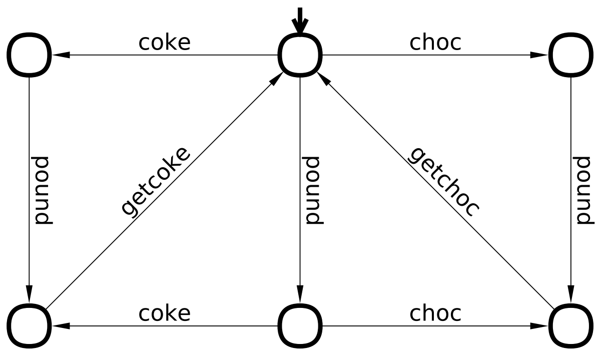
Workcraft

Concurrent vending machine

FSM modelling

The following FSM models a Concurrent Vending Machine that allows the user to insert a £1 coin (action `pound`) concurrently with making an order (actions `coke` and `choc`). Note that the concurrency between actions `pound` and `coke` as well as `pound` and `choc` is represented by interleaving – there are two corresponding *diamonds* in this FSM, and the layout is chosen so as to highlight them. Re-create it in Workcraft.



Simulate your model to make sure that the concurrent actions can happen in any order, and that the Vending Machine processes the orders correctly.

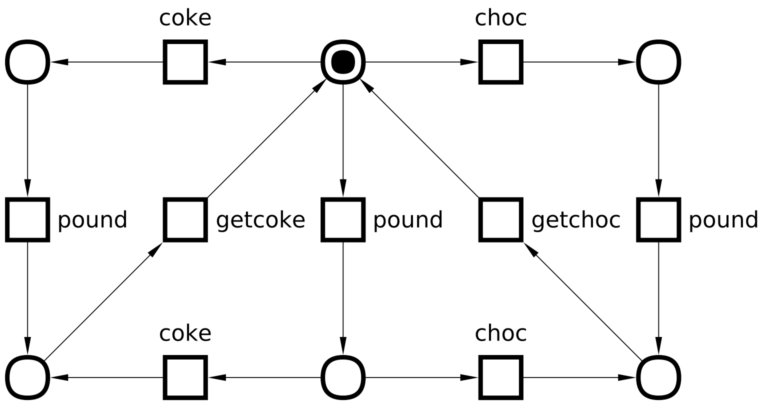
Formally verify whether the FSM

- has deadlocks
- has unreachable states
- is reversible
- is deterministic

From FSM to Petri net and back

Simple conversion

FSMs can be considered as a special case of Petri nets where each transition has exactly one incoming and one outgoing arcs and the initial marking consists of one token. In particular, any FSM can be automatically converted to a Petri net by replacing its states with places, arcs with transitions, and putting a single token on a place corresponding to the initial state. Perform this conversion in Workcraft using the *Conversion→Petri Net* menu item:

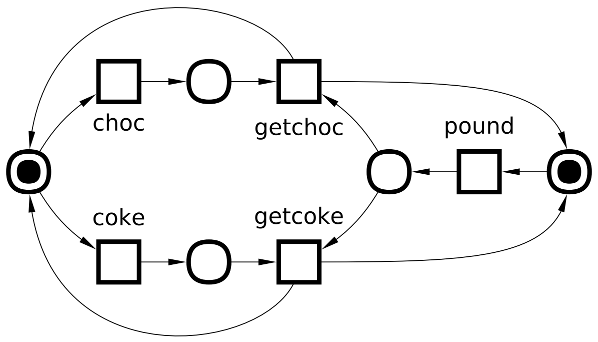


Simulate your model and make sure that it is equivalent to the above FSM model, in particular the executions are the same. Also, formally verify that it is still deadlock-free (the other properties given above for the FSM either do not make sense in the Petri nets context, or are not supported yet). Pragmatically speaking, this Petri net model does not offer any advantage over the original FSM model:

- It is larger than the original FSM (if we take the total number of nodes and arcs as the measure).
- Concurrency is still modelled as interleaving. Note that modelling concurrency by interleaving is natural in FSMs, but unnatural in Petri nets, where concurrent transitions would be a superior way of modelling concurrency.

PN synthesis

A better Petri net can often be obtained from the initial FSM model by the process called *synthesis*. It is a much more complicated procedure than the one outlined above, but it can be automated. Starting from the original FSM, synthesise a Petri net with the same reachability graph as this FSM using the *Conversion→Net synthesis [Petrify]* menu item. You can manually improve the graph layout, as shown below. Note that transitions `pound` and `coke` as well as `pound` and `choc` are now truly concurrent.



Simulate this Petri net, to make sure that it is equivalent to the original FSM model, and formally verify its correctness properties.

Reachability graph

Construct the reachability graph of this Petri net (*Conversion→Finite State Machine [Petrify]* menu item). Make sure that this reachability graph is the same as the original FSM (you will need to do manual layout to make it look like the original FSM).