

## INTERNATIONAL STUDENT CONTESTS

A study based on materials of The Three University Missions Moscow International University Ranking 2018

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### Annotation

The present study continues a series of analytical materials based on the data of The Three University Missions Moscow International University Ranking. This publication is based on data from the second edition of the ranking, published in November 2018 [10]. One of the ranking criteria structurally included in the Education ranking factor [9] is Wins in International Student Contests by Students. The purpose of the present study is to describe the current state and development tendencies of the modern university student contest movement on the global level, and to recognize the factors that influence university participation in international student contests.

As part of the study, we conducted an analysis of the structure of the international university student contest movement: 14 prestigious global international student contests and universities, whose students became contest winners or medalists in 2013–2017.

#### **Main Conclusions**

Despite their imperfect nature, international student contests are the only available tool for objective omparison of the global competitiveness of the students from different universities. Global knowledge assessment systems, such as the global testing for school pupils, do not exist for university students.

The idea that the top universities are not interested in student contests is false. Prestigious international student contests have a global reach: The number of participating countries for some contests exceeds 100, with 55 of them represented by award-winning universities. Among the 164 universities whose students won contest awards are the world's top universities, such as MIT, Harvard, Yale, Oxford, Cambridge and many others.

**The contest movement revolves around natural science and IT.** IT, mathematics, and physics contests have the highest competitiveness level and attract participants from all across the world.

**The participants are focused on separate subject areas.** Most universities, and even countries, successfully compete in student contests in just one subject area. Just a small number of them are able to successfully participate in several subject areas on an international level. The universities representing China, Poland, Germany, Russia, the U.K. and the U.S. occupy a central position in the global student contest movement.

The universities that successfully participate in student contests are active in the "third mission" area. They put more effort into making online education available for everyone, information about them is searched on the web more often, and their research publications are more relevant for a wide audience.



## Introduction

International student contests are competitions held on one subject area between bachelor, master, and other equivalent degree students, or, more rarely, with the participation of PhD programme students.

International student contests are effectively the only objective tool for comparing university student competitiveness on a global level. Unlike pre-tertiary education, there are no global assessment systems such as the PISA, ILSA, or PIRLS for university students. The standard scientometric indicators widely used to assess research staff and teacher training levels are, meanwhile, poorly suited for student assessment because most students do not have any indexed research publications. Therefore, international student contests provide a unique opportunity to compare education quality within the contest's subject area on a global level, provided that equal access for participants from different countries is available.

Student contests can be team-based or individual. In some cases, the contest may offer extra individual rewards for outstanding achievements while still being team-based. This is typical of management and business case contests, among others. By contrast, the IMC, the international mathematics competition, is an individual contest, but the organizing team still provides unofficial team scoring for the participating countries.

As a rule, the most prestigious contests require personal attendance from their participants. Exceptions are usually made for research paper contests and qualification contest phases, which may be long-distance. The largest contests, such as the ACM International Collegiate Programming Contest (ICPC), may consist of multiple phases on the municipal, national, or regional levels.

The goal set for participants is to solve one or several tasks. Their specifics and assessment criteria may differ significantly, depending on the contest's subject area.

For example, in the ICPC programming competition the team has to solve several applied problems that require the participants to have a good command of different areas of applied mathematics, data structures, algorithms, etc. The IMC mathematics competition, on the other hand, offers theoretical problems that are solved individually. In both cases, the assessment criteria include the quality and completeness of the solution, as well as the time spent solving the problems.

Participants in UPS, the international student physics contest, spend 48 hours solving one complex problem. They have to complete all of the calculations required to solve the problem, as well as prepare a research paper within the allotted time. Management and business case contests require the participants to complete a project within a short time and defend it before the jury.

Contests such as The World Universities Debating Championships and The Philip C. Jessup International Law Moot Court Competition require the teams to not only prepare a well-founded presentation in accordance with the task at hand, but also debate with each other directly.

The international contest movement as seen today originated in 1959, the year of founding of the oldest, top-ranking subject-based contest for school students: the International Mathematical Olympiad. Today, its participants include high-school students from over 100 countries. The international school contests movement is actively developing, and includes 12 annual competitions



in every main subject area, featuring the participation of dozens of countries [5]. Contest participants take part in multiple contest phases to qualify. The requirements for participant training are extremely high, and a victory in one of these contests practically guarantees admission to the top specialized universities of the country, or even abroad.

However, the Moscow International University Ranking could not take international contests for school students into account, and therefore we will not include them in the present study.

Just like high school students, university students have compelling reasons to participate in international student contests, but the benefits of participation are a matter of dispute. Programming competitions represent this point best. As noted by ICPC winners and finalists, preparation for the contest provides major practical benefits, teaching the participants to focus on the task at hand and solve complex problems, as well as to work in a team. It also helps to develop the habits of writing bug-free code and finding fast algorithmic solutions.

According to Maxim Buzdalov, the winner of ICPC World Finals and co-author of a competitive programming course, medalists of a prestigious programming competition become sought-after candidates for the world's top IT corporations [1, 2]. Not everyone shares his opinion, though: Peter Norvig, Director of Research at Google Inc, notes that high-level achievements in competitive programming are in negative correlation with real-life work efficiency [4].

#### International student contest selection

14 student contests were selected for The Three University Missions 2018 ranking when calculating the Wins in International Student Contests by Students criterion in the Education criterion group [9]. These contest met the following conditions:

• **Duration:** The contest had been conducted for at least 4 years prior to the moment of data compilation (June 2018).

• **Globality:** The contest's participants include representatives of at least 5 countries and 2 continents (Australia and Oceania, Asia, Africa, Europe, North America, and South America).

• **Transparency:** Information about the contest's winners and medalists is published on the official contest website(s) with an indication of their affiliation.

The relevance of these criteria is determined by the aims of the global university ranking: a student contest must be equally available to participants from any university in the world. Due to these restrictions, some international contests held on a macro-regional level (e.g. between the EU countries), as well as contests that do not release all information about their winners and medalists were excluded from the list.

To compile the ranking, data about international student contest victories in 2013–2017 was collected. Students from 164 universities out of the 471 short-listed universities from 102 countries and territories won awards in at least one international contest from the list in question.

Overall, data on a total of 1145 awards in both team-based and individual contests was compiled.

The organizers of the selected contests include professional associations and academic communities, universities, companies, and non-commercial organizations. The U.S. has the largest representation in the pool of organizers: 5 out of 14 contests originated in the U.S.



The history of international student contests is shorter than that of high school student contests. The ICPC, the oldest contest included in the present study, has been held by the Association for Computing Machinery (ACM) since 1977. Together with The World Universities Debating Championships, this contest has the widest geographic coverage with, including the international semifinals, the representatives of over 100 countries participating. Most contests that meet the selection criteria attract participants from fewer countries.

We believe that the number of participating countries reflects the competitiveness level of each contest. Therefore, each contest was assigned a weight coefficient proportional to the number of participating countries to ensure that the indicators are comparable when compiling the ranking. The maximum weight of 1 was given to the ACM ICPC and The Annual Willem C. Vis International Commercial Arbitration Moot. The present study used the absolute values of the number of victories and awards as well as weighted values calculated by multiplying the number of victories and awards by the weight coefficient of the corresponding contest.

The selected contests were organized into four subject areas for the purposes of this study: mathematics, information technologies, natural and engineering sciences, and the humanities. The contests were additionally divided into three categories based on their geographical coverage level: A (over 60 participating countries), B (over 20 countries), and C (fewer than 20 countries). See Appendix 1 for a full list of the selected contests and their weighted coefficients. See Appendix 2 for a list of universities whose students became the winners or medalists of the selected contests in 2013–2017.

#### **International Student Contests Study**







## Data Structure

The International Mathematics Competition for University Students (IMC), the International Collegiate Programming Contest (ICPC), and the University Physics Competition (UPC) have the highest number of prize-winning universities in the sample *(Fig. 1 on page 6)*.

Contests in the fields of information technology and mathematics (AMC ICPC, NSUCRYPTO, IMC) form the most close-knit community — about 20 universities won prizes in at least two of them in 2013—2017, while most universities won prizes in only one contest from the list during the same period (*Fig. 2*).

Students of more than 70% of universities in the sample — 118 — won prizes in only one out of 14 contests in 5 years. Students of 28 universities won prizes in two contests, students of 14 universities — in three contests, and students of four universities won prizes in four contests: the University of Cambridge, Harvard University, the Pennsylvania State University, and the University of Belgrade.

No students won prizes in more than four contests.  $\ensuremath{{\rm \bullet}}$ 

## **Per-Country Coverage**

The universities representing Europe (70) and Asia (40) constitute the largest part of the universities whose students won prestigious contests from the list. They are followed by North America (31), Oceania (9) and Africa (2) *(Fig. 3)*.

Proportion of universities by the number of contests won by their students



**Figure 2.** Three-quarters of universities won only one out of 14 contests in 5 years



Macro-regional structure of universities whose students won international contests

Figure 3. European universities constitute almost half of the award-winning universities



The leading international contests included in the list cover a total of 55 countries. The greatest number of universities whose students became the winners and medalists of at least one of the selected contests are in the U.S., followed by Russia and China *(Fig. 1)*.

Table 1

#### The number of universities whose students won at least 1 award in the international contests in 2013–2017. Included are the countries with at least 3 universities

Rank	Country	Number of award-winning universities
1	United States	23
2	Russian Federation	11
3	China	10
4	United Kingdom	8
4	Canada	8
6	Australia	7
7	The Netherlands	6
7	Germany	6
7	India	6
10	Spain	5
10	Brazil	5
12	Indonesia	4
13	Poland	3
13	Israel	3
13	Iran	3
13	South Korea	3
13	Hong Kong	3

The order changes if the competitiveness level in each contest is taken into account. As stated in the introduction, each contest was assigned a weight in proportion with the number of participating countries as per the methodology of the Moscow ranking. This approach allows for a more balanced assessment of student competitiveness, enabling us to compare contests with different subject areas. See *Table 2* for the total number of weighted victories.

If the competitiveness level is taken into account, Russia moves to the top of the ranking despite having only half as many universities whose students won contest awards as the U.S. This can be attributed to the consistent successful performance of the Russian students in IT and mathematics contests for many years.

Russia is followed by China, Poland, the U.S., and Japan by the number of weighted victories in the IT subject area. The Netherlands, Poland, Belgium, and Spain are ranked second to fifth by the number of mathematics contests awards. China, the U.S., Canada, Spain, and Great Britain are the top five countries in the natural engineering science contests. Australia, the U.S., the UK, Canada, and New Zealand are the leaders by victories in international contests in the humanities.

Overall, Asian universities tend to show the most successful performance in IT student contests: apart from China and Japan, Taiwanese and South Korean students won many contest awards. European universities dominate the ranking of mathematics contests. There are no similar tendencies in natural science contests, but it should be noted that the U.S. and Canada were included in the top 5 countries.



Table 2

#### Top 15 countries by the number of weighted victories in international student contests in 2013—2017

	Country	Total points (weighted victories)
1	Russian Federation	61.35
2	China	27.88
3	United States	27.84
4	Poland	22.82
5	The Netherlands	18.85
6	United Kingdom	17.00
7	Spain	13.86
8	Canada	10.51
9	Belgium	9.98
10	Croatia	8.90
11	Ukraine	8.80
12	Germany	8.27
13	Czech Republic	8.20
14	Australia	7.17
15	Israel	6.68

Finally, awards in humanities contests are usually won by students from English-speaking countries. Overall, the top countries by victories in international contests tend to have strong academic schools in the relevant areas (see Tables 3a–3d).

#### Table 3a

#### Top countries by victories in **IT** contests:

weighted victory number ranking, number of research publications (according to InCites, data from Web of Science up to December 7, 2018 considered, subject area: OECD 1.02 Computer and information sciences [5], publication types: Article, Review, Proceedings)

Country	Weighted victory number ranking	Number of publications (2013–2017)	Normalized citation impact (NCl)	Top 1% publications by citation impact (%)
Russian Federation	1	10,858	0.94	1.02
China	2	168,256	0.98	1.47
Poland	3	13,089	1.35	1.63
United States	4	132,795	1.85	2.86
Japan	5	63,111	0.90	0.80

Table 3b

#### Top countries by victories in **Mathematics** contests: weighted victory number ranking, number of research publications (according to InCites, data from Web of Science up to December 7, 2018 considered, subject area: OECD 1.01 Mathematics, publication types: Article, Review)

Country	Weighted victory number ranking	Number of publications (2013–2017)	Normalized citation impact (NCl)	Top 1% publications by citation impact (%)
Russian Federation	1	13,923	0.53	0.57
The Netherlands	2	5,057	0.85	1.27
Poland	3	8,463	0.58	0.83
Belgium	4	4,318	0.78	0.83
Spain	5	14,156	0.7	1.00



#### Таблица Зс

#### Top countries by victories in **Science and Engineering** contests: weighted victory number ranking, number of research publications ((according to InCites, data from Web of Science up to December 7, 2018 considered, subject area: OECD 1 Natural Sciences & 2 Engineering and Technology, publication types: Article, Review)

Country	Weighted victory number ranking	Number of publications (2013–2017)	Normalized citation impact (NCl)	Top 1% publications by citation impact (%)
China	1	1,139,797	1.10	1.49
United States	2	1,101,220	1.36	2.09
Canada	3	191,772	1.27	1.88
Spain	4	193,826	1.22	1.57
United Kingdom	5	322,347	1.45	2.36

#### Таблица 3d

#### . Top countries by victories in **Humanities** contests: weighted victory number ranking, number of research publications (according to InCites, data from Web of Science up to December 7, 2018 considered, subject area: OECD 6 Humanities, publication types: Article, Review, Book, Book Chapter)

Country	Weighted victory number ranking	Number of publications (2013–2017)	Normalized citation impact (NCl)	Top 1% publications by citation impact (%)
Australia	1	14,642	1.38	1.86
United States	2	107,586	1.09	1.49
United Kingdom	3	54,215	1.19	1.50
Canada	4	15,986	1.20	1.50
New Zealand	5	2,443	1.36	1.15

However, the balance of power is also affected by other, less obvious factors. As for **Mathematics** contests, the **geographical** factor should be taken into account: all top countries by the number of victories are European, and the IMC, the largest contest in this subject area, with the largest number of awards, is held in Europe on an annual basis. As for Humanities contests, the dominance of students from English-speaking countries can be attributed to the specifics of the contest problems in this subject area. To successfully perform in such contests as business cases, debates, or legal studies competitions, the participants are required to demonstrate not only outstanding knowledge and skills in the relevant subject area, but also high level of fluency in the English language.



## Which Universities Win Contests

The assessment of student success in contests using the weighted score considers not only the number of contests won by the students or student teams, but also the level of competition in each contest. Universities that have participated in contests with the widest country coverage gain an advantage *(Table 4)*.

Table 4

	University	Country	Weighted score
1	Moscow Institute of Physics and Technology	Russian Federation	13.40
2	University of Warsaw	Poland	12.06
3	Saint Petersburg State University	Russian Federation	10.90
4	Lomonosov Moscow State University	Russian Federation	10.65
5	ITMO University	Russian Federation	9.50
6	University of Amsterdam	The Netherlands	9.30
7	University of Zagreb	Croatia	8.90
8	Shanghai Jiao Tong University	China	8.53
9	Taras Shevchenko National University of Kyiv	Ukraine	8.50
10	Jagiellonian University in Krakow	Poland	7.46
11	Novosibirsk State University	Russian Federation	6.51
12	Comenius University Bratislava	Slovakia	6.40
13	National Research University Higher School of Economics (HSE)	Russian Federation	6.20
14	Charles University	Czech Republic	6.10
15	Ghent University	Belgium	6.00

#### University ranking by the number of weighted wins in international student contests in 2013—2017

The team of the top-ranking university, MIPT, has won prizes in two ICPC programming contests and received over 38 awards in the IMC mathematics contest in five years. SPBU, ranking third, has managed to win the ICPC four times in five years. The second-ranking University of Warsaw won prizes in the ICPC in each of those five years. Out of 15 universities represented in the table, only three have never won the ICPC: the University of Amsterdam, Novosibirsk State University, and Ghent University; however, their students have won many prizes in the IMC.

That said, it is important to keep in mind that all 164 universities whose students have won at least one contest in five years can be considered successful in international contests compared with the many shortlisted universities that have a zero success rate. Therefore, universities with the highest number of prizes are not the only element important for the understanding of the structure of the international contest movement, but all 164 mentioned universities as a whole.

We assume that universities whose students achieve success in international contests have a number of common features. Using logistic regression analysis, we have compared universities from the reviewed list whose students have won prizes in international contests at least once (Appendix 1). We have used stepwise regression with the Akaike information criterion [3, 8] on a data set without missing values (296 universities) and then checked the obtained predictors variables predicting the success of universities in international student contests — on the full data set.



Students of **major universities** are often successful in international student contests: **budget level** and **the number of academic staff** allow for statistically significant prediction of student success in contests. The total number of students is not a significant factor.

Also successful in international contests are universities that are important for their national academic community, i.e. those that are responsible for **a substantial share of scientific publications in the country.** 

Finally, the students of universities that actively engage in «third mission» activities also tend to succeed in international contests. First, these are universities that **publish massive open online courses** on the leading international platforms such as Coursera and edX. Second, these include universities whose scientific publications have the highest FVWI, indicating that they are more popular among the users of the Scopus database: not just among scientists, but also with consumers of scientific knowledge in the periphery and outside of the academic community: students, journalists, business representatives, etc.

**American** universities whose students win in contests share the same distinctive feature — **high traffic on their Wikipedia pages.** This may indicate that universities that actively participate in the contest movement have a closer connection with the public.

Finally, the most successful **European** universities are the most **internationalized and well-staffed:** they have **a higher share of foreign students** and a better ratio of **the number of academic staff to the number of students**.

Other macroregions – Africa, Asia, Latin America, and Oceania – show no specific trends.



# Structure of the international contest movement: global contests are not always the most massive

MThe structure in Fig.1 can be conceptualized by transforming the contest nodes into connections between universities *(puc. 4)*.



has won a contest where no other university has achieved success



The figure shows that the structure of the international university contest movement is heterogeneous. A pivotal role in this structure is played by the contests with the widest country coverage — contests of categories A and B, primarily the massive ones. These include the IMC and UPC — these contests have been won at least once by 81 and 43 universities from the respective samples. To put that in context, in five years only 27 universities have won prizes in the highly competitive ACM ACPC, whose preliminary stages cover over 100 countries. Interestingly, in spite of the wide coverage of the IMC and UPC, only 7 universities have won both these contests, including the Jagiellonian University in Krakow and the University of Warsaw, which are indicated in the figure.

Universities that have won prizes only in contests with a narrow country coverage were appropriately less likely to compete in a contest with other universities from the sample. Carleton University is the clearest example, being the only university reviewed to win a prize in the NIBS Worldwide Case Competition.

The core of the structure of the international contest movement as indicated using the method of «islands» consists of universities whose students have won the most prizes in the highest number of contests with allowance for their coverage *(Fig. 5)*.



Core structure of the international university contest movement

**Figure 5.** The University of Warsaw, the Jagiellonian University in Krakow, and Shanghai University are among the most successful contenders

Figure 5 shows that universities whose students are the most successful in various international contests can be divided into two clusters. The first component (on the left) includes universities whose students are more successful in **IT and mathematics** contests, primarily the ICPC and IMC, These include: Lomonosov Moscow State University, Moscow Institute of Physics and Technology, St. Petersburg State University (Russia); the University of Amsterdam (The Netherlands); Taras Shevchenko National University of Kyiv (Ukraine); Ghent University (Belgium), and the University of Zagreb (Croatia).



The second component (on the right) includes universities more successful in natural sciences and engineering contests, These include: the University of Toronto (Canada); Nanjing University and Xi'an Jiaotong University (China); the National University of Singapore; the Georgia Institute of Technology and Washington University in St. Louis (USA); the Autonomous University of Barcelona (Spain) and the University of Liverpool (United Kingdom). Students of the University of Singapore have also won multiple prizes in various international humanities contests, while students of both Chinese universities have won The Mathematical Contest in Modeling.

Shanghai Jiao Tong University (China), the University of Warsaw, and the Jagiellonian University (Poland) hold the strongest position — their students have won many prizes in IT, mathematics, and humanities contests. These universities can be considered the most successful participants of the global contest movement.

If we examine student victories in international contests on a national scale, the university contest communities of the US, Germany, and the United Kingdom prove to be the most successful, as their universities have won prizes across all four disciplines in five years (Fig. 6). However, most universities in these countries have won only one of the student contests reviewed. The only exceptions are the University of Cambridge, Harvard University, and the Pennsylvania State University – their students have won in four different contests in five years; the University of Glasgow, the University of California, Berkeley, Carnegie Mellon University, the University of Colorado Boulder (won in three different contests), and Yale University with victories in two contests.

Students from Singapore, Hong Kong, the Netherlands, Poland, Russia, Argentina, and China have won prizes in three out of four disciplines, students from 18 other countries — in two out of four disciplines.



Structure of the international university contest movement by country and discipline. The size of each node is proportionate to the number of contests and prizes won

have won prizes across all disciplines



## Conclusions

In this study, we reviewed the most prestigious international student contests, information on the winners and medalists of which is available in the public domain. Information about the winners and medalists of 14 international contests in 2013–2017 was compiled.

The data reviewed demonstrates a high level of irregularity: most universities, including multi-profile ones, consistently participate in just one contest out of all those reviewed. This can be explained by strict contest qualification criteria that allow for the comparison of student achievements on a global level. It can also be attributed to the shorter history of international university student contests when compared to school student contests.

Natural science and technology competitions dominate the list of global-level contests. IT and applied mathematics contests have the highest number of participants and show the widest country coverage. This can be attributed to the increasing global demand for specialists in these areas, among other things. Beyond that, the realization of global student contests in the humanities presents additional difficulties when compared to natural science and technology contests. Many require the presence of several qualified jury members, and involve conducting debates between participants. International contests in the humanities additionally require the participants to have an outstanding command of the English language. On the other hand, contests in IT, mathematics, and physics allow for the participation of teams that speak English on an average level, and the assessment system is more standardized.

The universities whose students participate and win awards in the international contests are usually large universities that play an essential role in the academic community of their respective countries, and actively participate in "third mission" activities: the development of accessible education (MOOC) and the publication of research papers of interest to a wide audience. Further, when it comes to European universities, student contest awards are usually associated with prestigious universities that have better teaching staff and attract more students from abroad.

Canada, China, Russia, the U.K., and the U.S. are the top five countries by total number of universities whose students won awards in the most prestigious international contests.

When taking the competitiveness level for each contest into account, students from Russia, China, and Poland demonstrate the most successful performance in IT contests. Students from European universities dominate as frequent winners of mathematics contests, with students from Russia, the Netherlands, Poland, Belgium, and Spain demonstrating the most successful performance. China, the U.S., the UK, Canada, and Spain are the top countries by victories in natural and engineering science contests. The most successful performance in international humanities contests is demonstrated by students from English-speaking countries: Australia, the U.S., the UK, Canada, and New Zealand. Russian universities won the highest number of awards when taking the competitiveness level into account.

Most prestigious contests from the list were founded in the U.S., which has the highest number of universities whose students have won an international contest at least once.

On the macro-regional level, most contest winners represented European universities.



For subsequent studies of the international student contest movement, we believe it is important to expand the contest list, especially in areas that lack representation in the list (provided that the geographical coverage and competitiveness level are comparable to those of the contests presented in the study), as well as to analyze data about contest participants in addition to information about the winners and medalists.

## **Cited Sources**

1. **Buzdalov, Maxim.** Career Benefits of Competitive Programming – EdX Blog, March 01, 2017. *https://blog.edx.org/5-career-benefits-of-competitive-programming* 

2. **Echavarria, Ana.** Competitive Programming Turned Me Into A Much Better Developer. *https://www.forbes.com/sites/quora/2016/12/15/competitive-programming-turned-me-into-a-much-better-developer/#6bdfbca676db* 

3. **Max Kuhn.** Contributions from Jed Wing, Steve Weston, Andre Williams, Chris Keefer, Allan Engelhardt, Tony Cooper, Zachary Mayer, Brenton Kenkel, the R Core Team, Michael Benesty, Reynald Lescarbeau, Andrew Ziem, Luca Scrucca, Yuan Tang, Can Candan and Tyler Hunt. (2018). caret: Classification and Regression Training. R package version 6.0–81.

4. **Norvig, Peter.** Being good at programming competitions correlates negatively with being good on the job *https://catonmat.net/programming-competitions-work-performance* 

5. REVISED FIELD OF SCIENCE AND TECHNOLOGY (FOS) CLASSIFICATION IN THE FRASCATI MANUAL. *https://www.oecd.org/science/inno/38235147.pdf /* Working Party of National Experts on Science and Technology Indicators, OECD. 26-Feb-2007

6. The International Mathematical Olympiad official website http://www.imo-official.org/

7. **V. Batagelj, A. Mrvar:** Pajek — Analysis and Visualization of Large Networks. In Juenger, M., Mutzel, P. (Eds.): Graph Drawing Software. Springer (series Mathematics and Visualization), Berlin 2003. 77–103. ISBN3-540-00881-0.

8. **Venables, W. N. & Ripley, B. D.** (2002) Modern Applied Statistics with S. Fourth Edition. Springer, New York. ISBN0-387-95457-0

9. Methodology of Moscow International University Rating "The Three University Missions" (November, 2018) *https://mosiur.org/methods/methodology/* 

10. Moscow International University Rating "The Three University Missions" for 2018 is published *https://mosiur.org/news/#43* 



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## Appendix 1. List of international student competitions included in The Three University Missions 2018 ranking

	Contest	Abbreviation	Organizer	Website	Discipline	Weighting facto *	Category **	Number of win- ning universities
1	ACM International Collegiate Programming Contest	ICPC	IBM, Baylor University, Association for Computing Machinery (US)	icpc.baylor.edu	ІТ	1	А	27
2	International Mathematics Competition for University Students	IMC	University College London (UK) & American University in Bulgaria	imc-math.org	Mathematics	0.30	В	81
3	The SIAM Award in the Mathematical Contest in Modeling	SIAM	Society for Industrial and Applied Mathematics (US)	siam.org/prizes	Mathematics	0.35	В	3
4	The Mathematical Contest in Modeling	MC Modeling	Consortium for Mathematics and Its Applications (US)	comap.com/ undergraduate/ contests/index.html	Mathematics	0.17	С	17
5	The University Physics Competition	UPC	American Physical Society, American Astronomical Society; The UPC Committee (Wesleyan College, University of Winnipeg, Utica College, US)	uphysicsc.com	Natural Sciences and Engineering	0.19	с	43
6	Green Brain of the Year Contest	Green Brain	Middle East Technical University (Turkey)	ncc.metu.edu.tr/ greenbrain	Natural Sciences and Engineering	0.23	с	6
7	The World Universities Debating Championships	WUDC	International World Universities Debating Council	wudc2019.uct.ac.za	Humanities	0.68	А	11
8	Belgrade Business International Case Competition	BBICC	Faculty of Organizational Sciences, University of Belgrade (Serbia)	bbicc.org	Humanities	0.09	с	9
9	John Molson Undergraduate Case Competition	JMUCC	JMUCC (Canada)	jmucc.ca	Humanities	0.13	с	5
10	McGill Management International Case Competition	MMICC	McGill University (Canada)	mmicc.org	Humanities	0.19	с	7
11	Network of International Business Schools Worldwide Case & Business Plan Competitions	NIBS	Network of International Business Schools (30+ countries; Org. Com.: Guatemala)	nibsweb.org/ competitions/	Humanities	0.29	В	1
12	The Philip C. Jessup International Law Moot Court Competition	Jessup	International Law Students Association (Org. Com.: US)	ilsa.org	Humanities	0.92	А	5
13	The Annual Willem C. Vis International Commercial Arbitration Moot	ICAM	Association for the Organization and Promotion of the Willem C.Vis International Commercial Arbitration Moot (Austria)	visgmoot.pace.edu	Humanities	1	A	7
14	NSUCRYPTO	NSUCRYPTO	Novosibirsk State University (Russia)	nsucrypto.nsu.ru	ІТ	0.09	С	10

\* – calculated in proportion to the number of countries represented among the contest participants. \*\* – assigned based on country coverage: "A" – over 60, "B" – over 20, "C" – the rest, corresponding to the selection criteria of the Moscow International University Ranking methodology.



## Appendix 2. List of universities with students who won or placed in international student contests in 2013–2017

Abbreviation (in diagrams)	Университет	Country
AalbU	Aalborg University	Denmark
AMUP	Adam Mickiewicz University in Poznan	Poland
AU	Aalto University	Finland
AUB	American University of Beirut	Lebanon
AUM	Autonomous University of Madrid	Spain
AUT	Amirkabir University of Technology	Iran
AUThes	Aristotle University of Thessaloniki	Greece
BAU	Bogor Agricultural University	Indonesia
BMSTU	Bauman Moscow State Technical University	Russian Federation
BNU	Beijing Normal University	China
BSU	Belarusian State University	Belarus
BU	Brown University	United States
CarlU	Carleton University	Canada
СМИ	Carnegie Mellon University	United States
CornU	Cornell University	United States
CU	Charles University	Czech Republic
CU	Columbia University	United States
CUB	Comenius University Bratislava	Slovakia
DU	Duke University	United States
DU	Durham University	United Kingdom
ENS,P	École normale supérieure, Paris	France
EP	École Polytechnique	France
EUR	Erasmus University Rotterdam	The Netherlands
FU	Fudan University	China
GIT	Georgia Institute of Technology	United States
GMU	Gadjah Mada University	Indonesia
GU	Ghent University	Belgium
НКИЅТ	Hong Kong University of Science and Technology	Hong Kong
HSE	National Research University Higher School of Economics	Russian Federation
НО	Harvard University	United States
HUB	Humboldt University of Berlin	Germany
IIS,B	Indian Institute of Science, Bengaluru	India
lit,d	Indian Institute of Technology, Delhi	India
ІІТ,К	Indian Institute of Technology, Kharagpur	India



Abbreviation (in diagrams)	Университет	Country
ІІТК	Indian Institute of Technology Kanpur	India
ШТМ	Indian Institute of Technology Madras (Chennai)	India
ITB	Institute Technology of Bandung	Indonesia
ІТМО	ITMO University	Russian Federation
IU	Indiana University	United States
IUT	Isfahan University of Technology	Iran
JHU	Johns Hopkins University	United States
JUK	Jagiellonian University in Krakow	Poland
KAIST	Korea Advanced Institute of Science and Technology	South Korea
KCL	King's College London	United Kingdom
KTHRIT	KTH Royal Institute of Technology	Sweden
KU	Korea University	South Korea
KUL	KU Leuven	Belgium
LMSU	Lomonosov Moscow State University	Russian Federation
LU	Leiden University	The Netherlands
MaasU	Maastricht University	The Netherlands
McGU	McGill University	Canada
MEPhI	National Research Nuclear University MEPhI	Russian Federation
МІРТ	Moscow Institute of Physics and Technology	Russian Federation
MIT	Massachusetts Institute of Technology	United States
MonU	Monash University	Australia
MU	Masaryk University	Czech Republic
NanTU	Nanyang Technological University, Singapore	Singapore
NSU	Novosibirsk State University	Russian Federation
NTNU	Norwegian University of Science & Technology	Norway
NTU	National Taiwan University	Taiwan
NU	Nanjing University	China
NUM	National University of Mongolia	Mongolia
NUS	National University of Singapore (NUS)	Singapore
NUU	National University of Uzbekistan	Uzbekistan
PGSPPU	Peter the Great St. Petersburg Polytechnic University	Russian Federation
PU	Peking University	China
PUB	Polytechnic University of Bucharest	Romania
PUC	Pontifical University of Chile (PUC)	Chile
PUCV	Pontificia Universidad Católica de Valparaíso	Chile
QUT	Queensland University of Technology	Australia
RU	Rutgers University	United States
RUC	Renmin University of China	China
RUN	Radboud University Nijmegen	The Netherlands



Abbreviation (in diagrams)	Университет	Country
RWTHAU	RWTH Aachen University	Germany
SFU	Simon Fraser University	Canada
SJTU	Shanghai Jiao Tong University	China
SNU	Seoul National University	South Korea
SPSU	Saint Petersburg State University	Russian Federation
SUSKO	Sofia University St. Kliment Ohridski	Bulgaria
SYSU	Sun Yat-sen University (SYSU)	China
TAU	Tel Aviv University	Israel
TCD	Trinity College Dublin	Ireland
тсинк	The Chinese University of Hong Kong	Hong Kong
тниј	The Hebrew University of Jerusalem	Israel
ТІІТ	Technion Israel Institute of Technology	Israel
TSNUK	Taras Shevchenko National University of Kyiv	Ukraine
TSU	Tomsk State University	<b>Russian Federation</b>
TU	Tsinghua University	China
TUA	The University of Auckland	New Zealand
TUB	Technical University of Berlin	Germany
TuftsU	Tufts University	United States
тинк	The University of Hong Kong	Hong Kong
ТИМ	The University of Melbourne	Australia
TUMun	Technical University of Munich	Germany
TUQ	The University of Queensland	Australia
UA	University of Adelaide	Australia
UAB	Autonomous University of Barcelona (UAB)	Spain
UAC	University of the Andes Colombia	Colombia
UAlb	University of Alberta	Canada
UAmst	University of Amsterdam	The Netherlands
UAth	University of Athens	Greece
UB	University of Barcelona	Spain
UBA	University of Buenos Aires (UBA)	Argentina
UBC	University of British Columbia	Canada
UBelg	University of Belgrade	Serbia
UBonn	University of Bonn	Germany
UC	University of Cambridge	United Kingdom
UC	University of Chicago	United States
UC,B	University of California, Berkeley	United States
UCB	University of Colorado Boulder	United States
UCL	University College London	United Kingdom
υсм	Universidad Complutense de Madrid (UCM)	Spain



Abbreviation (in diagrams)	Университет	Country
UCop	University of Copenhagen	Denmark
UCR	Universidad Costa Rica	Costa Rica
UCT	University of Cape Town	South Africa
UD,D	University of Delhi, Delhi	India
UF	University of Florida	United States
UFMG	Universidade Federal de Minas Gerais	Brazil
UFRGS	Federal University of Rio Grande do Sul	Brazil
UFRJ	Federal University of Rio de Janeiro	Brazil
UFU	Ural Federal University	Russian Federation
UG	University of Glasgow	United Kingdom
UGot	University of Göttingen	Germany
UH	University of Helsinki	Finland
UI	University of Indonesia	Indonesia
UIU-C	University of Illinois at Urbana-Champaign	United States
UL	University of Liverpool	United Kingdom
ULj	University of Ljubljana	Slovenia
ULux	University of Luxembourg	Luxembourg
UM	University of Michigan	United States
UN	University of Newcastle	Australia
UNAM	National Autonomous University of Mexico	Mexico
UNCCH	University of North Carolina at Chapel Hill	United States
UND	University of Notre Dame	United States
UNICAMP	Universidade Estadual de Campinas	Brazil
UOs	University of Oslo	Norway
UOtago	University of Otago	New Zealand
UOtt	University of Ottawa	Canada
UOxf	University of Oxford	United Kingdom
UP	Universidade do Porto	Portugal
UPenn	University of Pennsylvania	United States
URTV	University of Rome Tor Vergata	Italy
US	University of Sydney	Australia
USaoP	University of São Paulo	Brazil
UTar	University of Tartu	Estonia
UTeh	University of Tehran	Iran
UTok	University of Tokyo	Japan
UTor	University of Toronto	Canada
UU	Utrecht University	The Netherlands
UV	University of Valencia	Spain
UV	University of Vienna	Austria



Abbreviation (in diagrams)	Университет	Country
UVG	Universidad del Valle de Guatemala	Guatemala
UW	University of Warsaw	Poland
UWarw	University of Warwick	United Kingdom
UWat	University of Waterloo	Canada
UWit	University of Witwatersrand	South Africa
UZ	University of Zurich	Switzerland
UZag	University of Zagreb	Croatia
VNKKNU	V.N. Karazin Kharkiv National University	Ukraine
WUSL	Washington University in St. Louis	United States
ХЈТО	Xian Jiao Tong University	China
YSU	Yerevan State University	Armenia
YU	Yale University	United States
ZU	Zhejiang University	China



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