Recherche de chemin et labyrinthe

(Starcraft 2)

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Atelier ISN 2019 – 7 Mars 2019

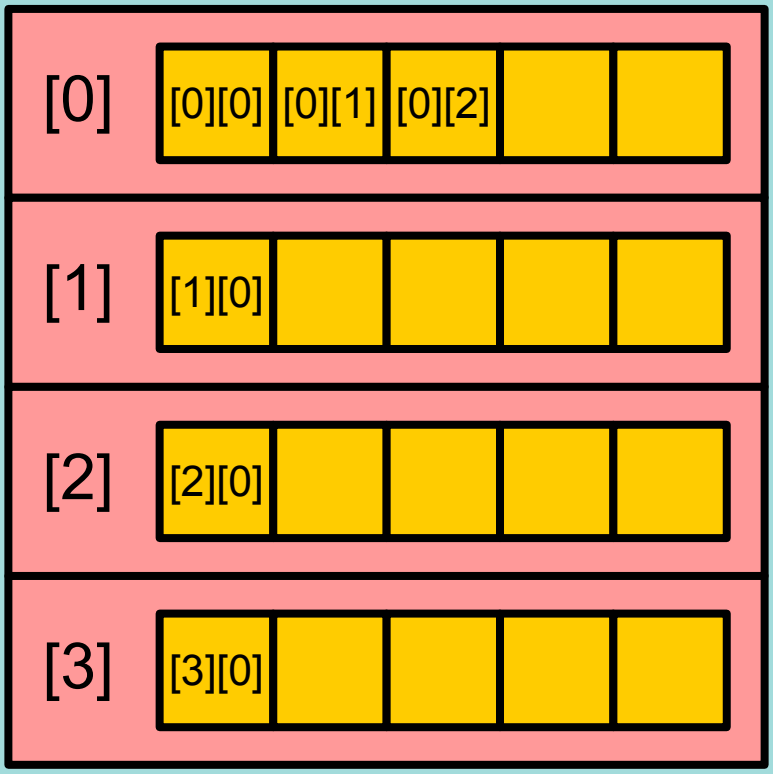
Plan

- Structure de labyrinthe
- Recherche de chemin
  - Algorithme de Lee / la vague
- Extensions
  - Dijkstra
  - A *
  - Autres problèmes

Structure de labyrinthe

- Cf Code python fourni
  - Tableau à deux dimensions

```
laby = []
laby +=[[1,1,1,1,1,1,1,1]]
laby +=[[1,0,0,1,0,0,0,1]]
laby +=[[1,0,0,1,0,1,0,1]]
laby +=[[1,0,1,1,1,1,0,1]]
laby +=[[1,0,0,0,0,0,0,1]]
laby +=[[1,1,0,1,1,0,1,1]]
laby +=[[1,0,0,0,0,0,0,1]]
Laby +=[[1,1,1,1,1,1,1,1]]
transpose(laby)
----------------------------
laby[x][y]
```



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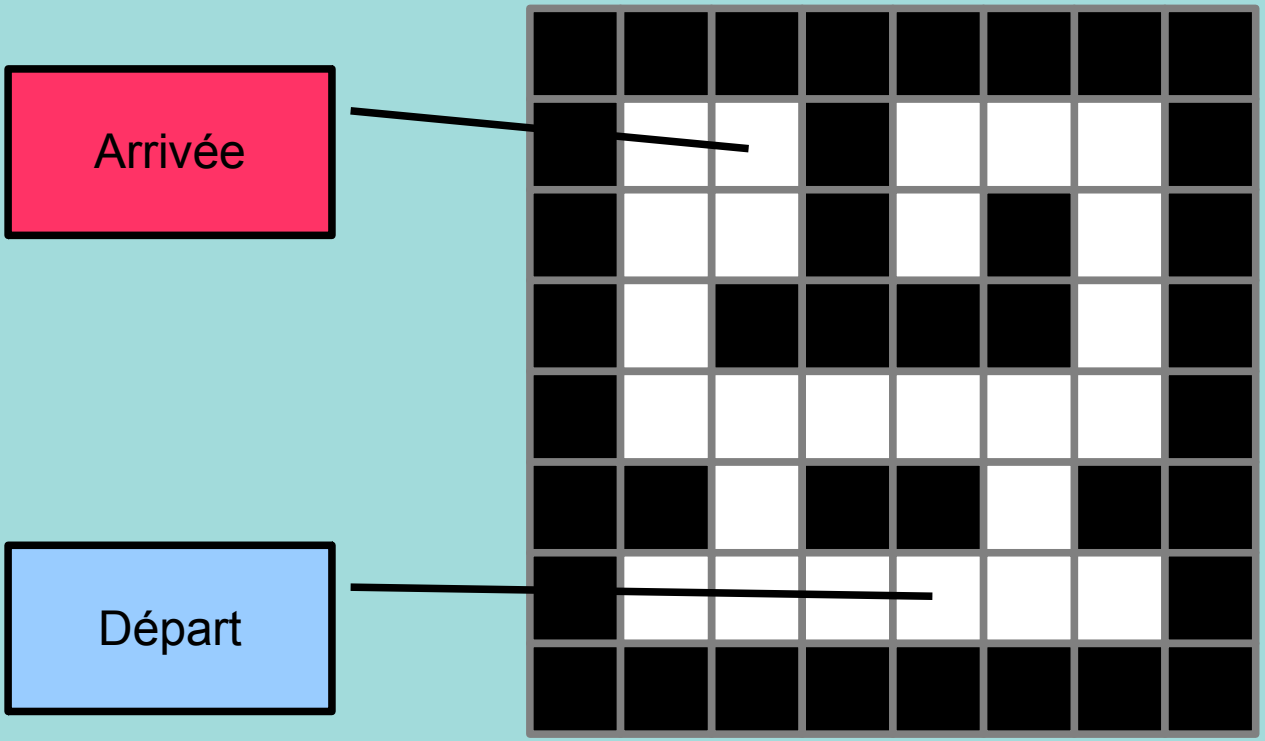
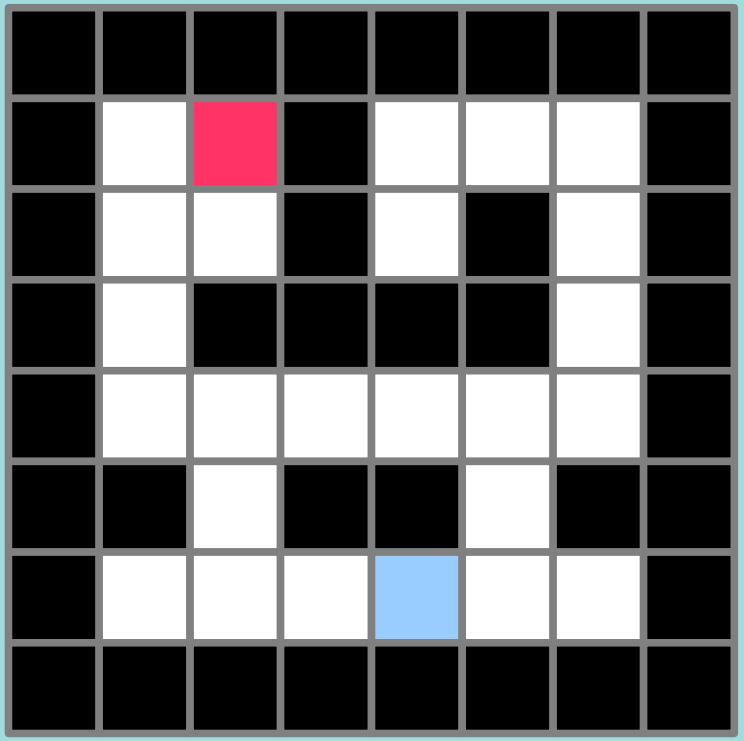
Recherche de chemins



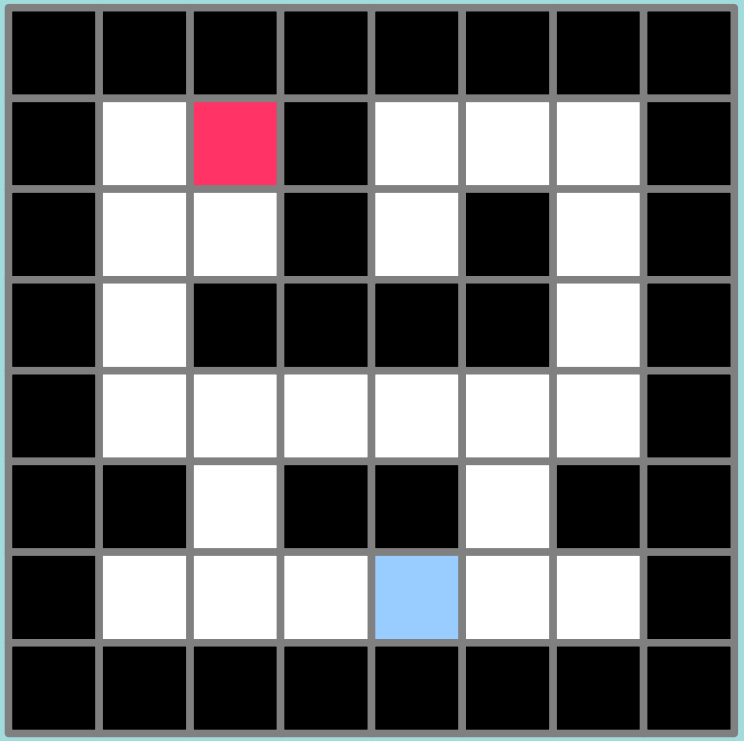
Recherche de chemins

- Quel est le chemin le plus court ?



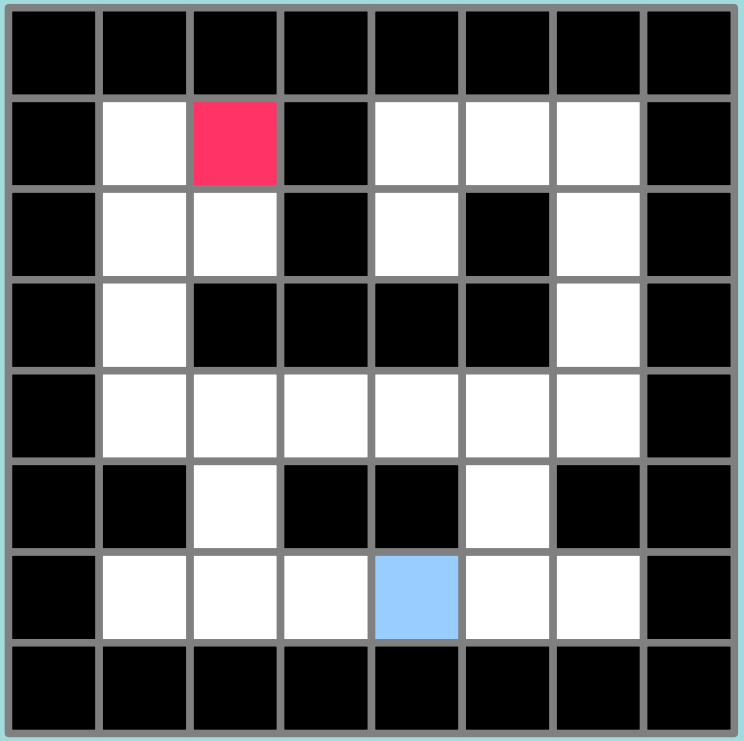
Recherche de chemins

- Quel est le chemin le plus court ?
  - Pourquoi difficile ?
- Solution possibles ?



Recherche de chemins

- Quel est le chemin le plus court ?
  - Pourquoi difficile ?
- 1. Enumérer chemins
  - Explosion combinatoire
- 2. Raisonner sur distances
  - Quelle info trivial ?



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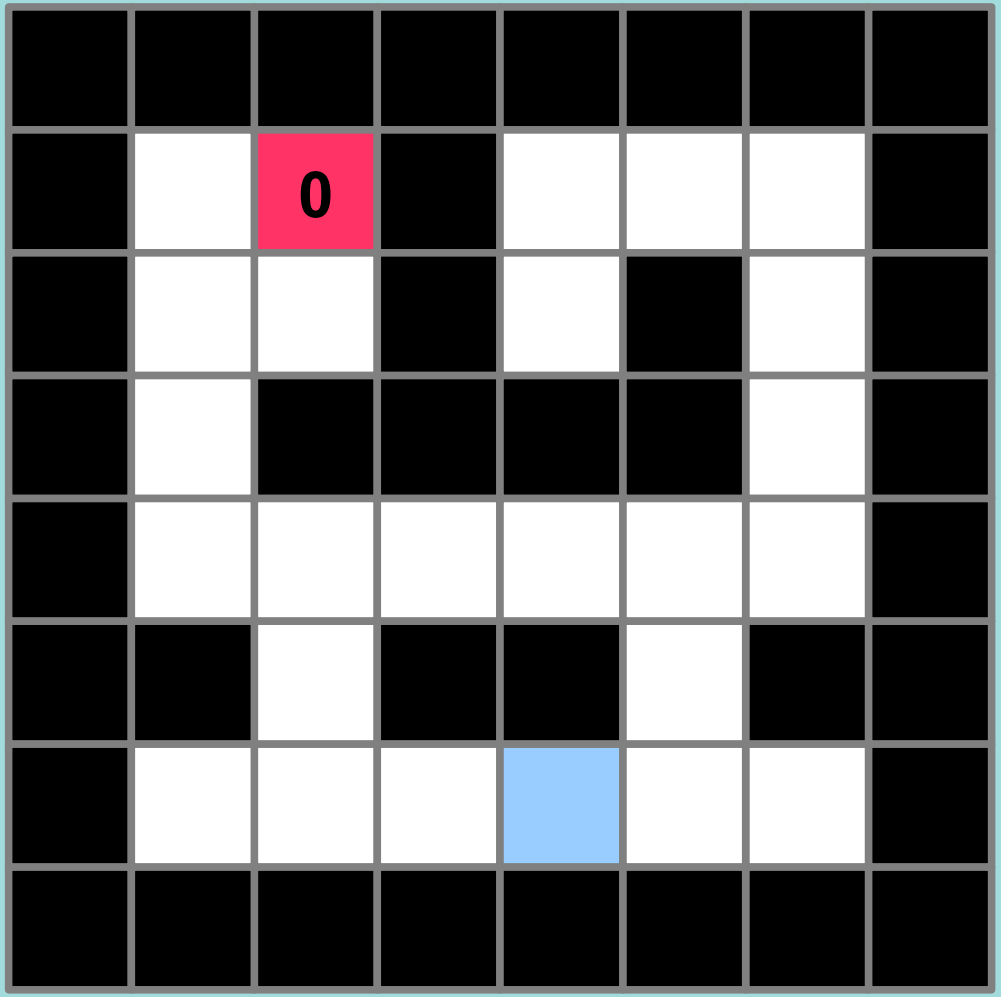
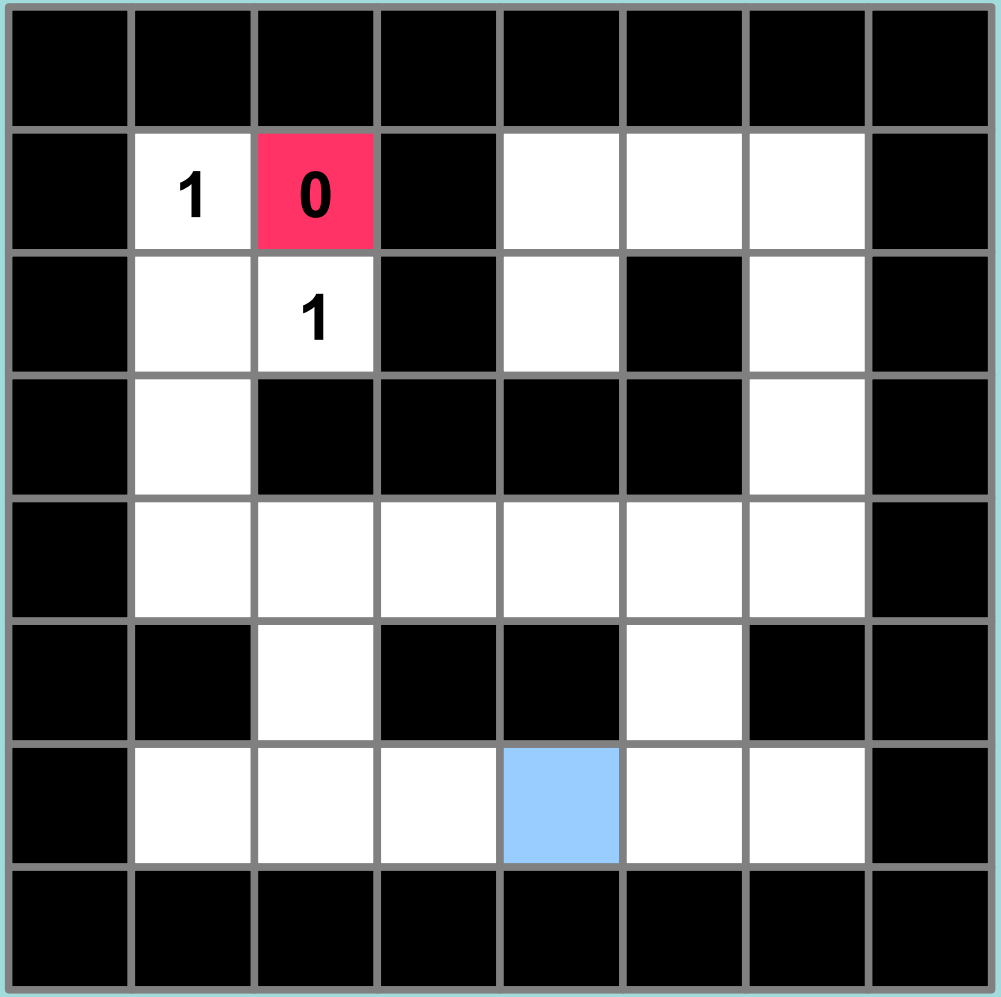


Algorithme de propagation

Recherche de chemins



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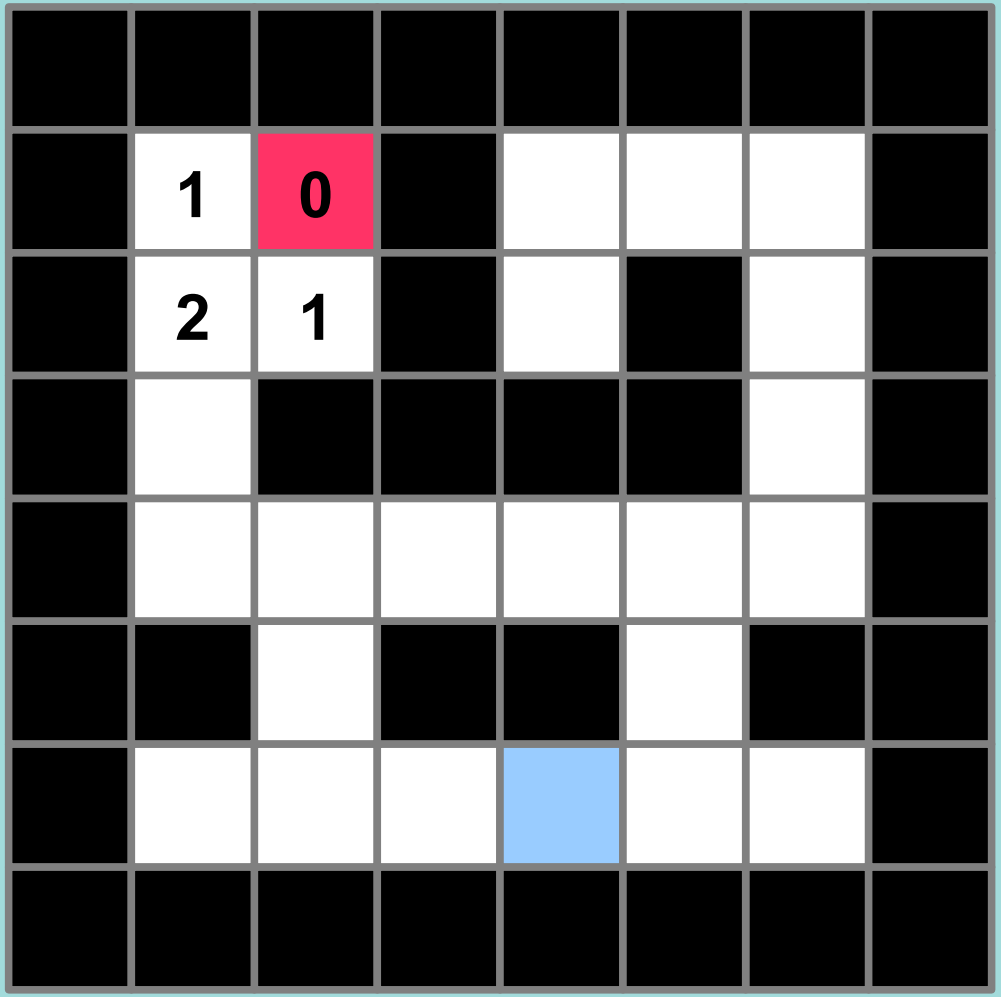

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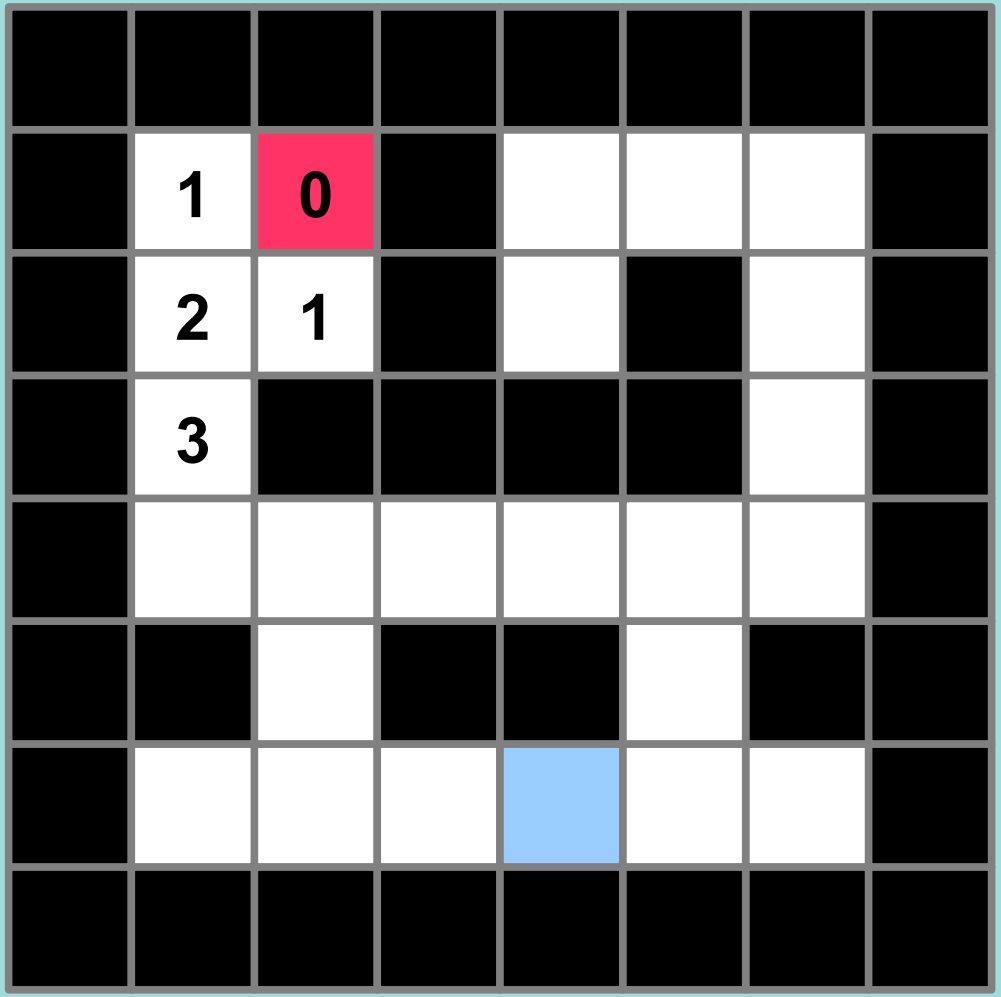

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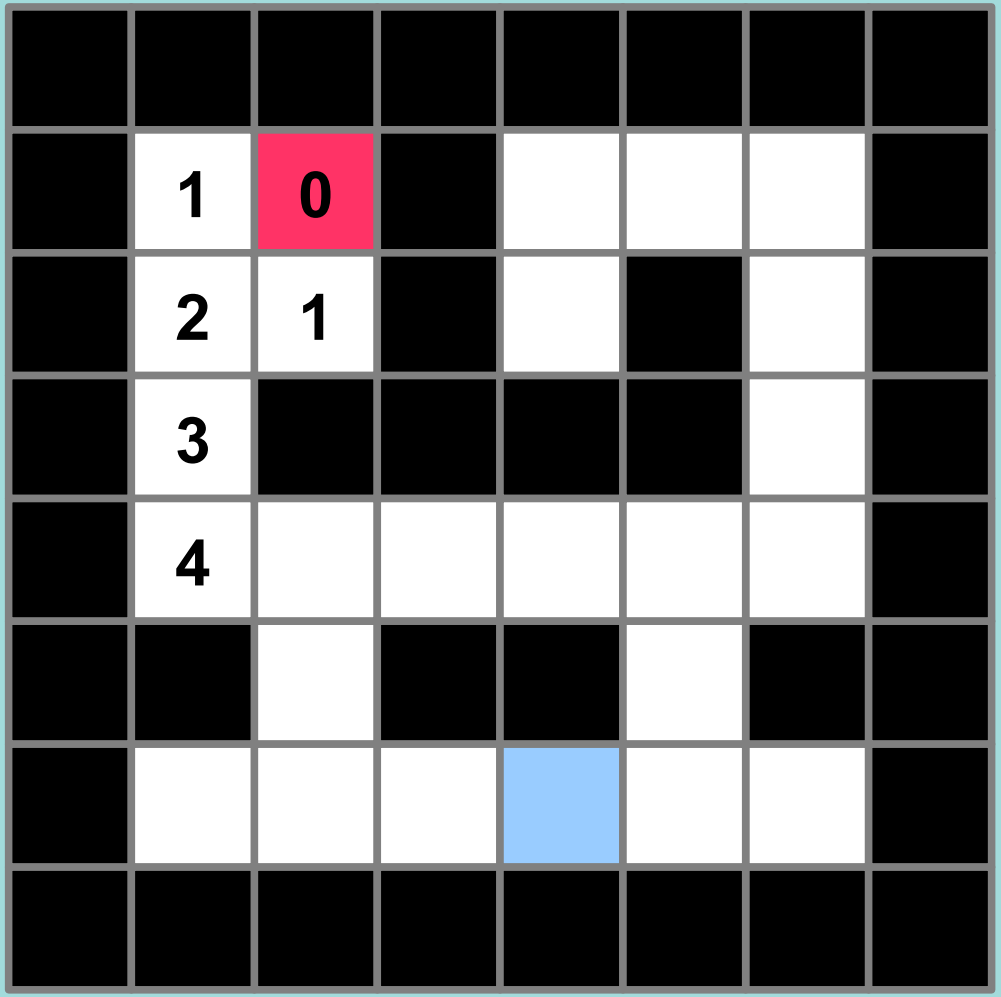

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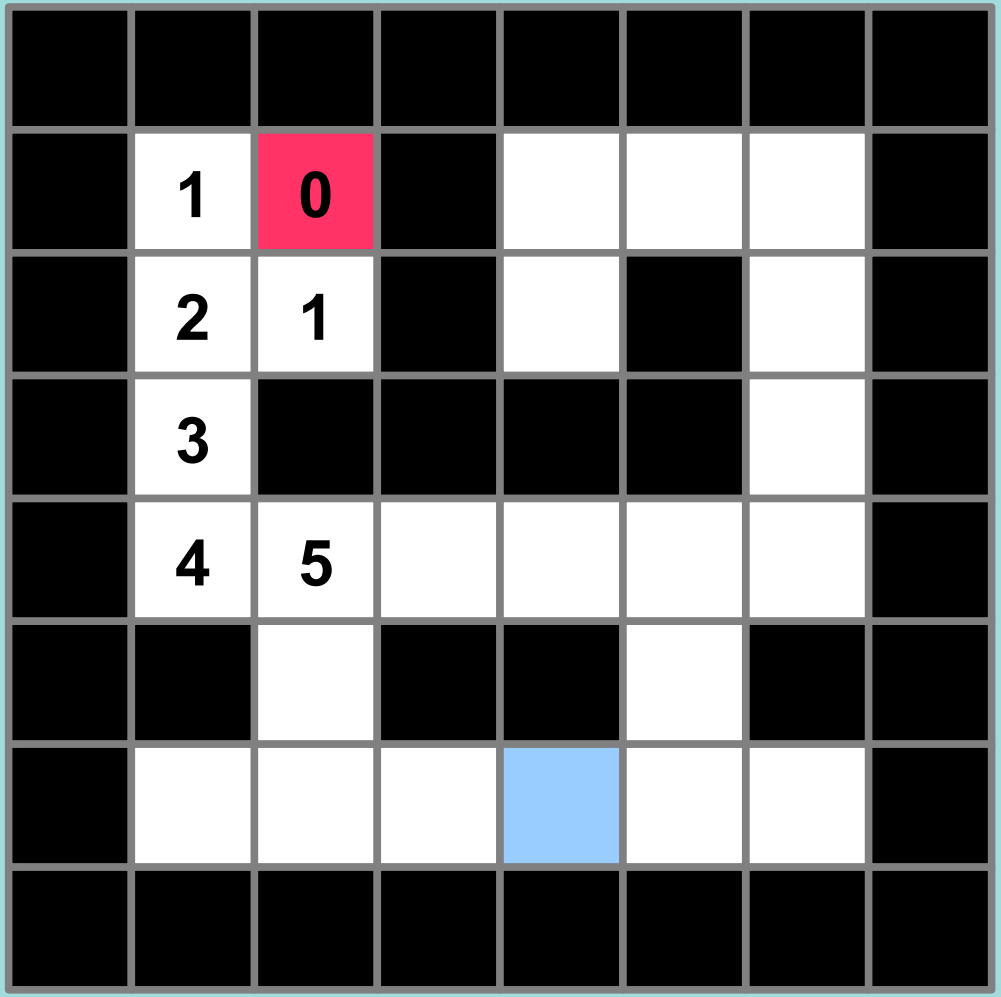

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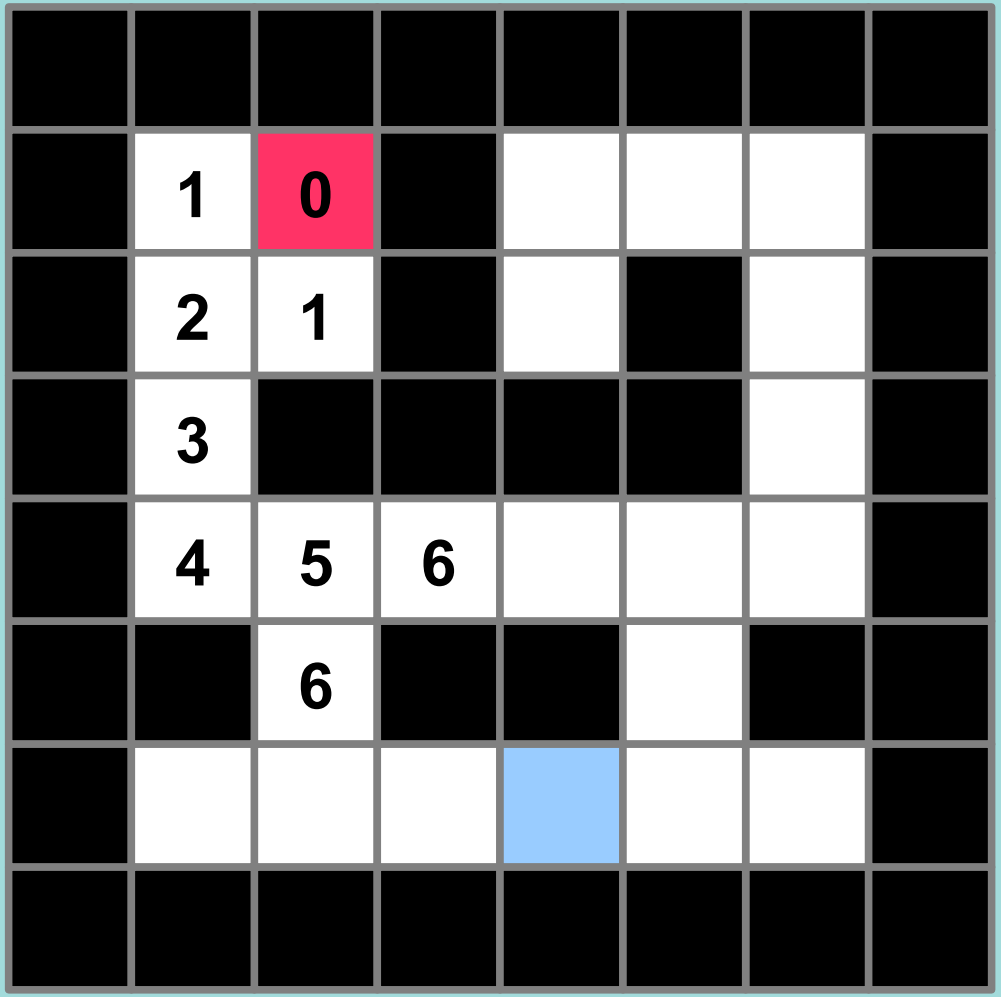

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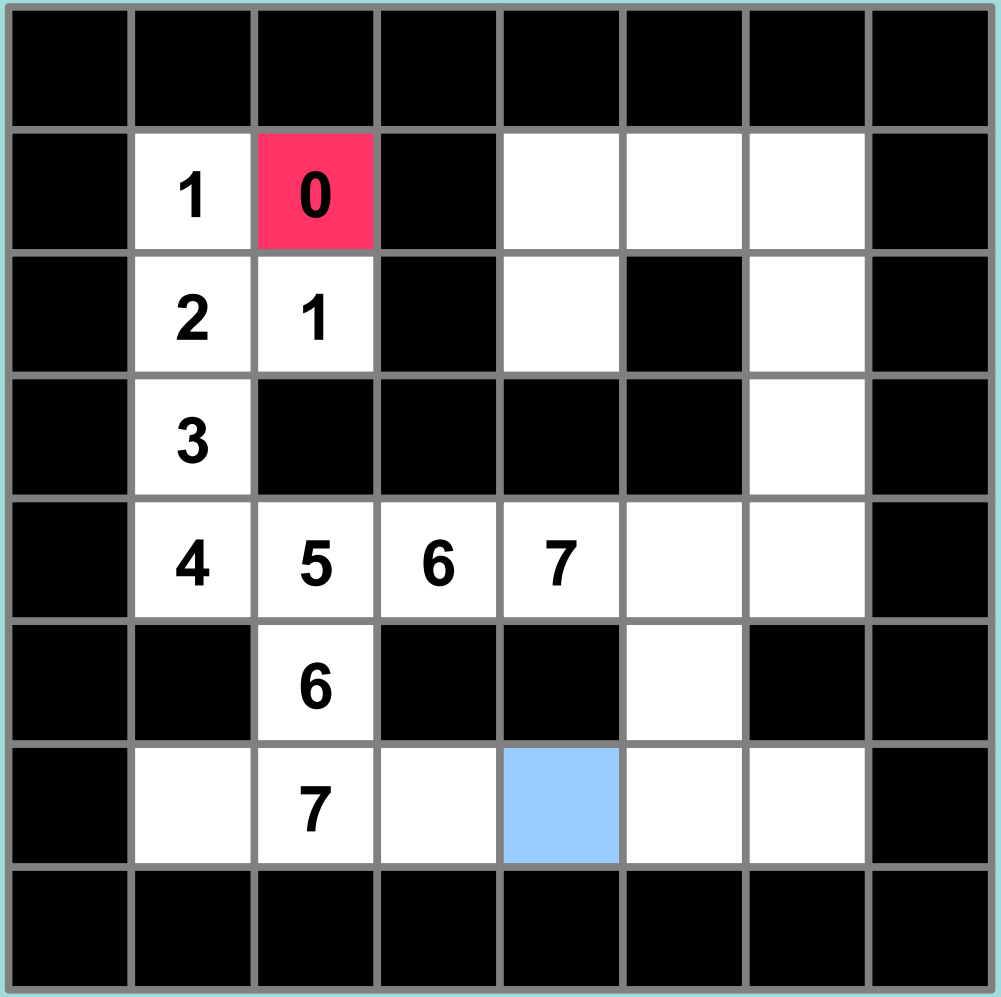

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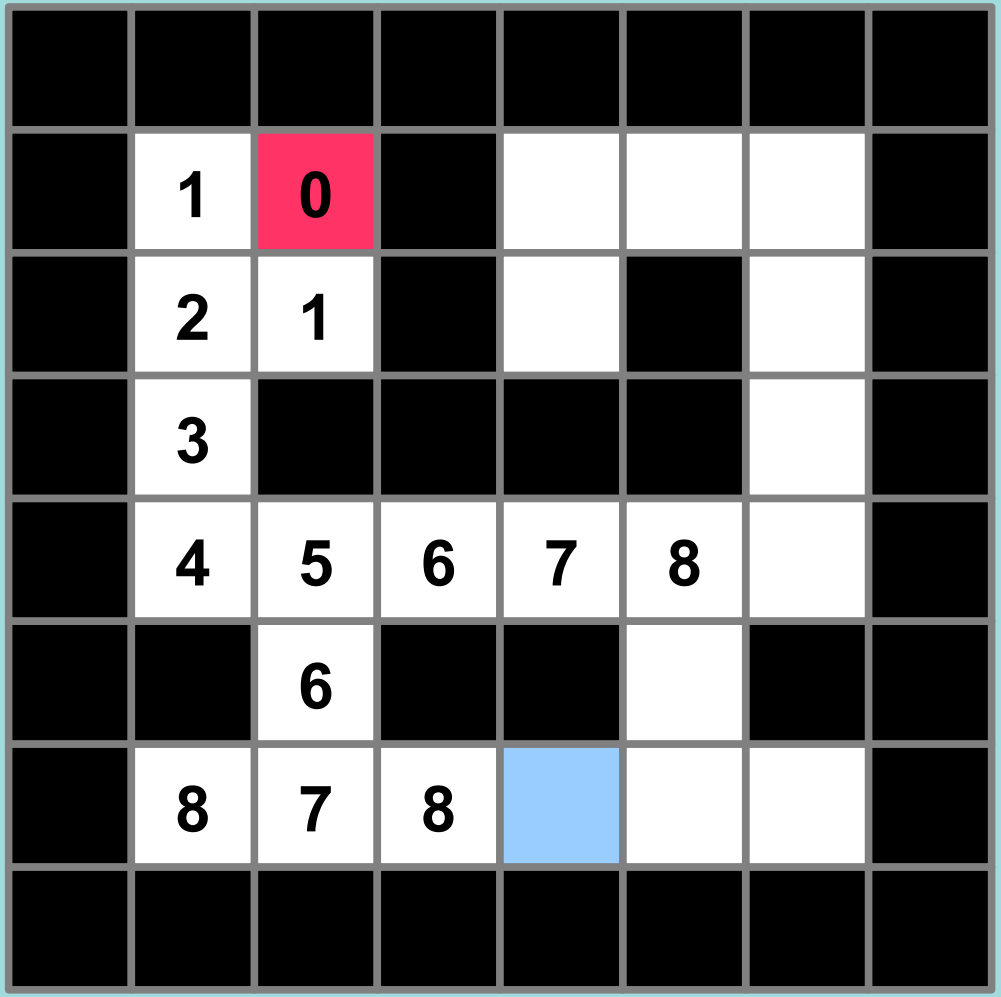

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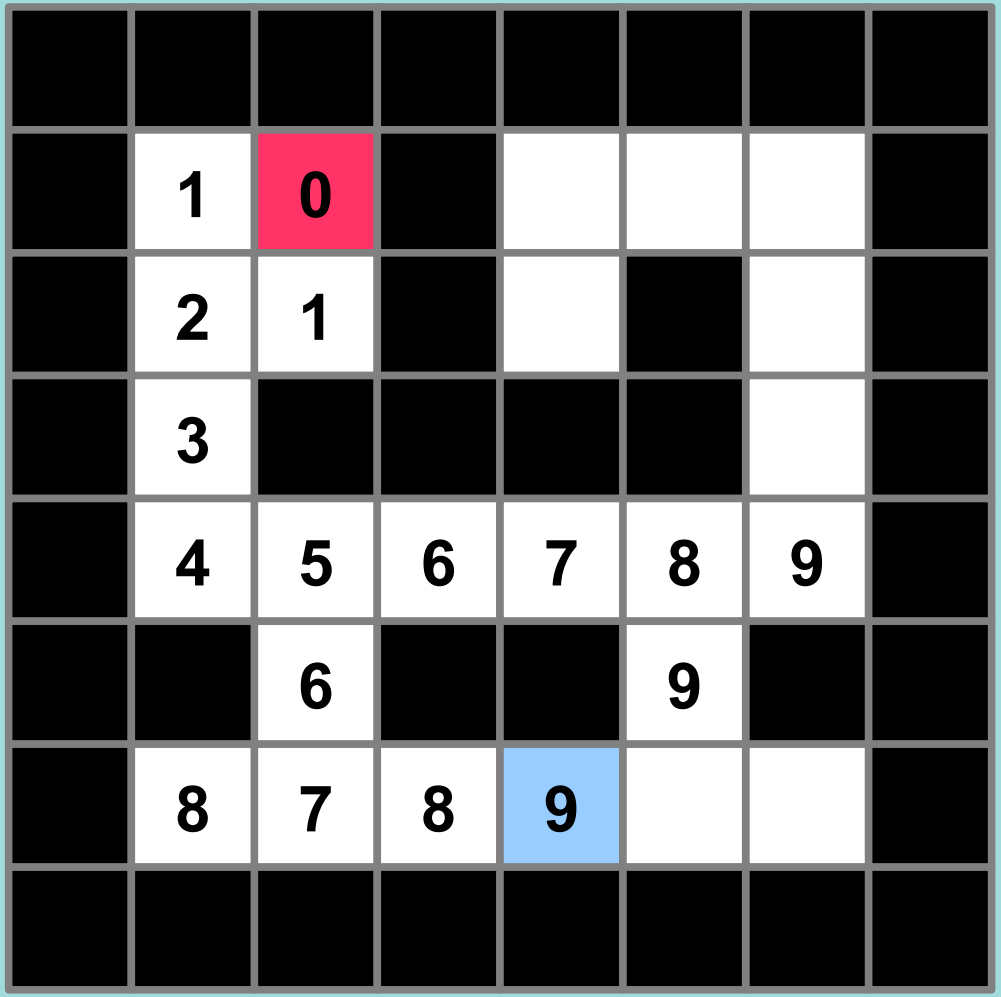

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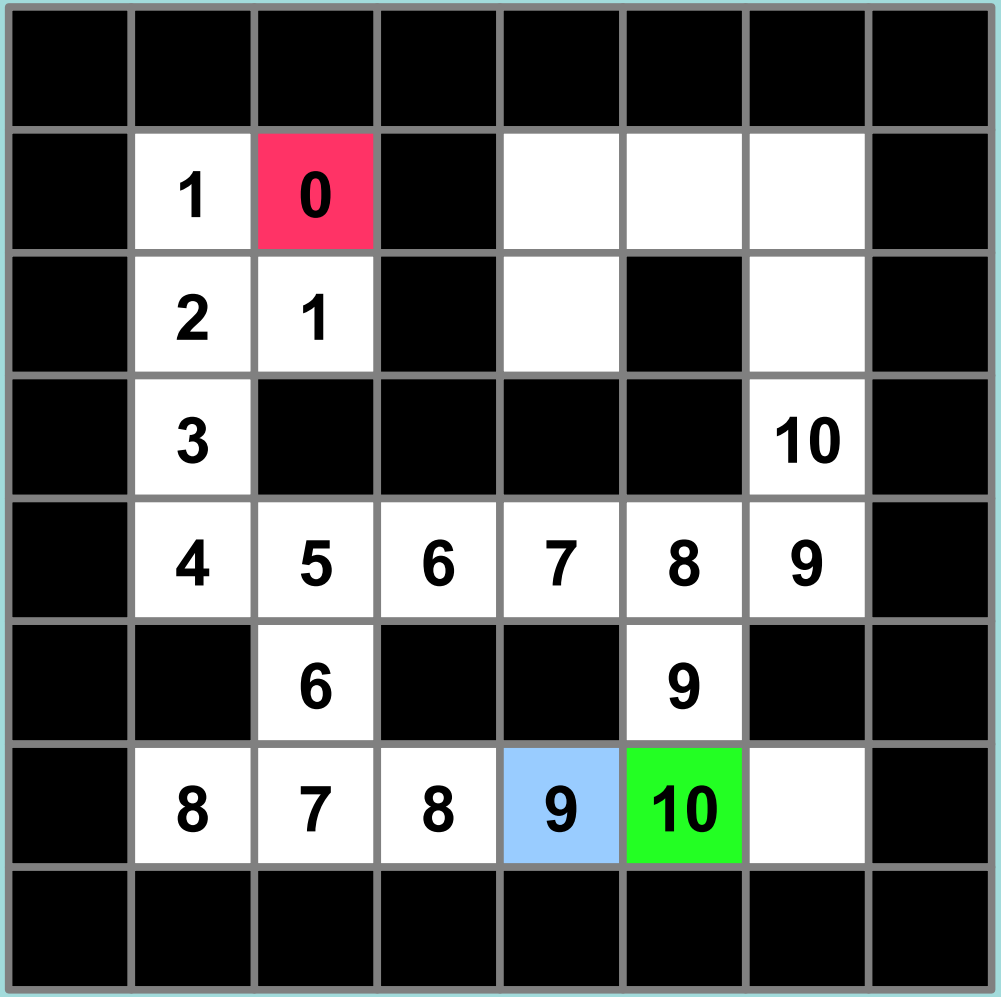

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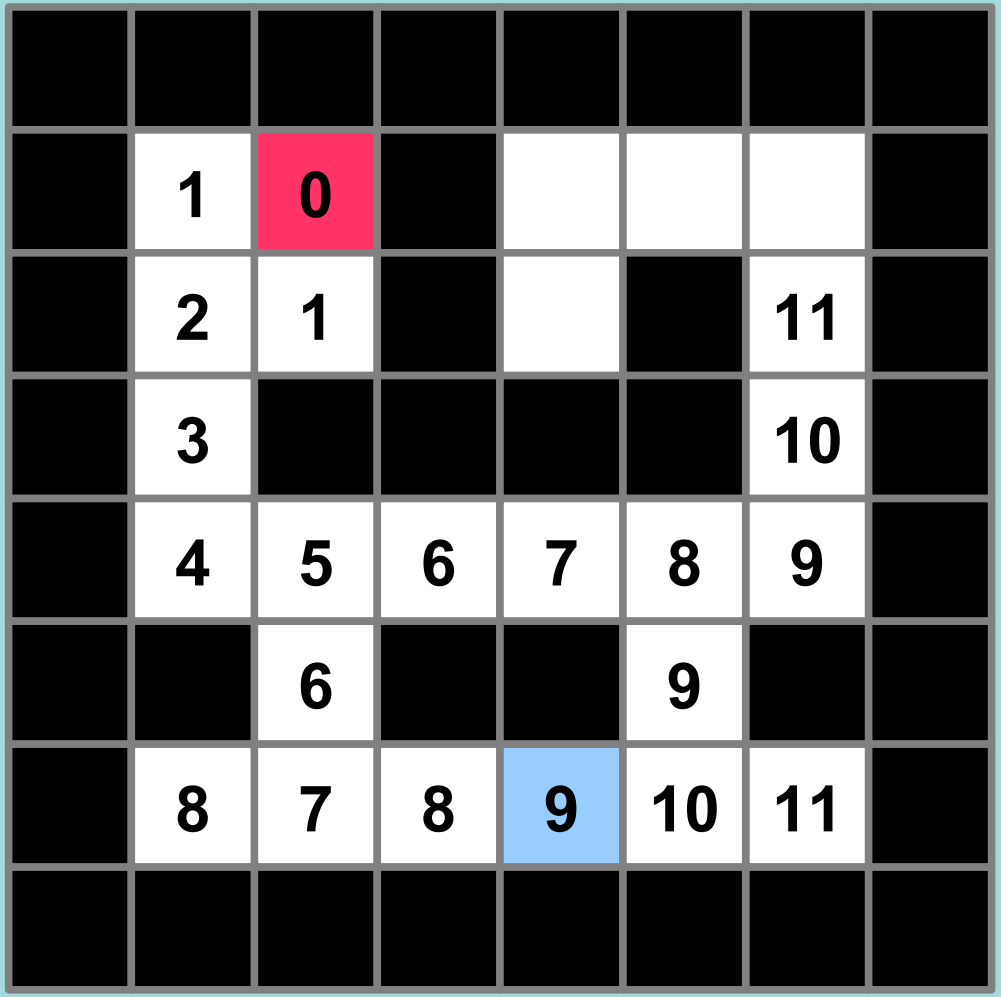

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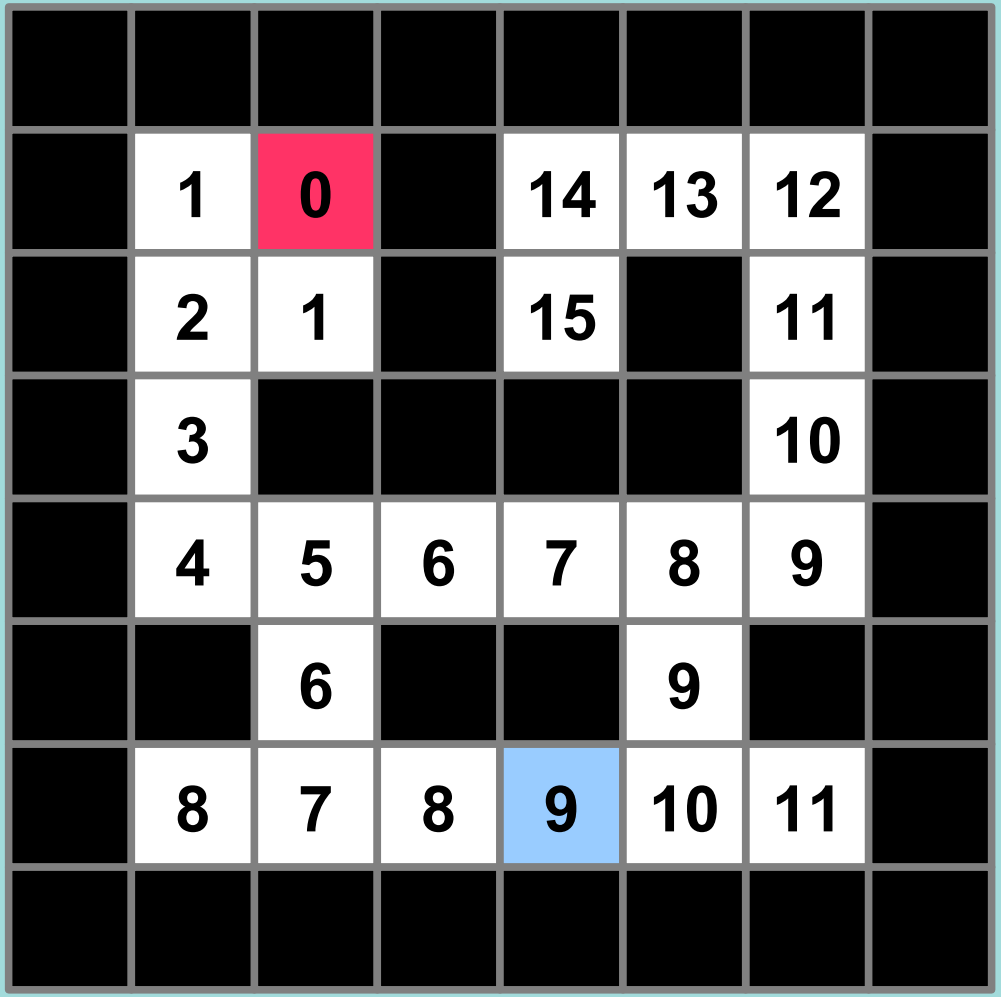

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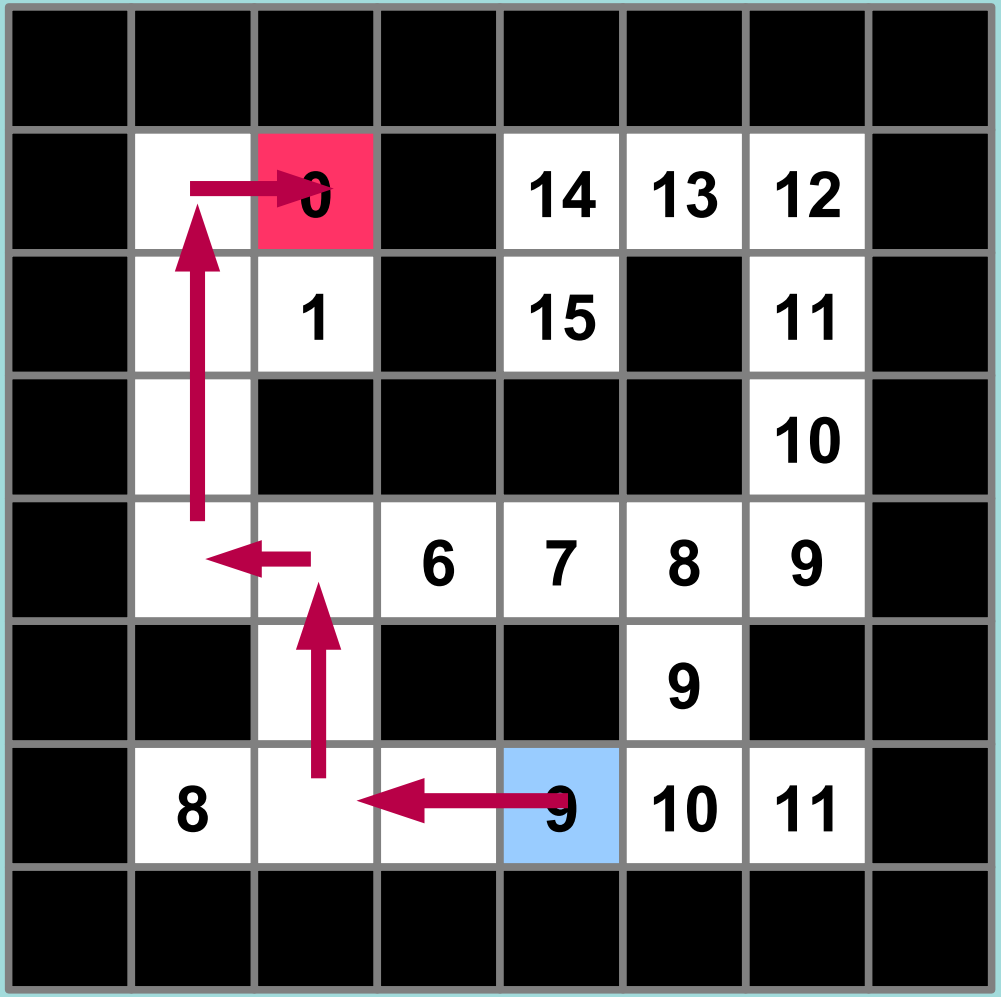

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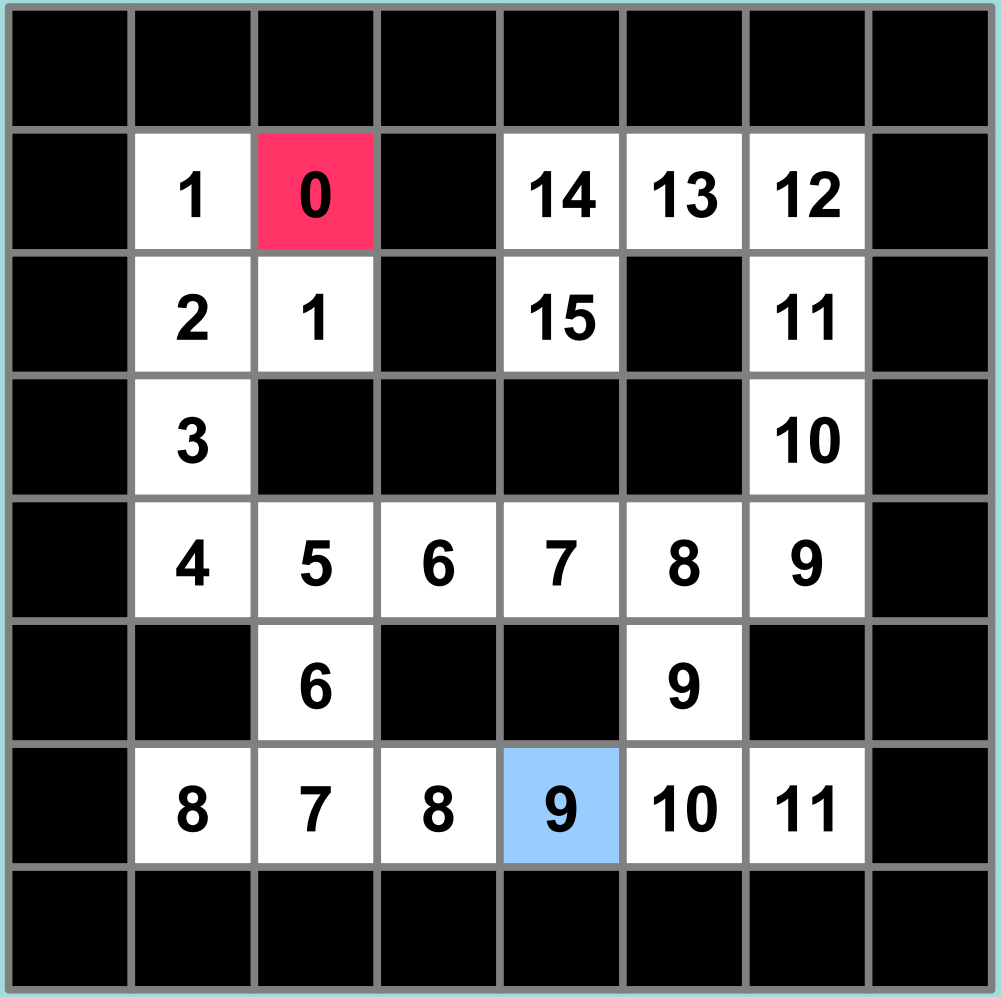

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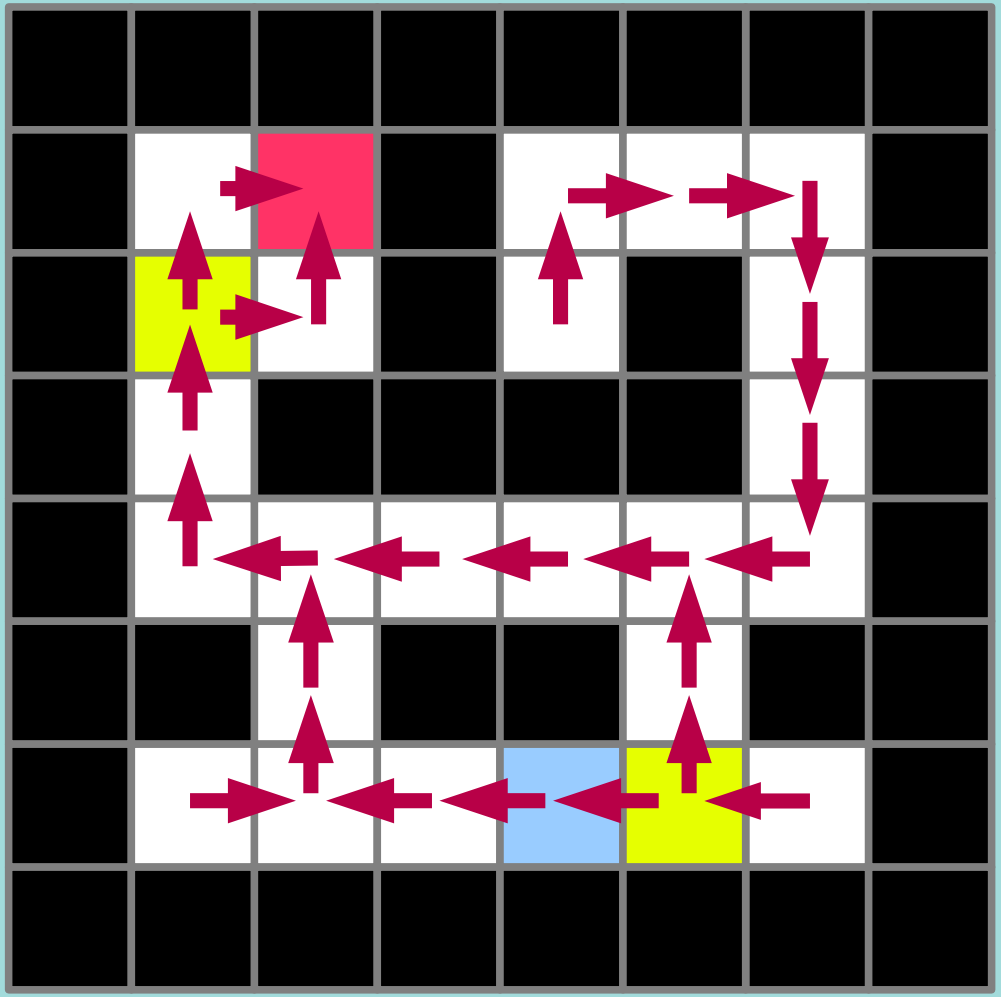
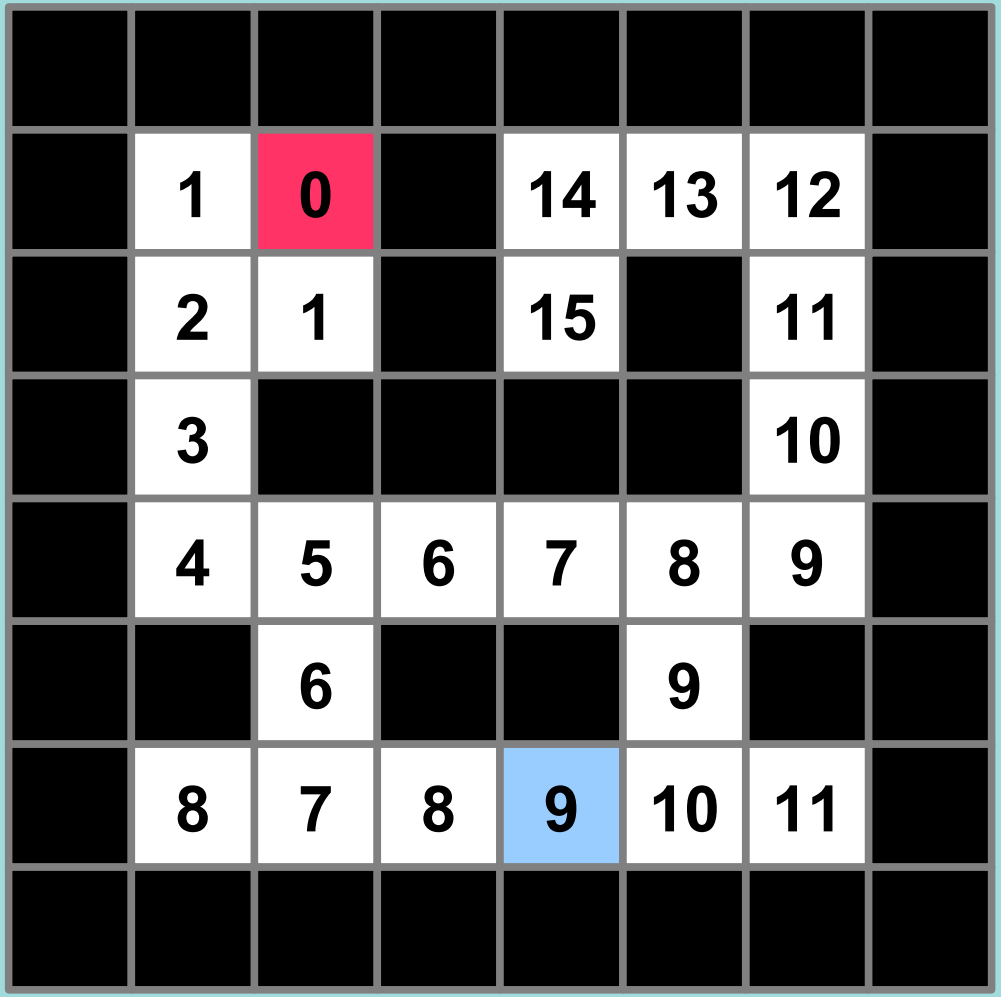


Algorithme de propagation

Coder en python

- Démarche
  - [X] Savoir résoudre à la main
  - [ ] Comprendre la stratégie mise en oeuvre
  - [ ] Ecrire algorithme de haut niveau
  - [ ] Traduire en commentaire
  - [ ] Ajouter le code entre les commentaires
- Intérêt
  - Séparer code de l'algo et réduire bugs
  - Avoir code correctement commenté

Recherche de chemins



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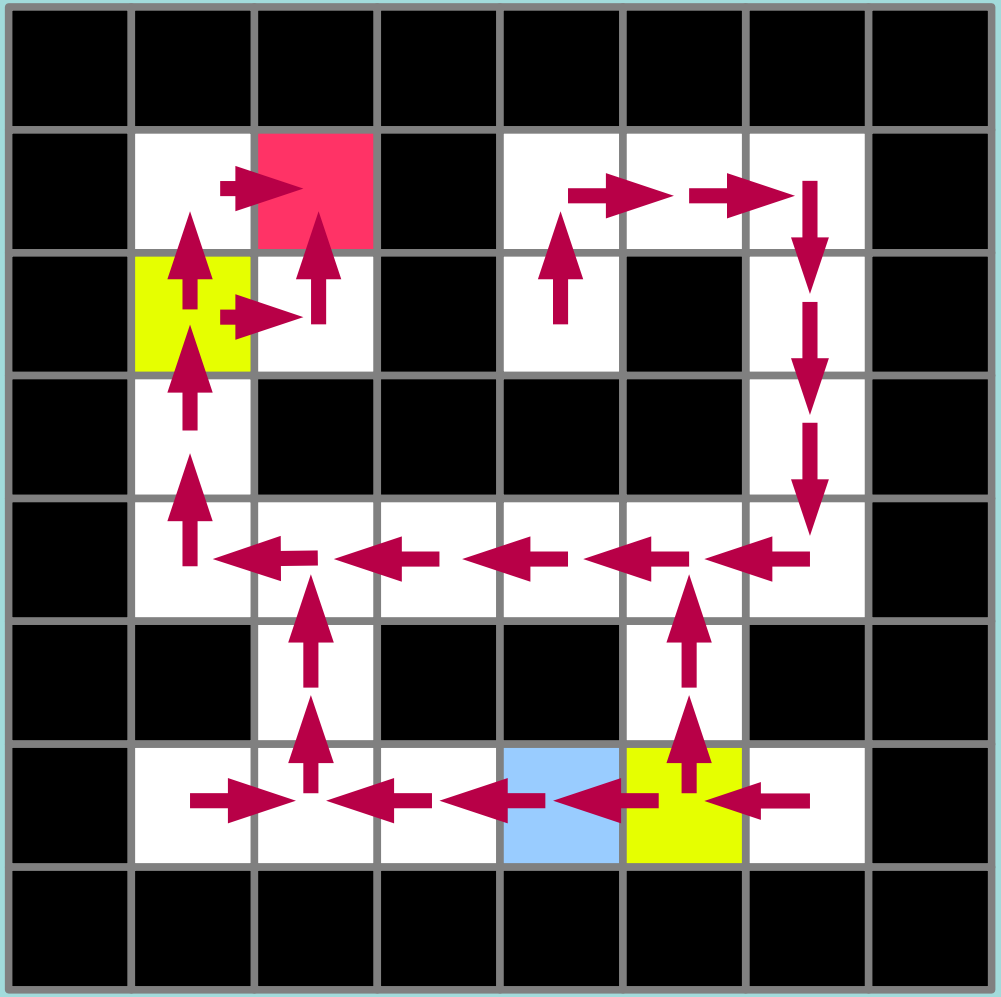

Algorithme de propagation

Messages à emporter

- 1. Algorithme de recherche de chemin
  - Principe de propagation de valeur (accessible)
  - Algorithme de Lee
  - Gestion de frontières (liste ouverte)

- 2. Manière de coder
  - Comprendre le probleme
  - Résoudre exemple
  - Ecrire les commentaires
  - Ecrire le code

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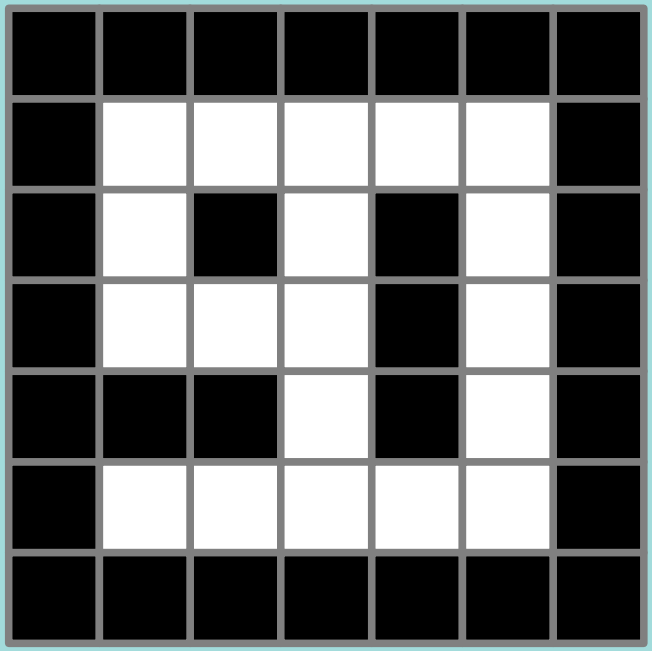
3 Extensions

- Ajoute des couts aux arcs
  - Dijkstra
- Accélérer la recherche
  - Algorithme A*
- Etendre à d'autres cadres
  - Théorie des graphes

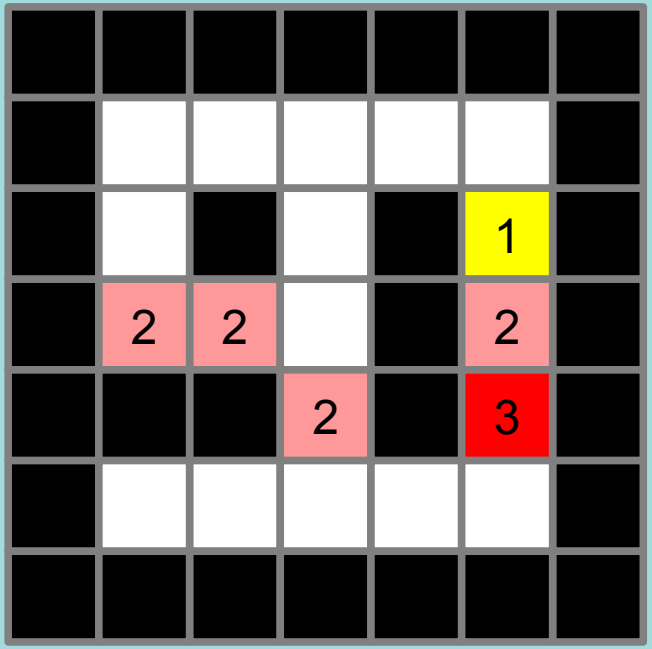
Dijkstra

Edsger Dijkstra (1930-2002)

- Tableau de coûts
  - Exemple altitude sur les cases
  - Ajoute coût de la case



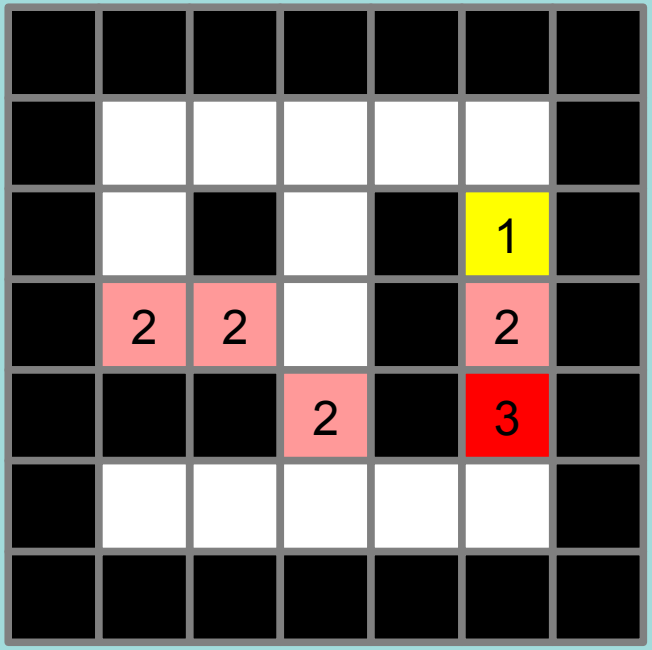
Murs



Cout = difference altitude

Dijkstra

- Principe
  - Développe cases distance plus faible
  - Met à jour si valeur est meilleure
- Algo
  - Trier la liste ouverte par coût
  - Vérifier chemin réalisable
- Garantie
  - Car coûts > 0



Coût = différence altitude

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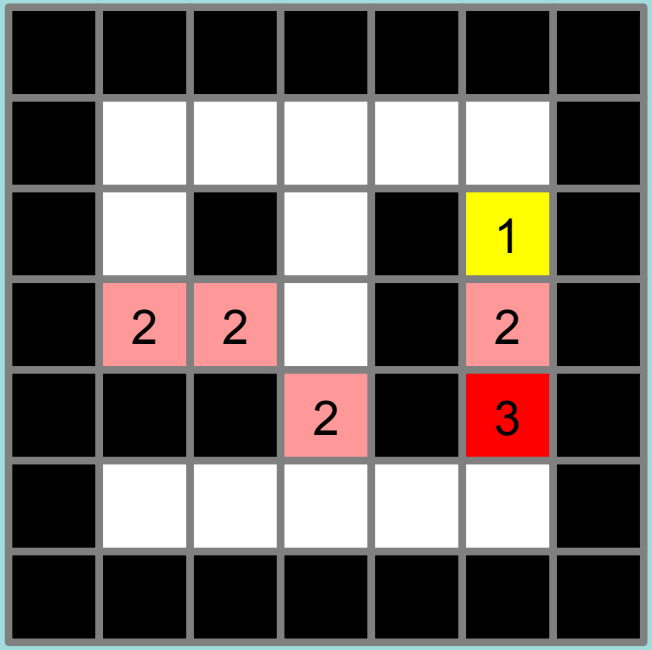
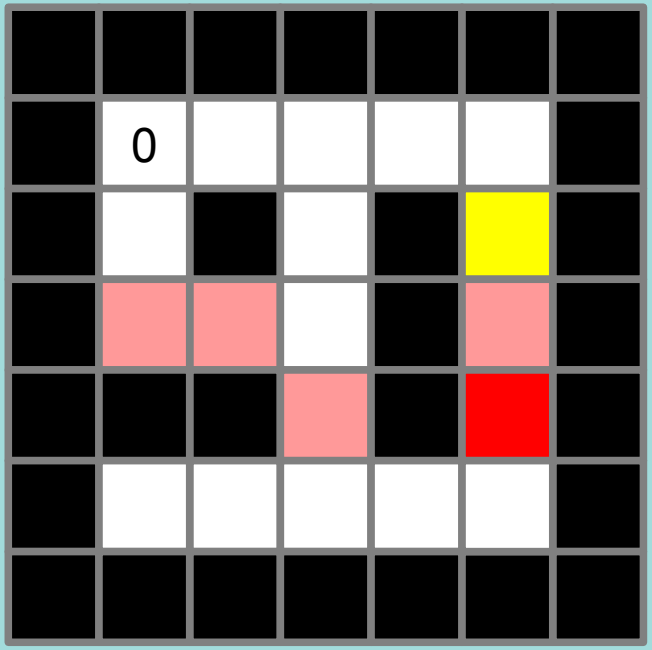


Coût = différence altitude



Distances

Dijkstra

- Principe
  - Développe cases distance plus faible
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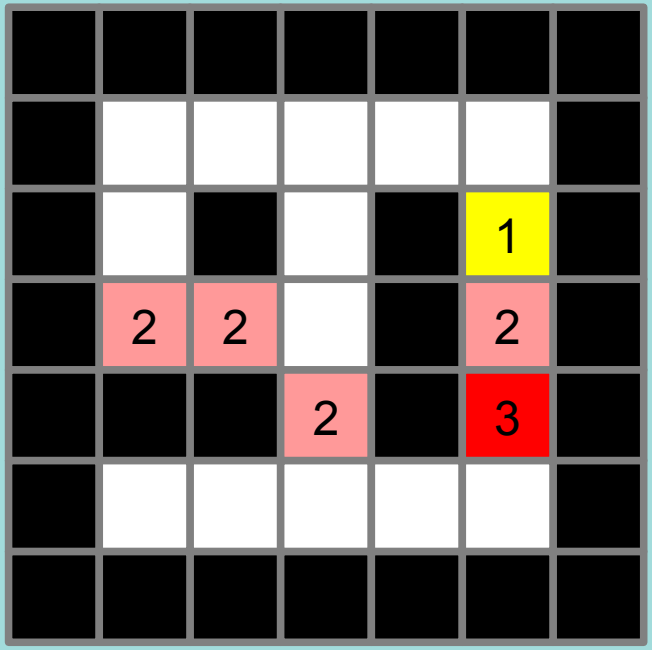
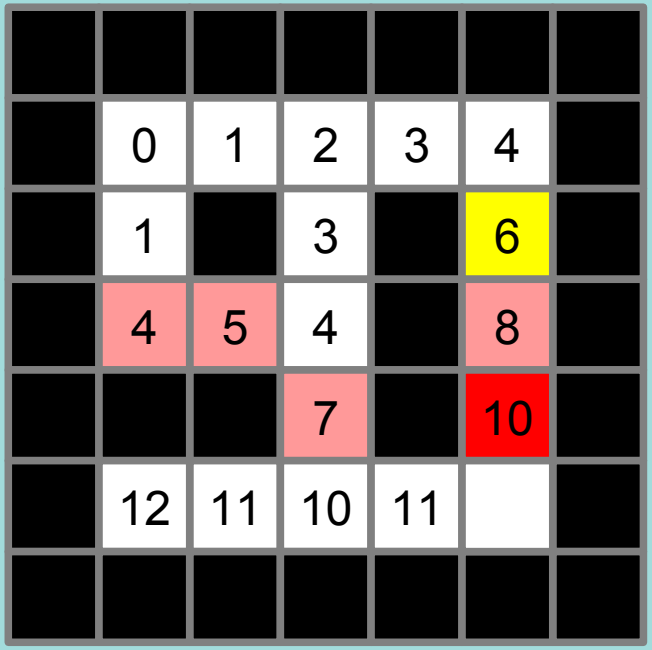


Coût = différence altitude



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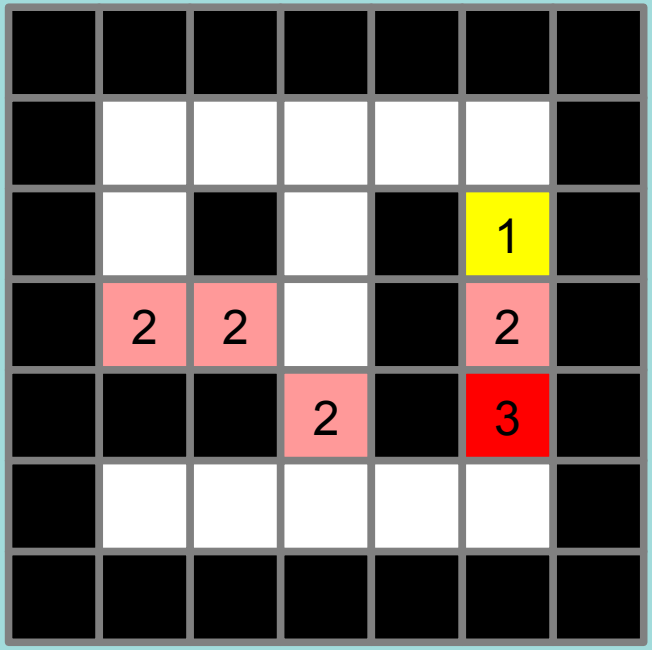

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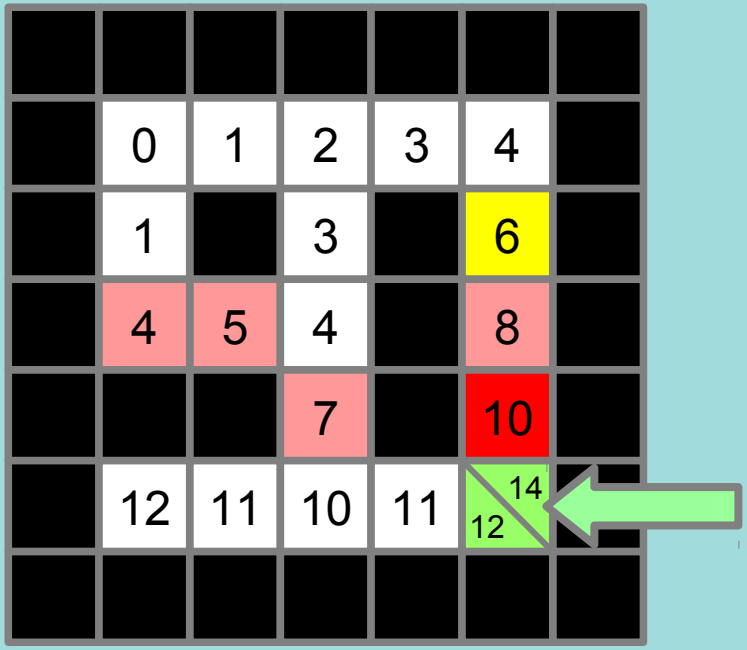

Distances

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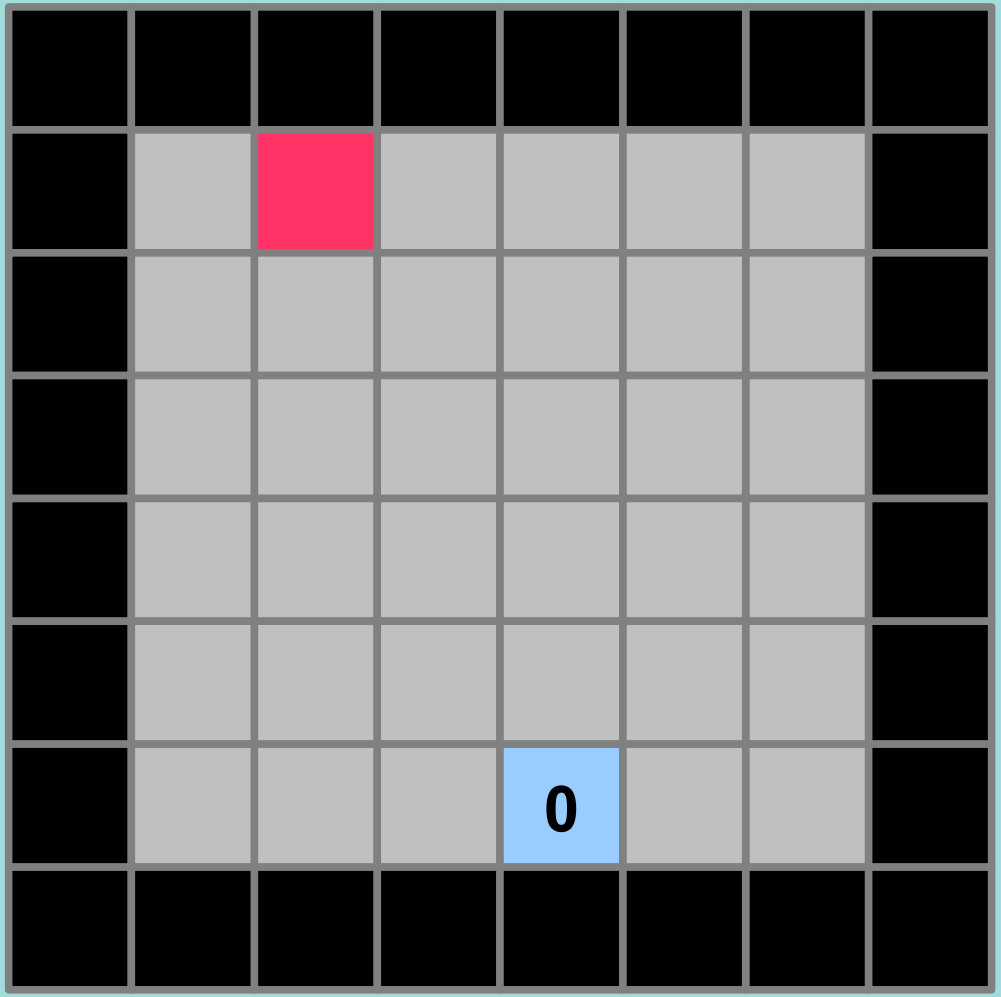
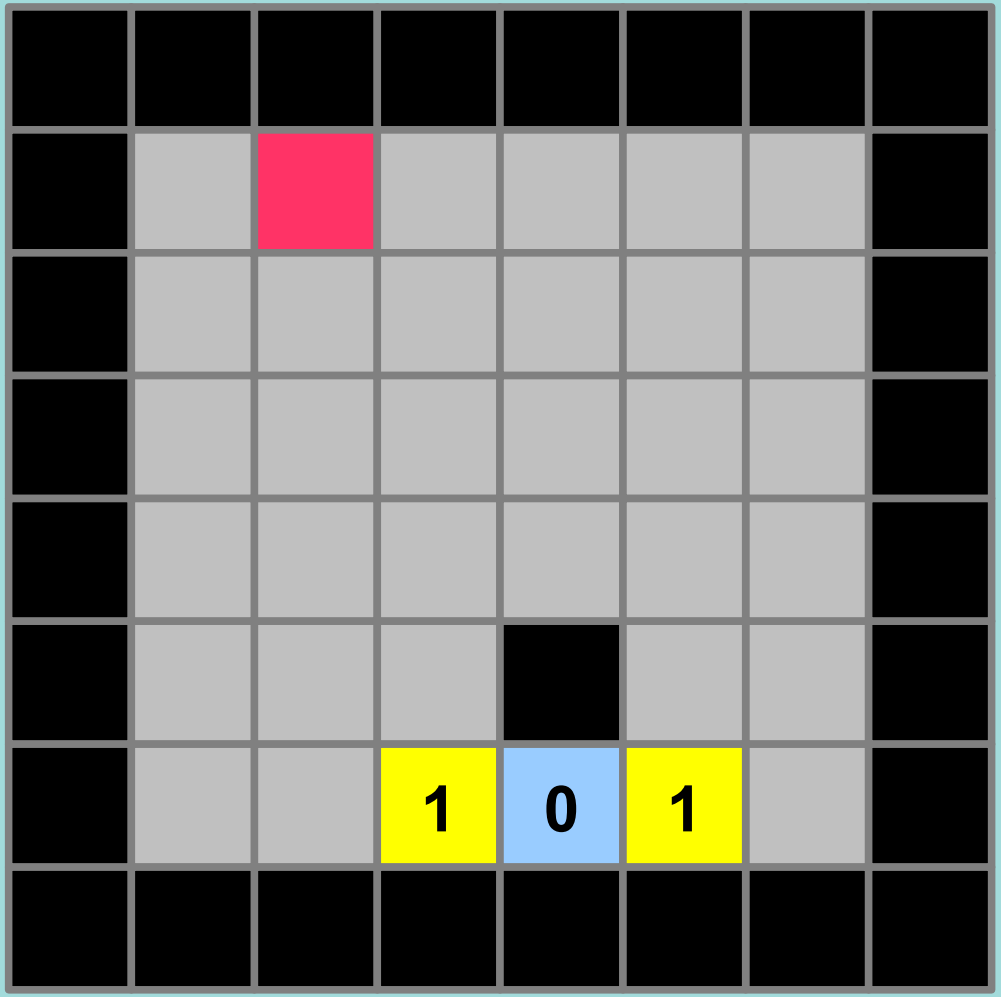
Algorithme A*



Algorithme de propagation

Algorithme A*



Algorithme de propagation + optimisme

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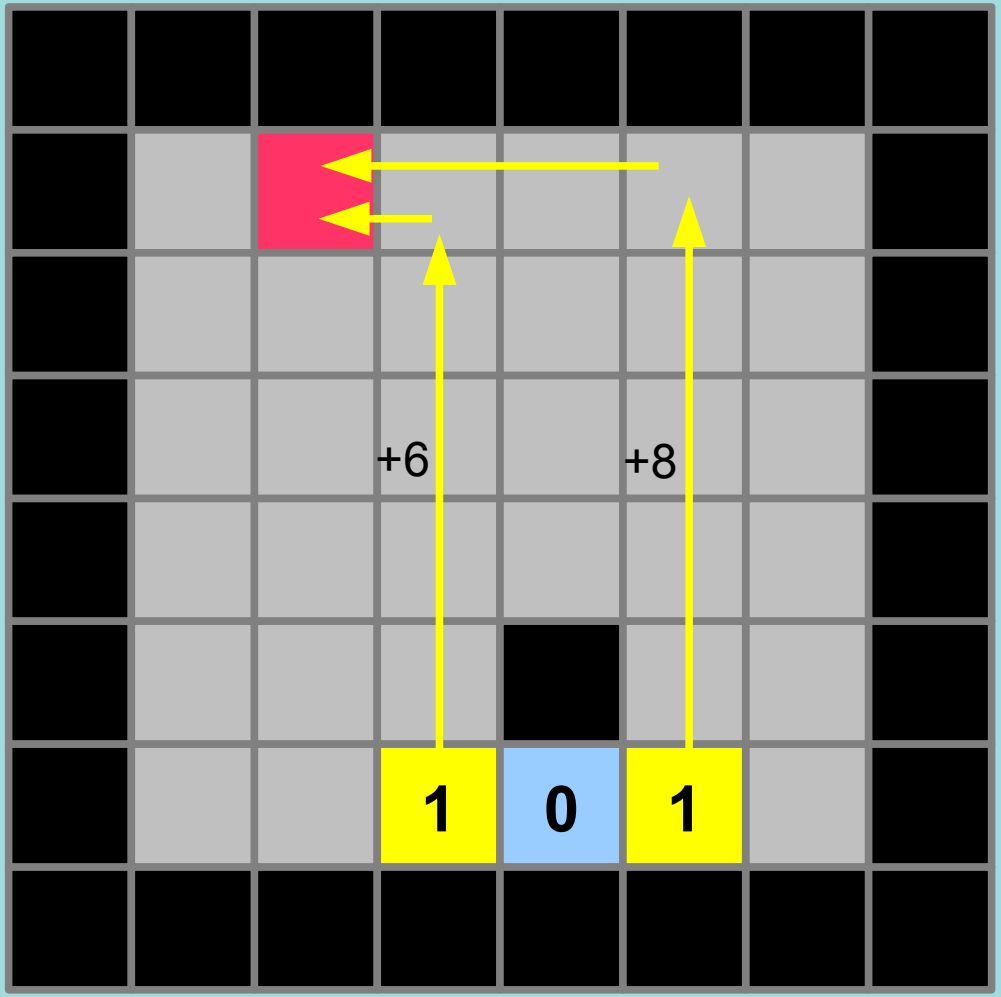

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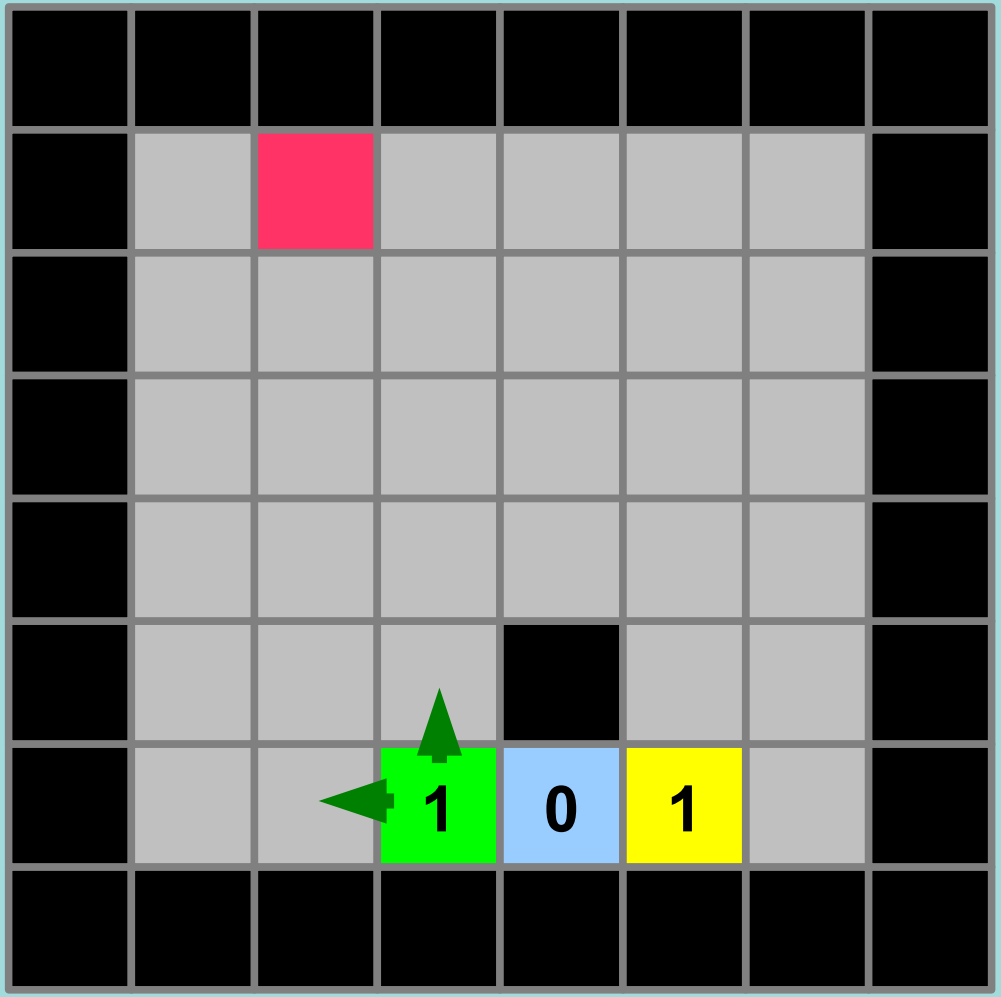

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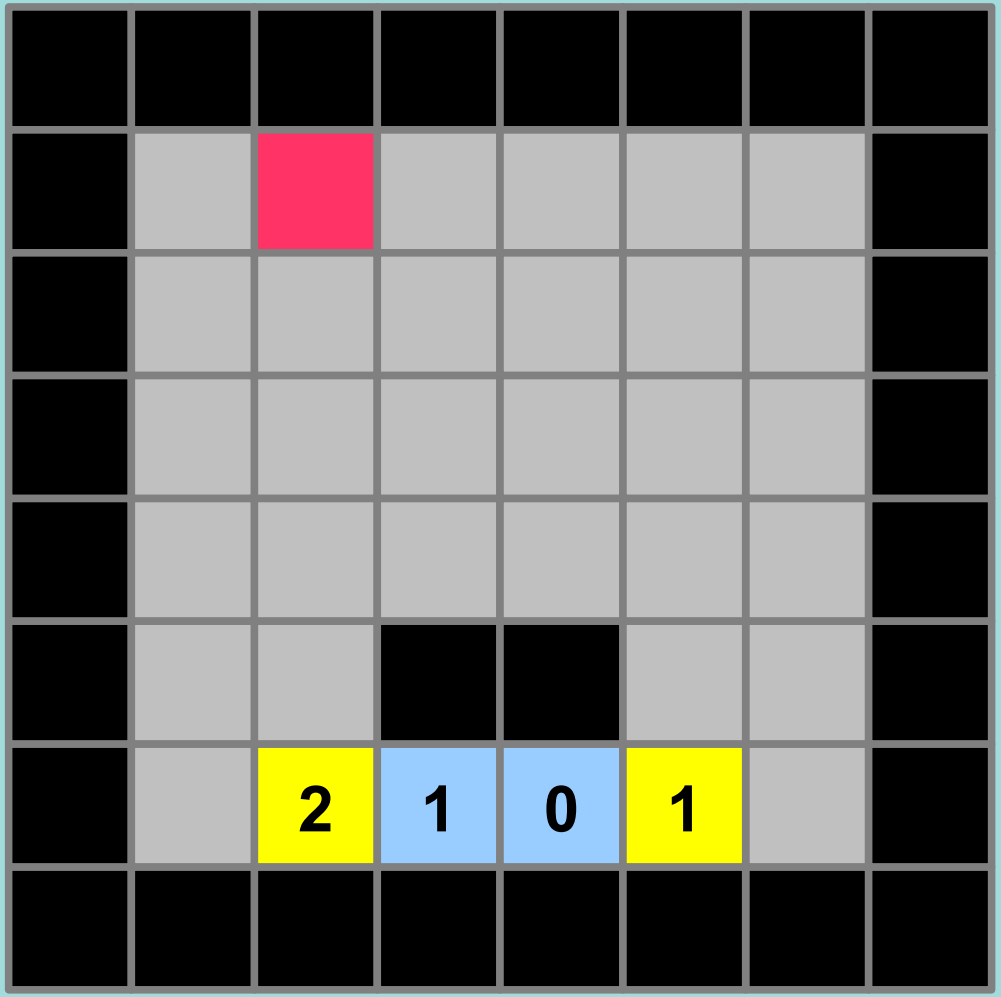

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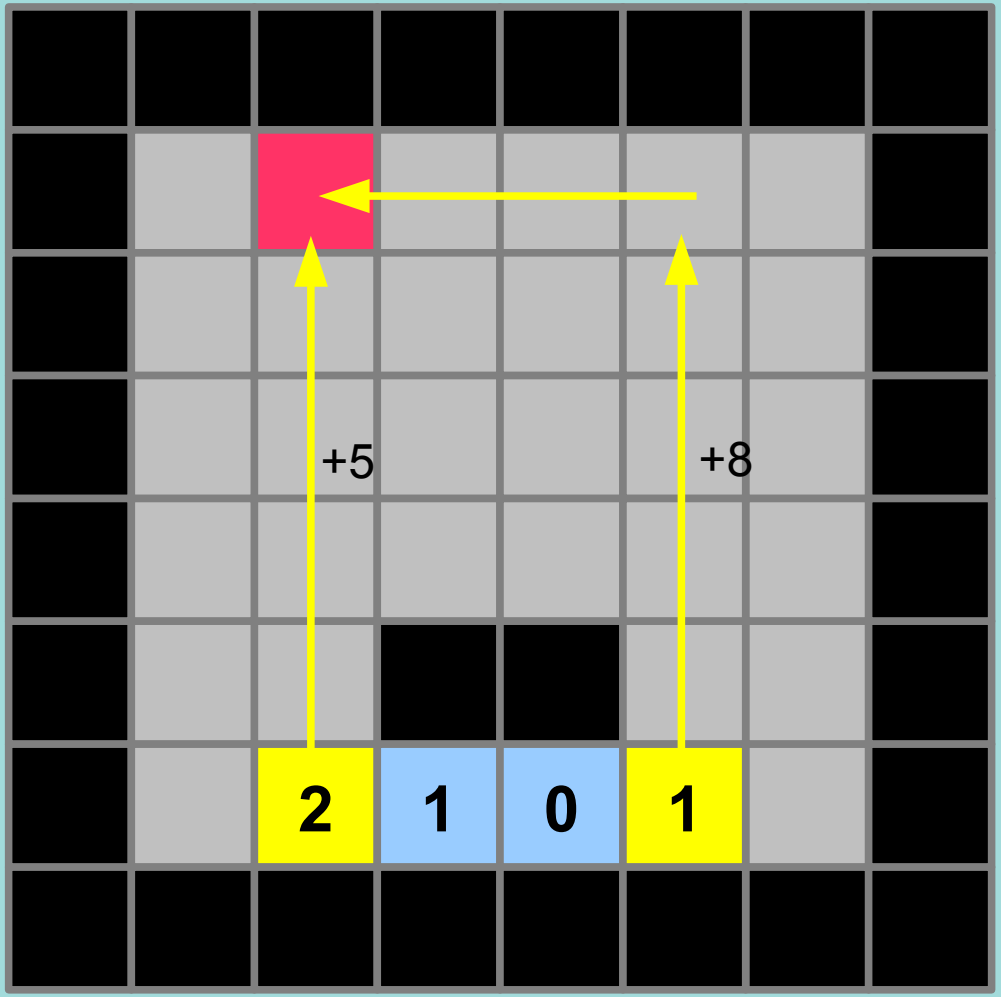

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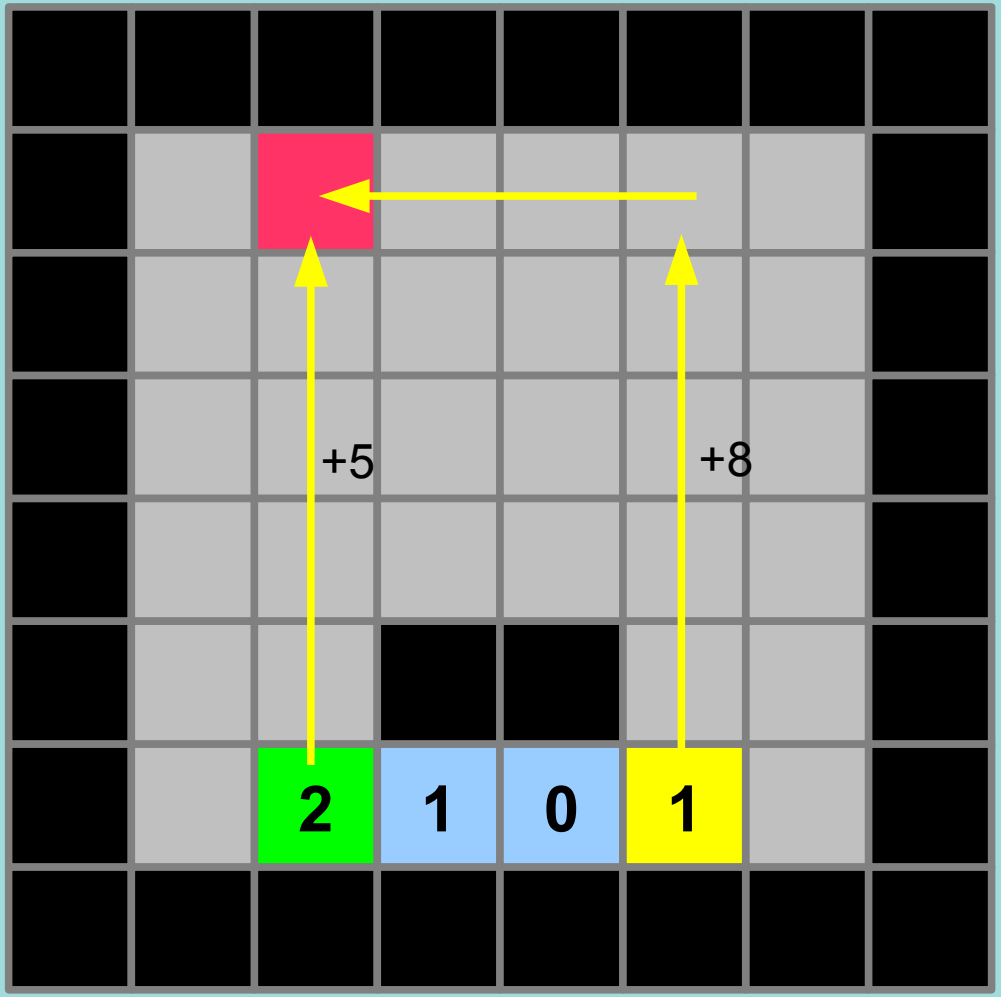

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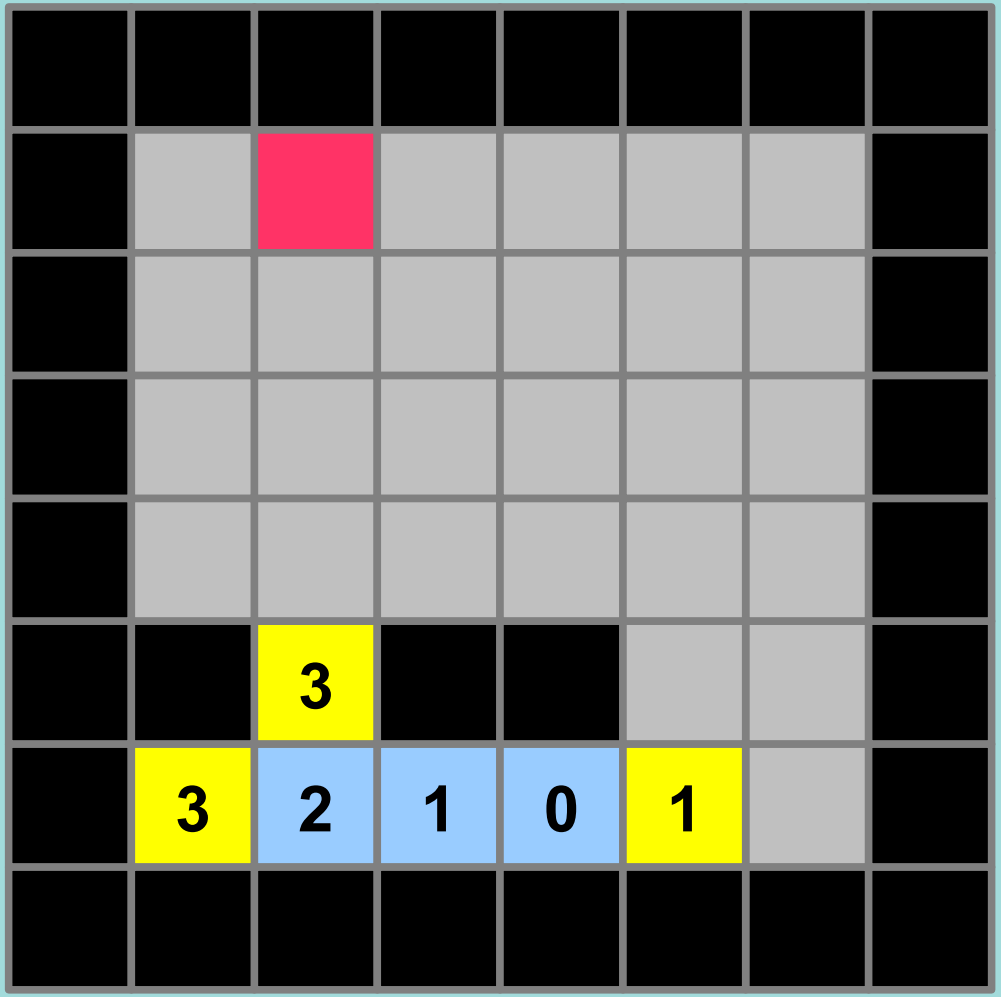

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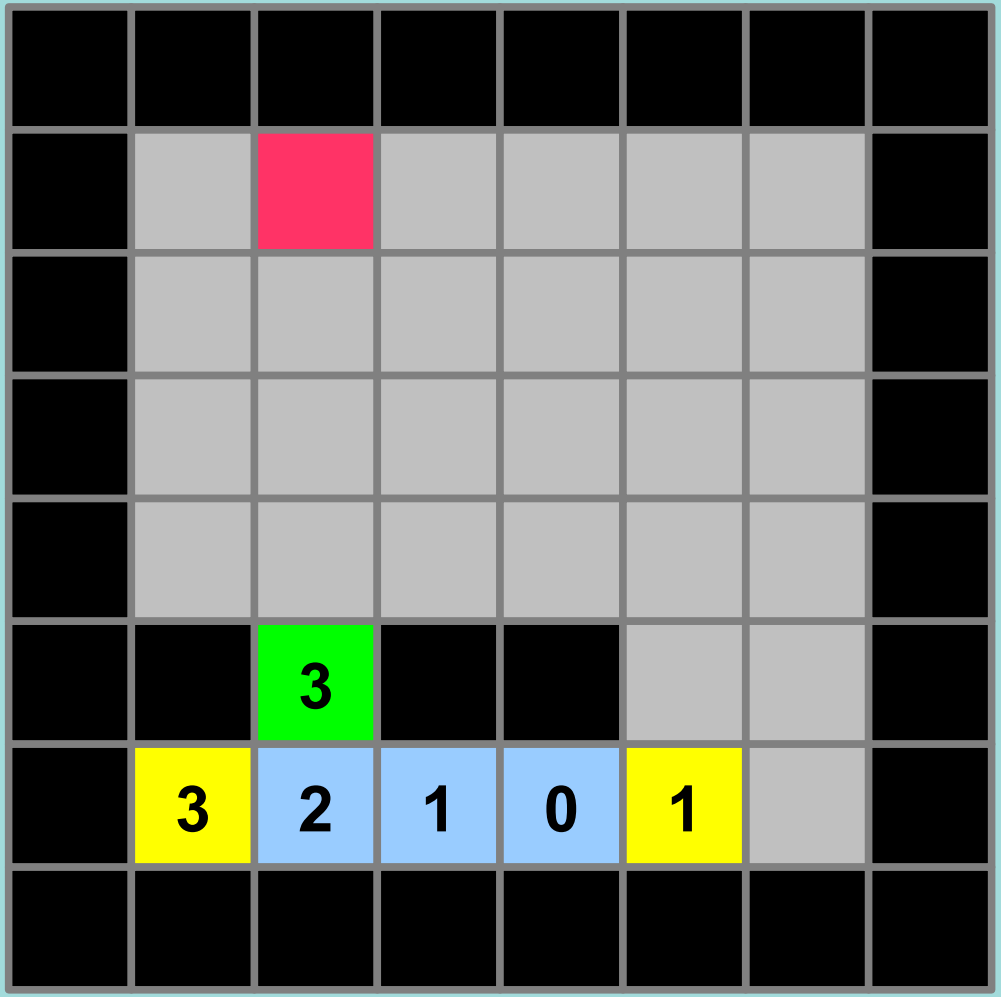

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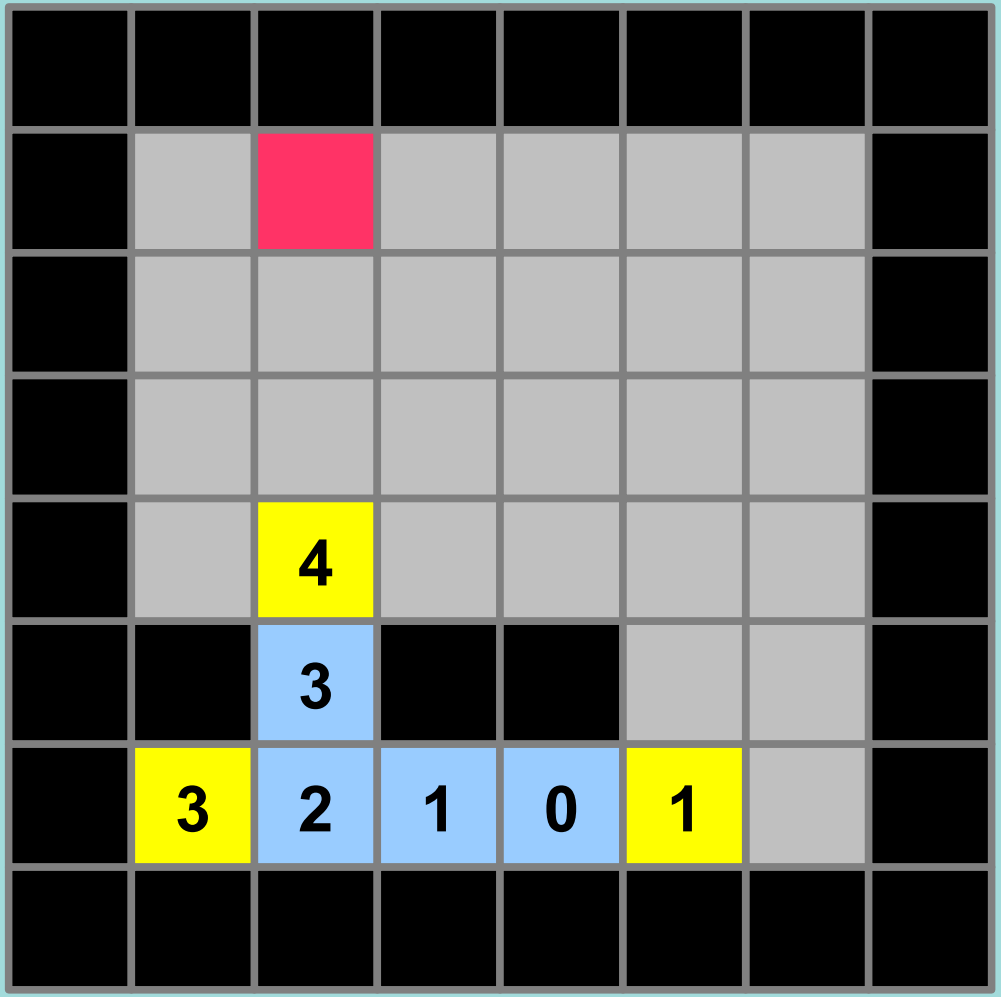

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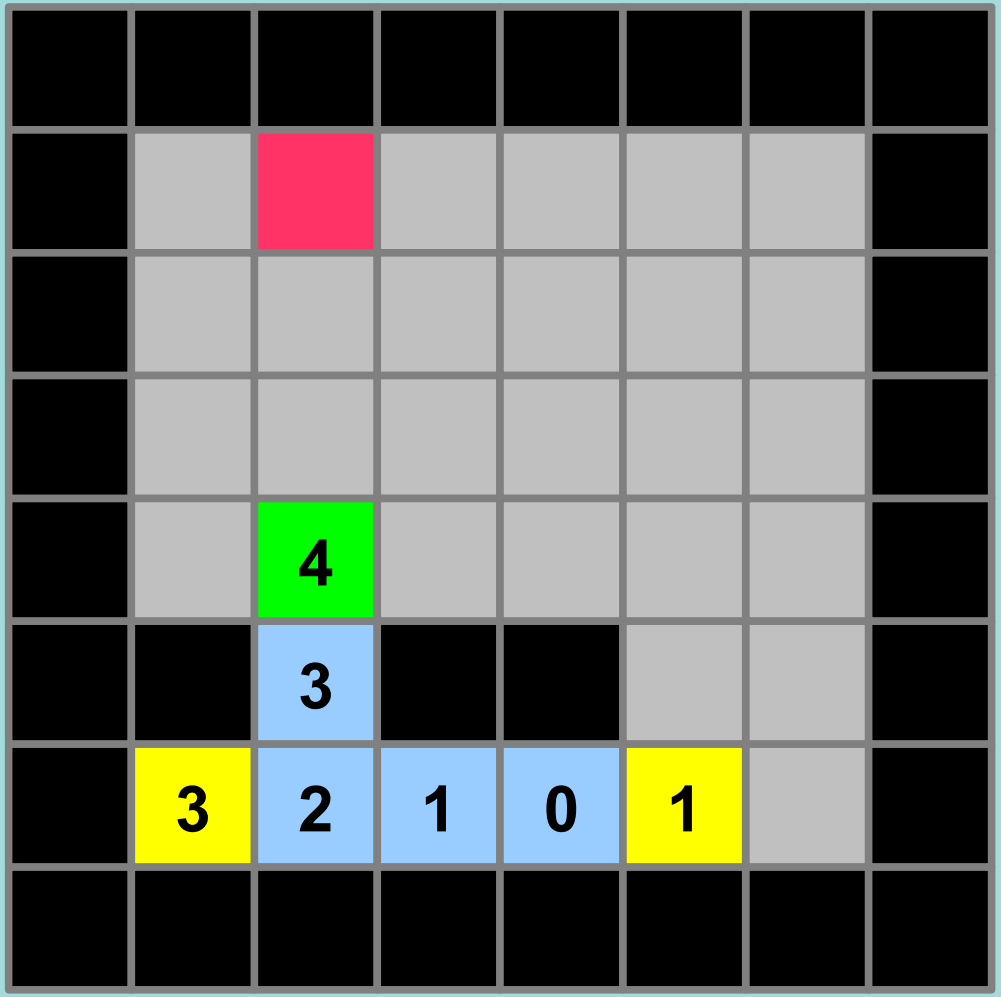

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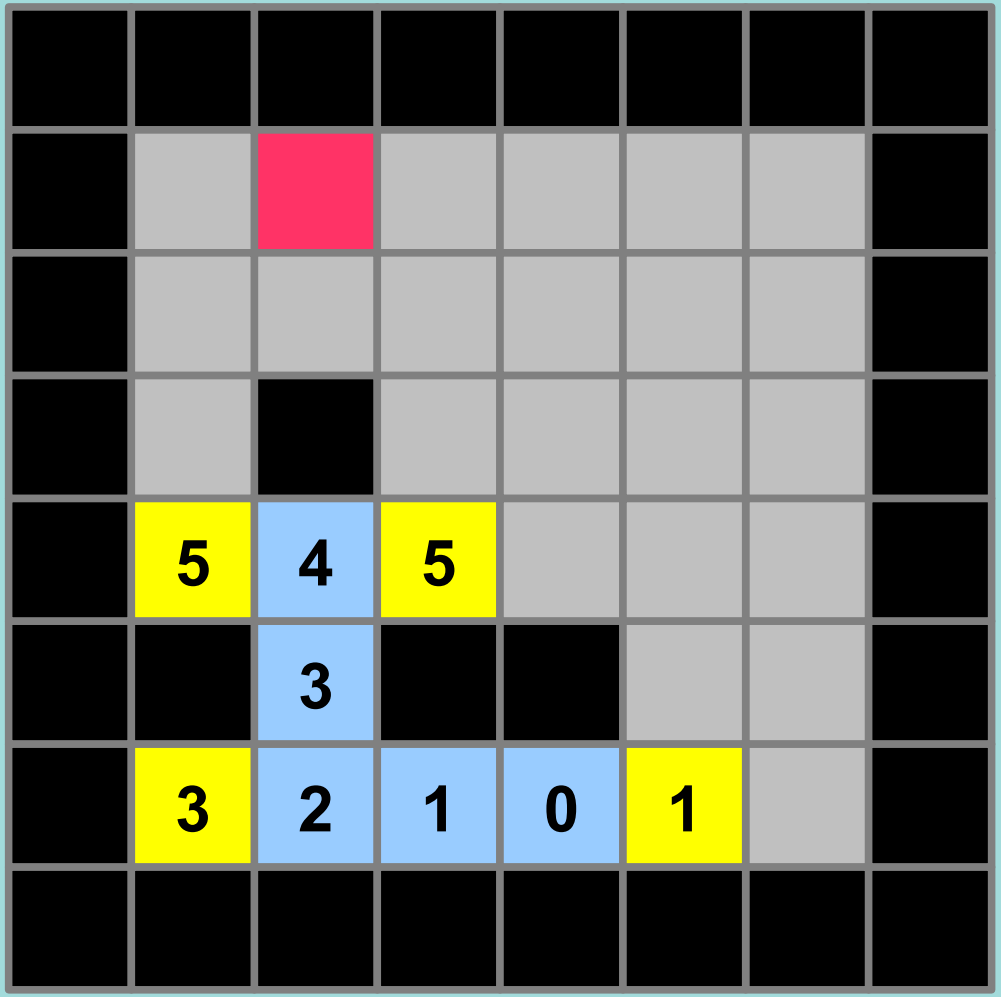

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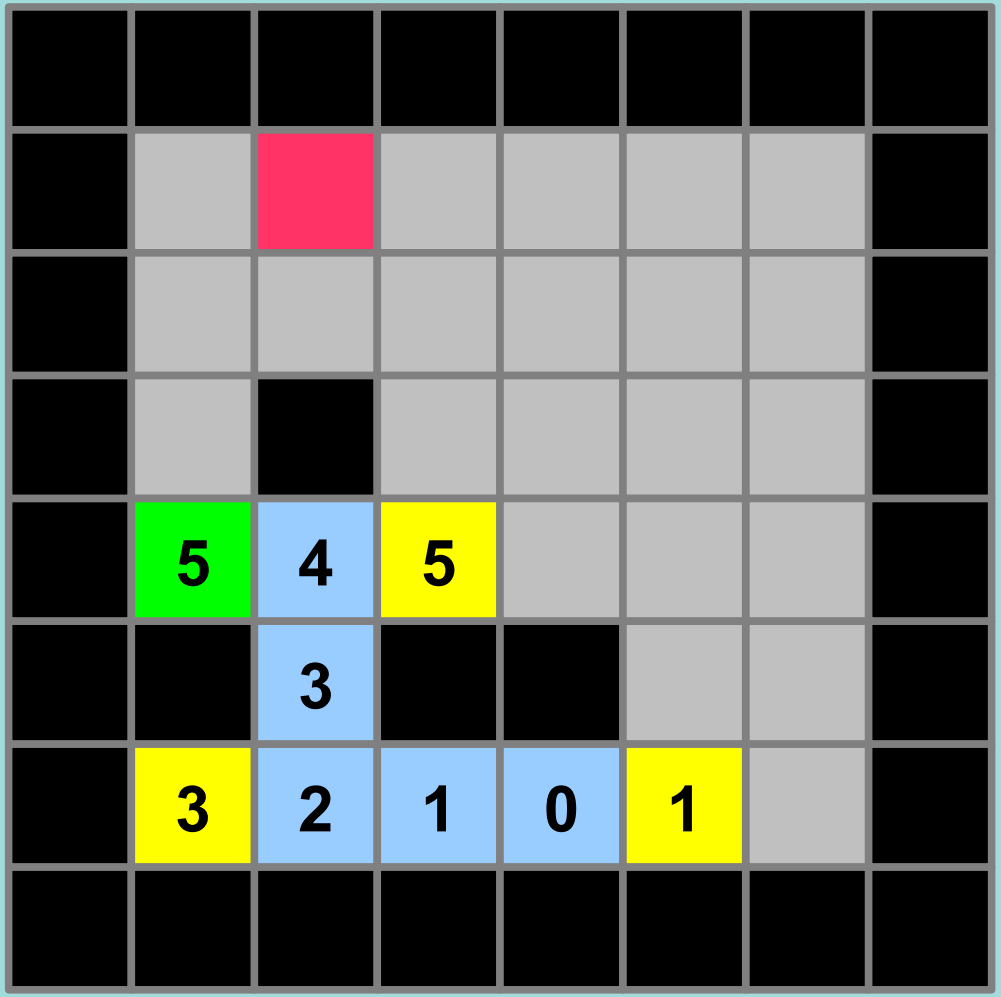

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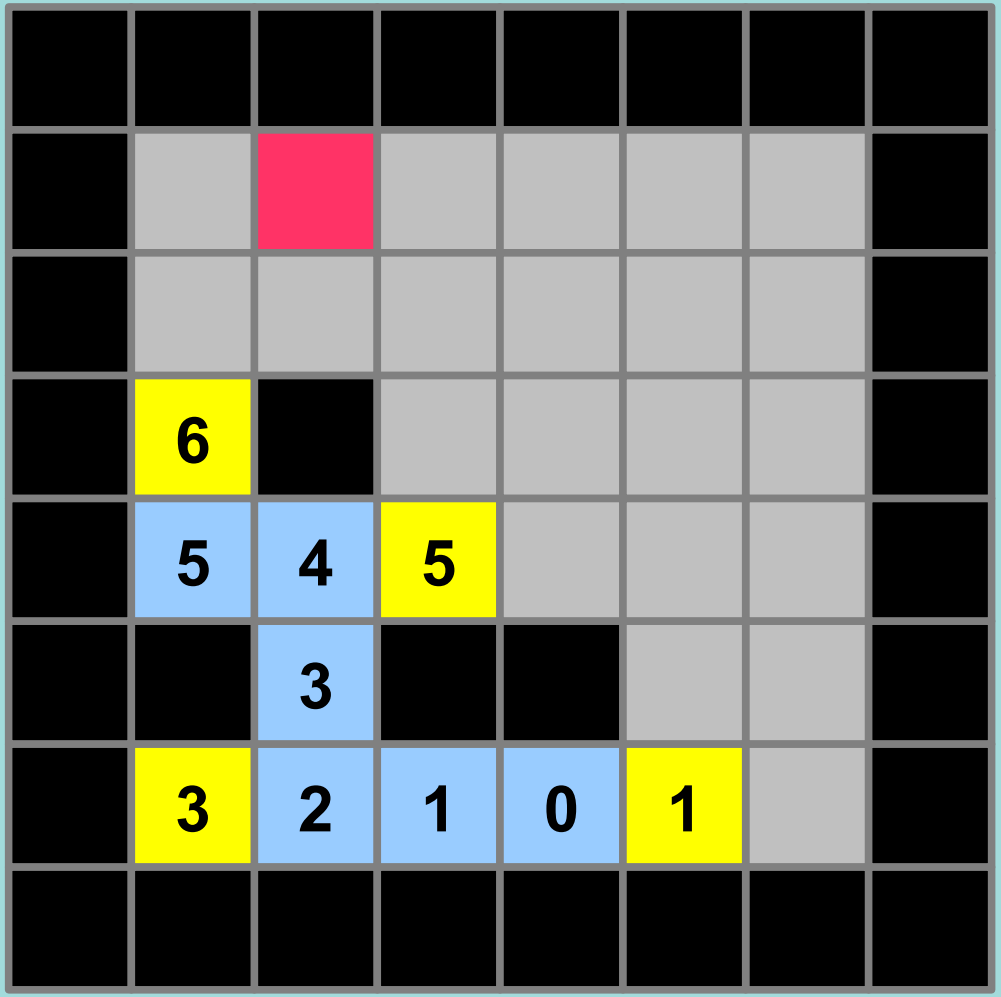

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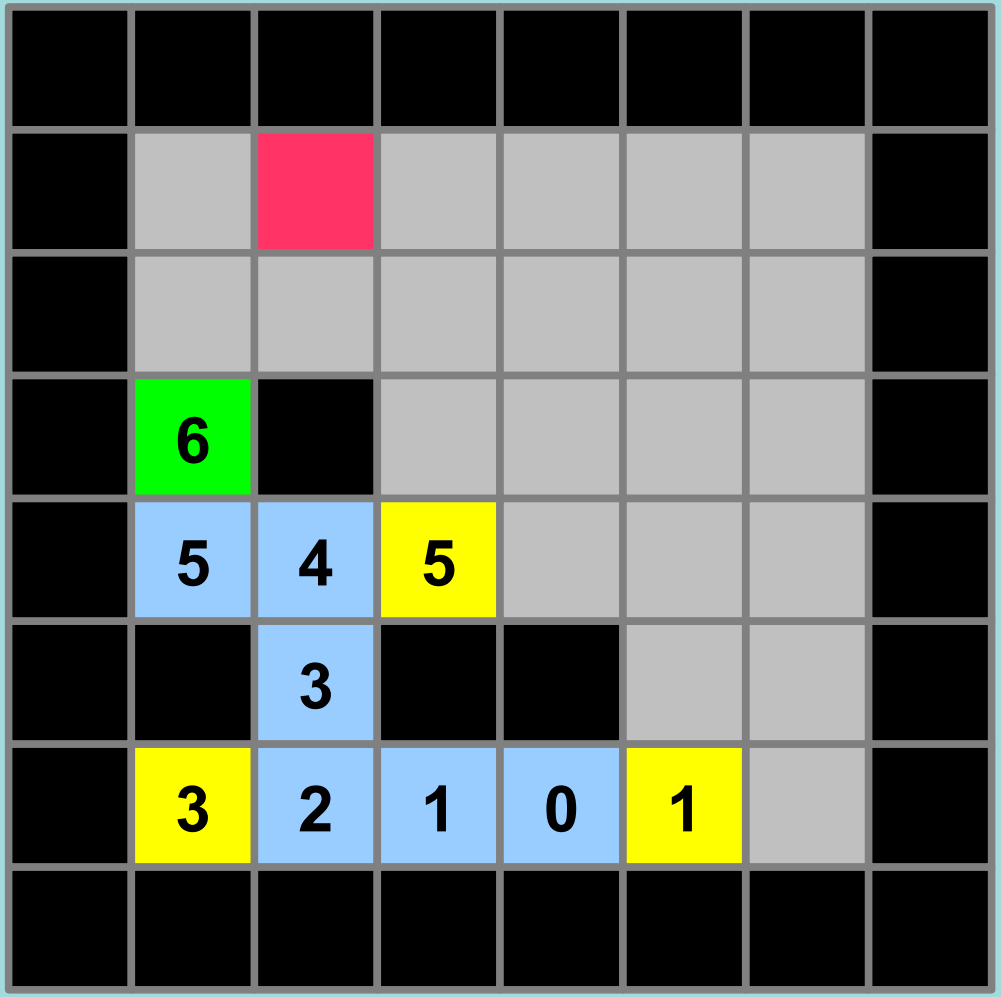

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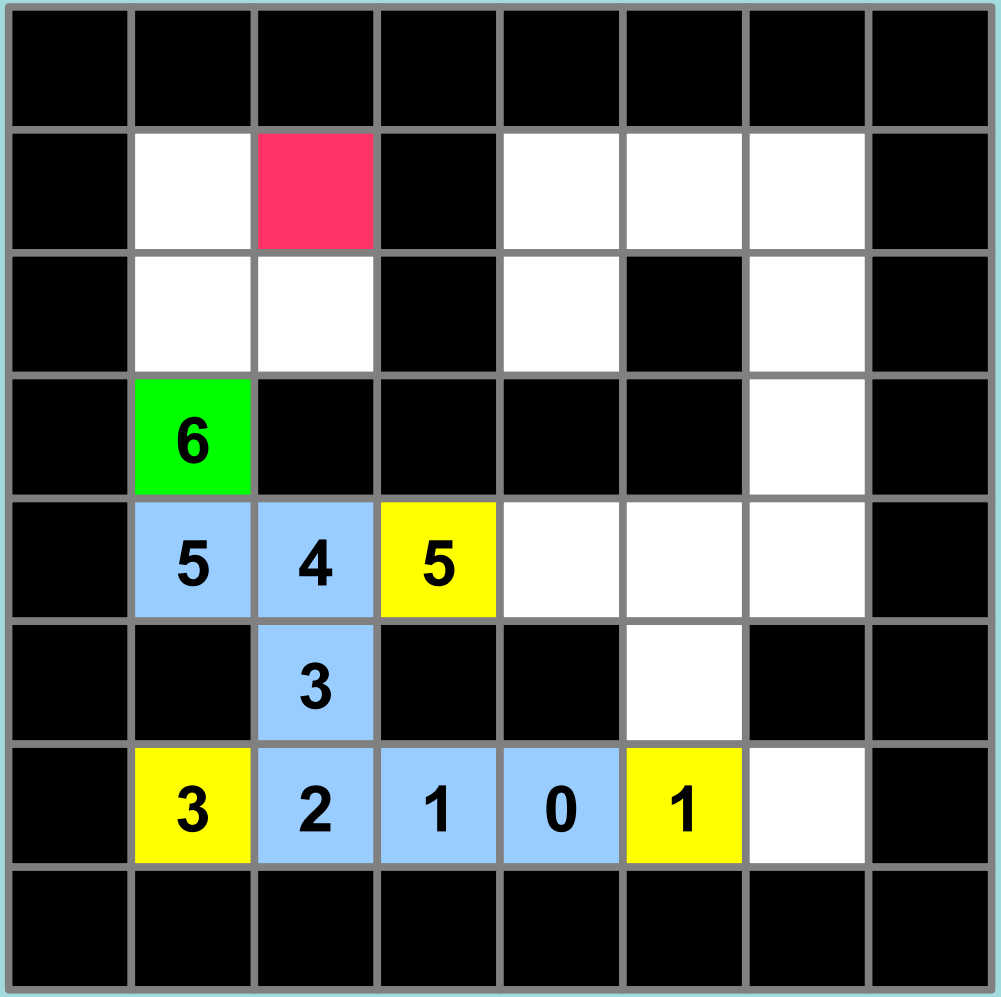

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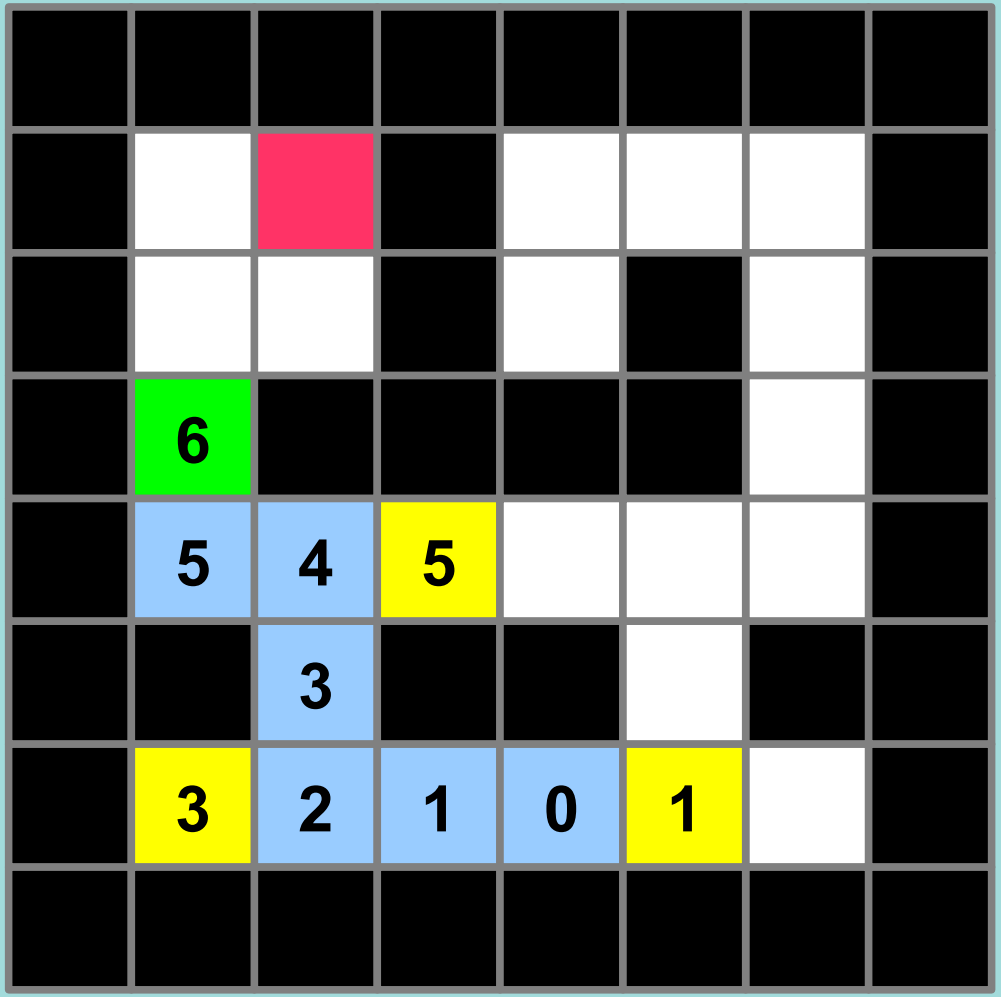
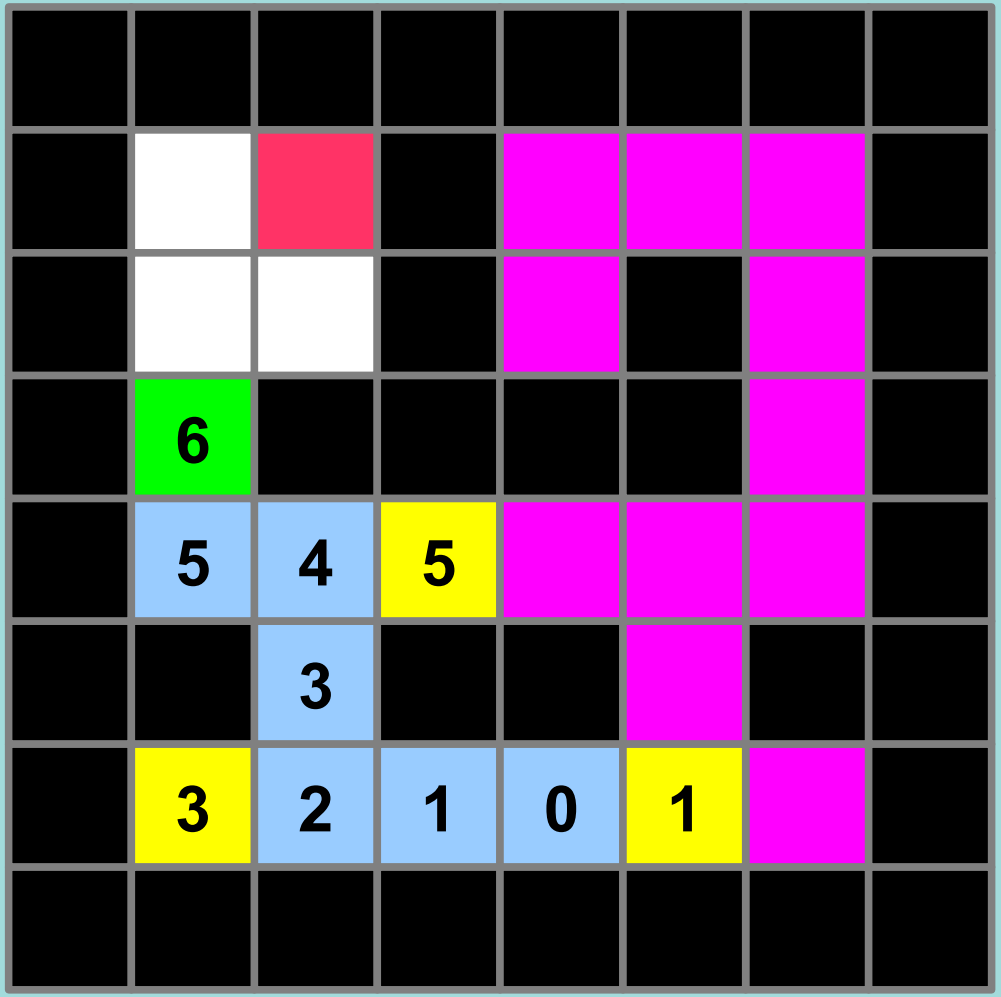


Conclusion ?

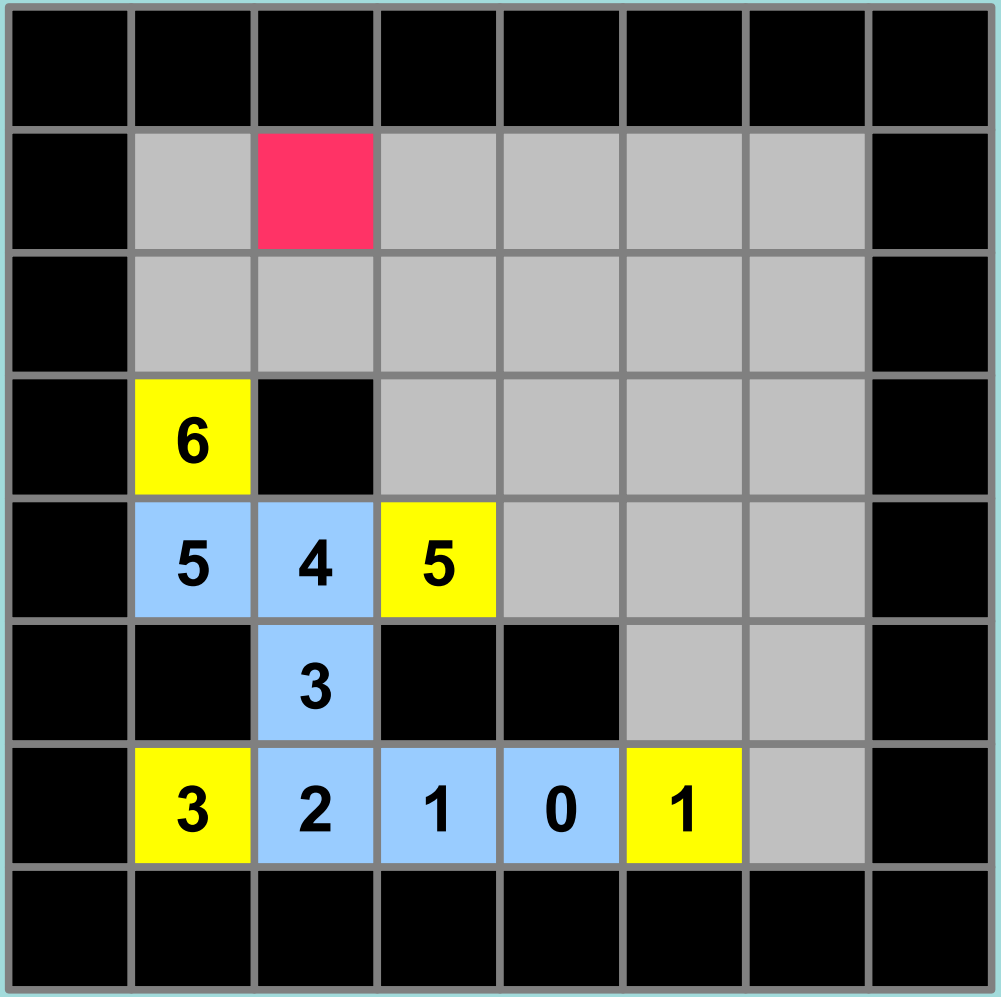
Algorithme A*



Conclusion ?

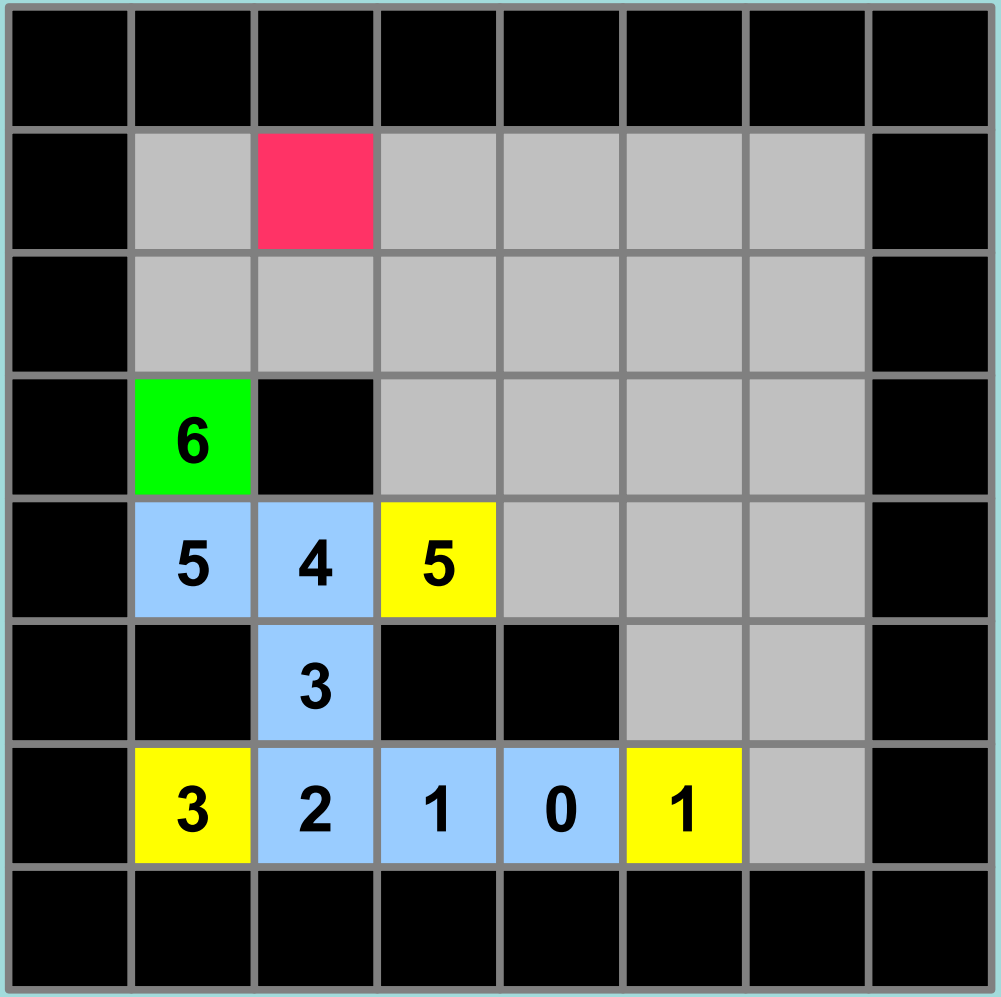
Changement labyrinthe

Changement labyrinthe



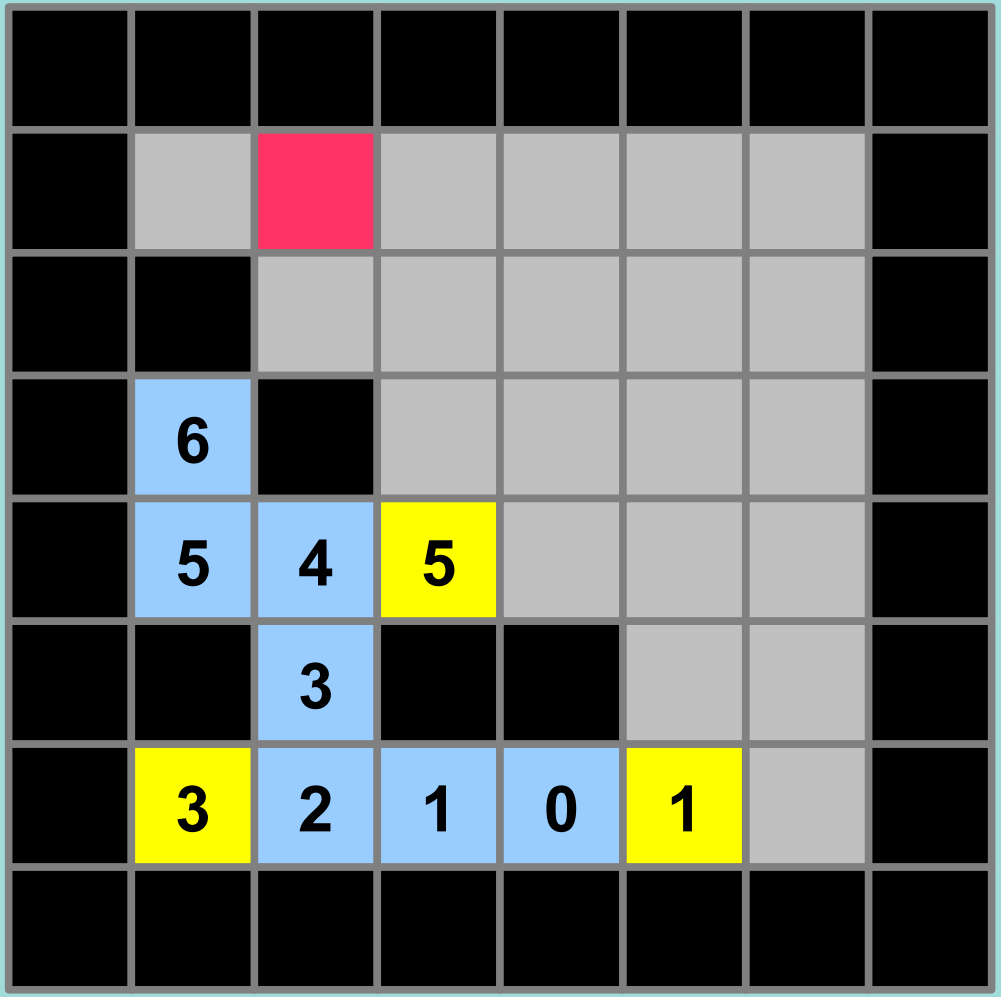
Algorithme de propagation + optimisme

Algorithme A*



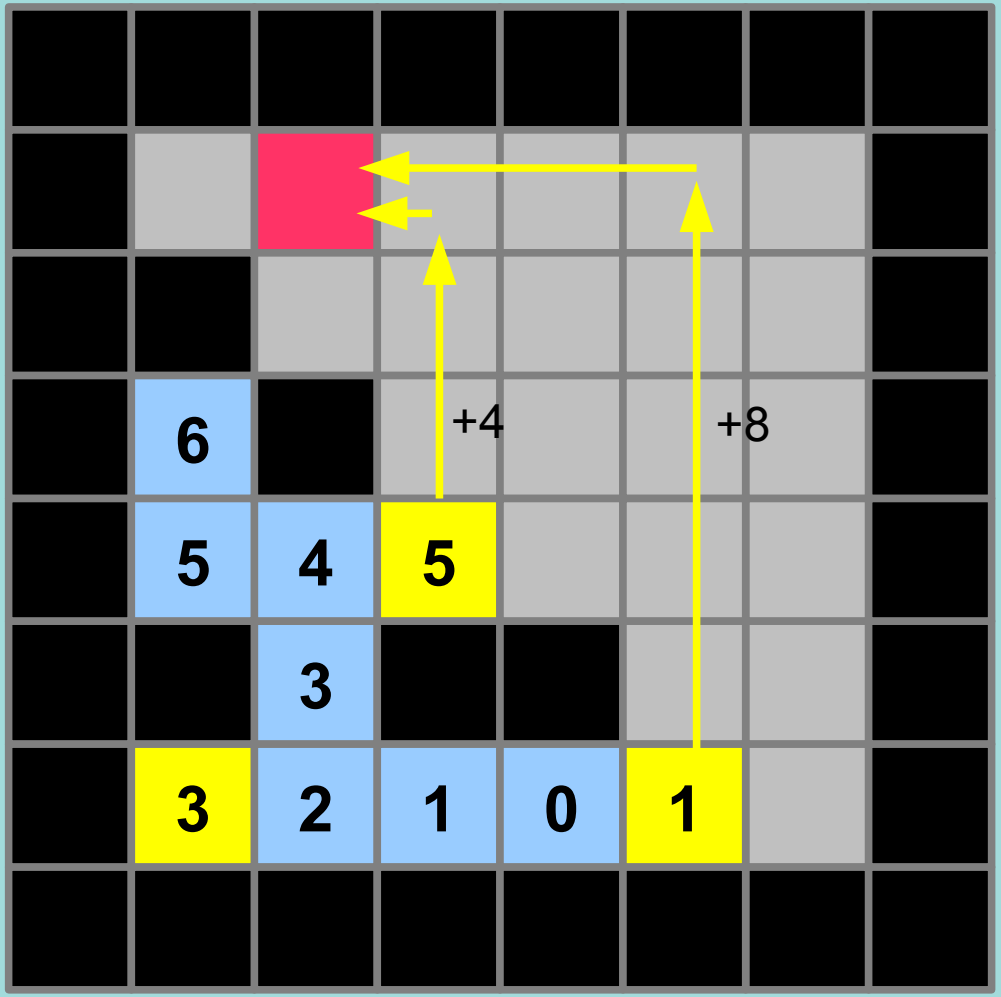
Algorithme de propagation + optimisme

Algorithme A*



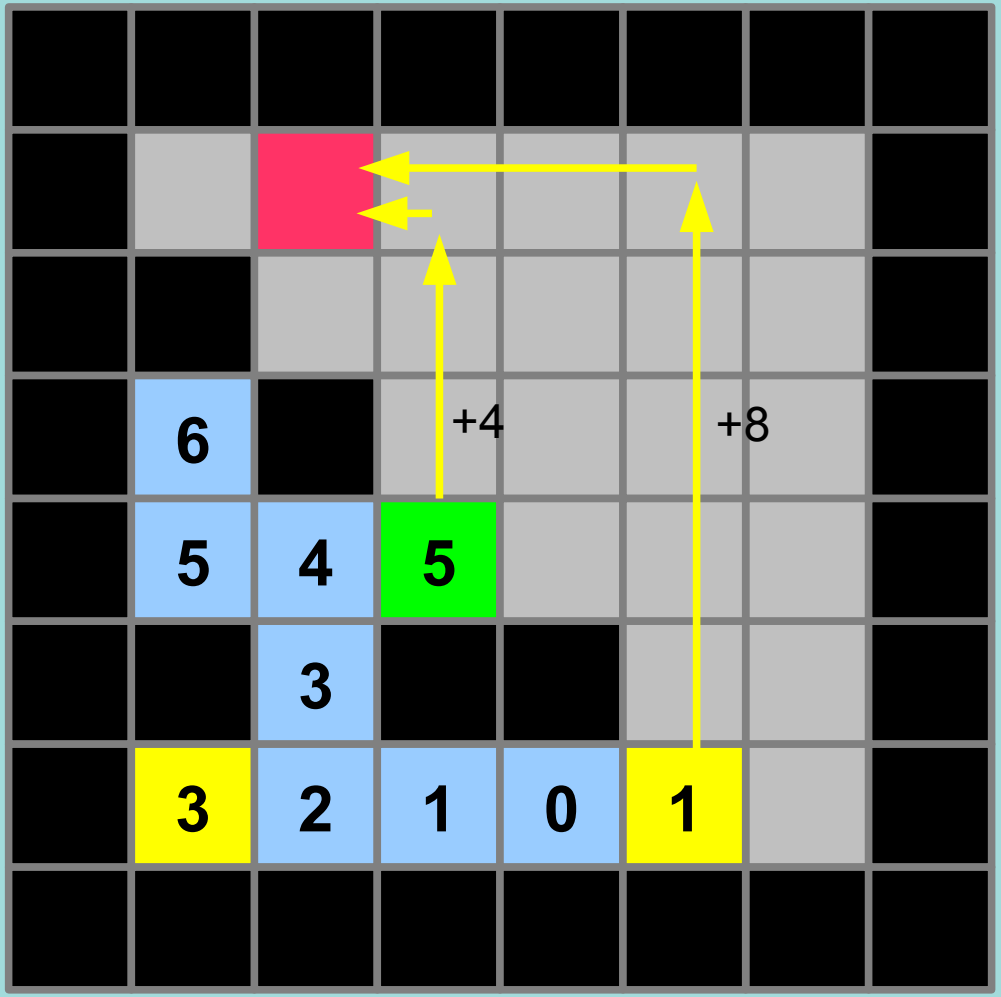
Algorithme de propagation + optimisme

Algorithme A*



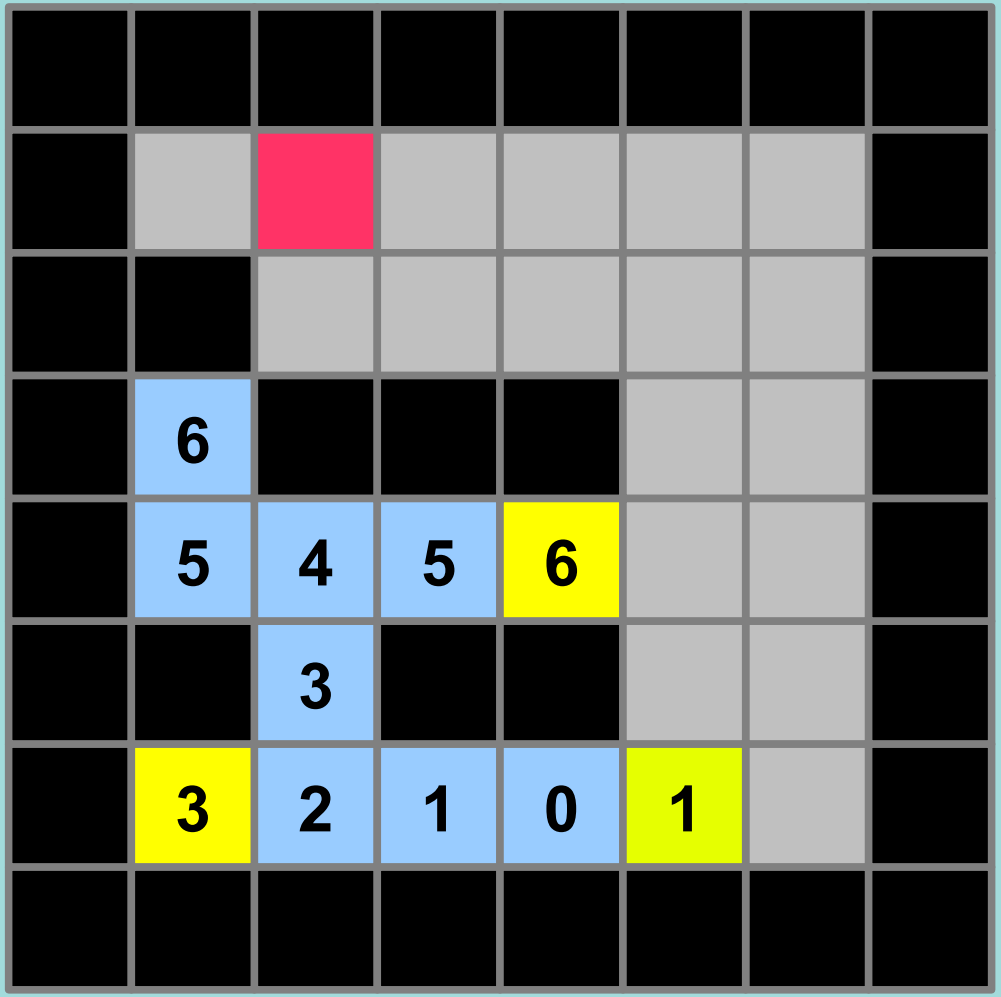
Algorithme de propagation + optimisme

Algorithme A*



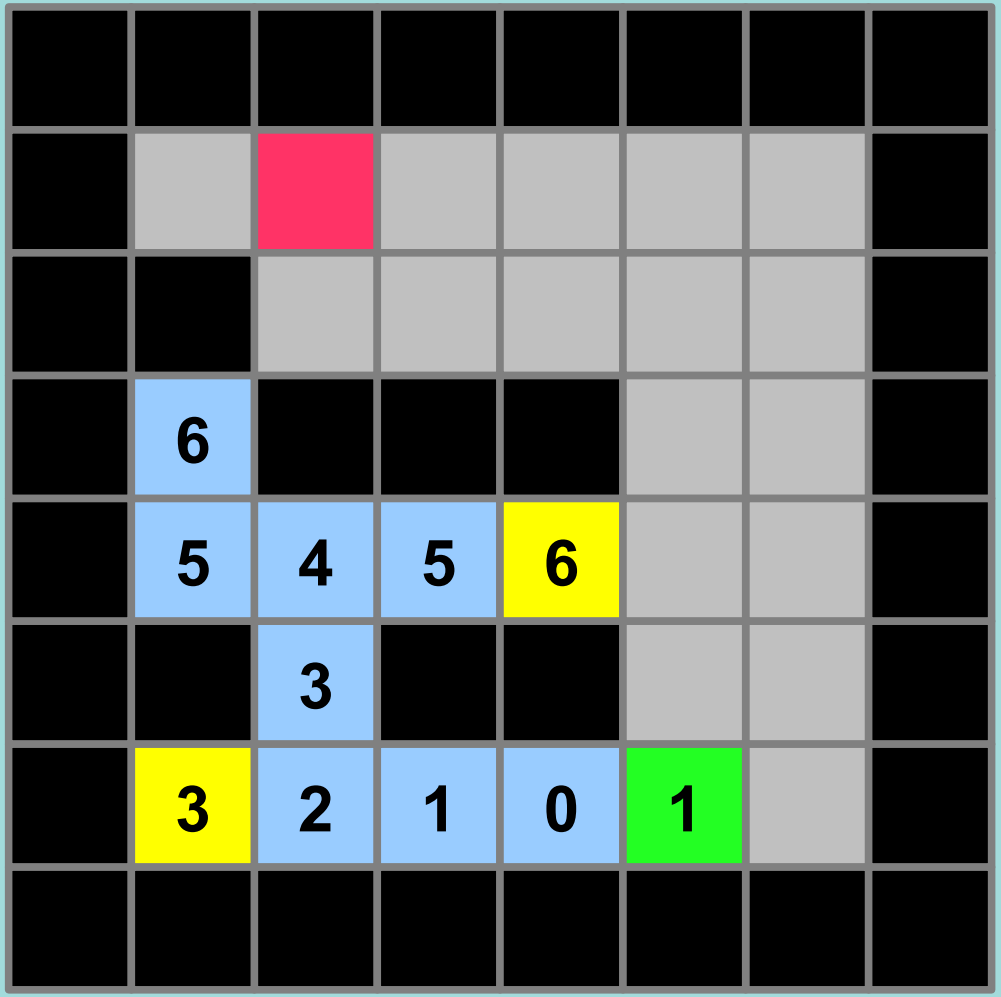
Algorithme de propagation + optimisme

Algorithme A*



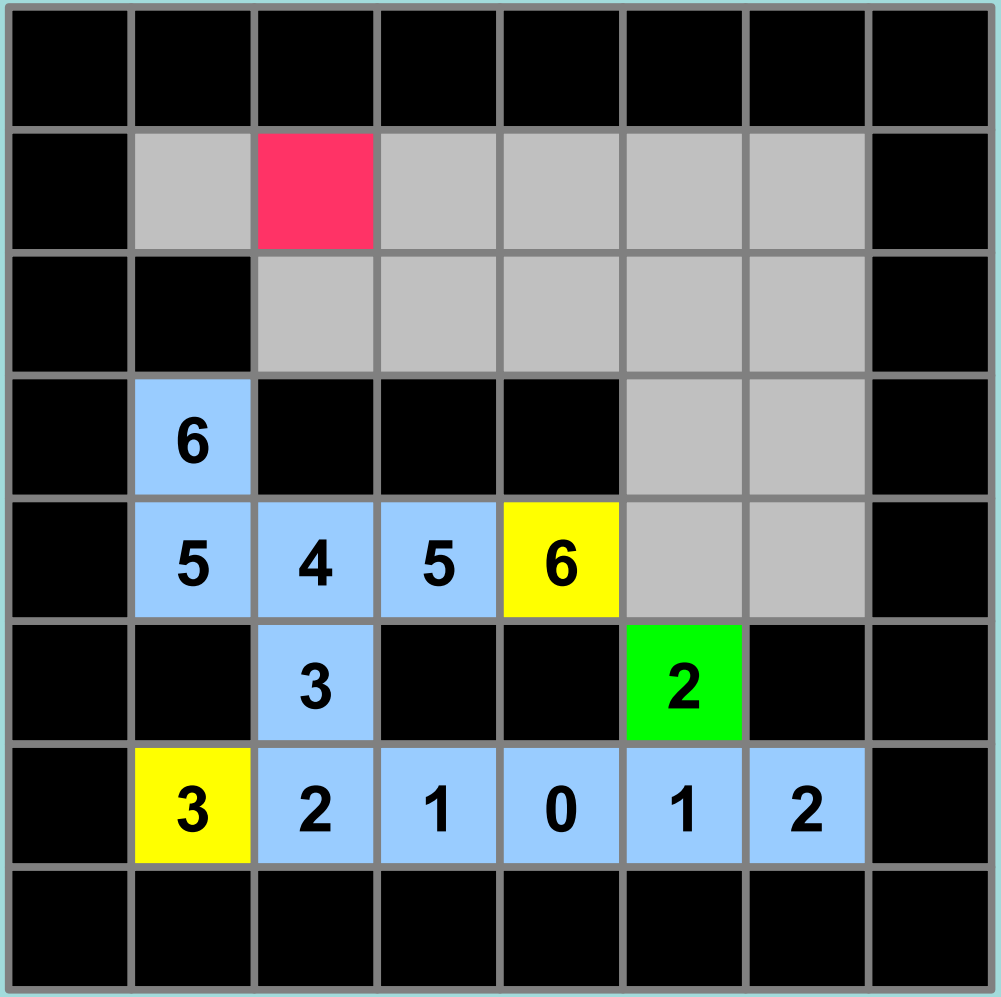
Algorithme de propagation + optimisme

Algorithme A*



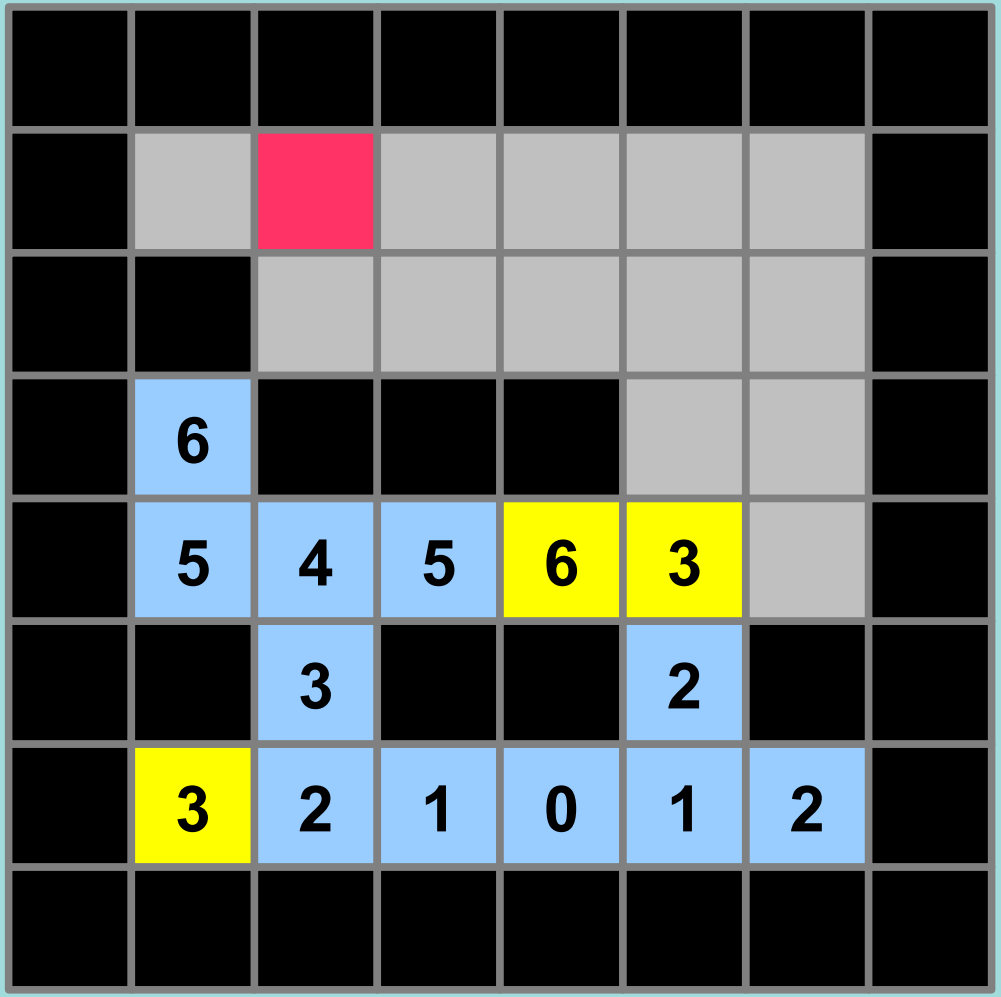
Algorithme de propagation + optimisme

Algorithme A*



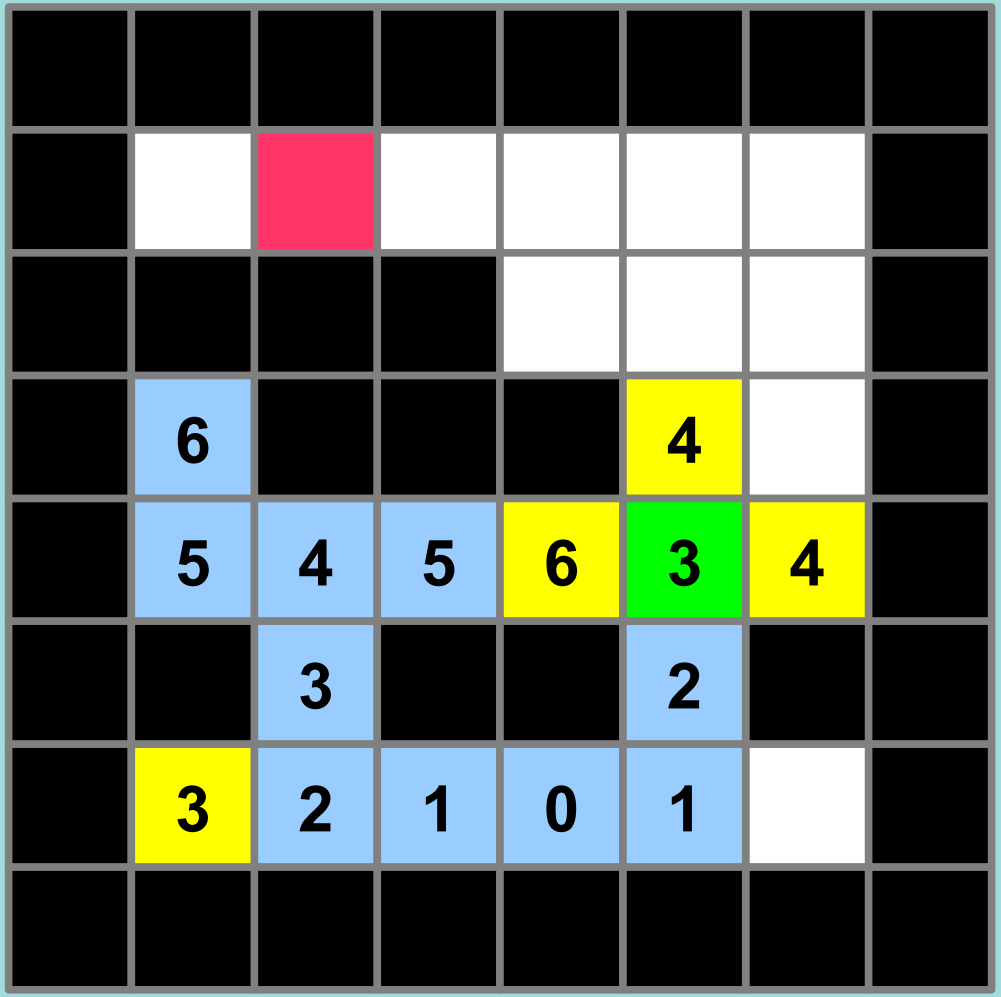
Algorithme de propagation + optimisme

Algorithme A*



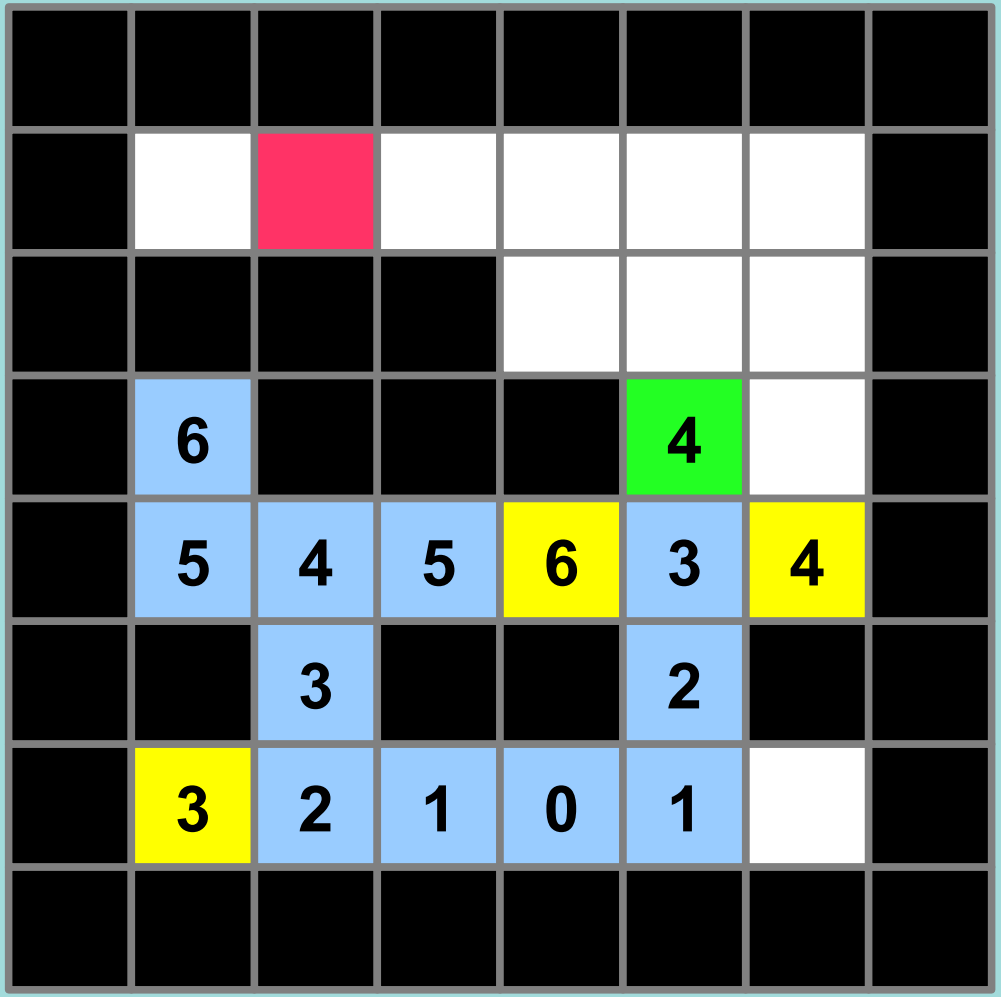
Algorithme de propagation + optimisme

Algorithme A*



Algorithme de propagation + optimisme

Algorithme A*



Algorithme de propagation + optimisme

Algorithme A*

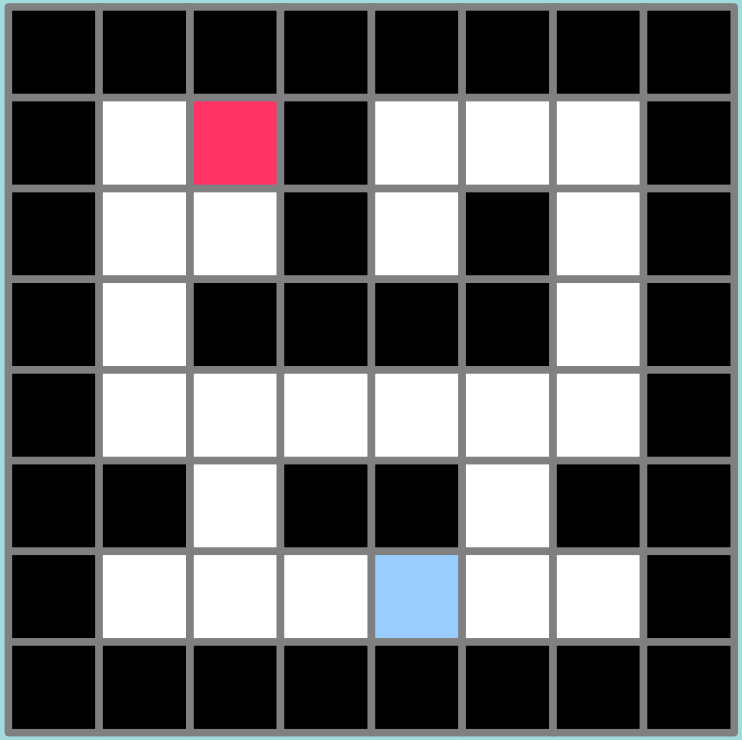
- Démo étudiant DUT

3 Extensions

- Ajoute des couts aux arcs
  - Dijkstra
- Accélérer la recherche
  - Algorithme A*
- Etendre à d'autres cadres
  - Théorie des graphes

Problème labyrinthe

- Structure particulière
  - Cases côtes à côtes
  - Connexité fixée
  - Coûts de 1

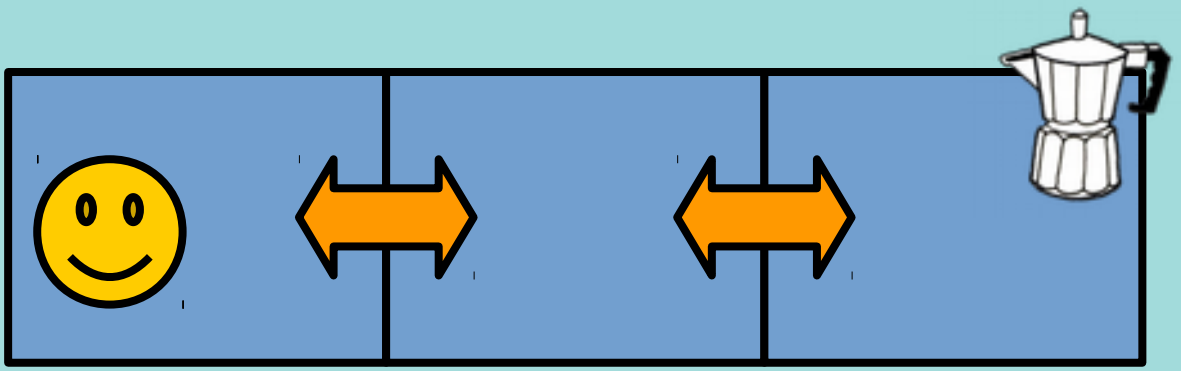


- De manière plus générale
  - Graphe (Noeuds + Arcs)

- Algorithmes identiques
  - Vraie question : Modélisation du probleme

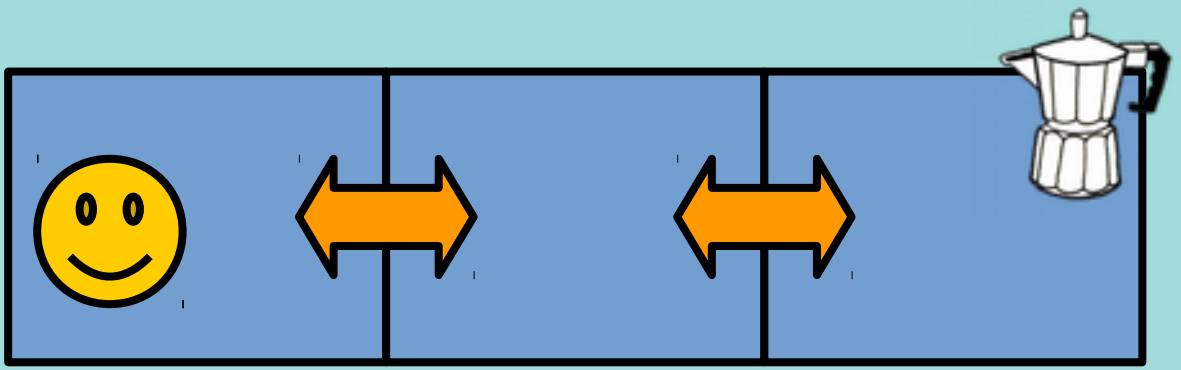
Problème

- Robot qui va chercher un café
  - 3 pièces qui se suivent
  - Cafetière au fond
  - Possibilité de déplacer, prendre, poser



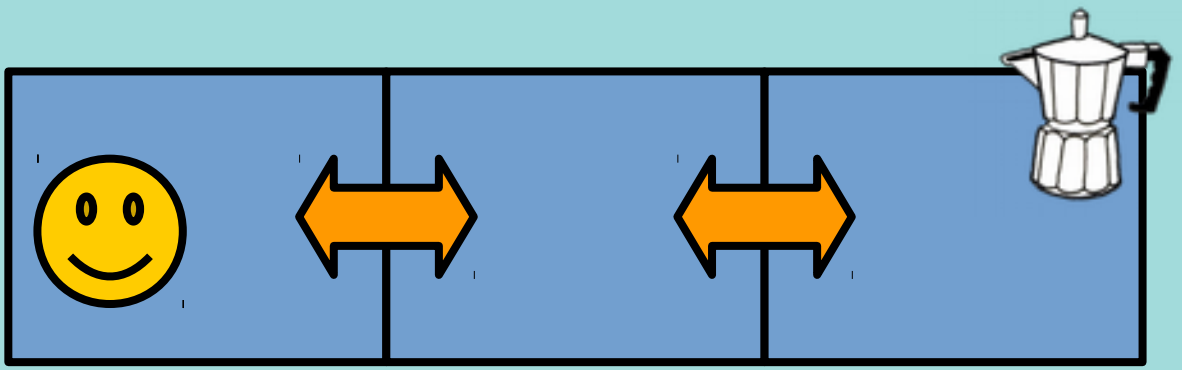
Problème

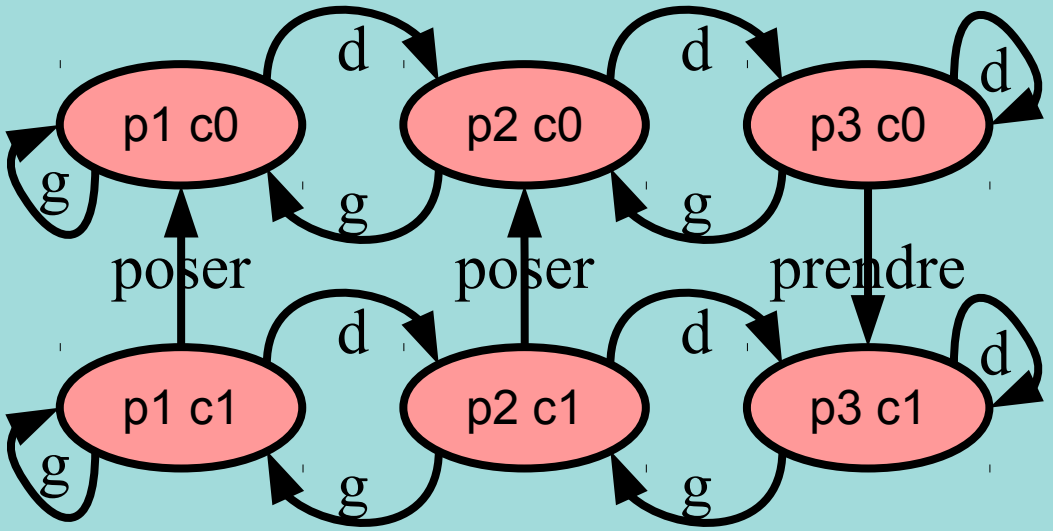
- Robot qui va chercher un café
  - Modélisation du problème



Problème

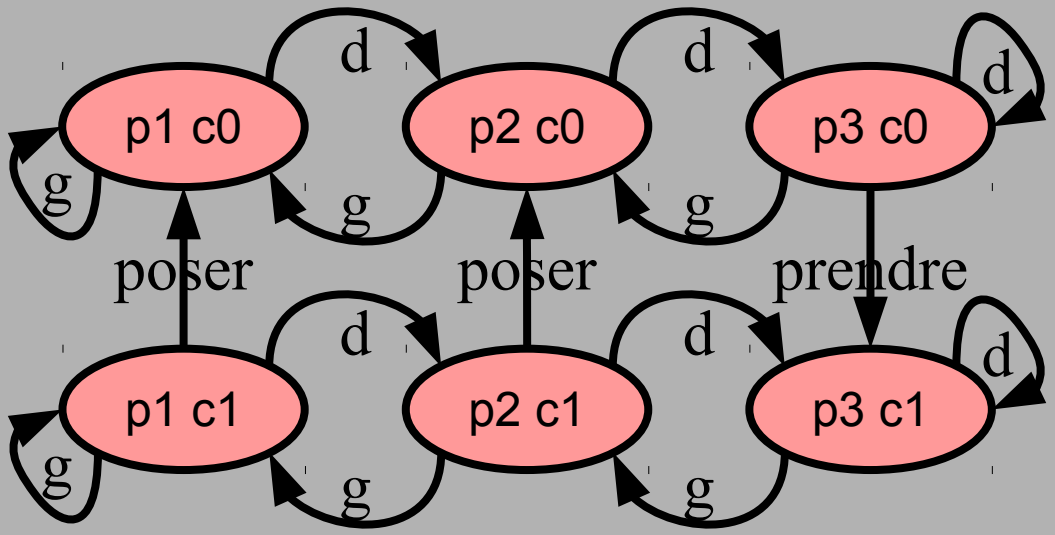
- Robot qui va chercher un café





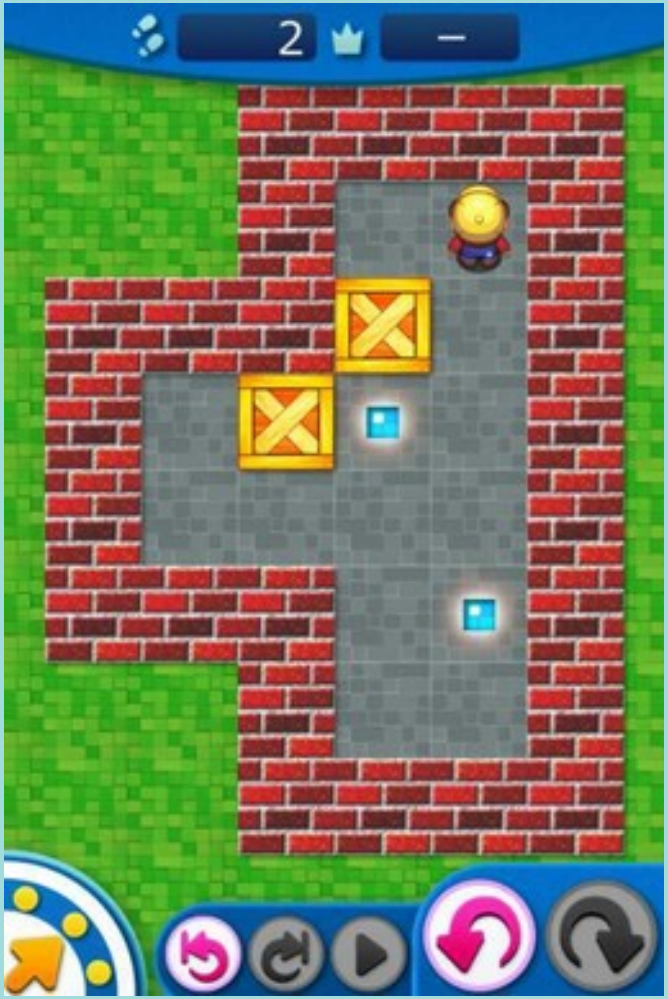
Problème

```
def actions():
    return(['gauche','droite','prendre','poser'])

def etats():
    return([(1,0),(1,1),(2,0),(2,1),(3,0),(3,1)])

def transition(s,a):
    (pos,cafe)=s

    if (a=='gauche'):
        if (pos>1):
            pos=pos-1

    if (a=='droite'):
        if (pos<3):
            pos=pos+1

    if (a=='prendre'):
        if (pos==3):
            Cafe=1

    if (a=='poser'):
        Cafe=0

return(pos,cafe)
```



Probleme : Sokoban

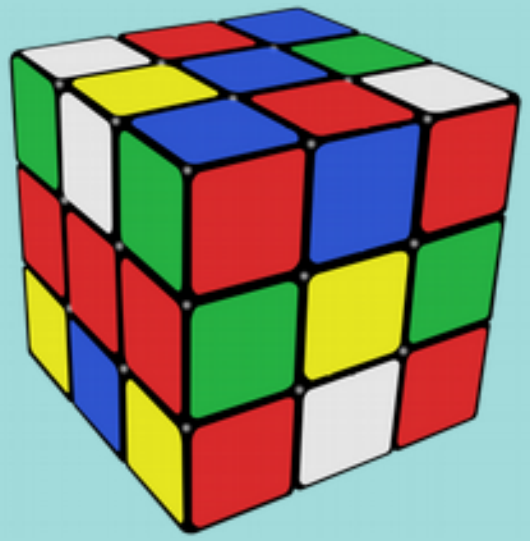
- Sokoban
  - Caisse et murs
  - Amener les caisses
- A faire
  - Modéliser le probleme
  - Appliquer algo
  - Heuristique si A*



Problèmes : puzzle solo

Taquin

Rush hour



Rubick's cube

Problèmes : puzzle solo

Dr Eureka (blue orange)

Et beaucoup d'autres

- Thinkfun / Smartgames

Turnstile