VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

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A PROJECT REPORT

SORTING ALGO VISUAILIZATION

BY

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Year 2021-22

Under the Guidance of

MRS. VAISHALI GATTY

CERTIFICATE

This is to certify that the project entitled **SORTING ALGO VISUAILIZATION** of **NARENDER KESWANI [24], PRATHAMESH BHOSALE[10] & CHINMAY VYAPARI[62]** is submitted to satisfactorily complete a course of **MCAL11 - DATA STRUCTURES LAB WITH C AND / C++** under my supervision in the academic year **2021-2022**.

Vaishali Gatty	**(Name and sign)**
Supervisor/Guide	**Co-Supervisor/Guide**

Dr. ShivKumar Goel	**Dr. Mrs. J.M. Nair**
Head of Department	**Principal**

ACKNOWLEDGEMENT

With immense please we are presenting "**SORTING ALGO VISUAILIZATION**" Project report as part of the curriculum of '**Master of Computer Application**'. We wish to thank all the people who gave us unending support.

We, **NARENDER KESWANI [24], PRATHAMESH BHOSALE[10] & CHINMAY VYAPARI[62]** express our profound thanks to **Mrs. Vaishali Gatty** and all those who have indirectly guided and helped us in preparation of this project.

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Check Live Project at: https://sorting.narenderkeswani.com/

1. INTRODUCTION:

Algorithms and data structures as an essential part of knowledge in a framework of computer science1 have their stable position in computer science curriculam, since every computer scientist and every professional programmer should have the basic knowledge from the area. Our scope here is the higher education in the field of computer science. So within the paper, we discuss the extension of standard methods of teaching algorithms, using the whiteboard or slides, with the algorithm visualizations. According to they can be used to attract students' attention during the lecture, explain concepts in visual terms, encourage a practical learning process, and facilitate better communication between students and instructors.

DS Algorithm visualization illustrates how data structure algorithms work in a graphical way. It mainly aims to simplify and deepen the understanding of algorithms operation. Within the paper we discuss the possibility of enriching the standard methods of teaching algorithms, with the algorithm visualizations. As a step in this direction, we introduce the DS Algorithm visualizer platform, present our practical experiences and describe possible future directions, based on our experiences and exploration performed by means of a simple questionnaire

How do you get something done? You don't have to be extremely complex in solving the problem, for example, if your car's headlight is broken (although nowadays, manufacturers are trying the patience of the community with their increasingly abstract, space-age designs). The main issue is figuring out the best way to go about it. To locate step-by-step directions in your car's handbook, you conduct research, or do you use instinct to find someone who knows how to do it? In short, my instinct tells me that I am a visual learner and hence more suited to acquire topics by watching them than by reading about them. In this case, I found that seeing the data move to its rightful spot as the result of an algorithm is MUCH easier to follow than looking at the source code and trying to figure out where the data was supposed to go. Our project was born out of our curiosity about sorting algorithms, Selection Sort, Bubble Sort, Insertion Sort,Heap Sort and Merge Sort are the four sorting algorithms. Let's imagine that you have printed each person's age on a separate index card. Bring the youngest card to the front and then sort the cards by age. To discover the next smallest item, identify the age that has already been ordered and position it behind the already ordered age. Index cards full of ages will be at the end of the pile. Selection Sort works in the same way as this. In this case, to sort a set of data, you select the smallest first, and then the next smallest, and so on until you've sorted all of the data. This technique is quite simple to explain to someone in conversation, but more advanced sorting algorithms, such as Quick Sort, which requires the data to be moved around a pivot point, are not easy to grasp using text alone. I wanted the animation to appeal to a wide spectrum of individuals utilizing various technology media, and so I had it made in a web-based format. Instead of requiring the user to install extra software or attempt to organize setups to use the tool, this helps to remove this source of anxiety. It uses HTML5 (Hypertext Markup Text Language) JavaScript, , CSS and React Framework for the website's layout (Cascading Style Sheets).

2. OBJECTIVES & PURPOSE:

Objectives:

The Objectives of Our Website are:

- ✓ Provide simple information and services for all faculty and students.
- ✓ Enhance the quality of learning of various Data Structures.
- ✓ Meet the learning style or understand the needs of students.
- ✓ Improve the efficiency and effectiveness.
- ✓ Improve user-accessibility and time flexibility to engage learners in the learning process.
- ✓ Expand and enhance technology support tools to meet the current needs and expectations.

Purpose:

- ✓ Enhance the quality of learning and teaching.
- ✓ Meet the learning style or needs of students.
- ✓ Improve the efficiency and effectiveness.
- ✓ Improve user-accessibility and time flexibility to engage learners in the learning process.

3. SPECIFICATIONS:

Software Requirement

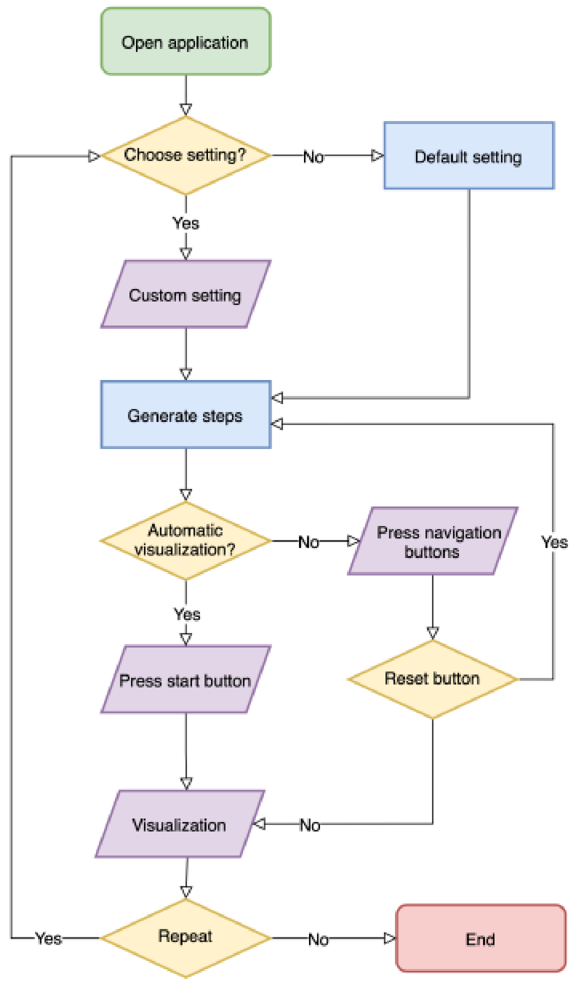
- ✓ IDE(VS Code)
- ✓ Any Operating System
- ✓ Web Browser
- ✓ React Js
- ✓ NPM Package Manager

Hardware Requirement

- ✓ 4 Gb Ram
- ✓ 50 Gb Hard Disk
- ✓ i3 Intel Processor

4. SYSTEM DESIGN:

Flow Chart:



Application Flow chart

5. CODE & SCREEN SHOTS:

1) Bubble Sort

BubbleSort.js:

```
export async function* BubbleSort(array, swap, highlight, marksort) {
  for (let i = 0; i < array.length; i++) {
    for (var j = 0; j < array.length - i - 1; j++) {
      yield await highlight([j, j + 1]);
      if (array[j] > array[j + 1]) {
        yield await swap(j, j + 1);
      }
    }
    marksort(j);
    yield;
  }
}
```

2) Selection Sort

SelectionSort.js

```
export async function* HeapSort(array, swap, highlight, markSort) {
  let arrLength = array.length;
  for (let i = Math.floor(arrLength / 2) - 1; i >= 0; i--) {
    yield* await maxHeap(i);
  }

  for (let i = array.length - 1; i > 0; i--) {
    arrLength--;
    markSort(arrLength);
    yield await swap(0, i);
    yield* await maxHeap(0);
  }

  markSort(0);
  async function* maxHeap(i) {
    const left = 2 * i + 1;
    const right = 2 * i + 2;
    let max = i;

    const highlightArray = [];
    if(left < arrLength)
      highlightArray.push(left);
    if(right < arrLength)
      highlightArray.push(right);
    yield await highlight(highlightArray, i);

    if(left < arrLength){
      if (array[left] > array[max]) {
        max = left;
      }
    }

    if(right < arrLength){
      if (array[right] > array[max]) {
        max = right;
      }
    }

    if (max !== i) {
      yield await swap(i, max);
      yield* await maxHeap(max);
    }
  }
}
```

3) Insertion Sort

InsertionSort.js

```
export async function* InsertionSort(array, swap, highlight, marksort) {
  for (let i = 0; i < array.length; i++) {
    let keyIndex = i;
    for (var j = i - 1; j >= 0; j--) {
      yield await highlight([keyIndex, j]);

      if (array[j] > array[keyIndex]) {
        yield await swap(j, keyIndex);
        keyIndex = j;
      } else {
        yield;
        break;
      }
    }

    marksort(i);
    yield;
  }
}
```

4) Heap Sort

HeapSort.js

```
export async function* QuickSort(
  array,
  swap,
  highlight,
  markSort,
  low = 0,
  high = array.length - 1
) {

  if (low <= high) {
    let pivot = yield* await partition(array, low, high);
    yield* await QuickSort(array, swap, highlight, markSort, low, pivot - 1);
    yield* await QuickSort(array, swap, highlight, markSort, pivot + 1, high);
  }
  async function* partition(array, low, high) {
    let pivot = low;
    let i = low;
    let j = high + 1;

    while (i < j) {

      while (--j > low) {
        yield await highlight([i, j], pivot);
        if (array[j] < array[pivot]) {
          break;
        }
      }

      while (i <= high && i < j) {
        yield await highlight([i], pivot);
        if (array[++i] > array[pivot]) {
          break;
        }
      }

      if (i < j) {
        yield await swap(i, j);
      }
    }

    if (pivot !== j) {
      yield await swap(pivot, j);
    }

    markSort(j);
    yield;
    return j;
  }
}
```

5) Quick Sort

QuickSort.js

```
export async function* SelectionSort(array, swap, highlight, marksort) {
  for (let i = 0; i < array.length; i++) {
    let maxIndex = 0;
    for (var j = 0; j < array.length - i; j++) {
      yield await highlight([maxIndex, j]);

      if (array[maxIndex] < array[j]) {
        maxIndex = j;
      }
    }

    j = j - 1;
    if (maxIndex !== j && array[maxIndex] !== array[j]) {
      yield await swap(maxIndex, j);
    }

    marksort(j);
    yield;
  }
}
```

Web Application Files:

App.js:

```
import React from "react";
import styled from "styled-components";
import { MainApp } from "./components/MainApp";

const Container = styled.div`
  margin: 0 10px;
  min-height: calc(100vh - 50px);
  position: relative;
  margin-bottom: 50px;
  backgroundColor: black;
`;

export default function App() {
  return (
    <Container>
      <MainApp />
    </Container>
  );
}
```

ArrayContainer.jsx:

```
import React from "react";
import styled from "styled-components";
import { useControls } from "../../common/store";
import {
  ArrayHolder,
  ArrayItem,
  sourceAnimation,
  destinationAnimation,
} from "../../common/styles";

export const comparisionColor = "pink";
export const swapColor = "yellow";
export const sortedColor = "springgreen";
export const pivotColor = "sandybrown";

let swapTime = useControls.getState().swapTime;
useControls.subscribe(
  (time) => (swapTime = time),
  (state) => state.swapTime
);
```

```
const Source = styled(ArrayItem)`
  animation: ${(props) => destinationAnimation(props.distance, swapColor)}
    ${() => swapTime / 1000}s forwards;
`;

const Destination = styled(ArrayItem)`
  animation: ${(props) => sourceAnimation(props.distance, swapColor)}
    ${() => swapTime / 1000}s forwards;
`;

export function ArrayContainer({
  array,
  source,
  destination,
  pivot = -1,
  highlightIndices,
  sortedIndices,
}) {

  function getBackgroundColor(i) {
    if (i === pivot) {
      return pivotColor;
    }

    if (highlightIndices.includes(i)) {
      return comparisionColor;
    }

    if (sortedIndices.includes(i)) {
      return sortedColor;
    }
    return "";
  }

  return (
<ArrayHolder>
  {array.map((value, i) => {
    if (i === source) {
      return (
        <Source
          key={i + ":" + source + ":" + destination + ":" + value}
          distance={destination - source}
          style={{
            order: destination,
            backgroundColor: getBackgroundColor(i),
          }}
        >
          {value}
        </Source>
      );
    }
    if (i === destination) {
      return (
        <Destination
          key={i + ":" + destination + ":" + source + ":" + value}
          distance={destination - source}
          style={{
            order: source,
            backgroundColor: getBackgroundColor(i),
          }}
        >
          {value}
        </Destination>
      );
    }
    return (
      <ArrayItem
        key={i + ":" + destination + ":" + source + ":" + value}
        style={{
          order: i,
          backgroundColor: getBackgroundColor(i),
          }}
        >
          {value}
        </ArrayItem>
      );
    })}
  </ArrayHolder>
 );
}
```

SortManager.jsx:

```
import React, { useEffect, useRef, useState } from "react";
import styled from "styled-components";
import { ArrayContainer } from "./ArrayContainer";
import { Timer } from "./Timer";
import Card from "@material-ui/core/Card";
import shallow from "zustand/shallow";
import { useControls, useData } from "../../common/store";

let compareTime = useControls.getState().compareTime;
let swapTime = useControls.getState().swapTime;

export const comparisionColor = "pink";
export const swapColor = "yellow";
export const sortedColor = "springgreen";
export const pivotColor = "sandybrown";

function delay(time) {
  return new Promise((resolve) => setTimeout(resolve, time));
}

useControls.subscribe(
  ([cTime, sTime]) => {
    compareTime = cTime;
    swapTime = sTime;
  },
  (state) => [state.compareTime, state.swapTime],
  shallow
);

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

const AlgoHeaderBar = styled.div`
  display: flex;
  justify-content: space-between;
  align-items: center;
  column-gap: 20px;
`;

const TimerDiv = styled.div`
  display: flex;
  column-gap: 5px;
  min-width: 8rem;
  justify-content: flex-end;
`;

const InfoFlex = styled.div`
  display: flex;
  justify-content: space-between;
`;

export const SortManager = React.memo(function ({
  array,
  sortFunction,
  sortingAlgorithmName,
}) {
  const [swapIndices, setSwapIndices] = useState([-1, -1]);
const [hightlightedIndices, setHightlightedIndices] = useState([-1, -1]);

const algoArray = useRef([]);
const sortedIndices = useRef([]);
const pivot = useRef(-1);
const swapCount = useRef(0);
const comparisionCount = useRef(0);
const isAlgoExecutionOver = useRef(false);
const isComponentUnMounted = useRef(false);

const markSortngDone = useControls((state) => state.markSortngDone);
const progress = useRef("");
const sortProgressIterator = useRef(null);

async function reset() {
  algoArray.current = [...useData.getState().sortingArray];
  sortedIndices.current = [];
  pivot.current = -1;
  swapCount.current = 0;
  comparisionCount.current = 0;
  isAlgoExecutionOver.current = false;
  setSwapIndices([-1, -1]);
  setHightlightedIndices([-1, -1]);

  sortProgressIterator.current = await sortFunction(
    algoArray.current,
    swap,
    highlight,
    markSort
  );
}

useEffect(() => {
  progress.current = useControls.getState().progress;
  useControls.subscribe(
    (value) => {
      progress.current = value;

      if (progress.current === "start")
      {
        runAlgo();
      }
      if (progress.current === "reset")
      {
        reset();
      }

    },
    (state) => state.progress,
  );

  return () => {
    isComponentUnMounted.current = true;
  };
}, []);

useEffect(() => {
  reset();
}, [array]);

async function runAlgo() {
  let completion = { done: false };
  while (
    !completion?.done &&
    progress.current === "start" &&
    !isComponentUnMounted.current
  ) {
    completion = await sortProgressIterator.current?.next();
  }

  if (isComponentUnMounted.current) {
    return;
  }

  if (!isAlgoExecutionOver.current && completion?.done) {
    isAlgoExecutionOver.current = true;
    pivot.current = -1;
    setSwapIndices([-1, -1]);
    setHightlightedIndices([-1, -1]);
    markSortngDone();
  }
}

async function swap(i, j) {
  let tmp = algoArray.current[i];
  algoArray.current[i] = algoArray.current[j];
  algoArray.current[j] = tmp;
  setSwapIndices([i, j]);

  pivot.current = -1;
  swapCount.current += 1;
  await delay(swapTime);
}

async function highlight(indices, p) {
  setSwapIndices([-1, -1]);
  comparisionCount.current += 1;
  pivot.current = p;
  setHightlightedIndices(indices);
  await delay(compareTime);
}

function markSort(...indices) {
  sortedIndices.current.push(...indices);
}

const arrayContainer = (
  <ArrayContainer
```

```
      array={algoArray.current}
      source={swapIndices[0]}
      destination={swapIndices[1]}
      pivot={pivot.current}
      highlightIndices={hightlightedIndices}
      sortedIndices={sortedIndices.current}
    />
  );

  return (
    <Container>
      <AlgoHeaderBar>
        <strong>{sortingAlgorithmName}</strong>
        <TimerDiv>
          <span>Time:</span>
          <strong>
            <Timer isAlgoExecutionOver={isAlgoExecutionOver.current} />
          </strong>
        </TimerDiv>
      </AlgoHeaderBar>

      {(sortingAlgorithmName = arrayContainer)}
      <InfoFlex>
        <div>
          Number of Swaps: <strong>{swapCount.current}</strong>
        </div>
        <div>
          Number of Comparisions:
<strong>{comparisionCount.current}</strong>
        </div>
      </InfoFlex>
    </Container>
  );
});
```

Timer.jsx:

```
import { useEffect, useState } from "react";
import { useControls } from "../../common/store";

export function Timer({ isAlgoExecutionOver }) {
  const [minutes, setMinutes] = useState(0);
  const [seconds, setSeconds] = useState(0);
  const [milliSeconds, setMilliSeconds] = useState(0);

  const progress = useControls((state) => state.progress);

  function resetTimer() {
    setMilliSeconds(0);
    setSeconds(0);
    setMinutes(0);
  }

  useEffect(() => {
    if (isAlgoExecutionOver) return;
    if (progress === "start")
      var intervalId = setInterval(() => setMilliSeconds((ml) => ml + 1), 100);
    else if (progress === "reset") resetTimer();
    return () => clearInterval(intervalId);
  }, [progress, isAlgoExecutionOver]);

  useEffect(() => {
    if (milliSeconds === 10) {
      setSeconds((seconds) => seconds + 1);
      setMilliSeconds(0);
    }
  }, [milliSeconds]);

  useEffect(() => {
    if (seconds === 60) {
      setMinutes((minutes) => minutes + 1);
      setSeconds(0);
    }
  }, [seconds]);

  return `${minutes.toString().padStart(2, 0)}:${seconds
    .toString()
    .padStart(2, 0)}:${milliSeconds} s`;
}
```

Controller.jsx:

```
import React, { useState } from "react";
import styled from "styled-components";
import { VscDebugStart } from "react-icons/vsc";
import { VscDebugRestart } from "react-icons/vsc";
import { ImPause } from "react-icons/im";
import TextField from "@material-ui/core/TextField";
import shallow from "zustand/shallow";
import Card from "@material-ui/core/Card";
import { useControls, useData } from "../common/store";

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

const TabArrayBar = styled.div`
  font-size: 2rem;
  display: flex;
  align-items: center;
  margin: 15px 0;
  flex-wrap: wrap;
`;

const ArrayBar = styled.div`
```

```
  display: flex;
  align-items: center;
  flex-basis: 40%;
  min-width: 500px;
`;

const ExecutionBar = styled.div`
  display: flex;
  align-items: center;
  flex-basis: 15%;
`;

function convertInputToArrayString(string) {
  string = string.replaceAll(/\s/g, "");
  string = string.replaceAll(/\d{4}/g, "");
  string = string.replaceAll(/\s\s/g, " ");
  string = string.replaceAll(/\s,/g, ",");
  string = string.replaceAll(/,,/g, ",");
  string = string.replaceAll(/[^0-9,\s]/g, "");
  return string;
}

function convertArrayStringToArray(string) {
  return string
    .split(",")
    .filter((v) => v !== "")
    .map((v) => +v);
}

function delay(time) {
  return new Promise((resolve) => setTimeout(resolve, time));
}

export function Controller() {

  const [isPausing, setIsPausing] = useState(false);
  const [progress] = useControls(
    (state) => [state.progress],
    shallow
  );

  const [sortingArray, setSortingArray] = useData(
    (state) => [state.sortingArray, state.setSortingArray],
    shallow
  );

  const [startSorting, pauseSorting, resetSorting, setSpeed] = useControls(
    (state) => [
      state.startSorting,
      state.pauseSorting,
      state.resetSorting,
      state.setSpeed,
    ],
    shallow
  );
  setSpeed(1);

  const [arrayInput, setArrayInput] = useState(sortingArray);

  const startElement = <VscDebugStart onClick={startSorting} />;
  const pauseElement = <ImPause onClick={pauseAndDelaySorting} />;
  const resetElement = <VscDebugRestart onClick={resetSorting} />;
  const disabledPauseElement = <ImPause style={{ color: "#e5e5e5" }} />;

  async function pauseAndDelaySorting(){
    pauseSorting();
    setIsPausing(true);
    await delay(useControls.getState().swapTime);
    setIsPausing(false);
  }

  function arrayDataChangeHandler(value) {
    const arrayString = convertInputToArrayString(value);
    setArrayInput(arrayString);

    const array = convertArrayStringToArray(arrayString);
    setSortingArray(array);
    resetSorting();
  }

  function getProgressButton() {
    if(isPausing)
      return disabledPauseElement;

    switch (progress) {
      case "reset":
        return startElement;
      case "start":
        return pauseElement;
      case "pause":
        return startElement;
      case "done":
        return disabledPauseElement;
      default:
        return "Not Found";
    }
  }

  return (
    <Container>
      <TabArrayBar>
        <ArrayBar>
          <TextField
            id="outlined-basic"
            label="Input"
            variant="outlined"
            onChange={(event) => arrayDataChangeHandler(event.target.value)}
            value={arrayInput}
            size="small"
            style={{ flexGrow: 1, margin: "0 10px" }}
          />
        </ArrayBar>
        <ExecutionBar>
          <div
            style={{ display: "flex", marginLeft: "10px", columnGap: "5px" }}
          >
            {getProgressButton()}
            {resetElement}
          </div>
        </ExecutionBar>
      </TabArrayBar>
    </Container>
  );
 }
```

MainApp.jsx:

```
import React from "react";
import { makeStyles } from "@material-ui/core/styles";
import { Tab, Tabs, TabList, TabPanel } from "react-tabs";
import "react-tabs/style/react-tabs.css";
import { useControls, useData } from "../common/store";
import shallow from "zustand/shallow";
import styled from "styled-components";
import Card from "@material-ui/core/Card";
import { BubbleSort } from "../sortFunctions/BubbleSort";
import { SelectionSort } from "../sortFunctions/SelectionSort";
import { InsertionSort } from "../sortFunctions/InsertionSort";
import { QuickSort } from "../sortFunctions/QuickSort";
import { HeapSort } from "../sortFunctions/HeapSort.js";
import { BubbleSortTheory } from "./BubbleSortTheory";
import { Controller } from "./Controller";
import { SortManager } from "./visualizer/SortManager";
import { SelectionSortTheory } from "./SelectionSortTheory";
import { InsertionSortTheory } from "./InsertionSortTheory";
import { HeapSortTheory } from "./HeapSortTheory";
import { QuickSortTheory } from "./QuickSortTheory";

const useStyles = makeStyles((theme) => ({
  root: {
    flexGrow: 1,
    width: "100%",
    backgroundColor: theme.palette.background.paper,
  },
}));

const FooterDiv = styled(Card)`
  display: flex;
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
  justify-content: center;
  align-items: center;
  position: absolute;
  width: 100%;
`;

export function MainApp() {
  const classes = useStyles();

  const [sortingArray] = useData(
    (state) => [state.sortingArray],
    shallow
  );


  const [resetSorting] = useControls(
    (state) => [
      state.resetSorting,
    ],
    shallow
  );

  return (
    <div className={classes.root}>
      <div
        style={{
          display: "flex",
          justifyContent: "space-between",
          alignItems: "center",
        }}
      ></div>
      <Tabs>
        <TabList>
          <Tab onClick={resetSorting}>BubbleSort</Tab>
          <Tab onClick={resetSorting}>SelectionSort</Tab>
          <Tab onClick={resetSorting}>InsertionSort</Tab>
          <Tab onClick={resetSorting}>HeapSort</Tab>
          <Tab onClick={resetSorting}>QuickSort</Tab>
        </TabList>
        <Controller />
        <br />
        <TabPanel>
          <SortManager
            array={sortingArray}
            sortFunction={BubbleSort}
            sortingAlgorithmName={"BubbleSort"}
            key={"BubbleSort"}
          />
          <br />
          <BubbleSortTheory />
        </TabPanel>
        <TabPanel>
          <SortManager
            array={sortingArray}
            sortFunction={SelectionSort}
            sortingAlgorithmName={"SelectionSort"}
            key={"SelectionSort"}
          />
          <br />
          <SelectionSortTheory />
        </TabPanel>
        <TabPanel>
          <SortManager
            array={sortingArray}
            sortFunction={InsertionSort}
            sortingAlgorithmName={"InsertionSort"}
            key={"InsertionSort"}
          />
          <br />
          <InsertionSortTheory />
        </TabPanel>
        <TabPanel>
          <SortManager
            array={sortingArray}
            sortFunction={HeapSort}
            sortingAlgorithmName={"HeapSort"}
            key={"HeapSort"}
          />
          <br />
          <HeapSortTheory />
        </TabPanel>
        <TabPanel>
          <SortManager
            array={sortingArray}
            sortFunction={QuickSort}
            sortingAlgorithmName={"QuickSort"}
            key={"QuickSort"}
          />
          <br />
          <QuickSortTheory />
        </TabPanel>
```

```
      </Tabs>
      <br />
      <FooterDiv>
        <h4>
          <span>
            Made with ♥ by &nbsp;
            <a href="https://www.narenderkeswani.com/">
              Narender Keswani, Prathamesh Bhosale & Chinmay Vyapari
            </a>
          </span>
        </h4>
      </FooterDiv>
    </div>
  );
}
```

BubbleSortTheory.jsx:

```
import React from "react";
import CodeEditor from "@uiw/react-textarea-code-editor";
import { Tab, Tabs, TabList, TabPanel } from "react-tabs";
import "react-tabs/style/react-tabs.css";
import Card from "@material-ui/core/Card";
import styled from "styled-components";

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

export function BubbleSortTheory() {

const [cppcode, setcppCode] = React.useState(
  `// C++ program for implementation of Bubble sort
#include <bits/stdc++.h>
```

```
using namespace std;

void swap(int *xp, int *yp)
{
        int temp = *xp;
        *xp = *yp;
        *yp = temp;
}

// A function to implement bubble sort
void bubbleSort(int arr[], int n)
{
        int i, j;
        for (i = 0; i < n-1; i++)

        // Last i elements are already in place
        for (j = 0; j < n-i-1; j++)
                if (arr[j] > arr[j+1])
                        swap(&arr[j], &arr[j+1]);
}

/* Function to print an array */
void printArray(int arr[], int size)
{
        int i;
        for (i = 0; i < size; i++)
                cout << arr[i] << " ";
        cout << endl;
}

// Driver code
int main()
{
        int arr[] = {64, 34, 25, 12, 22, 11, 90};
        int n = sizeof(arr)/sizeof(arr[0]);
        bubbleSort(arr, n);
```

```
	cout<<"Sorted array: \n";
	printArray(arr, n);
	return 0;
}
`
);

const [ccode, setcCode] = React.useState(
  `// C program for implementation of Bubble sort
#include <stdio.h>

void swap(int *xp, int *yp)
{
	int temp = *xp;
	*xp = *yp;
	*yp = temp;
}

// A function to implement bubble sort
void bubbleSort(int arr[], int n)
{
int i, j;
for (i = 0; i < n-1; i++)

	// Last i elements are already in place
	for (j = 0; j < n-i-1; j++)
		if (arr[j] > arr[j+1])
			swap(&arr[j], &arr[j+1]);
}

/* Function to print an array */
void printArray(int arr[], int size)
{
	int i;
	for (i=0; i < size; i++)
		printf("%d ", arr[i]);
```

```
        printf("\n");
}

// Driver program to test above functions
int main()
{
        int arr[] = {64, 34, 25, 12, 22, 11, 90};
        int n = sizeof(arr)/sizeof(arr[0]);
        bubbleSort(arr, n);
        printf("Sorted array: \n");
        printArray(arr, n);
        return 0;
}

`
);

const [javacode, setjavaCode] = React.useState(
 `
// Java program for implementation of Bubble Sort
class BubbleSort
{
        void bubbleSort(int arr[])
        {
                int n = arr.length;
                for (int i = 0; i < n-1; i++)
                        for (int j = 0; j < n-i-1; j++)
                                if (arr[j] > arr[j+1])
                                {
                                        // swap arr[j+1] and arr[j]
                                        int temp = arr[j];
                                        arr[j] = arr[j+1];
                                        arr[j+1] = temp;
                                }
        }
        /* Prints the array */
        void printArray(int arr[])
        {
                int n = arr.length;
                for (int i=0; i<n; ++i)
                        System.out.print(arr[i] + " ");
                System.out.println();
        }

        // Driver method to test above
        public static void main(String args[])
        {
                BubbleSort ob = new BubbleSort();
                int arr[] = {64, 34, 25, 12, 22, 11, 90};
                ob.bubbleSort(arr);
                System.out.println("Sorted array");
                ob.printArray(arr);
        }
}

`

);

const [pythoncode, setpythonCode] = React.useState(
  `# Python program for implementation of Bubble Sort

def bubbleSort(arr):
        n = len(arr)

        # Traverse through all array elements
        for i in range(n):

                # Last i elements are already in place
                for j in range(0, n-i-1):

                        # traverse the array from 0 to n-i-1
                # Swap if the element found is greater
                # than the next element
                if arr[j] > arr[j+1] :
                    arr[j], arr[j+1] = arr[j+1], arr[j]

# Driver code to test above
arr = [64, 34, 25, 12, 22, 11, 90]

bubbleSort(arr)

print ("Sorted array is:")
for i in range(len(arr)):
    print ("%d" %arr[i]),
`
);

const [cscode, setcsCode] = React.useState(
  `
// C# program for implementation
// of Bubble Sort
using System;

class GFG
{
    static void bubbleSort(int []arr)
    {
        int n = arr.Length;
        for (int i = 0; i < n - 1; i++)
            for (int j = 0; j < n - i - 1; j++)
                if (arr[j] > arr[j + 1])
                {
                    // swap temp and arr[i]
                    int temp = arr[j];
                    arr[j] = arr[j + 1];
                    arr[j + 1] = temp;
                }
    }

    /* Prints the array */
    static void printArray(int []arr)
    {
        int n = arr.Length;
        for (int i = 0; i < n; ++i)
                Console.Write(arr[i] + " ");
        Console.WriteLine();
    }

    // Driver method
    public static void Main()
    {
        int []arr = {64, 34, 25, 12, 22, 11, 90};
        bubbleSort(arr);
        Console.WriteLine("Sorted array");
        printArray(arr);
    }

}
`
);

const [phpcode, setphpCode] = React.useState(
  `
  <?php
// PHP program for implementation
// of Bubble Sort

function bubbleSort(&$arr)
{
    $n = sizeof($arr);

    // Traverse through all array elements
    for($i = 0; $i < $n; $i++)
```

```
          {
                    // Last i elements are already in place
                    for ($j = 0; $j < $n - $i - 1; $j++)
                    {
                              // traverse the array from 0 to n-i-1
                              // Swap if the element found is greater
                              // than the next element
                              if ($arr[$j] > $arr[$j+1])
                              {
                                        $t = $arr[$j];
                                        $arr[$j] = $arr[$j+1];
                                        $arr[$j+1] = $t;
                              }
                    }
          }
}

// Driver code to test above
$arr = array(64, 34, 25, 12, 22, 11, 90);

$len = sizeof($arr);
bubbleSort($arr);

echo "Sorted array : \n";

for ($i = 0; $i < $len; $i++)
          echo $arr[$i]." ";

// This code is contributed by ChitraNayal.
?>

`

);

  return (
    <Container>
```

```
        <h4>
          Bubble sort is a sorting algorithm that compares two adjacent elements
          and swaps them until they are not in the intended order. Just like the
          movement of air bubbles in the water that rise up to the surface, each
          element of the array move to the end in each iteration. Therefore, it is
          called a bubble sort.
        </h4>
        <Tabs>
          <TabList>
            <Tab>C++</Tab>
            <Tab>C</Tab>
            <Tab>Java</Tab>
            <Tab>Python</Tab>
            <Tab>C#</Tab>
            <Tab>PHP</Tab>
          </TabList>

          <TabPanel>
            <CodeEditor
              value={cppcode}
              language="cpp"
              onChange={(evn) => setcppCode(evn.target.value)}
              padding={15}
              style={{
                fontSize: 12,
                backgroundColor: "#f5f5f5",
                fontFamily:
                  "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
              }}
            />
          </TabPanel>
          <TabPanel>
            <CodeEditor
              value={ccode}
              language="c"
              onChange={(evn) => setcCode(evn.target.value)}
              padding={15}
              style={{
                fontSize: 12,
                backgroundColor: "#f5f5f5",
                fontFamily:
                  "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
              }}
            />
          </TabPanel>
          <TabPanel>
            <CodeEditor
              value={javacode}
              language="java"
              onChange={(evn) => setjavaCode(evn.target.value)}
              padding={15}
              style={{
                fontSize: 12,
                backgroundColor: "#f5f5f5",
                fontFamily:
                  "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
              }}
            />
          </TabPanel>
          <TabPanel>
            <CodeEditor
              value={pythoncode}
              language="py"
              onChange={(evn) => setpythonCode(evn.target.value)}
              padding={15}
              style={{
                fontSize: 12,
                backgroundColor: "#f5f5f5",
                fontFamily:
                  "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
              }}
            />
          </TabPanel>
          <TabPanel>
            <CodeEditor
              value={cscode}
              language="csharp"
              onChange={(evn) => setcsCode(evn.target.value)}
              padding={15}
              style={{
                fontSize: 12,
                backgroundColor: "#f5f5f5",
                fontFamily:
                  "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
              }}
            />
          </TabPanel>
          <TabPanel>
            <CodeEditor
              value={phpcode}
              language="php"
              onChange={(evn) => setphpCode(evn.target.value)}
              padding={15}
              style={{
                fontSize: 12,
                backgroundColor: "#f5f5f5",
                fontFamily:
                  "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
              }}
            />
          </TabPanel>
        </Tabs>
      </Container>
     );
}
```

HeapSortTheory.jsx:

```
import React from "react";
import CodeEditor from "@uiw/react-textarea-code-editor";
import { Tab, Tabs, TabList, TabPanel } from "react-tabs";
import "react-tabs/style/react-tabs.css";
import Card from "@material-ui/core/Card";
import styled from "styled-components";

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

export function HeapSortTheory() {

  const [cppcode, setcppCode] = React.useState(
    `
  // C++ program for implementation of Heap Sort
#include <iostream>

using namespace std;

// To heapify a subtree rooted with node i which is
// an index in arr[]. n is size of heap
void heapify(int arr[], int n, int i)
{
	int largest = i; // Initialize largest as root
	int l = 2 * i + 1; // left = 2*i + 1
	int r = 2 * i + 2; // right = 2*i + 2

	// If left child is larger than root
	if (l < n && arr[l] > arr[largest])
		largest = l;
```

```
        // If right child is larger than largest so far
        if (r < n && arr[r] > arr[largest])
                largest = r;

        // If largest is not root
        if (largest != i) {
                swap(arr[i], arr[largest]);

                // Recursively heapify the affected sub-tree
                heapify(arr, n, largest);
        }
}

// main function to do heap sort
void heapSort(int arr[], int n)
{
        // Build heap (rearrange array)
        for (int i = n / 2 - 1; i >= 0; i--)
                heapify(arr, n, i);

        // One by one extract an element from heap
        for (int i = n - 1; i > 0; i--) {
                // Move current root to end
                swap(arr[0], arr[i]);

                // call max heapify on the reduced heap
                heapify(arr, i, 0);
        }
}

/* A utility function to print array of size n */
void printArray(int arr[], int n)
{
        for (int i = 0; i < n; ++i)
                cout << arr[i] << " ";
        cout << "\n";
```

```
}

// Driver code
int main()
{
        int arr[] = { 12, 11, 13, 5, 6, 7 };
        int n = sizeof(arr) / sizeof(arr[0]);

        heapSort(arr, n);

        cout << "Sorted array is \n";
        printArray(arr, n);
}
`
  );

  const [javacode, setjavaCode] = React.useState(
   `
// Java program for implementation of Heap Sort
public class HeapSort {
        public void sort(int arr[])
        {
                int n = arr.length;

                // Build heap (rearrange array)
                for (int i = n / 2 - 1; i >= 0; i--)
                        heapify(arr, n, i);

                // One by one extract an element from heap
                for (int i = n - 1; i > 0; i--) {
                        // Move current root to end
                        int temp = arr[0];
                        arr[0] = arr[i];
                        arr[i] = temp;

                        // call max heapify on the reduced heap
                        heapify(arr, i, 0);
                }
        }

        // To heapify a subtree rooted with node i which is
        // an index in arr[]. n is size of heap
        void heapify(int arr[], int n, int i)
        {
                int largest = i; // Initialize largest as root
                int l = 2 * i + 1; // left = 2*i + 1
                int r = 2 * i + 2; // right = 2*i + 2

                // If left child is larger than root
                if (l < n && arr[l] > arr[largest])
                        largest = l;

                // If right child is larger than largest so far
                if (r < n && arr[r] > arr[largest])
                        largest = r;

                // If largest is not root
                if (largest != i) {
                        int swap = arr[i];
                        arr[i] = arr[largest];
                        arr[largest] = swap;

                        // Recursively heapify the affected sub-tree
                        heapify(arr, n, largest);
                }
        }

        /* A utility function to print array of size n */
        static void printArray(int arr[])
        {
                int n = arr.length;
                for (int i = 0; i < n; ++i)
```

```
                    System.out.print(arr[i] + " ");
                System.out.println();
        }

        // Driver code
        public static void main(String args[])
        {
                int arr[] = { 12, 11, 13, 5, 6, 7 };
                int n = arr.length;

                HeapSort ob = new HeapSort();
                ob.sort(arr);

                System.out.println("Sorted array is");
                printArray(arr);
        }
}
`
  );

  const [pythoncode, setpythonCode] = React.useState(
   `
# Python program for implementation of heap Sort

# To heapify subtree rooted at index i.
# n is size of heap


def heapify(arr, n, i):
        largest = i # Initialize largest as root
        l = 2 * i + 1   # left = 2*i + 1
        r = 2 * i + 2   # right = 2*i + 2

        # See if left child of root exists and is
        # greater than root
        if l < n and arr[largest] < arr[l]:
```

```
		largest = l

	# See if right child of root exists and is
	# greater than root
	if r < n and arr[largest] < arr[r]:
		largest = r

	# Change root, if needed
	if largest != i:
		arr[i], arr[largest] = arr[largest], arr[i] # swap

		# Heapify the root.
		heapify(arr, n, largest)

# The main function to sort an array of given size


def heapSort(arr):
	n = len(arr)

	# Build a maxheap.
	for i in range(n//2 - 1, -1, -1):
		heapify(arr, n, i)

	# One by one extract elements
	for i in range(n-1, 0, -1):
		arr[i], arr[0] = arr[0], arr[i] # swap
		heapify(arr, i, 0)



# Driver code
arr = [12, 11, 13, 5, 6, 7]
heapSort(arr)
n = len(arr)
print("Sorted array is")
for i in range(n):
        print("%d" % arr[i],end=" ")
`

  );

  const [cscode, setcsCode] = React.useState(
    `
// C# program for implementation of Heap Sort
using System;

public class HeapSort {
        public void sort(int[] arr)
        {
                int n = arr.Length;

                // Build heap (rearrange array)
                for (int i = n / 2 - 1; i >= 0; i--)
                        heapify(arr, n, i);

                // One by one extract an element from heap
                for (int i = n - 1; i > 0; i--) {
                        // Move current root to end
                        int temp = arr[0];
                        arr[0] = arr[i];
                        arr[i] = temp;

                        // call max heapify on the reduced heap
                        heapify(arr, i, 0);
                }
        }

        // To heapify a subtree rooted with node i which is
        // an index in arr[]. n is size of heap
        void heapify(int[] arr, int n, int i)
        {
                int largest = i; // Initialize largest as root
                int l = 2 * i + 1; // left = 2*i + 1
        int r = 2 * i + 2; // right = 2*i + 2

        // If left child is larger than root
        if (l < n && arr[l] > arr[largest])
            largest = l;

        // If right child is larger than largest so far
        if (r < n && arr[r] > arr[largest])
            largest = r;

        // If largest is not root
        if (largest != i) {
            int swap = arr[i];
            arr[i] = arr[largest];
            arr[largest] = swap;

            // Recursively heapify the affected sub-tree
            heapify(arr, n, largest);
        }
    }

    /* A utility function to print array of size n */
    static void printArray(int[] arr)
    {
        int n = arr.Length;
        for (int i = 0; i < n; ++i)
            Console.Write(arr[i] + " ");
        Console.Read();
    }

    // Driver code
    public static void Main()
    {
        int[] arr = { 12, 11, 13, 5, 6, 7 };
        int n = arr.Length;
```

```
                    HeapSort ob = new HeapSort();
                    ob.sort(arr);

                    Console.WriteLine("Sorted array is");
                    printArray(arr);
          }
}
`
  );

  const [phpcode, setphpCode] = React.useState(
    `
<?php

// Php program for implementation of Heap Sort

// To heapify a subtree rooted with node i which is
// an index in arr[]. n is size of heap
function heapify(&$arr, $n, $i)
{
          $largest = $i; // Initialize largest as root
          $l = 2*$i + 1; // left = 2*i + 1
          $r = 2*$i + 2; // right = 2*i + 2

          // If left child is larger than root
          if ($l < $n && $arr[$l] > $arr[$largest])
                    $largest = $l;

          // If right child is larger than largest so far
          if ($r < $n && $arr[$r] > $arr[$largest])
                    $largest = $r;

          // If largest is not root
          if ($largest != $i)
          {
                    $swap = $arr[$i];
```

```
                $arr[$i] = $arr[$largest];
                $arr[$largest] = $swap;

                // Recursively heapify the affected sub-tree
                heapify($arr, $n, $largest);
        }
}

// main function to do heap sort
function heapSort(&$arr, $n)
{
        // Build heap (rearrange array)
        for ($i = $n / 2 - 1; $i >= 0; $i--)
                heapify($arr, $n, $i);

        // One by one extract an element from heap
        for ($i = $n-1; $i > 0; $i--)
        {
                // Move current root to end
                $temp = $arr[0];
                        $arr[0] = $arr[$i];
                        $arr[$i] = $temp;

                // call max heapify on the reduced heap
                heapify($arr, $i, 0);
        }
}

/* A utility function to print array of size n */
function printArray(&$arr, $n)
{
        for ($i = 0; $i < $n; ++$i)
                echo ($arr[$i]." ") ;

}
```

```
// Driver program
        $arr = array(12, 11, 13, 5, 6, 7);
        $n = sizeof($arr)/sizeof($arr[0]);

        heapSort($arr, $n);

        echo 'Sorted array is ' . "\n";

        printArray($arr , $n);
?>


`
  );

  return (
    <Container>
      <h4>
        Heap sort is one of the sorting algorithms used to arrange a list of
        elements in order. Heapsort algorithm uses one of the tree concepts
        called Heap Tree. In this sorting algorithm, we use Max Heap to arrange
        list of elements in Descending order and Min Heap to arrange list
        elements in Ascending order.
      </h4>
      <Tabs>
        <TabList>
          <Tab>C++</Tab>
          <Tab>C</Tab>
          <Tab>Java</Tab>
          <Tab>Python</Tab>
          <Tab>C#</Tab>
          <Tab>PHP</Tab>
        </TabList>

        <TabPanel>
          <CodeEditor
```

```
            value={cppcode}
            language="cpp"
            onChange={(evn) => setcppCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={javacode}
            language="java"
            onChange={(evn) => setjavaCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={pythoncode}
            language="py"
            onChange={(evn) => setpythonCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={cscode}
            language="csharp"
            onChange={(evn) => setcsCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={phpcode}
            language="php"
            onChange={(evn) => setphpCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
       </Tabs>
    </Container>
  );
}
```

InsertionsSortTheory.jsx:

```
import React from "react";
import CodeEditor from "@uiw/react-textarea-code-editor";
import { Tab, Tabs, TabList, TabPanel } from "react-tabs";
import "react-tabs/style/react-tabs.css";
import Card from "@material-ui/core/Card";
import styled from "styled-components";

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

export function InsertionSortTheory() {

  const [cppcode, setcppCode] = React.useState(
    `// C++ program for insertion sort
#include <bits/stdc++.h>
using namespace std;

/* Function to sort an array using insertion sort*/
void insertionSort(int arr[], int n)
{
	int i, key, j;
	for (i = 1; i < n; i++)
	{
		key = arr[i];
		j = i - 1;

		/* Move elements of arr[0..i-1], that are
```

```
                greater than key, to one position ahead
                of their current position */
                while (j >= 0 && arr[j] > key)
                {
                        arr[j + 1] = arr[j];
                        j = j - 1;
                }
                arr[j + 1] = key;
        }
}

// A utility function to print an array of size n
void printArray(int arr[], int n)
{
        int i;
        for (i = 0; i < n; i++)
                cout << arr[i] << " ";
        cout << endl;
}

/* Driver code */
int main()
{
        int arr[] = { 12, 11, 13, 5, 6 };
        int n = sizeof(arr) / sizeof(arr[0]);

        insertionSort(arr, n);
        printArray(arr, n);

        return 0;
}
`
  );

  const [ccode, setcCode] = React.useState(
    `
```

```
 // C program for insertion sort
#include <math.h>
#include <stdio.h>

/* Function to sort an array using insertion sort*/
void insertionSort(int arr[], int n)
{
	int i, key, j;
	for (i = 1; i < n; i++) {
		key = arr[i];
		j = i - 1;

		/* Move elements of arr[0..i-1], that are
		greater than key, to one position ahead
		of their current position */
		while (j >= 0 && arr[j] > key) {
			arr[j + 1] = arr[j];
			j = j - 1;
		}
		arr[j + 1] = key;
	}
}

// A utility function to print an array of size n
void printArray(int arr[], int n)
{
	int i;
	for (i = 0; i < n; i++)
		printf("%d ", arr[i]);
	printf("\n");
}

/* Driver program to test insertion sort */
int main()
{
	int arr[] = { 12, 11, 13, 5, 6 };
```

```
        int n = sizeof(arr) / sizeof(arr[0]);

        insertionSort(arr, n);
        printArray(arr, n);

        return 0;
}
`
  );

  const [javacode, setjavaCode] = React.useState(
    `
// Java program for implementation of Insertion Sort
class InsertionSort {
        /*Function to sort array using insertion sort*/
        void sort(int arr[])
        {
                int n = arr.length;
                for (int i = 1; i < n; ++i) {
                        int key = arr[i];
                        int j = i - 1;

                        /* Move elements of arr[0..i-1], that are
                        greater than key, to one position ahead
                        of their current position */
                        while (j >= 0 && arr[j] > key) {
                                arr[j + 1] = arr[j];
                                j = j - 1;
                        }
                        arr[j + 1] = key;
                }
        }

        /* A utility function to print array of size n*/
        static void printArray(int arr[])
        {
                int n = arr.length;
                for (int i = 0; i < n; ++i)
                        System.out.print(arr[i] + " ");

                System.out.println();
        }

        // Driver method
        public static void main(String args[])
        {
                int arr[] = { 12, 11, 13, 5, 6 };

                InsertionSort ob = new InsertionSort();
                ob.sort(arr);

                printArray(arr);
        }
}

`
  );

  const [pythoncode, setpythonCode] = React.useState(
    `
  # Python program for implementation of Insertion Sort

# Function to do insertion sort
def insertionSort(arr):

        # Traverse through 1 to len(arr)
        for i in range(1, len(arr)):

                key = arr[i]

                # Move elements of arr[0..i-1], that are
                # greater than key, to one position ahead
                # of their current position
                j = i-1
                while j >= 0 and key < arr[j] :
                        arr[j + 1] = arr[j]
                        j -= 1
                arr[j + 1] = key


# Driver code to test above
arr = [12, 11, 13, 5, 6]
insertionSort(arr)
for i in range(len(arr)):
        print ("% d" % arr[i])
`
 );

 const [cscode, setcsCode] = React.useState(
  `
// C# program for implementation of Insertion Sort
using System;

class InsertionSort {

        // Function to sort array
        // using insertion sort
        void sort(int[] arr)
        {
                int n = arr.Length;
                for (int i = 1; i < n; ++i) {
                        int key = arr[i];
                        int j = i - 1;

                        // Move elements of arr[0..i-1],
                        // that are greater than key,
                        // to one position ahead of
                        // their current position
                        while (j >= 0 && arr[j] > key) {
                                arr[j + 1] = arr[j];
                                j = j - 1;
                        }
                        arr[j + 1] = key;
                }
        }

        // A utility function to print
        // array of size n
        static void printArray(int[] arr)
        {
                int n = arr.Length;
                for (int i = 0; i < n; ++i)
                        Console.Write(arr[i] + " ");

                Console.Write("\n");
        }

        // Driver Code
        public static void Main()
        {
                int[] arr = { 12, 11, 13, 5, 6 };
                InsertionSort ob = new InsertionSort();
                ob.sort(arr);
                printArray(arr);
        }
}

`
  );

  const [phpcode, setphpCode] = React.useState(
    `
<?php
// PHP program for insertion sort
// Function to sort an array
// using insertion sort
function insertionSort(&$arr, $n)
{
        for ($i = 1; $i < $n; $i++)
        {
                $key = $arr[$i];
                $j = $i-1;

                // Move elements of arr[0..i-1],
                // that are greater than key, to
                // one position ahead of their
                // current position
                while ($j >= 0 && $arr[$j] > $key)
                {
                        $arr[$j + 1] = $arr[$j];
                        $j = $j - 1;
                }

                $arr[$j + 1] = $key;
        }
}

// A utility function to
// print an array of size n
function printArray(&$arr, $n)
{
        for ($i = 0; $i < $n; $i++)
                echo $arr[$i]." ";
        echo "\n";
}

// Driver Code
$arr = array(12, 11, 13, 5, 6);
$n = sizeof($arr);
```

```
insertionSort($arr, $n);
printArray($arr, $n);
?>

`
  );

  return (
    <Container>
      <h4>
        Insertion sort is a simple sorting algorithm that works similar to the
        way you sort playing cards in your hands. The array is virtually split
        into a sorted and an unsorted part. Values from the unsorted part are
        picked and placed at the correct position in the sorted part.
      </h4>
      <Tabs>
        <TabList>
          <Tab>C++</Tab>
          <Tab>C</Tab>
          <Tab>Java</Tab>
          <Tab>Python</Tab>
          <Tab>C#</Tab>
          <Tab>PHP</Tab>
        </TabList>

        <TabPanel>
          <CodeEditor
            value={cppcode}
            language="cpp"
            onChange={(evn) => setcppCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={ccode}
            language="c"
            onChange={(evn) => setcCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={javacode}
            language="java"
            onChange={(evn) => setjavaCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={pythoncode}
            language="py"
            onChange={(evn) => setpythonCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={cscode}
            language="csharp"
            onChange={(evn) => setcsCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={phpcode}
            language="php"
            onChange={(evn) => setphpCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
      </Tabs>
    </Container>
  );
}
```

QuickSortTheory.jsx:

```
import React from "react";
import CodeEditor from "@uiw/react-textarea-code-editor";
import { Tab, Tabs, TabList, TabPanel } from "react-tabs";
import "react-tabs/style/react-tabs.css";
import Card from "@material-ui/core/Card";
import styled from "styled-components";

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

export function QuickSortTheory() {

  const [cppcode, setcppCode] = React.useState(
    `
/* C++ implementation of QuickSort */
#include <bits/stdc++.h>
using namespace std;

// A utility function to swap two elements
void swap(int* a, int* b)
{
          int t = *a;
```

```
        *a = *b;
        *b = t;
}

/* This function takes last element as pivot, places
the pivot element at its correct position in sorted
array, and places all smaller (smaller than pivot)
to left of pivot and all greater elements to right
of pivot */
int partition (int arr[], int low, int high)
{
        int pivot = arr[high]; // pivot
        int i = (low - 1); // Index of smaller element and indicates the right position of
pivot found so far

        for (int j = low; j <= high - 1; j++)
        {
                // If current element is smaller than the pivot
                if (arr[j] < pivot)
                {
                        i++; // increment index of smaller element
                        swap(&arr[i], &arr[j]);
                }
        }
        swap(&arr[i + 1], &arr[high]);
        return (i + 1);
}

/* The main function that implements QuickSort
arr[] --> Array to be sorted,
low --> Starting index,
high --> Ending index */
void quickSort(int arr[], int low, int high)
{
        if (low < high)
        {
                /* pi is partitioning index, arr[p] is now
                at right place */
                int pi = partition(arr, low, high);

                // Separately sort elements before
                // partition and after partition
                quickSort(arr, low, pi - 1);
                quickSort(arr, pi + 1, high);
        }
}

/* Function to print an array */
void printArray(int arr[], int size)
{
        int i;
        for (i = 0; i < size; i++)
                cout << arr[i] << " ";
        cout << endl;
}

// Driver Code
int main()
{
        int arr[] = {10, 7, 8, 9, 1, 5};
        int n = sizeof(arr) / sizeof(arr[0]);
        quickSort(arr, 0, n - 1);
        cout << "Sorted array: \n";
        printArray(arr, n);
        return 0;
}
`
  );

  const [javacode, setjavaCode] = React.useState(
    `
// Java implementation of QuickSort
import java.io.*;
```

```
class GFG{

// A utility function to swap two elements
static void swap(int[] arr, int i, int j)
{
        int temp = arr[i];
        arr[i] = arr[j];
        arr[j] = temp;
}

/* This function takes last element as pivot, places
the pivot element at its correct position in sorted
array, and places all smaller (smaller than pivot)
to left of pivot and all greater elements to right
of pivot */
static int partition(int[] arr, int low, int high)
{

        // pivot
        int pivot = arr[high];

        // Index of smaller element and
        // indicates the right position
        // of pivot found so far
        int i = (low - 1);

        for(int j = low; j <= high - 1; j++)
        {

                // If current element is smaller
                // than the pivot
                if (arr[j] < pivot)
                {

                        // Increment index of
                // smaller element
                i++;
                swap(arr, i, j);
            }
        }
        swap(arr, i + 1, high);
        return (i + 1);
    }

    /* The main function that implements QuickSort
            arr[] --> Array to be sorted,
            low --> Starting index,
            high --> Ending index
    */
    static void quickSort(int[] arr, int low, int high)
    {
        if (low < high)
        {

            // pi is partitioning index, arr[p]
            // is now at right place
            int pi = partition(arr, low, high);

            // Separately sort elements before
            // partition and after partition
            quickSort(arr, low, pi - 1);
            quickSort(arr, pi + 1, high);
        }
    }

    // Function to print an array
    static void printArray(int[] arr, int size)
    {
        for(int i = 0; i < size; i++)
            System.out.print(arr[i] + " ");
```

```
          System.out.println();
}

// Driver Code
public static void main(String[] args)
{
          int[] arr = { 10, 7, 8, 9, 1, 5 };
          int n = arr.length;

          quickSort(arr, 0, n - 1);
          System.out.println("Sorted array: ");
          printArray(arr, n);
}
}

// This code is contributed by Ayush Choudhary
`
  );

  const [pythoncode, setpythonCode] = React.useState(
    `
# Python3 implementation of QuickSort

# This Function handles sorting part of quick sort
# start and end points to first and last element of
# an array respectively
def partition(start, end, array):

          # Initializing pivot's index to start
          pivot_index = start
          pivot = array[pivot_index]

          # This loop runs till start pointer crosses
          # end pointer, and when it does we swap the
          # pivot with element on end pointer
          while start < end:
```

```
        # Increment the start pointer till it finds an
        # element greater than pivot
        while start < len(array) and array[start] <= pivot:
            start += 1

        # Decrement the end pointer till it finds an
        # element less than pivot
        while array[end] > pivot:
            end -= 1

        # If start and end have not crossed each other,
        # swap the numbers on start and end
        if(start < end):
            array[start], array[end] = array[end], array[start]

    # Swap pivot element with element on end pointer.
    # This puts pivot on its correct sorted place.
    array[end], array[pivot_index] = array[pivot_index], array[end]

    # Returning end pointer to divide the array into 2
    return end

# The main function that implements QuickSort
def quick_sort(start, end, array):

    if (start < end):

        # p is partitioning index, array[p]
        # is at right place
        p = partition(start, end, array)

        # Sort elements before partition
        # and after partition
        quick_sort(start, p - 1, array)
        quick_sort(p + 1, end, array)
```

```
# Driver code
array = [ 10, 7, 8, 9, 1, 5 ]
quick_sort(0, len(array) - 1, array)

print(f'Sorted array: {array}')
`
  );

  return (
    <Container>
      <h4>
        QuickSort is a Divide and Conquer algorithm. It picks an element as
        pivot and partitions the given array around the picked pivot. There are
        many different versions of quickSort that pick pivot in different ways.
        <span>
          <ol>
            <li>Always pick first element as pivot.</li>
            <li>Always pick last element as pivot</li>
            <li>Pick a random element as pivot. </li>
            <li>Pick median as pivot. </li>
          </ol>
        </span>
        The key process in quickSort is partition(). Target of partitions is,
        given an array and an element x of array as pivot, put x at its correct
        position in sorted array and put all smaller elements (smaller than x)
        before x, and put all greater elements (greater than x) after x.
      </h4>
      <Tabs>
        <TabList>
          <Tab>C++</Tab>
          <Tab>C</Tab>
          <Tab>Java</Tab>
          <Tab>Python</Tab>
        </TabList>
        <TabPanel>
          <CodeEditor
            value={cppcode}
            language="cpp"
            onChange={(evn) => setcppCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={javacode}
            language="java"
            onChange={(evn) => setjavaCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={pythoncode}
            language="py"
            onChange={(evn) => setpythonCode(evn.target.value)}
            padding={15}
            style={{
```

```
            fontSize: 12,
            backgroundColor: "#f5f5f5",
            fontFamily:
              "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
          }}
        />
      </TabPanel>
    </Tabs>
  </Container>
 );
}
```

SelectionSortTheory.jsx:

```
import React from "react";
import CodeEditor from "@uiw/react-textarea-code-editor";
import { Tab, Tabs, TabList, TabPanel } from "react-tabs";
import "react-tabs/style/react-tabs.css";
import Card from "@material-ui/core/Card";
import styled from "styled-components";

const Container = styled(Card)`
  padding: 10px;
  border: 1px solid rgba(0, 0, 0, 0.15);
`;

export function SelectionSortTheory() {
  const [cppcode, setcppCode] = React.useState(
    `// C++ program for implementation of selection sort
#include <bits/stdc++.h>
using namespace std;

void swap(int *xp, int *yp)
```

```
{
        int temp = *xp;
        *xp = *yp;
        *yp = temp;
}

void selectionSort(int arr[], int n)
{
        int i, j, min_idx;

        // One by one move boundary of unsorted subarray
        for (i = 0; i < n-1; i++)
        {
                // Find the minimum element in unsorted array
                min_idx = i;
                for (j = i+1; j < n; j++)
                if (arr[j] < arr[min_idx])
                        min_idx = j;

                // Swap the found minimum element with the first element
                swap(&arr[min_idx], &arr[i]);
        }
}

/* Function to print an array */
void printArray(int arr[], int size)
{
        int i;
        for (i=0; i < size; i++)
                cout << arr[i] << " ";
        cout << endl;
}

// Driver program to test above functions
int main()
{
```

```
          int arr[] = {64, 25, 12, 22, 11};
          int n = sizeof(arr)/sizeof(arr[0]);
          selectionSort(arr, n);
          cout << "Sorted array: \n";
          printArray(arr, n);
          return 0;
}
`
  );

  const [ccode, setcCode] = React.useState(
    `
  // C program for implementation of selection sort
#include <stdio.h>

void swap(int *xp, int *yp)
{
          int temp = *xp;
          *xp = *yp;
          *yp = temp;
}

void selectionSort(int arr[], int n)
{
          int i, j, min_idx;

          // One by one move boundary of unsorted subarray
          for (i = 0; i < n-1; i++)
          {
                    // Find the minimum element in unsorted array
                    min_idx = i;
                    for (j = i+1; j < n; j++)
                    if (arr[j] < arr[min_idx])
                              min_idx = j;

                    // Swap the found minimum element with the first element
```

```
                swap(&arr[min_idx], &arr[i]);
        }
}

/* Function to print an array */
void printArray(int arr[], int size)
{
        int i;
        for (i=0; i < size; i++)
                printf("%d ", arr[i]);
        printf("\n");
}

// Driver program to test above functions
int main()
{
        int arr[] = {64, 25, 12, 22, 11};
        int n = sizeof(arr)/sizeof(arr[0]);
        selectionSort(arr, n);
        printf("Sorted array: \n");
        printArray(arr, n);
        return 0;
}
`
  );

  const [javacode, setjavaCode] = React.useState(
    `
// Java program for implementation of Selection Sort
class SelectionSort
{
        void sort(int arr[])
        {
                int n = arr.length;

                // One by one move boundary of unsorted subarray
        for (int i = 0; i < n-1; i++)
        {
            // Find the minimum element in unsorted array
            int min_idx = i;
            for (int j = i+1; j < n; j++)
                if (arr[j] < arr[min_idx])
                    min_idx = j;

            // Swap the found minimum element with the first
            // element
            int temp = arr[min_idx];
            arr[min_idx] = arr[i];
            arr[i] = temp;
        }
    }

    // Prints the array
    void printArray(int arr[])
    {
        int n = arr.length;
        for (int i=0; i<n; ++i)
            System.out.print(arr[i]+" ");
        System.out.println();
    }

    // Driver code to test above
    public static void main(String args[])
    {
        SelectionSort ob = new SelectionSort();
        int arr[] = {64,25,12,22,11};
        ob.sort(arr);
        System.out.println("Sorted array");
        ob.printArray(arr);
    }
}
```

```
`
  );

  const [pythoncode, setpythonCode] = React.useState(
    `# Python program for implementation of Selection
# Sort
import sys
A = [64, 25, 12, 22, 11]

# Traverse through all array elements
for i in range(len(A)):

        # Find the minimum element in remaining
        # unsorted array
        min_idx = i
        for j in range(i+1, len(A)):
                if A[min_idx] > A[j]:
                        min_idx = j

        # Swap the found minimum element with
        # the first element
        A[i], A[min_idx] = A[min_idx], A[i]

# Driver code to test above
print ("Sorted array")
for i in range(len(A)):
        print("%d" %A[i],end=" ")
`
  );

  const [cscode, setcsCode] = React.useState(
    `
// C# program for implementation
// of Selection Sort
using System;
```

```
class GFG
{
    static void sort(int []arr)
    {
        int n = arr.Length;

        // One by one move boundary of unsorted subarray
        for (int i = 0; i < n - 1; i++)
        {
            // Find the minimum element in unsorted array
            int min_idx = i;
            for (int j = i + 1; j < n; j++)
                if (arr[j] < arr[min_idx])
                    min_idx = j;

            // Swap the found minimum element with the first
            // element
            int temp = arr[min_idx];
            arr[min_idx] = arr[i];
            arr[i] = temp;
        }
    }

    // Prints the array
    static void printArray(int []arr)
    {
        int n = arr.Length;
        for (int i=0; i<n; ++i)
            Console.Write(arr[i]+" ");
        Console.WriteLine();
    }

    // Driver code
    public static void Main()
    {
```

```
                int []arr = {64,25,12,22,11};
                sort(arr);
                Console.WriteLine("Sorted array");
                printArray(arr);
        }

}
`
 );

 const [phpcode, setphpCode] = React.useState(
  `
<?php
// PHP program for implementation
// of selection sort
function selection_sort(&$arr, $n)
{
        for($i = 0; $i < $n ; $i++)
        {
                $low = $i;
                for($j = $i + 1; $j < $n ; $j++)
                {
                        if ($arr[$j] < $arr[$low])
                        {
                                $low = $j;
                        }
                }

                // swap the minimum value to $ith node
                if ($arr[$i] > $arr[$low])
                {
                        $tmp = $arr[$i];
                        $arr[$i] = $arr[$low];
                        $arr[$low] = $tmp;
                }
        }
```

```
}

// Driver Code
$arr = array(64, 25, 12, 22, 11);
$len = count($arr);
selection_sort($arr, $len);
echo "Sorted array : \n";

for ($i = 0; $i < $len; $i++)
          echo $arr[$i] . " ";
?>

`
  );

  return (
    <Container>
      <h4>
        Selection sort is a sorting algorithm that selects the smallest element
        from an unsorted list in each iteration and places that element at the
        beginning of the unsorted list.
      </h4>
      <Tabs>
        <TabList>
          <Tab>C++</Tab>
          <Tab>C</Tab>
          <Tab>Java</Tab>
          <Tab>Python</Tab>
          <Tab>C#</Tab>
          <Tab>PHP</Tab>
        </TabList>

        <TabPanel>
          <CodeEditor
            value={cppcode}
            language="cpp"
            onChange={(evn) => setcppCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
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            language="c"
            onChange={(evn) => setcCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
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            language="java"
            onChange={(evn) => setjavaCode(evn.target.value)}
            padding={15}
            style={{
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              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={pythoncode}
            language="py"
            onChange={(evn) => setpythonCode(evn.target.value)}
            padding={15}
            style={{
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              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={cscode}
            language="csharp"
            onChange={(evn) => setcsCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
        <TabPanel>
          <CodeEditor
            value={phpcode}
            language="php"
            onChange={(evn) => setphpCode(evn.target.value)}
            padding={15}
            style={{
              fontSize: 12,
              backgroundColor: "#f5f5f5",
              fontFamily:
                "ui-monospace,SFMono-Regular,SF Mono,Consolas,Liberation
Mono,Menlo,monospace",
            }}
          />
        </TabPanel>
      </Tabs>
    </Container>
  );
}
```
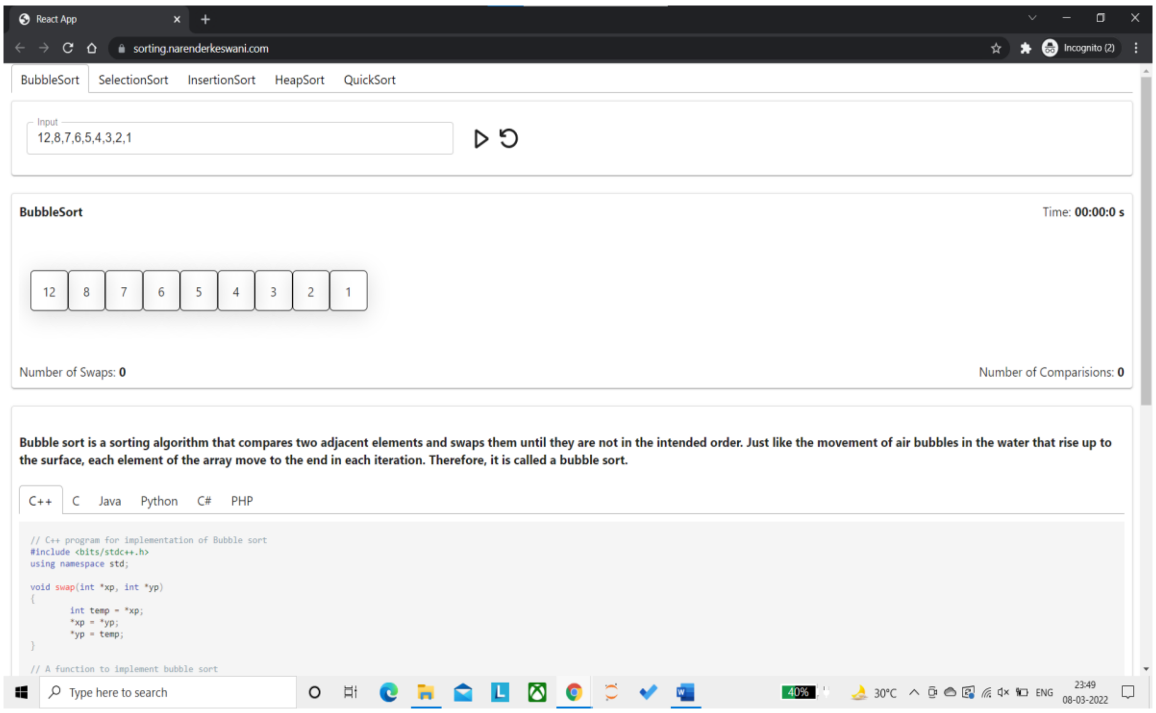

ScreenShots:

Basic Layout:

We can see a panel with bubble sort selected as the method, it has provided us with an input box(for array), visualization panel, algorithm description panel and code panel.



Bubble sort is a sorting algorithm that compares two adjacent elements and swaps them until they are not in the intended order. Just like the movement of air bubbles in the water that rise up to the surface, each element of the array move to the end in each iteration. Therefore, it is called a bubble sort.

```
// C++ program for implementation of Bubble sort
#include <bits/stdc++.h>
using namespace std;

void swap(int *xp, int *yp)
{
        int temp = *xp;
        *xp = *yp;
        *yp = temp;
}

// A function to implement bubble sort
```

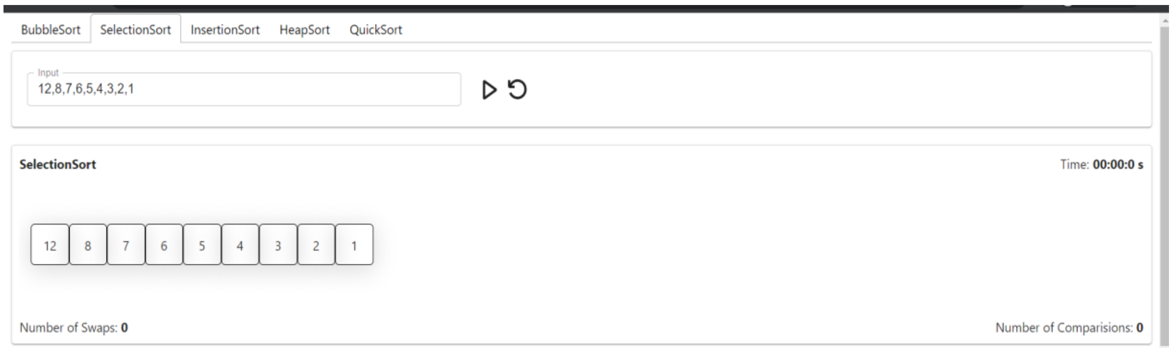
Functioning Visualization Panel:

We can see the input box where we can put our array to be sorted with separation by comma. We can see a run button to start visualization and a restart button to restart it.

We can also see a timer at the right corner that shows the total time taken by the algorithm to sort the array.

We also have a count of the number of comparisons the algorithm does throughout the sorting process.

In the bottom left, we have the number of swaps the algorithm will perform throughout the process.



12,8,7,6,5,4,3,2,1

SelectionSort

Time: **00:00:0 s**

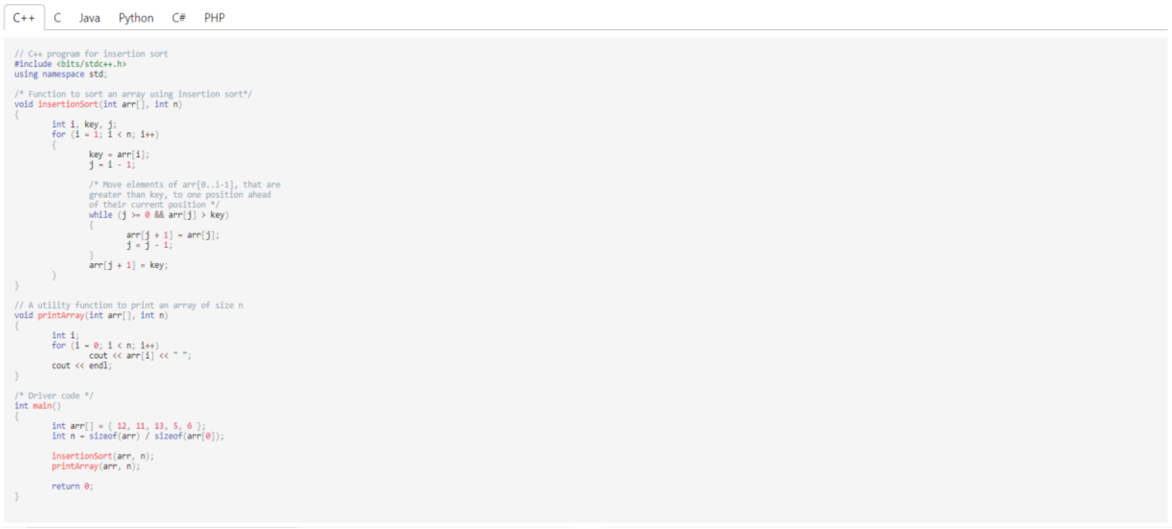
12	8	7	6	5	4	3	2	1

Number of Swaps: **0**

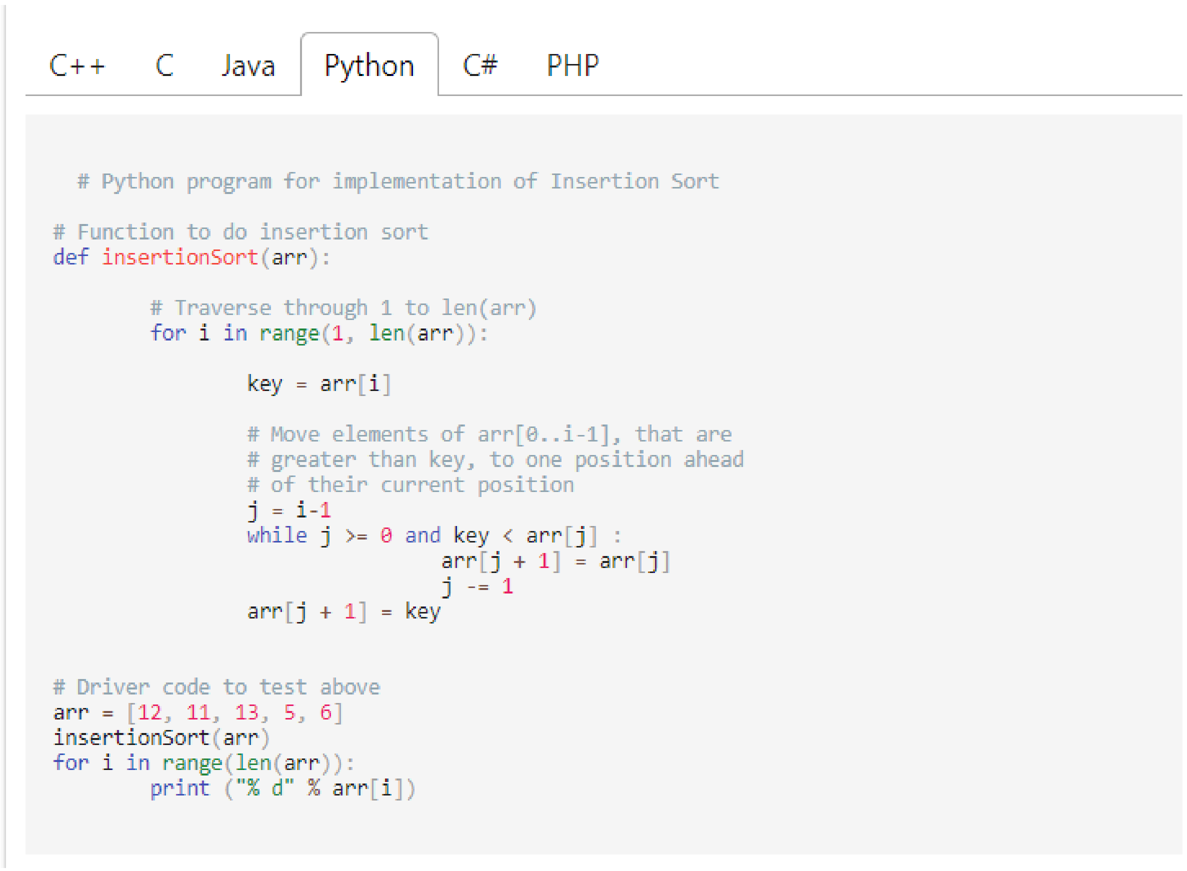
Number of Comparisions: **0**

Code Panel:

We can see that we get the code of the selected algorithm in selected programming languages.



```cpp
// C++ program for insertion sort
#include <bits/stdc++.h>
using namespace std;

/* Function to sort an array using insertion sort*/
void insertionSort(int arr[], int n)
{
        int i, key, j;
        for (i = 1; i < n; i++)
        {
                key = arr[i];
                j = i - 1;

                /* Move elements of arr[0..i-1], that are
                greater than key, to one position ahead
                of their current position */
                while (j >= 0 && arr[j] > key)
                {
                        arr[j + 1] = arr[j];
                        j = j - 1;
                }
                arr[j + 1] = key;
        }
}

// A utility function to print an array of size n
void printArray(int arr[], int n)
{
        int i;
        for (i = 0; i < n; i++)
                cout << arr[i] << " ";
        cout << endl;
}

/* Driver code */
int main()
{
        int arr[] = { 12, 11, 13, 5, 6 };
        int n = sizeof(arr) / sizeof(arr[0]);

        insertionSort(arr, n);
        printArray(arr, n);

        return 0;
}
```

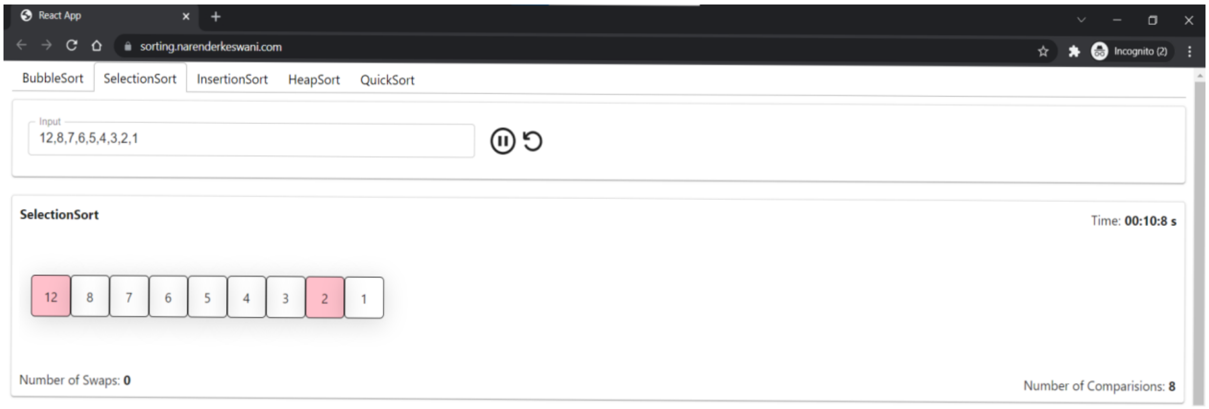


```
  # Python program for implementation of Insertion Sort

# Function to do insertion sort
def insertionSort(arr):

        # Traverse through 1 to len(arr)
        for i in range(1, len(arr)):

                key = arr[i]

                # Move elements of arr[0..i-1], that are
                # greater than key, to one position ahead
                # of their current position
                j = i-1
                while j >= 0 and key < arr[j] :
                                arr[j + 1] = arr[j]
                                j -= 1
                arr[j + 1] = key


# Driver code to test above
arr = [12, 11, 13, 5, 6]
insertionSort(arr)
for i in range(len(arr)):
        print ("% d" % arr[i])
```

Visualization Process:

Comparison

The numbers in red indicate that they are being compared in that iteration.



Input
12,8,7,6,5,4,3,2,1

SelectionSort

Time: **00:10:8 s**

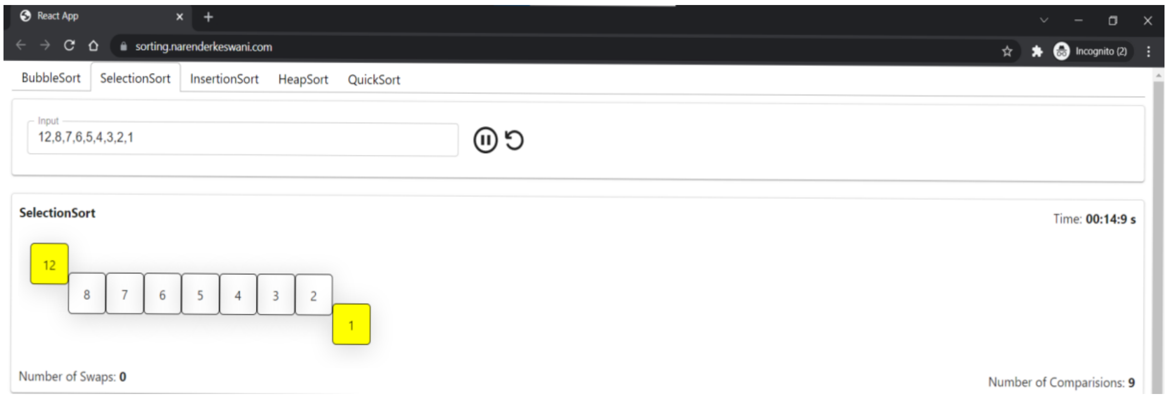
| 12 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

Number of Swaps: **0**

Number of Comparisions: **8**

Swap

Numbers in yellow indicate that the condition is satisfied and hence those two numbers will now be swapped. We can observe the number of swaps, comparisons and time till current iteration.



12,8,7,6,5,4,3,2,1

SelectionSort

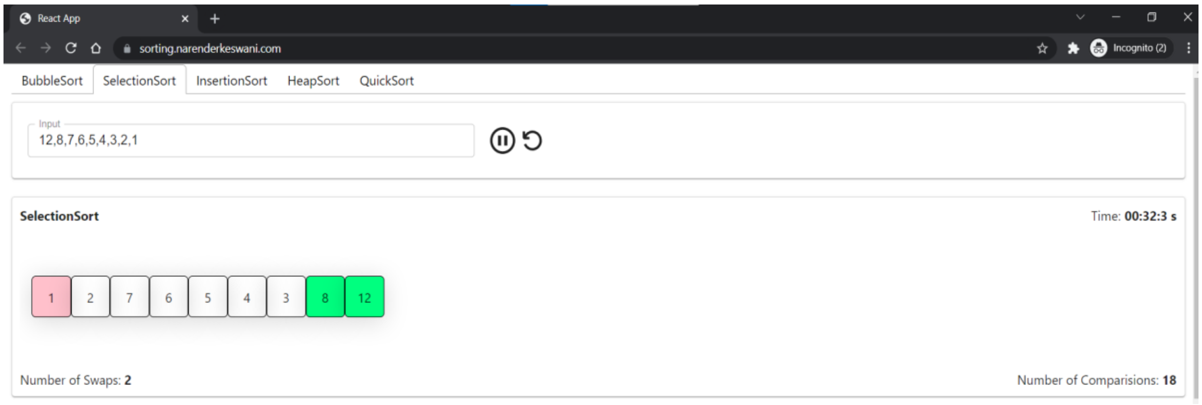
Time: 00:14:9 s

Number of Swaps: 0

Number of Comparisions: 9

Position Finalized

The numbers which now have a fixed position in the array are indicated in green box.



12,8,7,6,5,4,3,2,1

SelectionSort

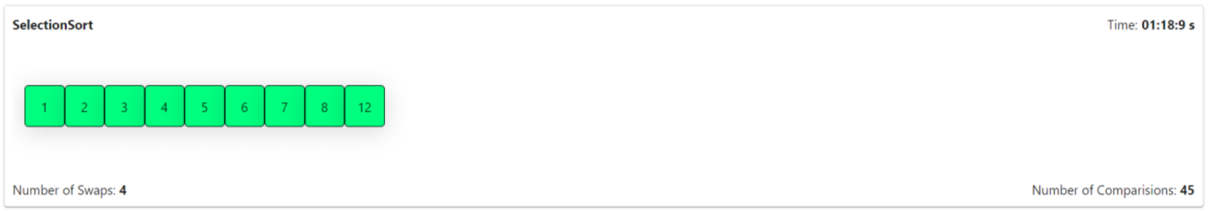
Time: 00:32:3 s

Number of Swaps: 2

Number of Comparisions: 18

Whole array sorted

When all the boxes are green, the algorithm stops as the array is sorted. Now the number of swaps, comparisons and time is final.


SelectionSort

Time: 01:18:9 s

Number of Swaps: 4

Number of Comparisions: 45

6. CONCLUSION:

Online education is here and is highly likely to stay and grow. The review of its history clearly shows online education has developed rapidly, fueled by Internet connectivity, advanced technology, and a massive market. The Internet has made online learning possible, and many researchers and educators are interested in online learning to enhance and improve student learning outcomes. This website Gives Overview and Visualization of a Each and every Data Structure which we will including in that Website Online Education Brought a Positive Impact in the Lives of Student and Working Professionals. In future this website can get updated as per the requirement of the Student with new ideas and also different Programming concepts and all other languages. We can Also Include compile, video lecture, coding projects, coding challenges. We will include more features, function For Online Learning Like code editor, We can Also Include compile, video lecture, coding projects, coding challenges.

This system is implemented for visualizing of algorithms. This is a helpful tool for all kinds of learners/scholars to easily understand the implicit sequences of algorithm . Here the users are allowed to select the options, either searching or sorting and graph path finding . Then they are allowed to give input and they can select the algorithms from the list and the algorithm is explained visually. In future to enhance and continue this project, the system may include greedy algorithm and dynamic progrmming . Voice can further be included to the system, to give more interaction for the end users. It helps to improve the quality of education in the field

7. REFERENCES:

[1] K. Mehlhorn, P. Sanders, Algorithms and Data Structures (Springer-Verlag, Berlin Heidelberg, 2008)

[2] GeeksForGeeks: https://www.geeksforgeeks.org/sorting-algorithms/

[3] S. Khuri, Designing Effective Algorithm Visualizations, In proceedings of: First International Program Visualization Workshop, ITiCSE, Porvoo, Finland, July 7 - 8, 2000, Available: http://www.cs.sjsu.edu/~khuri/invited.html

[4] C.D. Hundhausen, S.A. Douglas, J.T. Stasko, A Meta-Study of Algorithm Visualization Effectiveness, J. Visual Lang. Comput. 13, 259–290, 2002

[5] ACM/IEEE-CS Joint Task Force on Computing Curricula, Computer Science Curricula 2013, ACM Press and IEEE Computer Society Press, December 2013.

Check Live Project at: https://sorting.narenderkeswani.com/