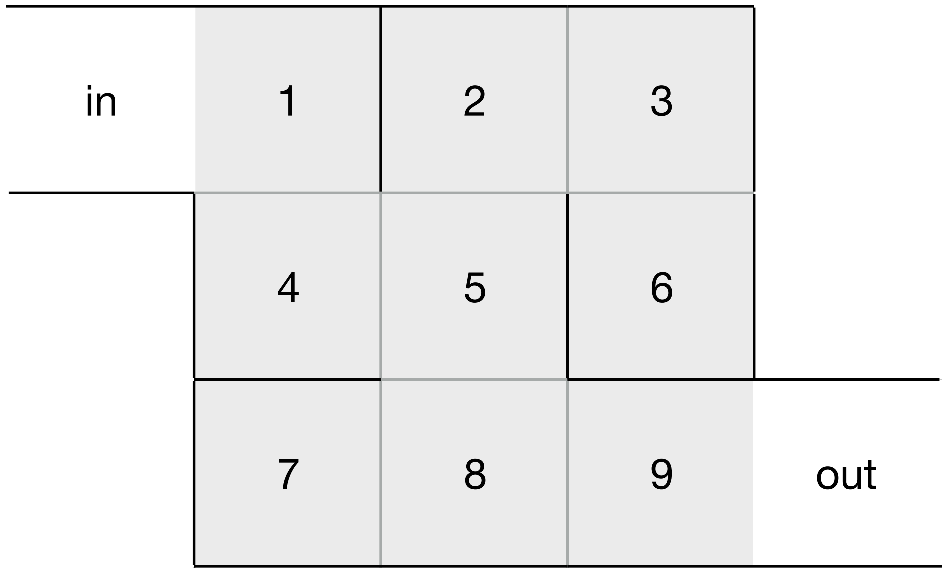
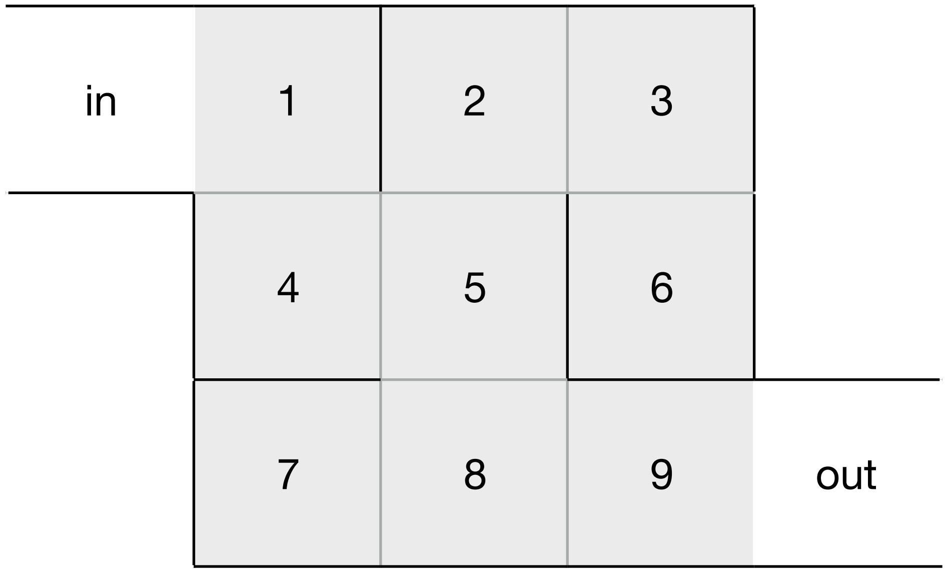
AI Games course

Certificate 1, session 2

The maze example



The maze example: graph representation



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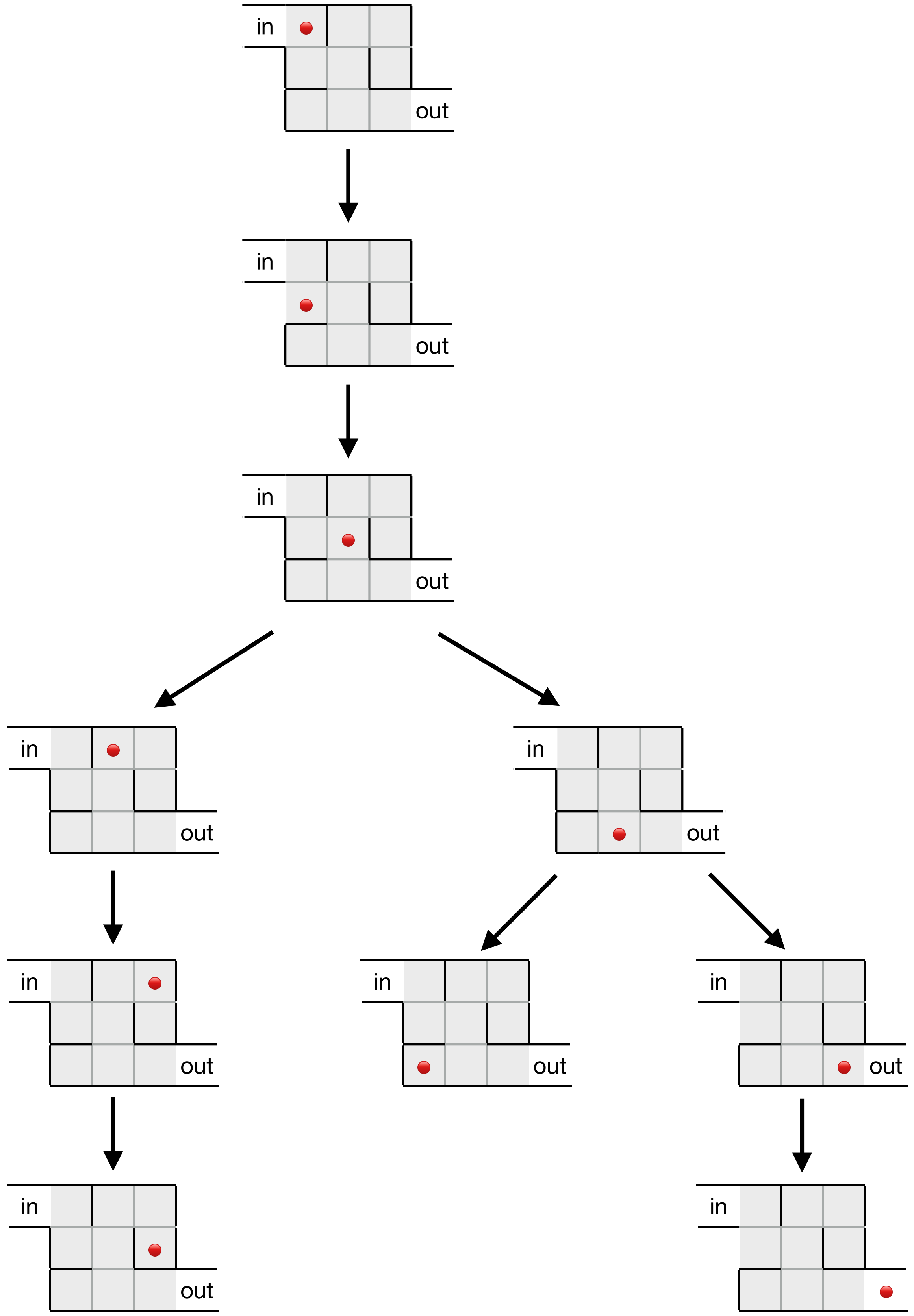
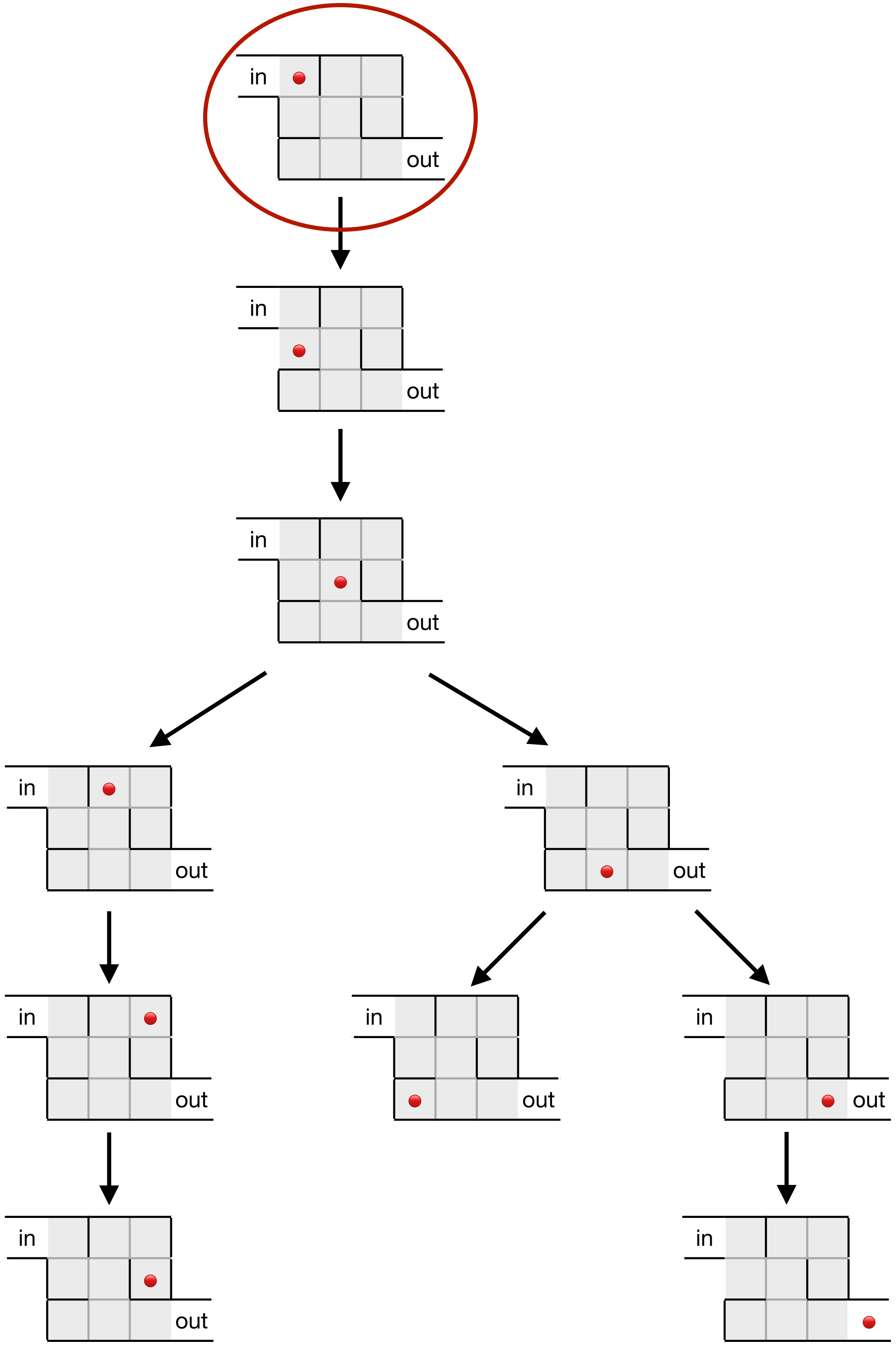
maze = {'in': set([1]),
         1: set(['in',4]),
         2: set([3,5]),
         3: set([2,6]),
         4: set([1,5]),
         5: set([2,4,8]),
         6: set([3]),
         7: set([8]),
         8: set([5,7,9]),
         9: set([8,'out']),
         'out': set([9])}
```

Maze
“space tree”



Depth-first search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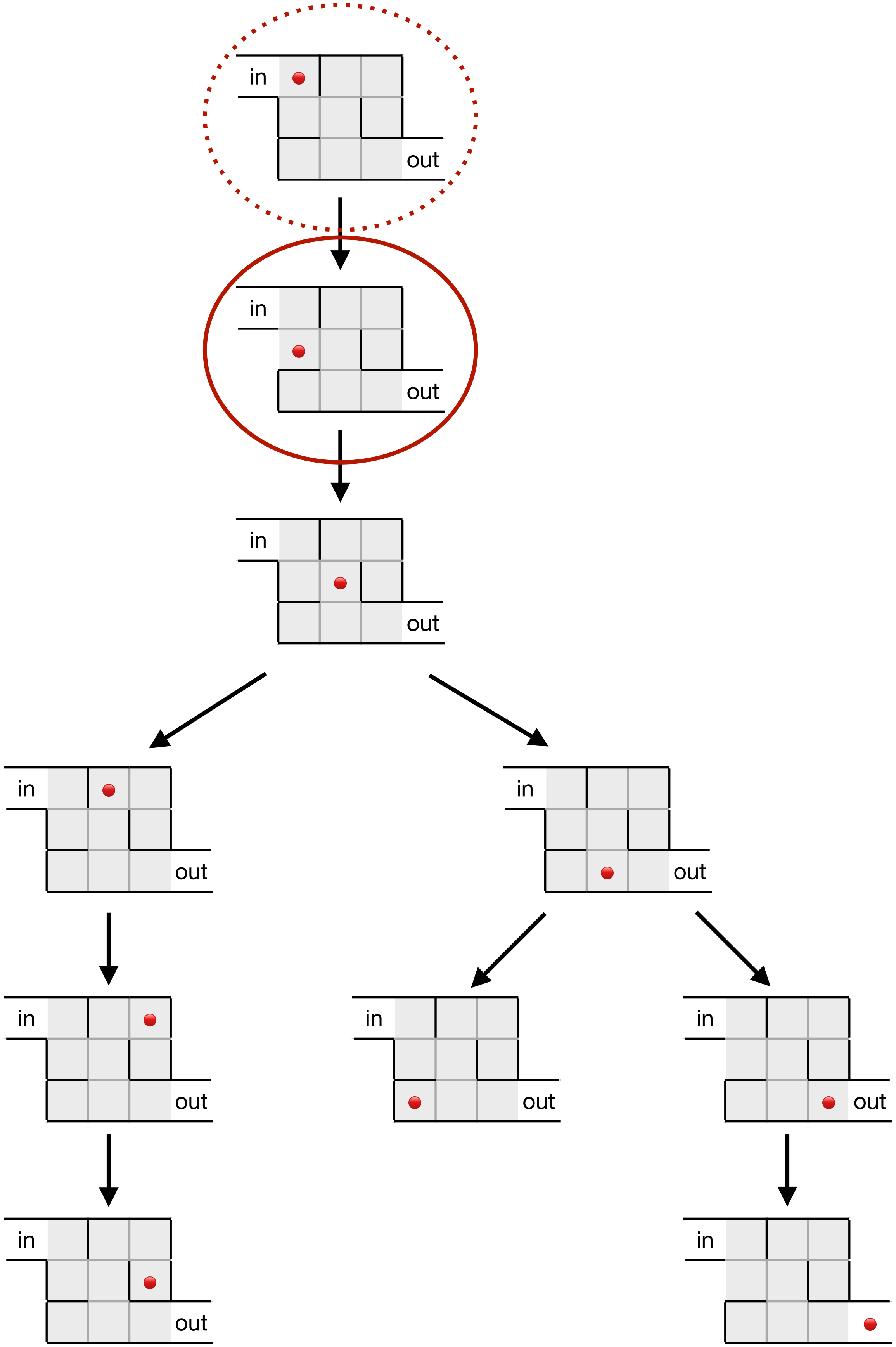
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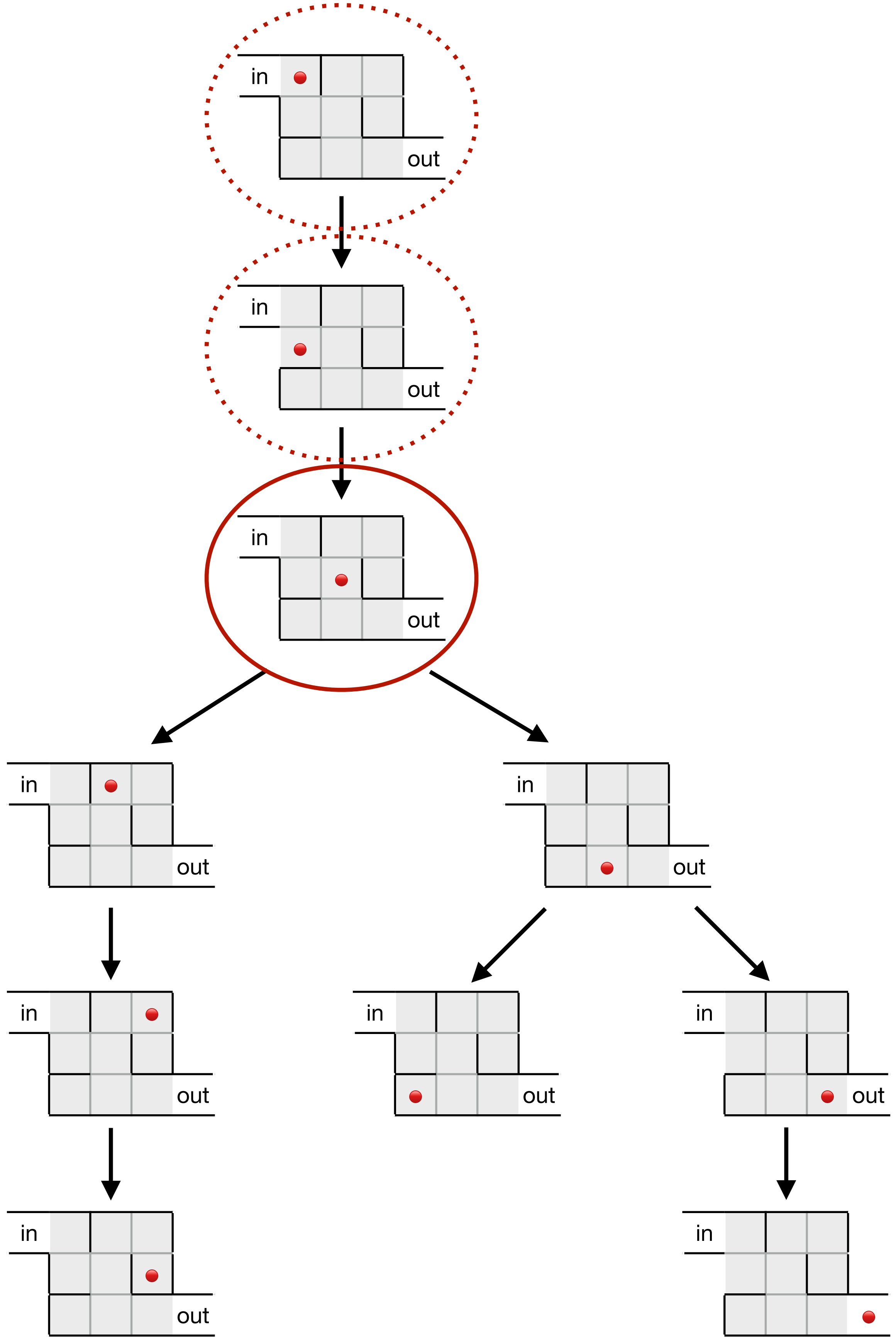
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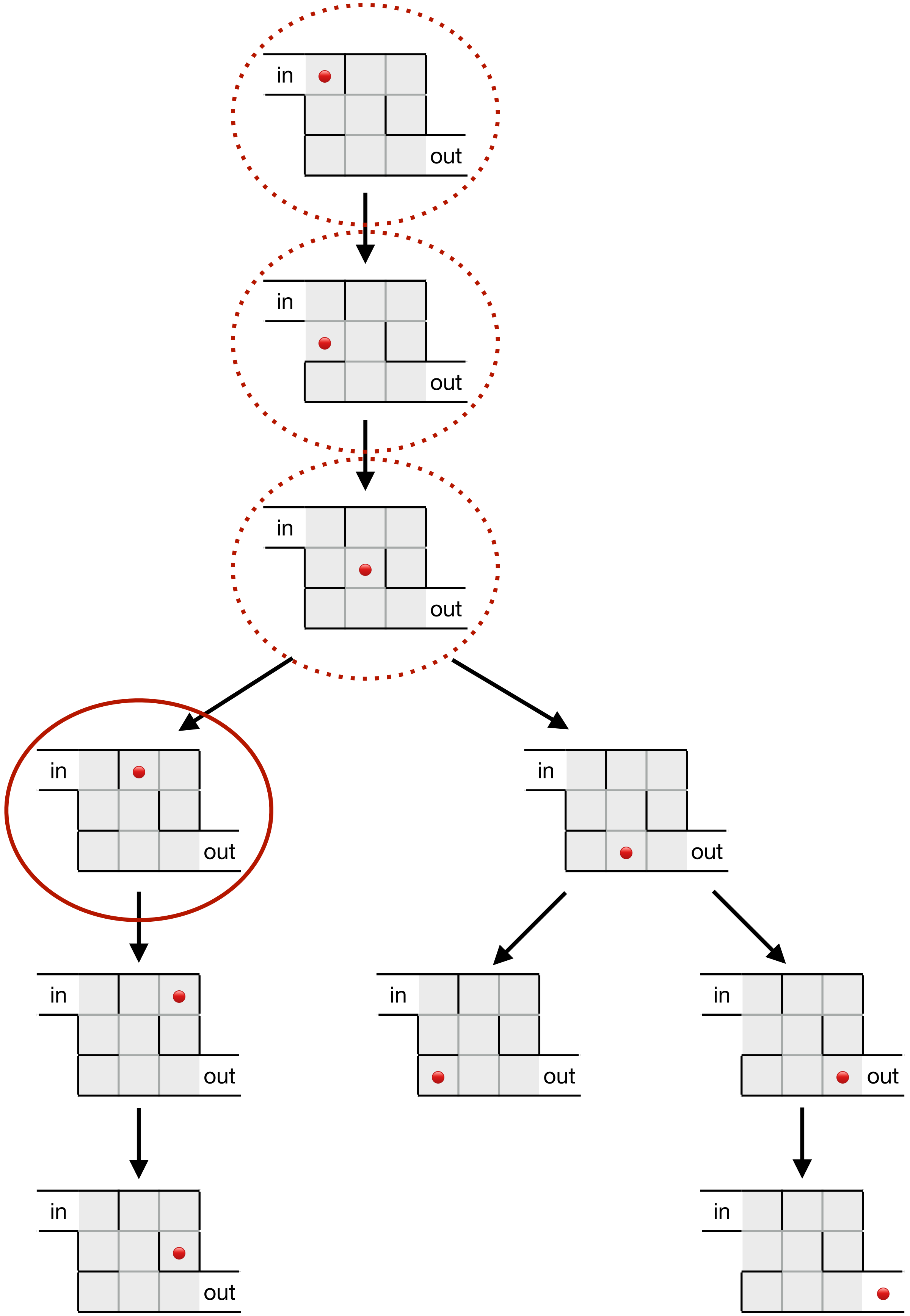
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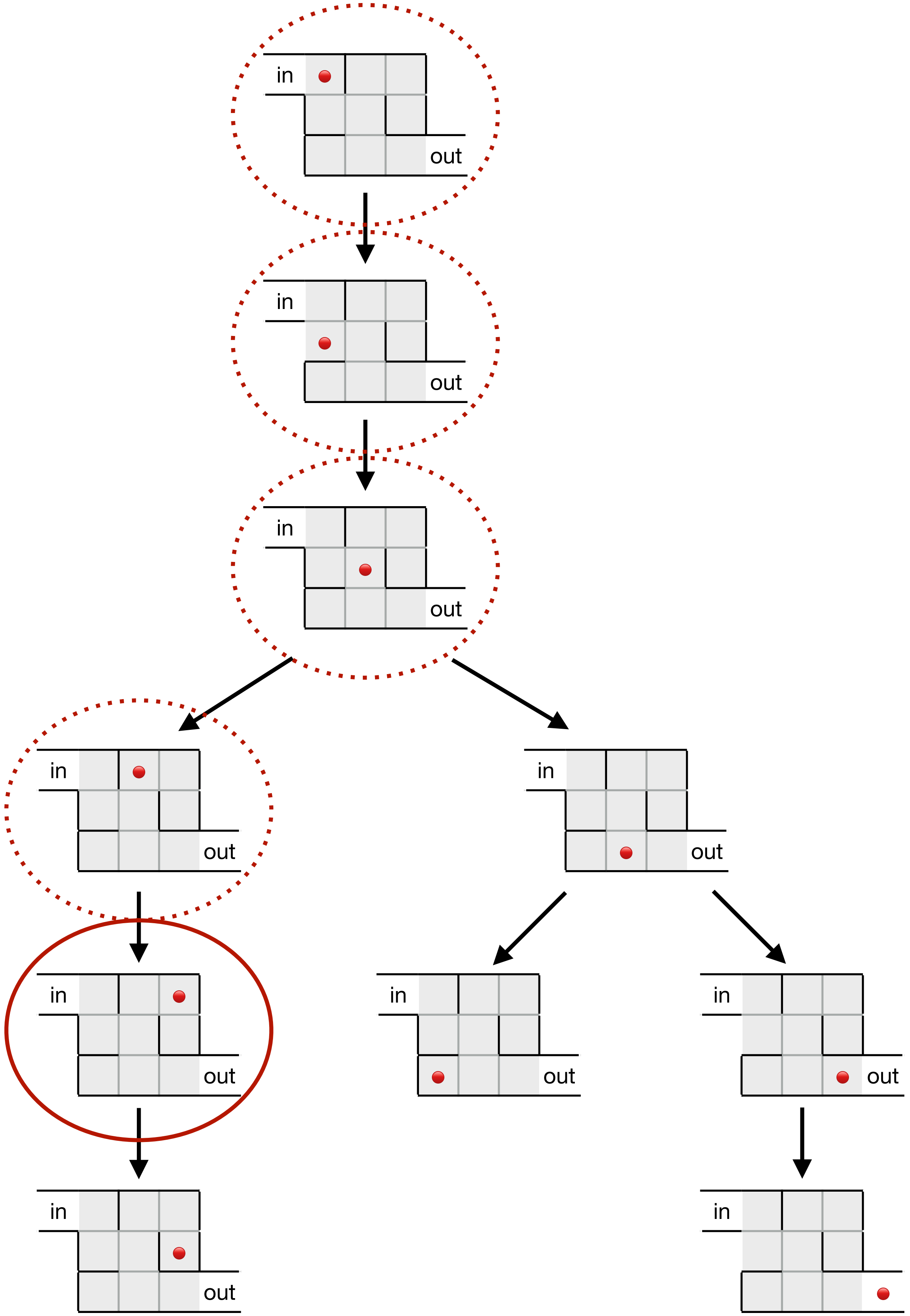
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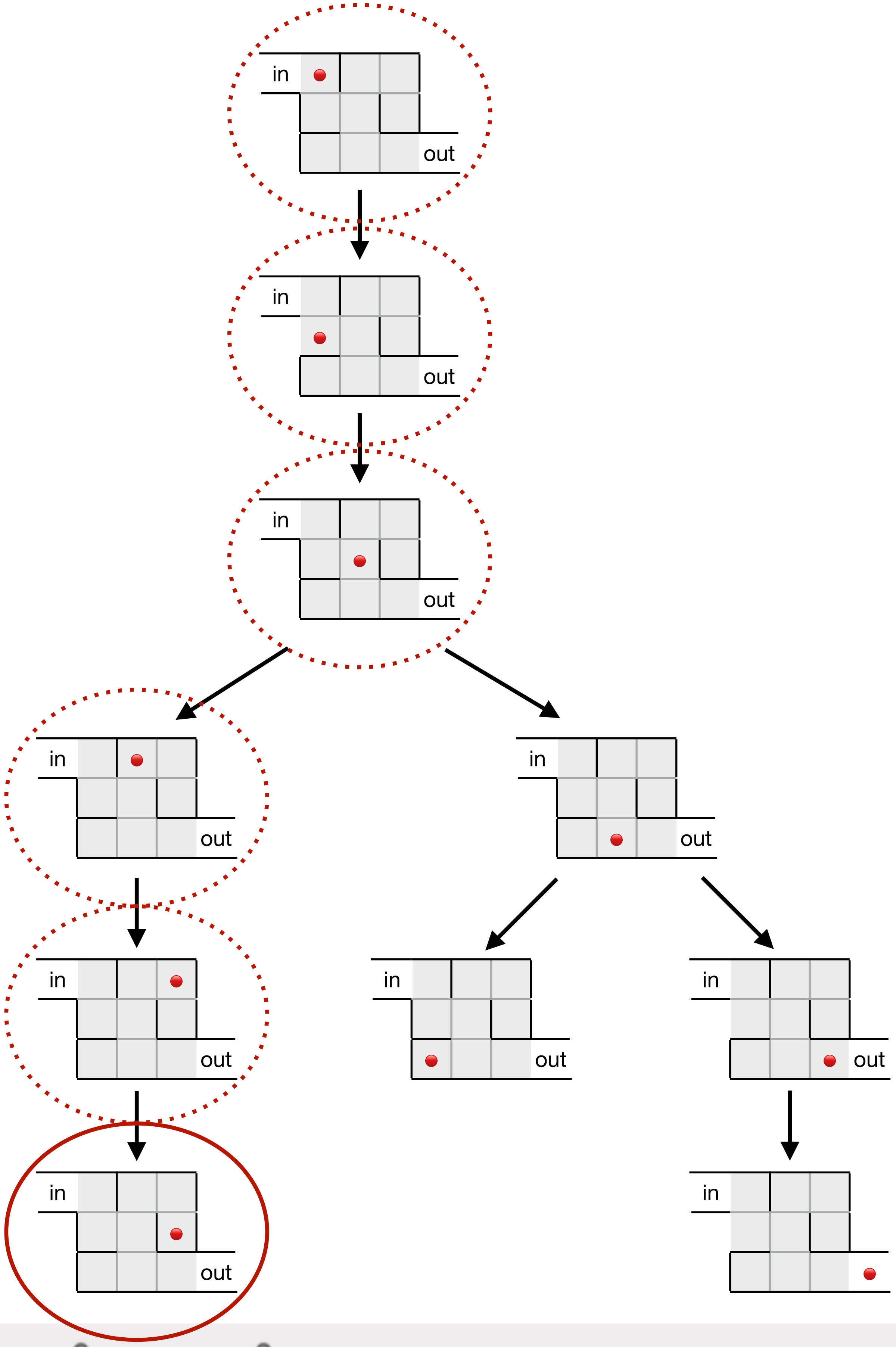
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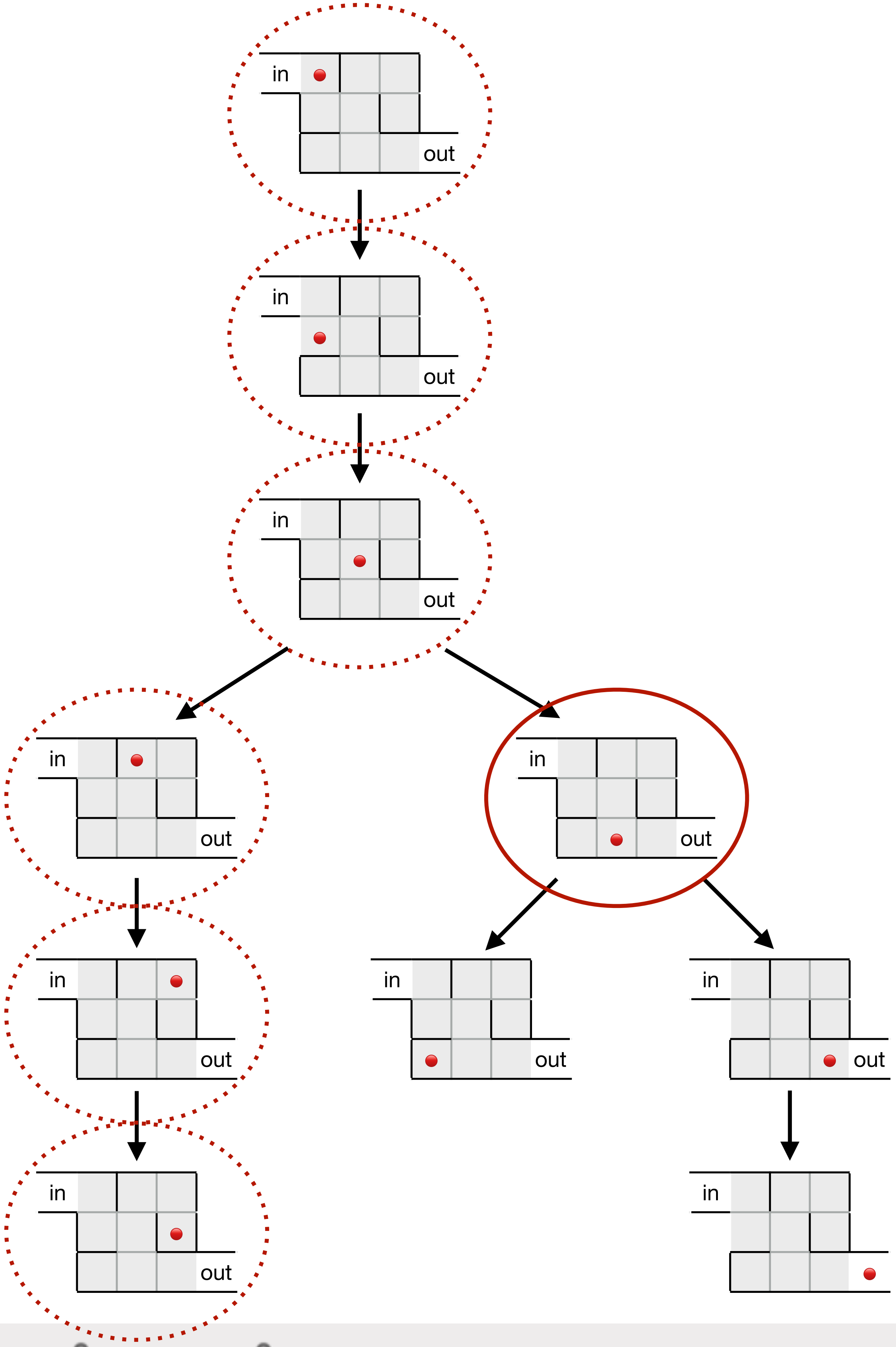
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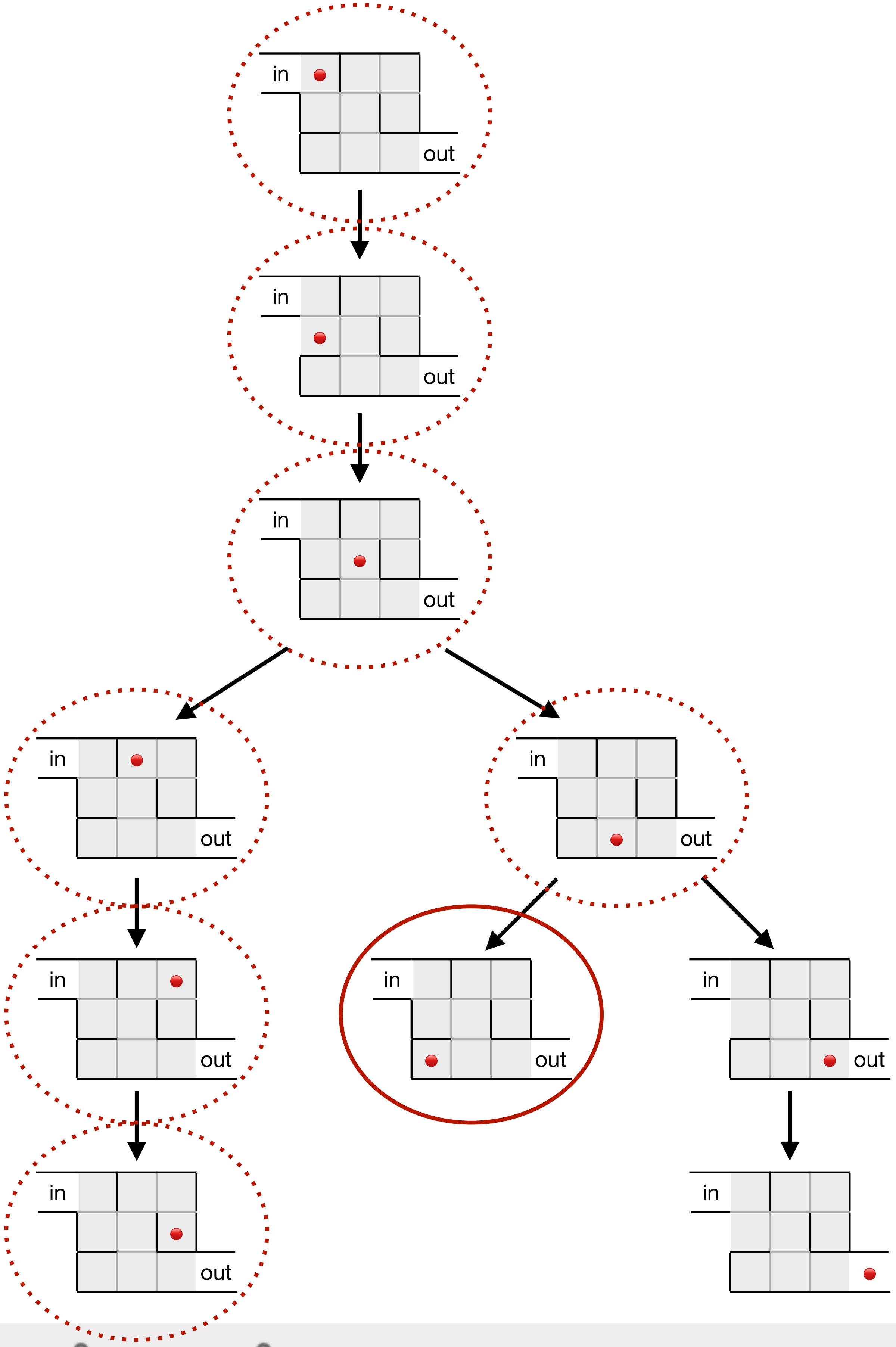
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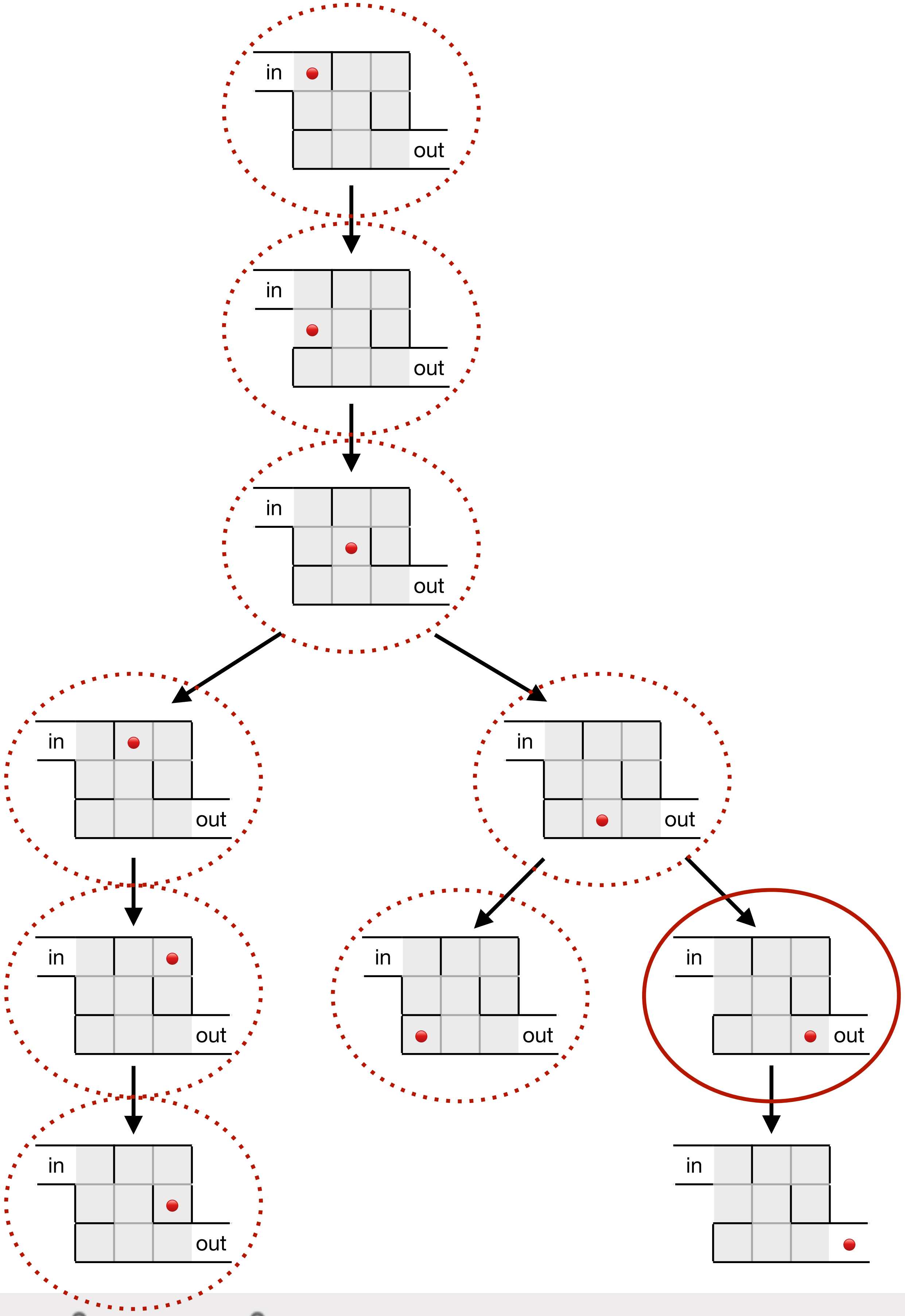
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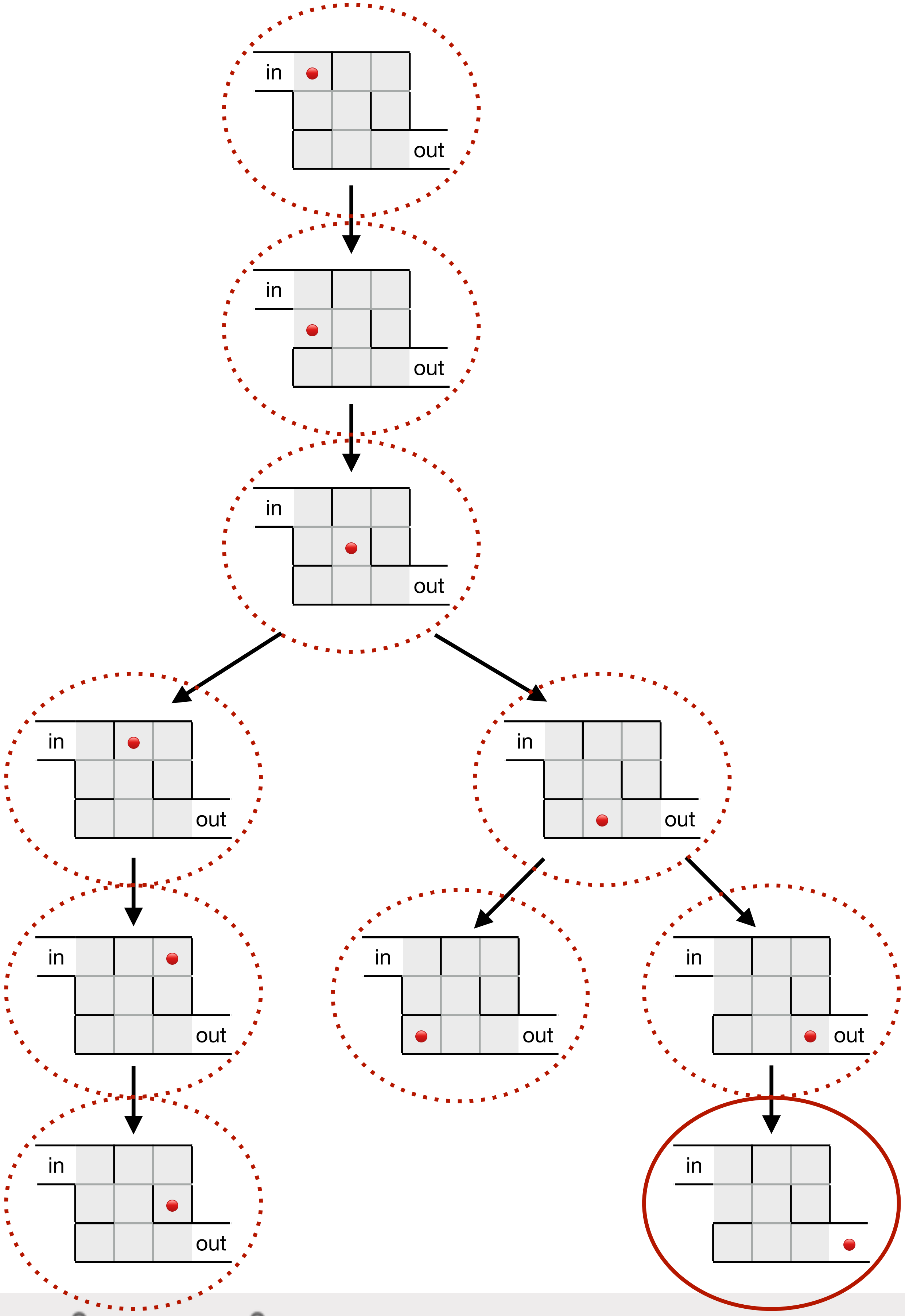
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DFS algorithm

```
DFS: given a graph G and a starting node n
   0. put n into a stack
   1. pop top node from the stack and mark it as visited
   2. put all nodes reachable from the top node in the stack
   3. while the stack is not empty, recursively apply steps 1-3
```

DFS algorithm

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```
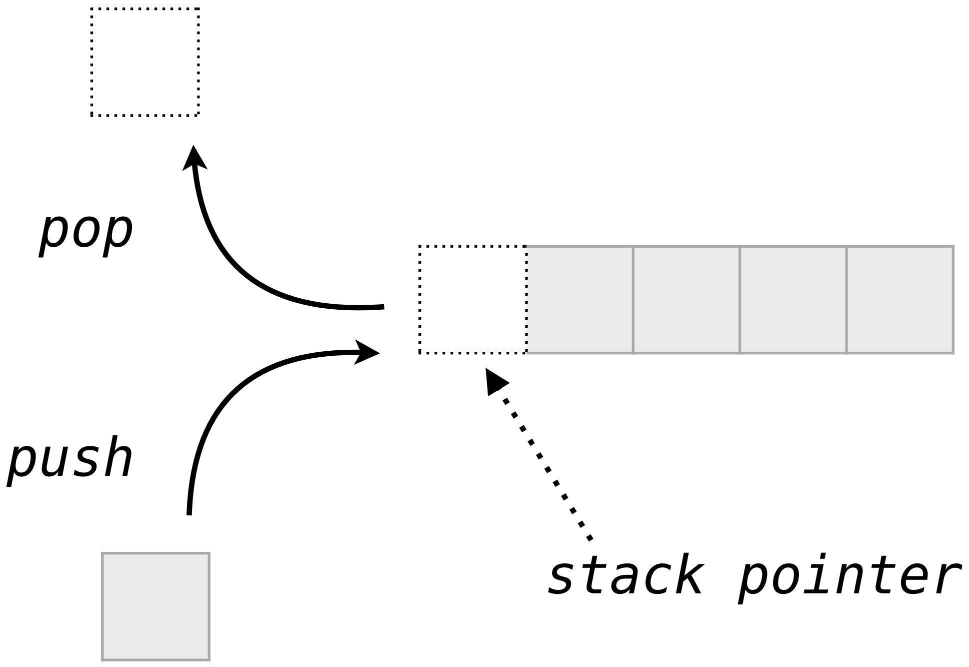

Stack:



LIFO:
last in,
first out

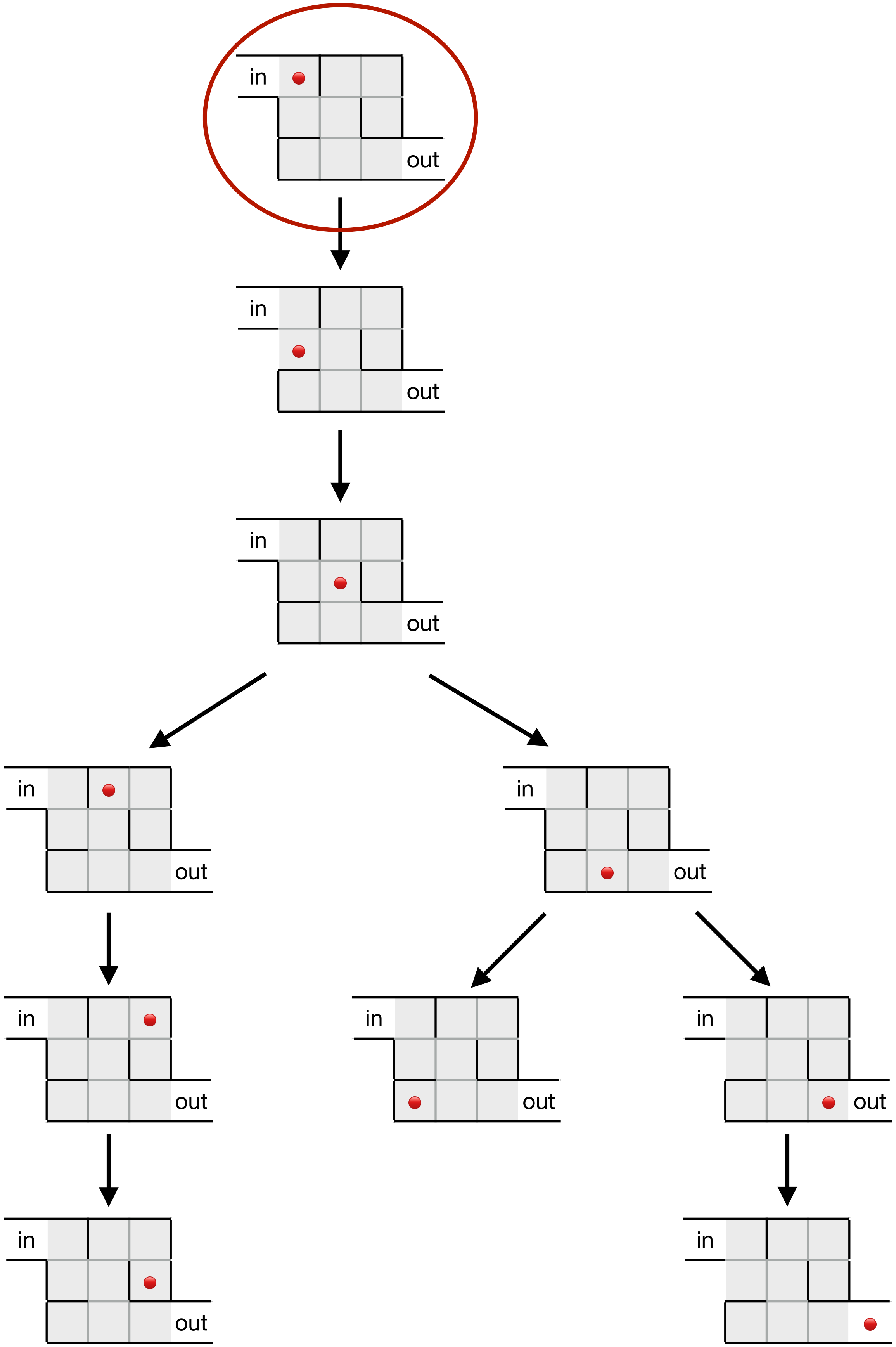
DFS algorithm

```
def dfs(graph, start):
    visited, stack = set(), [start]
    while stack:
        vertex = stack.pop()
        if vertex not in visited:
            visited.add(vertex)

            print(vertex)
```

DFS algorithm

```
def dfs(graph, start):
    visited, stack = set(), [start]
    while stack:
        vertex = stack.pop()
        if vertex not in visited:
            visited.add(vertex)
            stack.extend(graph[vertex] - visited)
            print(vertex)
```

Breadth-first search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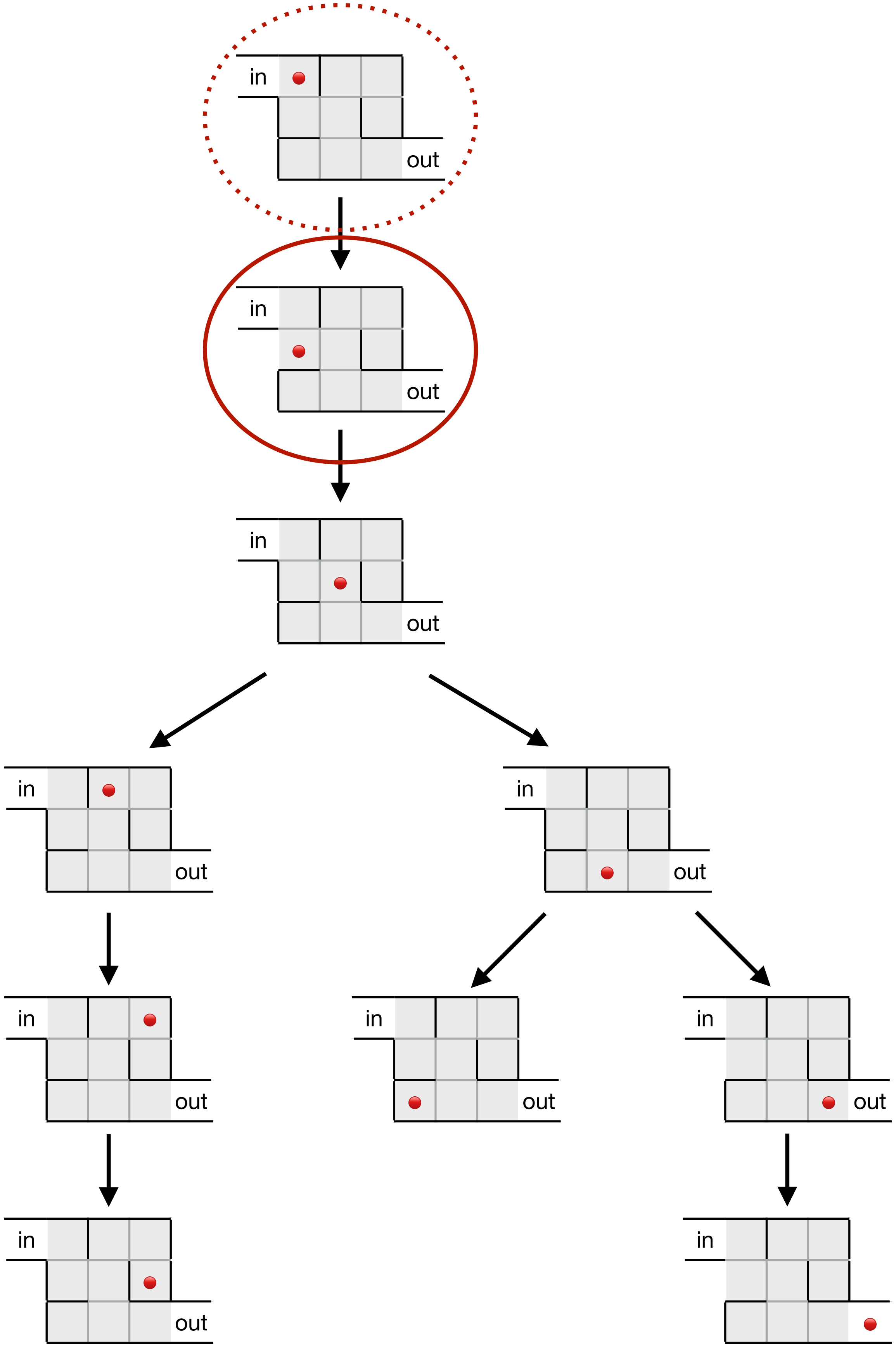
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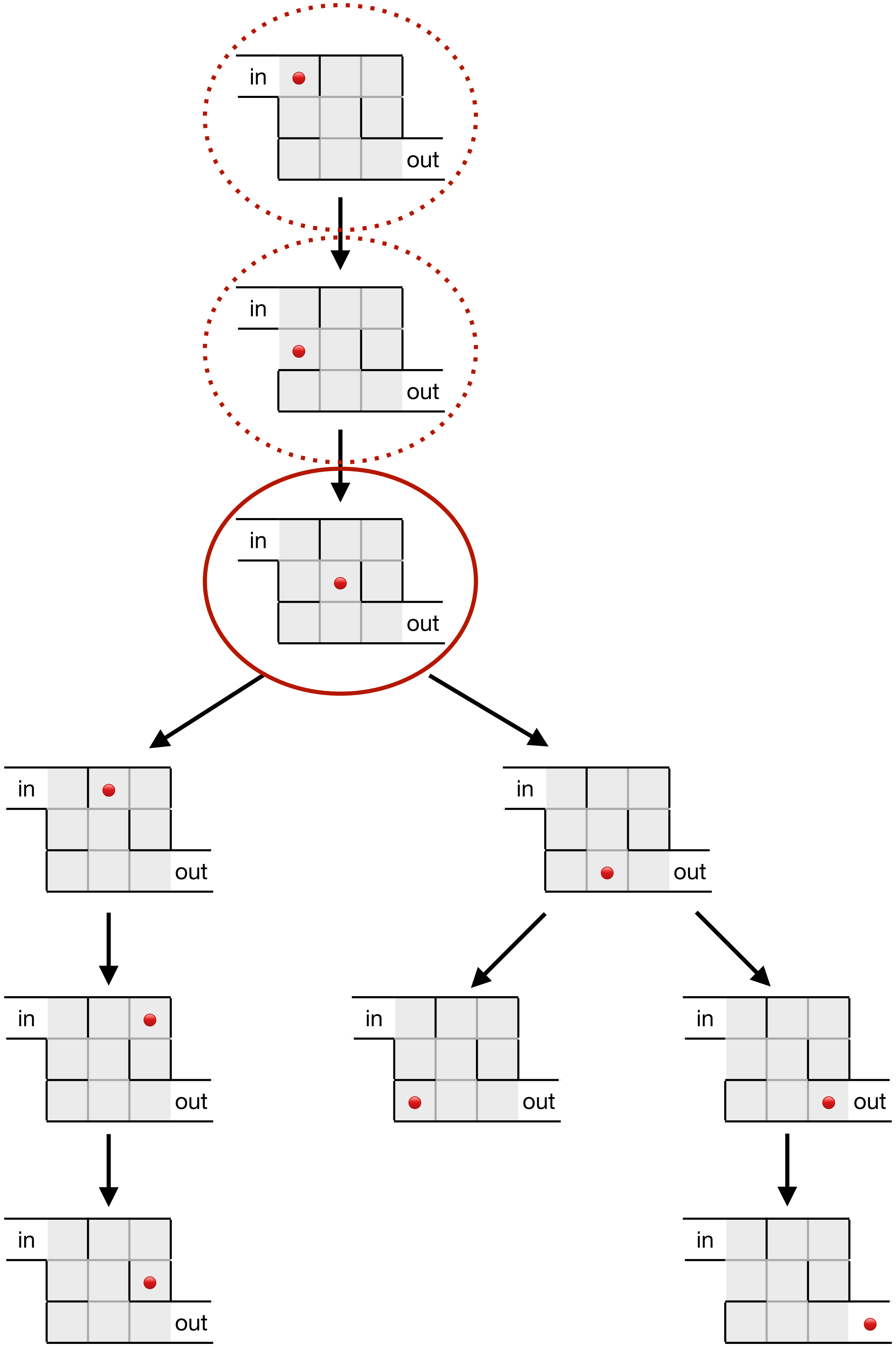
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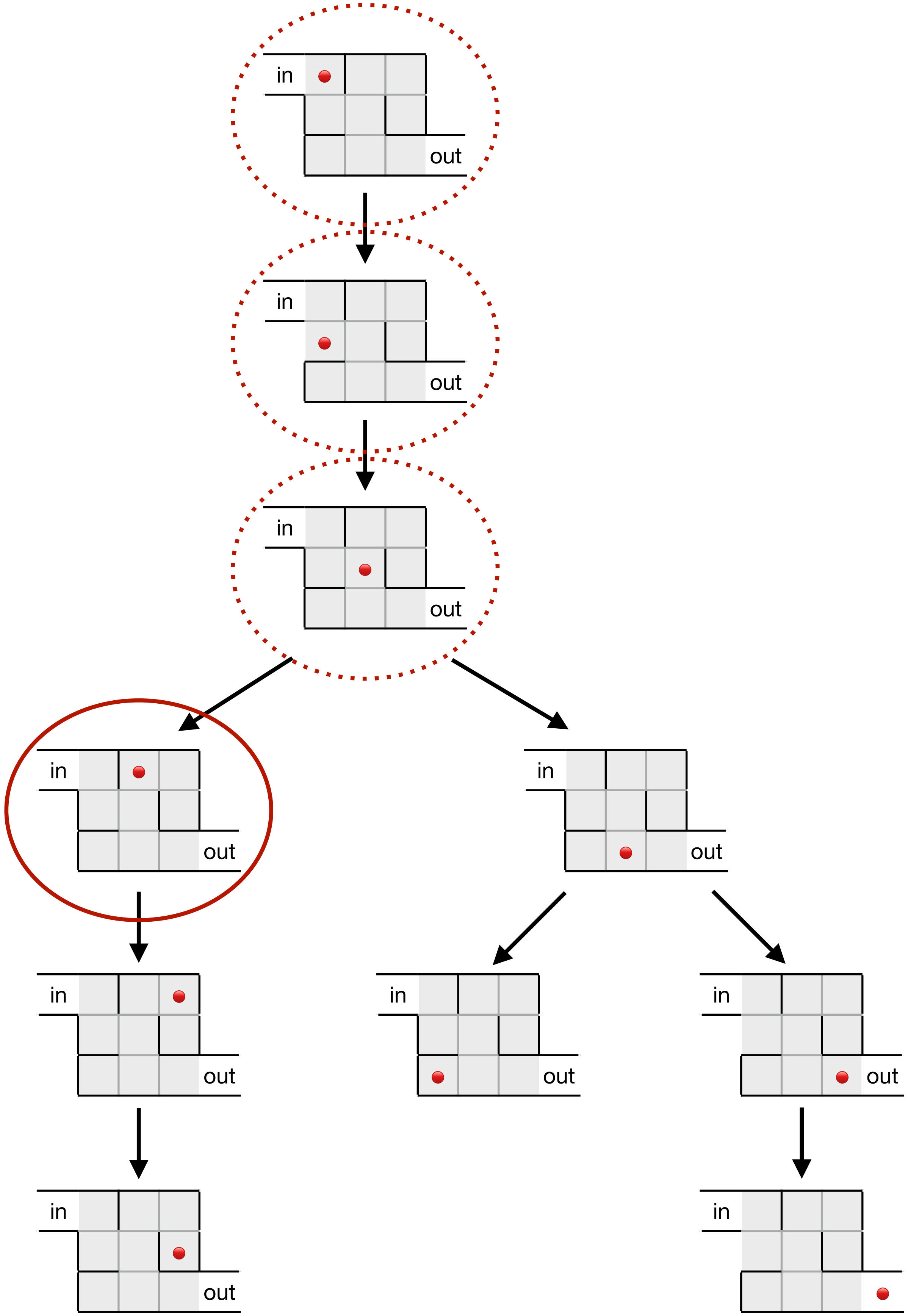
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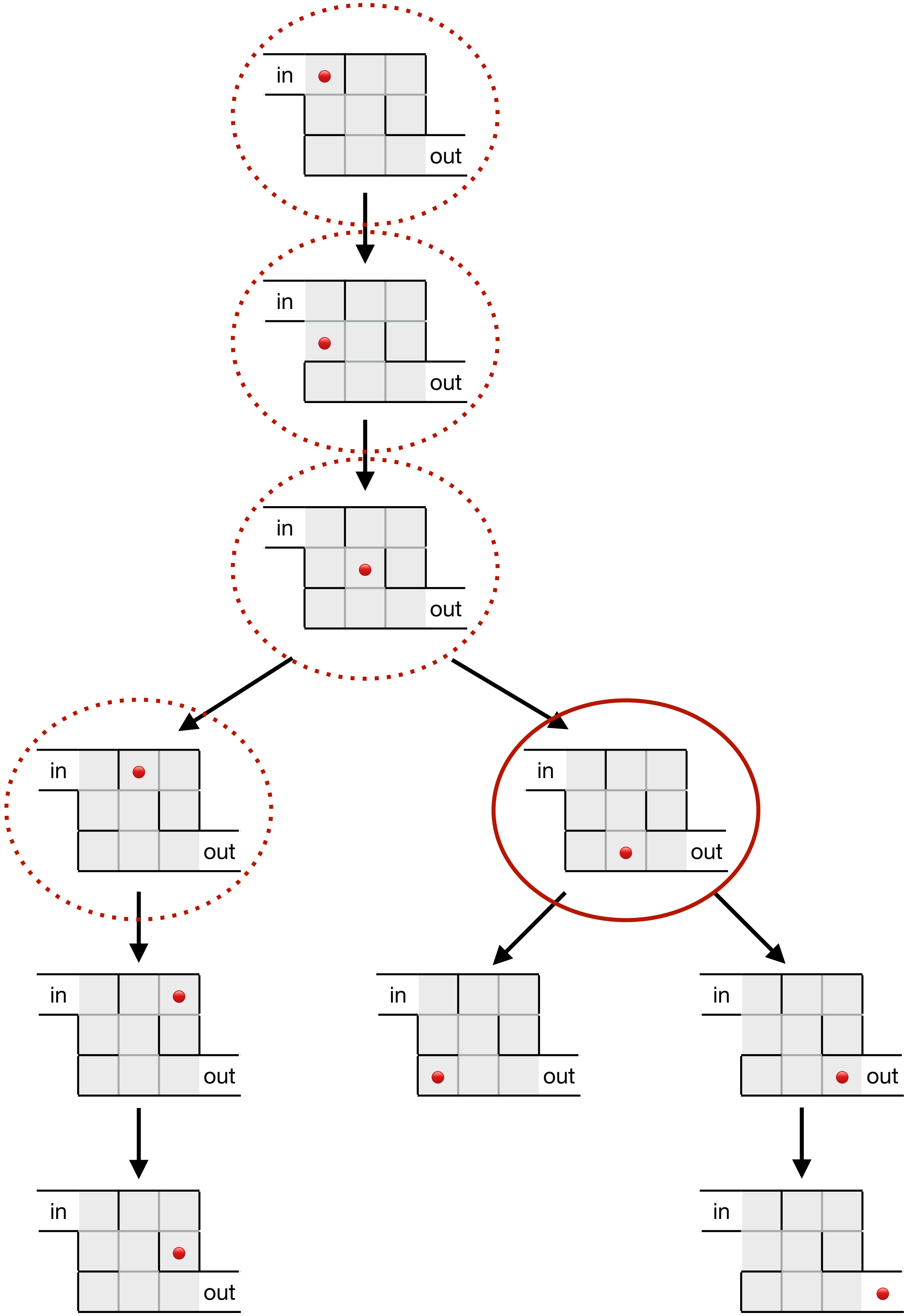
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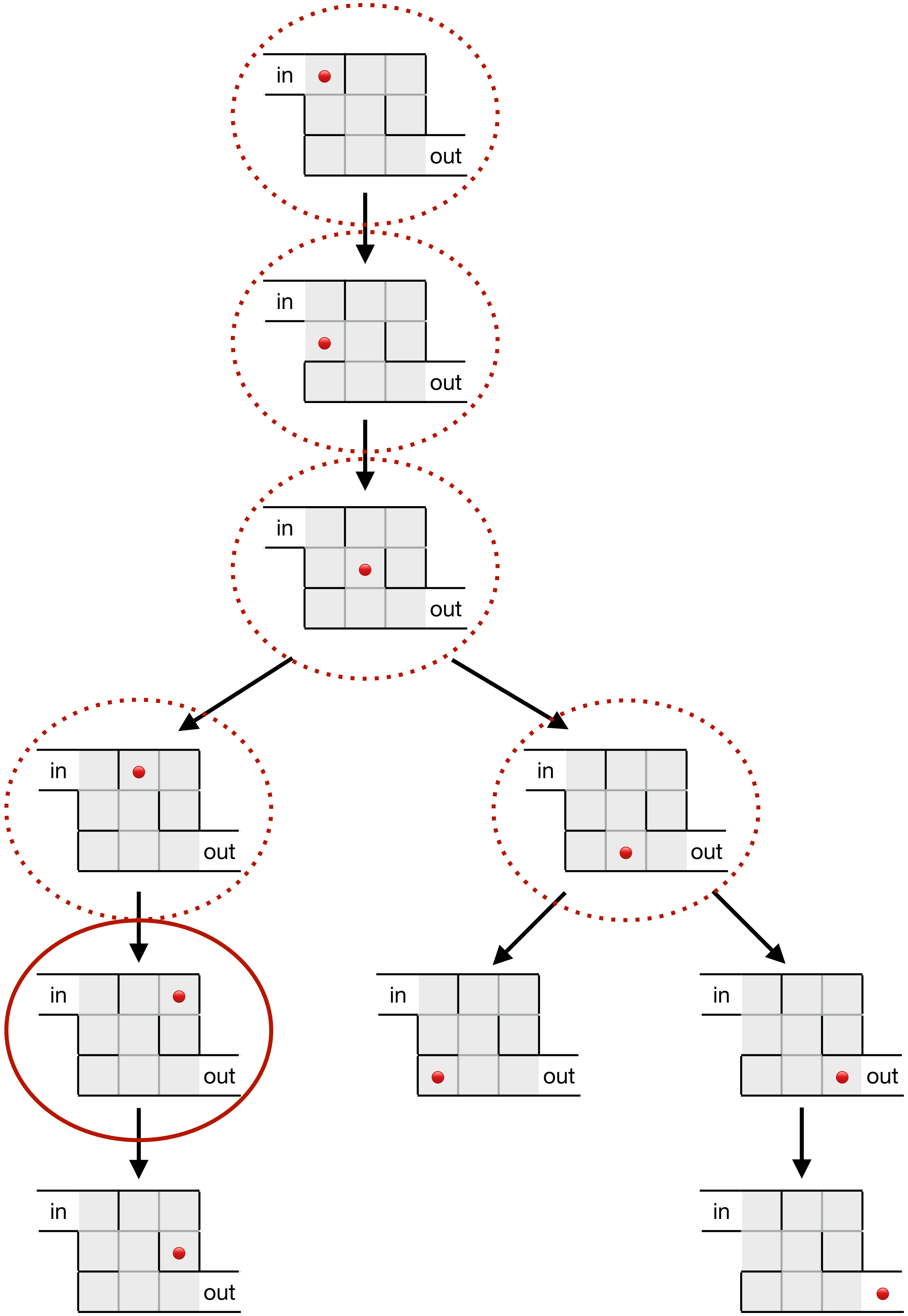
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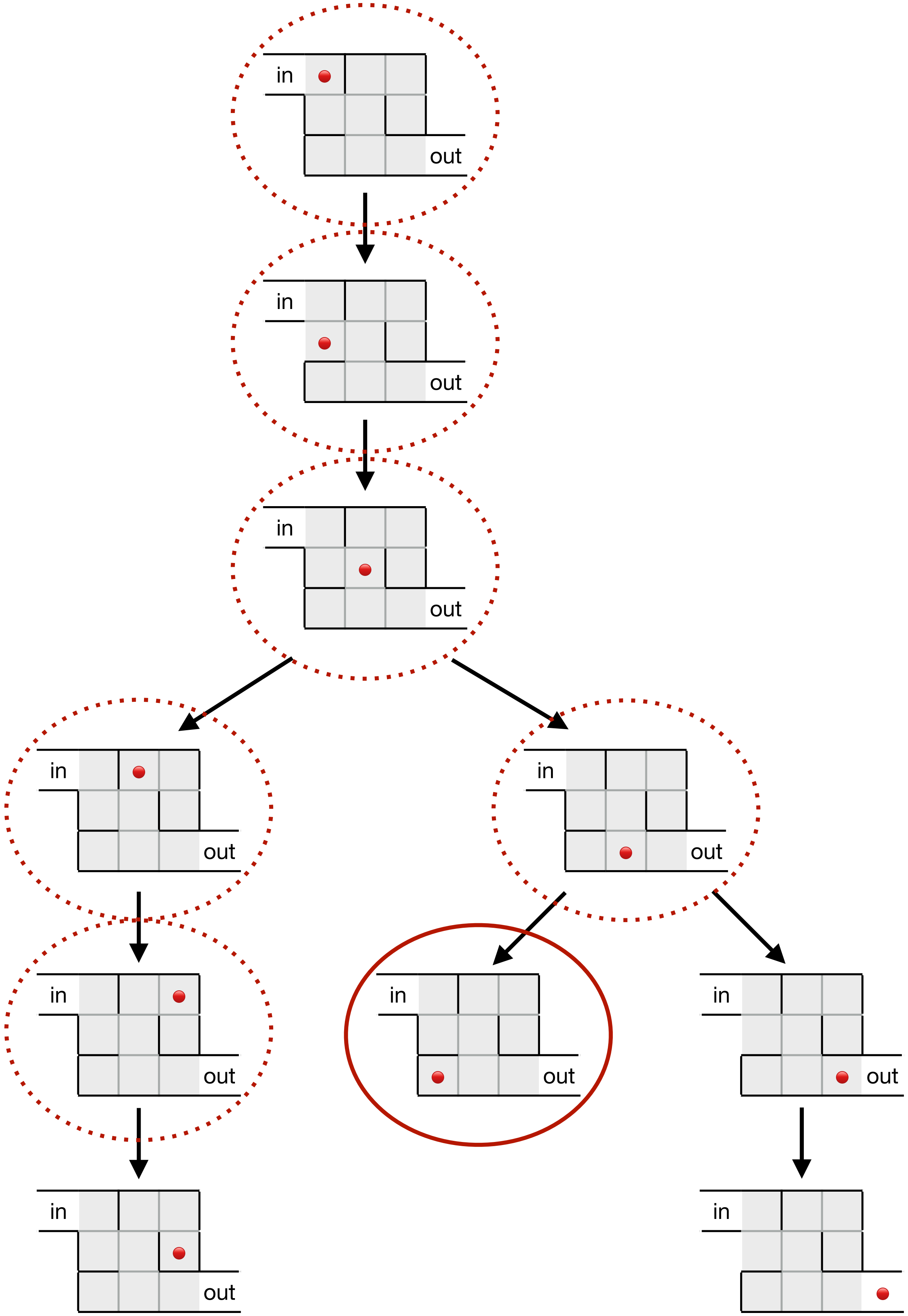
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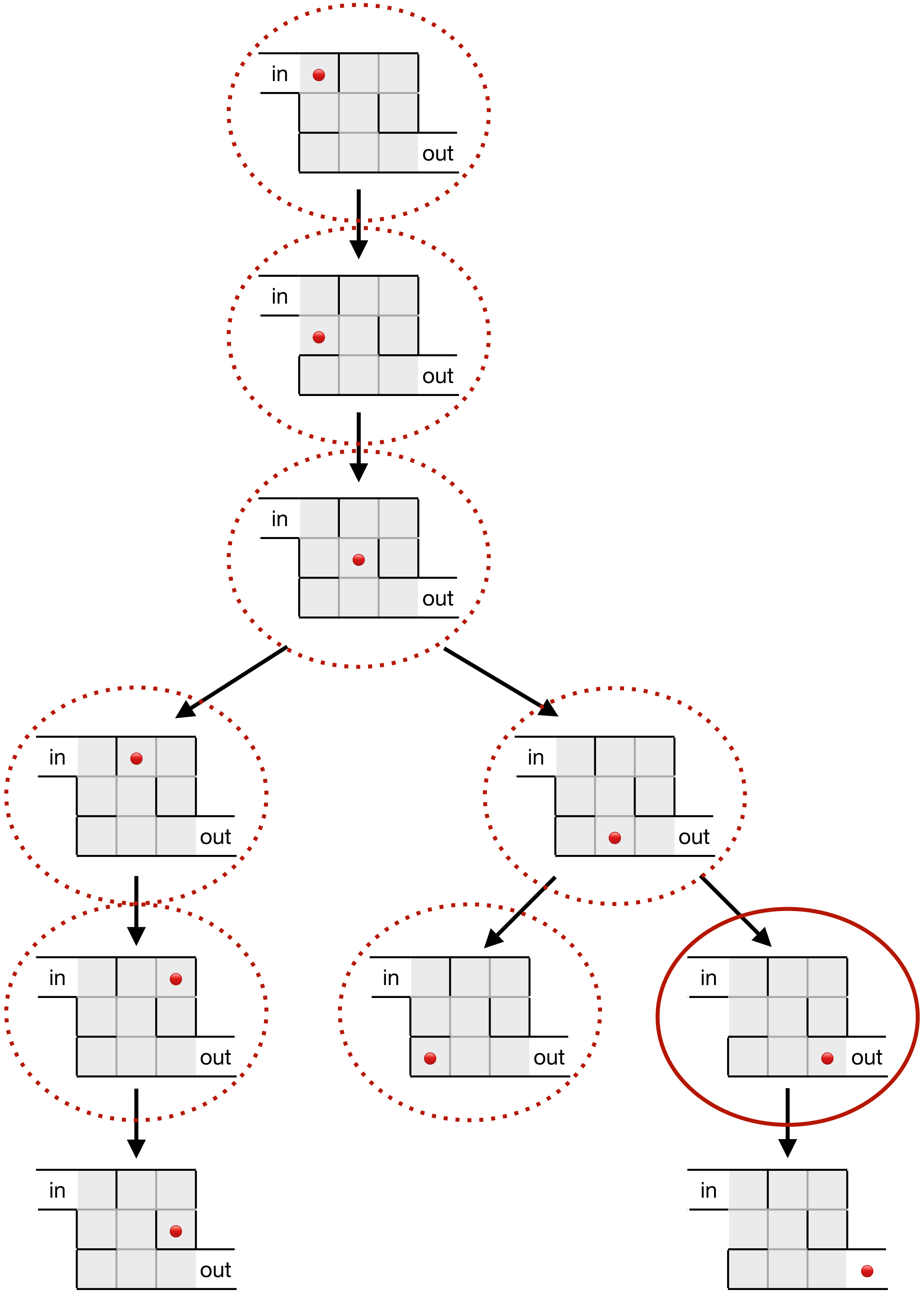
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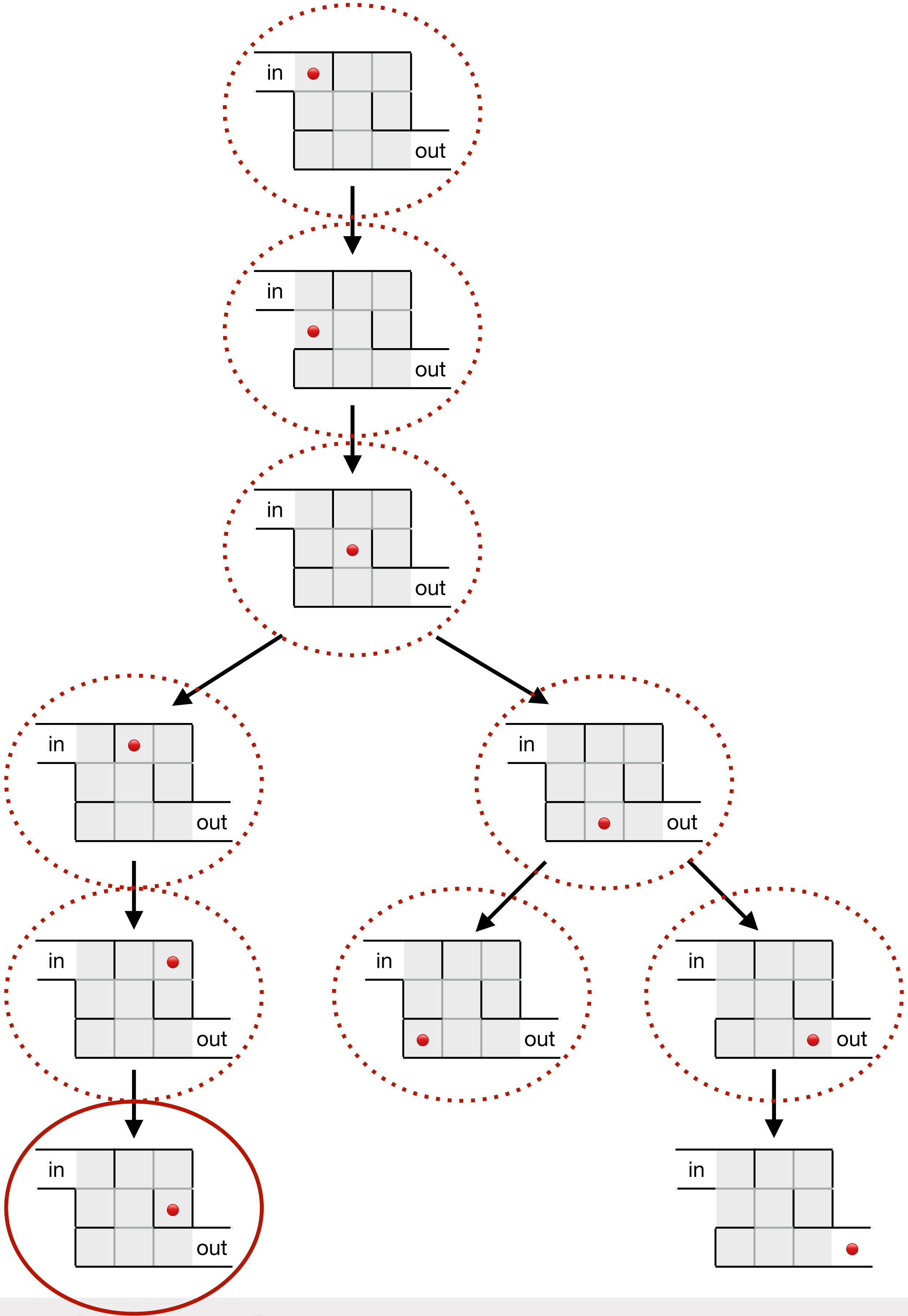
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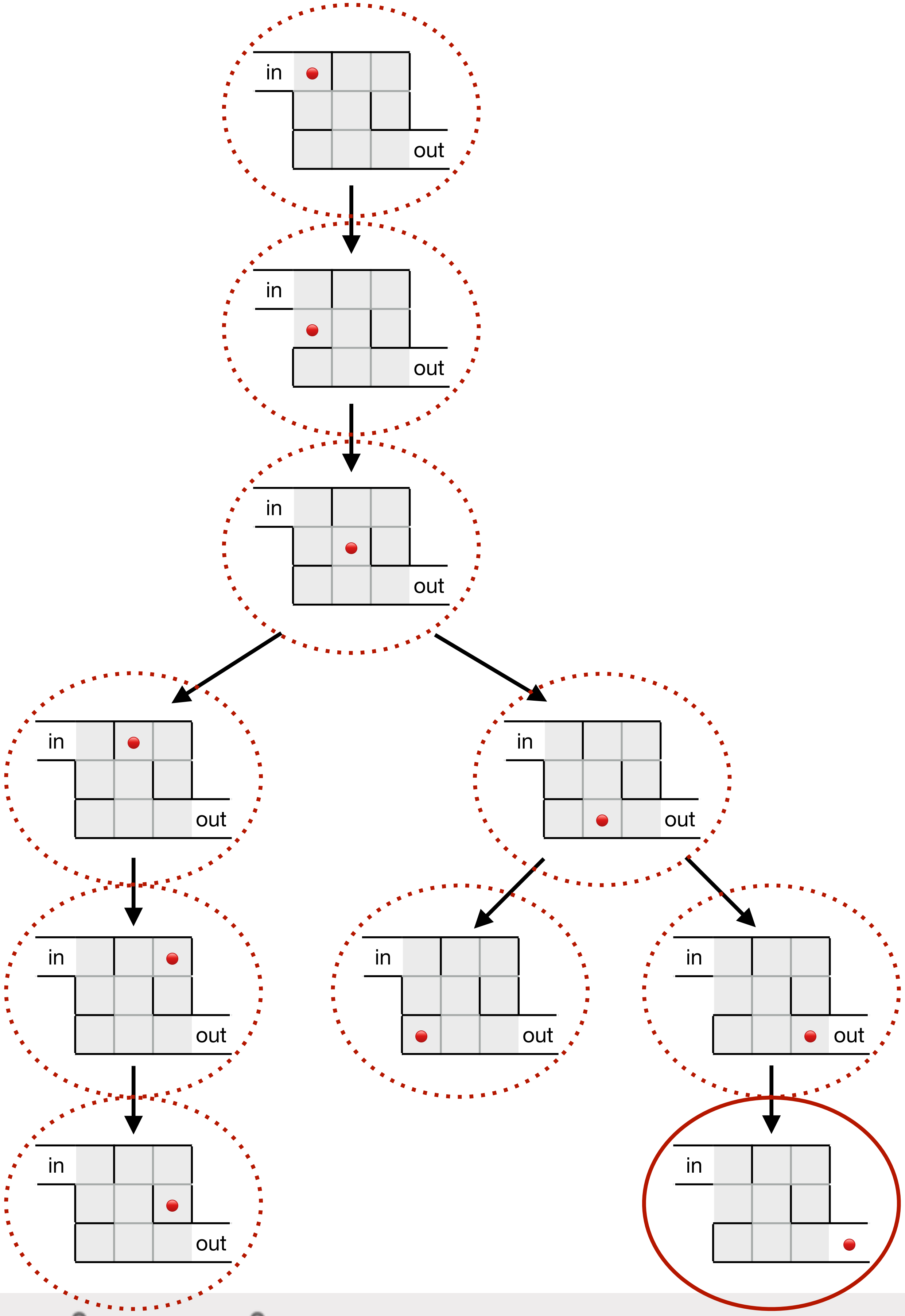
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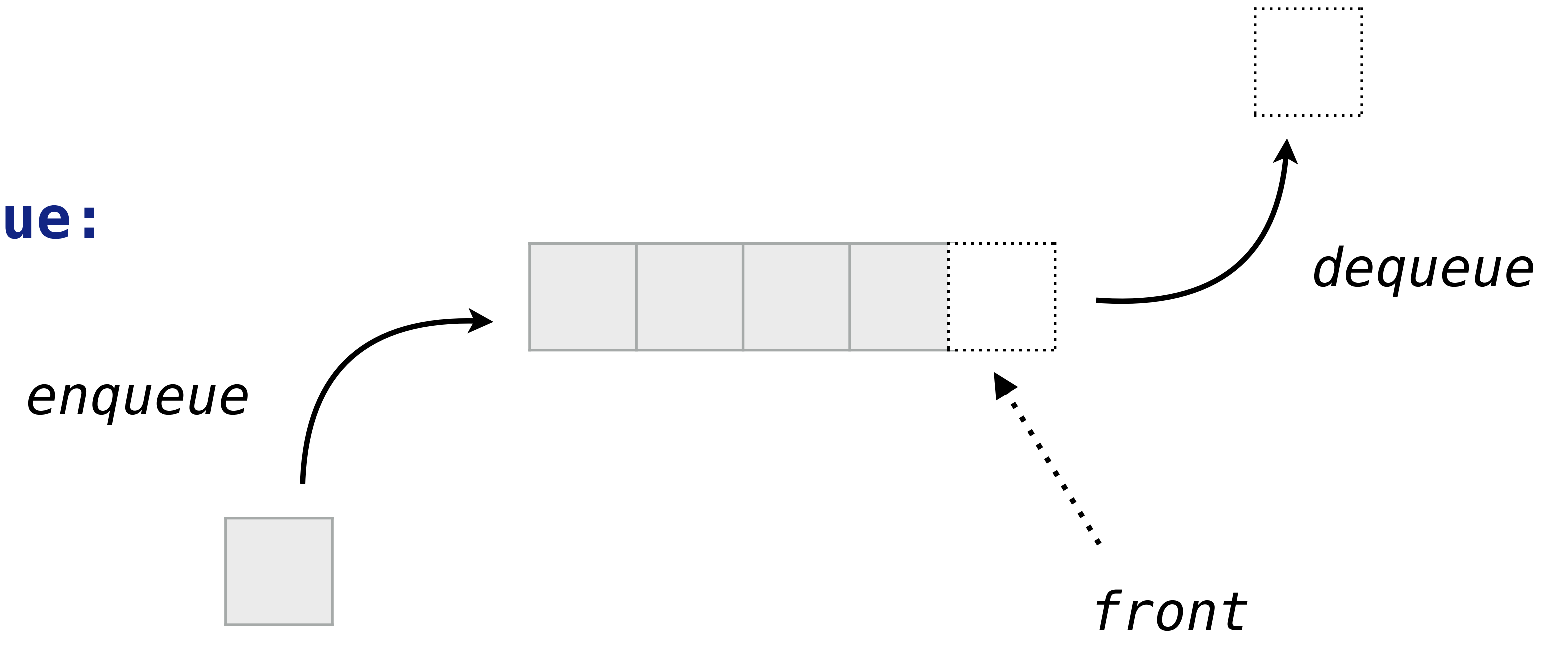
BFS algorithm

```
BFS: given a graph G and a starting node n
   0. put n into a queue
   1. dequeue first node from the queue and mark it as visited
   2. put all nodes reachable from the first node in the queue
   3. while the queue is not empty, recursively apply steps 1-3
```

BFS algorithm

```
BFS: given a graph G and a starting node n
   0. put n into a queue
   1. dequeue first node from the queue and mark it as visited
   2. put all nodes reachable from the first node in the queue
   3. while the queue is not empty, recursively apply steps 1-3
```

Queue:



FIFO:
first in,
first out

BFS algorithm

```python
def bfs(graph, start):
    visited, queue = set(), [start]
    while queue:
        vertex = queue.pop(0)
        if vertex not in visited:
            visited.add(vertex)

            print(vertex)
```

BFS algorithm

```python
def bfs(graph, start):
    visited, queue = set(), [start]
    while queue:
        vertex = queue.pop(0)
        if vertex not in visited:
            visited.add(vertex)
            queue.extend(sorted(graph[vertex] - visited))
            print(vertex)
```

Search in Battleship

Target vs Hunt mode

- in the *Hunt* mode, we randomly search for ships on the board:

  ```
  chooseRandomValidTarget(gamestate)
  ```

- in the *Target* mode, when a ship is hit, we try to sink it by searching through its neighbourhood cells!

  which type of search should we choose?

Search in Target mode

X				
		●		X
X				

X is a missed shot,

● is a hit ship.

Search in Target mode

X				
		1		
	4	●	2	X
X		3		

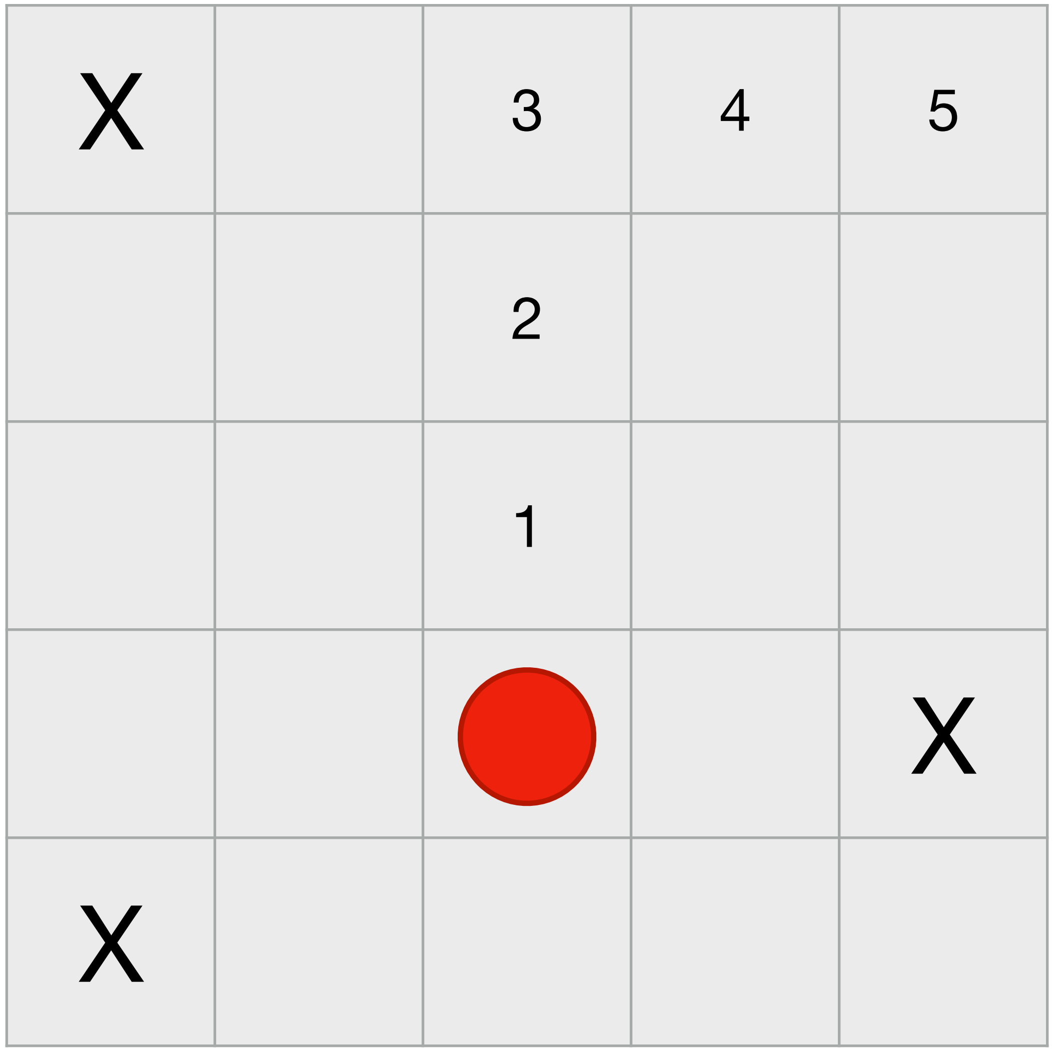
BFS will first consider all neighbours of the start node, even if the next hit is discovered.

Search in Target mode

X				
		●		
	4	●	2	X
X		3		

BFS will first consider all neighbours of the start node, even if the next hit is discovered.

Search in Target mode



X		3	4	5
		2		
		1		
		●		X
X				

DFS, on the other hand, will follow consider all neighbours of the start node, even if the next hit is discovered.

Search in Target mode

X		3	4	5
		2		
		X		
		●		X
X				

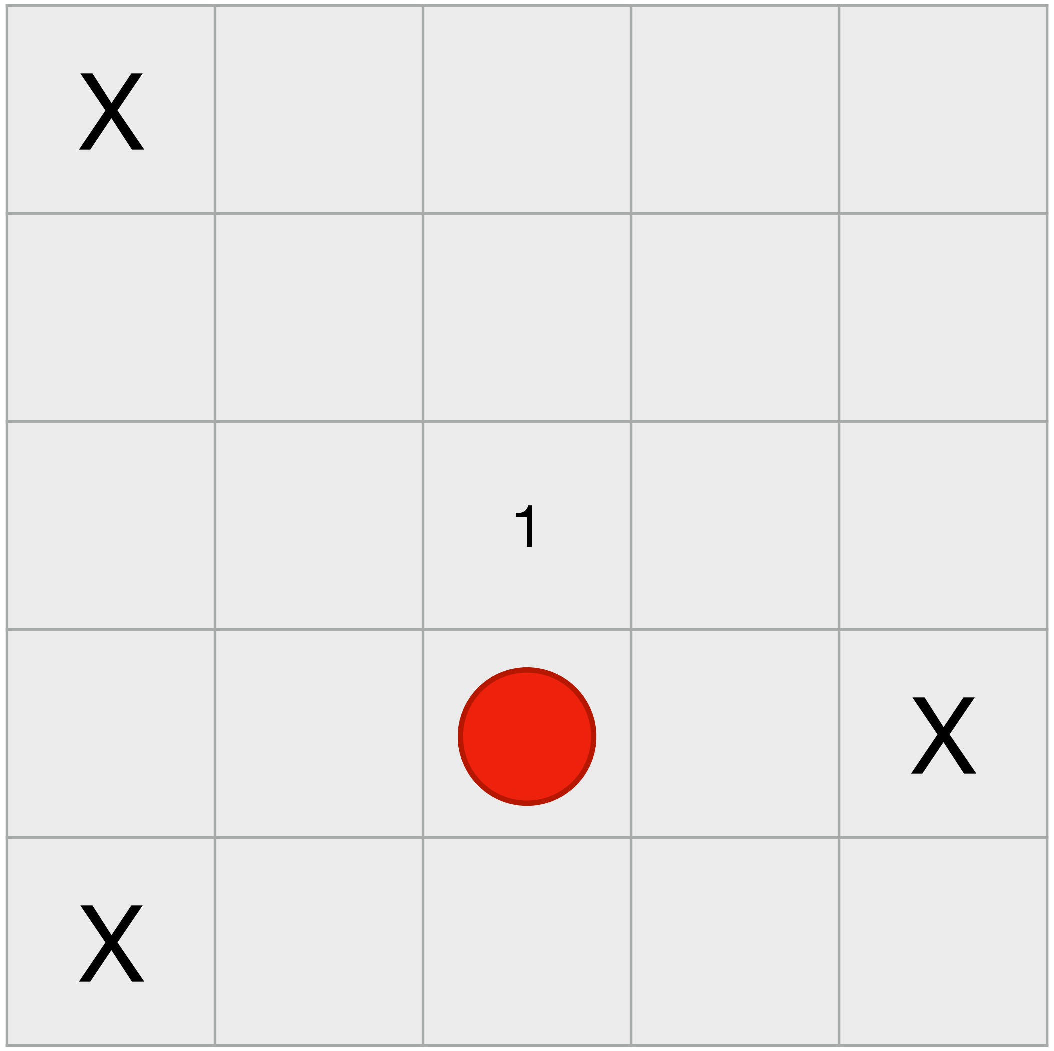
DFS, on the other hand, will follow consider all neighbours of the start node, even if the next hit is discovered.

Search in Target mode

X		3	4	5
		X		
		X		
		●		X
X				

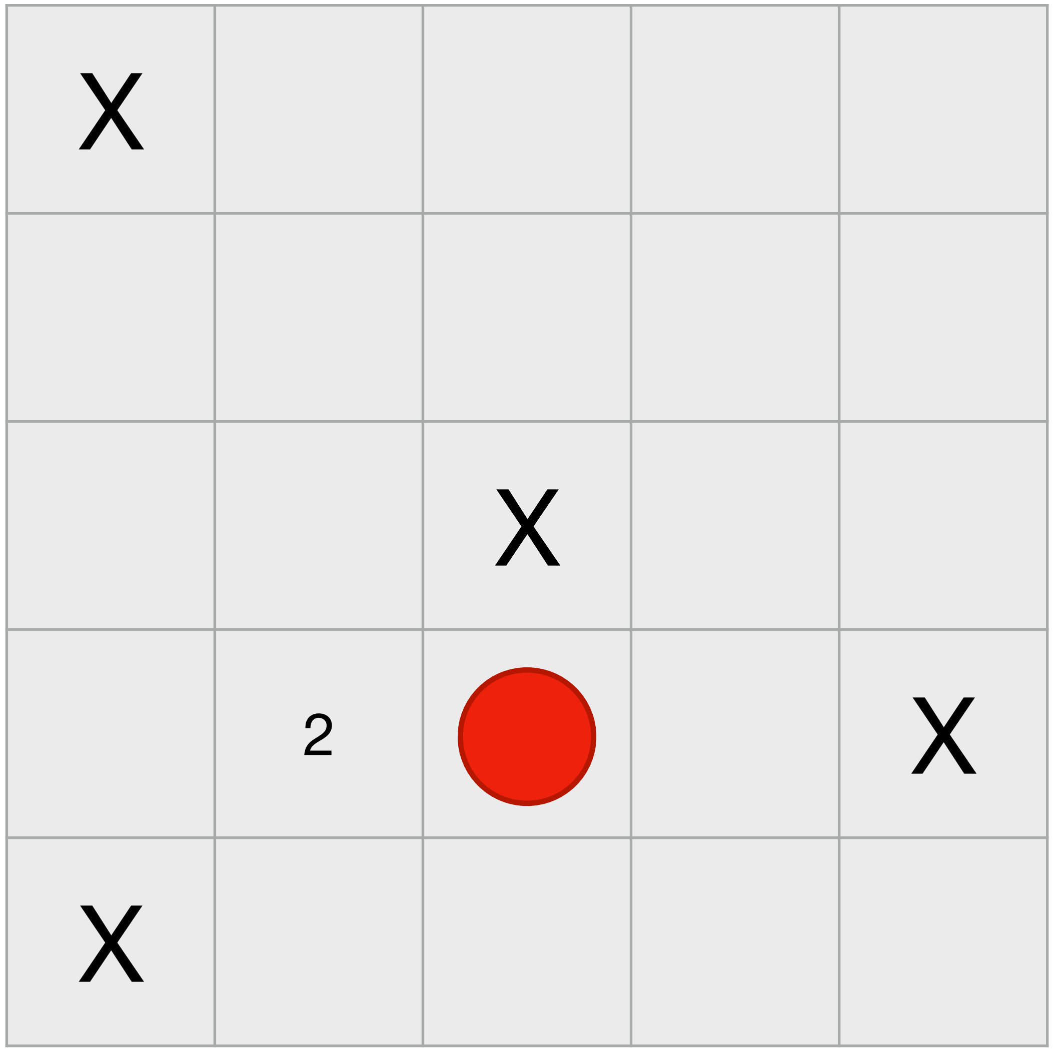
DFS, on the other hand, will follow consider all neighbours of the start node, even if the next hit is discovered.

Search in Target mode



Solution: DFS with pruning
whenever the top node returns a miss, we do not add its neighbours to the stack.

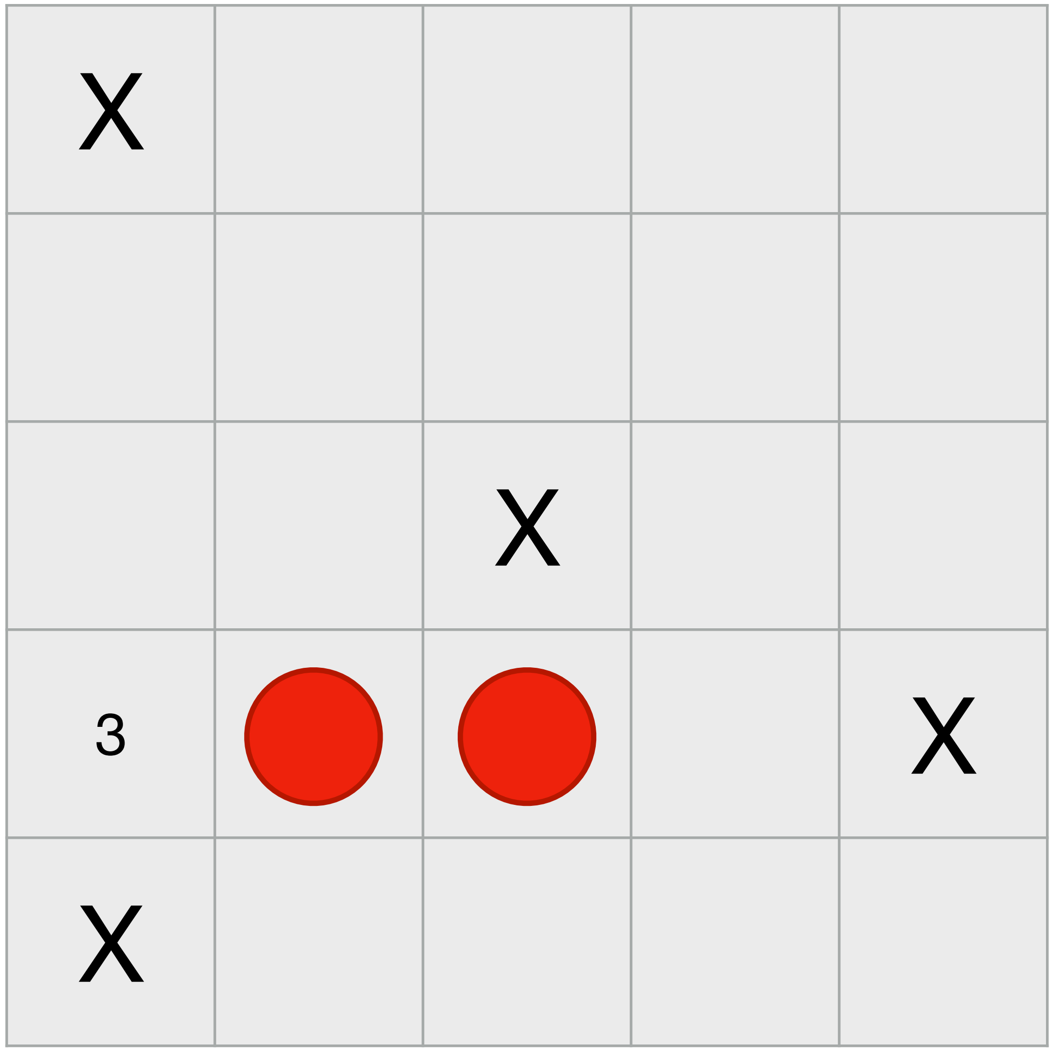
Search in Target mode



X				
		X		
	2	●		X
X				

Solution: DFS with pruning whenever the top node returns a miss, we do not add its neighbours to the stack.

Search in Target mode



X				
		X		
3	●	●		X
X				

Solution: DFS with pruning
whenever the top node returns a miss, we do not add its neighbours to the stack.

Coding search strategies

Using the online editor

- **Problem**: in the online editor you cannot *memorize* the previous search state, in particular, your previous moves.

- Hence, you do not know where to *backtrack.*

You only get the ‘GameState’:

```
{'Ships': [5, 4, 3, 3, 2], 'IsMover': True, 'Round': 5, 'GameStatus': 'RUNNING', 'GameId': 123, 'OpponentId': ‘enemy’,
'MyBoard': [['', '2', '2', '2', '', '', '', ''], ['', '', '', '', '', '', '', ''], ['0', '', '', '', '', '', '', ''],
['0', '4', '4', '', '', '', '', ''], ['0', '', '', '', '', '', '', '3'], ['0', '', '', '', '', '', '', '3'], ['0', '',
'', '', '', '', '', '3'], ['', '1', '1', '1', '1', '', '', '']],
'OppBoard': [['', '', '', '', '', '', '', ''], ['', '', '', '', '', '', '', ''], ['', '', '', '', '', '', '', ''], ['',
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```
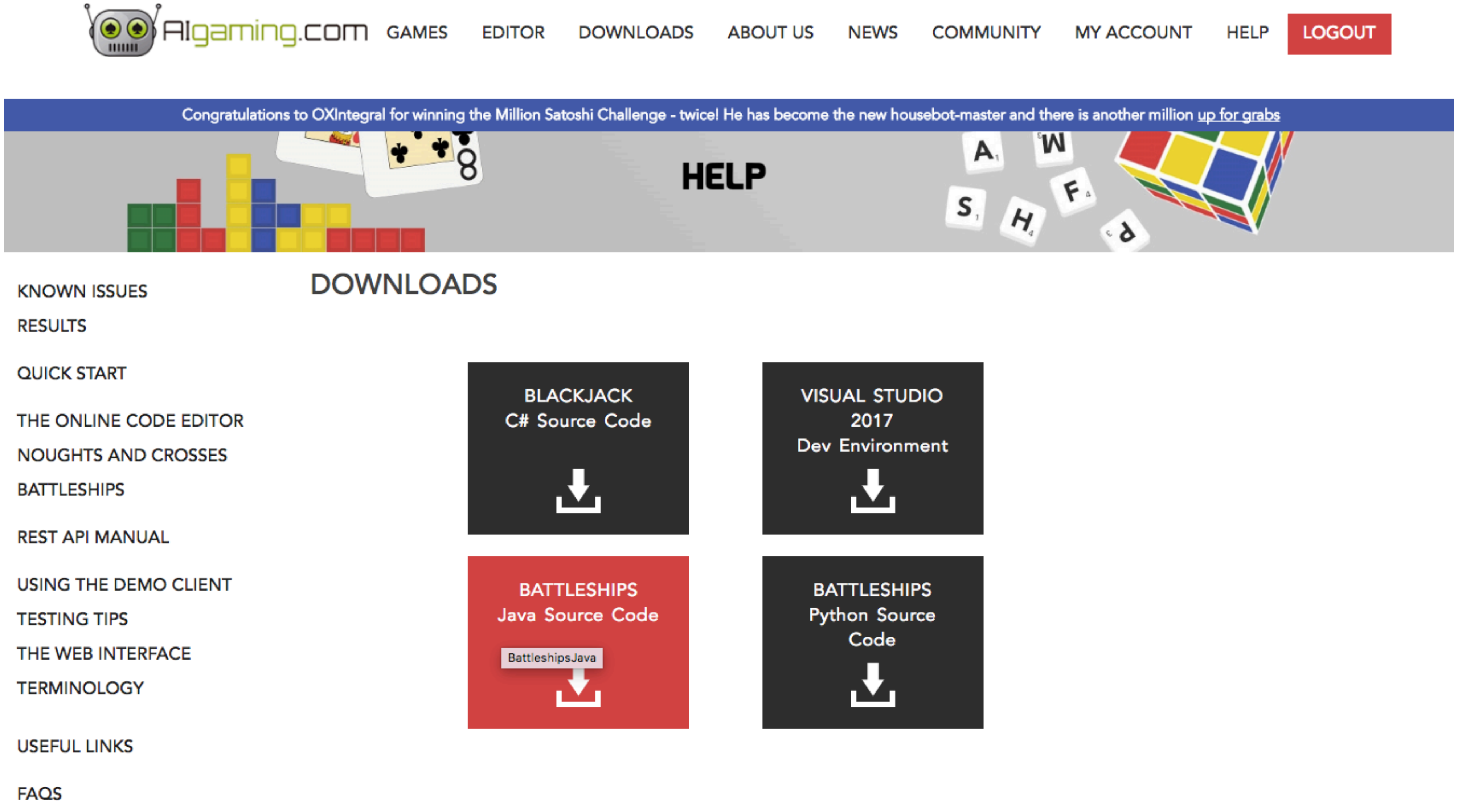

Using the online editor

- **Problem**: in the online editor you cannot *memorize* the previous search state, in particular, your previous moves.
- Hence, you do not know where to *backtrack.*
- **Solution**: go to the source code!

Using the demo client

https://www.aigaming.com/Help?url=downloads



Congratulations to OXIntegral for winning the Million Satoshi Challenge - twice! He has become the new housebot-master and there is another million up for grabs

HELP

DOWNLOADS

BLACKJACK
C# Source Code

VISUAL STUDIO
2017
Dev Environment

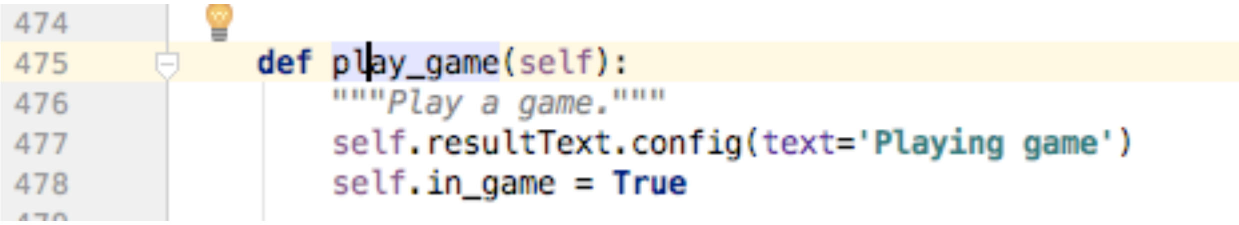
BATTLESHIPS
Java Source Code

BattleshipsJava

BATTLESHIPS
Python Source
Code

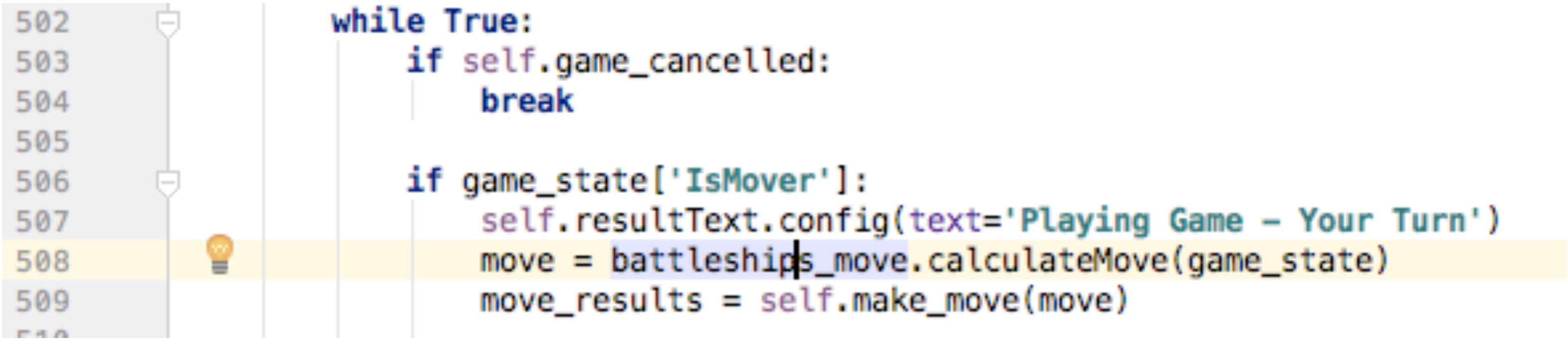
The important parts

- **battleships_layout.py:**
  - function *play_game*



```
    def play_game(self):
        """Play a game."""
        self.resultText.config(text='Playing game')
        self.in_game = True
```

    - the *while* loop

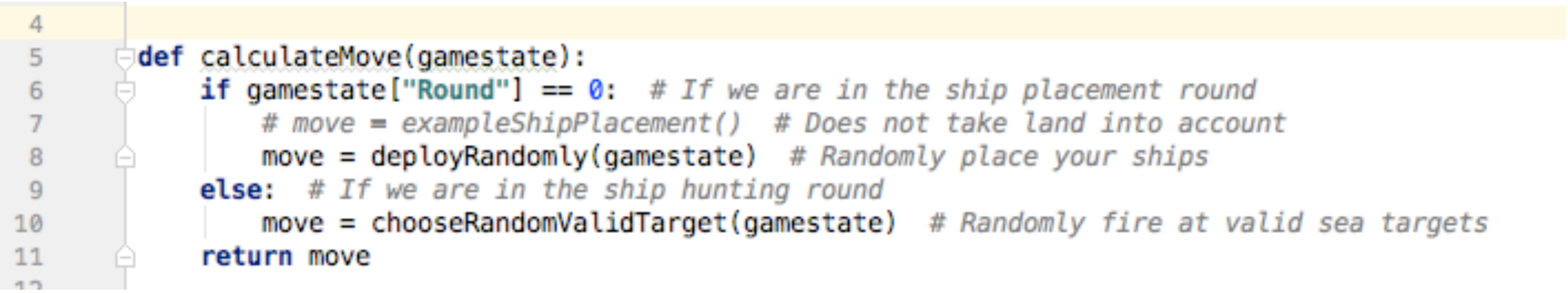


```
        while True:
            if self.game_cancelled:
                break

            if game_state['IsMover']:
                self.resultText.config(text='Playing Game - Your Turn')
                move = battleships_move.calculateMove(game_state)
                move_results = self.make_move(move)
```

Here you can store your moves!

The important parts

- **battleships_move.py:**
    - function *calculateMove*



```
def calculateMove(gamestate):
    if gamestate["Round"] == 0:  # If we are in the ship placement round
        # move = exampleShipPlacement()  # Does not take land into account
        move = deployRandomly(gamestate)  # Randomly place your ships
    else:  # If we are in the ship hunting round
        move = chooseRandomValidTarget(gamestate)  # Randomly fire at valid sea targets
    return move
```

Here you can modify your moves strategy and *search*!

Homework: integrate DFS with pruning strategy into the battleships code