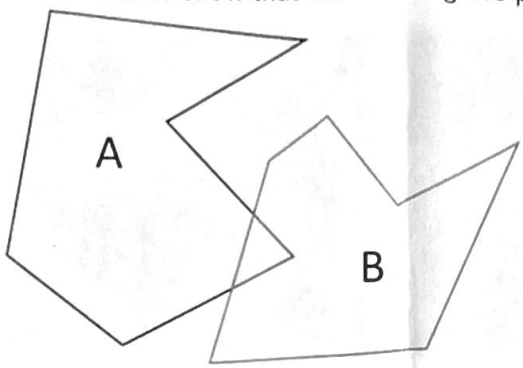
Answer all the questions. You can write your answers in English, Finnish, or Swedish.
Unless otherwise specified, each question is worth a maximum of 6 points.

1. Answer the following. You can find the DE-9IM matrix and the topological pattern matrices on the backside of this paper
   a. Use DE-9IM to show that the following two polygons *overlap* (4p)




   b. Why, according to DE-9IM, a point object cannot *touch* another object? (1p)
   c. According to the DE-9IM pattern matrix, can anything be *within* a point object? (1p)

2. In this question parts a) and b) are related to a Simple Features object given in WKT format as POLYGON((1.00 4.00, 3.00 1.00, 5.00 3.00, 4.00 5.00, 3.00 3.00, 1.00 4.000000000000000000000001))
   a. Draw the object (2p)
   b. Is the object a valid Simple Features polygon? Justify your answer (2p)
   c. Is the object given in WKT as POLYGON((1 1, 1 5, 3 3)) a valid Simple Features polygon? Justify your answer (2p)

3. Answer the following
   a. Describe the line sweep problem solving method on conceptual level (3p)
   b. How can line sweep be used for solving the map overlay problem for polygon networks, and which parts of the overall map overlay problem line sweep solves? (3p)

4. How can the shortest path be calculated using a cost surface, and how does the size (4, 8, 16, etc.) of a pixel neighborhood affect the efficiency of the calculation and the quality of the result?

5. Describe the problem of finding point location in a polygon network and an efficient method for solving it

$$DE-9IM(A,B)=\begin{bmatrix}\dim(I(A)\cap I(B)) & \dim(I(A)\cap B(B)) & \dim(I(A)\cap E(B))\\ \dim(B(A)\cap I(B)) & \dim(B(A)\cap B(B)) & \dim(B(A)\cap E(B))\\ \dim(E(A)\cap I(B)) & \dim(E(A)\cap B(B)) & \dim(E(A)\cap E(B))\end{bmatrix}$$

A.overlaps(B): $\begin{bmatrix}T & * & T\\ * & * & *\\ T & * & *\end{bmatrix}$ or $\begin{bmatrix}1 & * & T\\ * & * & *\\ T & * & *\end{bmatrix}$

A.touches(B): $\begin{bmatrix}F & T & *\\ * & * & *\\ * & * & *\end{bmatrix}$ or $\begin{bmatrix}F & * & *\\ T & * & *\\ * & * & *\end{bmatrix}$ or $\begin{bmatrix}F & * & *\\ * & T & *\\ * & * & *\end{bmatrix}$

A.within(B): $\begin{bmatrix}T & * & F\\ * & * & F\\ * & * & *\end{bmatrix}$

Different matrixes are for types of cases (e.g different dimensionalities). The second crosses matrix, for example, is for the L/L –case.