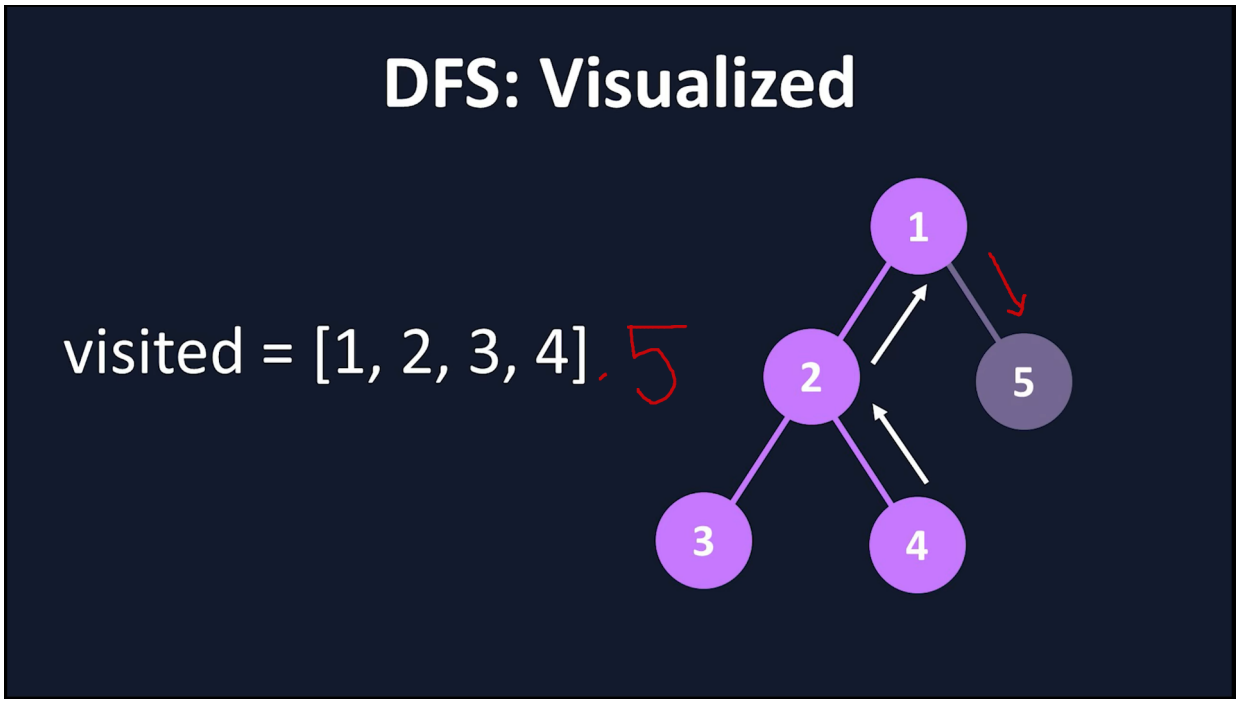
Overview of important Algorithms

- Searching
  - Binary Search
  - Depth First Search for trees and graphs
    - start from the top of a tree and go as deep as possible along the same branch
    - once you are at the bottom then go to nearest unvisited node usually a sibling of the deepest node
      - this process is called **Backtracking**
    - used to solve a maze
    - `O(number of nodes + number of branches)`
    - 

  - Breadth First Search for trees and graphs
    - you don't go to deepest point like DFS
    - instead you make sure that the sibling node has been visited
    - once you are on a node look at its children and add them to a queue and then you visit the node in the queue and add them to visited array and remove them from sibling queue
    - if the node in the queues has more children then add them to queue when marking it visited
    - used in chess
    - `O(number of nodes + number of branches)`
- Sorting

- Insertion Sort
  - compares the nth element with (n+1)th element and swaps them if nth element is larger
  - best case `O(n)` if everything is already sorted
  - worst case `O(n^2)` when nothing is sorted beforehand
- Merge Sort
  - divide and conquer and conquer by divide and conquer and so on
  - recursion
  - splits array in half till we have pairs of 2
  - then all pairs of 2 are sorted and then 2 pairs of 2 are merged and sorted till the array is completely merged back again
  - best and worst case are same `O(n log n)`
- Quick Sort
  - recursive like merge sort so divides and conquers
  - we choose a pivot element of the array which is closest to the median of the array elements
  - then we split the lists into 2 such that one list has elements less than the pivot element and one where all elements are greater than the pivot element
  - we repeat the same on these 2 lists
  - we move the pivot element to the end of the list
  - we place 2 pointers one on the 0th index and the 2nd on the 2nd last element and compare the two if the 0th one is larger we swap
  - deep doing it till the 2 pointers meet
  - when they meet replace that element with the last one
  - we know have 2 lists like we wanted and we can do the same thing on them individually
  - best case `O(n log n)`
  - worst case `O(n^2)`
  - still can be 2 to 3 times faster than merge sort by reducing the chances of worst case
  - needs less memory `O(log n)` than merge sort `O(n)`
- Greedy Algorithm
  - It makes the best possible decision at every local step
  - when not to be greedy
    - not meant for efficiency

- when to be greedy
  - when you don't want to find the most efficient way out of millions of permutations then greedy might be a good enough solution
  - when optimal solution not possible and brute force is not acceptable become greedy