Computational analysis of biological structures and networks

Manuele Bicego

Master's degree in Medical Bioinformatics

Computer Science Dept.
University of Verona
The course

Timetable:

**Wednesday**  9.30 - 11.30 (Lecture Hall G)

**Thursday**  12.30 - 13.30 (Lecture Hall G)

*from Mar 1, 2017 to Mar 31, 2017*

**Friday**  8.30 - 11.30 (Lecture Hall G)

*from Apr 1, 2017 to end*

**Friday**  8.30 - 11.30 (Lab Alfa)
## Lecturers

<table>
<thead>
<tr>
<th>Manuele Bicego (5CFU)</th>
<th>Marco Cristani (1CFU)</th>
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<tbody>
<tr>
<td><strong>Office</strong></td>
<td>Ca' Vignal 2, Floor 1, Room 55</td>
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<tr>
<td><strong>Telephone</strong></td>
<td>045 8027072</td>
</tr>
<tr>
<td><strong>Email</strong></td>
<td><a href="mailto:manuele.bicego@univr.it">manuele.bicego@univr.it</a></td>
</tr>
<tr>
<td><strong>Office Hours</strong></td>
<td>Thursday 10.00-12.00 (or send an e-mail)</td>
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Requirements

- Notions from the course “Riconoscimento e Recupero dell'informazione per Bioinformatica” (Bs degree in Bioinformatics)

- Basic notions of Algorithms, Probability, Statistics, Algebra

- Programming skills (for lab part)
  - Programming language used: Matlab, Python
Overview

- Title: “Computational analysis of biological structures and networks”
- Many possible viewpoints: here we adopt the Pattern Recognition perspective

- The course is about **Pattern Recognition tools and techniques** to model biological **complex** objects
  - Objects with a **complex structure** (strings, 3D structures, sets, graphs, networks...)
The course is divided in two parts:

PART 1: **Theory** (first part of the semester):
- PR tools and techniques to model structured data

PART 2: **Laboratory** (second part of the semester)
- Exercises on theory (*matlab*)
- Deep learning theory and exercises (with Marco Cristani – *phyton*)
Program (Theory)

- **Chapter 1.** Introduction
  - Basic Pattern Recognition concepts (recap from Bs. Course)
  - Introduction to structured data (data with complex structure)

- **Chapter 2.** Representation of structured data
  - Advanced dimensionality reduction techniques
  - The Bag of words representation
  - The dissimilarity-based representation
Chapter 3. Models for structured data
• Generative models (Bayes Networks)
• Learning and inference

Chapter 4. Advanced concepts
• Kernels for structured data
• Advanced learning paradigms for structured data
  (Multiple instance learning, semi supervised learning, transfer learning)
Material

- Slides, notes, suggested readings...
- Course slides will be posted on line *before* classes

- All info can be found at the course homepage

- Reference lab: VIPS (Vision, Image Processing & Sound), CV2, piano -2
  Info: http://vips.scienze.univr.it
Reference books


Some specific readings will be suggested for every chapter
Assessment methods

Two parts:

• First part: few questions on course topics (written exam, during exam sessions)

• Second part: talk within a tematic workshop (as in a conference)
Assessment methods

**Talk** within a tematic workshop: details

- The topic of the tematic workshop will be decided in advance
- Each student chooses a scientific paper to be presented in 10 minutes
- One tematic workshop will be held at the end of the course
- Other sessions in September and February