
7	49	46	44	43	43	43	43
8	49	44	42	41	41	40	40
9	49	41	37	37	34	34	34
10	49	41	37	36	33	33	32
11	49	41	37	36	32	32	31
12	49	41	37	36	32	31	30

$a_1 = 12$	6	7	8	9	10	11	12
6	55	52	52	52	52	52	52
7	49	46	44	43	43	43	43
8	49	44	42	41	41	40	40
9	49	41	37	37	34	34	34
10	49	41	37	35	33	33	32
11	49	41	37	35	32	31	30
12	49	41	37	35	32	31	30

3. Consider the following project network in activity-on-the-node representation:



The planned activity duration and the per period requirement for a single renewable resource are shown above each node. The net incremental cash flow generated at the completion of the corresponding activity is shown below each node. The project deadline equals 8 periods. The renewable resource has an availability of 4 units per period. The discount rate $\alpha = 0.01$.

- **a)** Apply an exact procedure for generating a schedule that yields an upper bound on the net present value of the project. Explain your computational steps in complete detail (only consider two significant digits).
- **b)** Draw the resource profile for the obtained schedule. Identify any resource conflict.
- **c)** Assume that you want to apply a branch-and-bound procedure for maximizing the project's net present value. Which activities belong to the delaying set? Determine the delaying alternatives that will allow you to identify the nodes of the branch-and-bound search tree to be chosen for branching and draw the corresponding partial search tree.

4. Consider the following data for a project in activity-on-the-arc format:

Activity	Immediate predecessors	Normal duration (periods)	Crash duration (periods)	Incremental crashing cost per period (euro/period)
A	-	2	1	2
B	-	4	1	6
C	A	3	1	1
D	A	4	2	2
E	B,C	2	1	6

a) Draw the corresponding *activity-on-the-arc network*. Assuming that the project activities are at their normal duration, identify the critical path and the corresponding resulting project duration.

b) Apply the *labeling algorithm* of Fulkerson and Kelley to reduce the project duration to a makespan of 5 time periods (you may stop the procedure as soon as the project duration has been reduced to a total of 5 periods). *Clearly indicate which activities are crashed*. Explain all your computational steps in sufficient detail.