Note: Structure your proofs using the solutions to assignment 1 as a model. State the full "**Proposition:**" followed by "**Proof:**", indent your argument where appropriate for readability and be careful with notation.

As with any proof, clarity of presentation is as important as solving the problem. Strive to make your proofs clear, concise and precise. Feel free to use results from earlier problems in subsequent ones.

In 1, 2 and 3 below $n \in \mathbb{N}$ with $n > 1$.

1. Prove that $\mathbb{R}^n$ is connected using the technique of Theorem 4.1 from the text.
2. Let $S \subset \mathbb{R}^n$ and x, $y \in S$. We say that x and y are ***polygonally connected*** in S if they can be joined by a path consisting of a finite number of line segments of finite length lying entirely in S. Such a path is called a ***polygonal curve*** joining x and y. A single point is trivially polygonally connected to itself.

   Let $S \subset \mathbb{R}^n$. Prove that if every pair of points in S is polygonally connected in S then S is connected. As a corollary prove that $\mathbb{R}^n - \{0\}$ is connected.
3. Prove a partial converse of the previous result (a bit trickier): If $S \subset \mathbb{R}^n$ is open and connected then every pair of points in S is polygonally connected in S.
   Hint: Let $x \in S$ and U_1 be the set of points polygonally connected in S to x, and let $U_2 = S - U_1$. Show that both U_1 and U_2 are open.
4. Textbook Exercise 4.1
5. Textbook Exercise 4.3