Petri-Net Supplement:

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Foundations of Software Engineering

CSCI 5828 - Spring Semester, 2008

Petri Nets

➢ Formal Definition

$$N = \{P,T,A,M_0\}, \text{ where}$$
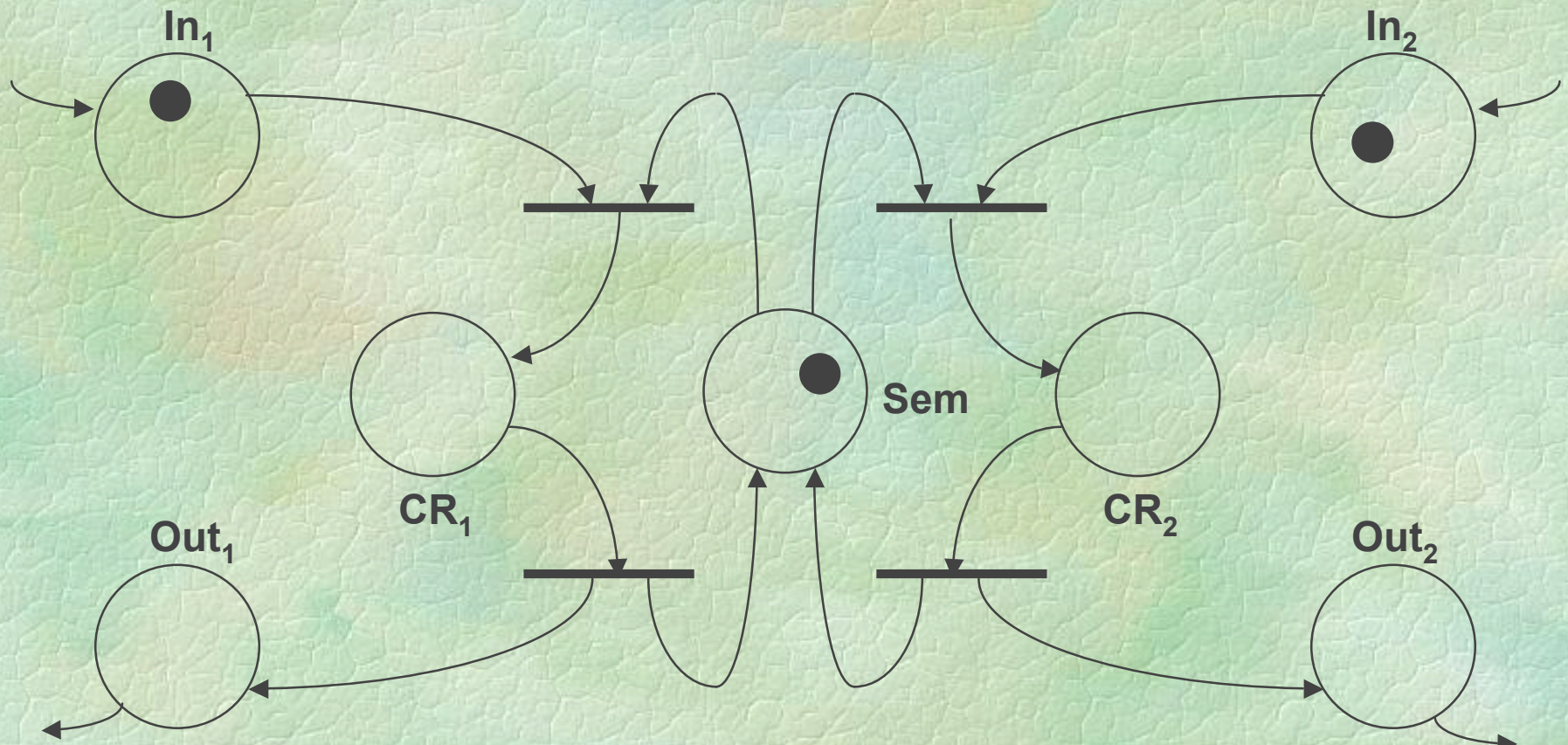
P is a finite set of *places*
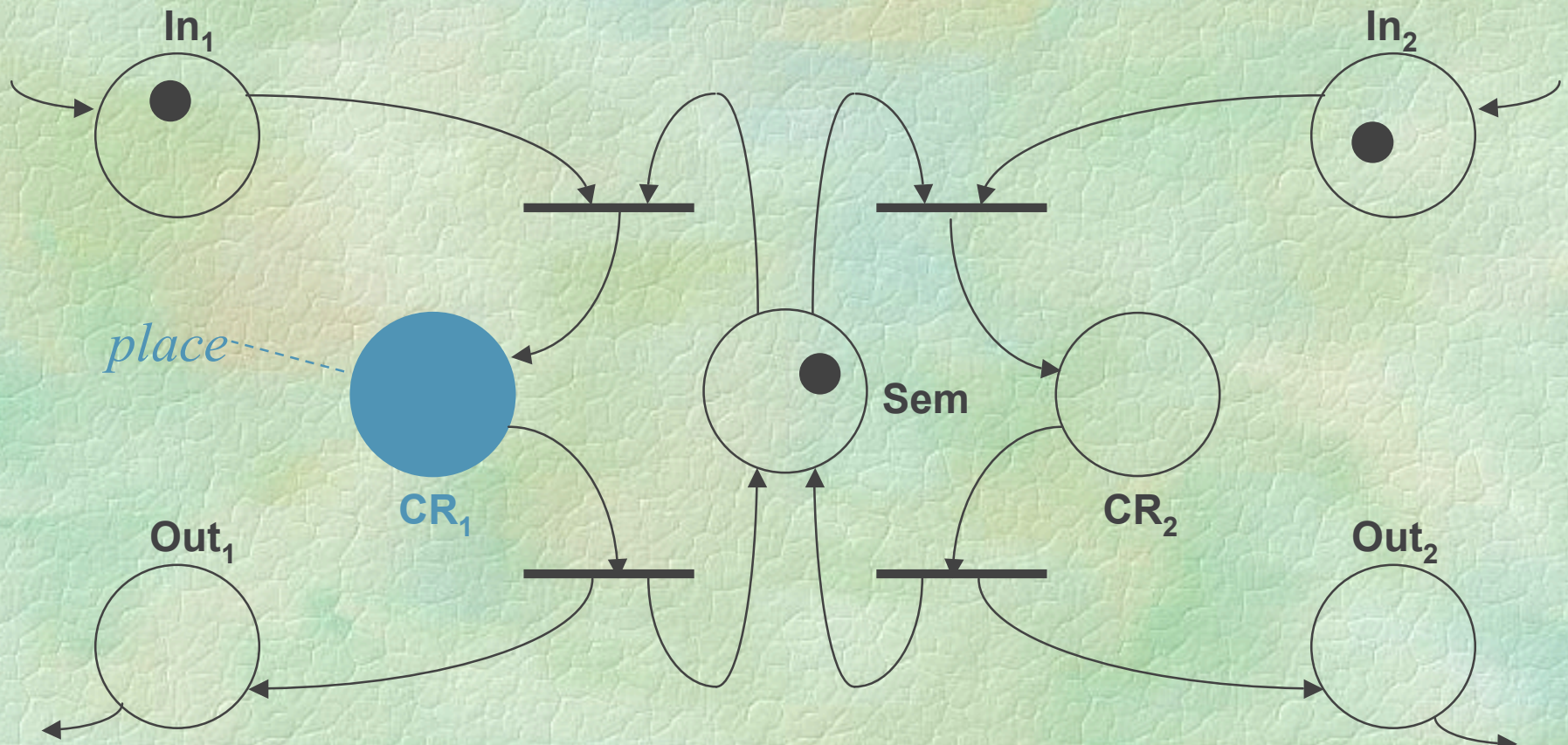
T is a finite set of *transitions*

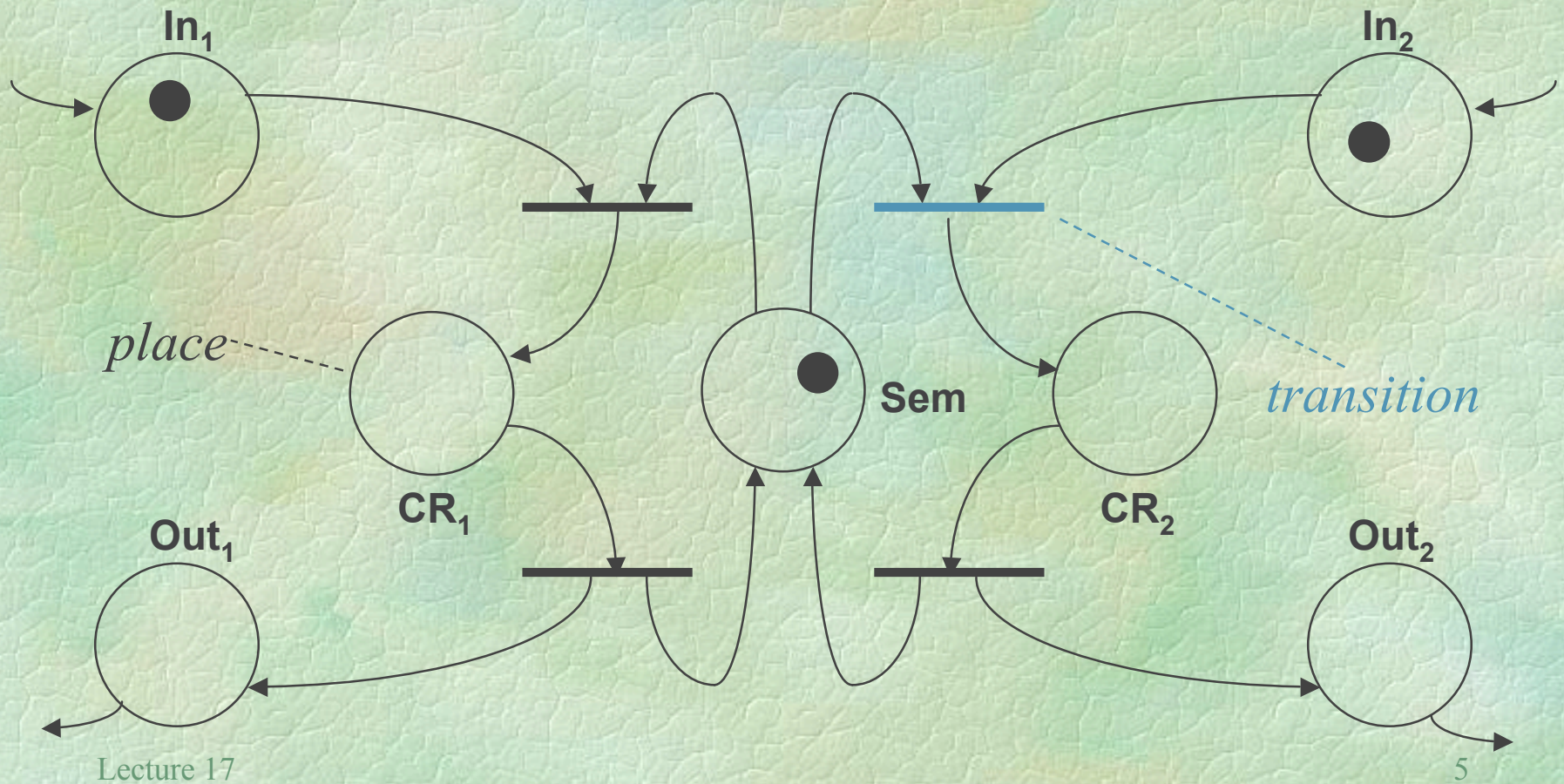A is a finite set of *arcs (arrows)*
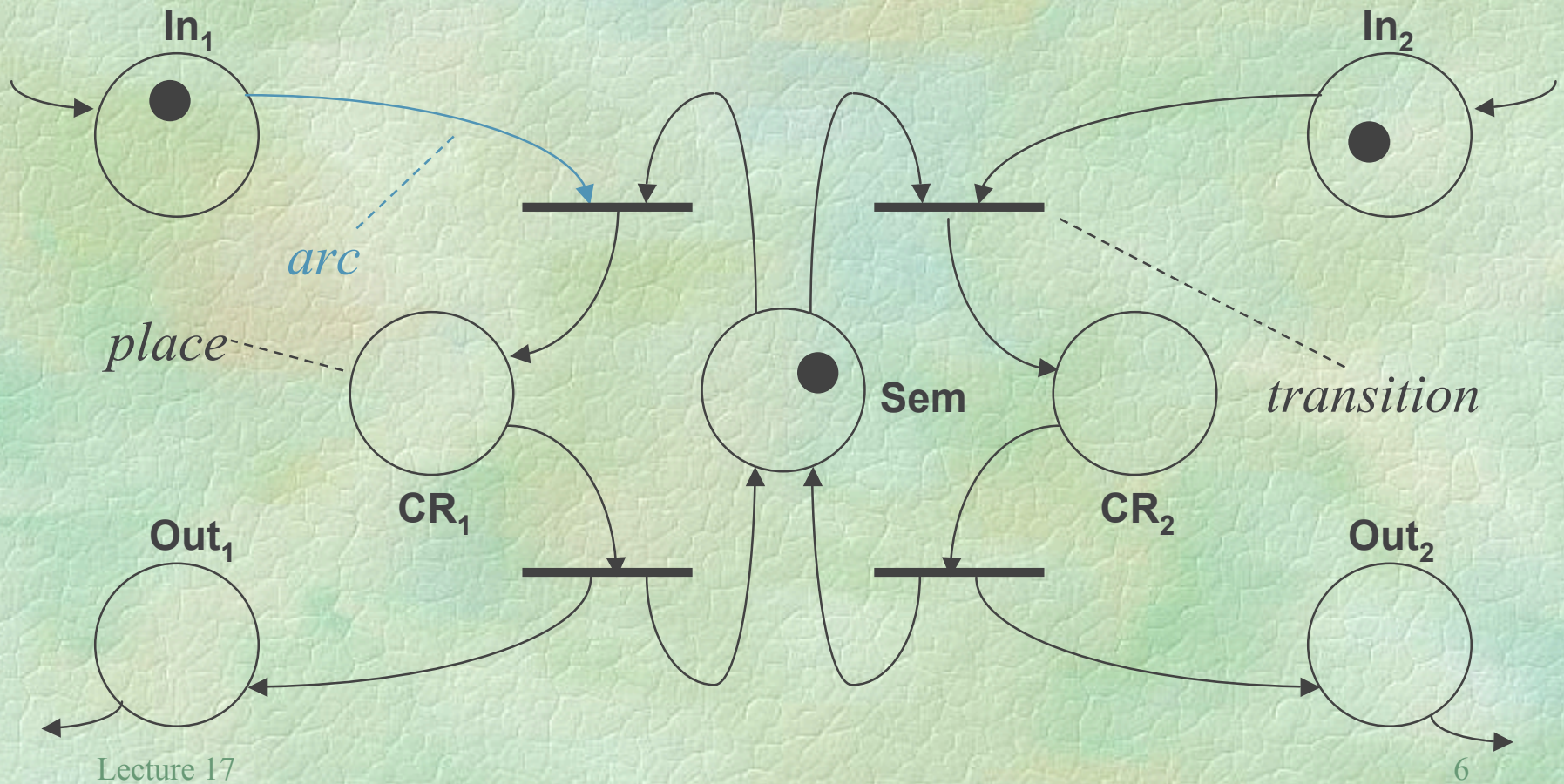
M_0 is the *initial marking* of N
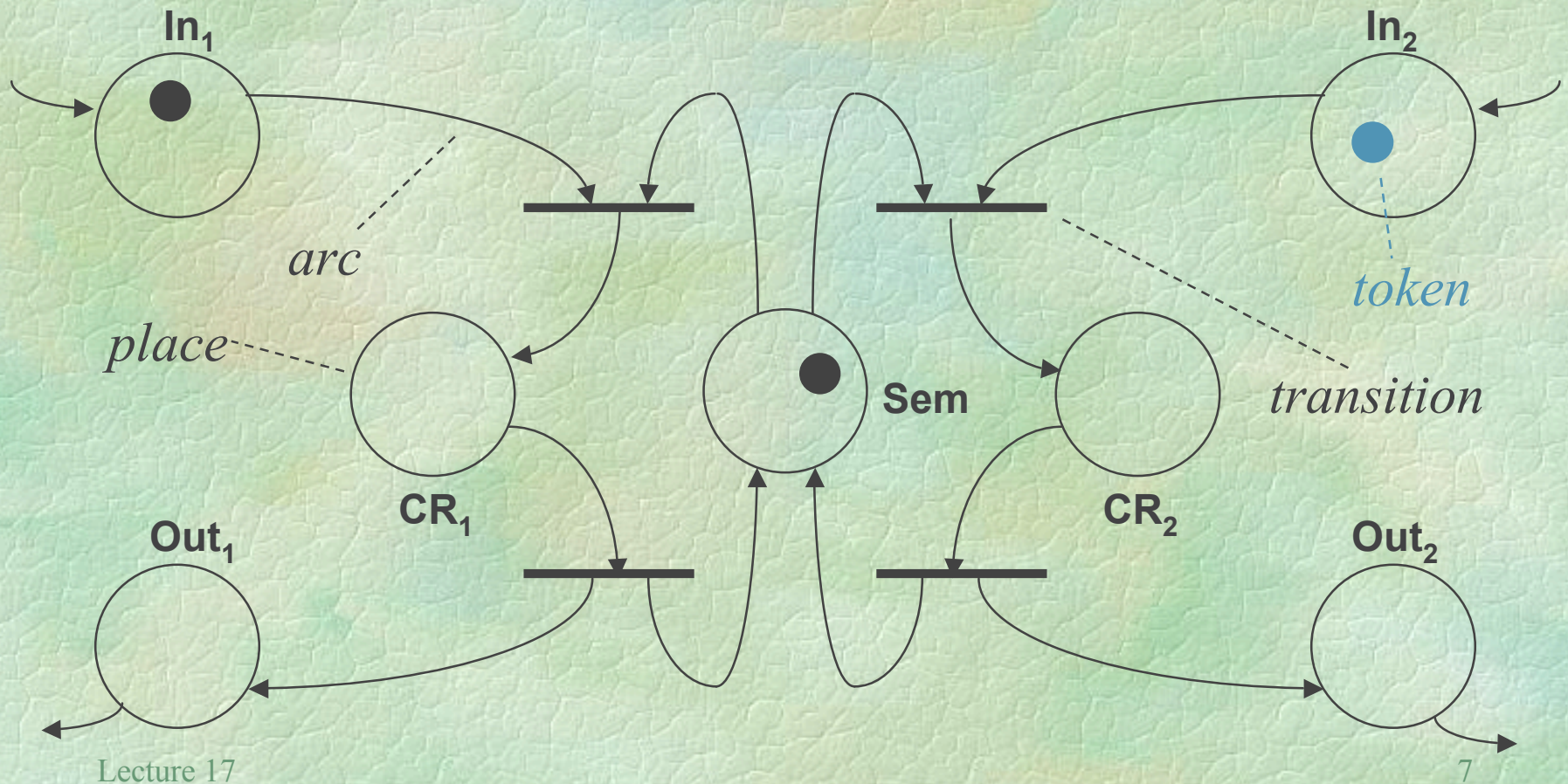
Graphical Representation

Graphical Representation

place

In_1

In_2

CR_1

Sem

CR_2

Out_1

Out_2

Graphical Representation

In₁ In₂

place

transition

Sem

CR₁ CR₂

Out₁ Out₂

Graphical Representation

In$_1$

In$_2$

arc

place

transition

CR$_1$

Sem

CR$_2$

Out$_1$

Out$_2$

Graphical Representation

In$_1$

In$_2$

arc

place

token

transition

Sem

CR$_1$

CR$_2$

Out$_1$

Out$_2$

Graphical Representation

In$_1$

In$_2$

arc

place

token

transition

Sem

CR$_1$

CR$_2$

Out$_1$

Out$_2$
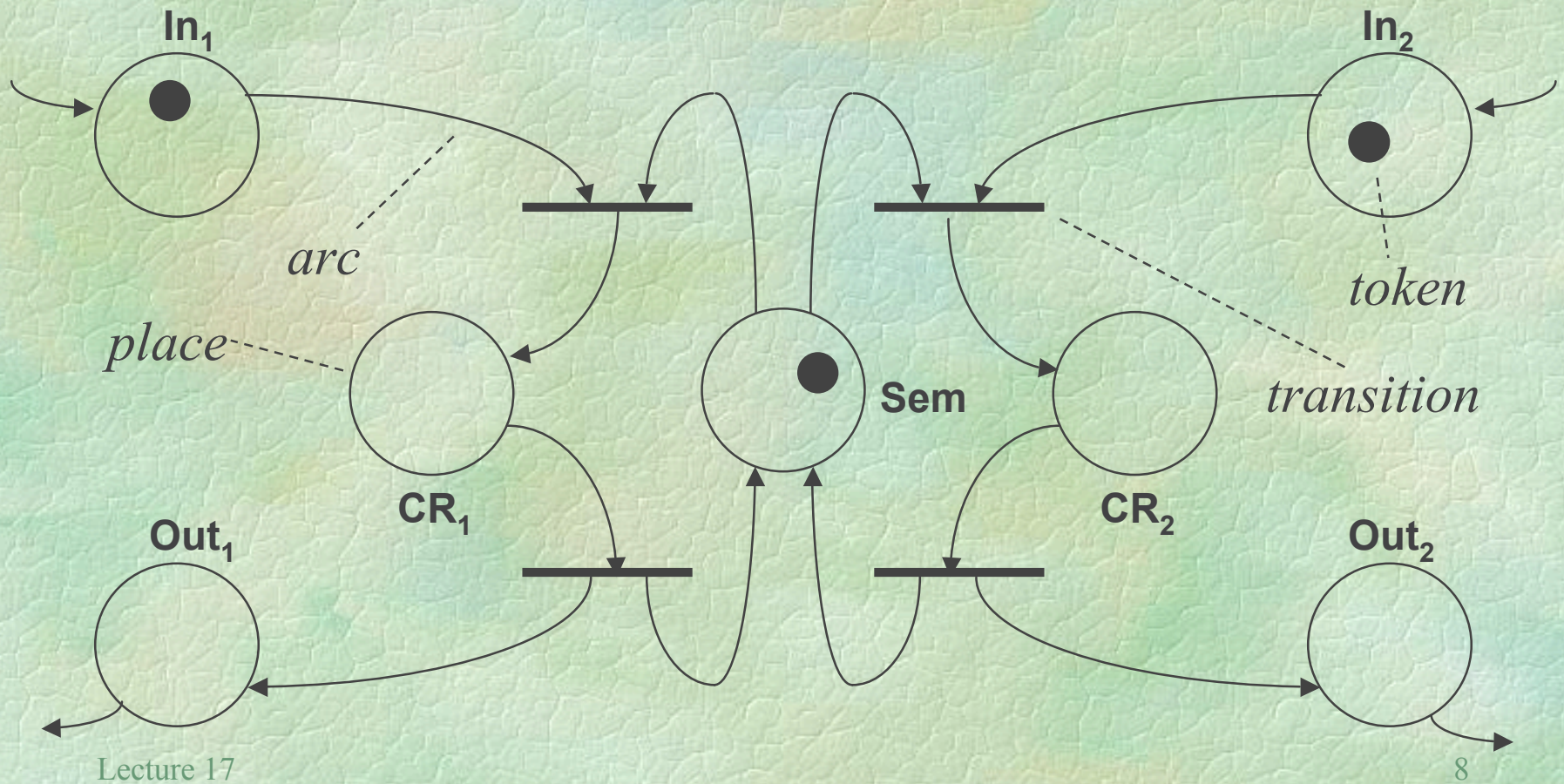
Petri Nets

➢ Intuitive Meaning

- A place holds *tokens*

- A transition represents *activity*

- An arc connects a place and a transition

- A marking is an arrangement of tokens in places, representing *state*

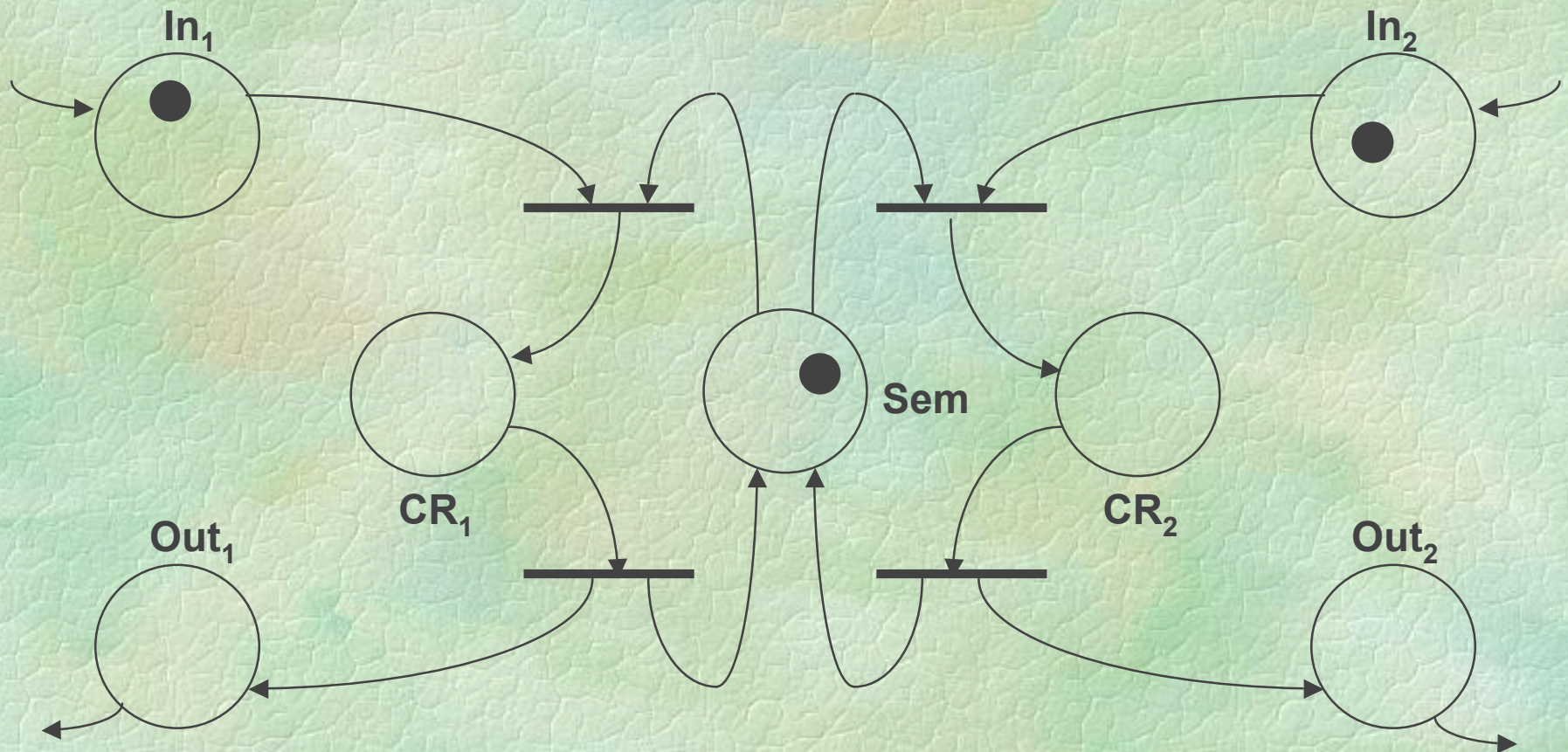- An initial marking represents an initial state

Execution Model

➢ Input and Output Places

- Place P is an *input place* for transition T if there is an arc from P to T

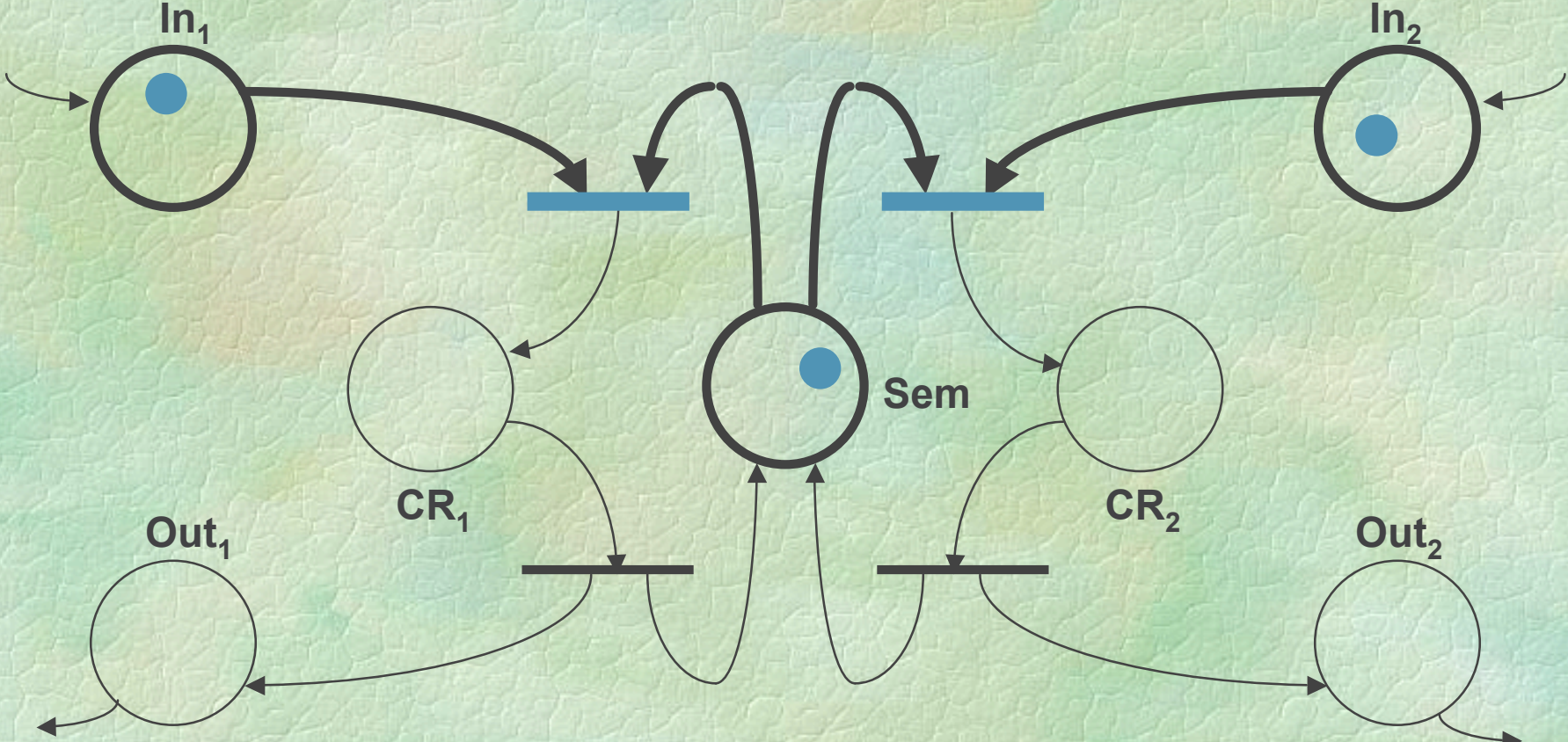- Place P is an *output place* for transition T if there is an arc from T to P

➢ Enabled Transition

- A transition is *enabled* if there is at least one token at each of its input places

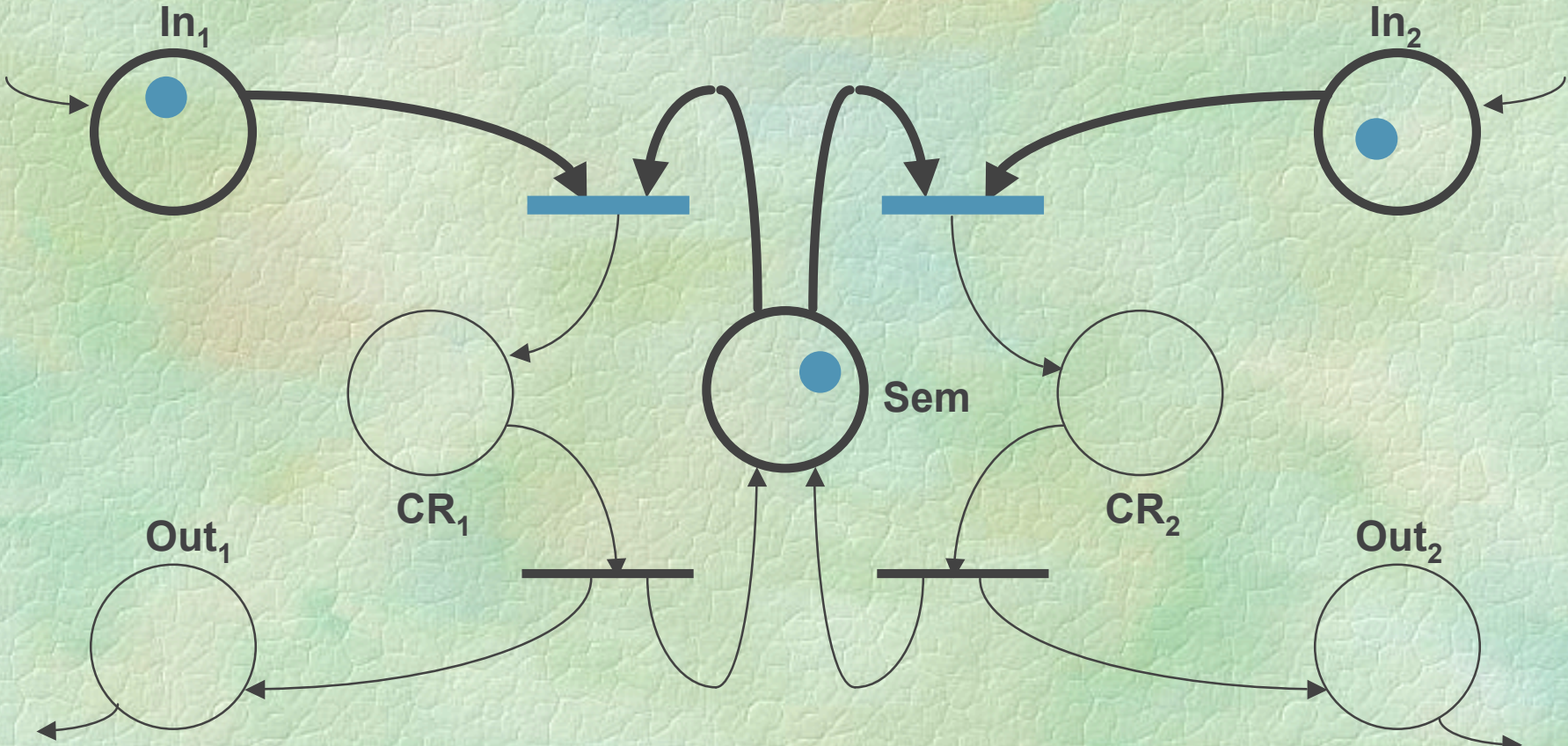# Petri Net Semaphore

Enabled Transitions

Execution Model

➢ Firing a Transition

- An enabled transition is nondeterministically selected and *fired* by removing one token from each of its input places and depositing one token at each of its output places
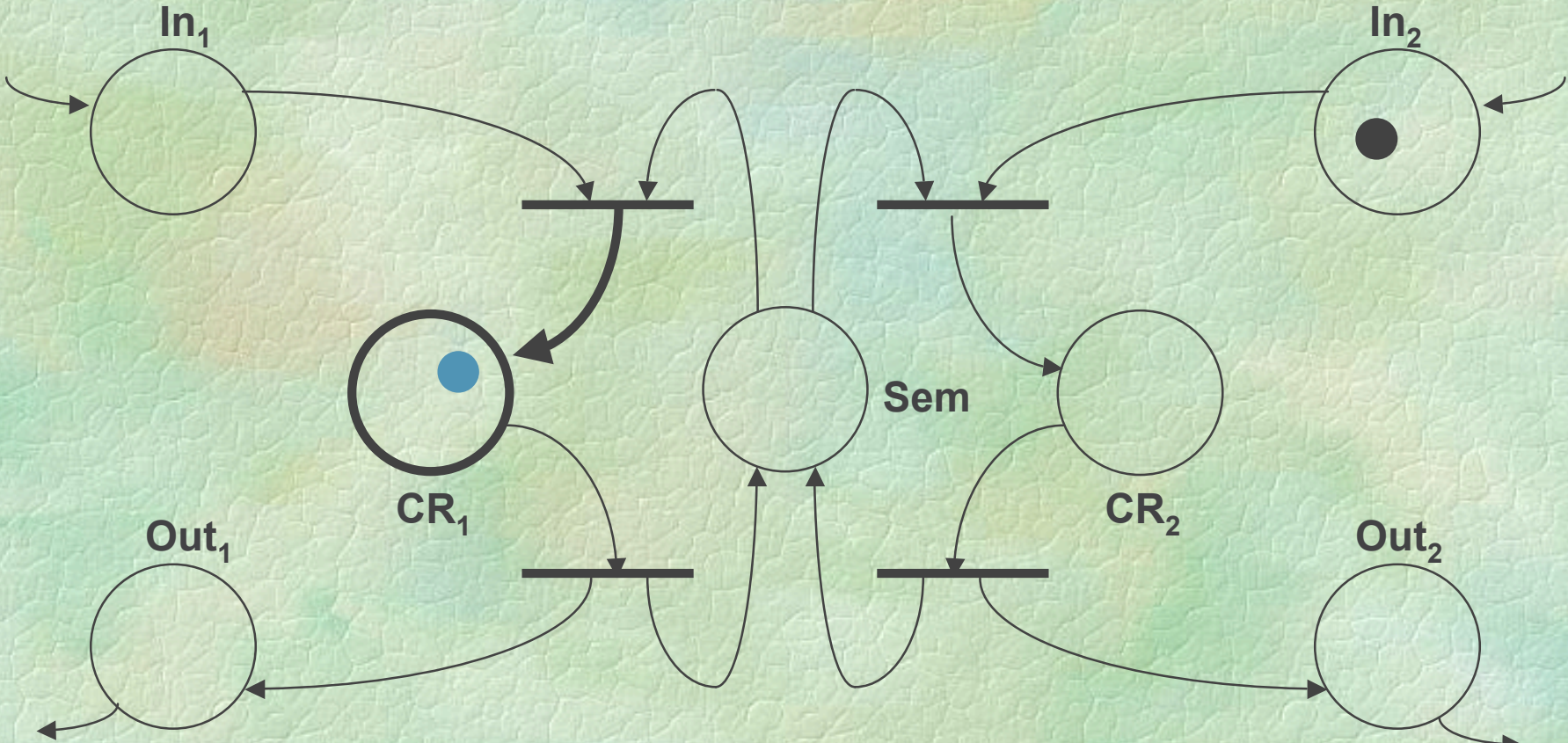
➢ Firing Sequence

- A *firing sequence* is a sequence $<t_0, t_1, \ldots, t_n>$ such that t_0 is enabled and fired in M_0, t_1 is enabled and fired in M_1, etc.

Enabled Transitions

In_1   In_2

CR_1   Sem   CR_2

Out_1   Out_2

After Firing

Enabled Transition
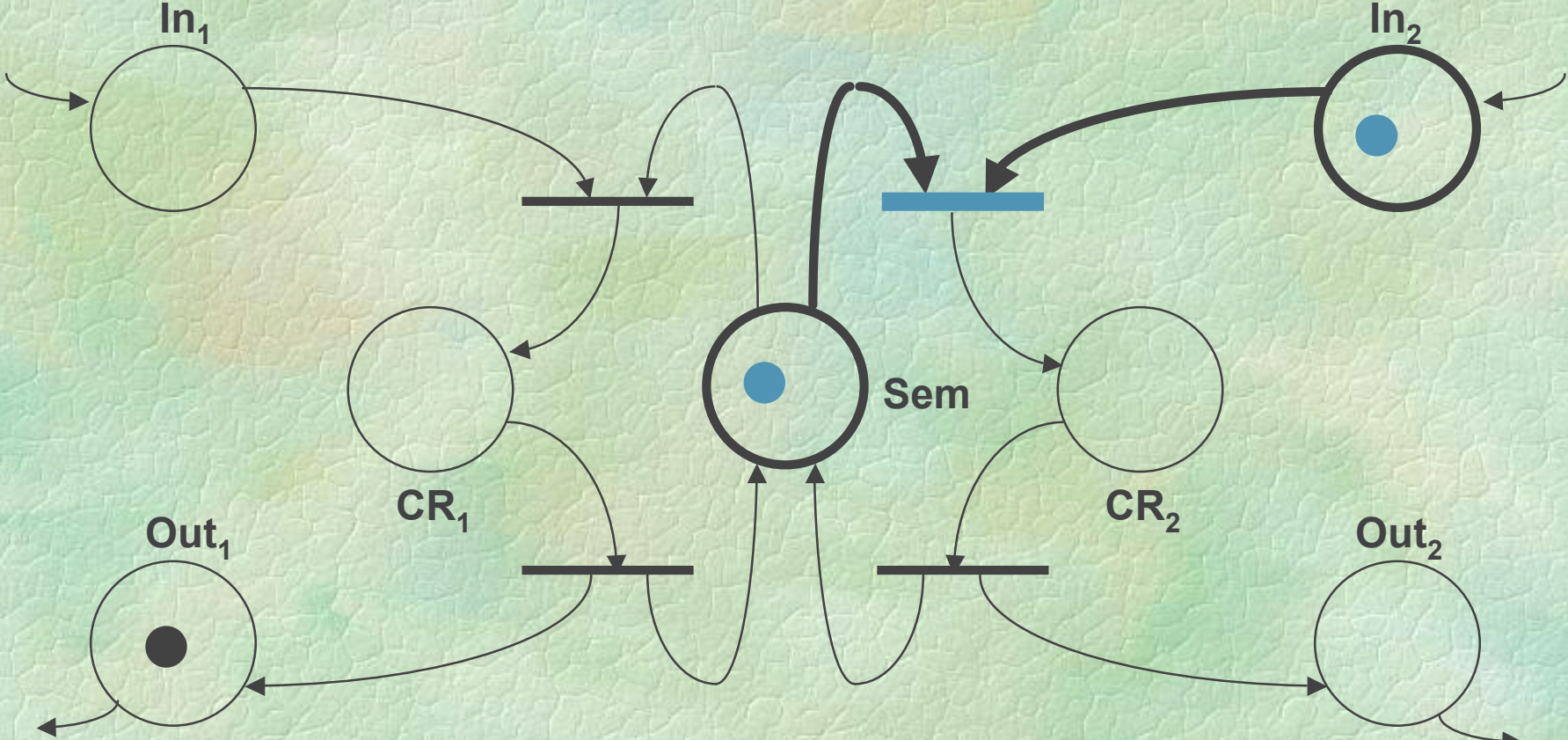
After Firing

In_1
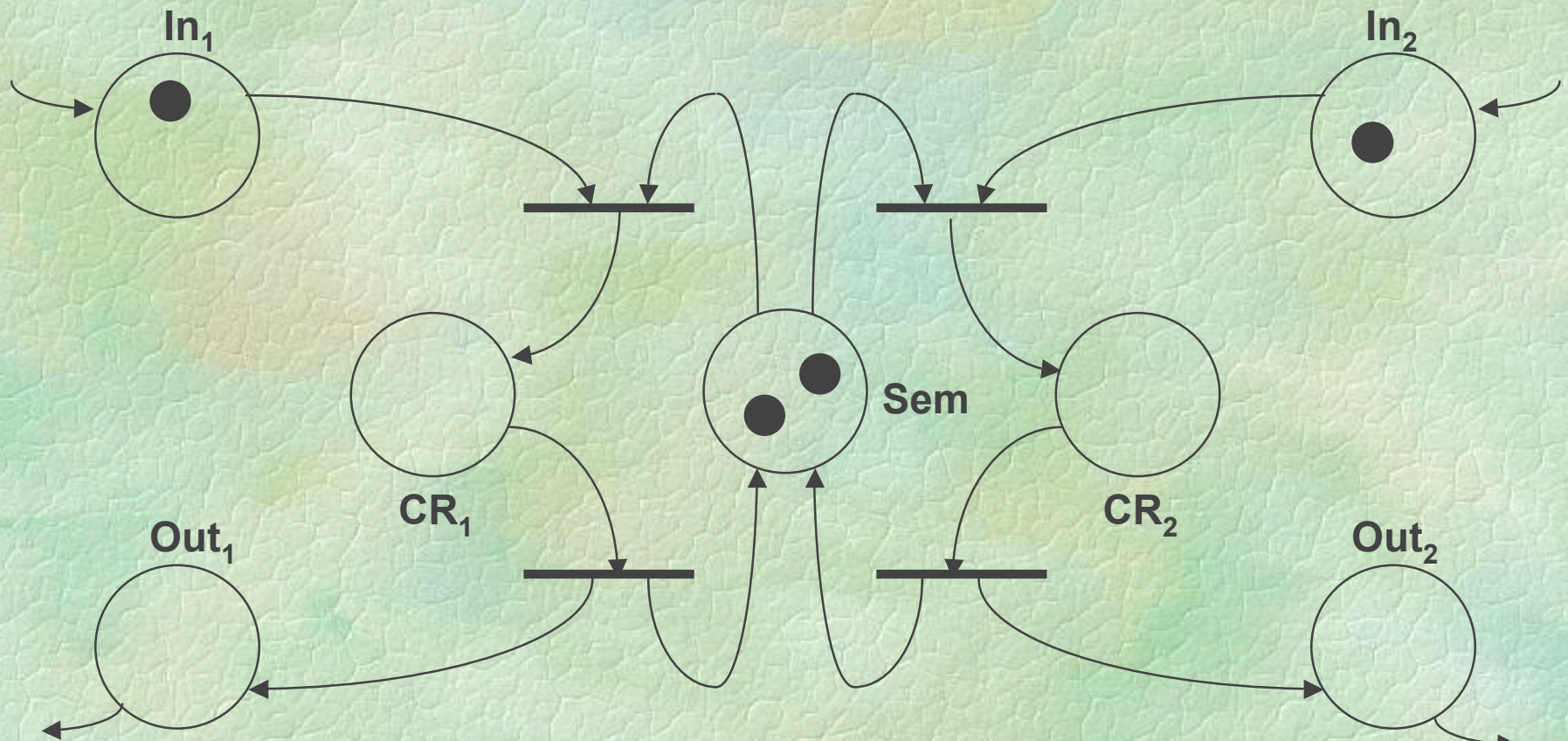
In_2

Sem

CR_1

CR_2
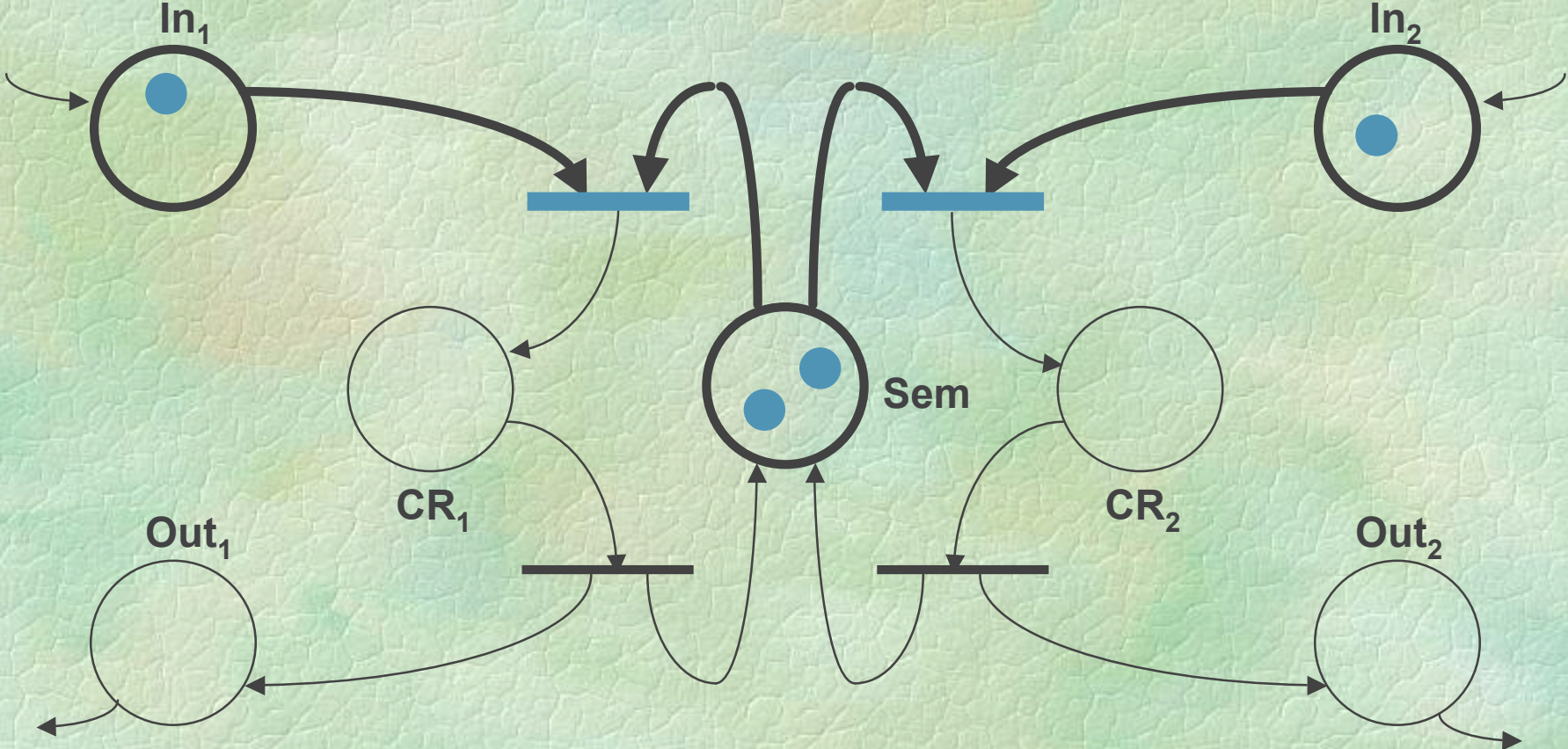
Out_1

Out_2
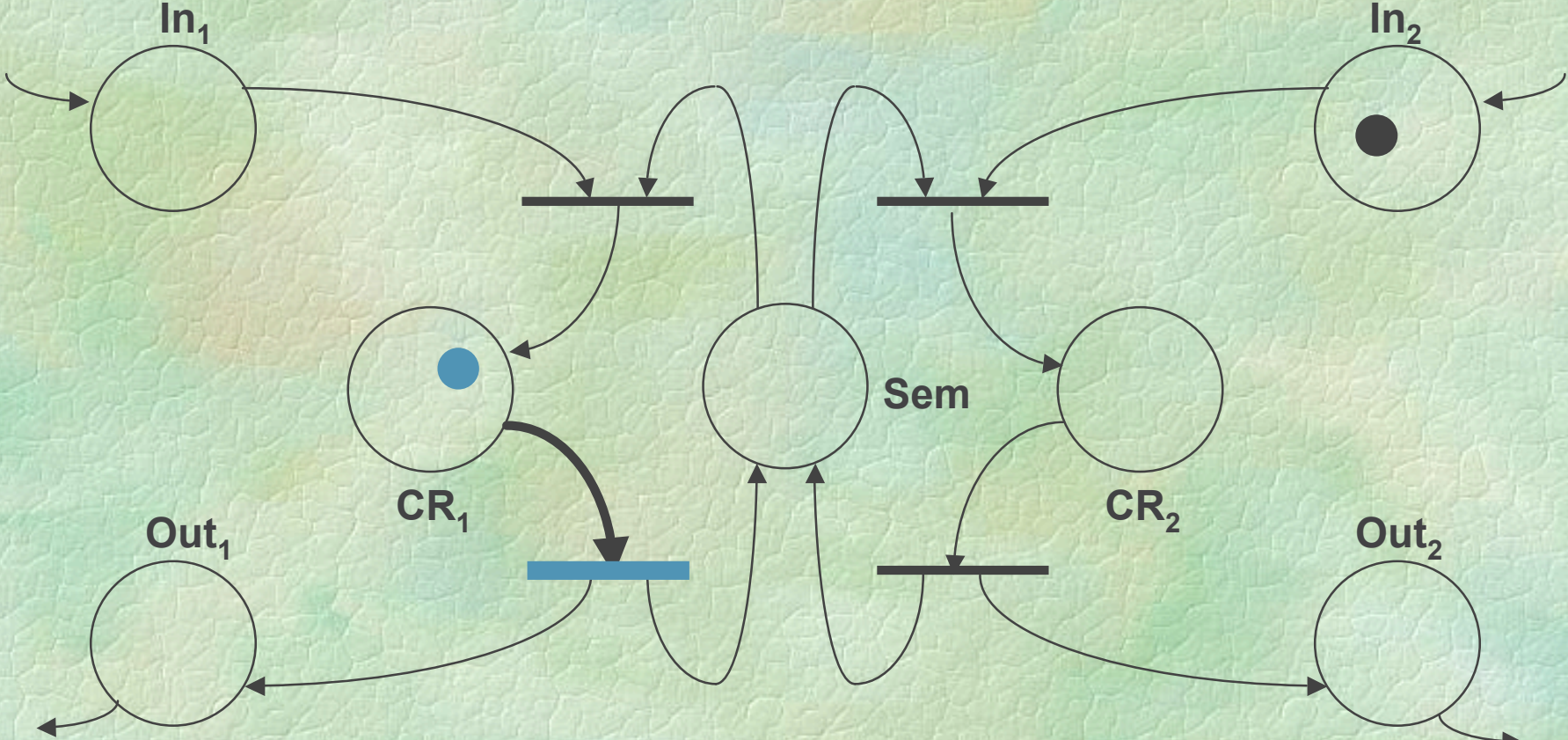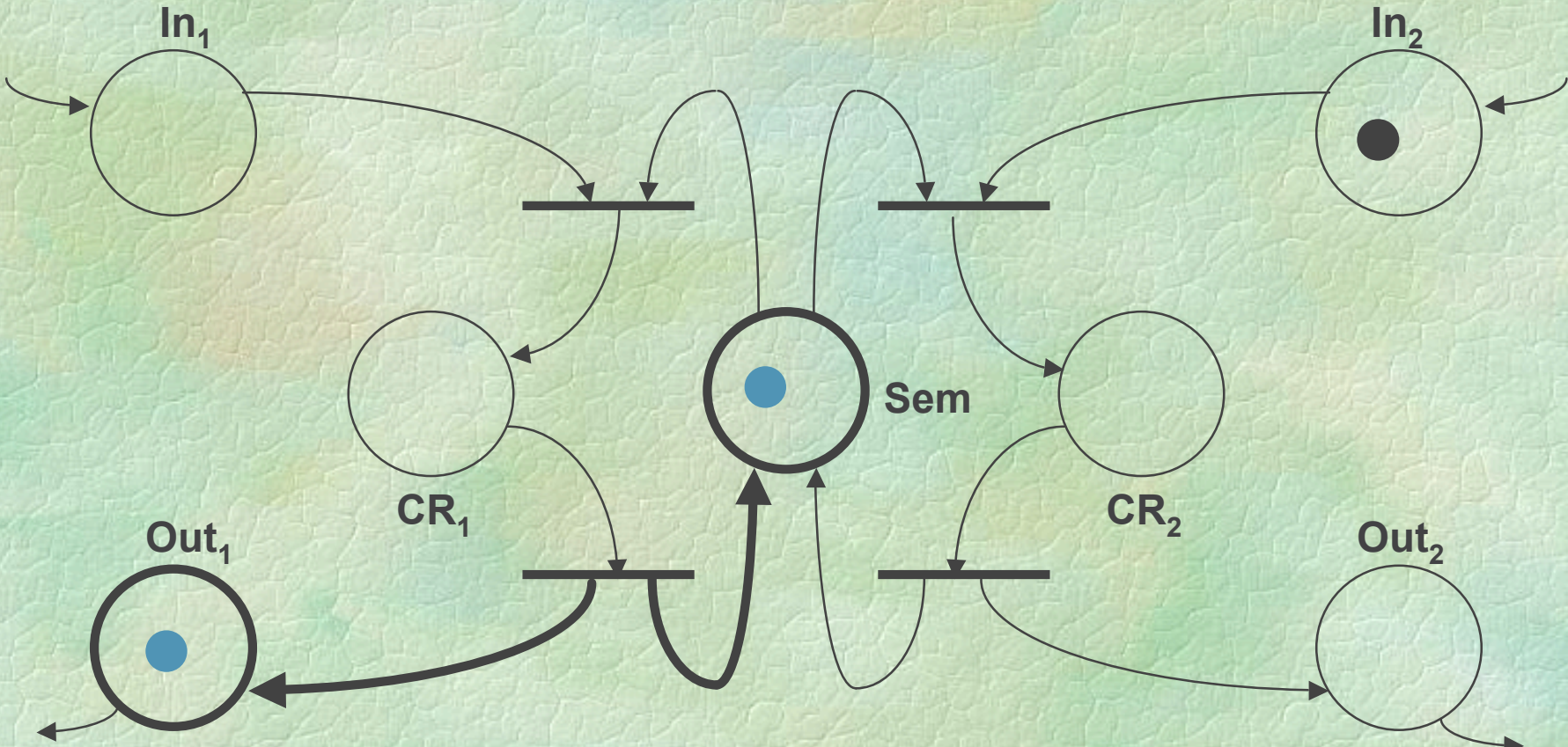
Enabled Transition

Breaking the Semaphore

➢ Lets look at the semaphore example again and see how a change to the initial marking will change the semantics of the Petri Net

- In particular, we will break the semantics of the semaphore by adding *one* token
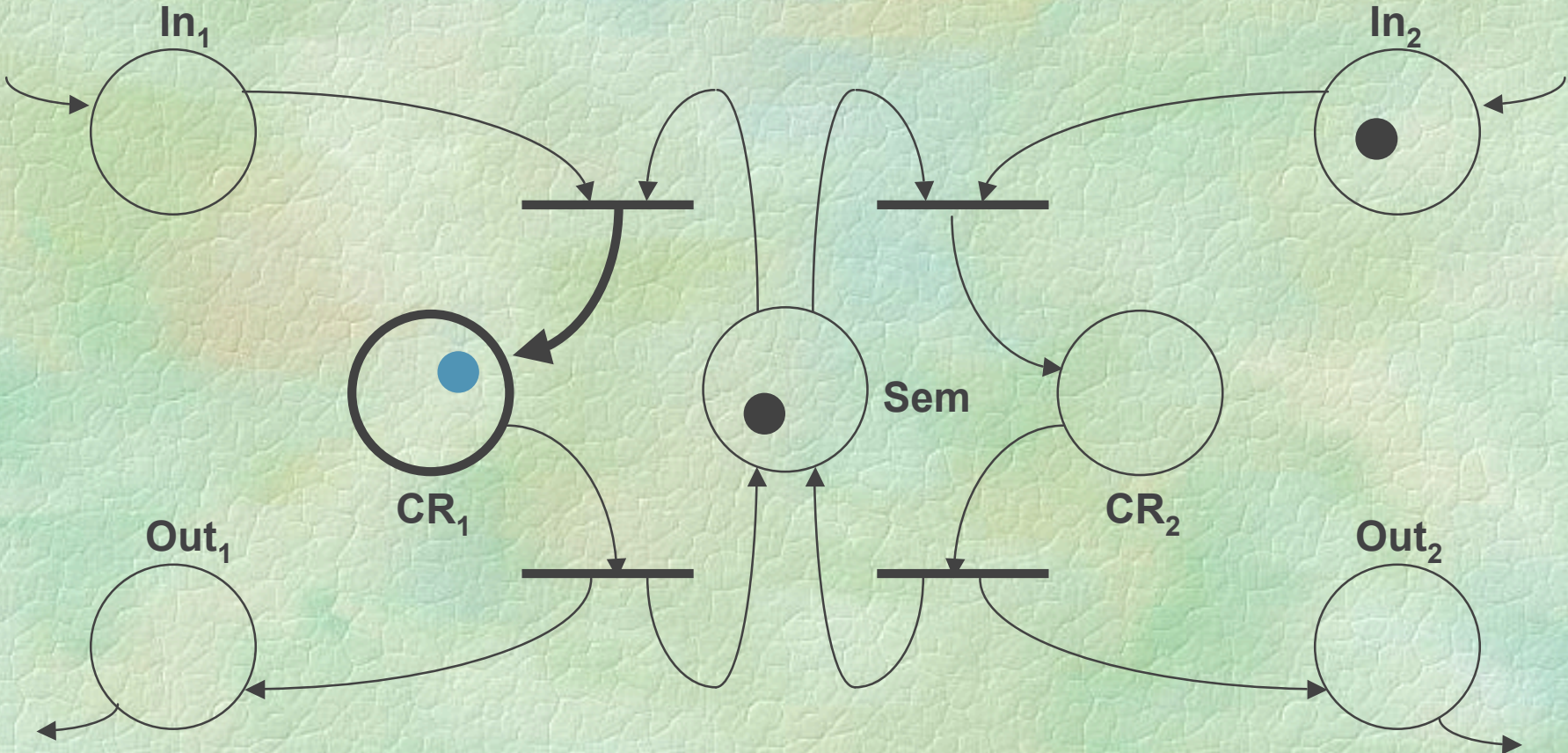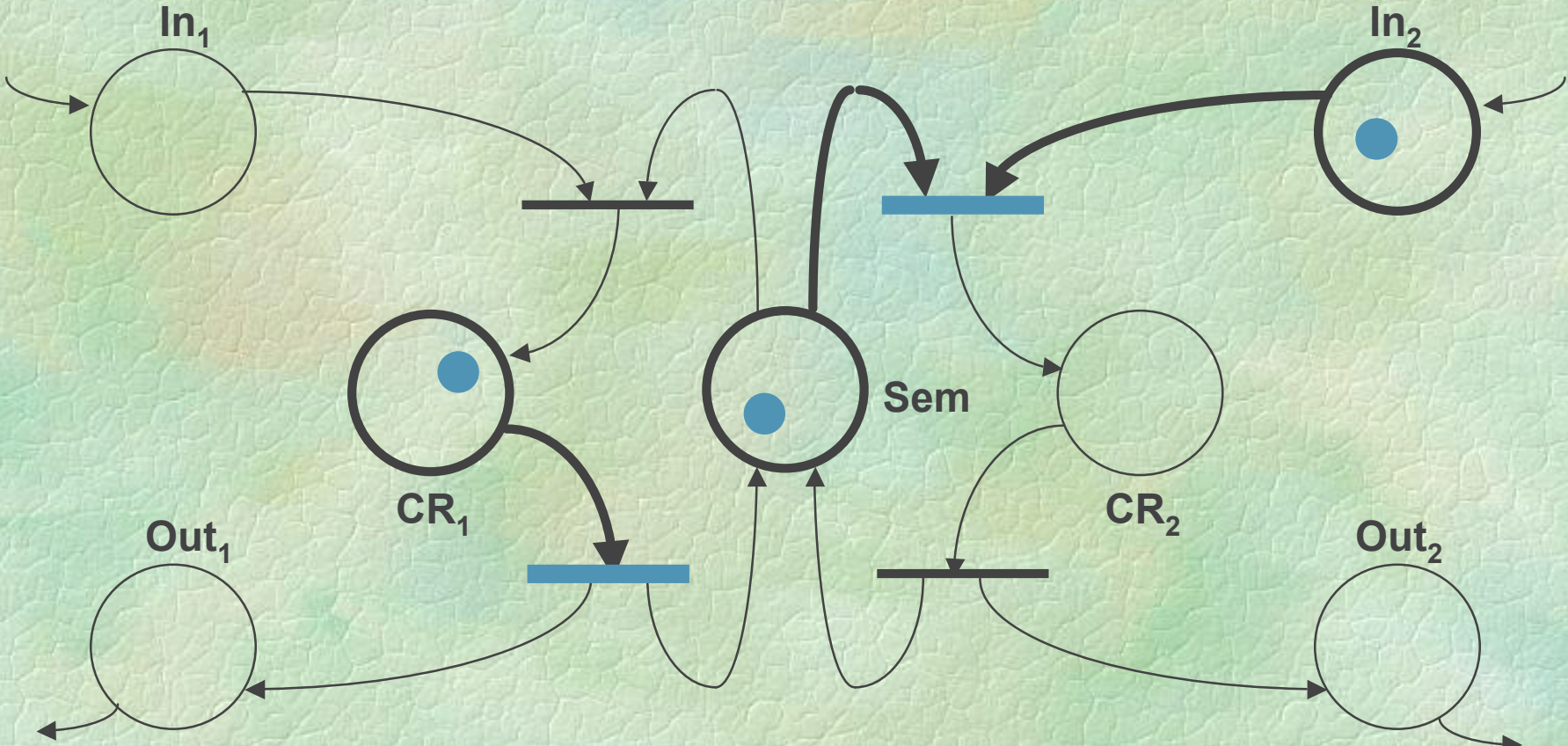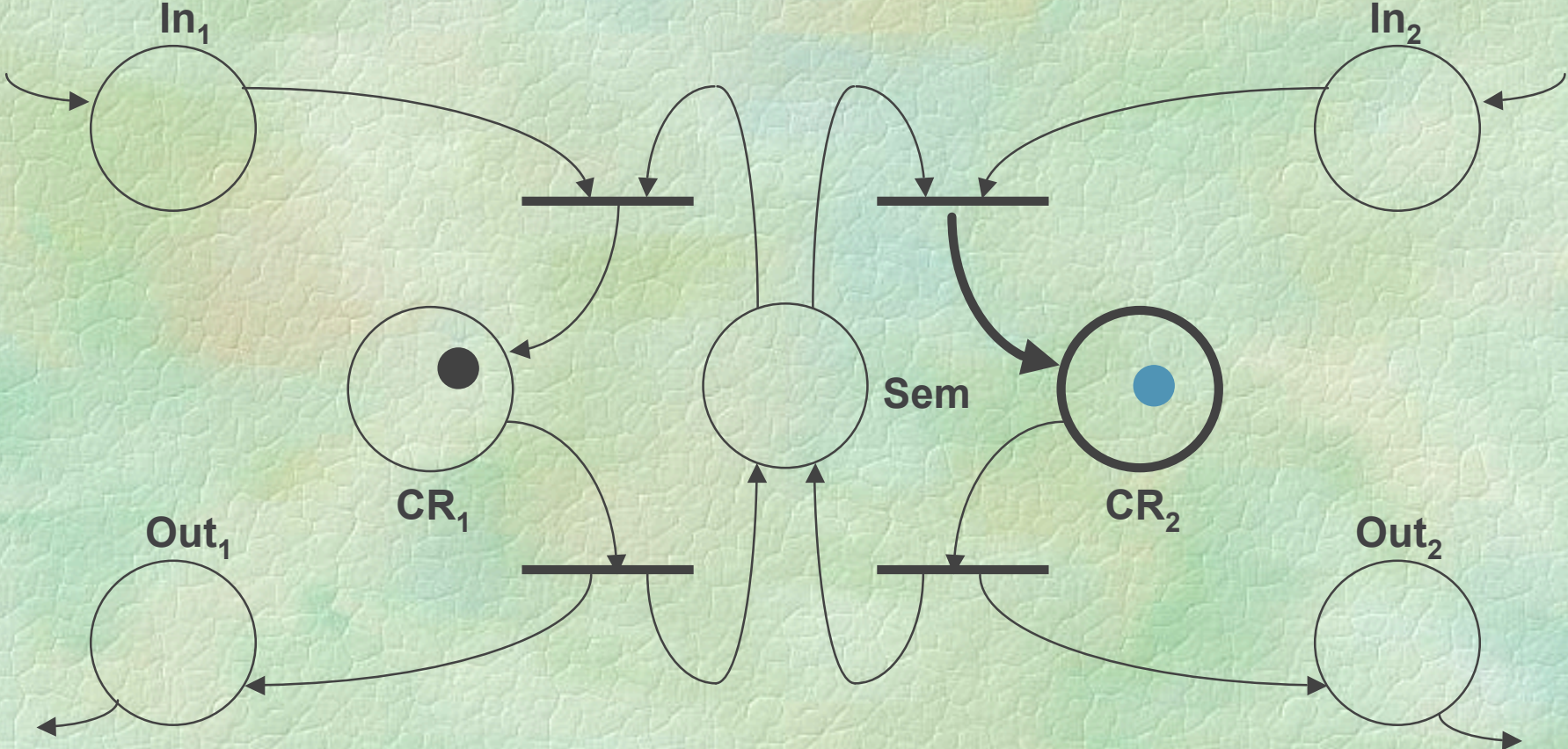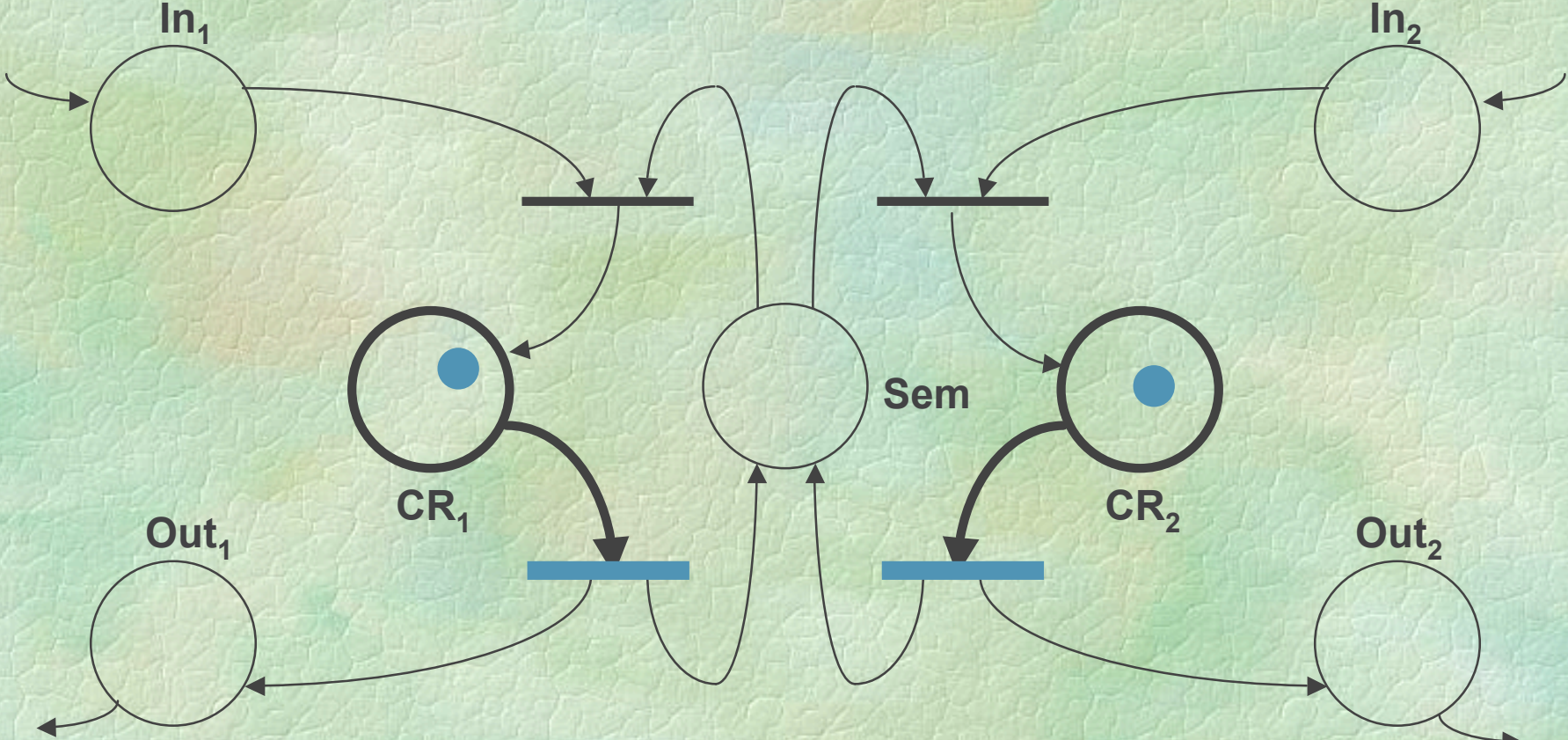
Petri Net Semaphore

Enabled Transitions

After Firing

Enabled Transitions

In_1

In_2

CR_1

Sem

CR_2

Out_1

Out_2

After Firing

Enabled Transitions

After Firing