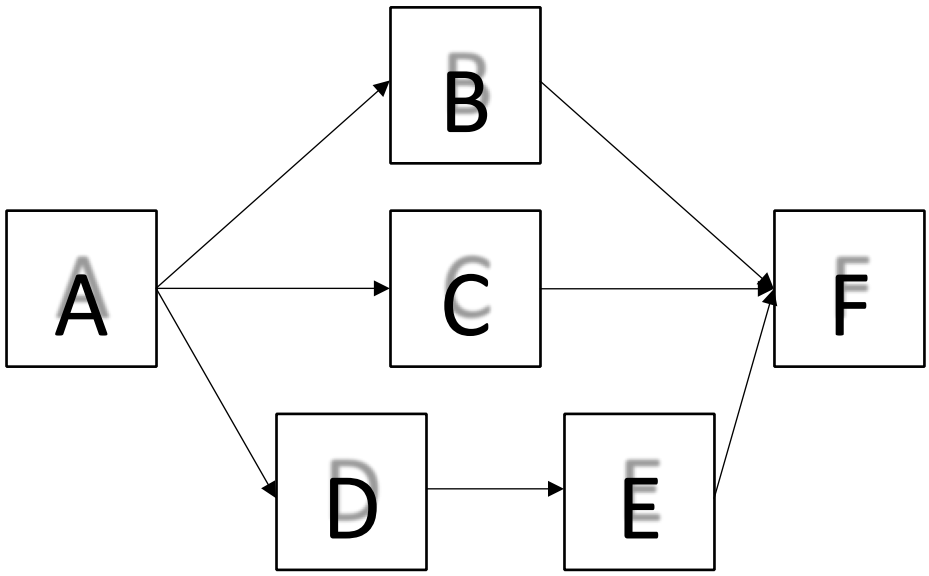
Process Engineering 623.252 - Winter Term 2022

Assignment 2
Petri nets, Workflow nets
(10 points)

Solve the following exercises, and upload your solutions to Moodle FOLLOWING THE GUIDELINES FOR SUBMISSION specified at the end of the assignment sheet.

Exercise 1 – Modeling Petri nets [2 points]

Project X is your secret project to take over the world, which consists of six tasks: let's call them A, B, C, D, E, F for secrecy. The first task to execute is A, after which you need to execute in parallel (in no particular order) B, C, and the sequence D, E. After the parallel execution, the last task to execute is F. The following image is an abstract representation of the order of execution described above:



Tasks:

1) Model a Petri net that describes Project X. *(0,5 points)*
2) Now task E must be executed immediately after D, i.e. it is not allowed to execute B and C between D and E (e.g., ABDECF is a valid trace, while ABDCEF is not valid). Show the new Petri net. *(1,5 points)*

Exercise 2 – Analyzing Petri nets [3 points]

Given the following Petri net N = (P, T, I, O, M_0):

- Places: P = {p_1, p_2, p_3, p_4, p_5}
- Transitions: T = {t_1, t_2, t_3, t_4}
- Input Relations: I = {(p_1, t_1), (p_2, t_2), (p_3, t_2), (p_3, t_4), (p_4, t_3), (p_5, t_2)}
- Output Relations: O = {(t_1, p_2), (t_1, p_3), (t_1, p_5), (t_2, p_5), (t_3, p_2), (t_3, p_3), (t_4, p_4)}
- Initial Marking: M_0 = (1, 2, 0, 0, 0)

Tasks:

1) Give a graphical notation of the Petri net. *(0,5 points)*
2) Construct a reachability graph for the Petri net. *(0,5 points)*
3) Discuss boundedness, safeness, conservativeness and liveness of the Petri net. *(0,5 points)*
4) Which transitions are dead? *(0,5 points)*
5) Can deadlocks occur in the Petri net? Where/when? *(0,5 points)*
6) Is the Petri net a workflow net? Justify your answer. *(0,5 points)*

Task 3 – Modeling Workflow nets [5 points]

Peter is a researcher in biology. When he has a new experiment to work on, he first asks his colleague for the samples he needs, and starts gathering all the necessary equipment. When he has received the samples and has finished gathering the equipment, he can start the experiment. The experiment consists of three phases:

- In phase 1, he has to insert all the experimental setup information into the lab information system. Since the lab does not have much funds, there is only one computer available, which is shared with his colleague Julia. If Julia is using the computer, Peter has to wait until she finishes using it; as soon as the computer is available, Peter can use it. When phase 1 is completed, he can start with phase 2.
- In phase 2, the actual experiment with samples and equipment is performed. If the experiment is successful, Peter can move on to phase 3; otherwise, he has to start again with a new iteration of phase 2 until the experiment is successful.
- In phase 3, Peter has to insert the experimental results into the lab information system, again with the problem of the shared computer like for phase 1. At the same time, he calls on the phone the head of the lab to communicate his findings.

After completing phase 3, Peter puts back the used equipment. Finally, he writes a detailed report, and submits it to a journal for publication.

Task: Model the workflow described above with a workflow net which captures all actions. Make sure you correctly model the potential interference of Peter's colleagues for using the computer! *(4 points)*
Software: use WoPeD for modeling the Petri nets. With WoPeD you can also "play the token game" to

simulate the execution of your modeled Petri nets. You can download it for free at the following link: https://woped.dhbw-karlsruhe.de/.

Upload: please upload your solution to Moodle as a compressed archive (e.g., .zip file) including:

1. The .pnml files generated with WoPeD.
2. A .pdf file including the Petri nets for the 3 exercises (you can export them as .png images from WoPeD), and the answers to the questions of Exercise 2.

Provide a single upload per group, but do not forget to include the names of all group members in the .pdf file you are submitting!