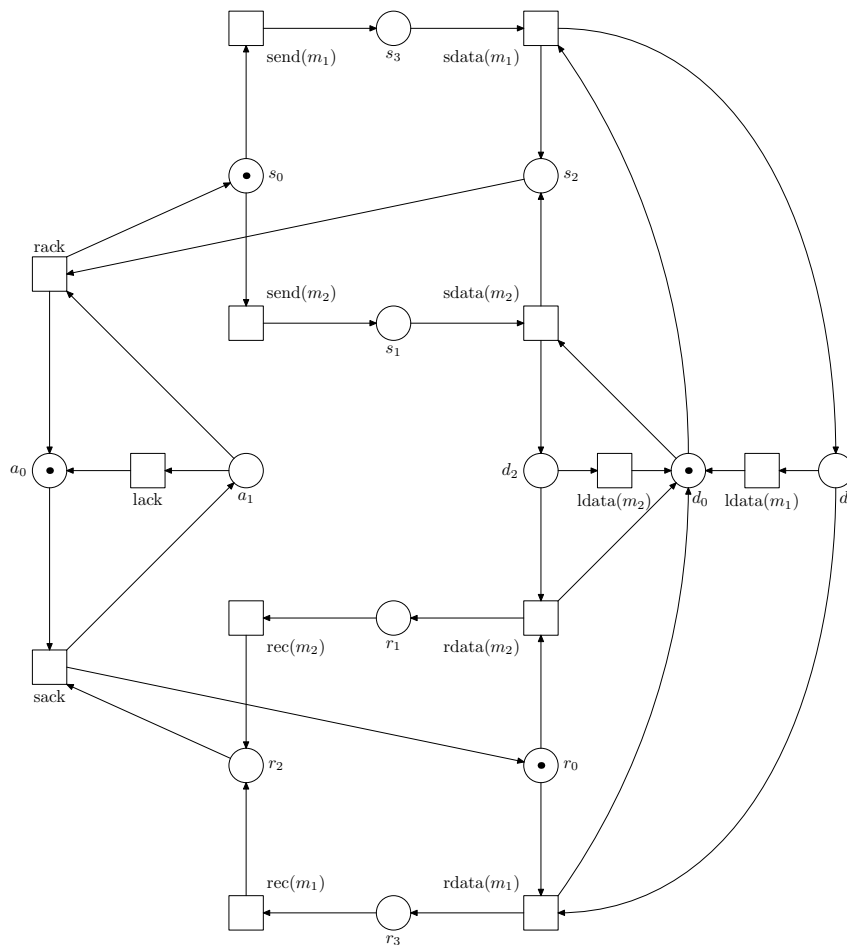
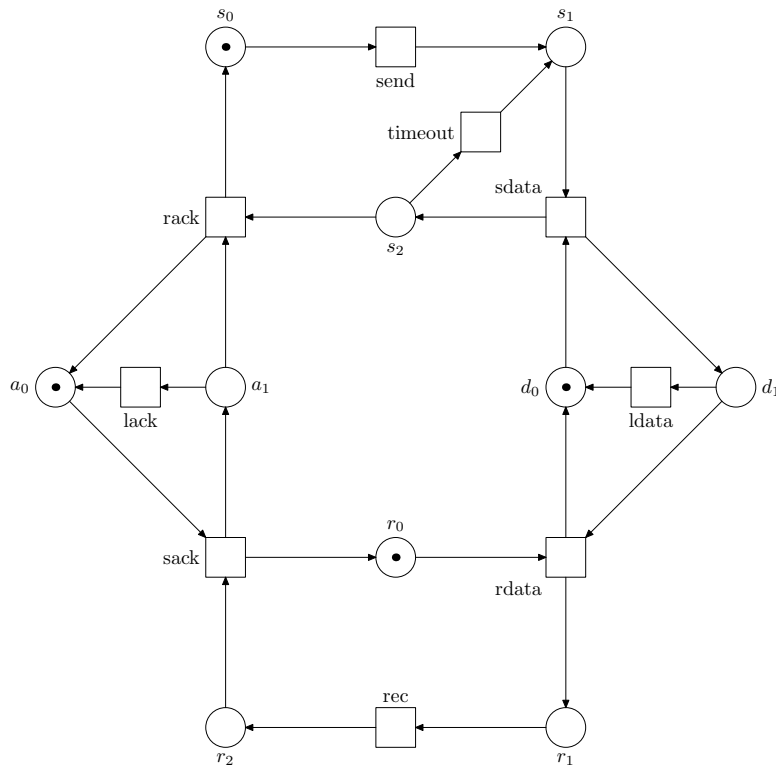


1. Consider the following Place/Transition net models of a simple data transmission protocol. The $\text{send}(m_x)$ transitions model the request to the protocol to send a message x , and the $\text{rec}(m_x)$ the act of delivering the message.



- (a) Compute the reachability graph of the net.
- (b) Is the delivery of a message guaranteed? Can the receiver receive the message several times even if it has been sent only once? Can the model deadlock?
- (c) Can you think of any ways of abstracting away unnecessary details from the protocol model?

2. The model is modified by the addition of a timer transition (transition called “timeout”). (Note: We do NOT have a notion of time in Place/Transition nets, so the modelling is an approximation of “real world timer” behavior.) We also make the model a bit more abstract by removing the message identities. We obtain the following Place/Transition net.



- (a) Does the protocol now work “correctly”? (I.e., redo the analysis done for the first model with the modified model.)
- (b) Remove the transitions “ldata” and “lack” from the model to model a case where we have a reliable channel, but where the timer can still fire. (I.e., model the real-life case where the timeout might have been set to too low a value?) Does the protocol in this case work “correctly”? (I.e., redo the analysis done for the first model with the modified model.)