

Annex 1

30th European Union Contest for Young Scientists, Dublin 2018

Core Prizes

Three first prizes (€7 000 per project)

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| Country: Germany |
| Contestant: Adrian Fleck (20), Anna Amelie Fleck (16), |
| Field: Materials |
| Project title: FleckProtec – Body Protection Made From Starch |
| Abstract: Whether for inline skating or motorsport, protectors keep our backs, shoulders and joints protected, which is vital especially in the event of a fall. Most protective equipment is made from rigid plastic and limits an athlete's freedom of movement. That is not the case for the protector from Anna and Adrian Fleck. It is made of a flexible silicone shell filled with a fluid containing starch. This fluid turns into a solid when a strong force is applied, providing reliable protection from injury as a result. Not only have the siblings used the unusual non-Newtonian property of the starch liquid but they also have developed their own measuring equipment with which they compared the effectiveness of their "FleckProtec" with the effectiveness of commercially available products. |

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| Country: Canada |
| Contestant: Nicolas Fedrigo (17), |
| Field: Medicine |
| Project title: Improving Spinal Fusions: Redesigning the Pedicle Probe to Prevent Vertebral Breaches |
| Abstract: Twenty-nine percent of patients who undergo spinal fusion surgery suffer from accidental damage to the spinal cord from pedicle screws, causing various complications, including paralysis. My goal was to make spinal fusions safer by redesigning the tool used to direct placement of the screws – the pedicle probe – to provide real-time feedback on the probe's location. I developed a probe that detects the difference between the higher density compact bone and lower density spongy bone in vertebrae. The probe warns the user when it contacts the wrong type of bone with a vibration and a light, informing the surgeon to redirect the probe to place screws correctly. My sensor-enabled probe has the potential to significantly reduce the incidence of vertebral breaches during spinal fusion surgery. |

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| Country: Canada |
| Contestant: Brendon Matusch (15), |
| Field: Engineering |
| Project title: Development of a Level 2 Autonomous Vehicle Using Convolutional Neural Networks and Reinforcement Learning |
| Abstract: This project investigated autonomous driving to identify software strategies that are reliable, safe, and efficient. I developed several techniques based on machine learning concepts, extended and combined with my own innovations, to create a level 2 autonomous vehicle. I tested first using a custom Unity software simulation and then in a real-world vehicle that I constructed from a modified go-cart. I focused on the steering system, testing many machine learning techniques to detect road lines, locate the center of the lane and then use this information to plan a path for the vehicle. Some of these techniques enabled the vehicle to learn to drive without any human-collected training data. I also developed systems for adaptive cruise control and road sign recognition. |

Three second prizes (€5 000 per project)

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| Country: France |
| Contestant: Alexandru Liviu BRATOSIN (17), Petru MOLLA (17), Mihnea Vlad BOJIAN (18), |
| Field: Biology |
| Project title: DNADrive |
| Abstract: Have you ever experienced the hopelessness of being left without storage space on your phone? Or you may have wanted to back up all of the files that your company created, but cloud services were too expensive and of low capacity? Or maybe you're an ex-politician whose secret files leaked? Fret no more! DNADrive aims to create a safer and more extensive digital data storage alternative for all of your archiving needs. By exploiting the immune system of a certain bacterial strain, we've managed to write information in bacterial genome, encoded by our home-cooked conversion algorithm. Besides its uncountable advantages, 1g of DNA would have a capacity equivalent to 450 million 1TB hard disks, all at a maintenance rate of around 10€ a year. This is the beginning of a new era in data storage. |

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| Country: Estonia |
| Contestant: Karl Hendrik Tamkivi (18), |
| Field: Biology |
| Project title: Positioning of bat maternity roosts in relation to surrounding landscape complex in Western Saaremaa |
| Abstract: Landscape fragmentation and the decreasing number of natural habitats have brought bat populations to their historical minimum. In this research bats' preferences for maternity roost buildings were studied. Within 17 fieldwork nights during midsummer 21 roost sites in Western Saaremaa were mapped and later analyzed with QGIS in different size buffers while comparing the results to randomly selected buildings. Landscape analyses showed that colonies |

of northern bat were positively correlated to length of surrounding woodland edge and negatively to amount of human related land-classes. The simplest measures for changing the landscapes while also considering the well-being of northern bat would be observing the ratio of open and wooded land classes and regulating the density of buildings.

Country: Portugal

Contestant: Francisco Miguel Araújo (17),

Field: Mathematics

Project title: Commutativity theorems for groups and semigroups

Abstract: Commutativity theorems for groups are statements with the following structure: If a group G satisfies property P , then G is commutative. For example, if in a group G every element is the inverse of itself, then G is commutative. In 2016, G. Venkataraman, an expert in groups holding a PhD from Oxford, proved the following commutativity theorem: If in a finite group the squares commute and the cubes commute, then the group is commutative. She also offered the conjecture that the result holds for arbitrary groups. Our main result is the following. Let S be a subsemigroup of a samilattice of cancellative semigroups. If the p -powers commute and the q -powers commute, for p and q natural coprime numbers, then S is commutative. This result, in particular, fully answers Venkataraman's question.

Three third prizes (€3 500 per project)

Country: Georgia

Contestant: Marina Gudzhabidze (18), Dea Ilarionova (17), Shorena Gudzhabidze (17),

Field: Physics

Project title: Hand-Held Detector With Retroreflective Mosaic Screens To Visualize Optical Inhomogeneities

Abstract: We have all seen shimmering mirages on a hot road, or the optical distortions caused by the hot air emerging from an aircraft jet engine. These phenomena are an example of the Schlieren effect. In classical Schlieren photography is used concave mirror, which reveals technical and economic difficulties. To solve these problems we created optical system that includes: hand-held detector which reveals local fluctuations in the air and mosaic screens formed with retro reflective elements, such as: cube corner retro reflectors or reflective glass spheres that excludes concave mirrors' difficult setting up process. Thus with our innovation the usage of Schlieren method widened and can be used in: leak detection, study of boundary layer detachment etc.

Country: South Korea

Contestant: Kyuhee Jo (18), Chaeyoung Lee (18),

Field: Computing

Project title: Building a robust classification model for speech-based Parkinson's Disease diagnosis

Abstract: Parkinson's disease (PD) impacts more than 10 million people worldwide. However, the

conventional method of diagnosing PD based on physicians' decision is time-consuming and often inaccurate. Hence, we aim to develop an accurate PD diagnosis model based on subtle voice impairment. With the help of deep learning, we have successfully increased the classification accuracy and efficiency by eliminating complex feature extraction and selection steps necessary in machine learning. Furthermore, we propose to implement Generative Adversarial Network to standardize parameters such as the volume of voice and the quality of the recording which may confound the diagnosis. The revised inputs, when put into a network particularly trained with the standard data, resulted in higher accuracy.

Country: China

Contestant: Sijia Zhang (18),

Field: Social sciences

Project title: Investigation into the Verbal Conflict Problem in Middle School Students' Families

Abstract: The purpose of this project is to analyse the interactions between family members, identify the most likely situations to cause conflict and propose approaches to a more effective resolution. The project was conducted across twenty-five provinces in China, surveying 1,800 people by questionnaire. The results were then analysed using SPSS software and six categories of situations were identified that could lead to conflict. Using FSEM, the most common situation that could cause this was also determined. The project looked into three main types of training experiment of association chain construction based on the constructivist learning theory. The project included 264 experiments lasting 9 months and involved 22 families. It showed that the experiment was both practical and effective.

Honorary Awards

Stockholm International Youth Science Seminar 2018

Selected winners attend the 2018 Nobel Prize ceremonies, meet the Nobel Laureates and take part in a series of other scientific/cultural activities during the week.

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| Contestant: Francisco Miguel Araújo (17) |
| Field: Mathematics |
| Project title: Commutativity theorems for groups and semigroups |

London International Youth Science Forum 2019

Selected winners meet young scientists from around the world and take part in the annual two-week intensive summer science festival during July-August 2019.

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| Field: Biology |
| Project title: Positioning of bat maternity roosts in relation to surrounding landscape complex in Western Saaremaa |

Special donated Prizes

There are 28 special donated prizes:

- JRC (Joint Research Centre): The European Commission's internal science service (3 prizes)
- Intel ISEF 2019 (3 prizes)
- EIROforum: a one-week stay at each of the eight members of EIROforum
 1. CERN - The European Laboratory for Particle Physics
 2. EUROfusion – JET
 3. EMBL - The European Molecular Biology Laboratory
 4. ESO - The European Southern Observatory
 5. ESA - The European Space Agency
 6. ESRF - The European Synchrotron Radiation Facility
 7. ILL - The Institute Laue-Langevin
 8. XFEL - the European X-Ray Free-Electron Laser Facility
- Bioeconomy prizes
 1. The BBI JU Biobased Industries Joint Undertaking prize
 2. The European Food and Drink Industry prize
 3. The CarGill prize
 4. The Kerry prize
 5. The Tate&Lyle prize
- EuCheMS (The European Chemistry Society) prize
- Swiss international talent forum prize
- WOLFRAM: licence to Mathematica and WolframAlphaPro
- PRACE Prize
- Salvetti Foundation prize
- Bulgarian Mathematics Summer School Award
- Host Country awards
 1. Science Foundation Ireland prize
 2. Irish Research Council prize
 3. Institute of Physics prize

JRC - Joint Research Centre

3 prizes: two-day stays at the JRC's Institutes in Ispra, Italy

| Country | Contestants | Field | Project title |
|----------|--|-------------|---|
| Bulgaria | Aleksandar Kostadinov Shopov (18) Atanas Konstantinov Stefanov (17) | Physics | Colour relations in young stellar objects |
| France | Lisa BATTISTINI (18) Thomas BOISSIN (18) Léo-Nils BOISSIER (17) | Engineering | Eyeprint, give relief to your senses |
| Austria | Stefan Gruber-Hofer (19) Johannes Ortner (19) Michael Eder (19) | Engineering | Development of a sampler for solid recycled materials |

Intel ISEF 2019 Prizes

3 prizes: participate at Intel ISEF 2019, Phoenix (AZ), USA

| Country | Contestants | Field | Project title |
|-------------|----------------------------|-----------------|---|
| Bulgaria | Ivaylo Malinov Zhelev (19) | Computing | Digital image denoising based on sphere-constrained total variation optimization with an additional noise component |
| Spain | Ginés Marín Martínez (17) | Social sciences | Collaborative economy suspended, The Legal Challenge of Uber and BlaBlaCar: Job Precarity? Unfair Competition? |
| Switzerland | Tobia Simon Ochsner (18) | Computing | Creating playlists with artificial intelligence |

EIROforum Prizes

CERN - The European Laboratory for Particle Physics

One week stay in Geneva, Switzerland

| Country | Contestants | Field | Project title |
|---------|-------------------------|---------|--|
| Denmark | Kasper Fredenslund (18) | Physics | Neural Networks for Detecting Elementary Particles |

EUROFusion - JET

One week stay at Culham, United Kingdom

| Country | Contestants | Field | Project title |
|---------|--|-------------|---------------------------------------|
| Greece | Paraskevi-Marina Kandreli (16) Nikolaos-Panagiotis Kalampokis (18) Konstantinos Lolos (17) | Engineering | Algorithm Guided Modular Probe (AGMP) |

EMBL - The European Molecular Biology Laboratory

One week in Heidelberg, Germany

| Country | Contestants | Field | Project title |
|----------|----------------------|----------|---|
| Slovakia | Janka Motešická (18) | Medicine | Influence of PKC δ regulators on photodynamic therapy efficacy |

ESO - The European Southern Observatory

Visit to ESO site in Chile

| Country | Contestants | Field | Project title |
|-------------|-----------------------------------|---------|--|
| Switzerland | Sébastien Christophe Garmier (19) | Physics | cuRRay: CUDA ray tracer for light rays in relativistic Kerr-Newman spacetime |

ESA - The European Space Agency

Participate at a major European space science conference under the sponsorship of the European Space Agency, including coverage of their travel and accommodation costs.

| Country | Contestants | Field | Project title |
|---------|--------------------|---------|---|
| Germany | Max von Wolff (18) | Physics | A method for particulate raindrop analysis contributing |

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| | | | to more accurate weather forecasts |
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ESRF - The European Synchrotron Radiation Facility

One week stay in Grenoble, France

| Country | Contestants | Field | Project title |
|----------------|-------------------------|-----------|---|
| United Kingdom | Emily Shao Ting Xu (18) | Chemistry | Chiral separation of racemic mixtures using liquid phase separation techniques with homochiral metal organic frameworks |

ILL - The Institute Laue-Langevin

One week stay in Grenoble, France

| Country | Contestants | Field | Project title |
|---------|-----------------|---------|---|
| Israel | Ittai Eden (18) | Physics | Paleomagnetic Dating of a Mud Brick Wall in Tel Megiddo |

XFEL - the European X-Ray Free-Electron Laser Facility

One week stay in Hamburg, Germany

| Country | Contestants | Field | Project title |
|----------------|---------------------------|-------------|---|
| United Kingdom | Joshua Luke Mitchell (18) | Engineering | The PlyBot - A Low-Cost Flatpack SCARA 3D Printer |

Bioeconomy Prizes**BBI JU**

Study trip to Belgium

| Country | Contestants | Field | Project title |
|-----------|------------------------|-----------|---|
| Lithuania | Gabija Imbrasaitė (18) | Materials | Bioplastic film with Penicillium roqueforti for pear preservation |

The European Food and Drink Industry Prize

€2,000

| Country | Contestants | Field | Project title |
|---------|--|-------------|--|
| Cyprus | Ioanna Karaiskaki (15) Anna Maria Agathokleous (16) Pavlos Makrides (17) | Environment | Plastics in the marine environment of Cyprus: monitoring and potential bioremediation strategies |

The CarGill Prize

Visit to its state of the art R&D centre at Vilvoorde, Belgium

| Country | Contestants | Field | Project title |
|----------|---|-------------|---------------|
| Portugal | João Maria Pinto Leite (18) Mário Jorge Queirós Ribeiro (18) Catarina Isabel Fonseca Brandão (18) | Environment | ENTOFARM.PT |

The Kerry Prize

Visit back to Dublin for winning team

| Country | Contestants | Field | Project title |
|---------|-------------------|---------|---|
| Hungary | Blanka Novák (18) | Biology | Innovative approach to the antibacterial and prebiotic <i>Lycium barbarum</i> extract |

The Tate&Lyle Prize

Visit to either France or Germany laboratories

| Country | Contestants | Field | Project title |
|---------|--|---------|--|
| Latvia | Kārlis Emīls Vītols (17) Annija Kotova (18) | Biology | The research of the feed base of Riga State German Grammar School's bee colonies |

EuCheMS

€ 1,000

| Country | Contestants | Field | Project title |
|------------------|---|-----------|---|
| European Schools | Leandra Marie Viktoria Zinke (17) Katarina Juhart (17) Sofia Quitter (17) | Chemistry | Anti-Bacterial Silvernanoparticle Coating |

Swiss international talent forum

| Country | Contestants | Field | Project title |
|----------|----------------------------|-----------|--|
| Bulgaria | Ivaylo Malinov Zhelev (19) | Computing | Digital image denosing based on sphere-constrained total variation optimization with an additional noise component |

Salveti Foundation Award

€2,000

| Country | Contestants | Field | Project title |
|---------|--------------------------------|-----------|--|
| Russia | Mariia Andreevna Soloveva (18) | Chemistry | Protection of metal from destructive corrosion |

Prace

Visit to supercomputing center

| Country | Contestants | Field | Project title |
|----------|--------------------|-----------|--|
| Slovakia | Filip Kučerák (17) | Computing | Trevo: Trees as a result of an algorithm |

Bulgarian Mathematics Summer School Award

Visit to Summer School in Bulgaria

| Country | Contestants | Field | Project title |
|-------------|--------------------------|-----------|---|
| Switzerland | Tobia Simon Ochsner (18) | Computing | Creating playlists with artificial intelligence |

Expo Sciences Luxembourg

Visit to Expo Sciences Luxembourg

| Country | Contestants | Field | Project title |
|---------|-------------------|---------|--|
| Ireland | Simon Meehan (16) | Biology | Investigation of antimicrobial effects of both aerial and sections parts of selected plants against <i>Staphylococcus aureus</i> |

Wolfram Research

All Mathematics, Physics and Computing projects receive a one year licence to Mathematica and WolframAlphaPro

Host Organizer Prizes

Science Foundation Ireland (SFI) Prize

€2,000

| Country | Contestants | Field | Project title |
|---------|--------------------|---------|---|
| China | Qingyang Wang (18) | Physics | The Study of Carbon Dots Synthesis and Fluorescence with Assistance of Microplasma Processing |

Irish Research Council prize

€2,000

| Country | Contestants | Field | Project title |
|-------------|-------------------|-------------|--|
| South Korea | Dahyeon Choi (17) | Engineering | Development of an interactive and dynamic artificial intelligence storytelling system based on neural conversation models and speech recognition |

Institute of Physics prize

€2,000

| Country | Contestants | Field | Project title |
|---------|-----------------------|-----------|--|
| USA | Daniel Zion Kang (16) | Materials | Paintable Electronics - Novel Graphene Acrylic Thin Film |