CyberSchool: Development of the first *Ecole Universitaire de Recherche* in cybersecurity in France
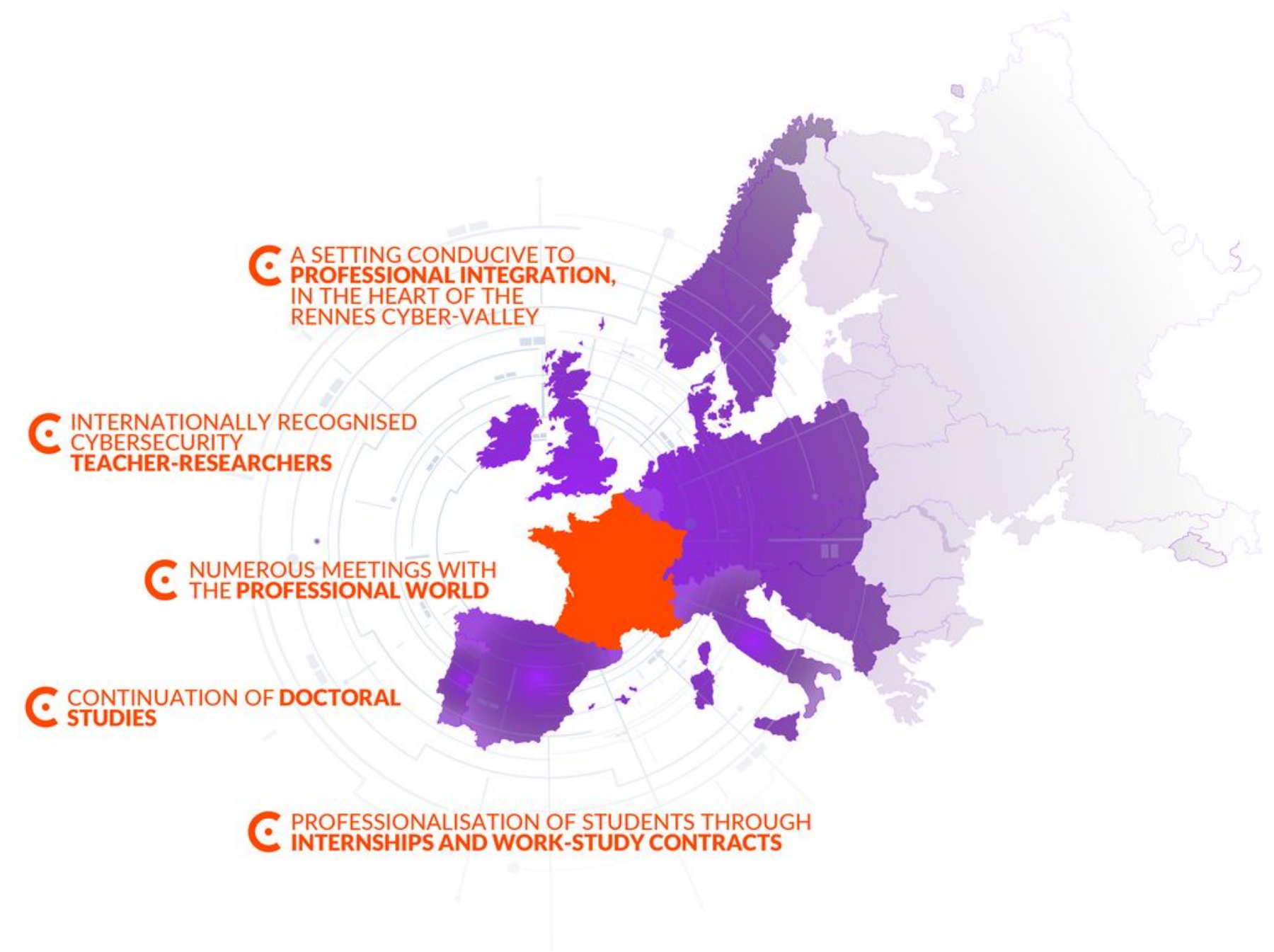
CYBERSCHOOL

Frédéric Renouard, Université de Rennes
Pierre-Alain Fouque, Université de Rennes
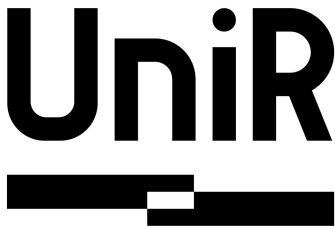RESSI – May 2022

What is CyberSchool ?
The Graduate Cybersecurity Research School

- CyberSchool is a winning project of the French *Investments d'Avenir* programme and is the only *Ecole Universitaire de Recherche* in cybersecurity in France

- CyberSchool offers innovative Master's and PhD programmes; Masters are research-based

- CyberSchool trains future specialists, engineers and scientists in cybersecurity

- The school fosters concrete synergies between an academic cursus, research and professional experience

- CyberSchool is based in Rennes, Beaulieu campus

A SETTING CONDUCIVE TO **PROFESSIONAL INTEGRATION,** IN THE HEART OF THE RENNES CYBER-VALLEY

INTERNATIONALLY RECOGNISED CYBERSECURITY **TEACHER-RESEARCHERS**

NUMEROUS MEETINGS WITH THE **PROFESSIONAL WORLD**

CONTINUATION OF **DOCTORAL STUDIES**

PROFESSIONALISATION OF STUDENTS THROUGH **INTERNSHIPS AND WORK-STUDY CONTRACTS**

Partners

Laboratories

UMR IRISA — Research and innovation in digital science and technology

CREST — Center for Research in Economics and Statistics

IRMAR — Research laboratory in Mathematics

IODE — West Institute: Law and Europe

IETR — INSTITUT D'ÉLECTRONIQUE ET DES TECHNOLOGIES DU NUMÉRIQUE — Electronics, telecommunications, and digital technologies

EUR CYBERSCHOOL
Main objectives

Increase the number of Master and Doctoral degree graduates in cybersecurity
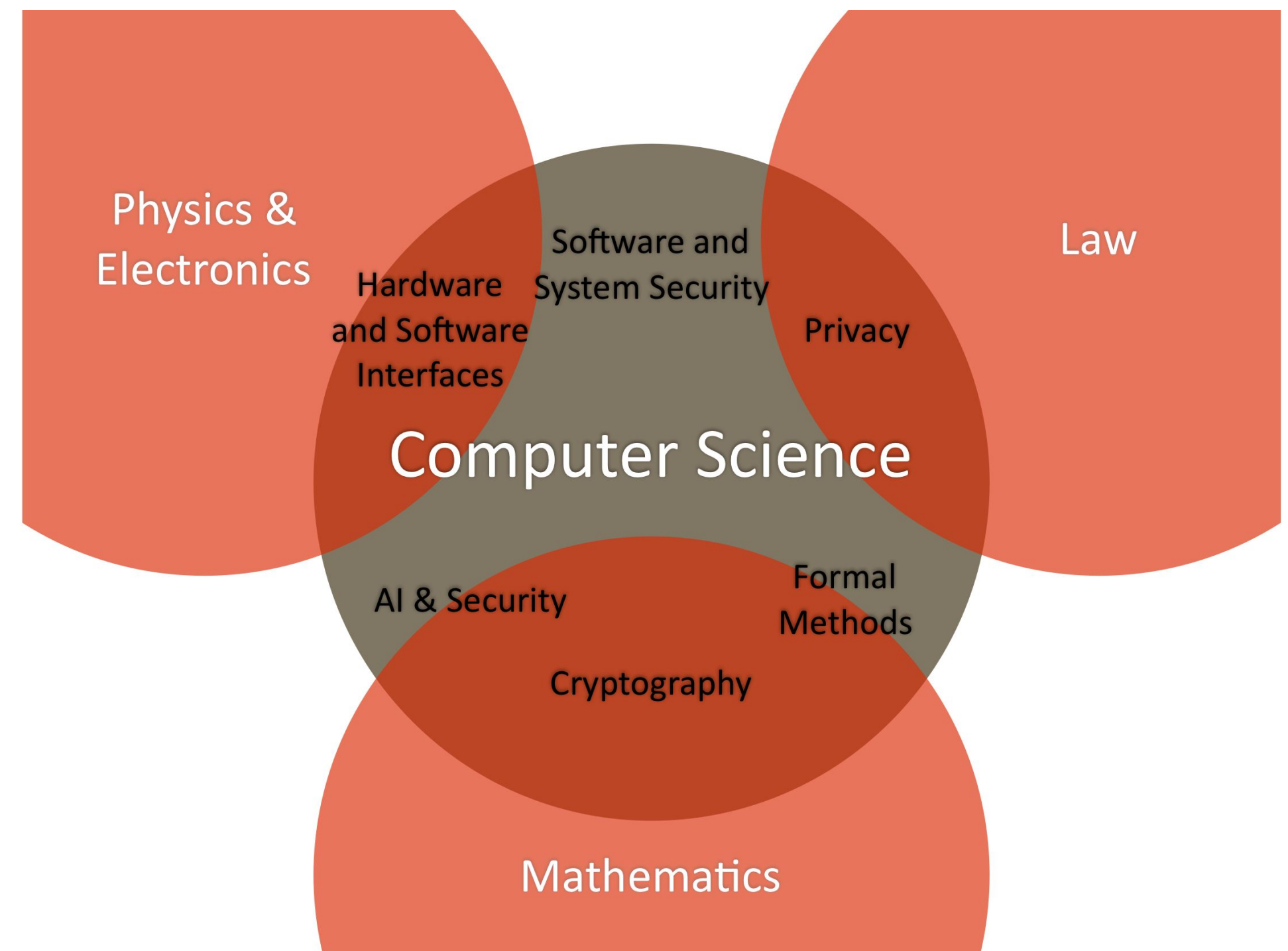
Double the number of master-level students

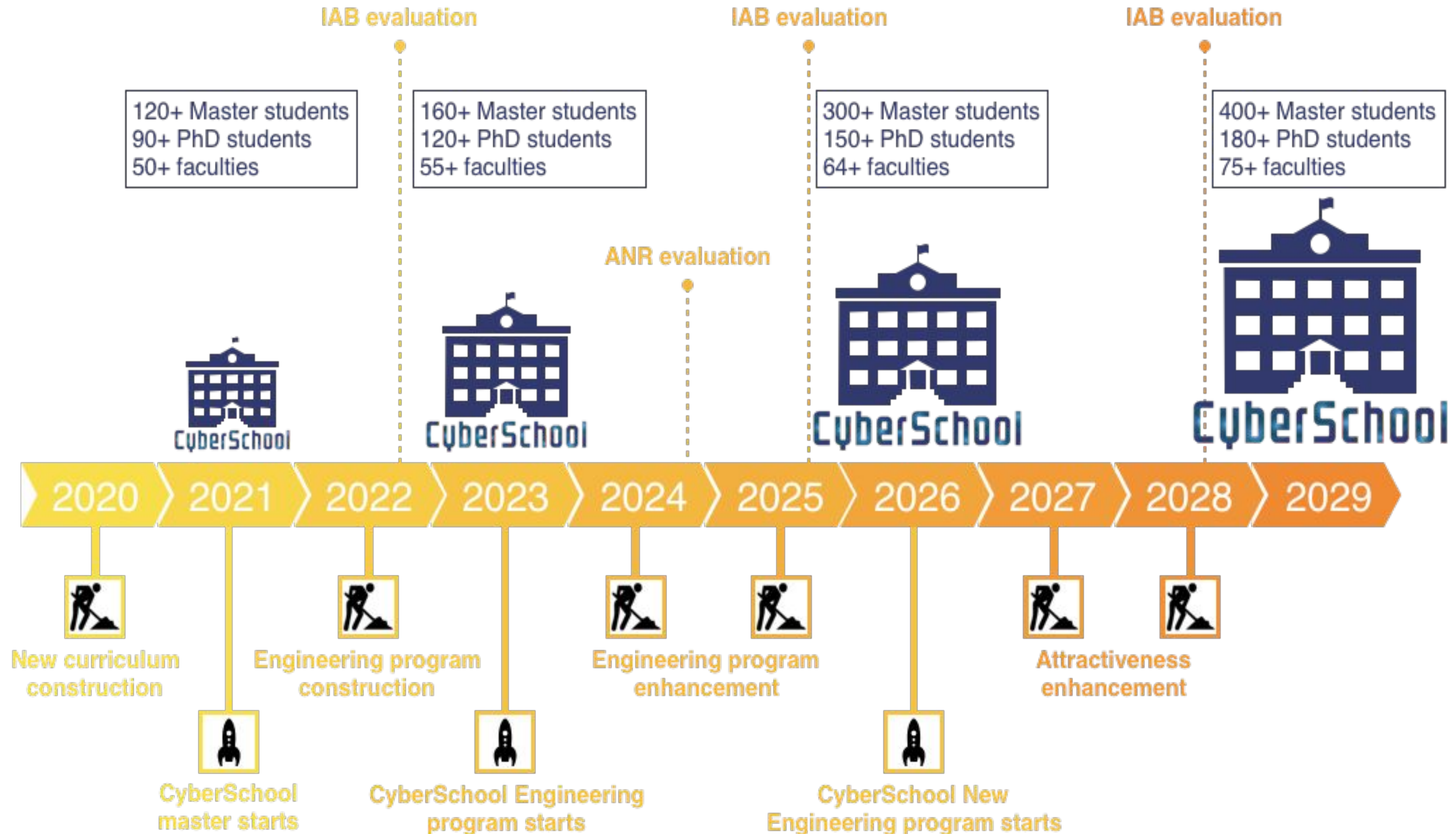**Offer a research-based education**

Train experts to strengthen the innovation capacity of companies in specialised areas of cybersecurity

Provide education by specialists covering key areas of cybersecurity

Integrate students into academic and industrial research laboratories

Physics & Electronics

Law

Software and System Security

Hardware and Software Interfaces

Privacy

Computer Science

AI & Security

Formal Methods

Cryptography

Mathematics

A roadmap for growth

IAB evaluation

120+ Master students
90+ PhD students
50+ faculties

160+ Master students
120+ PhD students
55+ faculties

IAB evaluation

300+ Master students
150+ PhD students
64+ faculties

IAB evaluation

400+ Master students
180+ PhD students
75+ faculties

ANR evaluation

CyberSchool

CyberSchool

CyberSchool

CyberSchool

2020 2021 2022 2023 2024 2025 2026 2027 2028 2029

New curriculum
construction

Engineering program
construction

Engineering program
enhancement

Attractiveness
enhancement

CyberSchool
master starts

CyberSchool Engineering
program starts

CyberSchool New
Engineering program starts
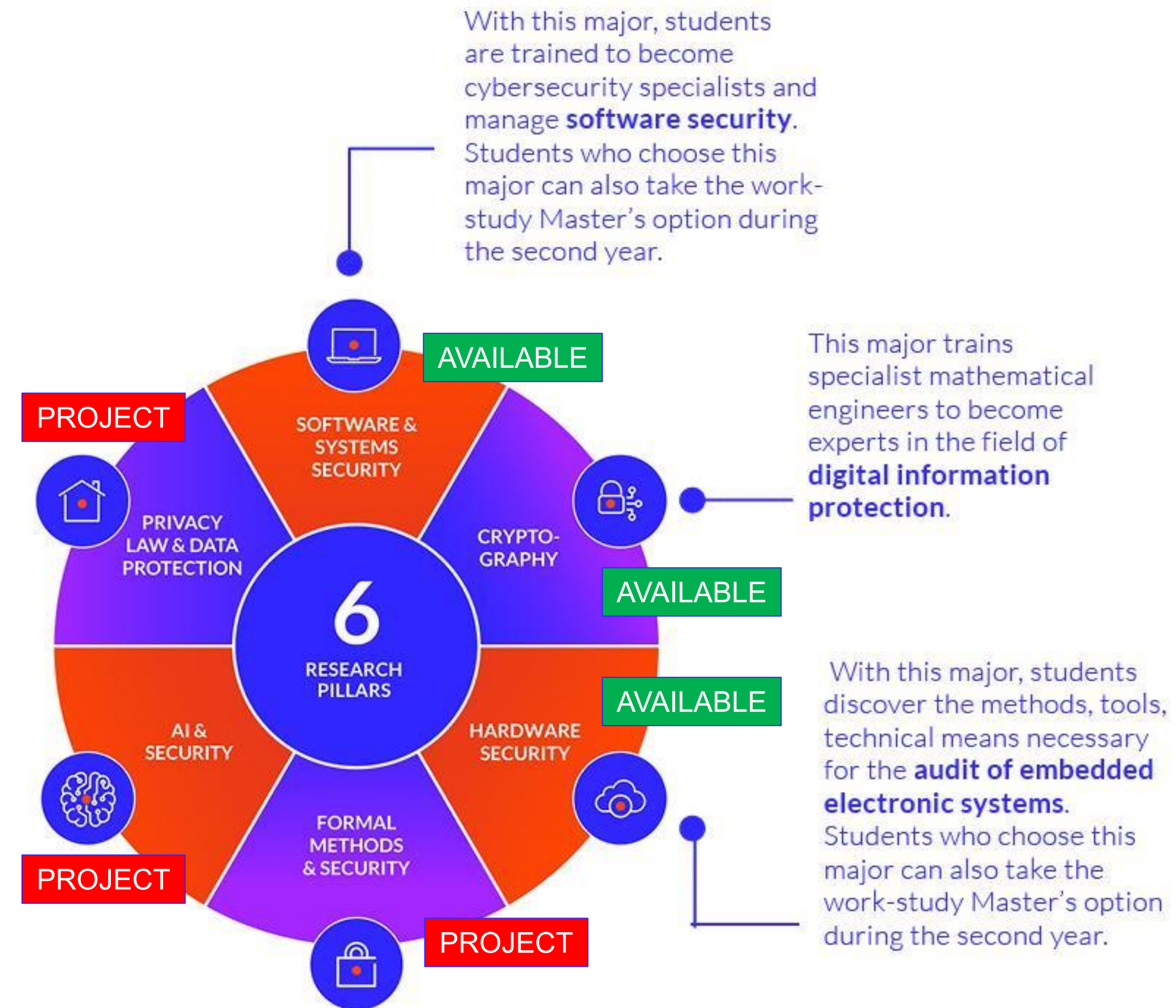
6

EUR CYBERSCHOOL
6 research pillars

MASTER
Programs

To master the cybersecurity threats and anticipate new ones

To promote efficient protecting measures and techniques made by researchers for the industry
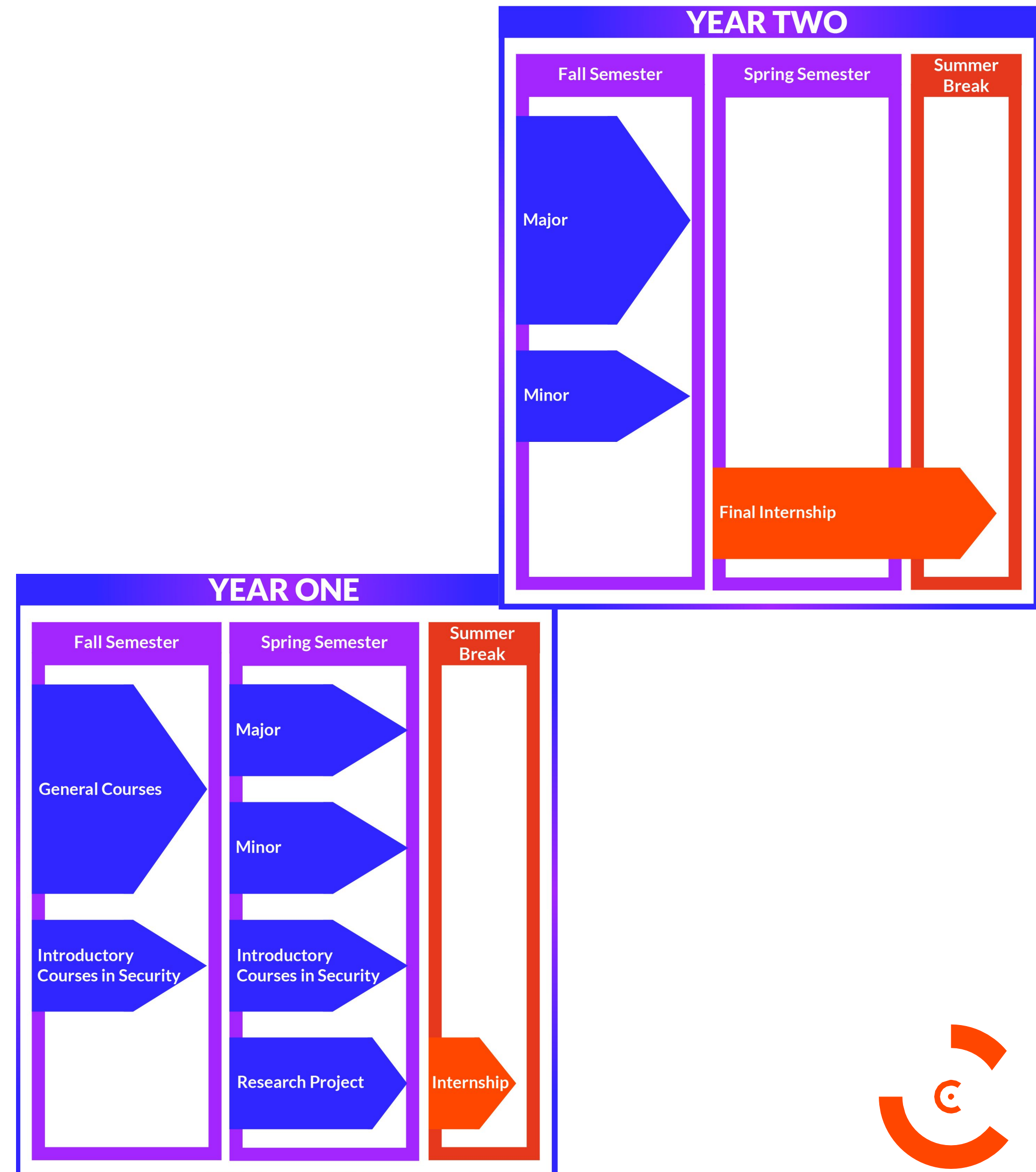
To train a young generation of researchers in cybersecurity

With this major, students are trained to become cybersecurity specialists and manage **software security**. Students who choose this major can also take the work-study Master's option during the second year.

This major trains specialist mathematical engineers to become experts in the field of **digital information protection**.

With this major, students discover the methods, tools, technical means necessary for the **audit of embedded electronic systems**. Students who choose this major can also take the work-study Master's option during the second year.

AVAILABLE

PROJECT

SOFTWARE & SYSTEMS SECURITY

PRIVACY LAW & DATA PROTECTION

CRYPTO-GRAPHY

6 RESEARCH PILLARS

AVAILABLE

AI & SECURITY

HARDWARE SECURITY

AVAILABLE

FORMAL METHODS & SECURITY

PROJECT

PROJECT

MASTER
Programs

Curriculum includes:

- A **common core** in cybersecurity
- A **major** and a **minor**, from the 6 research pillars
- A **research project** in the first year (second semester)
- One or two **internships** in a security team in a laboratory (academic or company) or in a company
- Meetings with the professional world
- Work-study option for some majors (second year)

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YEAR TWO

Fall Semester	Spring Semester	Summer Break
Major		
Minor		
	Final Internship	

YEAR ONE

Fall Semester	Spring Semester	Summer Break
General Courses	Major	
	Minor	
Introductory Courses in Security	Introductory Courses in Security	
	Research Project	Internship

SEMESTER 1 & SEMESTER 2		
Courses common to all majors		
Unix Refresher, Maths Refresher		
Network security		
Low level programming		
Research project		
English		
Internship (optional)		
Cryptography	**Software & System Security**	**Hardware Security**
Machine learning	System security	
Algèbre générale de base	Introduction to security	
Algorithmique de base	Algorithms and complexity	
Probabilités pour la théorie de l'information	Maths for security	
Réussir son insertion professionnelle	Embedded systems	Embedded systems
Codes correcteurs d'erreur	Software exploitation	Software exploitation
Complexité	Software security	
Cryptographie	Privacy	
	Machine learning	
	Software fundations	
	Operating system kernels	
	Rust programming	

Compulsory   Electives: *3 among 7*

SEMESTER 3 & SEMESTER 4
Cryptography
Courbes elliptiques pour la cryptographie
Réseaux euclidiens en cryptographie
Programmation 1
Secured implementations for cryptography
Advanced Network Security
Réussir son insertion professionnelle
Théorie algorithmique des nombres pour la cryptographie
Cryptographie quantique
Codes correcteurs en cryptographie
Internship
English
Security challenges
Security proof
Protocoles de sécurité
C++, programmation objet et C++, Base
Blockchain
Cryptanalysis
Sécurité des donnéees pour la propriété intellectuelle et la vie privée
Programmation parallèle sur GPU

SEMESTER 3 & SEMESTER 4	
Software & System Security	**Hardware Security**
Security policies and Pentest	
Advanced cryptography	
Data protection and Cybersecurity law fundamentals	
English	
Operating system security	Secured implementations for cryptography
Security challenges	Advanced hardware protection
Advanced network security	Interception of Non-Protocol Radio Signals
Work-study	
Network administration	
Crisis management	
Web application security	
Intrusion detection systems	
Cybersecurity for the company	
Chief information security officer	
Work-study	
Work-study follow up	
Classic	
Security proof	
Cryptanalysis	
Blockchain	
Intrusion detection systems	
Network administration	
Web application security	
Research project	
Réussir son insertion professionnelle	
Internship	

Compulsory

Electives:
- *Cryptography: 3 among 8*
- *Software & System Security: 4 among 6*
- *Hardware Security: 4 among 6*

Courses specific to the majors

INSTITUTIONAL COOPERATION

Co-accredited master's degree

- The CyberSchool Master will soon be co-accredited by several of the CyberSchool partner institutions (engineering schools)
- Students will continue to be enlisted in their own institution
- Students having successfully followed a CyberSchool track will receive
  - The diploma of their own institution and initial curriculum
  - The CyberSchool master's degree

PEDAGOGICAL COOPERATION

- Leveraging a unique network of teachers and researchers from 10 academic partners to pool resources / innovate in education in cybersecurity

- Pedagogical cooperation: practices-sharing, co-design, co-development, co-delivery, continuous improvement, innovation in education, training-the-trainers, diffusion

Teachers Community of Practice in cybersecurity

Shared and open course catalog

Shared pedagogical resources

Shared pedagogical equipments

Shared conferences

Coope-ration support

CYBERSCHOOL DOCTORAL TRACK

CyberSchool doctoral track
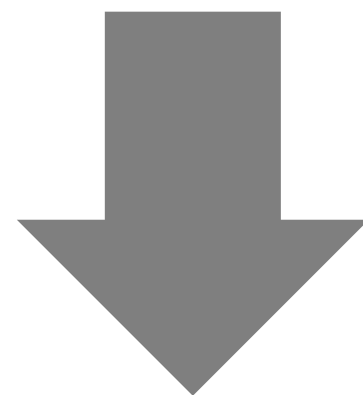
PRO NETWORK

EDUCATION

RESEARCH

CyberSchool doctoral label

- Instruments accessible "à la carte"
- For all doctoral students in the cybersecurity area
- A way to meet obligations set by Doctoral Schools

- To enrich their thesis experience
  - Cybersecurity/transversal skills and competencies, companies and ecosystem, international

- A label attesting to the acquisition of valuable skills whatever the career (academic, industry)
- Flexible acquisition method based on a 'points system' (no compulsory activity)

CYBERSCHOOL
A 'talents factory' for research

- A research-oriented master's degree
- Training in and through research
- Strong marketing / visibility actions

- High added-value doctoral track in Cybersecurity

- Visibility of on-site Cybersecurity Research
- Increased connectivity with businesses

MASTER → **DOCTORAL** → **RESEARCH**

- Increase the incoming flow of students
- Increase the quality of recruitment

- Increase the incoming flow of students applying for a thesis
- Increase the attractiveness of the territory for candidates for a thesis

- Increase the visibility of the site's cybersecurity research activities
- Provide an attractive environment for current or new researchers
- Further increase the research themes coverage on the site

INTERNATIONAL COOPERATION

Through **networks** and **bilateral cooperation**

EIT Digital

- European double-degree program in cybersecurity

EDUC Alliance

- Pedag. cooperation, teachers exchanges, seminars
- Virtual mobility courses, internships
- Joint programs
- ...

Thanks

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Our partners

MINISTÈRE DES ARMÉES · DGA · Région BRETAGNE · METROPOLE Rennes

Any questions?

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**CyberSchool - Ecole Universitaire
de Recherche en cybersécurité**