

Curriculum Reform in Computing in Spain

Sergio Luján Mora



Department of Software and
Computing Systems



Universitat d'Alacant
Universidad de Alicante

Content

- Introduction
- Computing Disciplines
 - Computer Engineering
 - Computer Science
 - Information Systems
 - Information Technology
 - Software Engineering
- Bachelor on Computing
- Master on Computing
- New Teaching Methods

Introduction

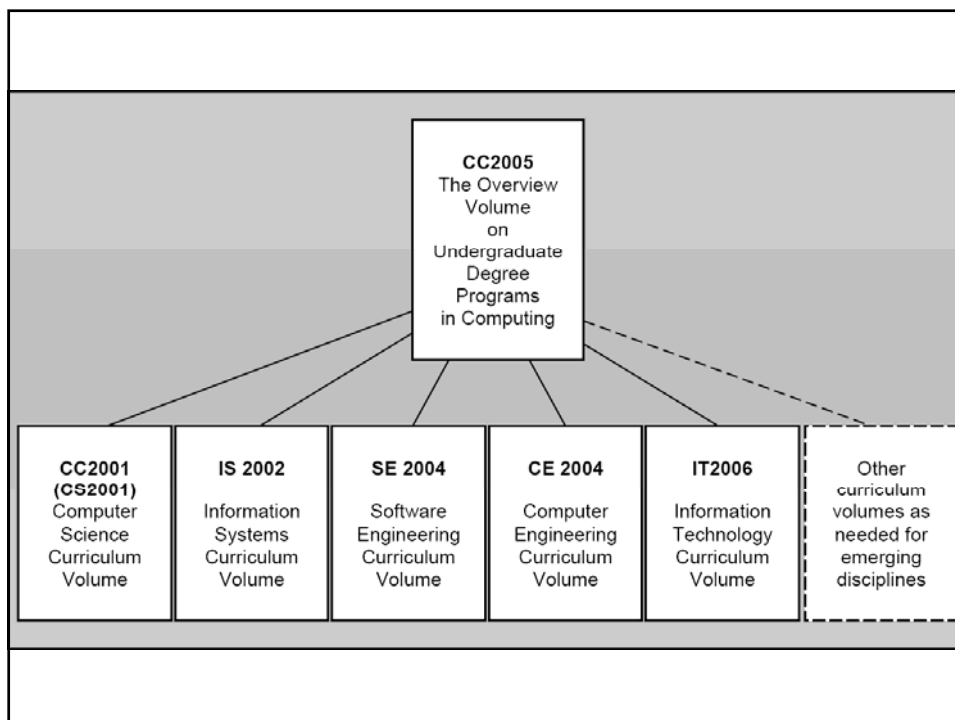
- Computing is a broad discipline that crosses the boundaries between mathematics, science, and engineering
- New computing disciplines emerge over time
- Several reports that define and update guidelines for computing curricula have appeared over the past four decades

Introduction

- *Computing Curricula 2005 (CC2005)*:
 - A cooperative project of:
 - The Association for Computing Machinery (ACM)
 - The Association for Information Systems (AIS)
 - The Computer Society (IEEE-CS)
 - CC2005 is oriented to higher education in the United States and Canada
 - Download from:
 - <http://www.acm.org/education/curricula.html>
 - <http://computer.org/curriculum>

Introduction

- Five discipline-specific volumes:
 - Computer engineering (CE)
 - Computer science (CS)
 - Information systems (IS)
 - Information technology (IT) → New
 - Software engineering (SE)



Introduction

- *CC2005 Overview Report:*
 - Its goal is to provide perspective for those in academia who need to understand what the major computing disciplines are and how the respective undergraduate degree programs compare and complement each other
- *The Guide to Undergraduate Programs in Computing:*
 - This guide will offer guidance to a broader audience, including prospective students, their parents and guidance counselors, and others who have reason to care about the choices that await students who move from high school to college

Computer Engineering

- Spanish: *Ingeniería de computadores*
- Content:
 - The design and construction of computers and computer-based systems
 - It involves the study of hardware, software, communications, and the interaction among them
 - Its curriculum focuses on the theories, principles, and practices of traditional electrical engineering and mathematics and applies them to the problems of designing computers and computer-based devices

Computer Science

- Spanish: *Computación*
- Content:
 - Theoretical and algorithmic foundations
 - Robotics
 - Computer vision
 - Intelligent systems
 - Bioinformatics

Information Systems

- Spanish: *Sistemas de información*
- Content:
 - Its curriculum focuses on integrating information technology solutions and business processes to meet the information needs of businesses and other enterprises, enabling them to achieve their objectives in an effective, efficient way
- Two main degree programs:
 - Computer Information Systems: strong technology focus
 - Management Information Systems: emphasize the organizational and behavioral aspects of IS

Information Technology

- Spanish: *Tecnologías de la información*
- Content:
 - The professional on IT assumes responsibility for selecting hardware and software products appropriate for an organization, integrating those products with organizational needs and infrastructure, and installing, customizing, and maintaining those applications for the organization's computer users

Software Engineering

- Spanish: *Ingeniería del software*
- Content:
 - A foundation in programming fundamentals and basic CS theory
 - Problem modeling and analysis
 - Software design
 - Software verification and validation
 - Software quality
 - Software process
 - Software management

Bachelor on Computing

- **Graduado/a en Ingeniería Informática por la Universidad de Alicante**
- Offers: 240 new students every year

Bachelor on Computing

- 240 ECTS = 4 years
- 1 ECTS = 25 hours } 6000 hours, 1500 hours per year
- Modules:
 - Fundamentals: 60 ECTS
 - Common of computing: 108 ECTS
 - Specific: 48 ECTS
 - Computer Engineering
 - Computer Science
 - Information Systems
 - Information Technology
 - Software Engineering
 - Professional training or English: 12 ECTS
 - Final project: 12 ECTS
- All the subjects: 6 ECTS

Bachelor on Computing

- Fundamentals: (first semester)
 - Mathematics 1 (*Matemáticas 1*)
 - Physics Fundamentals of Computing (*Fundamentos Físicos de la Informática*)
 - Programming 1 (*Programación 1*)
 - Fundamentals of Computers (*Fundamentos de los Computadores*)
 - Information Systems and Technologies (*Sistemas y Tecnologías de Información*)

Bachelor on Computing

- Fundamentals: (second semester)
 - Mathematics 2 (*Matemáticas 2*)
 - Discrete Mathematics (*Matemática Discreta*)
 - Programming 2 (*Programación 2*)
 - Fundamentals of Databases (*Fundamentos de las Bases de Datos*)
 - Statistics (*Estadística*) → Third semester

Bachelor on Computing

- Common of computing:
 - Computer Structures (*Estructura de los Computadores*)
 - Computer Architecture (*Arquitectura de los Computadores*)
 - Computer Engineering (*Ingeniería de los Computadores*)
 - Programming and Data Structures (*Programación y Estructuras de Datos*)
 - Programming 3 (*Programación 3*)
 - Design of Databases (*Diseño de Bases de Datos*)
 - Operating Systems (*Sistemas Operativos*)

Bachelor on Computing

- Common of computing:
 - Computer Networks (*Redes de Computadores*)
 - Administration of Operating Systems and Computer Networks (*Administración de Sistemas Operativos y de Redes de Computadores*)
 - Languages and Programming Paradigms (*Lenguajes y Paradigmas de Programación*)
 - Analysis and Design of Algorithms (*Análisis y Diseño de Algoritmos*)
 - Advanced Tools for Application Development (*Herramientas Avanzadas para el Desarrollo de Aplicaciones*)

Bachelor on Computing

- Common of computing:
 - Distributed Systems (*Sistemas Distribuidos*)
 - Analysis and Specification of Software Systems (*Análisis y Especificación de Sistemas Software*)
 - Intelligent Systems (*Sistemas Inteligentes*)
 - Design of Software Systems (*Diseño de Sistemas Software*)
 - Planning and Validation of Software Systems (*Planificación y Pruebas de Sistemas Software*)
 - Software Projects Management (*Gestión de Proyectos Informáticos*)

Bachelor on Computing

- Specific → **Computer Engineering:**
 - Real-time Systems (*Sistemas de Tiempo Real*)
 - Concurrent Programming (*Programación Concurrente*)
 - Computer and Network Maintenance Engineering (*Ingeniería de Mantenimiento de Computadores y Redes*)
 - Home Automation and Intelligent Environments (*Domótica y Entornos Inteligentes*)
 - Embedded Systems (*Sistemas Embebidos*)
 - Industrial Systems (*Sistemas Industriales*)
 - Software Development for Parallel Architectures (*Desarrollo de Software en Arquitecturas Paralelas*)
 - Automation and Robotics (*Automatización y Robótica*)

Bachelor on Computing

- **Specific → Computer Science:**
 - Computability (*Teoría de la Computación*)
 - Artificial Vision and Robotics (*Visión Artificial y Robótica*)
 - Automatic Reasoning (*Razonamiento Automático*)
 - Interactive Graphic Systems (*Sistemas Gráficos Interactivos*)
 - Programming Challenges (*Desafíos de Programación*)
 - Language Processing (*Procesamiento de Lenguajes*)
 - Use of Information (*Explotación de la Información*)
 - Architecture and Technology of Robots (*Tecnología y Arquitectura Robótica*)

Bachelor on Computing

- **Specific → Information Systems:**
 - Data Processing for Information Systems (*Tratamiento de Datos para Sistemas de Información*)
 - Technology Scenarios in Organizations (*Escenarios Tecnológicos en las Organizaciones*)
 - Information Management (*Gestión de la Información*)
 - Requirements Engineering (*Ingeniería de Requisitos*)
 - Business Intelligence and Process Management (*Inteligencia de Negocio y Gestión de Procesos*)
 - Integration of Applications and Business Processes (*Integración de Aplicaciones y Procesos Empresariales*)
 - Electronic Business Management (*Administración de Negocio Electrónico*)
 - Business Management (*Administración de Empresas*)

Bachelor on Computing

- **Specific → Information Technology:**
 - Security Strategies (*Estrategias de Seguridad*)
 - Management and Government of Information Technologies (*Gestión y Gobierno de las Tecnologías de la Información*)
 - Application Development in Internet (*Desarrollo de Aplicaciones en Internet*)
 - Content and Users Web Management Systems (*Sistemas de Gestión de Contenidos y de Usuarios en la Web*)
 - Management and Implementation of Computer Networks (*Gestión e Implantación de Redes de Computadores*)
 - Administration and Implementation of Internet Services (*Administración e Implantación de Servicios en Internet*)
 - Databases Administration and Management (*Administración y Gestión de Bases de Datos*)
 - Network Interconnection (*Interconexión de Redes*)

Bachelor on Computing

- **Specific → Software Engineering:**
 - Agile Methods of Software Development (*Metodologías Ágiles de Desarrollo de Software*)
 - Security in Software Design (*Seguridad en el Diseño de Software*)
 - Distributed Applications in Internet (*Aplicaciones Distribuidas en Internet*)
 - Advanced Techniques of Software Specification (*Técnicas Avanzadas de Especificación Software*)
 - Software Quality Assurance (*Gestión de Calidad Software*)
 - Collaborative Development of Applications (*Desarrollo Colaborativo de Aplicaciones*)
 - Web Engineering (*Ingeniería Web*)
 - Methods and Technologies of System Integration (*Metodologías y Tecnologías de Integración de Sistemas*)

Master on Computing

- Professional master
- Research master → PhD studies

Master on Computing

- **Máster Oficial en Desarrollo de Aplicaciones y Servicios web (2007)**
 - Masters in the Development of Applications and Web Services (2007) (2007-08)
- Offers: 30 new students every year
- 1 year = 60 ECTS
- 1 ECTS = 25 hours

Master on Computing

- Compulsory:
 - Advanced Programming in .NET
 - Application Servers
 - Databases
 - Design of Applications .NET
 - Systems
 - Distributed Application Project
 - Distributed Applications in .NET
 - Object Oriented Analysis

Master on Computing

- Compulsory:
 - Programming of Mobile Devices
 - Software Architecture of Systems
 - Software Development Methodologies
 - Test and Quality of Software
 - User Interface Design
 - Web Application Project
 - Web Applications in .NET
 - Web Servers
 - XML

Master on Computing

- Optional:
 - Development of Enterprise Resources Planning
 - Development of Mainframe Systems
 - Management of Enterprise Domain Applications
 - New Trends in Internet
 - Advanced Programming in Java
 - Rich Internet Applications

Master on Computing

- **Máster Universitario en Tecnologías de la Informática por la Universidad de Alicante**
- Offers: 40 new students every year
- 1 year = 60 ECTS
- 1 ECTS = 25 hours

Master on Computing

- Modules:
 - Introduction to research method
 - Scientific research method
 - Communication, technical documents and strategies of team work

Master on Computing

- Modules:
 - Artificial intelligent
 - Automatic learning
 - Intelligent system development
 - Learning based on structured data and searching based on similarity
 - Management of musical information
 - Virtual reality
 - Autonomous robots
 - Artificial vision

Master on Computing

- Modules:
 - Human language technologies
 - Human language technologies
 - Intelligent searching of information on the Web
 - Textual information extraction
 - Automatic translation: fundamentals and applications
 - Advanced automatic translation
 - Use and design of ontologies of natural language and semantic web

Master on Computing

- Modules:
 - Internet technologies and data warehouses
 - Quality in the design of web applications
 - Design of data warehouses
 - Advanced software production
 - XML text markup and digital libraries

Master on Computing

- Modules:
 - Infrastructure for the society of information
 - Ubiquitous computing
 - Design of embedded systems
 - Special architectures
 - Parallel programming
 - Cryptographic techniques
 - Advanced computer manufacturing

Master on Computing

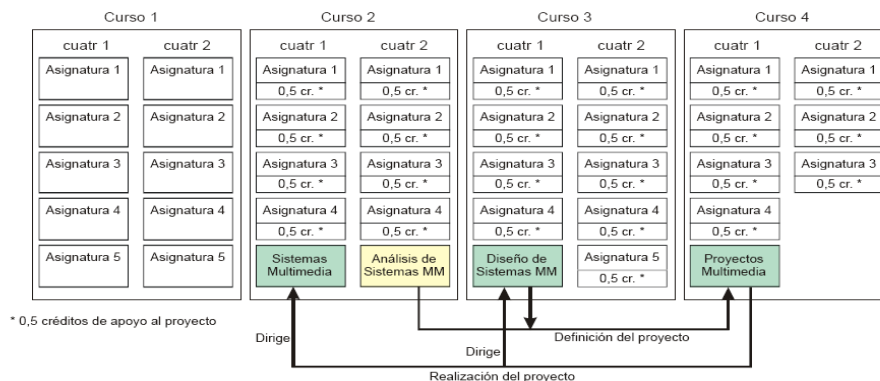
- Modules:
 - Services and applications for the society of information
 - E-business
 - E-home
 - Health care computer systems
 - Interfaces for intelligent systems
 - Cryptography
 - Communication security

New Teaching Methods

- Computing education in the 21st century needs to move beyond the lecture format, supplemented by laboratory sessions, tutorials, etc.
- Alternative approaches can help students learn more effectively
- Some of the approaches that might be considered to supplement or even largely replace the lecture format in certain cases, include:

New Teaching Methods

- **Project based learning:** Based on “problem based learning”, students can integrate much of the material they have learned in different subjects



New Teaching Methods

- **Just-in-time learning:**
 - Teaching fundamental material immediately before teaching the application of that material
 - For example, teaching aspects of mathematics the day before they are applied in a software engineering context
 - There is evidence that this helps students retain the fundamental material, although it can be difficult to accomplish since faculty must co-ordinate across courses
- **Learning by failure:**
 - Students are given a task that they will have difficulty with
 - They are then taught methods that would enable them in future to do the task more easily

New Teaching Methods

- **Self-study materials:**
 - That students work through on their own schedule
 - This includes on-line and computer-based learning
- **Topic expert student:**
 - Research one topic from a list of topics that will be covered in the course
 - Write a summary paper describing their chosen topic
 - Present a 15-20 minute description of their topic to the class
 - Be the class expert on this topic if the class has a question
- **New technologies:**
 - Blogs, wikis, etc.