Last update: 06-05-2019

230155 - GXS - Networks and Services Management

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 744 - ENTEL - Department of Network Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: JOAN SERRAT

Others: Juan-Luis Gorricho
Joan Serrat

Teaching methodology

- Descriptive classes
- Lectures by the students to show applications
- Individual work consisting in the search and analysis of bibliography (remote)
- Individual work intended as a means of learning (remote)
- Exercices assigned by teachers (remote)

Learning objectives of the subject

- Understand the nature of problems that solve the management and control of networks and services
- Understand and know how to use the most common optimization techniques in the field of telecommunication networks
- Understand and know how to use the most common techniques of statistical inference
- Understand and know how to use reinforcement learning techniques to solve network management problems

Study load

Total learning time: 150h	Hours large group:	52h	34.67%
	Self study:	98h	65.33%

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Content

1. Introduction to network control and management

Learning time: 25h

Theory classes: 10h
Self study : 15h

Description:
This topic will introduce the management and control of existing telecommunication networks and services. Once the work scenario of the subject has been identified from a global perspective, an introduction will be made to the problems that are commonly presented and how the so-called artificial intelligence techniques can be applied to solve them. Finally, the three major techniques studied in the subject: optimization, statistical inference and reinforcement learning will be presented.

2. Network optimization problems

Learning time: 35h

Theory classes: 14h
Self study : 21h

Description:
In this topic we will study different mathematical tools used to solve optimization problems in telecommunication networks. By optimizing, understood as the efficient use of network resources, we will identify different mathematical models for the use of these networks, among others, the models based on problems of constraint satisfaction, linear programming or combinatorial optimization. The type problems that are most often given in optimization will be identified and numerical exercises will be performed applying the techniques explained in this topic.

3. Probabilistic diagnosis and inference of network behaviours

Learning time: 35h

Theory classes: 14h
Self study : 21h

Description:
In this topic, the behavior of telecommunication networks is studied from a statistical point of view. Starting from a system of statistical sampling of certain network operation parameters, the corresponding probabilistic model will be generated with a set of random variables. The dependence relations between these random variables will be studied to later model the overall behavior of the system through a Bayesian Network. From this Bayesian Network we will study how statistical inferences can be made, such as: the diagnosis of the operation of the network or the forecast of the future behavior of the network when the conditions of operation of the network change.

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4. Reinforcement learning applied to network management	Learning time: 35h Theory classes: 14h Self study : 21h

Description:
This topic will study the reinforcement learning technique applied to network management. This technique consists of modeling the behavior of a telecommunications network as a state machine where each state is characterized by the quantification of a reward function or system performance as a result of being in this state. The reinforcement learning technique involves taking actions or modifying the operating parameters of the system in order to improve the performance of the network. Any action exerted on the system will cause a change of state of the system and therefore obtaining a new reward or performance of the system. The ultimate purpose will be to maximize long-term performance.

Qualification system

There will be two partial exams, one around midterm (C1) and the other at the end (C2). The scope of each exam will be determined later but likely will be half of the matter each. On the other hand the individual homework (TI) will be also evaluated. The grade of continuous evaluation will be 0,7*(C1+C2)/2 + 0,3*TI. If this grade is greater or equal to five the matter will be passed and it won't be necessary the final exam. Otherwise it will be necessary to pass a final exam of the whole program

Bibliography

Basic:

Clemm, A. Network management fundamentals. Cisco Press, 2006. ISBN 1-58720-137-2.

Sutton, R.S.; Barto, A.G. Reinforcement learning: an introduction. Cambridge, MA: MIT Press, 1998. ISBN 0262193981.

Russell, S.; Norvig, P. Artificial intelligence : a modern approach. 3th edition. Prentice Hall, 2016. ISBN 9780136042594.

Winston, W.L. Operations research : applications and algorithms. 4th. ed. Belmont : Brooks/Cole: Thomson Learning, 2004. ISBN 0534423620.