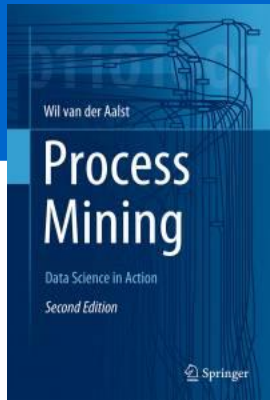


Process Mining: Data Science in Action

Petri Nets (1/2)

prof.dr.ir. Wil van der Aalst
www.processmining.org



TU/e

Technische Universiteit
Eindhoven
University of Technology

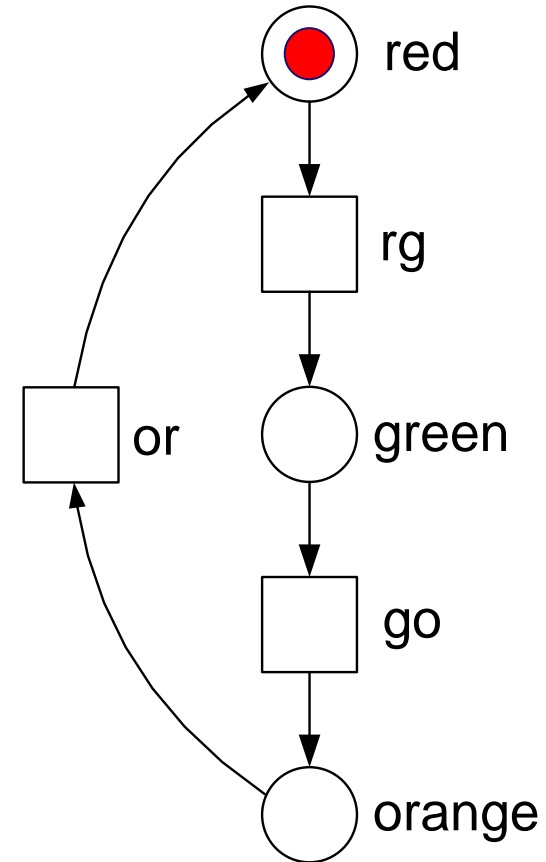
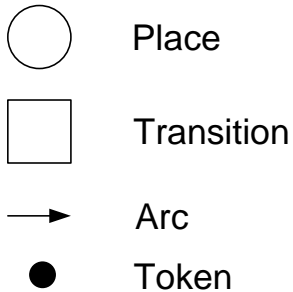
Where innovation starts

A very simple process ...



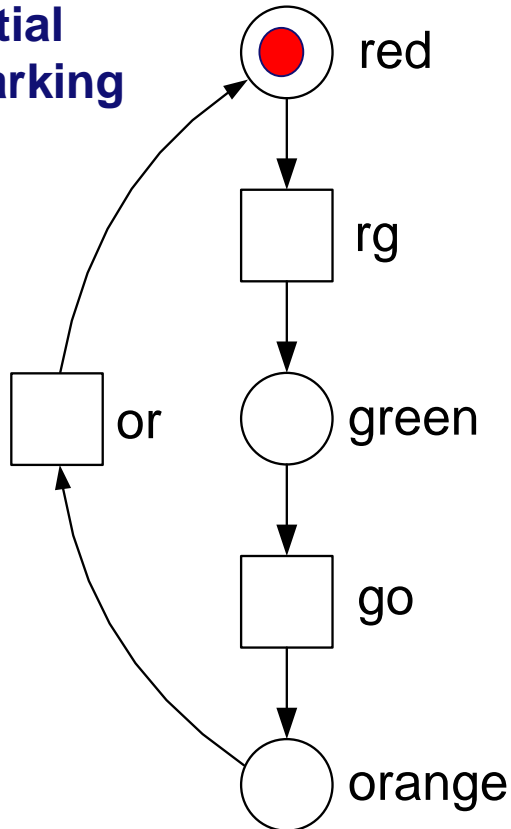
Traffic light Petri net

- **Network is static and composed of places and transitions.**
- **Places hold tokens.**
- **Transitions produce and/or consume tokens.**

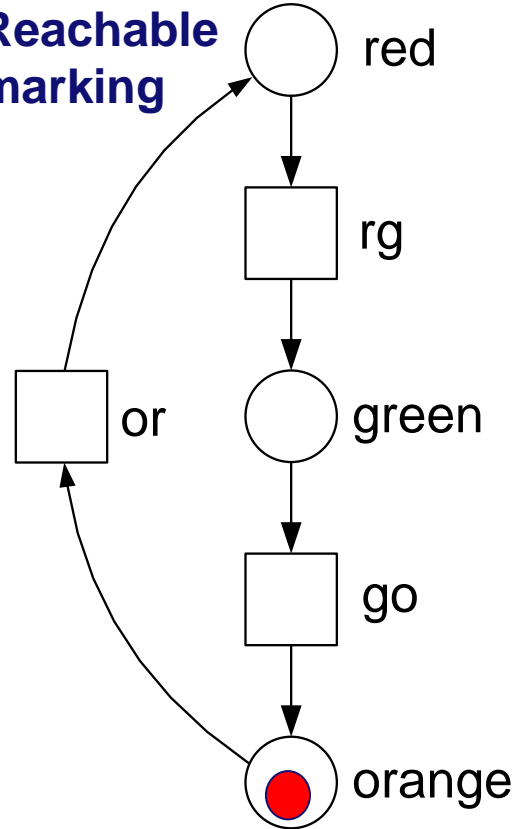


Markings

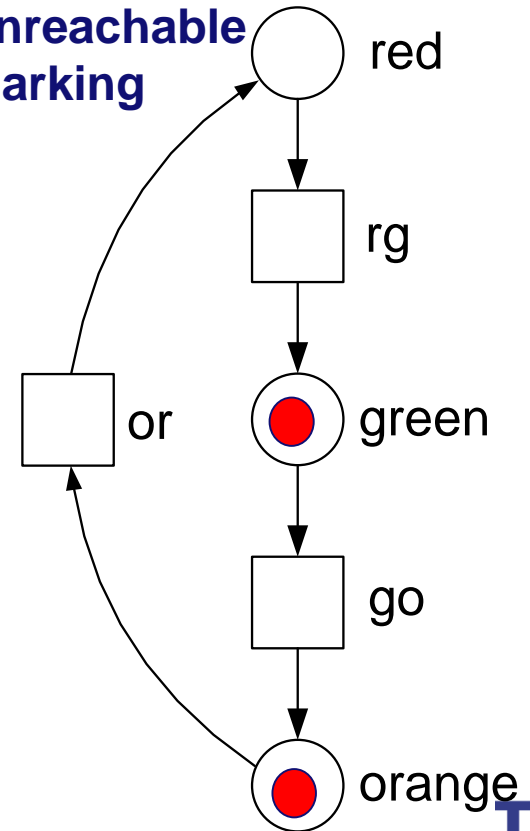
Initial marking



Reachable marking

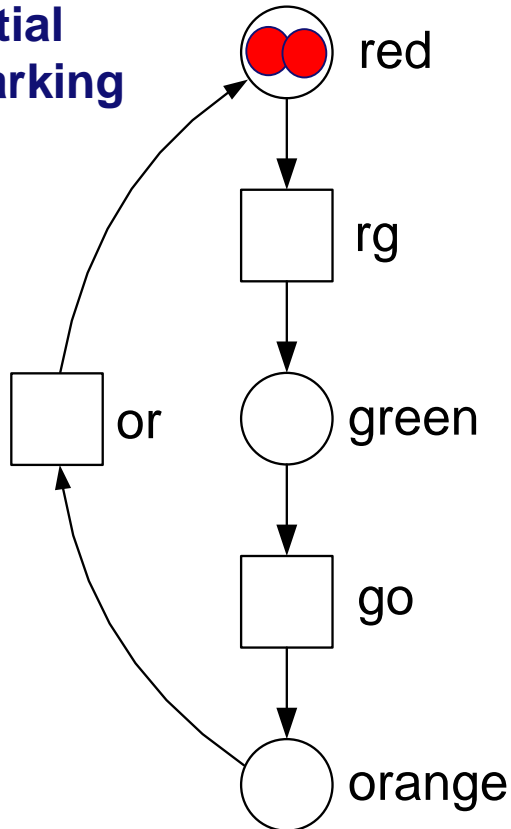


Unreachable marking

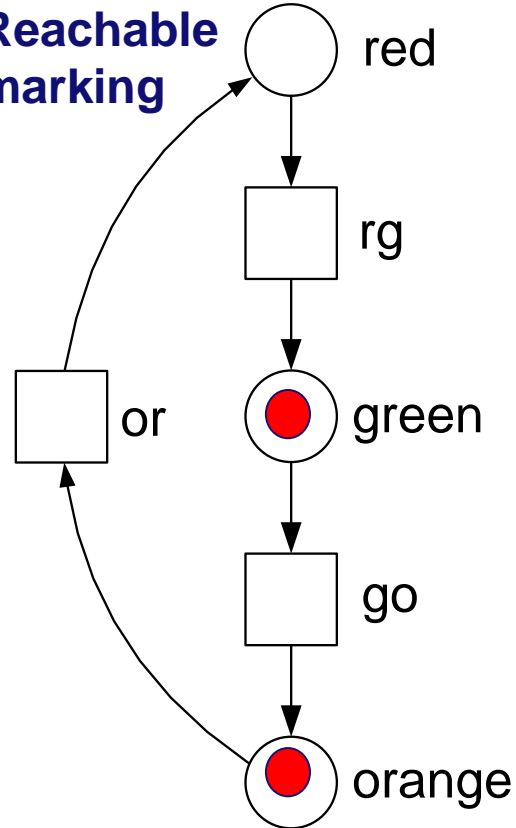


Markings

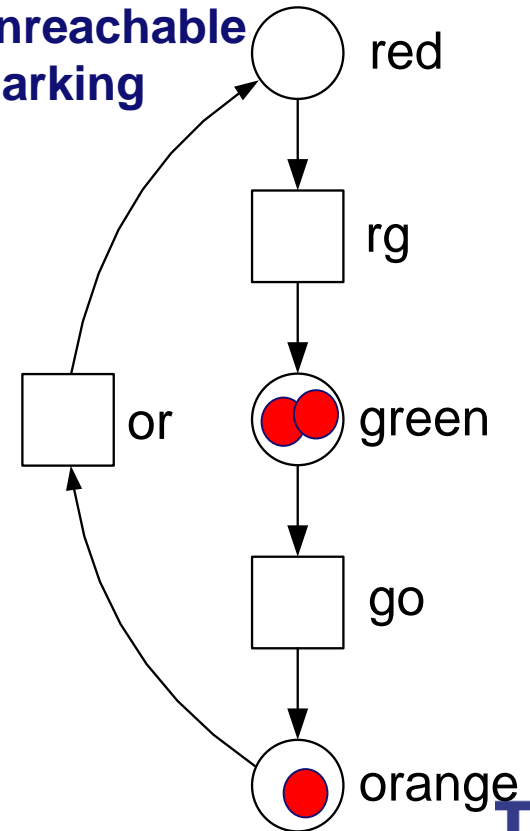
Initial marking



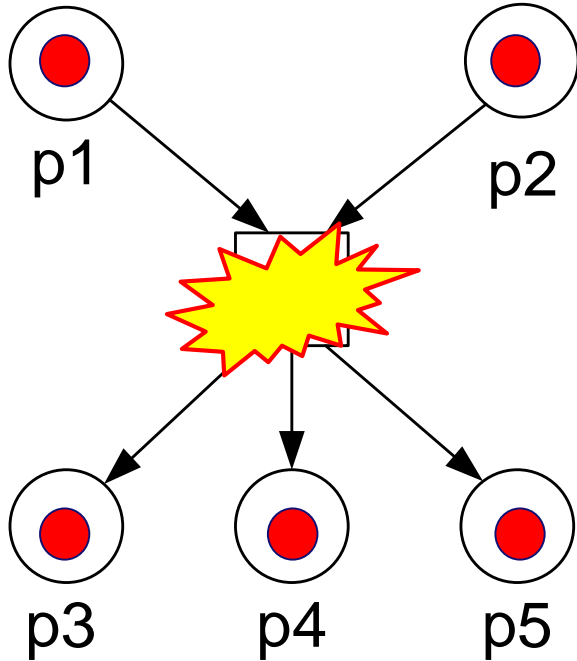
Reachable marking



Unreachable marking

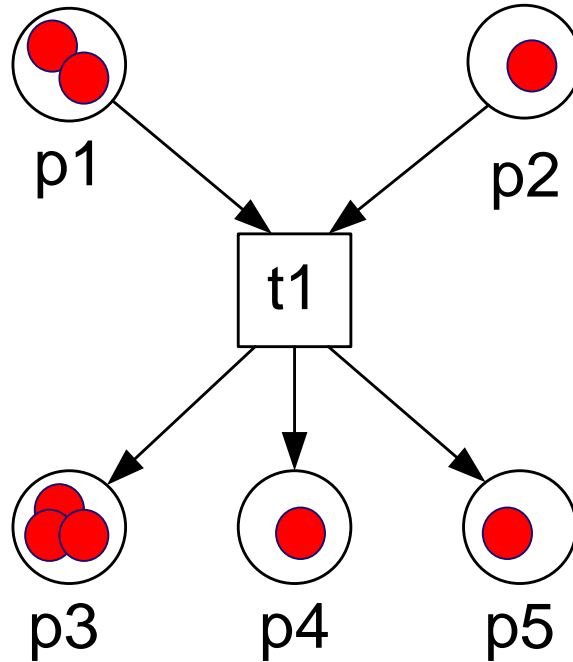


Enabling and firing

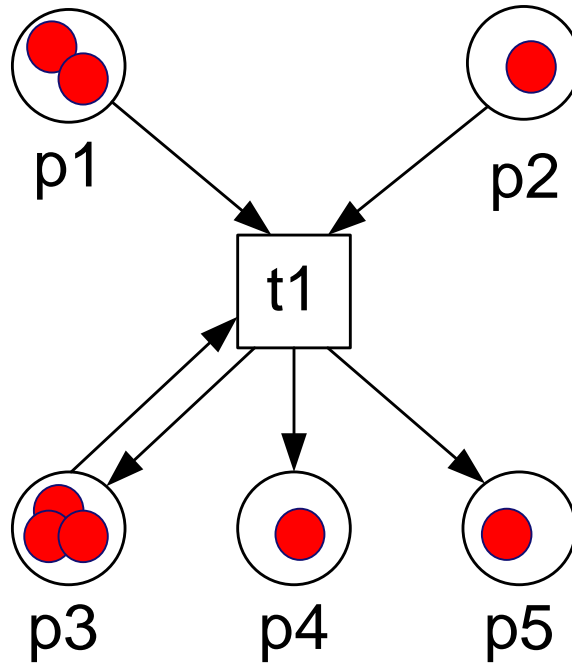


- Transition t1 is **enabled** if each input place contains a token.
- An enabled transition can **fire** by **consuming** a token from each input place and **producing** a token for each output place

What if there are more tokens?

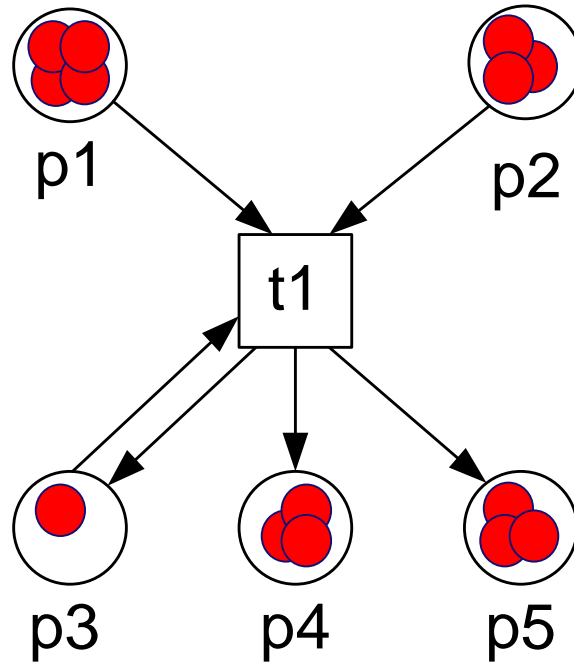


What if a place is both input and output?



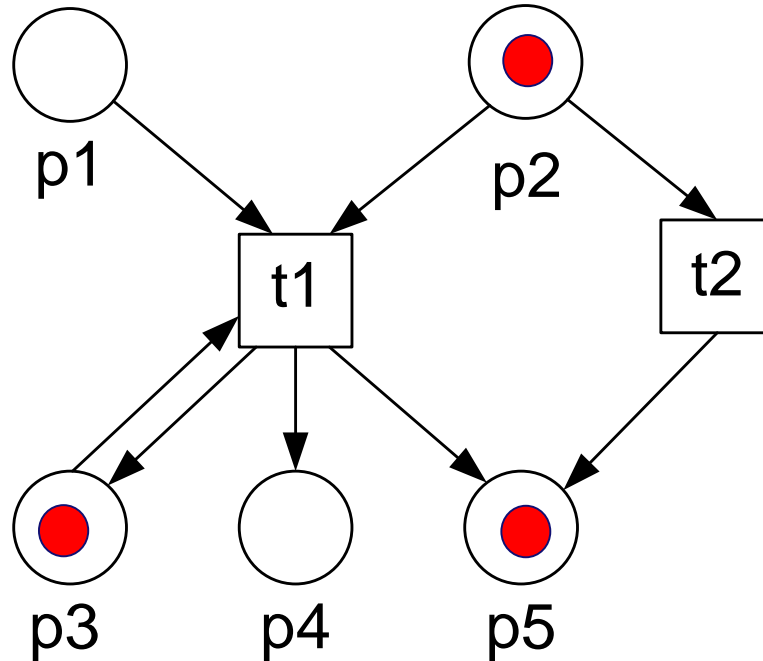
How many times can t1 fire and what is the final marking?

3 times



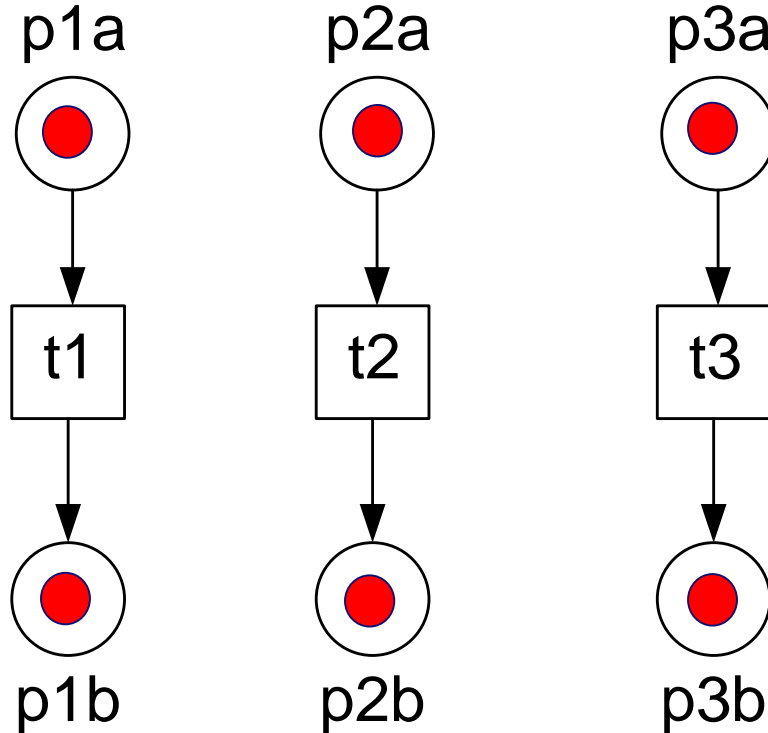
Firing is atomic!

What if there are multiple transitions?



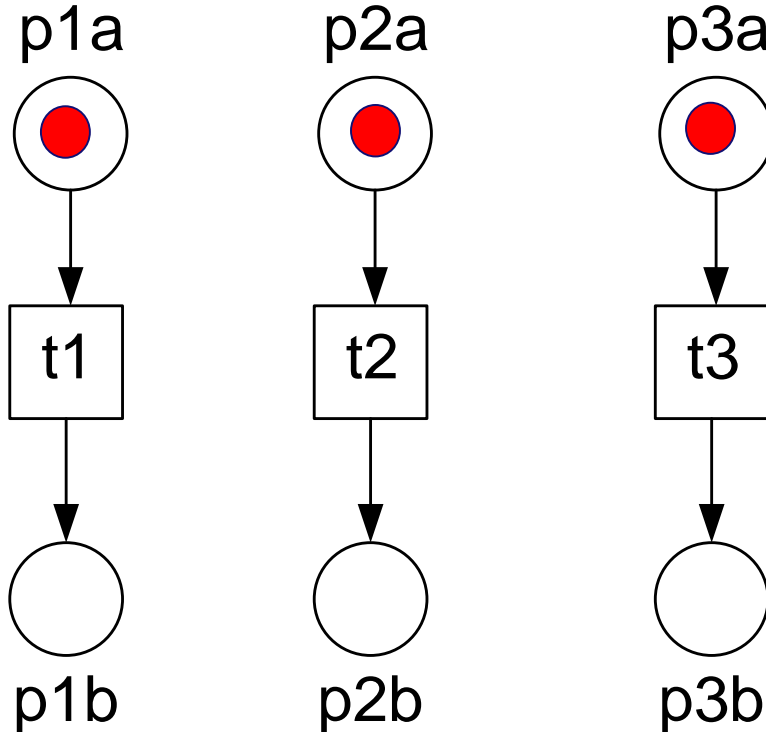
**t1 is not enabled,
so t2 fires**

What if there are multiple transitions?



**all three transitions
are enabled and can
fire in any order or
even concurrently**

What if there are multiple transitions?

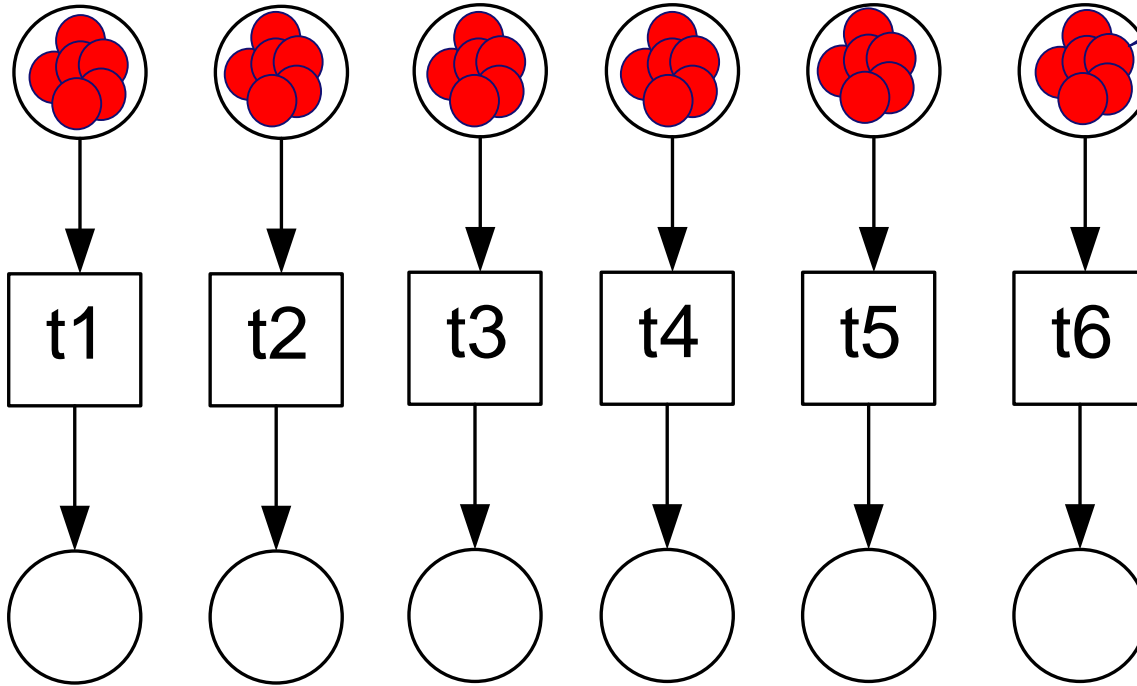


$2 \times 2 \times 2 = 8$
reachable states

**In this course we
assume interleaving
semantics (no real
limitation).**

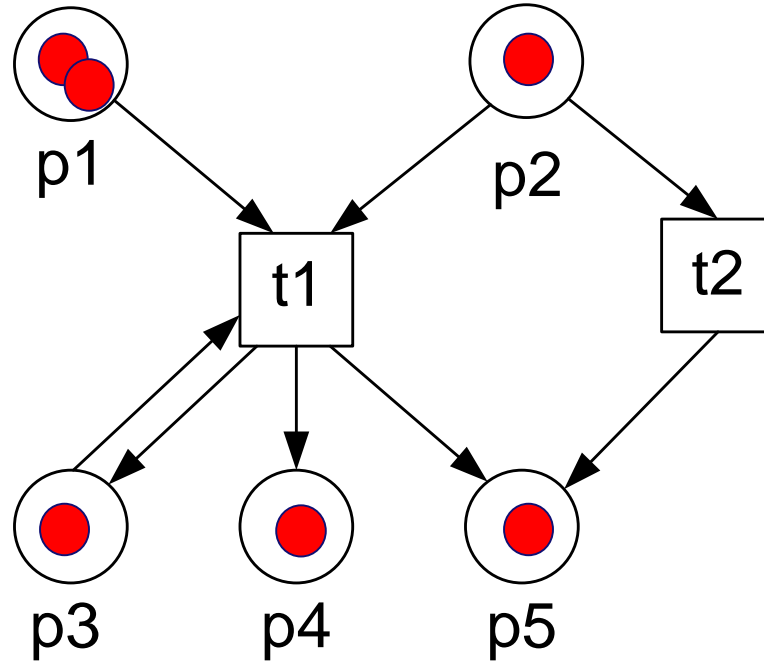
State explosion

6 tokens



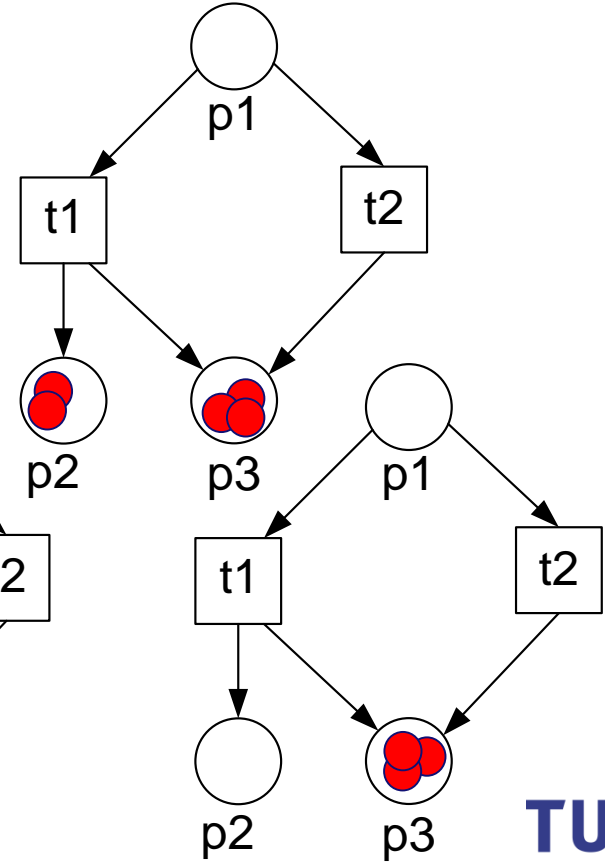
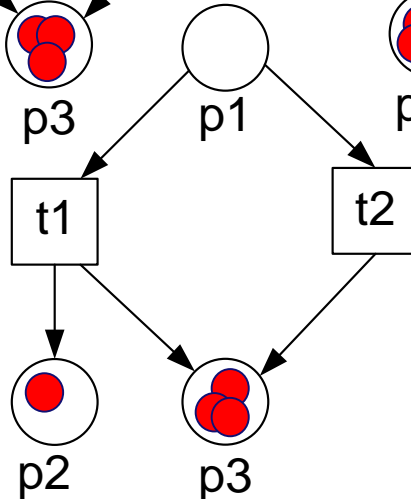
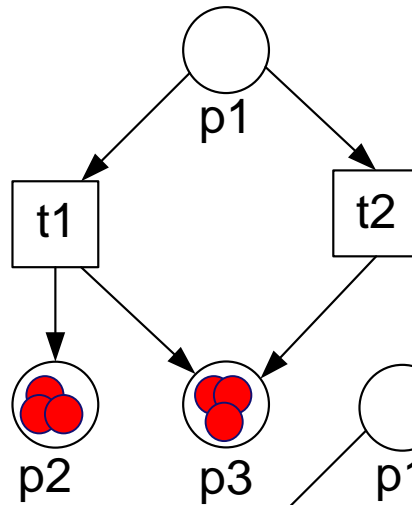
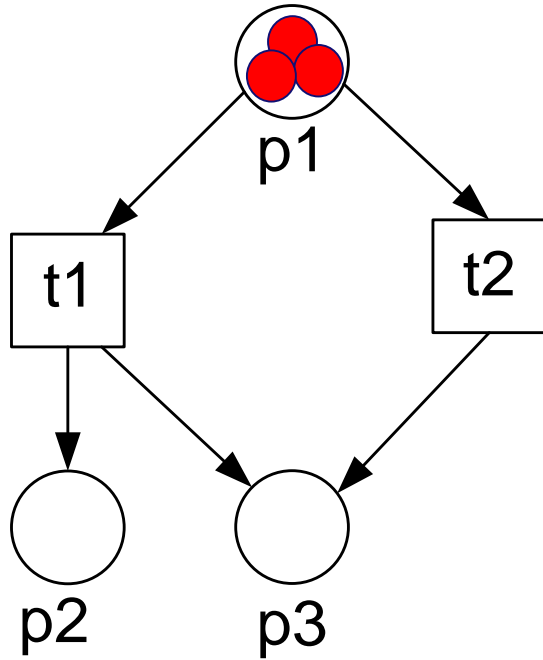
$7^6 = 117649$
reachable states

What if there are multiple transitions?

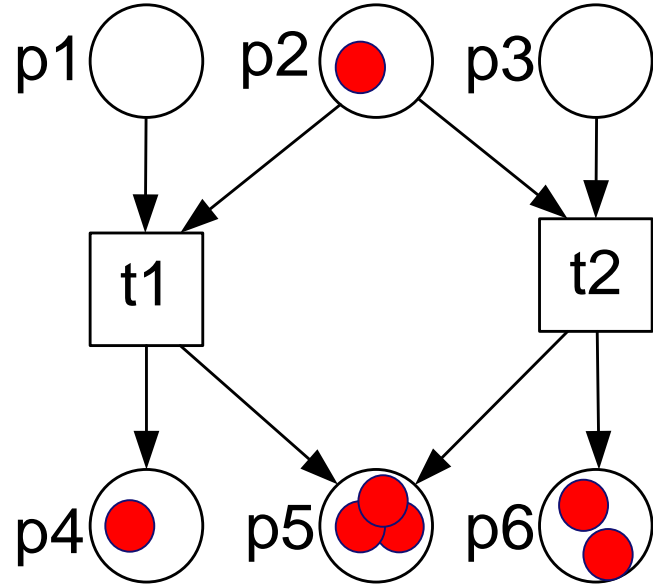
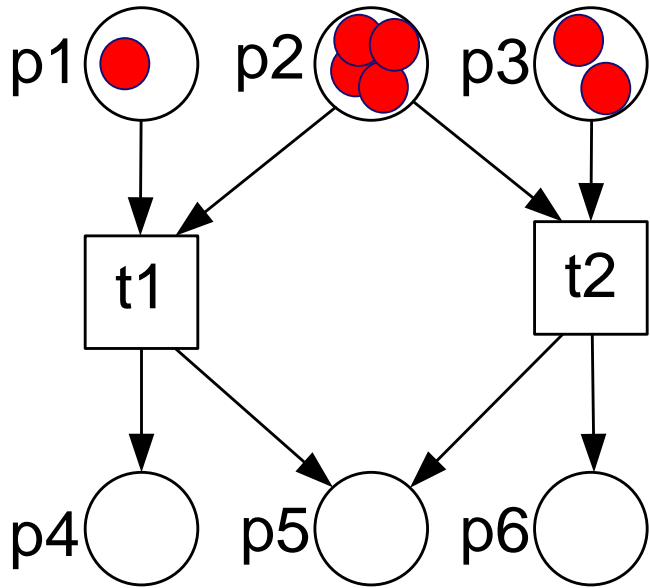


**both are enabled
but only one can
fire**

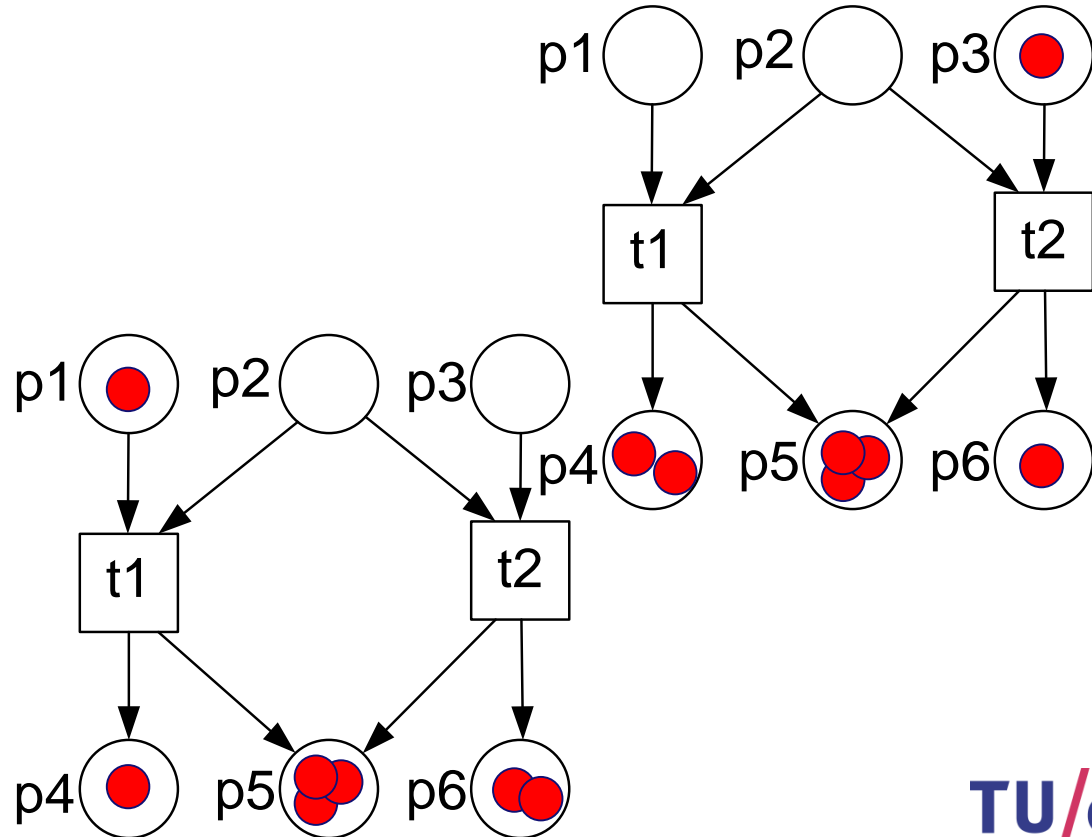
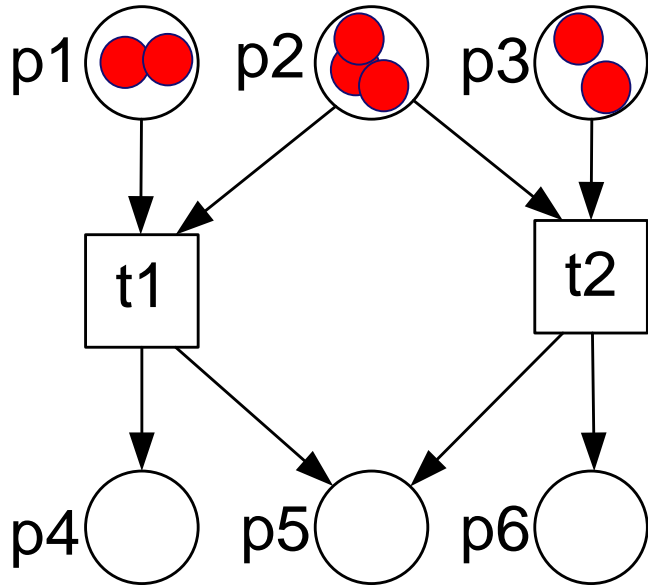
Give all possible final markings



Give all possible final markings

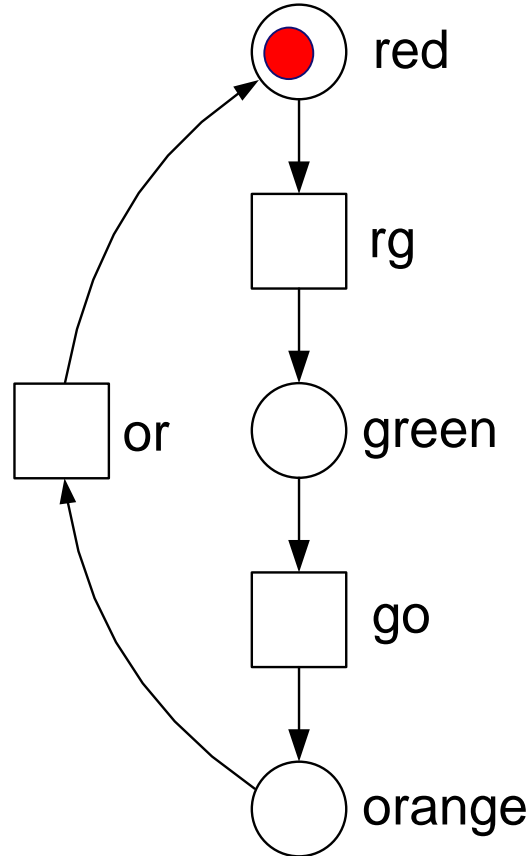


Give all possible final markings

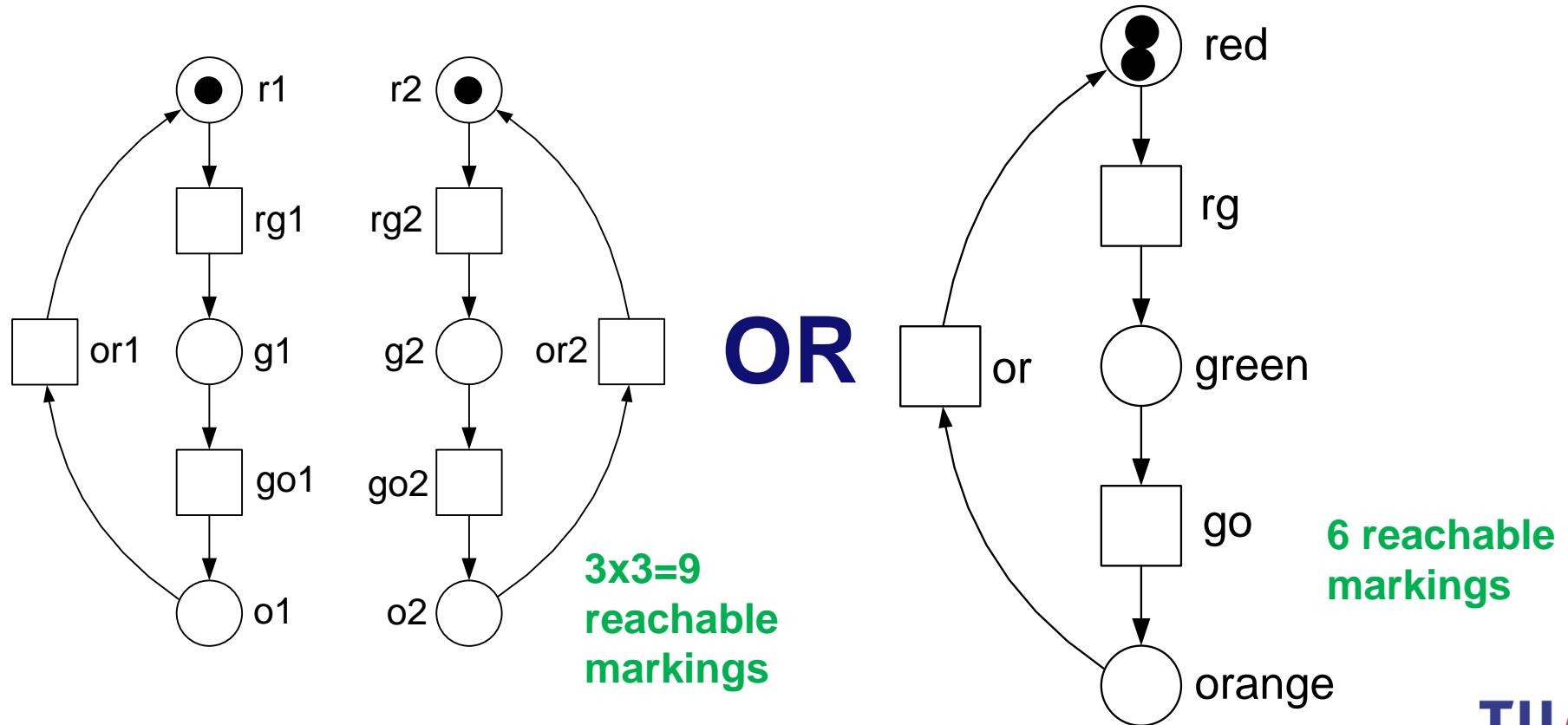


How to model two traffic lights?

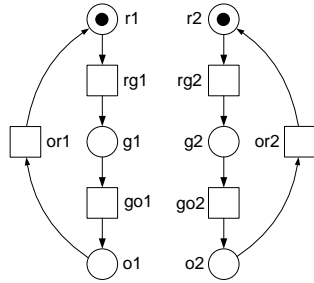
2x



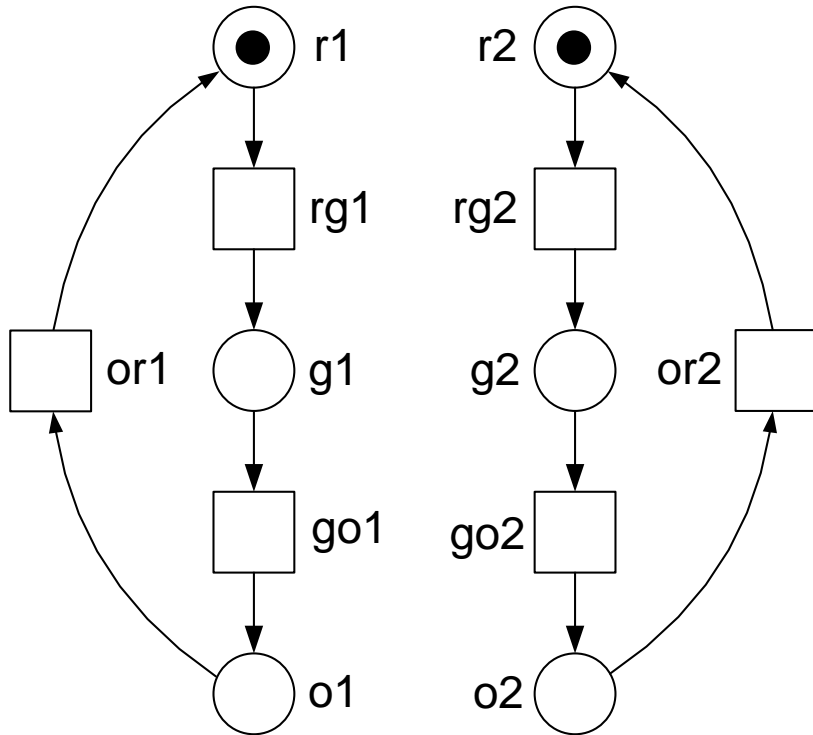
Two traffic lights



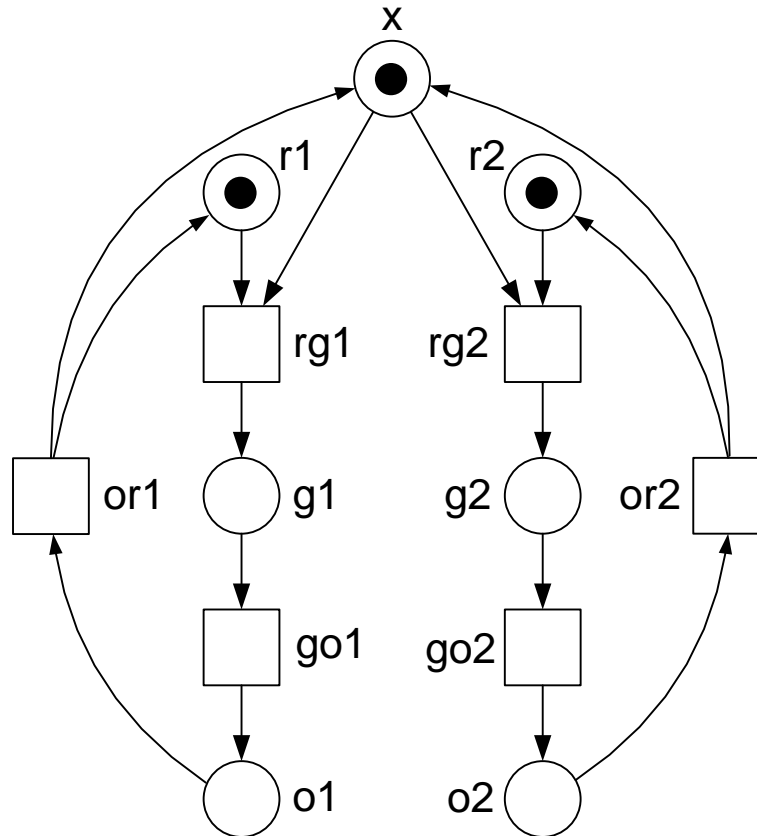
Problem



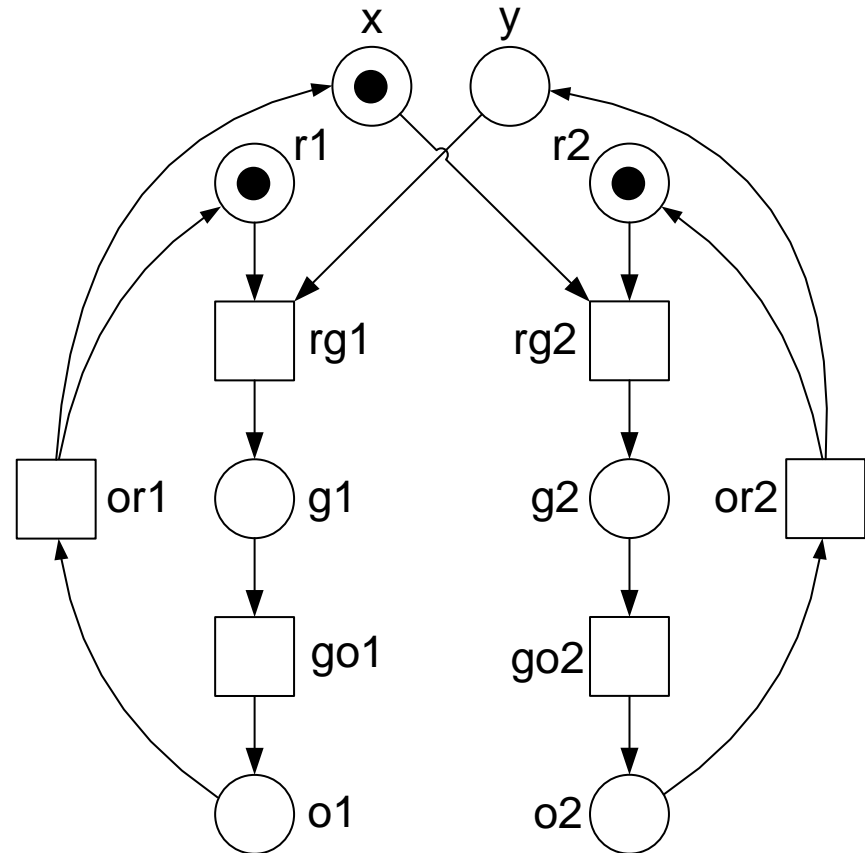
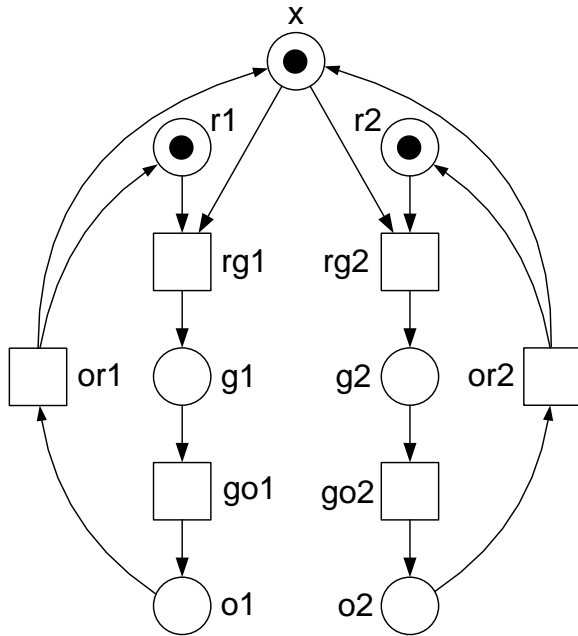
How to make them safe?



Safe traffic lights (non-deterministic)



How to make them alternate?



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in Action

Chapter 2

Process Mining:
The Missing Link

Part II: Preliminaries

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Process Modeling
and Analysis

Chapter 4

Data Mining

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Getting the Data

Chapter 6

Process Discovery:
An Introduction

Chapter 7

Advanced Process
Discovery Techniques

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Checking

Chapter 9

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Perspectives

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Software

Chapter 12

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Large

Chapter 13

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Chapter 14

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Processes”

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Cartography and
Navigation

Chapter 16

Epilogue

