# Title: Longest Range of Peaks Problem

# Problem Description

Suppose that we are given an array *A*[1*,*2*,...,n*] containing *n* ≥ 3 positive, not necessary distinct, integers. We do not assume that the input array is sorted. We first define a notion of a *peak*. Any three consecutive indices *i,i*+1*,i*+2 such that 1 ≤ *i* ≤ *n*−2 and *A*[*i*] *< A*[*i*+1] and *A*[*i*+1] *> A*[*i*+2], is called a *peak*; note that the inequalities are strict.

A *range* is a collection of disjoint peaks. Formally, a *range* that consists of *k* ≥ 1 peaks is the following collection of indices in array *A*: {*i*1*,i*2*,...,ik*} such that:

1. 1 ≤ *i*1 *< i*2 *<* ··· *< ik* ≤ *n* − 2 (indices are distinct increasing integers from {1*,*2*,...,n*}),
2. *i*1+2 *< i*2*,i*2+2 *< i*3*,*··· *,ik*−1+2 *< ik* (peaks are disjoint, i.e., indices are separated from one another by at least 2 positions in array *A*),
3. Each three consecutive indices *ij,ij* +1*,ij* +2 (for *j* = 1*,*2*,...,k*) form a peak, that is, *A*[*ij*] *< A*[*ij* + 1] and *A*[*ij* + 1] *> A*[*ij* + 2] for each *j* = 1*,*2*,...,k* (we have *k* disjoint peaks)
4. For every two consecutive peaks *ij,ij*+1*,ij*+2 and *ij*+1*,ij*+1+1*,ij*+1+ 2, (for *j* = 1*,*2*,...,k* −1), we have the following additional condition:

*A*[*ij* + 1] ≥ *A*[*ij*+1] and *A*[*ij* + 2] ≤ *A*[*ij*+1] (note weak inequalities here). This condition intuitively means that the east slope of the peak *ij,ij* +1*,ij* +2 contains the base (first element *ij*+1) of the west slope of the very next peak *ij*+1*,ij*+1 + 1*,ij*+1 + 2.

If a *range* consists of *k* ≥ 1 peaks, then its *length* is *k*. The Longest Range of Peaks Problem is to find the length of the longest range of peaks in the input array *A*, or output 0 if there is no peak in array *A*.

**Examples:**

Let us consider input *A*[1*,*6*,*2*,*11*,*2*,*10*,*5*,*7*,*3] with *n* = 9. Here *A*[1]*,A*[2]*,A*[3]; *A*[3]*,A*[4]*,A*[5]; *A*[5]*,A*[6]*,A*[7]; *A*[7]*,A*[8]*,A*[9] are four peaks in *A*. These are all peaks in array *A*. We also have the following range of length 2: *A*[1]*,A*[2]*,A*[3]; *A*[5]*,A*[6]*,A*[7]. Another range of length 2 is: *A*[3]*,A*[4]*,A*[5]; *A*[7]*,A*[8]*,A*[9]. And another range of length 2 is: *A*[1]*,A*[2]*,A*[3]; *A*[7]*,A*[8]*,A*[9]. Here, any of these 3 ranges is the the longest range in this instance of the problem and so the output of the Longest Range of Peaks Problem is 2.

Let us consider now input *A*[1*,*6*,*2*,*2*,*2*,*10*,*5*,*7*,*8*,*3] with *n* = 10. Here, the longest range has length 3 and it is: *A*[1]*,A*[2]*,A*[3]; *A*[5]*,A*[6]*,A*[7]; *A*[8]*,A*[9]*,A*[10], so the output of the Longest Range of Peaks Problem is 3. Observe, for instance, that *A*[1]*,A*[2]*,A*[3]; *A*[8]*,A*[9]*,A*[10] is **not** a range because the condition (4) above is false, namely, *A*[8] = 7 is not between *A*[3] = 2 and *A*[2] = 6.

If the input array is sorted in non-decreasing order, for instance *A*[1*,*6*,*8*,*8*,*10*,*13], then there is no peak, and so the output of the Longest Range of Peaks Problem is 0. Similarly, if the array is sorted in non-increasing order, for instance *A*[15*,*11*,*4*,*4*,*3*,*3], then there is no peak, and so the output of the problem is 0.

Some further examples of inputs.

Suppose, for instance, that *n* = 13 and that the input sequence is:

1 3 2 1 7 5 7 10 1 1 1 3 2*,*

that is, *A*[1] = 1*,A*[2] = 3*,A*[3] = 2*,A*[4] = 1*,A*[5] = 7*,A*[6] = 5*,A*[7] = 7*,A*[8] = 10*,A*[9] = 1*,A*[10] = 1*,A*[11] = 1*,A*[12] = 3*,A*[13] = 2. Then, the longest range of peaks is: *A*[4]*,A*[5]*,A*[6]; *A*[7]*,A*[8]*,A*[9]; *A*[11]*,A*[12]*,A*[13] and has length 3. The output to the problem is 3.

Suppose, for instance, that *n* = 11 and that the input sequence is:

1 5 2 2 2 7 4 4 4 5 4*,*

that is, *A*[1] = 1*,A*[2] = 5*,A*[3] = 2*,A*[4] = 2*,A*[5] = 2*,A*[6] = 7*,A*[7] = 4*,A*[8] = 4*,A*[9] = 4*,A*[10] = 5*,A*[11] = 4. Then, the longest range of peaks is: *A*[1]*,A*[2]*,A*[3]; *A*[5]*,A*[6]*,A*[7]; *A*[9]*,A*[10]*,A*[11] and has length 3. The output to the problem is 3.