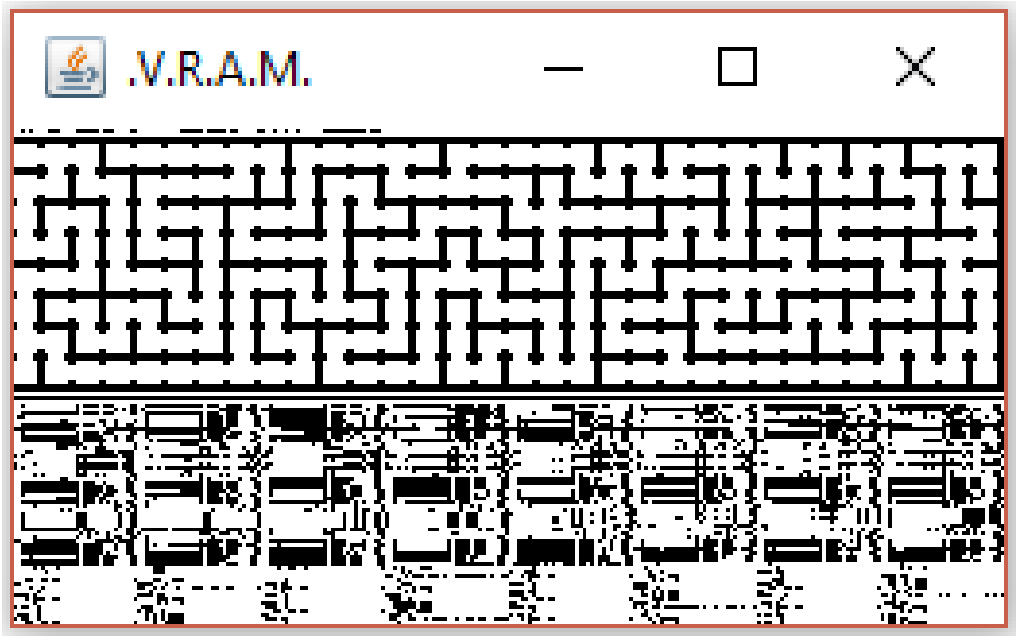
# Project 1

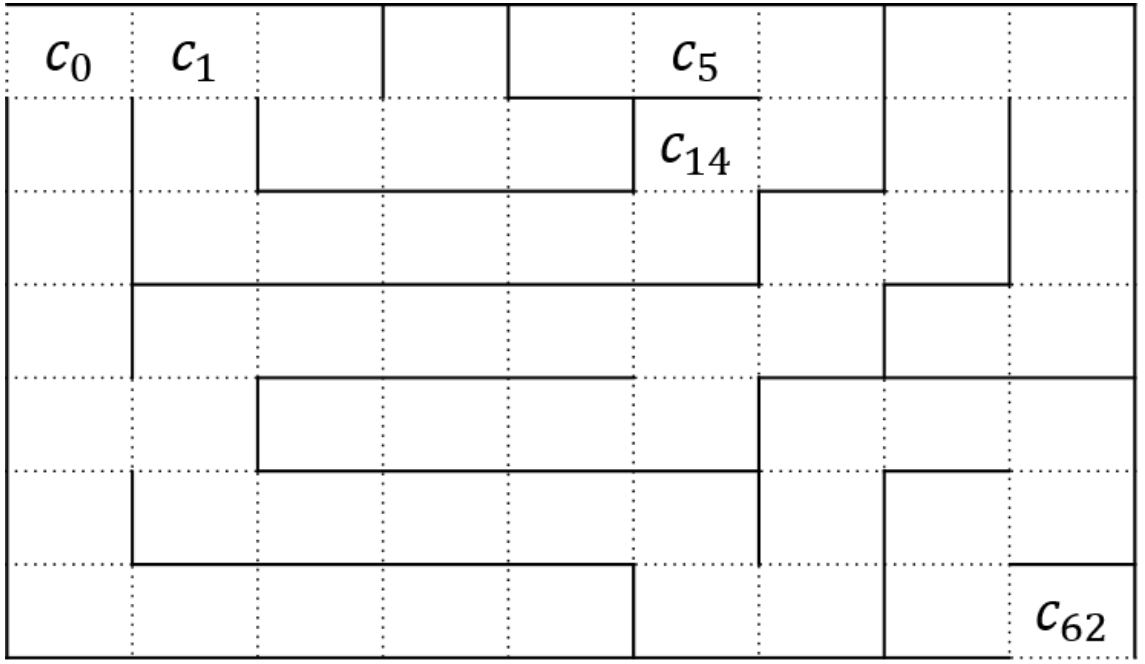
Draw a random perfect maze in the memory.




To be done by teams of **two people**

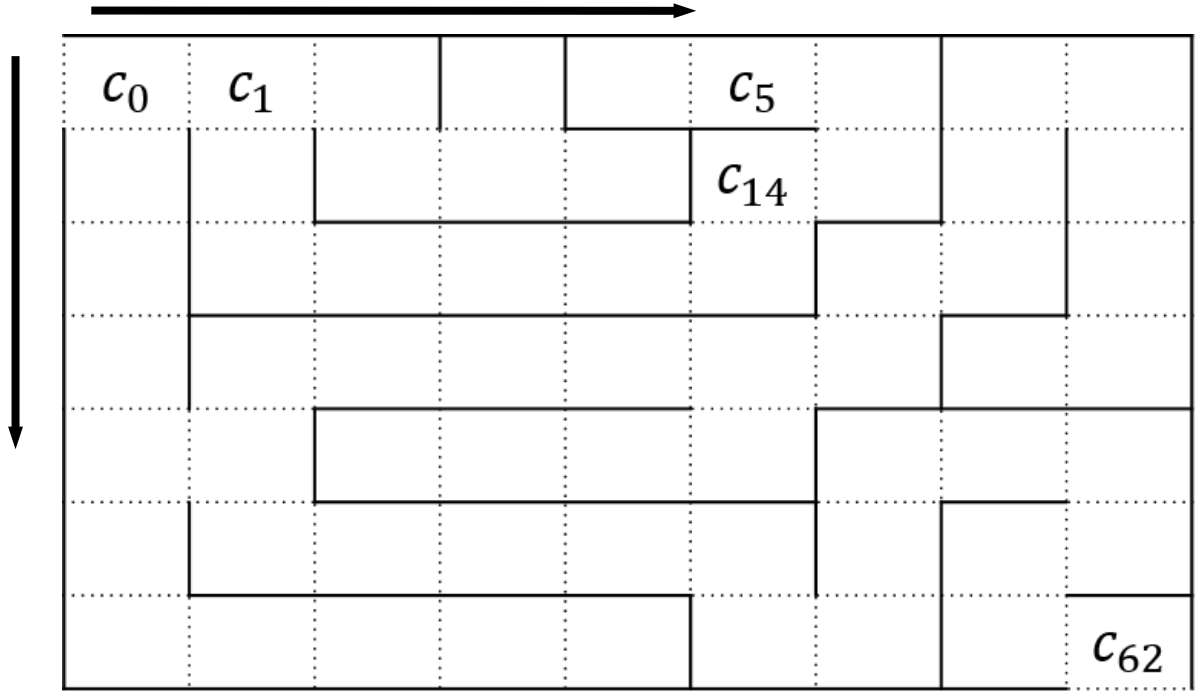
**Deadline** : October 29, 2017, 23:59

# Perfect maze




- **Perfect maze** : no cycle and a unique path between all pairs of cells

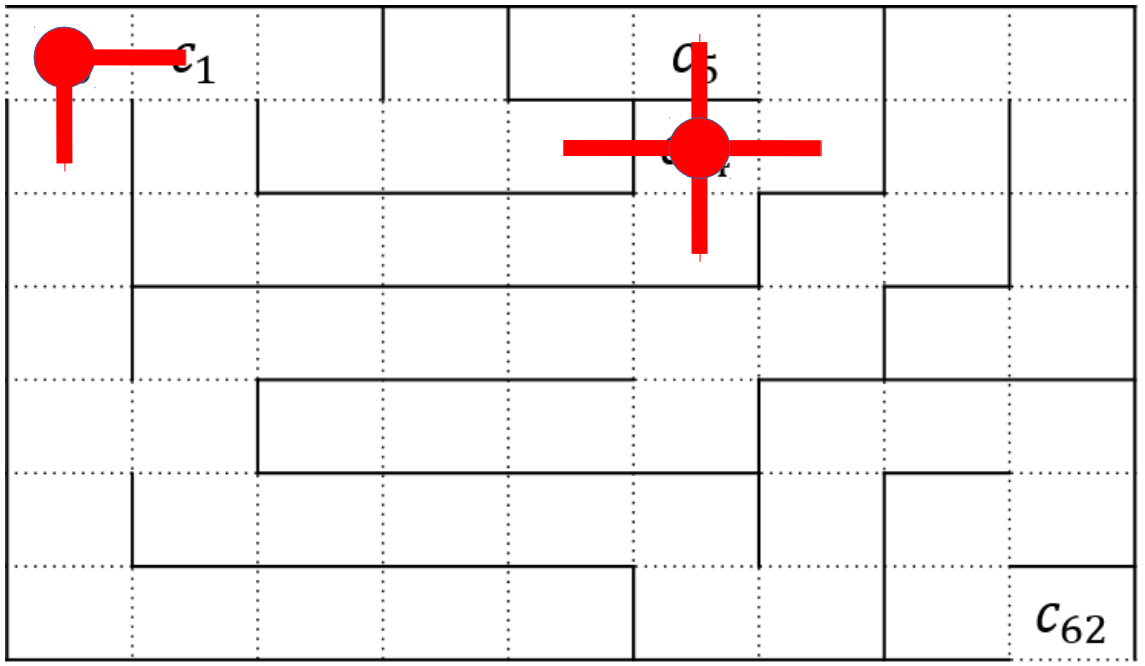
# Perfect maze




- **Perfect maze** : no cycle and a unique path between all pairs of cells
- Left-to-right, top-to-bottom numbering for cells

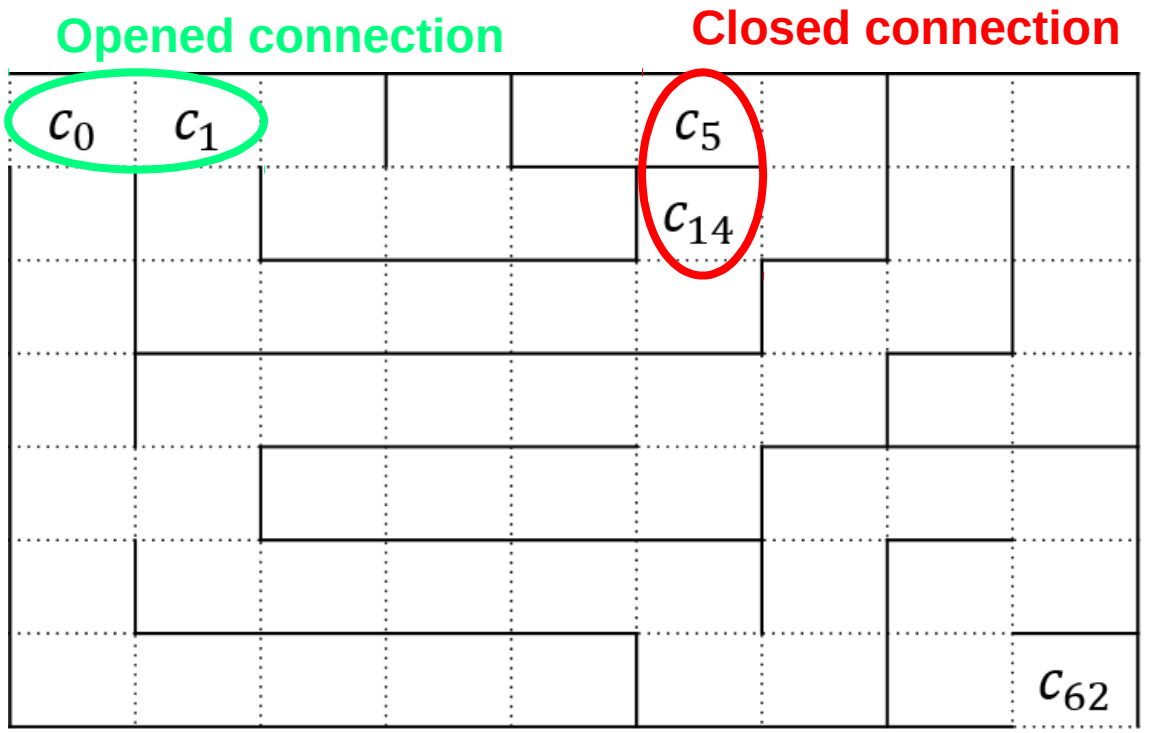
# Perfect maze

**Beware of borders !! (e.g. only 2 neighbours for cell $c_0$)**




- **Perfect maze** : no cycle and a unique path between all pairs of cells
- Left-to-right, top-to-bottom numbering for cells
- A cell is connected to its 4 neighbours (top, bottom, left, right)

# Perfect maze



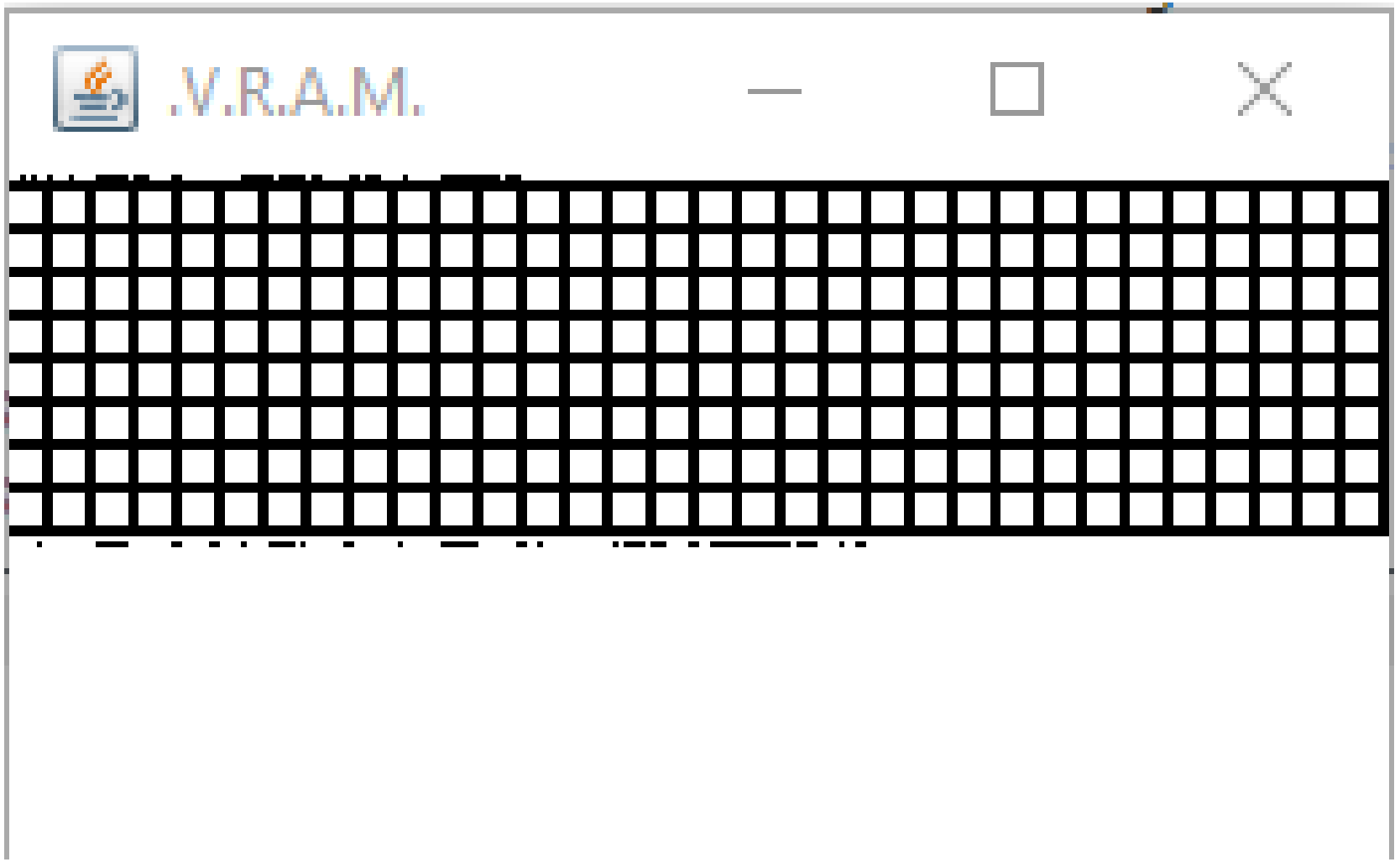

- **Perfect maze** : no cycle and a unique path between all pairs of cells
- Left-to-right, top-to-bottom numbering for cells
- A cell is connected to its 4 neighbours (top, bottom, left, right)
- A connection is either closed or opened

# Algorithm for a perfect maze

```
PerfectMaze(R, C)
1  M = "a maze with R rows and C columns with all connections closed"
2  nbCells = R × C
3  // pick random cell c_s to start building the perfect maze
4  s = Rand() % nbCells − 1
5  // V[i] contains 1 if there is a path between cell c_i and c_s, 0 otherwise
6  // in other words, it contains 1 if the cell c_i was already connected to the maze being built
7  V = "array of zeros of size nbCells"
8  return PerfectMazeAux(M, V, R, C, s)
```

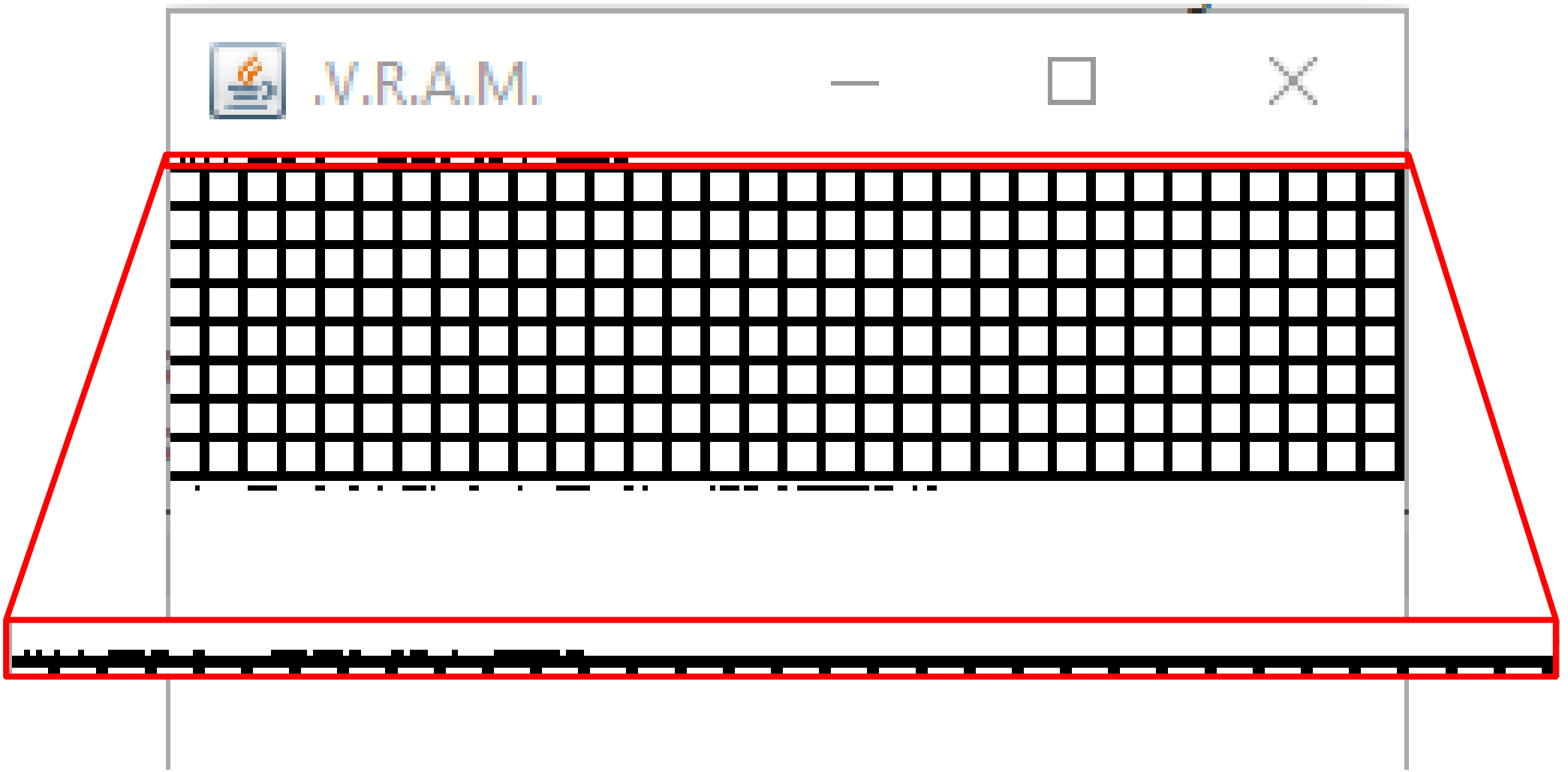
```
PerfectMazeAux(M, R, C, V, c)
1  V[c] = 1
2  N = "create array with c_c neighbours indexes"
3  N = RandomShuffle(N)
4  for n ∈ N
5       if V[n] == 0
6            Connect(M, c, n)
7            M = PerfectMazeAux(M, V, R, C, n)
8  return M
```

# Memory view



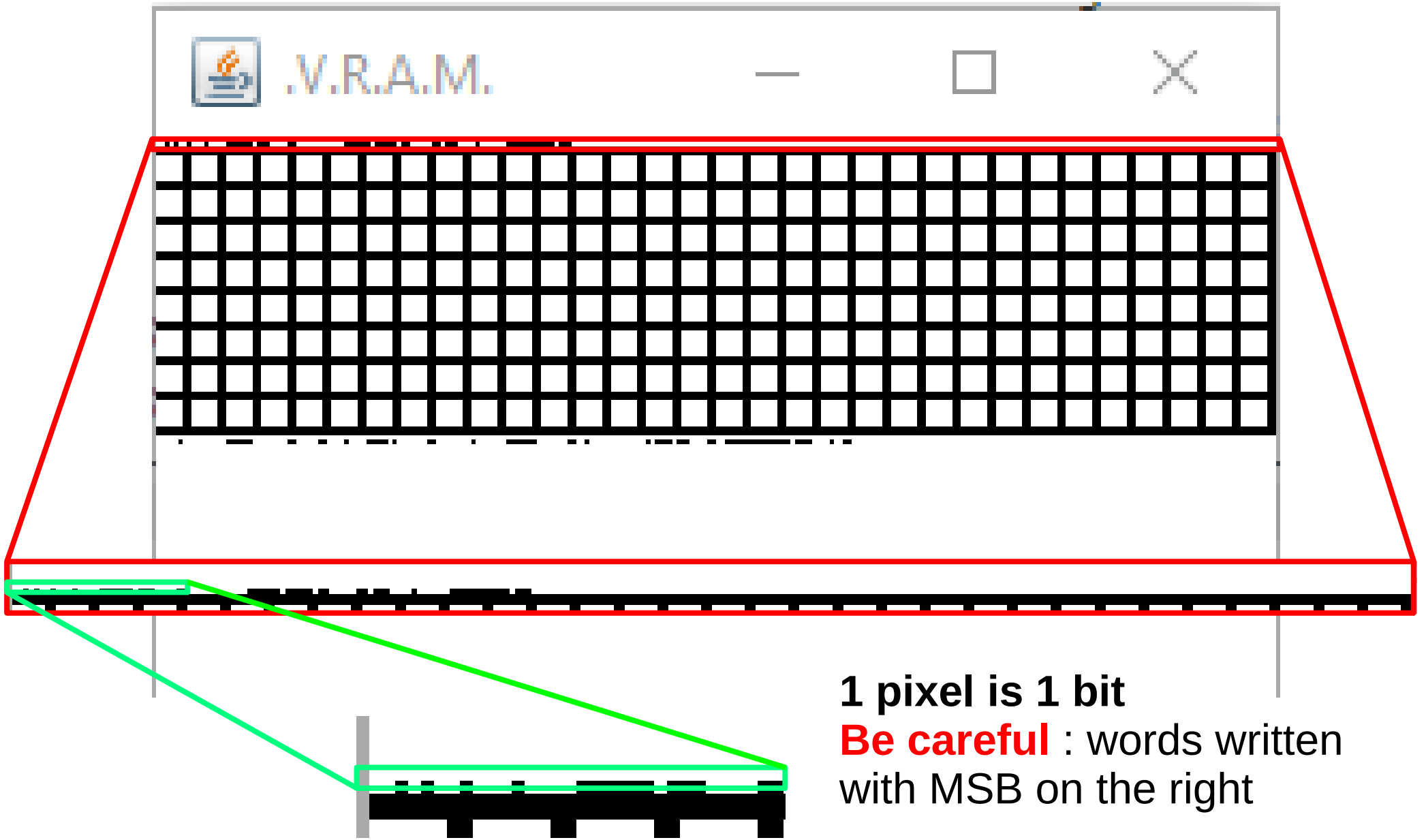

It displays the 1024 first words of the dynamic memory !

# Memory view




One pixel line is composed of **8** 32-bits words.

# Memory view

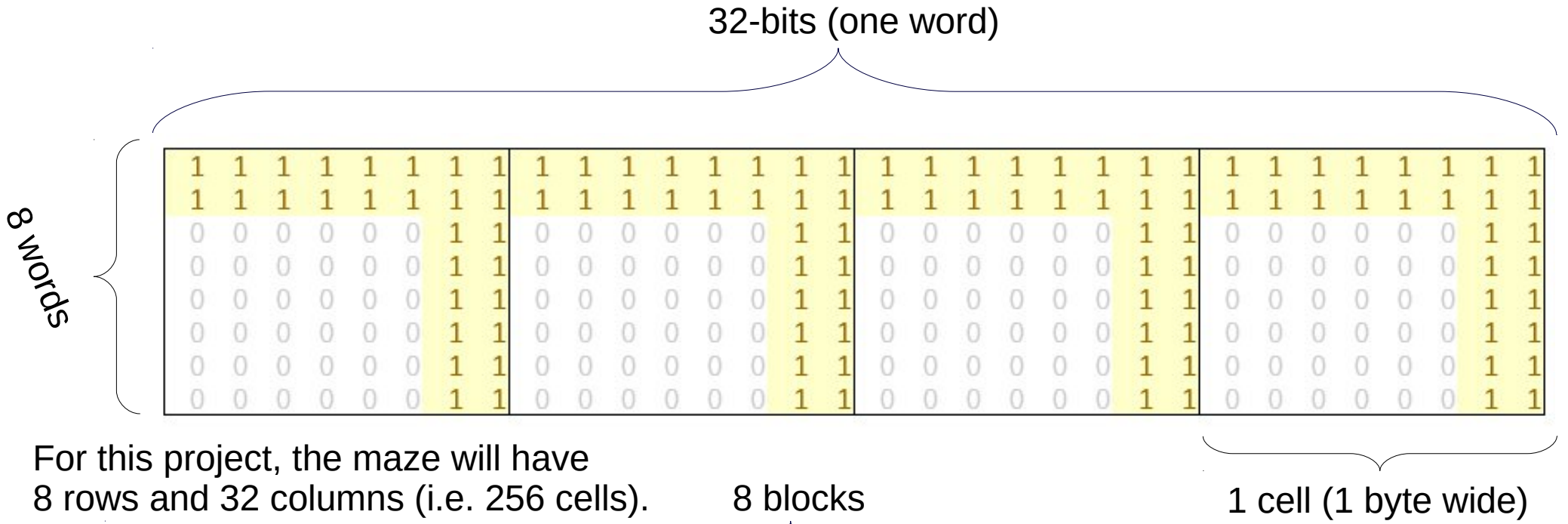



**1 pixel is 1 bit**

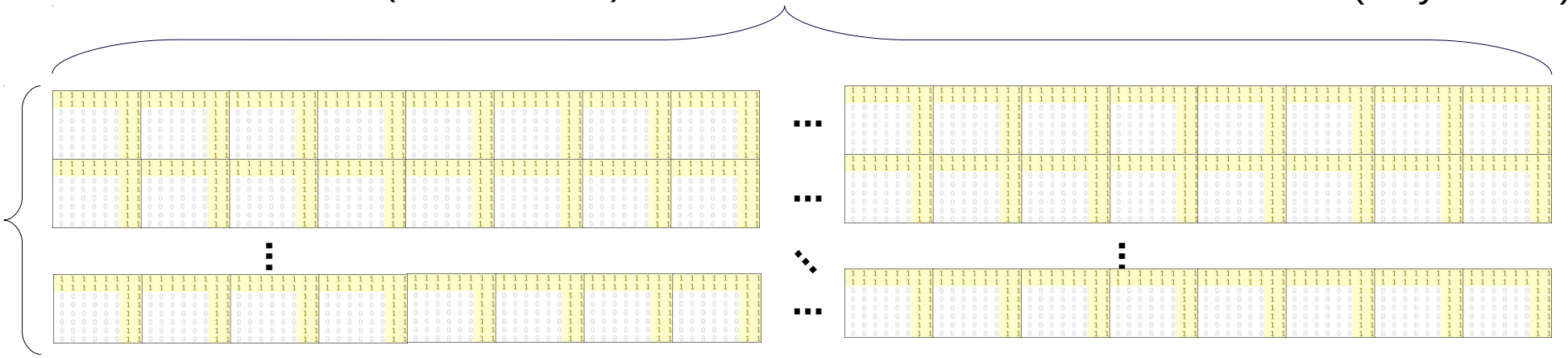
**Be careful** : words written with MSB on the right

# The maze in memory

(as displayed in the memory view of the simulator)

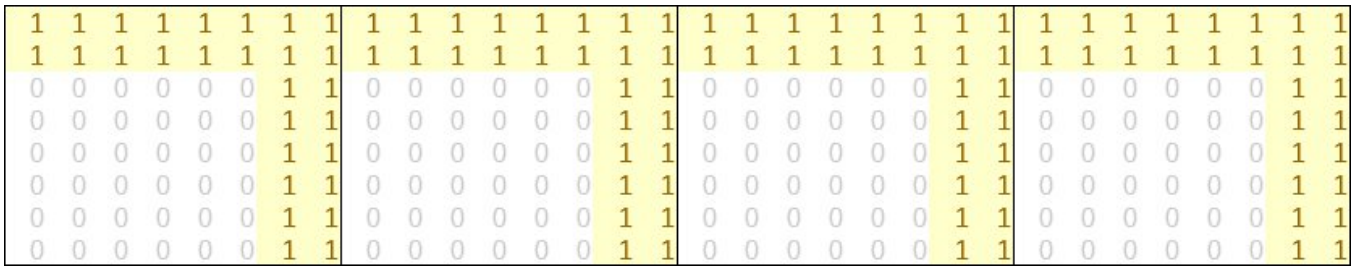



For this project, the maze will have
8 rows and 32 columns (i.e. 256 cells).

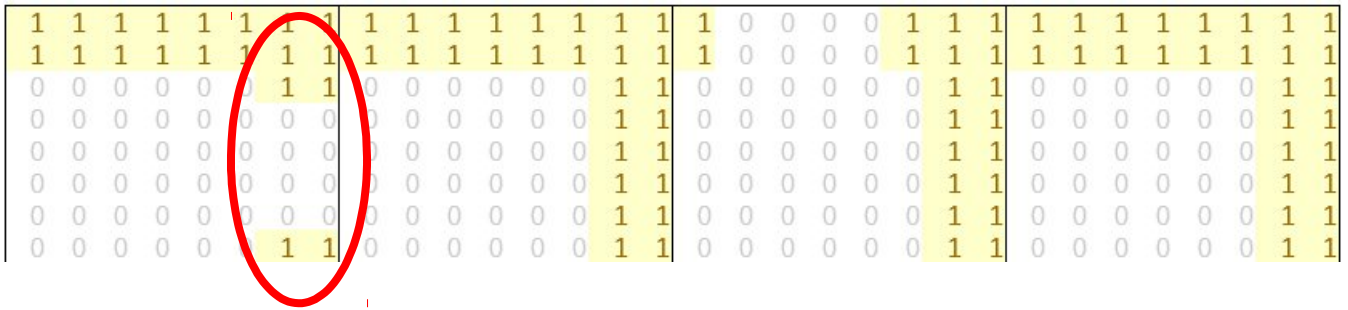


# The maze in memory

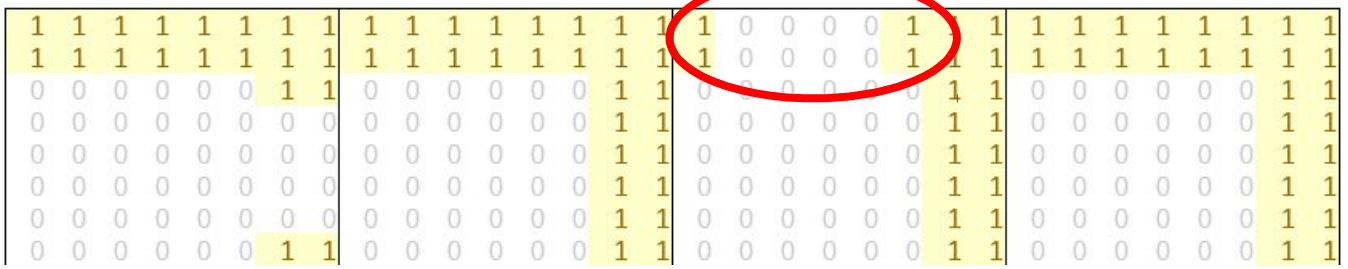
(as displayed in the memory view of the simulator)



Open horizontal connection



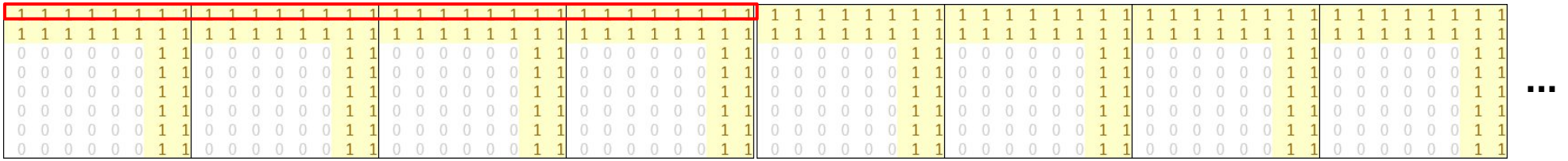
Open vertical connection



# The maze in memory

(as displayed in the memory view of the simulator)

word 0, memory address : 64

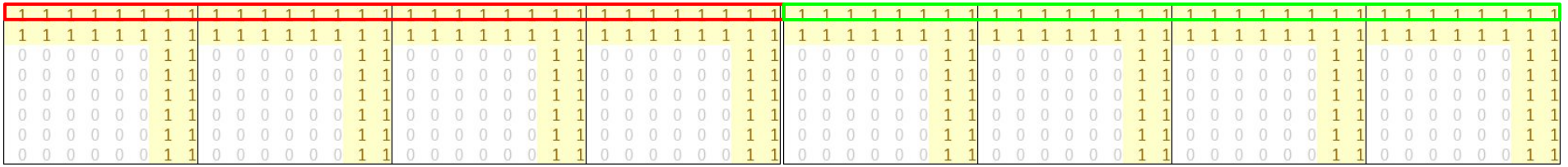


# The maze in memory

(as displayed in the memory view of the simulator)

word 0, memory address : 64

word 1, memory address : 68



...

⋮

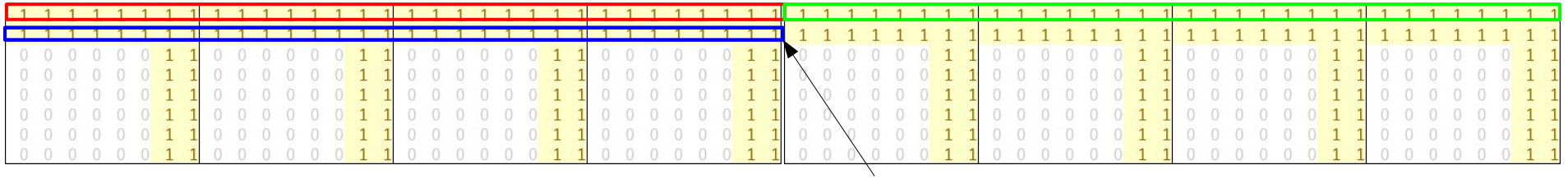
⋮

# The maze in memory

(as displayed in the memory view of the simulator)

word 0, memory address : 64

word 1, memory address : 68



word 8, memory address : 96

⋮ ⋮

# The maze in memory

(as displayed in the memory view of the simulator)

word 0, memory address : 64

word 1, memory address : 68

word 8, memory address : 96

word 24, memory address : 128

# The maze in memory

(as displayed in the memory view of the simulator)

word 0, memory address : 64

word 1, memory address : 68

word 8, memory address : 96

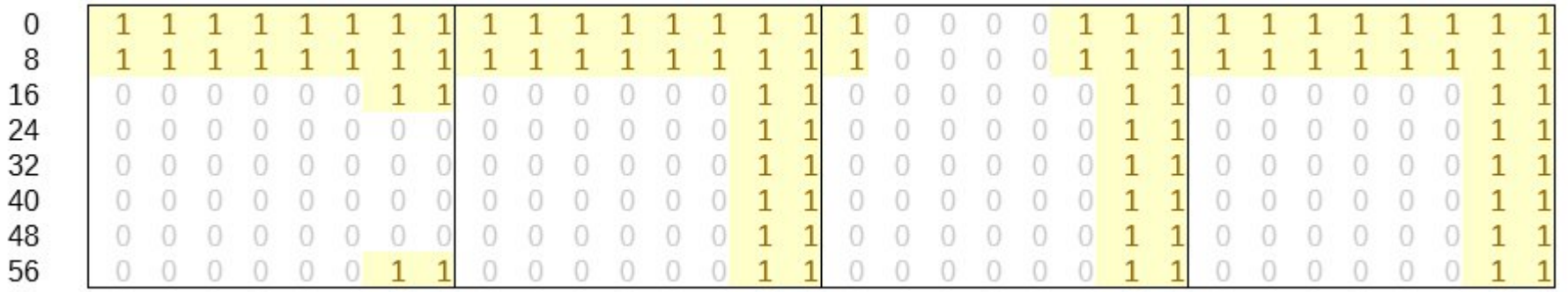
word 24, memory address : 128

Hexadecimal representation :

- word 0 : `0xFFFFFFFF`
- word 24 : `0xC0C0C0C0`

# The maze in memory

(as displayed in the memory view of the simulator)




Opening a door = applying a binary AND between some words and a mask

Horizontal conn. opening

```
word24 = word24 & 0xFFFFFF00
word32 = word32 & 0xFFFFFF00
word40 = word40 & 0xFFFFFF00
word48 = word48 & 0xFFFFFF00
```

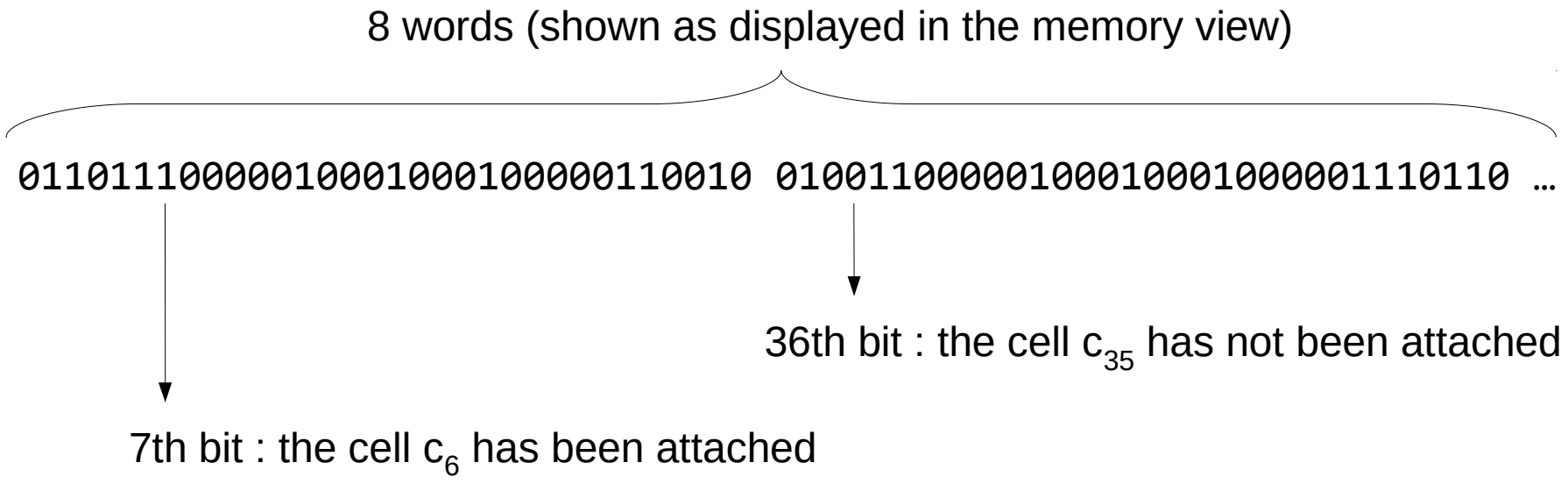
Vertical conn. opening

```
word0 = word0 & 0xFFE1FFFF
word8 = word8 & 0xFFE1FFFF
```

**Be sure** to apply the masking operations on the right byte

# The `visited` bitmap

- The bitmap stores the information about cells that were already connected to the maze being built
- It consists of 8 words



# Coding guidelines

- Focus on code clarity and understandability before efficiency
- Still, your code shouldn’t be unreasonably inefficient (tip: use as few registers as possible, avoid repeating useless operations)
- Document your code !!
- Procedures and macros should be documented:
  - Parameters
  - Operations performed

# Files and submission

You are provided with:

- **perfect_maze.c** : a C implementation of the maze construction algorithm. You can use it as basis for your assembly implementation.
- **beta.usam** : definition of the beta-assembly. Check this file to see which macro you can use.
- **main.asm** : this file contains the main program that will be used to test your procedure

You must submit **in a ZIP file named « sXXXXXX_NAME1_sYYYYYY_NAME2.zip »**:

- **perfect_maze.asm** : a file containing your implementation of the maze construction algorithm
- **(optional) report.pdf** : if you think you need more than the comments to explain some parts of your code, you can write those explanations in a short report (maximum two pages).
- **Submitting other files will be sanctioned**