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Exercise 11

Task 1
Let $f\colon \mathbb{R} \to \mathbb{R}$ be a polynomial defined by

$$f(x) = 4x^5 - 2x^4 + 25x^2 - 5x + 1.$$

Use Cauchy's bound to find an interval which contains all real-valued zeros of f.

Task 2
Consider the structure $(\mathbb{N}, 0, s)$, where s is the successor function ($s(n) = n+1$). Formulate the axiom of induction using an MSO-sentence!

Axiom of induction: Every subset of the natural numbers, which constains 0 and which contains for every element of the subset also its successor, is equal to the set of natural numbers.

Task 3
Consider the structure $(\mathbb{R}, <)$. Formulate the following statements using MSO-sentences:

(a) Every set is a subset of itself.

(b) There is a non-empty set.

(c) For every set X there is a set Y, such that the intersection of X and Y is empty.

(d) Every set that contains at least two distinct elements has a non-empty proper subset.

(e) Every open interval contains a closed subinterval.