



Experimental Software Engineering

Learning Guide – Information for Students

1. Description

| | |
|-------------------------------|---|
| Grade | European Master in Software Engineering |
| Module | N/A |
| Area | Advanced Software Engineering Aspects |
| Subject | Experimental Software Engineering |
| Type | Elective |
| ECTS credits | 6 |
| Responsible department | Software Engineering |
| Major/Section/ | N/A |

| | |
|----------------------|---|
| Academic year | 2012/2013 |
| Term | 2 nd term |
| Language | English |
| Web site | http://www.grise.upm.es/UPM_subjects.php?name=ESE |



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2. Faculty

| NAME and SURNAME | OFFICE | email |
|--------------------------|---------------|-------------------|
| Natalia Juristo (Coord.) | D-5104 | natalia@fi.upm.es |
| Sira Vegas | D-5105 | sira@fi.upm.es |

3. Prior knowledge required to take the subject

| | |
|---|-----|
| Passed subjects | N/A |
| Other required learning outcomes | N/A |



4. Learning goals

| SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL | | |
|---|--|--------------|
| Code | Competence | Level |
| CE13 | To have a vision of the different specific and emergent aspects of the Software Engineering, and to go further in some of them. | A |
| CE14 | To understand what nowadays software engineering procedures can and cannot reach, their limitations and their possible future evolution. | C |

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

| SUBJECT LEARNING OUTCOMES | | | |
|----------------------------------|---|----------------------------|--------------------------|
| Code | Learning outcome | Related competences | Proficiency level |
| LR1 | Given a particular software engineering field, the student will be able to design and evaluate the most adequate approach to solve some of the related problems, highlighting the technical difficulties and limits of application. | CE13, C14 | A |

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)



5. Subject assessment system

| ACHIEVEMENT INDICATORS | | |
|------------------------|---|---------------|
| Ref | Indicator | Related to LR |
| I1 | Understand the limitation of nowadays software engineering technologies due to the lack of a scientific study of them | LR1 |
| I2 | Understand what an experimental laboratory and an experiment are for software engineering | LR1 |
| I3 | Know the different elements of a software engineering experiments: response variable, factors, levels, etc. | LR1 |
| I4 | Design experiments for software engineering technologies: randomization, other control strategies, types of designs, etc. | LR1 |
| I5 | Understand the report of software engineering experiments | LR1 |
| I6 | Apply basic statistical data analysis techniques (i.e.: t-test, ANOVA, sample size calculation) | LR1 |

| CONTINUOUS ASSESSMENT | | | |
|---|-----------------------|--------------------|--------------------|
| Brief description of assessable activities | Time | Place | Weight in grade |
| <ul style="list-style-type: none">Set up an experiment (operationalize and design it) | 5 th Weeks | Classroom & moodle | 25% |
| <ul style="list-style-type: none">Run the experiment and collect observations | 7 th week | Classroom & moodle | 25% |
| <ul style="list-style-type: none">Analyze the data collected | 8 th week | Classroom & moodle | 25% |
| <ul style="list-style-type: none">Interpret the results including comparisons with the results of the classroom mates experiment versions | 9 th week | Classroom & moodle | 25% |
| | | | Total: 100% |



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GRADING CRITERIA

- Students will be evaluated using the assignments only. No examination will be made.
- The assessment of assignments will depend on (1) presentation made by the students at the classroom and (2) the correctness of the results.
- The final grade will be calculated using a weighted average as described before.



5. Contents and learning activities

| SPECIFIC CONTENTS | | |
|---|---|---------------------------|
| Unit / Topic / Chapter | Section | Related indicators |
| Chapter 1: Introduction to experimental software engineering | 1.1. Basics of experimentalism 1.2. The scientific method 1.3. Scientific Rules: Cause-effect relationships 1.4. Scientific immaturity of software engineering | 11 |
| Chapter 2: Laboratory and experiment | 2.1. The concept of laboratory 2.2. The concept of experiment 2.3. A lab for software engineering 2.4. An experiment for software engineering | 12 |
| Chapter 3: Elements of an experiment | 3.1. Response variables 3.2. Factors and levels 3.3. Types of empirical studies | 13, 15 |
| Chapter 4: Designing experiments | 4.1. Types of variables 4.2. Types of control 4.3. Validity | 14, 15 |
| Chapter 5: Data analysis | 5.1. Basics of inferential statistics 5.2. Procedures to compare 2 means: t, Mann-Whitney 5.3. Procedures to compare k means: ANOVA 5.4. Statistical power | 16 |
| | | |



6. Brief description of organizational modalities and teaching methods

| TEACHING ORGANIZATION | | |
|------------------------------|--------------------------------|---|
| Scenario | Organizational Modality | Purpose |
| | Theory Classes | <i>Talk to students</i> |
| | Seminars/Workshops | <i>Construct knowledge through student interaction and activity</i> |
| | Practical Classes | <i>Show students what to do</i> |
| | Placements | <i>Round out student training in a professional setting</i> |
| | Personal Tutoring | <i>Give students personalized attention</i> |
| | Group Work | <i>Get students to learn from each other</i> |
| | Independent Work | <i>Develop self-learning ability</i> |



| TEACHING METHODS | | |
|-------------------------|--|---|
| | Method | Purpose |
| | Explanation/Lecture | <i>Transfer information and activate student cognitive processes</i> |
| | Case Studies | <i>Learning by analyzing real or simulated case studies</i> |
| | Exercises and Problem Solving | <i>Exercise, test and practice prior knowledge</i> |
| | Problem-Based Learning (PBL) | <i>Develop active learning through problem solving</i> |
| | Project-Oriented Learning (POL) | <i>Complete a problem-solving project applying acquired skills and knowledge</i> |
| | Cooperative Learning | <i>Develop active and meaningful learning through cooperation</i> |
| | Learning Contract | <i>Develop independent learning</i> |

Known as explanation, this teaching method involves the “*presentation of a logically structured topic with the aim of providing information organized according to criteria suited for the purpose*”. This methodology, also known as *lecture*, mainly focuses on the verbal exposition by the teacher of contents on the subject under study. The term *master class* is often used to refer to a special type of lecture taught by a professor on special occasions

Intensive and exhaustive analysis of a real fact, problem or event for the purpose of understanding, interpreting or solving the problem, generating hypotheses, comparing data, thinking, learning or diagnosis and, sometimes, training in possible alternative problem-solving procedures.

Situations where students are asked to develop the suitable or correct solutions by exercising routines, applying formulae or running algorithms, applying information processing procedures and interpreting the results. It is often used to supplement lectures.

Teaching and learning method whose starting point is a problem, designed by the teacher, that the student has to solve to develop a number of previously defined competences.

Teaching and learning method where have a set time to develop a project to solve a problem or perform a task by planning, designing and completing a series of activities. The whole thing is based on developing and applying what they have learned and making effective use of resources.

Interactive approach to the organization of classroom work where students are responsible for their own and their peers’ learning as part of a co-responsibility strategy for achieving group goals and incentives. This is both one of a number of methods for use and an overall teaching approach, or philosophy.

An agreement between the teacher and student on the achievement of learning outcomes through an independent work proposal, supervised by the teacher, and to be accomplished within a set period. The essential points of a learning contract are that it is a written agreement, stating required work and reward, requiring personal involvement and having a time frame for accomplishment.



| BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS | |
|--|--|
| THEORY CLASSES | Every chapter/part of the course begins with a 1-2 hours of theory classes |
| PROBLEM-SOLVING CLASSES | Exercised are sandwiched in the theory classes. Every chapter/part of the course counts on 1-2 hours of exercised solved by the professor through discussion with the students |
| PRACTICAL WORK | Every chapter/part of the course counts with a practical work performed by the students. |
| INDIVIDUAL WORK | The practical work is performed partly individually partly in a group |
| GROUP WORK | The practical work is performed partly individually partly in a group |
| PERSONAL TUTORING | Students can access professors for tutoring constantly by e-mail and moodle. |



7. Teaching resources

| TEACHING RESOURCES | |
|----------------------------|--|
| RECOMMENDED READING | Natalia Juristo, Ana Moreno; Basics of software engineering experimentation. Kluwer 2001. |
| | Claes Wohlin et al.; Experimentation in software engineering: An introduction. Kluwer 2000. |
| WEB RESOURCES | Subject web site http://www.grise.upm.es/UPM_subjects.php?name=ESE |
| | Subject Moodle site http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=1575 |
| EQUIPMENT | Laboratory: TBD |
| | Room: TBD |
| | Group work room: TBD |



8. Subject schedule

| Week | Classroom activities | Lab activities | Individual work | Group work | Assessment activities | Others |
|--------------|--|----------------|--|--|-----------------------|--------|
| 1 (8 hours) | <ul style="list-style-type: none"> Lecture: Chapter 1 (4 hours) | - | <ul style="list-style-type: none"> Individual study (4 hours) | • | - | - |
| 2 (4 hours) | <ul style="list-style-type: none"> Lecture: Chapter 2(1 hour) Problem-solving activity: Chapter 2 (1 hours) | • | <ul style="list-style-type: none"> Individual study (2 hours) | • | - | - |
| 3 (8 hours) | <ul style="list-style-type: none"> Lecture: Chapter 3 (1 hours) Problem-solving activity: Chapter 3 (1 hour) Lecture: Chapter 5 (2 hours) | | <ul style="list-style-type: none"> Individual study (4 hours) | • | | |
| 4 (8 hours) | <ul style="list-style-type: none"> Lecture: Chapter 4 (2 hours) Problem-solving activity: Chapter 4 (2 hour) | • | <ul style="list-style-type: none"> Individual study (4 hours) | | | |
| 5 (20 hours) | <ul style="list-style-type: none"> Lecture: Chapter 5 (2 hours) | - | <ul style="list-style-type: none"> Assignment 1: Set up an experiment (9 hours) | <ul style="list-style-type: none"> Assignment 1: Set up an experiment (9 hours) | • | |



| | | | | | | |
|---------------|---|--|--|--|---|---|
| 6 (16 hours) | <ul style="list-style-type: none"> Lecture: Chapter 5 (2 hours) | Brainstorming and group discussion at classroom about the set ups (2 hours) | <ul style="list-style-type: none"> Assignment 1: Set up an experiment (6 hours) | <ul style="list-style-type: none"> Assignment 1: Set up an experiment (6 hours) | • | - |
| 7 (30 hours) | - | • - | Assignment 2: Run the experiment (15 hours) | Assignment 2: Run the experiment (15 hours) | • | - |
| 8 (14 hours) | <ul style="list-style-type: none"> Lecture: Chapter 5 (2 hours) Problem-solving activity: Chapter 5 (2 hours) | | <ul style="list-style-type: none"> Assignment 3: Analyze collected data (5 hours) | Assignment 3: Analyze collected data (5 hours) | - | - |
| 9 (14 hours) | - | • - | <ul style="list-style-type: none"> Preparation of presentation (5 hours) | <ul style="list-style-type: none"> Preparation of presentation (5 hours) | <ul style="list-style-type: none"> Presentation of assignments 1-3 (4 hours) | - |
| 10 (14 hours) | | Brainstorming and group discussion at classroom about assignment 4 (4 hours) | Assignment 4: Interpreting results (5 hours) | Assignment 4: Interpreting results (5 hours) | • | |



| | | | | | | |
|---------------|--|--|--|--|--|--|
| 11 (14 hours) | | Brainstorming and group discussion at classroom about assignment 4 (4 hours) | Assignment 4: Interpreting results (5 hours) | Assignment 4: Interpreting results (5 hours) | • | |
| 12 (12 hours) | | • | • Preparation of presentation (4 hours) | • Preparation of presentation (4 hours) | • Presentation of assignment 4 (4 hours) | |

Note: Student workload specified for each activity in hours