

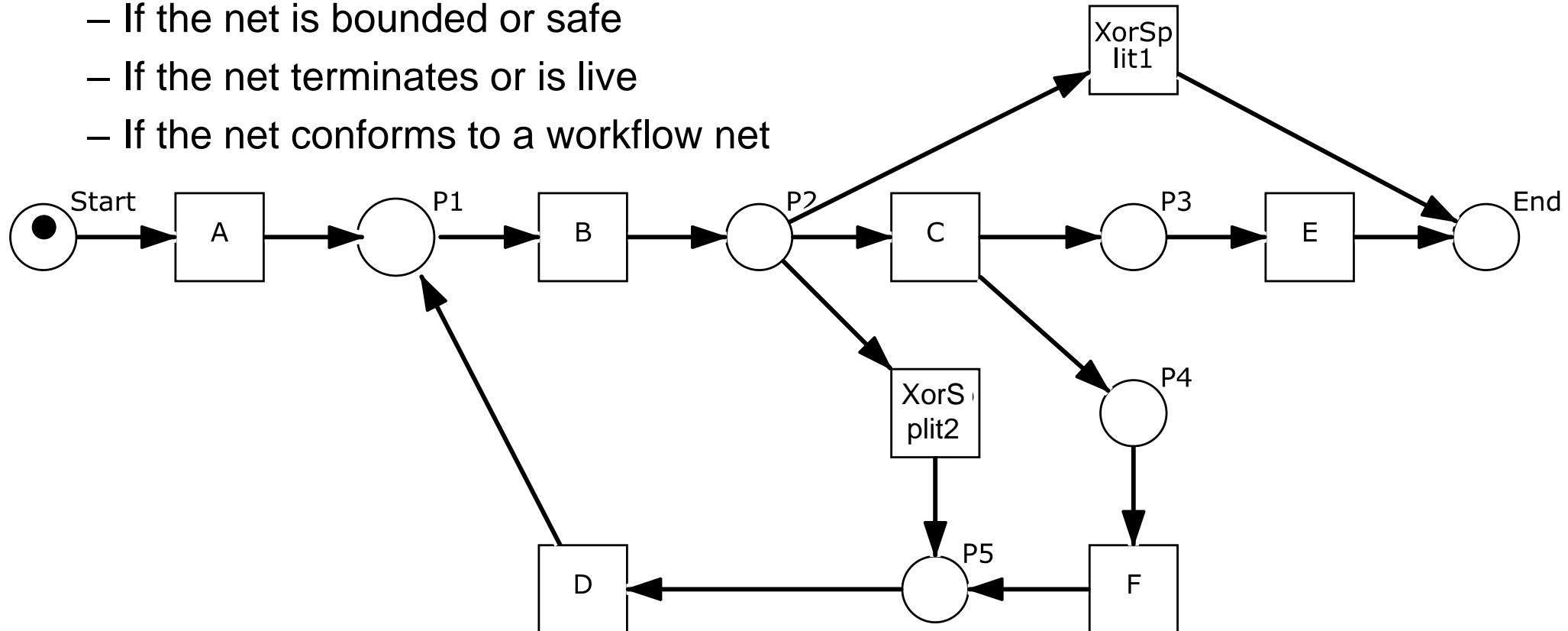
02291 System Integration

Behavioral Models with Petri Nets: Solutions to exercises

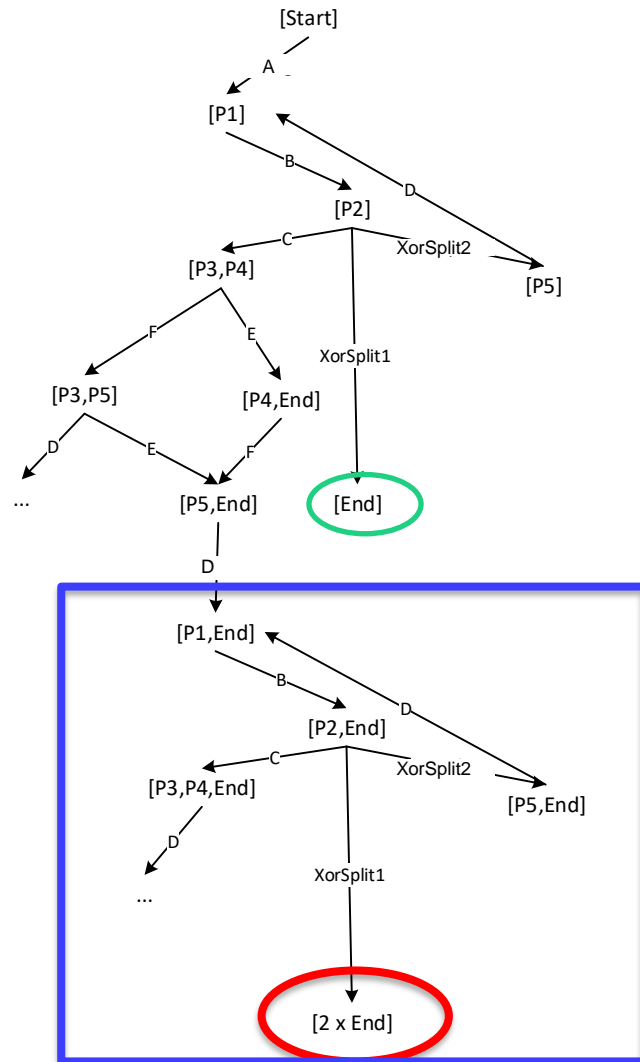
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Exercise 1

- Given the following Petri Net, compute:
 - P, T, F sets
 - The reachability graph
 - If the net is bounded or safe
 - If the net terminates or is live
 - If the net conforms to a workflow net



Exercise 1 – Reachability graph



- $P = \{\text{Start}, P1, P2, P3, P4, P5, \text{End}\}$
- $T = \{A, B, C, D, E, F, \text{XorSplit1}, \text{XorSplit2}\}$
- $F = \{(\text{Start}, A), (A, P1), (P1, B), (B, P2), (P2, \text{XorSplit1}), (P2, C), (P2, \text{XorSplit2}), (\text{XorSplit1}, \text{End}), (C, P3), (C, P4), (P3, E), (E, \text{End}), (P4, F), (F, P5), (P5, D), (D, P1), (\text{XorSplit2}, P5)\}$

Infinite reachability graph (tokens always grow)

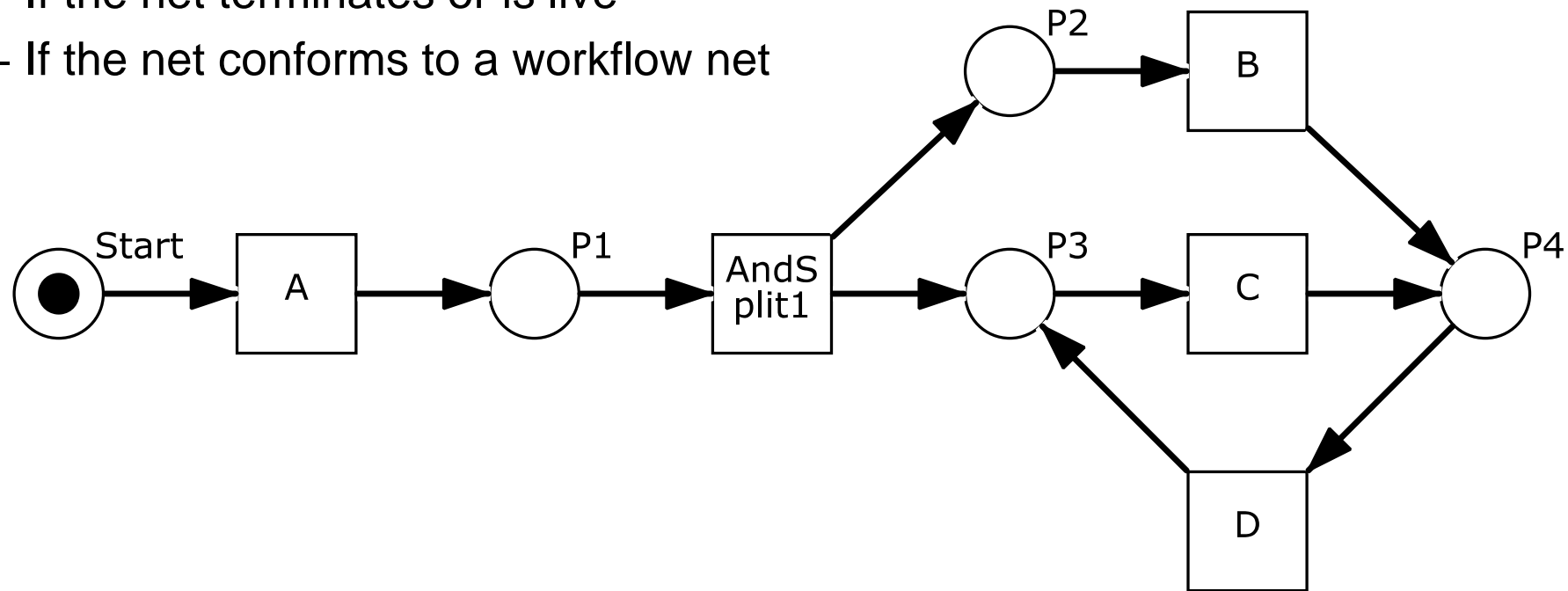
Not safe (not 1-bounded)

Not live (there are final markings)

Net conforms to a workflow net: only one input (Start) and one output (End) place, every node is in a path from Start to End

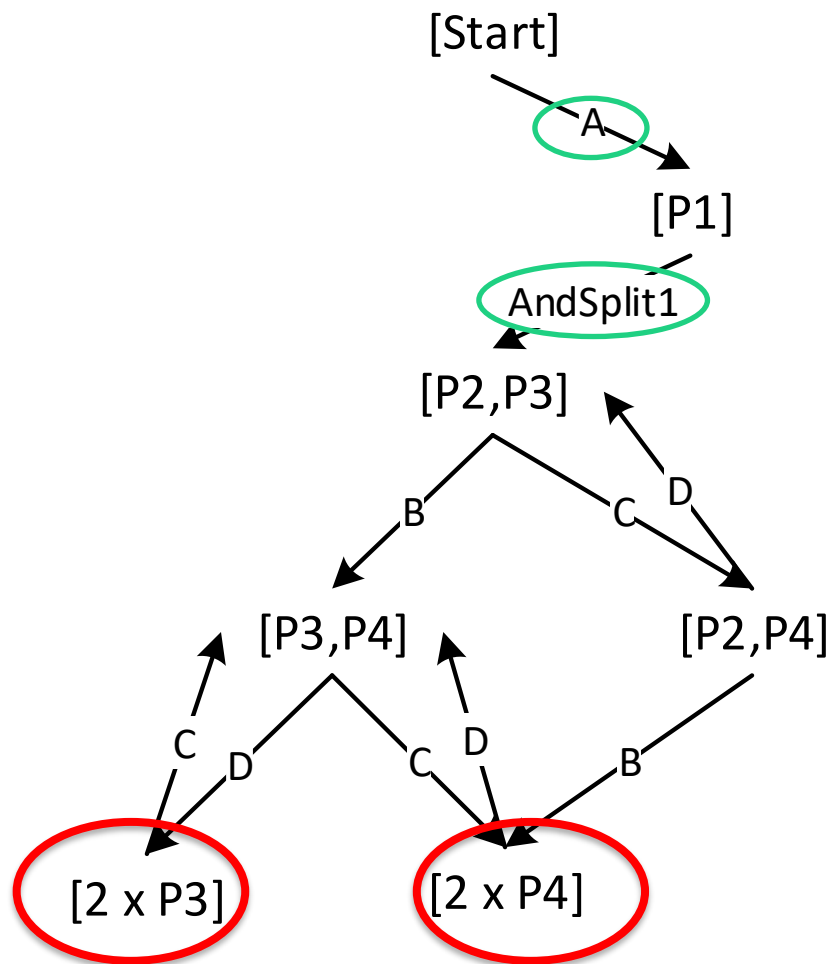
Exercise 2

- Given the following Petri Net, compute:
 - P, T, F sets
 - The reachability graph
 - If the net is bounded or safe
 - If the net terminates or is live
 - If the net conforms to a workflow net



Exercise 2 – Reachability graph

- $P = \{\text{Start}, P1, P2, P3, P4\}$
- $T = \{A, \text{AndSplit1}, B, C, D\}$
- $F = \{(\text{Start}, A), (A, P1), (P1, \text{AndSplit1}), (\text{AndSplit1}, P2), (\text{AndSplit1}, P3), (P2, B), (B, P4), (P3, C), (C, P4), (P4, D), (D, P3)\}$



Not safe (2-bounded), cannot become sound

Not live (we cannot fire A or AndSplit1 more than once)

No final place, hence not terminating (and not conforming to a workflow net)!

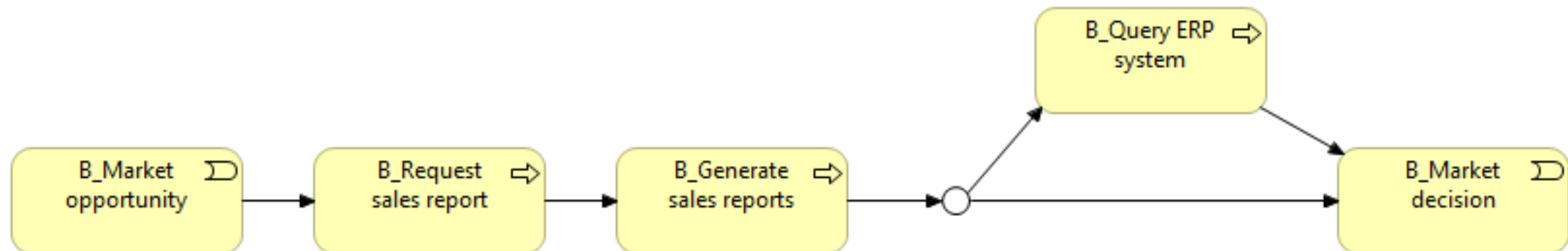
Exercise 3

Speedy is a delivery company that wants to create a new reporting system for the top management. After inspecting the sales reports, the top management may also need to query the existing ERP system, based on Oracle Fusion, to get detailed sales and HR information.

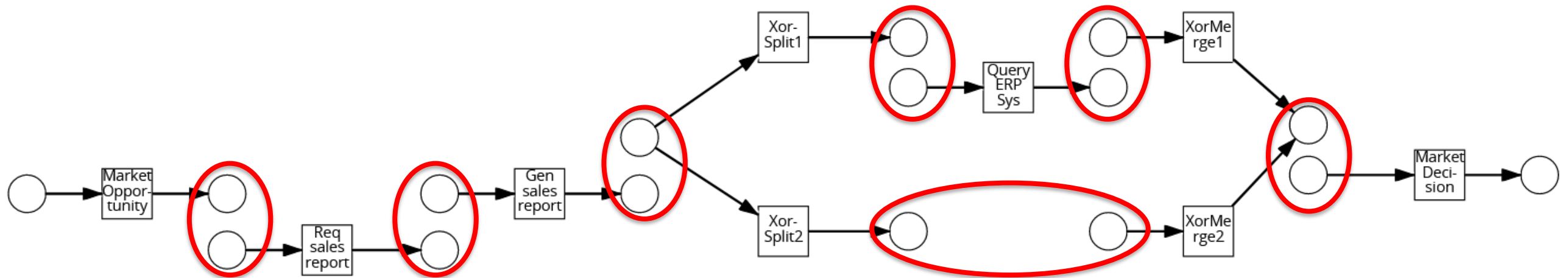
An ArchiMate model representing the process is enclosed below.

Starting from this model, create an equivalent Petri Net and try to answer the following questions:

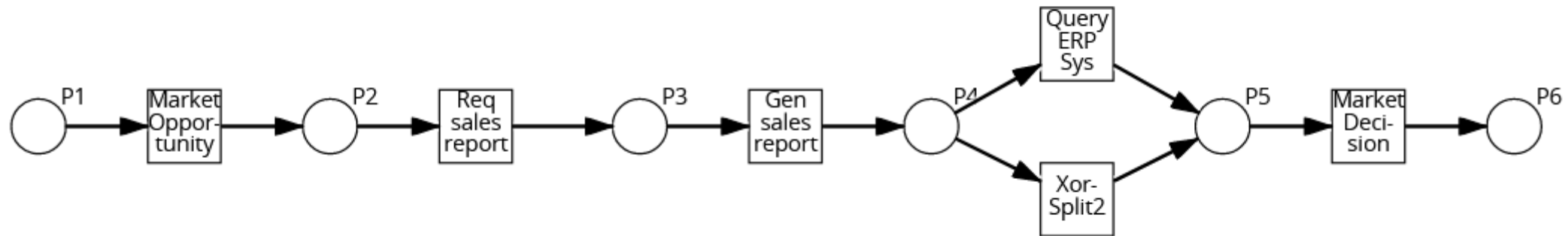
- What is the reachability graph of the net?
- Is the net sound?



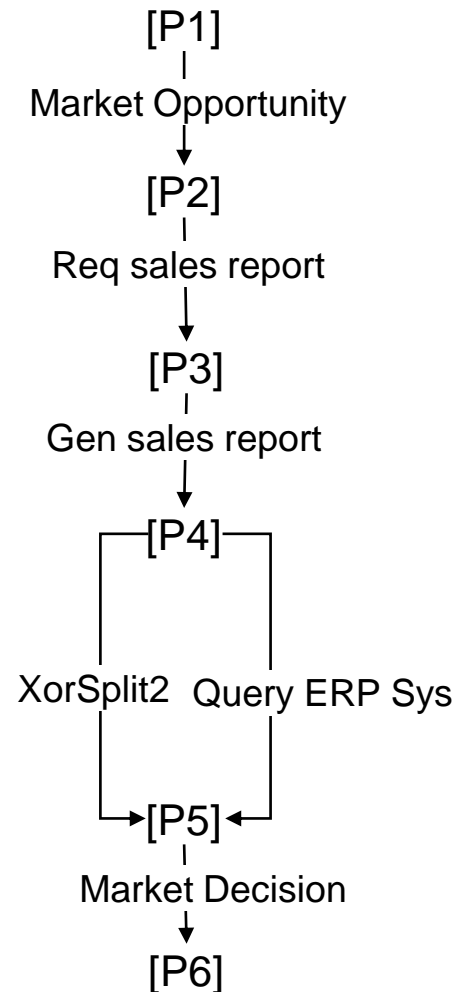
Exercise 3 – Petri Net



Exercise 3 – Optimized Petri Net



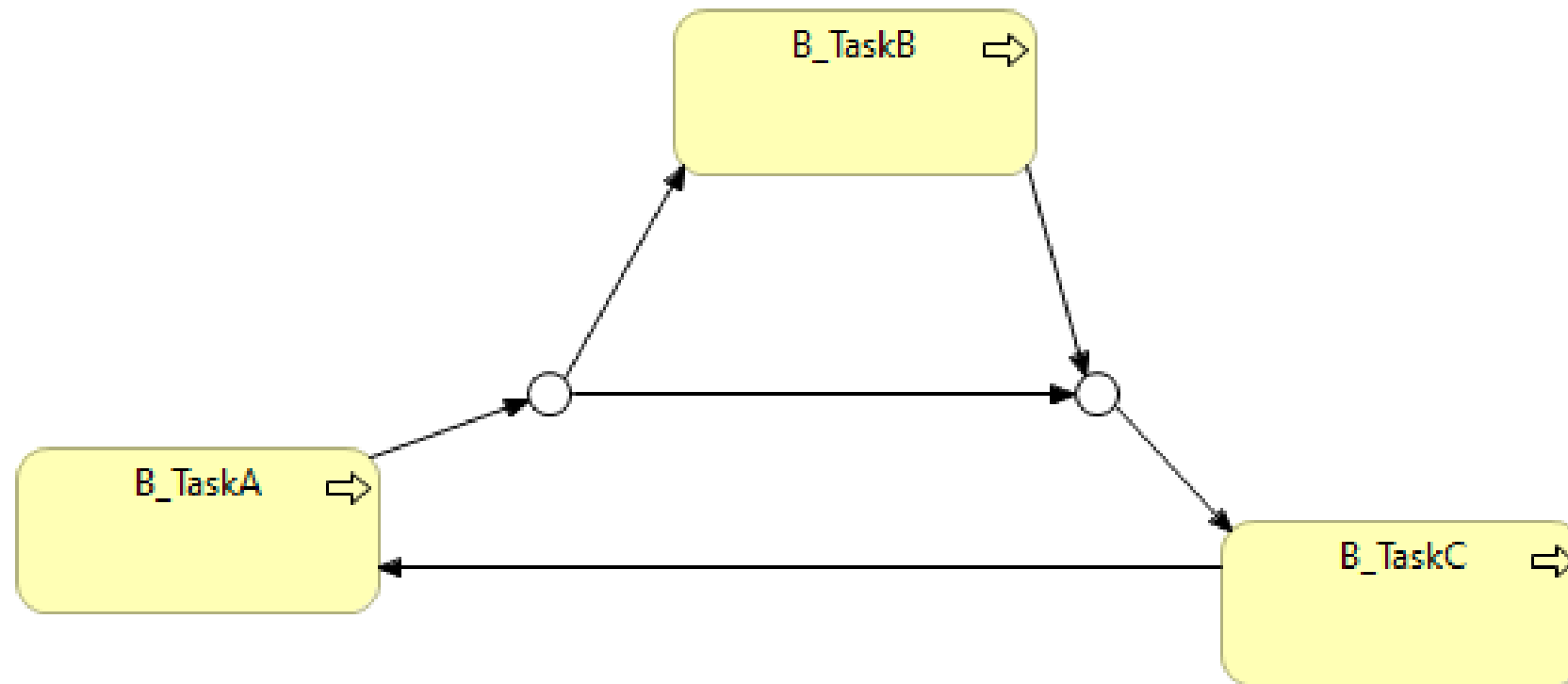
Exercise 3 – Reachability graph



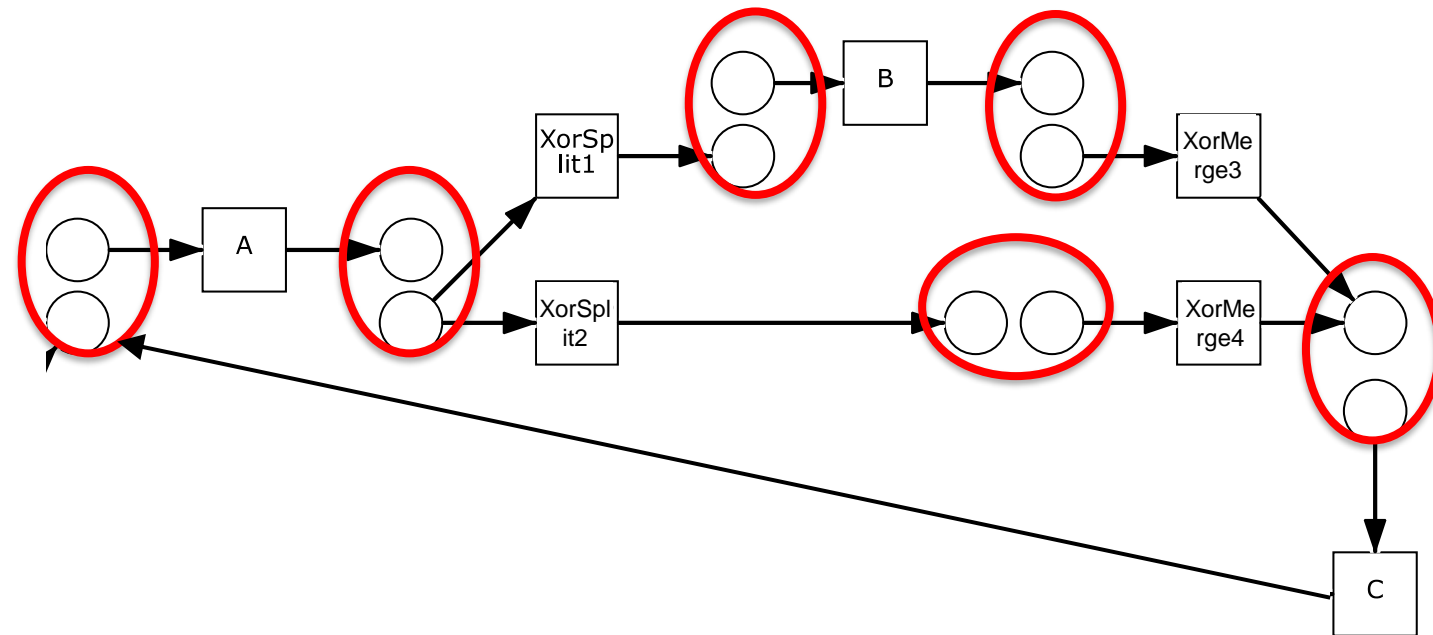
Net conforms to a workflow net: only one input (P1) and one output (P6) place, every node is in a path from P1 to P6

Exercise 4

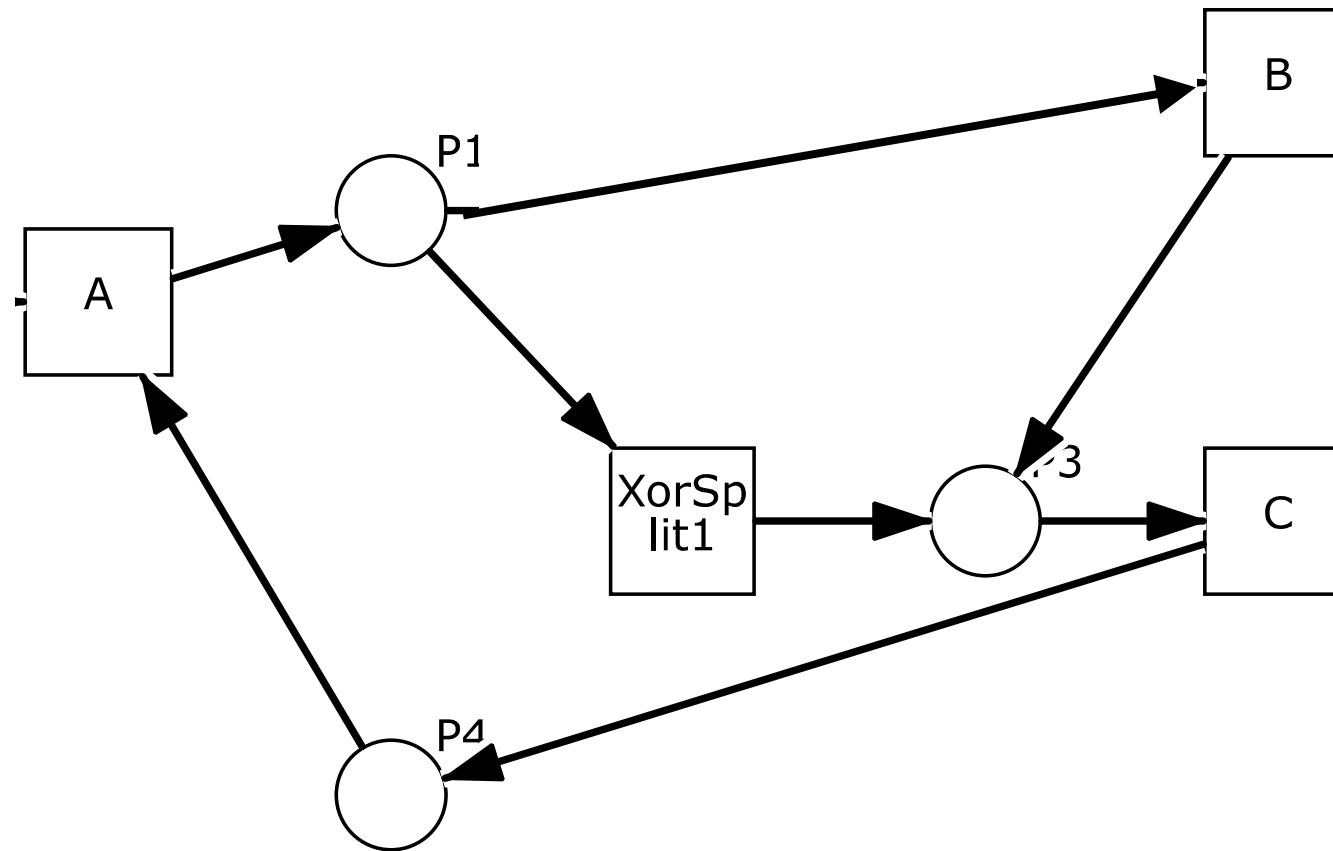
- Translate the following process model into a Petri Net.
- Check if the resulting Petri Net is sound. If not, propose an action to repair the process, to make it sound.



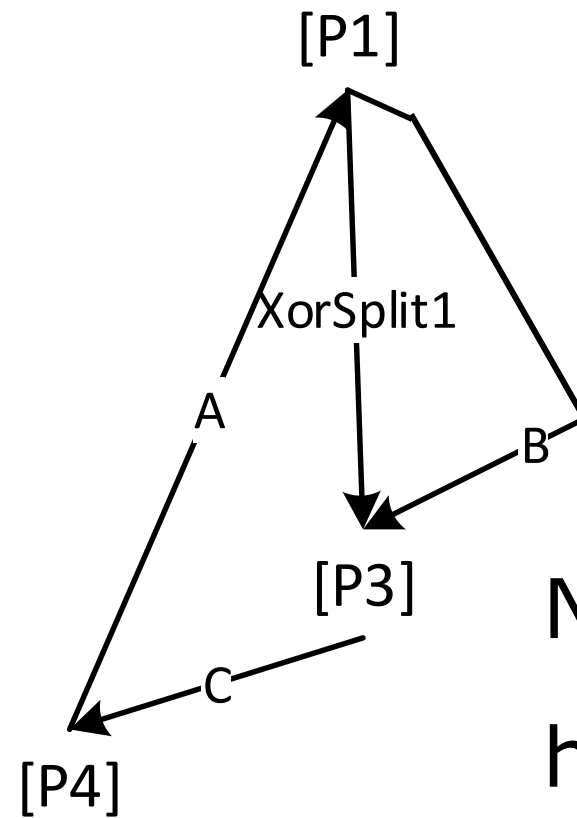
Exercise 4 – Petri Net



Exercise 4 – Optimized Petri Net

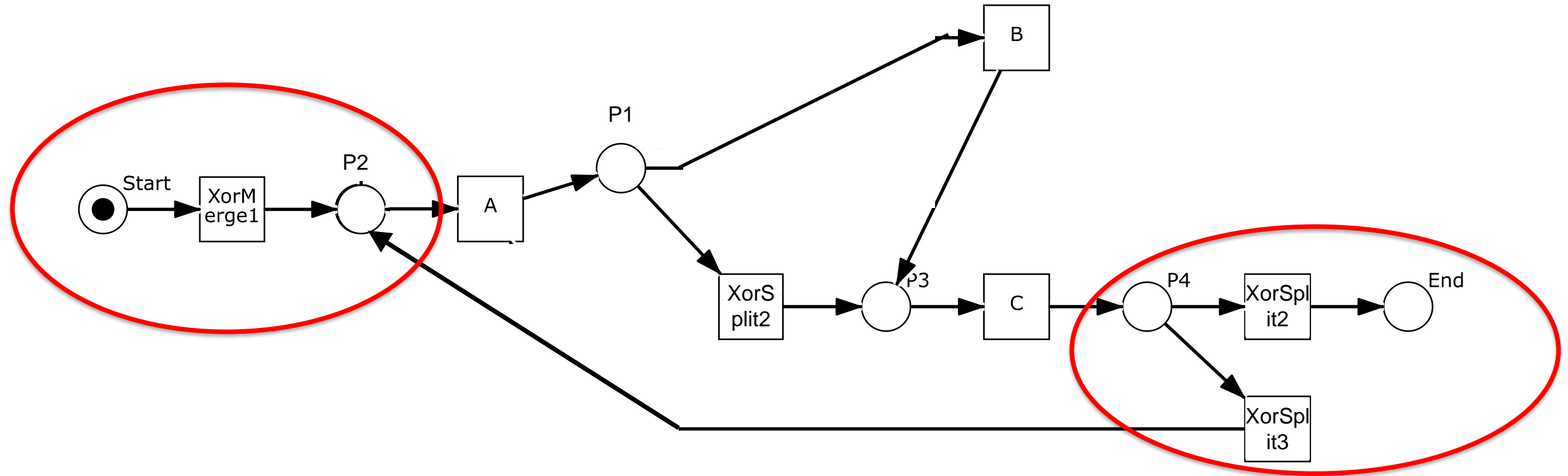


Exercise 4 – Reachability graph

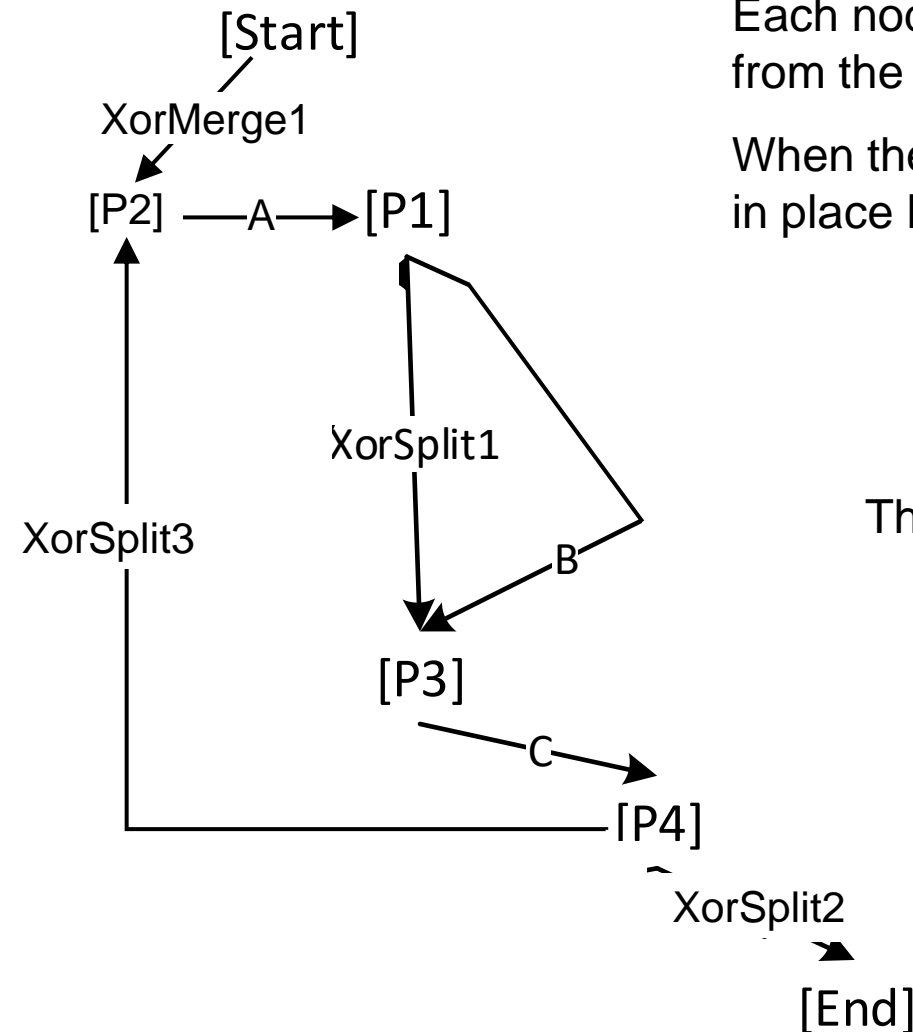


No initial and no final place,
hence not sound!

Exercise 4 – Repaired process



Exercise 4 – Reachability graph of repaired process



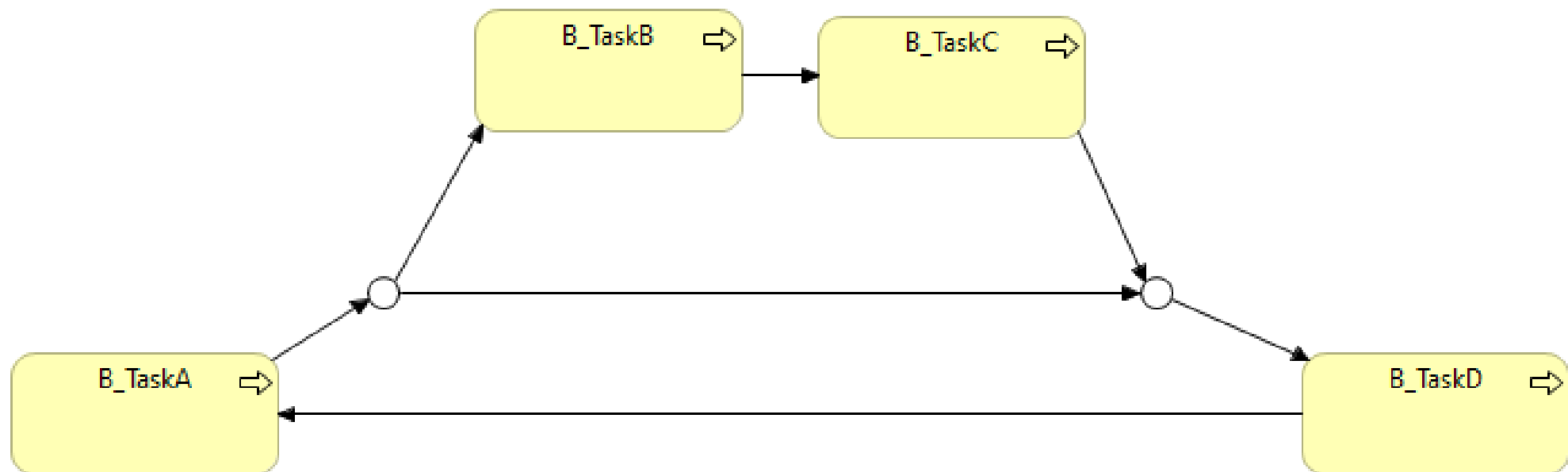
Each node in the process model is on a path from the initial node to the final node

When the procedure terminates, there is a token in place End and all the other places are empty

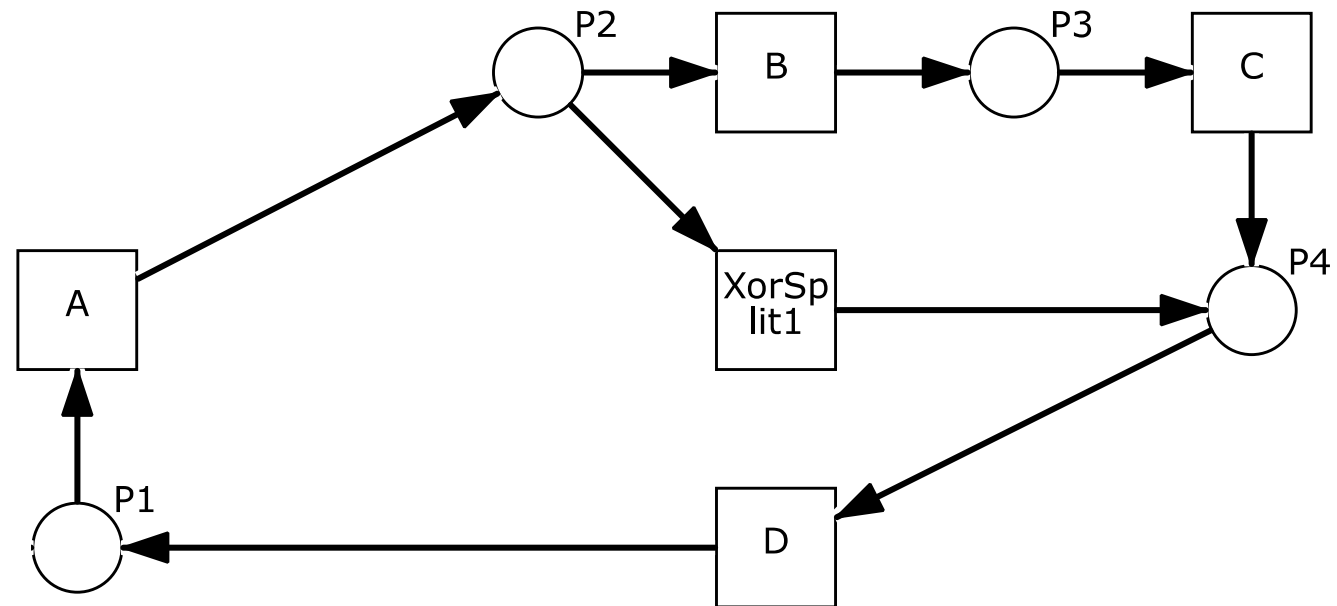
The process is now sound!

Exercise 5

- Translate the following process model into a Petri Net.
- Check if the resulting Petri Net is sound. If not, propose an action to repair the process, to make it sound.

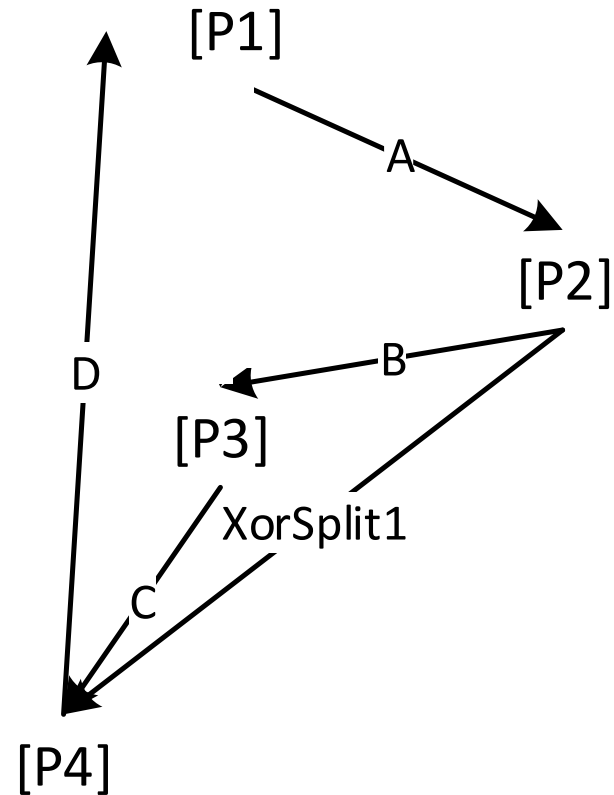


Exercise 5 – Optimized Petri Net

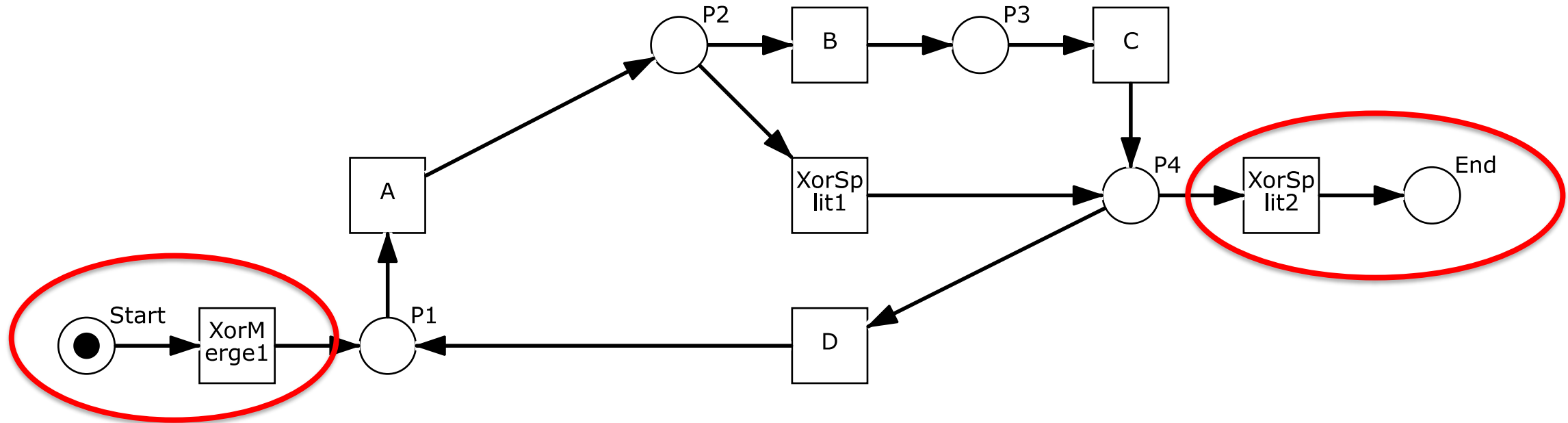


Exercise 5 – Reachability graph

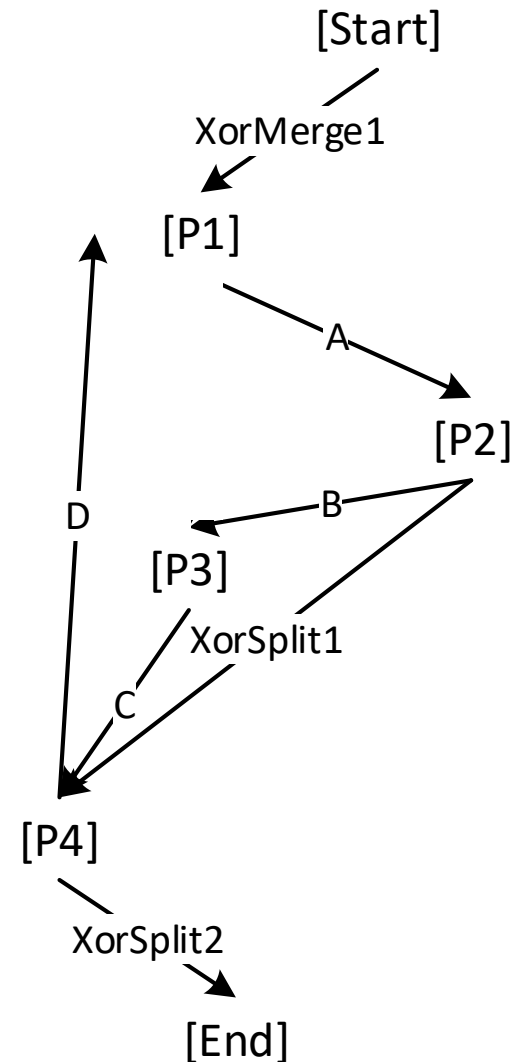
No initial and no final place,
hence not sound!



Exercise 5 – Repaired process



Exercise 5 – Reachability graph of repaired process



Each node in the process model is on a path from the initial node to the final node

When the procedure terminates, there is a token in place End and all the other places are empty

The process is now sound!