The subject gives a review of the pattern classification and recognition from the mathematical point of view and at the same time, applies the methods to several areas of signal processing.

The structure of the general problem of pattern recognition (i.e., pre-processing, feature extraction and classification), can be applied to different areas, such as quality control, biomedical applications and diagnosis, communication systems, image processing, and speech recognition.

The subject will give a general view of the Bayesian decision theory, maximum likelihood estimation, non-parametric classification techniques and non-supervised learning, with application to different areas of signal processing, such as classification of biomedical signals, images, signal detection, signal modulation, etc.

For each of the selected applications, the work done in class, will deal with different classification criteria, in order to...
analyze the compromise between good performance and computation efficiency of each classifier. The 6 credits of the subject are divided between theoretical classes, and at the same time, practical classes at the laboratory (MATLAB), where the student will develop the selected applications, with emphasis in the applications on medical diagnosis, image possessing, and communications. In each of the theoretical parts, the methods and algorithms will be developed so that they can be understood and programmed at the same time. Some advanced techniques will also be presented.

Study load

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<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Self study:</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>26h</td>
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<td></td>
<td>150h</td>
<td>98h</td>
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<td>17.33%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
<th>Description</th>
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| **1. Introduction (2 hours)**                                           | **2h**        | 1. Feature extraction  
1.2 Classes or models  
1.3 Probability density function |
| **2. Models on probability density function (8 hours)**                 | **8h**        | 2.1 Minimization of the Bayesian risk  
2.2 Gaussian model  
2.3 Linear and quadratic discriminants |
| **3. Feature selection (4 hours)**                                      | **4h**        | 3.1 Principal components analysis  
3.2 Multiple discriminants analysis  
3.3 Independent components analysis |
| **4. Non-parametric techniques, supervised learning (8 hours)**         | **4h**        | 4.1 Parzen windows and k-nearest neighbours  
4.2 Linear classifiers and support vector machines  
4.3 Neural networks  
4.4 Decision trees |
5. Unsupervised learning (4 hours)  

**Description:**
- 5.1 EM and k-means
- 5.2 Clustering

**Learning time:** 4h  
Theory classes: 4h

6. Algorithm independent machine learning: evaluation and selection (2 hours)  

**Description:**
- 6.1 Non free lunch theorem
- 6.2 Complexity
- 6.3 Bias and variance
- 6.4 Bagging and boosting
- 6.5 Comparing classifiers
- 6.6 Combining classifiers outputs

**Learning time:** 2h  
Theory classes: 2h

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### Qualification system

- 45% Final Examination
- 45% Laboratory classes
- 10% Personal contributions

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### Regulations for carrying out activities
Bibliography

Basic:


Complementary:


Others resources: