Universidad Zaragoza

Academic Year/course: 2023/24

30237 - Multiprocessors

Syllabus Information

Academic year: 2023/24
Subject: 30237 - Multiprocessors
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 439 - Bachelor's Degree in Informatics Engineering
ECTS: 6.0
Year: 3
Semester: Second semester
Subject type:
Module:

1. General information

This subject completes the knowledge in the Degree in Computer Engineering related to the organization and architecture of computers in the context of Computer Engineering. The exploitation of parallelism, both vector and spatial (multiple processors) is in fact the basic lever of all complex digital systems in society: from cell phones to supercomputers, to all kinds of embedded systems, tablets, laptops, desktop computers or data center servers. To this end, we will cover the following contents:

- Present simple code analysis techniques to determine if data parallelism exists.
- Present a vector processor design (organization) that exploits this data parallelism.
- Flynn's taxonomy. Classification of organizations according to their ability to exploit parallelism.
- Analyze and understand the basic building blocks of modern shared-memory multiprocessor design: interconnection network, synchronization, memory model or consistency and coherence model.

Subject requirements

To take this subject it is recommended to have taken the following subjects: Computer Architecture and Organization 1 and 2; Concurrent and Distributed Systems Programming; and Operating Systems.

This subject does not explicitly work on or evaluate any of the Sustainable Development Goals, SDGs, included in the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/)

2. Learning results

- Know the multiprocessor families, identify the main components of a multiprocessor and its functions. Understand coherence and consistency problems and their basic solutions. Get to know the theory and the practice of automatic parallelism extraction.
- Know the organization of commercial multiprocessors, both on-chip and multi-module or multi-board, especially with regard to memory and interconnection network.
- Program simple, but multiprocessor-aware algorithms using a multiprocessor programming standard.

3. Syllabus

Module I: Segmented Vector Processors: supercomputers

1. Introduction. Parallelism
2. Vector extension of an ld/st architecture
3. Two programming aspects: vector length and vector Stride
4. Memory bank access conflicts
5. DLXV architecture: complete repertoire of instructions
6. Vector compilation = automatic extraction of vector operations
7. Final considerations: Amdahl's Law

8. Commercial Vector Processors

Module II: Shared Memory Multiprocessors

1. Classification of parallel computers according to M.J. Flynn
2. Objectives and problems of MIMD machines
3. H.S. Stone's simple model for partitioning processes to processors
4. Shared Memory Multiprocessors. Overview
5. Interconnection network
6. Synchronization Mechanisms
7. Parallel compilation
8. The problem of consistency
9. The memory model
10. Diffusion-based consistency protocols
11. Multilevel cache hierarchy
12. Directory-based consistency protocols

13- Examples of current chips with more than one processor (core)

4. Academic activities

The subject is made up of lectures, problem classes, laboratory practices and non-classroom practical work.

The detailed calendar of the various activities to be carried out will be established once the University has approved the academic calendar for the corresponding academic year. In any case, the dates of the different activities will be announced well in advance on the support platform for face-to-face teaching Moodle 2 of the Digital Ring Docente (http://add.unizar.es) of the University.

5. Assessment system

The assessment will consist of:

- Theory and problems exam (80 - 100 points)
- Practice exam (0-20 points)
    - Optionally, throughout the subject, students can hand in non-classroom work and solved scripts of laboratory. They will be counted in this part of the exam.

In order to pass the subject, students must obtain at least 50 points out of the total.

The delivery of the results of laboratory practices and practical work will be done coinciding with the dates scheduled for the exam in each call.