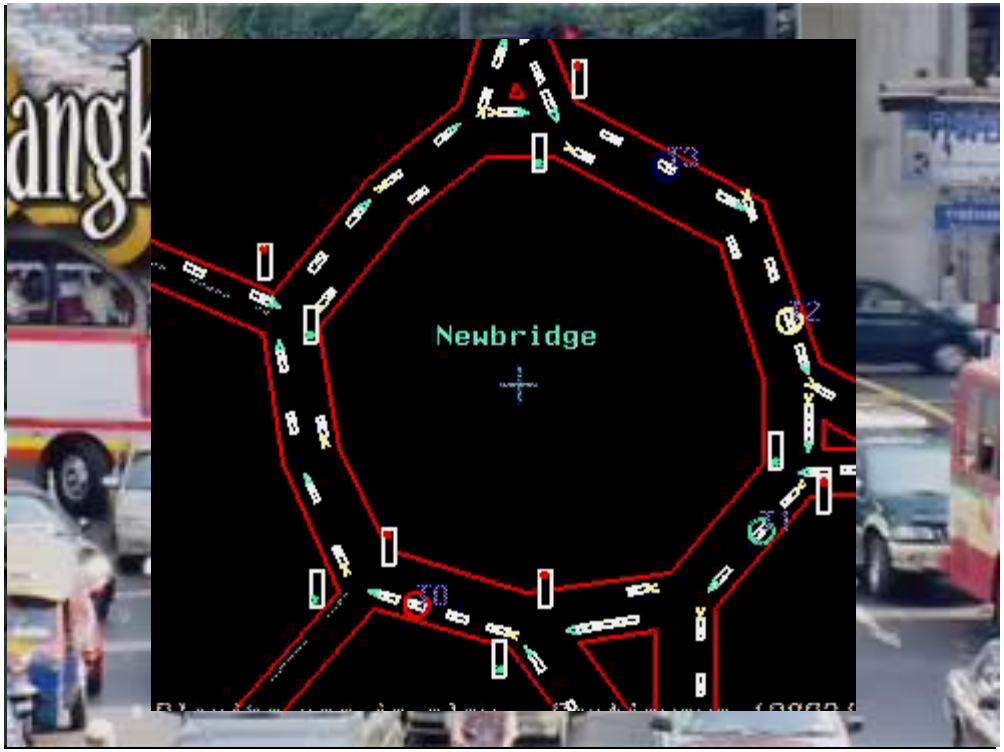
Computer Simulation

Traffic Modelling

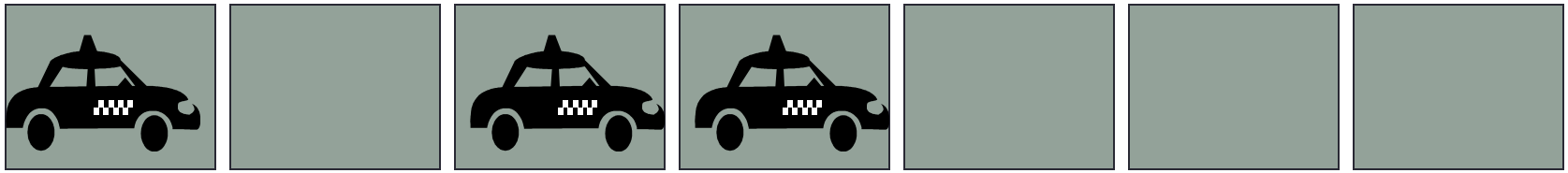
Traffic Flow

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



Simple Traffic Model

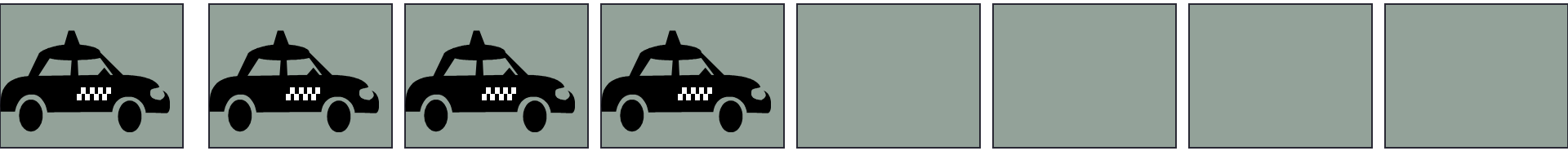
- divide road into a series of cells
  - either occupied or unoccupied
- perform a number of steps
  - each step, cars move forward if space ahead is empty



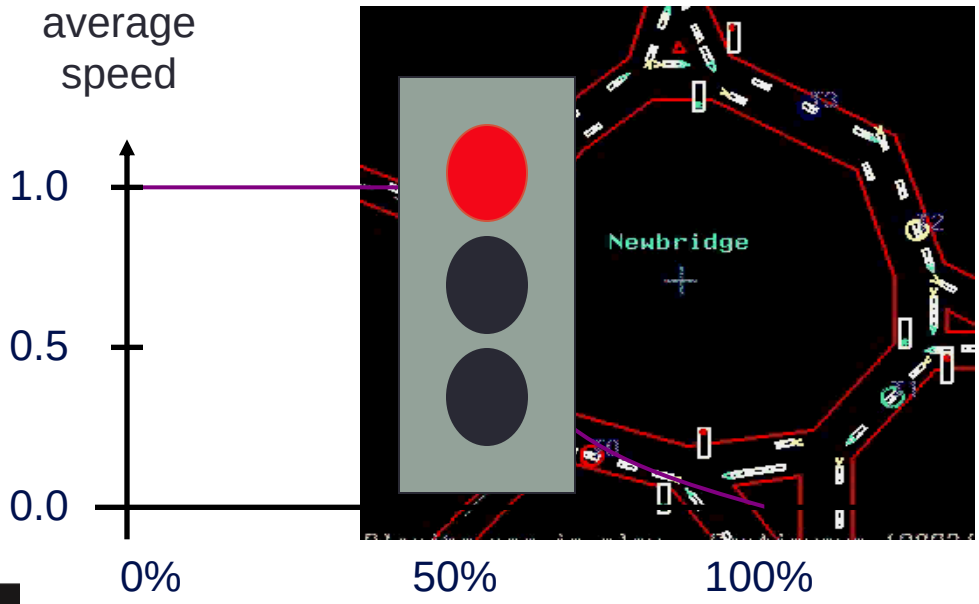
could do this by moving pawns on a chess board

traffic behaviour

- model predicts a number of interesting features
- traffic lights



- congestion
- more complicated models are used in practice



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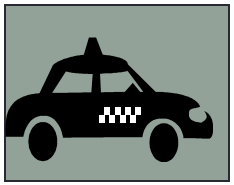
how fast can we run the model?

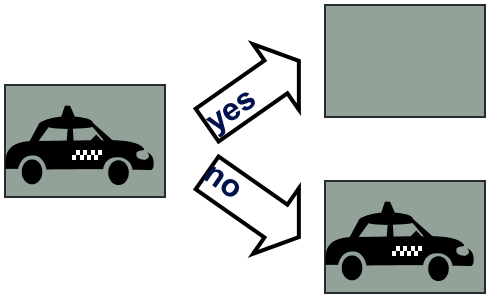
- measure speed in Car Operations Per second
  - how many COPs?
- around 2 COPs

modelling (of traffic)

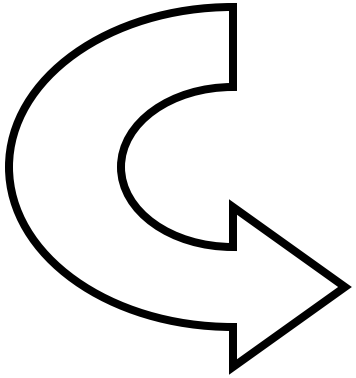


pawns on a chessboard

real traffic



update rules



modelled in parallel

modelled by hand

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computer simulation (of the weather)

$$\frac{\partial \rho}{\partial t} + \nabla . \rho \mathbf{u} = 0$$

$$\rho \frac{\partial \mathbf{u}}{\partial t} + \rho \mathbf{u} . \nabla \mathbf{u} = -\nabla P - 2\mathbf{\Omega} \times \mathbf{u} + \eta \nabla^2 \mathbf{u}$$

$$\frac{\partial T}{\partial t} + \nabla . \mathbf{u} T = \kappa \nabla^2 T + \mathcal{F} .$$

mathematical equations

real weather

computer simulation requires trillions of FLOPS (not COPs!)

parallel program

$$u_i = (1-w)u_i + w\left(\frac{1}{2+ah}\right)(u_{i-1} + (1+ah)\,u_{i+1})$$

numerical solution methods

```
begin program weather
  double precision u(60,60,25)
  do i = 1, n
```

computer program

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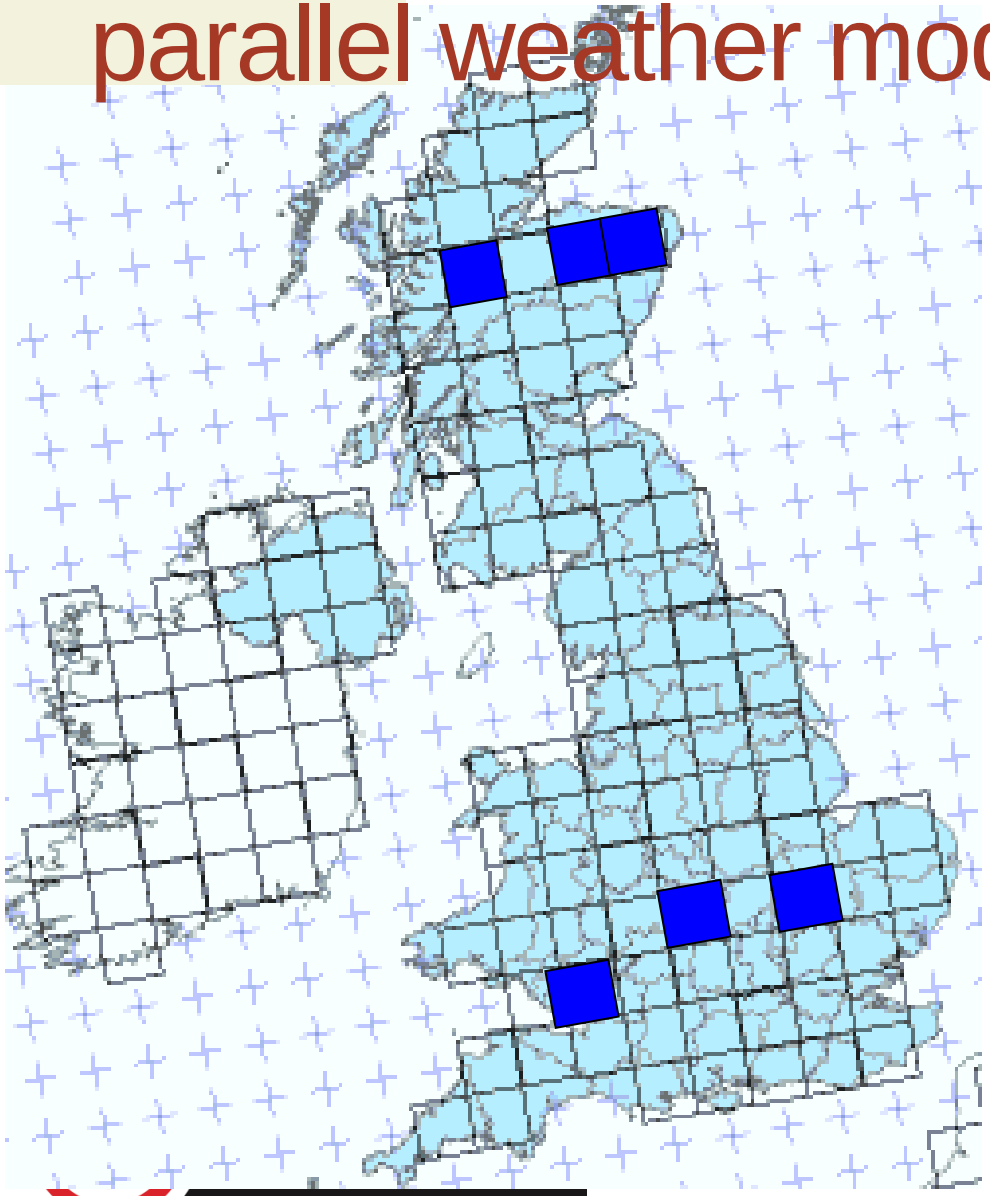
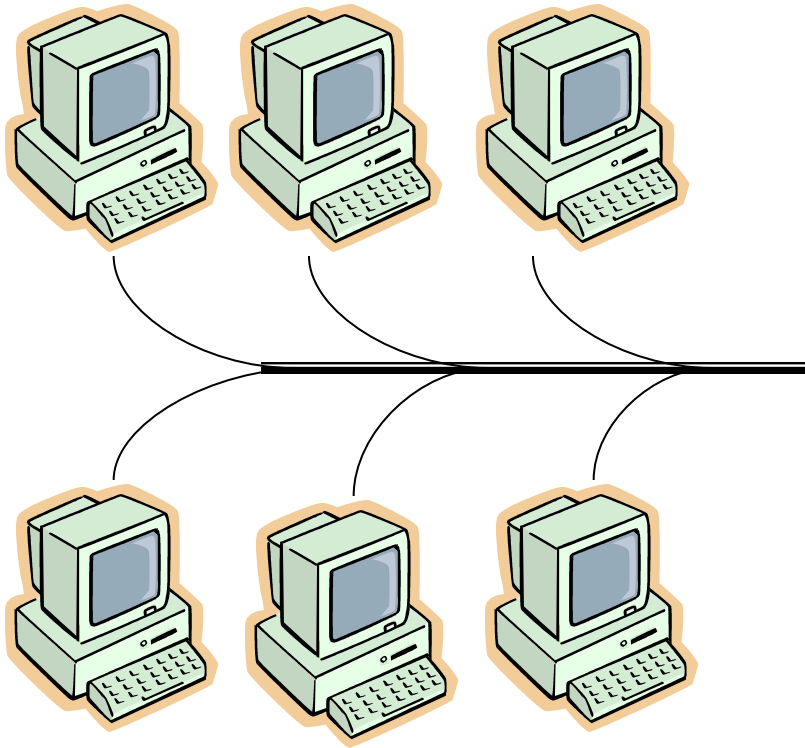
parallel weather modelling





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