29e CONGRÈS

MATh en JEANS

Students presenting their annual research

Student talks | Forum | Invited talks

Padova: March 27th-29th 2018

Department of Mathematics - University of Padova

Berlin: March 13th-16th 2018
Pondichéry: March 16th-18th 2018
Lyon: March 22nd-24th 2018
Sarreguemines: March 22nd-24th 2018
Nancy: March 23rd-24th 2018
Orsay: March 23rd-25th 2018
Poitiers: March 23rd-25th 2018
Chicago: March 27th-28th 2018
Padova: March 27th-29th 2018
Montpellier: March 05th-07th 2018
Nantes: April 12th-13th 2018
Calais: April 12th-14th 2018

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We are very pleased to welcome all of you to the first MATh.en.JEANS congress in Padova, which is also the first high school student meeting hosted by our department. This is a not just a coincidence. In the last several years, the Dept of Mathematics "Tullio Levi-Civita" has developed a growing network of relationships with high schools of the zone of Padova. The exchange of information between schools and university, as well as coordinated common activities, has been very fruitful. In particular, the collaboration was aimed at showing young students some aspects and applications of Mathematics that standard school courses cannot consider. In some sense, we can say that those activities wanted to put into practice the MATh.en.JEANS motto "Ne subissez pas les maths, vivez les!".

The collaboration with MATh.en.JEANS is obviously different from any other collaboration, not only because of its international perspective, but mainly because of its very particular task: directing young students to the edge of mathematic research. This is not less important than other activities. All mathematicians are aware of the potential that young people can exhibit in mathematics, and the success of MATh.en.JEANS confirms that it is certainly worthwhile to invest some energies for developing this potential. We are also sure that, for young students involved in the MATh.en.JEANS activities, the motto could be extended to "Ne subissez pas les maths, vivez les en vous amusant!"

Organizing a conference takes a lot of time and coordination and we would like to thank all the people and institutions that made this possible. Among them, we would like to single out:
The MATh.en.JEANS association, which provided a very precious help in the organization as well as almost all conference material – The University of Padova and the Department of Mathematics "Tullio Levi-Civita" for the financial support – The Italian national project Piano Lauree Scientifiche, which promotes the collaboration between universities and high schools and provided a financial support – The City of Padova, for the welcome speech and the visits to the civic museums – The GEO-PadovaFiere company, which very generously sponsored the conference works in its area – The staff of the administrative office of our department, for having dealt with the complex bureaucracy that these meetings always involve.

We would also like to thank and congratulate all the students taking part in the meeting for their brilliant results. In this respect, we are particularly grateful to all the teachers who supervised the activities of the students. Their work, often outside the standard working time, has been essential for making this conference possible.

Thanks to everybody!

Alberto Zanardo, for the local organizing team

Contents

Schedule

R1, R2, R3 = Room 1, Room 2, Room 3

Tuesday, March 27

9:30 – 11:00
Registration and Poster installation

11:00 – 11:30 Opening
Dominique Lavigne Grihon (MATh.en.JEANS association)
Marco Ferrante (Head of the Dept of Mathematics)

11:30 – 12:30 Invited talk
Anna Salvadori - Dept. of Mathematics and Computer Science of the University of Perugia
"A magic formula of nature"

Abstract: The description of the forms is one of the major problems of biology, especially when dealing with complicated shapes such as leaves or shells. For centuries, scientists have been trying to express the forms of nature in mathematical terms. The Dutch botanist Johan Gielis has proposed a formula that can describe a wide range of natural shapes, the so called Gielis' superformula.

It represents a tool for analysis and comparison, moreover it can be used in reconstruction and recognition programs.

12:30 – 14:30 Lunch

14:30 – 15:00 Parallel sessions
Colegiul National Emil Racovita (Cluj-Napoca) and Lycée d'Altitude (Briançon) - "Shape of a church bell" - R1
Costache Negruzzi High School (Iasi) - "The coffee machine" - R2
Colegiul Național Mihai Eminescu (Satu Mare) and Bellevue High School (Alès) - "Shortest path" - R3

15:10 – 15:40 Parallel sessions
Colegiul National Emil Racovita (Cluj-Napoca) and Lycée d'Altitude, (Briançon) - "The Plotter" - R1
Costache Negruzzi High School (Iasi) - "On time" - R2
Costache Negruzzi High School (Iasi) - "Snowflakes" - R3

15:40 – 16:10 Coffee break

16:10 – 16:40 Parallel sessions
Colegiul National Emil Racovita (Cluj-Napoca) and Lycée d'Altitude, (Briançon) - "The juggling" - R1
Costache Negruzzi High School (Iasi) - "A very short alphabet" - R2
Liceo I. Nievo (Padova) - "Pandemics 2" - R3

16:50 – 17:20 Parallel sessions
Colegiul National Emil Racovita (Cluj-Napoca) - "When does the bus leave?" - R1
Costache Negruzzi High School (Iasi) - "Pizza time" - R2
Colegiul Național Mihai Eminescu (Satu Mare) - "Let us play with sandpiles!" - R3

17:20 – 18:30 Poster session (forum)

Schedule

R1, R2, R3 = Room 1, Room 2, Room 3

Wednesday, March 28

9:00 – 9:30 Parallel sessions
Costache Negruzzi High School (Iasi) - “A sweet problem” - R1
Lycée Vaclav Havel (Bègles) and Liceo E. Curiel (Padova) - “Panic in the rocket” - R2
Colegiul National Emil Racovita (Cluj-Napoca) - “Algorithm of video games” - R3

9:40 – 10:10 Parallel sessions
Costache Negruzzi High School (Iasi) - “How deep is my well?” - R1
ISISS M. Casagrande (Pieve Di Soligo) - “Egyptian fractions” - R2
Colegiul Național Mihai Eminescu (Satu Mare) - “Probabilities, triangles and quadrilaterals” - R3

10:10 – 10:50 Coffee Break

10:50 – 11:20 Parallel sessions
Costache Negruzzi High School (Iasi) - “Paper work” - R1
Liceo Ettore Majorana (Mirano) - “Math of the Walking Dead” - R2
Colegiul Național Mihai Eminescu (Satu Mare) - “Count the collisions!” - R3

11:30 – 12:00 Parallel sessions
Costache Negruzzi High School (Iasi) - “A not so fair game” - R1
Liceo Scientifico R. Bruni (Padova) - “Determination and qualitative analysis of a continuous epidemic model” - R2
Bellevue High School (Alès) - “Triangles and probabilities” - R3

12:10 – 12:40 Parallel sessions
Costache Negruzzi High School (Iasi) - “Lattice” - R1
Bellevue High School (Alès) - “Shortest path” - R2
Lycée Vaclav Havel (Bègles) and Liceo E. Curiel (Padova) - “Zeus’ chariot” - R3

12:40 – 14:30 Lunch

15:00 – 16:00
Welcome speech from local authorities in the “Palazzo della Ragione”
http://padovacultura.padovanet.it/it/musei/palazzo-della-ragione

16:00 – 19:00 Museums (see next page)

Thursday, March 29

9:00 – 10:30 Poster session (forum)

9:30 – 10:30
Teachers and researchers meeting (in parallel of the poster session)

10:30 – 11:00 Coffee Break

11:00 – 11:30 Parallel sessions
Lycée Stendhal (Milano) - “About measure and lengths” - R1
ISISS M. Casagrande (Pieve Di Soligo) - “Pandemics” - R2

11:30 – 12:30 Invited talk
Primo Brandi - University of Perugia - “Shortest and Quickest paths”

Abstract: Erone’s principle. Shortest paths on some Euclidian surfaces (plane, sphere, cylinder, cone, ellipsoid). Reflection law. Fermat’s principle. Refraction law. Poincarè’s half-plane. Poincaré’s disk model. Escher’s limit circle. Gravitational lens.

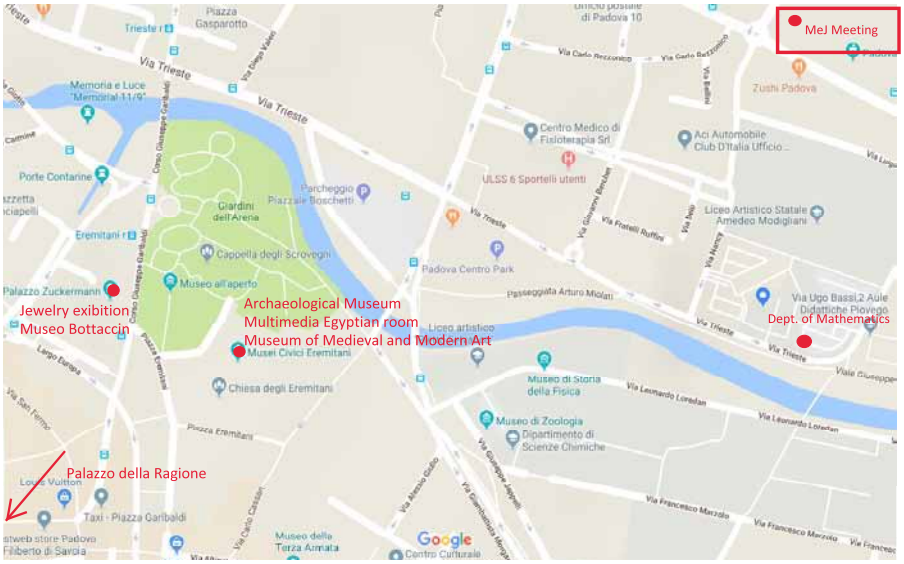
12:30 – 12:30 Conclusion

13:00 Lunch

Afternoon Museums

On March 28 and 29 all participants have free access to the following museums, the congress badge must be shown at the entrance.

- Palazzo della Ragione
- Musei Civici Eremitani
  - Archeological Museum
  - Multimedia Egyptian Room
  - Museum of Medieval and Modern Art
- Palazzo Zuckermann
  - Jewelry exibition
  - Museo Bottaccin



MATH OF THE WALKING DEAD

LICEO ETTORE MAJORANA (MIRANO)

Team

Students: Roncaglia Federico, Voltan Nicolò, Cazzin Riccardo, Stevanato Giacomo, Casarin Pietro, Morrone Gabriele, Bellin Leonardo, Casarin Fabio, Sanguin Giacomo, Pesce Francesco.
Teachers: Mario Puppi, Carlo Andreatta.
Researchers: Alberto Zanardo and Riccardo Colpi, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

The Walking Dead is a Tv serial which tells the story of a Zombie Apocalypse. Zombie stories are classic themes in science fiction, often consistent with infectious disease biology. In the episodes of serial The Wal-king Dead or films such as World War Z and Resident Evil, infection is caused by virus. In the novel Deck Z contagion is caused by bacteria, and prions are the cause in the film Zombieland. Zombism is a deadly disease that kills every infected human and turns the host into a deadly vector of the disease.

Our challenge is:

- develop a model of the interaction between humans and zombies
- study the model using computer simulations to identify values of parameters consistent with observa-tions based on Tv series The Walking Dead
- use the model to make prediction about survival of humanity and know how large number of the population will survive to a zombie attack

We'll make a model of zombism using assumptions adopted for traditional diseases that affect a population. Every day a human will be in one of three states:

- the state of susceptible or uninfected humans
- the infected state of zombies
- the removed state of a human died for natural causes or a zombie killed by an uninfected human

Two transitions are possible: a human can become infected by a zombie, and a zombie can be destroyed by a human. Two parameters govern the two transitions:

- a parameter gives the rate at which a zombie will infect humans
- another parameter gives the rate that a human kills the zombies

We write the equations which describe explicitly the evolution of humans and zombies in time, and we study the model using two methods:

- running computer simulations we observe parameters involving infection rates and death rates to see how are affected the population of zombies and humans over time
- searching for the invariants quantities of the evolution and using them to construct useful approxima-tion of the evolution

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 10:50 in Room 2.

THE COFFEE MACHINE

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Cristea Radu, Robila Matei.
Teacher: Ionesei Silviana.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

Our task to complete was about a coffee machine in which to insert banknotes and coins of different values. To our surprise, we noticed that there are many possible combinations of paying a certain amount of money, whether we consider the order of inserting the money in the machine or not. We solved these counting problems using the second order linear recurrent sequences, the combinations with repetition formula and the first order diophantine equations.

We could see that the machines which can provide a range of products give the change in a minimum number of banknotes and coins. Then we designed an algorithm in order to find the minimum number of monetary values given as change for any amount inserted in the machine.

On completion of the tasks, we could identify some connections to a well-known programming problem/question – "the rucksack problem".

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 14:30 in Room 2.

Notes

ON TIME

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Bandac Mara, Cozma Alexia, Oniciuc Nicoleta, Tarcan Sara.
Teacher: Ionesei Silviana.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

Our team has completed a set of tasks related to a classic clock.

We set a general calculus formula of finding the angle between the minute hand and the hour hand at a certain time of the day, which enabled us to easily solve most of the problem subtasks. We were supposed to calculate both probabilities based on the classic formula and geometrical probabilities. To our excitement, we found out that the hands of an analogue clock can be sides of an isosceles triangle and we could indicate the hours and minutes when this happens.

We could also notice that there are clocks whose minute hands can hardly be distinguished from its hour hands. Then we set out to count the times per day when the clock hands accurately indicate the time, even if they interchange positions.

To complete these tasks, the divisibility properties of integers and the measurement of angles based on their trigonometric functions were of great use to us.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 15:10 in Room 2.

Notes

PIZZA TIME

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Satcau Ivona Elena, Jitareanu Ana Taisia, Danila Anastasia Maria, Scarlat Georgiana, Zapratan Ruxandra Andreea.
Teacher: Ioana Catalina Anton.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

Our team will present at the congress various problems of geometry and algebra based on the same subject (pizza) that look easy with helpful drawings but which prove to be difficult to decipher. The name of the topic is ''Pizza Time'' and the problems focus on situations commonly encountered. A first problem involves finding the person who ate more pizza cut differently and to solve it we used helper constructions. Another problem involves finding the number of toppings for a restaurant that has 1001 combinations of pizza. We used some formulas and got an incredible result for a restaurant. There were also problems with diameters and possibilities that we tried not to get rid of and we came up with a solution to be checked.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 17:50 in Room 2.

Notes

A VERY SHORT ALPHABET

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Druhus Daria Elena, Manole Maria, Rotariu Diana Gabriela.
Teacher: Ioana Catalina Anton.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

We suppose that we have an alphabet including only the letters α, β, γ, δ.

- Find the number of distinct words of 7 letters which contain an even number of α.
- How many words of 7 letters of this alphabet don't contain two consecutive α?
- Find the number of all the distinct words of 7 letters, which doesn't contain the sequence γδ, δγ.
- How many words of 7 letters formed considering all the conditions above are?

Using principles of recurrences, we approach as a rule for any alphabet formed of n letters the conditions above. We know thanks to the principle of multiplication that we have a total of 4^n words. Using unknown quantities for the number of the words with even number of letters of α and odd number of letters of α, we find recurrences equations.
Again, we judge by the first letter, which can be either α either one of the three one remained and we create recurrences. For the last requirement we combine all the methods used above. Of course, we replace the general n used in the equations with 7, the number of the letter which a word must contain.

This is a diverse and complex problem, which is very useful in every day life for creating and decoding passwords. This problem is a particularly case because there are used greek letters with which we form words, having certain conditions, which we may find in real life for different passwords.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 17:10 in Room 2.

Notes

A SWEET PROBLEM

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Hanus Ioana Stefana, Iftene Tudor, Luca Stefan, Tabarna Andrei Alexandru.
Teacher: Irina Capraru.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

A cake as a cuboid has to be served by 100 persons at a birthday party. The person who celebrates his birthday has to cut the cake such that everybody who is there can eat a piece in order to taste the sweet cake. Pieces can be every shape or size; they do not have to be equal, but they cannot be rearranged after any cut. The cake can be cut every direction.

a) Which one is the minimum number of cuts the celebrated person should do in order to satisfy all guests (everybody tastes the cake)?

b) Which one is the minimum number of cuts in order to get equal pieces?

c) The cake is covered by chocolate (except the base). The aria covered by chocolate is equal to 0.4 m2. Find the dimensions of the cake that has maximum volume. The thickness of the glaze is neglected.

d) A company produces packs for cakes. The pack has to be a cuboid made of cardboard with a volume of 0.03 m3, with a double base as a square. The price of cardboard is 0.5 USD for 1 m2. Build the cheapest box.

e) Analyse the situation when the box is like a truncated pyramid.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 9:00 in Room 1.

Notes

HOW DEEP IS MY WELL?

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Avatajitei Viviana-Andreea, Barceanu Teodora, Bojoi Cristian, Craciunescu Diana, Grumeza Mara-Krysta, Ostopovici Rares-Mihai.
Teacher: Ioana Catalina Anton.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

"How deep is my well?" is a problem in which a child drops a stone into a well and hears the water splash after exactly 2,4 seconds, without touching the well's walls. We had to determine how deep is the well in the following situations: if the splash is heard immediately after the stone hits the water and if considering the delay caused by the speed of sound.

Knowing that the difference between the depth values obtained previously is significant only if it is over half metre we had to find out which is the minimum depth of the well. Then we had to calculate the depth of the well if the time after we hear the splash is noted with s seconds. The next point asks us to calculate the time after we hear the splash if the stone is dropped into a 40 metres depth well. The last point we had to answer the tasks above considering that the stone has been thrown into the well with a speed of 10 m/s.

In addition to the original problem tasks we added one more: a thief wants to hide some diamonds and he had to choose the most convenient shape of box to store the diamond and also how to store the boxes in the well so the water won't overflow.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 9:40 in Room 1.

Notes

PAPER WORK

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Apostolescu Elisa, Baroi Sara Iuliana, Birsan David Robert, Hirbu Vlad Florin, Nedelcu Mara, Zavadovschi Bogdan.
Teacher: Ioana Catalina Anton.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

"Paper Work" is a problem in which is given a normal A4-format paper and we are supposed to prove what an origami-passionate guy often does. In the first task we need to fold the paper so as to have the minimum value for the hypotenuse.

After, we are supposed to create an equilateral triangle which is supposed to have the maximum area; this means that it must have the largest possible side.

Ending up with origami, we are moving up to a stage that is based on building a box, first without a lid; it must have the maximum volume, with lower cuts.

The last point of our problem is to build a box with the same proprieties but now it must have a lid. For this we have two cases, but we prove that any way we make the lid we have the same maximum volume.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 10:50 in Room 1.

Notes

LATTICE

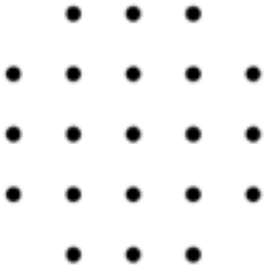
„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Enache Tudor-Eduard, Motruc Andrei-Constantin, Neacsa Matei, Pintilie Andreea-Iustina, Prodan Ana, Dascalu Diana-Elena .
Teacher: Ioana Catalina Anton.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

The annexed network consists of the nodes of a 5×5 lattice by removing the nodes in the four corners.
(a) Determine how many lines go through exactly two nodes of the network.
(b) How many squares with peaks in network's nodes can be built? Generalize to a similar n×n type of network.
(c) By randomly choosing 4 dots from the shown network, which is the probability that these dots are the peaks of a square?
(d) By randomly choosing 3 dots from the shown network, which is the probability that these dots are the peaks of a triangle?
Random choices are made so that all dots have the same chance of being chosen.



This is also how lotteries work. The numbers are drawn one at a time, and if we have the lucky numbers (no matter what order) we win!

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 11:30 in Room 1.

Notes

A NOT SO FAIR GAME

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Bejenariu Iunia, Brasov Darius, Coroama Georgiana-Ioana, Ionita Ana, Tiperciuc Ana, Verstiuc Georgiana-Denisa.
Teacher: Ioana Catalina Anton.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

Our problem is based on a craps game between Păcală and Tândală, two famous fictional characters in Romanian folklore, literature and humor.
Păcală created three different dice, modifying the number of dots from each face:

Die 1:	5	7	8	9	10	18
Die 2:	2	3	4	15	16	17
Die 3:	1	6	11	12	13	14

For every dice, all the faces have equal chances to appear. Every player picks a die and keeps it until the end of the game. One game consists of each player throwing their chosen die, and the one who accumulates the most points wins the game. This type of game can be repeated multiple times, in identical and independent conditions.

a) Being polite, Păcală invites Tândală to choose his die first. We are supposed to prove that, no matter which die Tândală picks, Păcală has the possibility to choose a better one from the ones left. In other words, in each game, Păcală has better odds of winning the game.

b) In each game, the one who obtains more points receives 1 € from the other player. What we have to do is to find Păcală' s average gain after 60 games.

c) The next question we have to answer to is: "What is the probability that, after 10 turns, Tândală has at least 5 €?"

d) In the beginning of the game, each of the two players had 10 €. In each game, the winner receives 1 € from the loser. We are asked to find the average number of games required for one of the players to become broke.

e) Tândală finally understands Păcală's trick and decides to bring in three new dice, numbered from 1 to 6, with the possibility of repetition, so that he may have a higher chance of winning. We must help him create his dice.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 11:30 in Room 1.

SNOWFLAKES

„COSTACHE NEGRUZZI" HIGH SCHOOL (IASI)

Team

Students: Apostol Lucia, Al Deiri Nadine, Ani Maria, Gurlui Octavian, Manea Andreea, Popa Alexia.
Teacher: Ionesei Silviana.
Researcher: Stoleriu Iulian, „Alexandru Ioan Cuza" University, Iasi, Romania.

Presentation of the research topic

Few have the chance to actually experience the world of mathematics, and even fewer manage to get a grip on a subject related to this vortex of ideas, problems and equations.

This is why we truly consider ourselves lucky- we had the opportunity to get an insight into the myriad of concepts and notions related to the unique subjects of fractals, Koch's Snowflake, the Coastline Paradox and many others. At first we were unsure whether we were going to succeed and we definitely believed it was harder than in reality - thankfully, after some moments spent researching and actually solving the problem, we realised it was not only doable, but also successful. Our task was mainly based on Koch's snowflake, which is why we had to calculate the number of sides, the perimeter and the area of the figure after 10 iterations, task that was achieved mostly through mathematical induction. After doing so, we noticed maybe the most special aspect of our problem: after an extremely large number of iterations, our figure seems to become two-dimensional! After this wondrous discovery, we faced yet another challenge: a reversed snowflake, which was created by replacing the initial segment with a triangle towards the interior. What we surprisingly found out afterwards is that the new figure had the same number of sides after the same number of iterations, but of course, a different area.

We concluded this project with examples of fractals used in daily life and were shocked to find out more uses than we could have thought of, having extremely important implications in art and architecture.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 15:10 in Room 3.

Notes

DETERMINATION AND QUALITATIVE ANALYSIS OF A CONTINUOUS EPIDEMIC MODEL

LICEO SCIENTIFICO "R. BRUNI" (PADOVA)

Team

Students: Franco Giuseppe, Gottardo Federica, Scuttari Pietro.
Teacher: Dario Benetti.
Researcher: Alberto Zanardo, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

The problem we faced consists in analyzing the spreading of a disease in a population. This illness had agiven probability of spreading from person to person, a given probability of killing an infected personand a given probability that an infected person has to recover. We made some hypothesis to simplify the problem such as keeping the number of people constant, in other words we included in the population the dead, and the fact that once healed an ill person cannot get infected again.
Firstly we tried to solve this problem utilizing the tree graphs and calculating a formula that would give us the number of healthy people, the ill, the dead and those who recovered for a determined group of people. We tried to look for a recursion which would have allowed us to write a generic formula for any given population. We decided to abandon this method because we did not find any recursion between the coefficients of the formulas we had obtained.
The graph method did not lead to a general formula so we changed method and started to work out a formula by calculating how the number of healthy people, the number of the ill, the number of those who healed up and the number of the dead change: firstly in discrete time frame then, by calculating the derivatives, in continuous time obtaining a system of differential functions similar to the Kermack-McKendrick Model (1927). Since we were not able to solve this system we tried to give a qualitative estimate of the dead at the end of the epidemic.
We used these functions to simulate with a computer program the evolution of the illness. We tried to give a quantitative estimate on the number of dead at the end of the epidemic by changing the values of the different variables and seeing the impact that these changes had. This helped us determine when it is better to vaccine the population and when it is better to isolate the population in smaller group.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 11:30 in Room 2.

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EVOLUTION OF ANIMAL POPULATION

BELLEVUE HIGH SCHOOL (ALÈS)

Team

Students: Lasgues Gabriel, Molko Maxime.
Teachers: Élodie Fort, Sébastien Castagnedoli.
Researcher: Serge Dumont, University of Nîmes, France.

Presentation of the research topic

We purpose to study the evolution of pair of animals.
At each time step n, we assume that:

- Each pair of children from the previous step becomes an adult couple;
- Each adult couple of the previous step has a couple of children.

The possible questions are then:

- Is it possible to describe the evolution of the population?
- Is it possible to give a direct estimation (approximate) of the total number of animals at each time n, without calculating the population at all the previous times?
- How to introduce mortality into the model? (The case of mortality in the grandparent's population may be interesting).

The most standard case is to start with a single couple of children. This subject is related to the se-quences (of integers), the polynomials of degrees 2, the number of gold, and even polynomials of de-gree 3.

The research work and results will be presented via a poster in the forum.

Notes

SHAPE OF A CHURCH BELL

COLEGIUL NATIONAL EMIL RACOVITA (CLUJ-NAPOCA)

Twinned with
Lycée d'Altitude, (Briançon)

Team

Student: Papahagi Matthieu-Georges, Abelli Benjamin, Spieth Antonin, Steinmetz Louis.
Teachers: Ariana-Stanca Vacaretu, Guillaume Faux, Thierry Javle, Mickael Lissonde, Noëlle Trovato.
Researcher: Lorand Parajdi, Babes-Bolyai University, Cluj-Napoca, Romania and Yves Papegay, Inria Sophia Antipolis - Méditerranée, France.

Presentation of the research topic

How can we recreate the shape of the Briançon's Collegiate Church?

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 14:30 in Room 1.

Notes

THE PLOTTER

COLEGIUL NATIONAL EMIL RACOVITA (CLUJ-NAPOCA)

Twinned with
Lycée d'Altitude, (Briançon)

Team

Students: Petruta Nora-Irina, Stinian Georgia-Maria, Benevides Nathan, Costi Loïs.
Teachers: Ariana-Stanca Vacaretu, Guillaume Faux, Thierry Javle, Mickael Lissonde, Noëlle Trovato.
Researcher: Lorand Parajdi, Babes-Bolyai University, Cluj-Napoca, Romania and Yves Papegay, Inria Sophia Antipolis - Méditerranée, France.

Presentation of the research topic

A robot is realised by cables being tied by a plan with 3 or 4 motors. How can we drive the motors as starting from point S we end in a given point D.
The same problem, but with the mention that the robot has to go through the segment [SF].
For the beginning: 3 motors A, B, C are positioned in each vertex of a right triangle with the sides AB=3, AC=4 and BC=5. A pen is tied at the three motors and is positioned in point S=m[AC], how can we drive those 3 motors in order to place our pen in point F = m[AB]? What if the way must correspond to the segment [SF]?

- Design: how many cables do we need? How do you position those 3 motors in order to optimise the writing surface- with 3 cables, 4 motors?
- Modelling: write direct geometrical models which give the length of the cables depending on the pen and vice versa.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 15:10 in Room 1.

Notes

WHEN DOES THE BUS LEAVE?

COLEGIUL NATIONAL EMIL RACOVITA (CLUJ-NAPOCA)

Team

Students: Ispas Catalin-Aurel, Grebla Mihai.
Teacher: Ariana-Stanca Vacaretu.
Researcher: Lorand Parajdi, Babes-Bolyai University, Cluj-Napoca, Romania.

Presentation of the research topic

How do you know how many buses does it take to make a working schedule for the city of Cluj. Write down the programme and the routes for the buses.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 17:50 in Room 1.

Notes

ALGORITHM OF VIDEO GAMES

COLEGIUL NATIONAL EMIL RACOVITA (CLUJ-NAPOCA)

Team

Students: Lazarescu Anda-Monica, Arion Dan-Vasile.
Teacher: Ariana-Stanca Vacaretu.
Researcher: Lorand Parajdi, Babes-Bolyai University, Cluj-Napoca, Romania.

Presentation of the research topic

We try to model the flight of birds in groups. We will limit ourselves initially to a plane model (2D). The following rules are considered concerning the movement of the birds:

- One bird is characterized by a position in x and y, and a speed also in x and y.
- Every bird has a sight of radius R. It can't see the birds outside her visual field.
- It has a visual field smaller than 180 degrees and it cannot see beyond it.
- It is attracted inversely proportional by the gravity centre of the birds it can see.
- It is moving away from the birds it sees proportionally with the reverse of the square of the distance between them.
- Every bird changes its direction step by step (speed in x and y) with the neighbouring birds.

The attraction and the remoteness are forces that you should consider as accelerations (with constant mass), which you should calculate at each step and add them at the speed.

The research work and results will be presented via a via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 9:00 in Room 3.

Notes

THE JUGGLING

COLEGIUL NATIONAL EMIL RACOVITA (CLUJ-NAPOCA)

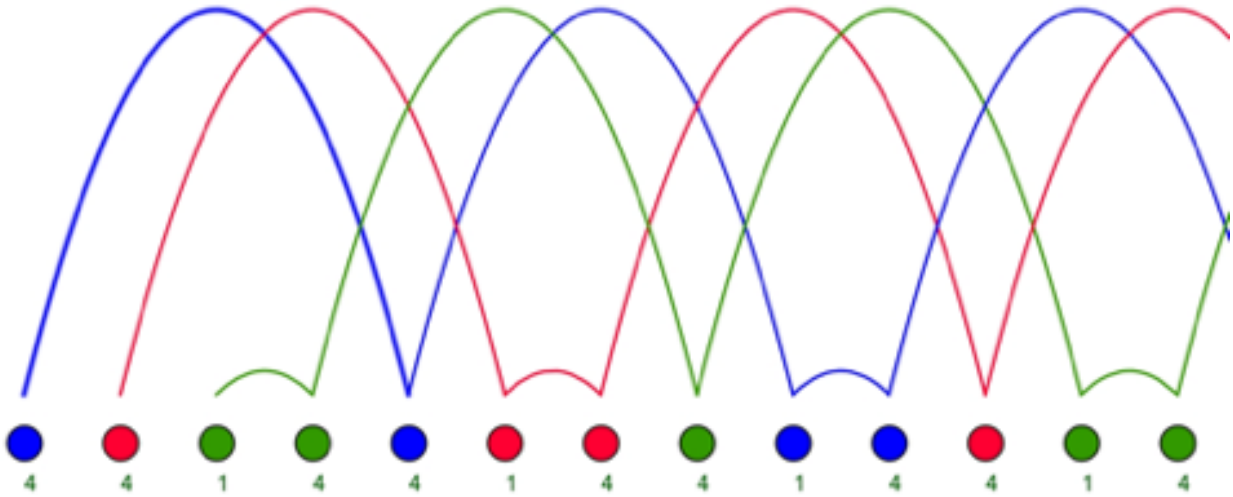
Twinned with
Lycée d'Altitude, (Briançon)

Team

Students: Zogorean Razvan-Andrei, Huzler Eileen, Borget Antoine.
Teachers: Ariana-Stanca Vacaretu, Guillaume Faux, Thierry Javle, Mickael Lissonde, Noëlle Trovato.
Researcher: Lorand Parajdi, Babes-Bolyai University, Cluj-Napoca, Romania and Yves Papegay, Inria Sophia Antipolis - Méditerranée, France.

Presentation of the research topic

It is possible to code a series of juggling. For example, 441 means that the first ball is thrown in the air for 4 units of time, the next ball also for 4 units of time and the last ball for one unit of time, then we repeat the process. The diagram of phases:



Supposing this process works, imagine other examples with 3 balls.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 17:10 in Room 1.

Notes

ABOUT MEASURE AND LENGTHS

LYCÉE STENDHAL (MILANO)

Team

Students: Coin Maxence, Durif Théo, Maire Sacha, Coin Alix, Boivin Thibault, Canchon Julien.
Teacher: Dominique de Luca.
Researcher: Charles Frances, University of Strasbourg, France.

Presentation of the research topic

How to measure the length of a curve? Is it possible to measure the length of every curve? What can we call a distance? Is time a distance? What happens if the length of our unity of measurement changes according to where we are?
Different ways to approach these concepts.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Thursday, March 29 at 11:00 in Room 1.

Notes

EVOLUTION OF PLANT POPULATION

BELLEVUE HIGH SCHOOL (ALÈS)

Team

Students: Victor Lapanne, Victor Perez, Baptiste de Saleon.
Teachers: Élodie Fort, Sébastien Castagnedoli.
Researcher: Serge Dumont, University of Nîmes, France.

Presentation of the research topic

Let us consider the number N(t) of people in a population at time t (discrete, measured in years), one can consider the simple evolution model:

- If no favorable events occurs within the t, there is no new individual (and death of some older ones), then N(t + 1) = a N(t) with a<1 ;
- If a favorable events occurs within the year t, there is apparition of new individuals, and then N(t + 1) = b N(t) with b>1.

Moreover, one considers a favorable event occurs in the year t with a probabity p.
One can study, if we start with a population of N0 individuals in the first year t0, what will approximately be the population at a year t, with t sufficiently large.
One can also enrich the model, considering the number ni(t) of each state i of the individuals (young, adult, old, ...) at time t for i ranging from 1 to s (s: total number of states), and consider the transition coefficients from a state i to a state j within the year t with coefficient Mij(t). We then have
nj(t+1)= \sum_(i=1}^s Mij(t)ni(t) and N(t+1)=\sum_{j=1}^s nj(t+1)
In the case of unfavorable year for the passage from the state i to the state j, then Mij(t)=aij(t)<1, and in the case of a favorable year Mij(t)=aij(t)>1.
These coefficients dépend on a transition probability pij(t).
We can then study the total number of individuals at time t, and the number of individuals in each state i.

The research work and results will be presented via a poster in a forum.

Notes

SHORTEST PATH

BELLEVUE HIGH SCHOOL (ALÈS)

Twinned with
Colegiul Național "Mihai Eminescu" (Satu Mare)

Team

Students: Baldit Thomas, Bousnari Clara, Chazalet Mathéo, David Olivia, Escobar Khymaï, Issert Noémie, Lasgues Charly, Paradis Lou, Pichon Laurianne, Marciuc Ștefania, Știrbu Vlad.
Teachers: Élodie Fort, Sébastien Castagnedoli, Daly Marciuc.
Researcher: Serge Dumont, University of Nîmes, France.

Presentation of the research topic

Let us consider a domain where the propagation velocity is defined (not necessarily constant) at each point.

In such a domain, one may wonder what is the fastest way to go from point A to point B, and how to find the optimal path for A to B.
We can consider as a first step the case where the speed is constant in each mesh of a regular grid.

Is the optimal path always unique?

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 11:30 in Room 2 (Bellevue).
Scheduled on Tuesday, March 27 at 14:30 in Room 3 (Mihai Eminescu).

Notes

TRIANGLES AND PROBABILITIES

BELLEVUE HIGH SCHOOL (ALÈS)

Team

Students: Azrak Amélie, Busin Auriane, Chabert Aloïs, Lindamood Greg.
Teachers: Élodie Fort, Sébastien Castagnedoli.
Researcher: Serge Dumont, University of Nîmes, France.

Presentation of the research topic

Assume a stick is randomly broken into three pieces. What is the probability that the obtained pieces can form a triangle?
2. Let be the following numbers: 1, 2, 3, 4,…., n. We randomly choose 3 of them. What is the probabili-ty that the chosen numbers can be the lengths of the sides of a triangle?

We are wondering what happens if we modify problem 2, considering another sets of numbers. For example, what is probability for the set {1^2, 2^2,...., n^2} or {1^3,2^3,...., n^3} etc.

Secondly, what is the probability that four randomly chosen numbers of these sets can be the lengths of the sides of a quadrilateral?

The research work and results will be presented via alk and a poster in the forum.
Scheduled on Wednesday, March 28 at 11:30 in Room 3.

Notes

EGYPTIAN FRACTIONS

ISISS MARCO CASAGRANDE (PIEVE DI SOLIGO)

Team

Students: Sota Simona, Barella Gaia, Casagrande Marco, Lucchetta Antonio, Pizzolotto Azzurra Sofia, Antoniazzi Mario, Barisan Paolo, Metaliu Klara, Toffolon Mattia, Carollo Marco, Dal Cin Alex, Grotto Giusi, Vitali Marina, Lorenzon Gioella.
Teachers: Breda Fabio, Cardano Francesco Maria, Zampieri Francesco.
Alberto Zanardo, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

The aims of this article are to verify if we can always write a proper irriducible fraction a/b as an egyptian fraction; to verify if there are different and eventually infinite possible expansions; to explore different ways to expand a proper fraction, comparing various methods in order to understand if there is a preferable one, depending on the results they lead to.
We studied Fibonacci's method, Golomb's method and a method based on practical numbers, retracing the original proofs, introducing new results and proposing some variants to the methods.
Most importantly, we observed that through Fibonacci's algorithm every proper fraction can be expand into egyptian frac-tions, and the ways to do that are infinite in number.
We proposed a new original method based on a geometric approach to the problem.
We studied the tree composed of the unitary fractions that expand a given proper fraction, designing a function that allows to determine the terms of the tree.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 9:40 in Room 2.

Notes

2018 MATHEMATICS GAME

LICEUL TEORETIC EDUCATIONAL CENTER (CONSTANTA)

Team

Students: Cãlin Ichim, Vlad Baba, Victor Marin, Darius Vlad, Melvin Abibula, Rares Muste.
Teachers: Ispas Claudia-Nicoleta, Grigoraş Nicoleta.
Researcher: Ene Viviana, Ovidius University of Constanta, Romania.

Presentation of the research topic

Use the digits in the year 2018 to write mathematical expressions for the numbers 1 through 100.
You must use all four digits. You may not use any other numbers.
Solutions that keep the year digits in 2-0-1-8 order are preferred, but not required.

The research work and results will be presented via a poster in the forum.

Notes

CHORDS IN A CIRCLE

LICEUL TEORETIC EDUCATIONAL CENTER (CONSTANTA)

Team

Students: Felix Urga, Catalin Ispas, Giulia Matei, David Tronaru, Evgenij Angelovski, Kashani Alexandru, Edi Sarkis, Diana Chiriac, Alexia Chiru.
Teachers: Ispas Claudia-Nicoleta, Giurcã Adriana.
Researcher: Ene Viviana, Ovidius University of Constanta, Romania.

Presentation of the research topic

Consider a circle divided by n chords in such a way that every chord intersects every other chord interior to the circle and no three chords intersect in a common point. Complete a table with the answer of the following questions: a) Into how many regions is the circle divided by the chords? b) How many points of intersection are there?
c) Into how many segments do the chords divide one another? Is there a pattern?

The research work and results will be presented via a poster in the forum.

Notes

NINE COLOURS

LICEUL TEORETIC EDUCATIONAL CENTER (CONSTANTA)

Team

Students: Eric Melinte Moraru, Radu Matei Popescu, Darius Grosu, Vlad Ciufu.
Teachers: Ispas Claudia-Nicoleta, Grigoraş Nicoleta.
Researcher: Ene Viviana, Ovidius University of Constanta, Romania.

Presentation of the research topic

If you have 27 small cubes, 3 each of nine colours, can you make a 3 by 3 by 3 cube so that each face of the bigger cube contains one of every colour?

The research work and results will be presented via a poster in the forum.

Notes

THE MOUSE AND THE CAT

LICEUL TEORETIC EDUCATIONAL CENTER (CONSTANTA)

Team

Students: Matei Hostina, Soranna Nicola, Vlad Dunaev, Iustinian Tronaru.
Teacher: Munteanu Anca.
Researcher: Ene Viviana, Ovidius University of Constanta, Romania.

Presentation of the research topic

A mouse is followed by a cat, and he wants to reach his house as fast as possible, but first he wants to grab a piece of cheese from the wall of cheese (look at the drawing). If he could find the shortest path, then he will manage to get back to his house before the cat caches him. Could you help him find his way? In how many ways can you do it?

The research work and results will be presented via a poster in the forum.

Notes

ANCIENT LANGUAGE

LICEUL TEORETIC EDUCATIONAL CENTER (CONSTANTA)

Team

Students: Ariana Grigoras, Raluca Modoi, Silviu Zaman, Samer Kinj, Carola Fãinãrea.
Teachers: Munteanu Anca, Giurcã Adriana.
Researcher: Ene Viviana, Ovidius University of Constanta, Romania.

Presentation of the research topic

People of an ancient tribe used a language in which words were formed only with letters A and B. Researchers found that for any two words of equal length, there are at least the corresponding positions in which the letters are different. For example, the words ABBAA and AAAAB differ in positions 2, 3 and 5, that is in three positions. Let E n N, n 3. Prove that in this language there can not be more than t words of length n (at the full part of the n real number a).

The research work and results will be presented via a poster in the forum.

Notes

PROBABILITIES, TRIANGLES AND QUADRILATERALS

COLEGIUL NAȚIONAL ”MIHAI EMINESCU” (SATU MARE)

Team

Students: Pop Bogdan, Chereji Iulia, Măgureanu Andrei, Rîpan George.
Teacher: Daly Marciuc.
Researcher: Daly Marciuc, University of Bucharest, Romania.

Presentation of the research topic

1. Assume a stick is randomly broken into three pieces. What is the probability that the obtained pieces can form a triangle?
2. Let be the set An = {1, 2, 3, 4,…., n}. We randomly choose 3 of its elements. What is the probability that the chosen numbers be the lengths of the sides of a triangle?
1’. Assume a stick is randomly broken into four pieces. What is the probability that the obtained pieces can form a quadrilateral?
2’. Let be the set An = {1, 2, 3, 4,…., n}. We randomly choose 3 of its elements. What is the probability that the chosen numbers be the lengths of the sides of a triangle?

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 9:40 in Room 3.

Notes

COUNT THE COLLISIONS!

COLEGIUL NAȚIONAL ”MIHAI EMINESCU” (SATU MARE)

Team

Students: Stan Ioana, Roman Ioana, Oșan Mihai, Varga Andrea.
Teacher: Daly Marciuc.
Researcher: Daly Marciuc, University of Bucharest, Romania.

Presentation of the research topic

A very small ball collides against two walls forming an angle u. How many collisions will occur?
You know:

- angle u (AOB angle);
- angle i of first collision (SA1B angle).

You should find the number n of collisions.
We suppose that the ball S is very small and the walls OA and OB are very long.
If you know in addition the speed v of the ball and the length l of OA and OB walls, can you calculate the time needed for the ball to escape outside the triangle OAB?
We assume that the speed of the ball changes its direction at each collision but does not change its magnitude. We also know the lengths of segments SA1 and OA1.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 10:50 in Room 3.

Notes

LET US PLAY WITH SANDPILES!

COLEGIUL NAȚIONAL ”MIHAI EMINESCU” (SATU MARE)

Team

Students: Ardelean Andrei, Opre Mihnea.
Teachers: Daly Marciuc.
Researcher: Serge Dumont, University of Nîmes, France.

Presentation of the research topic

Consider a sand pile over a general shape table, how is the crest of the pile?
You know:

- The stability angle of the sand pile, that is the angle of the sand pile slope;
- The shape of the table;
- The way the sand has been spilled on the table (2 situations could be considered as a first step: a concentred source or an uniformly distributed source)

Other possible questions:

- Any source distribution of sand lead to the same final equilibrium state?
- How are the transport rays?
- What occurs if walls are placed on some part of the table boundary?

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Tuesday, March 27 at 17:50 in Room 3.

Notes

PANDEMICS

ISISS MARCO CASAGRANDE (PIEVE DI SOLIGO)

Team

Students: De Biasi Anna, Gatti Beatrice, Micheletto Marco, Piccin Erica, Munarin Andrea, Breda Leonardo, Viviani Camilla, De Faveri Francesco Luigi, Boscaratto Simone, Della Libera Bianca.
Teachers: Breda Fabio, Cardano Francesco Maria, Zampieri Francesco.
Researcher: Alberto Zanardo, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

A disease is spreading. At every moment for each patient occurs that:
1) A patient could infect another entity with a certain probability
2) A patient could heal with a certain probability
3) A patient could die with a certain probability.

What could happen considering different probabilities? Is it better to vaccinate a part of the population or to isolate the population in small groups?

We attempted a statistical approach developing a n×n cells matrix that represents the population, with the disease spreading by its centre; it accepts the three probabilities in input and returns the percentages of dead, healed and not even infected cells and the number of steps needed for stability, given that we consider the disease spreadable just by an infected cell to the still healthy among the eight adjacent ones. Treating the probabilities as variables, we looked for mathematical relations in a 4-dimensional space for any data obtained and then we developed the matrix to include a certain percentage of vaccinated people and to simulate quarantine zones.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Thursday, March 29 at 11:00 in Room 2.

Notes

PANIC IN THE ROCKET

LYCÉE VACLAV HAVEL (BÈGLES)

Twinned with
Liceo Eugenio Curiel (Padova)

Team

Students: Borne Florentin, Duverneuil Tom, Rebeyrol Romane, Rocher Mathilde, Aubisse Marie, Tosca Guilia, Montaye Louise, Chabrier Julien, Philippe Noé, Cattapan Margherita, Vardabasso Irene, Quartesan Alberto, Giacon Matteo, Ancona Claudio, Antonini Alessandro, Romio Manuel, Alessi Caterina, Lazzarin Francesco, Chen Matteo, Bru-netti Tommaso, Barticel Eduard, Staver Alexandre, Mosca Matteo.
Teachers: Cathy Racadot, Anne-Pascale Lemay, Nadine Castagnos, Luca Fortin, Mauro Dianin.
Researchers: Adrien Boussicault, LABRI, University of Bordeaux, France and Alberto Zanardo, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

After a magnetic storm, robots have lost their functions (captain or worker). Programs must be created to help these robots. Thanks to the program, they can communicate between themselves; at the end of the program, there will be only one captain and workers.
We have to create those programs according to the rules of communication given by our researcher.

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 9:00 in Room 2.

Notes

ZEUS'CHARIOT

LYCÉE VACLAV HAVEL (BÈGLES)

Twinned with
Liceo Eugenio Curiel (Padova)

Team

Students: Borne Florentin, Duverneuil Tom, Rebeyrol Romane, Rocher Mathilde, Aubisse Marie, Tosca Guilia, Montaye Louise , Chabrier Julien, Philippe Noé, Achouri Sara, Liu Giacomo, Carotenuto Jacopo, Bortoletto Riccardo, Precoma Marco, Tonon Francesco, Bon Pietro, Tonello Matteo, Tosato Giulio, Faggian Giorgio, Bortolato Marco.
Teachers: Cathy Racadot, Anne-Pascale Lemay, Nadine Castagnos, Luca Fortin, Mauro Dianin.
Researchers: Adrien Boussicault, LABRI, University of Bordeaux, France and Alberto Zanardo, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

Zeus has bought a chariot on the Internet. Unfortunately, the chariot doesn't wheel along very well. It can only move making a fifth of circle.
Is it possible to reach any point that way? Is it possible to come back to the departure point?

The research work and results will be presented via a talk and a poster in the forum.
Scheduled on Wednesday, March 28 at 12:10 in Room 3.

Notes

PANDEMICS 2

LICEO NIEVO (PADOVA)

Team

Students: Sara Gomiero, Leonardo Tessari, Grimaldi Riccardo, Buso Riccardo.
Teacher: Alessandro Giacon.
Researcher: Alberto Zanardo, Department of Mathematics of Padova University, Italy.

Presentation of the research topic

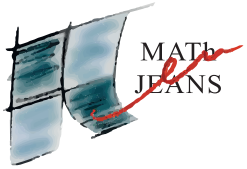
The research consists on an analysis of an epidemic crisis, in which, day after day a contagious disease continues spreading through the population. This illness must be analysed during all its phases, from incubation to the death of the patient, with all the probabilities of certain events happening, ultimately finding the best and most efficient way of curing the population.

The research work and results will be presented via a talk.
Scheduled on Tuesday, March 27 at 17:10 in Room 3.

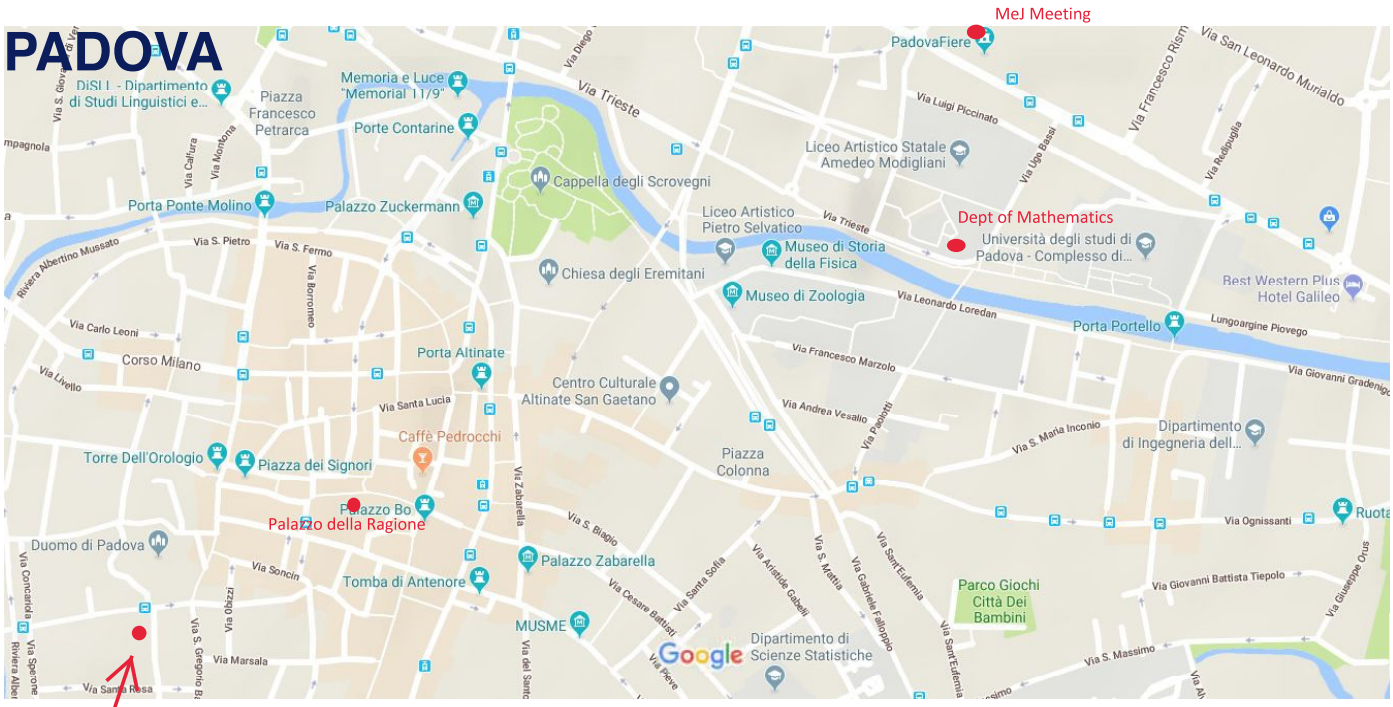
Notes

Partners

THANK YOU VERY MUCH!



Maps



DINNER: 18.45 - 21.00
Mensa Pio X, ACLI
Via Bomporti, 20

DINNER: 18.45 - 21.00
Mensa Pio X, ACLI
Via Bomporti, 20

MATh.en.JEANS congress
Padova, March 27-29, 2018

PadovaFiere, stand 14

Galileo's podium

Università degli Studi di Padova

Dipartimento di Matematica "Tullio Levi-Civita"

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