9th October 2023

EEE1111 - ALGORITHMS AND DATA STRUCTURES WORKSHEET

Date	Number of User	Number of Logins
01.05.2023	10.164.251	63.021.065
02.05.2023	16.330.827	63.033.018
03.05.2023	15.127.150	63.041.776
04.05.2023	14.598.691	63.049.955
05.05.2023	14.270.115	63.058.553
06.05.2023	9.847.343	63.057.960
07.05.2023	9.191.391	63.058.178
08.05.2023	20.358.442	63.069.180
09.05.2023	17.251.802	63.076.544
10.05.2023	15.907.337	63.084.360
11.05.2023	14.270.511	63.092.103
12.05.2023	13.213.020	63.100.240
13.05.2023	9.348.927	63.100.647
14.05.2023	9.629.216	63.100.854
15.05.2023	11.929.745	63.108.596
16.05.2023	12.796.195	63.117.114
17.05.2023	12.459.491	63.125.061
18.05.2023	12.138.921	63.132.481
19.05.2023	8.030.905	63.133.192
20.05.2023	7.246.754	63.133.633
21.05.2023	7.217.819	63.134.023
22.05.2023	15.663.798	63.143.703
23.05.2023	14.657.510	63.151.049
24.05.2023	13.891.395	63.158.305
25.05.2023	13.490.705	63.165.277
26.05.2023	13.508.114	63.172.062
27.05.2023	8.667.563	63.171.892
28.05.2023	10.686.003	63.171.723
29.05.2023	14.081.875	63.180.543
30.05.2023	13.986.422	63.186.729

The given table displays the monthly number of users and logins for an e-commerce application. Write three algorithm examples using this data.

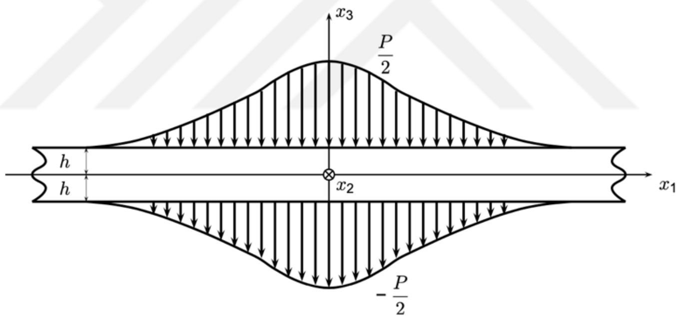

Figure Antisymmetric deformation of an elastic layer under normal surface loading

Consider antisymmetric deformation of an elastic plate subjected to prescribed normal stress at the faces, as given in Figure.

Ω	Kirchhoff plate dispersion relation (3.30)	Refined Plate dispersion relation (3.31)	Rayleigh wave asymptote (3.32)	Composite dispersion relation (3.33)
0.1	0.3256	0.3375		0.3348
0.2	0.4605	0.4947		0.4869
0.3	0.5640	0.6278		0.6130
0.4	0.6513	0.7506		0.7275
0.5	0.7282	0.8684		0.8357
1.	1.029	1.438		1.343
1.5	1.261	2.013		1.845
2	1.456	2.600		2.354
2.5			2.719	2.871
3			3.262	3.394
4			4.350	4.453
5			5.438	5.522
6			6.525	6.596
8			8.701	8.755
10			10.87	10.91
11			11.96	12.00
12			13.05	13.08

We may obtain the numerical results for small and large values of Ω in dispersion relations (3.30), (3.31), (3.32), and (3.33), corresponding to low and high– frequency limits. Table shows the numerical results for the dispersion relations.

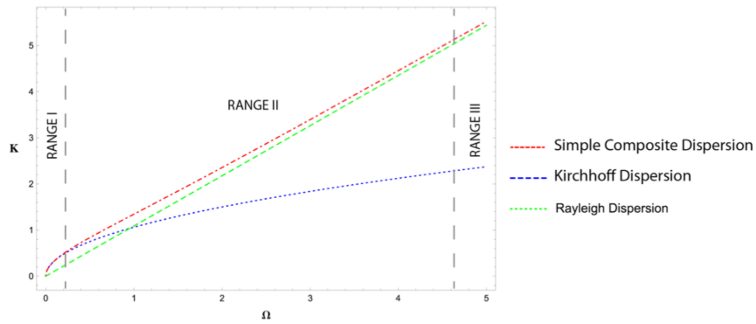

Figure Dispersion curves for Kirchhoff equation (3.30), composite equation (3.33), and Rayleigh wave (3.32).

Given figure displays dispersion curves for Kirchoff plate (3.30), simple composite equation(3.33) and Rayleigh wave (3.32) plotted by blue, red and green lines, respectively.

Write three algorithm examples using the data provided above for this problem.

Answer the following questions in a few sentences.

1. How can the choice of a specific data structure impact the performance of an algorithm?

2. What role do algorithms play in data-driven decision-making processes?

3. In algorithm optimization, what advantages does changing the structure of the data provide?

4. What is the importance of data integrity in algorithm design?

16th October 2023

EEE1111 - ALGORITHMS AND DATA STRUCTURES WORKSHEET

1. Prove that $5x^3 = O(x^4)$.
2. Prove that $8 = O(x)$.
3. Let $f(x) = 5x^2 + 3xlog(x) + 2$. Find a valid witness pair c and k to ensure that $f(x)$ is $O(x^2)$.
4. Let $f(x) = x^2 + 10x + 25$. Find a valid witness pair c and k to ensure that $f(x)$ is $O(x^2)$.
5. Let $f(x) = 7x\log(x) + 3x + 12$. Find a valid witness pair c and k to ensure that $f(x)$ is $O(x\log(x))$.
6. Find the least integer n such that $f(x)$ is $O(x^n)$ for $f(x) = \frac{3x^4+5x^2+6}{5x^3+4}$.
7. Find a Big-O estimate of $(x+1)\log(x^2+1) + 3x^2$.
8. Show that $f(x) = x^5 + 6x$ is not $O(x)$.
9. What is the Big-O estimate for the sum of the first n integers?
10. What is the Big-O estimate for the sum of the squares of the first n numbers?

6th November 2023

EEE1111 - ALGORITHMS AND DATA STRUCTURES WORKSHEET

1. Explain the difference between primitive data structures and non-primitive data structures. Give examples of each type.

2. Explain the difference between structured data unstructured data.

3. Why is it important to have a good understanding of data structures?

4. How does choosing the right data structure impact the efficiency of algorithms?

4th December 2023

EEE1111 - ALGORITHMS AND DATA STRUCTURES WORKSHEET

1. In a circuit design software, you have a fixed 50 resistors. Each resistor has a unique resistance value that needs to be accessed quickly for calculations. Which data structure is more suitable for this application, an array or a linked list, and why?

2. Imagine a sensor network where new sensors are frequently added and old ones are removed based on environmental needs. The sensors collect data on various parameters like humidity, temperature, and light intensity. What data structure would you recommend for storing information about these sensors, and why?

3. A communication device operates on ten channels, each of which can be either in an idle or active state. The system needs to check the status of each channel frequently and update it based on the data transmission. Should an array or a linked list be used to store the status of these channels, and what are the reasons for your choice?

4. A power grid dynamically connects and disconnects various loads (like factories, residential areas) based on the power demand and supply. The number of loads connected to the grid changes throughout the day. Which data structure, an array or a linked list, would be more efficient for managing these loads, and why?

5. An embedded system in a home automation device has a limited and fixed amount of memory available for storing device state information. Considering the memory constraints and the need for fast access to the device states, which data structure should be chosen, and what are the reasons for your choice?

25th December 2023

EEE1111 - ALGORITHMS AND DATA STRUCTURES WORKSHEET

1. Consider the following recursive function:

```
FUNCTION MysteryFunction(a, b)
    IF b == 0 THEN
        RETURN 1
    ELSE
        RETURN a * MysteryFunction(a, b - 1)
END FUNCTION
```

What does $MysteryFunction(a, b)$ compute, and what base case is missing to make it a proper recursive function?

2. Consider the following recursive function:

```
FUNCTION CalculateSeriesSum(n)
    IF n == 1 THEN
        RETURN 1
    ELSE
        RETURN 1/n + CalculateSeriesSum(n - 1)
END FUNCTION
```

What does $CalculateSeriesSum(n)$ compute, and what additional base case could be included to handle potential errors?

3. Given an array $[5, 3, 8, 4, 2]$, show the state of the array after the first two passes of Bubble Sort. Explain why Bubble Sort might not be the best choice for sorting large arrays.
4. Why is Insertion Sort more efficient than Bubble Sort for nearly sorted arrays? Provide an example to support your explanation.
5. Describe a scenario where Insertion Sort performs at its worst-case time complexity. How does the initial arrangement of elements in the array affect the performance of Insertion Sort, and why?