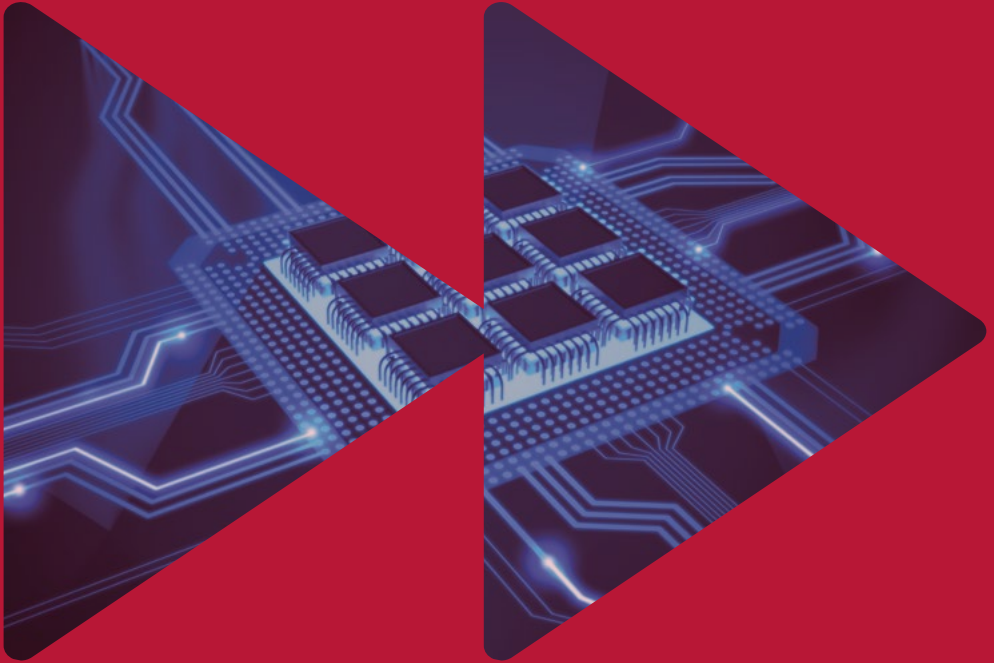




UNIVERSIDAD  
COMPLUTENSE  
MADRID



Inter-University Master's Degree  
School of Computer Science

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FORMAL METHODS IN  
COMPUTER SCIENCE

# UNIVERSITY MASTER'S DEGREE FORMAL METHODS IN COMPUTER SCIENCE

Field of Knowledge: Computer Science and Systems Engineering  
Responsible school: School of Computer Science (UCM)  
Partner universities: U. Politécnica de Madrid (UPM)

Orientation: academic  
Credits: 60 ECTS  
Duration: 1 course (2 semesters)  
Mode: in-person

<https://informatica.ucm.es/master-en-metodos-formales-en-ingenieria-informatica>

## AIMS

Software development is facing major challenges arising from its ubiquity in today's society: we rely on programs that control devices, vehicles, banking transactions, the stock market, medical devices, etc. Apart from cases resulting in loss of life due to software failures, they often cause widespread disruption to millions of people's lives. Nowadays, the only known method to ensure the correctness of software is to use so-called formal methods, which are broadly characterized by the mathematical modeling of the software, and the processes it performs, in order to prove that the desired requirements are met.

Graduate students from this master's degree are able to apply formal methods to rigorously build computer systems. The aim is to train highly qualified professionals who can successfully deal with the design of reliable systems that are not fault-tolerant, their correct deployment, and the evaluation or audit of third-party systems. Likewise, it also seeks to provide solid training for future researchers in the area of formal methods.

## APPLICANTS

The master is targeted to students with a bachelor degree in Computer Science, Computer Engineering, Software Engineering (or similar) as well as double degrees of such studies with Mathematics. In any case, the students that apply for this master should have a high interest in mathematics and, in particular, in logic and algebra. Due to this, the master is also targeted to students with a bachelor degree in Mathematics

with a specialization in Computer Science or with a solid background mainly in the area of computing. Since the master is taught entirely in English, students from non-English speaking countries are required to hold at least a B2 level (or equivalent) qualification.

## CAREER PROSPECTS

Students who complete the master's degree will be experts in formal methods capable of carrying out the development of computer systems with critical conditions of efficiency, security or reliability. The demand for this profile has grown significantly with the proliferation of technology-based companies which need to develop fully reliable computer systems that are resistant to external attacks. These organizations include large software companies or service providers -such as Microsoft, Facebook, Google, or Amazon-, companies in the area of blockchain technologies -such as Ethereum or Solana-, or in the implementation of autonomous systems (personal assistants, self-driving cars) or defense. Therefore, there is an increasing need for professionals who know the techniques and tools developed in the field of formal methods and who know how to apply them to solve real-world problems with high complexity or correctness guarantees. The growing demand combined with the lack of professionals of this profile generates great future opportunities for graduates of the master's degree.

Working as a researcher in academia or in research centres is of course another possible career path. Opportunities in the Madrid region include all of

the Universities in Madrid, the IMDEA Software Institute, the IMDEA Networks Institute, and some Institutes in the CSIC. Universities and research centres in other areas of Spain, such as CERCA and ICREA in Cataluña, or CIC and BERG in the Basque Country, also consider Computer Science and Engineering as a priority research area and undertake research in fields where computer science plays an essential role.

## STRUCTURE

The master's programme consists of 60 credits: the compulsory core module Fundamental Formal Methods, with 2 courses (12 ECTS), and the elective module Complementary Formal Methods, with 6 courses (36 ECTS) chosen from the 9 available, one of which includes internships in companies or research groups. The programme is completed with a supervisor-led master's thesis (12 ECTS).

## CURRICULUM

COURSE TYPE	ECTS
Core	12
Elective	36
Master's Thesis	12
<b>Total</b>	<b>60</b>

CORE COURSES (COMPULSORY)	ECTS	SEMESTER
Fundamental Formal Methods Module		
Static Analysis of Programs and Constraint Solving	6	1 <sup>o</sup>
Theory of Programming Languages	6	1 <sup>o</sup>

ELECTIVE COURSES	ECTS	SEMESTER
Complementary Formal Methods Module		
Concurrency Models	6	1 <sup>o</sup>
Cryptographic Protocols and Applications	6	1 <sup>o</sup>
Design of Bio-inspired Algorithms	6	1 <sup>o</sup>
Formal Methods for Testing	6	1 <sup>o</sup>
Internships in Companies or Research Groups	6	1 <sup>o</sup> or 2 <sup>o</sup>
Analysis of Concurrent and Distributed Systems	6	2 <sup>o</sup>
Computer-Aided Program Verification	6	2 <sup>o</sup>
Design of Correct-by-Construction Systems	6	2 <sup>o</sup>
Quantum Computing	6	2 <sup>o</sup>

Final Project	ECTS	SEMESTER
Master's Thesis	12	2



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Másteres UCM



## School of Computer Science

Campus de Moncloa  
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For further information:

[informatica.ucm.es/master-en-metodos-formales-en-ingenieria-informatica](http://informatica.ucm.es/master-en-metodos-formales-en-ingenieria-informatica)

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