



## Teaching Guide

| Teaching Guide      |                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                                    |           |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------------------|-----------|
| Identifying Data    |                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                                    | 2019/20   |
| Subject (*)         | Software Verification and Validation                                                                                                                                                                                                                                                                                                                                                                                         |        | Code                               | 614G01053 |
| Study programme     | Grao en Enxeñaría Informática                                                                                                                                                                                                                                                                                                                                                                                                |        |                                    |           |
| Descriptors         |                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                                    |           |
| Cycle               | Period                                                                                                                                                                                                                                                                                                                                                                                                                       | Year   | Type                               | Credits   |
| Graduate            | 1st four-month period                                                                                                                                                                                                                                                                                                                                                                                                        | Fourth | Optional                           | 6         |
| Language            | Spanish                                                                                                                                                                                                                                                                                                                                                                                                                      |        |                                    |           |
| Teaching method     | Face-to-face                                                                                                                                                                                                                                                                                                                                                                                                                 |        |                                    |           |
| Prerequisites       |                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                                    |           |
| Department          | Ciencias da Computación e Tecnoloxías da InformaciónComputación                                                                                                                                                                                                                                                                                                                                                              |        |                                    |           |
| Coordinador         | Castro Souto, Laura Milagros                                                                                                                                                                                                                                                                                                                                                                                                 | E-mail | laura.milagros.castro.souto@udc.es |           |
| Lecturers           | Cabalar Fernandez, Jose Pedro                                                                                                                                                                                                                                                                                                                                                                                                | E-mail | pedro.cabalar@udc.es               |           |
|                     | Castro Souto, Laura Milagros                                                                                                                                                                                                                                                                                                                                                                                                 |        | laura.milagros.castro.souto@udc.es |           |
|                     | Perez Vega, Gilberto                                                                                                                                                                                                                                                                                                                                                                                                         |        | gilberto.pvega@udc.es              |           |
| Web                 | moodle.udc.es                                                                                                                                                                                                                                                                                                                                                                                                                |        |                                    |           |
| General description | This subject is intended to master the current solutions in Software Engineering for the validation and verification of software. This includes:<br>- knowledge of functional and non-functional techniques and tools for software validation at all levels (unit, integration, system);<br>- knowledge of techniques and tools for automatic reasoning; and<br>- knowledge of techniques and tools for formal verification. |        |                                    |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A28  | Capacidade de identificar e analizar problemas, e deseñar, desenvolver, implementar, verificar e documentar solucións software sobre a base dun coñecemento adecuado das teorías, modelos e técnicas actuais. |
| B1   | Capacidade de resolución de problemas                                                                                                                                                                         |
| B3   | Capacidade de análise e síntese                                                                                                                                                                               |
| C2   | Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.                                                                                                                           |
| C3   | Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.                               |
| C6   | Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.                                                                             |
| C7   | Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.                                                                                                                              |
| C8   | Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.                                                                 |

## Learning outcomes

| Learning outcomes                                                                                                                                                                                                    | Study programme competences |          |                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------|----------------------------|
| Ability to identify and analyse problems, and to design, develop, implement, validate and document software solutions on the basis of an deep understanding and knowledge of modern theories, models and techniques. | A28                         | B1<br>B3 | C2<br>C3<br>C6<br>C7<br>C8 |

## Contents

| Topic | Sub-topic |
|-------|-----------|
|-------|-----------|



|                                                 |                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part I: Software Validation                     | I.1 Test specification, design and execution<br>I1.1. Levels and types of tests<br>I1.2. Properties and traceability of requirements<br>I1.3. Automation<br>I.2 Test management: planning, assessment, metrics and reviews                                                                           |
| Part II: Formal methods and automatic reasoning | II.1 Introduction: natural deduction and calculus of sequences<br>II.2 Automatic proofs using PVS<br>II.3 What is a theorem prover and what is it used for?<br>II.4 PVS specification language: types, expressions, theories, subtyping<br>II.5 PVS prover: tactics, recursion, equational reasoning |
| Part III: Model checking                        | III.1 Introduction to modal temporal logic<br>III.2 Properties specification: deadlocks, safety, liveness, fairness<br>III.3 How a model checker works<br>III.4 Introduction to the use of a model checking tool                                                                                     |

| Planning                                                                                                                        |                    |                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies       | Ordinary class hours | Student's personal work hours | Total hours |
| Guest lecture / keynote speech                                                                                                  | B3 C2 C7 C8        | 21                   | 26.25                         | 47.25       |
| Laboratory practice                                                                                                             | A28 B1 B3 C2 C3 C6 | 14                   | 35                            | 49          |
| Supervised projects                                                                                                             | A28 B1 B3 C2 C3 C6 | 7                    | 7                             | 14          |
| Objective test                                                                                                                  | B1 B3 C6           | 3                    | 31.5                          | 34.5        |
| Personalized attention                                                                                                          |                    | 5.25                 | 0                             | 5.25        |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |                    |                      |                               |             |

| Methodologies                  |                                                                                   |
|--------------------------------|-----------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                       |
| Guest lecture / keynote speech | Master class where the theoretical contents of the study programme are presented. |
| Laboratory practice            | Hands-on work sessions in the lab.                                                |
| Supervised projects            | Student assignments to be done during reduced-group classes.                      |
| Objective test                 | Written test.                                                                     |

| Personalized attention                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Objective test<br>Supervised projects<br>Guest lecture / keynote speech<br>Laboratory practice | <p>Questions/answers about the theoretical/practical aspects of the subjects, during the corresponding office hours of each teacher.</p> <p>Part-time students should be able to follow this subject without issues, given that attendance is not mandatory nor awarded qualification. However, part-time students are responsible for keeping up-to-date with the materials posted on the Moodle platform, as well as the assignments to be handed in. When the assignments are to be handed in by means other than telematic, they will be set up between part-time students and teachers to the best both their schedules allow.</p> |

| Assessment     |              |                                                                                                          |               |
|----------------|--------------|----------------------------------------------------------------------------------------------------------|---------------|
| Methodologies  | Competencies | Description                                                                                              | Qualification |
| Objective test | B1 B3 C6     | Written test, up to a maximum of 4 points in the final score. A minimum of 2 points is required to pass. | 40            |



|                     |                    |                                                                                                                                                                                  |    |
|---------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Supervised projects | A28 B1 B3 C2 C3 C6 | Presentation and participation in student assignments, performed during reduced-group classes, up to a maximum of 2 points in the final score. These are not compulsory to pass. | 20 |
| Laboratory practice | A28 B1 B3 C2 C3 C6 | Hand in and presentation of hands-on student assignments, up to a maximum of 4 points in the final score. These are not compulsory to pass.                                      | 40 |

## Assessment comments

Those students who do not reach the minimum in the objective test, will be qualified with the qualification they obtain in that objective test.

In the second opportunity, the objective test may include a specific evaluation of the laboratory practice.

In compliance with the academic rules at UDC that apply to part-time students, physical presence in the classroom/laboratory will not be regarded as qualification element. That is to say, students may officially apply to be dismissed from attending lectures and laboratory practices. All in all, part-time students will still need to comply with deadlines established for supervised projects and laboratory projects.

## Sources of information

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"> <li>- Mordechai Ben-Ari (2012). Mathematical Logic for Computer Science. Springer</li> <li>- Ron Patton (2001). Software testing. Sams</li> <li>- Peter Farrell-Vinay (2008). Manage software testing. Auerbach</li> <li>- Kent Beck (2002). Test Driven Development (By Example). Addison-Wesley</li> <li>- Hébert, Fred (2019). Property-based testing with PropEr, Erlang, and Elixir : find bugs before your users do. The Pragmatic Bookshelf</li> <li>- Gerard J. Holzmann (2003). The SPIN model checker: primer and reference manual. Addison-Wesley</li> <li>- Mordechai Ben-Ari (2001). Mathematical Logic for Computer Science. Springer</li> <li>- Zohar Manna and Amir Pnueli (1991). The Temporal Logic of Reactive and Concurrent Systems. Specification. Springer</li> <li>- Zohar Manna and Amir Pnueli (1995). The Temporal Logic of Reactive and Concurrent Systems. Safety. Springer</li> </ul> |
| <b>Complementary</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Recommendations

### Subjects that it is recommended to have taken before

Software Design/614G01015  
 Concurrency and Parallelism/614G01018  
 Software Process/614G01019  
 Software Architecture/614G01221  
 Requirements Engineering/614G01222  
 Quality Assurance/614G01223

### Subjects that are recommended to be taken simultaneously

Knowledge Representation and Automatic Reasoning/614G01036  
 Theoretical Computer Science/614G01039  
 Development Methodologies/614G01051

### Subjects that continue the syllabus

Software Development Projects/614G01226

### Other comments

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.