Traffic Modelling

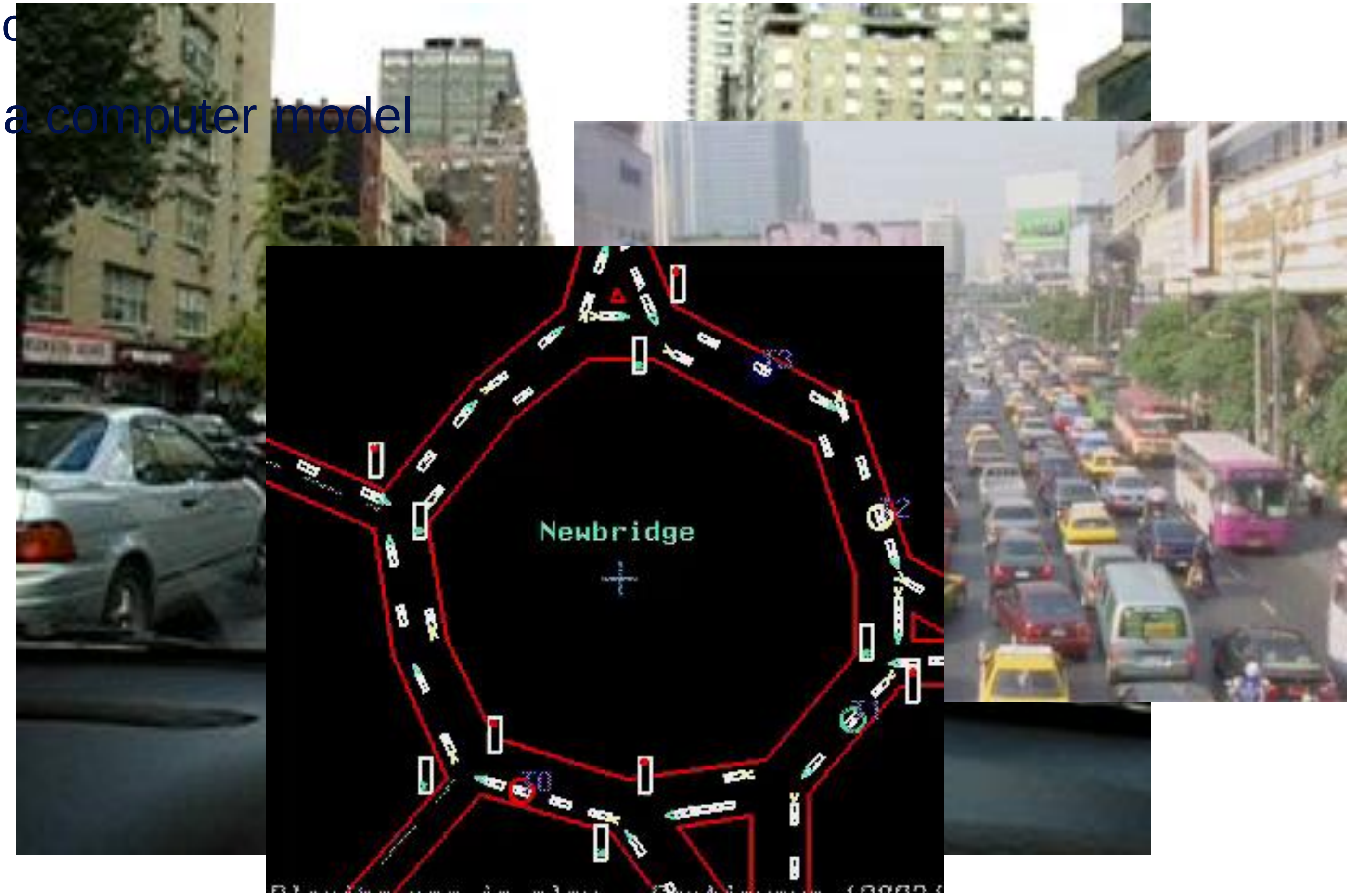
epcc

THE UNIVERSITY OF EDINBURGH

Reusing this material

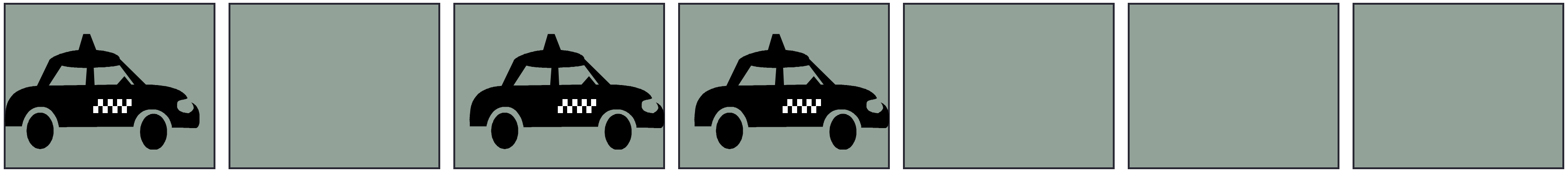
Traffic flow

- we want to predict traffic flow
  - – to lo
- build a computer model



Simple traffic model

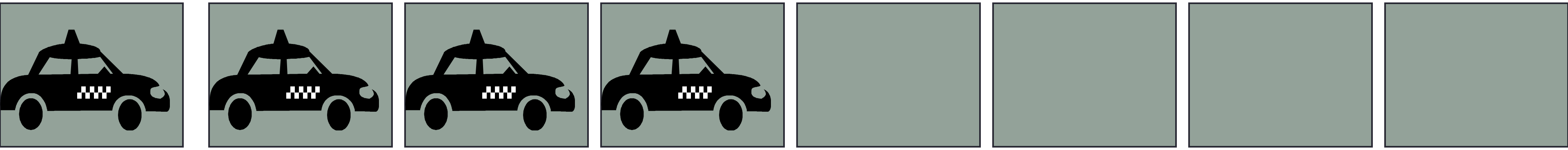
- divide road into a series of cells
  - either occupied or unoccupied
- perform a number of steps
  - each step, cars move forward if space ahead is empty



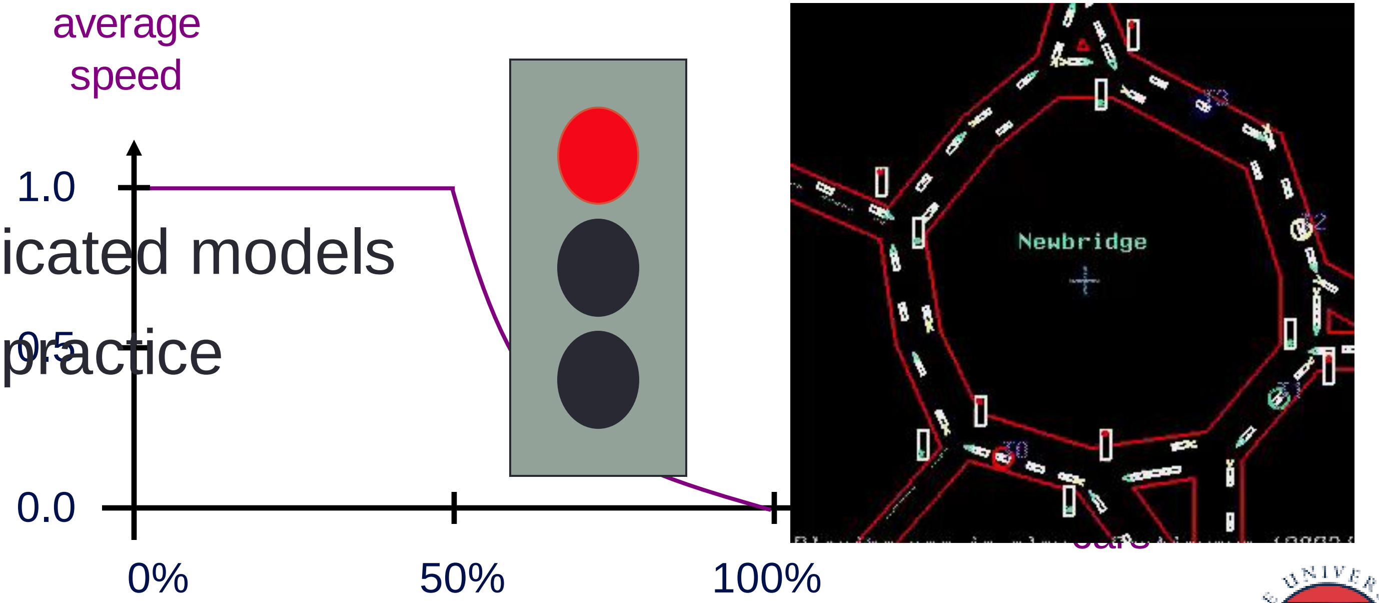
could do this by moving pawns on a chess board

Traffic behaviour

- model predicts a number of interesting features
- traffic lights

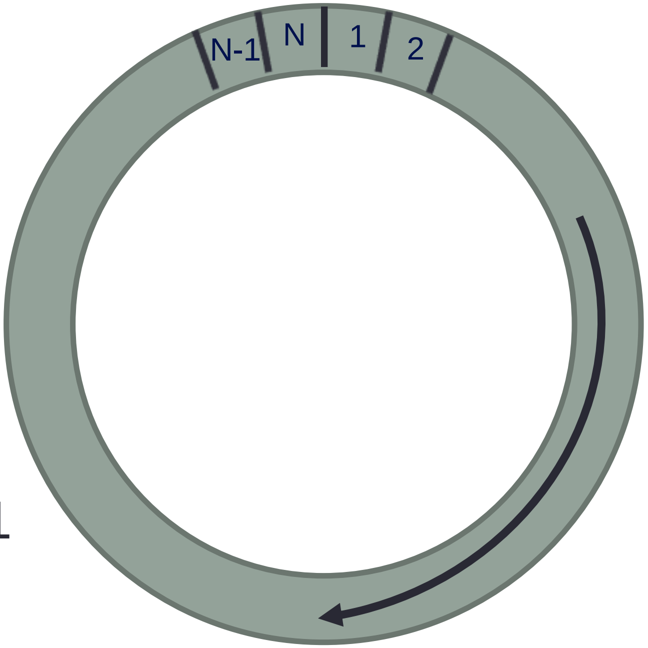


- congestion
- more complicated models are used in practice



Boundary conditions

- What happens if a car falls off the end of the road?
  - when does a car appear at the start?
- Consider a roundabout
  - periodic boundary conditions:
    - up from last cell *N* is first cell 1
    - down from first cell 1 is last cell *N*
- Implement with *ghost* or *halo* cells
  - road has *N*+2 cells 0, 1, 2, ..., *N*-1, *N*, *N*+1
  - copy cell 1 to cell *N*+1 and cell *N* to cell 0
  - then update cells 1 to *N* as normal



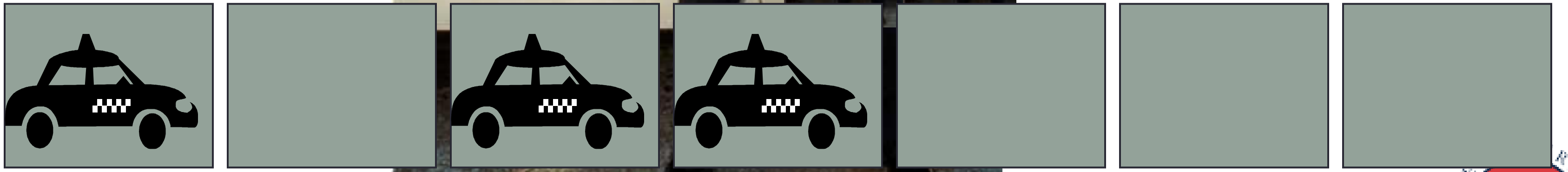
Pseudo Code: traffic on a roundabout

```
declare arrays old(i) and new(i), i = 0,1,...,N,N+1
initialise old(i) for i = 1,2,...,N-1,N (e.g. randomly)
loop over iterations
  set old(0) = old(N) and set old(N+1) = old(1)
  loop over i = 1,...,N
  if old(i) = 1  (occupied)
    if old(i+1) = 1 then new(i) = 1 else new(i) = 0
  else           (unoccupied)
    if old(i-1) = 1 then new(i) = 1 else new(i) = 0
  end loop over i
  set old(i) = new(i) for i = 1,2,...,N-1,N
end loop over iterations

# also need to count number of moves
# be careful to count EITHER car entering OR car leaving!
```

How fast can we run the model?

- measure speed in Car Operations Per second
  - how many COPs?
- around 2 COPs
- how fast would you expect?



Estimating speed

- Back of the envelope estimate
  - each cell requires about 7 operations per iteration
    - two if’s, a cell update, a cell copy back, count moves, two loop constructs
  - my CPU operates at 2GHZ
    - so about 300 MCOPs?

- Could be faster
  - modern CPUs do multiple operations per cycle (e.g. vectorisation)
- Could be slower
  - real programs often limited by memory bandwidth not CPU speed
- Depends on problem size
  - small problems fit into fast cache memory