

# Algorithm Lab

## Week 3: Binary Search

### Description

Binary search is a well-known divide and conquer algorithm. In original, binary search is designed for searching position of specific value in a sorted random-accessible list.

We can see an array  $A = \{a_1, a_2, \dots, a_n\}$  as a function  $A'(i) = a_i$  have domain  $[1, n]$ . If array  $A$  is an increasing-order array or a decreasing-order array, then the correspond function  $A'(i)$  is a monotone function. Thus, we can change the definition as followed:

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*Instance: A monotone function  $f(X) \rightarrow V$ , a value  $v \in V$ , and a precision  $\varepsilon$ .*

*Result:  $x \in X$  that  $v$  in range  $[f(x - \varepsilon), f(x + \varepsilon)]$ .*

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In this version, we can not only find the specific value in a sorted array (use  $\varepsilon = 1$ ), but also solve an equation  $y = f(x)$  where  $y$  is the specific value and  $f(x)$  is a monotone function.

### Questions

- 1 Write pseudo code of binary search algorithm.
- 2 Analysis pseudo code of step 1.
  - 2.1 Space complexity
  - 2.2 Time complexity in base case
  - 2.3 Time complexity in worst case
- 3 Implement your algorithm to solve ALG02A on <https://oj.csie.ndhu.edu.tw/>