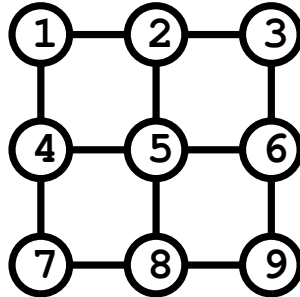


## 2002 Paper 7 Question 2

### Specification and Verification II

Consider a  $3 \times 3$  array of 9 switches



Suppose each switch  $1, 2, \dots, 9$  can be either on or off, and that toggling any switch will automatically toggle all its immediate neighbours. For example, toggling switch 5 will also toggle switches 2, 4, 6 and 8, and toggling switch 6 will also toggle switches 3, 5 and 9.

- (a) Devise (i) a state space and (ii) transition relation to represent the behaviour of the array of switches. [4 + 6 marks]
- (b) You are given the problem of getting from an initial state in which even numbered switches are on and odd numbered switches are off, to a final state in which all the switches are off.

Write down predicates on your state space that characterise the (i) initial and (ii) final states. [2 + 2 marks]

- (c) Explain how you might use a model checker to find a sequence of switches to toggle to get from the initial to final state. [6 marks]

You are not expected actually to solve the problem, but only to explain how to represent it in terms of model checking.