Least greatest proofs

For a set of numbers X, how do you formalize "there is a greatest X" or "there is a least X"?

Prove or **disprove**: There is a least prime number.

Prove or **disprove**: There is a greatest integer.

Approach 1, De Morgan's and universal generalization:

Approach 2, proof by contradiction:

Extra examples: Prove or disprove that $\mathbb{N}$, $\mathbb{Q}$ each have a least and a greatest element.