SEARCH

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CS51A – Spring 2019

Admin

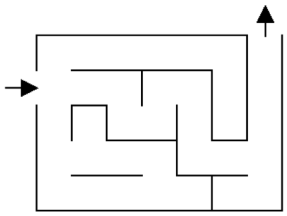
Assignment 8

What is AI?

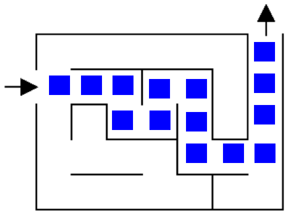
Think like a human Cognitive Modeling	Think rationally Logic-based Systems
Act like a human Turing Test	Act rationally Rational Agents

Next couple of weeks

Solve the maze!



Solve the maze!



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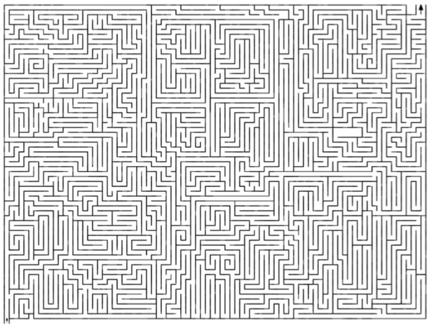
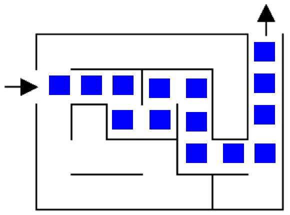
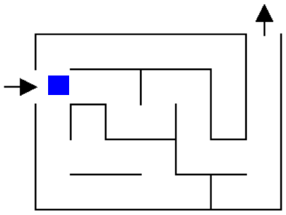


Solve the maze!



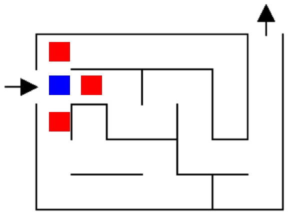
How did you figure it out?

One approach



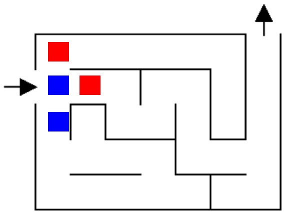
What now?

One approach



Three choices

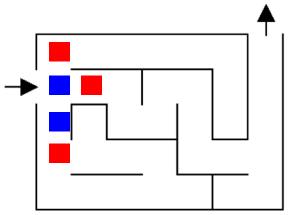
One approach



Pick one!

What now?

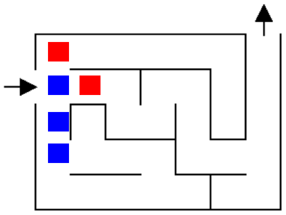
One approach



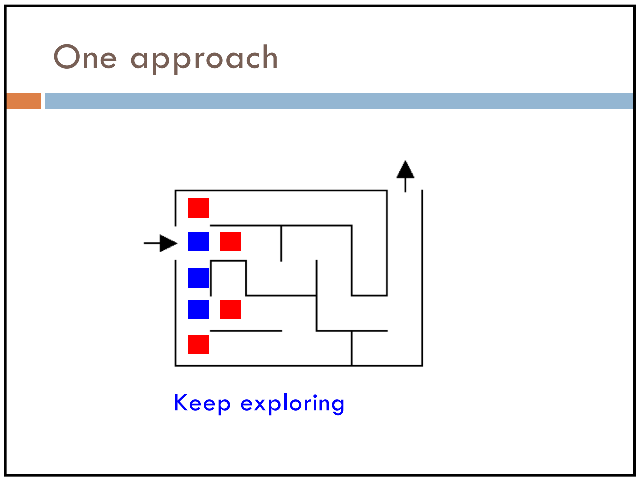
Still three options!

Which would you explore/pick?

One approach

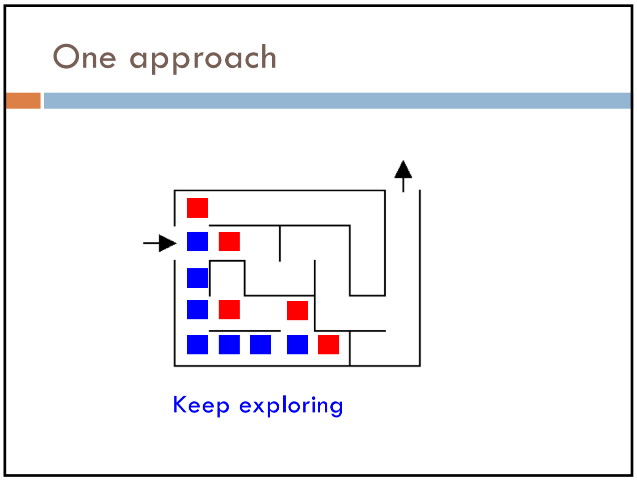


Most people go down a single path until they realize that it's wrong



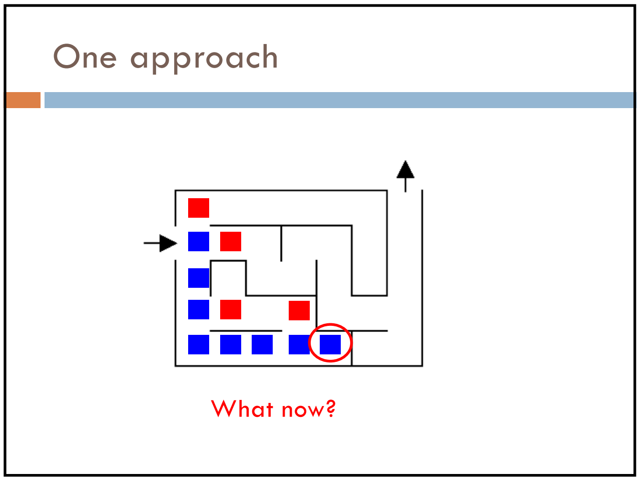
One approach

Keep exploring



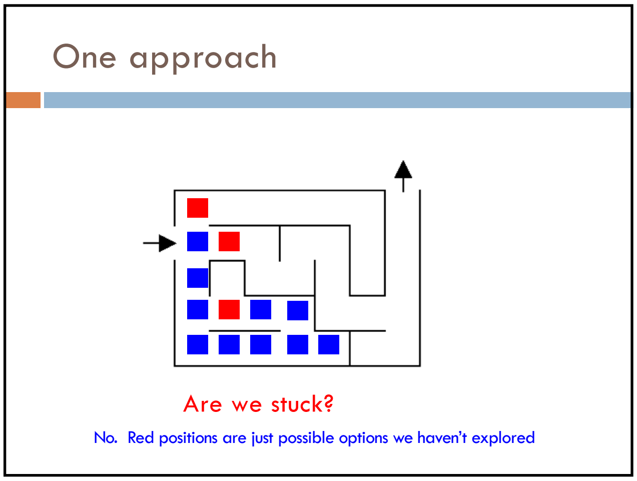
One approach

Keep exploring



One approach

What now?

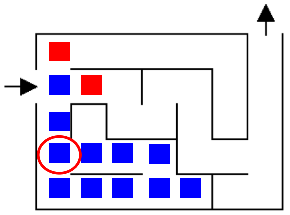


One approach

Are we stuck?

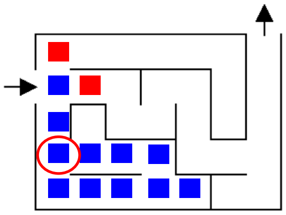
No. Red positions are just possible options we haven't explored

One approach



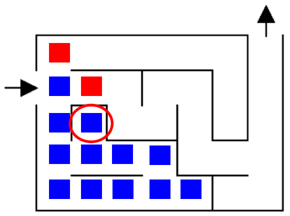
How do we know
not to go left?

One approach



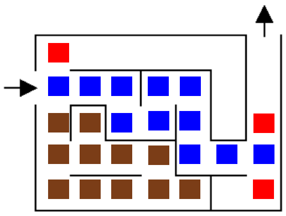
Have to be careful and keep track of
where we've been if we can loop

One approach



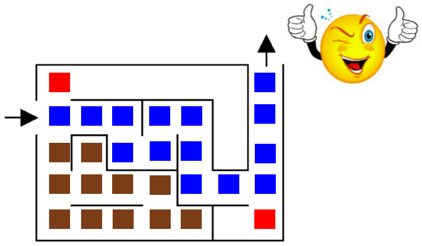
Now what?

One approach

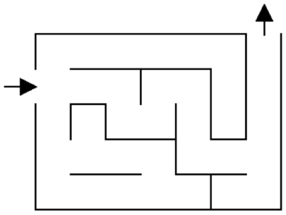


Now what?

One approach



Search problems



What information do we need to figure out a solution?

Search problems

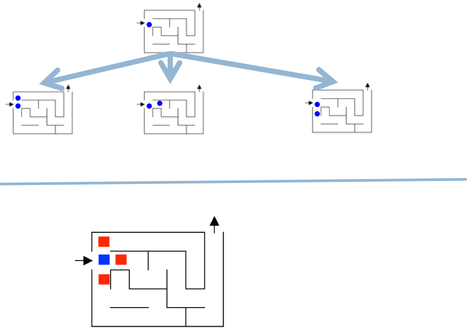
Where to start

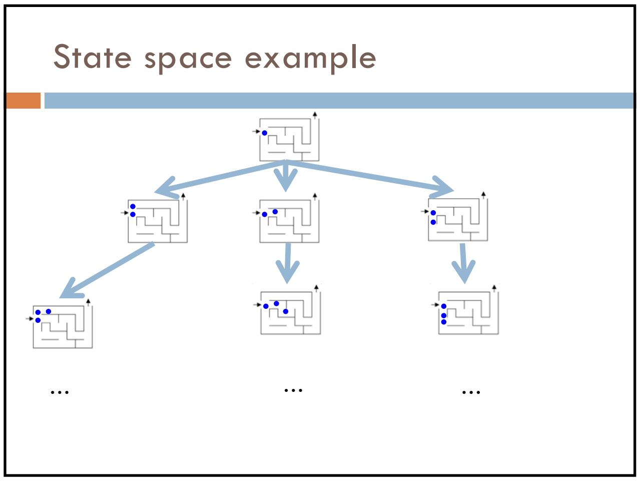
Where to finish (goal)

What the “world” (in this case a maze) looks like

- We’ll define the world as a collection of discrete states
- States are connected if we can get from one state to another by taking a particular action
- This is called the “state space”

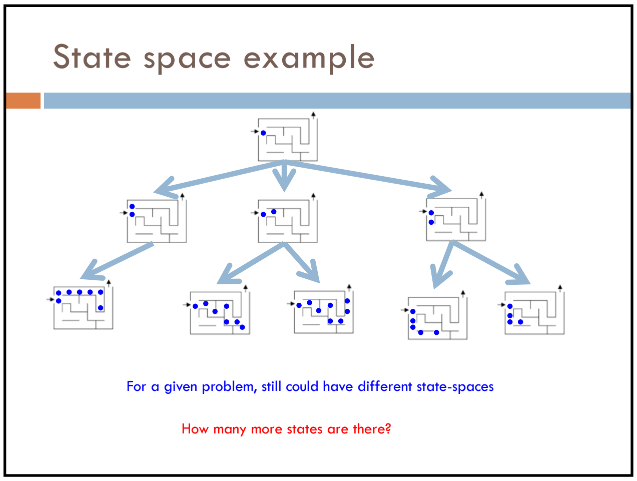
State space example





State space example

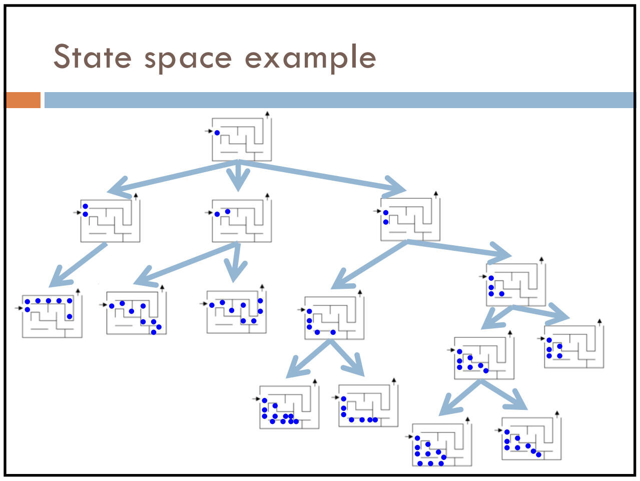
… … …



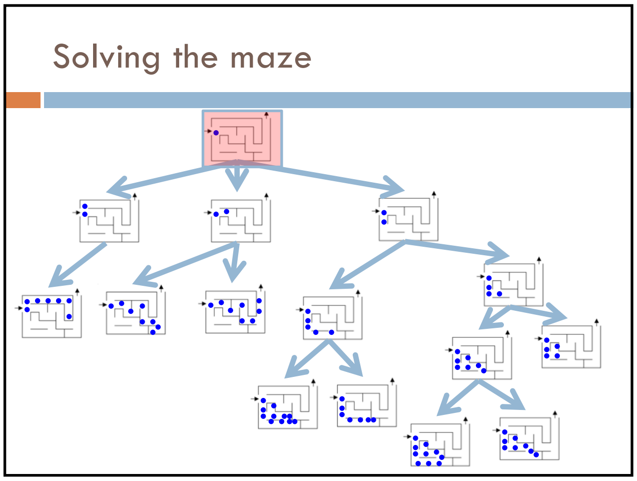
State space example

For a given problem, still could have different state-spaces

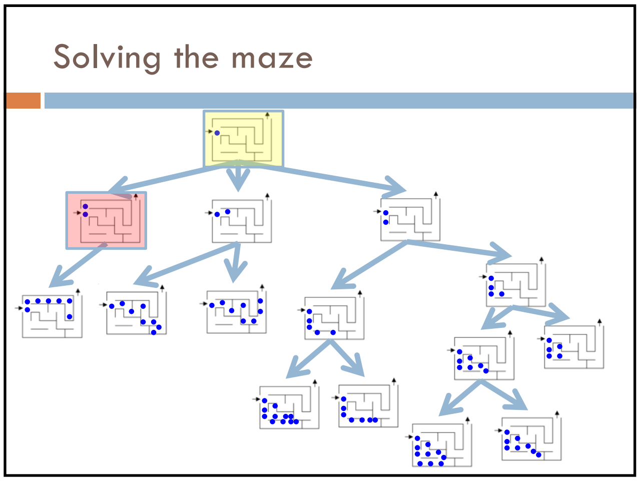
How many more states are there?



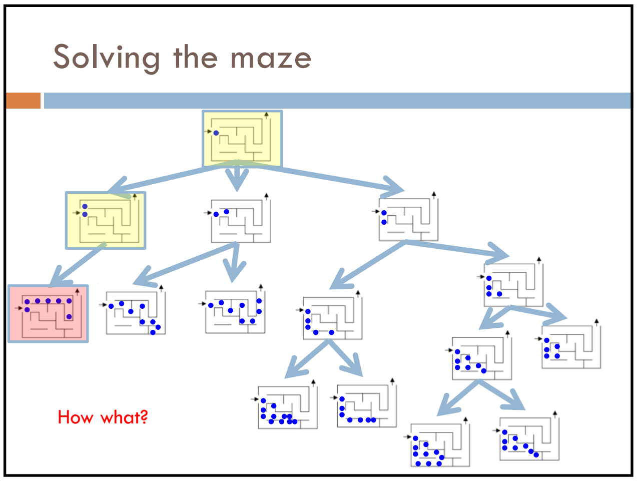
State space example



Solving the maze

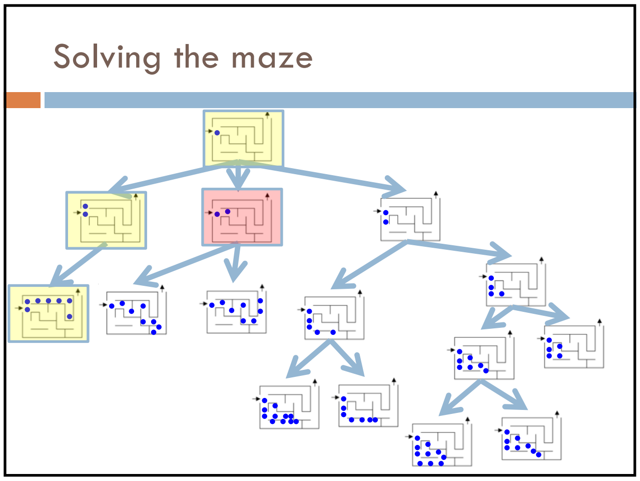


Solving the maze

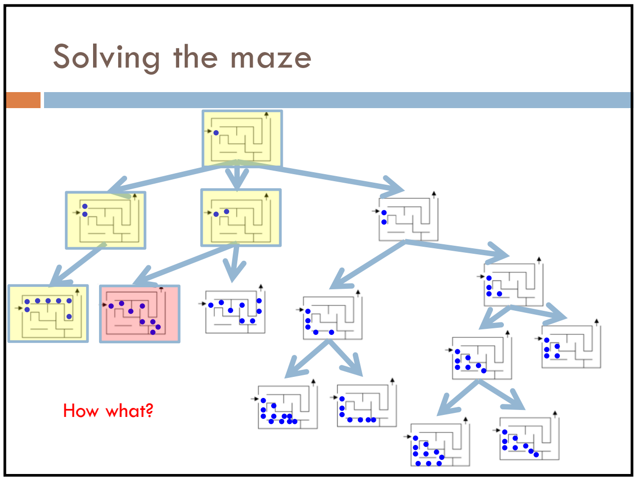


Solving the maze

How what?



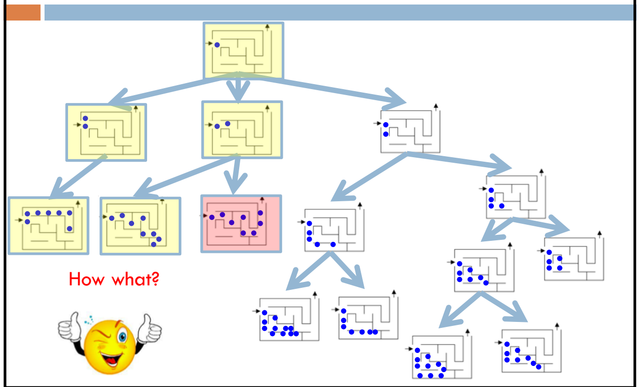
Solving the maze



Solving the maze

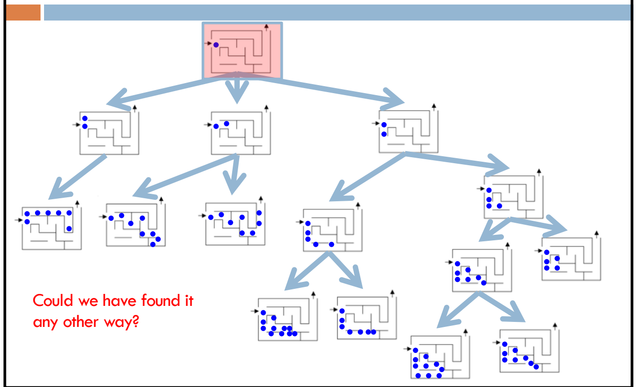
How what?

Solving the maze



How what?

Solving the maze



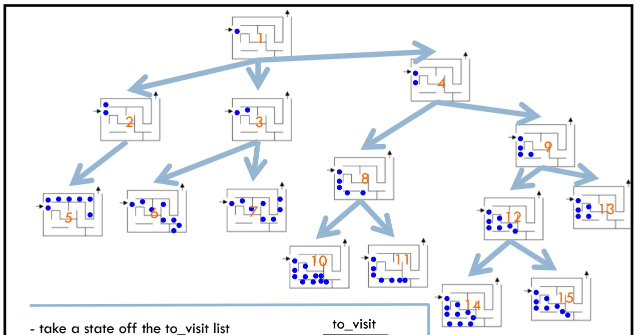
Could we have found it any other way?

Search algorithm

Keep track of a list of states that we *could* visit, we'll call it "to_visit"

General idea:

- take a state off the to_visit list
- if it's the goal state
  - we're done!
- if it's not the goal state
  - Add all of the successive states to the to_visit list
  - repeat



- take a state off the to_visit list
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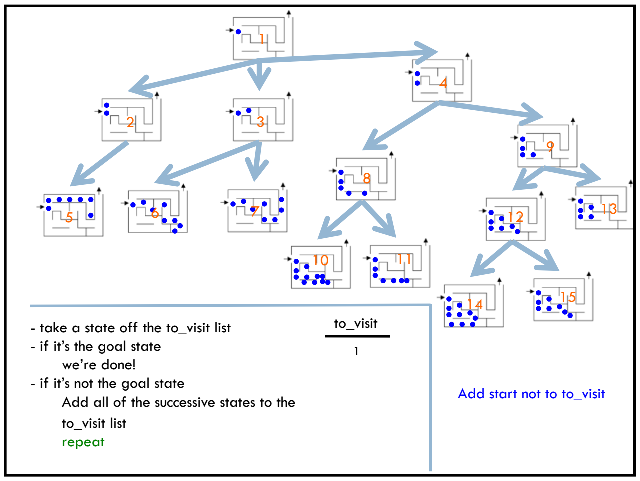
to_visit

How do we start?



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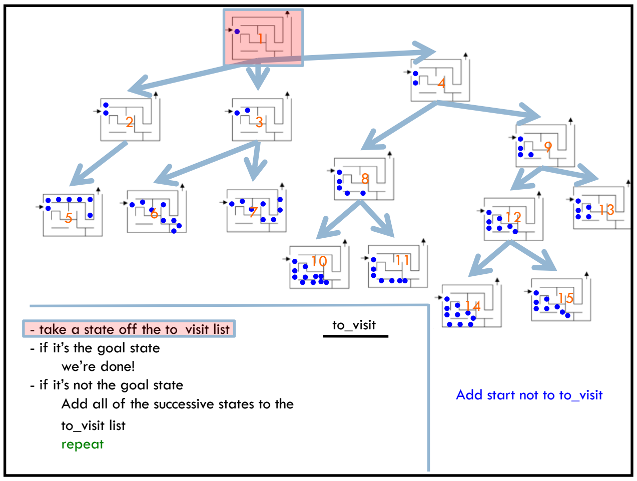
      repeat
```

to_visit

1

Add start not to to_visit



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to_visit

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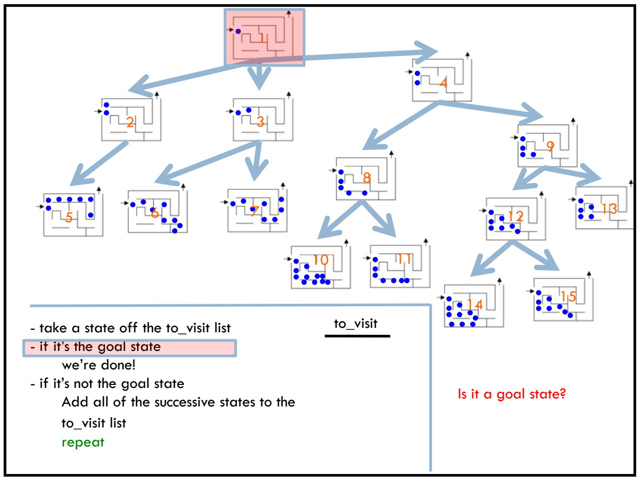

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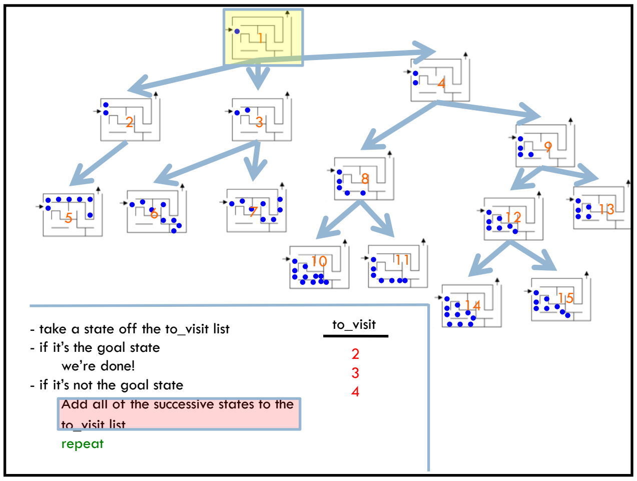
```

to_visit

Is it a goal state?



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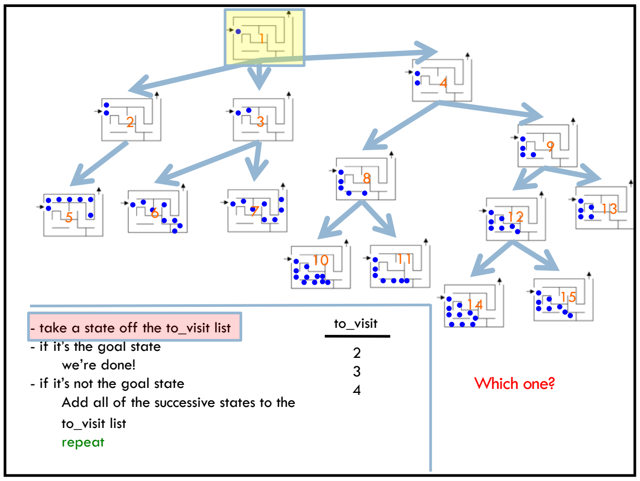
      repeat
```

to_visit

2
3
4



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- if it's the goal state
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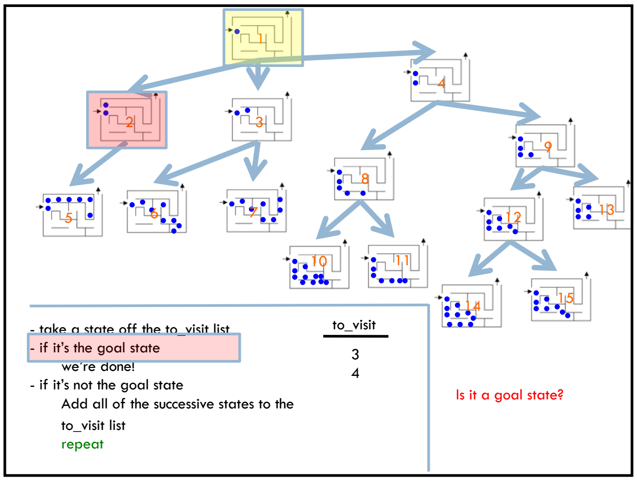
  repeat

to_visit
2
3
4

Which one?



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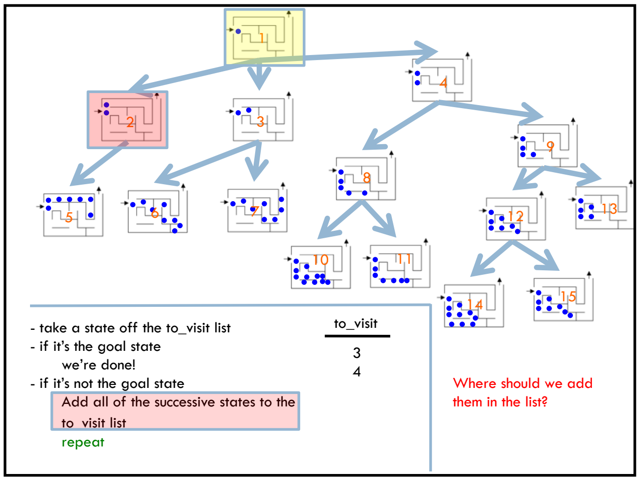
to_visit
3
4

Is it a goal state?



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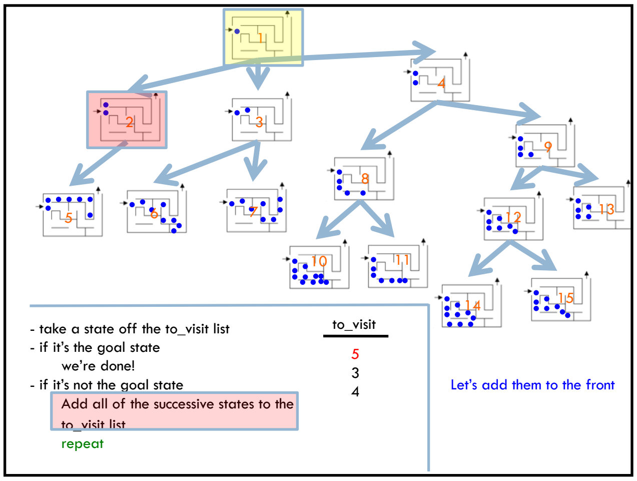
  repeat

to_visit
3
4

Where should we add them in the list?



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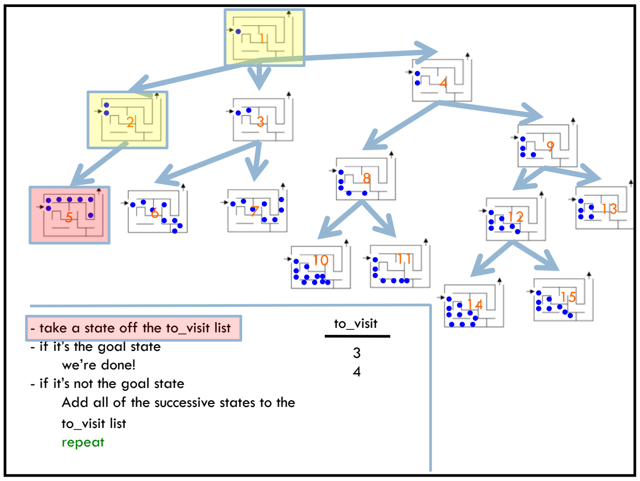
  repeat

to_visit
5
3
4

Let's add them to the front



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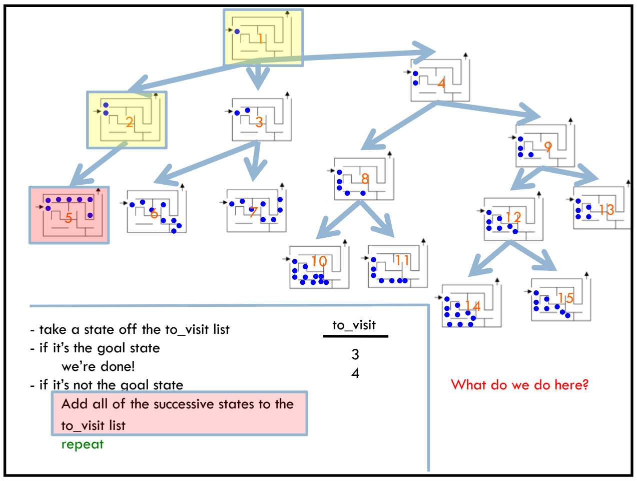
to_visit

3
4



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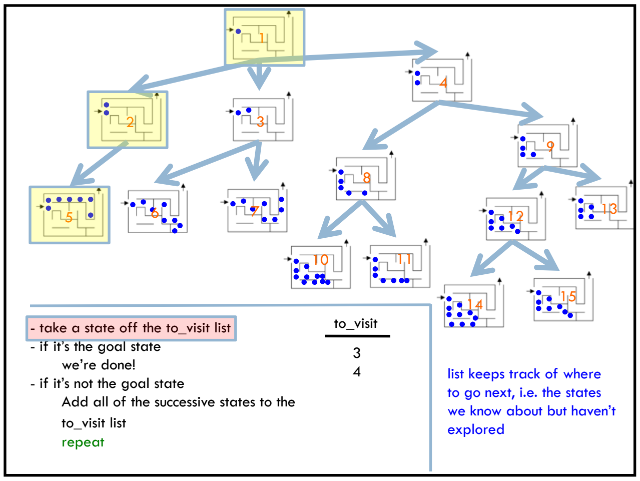
  repeat

to_visit

3
4

What do we do here?



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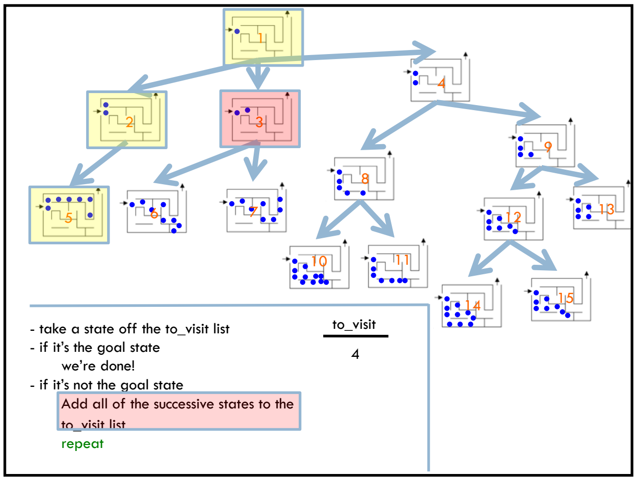
  repeat

to_visit

3
4

list keeps track of where to go next, i.e. the states we know about but haven't explored



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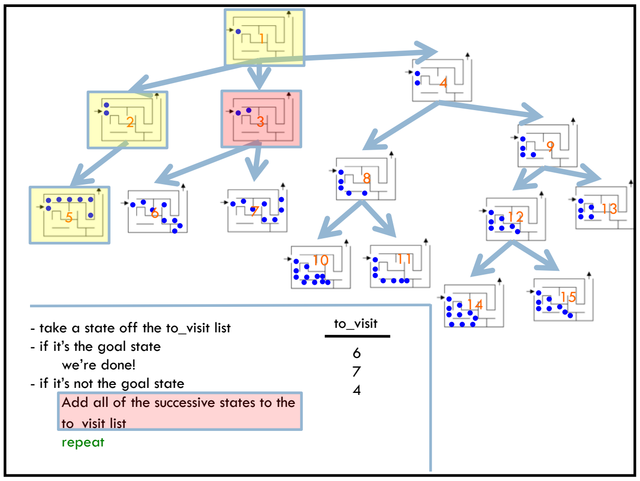
to_visit

4



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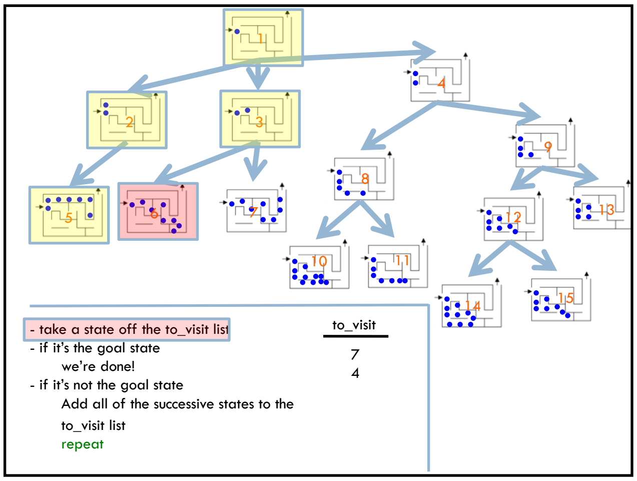
  repeat

to_visit

6
7
4



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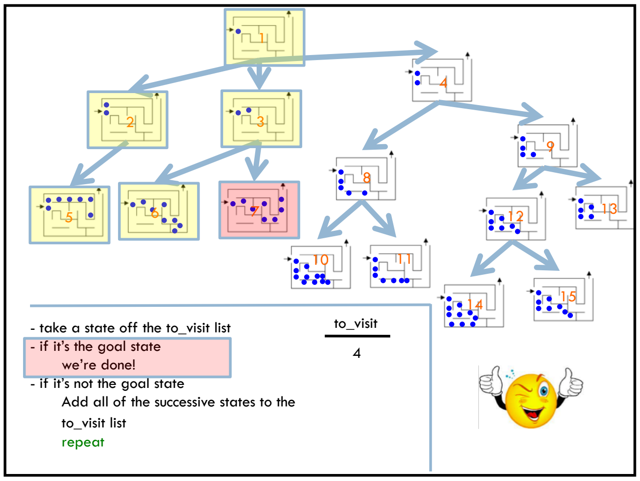
to_visit

7
4



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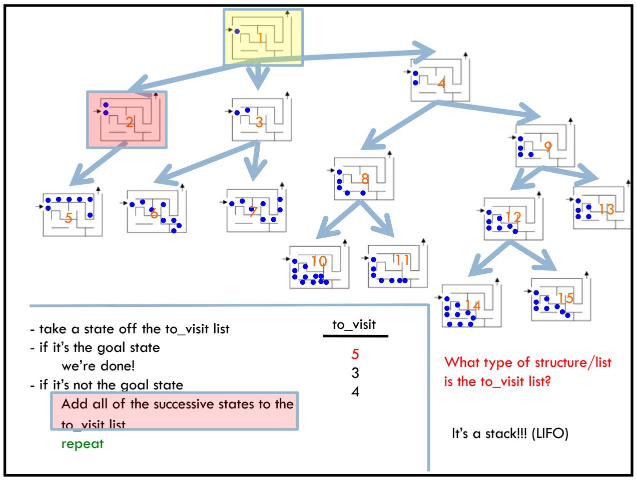
to_visit

4



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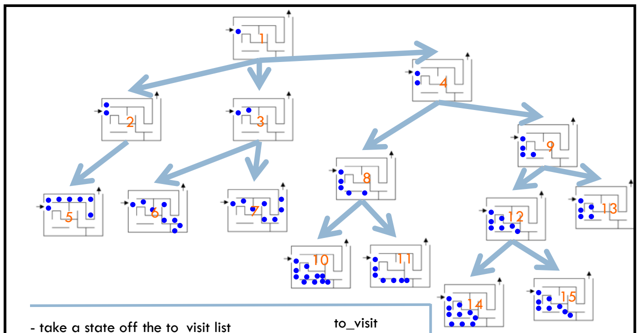
to_visit

5
3
4

What type of structure/list is the to_visit list?

It's a stack!!! (LIFO)



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  repeat

to_visit

1

What would happen if it was a queue?

Search algorithms

add the start state to to_visit

Repeat
- take a state off the to_visit list
- if it's the goal state
  - we're done!
- if it's not the goal state
  - Add all of the successive states to the to_visit list

Search algorithms

add the start state to to_visit

Repeat
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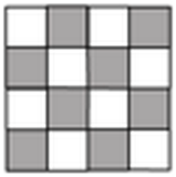
Depth first search (DFS): to_visit is a stack
Breadth first search (BFS): to_visit is a queue

N-queens problem

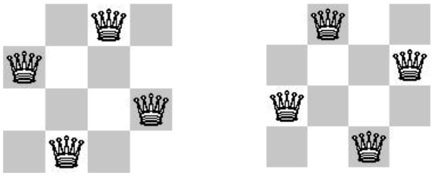
Place N queens on an N by N chess board such that none of the N queens are attacking any other queen.



Solution(s)?

N-queens problem

Place N queens on an N by N chess board such that none of the N queens are attacking any other queen.



N-queens problem

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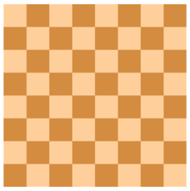


Solution(s)?

N-queens problem

Place N queens on an N by N chess board such that none of the N queens are attacking any other queen.

How do we solve this with search:

What is a state?

What is the start state?

What is the goal?

How do we transition from one state to the next?

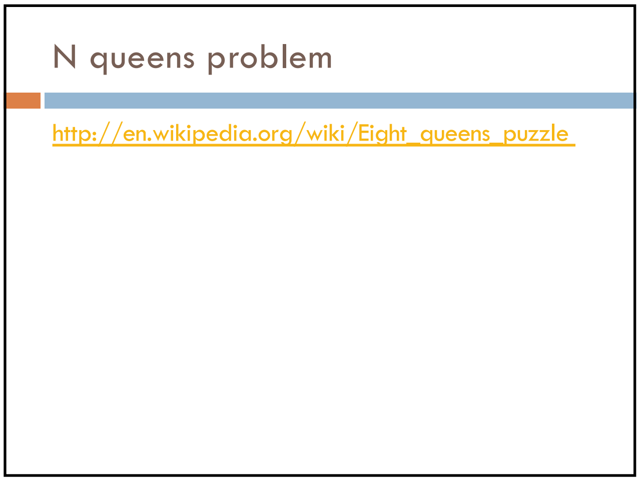
Search algorithm

add the start state to to_visit

Repeat

- take a state off the to_visit list
- if it's the goal state   Is this a goal state?
  - we're done!
- if it's not the goal state   What states can I get to from the current state?
  - Add all of the successive states to the to_visit list

Any problem that we can define these three things can be plugged into the search algorithm!



N queens problem

http://en.wikipedia.org/wiki/Eight_queens_puzzle