Cybersecurity Higher Education in Iceland before and after 2023
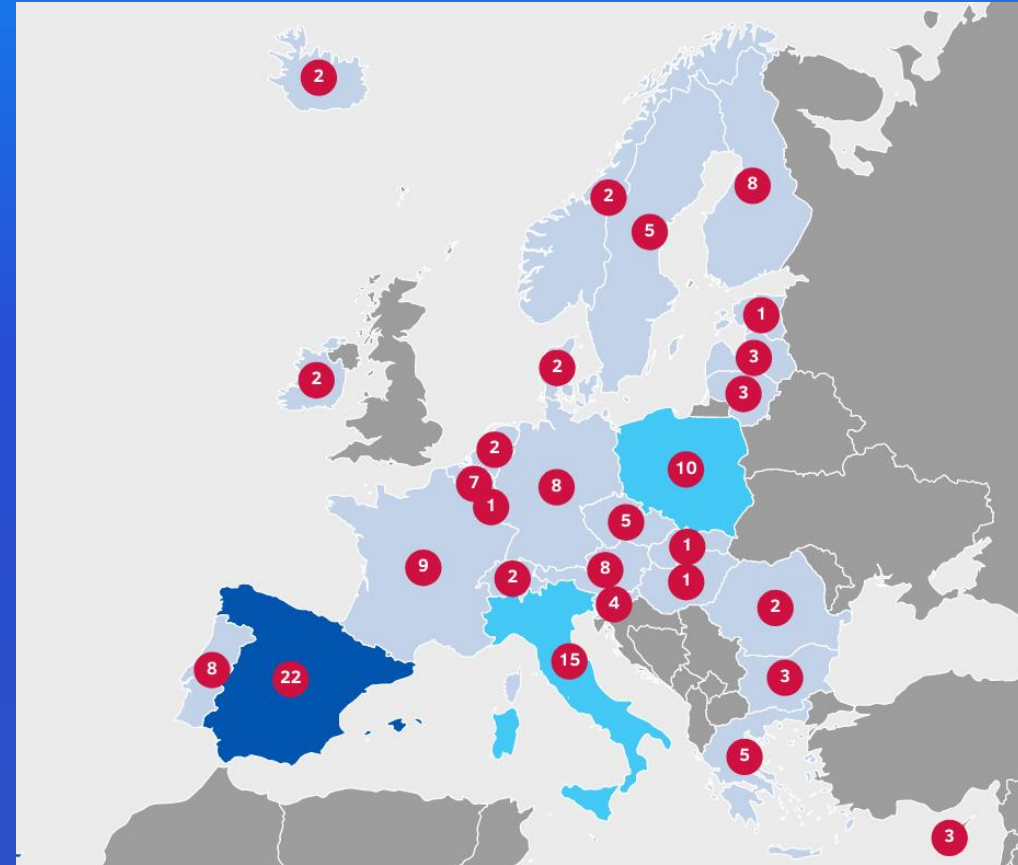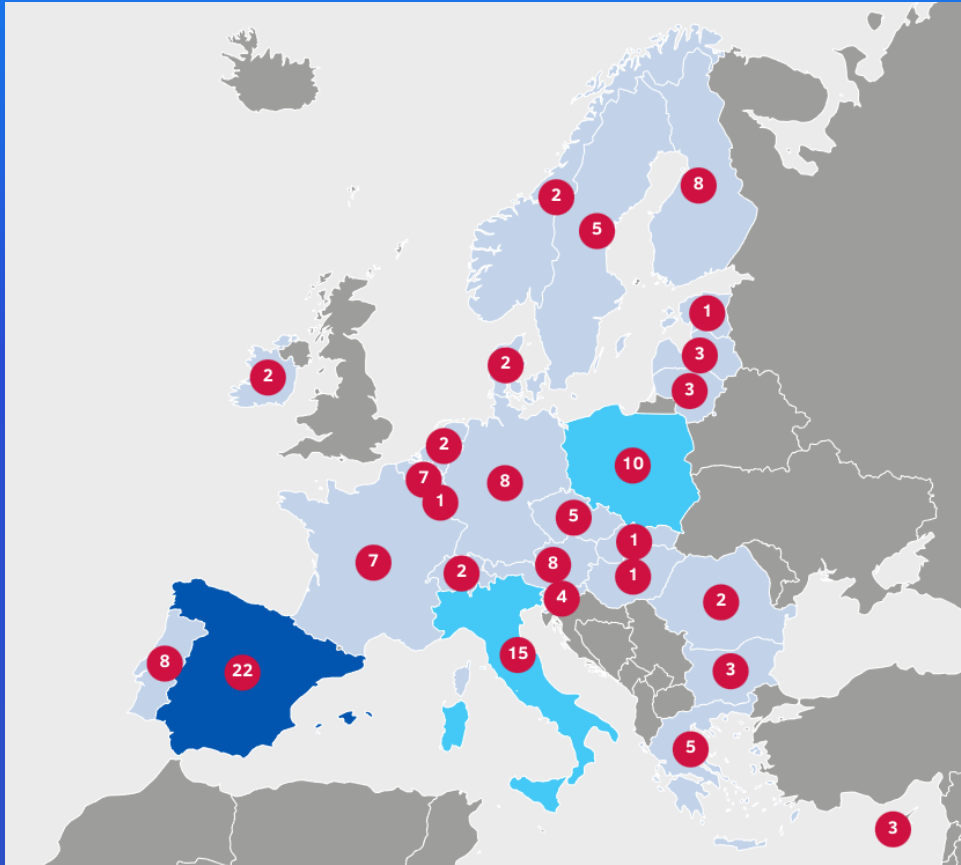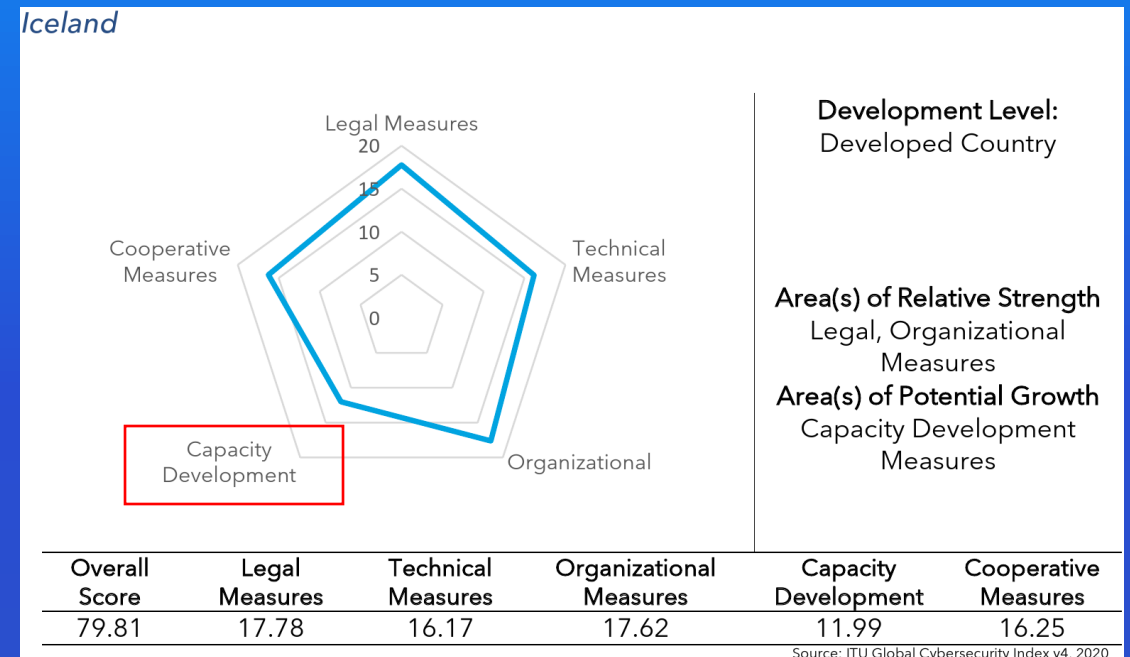

Image source: European Union Agency for Cybersecurity (ENISA): Cybersecurity Higher Education Database (CyberHEAD) – the largest validated Cybersecurity higher education database in the EU and EFTA countries. https://www.enisa.europa.eu/topics/education/cyberhead/

ITU Global Cybersecurity Index 2020

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- International Telecommunication Union (ITU):
  - Rank 1, Score 100.00: USA
  - Rank 2, Scores 99.54: United Kingdom and Saudia Arabia
  - Rank 3, Score 99.48: Estonia (comparable to Iceland GPD-wise)
    …
  - Rank 17, Score 96.89: Norway
  - Rank 22, Score 95.78: Finland
  - Rank 26, Score 94.55: Sweden
  - Rank 32, Score 92.60: Denmark
    …
  - Rank 58, Score 79.81: Iceland

Iceland

Development Level: Developed Country

Area(s) of Relative Strength
Legal, Organizational Measures

Area(s) of Potential Growth
Capacity Development Measures

Overall Score	Legal Measures	Technical Measures	Organizational Measures	Capacity Development	Cooperative Measures
79.81	17.78	16.17	17.62	11.99	16.25

Source: ITU Global Cybersecurity Index v4, 2020

Capacity development

Measuring awareness campaigns, training, education, and incentives for cybersecurity capacity development

142	Countries conduct cyber-awareness initiatives
94	Countries with cybersecurity R&D programs
98	Countries reported having national cybersecurity industries

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03/04/2024

Image source: ITU Global Cybersecurity Index v4, International Telecommunication Union, 2020

3

Cybersecurity Action plan of the Icelandic Government 2022-2027

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Improve Cybersecurity education at University level:

https://www.stjornarradid.is/verkefni/samgongur-og-fjarskipti/netoryggi/

120%

Stjórnarráð Íslands

VERKEFNI | EFST Á BAUGI | GÖGN | RÁÐUNEYTI | RÍKISSTJÓRN

Verkefni ⌄ | Samgöngur og fjarskipti ⌄ | Netöryggi

Aðgerðaáætlun í netöryggi

Aðgerðaáætlun stjórnvalda í netöryggi 2022-2027 var kynnt fyrir ríkisstjórn 28. október 2022. Aðgerðaáætlunin samanstendur af 64 fjölbreyttum aðgerðum. Út frá inntaki aðgerða eru þær flokkaðar í sex undirmarkmið sem tengjast meginmarkmiðum Netöryggisstefnu Íslands 2022-2037. Aðgerðirnar eru á ábyrgð átta ráðuneyta.

Markmið	Fjöldi og staða
⊟ **1 Afburða hæfni og nýting netöryggistækni**	
⊞ **1.1 Traust netöryggismenning og -vitund**	8
⊟ **1.2 Öflug menntun, rannsóknir og þróun**	14
⊞ Að nám um netöryggi verði tilgreint í aðalnámskrám leik-, grunn- og framhaldsskóla (MRN)	0
⊞ Aðild að öndvegissetri Atlantshafsbandalagsins um netvarnir (NATO CCD COE) (UTN)	1
⊞ Auka fræðslu innan réttarvörslukerfisins um netglæpi (DMR)	1
⊟ Auka námsframboð í netöryggifræðum á háskólastigi (HVIN)	1

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Image source: https://www.stjornarradid.is/verkefni/fjarskipti/netoryggi/

Ministry of Higher Education, Science and Innovation approaching EDIH-IS

- The Digital Europe Programme project
  European Digital Innovation Hub Iceland (EDIH-IS)
  covers digital transformation:
  - Includes Cybersecurity,
  - Includes the two major universities in Iceland providing IT-related higher education:
    - Reykjavik University and University of Iceland.

- **2022:**
  - The ministry approached EDIH-IS to facilitate collaboration of the two universities to design a joint Cybersecurity M.Sc. programme.
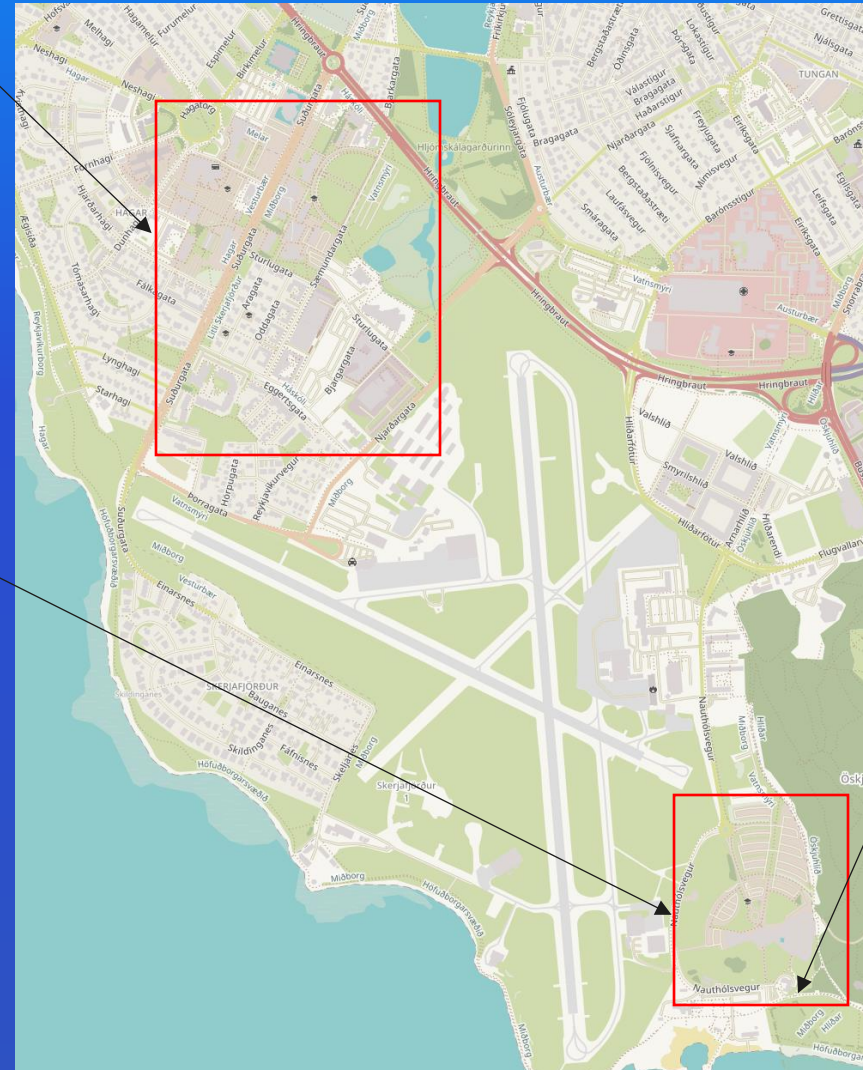
University of Iceland (UoI) and Reykjavik University (RU)

University of Iceland (UoI)

Reykjavik University (RU)

You are here:
NCC-IS kick-off

Map © OpenStreetMap contributors

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University collaboration fund of the Ministry of Higher Education, Science and Innovation

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- ## September 2022:
  - The ministry announced a collaboration fund:
    - Foster synergies by collaboration of the Icelandic universities.
  - Reykjavik University and University of Iceland applied.

- ## January 2023:
  - 90 million ISK (ca. 600 000 €) for two years granted to strengthen research and higher education in Cybersecurity:
  - Funding used to:
    - Hire staff (Cybersecurity professors, scientists, student assistants),
    - Collaboration with academia abroad (e.g. invite guest scholars),
    - Procure hardware needed for research and education,
    - Also used as co-funding for the 50% funding scheme of NCC-IS.

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M.Sc. Cybersecurity specialisation / emphasis

- **April 2023:**
  - First students enrolled in the Cybersecurity specialisation / emphasis that has been added to the existing Computer Science M.Sc. programmes (120 ECTS) at RU and UoI.

- **August 2023:**
  - Teaching started with first students.

- **Taught in English to attract as many students as possible.**

- **Includes Artificial Intelligence:**
  - Lack of workforce requires AI for defence,
  - attacks get more and more AI-based.

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Joint M.Sc. Cybersecurity specialisation / emphasis

- **Students enrol in the Computer Science M.Sc. programme at the university of their choice.**

    - Take "normal" M.Sc. Computer Science programme courses + mandatory courses specific to Cybersecurity.

    - Can take Cybersecurity courses from the other university as well.
        - Tuition fees of the other university are waived.
        - Semester at RU is 1-2 weeks later than at UoI, but no problem so far.

    - Additional courses imported from abroad.
        - E.g.: from Norwegian University of Science and Technology (NTNU Trondheim/Gjøvik) or together with Aalto University, Finland.

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Example courses

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- **Introduction to Information Security**
  - E.g.: ISO/IEC 27001,
  - Taught by external teachers from Industry.

- **Fundamentals of Ethical Hacking**
  - Attacker perspective security analysis.

- **Computer Security: Defence against the Dark Arts**
  - Methods for active and passive defence.

- **Secure Software Engineering**
  - Design, develop, and maintain an application following secure software engineering principles.

- **Applied Cryptography**
  - Practical approach to building and breaking of cryptographic implementations.

- **Quantum cryptography**
  - Quantum computing and quantum cryptography.

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Example courses (continued)

- **Foundations of the Internet**
  - Lower networks layers (below TCP/IP).
  - From Electrical Engineering department.

- **Network Measurements and Analysis**
  - TCP/IP measurements and advanced data analysis, e.g. for anomaly detection.
  - Taught together with Aalto University, Finland.

- **Machine Learning in Cyber Security**
  - Using AI for defense, but also how AI is used for attacks.

- **Privacy and Data Protection Law**
  - From Law department.

- **Internship in Cybersecurity**
  - Starting in 2nd year.

Example courses (continued)

- **The Governance of the Internet**
  - Overview of relevant ethical and social issues surrounding technology.
  - Addresses key internet and Cybersecurity governance issues and laws, such as NIS2 and GDPR.

- **Reverse Engineering and Malware Analysis**
  - Taught by visiting scholar from NTNU/major in the Norwegian Army Cyber Security Division.

- **Security Engineering for Critical Information Infrastructures**
  - Taught by Fulbright visiting scholar.

- **Cyber Conflicts, Cyber Security Threats and Engineering, National Information Infrastructures**
  - Taught by Fulbright visiting scholar.

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Example Course catalogue

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Specialisation: Cyber Security (Courses in 2024-2025)

Year of study unspecified

Fall	Spring
Ⓢ TÖL029M Introduction to Information Security 🇬🇧 ♀ 6e	Ⓢ TÖL213M Applied Cryptography 🚩 🏴 🇬🇧 ♀ 6e
Ⓢ TÖL104M Network Measurements and Analysis 🚩 🏴 🇬🇧 ♀ 6e	Ⓢ TÖL204F Seminar for MS-Students 🇳🇴 ♀ 2e
Ⓢ TÖL431L Final project 🇮🇸🇬🇧 ⚓ 30e ◔	Ⓢ TÖL431L Final project 🇮🇸🇬🇧 ⚓ 30e ◔
Ⓥ TÖL113F Quantum Cryptography 🚩 🇬🇧 ⊘ ♀ 6e	Ⓢ TÖL212F Governance of the Internet 🇬🇧 ♀ 6e
Ⓥ IÐN113F Time Series Analysis 🏴 🇬🇧 ⊘ 🌐 ⚓ 7,5e	Ⓥ RAF617M Fundaments of the Internet 🇳🇴 ♀ 6e
Ⓥ REI503M Performance analysis of computer systems 🚩 🚩 🇬🇧 ♀ ⚠ 6e	Ⓥ HBV205M Software Testing 🚩 🏴 🇬🇧 ♀ ⚠ 6e
Ⓥ REI504M Cloud Computing and Big Data 🏴 🇬🇧 ♀ 6e	Ⓥ LÖG283F Privacy and Data Protection Law 📅 🏴 🇳🇴 ⊘ ♀ 6e
Ⓥ REI505M Machine Learning 🚩 🚩 🇬🇧 ♀ 6e	Ⓥ RAF620M Introduction to machine learning and artificial intelligence 🚩 🇳🇴 ♀ 6e
Ⓥ TÖL022F Internship in Cybersecurity 🇬🇧 ♀ 6e	Ⓥ TÖL022F Internship in Cybersecurity 🇬🇧 ♀ 6e
Ⓥ TÖL103M Programming Projects on Internet of Things 🚩 🇬🇧 ♀ 6e	Ⓥ TÖL213M Applied Cryptography 🚩 🏴 🇬🇧 ♀ 6e
Ⓥ TÖL503M Distributed Systems 🚩 🚩 🇬🇧 ♀ ⚠ 6e	Ⓥ TÖL605M Fundamentals of Ethical Hacking 🚩 🇬🇧 ♀ 4e
Ⓥ TÖL506M Introduction to deep neural networks 🚩 🇮🇸 ♀ 6e	
Ⓥ VON001F Thesis skills: project management, writing skills and presentation 🇬🇧 ♀ 💻 4e	

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Student numbers

- Between 11 and 44 students attending these Cybersecurity courses.

- Some courses have a 50% RU and 50% UoI student share.

- Other Cybersecurity courses have an attendance that is more biased towards students where that course has its home.

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Synergies with Fulbright visiting scholars

Synergies with NCC-IS

Outlook

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- Funding from ministry for the first two years only.
  - Future funding is unclear.

- Working on offering more programmes, e.g.
  - M.Sc. in Cybersecurity (autumn 2025?),
  - Cybersecurity specialisations/emphasis for further programmes:
    - e.g. just added it to existing Software Engineering M.Sc. programme at UoI.

- Application deadlines:
  - UoI: 15th of April · https://www.hi.is
  - RU: 30th of April · https://www.ru.is
    - Computer Science/Software Engineering M.Sc. students already enrolled in another specialisation/emphasis, can change into the Cybersecurity specialisation/emphasis.

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UoI-RU Cybersecurity collaboration

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- Arnar Gunnarsson (arnarig at ru is)

- Ásta Guðrún Helgadóttir (astagh at hi is)

- Esa Hyytiä (esa at hi is)

- Hans P. Reiser (hansr at ru is)

- Helmut Neukirchen (helmut at hi is)

- Horia Corcalciuc (horia at hi is)

- Jacky Mallett (jacky at ru is)

- Tom Welsh (tomwelsh at hi is)

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