Lecture 1

Lecture notes: posted on the course page

Reference books

- Carmen Leiserson Rivest
- Aho Hopcroft Ullman
- Dasgupta, Papadimitriou, Vazirani
- Kleinberg & Tardos

\[ T(n) = 2T\left(\frac{n}{2}\right) + O(n) \]
= \[ 2T(\sqrt{n}) + n^2 \]

Lecture Notes on discrete Structures

Evaluation components:

- 2 Minor Ex (h.w. + project) 20% each
- Assignments Major 40%
- 20%
Shortest Path problem

Source → Destination

Single source shortest path

Dijkstra's algorithm

\[ G = (V, E) \]

\[ w: E \rightarrow \mathbb{R}^+ \]

\[ V = U + W \]

\[ \text{all vertices for which we know the shortest path} \]

\[ \text{yet to be computed} \]
Initial \( V \leftarrow S \)

labels on vertices \( \delta(v) \) for \( v \in V \)

\( \delta(v) \leftarrow \infty \)

(upper bound on shortest path distance to \( v \) from \( s \))

\( D(v) : \) exact shortest path distance

\( D(v) \leq \delta(v) \)

\( D(s) = 0 = \delta(s) \)

Over the iterations we improve \( \delta(v) \) until \( \delta(v) = D(v) \)

Updating labels

\( \delta(v) \leq \min_{i} \delta(v_i) + \omega(v_i, v) \)

Shortcut

For any edge \((v_i, v)\) \( \delta(v) = \delta(v_i) + \omega(v_i, v) \)
Dijkstra vs. Bellman Ford

non-negative vs. negative

**BF:** \[ \text{In any round, we repeated } \text{ shortcut all edges } \text{ (in any sequence)} \]

\[ O(|E|) \]

\[ O(|V| \cdot |E|) \]

**Correct?**

The no. of edges in a shortest path varies between 0 to (|V| - 1)