Computing Lab

CS 69201
Department of Computer Science and Engineering
IIT Kharagpur

Course Instructors and TAs

- Instructors
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Course Objectives

- Hands on Coding Experience.
- Learning C and Python through coding.
- Proficiency in Data Structures, Algorithms and System level Programming.
- Applying aforementioned topics in Real Life Problems.
- Developing problem-solving skills.

Course Coverage

- Pre Mid Semester
  - Data Structures, Algorithms, Graphs, Trees, Heaps.
  - Linear Programming.
  - Python Programming Applications
- Post Mid Semester
  - System level Programming - Introduction
  - POSIX Commands
  - Semaphores
  - POSIX Threads

Course Evaluation

- Assignment
  - In class & Home Assignments
- 3 Lab Tests
  - Opening Test (24/07/2024)
  - Mid Semester Exam (Mid September)
  - End Semester Exam (Mid November)
- Term Project (TBD)

Course Logistics

- **Moodle**
  - Make sure you have created your account in **CSE Moodle.** If not, do it with highest priority.
  - If created, navigate to **CS69201 Computing Lab** and Enter the Student Key - **NGSTUMM** in the Student Key.
- **Teams**
  - Join Teams channel. Make sure you have logged into Teams else create it with highest priority.
  - Navigate to Join or Create Team. Select on Join Teams > Join with a code. Paste the code : **en3wk6p**

Submission Guidelines

- All the submissions of Assignments, Tests and Projects will be made through Moodle.
- Late submission penalties will be imposed if any of the Assignments, Tests or Projects are submitted past deadline.
- **No Email submission** will be entertained!
- In case of Medical Emergency, inform the Faculty about the same, get a Medical Certificate from the Medical Officer at BCRTH and send the copy to the Faculty.

Plagiarism and Honor Code

- We are very strict with any practice of Plagiarism i.e. sharing or copying code among your coursemates or copying from the Internet.
- If anyone is caught for plagiarism, both the parties are given **ZERO marks** for the plagiarised submission whether you copied the code or you shared the code. Any excuses will **NOT** be entertained!
- You are always allowed to discuss your ideas with your coursemates but lending/borrowing code is a strict **NO**!

To be there in the lab latest by 2.05 PM

Resources

- ➢ Basics of C Programming - https://www.geeksforgeeks.org/c-programming-language/
- ➢ Data Structures - https://www.geeksforgeeks.org/data-structures/
- ➢ Algorithms - https://www.geeksforgeeks.org/introduction-to-algorithms/
- ➢ Cormen, Leiserson, Rivest, Stein Algorithms Book CLRS https://dl.ebooksworld.ir/books/Introduction.to.Algorithms.4th.Leiserson.Stein.Rivest.Cormen.MIT.Press.9780262046305.EBooksWorld.ir.pdf
- ➢ Python Programming - https://www.w3schools.com/python/
- ➢ Linux Programming Interface Michael Kerrisk - https://broman.dev/download/The%20Linux%20Programming%20Interface.pdf
- ➢ Socket by Brian “Beej Jorgensen”Hall - https://beej.us/guide/bgnet/

End of Logistics!

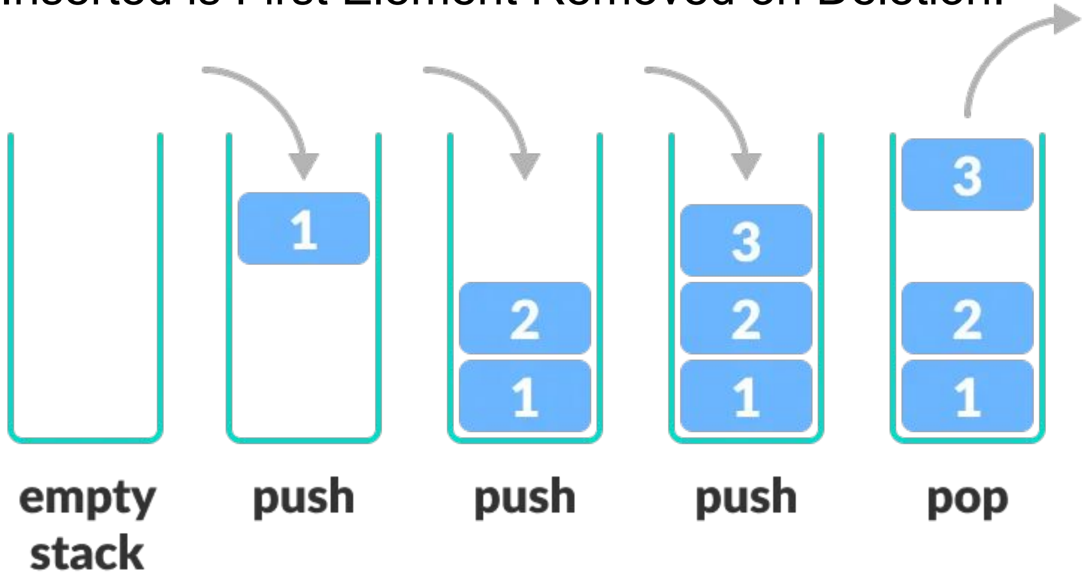
C Programming Basics

C Programming

- By now, many of you are familiar with C Programming Concepts :
  - Variables, Data Types, Initializations, Operators - Unary, Relational, Logical, Ternary
  - Conditional Statements - if-else, switch
  - Loops : for, while, do-while
  - Pointers, Memory Allocations, Arrays
  - Functions
  - Structs
  - File Handling
- Let us revisit the Data Structures of C

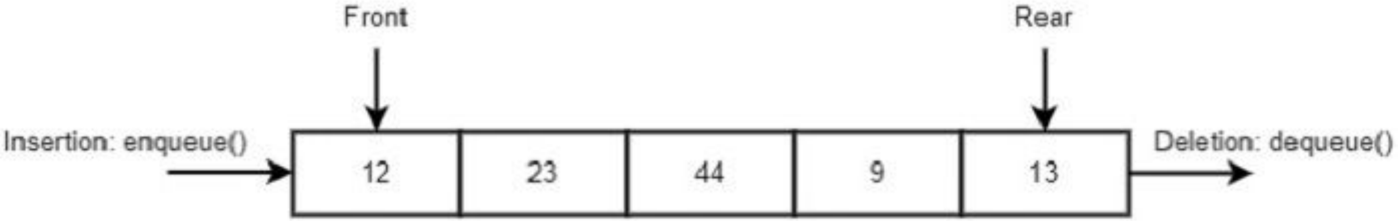
Stacks

- ➢ Data structure which follows the Last In First Out (LIFO) Mechanism.
- ➢ Last Element Inserted is First Element Removed on Deletion.



Queues

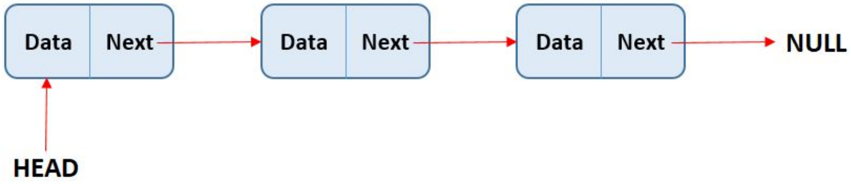
- Data structure which uses the First In First Out (FIFO) Mechanism.
- First element inserted is First Element Removed on Deletion.



Queue: FIFO Operation

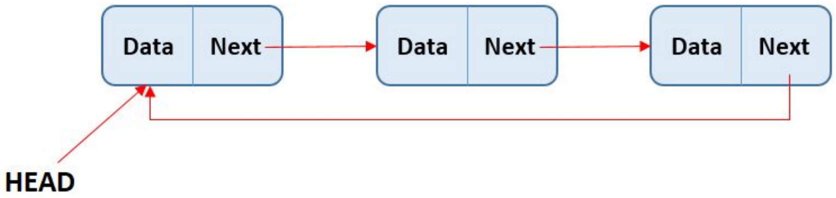
Linked List

- Data structure consisting of nodes each of which contains information and address/pointer to the next node.
- Types : Single Linked List, Circular Single Linked List, Double Linked List, Circular Doubly Linked List

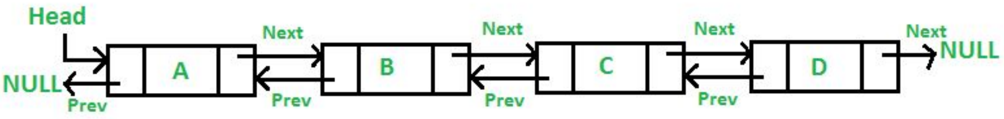


Single Linked List

Linked List



Circular Linked List



Doubly Linked List

Sorting

- Rearrange a given array or list of elements according to a comparison operator on the elements.
- Examples : Quick Sort, Merge Sort, Selection Sort, Bubble Sort, Radix Sort, Insertion Sort

Merge Sort

- Sorting algorithm based on Divide and Conquer Approach
- Procedure:
  - Divide the array into two halves, sort each half, and then merge the sorted halves back together.
  - For each half do the above till the array is sorted.

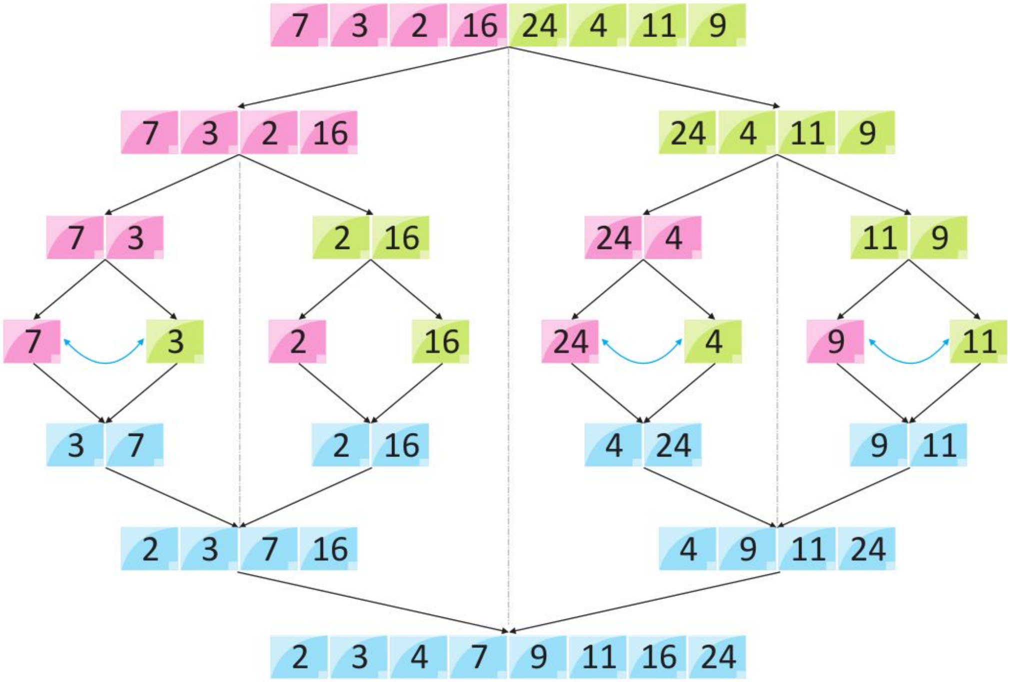
Algorithm MergeSort(Arr, start, end)

```
If start < end Then
    mid = (start + end)/2
    MergeSort(Arr, start, mid)
    MergeSort(Arr, mid + 1, end)
    Merge(Arr, start, mid, end)
```

Algorithm Merge(Arr, start, mid, end)

```
temp = Create array temp of same size Arr
i = start, j = mid + 1, k = start
While i <= mid and j <= end
    If Arr[i] > Arr[j] Then
        temp[k++] = Arr[j++]
    Else
        temp[k++] = Arr[i++]
While i <= mid
    temp[k++] = Arr[i++]
While j <= end
    temp[k++] = Arr[j++]
Loop from p = start to end
    Arr[p] = temp[p]
```

Merge Sort


7 3 2 16 24 4 11 9
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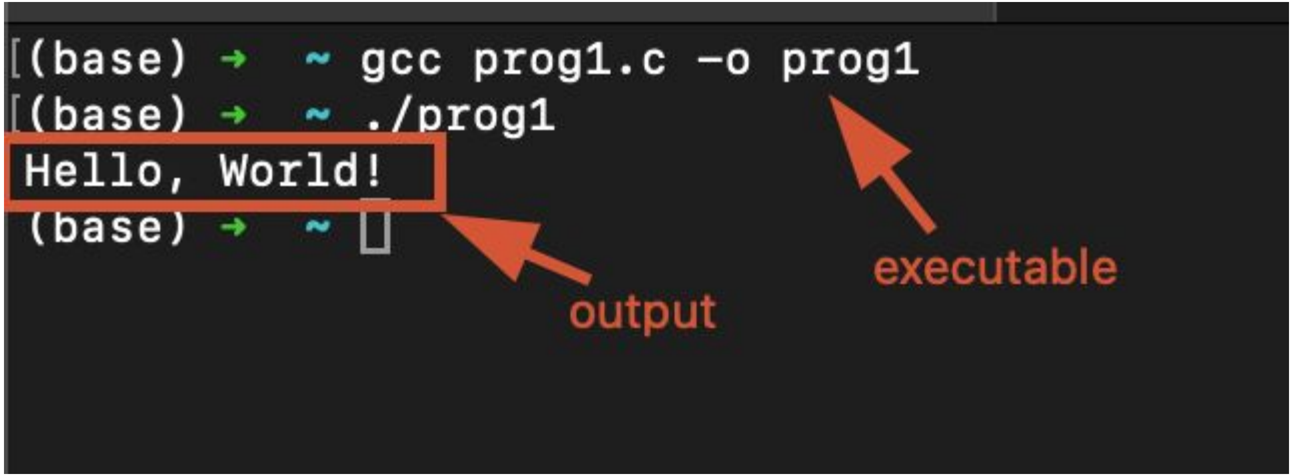
3 7
2 16
4 24
9 11
2 3 7 16
4 9 11 24
2 3 4 7 9 11 16 24

How to run c program

- Save your program with `.c` extension [ex. Prog1.c]
- Use the C compiler (GCC) to compile your program as `gcc prog1.c -o prog1`
- Execute the compiled program as ` ./prog1`



```
[(base) → ~ gcc prog1.c -o prog1
[(base) → ~ ./prog1
Hello, World!
(base) → ~ 
```

Sample Questions

- Catalan numbers C(n) is defined recursively as follows.

  C(0) = 1
  C(n) = C(0)C(n−1) +C(1)C(n−2) +···+C(n−1)C(0) [for n > 0]

  - Write a recursive function to return C(n).
  - Write a non-recursive function to return C(n).
  - Don’t use Catalan Number formula

$$C(n) = \binom{2n}{n} / (n+1).$$

Sample Questions

- ➢ Write a function to generate and print all those strings of length n over the alphabet {a,b,c}, in which no two consecutive symbols are the same.

  For example, your function should print ababcba, but not ababcca for n=7.

Sample Questions

- You are given an 8×8 chessboard. Your task is to place eight queens on the board such that no queen can attack any other queen, that is, no two of the queens share the same row, column or diagonal (forward or backward).

- Generalize the problem to an n×n board.

- Consider each cell coordinate of form (i,j) where 1<=i,j<=n and print those cell coordinates such that the queens cannot attack each other. First do for 8x8 and then generalise it

Exam on Basics of C Programming

- Tomorrow July 24, 2024
- Duration : 3 hours [2-5 PM].
- Exam Syllabus : Basics of C Programming, Stacks, Queues, Linked List, Sorting Techniques

Thank You!