

# Programming assignments

- Write a program to answer certain questions
- Groups of 3-4 (4 assignments)
- Each group presents results on February 10<sup>th</sup>
  - ≤15 minute presentation
  - Submit the source code

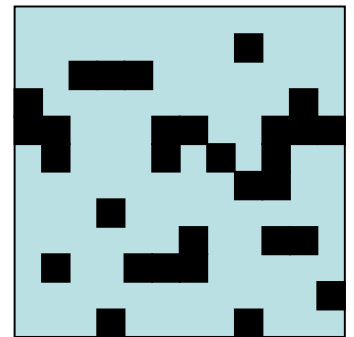
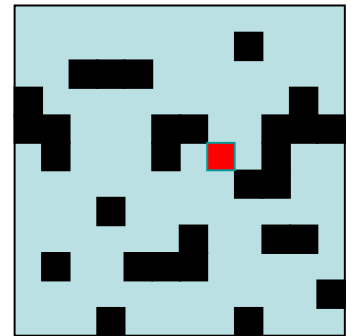
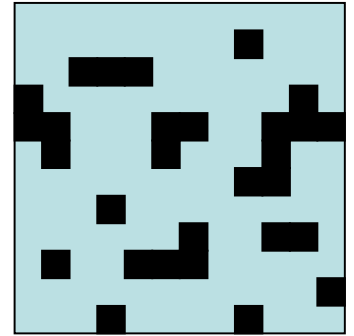
## 2. The "forest fire model"

- A Monte Carlo model to simulate distribution of forest fires over time
- Develops very interesting self-organised behaviour
- Basically consists of:
  - Planting trees
  - Burning trees

QuickTime and a  
Foto - JPEG decompressor  
are needed to see this picture.

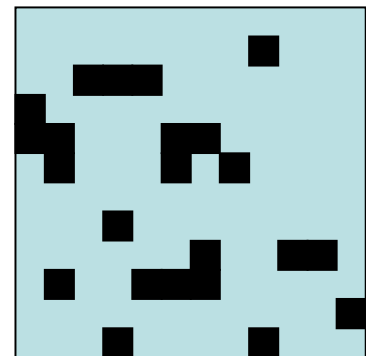
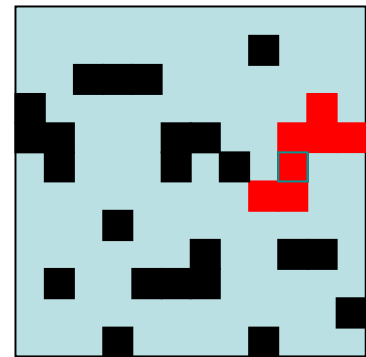
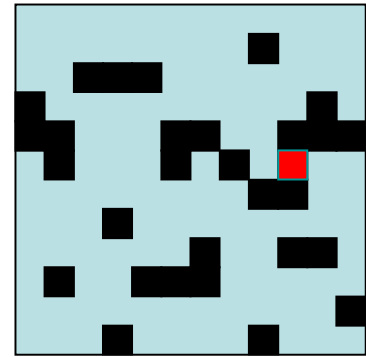
# Planting trees

- A Monte Carlo model to simulate distribution of forest fires over time
- Trees are points  $(x,y)$  on a lattice  $L$ 
  - $L_{(x,y)}=1$ : "TREE" (black)
  - $L_{(x,y)}=0$ : "NO TREE" (white)
- Simulation of growth of forest
- Each time step:
  - **Randomly select a coordinate  $x,y$** 
    - If  $L_{(x,y)}$ ="NO TREE", plant a tree  
( $L_{(x,y)} \rightarrow$ "TREE")



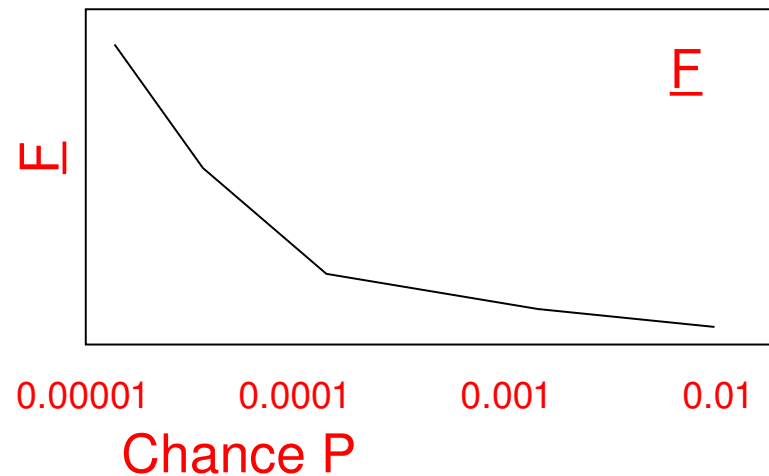
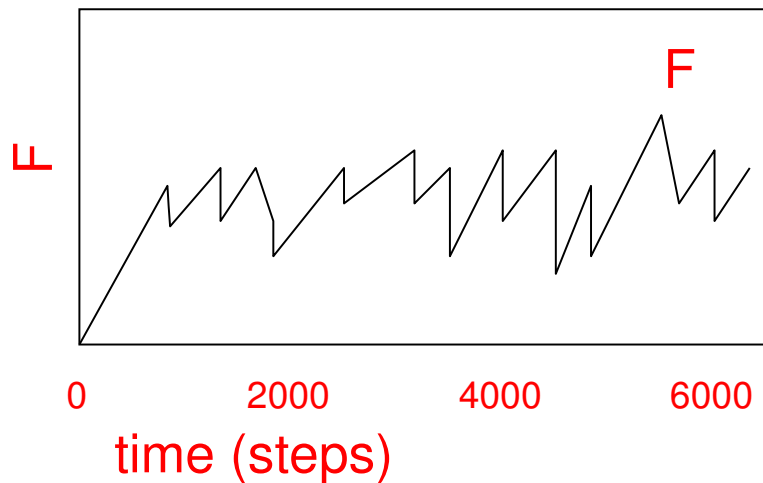
# Forest fires

- Simulation of forest fires
  - Every time step there is a chance  $P \ll 1$  that a match falls the area
  - If match falls on a tree, it burns and all its neighbours, and their neighbours, etc.
- Each time step:
  - **Randomly select a coordinate  $q,r$**
  - **Take random number  $p$  between 0 and 1**
    - If  $p < P$  and  $L_{(q,r)} = \text{"TREE"}$
    - Switch  $L_{(q,r)}$  and all connecting neighbours with  $L_{(x,y)} = \text{"TREE"}$  to  $\text{"NO TREE"}$



# Questions

- Make a graph of fraction ( $F$ ) of tree-covered land as a function of time (say 10,000 steps)
- What is the average fraction ( $\bar{E}$ ) of tree-covered land as a function of  $P$ ?



- # Strategy
- Create arrays
    - One 100x100 array for the model
    - One to store number of trees for every time step
  - Loop through time:
    - Plant a tree every step (tree = 1; no tree = 0)
    - Throw a match somewhere with chance  $P$ 
      - If tree is hit: burn it and all its neighbours (set these coordinates to 0)
    - Store the number of trees
  - Write data to file

# General strategy

- Consider which variables are needed
  - Constants (e.g.  $\Delta t$ ,  $P$ ,  $\kappa$  , etc.)
  - Arrays to store data
- Draw a flow diagram for the program
  - Which loops do you need?
  - Which "jobs" can be put in separate functions?

*Good luck!*