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NPTEL (<https://swayam.gov.in/explorer?ncCode=NPTEL>) » Design and analysis of algorithms (course)



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Course outline

About
NPTEL ()

How does an
NPTEL
online
course
work? ()

Week 1 :
Introduction
()

Week 1 :
Analysis of
algorithms ()

Week 1 Quiz
()

Week 5 Quiz

Your last recorded submission was on 2025-02-18, 22:33 Due date: 2025-02-26, 23:59 IST.

All questions carry equal weightage. You may submit as many times as you like within the deadline. Your final submission will be graded.

1) An image is represented as an $N \times N$ array A of pixels. There is a function that **2 points**
transforms the image as follows:

- The function scans each pixel $A[i][j]$. Depending on the current value of $A[i][j]$, some values in row i and column j are updated. It is possible that all values in row i and column j are updated. It is also possible that no values are updated.
- Updating a pixel takes time $O(\log N)$.
- Each pixel in the image is updated at most once by the function.

What is the best upper bound you can estimate for the total time taken across all the updates made by the function?

- ☐ $O(N^2)$
- ☒ $O(N^2 \log N)$
- ☐ $O(N^3)$
- ☐ $O(N^3 \log N)$

2) In the Union-Find data structure, suppose we want to add an operation **2 points**
 $\text{reassign}(j, k)$ that moves item j to the same component as item k . What would be the complexity of this operation for a set with n elements?

- ☐ $O(1)$ for both the array representation and the pointer representation.
- ☐ $O(1)$ for the array representation, but not $O(1)$ for the pointer representation.
- ☐ $O(1)$ for the pointer representation, but not $O(1)$ for the array representation.
- ☒ Not $O(1)$ for either the array representation or the pointer representation.

**Week 2 :
Searching
and sorting
()**

**Week 2 Quiz
()**

**Week 2
Programmin
g
Assignment
()**

**Week 3 :
Graphs ()**

**Week 3 Quiz
()**

**Week 3
Programmin
g
Assignment
()**

**Week 4 :
Weighted
graphs ()**

**Week 4 Quiz
()**

**Week 4
Programmin
g
Assignment
()**

**Week 5: Data
Structures:
Union-Find
and Heaps ()**

**Week 5 :
Divide and
Conquer ()**

**Week 5 Quiz
()**

3) In a **min-heap**, what is the most accurate description of the worst-case complexity **2 points** of the operation `find_max` that reports the value of the largest element in the heap, without removing it?

- ☐ $O(1)$
- ☐ $O(\log n)$
- ☒ $O(n)$
- ☐ $O(n \log n)$

4) After inserting 57 into a max-heap, the structure of the heap is **2 points** $[82, 57, 27, 42, 25, 18, 25, 27, 32]$. What was the structure of the heap before inserting 57?

- ☐ $[82, 42, 32, 27, 25, 18, 25, 27]$
- ☐ $[82, 27, 42, 32, 25, 18, 25, 27]$
- ☐ $[82, 42, 27, 25, 32, 18, 25, 27]$
- ☒ $[82, 42, 27, 32, 25, 18, 25, 27]$

5) Consider an alternative to binary search called ternary search that divides the **2 points** input array into three equal parts and recursively searches one of these three segments. What can we say about the asymptotic worst case complexity of ternary search versus binary search?

- ☐ The complexity of ternary search is the same as that of binary search.
- ☒ The complexity of binary search is strictly better than that of ternary search.
- ☐ The complexity of ternary search is strictly better than that of binary search.
- ☐ The relative complexity of ternary and binary search depends on the distribution of values across the array.

You may submit any number of times before the due date. The final submission will be considered for grading.

Submit Answers