General instructions: After reading the questions given below, follow the steps described in `Instructions.pdf` to see the input and the expected output for each test case.

1 Maximum Product Subarray

Given an integer array A of size N, find a subarray that has the maximum product. A *subarray* is a contiguous and non-empty sequence of elements in an array. Formally, your task is to find the value of the following expression:

$$\max_{i,j}\left(\prod_{k=i}^{j} A[k]\right) \quad \text{where } 0 \le i \le j < N$$

Return the maximum product possible as the answer using a Divide and Conquer approach. **Only solutions using Divide and Conquer will be accepted**

Note: The array can also have non-positive numbers (Otherwise, the solution to the problem is always trivial - select the complete array).

TEST CASE 1
Input Array: $[1, 5, -1]$
Output: 5
Explanation:
6 subarrays are possible - $[1], [5], [-1], [1, 5], [5, -1], [1, 5, -1]$ with the products as $1, 5, -1, 5, -5, -5$ respectively.
Since $\max(1, 5, -1, 5, -5, -5) = 5$, the answer is 5.

TEST CASE 2
Input Array: $[-1, 5, -2]$
Output: 10
Explanation:
6 subarrays are possible - $[-1], [5], [-2], [-1, 5], [5, -2], [-1, 5, -2]$ with the products $-1, 5, -2, -5, -10, 10$ respectively.
Since $\max(-1, 5, -2, -5, -10, 10) = 10$, the answer is 10.

TEST CASE 3
Input Array: $[-10]$
Output: -10
Explanation:
Only 1 subarray is possible - $[-10]$ with the product -10.
Since $\max(-10) = -10$, the answer is -10.

Expected Time Complexity: $O(N)$, N is the size of the input array.

2 Maximizing Minimum Distance

We have N ($N \geq 2$) sheep that need to graze on grass. Our farm is shaped like a $1D$ number line with M-mutually disjoint intervals ($M \geq 1$) where grass is available for our sheep. Each sheep wants to be placed at a unique point on the number line, where there is grass for it to eat. We want to place them so as to maximize D, where D represents the distance between the closest pair of sheep in our placement.

Return the maximum value of D.

Note 1: The sheep can only be placed on points where there is grass available. No two sheep can be put on the same point (i.e. it is given that $D \neq 0$ for all test cases).

Note 2: The M mutually disjoint intervals (where grass is available) are provided as tuples - (i, j) with $i \leq j$. These tuples are already sorted in order (from left to right).

TEST CASE 1
N: 5
M: 3
Farm: $[[0, 2], [4, 7], [9, 9]]$
Output: 2
Explanation: We can place the sheep at locations $0, 2, 4, 6,$ and 9 to get $D = 2$. No other placement of the sheep can provide a $D > 2$.

TEST CASE 2
N: 3
M: 3
Farm: $[[0,0],[1,2],[4,7]]$
Output: 3
Explanation: We can place the sheep at locations $0,4$ and 7 to get $D = 3$. No other placement of the sheep can provide a $D > 3$.

TEST CASE 3
N: 4
M: 3
Farm: $[[0,0],[1,2],[4,7]]$
Output: 2
Explanation: We can place the sheep at locations $0,2,4$ and 7 to get $D = 2$. No other placement of the sheep can provide a $D > 2$.

TEST CASE 4
N: 5
M: 3
Farm: $[[0,2],[4,7],[9,10]]$
Output: 2
Explanation: We can place the sheep at locations $0,2,4,7$ and 9 to get $D = 2$. No other placement of the sheep can provide a $D > 2$.

TEST CASE 5
N: 6
M: 3
Farm: $[[0,2],[4,7],[9,10]]$
Output: 1
Explanation: We can place the sheep at locations $0,1,2,4,5$ and 6 to get $D = 1$. No other placement of the sheep can provide a $D > 1$.

Expected Time Complexity: $O((N + M)log(maxDist))$, where N is the number of sheep, M is the number of disjoint sets containing grass, and $maxDist$ is the maximum distance between any two points with grass (a.k.a. the size of the farm). **The time complexity is a big Hint!**