340455 - REIN-I7P23 - Information Retrieval

**Coordinating unit:** 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

**Teaching unit:** 723 - CS - Department of Computer Science

**Academic year:** 2019

**Degree:** BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2018). (Teaching unit Optional)

BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)

**ECTS credits:** 6  

**Teaching languages:** Catalan

### Teaching staff

**Coordinator:** Neus Català Roig

**Others:** Neus Català Roig

### Prior skills

- To know and use comfortably basic concepts of linear algebra, discrete mathematics, probability and statistics.

- To program comfortably in object-oriented languages, including inheritance between classes.

- To know the main data structures to access information efficiently and their implementations (lists, hashing, trees, graphs, heaps). To be able to use them to build efficient programs. To be able to analyze the execution time and memory used by an algorithm of average difficulty. To have an idea of the difference in time to access main memory and disk.

- To know the main elements of a relational database and SQL-like access language.

### Requirements

Have passed ESTA, AMEP and DABD courses or at least being enrolled.

### Degree competences to which the subject contributes

**Specific:**

1. CEC07. Ability to learn and develop techniques of computing learning and design and implement applications and systems which use them, including those dedicated to automatic information and knowledge extraction from large data volums.

4. CEIS6. Ability to design appropriate solutions in one or more application domains using software engineering methods that integrate ethical, social, legal and economic aspects.

3. CEIS4. Ability to identify and analyze problems and design, develop, deploy, test and document software solutions based on an adequate knowledge of theories, models and techniques.

2. CEIS1. Ability to develop, to maintain and evaluate programming services and systems which satisfy all requirements of user having a reliable and efficient behavior, being comprehensible to develop and maintain and observe to current rules, applying theory, principals, methods, practices of programming engineering.

**Transversal:**

5. ENTREPRENEURSHIP AND INNOVATION: Knowing about and understanding how businesses are run and the sciences that govern their activity. Having the ability to understand labor laws and how planning, industrial and marketing strategies, quality and profits relate to each other.
The amount of information stored digitally in organizations, or collectively on the web, is today large enough to make searching this information a generally complicated task. The field known as "Information Retrieval" finds methods to organize information in such a way that finding information afterwards can be done simply and efficiently.

This course will cover basic keyword-based techniques to search in textual information. The course will also examine search in the web, where hyperlinks can be used not only to direct the search but to assess the interest value of each page - as is the case with the well-known PageRank algorithm. Extensions of these techniques to the case of Social Networks where interactions among users can provide very useful information will be seen. Finally, the course will study ways in which these techniques can be exploited for the benefit of specific organizations.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
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<tr>
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<td>Hours small group:</td>
<td>30h</td>
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<td></td>
<td>Guided activities:</td>
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<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time: 11h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 1h 30m</td>
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<td></td>
<td>Laboratory classes: 2h 30m</td>
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<td>Self study : 7h</td>
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**Description:**
Need of search and analysis techniques of massive information. Search and analysis vs. databases. Information retrieval process. Preprocessing and lexical analysis.

**Related activities:**
- Activity 1: Mid-term exam
- Activity 3: Final exam
- Activity 4: Laboratory sessions

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<thead>
<tr>
<th>Section</th>
<th>Learning time: 12h</th>
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<tbody>
<tr>
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<td>Theory classes: 1h 30m</td>
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<td></td>
<td>Laboratory classes: 3h 30m</td>
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<td>Self study : 7h</td>
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**Description:**
Formal definition and basic concepts: abstract models of documents and query languages. Boolean model. Vector model.

**Related activities:**
- Activity 1: Mid-term exam
- Activity 3: Final exam
- Activity 4: Laboratory sessions

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<tr>
<th>Section</th>
<th>Learning time: 10h</th>
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<tbody>
<tr>
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<td>Laboratory classes: 2h 30m</td>
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<tr>
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<td>Self study : 7h</td>
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**Description:**
Inverse and signature files. Index compression. Example: Efficient implementation of the rule of the cosine measure with tf-idf. Example: ElasticSearch.

**Related activities:**
- Activity 1: Mid-term exam
- Activity 3: Final exam
- Activity 4: Laboratory sessions
### 4. Evaluation in information retrieval

**Learning time:** 10h  
Theory classes: 0h 30m  
Laboratory classes: 2h 30m  
Self study: 7h

**Description:**  
Recall and precision. Other performance measures. Reference collections. Relevance feedback and query expansion.

**Related activities:**  
Activity 1: Mid-term exam  
Activity 3: Final exam  
Activity 4: Laboratory sessions

### 5. Web search

**Learning time:** 16h  
Theory classes: 3h  
Laboratory classes: 6h  
Self study: 7h

**Description:**  

**Related activities:**  
Activity 2: Second partial exam  
Activity 3: Final exam  
Activity 4: Laboratory sessions

### 6. Architecture of massive information processing systems

**Learning time:** 12h 30m  
Theory classes: 3h  
Laboratory classes: 6h  
Self study: 3h 30m

**Description:**  

**Related activities:**  
Activity 2: Second partial exam  
Activity 3: Final exam  
Activity 4: Laboratory sessions
7. **Network analysis**

**Learning time:** 15h  
- Theory classes: 2h  
- Laboratory classes: 6h  
- Self study: 7h

**Description:**  
Descriptive parameters and characteristics of networks: degree, diameter, small-world networks, among others.  
Algorithms on networks: clustering, community detection and detection of influential nodes, reputation, among others.

**Related activities:**  
Activity 2: Second partial exam  
Activity 3: Final exam  
Activity 4: Laboratory sessions

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8. **Information systems based on massive information analysis.**

**Learning time:** 10h 30m  
- Theory classes: 2h  
- Laboratory classes: 5h  
- Self study: 3h 30m

**Description:**  

**Related activities:**  
Activity 2: Second partial exam  
Activity 3: Final exam  
Activity 4: Laboratory sessions
**Qualification system**

The course will include the following evaluation events:
- Reports of laboratory sessions (L). Non re-avaluable tasks.
- A mid-term exam, covering material seen until the exam is done (C1). Re-avaluable task.
- A second partial exam (C2), covering what was not covered in the mid-term exam. Re-avaluable task.

Re-evaluation: There will be a Final Exam (F) covering the whole course. The mark of the Final Exam will substitute the previous grade obtained from re-avaluable tasks (C1 and C2) only if it is greater than the latter.

The final grade is computed by the following formula:

\[ 0.4 \times L + 0.3 \times C1 + 0.3 \times C2 \]

In case of re-evaluation, the final grade is computed by the following formula:

\[ 0.4 \times L + 0.6 \times F \]

**Regulations for carrying out activities**

Reports of laboratory sessions will be delivered online within a time limit for each session.

Mid-term exam, second partial exam and final exam are in-person.

**Bibliography**

**Basic:**


**Others resources:**

Web links:
- Three and a half degrees of separation, by Smriti Bhagat, Moira Burke, Carlos Diuk, Ismail Onur Filip, Sergey Edunov (https://research.fb.com/three-and-a-half-degrees-of-separation/?refid)
- The Heart of the Elastic Stack (https://www.elastic.co/products/elasticsearch)