

DNA sequencing

Sanger method: 1977 (used in HGP)

randomly cut into pieces of 500-700 basepairs.

||||| Ch 1

||||| Ch 1

||||| Ch 1

||||| Ch 1

say you found
✓ these snippets

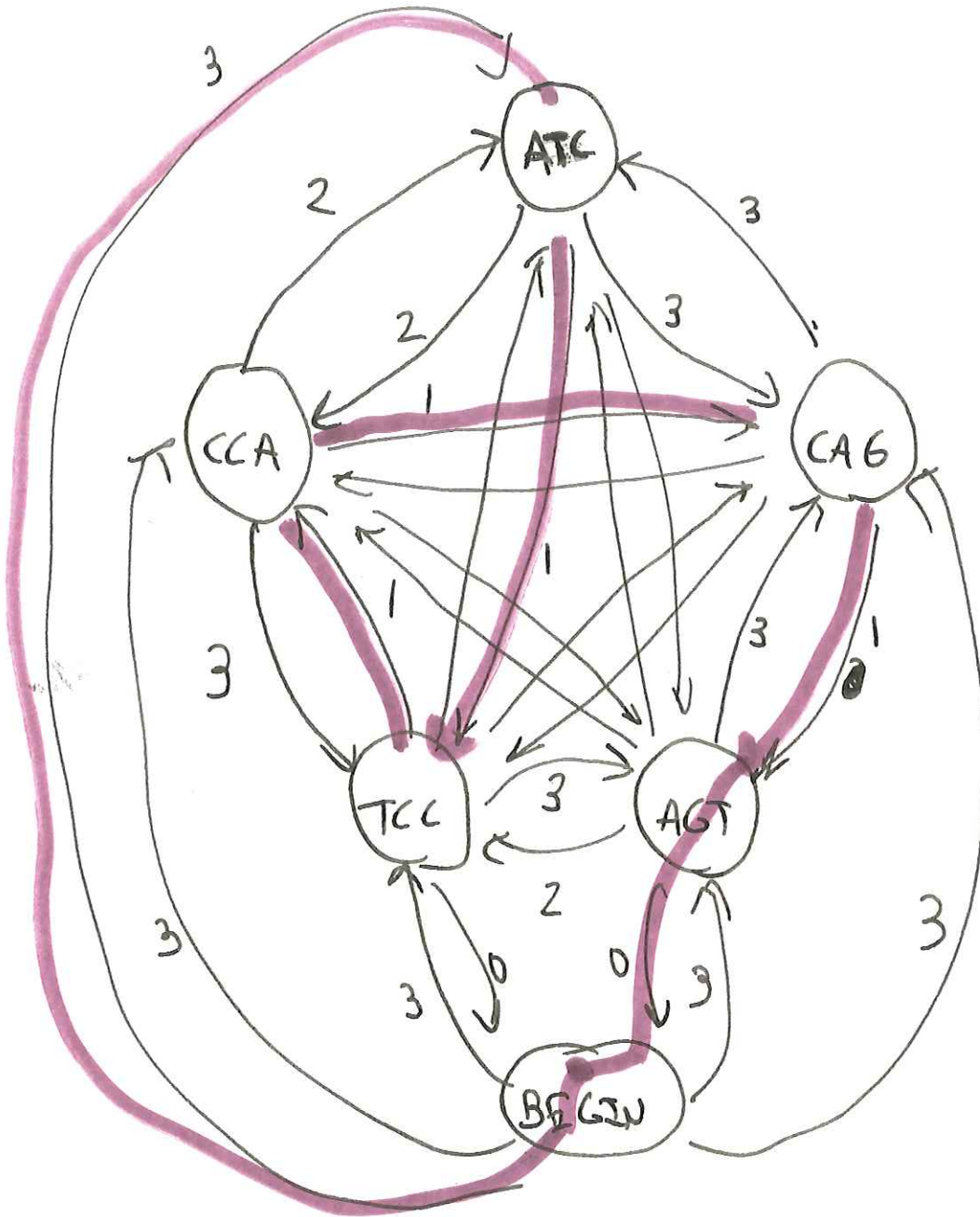
$S = \{ATC, CCA, CAG, TCC, AGT\}$

What's the shortest string?
containing all of those?

ATCTCCACAGAGT
ATCCAGT

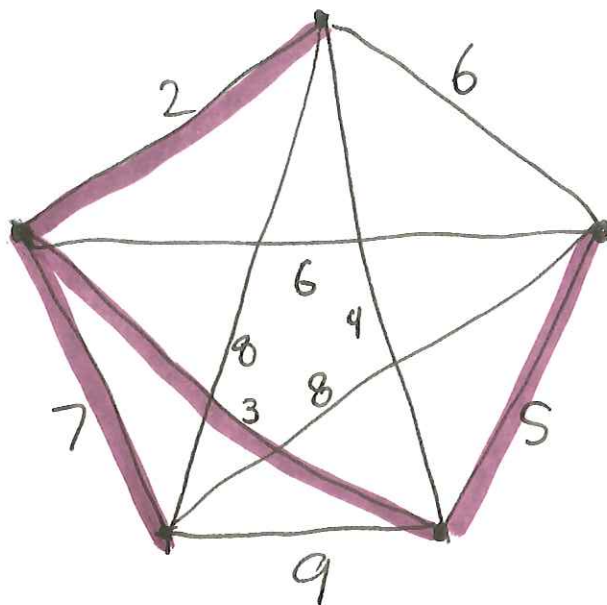
Shortest SuperString Problem:

Given a set of strings find the shortest string
containing all of them.



Find Shortest path
Hamiltonian cycle

|| It's travelling salesman
problem!



Minimum connector problem \nearrow find minimum "spanning tree"
 goes to every node $\underbrace{\hspace{1cm}}$ no cycle

Greedy algorithm always gives right answer.

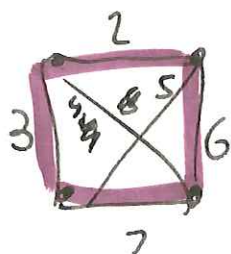
\rightarrow Keep picking shortest edge
 that doesn't give a cycle.

If you have a Hamiltonian cycle and you remove a vertex, what's left is a spanning tree.

So if you find the minimum spanning tree for a graph G with one node deleted, and you add the smallest weights connecting that node, you get a lower bound on TSP!

We have some algorithms to produce good guesses for TSP: given a graph, they find candidate best paths.

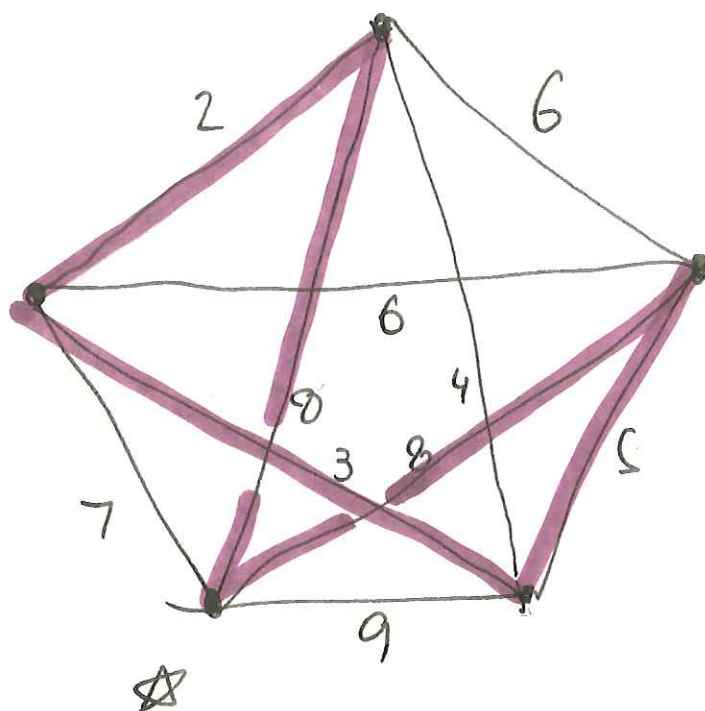
→ This gives an upper bound on the optimal cycle length.



Greedy algorithm: finds path of length $2+3+6+7=18$

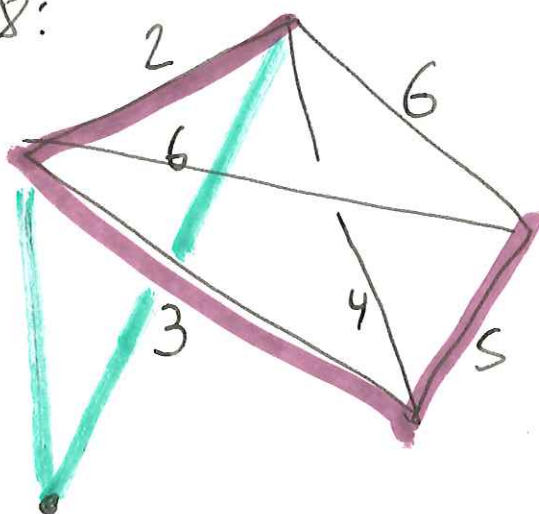
This tells me best path takes at most 18, but it be less.

→ How to find a lower bound?



Greedy: $2+3+5+8+8=26$

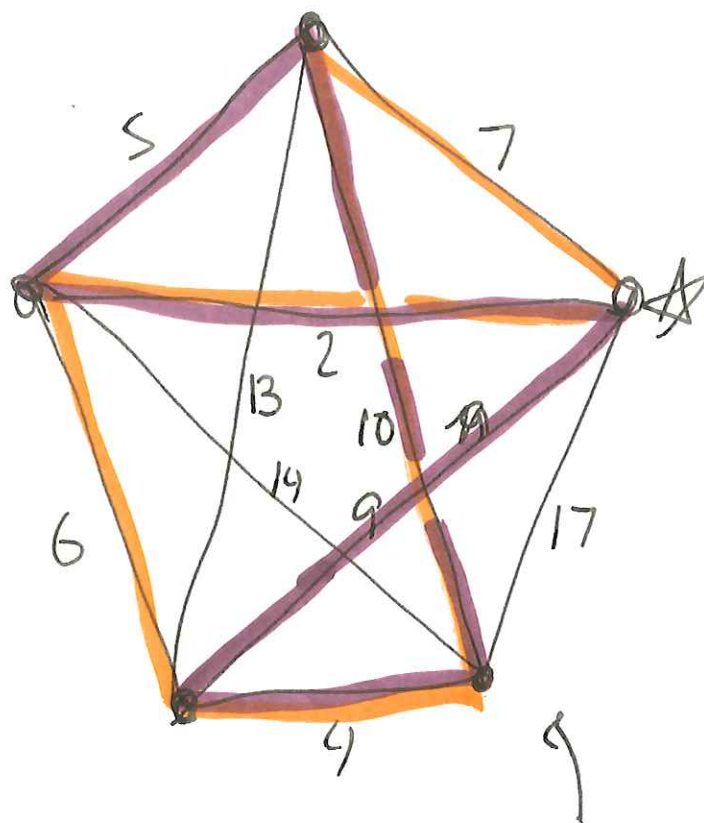
Delete \star :



Spanning tree

Shortest TSP \geq minimum spanning tree for deleted graph
 $+ 2$ Shortest edges to deleted node.

Try it:

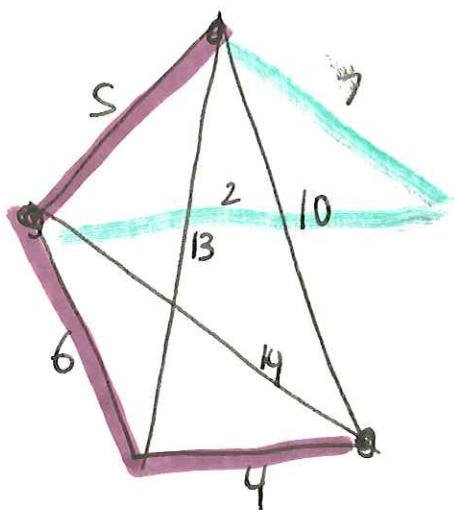


$$24 \leq \text{TSP} \leq 30$$

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Lower bound:

Delete *



$$\text{MST} = 5 + 6 + 4 = 15$$

Greedy algorithm

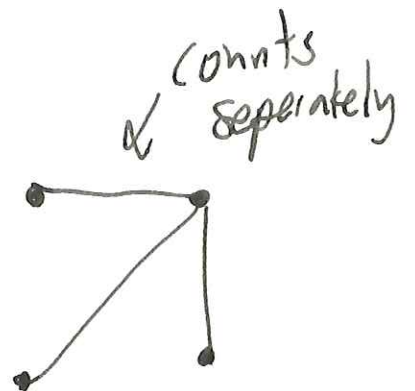
$$2 + 5 + 4 + 9 + 10 = 30$$

$$\text{TSP} \leq 30$$

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(proprietary algorithm)

Shortest connections
+ (2 + 7) so

$$\text{TSP} \geq 24$$



counts
separately

How many trees connect the 4 nodes?

↑
graph with no loops.

⌈ ⌊ ⌋ ⌈ ⌊ ⌋ ⌈ ⌊ ⌋ ⌈ ⌊ ⌋

⌋ ⌈ ⌊ ⌋ ⌈ ⌊ ⌋ ⌈ ⌊ ⌋ ⌈ ⌊ ⌋

16 of
them

5 nodes



Case I: Loop minus side

there are $\frac{5!}{2}$ of these = 60
order of sides

rotates
↓
||
5



connect 1 to 3, then any
of those three to last.

$$60 = 5 \times \binom{4}{3} \times 3 =$$

$$n=4 \Rightarrow 16$$

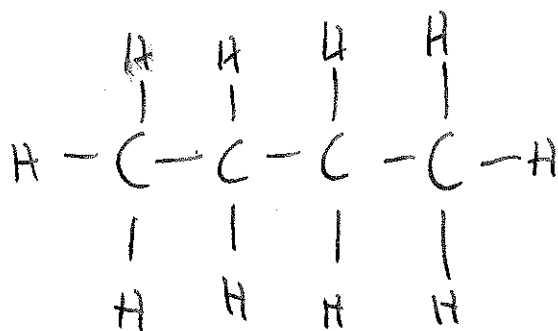
$$n=5 \Rightarrow 125 \quad n=3 \Rightarrow 3.$$

How many trees are there?

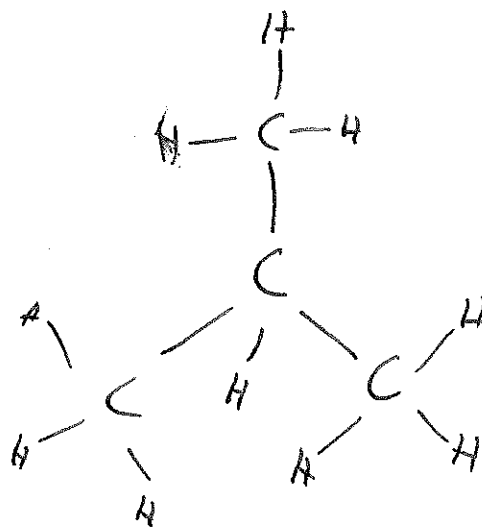
$$n^{n-2}$$

(Cayley; can you explain it?)

How many structural isomers of C_4H_{10} ?

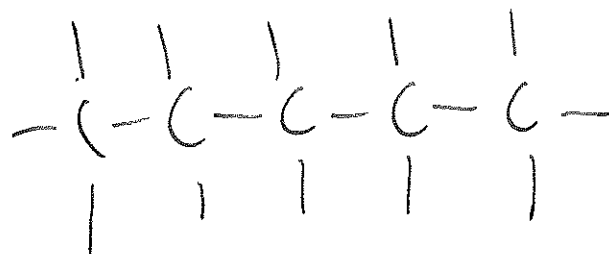


Butane



Isobutane

Methylpropane



How many alkanes with n carbons?