Algorithmic Thinking

Event Overview

I.   Description
- A. Competitors are tested on their general knowledge of algorithms and ability to develop and write algorithms in pseudocode that solves tasks efficiently. Coding languages can be used but will not result in the addition of extra points. Pseudocodes can be written in plain english as long as the graders understand the "gist" of what you are trying to say.

II.   Participants
- A. Competitors must work individually.

III.   Format
- A. Competitors must take a test with multiple choice and long response questions. Long response questions involve writing algorithms to solve specific tasks.

IV.   Materials
- A. Competitors are allowed to create a binder (online or physical) which they can use during the test.

V.   Scoring
- A. Competitors are graded based on their accuracy on the test. If a tie occurs, the following tiebreakers are used in the order listed:
  1. Predetermined tiebreaker questions
  2. Fastest time complexity for tasks
  3. Time

Event Topics

I.   Competitors may be tested on and asked to solve tasks involving any of the following topics and any subtopics falling under them:
- A. Time & Space Complexity Notations
- B. Complexity Classes
- C. Algorithm Reductions
- D. Search Algorithms
- E. Sorting Algorithms
- F. Pathfinding Algorithms

Sample Questions

1. An array A holds five elements numbered 1 to 5 in ascending order. What is A[3]?
   a. 3
   b. 4
   c. 5
   d. Undefined

   Answer: B (4) - Array indices start from 0, so the fourth element has an index of 4 - 1 = 3.

2. What is the Big O time complexity of implementing Binary Search?
   a. O(n)
   b. O(log n)
   c. $O(n^2)$
   d. O(n(log n))

   Answer: B ($O(\log_2 n)$) - In the worst case scenario, a binary search tree halves the number of possible answers during each step (since each branch has two possibilities, each of which has more subbranches). As a result,

3. Solve the following problem using pseudocode.

   Task

   You are given a free pass to watch premiere shows on the Blue Moon Festival. On this day, there are n number of shows, each with specific start (x) and end (y) times. Once you sit down to watch a show, you cannot watch another show until the current show is over. What is the maximum number of shows you can watch?

   Example Input
   5
   1 7
   2 5
   5 8
   7 9
   8 10
   First line contains n (number of shows). Next n lines include x and y, respectively the start and end times of each show.

   Example Output
   3

   Constraints
   $1 \le n \le 200{,}000$ $1 \le a < b \le 10{,}000{,}000$

Event Resources

- [USACO Guide](#)
  - Contains algorithms and exercises for specific algorithms. Levels are divided into bronze, silver, gold, and platinum. Platinum is the highest level of difficulty on this site.
- [Algorithms by Jeff E](#)
  - Textbook on logic and algorithms. Includes many of the search and sorting algorithms covered in the test.
- [Sorting Algorithms, GeeksforGeeks](#)
  - Contains hyperlinks to explanations and code for all of the sorting algorithms covered in the test
- [Search Algorithms, GeeksforGeeks](#)
  - Contains hyperlinks to explanations and code for all the search algorithms covered in the test