TSP

**Heuristic**

\[ \frac{1 + \varepsilon}{10\log n} \leq \frac{\log n}{n} \]

**Quality of the approach**

Vertex cover - NP-hard

A subset of vertices that "cover" all edges

\[ \Rightarrow \text{vertex cover} \]

Any vertex cover contains at least one from either column or column b

Any vertex cover has at least \( \frac{1 + \varepsilon}{2} \) vertices

Optimization \( \geq \frac{1 + \varepsilon}{2} \)

\[ \frac{1 + \varepsilon}{10\log n} \leq 2 \]
\[ \text{Goal} \quad \frac{|H|}{\log |P|} \leq \rho \quad \text{NP-hard} \]

H.C. — every edge has cost 1 \( G = (V,E) \)

odd min-cut edge and
with cost \( \rho |V| + 1 \)

H.C. \( \Rightarrow \) opt 2SP has cost \( |V| \)

No H.C. at least one

\[ (|V| - 1) \text{ long edges} \]

\[ \rho |V| + 1 \text{ expander edge} \]

\[ (\rho + 1) |V| \]
Approximate TSP with symmetry + 5-inequality

\[ 2 |OPT| \geq |st-mst| \geq 2 |MST| \]

\[ |WALK| = 2 |MST| \geq |HT| \]

\[ 2 |OPT| \geq |HT| \implies \frac{|HT|}{|OPT|} \leq 2 \]

Start at some city

Nearest neighbor

Greedy strategy

\[ \frac{|NN|}{|OPT|} \leq \left\lceil \frac{\log n}{2} \right\rceil + 1 \]

Opt. tour = \{l_1, l_2, l_3, \ldots, l_n\}  

|OPT| = 2 \sum l_i \\

\[ l_1 \geq l_2 \geq l_3 \geq \ldots \geq l_n \]

\[ |OPT| \geq 2 l_1 \]
cheapest in the

\[ \leq 2 \]