

Structures in Computer Science Programmes

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1 Assignment

- Study the structure of computer science study programmes.
- Describe the methodology for categorizing computer science subjects + X (ISCED-F 2013 - narrow field).
- Create and apply the methodology to at least two countries.
- Describe and evaluate the results of your work.

Additions from consultations:

- Prototype visualization of “how much are different areas represented in various countries”.
- Writing the report in English would be appreciated.

2 Methodology

The methodology describes the process of how to get to the same results for three sample countries and to stay consistent with further countries expansion. The only requirement is the access to search engine technology. Various search engines can be used.

1. Use following search query a) Name of the country in English b) study a programme (in a native language) and c) the name of the programme in the native language. For example: *a) Austria b) einen Studiengang studieren c) Angewandte Informatik*.

If you don't find results try to use name of the country in native language. Figure 1 shows used search query.

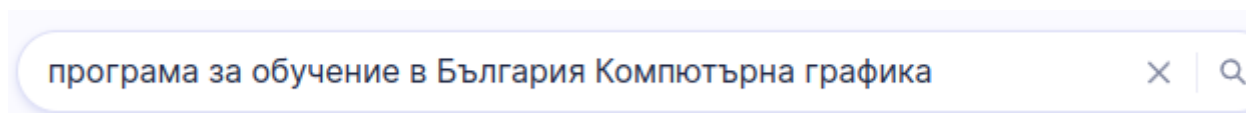


Figure 1: Bulgaria Computer Graphics

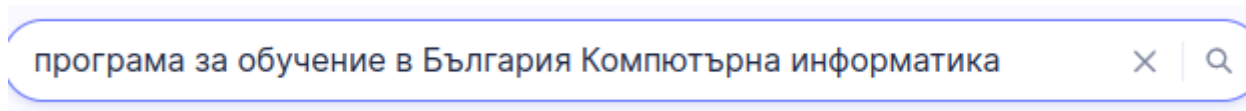


Figure 2: Bulgaria Computer Informatics

2. *Open a link that contains the searched programme and it is an university.* During our testing sample countries we had a very high success of finding a curriculum of the programme. If you can't find curriculum, try to look for another link or a website. If you don't find curriculum elsewhere, read the description of the programme.
3. *Read name of all courses.*
4. *Judge which CCAF field is the most relevant to the programme and record it to the spreadsheet.*
 - (a) Judge study programmes according to categories described by ACM.org in the [2020 report](#), section 2.3. Page 31 demonstrates ACM categories. Non-IT fields like biomedicine, economics write in general, but they can be less consistent than the ARM 6 categories.

3 Data analysis

3.1 Data collected

3.1.1 Ireland

	Computing	X
Applied Computing	Information Technology	
Business and Information Technology	Information Systems	
Business Information Systems	Information Systems	
Computational Problem-Solving	not found	
Computational Thinking	Information Systems	022 Humanities
Computer and Communications Engineering	not found	
Computer Applications	not found	
Computer Forensics & Security	Information Systems	042 Law
Computer Games Development	Information Technology	
Computer Networks and Systems Management	Information Technology	
Computer Science and Business	Information Systems	
Computer Science and Language	Computer Science	023 Languages
Computer Science, Mathematics and Philosophy	not found	
Computer Science	Computer Science	
Computer Systems	Computer Science	
Computer, Electronic and Communications Engineering	not found	
Computing - Games Design and Development	Computer Science	
Computing in Multimedia Systems/Web Engineering	not found	
Computing with Cloud	Information Technology	
Computing with French	not found	
Computing with Mobile App Development	not found	
Computing with Multimedia	not found	
Computing with Software Development	Information Technology	
Electronic and Computer Engineering	Computer Engineering	
Enterprise Computing	Information Systems	
Green Information Technology	not found	
Information Systems Management	Information Systems	
Information Technology	Information Technology	
Interactive Applications Design and Development	not found	
Internet Systems Development	not found	
Management Science and Information Systems Studies	Information Systems	041 Business and administration
Multimedia Programming and Design	not found	
Software Design and Development	Software Engineering	
Software Development and Computer Networking	not found	
Software Development	Software Engineering	
Software Engineering	Software Engineering	
Web Development	not found	

Table 1: Ireland

3.1.2 Bulgaria

	Computers	x
Бизнес информатика (Business Informatics)	Computer science	0412 Business administration
Бизнес информатика и иконометрия (Business Informatics and Econometrics)	Computer science	0311 Econometrics
Бизнес информационни технологии (Business Information Technologies)	Computer science	0412 Business administration
Био- и медицинска информатика (Bio- and Medical Informatics)	Computer science	0912 Medicine
Вградени системи (Embedded Systems)	Computer engineering	Kybernetics

Data Science	Computer science	
Desktop and Mobile Computers	Not found	
E-Business	Not found	
Електронен бизнес и електронно управление (E-Business and E-Management)	Not found	
Защита на информацията в компютърните системи и мрежи (Protection of Information in Computer Systems and Networks)	Cybersecurity	
Извличане на информация и откриване на знания (Information Retrieval and Knowledge Discovery)	Software engineering	
Изкуствен интелект (Artificial Intelligence)	Not found	
Икономическа информатика (Business informatics)	Not found	
Информатика (Informatics)	Computer science	
Информатика и информационни технологии (Informatics and Information Technologies)	Not found	
Информатика и информационни технологии в бизнеса (Informatics and Information Technologies in Business)	Computer science	
Информатика и компютърни науки (Informatics and Computer Science)	Computer science	
Информатика и софтуерни науки (Informatics and Software Science)	Computer science	
Информационно брокерство (Information Brokering)	Computer science	
Информационна сигурност (Information Security)	Not found	
Информационни системи (Information Systems)	Data science	
Информационни системи и технологии (Information Systems and Technologies)	Information systems	
Информационни технологии (Information Technologies)	Computer science	
Информационно-технологични услуги и проекти (IT Services and Projects)	Information systems	0419 Business and administration notelsewhere classified
Киберсигурност (Cybersecurity)	Cybersecurity	
Компютърна графика (Computer Graphics)	Computer engineering	
Компютърна информатика (Computer Informatics)	Not found	
Компютърна лингвистика (Computer Linguistics)	Data science	0232 Literature and linguistics
Компютърни игри и анимация (Computer Games and Animations)	Not found	
Компютърни информационни технологии (Computer Information Technologies)	Not found	
Компютърни науки (Computer Science)	Computer science	
Логика и алгоритми (Logic and Algorithms)	Computer science	
Мехатроника и роботика (Mechatronics and Robotics)	Not related to information technologies	
Мобилни и уеб технологии (Mobile and Web Technology)	Software engineering	
Мрежови технологии (Network Technologies)	Software engineering	
Мултимедийни технологии (Multimedia Technologies)	Not found	
Мултимедийни технологии и уеб дизайн (Multimedia Technology and Web Design)	Computer science	
Приложна информатика (Applied Computer Science)	Computer science	
Разпределени системи и мобилни технологии (Distributed Systems and Mobile Technologies)	Software engineering	
Системно администриране (System Administration)	Not found	

Софтуерно инженерство (Software Engineering)	Software engineering	
Софтуерни системи и технологии (Software Systems and Technologies)	Computer science	
Софтуерни технологии (Software Technologies)	Software engineering	
Софтуерни технологии и дизайн (Software Technologies and Design)	Computer science	
Софтуерни архитектури и управление на качеството (Software architectures and Quality Assurance of Software)	Software engineering	
Софтуерни технологии в Интернет (Internet Software Technologies)	Software engineering	
Технологии за знания и иновации (Technology Knowledge and Innovation)	Information systems	Knowledge management
Технологично предприемачество и иновации в информационните технологии (Technology Entrepreneurship and Innovations in IT)	Not related to information technologies	0400 Business, administration and law not further defined
Уеб дизайн (Wed design)	Not found	
Уеб технологии и разработване на софтуер (World-wide web technologies and software development)	Computer science	
Управление на проекти по информационни технологии (IT Project Management)	Not related to information technologies	0400 Business
Цифрови технологии в креативните и рекреативни индустрии (Digital technologies in creative and re-creative industries)	Not found	

Table 2: Bulgaria

3.2 Austria

Angewandte Informatik (Applied Informatics)	Computer science	
Automotive Computing	Computer science	0716 Motor vehicles, ships and aircraft
Applied Image and Signal Processing	Data Science	
Bioinformatik (Bioinformatics)	Computer science	0511 Biology - biometrics
Biomedizinisches Ingenieurwesen (Biomedical Engineering)	Computer science	0511 Biology - biometrics
Biomedizinische Ingenieurwissenschaften (Biomedical Engineering Sciences)	Data science	0512 Biology - biochemistry
Bio Data Science	Data science	0512 Biology - biochemistry
Business Data Science	Not found	
Business Informatics	Information systems	
Business Process Engineering & Management	Information systems	
Business Software Development	Software engineering	
Cloud Computing Engineering	Not found	
Computational Intelligence	Data science	
Computer Science and Digital Communications	Computer science	
Creative Computing	Software engineering	
Data Science and Artificial Intelligence	Data science	
Data Science and Engineering	Data science	
Digital Business and Software Engineering	Computer science	
E-Commerce	Not found	
Elektronik und Computer Engineering (Electronics and Computer Engineering)	Computer engineering	
Gesundheitsinformatik (E-health)	Computer science	0900 Health and welfare
Hardware-Software-Design	Computer engineering	
Health Care Informatics	Not found	

Human Centered Computing	Computer science	
Human Computer Interaction	Computer science	
Informatik (Informatics)	Computer science	
Informatik – Digital Innovation (Informatics - Digital Innovation)	Information systems	
Information Security Management	Cybersecurity	
Informations- und Kommunikationssysteme (Information and Communication Systems)	Computer science	
Informationstechnologien und Telekommunikation (Information technologies and telecommunication)	Computer science	
Informationstechnologien und Wirtschaftsinformatik (Information Technologies and Business Informatics)	Computer science	0410 Business and administration notfurther defined
Informationsmanagement (Information Management)	Computer science	0410 Business and administration notfurther defined
Computersicherheit (Information Management and IT Security)	Not found	
IT Security	Cybersecurity	
IT & Mobile Security	Software engineering	
Information Security	Not found	
Interactive Media	Software engineering	
Medieninformatik (Media Informatics)	Software engineering	
Medizinische Informatik (Medical Informatics)	Not found	
Mobile Computing	Software engineering	
Multimedia Technology	Computer science	
Pervasive Computing	Computer science	
Scientific Computing	Computer science	
Sichere Informationssysteme (Secure Information Systems)	Cybersecurity	
Softwareentwicklung (Software Engineering)	Software engineering	
Software & Information Engineering	Software engineering	
Software Engineering & Internet Computing	Software engineering	
Software Design and Cloud Computing	Computer science	
Software Design and Engineering	Software engineering	
Systems Design	Data science	
Systems Engineering	Not found	
Software Engineering und vernetzte Systeme (Software Engineering und Networked Systems)	Not found	
Technische Informatik (Computer Engineering)	Computer science	
Visual Computing	Computer science	
Web Communication & Information Systems	Software engineering	
Wirtschaftsinformatik (Business Informatics)	Data science	
Wirtschaftsinformatik und Digitale Transformation (Business Informatics and Digital Transformation)	Computer science	0410 Business and administration notfurther defined

Table 3: Austria

3.2.1 Data visualisations

In this section we will discuss the data visualisations. Visualisation by country. At first we calculated percentage rate of each category in each country (see table 4). Then we visualised them using geographical charts (figures 3, 4, 5, 6, 5, 7 10 , 9, 8).

Country	Computer engineering	Computer science	Cybersecurity	Data Science	Information systems	Information Technology	Not found	Not related to IT	Software engineering
Austria	3,51%	36,84%	5,26%	14,04%	5,26%	0,00%	15,79%	0,00%	19,30%
Bulgaria	3,85%	34,62%	3,85%	3,85%	5,77%	0,00%	26,92%	5,77%	15,38%
Ireland	2,70%	10,81%	1,92%	0,00%	18,92%	16,22%	40,54%	0,00%	8,11%

Table 4: Percentage rate of each subject category in each country

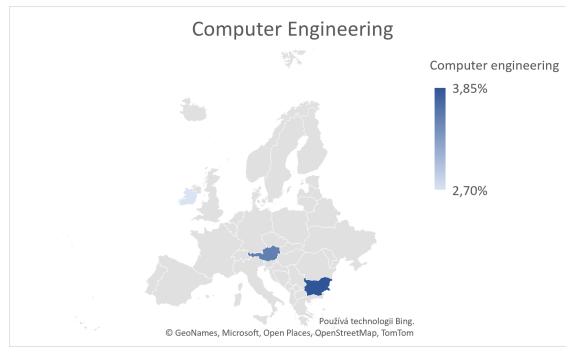


Figure 3: Computer Engineering



Figure 4: Computer Science

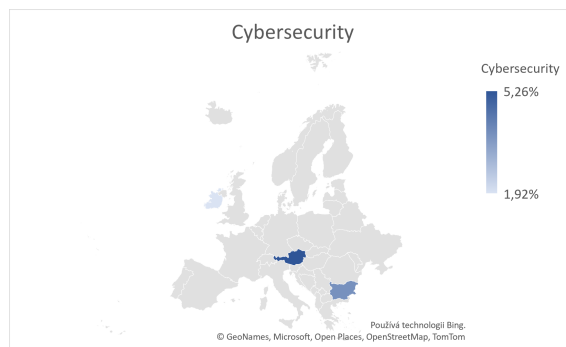


Figure 5: Cyber Security

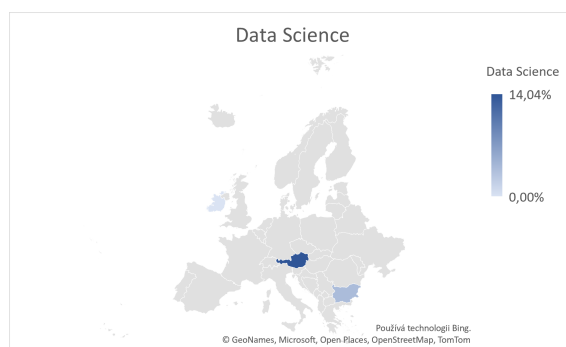


Figure 6: Data Science

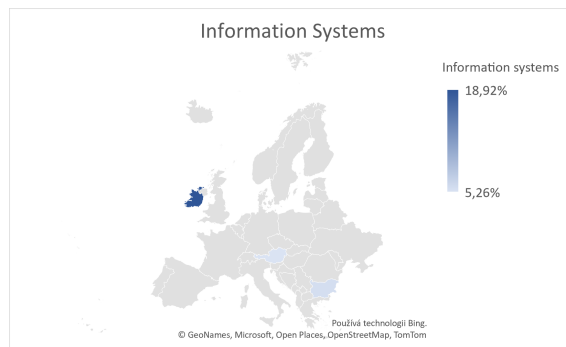


Figure 7: Information Systems

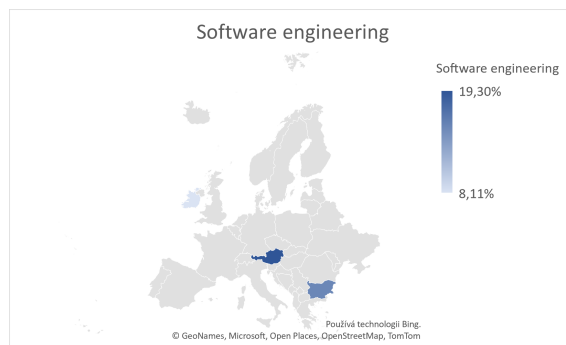


Figure 8: Software Engineering



Figure 9: Not found

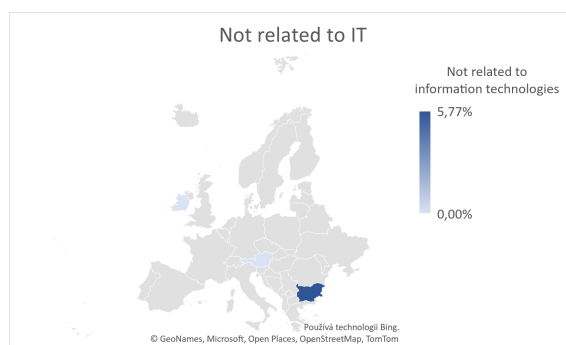


Figure 10: Not related to IT

To see the most common combinations we decided to create a table consisting of combination of one IT and one non-IT study field category provide us with most common combinations.

	071 Engi- neer- ing and engi- neer- ing trades	051 Bio- logical and re- lated sci- ences	090 Health and wel- fare	041 Busi- ness and ad- minis- tra- tion	031 Social and be- havioural sci- ences	091 Health	023 Lan- guages	022 Hu- mani- ties	042 Law
Computer engineering									
Computer science	1	2	1	5	1	1			
Cybersecurity									1
Data Science		2					2		
Information systems				2				1	
Information Technology									
Software engineering									

Table 5: Analysis of IT and non-IT study field category, values are in absolute values

4 Discussion

- Searching for a study programme online mentioned from the list was easy. At the start of the work in a different day one author struggled to find anything. A search setup was changed and tested. Didn't take a long time to get desired results as a first link suggested by search engines. The experimentation of a search setup was recorded down in a step one.
- If study programme exists, search setup from the methodology will catches it. If a user is successful with his or her search setup and the same search setup can't find out the next examined study programme in the list, the study programme doesn't exist. Study programmes in the list are likely to exist.
- During the research when we reviewed the programmes we noticed that list provided by Informatics Europe were outdated, because some programmes offered by universities were missing (see figure 9 and some were not added to the list even though they were listed on university website.

5 Notes

- Consider a question to map the age of found curriculum. Some programme curriculums were up to date, some curriculums were not updated for years.
- Potentially inspiring source for further research: Колко ученици учат програмиране и ИТ в България (2022/20023 г.)? How many students study programming and IT in Bulgaria (2022/20023)? [Link](#)

6 Conclusion

The article provides the methodology for further research. Because we researched only 3 countries, data are not complete. To be able to do any resolution more country data would be needed.