9th WORLD MATHEMATICS TEAM CHAMPIONSHIP

WMTC
INTERNATIONAL

2018

VARNA, BULGARIA

NOVEMBER 21 – 25, 2018

wmtc.international
wmtc-varna2018.com

2018 WMTC Daily Schedule

Date	Time	Schedule
November 21 – Wed		Airport Arrival Pickups/Registration
November 22 – Thu	8:30 am – 10:30 am 11:30 am – 1:00 pm 1:00 pm – 1:30 pm 1:30 pm – 2:00 pm 2:00 pm – 5:00 pm	Coaches/Proctors/Graders Meeting Lunch Proctors pick up competition envelopes Students take seats in competition hall Individual/Relay/Team Round
November 22 – Thu	5:00 pm - 7:00 pm 7:30 pm - 8:30 pm 8:30 pm - 10:30 pm	Student performances, gift exchanges, photograph sessions Dinner Grading
November 23 – Fri	8:30 am - 6:00 pm 6:30 pm – 7:30 pm 8:00 pm - 10:00 pm	All Day Tour Dinner Organizing Committee Meeting
November 24 – Sat	8:30 am - 10:30 am 10:30 am - 4:00 pm 6:00 pm - 7:00 pm 7:30 pm - 10:30 pm	Lectures for Junior, Intermediate, Advanced Levels Tour Dinner Award Ceremony and Performances
November 25 – Sun		Breakfast in Hotel Transfer to Airport for Departure

WMTC Scoring and Rules

	Problems	Times	Points problem/set	Points each round	Method Team Score	Max Team Total
Individual Round 1 Round 2	15 6 + 2	20 min 40 min	2 4 / 8	30 24 + 16	(Team Total) ÷ 6	70
Relay Round 1 Round 2 Round 3	2 2 2	8 min 8 min 8 min	20 or 15	60	(Team Total) ÷ 3	60
Team	14	40 min	5	70	× 100%	70

Welcome Message

The year 2018 is a very significant year for WMTC. It is our 9th year. It is not easy for a non-government sponsored or subsidized international mathematics team competition that is participated by students from every continent except Antarctica to exist for long 9 years and is still growing. I still remember the skepticism expressed by many people from the inner circle of mathematics during our first year.

I must thank the hard work that was put in by our coaches, students, parents, and by our co-founder Mr. Zhou from Beijing and his staffs. Their enthusiasm and encouraging words, effort, and belief kept WMTC going and expanding year after year.

This is also the first year for a European country hosting WMTC. Bulgaria is a country well known for her mathematics and her love for mathematics. Mathematics plays a very important role in her young people's growth. It is truly an honor for the Union of Bulgarian Mathematicians to agree to host WMTC. It adds legitimacy to our existence.

One thing that kept WMTC going and growing is our insistence in keeping our original objective which is to cultivate the interest of mathematics for our students regardless of their race, gender, or origin. Our goal is to let our students, and in many cases their parents, to discover that mathematics and the logic used in mathematics can be fun, useful, and a good way to make friends. Our goal is not to differentiate and select the top mathematics students from others. We do award prizes to our top scorers but it has more to do with using these awards to encourage and to incentivize them to open their eyes and mind to mathematics. One thing that prevents many students around the globe to try to show interest in mathematics is the fact that being good in mathematics is commonly considered as “abnormal” or “socially awkward or inept”. We believe doing mathematics in a team setting can help our students feeling more acceptable and less “out of place”. It is also a good way to make friends and to make good friends who have similar interest.

I hope everyone would enjoy the wonderful people and sights of Bulgaria. We look forward to Hong Kong which will host our 10th anniversary next year.

Quan K. Lam
WMTC Chairman

November, 2018

Welcome Message

Dear students, teachers and parents,

On behalf of the Union of Bulgarian Mathematicians I would like to welcome you in Bulgaria. Mathematical competitions play an important part in the development of young people. They build self-confidence, the ability to reason and desire to achieve.

In this broad picture WMTC plays an important role. It gives this rare opportunity not just to solve problems but to enjoy doing this in interaction with your teammates.

As you know, mathematics is called universal language of science. I wish you to enrich your vocabulary and to acquire in depth the grammar of this language.

Use this opportunity also to make new friends and to learn about their live. I hope you will have memorable stay here in Bulgaria.

Emil Kolev
WMTC 2018
Local Organizing Committee

November, 2018
Varna, Bulgaria

WMTC 2018 Special Lectures

Advanced Level

Restricted Patterns of the Past, Present and Future

Zvezdelina Stankova, UC Berkeley

Whether designing the new tile pattern in your family's kitchen backsplash, trying to avoid bad investment sequences, or simply counting all possible paths from your home to school that do not cross over the local river, inescapably you are venturing into the realm of restricted patterns.

In this talk, we shall discuss several paths of pattern-exploration, and think about whether or not there is a "true" way of approaching pattern-avoidance equivalence and ordering among the array of generated ideas and methods. No matter what your math background is, you will find your own path between realistic visualization and abstract thinking, and perhaps, you will fall in love with one of our open problems. Of course, the more math you know, the more adventurous you may feel about attacking these open problems.

Biography: Professor Zvezdelina Stankova (Zvezda) was drawn into the world of mathematics when, as a 5th grader, she joined the math circle at her school in Rousse, Bulgaria. Three months later she won the Regional Math Olympiad. Zvezda represented her home country at two International Mathematical Olympiads (IMOs), earning silver medals.

As a freshman at Sofia University, Zvezda won a competition to study in the U.S. where she completed her undergraduate degree at Bryn Mawr College in 1993. Zvezda completed her first math research in enumerative combinatorics at two summer programs in Duluth, Minnesota. The resulting papers contributed to her Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman, awarded by the Association for Women in Mathematics. In 1997, Zvezda received a Ph.D. from Harvard University, with a thesis on moduli spaces of curves, in the field of algebraic geometry. She also earned a high school teaching certificate in Massachusetts, and later, in California. As a postdoctoral fellow at the Mathematical Sciences Research Institute (MSRI) and UC Berkeley in 1997-1999, Zvezda co-founded the Bay Area Mathematical Olympiad and created the Berkeley Math Circle (BMC). She trained the U.S. national team for the IMOs for six years, including the memorable year of 2001 when three of the six team members were BMCers, and the U.S. tied with Russia for second overall in the world. Since 1999, Zvezda has worked at Mills College in Oakland, CA. Starting in the fall of 2016, she joined permanently the Math Department at UC Berkeley.

Zvezda's inspiring style and passion to teach were recognized by the Mathematical Association of America (MAA): in 2004 she received the first Henry L. Alder Award for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member. In 2011 MAA honored her with the highest math teaching award in the U.S., the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics. Individuals who receive this award are recognized for their teaching effectiveness and for their influence beyond their own institutions. Zvezda was featured in the Salutes Program of the ABC 7 News in spring 2011. In 2012, she was listed in Princeton's Review of "300 Best Professors."

In 2015-2016, Zvezda introduced a new middle school math program based on a new textbook series, which she translated, adapted, and co-authored. Zvezda's most enduring passion remains working at the BMC with young students motivated to discover new mathematical wonders. She spends a lot of time with her daughter and son, studying with them foreign languages and playing the piano, and teaching them mathematics the "Bulgarian" way.

Intermediate Level

The Princess Problem

Emil Kolev, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences

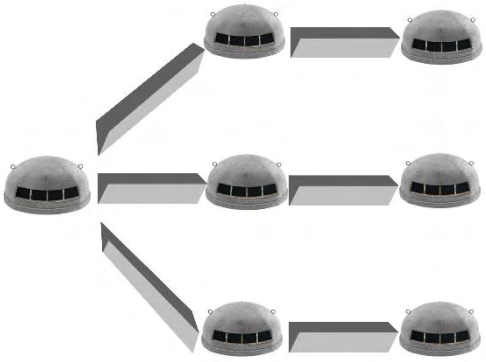
This lecture has been inspired by the following problem.

A princess lives in a row of seventeen adjacent rooms, each connected by a door to each room next to it. Each room also has a door to the outside. The princess enjoys the rooms but never stays in the same room two days in a row. At the end of each day she moves from the room she occupied to one of the rooms next to it (she chooses randomly).

On the first of June a prince arrives from a faraway kingdom to woo the princess. The princess's guardian explains the habits of the princess and the rules he must follow: Each day he may knock on a single outside door. If the princess is behind it she will open it and meet the prince. If not, the prince gets another chance the next day. Unfortunately the prince must return to his kingdom on July 1. Can he devise a strategy to make sure he meets the princess before then?

The same idea with slightly different flavor appears in a problem from the Pan-Russian mathematical Olympiad, 2000.

The soldier and the sniper



Fortification system consists of bunkers. Some of the bunkers are connected with trenches as shown on the picture.

A soldier is hiding in one of the bunkers. A sniper shoots on a bunker.

Between two consecutive shots the soldier necessarily runs across one of the trenches in a nearby bunker. Does there exist a strategy for the sniper that makes sure he hits the soldier?

Both problems can be described as search problems in terms of graph theory. This is done by replacing the rooms (or bunkers) by the vertices of a graph and the doors between rooms (or trenches) by the edges of the same graph.

In the lecture we generalize the idea behind the two problems. We solve both of them along with most difficult once. A variety of open problems are also described.

Junior Level

Math Problems on the Chess Board

Stanislav Harizanov, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences

Both solving mathematical problems and playing chess rely on combinatorial creativity. This lecture is a naive attempt to combine the two fields and various math problems, related to the chess board or the movement of its pieces will be formulated and analyzed.

The main idea behind the mathematical proofs will be a suitable coloring of the board cells so that the “right” modular arithmetic is applied. If time permits, we will also discuss packing puzzle, which is a solitary game where a player tries to find a way to cover a given shape using polyominoes, where a polyomino is a set of squares joined together by their edges. For arbitrary shapes and fixed polyomino type, the computational complexity of the algorithms that determine if such a shape can be tiled by such polyominoes or not is NP-complete. However, on rectangular boards the answer can be derived for all k-minoes, when $k = \{2,3,4\}$.

Bulgarian Telecommunication Company EAD is one of the leading telecoms in Bulgaria since 1992. The company operates under the VIVACOM brand.

The brand has become synonymous with high quality and trustworthy telecom service in both mobile and fixed-line provision, in high speed mobile internet, and high quality digital television services to both residential and business customers.

Together with dealing the telecom services, the company is traditionally investing in sustainability projects. We support various causes, giving a clear example of how businesses can collaborate with the community in order to achieve a better life for everyone.

The telecom believes that adding value to society is a universal responsibility. Our business success and our contribution to Bulgarian society are interrelated. Education has become a main focus of VIVACOM's corporate social responsibility. Education 4.0 is one of the projects we actively invest in is the digitalization of the Bulgarian education.

High School of Mathematics “Dr Petar Beron”

The School’s History

The High School of Mathematics - Varna was established in the autumn of 1883 as State Girls’ High School and in 1945 was named after Dr Petar Beron - a prominent figure of the Bulgarian Renaissance. By the First World War, the school became one of the main centres for education in Bulgaria due to the endeavours of teachers and students as well as Varna’s cultural society. Some of the most prominent figures of Bulgarian cultural, science and political life were students and teachers of the school. Among them were the distinguished mathematicians: Hristo Krastev, Krasimir Markov, Rumen Angelov, Diko Surojon, Rumen Markov, Ognyan Trifonov, Vasil Daskalov and others.

In the beginning of 1963 the first Mathematics class was formed. During 1968/69 school year it was established as a High School specialized in Mathematics. Since then a lot of experiments with new curriculum were carried out. Except the compulsory classes in Mathematics, the students also studied Mathematical Logic, Probability Theory, Combinatorics, Descriptive Geometry, Set Theory and others.

During the last years the student successful performance has continued by tradition mainly in the fields of Mathematics, Informatics and Physics.

The School’s Mission

Our aspiration has always been to prepare students for their higher education in the fields of mathematics, informatics and information technologies and thus to take part in the creation of specialists for various spheres of our country’s social life. This mission of a leader in the education system is based on the level of our students’ knowledge and performance, their interests and daily pursuits as well as on the selection of high-quality teaching staff. The school creed is the formation of scientific views, which are adequate to the educational demands of the present day and the creation of a highly responsible attitude towards the life of our society and its universal values.

The teaching staff endeavors to maintain the school’s image of a modern elite secondary school, where their high professionalism ensures that our students have excellent opportunities in various occupations. Tolerance, consideration and respect for every member of the staff add to the school’s image.

The School’s Goals

- to optimize the conditions in which the school performs its educational process in compliance with the national standards applied in secondary education;

- to create a modern and sustainable environment for the physical, scientific, moral and social development of our students;
- to empower teachers to constantly improve and innovate their teaching practice.

The range and variety of activities, which our students are involved in, boost their competence, adaptability and competitiveness and at the same time give them a good chance to improve themselves and manifest their intellectual potential. Our school provides adequate high-quality education and enables students’ creative development organizing various events – competitions, Olympiads in Mathematics and Informatics, subjects which are the priority of the School. The School concerts, the hours in the school sport clubs, the successful participation in different sport events together with the additional work in foreign language learning give our students the opportunity to express their individuality, vitality and high spirits.

Discover Australia

Penrhos is a leading all-girls day and boarding school in Perth, on the beautiful west coast of Australia.

From the girl in Pre-Kindergarten to the young woman in Year 12, we inspire our students to strive for the highest and achieve their personal best.

Our strong academic focus, especially in Mathematics, was recognised recently by receiving an award for the best Maths Mentor Program in Australia for girls as well as the prestigious 2017 Governors STEM award.

Penrhos is the first school to win this prestigious award in both Primary and Secondary categories.

Maths Mentor Program Coordinator Peter Chandler and his team are honoured to be sharing in the experience of the World Mathematics Team Championship.

Visit **penrhos.wa.edu.au** or contact Mr Chandler on tour at **chandp@penrhos.wa.edu.au** to learn more about opportunities to study at Penrhos.

PENRHOS COLLEGE

6 Morrison Street, Como 6152 **Western Australia**

penrhos.wa.edu.au

臺灣數學/科學圈

Taiwan Math / Science Circle

The **Taiwan Math/Science Circle(TWMC)** is a program for motivated students in Taiwan. It aims at drawing kids to both mathematics and science, teaching them to accept failures, preparing them for competitions, and introducing them to the fun of solving challenging problems and studying more difficult materials.

Circle Sessions: Knowledge for Every Level

Circles sessions often concentrate on problem solving techniques applicable in many areas. Sample circle topics include: symmetry, the pigeon – hole principle, divisibility, counting, probability, invariants, graphs, induction, plane geometry, or inversion in a circle. Teachers would encourage the students to think and would not be satisfied unless there is a rigorous solution to every problem.

TWMC Camps

The camps will allow the students to explore the concepts of math and science in fun and creative ways. The students will be exposed to many different materials that will allow them to grow greatly. These camps will bring out student's self-confidence and interest for both both of these subjects.

Contests

TWMC members will be encouraged to attend many different competitions, in and out of the country. These competitions provide a myriad of opportunities for them: a platform for students to demonstrate your talent and a stepping-stone to achieving greater things in life. They represent unconventional but effective ways of securing internships, scholarships, jobs and exposure to real-world issues. Students will also be able to connect to other talented youths and experience the joy of competing! TWMC is very grateful of the information about camps and competitions that were provided by various schools and organizations.

Taiwan Math/ Science Circle

www.taiwan-mathcircle.org.tw

TEL: +886-4-2243-1519

FAX: +886-4-2243-4727

Email: twmc.adm@gmail.com

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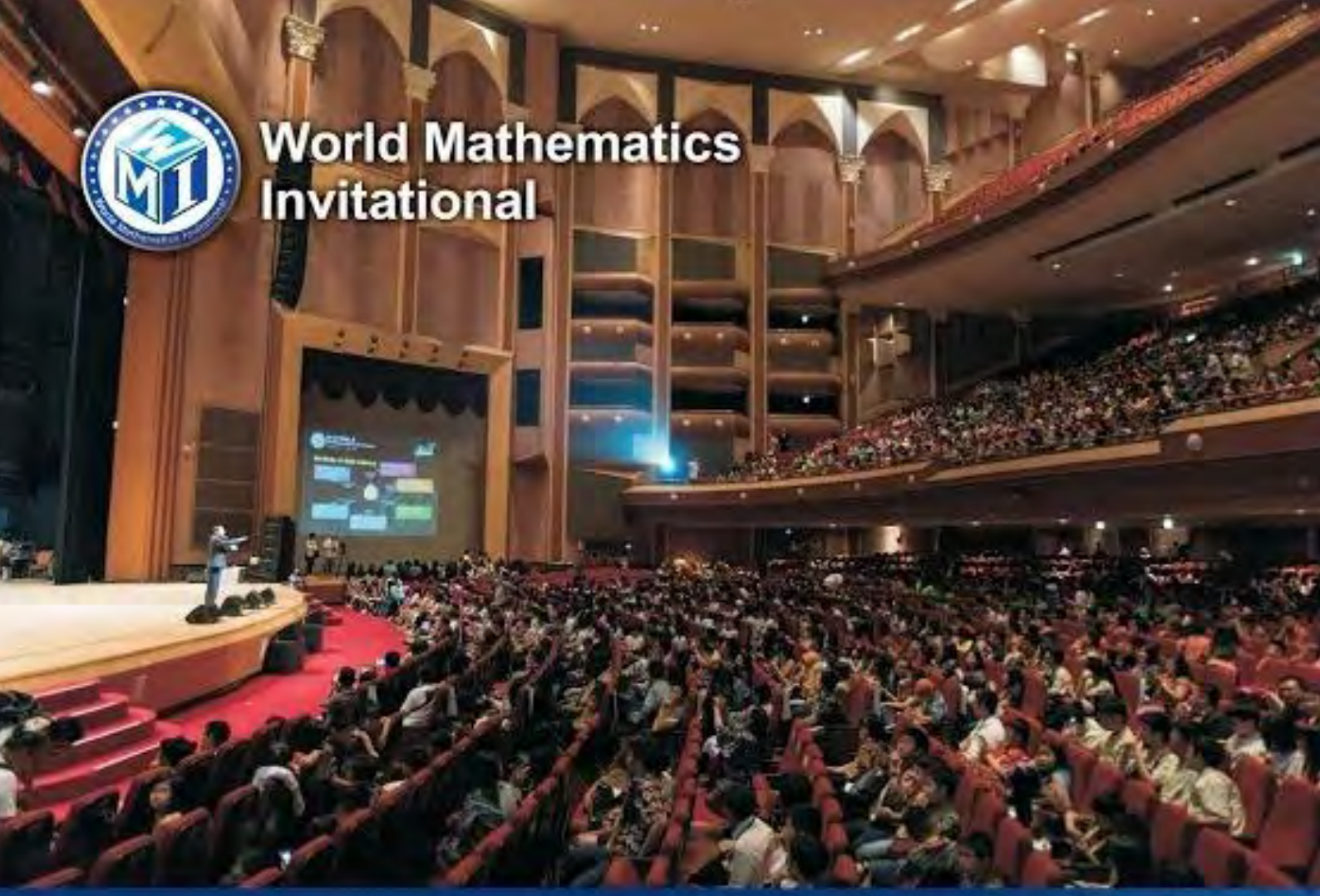

World Mathematics Invitational

WMI2019 Finals

7/12-7/16

wmiregister@gmail.com

Think Differently

WMI Organizing Committee

香港數學奧林匹克學校
Hong Kong Mathematical Olympiad School

Organized first HKPMO in 1994 & School established in 1995
A Registered Charity in Hong Kong : 91/4924

Rm E, 3/F, Nathan Tower,
518-520 Nathan Road,
Yau Ma Tei, Kowloon, Hong Kong
香港九龍油麻地彌敦道 518-520 號彌敦行 3 樓 E 室
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  - 奧林匹克數學課程
  - 趣味數學工作坊及解難能力思維訓練課程
  - 數學遊蹤、攤位遊戲、嘉年華、講座

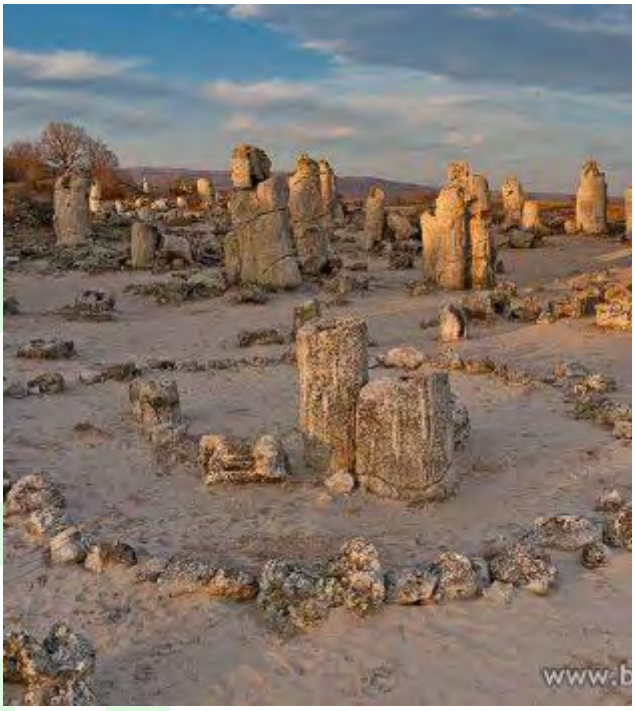
2018 WMTC Tour Info

Balchik Palace

(Quiet Nest)

Pobiti Kamani

(The Stone Desert)



Varna City Tour

Varna City Tour

SUMMER RESEARCH SCHOOL

IN MATHEMATICS & INFORMATICS

Who can apply?

Students aged 15 to 19, who have not yet completed their high school education, with achievements or interests in mathematics or computer science.

WHAT

Doing research on individual topic in math or computer science under the guidance of a mentor.

WHEN

Three weeks in the summer from the end of July to mid August.

WHERE

In Bulgaria, a beautiful and picturesque country in Eastern Europe.

www.math.bas.bg/srs

ISMC International Singapore Maths Competition

WWW.ISMC.SG | INFO@ISMC.SG

COME TOGETHER. OVER LOVE FOR MATHEMATICS.

ISMC 2019

We're excited! Primary students from all over the world
will again put on their thinking caps solving challenging problems.
This will be another great learning experience for all!

1

INTERNATIONALIZATION

INTERNATIONAL EXAM EXPERIENCE AND BE ON PAR WITH OTHER ESTABLISHED COUNTRIES.

DISTINGUISHED PORTFOLIO

2

CERTIFICATION AND RECOGNITION FROM AN INTERNATIONALLY PROMINENT EDUCATIONAL BODY.

3

GLOBAL BENCHMARK

MEASURE YOURSELF AGAINST WORLD'S BEST AND GET THE GLOBAL RANK.

CURRICULUM COMPATIBILITY

4

STUDENTS CAN COMPETE WITHOUT ADVANCED KNOWLEDGE OR ANY SPECIAL TRAINING.

5

INTERESTING QUESTIONS

PROBLEMS ARE DESIGNED BY INTERNATIONALLY RENOWNED MATH EDUCATORS.

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