Surrounded Regions

Got it! Let's go step by step but also write coordinates (row,col) so you can clearly see which cells we are talking about.

We are solving the Surrounded Regions problem.

✅ Input Grid with Coordinates

Let's label the grid with indices:

```scss
(0,0) X  (0,1) X  (0,2) X  (0,3) X
(1,0) X  (1,1) O  (1,2) O  (1,3) X
(2,0) X  (2,1) X  (2,2) O  (2,3) X
(3,0) X  (3,1) O  (3,2) X  (3,3) X
```

So the grid is:

```arduino
[
  ['X','X','X','X'],
  ['X','O','O','X'],
  ['X','X','O','X'],
  ['X','O','X','X']
]
```

✅ Step 1: Find Border 'O's

We scan border cells:

- Top row → (0,0),(0,1),(0,2),(0,3) → all are `X` → nothing
- Bottom row → (3,0),(3,1),(3,2),(3,3) → we find (3,1) = O → SAFE
- Left column → (0,0),(1,0),(2,0),(3,0) → all `X` → nothing
- Right column → (0,3),(1,3),(2,3),(3,3) → all `X` → nothing

✅ So only (3,1) is a border-connected O

We mark it as 'S' (SAFE)

Now the board looks like:

```scss
```

```
(0,0) X  (0,1) X  (0,2) X  (0,3) X
(1,0) X  (1,1) O  (1,2) O  (1,3) X
(2,0) X  (2,1) X  (2,2) O  (2,3) X
(3,0) X  (3,1) S  (3,2) X  (3,3) X
```

✅ Step 2: DFS/BFS from Border 'O's

Now we run DFS from (3,1):

- DFS(3,1) → mark as `S` (already marked)
- Check neighbors:
  - (2,1) → `X` → stop
  - (4,1) → out of bounds → stop
  - (3,0) → `X` → stop
  - (3,2) → `X` → stop

So no more cells connected to border.

✅ Only (3,1) remains SAFE.

✅ Step 3: Flip Surrounded Regions

Now scan the whole grid again:

- If you see 'O' → it is surrounded → change to 'X'
- If you see 'S' → it is safe → change back to 'O'

So:

- (1,1) = O → change to X
- (1,2) = O → change to X
- (2,2) = O → change to X
- (3,1) = S → change back to O

✅ Final Board

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```
(0,0) X  (0,1) X  (0,2) X  (0,3) X
(1,0) X  (1,1) X  (1,2) X  (1,3) X
```

(2,0) X (2,1) X (2,2) X (2,3) X
(3,0) X (3,1) O (3,2) X (3,3) X

Which looks like:

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```
[
  ['X','X','X','X'],
  ['X','X','X','X'],
  ['X','X','X','X'],
  ['X','O','X','X']
]
```

✅ Why does this work?

- Any 'O' touching the border is SAFE → we mark it as `S`.
- Any 'O' NOT connected to border is surrounded → change to `X`.

✅ Quick Visualization

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```
Before:
X X X X
X O O X
X X O X
X O X X

After marking border-safe:
X X X X
X O O X
X X O X
X S X X

After flipping:
X X X X
X X X X
X X X X
X O X X
```

Would you like me to also show a DFS path step-by-step like (3,1) → (2,1) → ... with arrows? Or should I make a smaller 3×3 example for even easier understanding?