



EMS Education Committee Mathematics Summer School for school students 2022

Date and Location: 25-30 July 2022, Rodon Mount Resort, Agros, Cyprus
Host organization: THALES Foundation of Cyprus and Cyprus Mathematical Society
www.thalescyprus.com

PROGRAMME and CONTENT

25 July 2022

Arrivals, (transfers from airport to those needed)

Registration

Welcome dinner

26 July

09:30-10:45

- Welcome by the Chair of the EMS Education Committee (**KRAMER**)
- EMS Education Committee Presentation and aims of the Summer School for school students (**MAKRIDES**)
- Video play of the European Mathematical Society
- Introduction of student participants (**STUDENTS**)

10:45–11.00 Break

11:00-12:45 **Module 1 plus posting of problem challenge or project (KRAMER)**

13:00-14:30 Lunch

14:45-16:15 **Module 2 plus project assignment, (SZEMBERG)**

16:30 -18.15 **Module 3 (KAKAS)**

18.30 – 19.30 **Visit Rose Factory in Agros, walking (optional)**

20:00 Dinner

27 July

09:00-10:45 **Module 4 plus project assignment (SZPOND)**

10:45-11:00 Break

11:00-12:45 **Module 5 (KRAMER)**

13:00-14:30 Lunch

14:45-16:15 **Module 6 (SZEMBERG)**

16:30-18:00 **Module 7 (SMYRLIS)**

18:00-19:30 **Moderation: Discussion between students on the problem challenge or project (90 min) KRAMER, SZEMBERG, SZPOND**

20:00 Dinner



28 July

8.30 Departure by bus to Nicosia

8:30-11:00 **Visit to the University of Cyprus (Department of Mathematics & Statistics)**

11:30 – 13:00 **Archaeological Museum of Cyprus in Nicosia**

13.00 Departure by bus to return to hotel Rodon in Agros

14:00-15:00 Lunch

15.00 – 16.00 rest time

16:00-17:45 **Module 8 (CHRISTOFIDES)**

18:00-19:45 **Module 9 (KRAMER)**

20:00 Dinner

29 July

09:00-10:45 **Module 10 (CHRISTOFIDES)**

10:45-11:00 Break

11:00-13:00 **Module 11 (KRAMER)**

13:00-14:30 Lunch

14:30 Depending on wishes of students

- more work on topics

or

- Excursion: Depart by bus to Limassol old town and new MARINA

18.00 Depart from Limassol to return to Agros

19:30-20:00 **Closing ceremony, Follow up networking and farewell**

20:30 Farewell dinner at hotel

30 July

Organized Departures

Topics covered by each professor

Jurg KRAMER, Professor- University of Berlin, Chair of Education Committee – European Mathematical Society

Thematic: **The mystery of prime numbers**

Abstract:

After recalling the definition of a prime number and the proof of the infinitude of primes, we will first investigate the possibility for a closed formula for all prime numbers. Since this turns out to be a complicated task, we shift our focus towards the counting of primes which brings us to the prime number theorem and a variant of the Riemann hypothesis. Introducing Riemann's zeta function will eventually allow us to formulate the standard variant of the Riemann hypothesis and related problems. In contrast to these more theoretical findings, the application driven interest in prime numbers comes from the field of cryptography, the so-called RSA encryption. The security of this cryptosystem relies on the empirical fact that there exists presently no „quick“ (i.e., polynomial time) algorithm to factor integers into primes.

Giorgos SMYRLIS, Professor of Mathematics, Department of Mathematics, University of Cyprus

Thematic: Mathematical Induction: Rigorous foundation, Variations of the method, applications

Demetris CHRISTOFIDES, Professor, UCLAN University, Cyprus Campus

Thematics

1) Szemerédi's Regularity Lemma.

2) Van der Waerden's Theorem.

Use and applications

1) Szemerédi's regularity lemma is one of the most powerful tools in extremal graph theory, particularly in the study of large dense graphs.

It says that in some sense all graphs can be approximated by random looking graphs. Therefore the lemma helps in proving theorems for arbitrary graphs whenever the corresponding result is easy for random graphs.

2) Ramsey theory is a branch of combinatorics in which theorems typically state that if we partition any sufficiently large enough structure into finitely many parts, one of the parts contains some large substructure.

For example the celebrated van Der Waerden's Theorem states that if we partition the integers into finitely many pieces, we can find an arbitrarily large arithmetic progression in one of the pieces.

Despite its apparent simplicity, this turned out to be quite a deep result. Its classical proof offers a unique opportunity for analyzing the process of mathematical thinking.



Justyna SZPOND + Tomasz SZEMBERG, Pedagogical University of Krakow, Poland

"Configurations of points and arrangements of curves with interesting properties".

Justyna SZPOND

1. Erdos-de Bruin Theorem and variations
2. Combinatorics of the Pappus and Pascal Theorems and arrangements derived from them.

Tomasz SZEMBERG

1. The Sylvester-Gallai Theorem its colourful versions and where it fails.
2. Tangent lines, flex points, sextactic conics and their generalizations.

The instructors are professors of mathematics at the Pedagogical University of Cracow and they plan to cover among other: Arrangements of lines are a classical subject of study in geometry. The first significant contribution to this subject is due to Pappus of Alexandria (ca. 290-350 AD). His statement has found many generalizations since then and is still a subject intriguing researchers in mathematics. In the Pappus arrangement there is a relatively big number of points where exactly 3 lines meet. It might have motivated Silvester to ask around 1890, if there exist arrangements of lines, where all intersection points among the lines belong to exactly 3 lines. This problem waited half a century for a solution and prompted a lot of research. There will be an opportunity to engage in this area of mathematics. We will touch upon recent developments which bring elliptic curves into the picture.

Antonis Kakas, Department of Computer Science, University of Cyprus

Thematic: On the Logical Foundations of Artificial Intelligence

Can classical Mathematical Logic serve well the needs of Artificial Intelligence?

Argumentation Logic as the Calculus for Artificial Intelligence.