5

State Modeling

5.1 Figure A5.1 shows a state diagram for an extension ladder. You could also include states for the ladder fully extended and fully contracted.

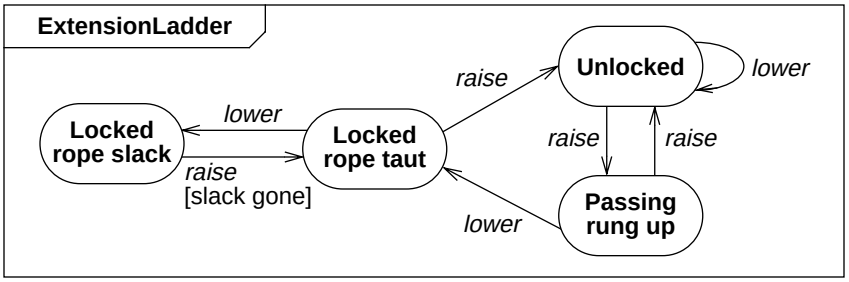

Figure A5.1 State diagram for an extension ladder.

5.2 In Figure A5.2 the event *A* refers to pressing the A button. In this diagram, releasing the button is unimportant and is not shown (although you must obviously release the button before you can press it again). Note that a new button event cannot be generated while any button is pressed. You can consider this a constraint on the input events themselves and need not show it in the state diagram (although it would not be wrong to do so).

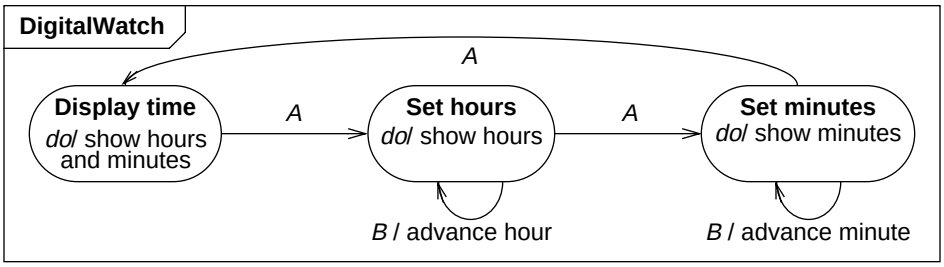

Figure A5.2 State diagram for a simple digital watch

5.3 Figure A5.3 elaborates the state diagram in the exercise.

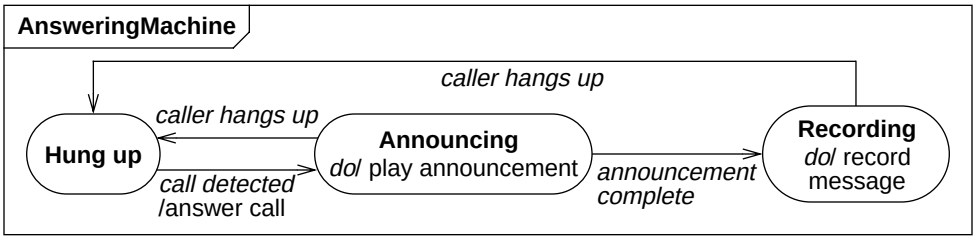

Figure A5.3 State diagram for a telephone answering machine

5.4 Figure A5.4 extends the state diagram from the previous answer to answer after five rings. The number of rings are kept in an internal counter that is reset on each new call and incremented on every ring.

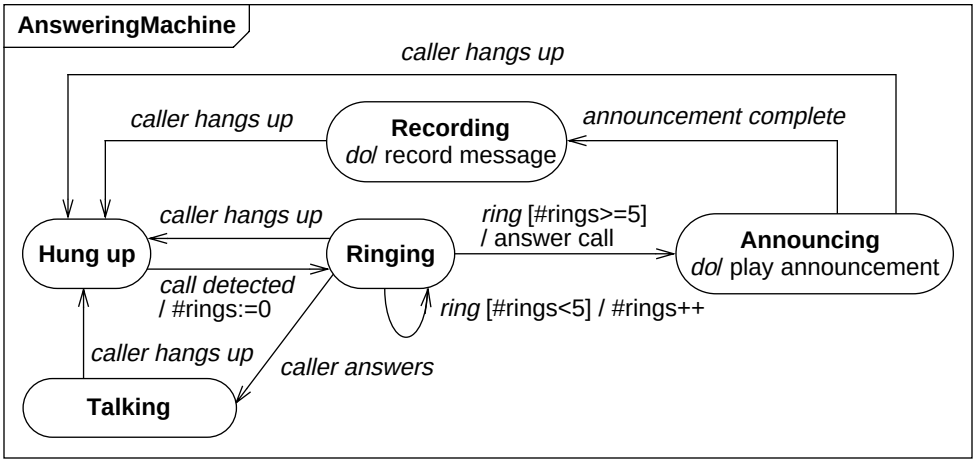

Figure A5.4 State diagram for a machine that answers after five rings

5.5 Figure A5.5 elaborates the state diagram in the exercise.

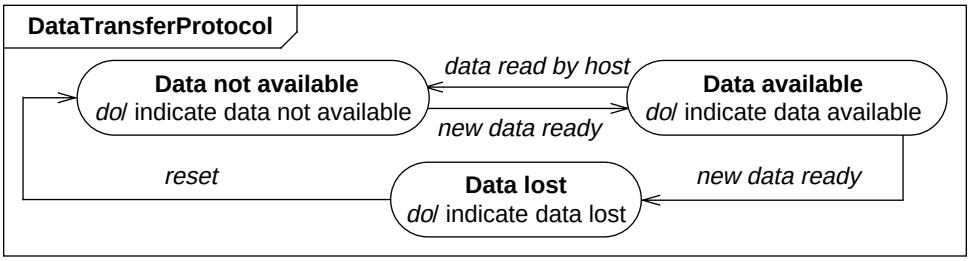

Figure A5.5 State diagram of a data transfer protocol

5.6 Figure A5.6 shows the completed state diagram for the motor control.

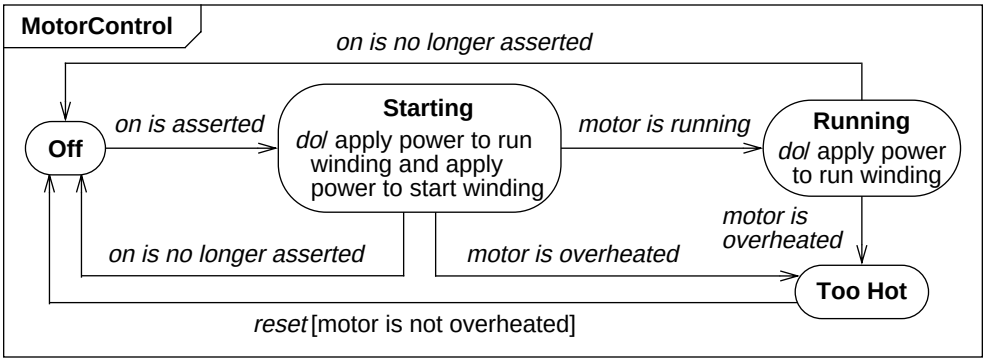

Figure A5.6 State diagram for a motor control

5.7 Figure A5.7 shows another approach for motor control.

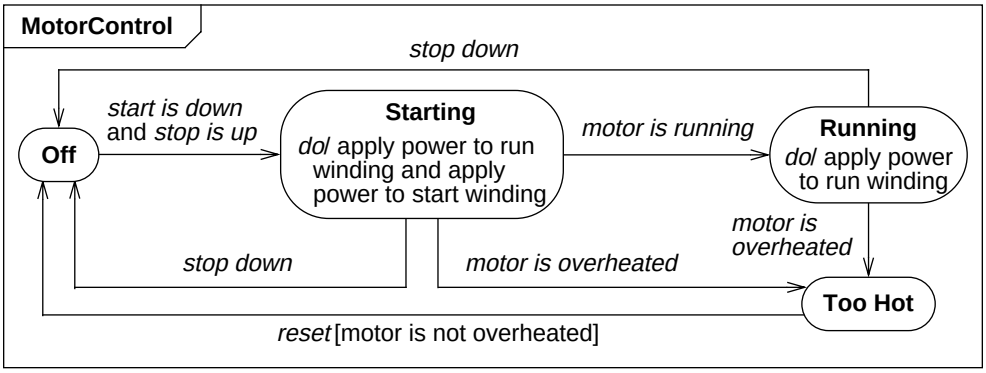

Figure A5.7 An alternate approach to motor control

5.8 Figure A5.8 shows a state diagram for a diagram editor. This is only a small part of a complete editor. In the real editor there are more ways to pick items and you can pick more than one item (next exercise).

Some events can be ignored. In state *Nothing selected* event left down with cursor on no object has no effect and therefore is not shown. Similarly, left drag (that is moving the cursor while the left button is down) has no effect in the *Nothing selected* state.

In the real editor, the right button is used to pop up a menu dependent on the selection state. There would be many selection substates, one for each kind of item (or combination of items) that can be selected. Similarly, there would be transitions to create new items.

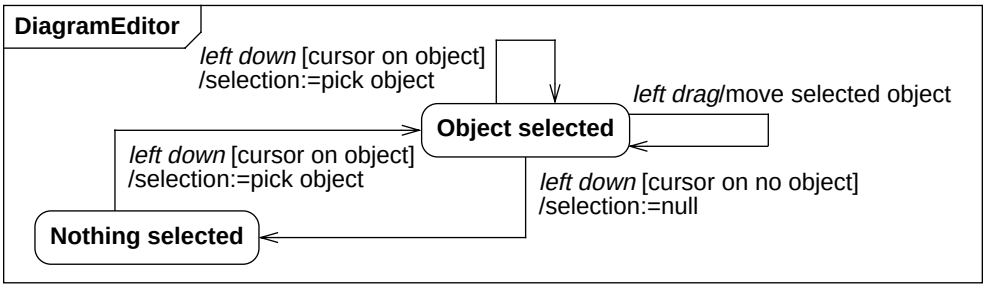

Figure A5.8 State diagram for a diagram editor

5.9 Figure A5.9 extends the diagram editor for selecting multiple objects.

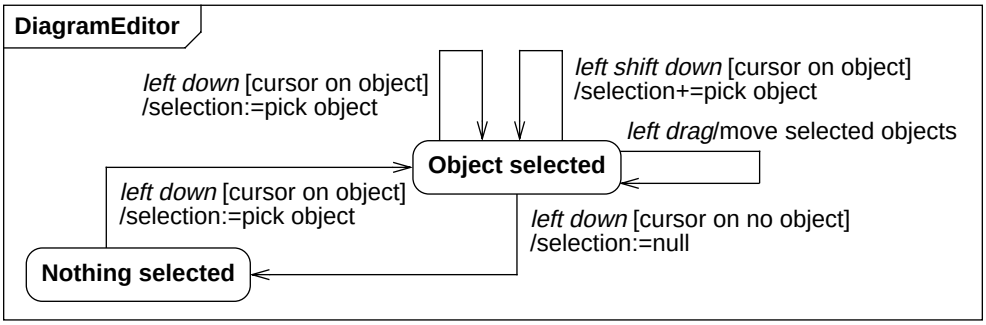

Figure A5.9 State diagram for a diagram editor with selection of multiple objects

5.10 Figure A5.10 extends Figure E5.4 to represent the observed jamming behavior properly.

5.11 Figure A5.11 shows a state diagram. Note that even simple state diagrams can lead to complex behavior. A *change* event occurs whenever the candle is taken out of its holder

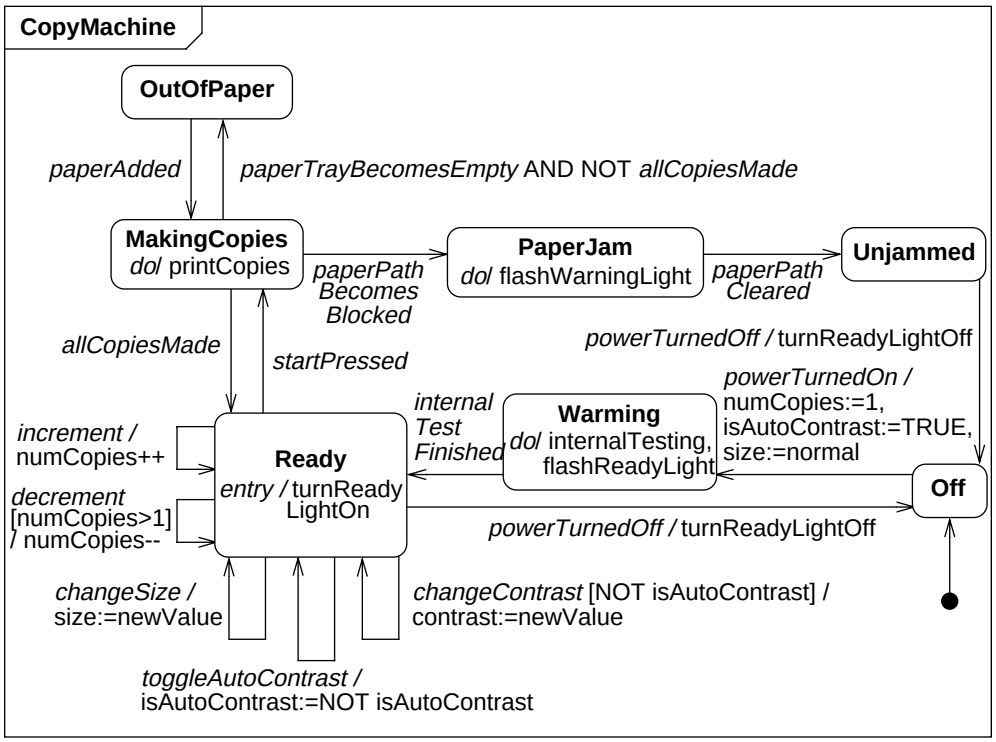

Figure A5.10 State diagram for copy machine with observed behavior for jamming

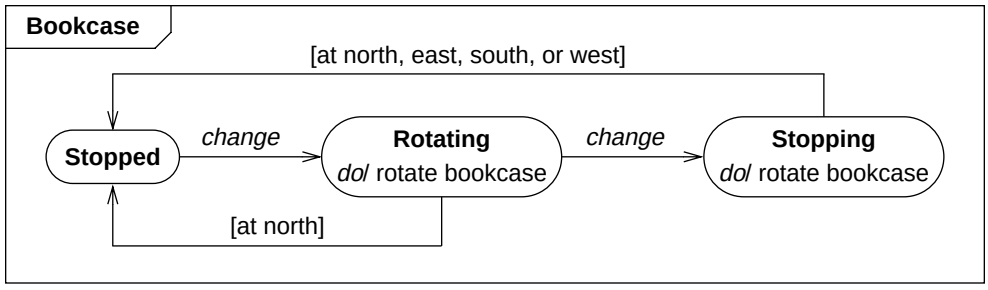

Figure A5.11 State diagram for bookcase control

or whenever it is put back. The condition *at north* is satisfied whenever the bookcase is behind the wall. The condition *at north, east, south, or west* is satisfied whenever the bookcase is facing front, back, or to the side.

When you first discovered the bookcase, it was in the *Stopped* state pointing south. When your friend removed the candle, a *change* event drove the bookcase into the *Ro-*

tating state. When the bookcase was pointing north, the condition *at north* put the bookcase back into the *Stopped* state. When your friend reinserted the candle, another *change* event put the bookcase into the *Rotating* state until it again pointed north. Pulling the candle out generated another *change* event and would have caused the bookcase to rotate a full turn if you had not blocked it with your body. Forcing the bookcase back is outside the scope of the control and does not have to be explained.

When you put the candle back again another *change* event was generated, putting the bookcase into the *Rotating* state once again. Taking the candle back out resulted in yet another *change* event, putting the bookcase into the *Stopping* state. After 1/4 turn, the condition *at north, east, south or west* was satisfied, putting the bookcase into the *Stopped* state.

What you should have done at first to gain entry was to take the candle out and quickly put it back before the bookcase completed 1/4 turn.