**Good Morning, I’ll be discussing the APPLICATIONS OF DYNAMIC PROGRAMMING**

**Firstly, we have**

**0/1 Knapsack Problems:**

* Knapsack problems appear in real-world decision-making processes in a wide variety of fields, such as finding the least wasteful way to cut raw materials, selection of investments and portfolios, selection of assets for asset-backed securitization, and generating keys for the Merkle–Hellman and other knapsack cryptosystems.

One early application of knapsack algorithms was in the construction and scoring of tests in which the test-takers have a choice as to which questions they answer. For example, if an exam contains 12 questions each worth 10 points, the test-taker need only answer 10 questions to achieve a maximum possible score of 100 points. However, on tests with a heterogeneous distribution of point values, it is more difficult to provide choices. So the mathematicians Feuerman and Weiss proposed a system in which students are given a heterogeneous test with a total of 125 possible points. The students are asked to answer all of the questions to the best of their abilities. Of the possible subsets of problems whose total point values add up to 100, a knapsack algorithm would determine which subset gives each student the highest possible score.

Eg. Greedy Algorithm, Maximize customer values within given supply capacity.

Secondly,

**Mathematical Optimisation Problems:** In the simplest case, an optimization problem consists of maximizing or minimizing a real function by systematically choosing input values from within an allowed set and computing the value of the function. The generalization of optimization theory and techniques to other formulations constitutes a large area of applied mathematics. More generally, optimization includes finding "best available" values of some objective function given a defined domain (or input), including a variety of different types of objective functions and different types of domains.

Eg. GPS, airline reservation system, amazon deliveries

**All pair shortest path problem:** The all pair shortest path algorithm, also known as Floyd-Warshall algorithm, is used to find all pair shortest path problem from a given weighted graph. As a result of this algorithm, it will generate a matrix, which will then represent the minimum distance from any node to all other nodes in the graph.

Eg. Communication Network, Motion Planning,

**Longest Common Subsequence Problems:** The LCS problem has an optimal substructure, i.e., the problem can be broken down into smaller, simpler subproblems, which can in turn be broken down into further simpler subproblems, and so on, until, finally, the solution becomes trivial.

Eg. DNA sequences (genes) can be represented as sequences of four letters ACGT, corresponding to the four sub-molecules forming DNA. When biologists find a new sequences, they typically want to know what other sequences it is most similar to. One way of computing how similar two sequences are is to find the length of their longest common subsequence.

**Time Sharing:** A time shared operating system allows multiple users to share computers simultaneously. Each action or order at a time the shared system becomes smaller, so only a little CPU time is required for each user. As the system rapidly switches from one user to another, each user is given the impression that the entire computer system is dedicated to its use, although it is being shared among multiple users.

Eg. Multics, Unix

**Robotics Control:** A certain number of considerations should be taken into account in the dynamic control of robot manipulators as highly complex non-linear systems. The problem of robot path planning can be solved using Dynamic Programming (DP) designed to perform well in case of a sudden path blockage. A conventional DP algorithm works well for real time scenarios only when the update frequency is high i.e. changes can be readily propagated.

Eg.

**Flight Control:** A self-learning controller which makes quick and successful adaptations to new conditions can considerably benefit autonomous operations of launch vehicles. An approach to the adaptive flight control is possible from the dynamic programming. An automated flight trajectory optimisation system is one of the few successes of dynamic programming in flight control.

Eg. Uninhabitated Air Vehicles for military purpose

**Reliability Design Problems:** Design for reliability ensures that products and systems perform a specified function within a given environment for an expected lifecycle. In reliability design, the problem is to design a system that is composed of several devices connected in series. So, if we duplicate the devices at each stage then the reliability of the system can be increased.

Eg. Load Sharing System design

Here is Samundranil with an example of Dynamic Programming.