**270632 - MGTN - Mechanisms and Game Theory in Networks**

**Coordinating unit:** 270 - FIB - Barcelona School of Informatics  
**Teaching unit:** 701 - DAC - Department of Computer Architecture  
**Academic year:** 2019  
**Degree:** MASTER’S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Teaching unit Optional)  
**ECTS credits:** 6  
**Teaching languages:** English

### Prior skills

None.

### Degree competences to which the subject contributes

**Specific:**
- CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.
- CEE2.2. Capability to understand models, problems and algorithms related to computer networks and to design and evaluate algorithms, protocols and systems that process the complexity of computer communications networks.
- CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

**Transversal:**
- CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

### Teaching methodology

During the initial sessions of each topic, the main results will be explained in the blackboard. The student will solve some exercises to prove their skills in the topic. Finally, there will be some sessions devoted to discuss in the classroom models taken from research papers that apply the related topics.

### Learning objectives of the subject

1. Capacity to formulate a convex optimization problem  
2. Capacity to apply convex optimization to networking problems.  
3. Capacity to understand what game theory is and how a game is solved.  
4. Capacity to apply game theory to networking problems
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 54h 36.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h 0.00%</td>
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<tr>
<td></td>
<td>Hours small group: 0h 0.00%</td>
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<tr>
<td></td>
<td>Guided activities: 0h 0.00%</td>
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<td>Self study: 96h 64.00%</td>
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### Content

#### Convex Optimization basics

**Degree competences to which the content contributes:**

**Description:**
Convex sets, convex functions, convex optimization problems (COP) and duality (Lagrange dual function, KKT optimality conditions), methods for solving COP’s (General Descent Methods, Interior Point Methods)

#### Convex Optimization Applications to networking

**Degree competences to which the content contributes:**

**Description:**
Exxamples on Resource allocation in networks, back-pressure, Power control, Publish-subscribe in DTN, Compressive Sensing.

#### Game Theory basics

**Degree competences to which the content contributes:**

**Description:**
Strategic and Extensive Forms of a Game, Non cooperative Games (Nash pure and mixed equilibria, correlated equilibria), Cooperative Games (core of a game, Shapley values, Nash Arbitration scheme), cost-sharing (Braess Paradox, Price of Anarchy and Stability), Auctions.

#### Game Theory Applications to Networking

**Degree competences to which the content contributes:**

**Description:**
Wireless Networking games, Energy-Efficient Power Control games, pricing, P2P games
### Planning of activities

<table>
<thead>
<tr>
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<th>Hours: 10h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
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<tr>
<td></td>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td></td>
<td>Self study: 0h</td>
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</tbody>
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#### Convex Optimization basics

**Specific objectives:**
1

#### Convex Optimization Applications to Networking

**Specific objectives:**
2

#### Game Theory Basics

**Specific objectives:**
3

#### Game Theory Applications to Networking

**Specific objectives:**
4
Evaluations

| Hours: 5h |
| --- | --- |
| Theory classes: 5h |
| Practical classes: 0h |
| Laboratory classes: 0h |
| Guided activities: 0h |
| Self study: 0h |

Description:
Evaluations: exam and presentation from students

Studying materials and project's realization

| Hours: 0h |
| --- | --- |
| Theory classes: 0h |
| Practical classes: 0h |
| Laboratory classes: 0h |
| Guided activities: 0h |
| Self study: 0h |

Qualification system

The evaluation is based on different activities

- Short projects and presentations in which the student has to deliver and defend the obtained results (P)
- A final exam (FE)

Each of the activities will be evaluated (0=<mark=<10).

The final mark for the course (FM) will be:

FM = 0.60xP + 0.4xFE

Where P = (1/N) x Sum (Pi) with i=1,…N

with Pi the projects and oral presentation mark. There will be a minimum of 2 practical projects and 1 oral presentation.
Bibliography

Basic:


Others resources:

Hyperlink

http://www.stanford.edu/~boyd/cvxbook/