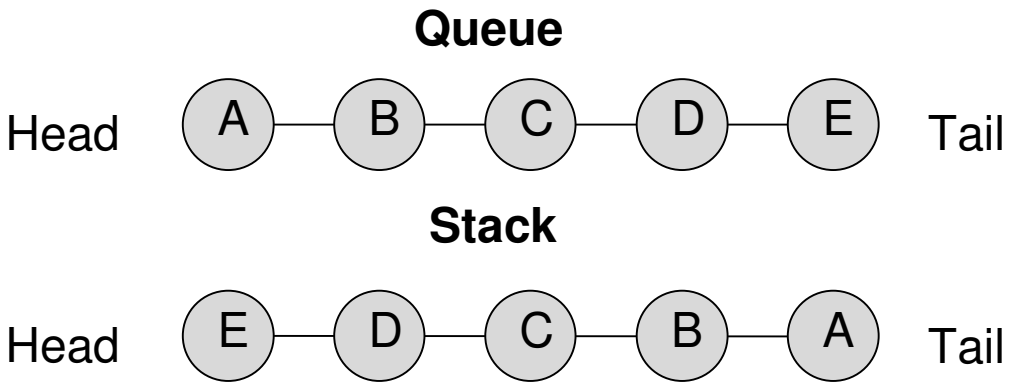
DATA STRUCTURES

- Queues ‘n Stacks
- Tries, Suffix Trees
- Heaps
- Sieve of Eratosthenes

QUEUES and STACKS

DESCRIPTION and IMPLEMENTATION



Operations: Add/Remove

QUEUES N STACKS

Uses: Many!

Queues / Stacks

•FIFO / FILO

•BFS / DFS

Search Tree Depth

Queue = Shallow

Stack = Deep

QUEUES IN STACKS

Example

IOI'96 Day 2
Problem 3: Magic Squares

|1|2|3|4|
|8|7|6|5|

- 'A': Exchange the top and bottom row,
- 'B': Single right circular shifting of the rectangle,
- 'C': Single clockwise rotation of the middle four squares.

QUEUES IN STACKS

Extra

Implementation: Dynamic vs. Static

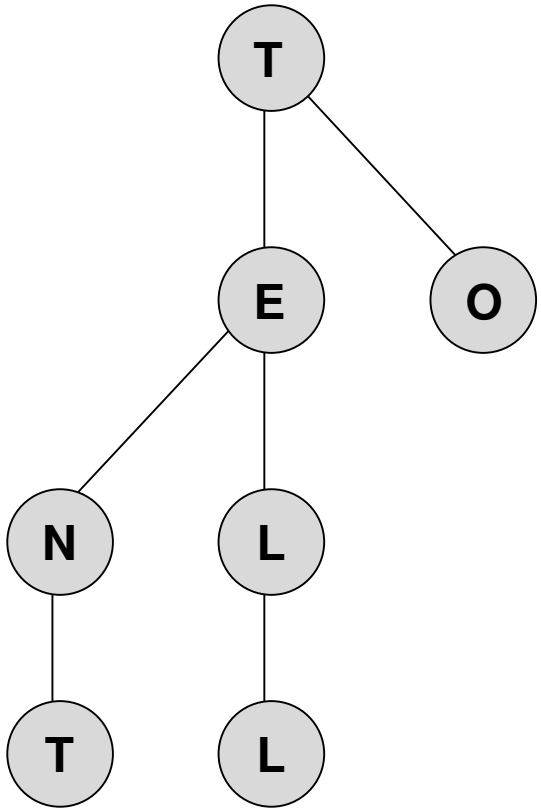
TRES

DESCRIPTION and IMPLEMENTATION

Operations: Create

Search

Walk



To

Tell

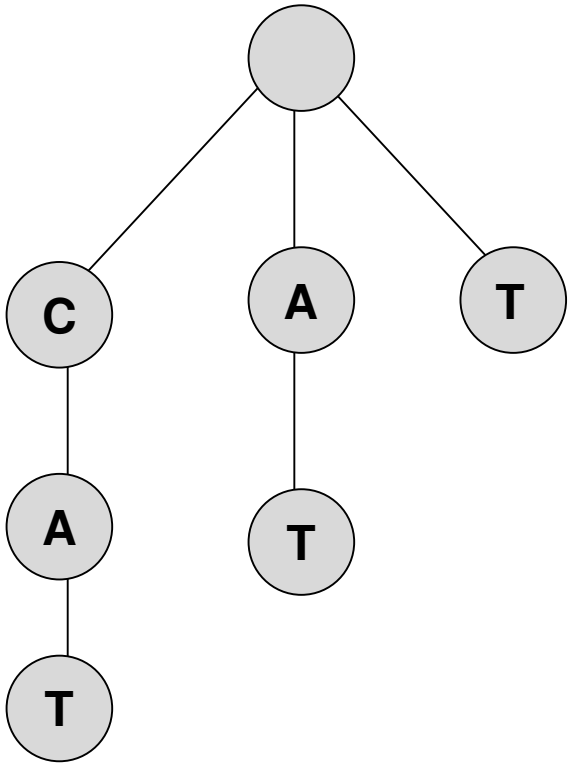
Tent

SUFFIX TREES

DESCRIPTION and IMPLEMENTATION

Operations: Create

Search



Suffix Tree: Cat

TRIES N SUFFIX TREES

- String Questions!

Uses:

- Find all occurrences of a substring in a string
- Longest substring common to a set of strings
- Longest Palindrome in a string
- Sorting of a dictionary
- Fast searching of a dictionary!

Example
IOI'98 Day 1
Problem 1: Contact

IOI'96 Day 2
Problem 2: Longest Prefix

IOI'95 Extra Problems
Problem 1: Word Chains

A list of one or more words is called a chain when each word in that list, except the first, is obtained from the preceding word by appending one or more letters on the right.
For instance, the list:
i
in
int
integer

is a chain of four words, but the list

input
integer

is not a chain. Note that every list of one word is a chain.

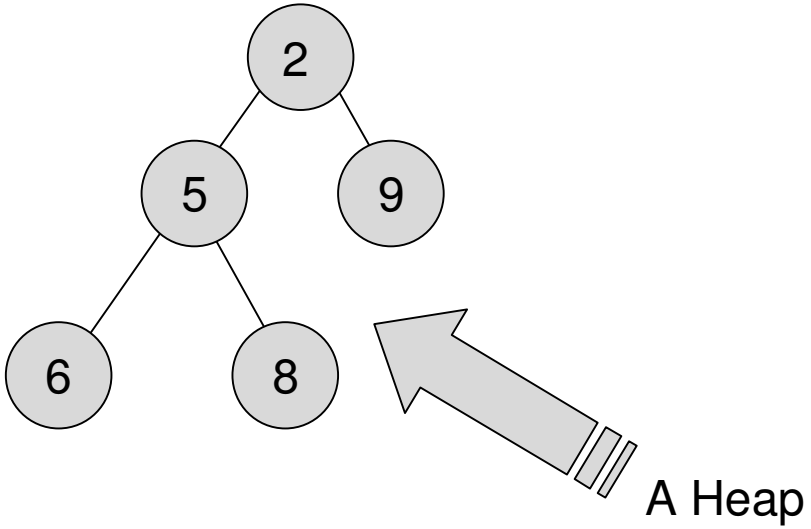
HEAPS

Description and Implementation

An element at position X:

Parent: Truncate(X/2)

Children: (2*X) and (2*X+1)



2 5 9 6 8

HEAPS

Heap Insert and Delete

Insert:

- Place the node at the bottom of the heap
- If it's smaller than it's parent swap the two.
- Rinse, repeat

Delete:

- Replace the node to be deleted with the node from the bottom of the heap.
- If this node if greater than either of it children swap it with the smaller of them
- Rinse, repeat

HEAPS

Uses:

To repeatedly Find the Minimum or Maximum of
a set of Dynamic Values

Dijkstra's Algorithm!

Krusal's MST Algorithm!

HEAPS

Example

IOI'95 Day 1
Problem 2:Shopping Offers

Given a set of items (up to 5) and their individual prices, and a set of special offers (up to 99) : 3 of item A plus 2 of item B for a certain price. Find the minimum cost to purchase a certain amount (up to 5) of each items.

Shortest Path Problem

Vertices: 6*6*6*6*6 = 7776

Edges: 99+5 = 104

Dijkstra's Algorithm Standard: $O(N^2)$ ~ $O(60000000)$

Dijkstra's Algorithm Heap: 0((E+V) log N) ~ O(30000)

SIEVE OF ERATOSTHENES

Use:

Fast primality testing for a range of numbers:

```
(*- Sieve of Eratosthenes *)
 For I := 2 To MAX Do
  If (Prime[I]) Then
  Begin
   J := I;
   While J*I <= N Do
   Begin
    Prime[I*J] := False;
    J := J + 1;
   End;
  End;
 (* Sieve of Eratosthenes -*)
```

SELECTED TOPICS

Example

IOI'94 Day 1
Problem 3: The Primes

- Given two integers A and B, output all 5x5 squares of single digits such that:
- Each row, each column and the two diagonals can be read as a five digit prime number. The rows are read from left to right. The columns are read from top to bottom. Both diagonals are read from left to right.
- The prime numbers must have a given digit sum "A".
- The digit in the top left-hand corner of the square is "B".
- A prime number may be used more than once in the same square.
- If there are several solutions, all must be presented.
- A five digit prime number cannot begin with zeros, ie 00003 is NOT a five digit prime number.

Input:

A = 11

B = 1

11351

14033

30323

53201

13313

```
return 0;
}
```