

# Criteria for Entering Various Competitions | Exams | Advanced Projects

by Storming Robots. Last updated: March 1st, 2018

|                       | RoboCupJunior   |                               |                                | ZeroRobotics                  | USACO                           | C-C++ Certification                                      | ④ Independent Project                   |
|-----------------------|---|-------------------------------|--------------------------------|-------------------------------|---------------------------------|--|---|
|                       | Rescue Line   | OnStage/Soccer                | Maze                           |                               |                                 |  |   |
| Time Required         | >3hrs+ / weekly   | >6hrs+ / weekly               | >6hrs+ / weekly                | >4hrs+ / weekly               | Self-adjustable                 | Self-adjustable  | self-adjustable                         |
| Type                  | Competition (Spring Term, but prep must start early)                                  |                               |                                | Competition (Fall)            | Exam (Nov-Apr)                  | Exam (Any)   | Project (Any)                           |
| Venue                 | Away  |                               |                                | Online                        | Online                          | Away   | Online                                  |
| Hardware              | Mindstorms / VexIQ / Arduino / Raspberry PI   |                               |                                | N/A                           | N/A                             | N/A  | self-defined                            |
| URL                   | robocupjunior.org   |                               |                                | zeroRobotics.mit.edu          | usaco.org                       | cpp-institution.org                                      | mp.stormingrobots.com                   |
| Add'l cost to SR fee  | \$60 - \$100 / USA level (Approximation)<br>\$200-\$300 / World level (Approximation) |                               |                                | \$0                           | \$0                             | \$0 for top 10 students. \$300 For Others.               | \$0 to cost of add'l materials, if any. |
| Age                   | 12 to 19  |                               |                                | High School                   | ② High School                   | High School  | High School                             |
| Math                  | Algebra I (prefer with Combinatorial Math for Maze and Soccer)                        |                               |                                | ① Pre-Cal                     | ③ Combinatorial Math            | Algebra I  | Algebra II+                             |
| Programming (minimum) | Robotics Projects with RobotC - Level III Analytics                                   | Algorithms in C/C++ - Level I | Algorithms in C/C++ - Level II | Algorithms in C/C++ - Level I | ⑤ Algorithms in C/C++ - Level I | Algorithms in C/C++ - Level II for C - Level III for C++ | Algorithms in C/C++ - Level III         |

① Minimum Pre-Cal. Linear Algebra and Motion in Physics will be a big plus.

Most high schools do not offer Linear Algebra, nor cover Physics/Motion until Senior Year. Most below 12th grade participants also learn it as they go.

② Usually High School, Not a must.

③ Algebra I+ for Silver. However, knowledge in Statistics and Combinatorial math will be greatly helpful, esp. for Platinum.

\* **Combinatorial Math usually is not available in regular school program. You may take the Math Contest in order to join Math Group by Raritan**

④ Independent Project: Will require an individual very self-disciplined and possess aptitude to self-learn.

⑤ Algorithms in C/C++ - Level I-II for Silver. Level II-III for Gold. Level IV for Platinum

# Why Combinatorial Mathematics with Computer Science?

**Combinatorial Mathematics** is about **Analysis of Algorithms**

Any time when memory or time efficiency is desired, combinatorial mathematics will be applicable.

C.M. is used in order to compute, measure, and maximize the efficiency minimizing the usage of memory, and/or iterations.

also is used in many real world problems such as Routing, scheduling, assignment, etc. are, at their core, graph theoretic problems. Many real world problems turn out to be using Combinatorial Maths with graph theory.

## Definition

By Wolfram MathWorld " the branch of mathematics studying the enumeration, combination, and permutation of sets of elements and the mathematical relations that characterize their properties.

It is a large subset of discrete mathematics that includes graph theory.

By MIT : Combinatorics involves the general study of mathematical reasoning about discrete objects. This may encompass

:

- Biology
- Applied Physics

## Sample Combinatorial Math and Computer Science application:

Take very rudimentary adhoc "bubble sorting" vs. divide and conquer "quicksort" methods.

Just to exemplify the difference between the two - say 'sorting 10K elements':

- with bubble sort : 100M times ( $10000^2$ ) iterations.
- with quick sort : <150K iterations.
- If each iteration takes 1 micro-second, the bubble sort will take 2 minutes to run, but <1 second to run quick sort. The difference grows exponentially.