

Message-Passing Thought Exercise

Traffic Modelling

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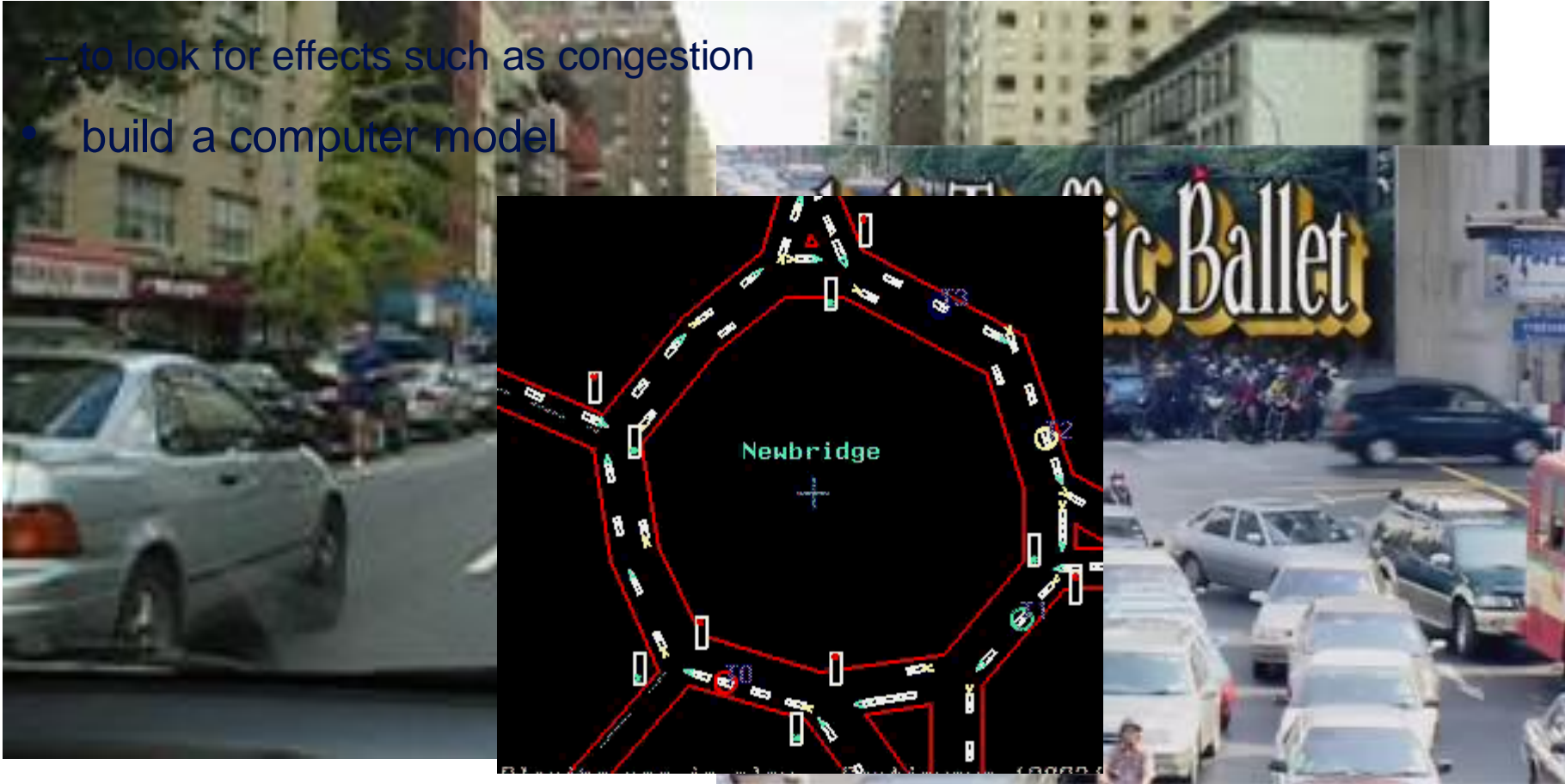
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Traffic flow

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



Simple traffic model

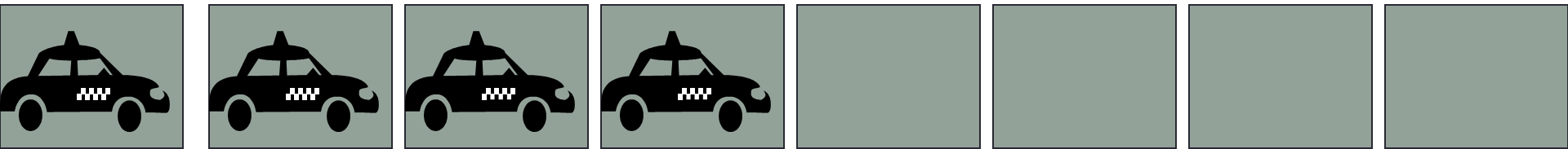
- divide road into a series of cells
 - either occupied or unoccupied
- perform a number of steps
 - each step, cars move forward if space ahead is empty



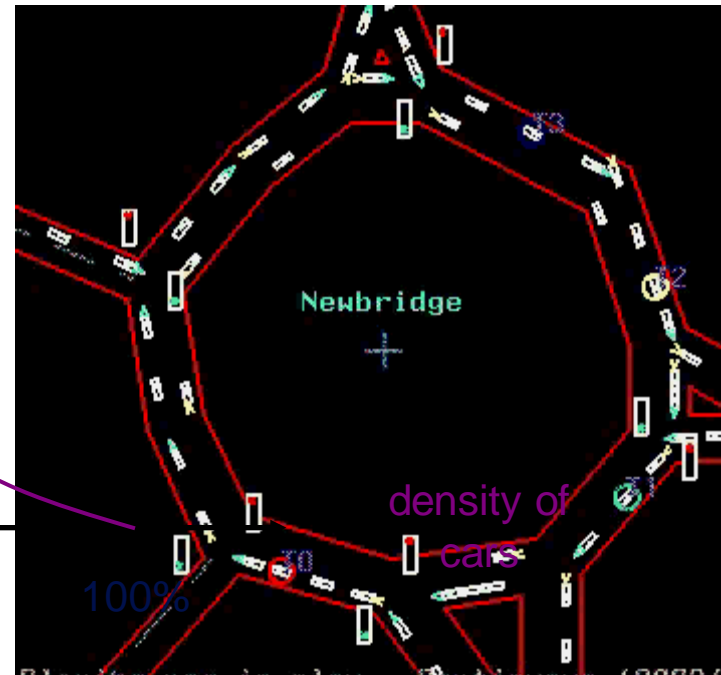
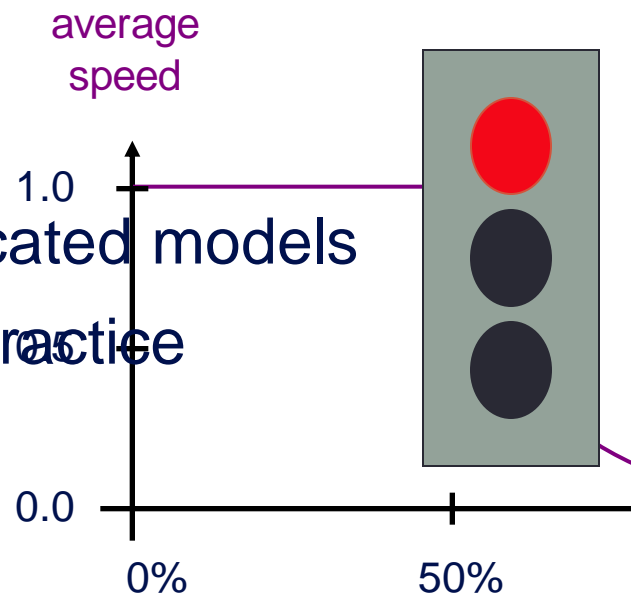
**could do this by moving
pawns on a chess board**

Traffic behaviour

- model predicts a number of interesting features
- traffic lights

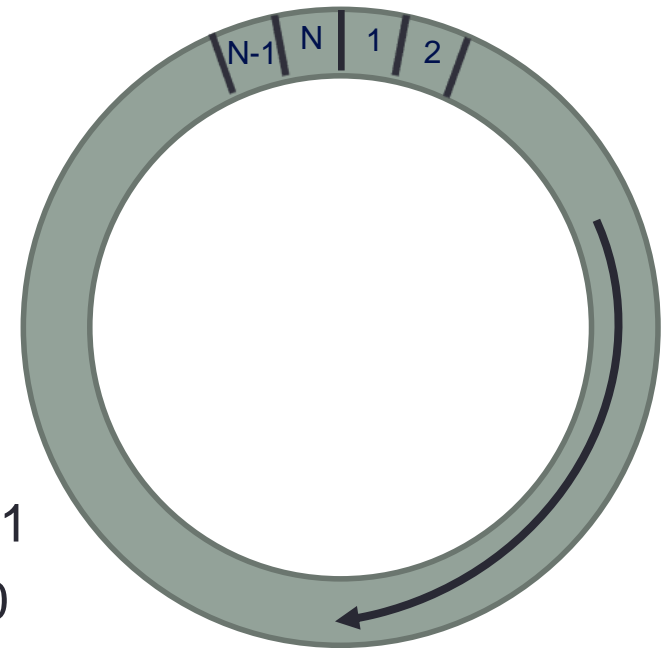


- congestion
- more complicated models are used in practice



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

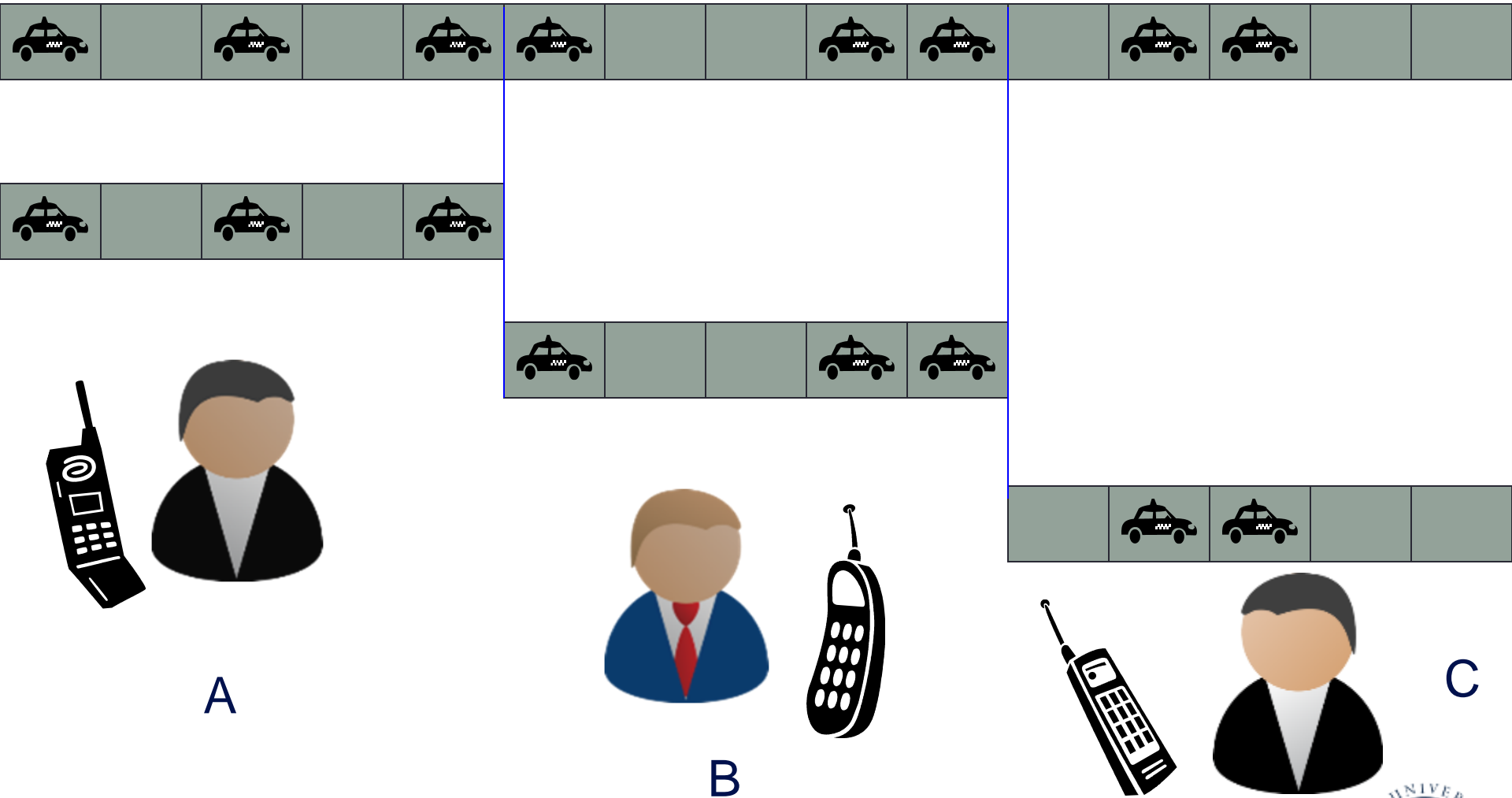


How fast can we run the model?

- 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
```