UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Barcelona School of Informatics

FIB

# FIB Masters

## Master in Innovation and Research In Informatics (MIRI)


**fib.info.masters@upc.edu**

**Oscar Romero**
Vice dean of Postgraduate Studies

# FIB Excellence


## Academic Excellence

## Research and innovation

56 Research groups
Research grants & internships
Research courses

## Internship Opportunities

959 internship agreements
>3 million Euro

## Mobility and Internationalisation

## Services & Social Life

Equal opportunities
Inclusion
Solidarity & cooperation
Cultural reception
Student associations

# Barcelona School of Informatics

The leading center for Computer Science studies.


# Top 10

## Computer Science Schools in Europe

Equipped with the right resources, expert teaching staff, and years of experience, we offer a diverse array of high-value courses

Social impact: our graduates are top-tier professionals, in high demand by organizations driven by innovation and growth

A pioneering school in higher education that has spearheaded Catalonia's progress in this field

## Leading the way since

# 1977

The FIB has been a benchmark centre since its inception in and the launch of its academic programmes in the 1976-1977 academic year

50 years of excellence in Bachelor's, Engineering, and Master's studies

As part of the UPC, we are responsible for the official degree programmes in Computer Engineering

# Barcelona School of Informatics

The leading center for Computer Science studies.

For more details, please visit our dedicated website: https://www.fib.upc.edu/en/masters/master-innovation-and-research-informatics, where you will find videos and slides from our general information session, as well as more detailed information about the school.

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# Master in Innovation and Research in Informatics

This master offers a strong and rigorous background in research and innovation in 4 fields of informatics:

Advanced Computing (AC),
Computer Graphics and Virtual Reality (CGVR),
Computer Networks and Distributed Systems (CNDS),
High-Performance Computing (HPC).

Accreditations: EQUAINE, AQU-Excellence

Language: English (B2)

120 ECTS: 2 years

- 30 Common compulsory
- 48 Specialisation (4 specialisations)
- 12 Electives
- 30 Master thesis

4 Specialisations: AC, CGVR, CNDS and HPC

- https://www.fib.upc.edu/en/masters/master-innovation-and-research-informatics/curriculum

Industrial Agreements – Curricular Internships, Professional Experience (elective ECTS)

Complementary courses might be required

# Advanced Computing

**Advanced Computing approaches complex computational problems from both theoretical and practical angles:**

- Understand the **limitations** of computational problems.
- Use these insights to provide **novel** and **efficient** algorithmic solutions.
- Acquire **analytical** tools and **skills** to understand the **fundamental principles** of computing.
- Develop problem-solving skills to build **cutting edge** solutions through the understanding and the interplay between theory and practice.

## Applications

- Intelligent systems
- Social networks
- Machine learning and data mining
- Human language processing
- Cloud and web technologies
- Algorithmics
- Game theory
- VLSI design

# Opportunities

## Participation with research groups

- ALBCOM: Algorithms, Computational Biology, Complexity and Formal Methods
- TALP: Center for Language and Speech Technologies and Applications
- LOGPROG: Logic and Programming
- LARCA: Relational Algorithmics, Complexity and Learning Laboratory

## Professional opportunities

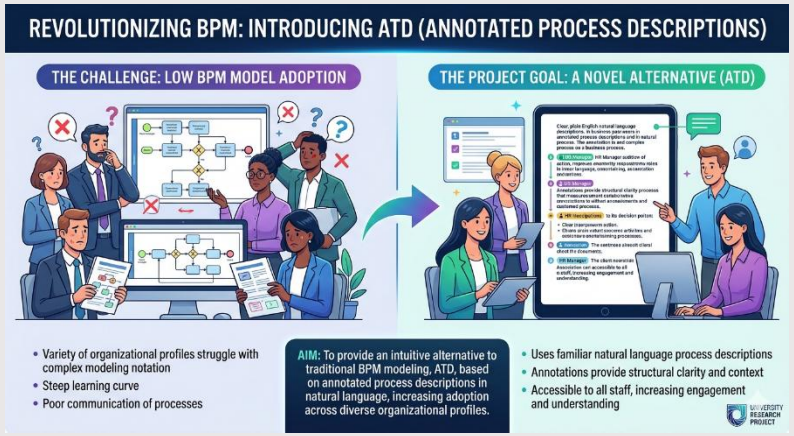
- Academy: local and international universities
- Big tech companies: Google, Amazon, ...
- CAD Companies: Qualitech, Marvell, SemiDynamics, Mentor Graphics, …
- Data Science: Planeta, Factorial HR, Quida, …

# Exemplary Master Thesis

## Model-Agnostic Process Modeling

Josep Sànchez-Ferreres

*Modeling techniques in Business Process Management often suffer from low adoption due to the variety of profiles found in organizations. This project aims to provide a novel alternative to BPM documentation, ATD, based on annotated process descriptions in natural language.*



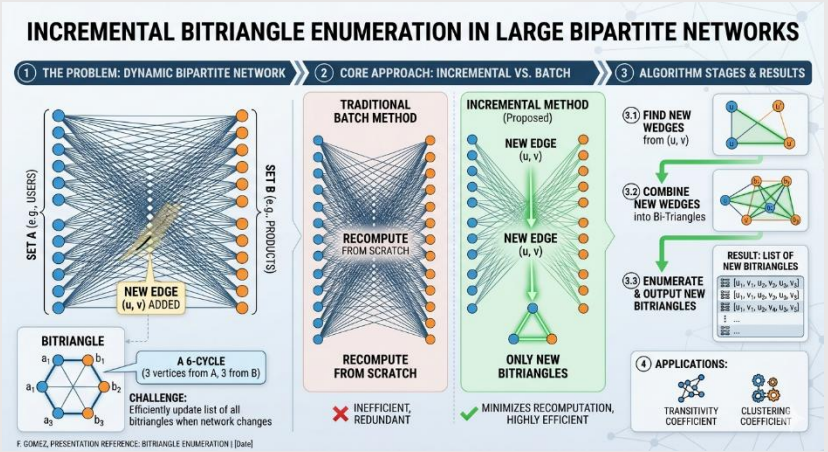

## An Algorithm for Incrementally Enumerating Bitriangles in Large Bipartite Networks

Juan Pablo Royo Sales

*This work tackles the problem of providing an algorithm for incrementally enumerating bitriangles in large bipartite networks.*

Further outcomes:

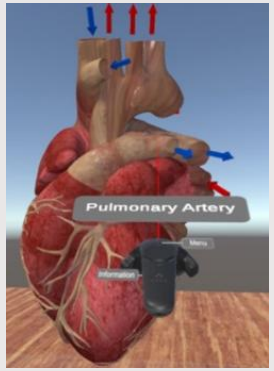
- Publications: PROLE2021
- Software: Dynamic Pipeline Framework
- https://hackage.haskell.org/package/dynamic-pipeline
- https://github.com/jproyo/upc-miri-tfm/tree/main/bt-graph-dp



# Computer Graphics and Virtual Reality

## State-of-the-art computer graphics

- Design efficient algorithms and solutions for real-life problems (education, medicine, architecture, cultural heritage, urban design, animation).
- Virtual Reality: building VR applications for HMDs and 3D large screens (Powerwall). Hands on experience with 3D interaction and navigation.

# Opportunities


## Participate in research projects

- by taking SIRI credits
- working as an intern at ViRVIG
- Master thesis with us or our international collaborators
- Co-authoring research papers
- Attend the ViRVIG seminar and other online conferences

## Topics

- Advanced 3D graphics
- Procedural modeling
- Real-time rendering
- Immersive interaction
- Geometry processing
- Virtual and Augmented Reality
- Computer Animation and Simulation
- Physically-based animation & rendering
- Modeling complex systems
- Visualization of complex n-dimensional information

# Exemplary Master Thesis

***A WebXR-based plattform for mixed geometry-based and image-based exploration of cultural heritage models***

Arnau Farràs

Eurographics Workshop on Graphics and Cultural Heritage 2021

***Visualization of ensembles of molecular simulation trajectories***

David Duran

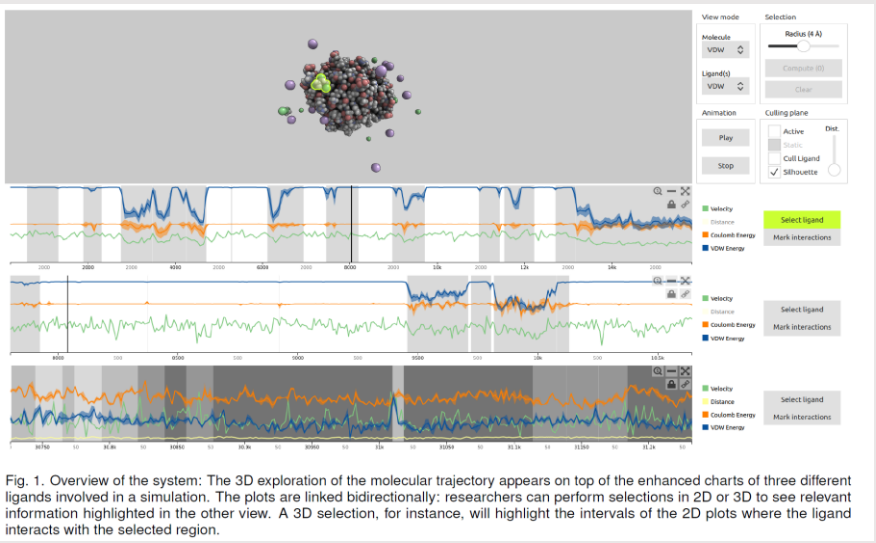


Fig. 1. Overview of the system: The 3D exploration of the molecular trajectory appears on top of the enhanced charts of three different ligands involved in a simulation. The plots are linked bidirectionally: researchers can perform selections in 2D or 3D to see relevant information highlighted in the other view. A 3D selection, for instance, will highlight the intervals of the 2D plots where the ligand interacts with the selected region.

IEEE Transactions on Visualization and Computer Graphics 2019

# Computer Networks and Distributed Systems

## Computer Networks

It is a set of devices that allows us to move data across nodes, including documents, sensor data, content sharing, audio, video, etc. They provide a fast a reliable way to share information and resources within business. Examples: Internet, mobile networks, cellular networks, sensor networks, optical networks, nano-networks, etc.

Topics covered

- Trends in the evolution of network architectures
- Routing and inter-networking
- Transport networks (backbone)
- New network and transport protocols
- Resource management
- 5G network architecture
- Software defined networks (SDN)
- Next generation Internet
- Energy oriented Internet
- New networking paradigms (nano-networks, graphene, miniaturizes wireless comm)
- Data centres and clouds
- Security in applications including blockchain and quantum security
- multimedia content transmission

## Distributed Systems

DS is a computing environment in which various components are spread across multiple computers (or other computing devices) on a network. These devices split up the work, coordinating their efforts to complete the job more efficiently than if a single device had been responsible for the task. DS provide scalability, reliability, efficiency and a better performance. Applications: WWW, P2P systems, network file systems, wireless sensor networks, distributed cache systems, distributed databases, blockchains, infrastructures for big data, etc.

Topics covered

- Cloud computing fundamentals (models for large scale systems, middelware, content distribution, virtualization, etc)
- Cloud service providers (such as AWS, Google AppEngine, Open Stack, OpenNebula
- IoT systems: sensor networks
- Big data analytics in the cloud
- ML and DL techniques to improve data quality
- P2P networks and overlay networks. Routing
- Publish/subscribe, group communication, self-properties, incentives, management, resource allocation, security and anonymity, characterization and evaluation
- Content and media distribution, storage, file sharing, communication, computing, social networks

# Opportunities

## Participation with research groups

- Statistical Analysis of Network and Systems (SANS): http://sans.ac.upc.edu
  - IoT, wireless sensor calibration, machine learning, deep learning, human mobility patterns characterization, smart cities, …
- Distributed Systems Group (DSG): http://dsg.ac.upc.edu
  - cloud computing, community networks, descentralized systems, resource management through virtualization, …
- VIRTOUS: https://virtuos.site.ac.upc.edu
  - Virtualization and cloud computing, …
- Broadband Communication Systems: https://cba.upc.edu
  - Optical networks, traffic monitoring and analysis, nanonetworking communications, networks –on-chip, green networking networks architectures, low-energy networks, cybersecurity, …
- High Performance Computing:
  - management of Software Defined Infrastructures, IoT stream processing platforms, automated characterization of cost-effectiveness of Big Data deployments, Build hardware prototypes for accelerating data-centric workloads, …
  - Deep Learning, Machine Learning & Artificial Intelligence, …

# Exemplary Master Thesis

## Fog - Applying blockchain to secure a distributed set of clusters

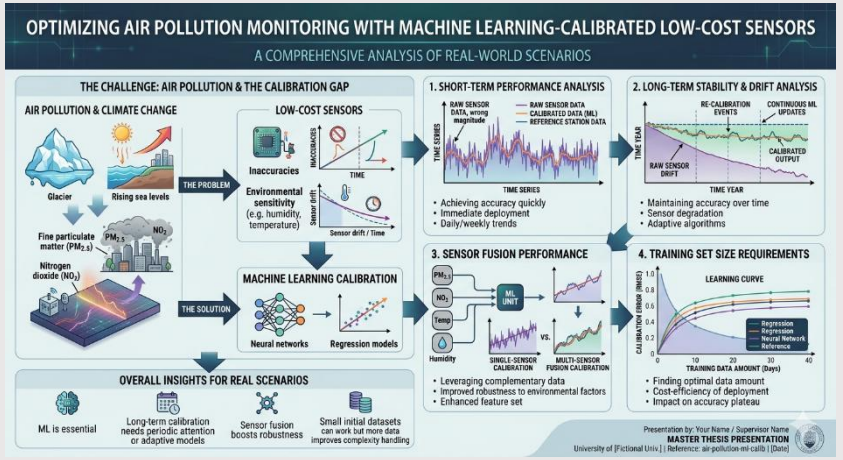
Pau Marcer Albareda

*Abstract: we can affirm that we are moving towards a world where everything will be connected (i.e. our cars, our houses, our wearable devices). The current centralized security architectures do not scale well enough in order to be applied on the Fog. Those models such as Certificate Authorities (CA's) are centralized, usually on cloud providers, and offer a much more static security. Therefore, we require new and completely distributed security architectures, capable of being flexible and scalable, while at the same time providing fault proof security to the Fog.*

## Calibration of low-cost air pollutant sensors using machine learning techniques

Pau Ferrer Cid

*Nowadays concern about air pollution has risen due to the effects of the climate change. The application of machine learning methods for the calibration of low-cost sensors is studied. The short-term, long-term, sensor fusion and training set size needed are analysed considering real scenarios.*



# High Performance Computing

HPC is the foundation for scientific, industrial, and societal advancements.

It is through data that groundbreaking scientific discoveries are made, game-changing innovations are fueled, and quality of life is improved for billions of people around the globe.

Simulation, data storage and analysis, artificial intelligence (AI), and machine learning (ML) technology all demand growing compute power that can only be leveraged through HPC

HPC solutions are used for a variety of purposes across multiple industries. Examples include:

- **Research labs**. HPC is used to help scientists find sources of renewable energy, understand the evolution of our universe, predict and track storms, and create new materials.
- **Media and entertainment**. HPC is used to edit feature films, render mind-blowing special effects, and stream live events around the world.
- **Oil and gas**. HPC is used to accurately identify where to drill and to help boost.
- **Artificial intelligence and machine learning.** HPC is used to detect credit card fraud, provide self-guided technical support, teach self-driving vehicles, and improve cancer screening techniques.
- **Financial services**. HPC is used to track real-time stock trends and automate trading.
- It is used to **design** new products, **simulate** test scenarios, and make sure that parts are kept in stock so that production lines aren’t held up.
- It is used to help **develop cures** for diseases like diabetes and cancer and to enable faster, more accurate patient diagnosis.

**The European Union considers HPC a strategic investment priority. Yet there is a significant lack of professionals in the HPC domain, therefore formation in the field is becoming critical.**

# Opportunities

## Participation with research groups / centres

- ARCO group
- CAP group
- VIRTUOS group
- Barcelona Supercomputing Centre

## Professional opportunities

- Participate in the design of: future processors, supercomputers, mobile systems, robotic systems, control systems
- Develop supercomputer applications and/or Improve applications performance: Weather prediction, Crash-tests, Bio-informatics, Genomics, Machine Learning, …
- Improve performance on other areas: after all a smartphone is not that different from supercomputer.
- Develop/optimize application kernels.
- Develop tools/compilers.

**EU4HPC**:

https://eumaster4hpc.uni.lu/

# Exemplary Master Thesis

### Analysis and optimization of a debug post-silicon hardware architecture

Joel Sanchez Moreno

*The goal of this thesis is to analyze the post-silicon validation hardware infrastructure implemented on multicore systems taking as an example Esperanto Technologies SoC, which has thousands of RISC-V processors and targets specific software applications. Then, based on the conclusions of the analysis, the project proposes a new post-silicon debug architecture that can fit on any System on-Chip without depending on its target application or complexity and that optimizes the options available on the market for multicore systems.*

.

### Hardware-software co-design for low-cost AI processing in space processors

Marc Solé i Bonet

*In the recent years there has been an increasing interest in artificial intelligence (AI) and machine learning (ML). The advantages of such applications are widespread across many areas and have drawn the attention of different sectors, such as aerospace. However, these applications require much more performance than the one provided by space processors. In space the environment is not ideal for high-performance cutting-edge processors, due to radiation. For this reason, radiation hardened or radiation tolerant processors are required, which use older technologies and redundant logic, ...*

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# Research & Innovation

UPC, and FIB specifically, is a leading research institution.

- Top university obtaining Horizon Europe projects
- Start-ups, spin-offs, innovation and technology transfer

Our Research →

One strong aspect of our masters is that our teaching staff are also researchers with wide experience on the topics they teach.

- Belong to different departments and research group
- Have strong networks with researchers all over the world
- Seminars and Courses on Introduction to Research

Our research groups belong to 8 transversal departments.

- Mathematics (MA)
- Business Administration (OE)
- Computer Architecture (AC)
- Physics (FIS)
- Services and Information Systems Engineering (ESSI)
- Computer Science (CS)
- Statistics and Operational Research (EIO)
- Systems Engineering, Automatic Control and Industrial Informatics (ESAII)


BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Barcelona Supercomputing Centre

# Large flow of Master students


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# Internships

## Hour requirements

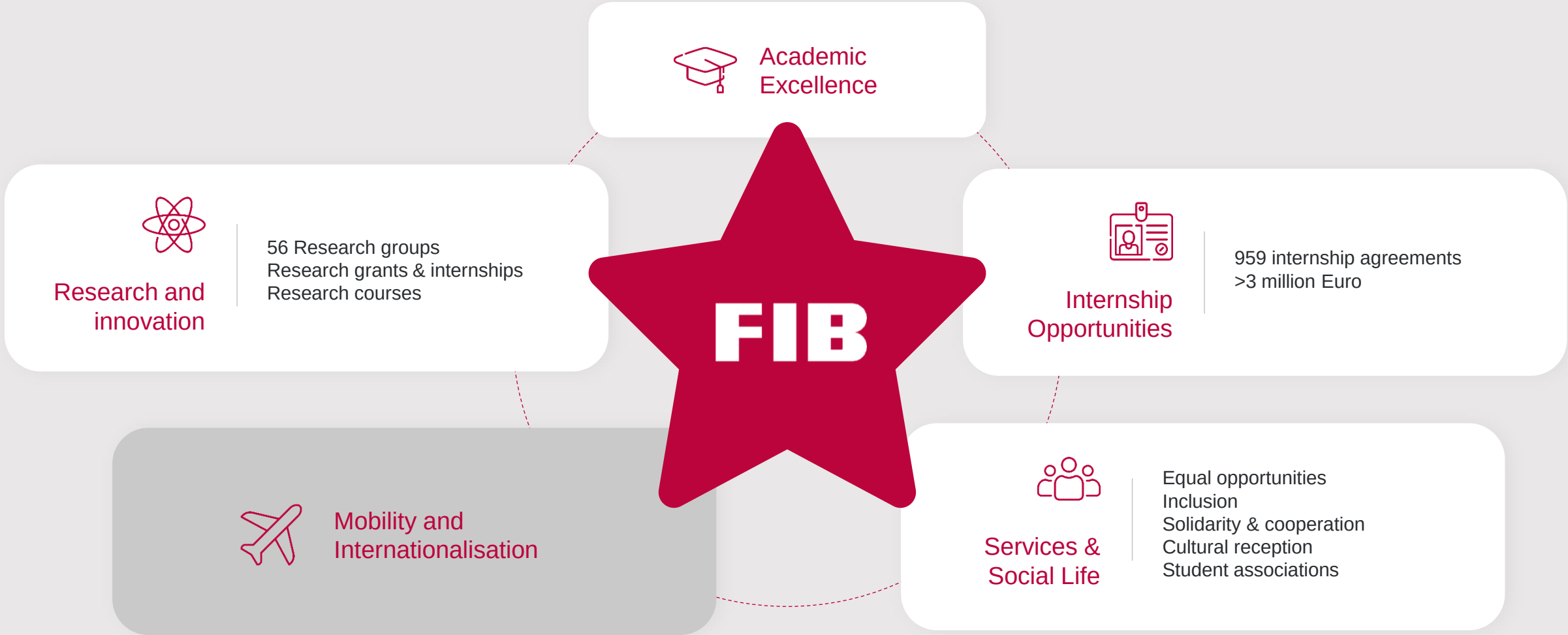
- Maximum per academic year: 1200 hours
- Master Thesis: 450 additional hours
- Company: minimum 11€ gross/hr
  maximum 20€ gross/hr
- UPC: 8€ gross / hr

## ECTS rate

- Elective ECTS (min 6, max 12) + Master Thesis ECTS
- Master Thesis (Mod B –company- or D –foreign company-)
- Professional Experience as elective ECTS (via work contract):
  - Previous or during the master
  - 1600 hours per 6 credit. Then, proportional

**30 hours = 1 ECTS**

# FIB Excellence



# MOBILITY and INTERNATIONALISATION

**138**

Universities

**43**

Countries

**4**

Double Degrees

>200 requests including bachelor and master students for 2024/2025

#fibersworldwide

# Politecnico di Torino

MIRI (1st year, 60 ECTS)

- All mandatory courses (common and specialization) + 6 ECTS of elective courses

Laurea Magistrale in Ingegneria Informatica (2nd year, 60 ECTS)

- If the student is following MIRI-HPC: Orientamiento Embedded Systems
- Otherwise, the student loses the MIRI specialisation and there gets: Orientamiento Software

# Grenoble INP – UGA Institute of Engineering and Management

MIRI (1st year, 60 ECTS)

- All mandatory courses (common and specialization) + 6 ECTS of elective courses

Grenoble INP – UGA

- 30 ECTS of courses + 30 ECTS of Master Thesis

Choose between two options:

Master of Science in Informatics at Grenoble (MoSIG)

Engineering specialization “Information Systems Engineering” (ISI)

# GeorgiaTech

MIRI (1st year, 60 ECTS)

- All mandatory courses (common and specialization) + 6 ECTS of elective courses

Master of Science in Computer Science (2nd year, 60 ECTS)

- First semester in Metz (GeorgiaTech Europe)
- Second semester in Atlanta

# Illinois Institute of Technology

MIRI (1st year, 60 ECTS)

- All mandatory courses (common and specialization) + 6 ECTS of elective courses

Illinois Tech, 2nd year- 2 semesters (August-May, 60 ECTS, coursework + research)

- Industrial Agreements – Curricular Internships, Professional Experience (elective ECTS)

# Procedure

## Interested in one of our masters? This is the procedure to follow.


Learn more
https://www.upc.edu/en/masters/access-admission-enrolment

# 2025/2026 Prices

**European Union (Resident) Applicants**

- MIRI: 19,37€ / ECTS

**Non-European Union (Resident) Applicants**

- MIRI: 45€ / ECTS

**Note:**
Prices for 2026/2027 will be published in July. Once published, UPC list the prices here:
https://www.upc.edu/en/masters/fees-grants

# Administrative and Academic Contacts

## General

**Information**
fib.info.masters@upc.edu

## Specific Academic Questions

MIRI-AC
**Amalia Duch**
amalia.duch@upc.edu

MIRI-CGVR
**Nuria Pelechano**
npelechano@cs.upc.edu

MIRI-CNDS
**José M. Barceló**
joseb@ac.upc.edu

MIRI-HPC, EU4HPC
**Josep Llosa**
josepll@ac.upc.edu

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# Services

## Equal Opportunities

- Bullying
- Gender Equality
- Transgender Community

Learn More →

## Inclusion

- Learning Needs
- Teaching Support
- Psychologic orientation

Learn More →

## Solidarity and Cooperation

Learn More →

## Learning Languages

Learn More →

## Cultural Reception

Learn More →

## Libraries

## Sports Club

## UPC Arts

Learn more
https://www.upc.edu/en/university-life-and-services

# University Life

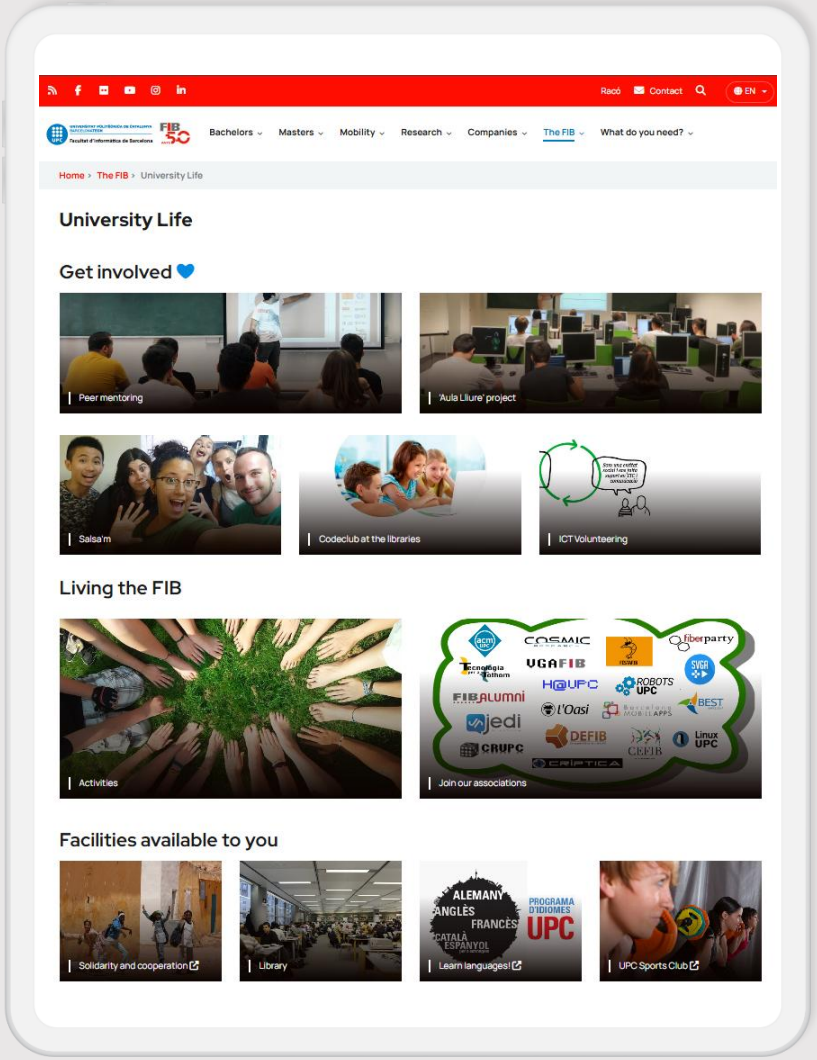






Learn more about
FIB promoted social activities

UGAFIB · Tecnologia per a Tothom · SVGA · Linux UPC · l'Oasi · fiberparty · jedi · hackers @UPC · FIBALUMNI · DEFIB · FIB Visiona · CRUPC · CRIPTICA · CEO · CEFIB · BEST BARCELONA · FESTAFIB



# FAQs

FAQ

## If I’m finishing my undergraduate studies this year, can I apply to a master?

Of course! You can be admitted. You only need to finish on time your registration in September. Indeed, if you finalize your bachelor thesis in October you can yet be admitted in our masters. Contact us for more details.

FAQ

## Can I work and study at the same time?

Of course! there are several opportunities to do extracurricular practices in companies that, in turn, may help you to obtain elective ECTS for some of our masters.

FAQ

## For new incoming students… what about enrolment?

Registration is online. If you require to hand in some documentation you can do it later, before the lectures start.

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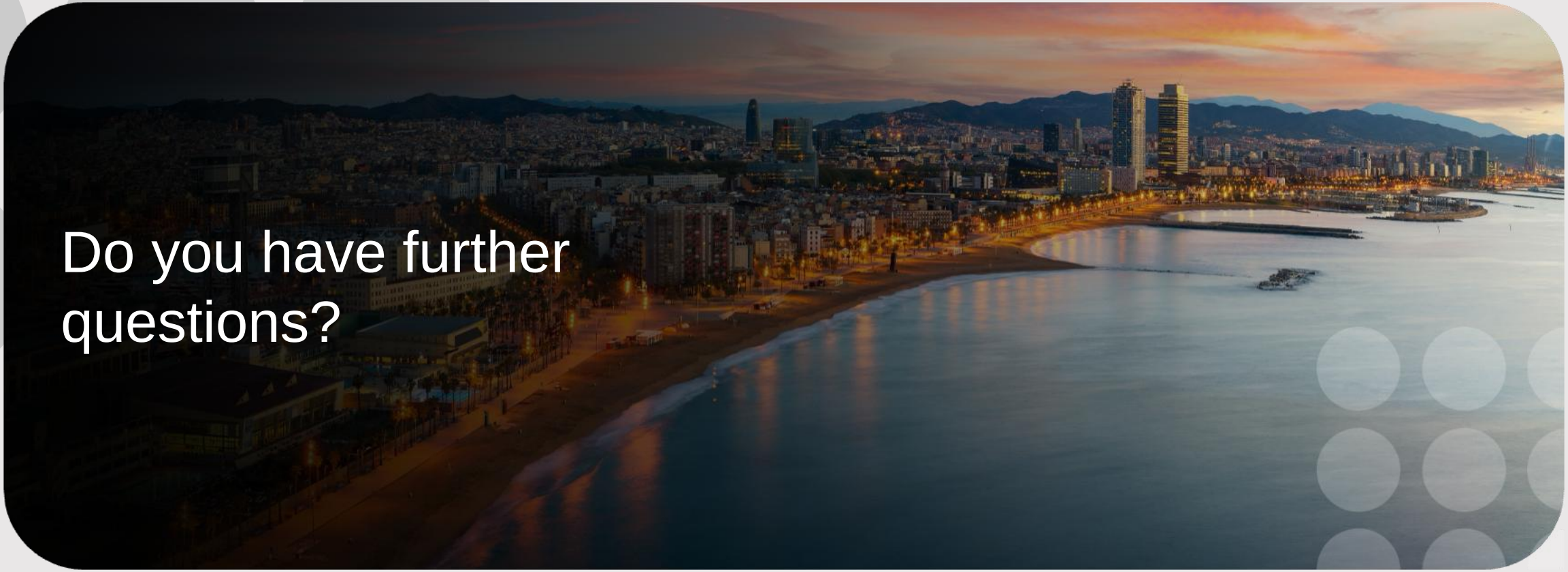

# Do you have further questions?

Do not hesitate to contact us at

fib.info.masters@upc.edu