Computer Science Admissions Test
2015
— Example only (not actual test) —

Read these instructions carefully before you begin

· The test duration is 100 minutes. Section A has 14 questions. Section B has 11 questions.

· Answer at most 7 questions in Section A, and as many as you can in Section B. No more than 7 answers will be considered in Section A. Correct answers in Section B are worth more marks. Feel free to choose the questions to answer and the order you attempt them.

· You must write your answer on the question sheet, next to the ANSWER label. Answers missing from the question sheets will not be marked!

· All answers must be justified. Write justifications in the work-booklet provided and the question number at the top of each page in the work-booklet. Justifications need not be thorough (e.g. induction proofs are not required) but they must be sufficiently clear.

· Calculators, phones, watches, other electronic devices or other paper are not permitted.

· All paper must be handed in at the end of the test.

· Do not discuss any test questions with others (e.g. candidates at the same or another College, the Internet, or elsewhere), especially before February. You would disadvantage yourself.

NOTE: It can be challenging to solve a third from the 25 questions, so don’t worry. Try to take 5-10 minutes to read all questions first, up to 10 minutes to answer one, and to start with Section A.

Good luck!
Section A — answer no more than 7 out of 14, of your choosing

1. Find all integers $a, b, c$ that satisfy $a\sqrt{2} - b = c\sqrt{3}$.

   ANSWER 1 →

2. You decide to take the stairs and to climb either 1 or 2 stairs at a time, at any given time. In how many different ways can you get up a flight of 11 stairs? Prove your answer.

   ANSWER 2 →

3. What is the units digit of the number $\sum_{n=1}^{1337} (n!)^4$?

   ANSWER 3 →

4. Let the function $f$ be as defined below. What is the value of $f(1337)$?

   ```
   function f(n):
       if n < 1:
           return 1
       else if n is even:
           return 1 + f(n-1)
       else:
           return 1 + f(n-3)
   ```

   ANSWER 14 →

Section B — answer as many as you can out of 11, of your choosing

15. You travel on Earth’s surface south $n$ miles, then east $n$ miles, then north $n$ miles and find yourself back where you started, without visiting any point more than twice. What is the closest you could have been to the south pole when you started? Assume Earth is a sphere with radius $R > n$.

   ANSWER 15 →

16. Let $n < 10$ be a non-negative integer. How many integers from 0 to 999 inclusive have the sum of their digits equal to $n$? Give your answer in terms of $n$. Hint: Try first for integers from 0 to 99.

   ANSWER 16 →

17. You must slice a square of side length $b$ into 6 pieces with equal areas, using 3 lines that intersect each other inside the square, one of which is a diagonal. Where on the sides of the square, with respect to the nearest corner, should the other two lines cut? Give your answer in terms of $b$.

   ANSWER 17 →
25. Does 30 divide $n^5 - n$ for all positive integers $n$?