Genetic Algorithm for Path Planning

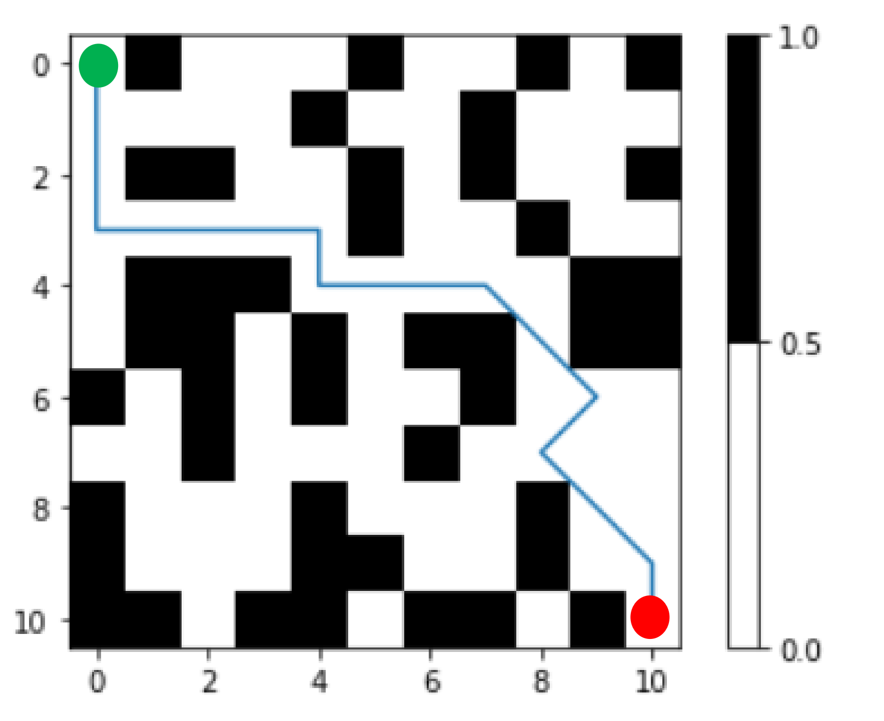
Team 12 : Ianis Bougdal-Lambert ‘ianisbl’, Gael Colas ‘colasg’

AA222 Final Presentation
31/05/2018

Representation

2D occupancy grid

$$occ\,[i,j] = \begin{cases} 1 \; if \; obstacle \; in \; cell \; (i,j) \\ 0 \; otherwise \end{cases}$$



Monotone Path $bina \in \{0,1\}^m$

$$m = 1 + (n-1)\,(2 + 1 + 1 + \mathrm{int}(\log_2 n))$$

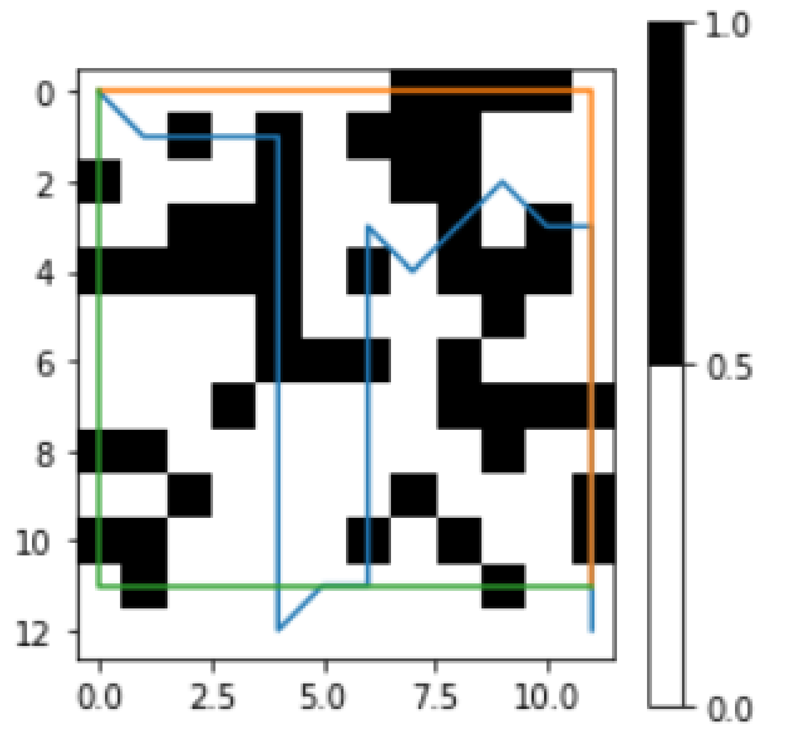
$$bina[0] = \begin{cases} 0 : x - monotone \; path \\ 1 : y - monotone \; path \end{cases}$$

Table of actions for $bina[0] = 0$

2 bits	Remaining bits	Movement
00	Nb of cells crossed	Vertical
01	Ignored	Diagonal-Up
10	Ignored	Horizontal
11	Ignored	Diagonal-Down

11011100101100000101000010011011011001101001101011010101001010011010010

Strategy



$$fitness(path) = \begin{cases} n^2 - n_{cell} & if\ valid \\ n^2 - n_{cell} / 20\, n_{coll} & if\ collisions \\ 1 & else \end{cases}$$

0. Initialization : **p individuals**

1. Selection : **Roulette Wheel**

2. Crossover : **1 point CO**

3. Mutation : **1 Bit Flip mutation**

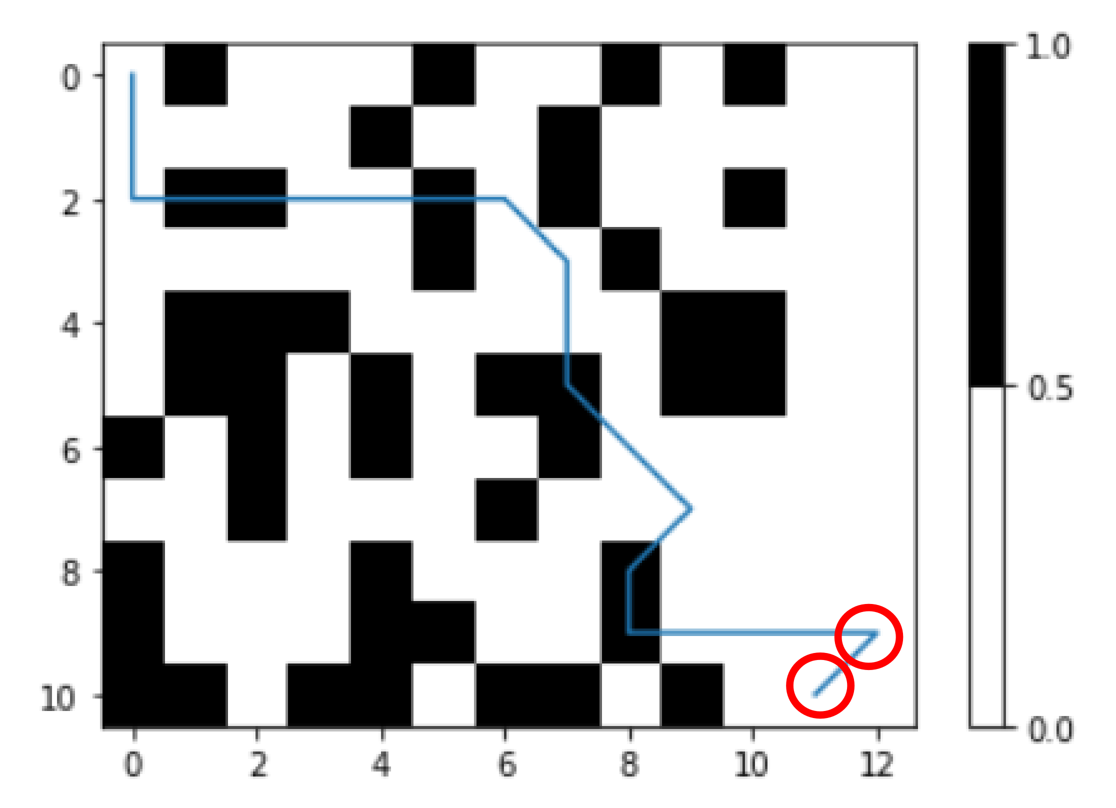
4. Repair process (next slide)

5. Replacement : **Generational**

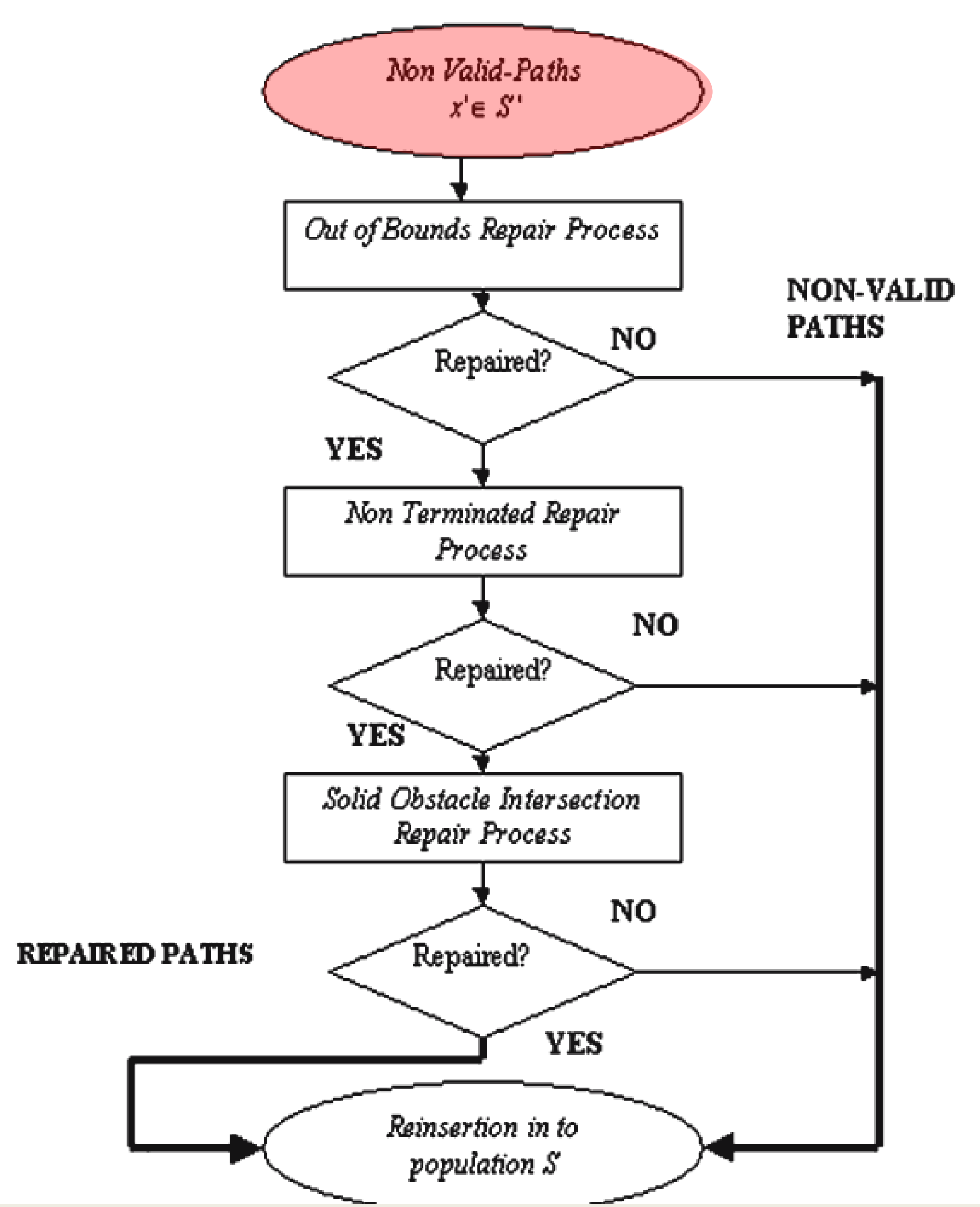
6. Loop to 1.

Repair Mechanism

Initial Path



Status : **Non-Valid** Path



Non Valid-Paths $x' \in S'$

Out of Bounds Repair Process

Repaired?

NO

NON-VALID PATHS

YES

Non Terminated Repair Process

Repaired?

NO

YES

Solid Obstacle Intersection Repair Process

Repaired?

NO

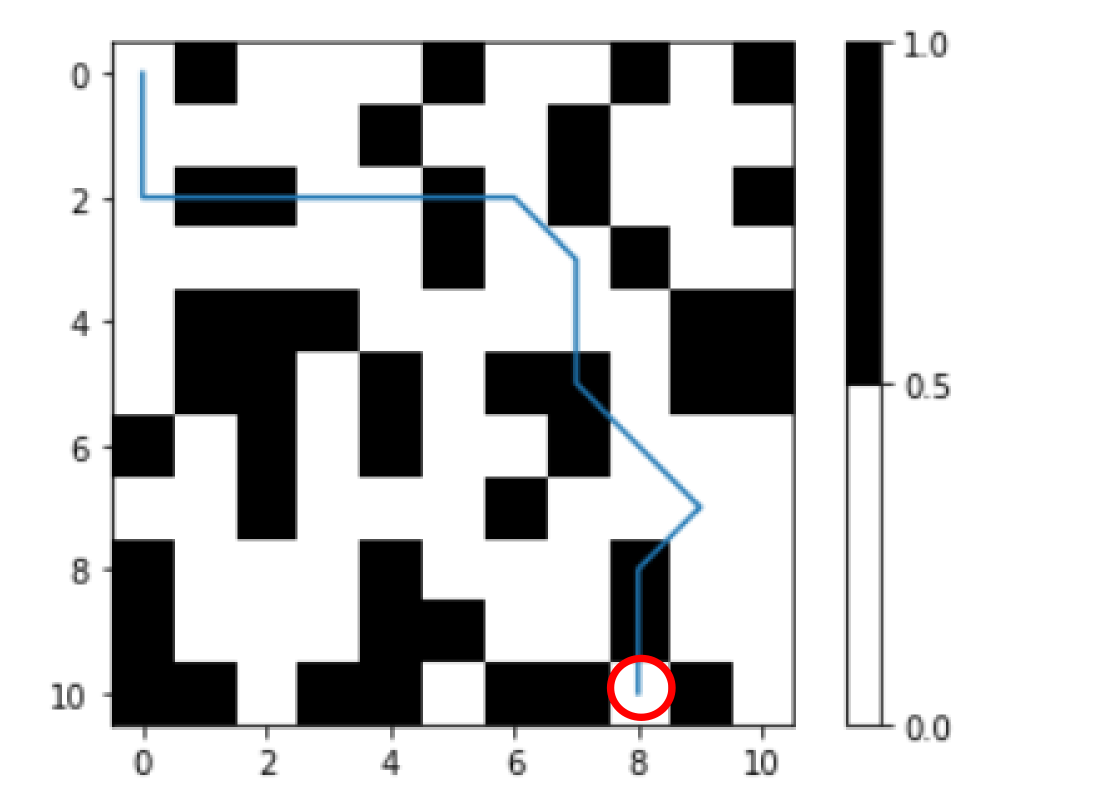
REPAIRED PATHS

YES

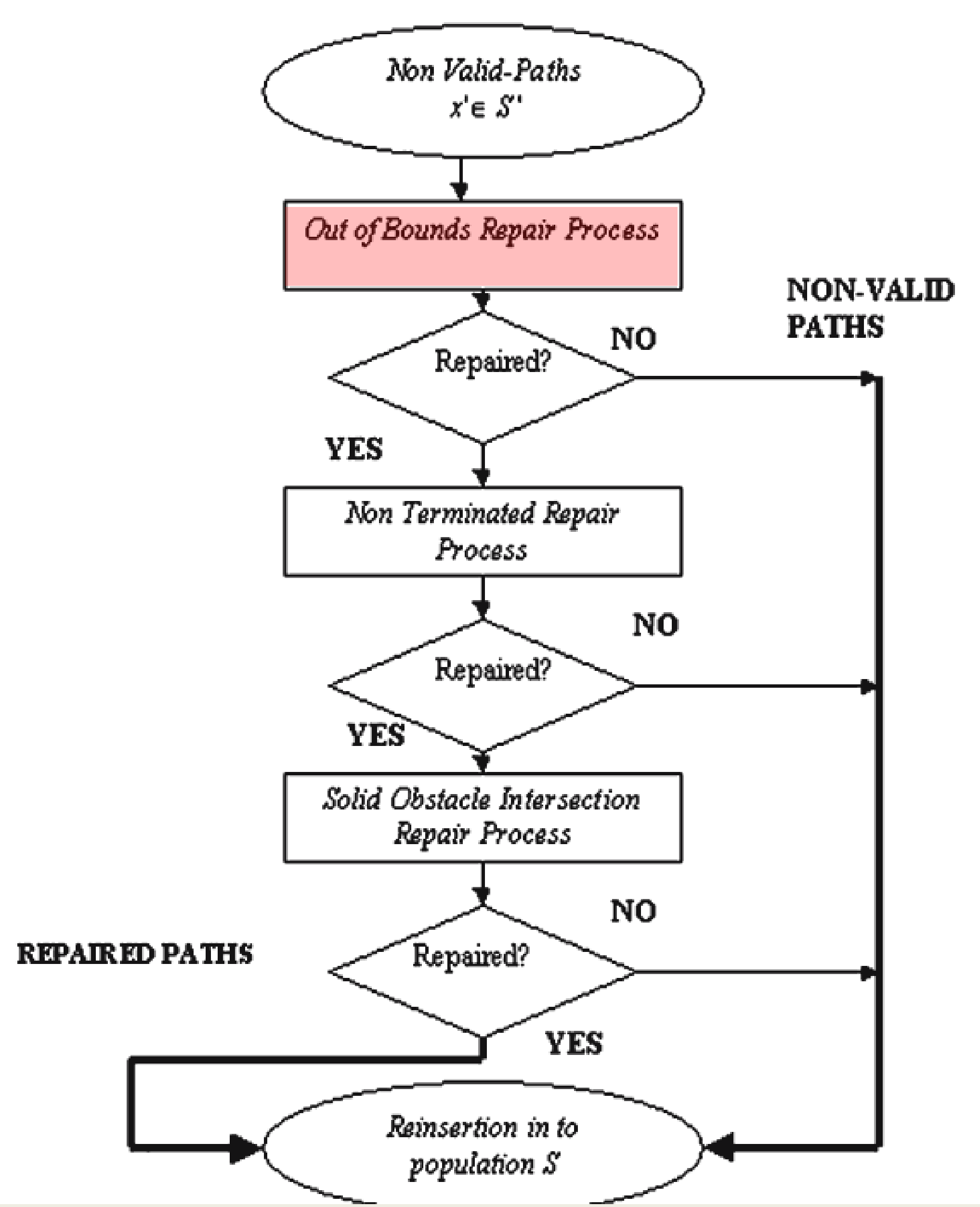
Reinsertion in to population S

Repair Mechanism

Out of Bounds Repair



Status : **Non-Valid** Path



Non Valid-Paths *x'∈ S'*

Out of Bounds Repair Process

Repaired?

NO

NON-VALID PATHS

YES

Non Terminated Repair Process

Repaired?

NO

YES

Solid Obstacle Intersection Repair Process

Repaired?

NO

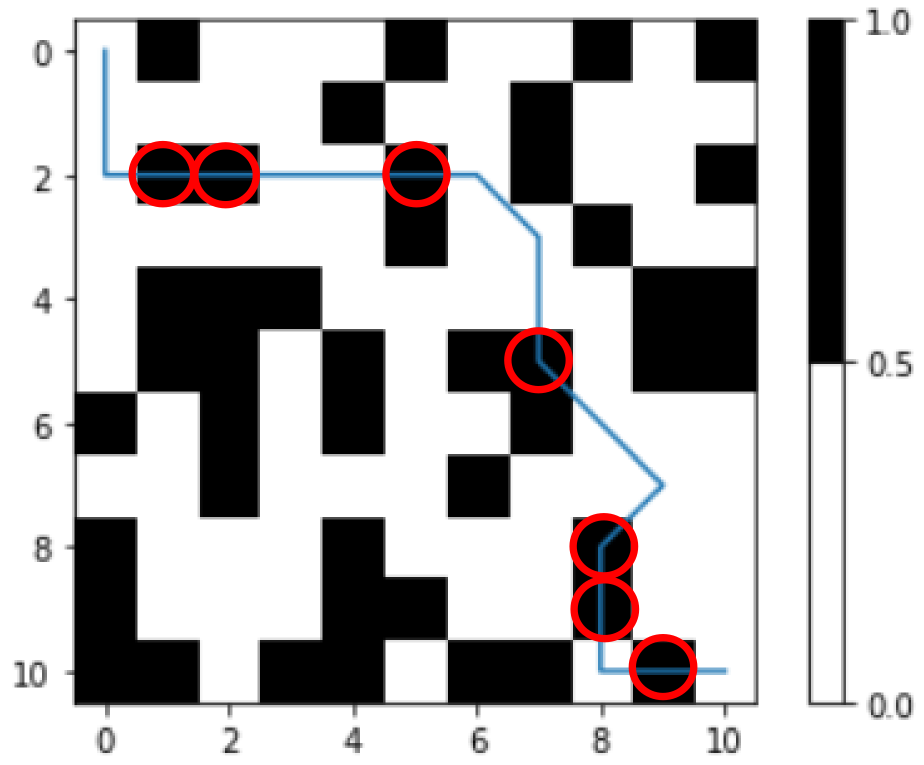
REPAIRED PATHS

YES

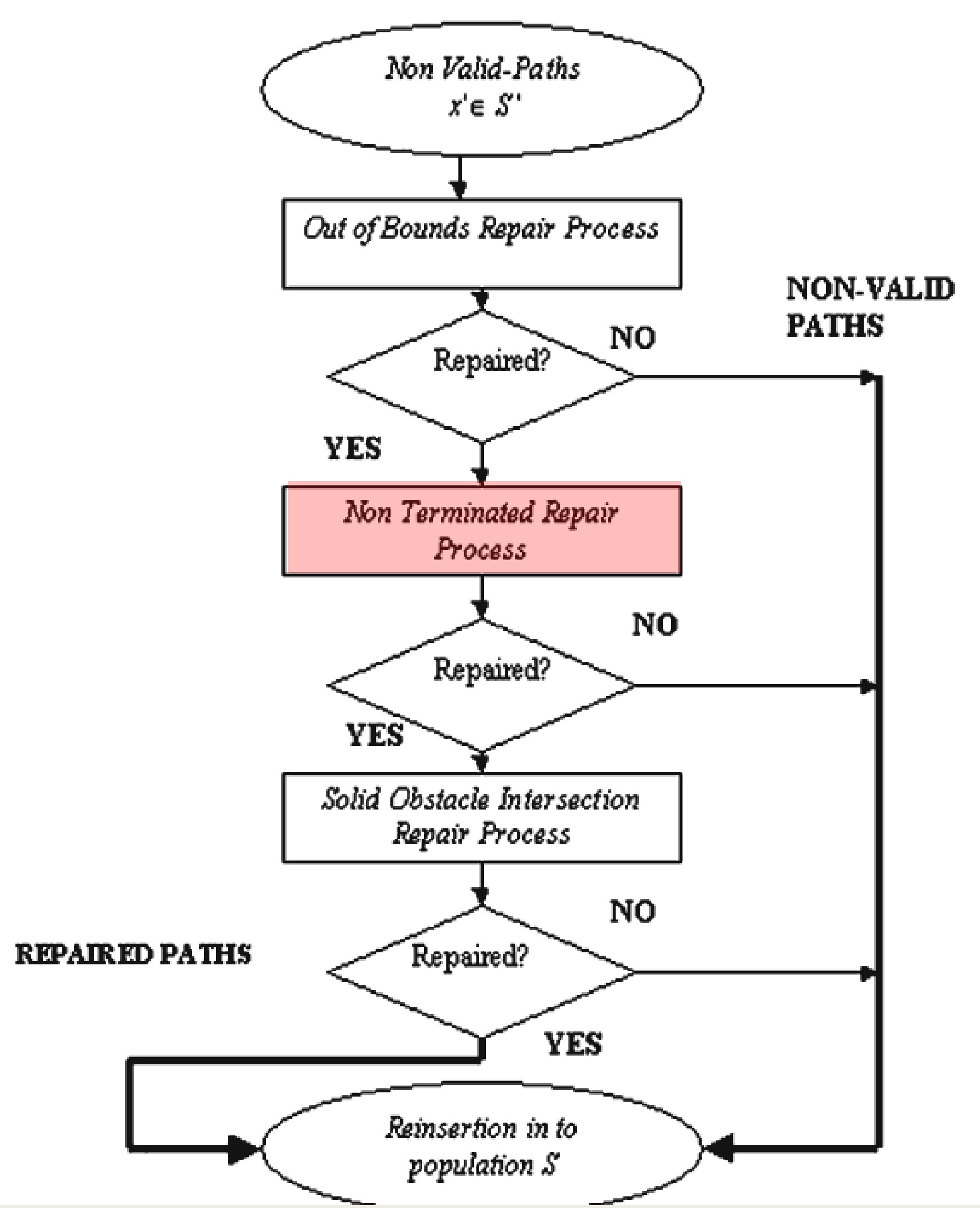
Reinsertion in to population S

Repair Mechanism

End Point Repair

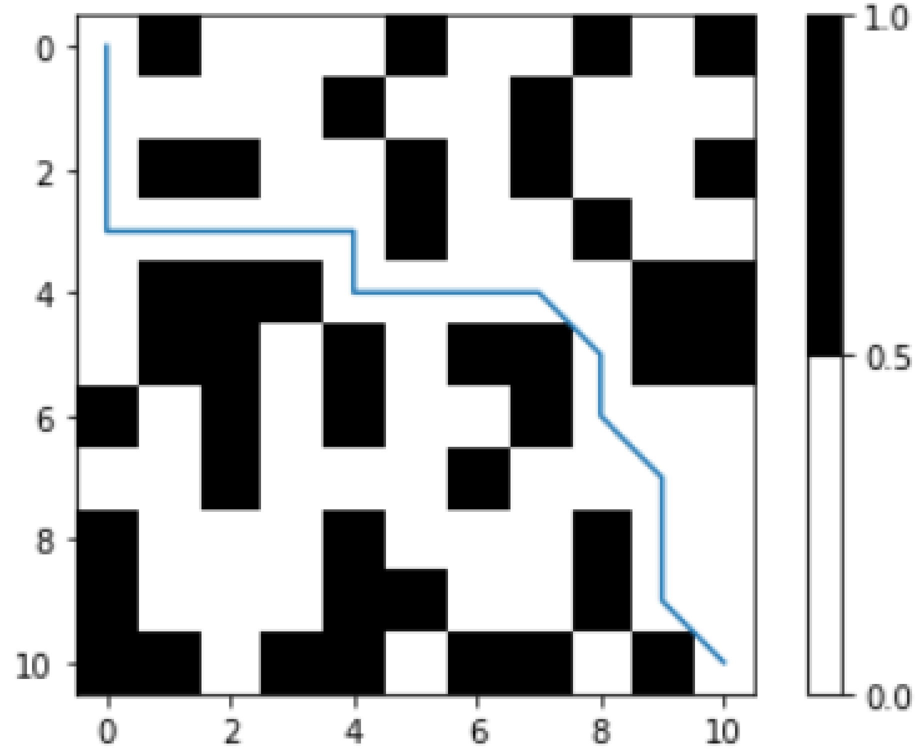


Status : **Non-Valid** Path



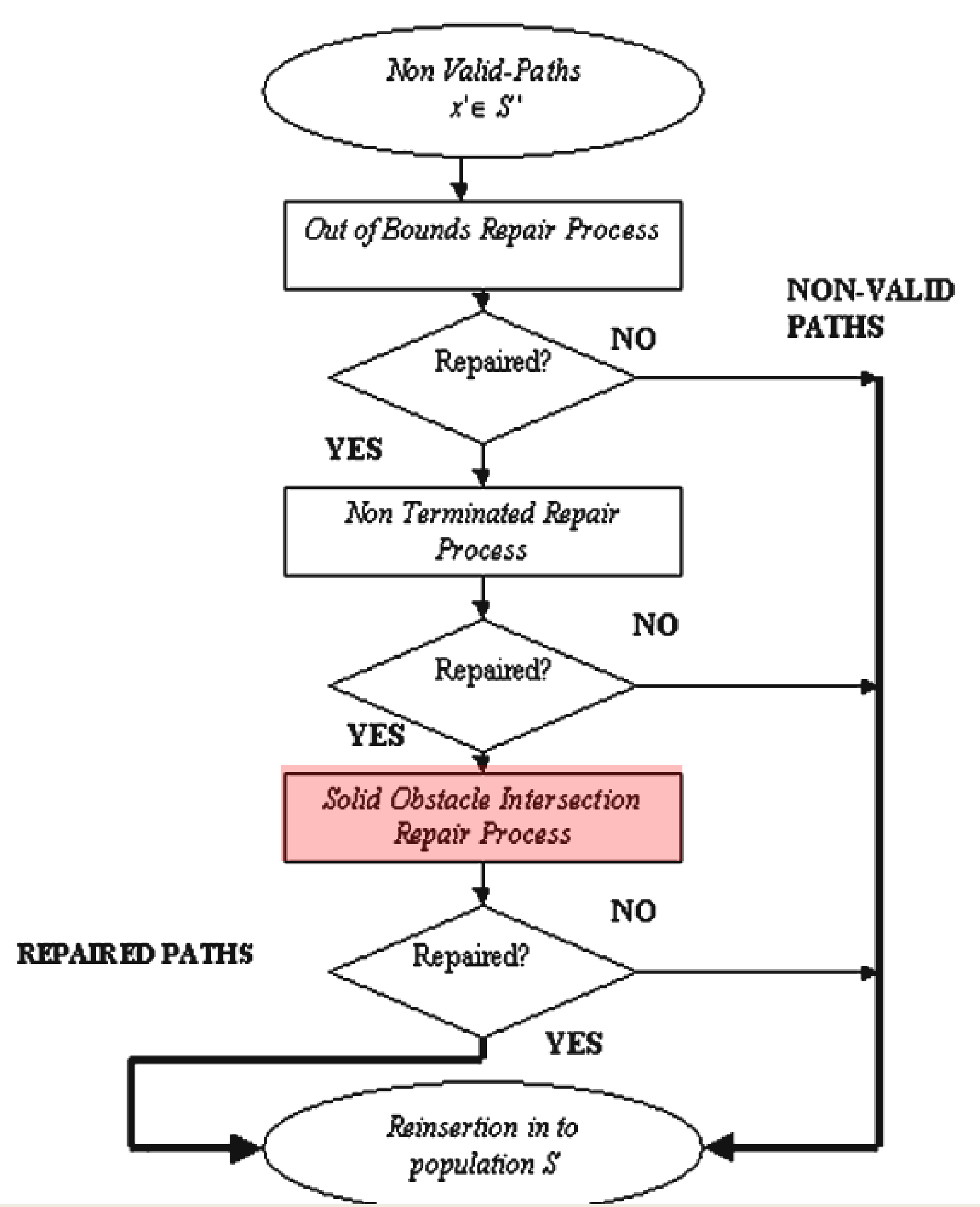
Non Valid-Paths
x'∈ S'
Out of Bounds Repair Process
Repaired?
NO
NON-VALID PATHS
YES
Non Terminated Repair Process
Repaired?
NO
YES
Solid Obstacle Intersection Repair Process
Repaired?
NO
REPAIRED PATHS
YES
Reinsertion in to population S

Collision Repair



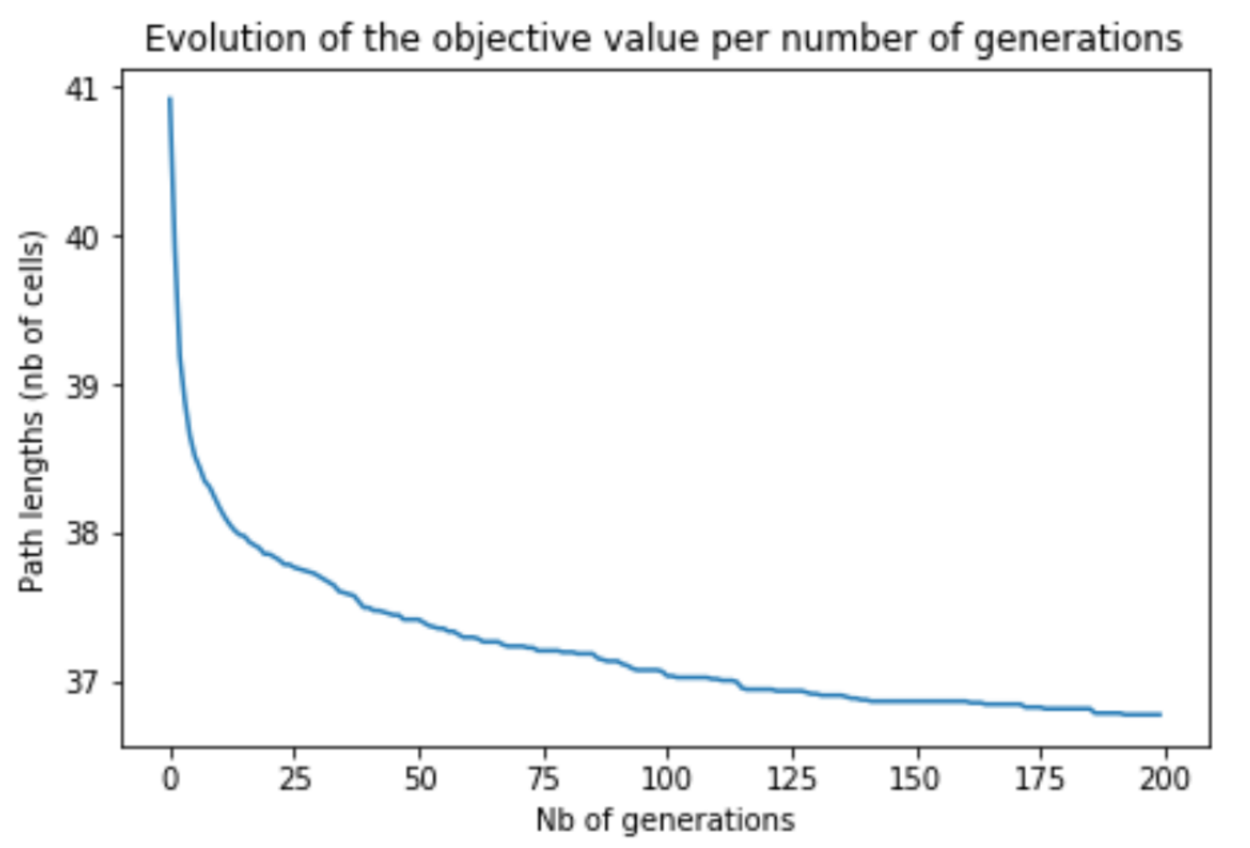
Status : **Valid** Path

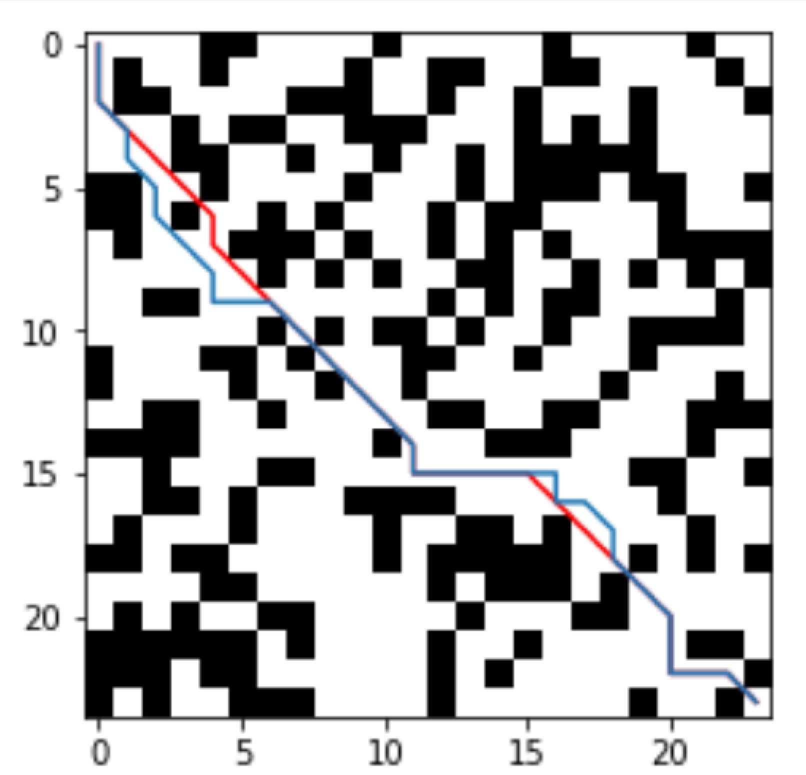
Repair Mechanism

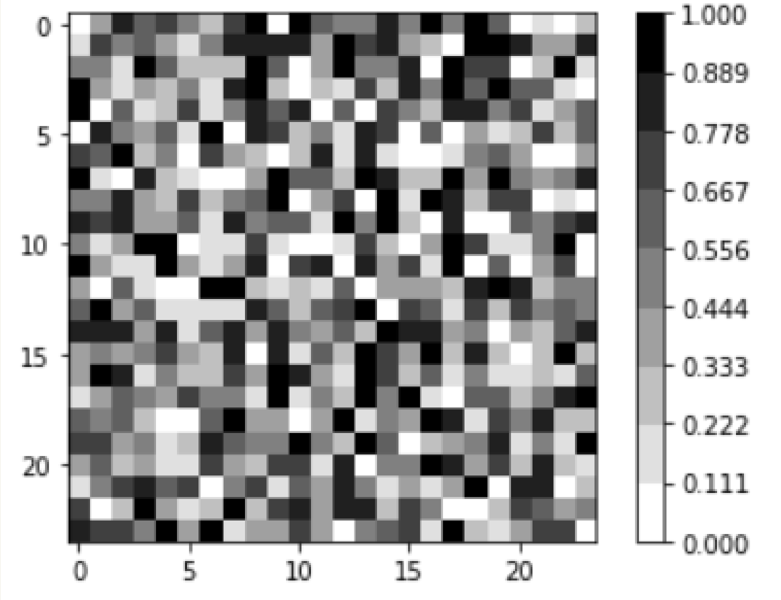

Non Valid-Paths
x'∈ S'
Out of Bounds Repair Process
Repaired?
NO
NON-VALID PATHS
YES
Non Terminated Repair Process
Repaired?
NO
YES
Solid Obstacle Intersection Repair Process
Repaired?
NO
REPAIRED PATHS
YES
Reinsertion in to population S

Results

Set-up : $n_{sim} = 100$; $n_{gen} = 200$; $p = 100$







Future Work

Multiobjective version

- *shortest path* : $n_{cell} = \sum_{(i,j) \in path} 1$
- *‘easiest’ path* : $val = \sum_{(i,j) \in path} occ[i,j]$

Where : $0 \leq occ[i,j] \leq 1$

Comparison with **Optimal Control methods**

- A^*
- *Differential Dynamic Programming*