MATH 615
LECTURE 1 – 8/29/2022

Operations Research – First half: Linear Programs and Network Models
Second half: decision analysis, simulations, meta-heuristics e.g. simulated annealing, tabu search, genetic programming.

Knapsack Problem

object	weight	Value	V/w
A	2	11	5.5
B	5	20	4
C	~~5~~	15	3
D	7	28	4
E	8	36	4.5
F	13	52	4

Max weight 20.

Maximize the value in the bag subject to constraint on the weight that can be carried. we limited ourselves to discrete ~~time~~ integer, not continuous.

B, D, E = 36 + 28 + 20 = 84
F, D = 80

No algorithm to solve the above in polynomial time (when adding ~~constraints~~ items).

Note: heuristic: never choose C unless already chose B since it has less value for same weight.

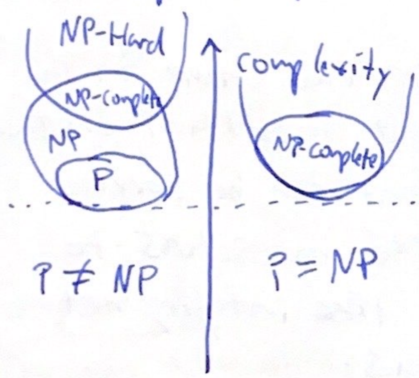
This problem is a simple version of more complex problem like portfolio allocation.

Review: Big O notation: asymptotically behavior of algorithm wrt its inputs, details resource use in time, memory, etc. compares behavior to a functional form e.g. polynomial time.

examples: Binary search ~ $O(\log n)$
Traveling salesman ~ $n!$ by brute force
Matrix multiplication ~ $O(n^3)$.
Merge Sort ~ $O(n \log n)$.
Max ~ $O(n)$
etc.

P and NP

- P is polynomial time algorithms $n^{O(1)}$ time.
- NP problems that can be checked in polynomial time, may not be solvable in polynomial time.
- NP-complete – problems all other NP can be reduced to in Polynomia time



← Review P = NP

optimization

Gradient Descent
Constrained optimization
Combinatorial optimization.
Multi-objective optimization – competing objectives, combo of metrics.
- Pareto Optimal, pareto Frontier