295601 - AB - Biostatistical Learning

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6  Teaching languages: Spanish

Teaching staff

Coordinator: JOSE JULIAN RODELLAR BENEDDE
Others: Segon quadrimestre:
  ANDREA MILENA ACEVEDO LIPES - M11
  FRANCESC POZO MONTERO - M11
  JOSE JULIAN RODELLAR BENEDDE - M11
  YOLANDA VIDAL SEGUI - M11

Opening hours

Timetable: By appointment

Prior skills

Programming course. Basic statistical concepts and tools.

Requirements

None

Teaching methodology

The course is developed through four hours per week: half correspond to theoretical lectures and half to laboratory sessions, supervised works and a final exam.
The teaching activities are distributed as follows:
- Theory lectures: 20%
- Computer sessions and works: 20%
- Autonomous learning: 60%

Learning objectives of the subject

Objectives proposed for the course:
Understand the basic theory of machine learning
Formulate statistical learning problems related to different biomedical applications
Understand a wide range of statistical learning algorithms along with their advantages and limitations
Implement statistical learning algorithms to solve biomedical problems with moderate complexity
Compare the performance of several techniques and recommend those that better fit to the proposed problems
# Study load

<table>
<thead>
<tr>
<th><strong>Total learning time</strong>: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
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<tr>
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<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<td></td>
<td>Hours small group:</td>
<td>30h</td>
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<td></td>
<td>Guided activities:</td>
<td>90h</td>
<td>60.00%</td>
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**Content**

**1. Introduction**

<table>
<thead>
<tr>
<th>Learning time: 12h</th>
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<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Laboratory classes: 2h</td>
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<tr>
<td>Self study: 6h</td>
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**Description:**

**Related activities:**
Theory lectures 1 and 2
Lab 1: Introduction to Python, Numpy and Pandas

**Specific objectives:**

**2. Linear regression**

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<thead>
<tr>
<th>Learning time: 8h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Laboratory classes: 2h</td>
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<tr>
<td>Self study: 4h</td>
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**Description:**
Linear regression model. Least squares. Statistical significance.

**Related activities:**
Theory lecture 3
Lab 2: linear regression with Python

**Specific objectives:**
# 3. Classification

**Learning time:** 21h  
Theory classes: 4h  
Laboratory classes: 2h  
Guided activities: 2h  
Self study: 13h

**Description:**  

**Related activities:**  
Theory lectures 4 and 5  
Lab 3: logistic regression and linear discriminant analysis  
Work 1

**Specific objectives:**  
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# 4. Re-sampling methods

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

**Description:**  
Cross validation. Bootstrap

**Related activities:**  
Theory lecture 6  
Lab 6: Cross validations and bootstrap

**Specific objectives:**  
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### 5. Linear model selection and regularization

<table>
<thead>
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<th>Description</th>
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<table>
<thead>
<tr>
<th>Related activities</th>
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<tbody>
<tr>
<td>Theory lectures 7 and 8</td>
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<tr>
<td>Lab 5: regression and nearest neighbours method</td>
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<tr>
<td>Lab 6: dimension reduction</td>
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<table>
<thead>
<tr>
<th>Specific objectives</th>
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<th>Learning time</th>
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<td>16h</td>
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#### Theory classes: 4h

#### Laboratory classes: 4h

#### Self study: 8h

### 6. Tree-based methods

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<tr>
<th>Related activities</th>
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<tbody>
<tr>
<td>Theory lectures 9 and 10</td>
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<tr>
<td>Lab 7: Tree methods for classification and regression</td>
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<tr>
<td>Work 2</td>
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<table>
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<th>Specific objectives</th>
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<table>
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<tr>
<th>Learning time</th>
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<td>21h</td>
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#### Theory classes: 4h

#### Laboratory classes: 2h

#### Guided activities: 2h

#### Self study: 13h
### 7. Support vector machines

**Learning time:** 20h  
Theory classes: 4h  
Laboratory classes: 2h  
Guided activities: 2h  
Self study: 12h

**Description:**  
Maximal margin classifier. Support vector machines (SVM). Classification of more than two classes.

**Related activities:**  
Theory lectures 11 and 12  
Lab 8: Applications of SVM  
Work 3

### 8. Neural networks

**Learning time:** 20h  
Theory classes: 4h  
Laboratory classes: 2h  
Guided activities: 2h  
Self study: 12h

**Description:**  

**Related activities:**  
Theory lectures 13 and 14  
Lab 9: Implementation of neural networks  
Work 4

**Specific objectives:**
9. Non-supervised learning

| Learning time: | 24h |
| Theory classes: | 16h |
| Laboratory classes: | 2h |
| Guided activities: | 2h |
| Self study: | 4h |

Related activities:
Theory lecture 15
Lab 10: Applications of clustering methods
Exam

Specific objectives:

Qualification system
Continuous evaluation along the course by means of practical works. By the end of the course the student will pass a final complementary exam.

Regulations for carrying out activities

Bibliography

Basic:

Complementary:

Others resources:
Materials available in ATENEA by the instructors