

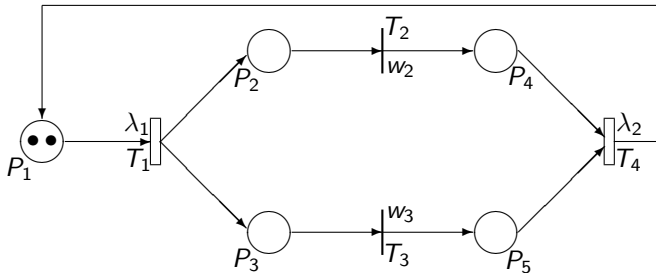
# Performance Modelling — GSPN Exercises

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## Exercise 1

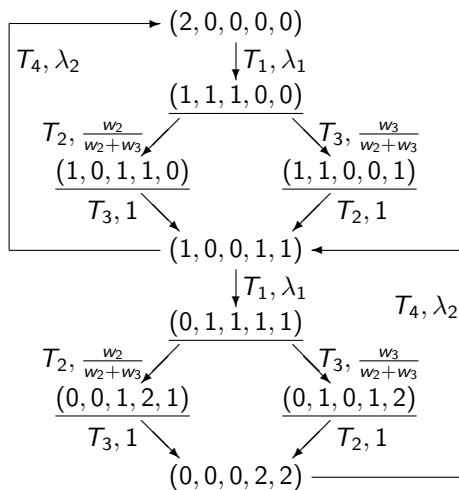
Consider the GSPN shown below.



Derive the reachability graph for the GSPN with the initial marking shown.

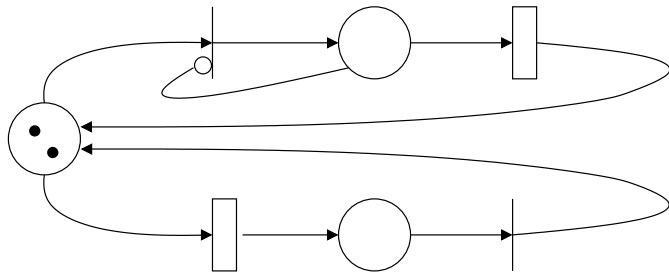
Distinguish the tangible and vanishing markings, labelling each timed transition with the appropriate rate and each immediate transition with the appropriate probability.

# Solution



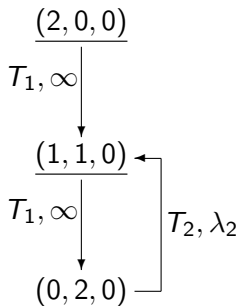
## Exercise 2

Construct the reachability graph for this GSPN with and without the inhibitor arc.

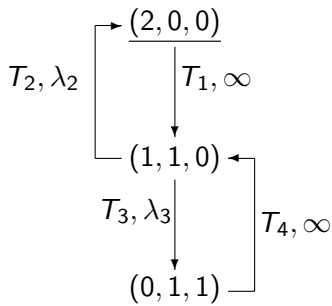


# Solution

Without inhibitor arc

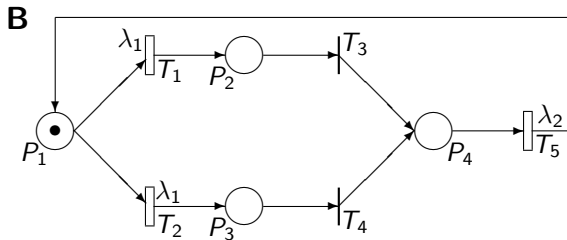
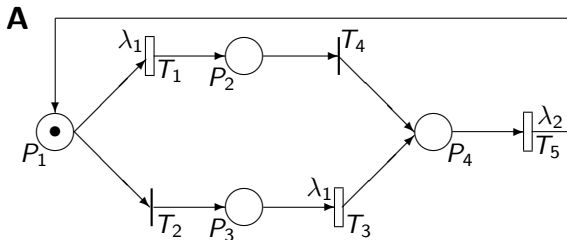


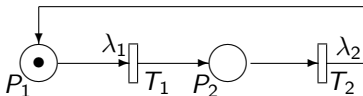
With inhibitor arc



## Exercise 3 (From exam paper in 2014)

Consider the three GSPN models shown below.



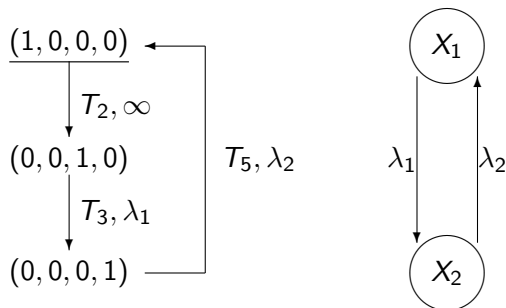
**C**

By constructing the reachability graphs or otherwise, show that GSPN A and GSPN C give rise to the same CTMC whilst the CTMC underlying GSPN B is different. Explain your reasoning.

## Solution

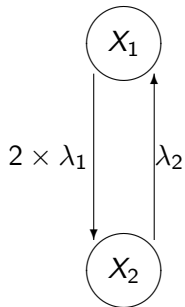
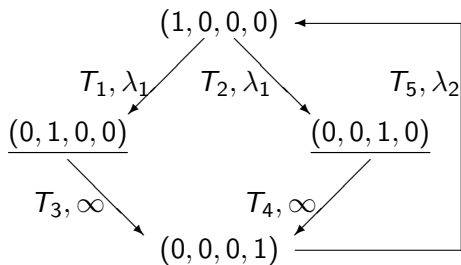
Vanishing markings are underlined.

Reachability graph and underlying CTMC of GSPN A

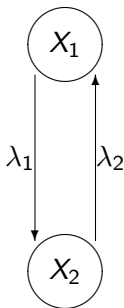
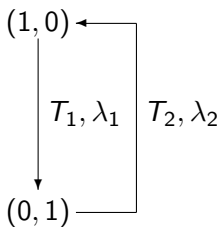




## Reachability graph and underlying CTMC of GSPN B

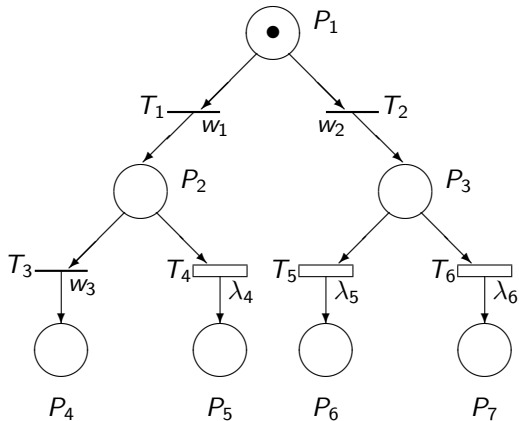


## Reachability graph and underlying CTMC of GSPN C



## Exercise 4 (From exam paper in 2011)

Consider the GSPN shown below.



After two transitions have fired what is the probability that there is a token in each of the places:

1  $P_4$

2  $P_5$

3  $P_6$

4  $P_7$

Justify your answer and show any calculation necessary in each case.

## Solution

- 1**  $P_4 : \frac{w_1}{w_1 + w_2}$  The conflict between the immediate transitions is resolved according to their weights and the immediate transition ( $T_3$ ) will always have priority over the timed transition ( $T_4$ ).
- 2**  $P_5 : 0$  Since  $T_3$  will always have priority over  $T_4$ ,  $T_4$  will never fire and  $P_5$  will remain unmarked.
- 3**  $P_6 : \frac{w_1}{w_1 + w_2} \frac{\lambda_5}{\lambda_5 + \lambda_6}$  As above the conflict between immediate transitions is resolved according to their weights and subsequently the conflict between the timed transitions is resolved by a race condition.
- 4**  $P_7 : \frac{w_1}{w_1 + w_2} \frac{\lambda_6}{\lambda_5 + \lambda_6}$  As above the conflict between immediate transitions is resolved according to their weights and subsequently the conflict between the timed transitions is resolved by a race condition.