1. Suppose we need to find the smallest and largest elements of an array of size \( n \). Show that this can be done with \( 3\lfloor n/2 \rfloor \) comparisons.

2. Show that the second smallest of \( n \) elements can be found with \( n + \lceil \log n \rceil - 2 \) comparisons in the worst case. (Hint: Also find the smallest element.)

3. Suppose that you have a black-box worst-case linear-time median subroutine. Give a simple, linear-time algorithm that solves the selection problem for an arbitrary order statistic.

4. Professor Olay is consulting for an oil company, which is planning a large pipeline running east to west through an oil fields of \( n \) wells. The company wants to connect a spur pipeline from each well directly to the main pipeline along a shortest route (either north or south), as shown on Figure 1. Given the \( x \) and \( y \)-coordinates of the wells, how should the professor pick the optimal location of the main pipeline, which would be the one that minimizes the total length of the spurs? Show how to determine the optimal location in linear time.

![Figure 1: Professor Olay needs to determine the position of the east-west oil pipeline that minimizes the total length of the north-south spurs.](image-url)