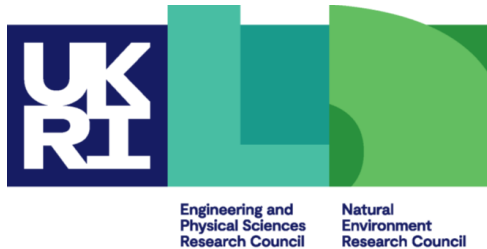


# Message-Passing Thought Exercise

---

Traffic Modelling



# Reusing this material



This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

<http://creativecommons.org/licenses/by-nc-sa/4.0/>

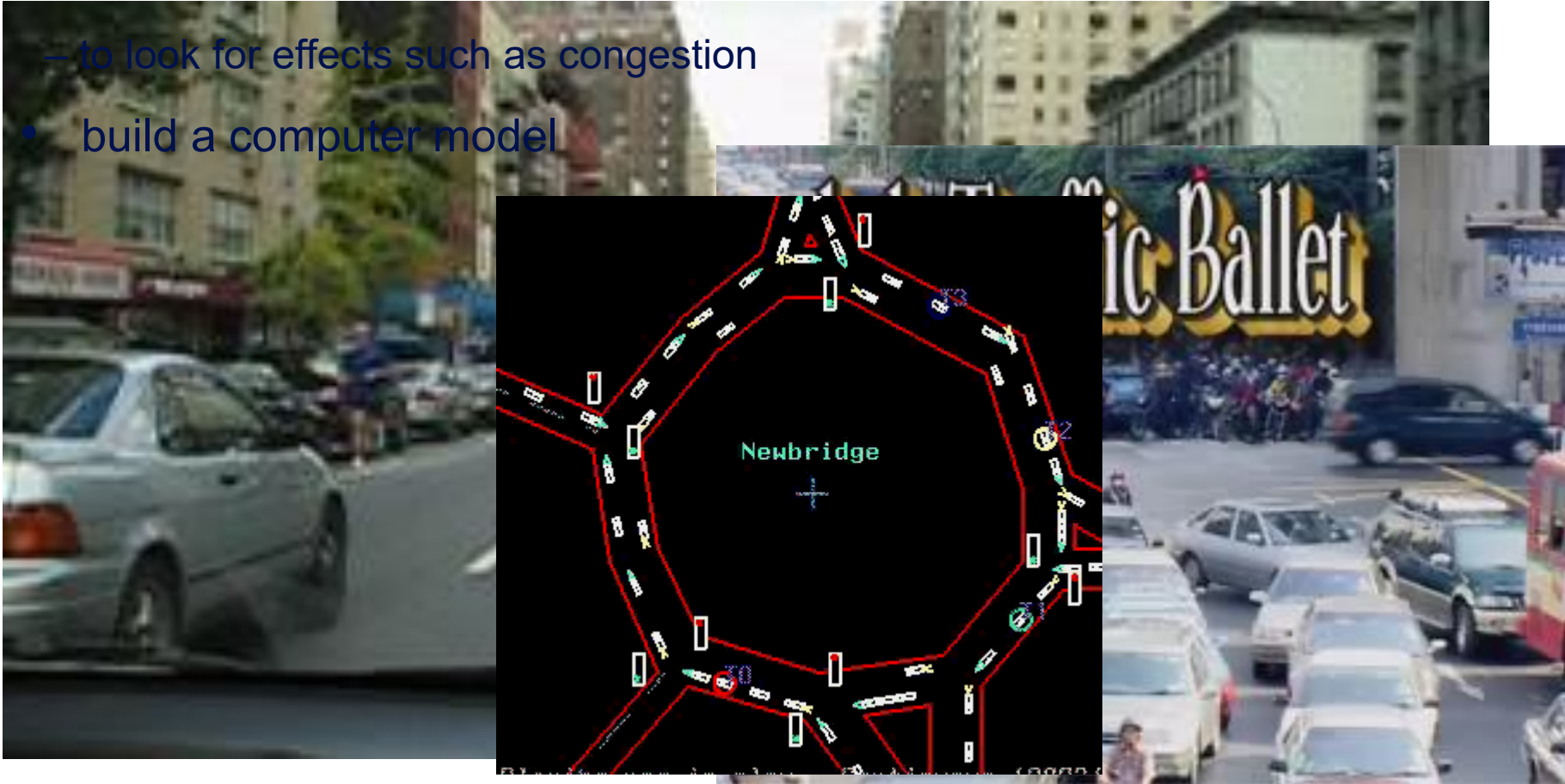
This means you are free to copy and redistribute the material and adapt and build on the material under the following terms: You must give appropriate credit, provide a link to the license and indicate if changes were made. If you adapt or build on the material you must distribute your work under the same license as the original.

Acknowledge EPCC as follows: “© EPCC, The University of Edinburgh, [www.epcc.ed.ac.uk](http://www.epcc.ed.ac.uk)”

Note that this presentation contains images owned by others. Please seek their permission before reusing these images.

# Traffic flow

- we want to predict traffic flow
  - to look for effects such as congestion
- build a computer model



# Simple traffic model

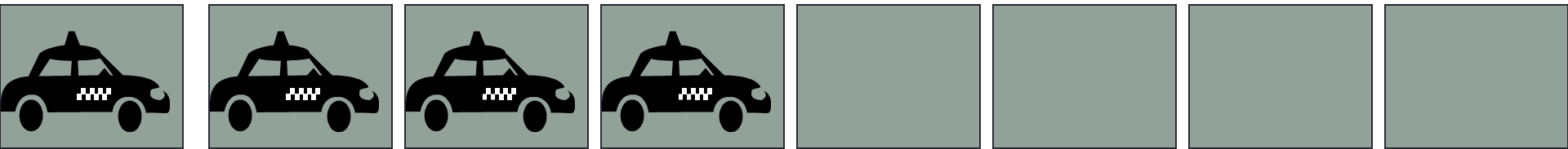
- divide road into a series of cells
  - either occupied or unoccupied
- perform a number of steps
  - each step, cars move forward if space ahead is empty



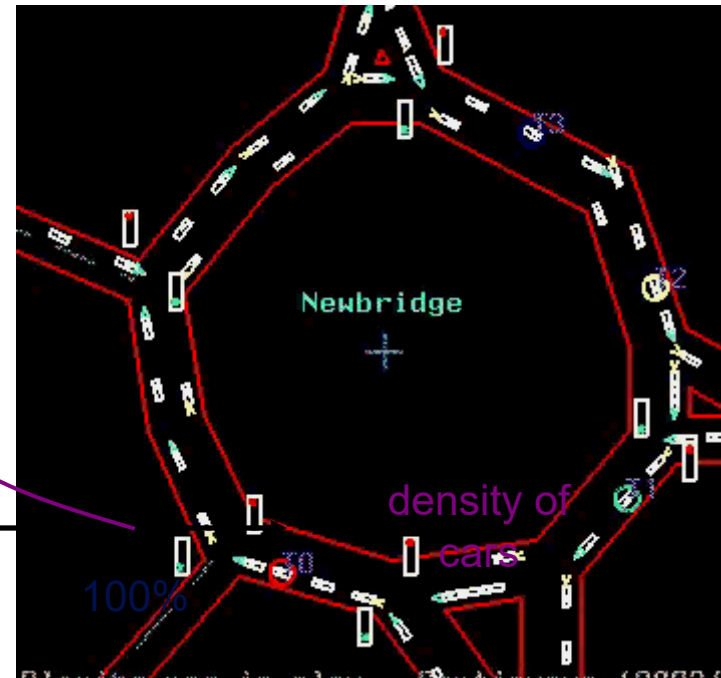
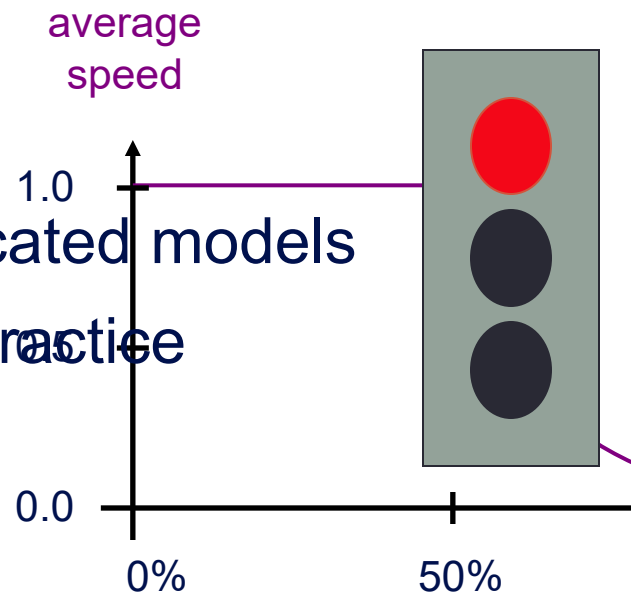
**could do this by moving  
pawns on a chess board**

# Traffic behaviour

- model predicts a number of interesting features
- traffic lights

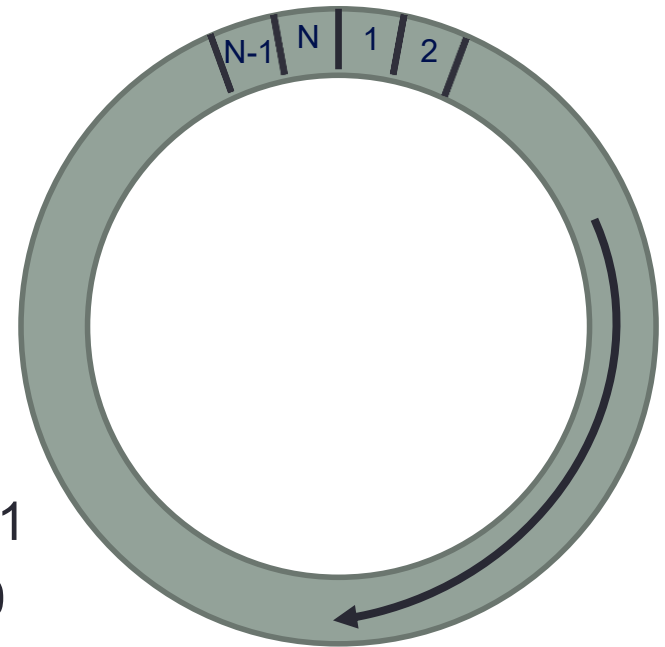


- congestion
- more complicated models are used in practice



# 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

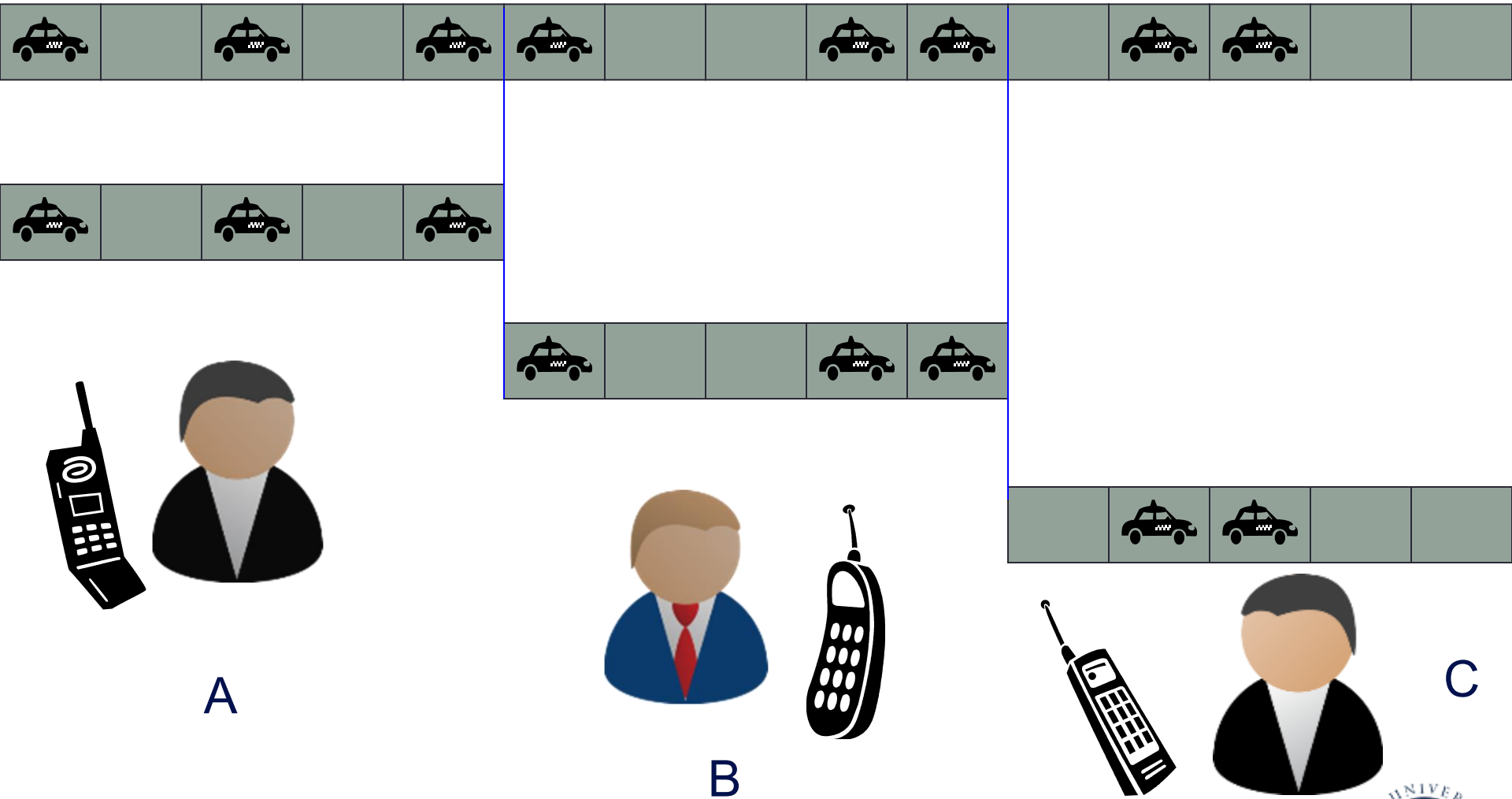


# How fast can we run the model?

- measure speed in Car Operations Per second
  - how many COPs?
- around 2 COPs
- but what about three people?
  - can they do six COPs?



# Parallel Traffic Modelling





# Pseudo Code: traffic on a roundabout

```
declare arrays old(i) and new(i),  $i = 0, 1, \dots, N, N+1$ 
initialise old(i) for  $i = 1, 2, \dots, N-1, N$  (eg randomly)
loop over iterations
  set old(0) = old(N) and set old(N+1) = old(1)
  loop over  $i = 1, \dots, N$ 
    if old(i) = 1
      if old(i+1) = 1 then new(i) = 1 else new(i) = 0
    if old(i) = 0
      if old(i-1) = 1 then new(i) = 1 else new(i) = 0
  end loop over i
  set old(i) = new(i) for  $i = 1, 2, \dots, N-1, N$ 
end loop over iterations
```