CMIMC 2018 Official Contest Information

CMIMC Staff

Latest version: January 1, 2018

1 Introduction

1. This document is the official contest information packet for the 2018 **Carnegie Mellon Informatics and Mathematics Competition** (**CMIMC**). The most recent version of this document takes authority over all other documents.
2. The 2018 CMIMC is to be held on **January 27, 2018** at **Carnegie Mellon University** in **Pittsburgh, PA**.

2 General Test Rules

1. Use of electronics during a round is forbidden. This includes the use of all calculators, such as any type of four-function, scientific, or graphing calculator.
2. Any communication is forbidden during non-collaboration rounds. Communication between members of different teams is forbidden during all rounds.
3. No clarifications will be given on questions during the rounds. Contests may **not** ask for help during the contest at any time.
4. Problems may be disputed by submitting a written protest to CMIMC staff; disputes will be handled in a consistent and fair manner. Written protests must be submitted prior to the end of lunch for individual rounds and prior to the faculty talk for the team round.
5. Solutions to individual and team rounds will be posted on-site shortly after the conclusion of each round. They will be made available on the CMIMC website after the end of the competition.

3 Contest

The contest consists of four rounds: **power round**, **team round**, **individual rounds**, and **finals**.

3.1 Power Round

1. The power round presents an interesting topic with all the necessary background information.
2. This round consists of some number of **proof-based** problems, to be solved in **60 minutes**, all related to the same interesting topic and which build off of each other. Problems will have varying difficulty; the number of points each problem is worth will be roughly proportional to the difficulty of the problem.

3. Competitors are allowed to collaborate with their team members on this round, but collaboration across teams is still prohibited.

4. Partial solutions will be awarded partial credit as deserved.

3.2 Team Round

1. The team round asks each team to split evenly into two groups and complete relay-style questions simultaneously. It consists of **ten two-part** questions, to be completed in **20 minutes**.

2. Each question consists of two parts, where the answer to the first part is needed for the second part. Each group will have the first part to half of the questions and the second part to the other half.

3. Competitors are allowed to collaborate with team members *in their group* only; collaboration with team members in the other group or with competitors in other teams is not allowed.

4. Each problem is worth a maximum of 10 points. Points are awarded based on the number of parts answered correctly, as well as the last submission time at which a part of the problem was submitted, as follows:

	0	1	2
10 min	0	3	10
20 min	0	2	6

5. More information may be found in the team round instructions document.

3.3 Individual Rounds

1. The individual rounds each consists of **ten short-answer** problems, to be solved in **60 minutes**.

2. Each competitor takes two different individual rounds. It is highly recommended that the competitors on any one team diversify the combinations of tests they take.

3. The topics are **algebra**, **combinatorics**, **geometry**, **number theory**, and **computer science**. The first four topics should be familiar; the computer science round will test knowledge of algorithms, data structures, graph theory, boolean logic, and more. No programming experience is necessary for the computer science round, but contestants should be comfortable reading and using pseudocode to solve problems.

3.4 Finals

1. The purpose of the finals round is to break ties in top-scoring individuals.

2. Each qualifier takes one finals round per subject in which they qualified. The problems on each finals round they take represent the subjects in which they qualified.

3. Each finals round consists of **three short-answer** problems to be solved in **20 minutes**.

4. Competitors may submit once at any time they desire. They will be ranked first by number of problems correctly solved, then by submission time.

5. This round is an invitational round.

4 Scoring

1. The top scores on the power and individual tests can be determined by examining raw scores. The top overall teams will be determined by a weighted score, calculated as follows.
2. A team's overall score is determined by the sum of its normalized aggregate individual score, its team round score, and its power round score. These contribute to approximately 50%, 20%, and 30% of the overall team score, respectively.
3. Scores on each round are normalized to account for the difficulty of each exam; all scores on each round are divided by the mean of the top ten scores on that round to obtain a normalized score. This normalized score is then multiplied by 50 for an individual test, 240 for the team test, and 360 for the power round.
4. A team's normalized aggregate individual score is the sum of normalized individual scores of all its members. If a team has fewer than six members, it is treated as if extra members received a score of 0.
5. If a team does not take the team or power round, for scoring purposes it is treated as if they received a score of 0 on those round(s).

5 Awards

1. Awards will be given to the 10 top-scoring competitors in each individual round, the 5 top-scoring teams on the power round, and the 5 top-scoring teams overall.

6 Conventions

1. **Unlike last year, the answers to this year's CMIMC problems will not necessarily be integer answers!** In other words, the answer to any problem can be expressed in terms of basic arithmetic operations, parentheses, exponents, factorials, trigonometric functions, binomial coefficients, and any other notations which are dictated by the problem in question. More information on answer submissions can be found in the acceptable answers format document.

   Note that on the Computer Science test, answers may also be strings.
2. Diagrams are not necessarily drawn to scale.
3. Polygons' vertices appear in the order by which the polygon is named. For example, polygon $ABCDE$ has vertices appearing in that order.
4. $\sqrt{x}$ refers to the positive square root of an integer. It is only defined for $x \geq 0$.
5. $\log x$ is defined as $\log_{10} x$. $\ln x$ is defined as $\log_e x$.
6. The letter i is used for the imaginary unit, i.e. $i^2 = -1$.
7. Divisors (or factors) of an integer refer to positive integer divisors only. Proper divisors of an integer are its divisors other than itself.
8. Prime numbers refer to positive primes only. 0 and 1 are not primes.
9. When letters are used to represent digits, they are overlined. For example, $\overline{x}01\overline{y}$ where $x = 2$ and $y = 7$ refers to the number 2017.

10. All angles are measured in radians unless otherwise indicated.
11. $-\frac{\pi}{2} \leq \sin^{-1} x \leq \frac{\pi}{2}$, $0 \leq \cos^{-1} x \leq \pi$, and $-\frac{\pi}{2} \leq \tan^{-1} x \leq \frac{\pi}{2}$.
12. The sum of the elements of the empty set is 0; the product of the elements of the empty set is 1.
13. a^{a^a} denotes $a^{(a^a)}$.
14. Computer science definitions, pseudocode conventions, and any necessary formulas are defined on the Computer Science Reference Sheet, which will be provided during the computer science individual round, team round, and computer science finals. This will be released shortly.

7 Events

1. There may be events after the team round. More info will come later as the contest approaches.

8 Registration

1. The competition is open *only* to high school students. Competitors do *not* have to be from the United States.
2. Competitors register on teams of at most six individuals. Teams must be accompanied by at least one adult coach. Competitors who are minors will need to have a parent or guardian sign and submit the competition's permission and liability waiver in order to compete.
3. While teams of any size are permitted, we will attempt to combine teams of size three or smaller so that students are not severely disadvantaged during the Team and Power rounds. These students will still represent their original teams for individual round purposes.
4. Teams do *not* have to be regional. That being said, we highly discourage team stacking, and in extreme cases it can lead to disqualification.
5. Teams participate in individual and team events.
6. The registration fee is \$15 per competitor. This is to be paid by mail by **November 13th, 2016**, or onsite with the late fee. The late fee is \$8 per competitor. Payment must be in the form of a check **payable to "Carnegie Mellon University" with the memo information as your team name**, mailed in to:

   CMIMC
   c/o MCS Associate Dean's Office
   Doherty Hall 1324
   Carnegie Mellon University
   5000 Forbes Avenue
   Pittsburgh, PA 15213

   Please include the team name as the memo on the check.

9 Schedule

1. **7:30am – 8:30am**: Registration
2. **8:35am – 8:55am**: Opening
3. **9:00am – 10:00am**: Power Round
4. **10:15am – 11:15am**: First Individual Round
5. **11:25am – 12:25pm**: Second Individual Round
6. **12:30pm – 1:30pm**: Lunch
7. **1:45pm – 2:15pm**: Team Round
8. **2:30pm – 4:00pm**: Finals / events
9. **4:00pm – 5:00pm**: Faculty talk
10. **5:00pm – 6:00pm**: Awards

10 Travel

1. Carnegie Mellon University is located at **5000 Forbes Avenue, Pittsburgh, PA 15213**.
2. Official travel information is to be found at www.cmu.edu/about/visit/accommodations.shtml.

11 Sponsors