# Minimum Spanning Tree and Traveling Salesman, Math 4707, Spring 2021

Consider the following collection of 9 points $A, B, C, D, E, F, G, H, I$ on a $5 \times 5$ grid:

$$\begin{array}{ccccc} A & B & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & C \\ \cdot & D & E & \cdot & \cdot \\ F & \cdot & \cdot & G & \cdot \\ H & \cdot & \cdot & \cdot & I \end{array}$$

The distance between points is their Euclidean distance: e.g., the distance between $A$ and $B$ is 1; between $B$ and $D$ is 2; between $G$ and $I$ is $\sqrt{2}$; between $C$ and $E$ is $\sqrt{5}$; etc.

1. Find a Minimum Spanning Tree connecting all these points.
2. Use the "MST traversal with shortcuts" approach to find a Hamiltonian cycle that's within a factor of two of the optimal solution to the Traveling Salesman Problem for this collection of points.
3. How short a Hamiltonian cycle can you find? **Hint**: try changing the starting point and the way you traverse the MST.
   I found a cycle with total distance $\approx 17.469...$[1], can you beat me?

[1] DFHEGICBAD