340368 - FOPR-I1O23 - Fundamentals of Programming

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering
Teaching unit: 723 - CS - Department of Computer Science
Academic year: 2018
Degree: BACHELOR'S DEGREE IN INFORMatics ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 7,5
Teaching languages: Catalan

Teaching staff

Coordinator: ÀNGELS HERNÁNDEZ GÓMEZ

Others: ÀNGELS HERNÁNDEZ GÓMEZ
BERNARDINO CASAS FERNÁNDEZ

Prior skills

Basic knowledge of mathematics for the required level at the university entrance exam.

Degree competences to which the subject contributes

Specific:
3. CEFB3. Ability to understand and to have a good command of discrete, logical, algorithmically mathematics and computing complexity and its application to automatical treatment of information by means of computational systems and its application to solve engineering problems.
4. CEFB4. Basic knowledge of use and computer programming, as well as of operating systems, data base and generally informatic programs with engineering applications.
5. CEFC6. Basic knowledge and application of algorithmic processes, informatic techniques to design solutions of problems, analyzing if proposed algorithms are apt and complex.
6. CEFC7. Knowledge, design and efficient use of data types and structures the most appropriate to resolve problems.

Transversal:
1. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
2. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

Teaching methodology

The course consists of:
- 2 hours per week of theory class in the classroom (large group) where the teacher presents contents,
- 3 hours per week in classroom lab (small group) where it's done practical work and evaluable activities are proposed and performed.

Learning objectives of the subject

1. To understand the programme building process and how to use the tools required: console, editor and compiler.
2. To know the syntax and the semantics expressions and the basic instructions of the imperative programming languages (C ++).
3. Being proficient in using functions and actions in programming.
4. To understand the function and parameter concepts.
5. To know in depth the tables and to identify where their use is appropriate.
6. To be able to contrast solutions regarding the use of time and memory resources and to choose the most appropriate in simple cases.
7. To understand the patterns of treat-all and search algorithms patterns.
8. Choosing an appropriate scheme solution.
9. To understand the recursion concept. To be able to propose recursive solutions to simple problems.
10. To comprehend in depth the binary search, insertion sort, selection sort, mergesort and quicksort.
11. To know in depth other fundamental algorithms: Hörner, fast product, etc.
12. To be able to write programs readable, elegant and efficient.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Hours large group:</th>
<th>45h</th>
<th>24.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td>Hours small group:</td>
<td>30h</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>112h 30m</td>
<td>60.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 6h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study : 1h</td>
</tr>
</tbody>
</table>

**Description:**
Programming examples
Algorithms, programming languages and computer programs
Steps in the design of a program

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 6h</th>
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</thead>
<tbody>
<tr>
<td><strong>Variables and statements</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
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<tr>
<td></td>
<td>Self study : 1h</td>
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</table>

**Description:**
Variables, data types and expressions
Statements:
- Assignment
- Input / Output
- Conditional statement

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 6h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loops</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study : 1h</td>
</tr>
</tbody>
</table>

**Description:**
While statement
For statement

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 6h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data types and visibility</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study : 1h</td>
</tr>
</tbody>
</table>

**Description:**
Data types
Type conversion
Visibility
### Subprograms: procedures and functions

**Learning time:** 7h  
Theory classes: 2h  
Laboratory classes: 3h  
Self study: 2h

**Description:**  
Subprogram concept  
Parameter passing  
Functions  
Procedures

### Algorithms on sequences. Invariants.

**Learning time:** 7h  
Theory classes: 2h  
Laboratory classes: 3h  
Self study: 2h

**Description:**  
Algorithms on sequences:  
- Treat-all algorithms  
- Search algorithms  
Reasoning about loops: invariants

### Recursion

**Learning time:** 6h  
Theory classes: 2h  
Laboratory classes: 3h  
Self study: 1h

**Description:**  
Recursive design  
Exemples

### Vectors

**Learning time:** 6h  
Theory classes: 2h  
Laboratory classes: 3h  
Self study: 1h

**Description:**  
Vectors  
Searching in vectors
### Vectors and strings

**Description:**
- More vectors examples
- Strings

**Learning time:** 6h
- Theory classes: 2h
- Practical classes: 3h
- Self study: 1h

### Multi-dimensional vectors

**Description:**
- Matrices
- N-dimensional vectors
- Search in a matrix
- Search in a sorted matrix
- Matrix multiplication

**Learning time:** 8h
- Theory classes: 2h
- Laboratory classes: 4h
- Self study: 2h

### Structures and data structure design

**Description:**
- Structures
- Data structure design

**Learning time:** 6h
- Theory classes: 2h
- Laboratory classes: 3h
- Self study: 1h

### Sorting

**Description:**
- Selection Sort
- Insertion Sort
- Bubble Sort
- Merge Sort

**Learning time:** 8h
- Theory classes: 2h
- Laboratory classes: 4h
- Self study: 2h
# Numerical algorithms

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 9h</th>
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<tbody>
<tr>
<td>Product of polynomials</td>
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</tr>
<tr>
<td>Sum of polynomials</td>
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<tr>
<td>Sum of sparse vectors</td>
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<tr>
<td>Root of a continuous function</td>
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<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Laboratory classes: 4h</td>
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<tr>
<td>Self study : 3h</td>
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# Advanced examples

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 7h</th>
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<tbody>
<tr>
<td>Sports tournament</td>
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<tr>
<td>Permutations</td>
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<tr>
<td>Sub-sequences summing n</td>
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<tr>
<td>Theory classes: 2h</td>
<td></td>
</tr>
<tr>
<td>Laboratory classes: 3h</td>
<td></td>
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<tr>
<td>Self study : 2h</td>
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# Conclusions

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 2h</th>
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<tbody>
<tr>
<td>Why is programming hard?</td>
<td></td>
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<tr>
<td>Useful programs</td>
<td></td>
</tr>
<tr>
<td>Correct programs</td>
<td></td>
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<tr>
<td>Efficient programs</td>
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<tr>
<td>Programs are mathematical objects</td>
<td></td>
</tr>
<tr>
<td>Easy to understand, modify and extend</td>
<td></td>
</tr>
<tr>
<td>Programming has limits</td>
<td></td>
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<tr>
<td>Quotes</td>
<td></td>
</tr>
<tr>
<td>Theory classes: 2h</td>
<td></td>
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</tbody>
</table>
**Qualification system**

QU = Grade from questionnaires, all with the same weight.  
AC = Grade from activities, all with the same weight.  
PR = Grade from programming task.  
C1 = Grade from Exam 1.  
C2 = Grade from Exam 2.  
PV = Validation Test.  

Nota Final = max (50% C2,  20% C1 + 30% C2) + 10% QU + 20% AC + 20% (PR*PV)  
The reevaluation contains the C2 test.

**Regulations for carrying out activities**

The activities (AC), the controls (C1 and C2) and the validation test (PV) are face and individual.  
The questionnaires (QU) are self-assessed and their delivery is electronic and individual.  
The programming task (PR) is done in groups. Teachers could ask about the work presented by the students and consider their answers when qualifying. The validation test shall be carried out in conjunction with Control 2.

**Bibliography**