

Divide and Conquer

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Prep Discussion

Prep dataset:
3, 42, 18, 21, 98, 53, 15, 77

How would you go about sorting
these numbers? Is that the
quickest way?

Introduction

What is Divide and Conquer

Divide and conquer is a problem-solving technique that breaks a large, complex problem into smaller, more manageable subproblems and solves them independently

Merge Sort

Merge Sort

Definition: Merge Sort is a divide and conquer sorting algorithm. It solves a problem by breaking it into smaller pieces, solving those pieces, and then combining the results.

If you have a list of numbers you want to sort, instead of trying to sort it all at once, Merge Sort:

1. Divides the list into halves repeatedly until each half has just one element. (A list of one item is automatically sorted!)
2. Conquers by recursively sorting those smaller lists.
3. Combines the smaller sorted lists back together in order

Merge Sort

Sort these people by how likely they are to reoffend, where the highest number is most likely to reoffend?

Example dataset:

Alice: Decile 18

Bob: Decile 2

Carmen: Decile 9

David: Decile 14

Ella: Decile 27

Fred: Decile 31

Grace: Decile 6

Hank: Decile 35

Merge Sort

Divide:

- [18, 2, 9, 14] [27, 31, 6, 35]
- [18, 2] [9, 14] [27, 31] [6, 35]
- [18] [2] [9] [14] [27] [31] [6] [35]

Conquer and Merge:

- [18] + [2] → [2, 18]
- [9] + [14] → [9, 14]
- [27] + [31] → [27, 31]
- [6] + [35] → [6, 35]
- [2, 18] + [9, 14] → [2, 9, 14, 18]
- [27, 31] + [6, 35] → [6, 27, 31, 35]
- [2, 9, 14, 18] + [6, 27, 31, 35] → [2, 6, 9, 14, 18, 27, 31, 35]
- [Bob, Grace, Carmen, David, Alice, Ella, Fred, Hank]

Example dataset:

Alice: Decile 18

Bob: Decile 2

Carmen: Decile 9

David: Decile 14

Ella: Decile 27

Fred: Decile 31

Grace: Decile 6

Hank: Decile 35

Merge Sort (Group Work)

Practice List:

- [Alice, Ella, Fred, Grace, Mona]
- [Elsa, Bob, Fred, Grace,
Carmen, Harry, Hank, Dream]
- [Harry, Ella, Alice, Elsa, Mona,
Bob, Hank, Fred, David]

Dataset:

Alice: Decile 18

Bob: Decile 2

Carmen: Decile 9

David: Decile 14

Ella: Decile 27

Fred: Decile 31

Grace: Decile 6

Hank: Decile 35

Harry: Decile 48

Dream: Decile 29

Elsa: Decile 51

Mona: Decile 13

Binary Search

Binary Search

Definition: Binary Search is a divide and conquer algorithm used to find a target value in a *sorted list* quickly. Instead of checking every element one by one, it repeatedly divides the search range in half until it either finds the target or determines that the target is not in the list.

How to:

1. Start with the entire sorted list.
2. Look at the middle element.
3. If the middle element equals your target → Found!
4. If the target is smaller, search only the left half.
5. If the target is larger, search only the right half.
6. Repeat until the list can't be divided anymore.

Binary Search

How would you use binary search to find the person with a score of 18?

Example dataset:

Bob: Decile 2

Grace: Decile 6

Carmen: Decile 9

David: Decile 14

Alice: Decile 18

Ella: Decile 27

Fred: Decile 31

Hank: Decile 35

Binary Search

Target Element: 18

- [2, 6, 9, 14, 18, 27, 31, 35]

The middle element is 14, and since 18 is greater than 14, you will search the *right half* of the list.

- [18, 27, 31, 35]

The middle element is 27, and since 18 is smaller than 27, search the *left half* of the list.

- [18]

The middle element is 18, and since this is your target, you can return Alice.

Example dataset:

Bob: Decile 2

Grace: Decile 6

Carmen: Decile 9

David: Decile 14

Alice: Decile 18

Ella: Decile 27

Fred: Decile 31

Hank: Decile 35

Binary Search (Group Work)

Practice List:

- [Bob, Carmen, Mona, Alice, Hank, Harry, Elsa] Target: 13
- [Grace, Mona, Alice, Ella, Fred, Hank, Harry, Elsa] Target: 41
- [Bob, Grace, Mona, David, Alice, Dream, Fred, Hank, Harry]
Target: 48

Dataset:
Bob: 2
Grace: 6
Carmen: 9
Mona: 13
David: 14
Alice: 18
Ella: 27
Dream: 29
Fred: 31
Hank: 35
Harry: 48
Elsa: 51

Homework