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ACUERDO ESPECÍFICO DE MOVILIDAD DE ESTUDIANTES EN RÉGIMEN DE INTERCAMBIO ENTRE LA UNIVERSIDAD DE MÁLAGA (ESPAÑA) Y LA UNIVERSIDAD ABDELMALEK ESSAÂDI (MARRUECOS) PARA LA OBTENCIÓN DE TÍTULOS OFICIALES EN AMBAS INSTITUCIONES

En Málaga a XX de XXXX de 2014

REUNIDOS

De una parte, la Universidad de Málaga, representada por la Excm. y Magfca. Rectora, Dra. D^a. Adelaida de la Calle Martín, con domicilio social en el Edificio del Rectorado, Avda. de Cervantes nº 2, 29071, Málaga (España),

Y de otra parte, la Universidad Abdelmalek Essaâdi, representada por el Sr. President D^o Houdaifa Ameziane, con domicilio legal en Avenue Palestine Mhanech II – BP 2117 Tetouan (Marruecos).

Actuando en función de sus respectivos cargos y en el ejercicio de las facultades que tienen conferidas, acuerdan suscribir el presente convenio específico de colaboración que se desarrolla en el marco del Convenio de Colaboración Internacional suscrito entre las Universidades de Málaga (España) y Abdelmalek Essaâdi (Marruecos) con arreglo a las siguientes

CLÁUSULAS

PRIMERA.- Objeto del Convenio.

El objeto del presente Convenio es el establecimiento de un marco de actuación para la colaboración entre la Universidad de Málaga y la la Université Abdelmalek Essaâdi a fin de establecer las condiciones que deben cumplir los estudiantes de las respectivas instituciones para la obtención de los títulos universitarios oficiales de Máster Universitario en Biología Celular y Molecular por la Universidad de Málaga, y de Máster en Bases Cellulaires et Moleculaires en Biotechnologies por la Université Abdelmalek Essaâdi .

SEGUNDA.- Descripción de los títulos.

- 1.- Las titulaciones implicadas en el presente acuerdo son las siguientes:
 - Máster Universitario en Biología Celular y Molecular por la Universidad de Málaga,



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adscrito a la Facultad de Ciencias con una carga lectiva de 60 créditos.

- Máster Universitario en Bases Celulaires et Moleculaires en Biotechnologies, adscrito a la Faculté de Sciences et Techniques (Tanger) con una carga lectiva de 120 créditos

2.- El Máster Universitario en Biología Celular y Molecular por la Universidad de Málaga es un título oficial, verificado e inscrito en el Registro de Universidades, Centros y Títulos del Ministerio de Educación Cultura y Deporte de España conforme a las normas vigentes con nº de registro 4312660. Como Anexo I al presente convenio se incorpora detallado el plan de estudios vigente del citado Máster Universitario.

3.- El Máster en Ciencias y Técnicas en Bases Cellulaires et Moléculaires en Biotechnologies por la Universidad Abdelmalek Essaâdi, Facultad de Ciencias y Técnicas de Tánger es un título oficial nacional registrado en la lista de las cualificaciones nacionales acreditados por el Ministerio de Enseñanza Superior, formación de Ejecutivos e investigación científica, Marruecos. Como Anexo II al presente convenio se incorpora detallado el plan de estudios vigente del citado Máster en Ciencias y Técnicas.

4.- Ambos títulos se corresponden con enseñanzas de posgrado que habilitan en sus correspondientes sistemas educativos para el acceso a los estudios de Doctorado.

TERCERA.- Condiciones.

1.- La admisión de los estudiantes a las titulaciones objeto del presente Convenio, se efectuará con arreglo a las normas reguladoras vigentes en los respectivos regímenes jurídicos. A efectos de facilitar dicha admisión, la oferta general de plazas para dichas titulaciones se reservarán seis plazas para alumnos de nuevo ingreso para cada curso académico.

2.- Solamente podrán cursar la doble titulación quienes acrediten cumplir los requisitos de acceso y admisión fijados en ambos planes de estudios. Los Coordinadores Académicos de ambos Másteres Universitarios, asistidos por las respectivas Comisiones Académicas, a la vista de la documentación y el curriculum académico acreditado por los interesados decidirán acerca de admisión de los candidatos, pudiendo, en su caso, condicionar la admisión a la superación de complementos de formación adicionales.

3.- Las condiciones exigidas a los estudiantes que deseen simultanear estudios y obtener el doble título son las siguientes:

- Haber sido admitido en la oferta específica del doble título.
- Haber formalizado la matrícula, en cada una de las Secretarías de Centro, en



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las asignaturas establecidas en el itinerario curricular.

4- Los alumnos de la Universidad de Málaga con matrícula activa en el correspondiente curso académico, matriculados en el Máster Universitario en Biología Celular y Molecular podrán solicitar acogerse al presente acuerdo siempre y cuando hayan superado, al menos, 30 créditos en el citado Máster Universitario.

5.- Los alumnos de la Université Abdelmalek Essaâdi con matrícula activa en el correspondiente curso académico, matriculados en el Máster Universitario en Bases Cellulaires et Moleculaires en Biotechnologies podrán solicitar acogerse al presente acuerdo siempre y cuando hayan superado, al menos, 90 créditos en el referido Master Universitario.

6.- De no cubrirse las plazas ofertadas por curso académico conforme a lo expuesto en los anteriores apartados 4 y 5 también podrán solicitar acogerse al presente acuerdo los egresados de ambas universidades que se encuentren en posesión de alguno de los dos títulos referidos anteriormente. En este caso, entre la fecha de solicitud de admisión y la de obtención del correspondiente título no podrán haber transcurrido más de tres años.

7- Los alumnos de la Université Abdelmalek Essaâdi acogidos al presente acuerdo deberán obtener, al menos, 30 créditos en el Máster Universitario de Biología Celular y Molecular de la Universidad de Málaga, entre los que se incluirán necesariamente los correspondientes al Trabajo Fin de Máster del perfil investigador (15 ects). Los créditos restantes los obtendrán cursando cualquier otra asignatura ofertada en el Máster.

8- Los alumnos de la Universidad de Málaga acogidos al presente acuerdo deberán realizar, al menos, 30 créditos en el Máster Universitario en Bases Cellulaires et Moleculaires en Biotechnologies de la Université Abdelmalek Essaâdi, entre los que se incluirán necesariamente los correspondientes al "Projet de fin d'études". Los créditos restantes los obtendrán cursando cualquier otra asignatura ofertada en el Máster.

CUARTA.- Marco académico y administrativo.

1.- Corresponderá a cada institución firmante el reconocimiento recíproco y automático de las materias/asignaturas superadas por los estudiantes en la Universidad de origen.

2.- Para el reconocimiento de las materias/asignaturas de los estudiantes se atenderá a lo establecido en las normas reguladores vigentes en la Universidad de Málaga y en la Université Abdelmalek Essaâdi, respetando en todo caso lo dispuesto en el punto anterior. A estos efectos, a la vista del expediente académico de los



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alumnos, corresponderá a la Comisión Académica de cada Máster determinar la equivalencia entre las asignaturas de ambos planes de estudios.

3.- Ambos Centros intercambiarán una certificación oficial del expediente académico de los estudiantes participantes, con el fin de facilitar el proceso de reconocimiento de estudios.

4.- Como Anexo III se incorpora una descripción del sistema de calificaciones aplicado en cada institución así como la equivalencia acordada entre ambos modelos.

5.- El programa de estudios (o acuerdo de aprendizaje) a cursar por cada alumno se concretará en las correspondientes matrículas oficiales que los estudiantes formalizarán en la Secretaría de la Facultad de Ciencias de la Universidad de Málaga y la Secretaría de la Faculté de Sciences et Techniques de la Université Abdelmalek Essaâdi .

6.- En el supuesto de que algún estudiante no obtuviese, en el periodo convenido, los créditos previstos en el correspondiente acuerdo de aprendizaje, la Universidad de acogida posibilitará a los alumnos repetir los exámenes en las respectivas materias/asignaturas de acuerdo con sus normas internas.

7.- La institución de acogida designará, para cada estudiante, un profesor responsable, que será su interlocutor principal durante toda la duración de la estancia. Los estudiantes acogidos se podrán beneficiar de los mismos recursos y medios pedagógicos que cada institución pone a disposición de sus estudiantes.

8.- Durante toda la duración de la estancia en la institución de acogida los estudiantes se someterán a las normas pedagógicas y administrativas de esa institución.

9.- Los estudiantes abonarán las tasas que correspondan por prestación de servicios docentes, administrativos y de expedición de certificaciones y títulos en la Universidad de acogida. Las instituciones podrán solicitar a los estudiantes acogidos un justificante del Seguro Médico.

10.- Al margen de lo referido en el punto anterior, como regla general, los estudiantes seleccionados deberán asumir los gastos ocasionados por:

- a. Los viajes desde la institución de origen hacia la institución de destino.
- b. El alojamiento y manutención.
- c. La gestión de documentación de viaje, etc.
- d. Adquisición de libros y demás material didáctico.

11.- En su caso, la Universidad de acogida facilitará la gestión del alojamiento y de los documentos necesarios para la obtención del visado.



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12.- Ambas instituciones podrán convenir becas y ayudas que faciliten la movilidad de alumnos entre las titulaciones objeto del presente acuerdo.

13.- Los Coordinadores Académicos del doble título son:

- Por el Máster Universitario en Biología Celular y Molecular el profesor Dr. Francisco M. Cánovas.
- Por el Máster Universitario en Bases Cellulaires et Moleculaires en Biotechnologies el profesor Dr. Mohamed Nhiri.

14.- Tras finalizar la estancia del alumno, la institución de acogida remitirá a la institución de origen una certificación oficial de las calificaciones obtenidas por éste, indicando si ha superado la totalidad de las materias/asignaturas incluidas en el acuerdo de aprendizaje. Para ello se establecen como Unidades Administrativas de referencia:

- En la Universidad de Málaga: Decanato Facultad de Ciencias – Campus de Teatinos – CP 29071 - Málaga (España).
- En la Université Abdelmalek Essaâdi: Le décanat de la Faculté des Sciences et Techniques de Tanger, BP. 416, Km 10 ancienne route de l'Aéroport, Tanger (Maroc).

QUINTO.- Entrada en vigor y duración.

Tras la firma del presente acuerdo, su entrada en vigor quedará supeditada a la aprobación por el Consejo de Gobierno de la Universidad de Málaga y el Conseil de la Université Université Abdelmalek Essaâdi del reconocimiento del doble título.

La vigencia será de cuatro cursos académicos con posibilidad de prórrogas iguales renovables tácitamente.

SEXTO.- Modificación del convenio.

Las partes podrán solicitar, por escrito, en cualquier momento, cambios en el presente documento, debiendo ser firmado por los representantes legales de ambas Universidades; en su caso, la aplicación quedará supeditada a su ratificación por el Consejo de Gobierno de la Universidad de Málaga y el Conseil de la Université Université Abdelmalek Essaâdi.

SEPTIMO.- Resolución del convenio

El presente convenio podrá resolverse por algunas de las siguientes causas:

- Por mutuo acuerdo entre las partes.
- Por incumplimiento de las obligaciones pactadas.
- Por decisión unilateral de una de las partes mediante comunicación expresa por escrito a la otra parte con una antelación de 6 meses, entendiéndose que las



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acciones en curso deberán llevarse a término, garantizando que los estudiantes que hubiesen iniciados sus estudios puedan concluirlos.

OCTAVO.- Resolución de controversias

Las partes acuerdan resolver de manera amistosa cualquier controversia que pudiera surgir en la interpretación del presente acuerdo. En el caso de que el desacuerdo no pueda ser resuelto del modo anterior, se nombrará un comité de arbitraje compuesto por un miembro designado por cada una de las partes y otro miembro elegido por mutuo acuerdo.

Las cuestiones litigiosas que pudieran surgir en la interpretación, modificación, efectos o resolución del presente convenio, y que no hayan sido resueltas de mutuo acuerdo por las partes o, en su caso, por el comité de arbitraje previsto en el mismo, serán sometidas a la consideración del Consejo de Gobierno de la Universidad de Málaga y el Conseil de la Université Université Abdelmalek Essaâdi.

Y en prueba de conformidad de cuanto antecede firman por duplicado el presente documento, del que cada institución ha recibido un ejemplar, en el lugar y fecha arriba indicados.

POR LA UNIVERSIDAD DE MALAGA

POR LA UNIVERSITÉ ABDELMALEK ESSAÂDI

D^a. Adelaida de la Calle Martín
Rectora.

D^o. Houdaifa Ameziane
Président.



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ANEXO I. Plan de estudios vigente del Master en Biología Celular y Molecular, Malaga
ANNEXE I. Programme d'études du Master "Biología Celular y Molecular"- Malaga

Módulo	Materia	Asignatura	ECTS
I.- Avances en Biología Celular y Molecular	Avances en Biología Celular y Molecular	Avances en Biología Celular y Molecular (Oblig.) -2º semestre-	5
II.- MÓDULO DE TÉCNICA S EXPERIM ENTALES	TÉCNICAS EXPERIMENTALES EN BIOLOGÍA CELULAR Y MOLECULAR I	TÉCNICAS EXPERIMENTALES EN BIOLOGÍA CELULAR Y MOLECULAR I -1º semestre-	3
	TÉCNICAS EXPERIMENTALES EN BIOLOGÍA CELULAR Y MOLECULAR II	TÉCNICAS EXPERIMENTALES EN BIOLOGÍA CELULAR Y MOLECULAR II -1º semestre-	3
	TÉCNICAS EXPERIMENTALES EN BIOLOGÍA CELULAR Y MOLECULAR III	TÉCNICAS EXPERIMENTALES EN BIOLOGÍA CELULAR Y MOLECULAR III -1º semestre-	3
III. MÓDULO DE ESPECIALIZACIÓN	ANÁLISIS Y MODELIZACIÓN DE SISTEMAS BIOLÓGICOS COMPLEJOS	ANÁLISIS Y MODELIZACIÓN DE SISTEMAS BIOLÓGICOS COMPLEJOS -2º semestre-	4
	BASES CELULARES Y MOLECULARES DE LA CONDUCTA, APRENDIZAJE Y MEMORIA	BASES CELULARES Y MOLECULARES DE LA CONDUCTA, APRENDIZAJE Y MEMORIA -2º semestre-	4
	BIOINFORMÁTICA	BIOINFORMÁTICA -2º semestre-	4
	BIOLOGÍA CELULAR	BIOLOGÍA CELULAR -1º semestre-	5
	BIOLOGÍA CELULAR Y MOLECULAR DE LA INTERACCIÓN MICROORG.- HUÉSPED	BIOLOGÍA CELULAR Y MOLECULAR DE LA INTERACCIÓN MICROORG.- HUÉSPED -2º semestre-	5
	BIOLOGÍA DEL DESARROLLO	BIOLOGÍA DEL DESARROLLO -1º semestre-	5
	BIOLOGÍA	BIOLOGÍA MOLECULAR -1º	5



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	MOLECULAR	semestre-	
	BIOLOGÍA MOLECULAR Y BIOTECNOLOGÍA DE PLANTAS	BIOLOGÍA MOLECULAR Y BIOTECNOLOGÍA DE PLANTAS -1º semestre-	4
	DESARROLLO DEL SISTEMA NERVIOSO	DESARROLLO DEL SISTEMA NERVIOSO -2º semestre-	4
	GENÓMICA ESTRUCTURAL Y FUNCIONAL	GENÓMICA ESTRUCTURAL Y FUNCIONAL -2º semestre-	5
	NEUROBIOLOGÍA CELULAR	NEUROBIOLOGÍA CELULAR -1º semestre-	4
	PATOLOGÍAS DE ESPECIES ACUÍCOLAS CULTIVADAS	PATOLOGÍAS DE ESPECIES ACUÍCOLAS CULTIVADAS -1º semestre-	4
	PATOLOGÍAS MICROBIANAS DE PLANTAS	PATOLOGÍAS MICROBIANAS DE PLANTAS -2º semestre-	4
	TECNOLOGÍA DEL DNA RECOMBINANTE	TECNOLOGÍA DEL DNA RECOMBINANTE -2º semestre-	4
IV. TRABAJO FIN DE MASTER	TRABAJO FIN DE MASTER (ITINERARIO INVESTIGADOR)	TRABAJO FIN DE MASTER (ITINERARIO INVESTIGADOR) -2º semestre-	15
	TRABAJO FIN DE MASTER (ITINERARIO ACADÉMICO)	TRABAJO FIN DE MASTER (ITINERARIO ACADÉMICO) -2º semestre-	6



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ANEXO II. Plan de estudios vigente del Master en “Bases Cellulaires et Moléculaires en Biotechnologies; MBCMB”. Tanger

ANNEXE II. Programme d’études du Master Bases Cellulaires et Moléculaires en Biotechnologies; MBCMB. Tanger

		Descriptifs des modules		ECTS
		Code du module	Intitulé du module	
Tronc commun	S1	BCMB1	Techniques Expérimentales en Biotechnologie	5
		BCMB2	Biologie Moléculaire	5
		BCMB3	Technologie d’ADN recombinant	5
		BCMB4	Communication cellulaire et voies de signalisation	5
		BCMB5	Bioinformatique	5
		BCMB6	Du protocole expérimental à la rédaction scientifique	5
	S2	BCMB7	Microbiologie Appliquée	5
		BCMB8	Génomique	5
		BCMB9	Concepts de Base en Génétique Quantitative	5
		BCMB10	Protéomique	5
		BCMB11	Technologie de transformation et de valorisation des bio-ressources	5
		BCMB12	Système de Management intégré QSE	5
Option Végétale	S3	BCMB13	Avancées en Biotechnologies	5
		BCMB14V	Techniques d’amélioration et de sélection chez les plantes	5
		BCMB15V	Pathologie microbienne des plantes	5
		BCMB16V	Biochimie Intégrative du Végétal	5
		BCMB17V	Interaction plantes-microorganismes	5
		BCMB18V	Lutte biologique et Protection Intégrée des plantes	5
Option Animale	S3	BCMB13	Avancées en Biotechnologies	5
		BCMB14A	Neurobiologie Cellulaire	5
		BCMB15A	Biologie de développement	5
		BCMB16A	Techniques d’amélioration et de sélection chez les animaux	5
		BCMB17A	Thérapie Cellulaire	5
		BCMB18A	Pathologies et génétique moléculaire	5
S4		PFE	Projet de fin d’études	30



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Anexo III- Descripción del sistema de calificaciones aplicado en cada institución y equivalencia acordada entre ambos modelos.

TABLA DE EQUIVALENCIA DE CALIFICACIONES SISTEMA UNIVERSITARIO ESPAÑOL Y SISTEMA UNIVERSITARIO DE MARRUECOS

Máster en Derecho Penal y Política Criminal Universidad de Málaga	Master Bases Cellulaires et Moléculaires en Biotechnologies. Universite Abdelmalek Essaâdi
0-4,9: Suspenso (SS).	Non Validé (NV)
5,0-6,9: Aprobado (AP)	Passable (P)
7,0-8,9: Notable (NT).	Assez Bien (AB)
9,0-10: Sobresaliente (SB)	Bien (B)
(10) Matrícula de Honor	Très Bien (TB)



ANNEXES

**to the Inter-University Cooperation Agreement
Between the University of Pisa (Italy) and the University of Malaga (Spain)
for Issuing a Double Master's Degree**

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ANNEX A - STRUCTURE AND CONTENTS OF THE “LAUREA MAGISTRALE IN INFORMATICA” AT THE UNIVERSITY OF PISA

OVERALL STRUCTURE

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Advanced Programming	9
Principles of programming languages	9
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Advanced Databases	9
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STRUCTURE AND CONTENTS OF THE FIRST YEAR AT THE UNIVERSITY OF PISA

Course Title	Aims and Contents	Cred.	Sem.
Advanced Algorithms	In this course we will study, design and analyze advanced algorithms and data structures for the efficient solution of combinatorial problems involving all basic data types, such as integers, strings, (geometric) points, trees and graphs. This course deepens and extends the algorithmic notions of students. The syllabus is structured to highlight the applicative scenarios in which the studied algorithms and data structures can be successfully applied. The level of detail with which each argument will be dealt with can change year-by-year, and will be decided according to requests coming from other courses and/or specific issues arising in, possibly novel, applicative scenarios.	9	1
Advanced programming	The objectives of this course are: to provide the students with a deep understanding of how high level programming concepts and metaphors map into executable systems and which are their costs and limitations to acquaint the students with modern principles, techniques, and best practices of sophisticated software construction to introduce the students to techniques of programming at higher abstraction levels, in particular generative programming, component programming and web computing to present state-of-the-art frameworks incorporating these techniques. This course focuses on the quality issues pertaining to detailed design and coding, such as reliability, performance, adaptability and integrability into larger systems.	9	1



Principles of programming languages	The objective of the course is to introduce principles and techniques for the implementation of programming languages. We introduce theory, principles and techniques to generate efficient tools that map programs into executable code. We then analyse different language paradigms, by illustrating examples of semantics-based techniques that can be exploited in the implementations of languages.	9	1&2
Numerical methods and optimization	The aim of the course is to introduce some of the main techniques and methodologies for the solution of numerical problems. These methods often require the joint exploitation of the typical techniques of numerical analysis and of optimization algorithms. We show some of the main situations in which optimization methods are applied to solve numerical analysis problems, and, vice versa, some of the main situations in which numerical analysis techniques are essential to solve optimization problems. We also discuss the application of these methods to some specific problems chosen e.g. in the following areas: regression and parameter estimation in statistics, approximation and data fitting, machine learning, data mining, image and signal reconstruction, economic equilibria and finance.	12	1&2
Advanced databases	The course first describes some advanced data models. The notion of semi-structured data is presented, together with some data models to deal with this kind of data. Specific attention is dedicated to the XQuery and XPath Data Model, and to the XQuery language. The RDF language and the OWL logic are presented as a notable example of a formalism to describe ontologies. Then, the course presents the main approaches to the implementation of centralized relational database systems. Particular attention will be paid to the fundamental concepts about relational database systems architecture, the main structures and algorithms to implement the modules for the management of permanent memory, the buffer, the storage structures, the access methods, the transactions and recovery, the concurrency, the cost-based query optimization. The final part of the course is dedicated to the approaches to physical database design and tuning to ensure the application performance desired.	9	2
Computing Models	We introduce the principles of operational semantics, the principles of denotational semantics, and the techniques to relate one to the other for an imperative language and for a higher order functional language. Operational and observational semantics of two process description languages (CCS and pi-calculus) is also presented. Finally, we consider operational nondeterministic models with	9	2



	discrete probabilities, and we present them from the perspective of probabilistic automata.		
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STRUCTURE AND CONTENTS OF THE SECOND YEAR AT THE UNIVERSITY OF PISA

Course Title	Aims and Contents	Cred.	Sem.
Distributed Systems	The course covers the programming models and the paradigms used with distributed and parallel systems, for both the application and support tool software. Taking into account structured programming models (algorithmical skeletons, parallel design patterns) as well as those models based on components and services, all the problems related to the functional (expressive power, modularity and reuse) and non functional (performance, fault tolerance, adaptivity) concerns will be considered. In the last part protocols, features and issues related to wireless, tolerance, adaptivity) concerns will be considered. In the last part protocols, features and issues related to wireless, multimedia and peer-to-peer architectures will be introduced along with the implications related to their usage to implement parallel/distributed applications.	9	1
Subsidiary courses	Students must submit a plan of study (to be approved by the MS Degree Council), where they indicate the subsidiary courses they would like to take. Every year different subsidiary courses are offered by the MS In the CS. The list of subsidiary course that will be offered by the MS in CS in a.y. 2014/2015 is reported below. Students can also propose the inclusion of other courses offered by other MS degrees, such as the other three MS degrees offered by the Department of Computer Science (http://www.di.unipi.it/en/education) or by other Departments.	18	1&2
"Free choice" courses	Students must submit a plan of study (to be approved the MS Degree Council), where they indicate the "free choice" courses they would like to take.	12	1&2
Master's Thesis		24	2

List of subsidiary courses that will be offered by the MS in CS during a.y. 2014/2015

Course Title	Aims and Contents	Cred.	Sem.
Introduction to 3D computer graphics	Basic principles and techniques of 3D Computer Graphics. - learn the principles and commonly used techniques of computer graphics, e.g., the graphics pipeline. - develop a facility with the relevant mathematics, e.g., 3D rotations using both vector	6	1



	algebra - gain introductory proficiencies with OpenGL, the most widely used platform-independent API.		
Mobile ad hoc networks and wireless sensor networks	The course aims at providing knowledge on mobile ad hoc, mesh, and sensor networks, by describing their organizations models and architectures, and by presenting the main design and implementation issues. The course presents the main issues at the MAC, network, transport, and application layers. In particular it gives emphasis to the issues in routing, energy management, topology control, and data management. It also presents some specific applications for wireless sensor networks, such as localization and tracking, and the problem of integration of wireless sensor networks in context aware systems or in other networks. Finally the course presents some standards, such as 802.11X, 802.15.x, Bluetooth and Zigbee, and gives some examples of commercial platforms for wireless sensor networks.	6	2
Foundations of Machine Learning	We introduce the principles and the critical analysis of the main paradigms for learning from data and their applications. The concepts are progressively introduced starting from simpler approaches up to the state-of-the-art models in the general conceptual framework of modern machine learning. The course focuses on the critical analysis of the characteristics for the design and use of the algorithms for learning functions from examples and for the experimental modelization and evaluation.	6	1
Peer to Peer Systems	The Course introduces a set of formal tools and techniques for the project and the realization of Peer to Peer Systems. The first part of the course is related to the presentation of the structured (in particular Distributed Hash Tables) and unstructured P2P overlays. The formalism of Markov chains is introduced to allow a rigorous analysis of the structured overlays. Furthermore some real case studies are presented (Kad, Dynamo). The peer to peer systems are laso studied from the point of view of the complex network analysis (small worlds and scale free networks). The gossip approach is presented and finally, in the last part of the course, content distributed networks are presented with reference to a set of case studies (Bittorrent, Spotify). Some highly scalable simulators for P2P system will also be presented.	6	1
Signal and image processing	The objective of the course is to describe basic methods of signal processing, in both the time and the frequency domain, and of image processing. At the end of the course, students should be able to apply these methods to various contexts for various practical and theoretical purposes. The analysis of	6	1



	one-dimensional signals will be centered on the Discrete Fourier Transform, while, with regard to images, morphological methods and segmentation methods will be described in addition to those based on the two-dimensional Fourier Transform.		
Design patterns	The design patterns defines a project technique that exploits the re-use of well known and verified schemas. The course presents the fundamental principles of object oriented programming and presents in detail the Design Patterns à la GoF (composite, strategy, decorator, abstract factory, command, etc.) showing motivations, structure and implementation aspects.	6	1
Natural language processing	Understanding the field of natural language processing, the main techniques, the algorithms and software architectures used in its applications. Ability to design, implement and evaluate natural language processing systems.	6	2
Algorithms for bioinformatics	The course focuses both on theoretical and combinatorial aspects of algorithmical problems that raise from applications in molecular biology, as well as on practical issues such as whole genomes sequencing and the consequent assembly task, sequences alignments, the inference of repeated patterns and of long approximated repetitions, and several biologically relevant problems for the management and investigation of genomic data.	6	2
Static analysis techniques	The goal of this course is to communicate how static analysis techniques can be applied throughout the software lifecycle to increase the effectiveness of software engineers. Students can better understand how to reason about programs and the benefits and limitations of various static analysis techniques. The course will cover static analysis techniques that can be used across the software lifecycle. Topics include not just analysis for correctness, but also analysis techniques for quality attributes such as security, reliability, performance (including realtime), memory usage, and evolvability. Students will become familiar with several analysis tools developed in academia and industry, both through readings in the research literature and practical experience trying out one or more tools.	6	2
Semantics and type theory	Some basic properties of models of computation are studied, like operational and abstract semantics, typing, higher order, concurrency, interaction. Algebraic semantics and elementary category theory are employed, but no prerequisites are required except for some elementary knowledge of logic and algebra.	6	2
Information retrieval	[shared from the MS in Computer Science and Networking] In this course we will study, design and analyze	6	1

	(theoretically and experimentally) software tools for IR-applications dealing with unstructured (raw data), structured (DB-centric) or semi-structured data (i.e. HTML, XML). We will mainly concentrate on the basic components of a modern Web search engine, by examining in detail the algorithmic solutions currently adopted to implement its main software modules. We will also discuss their performance and/or computational limitations, as well as introduce measures for evaluating their efficiency and efficacy. Finally, we will survey some algorithmic techniques which are frequently adopted in the design of IR-tools managing large datasets.		
Data mining: foundations	[shared from the MS in Business Informatics] Recent tremendous technical advances in processing power, storage capacity, and interconnectivity are creating unprecedented quantities of digital data. Data mining, the science of extracting useful knowledge from such huge data repositories, has emerged as an interdisciplinary field in computer science. Data mining techniques have been widely applied to problems in industry, science, engineering and government, and it is believed that data mining will have profound impact on our society. The objective of this course is to provide an introduction to the basic concepts of data mining and the knowledge discovery process, and associated analytical models and algorithms;	6	1
Parallel and distributed algorithms	[shared from the MS in Computer Science and Networking] The goal of the course is to introduce the main algorithmic techniques in the framework of parallel and distributed models of computing; to define the most significant complexity parameters and the computational limits of parallelism and concurrency. Finally computational tools to design and analyze parallel and distributed algorithms are given.		1
ITC risk analysis	[shared from the MS in Computer Science and Networking] The course introduces the main concepts and methodologies to analyze an ICT system from a security perspective and to increase the security offered by the system. A systemic approach is adopted where security is seen as an emergent properties starting from the OS layer.	6	2
Software services	[shared from the MS in Computer Science and Networking] The overall objective of the course is to introduce some of the main aspects of the design, analysis, and development of software services. After introducing the core standards of Web services, the course focuses on service composition as one of the	6	1



	<p>key aspects of service-oriented architectures, and the use of workflow languages supporting the specification and the execution of business processes is illustrated. The role of business process analysis is discussed, and some examples of modelling and analyses of business processes are illustrated. The advantages of enhanced service descriptions including policies and behavioural information, and the role of service agreements are also discussed. Finally, some of the currently emerging technologies - in particular RESTful and cloud-based services- are introduced.</p>		
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ANNEX B - STRUCTURE AND CONTENTS OF THE “MASTER UNIVERSITARIO EN INGENIERIA INFORMÁTICA” AT THE UNIVERSIDAD DE MÁLAGA

OVERALL STRUCTURE

FIRST YEAR	60
Research, Innovation and Technology Management	4,5
Integrated Management for Software Development	6
Deployment of Software Development Methodology	6
Qualitative and Quantitative Software Quality	4,5
Systems Architecture	6
Logic based Systems and Services	3
Information System and Technology Strategy Management	7,5
Security in Information Systems	4,5
High Performance and Embedded Architectures	6
Uncertainty Handling in Intelligent Systems	6
Graphics and Multimedia Systems	6
SECOND YEAR	30
<i>Optative courses</i>	18
Master's thesis	12

STRUCTURE AND CONTENTS OF THE FIRST YEAR AT THE UNIVERSIDAD DE MÁLAGA

Course Title	Aims and Contents	Cred.	Sem.
Research, Innovation and Technology Management	This course focuses on the knowledge and skills aimed at training the relevant technological knowledge responsible for the management and leadership of innovation projects, defining standards for the company and managing relationships with other agencies and businesses.	4,5	1
Integrated Management for Software Development	General principles (patterns traceability, infrastructures for a Software Factory) and tools (management of business goals, requirements, risks, etc..). Implementation, integration and interoperability of technology solutions. Project planning. Managers tasks, incidents and bugs. Estimation tools. Planning techniques. Monitoring and control of development: code repositories, software versioning, testing, integration and automation, analysis and code optimization.	6,0	1
Deployment of Software Development Methodology	The cycle of life and development methodologies: cases of success and failure. Appropriateness of the methodologies to the problem (environment, size, etc). Methodologies and orthogonal use in software development: development and cascading spiral, unified process; iterative and incremental development; agile methodologies; lean Development, etc. Process models.	6,0	1
Qualitative and Quantitative Software Quality	This course focuses on various quantitative and qualitative aspects of software quality. From a	4,5	1



	qualitative point of view: theoretical frameworks; current quality models for both the software product and software development process; mission and mechanisms of certification. From a quantitative point of view: use of measures for estimating the effort required in software development; software testing and techniques and tools for automatic generation of test cases.		
Systems Architecture	This course provides students with an in depth knowledge of the distributed infrastructure. In particular, aspects of design, evaluation, configuration, deployment and management of distributed architectures will be discussed, including servers, storage, networking and software system to meet design requirements. The aim is to train the student in the knowledge and skills of a systems architect.	6,0	1
Logic based Systems and Services	This course will provide students with an in depth knowledge of the fundamentals and the main logic based techniques currently employed for the development of applications and intelligent systems and knowledge-based systems. All this will be implemented in the exposure of real examples of applications and systems, however, the emphasis is not placed on these, but the underlying concepts and techniques.	3,0	1

Course Title	Aims and Contents	Cred.	Sem
Information System and Technology Strategy Management	Students will acquire skills for making long-term technological decisions. Especially important is to equip students with tools to decide between different products that constitute major software acquisitions for a large company and mark its strategy, the dependencies between them, prioritization, etc.	7,5	2
Security in Information Systems	The course aims to introduce students to the world of computer security: policies, regulations and existing security certifications area. In addition the students will specialize in those security technologies that are considered more advanced, paying special attention to the analysis, design and verification of security protocols, but without neglecting aspects such as privacy and anonymity. Also the work of the computer expert and the most common forensic technique and the work of the consultant or auditor security will be presented.	4,5	2
High Performance and Embedded Architectures	This course consists of two main parts. In the first part, the course provides the student with a thorough knowledge of the design and evaluation of High-Performance architectures and the systematic development of applications for these architectures. The characteristics of the systems and High Performance computing techniques for exploitation	6,0	2

	will be discussed. The second part will cover the design of embedded and ubiquitous architectures, with emphasis on distributed systems. Also, methods and tools for developing applications in these systems are studied.		
Uncertainty Handling in Intelligent Systems	This course will provide students with an in depth knowledge of the fundamentals and key statistics and probabilistic techniques currently employed for the development of applications and intelligent systems and knowledge-based systems. Real examples of applications and systems will be used to illustrate the underlying concepts and techniques.	6,0	2
Graphics and Multimedia Systems	The course provides the student with a thorough knowledge of the design and evaluation of computer graphics architectures, as well as methods and tools for the development of graphics applications. They also discuss techniques for the design of virtual environments. Also the management and distribution of multimedia content is illustrated. In addition, the requirements imposed by these multimedia applications and systems in hardware (especially, Storage and Networking), are studied.	6,0	2

STRUCTURE AND CONTENTS OF THE SECOND YEAR AT THE UNIVERSIDAD DE MÁLAGA

Course Title	Aims and Contents	Cred.	Sem.
Subsidiary courses	Every year different subsidiary courses are offered by the MS In the CS among the ones provided in the list reported below.	18	1&2
Master's Thesis		12	1&2

List of possible subsidiary courses that may be offered by the MS in CS at UMA

Course Title	Aims and Contents	Cred.	Sem.
Big Data Analysis	In this course the problems of Big Data and its application to data analysis environment of high performance computing are addressed.	4,5	TBD
The Web of Data	This course studies open data and standards for for publication. The concept of Linked Data, the standard RDF and the SPARQL language will be covered. Finally, semantic integration techniques for open data will be studied.	4,5	TBD
Techniques and Methodologies of Intrusion and Defense of Information Systems	The course will focus on presenting the student with the various phases that can divide a computer intrusion and the different types of attacks depending on the objectives and the methods used. Special emphasis will be placed on approaching and inventory techniques, focusing on locating attack targets based on their level of protection, network	4,5	TBD



	topologies as well as other valuable information on the target victim. It also will emphasize software attacks and particularly the tools to exploit vulnerabilities will w be presented.		
High Performance Software Design	This course provides students with an in depth knowledge of the software for designing and optimizing the different levels of parallelism available on modern architectures based on multi-core processors. Different types of parallelism available at the architectural level as well as programming tools best known to exploit such parallelism at the application level will be analyzed. Also, the most important tools for performance analysis and debugging of parallel programs will be studied.	4,5	TBD
Architecture and Programming for Mobile Devices.	This course addresses the architecture of the processors that incorporate mobile devices (smart-phones, tablets, etc.) as well as it enables students to optimize the performance of applications on these architectures and algorithms. The contents cover: Architectures for low power devices; Limitations due to low power consumption; Programming of low consumption; Tools and software development environments for mobile processors, profilers, compilers, debuggers, libraries; Considerations operating system level	4,5	TBD
Cloud Computing	This course is aimed at introducing the fundamentals and technologies enabling the exploitation of what is called Cloud Computing (Cloud Computing). The three levels of development are distinguished: IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (software as a service). For each case, the most relevant aspects will be detailed, from virtualization issues to cloud services offer, including the development of applications in the cloud. Legal issues associated with this scenario as well as the various existing business models will also be discussed.	4,5	TBD
Software for mobile networks	The course offers a specialization in software protocols and technologies for the different elements of the mobile networks. It will cover mobile network architectures, such as LTE, ongoing extensions (such as use in critical services or direct communication between mobile devices). It also covers technologies for the design, implementation and testing of software elements of the network access and the core network, as well as the use of the APIs to access network settings from mobile devices.	4,5	TBD
Smart Cities	This course will introduce the fundamentals as well as the communication technologies that enable the creation and management of intelligent services in the cities of the future (Smart Cities). For it, firstly will be provided a comprehensive study of the city from the point of view of ICT, focusing on existing technological solutions as well as in the description of	4,5	TBD

	the development opportunities for computing engineering in the near future.		
Computational Intelligence in Biomedicine	The goal of this course is to provide specific training in the field of application of intelligent analysis and data mining of clinical and bioinformatics systems nature. The content of this field covers the different stages in the process of knowledge discovery (KDD) with application to current problems in biomedicine. It begins with the preparation phase of the data, ie cleaning, filtering and organizing data for proper application of mining techniques and modeling. It continues with the construction of predictive models applied in decision -making in clinical practice to identify risk factors for certain diseases. Later statistical techniques that allow modeling and computational problems are studied: survival analysis, and the potential of ultra - sequencing technologies in personalized medicine are discussed. It concludes with the study of appropriate signal processing and biomedical imaging and its integration in decision supporting clinical diagnostics.	4,5	TBD
Intelligent Techniques for the Web	Current web is characterized by the generation and management of large volumes of data on transactions and items offered. This large volume of data requires AI techniques to provide users with personalized, safe and adapted services. The main objective of this course is to address the design and implementation of web applications capable of retrieving information intelligently, recommending items tailored to the preferences of each user, identifying suspicious transactions, etc.	4,5	TBD
Autonomous Robotic Systems	This course presents a global view and an applied approach not only to study autonomous robots but the also the technology used in this area. This area of study is emerging strongly in a variety of fields such as self-guided vehicles, the driver assistance, robots entertainment, robotic tele-presence, etc.	4,5	TBD
Virtual and Augmented Reality Systems	This course introduces the fundamentals and technologies that enable the exploitation of what is called mixed reality. Mixed Reality covers a spectrum of interaction paradigms ranging from virtual reality (which immerses the user in a virtual world) to the augmented reality (that enhances the real world with virtual elements). Both paradigms will be studied: their technologies, systems architectures and applications will be studied. Specific issues related to these technologies, human factors and design and evaluation methodologies will also be discussed.	4,5	TBD



ANNEX C - REQUIREMENTS TO OBTAIN THE DOUBLE DEGREE

To get the double degree, students must follow one of the following study plan templates. Each study plan must be approved by the two Universities.

FIRST YEAR AT UNIPI	57
Advanced Algorithms	9
Advanced Programming	9
Principles of programming languages	9
Numerical Methods and Optimization	12
Advanced Databases	9
Computing Models	9
SECOND YEAR AT UMA	63
Research, Innovation and Technology Management	4,5
Integrated Management for Software Development	6
Deployment of Software Development Methodology	6
Systems Architecture	6
<i>Optative courses</i>	9
Information System and Technology Strategy Management	7,5
Master's thesis ⁽¹⁾	24
FIRST YEAR AT UMA	
60	
Research, Innovation and Technology Management	4,5
Integrated Management for Software Development	6
Deployment of Software Development Methodology	6
Qualitative and Quantitative Software Quality	4,5
Systems Architecture	6
Logic based Systems and Services	3
Information System and Technology Strategy Management	7,5
Security in Information Systems	4,5
High Performance and Embedded Architectures	6
Uncertainty Handling in Intelligent Systems	6
Graphics and Multimedia Systems	6
SECOND YEAR AT UPI	60
18 ECTS from the following list: <ul style="list-style-type: none"> - Advanced algorithms - Advanced programming - Principles of programming languages - Advanced databases - Computing models and 6 ECTS from the set of subsidiary courses or 12 ECTS of Numerical Methods and Optimization and 12 ECTS from the set of subsidiary courses	24
"Free choice" courses ⁽²⁾	12
Master's thesis ⁽¹⁾	24

⁽¹⁾ Each thesis will be co-tutored by one supervisor from the University of Pisa and one supervisor from the University of Malaga.

⁽²⁾ The University of Pisa can recognize these 12 credits to students who acquired a 4-year BS Degree in Computer Science, in Computer Engineering, in Software Engineering, or similar.