COURSE HANDOUT

Course Code	ACSC13
Course Name	Design and Analysis of Algorithms
Class / Semester	IV SEM
Section	A-SECTION
Name of the Department	CSE-CYBER SECURITY
Employee ID	IARE11023
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Topic Covered	Probabilistic Analysis
Course Outcome/s	Understand the concept of probabilistic analysis and apply same on applications
Handout Number	14
Date	13 April, 2023

Content about topic covered: Probabilistic Analysis

Probabilistic Analysis

Probabilistic analysis of algorithms is a way to estimate the computational complexity of an algorithm or a computational problem. It starts with an assumption about how the set of all possible inputs is likely to be distributed, which is then used to design an efficient algorithm or figure out the complexity of a known algorithm.

In probabilistic analysis of probabilistic (randomized) algorithms, the distributions or averaging for all possible choices in randomized steps are also taken into an account, in addition to the input distributions.

Steps for the Probabilistic Analysis

We make the assumption that the candidates arrive in a random order in order to use probabilistic analysis.

Then, by calculating an expected running time, we analyse our algorithm.

Over the distribution of all possible inputs, this expectation is used.

The running time is therefore being averaged across all potential inputs.

Example

For this, Random variable X(s) is the number of applicants who are hired for a given input sequence s.

Indicator random variable Xi for applicant i will be 1 if applicant i is hired, 0 otherwise.

```
Hire-Assistant(n)
1  best = 0                // fictional least qualified candidate
2  for i = 1 to n
3    interview candidate i // paying cost  c_i
4    if candidate i is better than candidate best
5      best = i
6      hire candidate i    // paying cost c_h
```

Cost of this strategy using probabilistic analysis is as follows:

- If we interview n candidates and hire m of them, cost is $O(c_i n + c_h m)$
- We interview all n and c_i is small, so we focus on $c_h m$.
- $c_h m$ varies with each run and depends on interview order
- This is a common paradigm: finding the maximum or minimum in a sequence by examining each element,