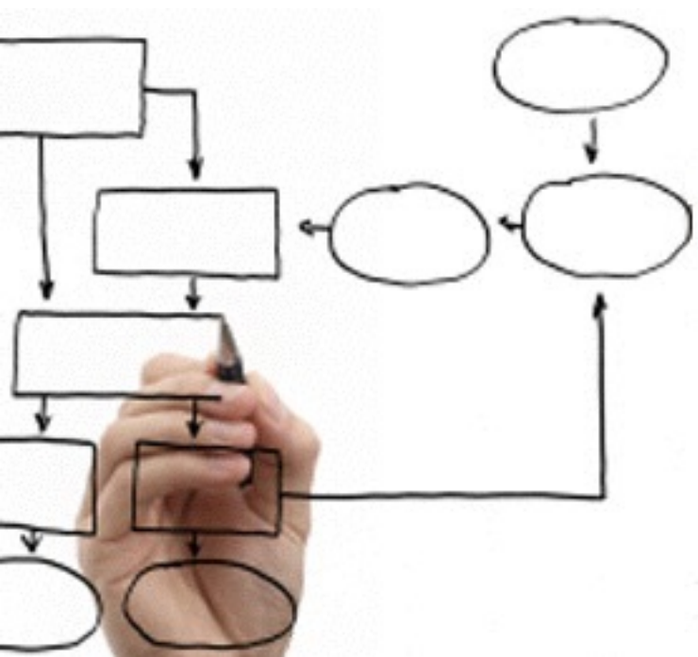
Methods for the specification and verification of business processes

MPB (6 cfu, 295AA)



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14 - Sound by construction

Object

We show a technique to build sound Workflow nets

Soundness proof by construction

Idea

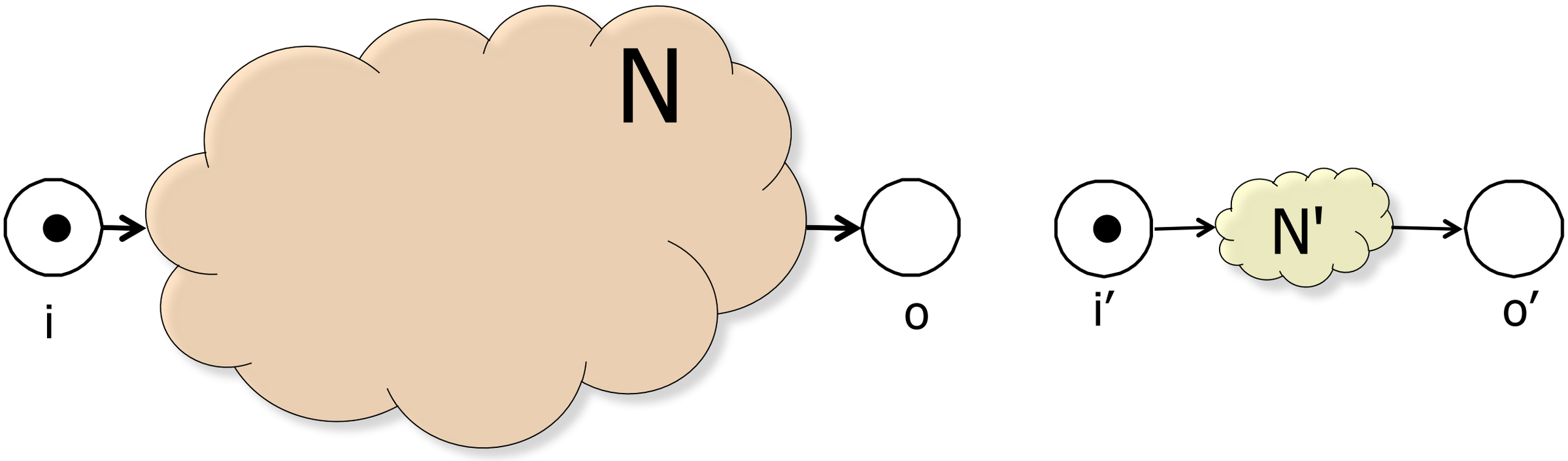
1. Find a suitable set of "building blocks"

they are (small) workflow nets that can be (easily) proved
to be sound
to be safe (1-bounded)

2. Define composition patterns so that
by composing safe and sound WF nets
we obtain safe and sound WF nets

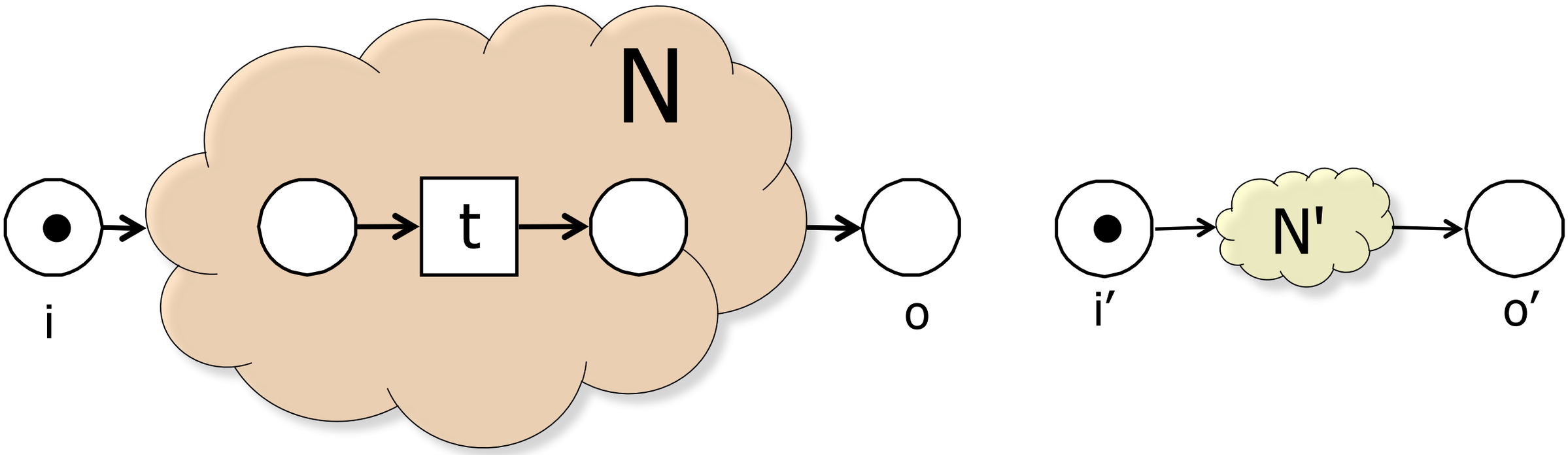
Sound and safe by composition

Let N, N' be two sound and safe workflow nets



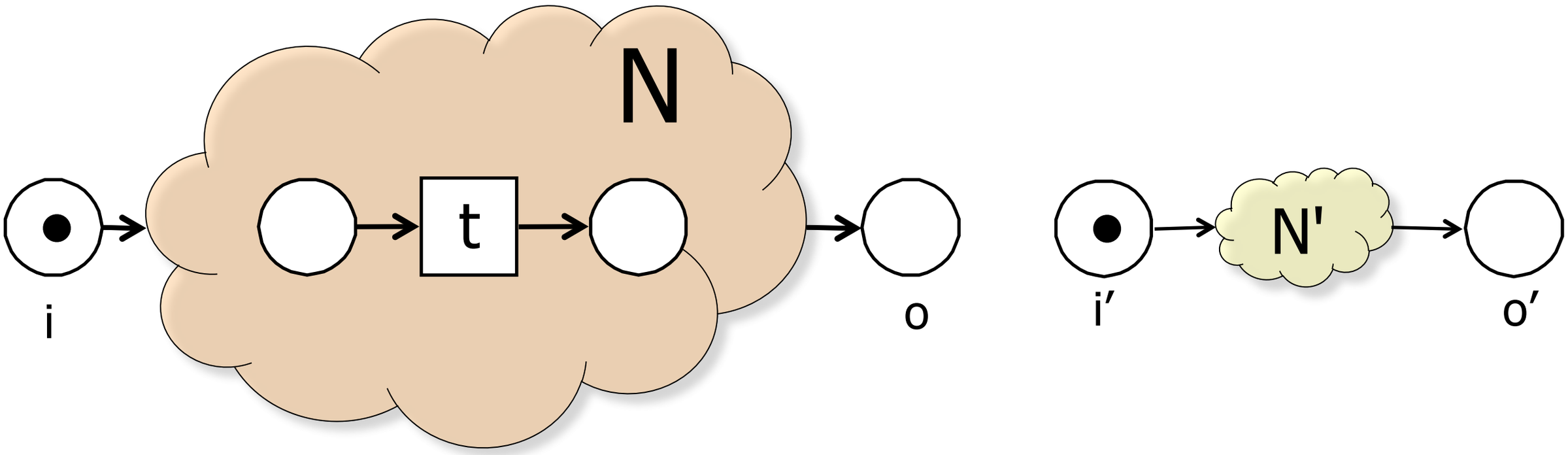
Sound and safe by composition

Let t be a task of N with exactly one input and one output place



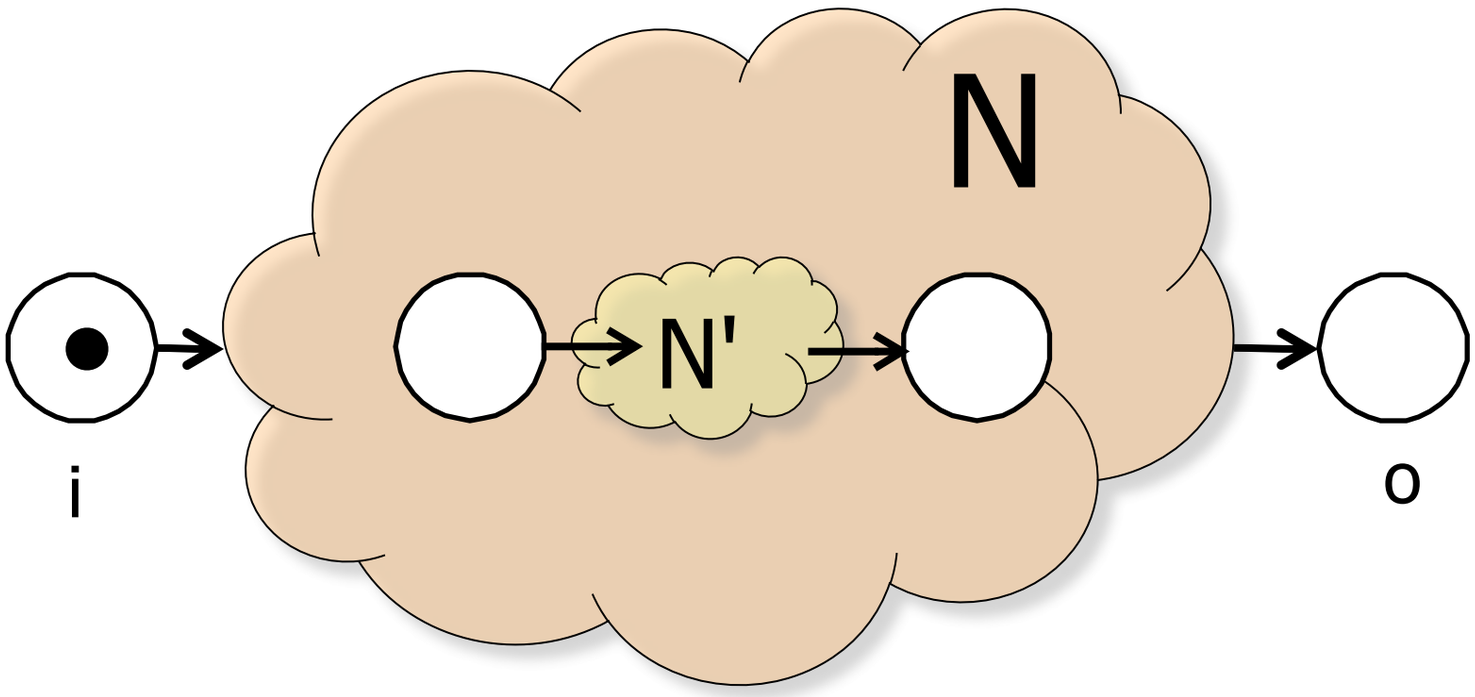
Sound and safe by composition

Let **N[N'/t]** denote the net obtained by replacing the task t in N by N'



Sound and safe by composition

The net **N[N'/t]** is
a **sound** and **safe workflow net**



Proof sketch

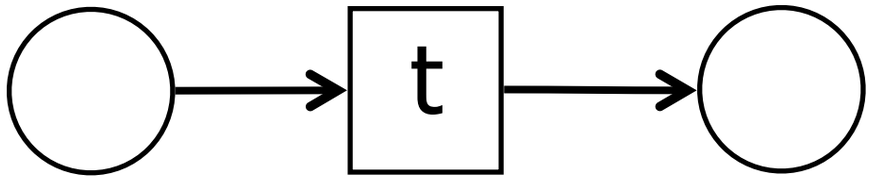
Intuitively

a sound workflow net behaves as a transition:
it takes one token from its input place and
it produces one token to its output place
(but not atomically)

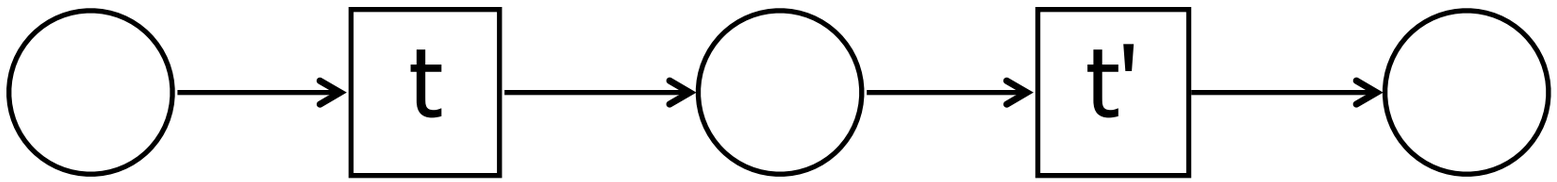
Formally

the crux of the proof is showing a bijective correspondence between
markings of the composed net N[N'/t]
and the pairs of markings in N and N'

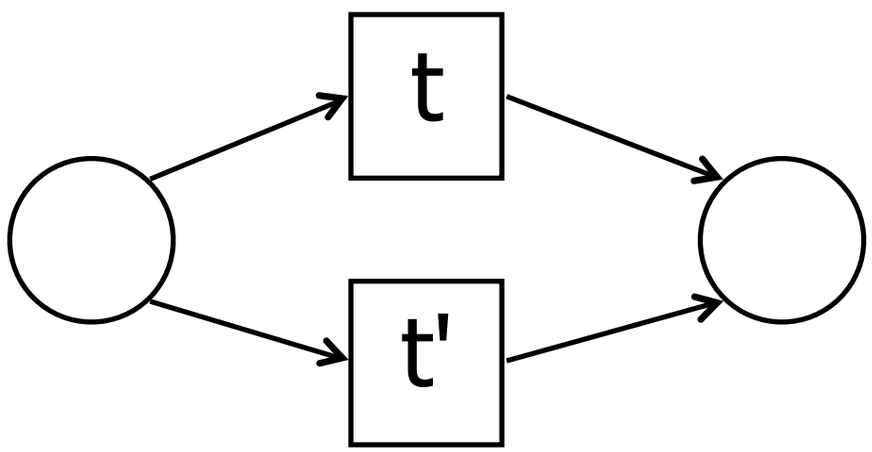
Some Building Blocks 1



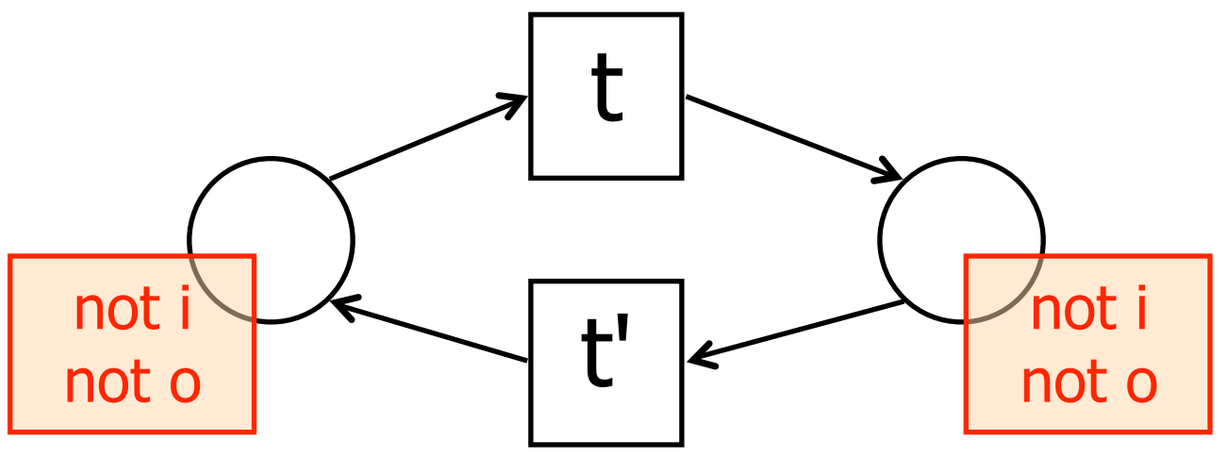
basic



sequence

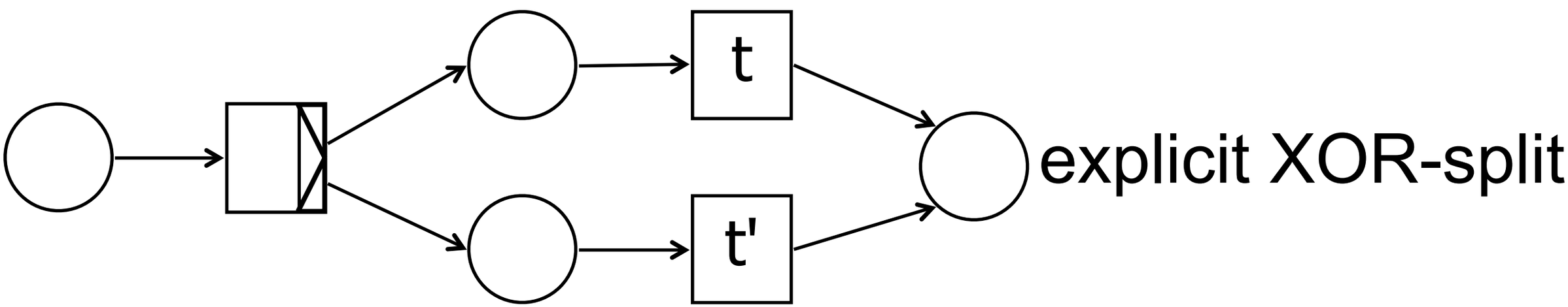


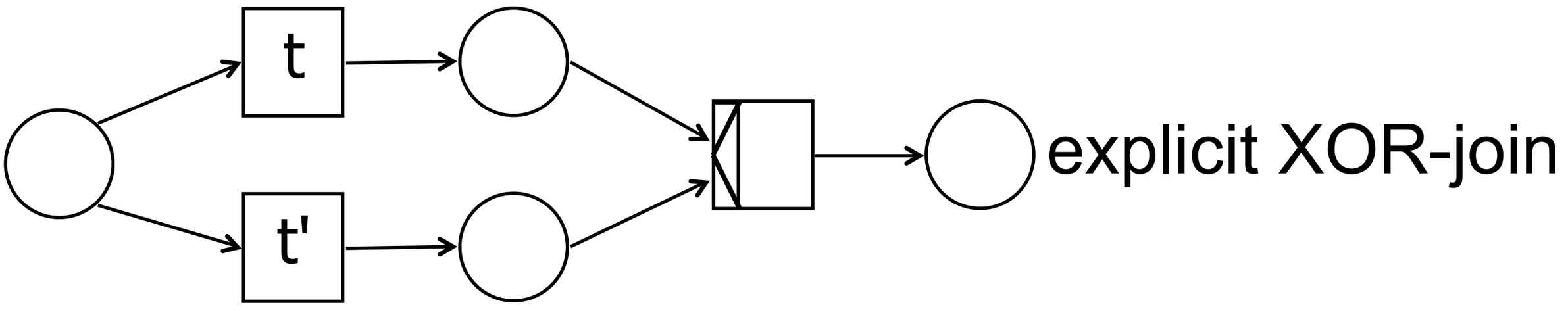
implicit XOR



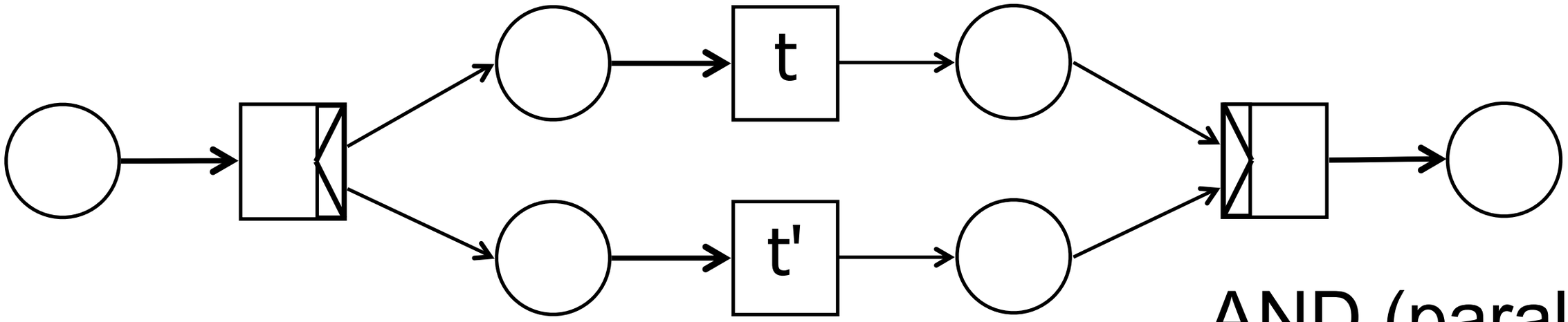
iteration

Some Building Blocks 2





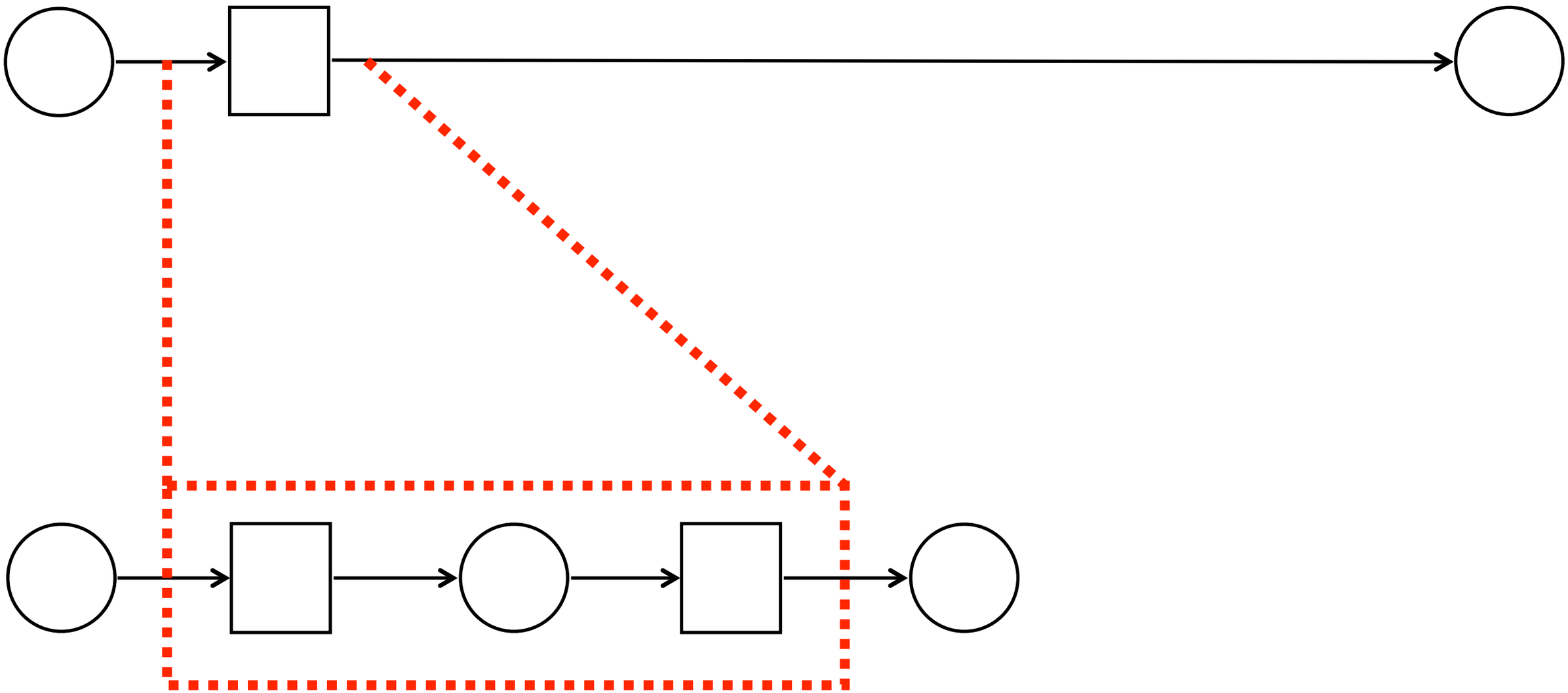
Some Building Blocks 3



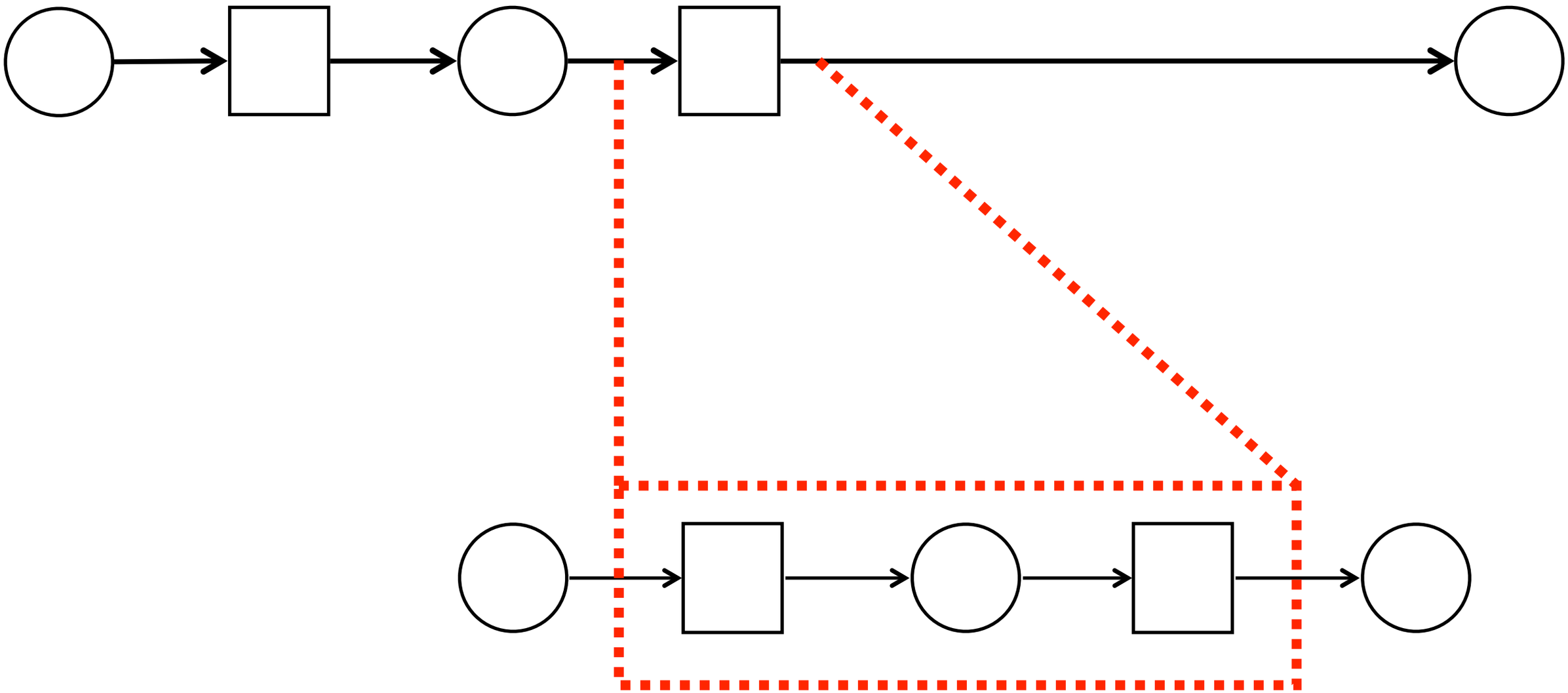
AND (parallel)

But you can define more blocks on your own

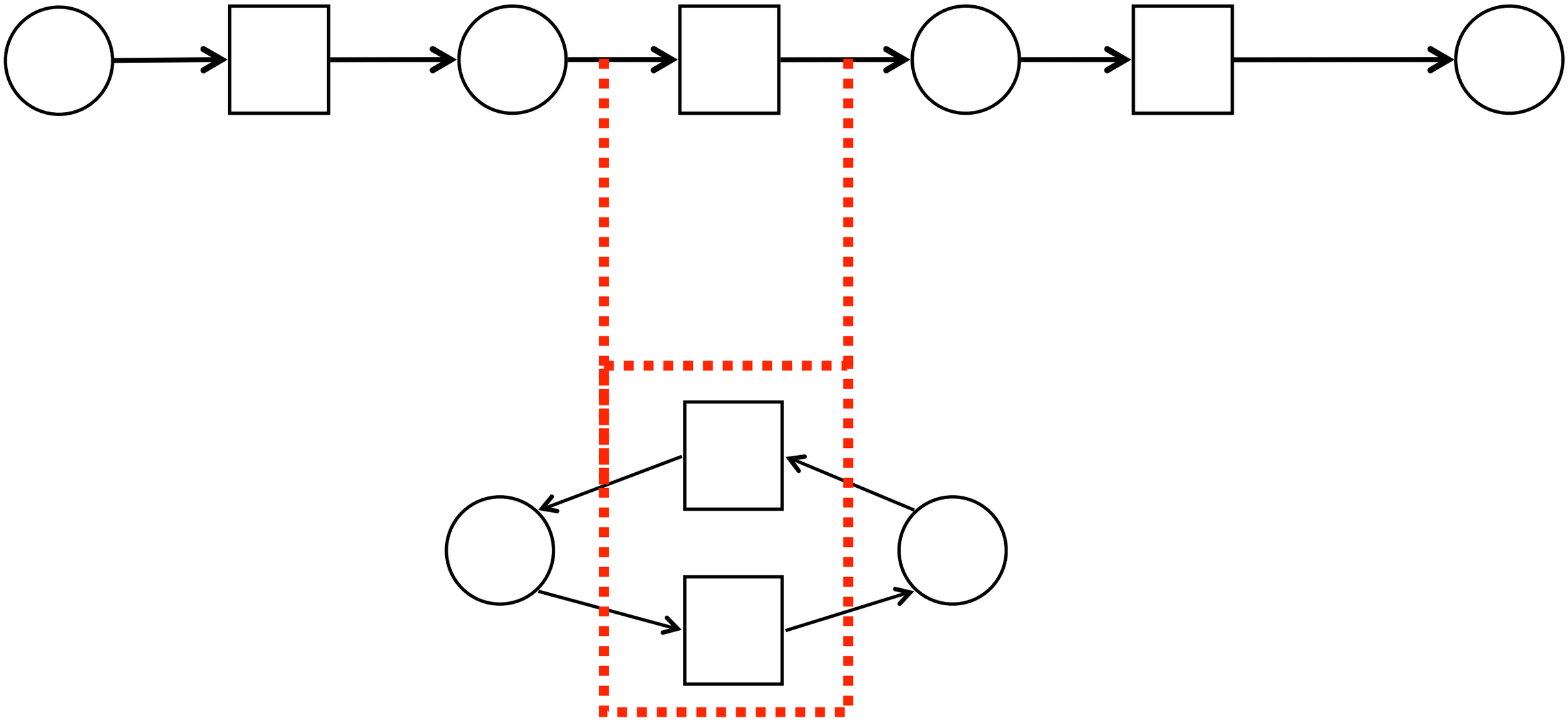
Example



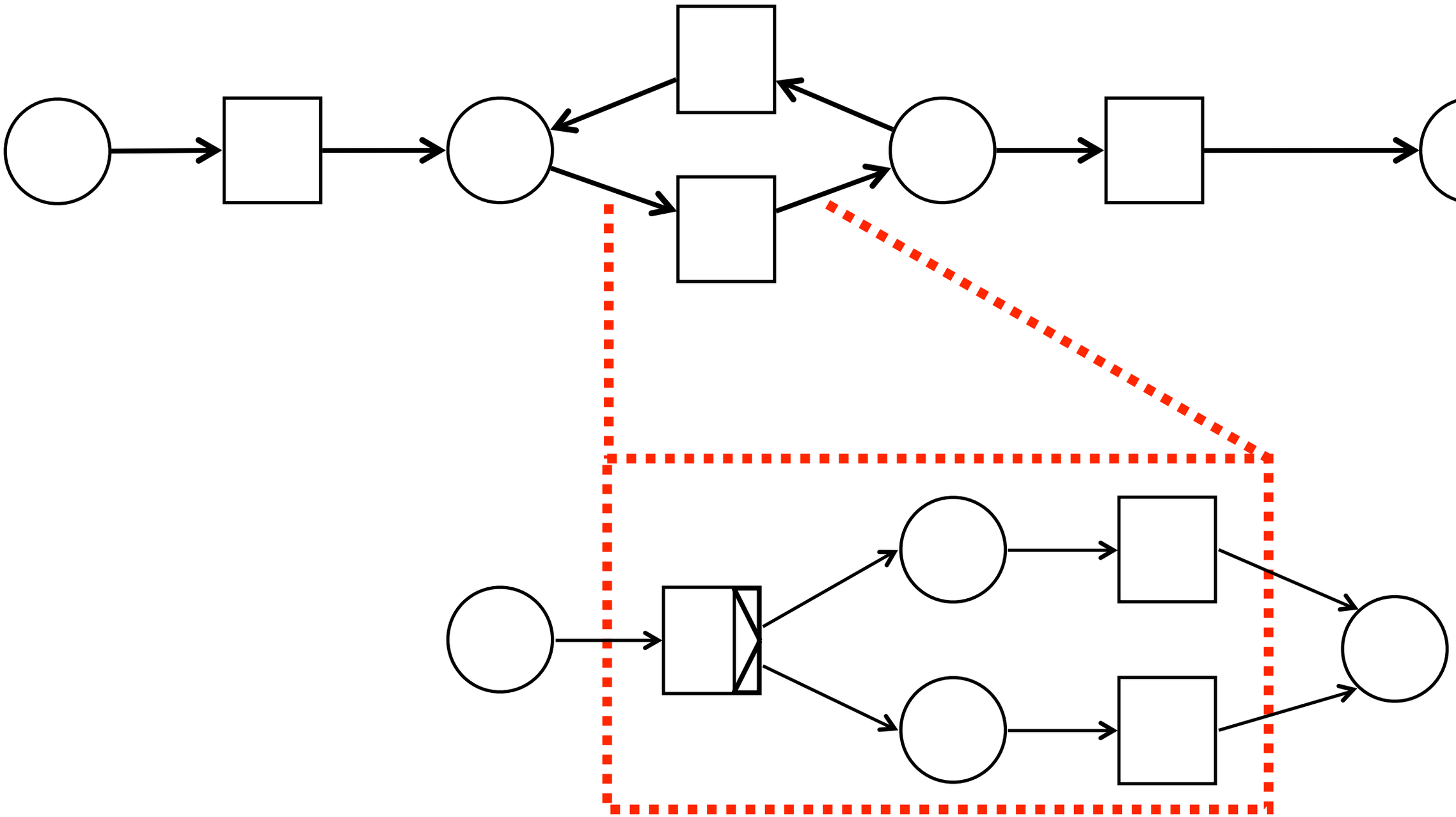
Example



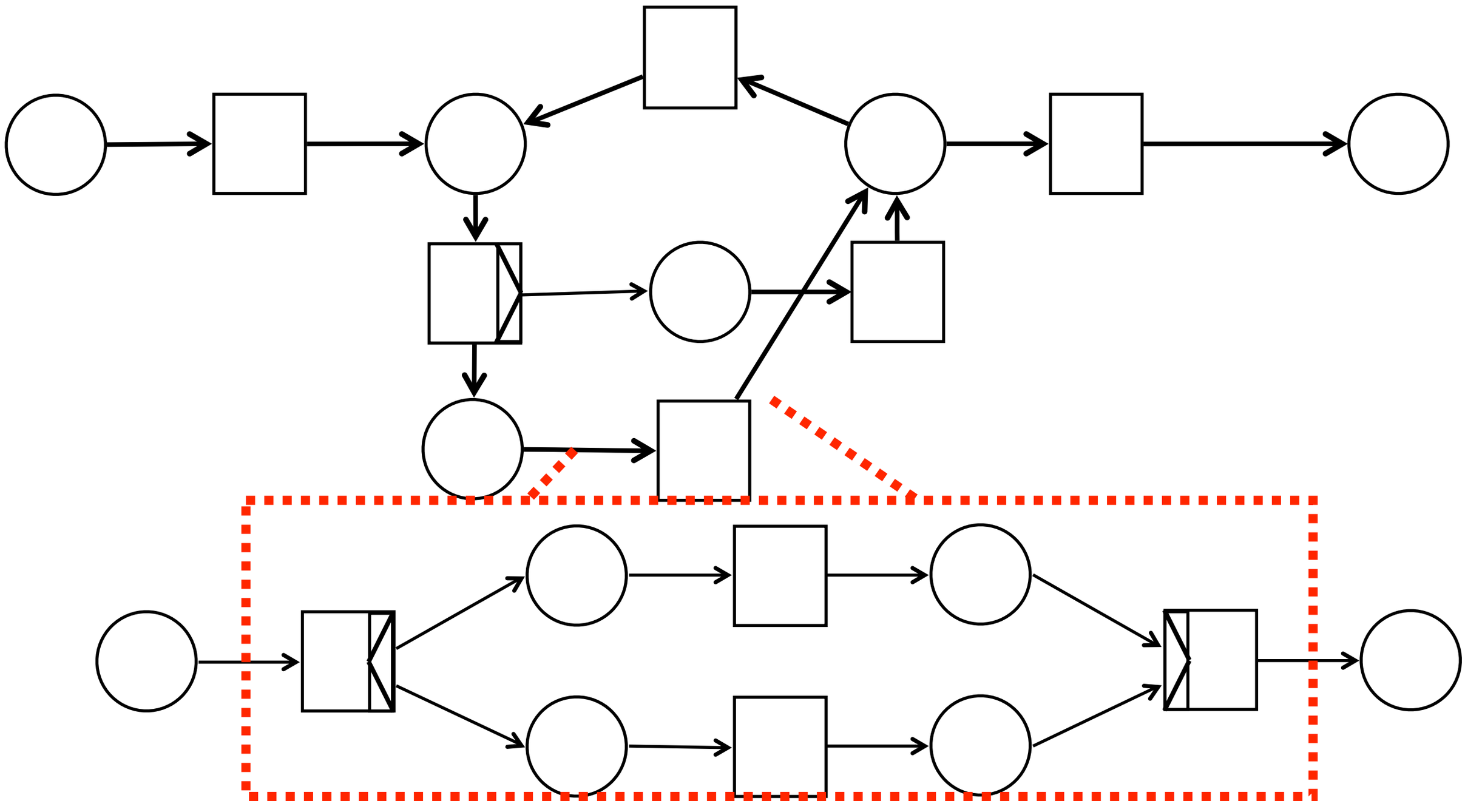
Example



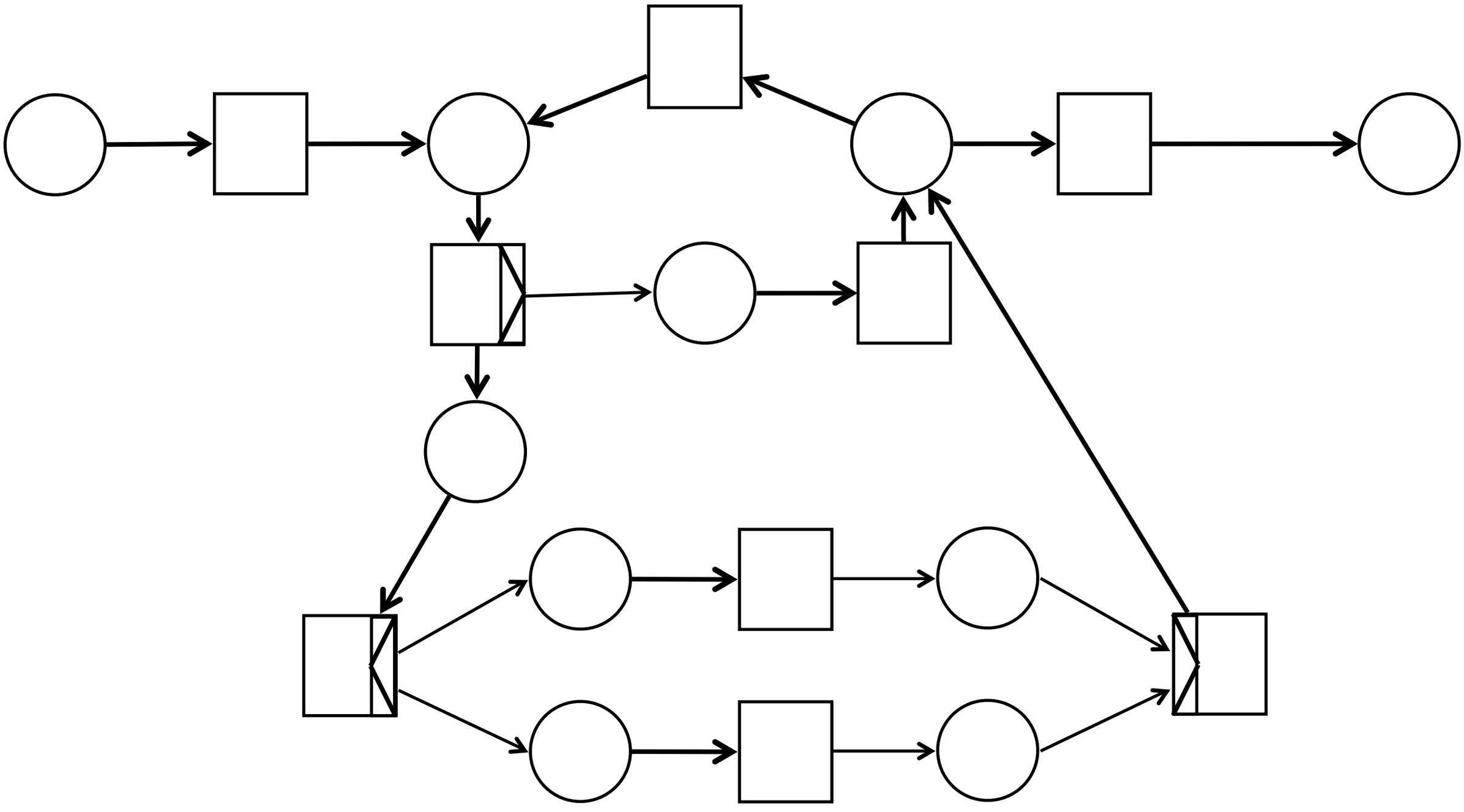
Example



Example

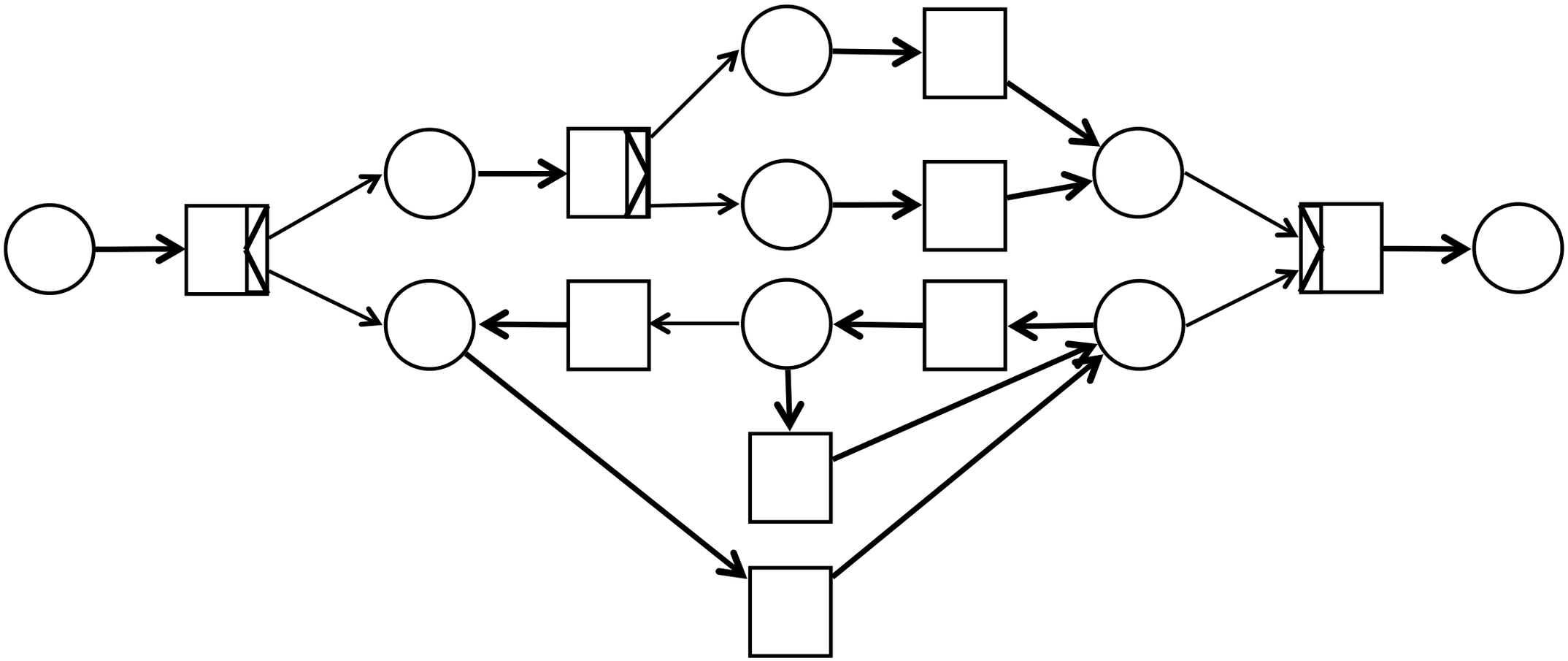


Example



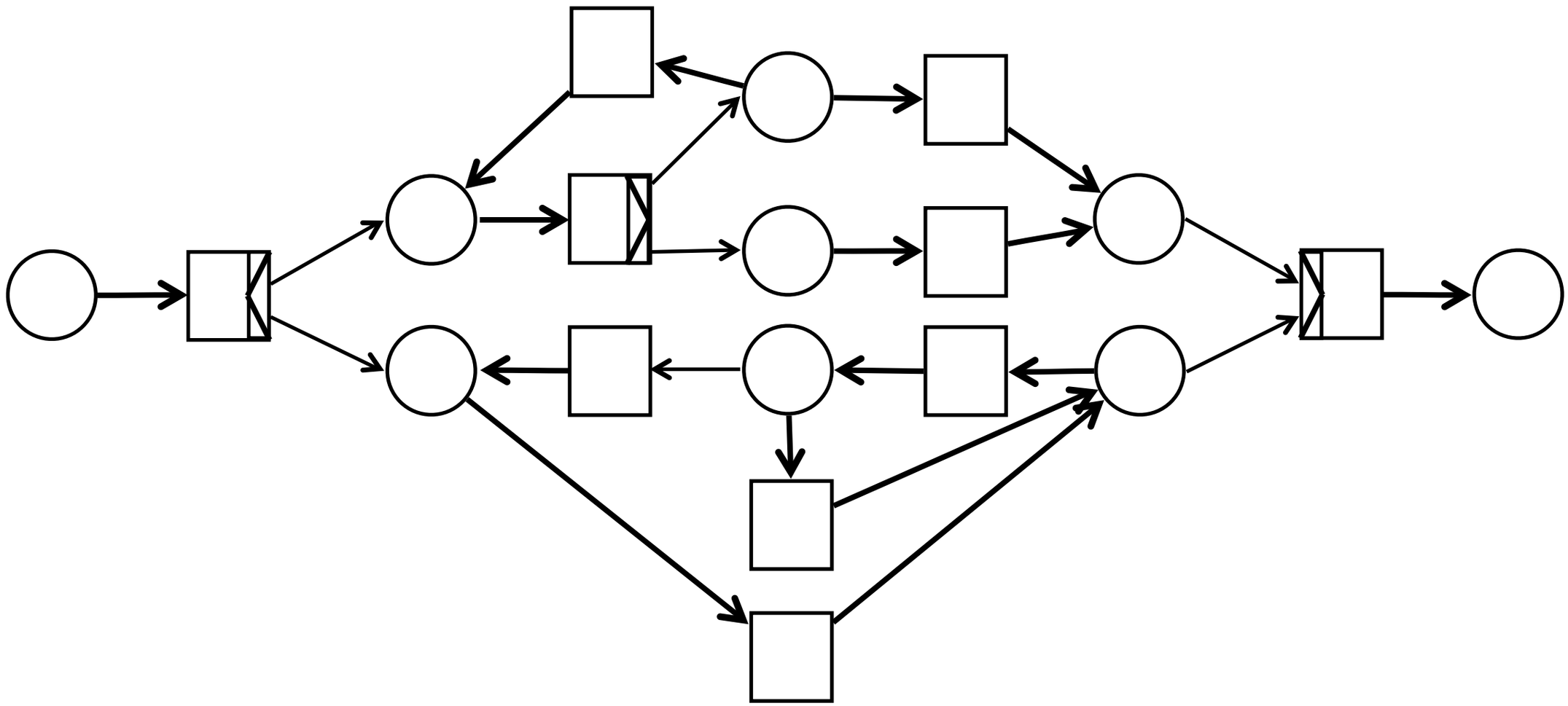
Exercise

Prove that the net below is
a safe and sound workflow net



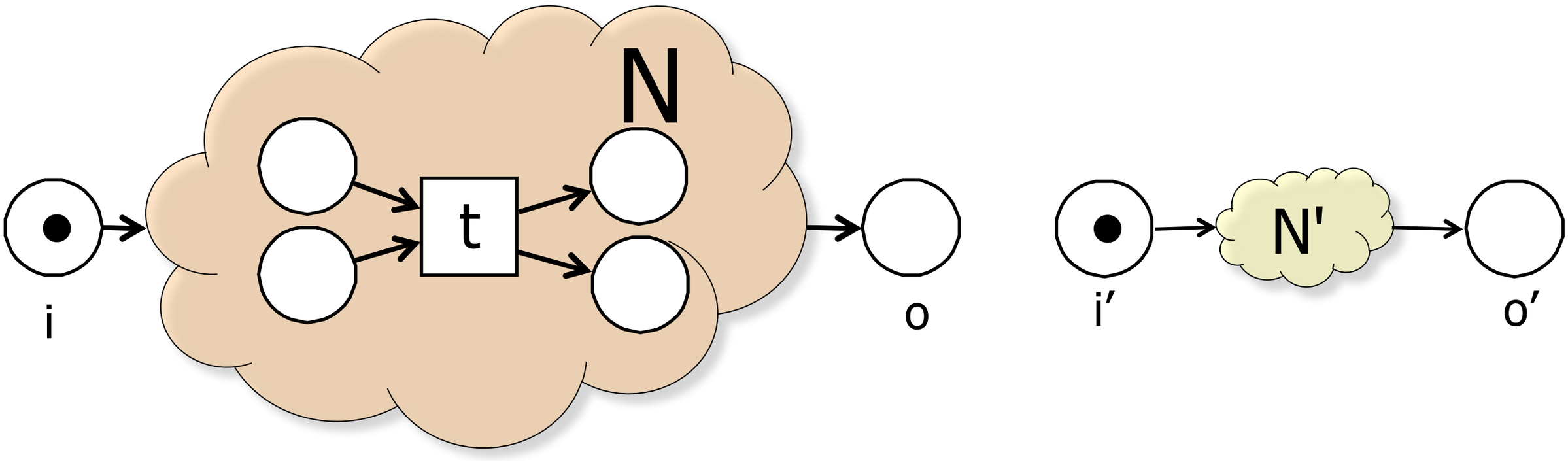
Exercise

Prove that the net below is
a safe and sound workflow net (hint: "desugar" it)



Generalization

We would like to progressively refine transitions with multiple incoming and outgoing arcs



Two facts

Lemma: Let N be a sound WF net.
If $(i,t) \in F$ then the pre-set of t is {i}

(otherwise t would be a dead transition)

Lemma: Let N be a sound WF net.
If $(t,o) \in F$ then the post-set of t is {o}

(otherwise t would be dead or proper completion would not hold)

General replacement

Let $T_{i'} = \{\, u \mid \bullet u = \{i'\} \,\}$.
Let $T_{o'} = \{\, v \mid v \bullet = \{o'\} \,\}$.

If $(p,t) \in F_N, u \in T_{i'}$ then $(p,u) \in F_{N[N'/t]}$

If $(t,q) \in F_N, v \in T_{o'}$ then $(v,q) \in F_{N[N'/t]}$