Course guide
270646 - PD - Processor Design

Last modified: 02/02/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: ROGER ESPASA SANS

Others: Segon quadrimestre:
ROGER ESPASA SANS - 10
LEONIDAS KOSMIDIS - 10

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEE4.1. Capability to analyze, evaluate and design computers and to propose new techniques for improvement in its architecture.

Generical:
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.

Transversal:
CTR3. TEAMWORK: Capacity of being able to work as a team member, either as a regular member or performing directive activities, in order to help the development of projects in a pragmatic manner and with sense of responsibility; capability to take into account the available resources.
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.

Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

TEACHING METHODOLOGY

The main concepts of processor architecture will be introduced in the lectures. In the interactive problem-solving classes the students will participate into applying the concepts learned into real world designs. Finally, the students will complete their learning experience with the lab sessions where they will put in practice the concepts learned in the lectures and applied in the problem-solving classes.

LEARNING OBJECTIVES OF THE SUBJECT

1.To understand and implement a simple pipelined processor.
2.To program skillfully in a hardware description language
3.To understand the intricacies of advanced microprocessor structures such as the memory hierarchy, branch prediction, out-of-order execution and multithreading (among other).

STUDY LOAD

Type	Hours	Percentage
Hours large group	54,0	36.00
Self study	96,0	64.00

Total learning time: 150 h

CONTENTS

Historical Perspective

Description:
Description of how processor design has evolved through the technology changes from mechanical devices to the current FinFET transistors.

Technology-Aware Processor Design

Description:
Introduction to the quantification and evaluation of technology-related metrics such as area, power and timing.

Processor Design Cycle and Fabrication

Description:
Description of the VLSI Design stages including an introduction to placement and routing techniques.

Memory Hierarchy

Description:
Introduction to the efficient construction of on-chip memory structures. Design choices. Performance and power consumption.

Modern Processor Architectures

Description:
Description and implementation of state-of-the-art processor architectures such as superscalar, multithreading or chip-multiprocessors

ACTIVITIES

Design and Simulation Tools

Description:
First contact with the circuit design and simulation tools. Introduction to the basic functionalities and components needed to implement a simple microprocessor.

Specific objectives:
1, 2

Related competencies :
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.
CEE4.1. Capability to analyze, evaluate and design computers and to propose new techniques for improvement in its architecture.
CTR3. TEAMWORK: Capacity of being able to work as a team member, either as a regular member or performing directive activities, in order to help the development of projects in a pragmatic manner and with sense of responsibility; capability to take into account the available resources.
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.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

GRADING SYSTEM

The course has three marks:
1) Lab sessions (Lab)
2) Presentation of a research topic (T)

The final mark will be computed as: 0,8 x Lab + 0,2 T

BIBLIOGRAPHY

Basic:
- Johnson, M. Superscalar microprocessor design. Prentice Hall, 1991. ISBN 0138756341.
- Weste, N.H.E.; Harris, D.M. CMOS VLSI design: a circuits and systems perspective. 4th ed. Addison Wesley, 2011. ISBN 9780321547743.
- Hennessy, J.L.; Patterson, D.A. Computer architecture: a quantitative approach. 6th ed. Elsevier/Morgan Kaufmann, 2019. ISBN 9780128119051.
- Wolf, M. High-performance embedded computing: applications in cyber-physical systems and mobile computing. 2nd ed. Elsevier, 2014. ISBN 9780124105119.