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>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 30h</td>
<td>20.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
# 1. Introduction

**Learning time:** 12h  
Theory classes: 4h  
Laboratory classes: 2h  
Self study: 6h

**Description:**  
Bias/variance tradeoff. Software: Python.

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

**Specific objectives:** 

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# 2. Linear regression

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

**Description:**  
Linear regression model. Least squares. Statistical significance.

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

**Specific objectives:** 

### 3. Classification

<table>
<thead>
<tr>
<th>Learning time: 21h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study: 13h</td>
</tr>
</tbody>
</table>

**Description:**

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

**Specific objectives:**

### 4. Re-sampling methods

<table>
<thead>
<tr>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study: 4h</td>
</tr>
</tbody>
</table>

**Description:**
Cross validation. Bootstrap

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

**Specific objectives:**

### 5. Linear model selection and regularitzation

**Learning time:** 16h  
- Theory classes: 4h  
- Laboratory classes: 4h  
- Self study: 8h

**Description:**  

**Related activities:**  
- Theory lectures 7 and 8  
- Lab 5: regression and nearest neighbours method  
- Lab 6: dimension reduction

**Specific objectives:**

### 6. Tree-based methods

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

**Description:**  

**Related activities:**  
- Theory lectures 9 and 10  
- Lab 7: Tree methods for classification and regression  
- Work 2

**Specific objectives:**

# 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

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# 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

**Description:**

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

**Specific objectives:**

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**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**

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**Bibliography**

**Basic:**

**Complementary:**

**Others resources:**
- Materials available in ATENEA by the instructors

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