UNIVERSITÀ DI PISA
Dipartimento di Informatica

Master's degree program in
Business Informatics
(2 years, 120 ECTS)

Study plan rules ("Regolamento") and students' guide
Starting from Academic Year 2016/17

Contact for information
businessinformatics@di.unipi.it

Web site
http://www.di.unipi.it/it/didattica/wbi-lm

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Preamble

The two years master's degree program *Business Informatics* is designed to prepare graduates both to master the information technologies and to understand the needs of organizations with a specific training in *Business Intelligence* and *Data Science* for decision support.

Only a *subset* of the courses of the Business Informatics degree are taught in English, namely those marked with an asterisk in this document. **The other courses are taught in *Italian***.

Students *with* a bachelor degree in Computer Science or Computer Engineering must attend mandatory *bachelor program basic courses* for at least 18 ETCS in the economics area offered by the Department of Economics in *Italian*, as it happens at the University of Pisa for all the bachelor program courses.

Students *without* a Bachelor Degree in Computer Science or in Computer Engineering, if admitted, will have a study plan which include mandatory *bachelor program basic courses* offered in *Italian* both in the economics area, for at least 18 ETCS, and in the basic computer science area, for at least 36 ETCS (e.g. computer programming, algorithms, logic, and databases).

Therefore, applicants must demonstrate knowledge of basic Italian, or, if their application is accepted, they must take an Italian language entry test or to attend a course on Italian during the first semester.

The master's degree program requires a solid background, high motivation, and hard working attitude. Concept abstraction, problem solving, formal modeling, mathematical reasoning, and basic concepts on computer programming and databases are essential characteristics that you should possess. Students shall not underestimate this advice: statistics on students' careers show that 1/5 of students gives no exam during the first year, and 1/4 withdraw within the first year.

The *assessment* of a course consists usually of a written and an oral exam. In the written exam, the student must demonstrate the use of knowledge of the course contents to solve problems. During the oral exam the student must be able to demonstrate knowledge of the course contents and be able to discuss the topics thoughtfully and with propriety of expression.

Attendance at courses is not mandatory. Part-time students, however, experience lower success rates in exams and longer time to graduate. We greatly recommend students to regularly attend lectures and to complete the courses each semester.

Our graduates are highly sought after in the job market. Not only statistics show that 100% of graduates are hired within one year from graduation, but also that they are assigned a responsibility role. This is the reward for their commitment and motivation.

Contents

Objectives and admission

1.1 Objectives of the study program

The two year graduate program in *Business Informatics* has been designed to meet the growing demand for professionals with an interdisciplinary skill both in informatics and in business to satisfy the increasing demand by companies to compete using analytics and data science methods. The graduate program is focused on Business Intelligence and Data Science techniques to support decision making. The interdisciplinary competence covered by the Business Informatics degree is intended to overcome the cultural divide between IT and management. In fact, as reported by several studies and publications, there is a shortage of trained professionals who can integrate the various skills and approaches necessary to overcome the traditional distrust of management in involving computer professionals in decision-making. This is because computer professionals tend to be regarded as bearers of important but highly specialized knowledge, which may either seem difficult to apply or which has little relevance to the needs of organizations.

The professional profile of graduates in *Business Informatics* is wider than traditional IT professionals with skills in areas such as operational information systems to support business activities. The aim is to provide graduates with specific professional skills that lead to an effective dialogue with managers to support tactical and strategic activities. To achieve this goal, key skills include *Business Intelligence* and *Data Science* (e.g. data warehousing, data mining, big data, e-commerce). These technological skills are complemented by economic and business skills on decision-oriented rather than just operational and management activities. In fact, the economic and business skills enable graduates to understand the operational performance of an organization and the decision-making criteria adopted by the management. The computer science skills enable them to translate this understanding into models using the latest IT, in order to contribute significantly to an organization's decision-making and to the systematic innovation of products, processes and services.

Those who successfully complete their degree in Business Informatics will be able to engage in activities that require the use of advanced methods in terms of design, development and management. This will also include estimations, testing and the management of innovative operational information systems or decision support systems. They will become experts of:

– The *Business Intelligence* and *Data Science* methods and tools to design, plan, implement and manage applications to provide managers with information synthesis

for deciding more effective tactics and strategies to increase their competitive edge.
- Information and communication technology supporting business and operational goals (operational information systems), management to make good business decisions (decision support information systems), and business services on the Web.
- The fundamentals of economics and management science.
- Enterprise organizational models, typical functions, primary and support activities, and the role of management planning and controlling systems.
- Decision support systems based on operations research models in production and distribution logistics.
- Methods and tools for analyzing business processes and the redesign of such processes eventually using the technology of Web services.

Finally, *Business Informatics* graduates will have the skills necessary to access more advanced levels of university education, such as the *PhD in Computer Science*.

1.2 Admission requirements

Applicants must hold a first cycle degree in Computer Science or Computer Engineering, or a degree with at least 40 ECTS credits in the following areas: Management, Economics, Informatics, Physics, Mathematics, Statistics.

In the case of other degrees, or academic qualifications obtained abroad, exceptions may be made only with a resolution of the Degree Programme Admissions Committee, on the basis of the specific background of the candidate.

Information on how to apply for the Master Programme can be found at:

www.di.unipi.it/en/education/mbi/enrollment-for-foreign-students

There are quotas on the number of extra-UE students that can enroll. Pre-applications will undergo a selection process. For more information, follow the link above.

Applicants must also be fluent in English, e.g., holding a certificate at level B1 or higher of CEFR or an equivalent other certificate.

Important notice: applicants have to demonstrate a basic knowledge of *Italian*, or, if their application is accepted, they must take an Italian language entry test or to attend a course on Italian during the first semester.

1.3 Pre-requisites

Basic knowledge on discrete mathematics, logics, computer programming, algorithmics, and data bases is required. Such topics are typically part of Bachelor programs in Computer Science or in Computer Engineering. Students with other Bachelor programs, if admitted, can learn such topics through one or more of the following elective subjects (see Chp. 2):

- Algorithms: Theory and practice (12 ECTS),
- Databases (6 ECTS),
- Logic of Programs (6 ECTS),
- Introduction to programming (12 ECTS),
- Discrete mathematis (6 ECTS).

These subject are taught in Italian because they are taken from the Bachelor program in Computer Science.

Program overview

This Master Programme is offered by the Department of Computer Science, in co-operation with the Department of Economics and Management of the Università di Pisa, and it has the following structure:

- Compulsory subjects with 48 ECTS credits from the *Informatics* area.
- Compulsory subject with 6 ECTS credits from the *Operations Research* area.
- Elective subjects with 18 ECTS credits from the *Business Economics* and *Statistics* areas.
- Elective subjects with 12 ECTS credits from the *Business Economics*, *Business Law*, *Informatics*, *Mathematics*, and *Statistics* areas.
- Elective subject with 9 ECTS credits, from a list defined every year by the Master Program Council.
- A thesis with 27 ECTS credits, which can be associated with an internship in a public institution or in a private company, both in Italy and abroad.

The effort for each subject is given in ECTS, which consists of (in average):

1 ECTS = 25 hours of study = 8 hours of teaching + 17 hours of study on your own.

2.1 Study program

The study program depends on the applicant BSc area, but in all cases it will have at least 48 ECTS credits of Informatics, with 36 in the field of the fundamentals of Business Intelligence, and it will be designed to give an interdisciplinary expertise in informatics and business to understand the needs of organization's activities in order to exploit new opportunities offered by information technology.

Only courses marked with an asterisk are offered in English.

Compulsory Courses from the *Informatics* area (48 ECTS)

- **Decision Support Databases***
  (INF/01 ECTS 6 BSD 600AA 1 Sem.)
- **Data mining***
  (INF/01 ECTS 12 DM 420AA)

  - Module I: Data mining: Foundations (6 ECTS 1 Sem.)
  - Module II: Data mining: advanced topics and applications (6 ECTS 2 Sem.)

– **Business Performance Analysis***
(INF/01 ECTS 12 APA 417AA)

  - Module I: Business process modeling (6 ECTS 1 Sem.)
  - Modulo II: Business Intelligence laboratory (6 ECTS 1 Sem.)

– **Elective courses from Table 2.1 (18 ECTS)**

Course	Description				
	SSD	ECTS	Abbr	Code	Sem.
***Informatics* Area**					
Big data analytics*	INF/01	6	BDA	599AA	1
Database structures and algorithms*	INF/01	6	BSA	411AA	2
ICT risk analysis*	INF/01	6	ARI	416AA	2
Information retrieval*	INF/01	6	IR	289AA	1
Laboratory on algorithms for big data*	INF/01	6	LAD	588AA	1
Machine learning: fundamentals*	INF/01	6	AA1	320AA	1
Peer-to-peer systems*	INF/01	6	P2P	261AA	2
Programmatic advertising*	INF/01	6	PRV	634AA	1
Social network analysis*	INF/01	6	SNA	589AA	2
Software services*	INF/01	6	SS	389AA	1
Technologies for web marketing*	INF/01	6	TWM	537AA	2
Text analytics*	INF/01	6	TXA	635AA	1
Visual analytics*	INF/01	6	VA	602AA	2

Table 2.1 GR1: Elective courses from the *Informatics* area (18 ECTS).

Compulsory Subject from the *Operations Research* area (6 ECTS)

– **Logistics***
(MAT/09 ECTS 6 LOG 255AA 1 Sem.)

Elective subjects from the *Business Economics* and *Statistics* areas (18 ECTS)

– **Elective courses from Table 2.2 (18 ECTS)**

Course	Description				
	SSD	ECTS	Abbr	Code	Sem.
***Business Economics* Area**					
Analisi e gestione dei costi	SECS-P/07	9	AGC	265PP	2
Analisi e ricerche di marketing	SECS-P/08	9	ARM	202PP	1
Economia aziendale II	SECS-P/07	9	EA2	018PP	1
Economia e gestione delle imprese	SECS-P/08	9	EGI	049PP	2
Organizzazione aziendale	SECS-P/10	6	OA	096PP	2
Pianificazione e controllo gestionale	SECS-P/07	9	PCG	278PP	1
***Statistics* Area**					
Data science for quantitative finance	SECS-S/06	6	DSF	501PP	1
Statistical methods for data science*	SECS-S/01	6	SMD	500PP	2

Table 2.2 GR2: Elective courses from the *Business Economics* and *Statistics* areas (18 ECTS).

Elective courses from the *Business Economics*, *Business Law*, *Informatics*, *Mathematics*, and *Statistics* areas (12 ECTS)

– **Elective courses from Table 2.3 (18 ECTS)**

Course	Descrizione				
	SSD	ECTS	Sigla	Codice	Sem.
***Business Economics* Area**					
Organizzazione aziendale	SECS-P/10	6	OA	096PP	2
***Business Law* Area**					
Diritto dell'informatica	IUS/05	6	DIR	058NN	1
***Informatics* Area**					
Algoritmica e laboratorio	INF/01	12	AIL	008AA	2
Basi di dati	INF/01	6	BD	244AA	2
Ingegneria del software	INF/01	6	IS	271AA	2
Introduzione all'Intelligenza Artificiale	INF/01	6	IIA	596AA	1
Laboratorio di basi di dati	INF/01	6	LBD	254AA	2
Logica per la programmazione	INF/01	6	LPP	009AA	1
Programmazione I e laboratorio	INF/01	12	PRL	007AA	1
***Matematics* Area**					
Decisioni in situazioni di complessità e di conflitto	MAT/09	6	DSC	488AA	1
Matematica discreta	MAT/02	6	MD	597AA	2
Model-Driven Decision-Making Methods*	MAT/09	6	MGM	601AA	2
Network Optimization Methods*	MAT/09	6	MOR	533AA	2
Ricerca operativa	MAT/09	6	RO	029AA	1
***Statistics* Area**					
Data science for quantitative finance	SECS-S/06	6	DSF	501PP	1
Statistical methods for data science*	SECS-S/01	6	SMD	500PP	2

Table 2.3 GR3: Elective courses from the *Business Economics*, *Business Law*, *Informatics*, *Mathematics*, and *Statistics* areas (12 ECTS). N.B.: the course MOR will not be given in A.Y. 2016/17.

Other elective subject (9 ECTS)

– The student can choose one or two courses among the ones from GR1, GR2, GR3 or from Table 2.4 to reach 9 ECTS. Suggested courses depend on the Bachelor degree program of the student.

Course	Description			
	SSD	ECTS	Abbr	Sem.
***Business Economics* Area**				
Business planning*	SECS-P/09	3		1
Corporate Social Responsibility in business & society*	SECS-P/08	3		2
Cost accounting*	SECS-P/07	3		1
Service marketing*	SECS-P/08	3		1
Social media marketing*		3		2
Strategic management*	SECS-P/07	3		1

Table 2.4 Subjects in English offered by the Department of Economics and Management. They can be included in the list of "other elective subjects".

2.2 Precedences

There is no formal precedence between courses. However, the following order should be respected to be able to attend subjects with profit:

- for **Business Performance Analysis***, to have attended: **Decision Support Databases*** and **Data mining***.
- for **Big data analytics***, to have attended: **Data mining***;
- for **Laboratory on algorithms for big data***, to have attended: **Data mining***;
- for **Programmatic advertising***, to have attended: **Technologies for web marketing***;
- for **Pianificazione e controllo gestionale**, to have attended: **Economia aziendale II**;
- for **Analisi e gestione dei costi**, to have attended: **Economia aziendale II**;
- for **Metodi decisionali guidati dai modelli***, to have attended: **Logistics***;
- for **Algoritmica e laboratorio**, to have attended: **Programmazione I e laboratorio**.

2.3 Study plan

A recommended pattern of study follows, based on the program requirements above. Areas of interest for the selection of subjects are shown in italics.

The allocation of elective courses by each year/semester is only an indication. The 120 ECTS credits required for graduation can be earned in less than two years.

The student at the time of enrollment is required to submit his study plan to the Director of the Master Program. The study plan may be updated annually from September to January.

Year	First Semester	ECTS	Second Semester	ECTS
First	*GR2*: *Subjects from the area Business Economics*	9	*GR2*: *Subjects from the area Business Economics*	9
	GR3: *Subjects from the area Business Economics, Law, Informatics, Mathematics, Statistics*	6	*GR3*: *Subjects from the area Business Economics, Law, Informatics, Mathematics, Statistics*	6
	Logistics*	6	*GR1*: *Subjects from the area Informatics (Characteristic)*	6
	Decision Support Databases* (*Characteristic*)	6		
	Data mining*: (Module I) Foundations (*Characteristic*)	6	Data mining*: (Module II) Advanced Topics and Applications (*Characteristic*)	6
Total		**33**		**27**
Second	Business Performance Analysis*: (Module I) Business Process Modeling (*Characteristic*)	6	Thesis	27
	Business Performance Analysis*: (Module II) Business Intelligence Laboratory (*Characteristic*)	6		
	GR1: *Subjects from the area Informatics (Characteristic)*	12		
	Elective subjects	9		
Total		**33**		**27**

Courses in English for AY 2016/17

A.1 Compulsory subjects

Business perfomance analysis (417AA) (12 ECTS)
Title in Italian: Analisi delle prestazioni aziendali
Semester: 1
Contact Person (module 1): Prof. Roberto BRUNI (bruni@di.unipi.it)
Contact Person (module 2): Prof. Salvatore RUGGIERI (ruggieri@di.unipi.it)
Web Page (module 1): didawiki.di.unipi.it/doku.php/magistraleinformaticaeconomia/mpb/
Web Page (module 2): www.di.unipi.it/∼ruggieri/teaching/lbi/

Objectives
The course presents techniques for Business Analytics according to two views: The process-driven view of Business Process Modeling and the data-driven view of Business Intelligence. The two views are dealt with in the two modules of the course. The first presents the main concepts and problematic issues related to the process management, where processes are understood as workflow over some basic activities, and to show some of the languages, conceptual models and tools that can help to handle the main problems in a proper way. The second module presents technologies and systems for data access, for building and analyzing data warehouses, for reporting, and for knowledge discovery in databases. The accent of the module is on the use of tools and on the analysis of application problems by means of non-trivial samples and case studies. The student will be aware and able to manage the main technologies of Business Intelligence, specifically software products for effective decision support.

Syllabus
Module 1: Business Process Modeling
– Introduction to Key Issues in Business Process Management.
– Terminology and Classification.
– Process Modeling. Conceptual Models and Levels of Abstraction.
– Rigorous Workflow Models: Petri Nets and Workflow Nets.
– Tool-supported Workflow Design and Analysis: Experimentation with Integrated Tools for Business Process Design, Analysis and Verification.

Module 2: Business Intelligence Laboratory
– Introduction: Tools for Business Intelligence.
– Data Access. Location, Format and API for Accessing Data in Text Files. Standards for RDBMS Data Connectivity.

– Extract Transform and Load. Tool for ETL. Case studies.
– Data Warehousing and OLAP. Tools for Dimensional Modeling. Case Studies.
– Tools for Reporting and Multidimensional Browsing. Case Studies
– Data Mining. Tools for Knowledge Discovery. Case Studies.

Data mining (420AA) (12 ECTS)
Title in Italian: Data mining
Semester: 1, 2
Contact Person: Prof. Dino PEDRESCHI (pedre@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/dm/

Objectives
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 course is divided into two modules. The first presents an introduction to the basic concepts of data mining and the knowledge discovery process, and associated analytical models and algorithms. The second module provides an account of advanced techniques for analysis and mining of novel forms of data, and the main application areas and prototypical case studies.

Syllabus
Module 1: Foundations
– Concepts of Data Mining and the Knowledge Discovery Process.
– Data Preprocessing and Exploratory Data Analysis.
– Frequent Patterns and Associations Rules.
– Classification: Decision Trees and Bayesian Methods.
– Cluster Analysis: Partition-based, Hierarchical and Density-based Custering.
– Experiments with Data Mining Toolkits.
Module 2: Advanced topics and applications
– Mining Time-Series and Spatio-Temporal Data.
– Mining Sequential Data, Mining Large Graphs and Networks.
– Advanced Association, Correlation and Frequent Pattern Analysis.
– Advanced Classification, Cluster Analysis and Outlier Detection.
– Visual Analytics.
– Data Mining Languages, Standards and System Architectures.
– Social Impact of Data Mining.
– Privacy-Preserving Data Mining.
– Applications: Retail Industry, Marketing, CRM, Telecommunication Industry, Financial Data Analysis, Risk Analysis, Fraud Detection, Mobility and Transportation, Public Administration and Health.

Decision support databases (600AA) (6 ECTS)
Title in Italian: Basi di dati di supporto alle decisioni
Semester: 1
Contact Person: Prof. Salvatore RUGGIERI (ruggieri@di.unipi.it)
Web Page: www.di.unipi.it/∼ruggieri/teaching/bsd/

Objectives
The course presents the main approaches to the design and implementation of decision support databases, and the characteristics of business intelligence tools and computer based information systems used to produce summary information to facilitate appropriate decision-making processes and make them more quick and objectives. Particular attention will be paid to themes such as conceptual and logical Data Warehouses design, data analysis using analytic SQL, algorithms for selecting materialized views, data warehouse systems technology (indexes, star query optimization, physical design, query rewrite methods to use materialized views). A part of the course will be dedicated to a set of case studies.

Syllabus
– Information systems and computer-based information systems in organizations.
– Decision Support System Based on Data Warehouses.
– Data Models for Data Warehouses and On-line Analytical Processing.
– Conceptual and logical design in Data Warehouses.
– Algorithms for Selecting Materialized Views.
– Data Warehouse Systems Technology: Indexes, Star Query Optimization,
– Physical Design, Query Rewrite Methods to Use Materialized Views.
– Case studies.

Logistics (255AA) (6 ECTS)
Title in Italian: Logistica
Semester: 1
Contact Person: Prof. Maria Grazia SCUTELLÀ (scut@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/magistraleinformaticaeconomia/log/

Objectives
The course presents the structure and functions of logistics systems, analyzing major decision problems arising in the medium/long term (tactical/strategic decisions). After an introduction to the main characteristics of logistics systems, with emphasis on distribution logistics, optimization models for decision support are discussed. Some relevant models and methods are then illustrated with the aid of appropriate software tools, and logistics case studies are presented.

Syllabus
– Introduction to Supply Chain.
– Models and Methods for Location Problems.
– Models and Methods for Transportation Problems.
– Models and Methods for the Design and Management of Distribution Centers.
– Models and Methods for Inventory Management.

A.2 Elective subjects from the GR1 group

Big data analytics (599AA) (6 ECTS)
Title in Italian: Big data analytics
Semester: 1
Contact Person: Prof. Fosca GIANNOTTI (fosca.giannotti@isti.cnr.it)
Web Page: didawiki.di.unipi.it/doku.php/bigdataanalytics/bda/

Objectives
In our digital society, every human activity is mediated by information technologies. Every minute, an avalanche of "big data" is produced by humans, consciously or not, that represents a novel, accurate digital proxy of social activities at global scale. Big data provide an unprecedented "social microscope", a novel opportunity to understand the complexity of our societies, and a paradigm shift for the social sciences. This course is an introduction to the emergent field of big data analytics and social mining, aimed at acquiring and analyzing big data from multiple sources to the purpose of discovering the patterns and models of human behavior that explain social phenomena. The focus is on what can be learnt from big data in different domains: mobility and transportation, urban planning, demographics, economics, social relationships, opinion and sentiment, etc.; and on the analytical and mining methods that can be used. An introduction to scalable analytics is also given, using the "map-reduce" paradigm.

Syllabus
Big data sources
– Open (linked) data, Web activity data, Social network data, Social media data, Mobile phone data, Navigation GPS data, Commercial transaction data, Tourism-related data, Crowdsourcing / crowdsensing.

Big data analytics and social mining methods for:
– the discovery of individual social profiles.
– the analysis of collective behavior.
– the discovery of emotional content of text and sentiment analysis.

Big data analytics domains
– Mobility and transportation.
– Nowcasting of socio-economic indicators of progress, happiness, etc.
– Twitterology and nowcasting of social mood and trends.
– Tourism.

Ethical issues of big data analytics.
– Privacy and personal data protection.
– Privacy-preserving analytics.
– Social responsibility of data scientists.

Scalable data analytics
– Paradigms of NO-SQL databases.
– Data analysis processes with the "map-reduce" paradigm.

Database structures and algorithms (411AA) (6 ECTS)
Title in Italian: Basi di dati: strutture e algoritmi
Semester: 2
Contact Person: Prof. Giorgio GHELLI (ghelli@di.unipi.it)
Web Page: www.di.unipi.it/∼ghelli/bd2/bd2.eng.html

Objectives
Database systems occupy a central position in our information-based society, and computer scientist and database application designers should have a good knowledge about both the theoretical and the engineering concepts that underline these systems to ensure the application performance desired. The student who completes the course successfully will be able to demonstrate advanced knowledge of the main issues related to the implementation of classical centralized relational database systems in order to be a sophisticated user of database technology and a high-performance applications developer.

Syllabus
– Architecture of a DBMS:
  The Relational and Storage Engines.
– Permanent Memory Manager and Buffer Manager.
– Storage Structures Manager:
  Heap and Sequential Organizations;
  Primary and Secondary (Index) Organizations.
– Access Method Manager: The Storage Engine Interface.
– Query Manager:
  Physical Operators for Relational Operators;
  Physical Query Plan Generation;
  Query Optimization.
– Transaction and Concurrency Managers.
– Physical Database Design and Tuning.

Notice
This course is part of a larger course (9 ECTS) entitled “Databases II” which is offered by the Master Degree in Computer Science. The teacher/web page will clarify which lectures are not part of the Business Informatics syllabus.

ICT risk analysis (416AA) (6 ECTS)
Title in Italian: Analisi dei rischi informatici
Semester: 2
Contact Person: Prof. Fabrizio BAIARDI (baiardi@di.unipi.it)
Web Page: pages.di.unipi.it/tonelli/baiardi/didattica_SR_selector.html

Objectives
The course is divided into two parts. The first one introduces the concepts underlying the risk management of an ICT system and the analysis that have to be implemented to assess and manage this risk. The approach extends to ICT system classical risk management strategies. The second parts of the course introduces cloud systems, their enabling technologies and the economic advantages they enable. Then, the security of cloud system is evaluated to show how they change the traditional approach to increase the security of an ICT system.

Syllabus
Risk Analysis of an ICT System
– Vulnerability of a System.
– Vulnerability Analysis of ICT Systems: Analysis of Standard Components, Analysis of Non Standard Components.
– Threat Analysis.
– Attack Analysis: Complex Attacks and their Formal Description, Automated Attacks (Virus and Worms).
– Impact Analysis.
– Risk Assessment and Management.
– Countermeasures: Encryption, Intrusion Detection Systems, Firewall, Secure Programming.

Security of Cloud Systems
– Enabling Technologies.
– Architectural Models.
– Deployment Models.
– Threats of Cloud System.
– Attack against Cloud.
– Countermeasures for Cloud Systems.

Notice
This course is part of a larger course (9 ECTS) entitled “Network security” which is offered by the Master Degree in Computer Science and Networking. The teacher/web page will clarify which lectures are not part of the Business Informatics syllabus.

Information retrieval (289AA) (6 ECTS)
Title in Italian: Information retrieval
Semester: 1
Contact Person: Prof. Paolo FERRAGINA (ferragin@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/magistraleinformatica/ir/

Objectives
In this course we will study, design and analyze (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.

Syllabus
– Search engines.
– Crawling, Text analysis, Indexing, Ranking.
– Storage of Web pages and (hyper-)link graph.
– Results processing and visualization.
– Other data types: XML, textual DBs.
– Data processing for IR tools.
– Data streaming.
– Data sketching.
– Data compression.
– Data clustering (sketch).

Laboratory on algorithms for big data (588AA) (6 ECTS)
Title in Italian: Laboratorio di algoritmi per big data
Semester: 1
Contact Person: Prof. Rossano VENTURINI (rossano@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/magistraleinformatica/lad/

Objectives
The course consists of a first part of lectures describing advanced algorithms and data structures (3 CFU), and a laboratory in the second part (3 CFU) in which the students will deploy these techniques to develop a software project. The students will select their projects among a set of proposals by major IT companies which are challenging from an algorithmic perspective. These companies will also contribute to identify/construct significant datasets that will help in testing the proposed algorithmic solutions. The course will provide the opportunity of: - facing with difficult algorithmic problems of practical interest involving big data; - evaluating the impact of efficient algorithmic solutions in the design of software managing big data; - implementing advanced software by using powerful and sophisticated libraries; - getting in touch with some companies for internships, scholarships, or thesis proposals.

Syllabus
– Compressed data structures for integers, texts, and trees.
– Randomized data structures: hashing and sketching.
– Graphs: compressed representations, navigation, and analysis.
– Geometric data structures (optional).

Machine learning: fundamentals (320AA) (6 ECTS)
Title in Italian: Apprendimento automatico: fondamenti
Semester: 1
Contact Person: Prof. Alessio MICHELI (micheli@di.unipi.it)
Web Page: www.di.unipi.it/∼micheli/DID/AA1.htm

Objectives
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.

Syllabus
– Introduction: Computational learning tasks, prediction, generalization.
– Basic concepts and models: structure of the hypothesis space, discrete and continuous spaces, linear models, nearest neighbor, prepositional models, inductive bias.
– Neural models: Perceptron and computational properties. Introduction to multilayer feedforward Neural Networks architectures and learning algorithms.
– Rule based models.
– Principles of learning processes and general practical aspects: Validation, Bias-Variance analysis. Elements of Statistical Learning Theory, VC-dimension. Ensemble learning.
– Support Vector Machines: linear case, kernel-based models.
– Bayesian and Graphical models.
– Unsupervised learning.
– Introduction to Applications.

Peer-to-peer systems (261AA) (6 ECTS)
Title in Italian: Sistemi peer-to-peer
Semester 2
Contact Person Prof. Laura RICCI (ricci@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/informatica/p2p/

Objectives
The course presents the main methodologies and techniques for the project and the implementation of P2P systems. Both unstructured and structured overlays will be analysed. Any technique will be exemplified by a set of real applications. The course will introduce a set of tools for the simulations and the implementation of P2P systems.

Syllabus
– P2P Systems: Classification and General Characteristics.
– Unstructured P2P Overlay Networks.
– Proximity Aware Overlays: Internet Coordinate Systems.
– Cooperative Content Distribution.
– Tools for P2P Network Simulation and Implementation.

Programmatic advertising (634AA) (6 ECTS)
Title in Italian: Programmatic advertising
Semester 1
Contact Person Prof. Nicola CIARAMELLA (ciaramella@noesis-research.com)

Objectives
The course aims at providing students with a conceptual framework and a toolbox for optimization of online advertising campaigns (inside sites, apps, games). At the end of the course the student should be able to design and possibly implement real-life systems for optimization of campaigns performance, intended in financial and marketing terms. The required mathematical background is limited to basic differential calculus and probability theory. The treatment is quantitative and concepts will be translated in formulas and algorithms. Nevertheless, focus will be on intuition and business meaning more than on formal rigor.

Syllabus
– The online advertising ecosystem. Advertisers, publishers, business intermediaries, technology providers, data providers. Trends and Programmatic Advertising.
– Online advertising campaign management: design, targeting, creation, monitoring, optimization and reporting.
– Data about people and their behavior. Classical segmentation, micro-segmentation, one-to-one relationships. Data management platforms.
– The publisher problem. Basic micro-economic concepts and decision theory: expected utility, marginal utility, pricing, decision trees, value of information, risk and uncertainty, opportunity cost, equilibrium and optimality.
– The advertiser problem. Market segmentation, customer profiling. The advertisers-publishers game.
– Forecasting visitors and campaigns behavior. Classical methods: linear regression, logistic regression, time series analysis. Factorization methods. Markovian methods.
– Learning and optimization. Facing uncertainty. The Exp-Exp dilemma. Multi-armed bandits. Reinforcement learning.

Social network analysis (589AA) (6 ECTS)
Title in Italian: Analisi delle reti sociali
Semester: 2
Contact Person: Prof. Dino PEDRESCHI (pedre@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/wma/

Objectives
Over the past decade there has been a growing public fascination with the complex "connectedness" of modern society. This connectedness is found in many contexts: in the rapid growth of the Internet and the Web, in the ease with which global communication now takes place, and in the ability of news and information as well as epidemics and financial crises to spread around the world with surprising speed and intensity. These are phenomena that involve networks and the aggregate behavior of groups of people; they are based on the links that connect us and the ways in which each of our decisions can have subtle consequences for the outcomes of everyone else. This short course is an introduction to the analysis of complex networks, with a special focus on social networks and the Web - its structure and function, and how it can be exploited to search for information. Drawing on ideas from computing and information science, applied mathematics, economics and sociology, the course describes the emerging field of study that is growing at the interface of all these areas, addressing fundamental questions about how the social, economic, and technological worlds are connected.

Syllabus
Graph theory and social networks
– Graphs.
– Social, information, biological and technological networks.
– Strong and weak ties.
– Networks in their surrounding context.
The World Wide Web
– The structure of the Web.
– Link analysis and Web search.
– Web mining and sponsored search markets.
Network dynamics
– Information cascades.
– Power laws and rich-get-richer phenomena.
– The small-world phenomenon.
– Epidemics.

Software services (389AA) (6 ECTS)
Title in Italian: Servizi software
Semester: 1
Contact Person: Prof. Antonio BROGI (brogi@di.unipi.it)
Web Page: www.di.unipi.it/∼brogi/AttivitaDidattica/Informatica/SoftwareServiceEngineering/

Objectives
The course presents the main aspects in the design and implementation of software services. After introducing the currently adopted standards for Web services, the course centers on service-oriented architectures and on the techniques for developing applications by discovering, composing and adapting existing services. The use of languages supporting the definition and the implementation of business processes via workflows is discussed. The course also describes some of the techniques employed for guaranteeing non-functional properties of services, such as quality of service and security properties. The last part of the course discusses the role of software service engineering in the more general context of service economy (and of the so-called "service science"), by illustrating the interplay between engineering and economic aspects (business models, service contracts) of services, as well as the relevance of the separation of concerns in the design of services.

Syllabus
– Protocols and Architecture of Software Services.
– Basic Standards of Web Services.
– Service-oriented Architectures.
– Introduction to the Design and Implementation of Software Services.
– Discovery, Composition and Adaptation of Software Services.
– Definition and Implementation of Business Processes via Workflows.
– Business Process Execution Languages.
– Management and Analysis of Non-functional Properties (Quality of Service, Security).
– Role of Service Engineering in the Context of the Service Economy.

Notice
This course is part of a larger course (9 ECTS) entitled "Software service engineering" which is offered by the Master Degree in Computer Science and Networking. The teacher/web page will clarify which lectures are not part of the Business Informatics syllabus.

Technologies for web marketing (537AA) (6 ECTS)
Title in Italian: Tecnologie per il web marketing
Semester: 2
Contact Person: Prof. Salvatore RUGGIERI (ruggieri@di.unipi.it)
Web Page: www.di.unipi.it/∼ruggieri/teaching/twm/

Objectives
Web analytics is the collection, measurement, analysis and reporting of Internet data (web, mobile, social media, email) for purposes of deep customer and market understanding and for digital service optimization. The course presents web analytics methods, algorithms, strategies and tools with applications to web personalization for improving user experience, to web marketing and advertising for improving visibility, to search engine optimization for improving ranking, and social media analysis for improving reachability and understanding opinions. Students are required to know basic data mining and data warehousing concepts.

Syllabus
– The mobile web.
– Tools: Google analytics.
– Web personalization and user segmentation.
– Recommender systems: collaborative filtering, content based, hybrid.
– Controlled experiments on the web.
– Search engine optimization and marketing.
– Social media analysis.
– Social media scoring and marketing.
– Real time analytics.
– Privacy, profiling and regulations.

Text analytics (635AA) (6 ECTS)
Title in Italian: Text analytics
Semester: 1
Contact Person: Prof. Giuseppe ATTARDI (attardi@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/magistraleinformatica/eln/

Objectives
Learning fundamental techniques, algorithms and models used in natural language processing. Understanding of the architectures of typical text analytics applications and of libraries for building them. Expertise in design, implementation and evaluation of applications that exploit analysis, interpretation and transformation of texts.

Syllabus
– Mathematical Background: Probability and Statistics, Language Models, Hidden Markov Models, Viterbi Algorithm, Generative vs Discriminative Models.
– Linguistic Essentials: Part of Speech and Morphology, Phrase structure, Collocations, n-gram Models, Word Sense Disambiguation, Word Embeddings.
– Preprocessing: Encoding, Regular Expressions, Segmentation, Tokenization, Normalization.
– Machine Learning Basics.
– Text Classification and Clustering.
– Tagging: Part of Speech, Named Entity.
– Sentence Structure: Constituency Parsing, Dependency Parsing.
– Semantic Analysis.
– Statistical Machine Translation.
– Deep Learning.
– Software Libraries.
– Applications: Opinion Mining, Entity Linking, Semantic Search, Question Answering, Language Inference.

Notice
This course is offered by the Master Degree in Computer Science with the title “Natural Language Processing”.

Visual analytics (602AA) (6 ECTS)
Title in Italian: Visual analytics
Semester: 2
Contact Person: Prof. Salvatore RINZIVILLO (rinzivillo@isti.cnr.it)
Web Page: didawiki.di.unipi.it/doku.php/magistraleinformaticaeconomia/va/

Objectives
The availability of large data sources provides new opportunities for understanding patterns and behaviors of modern society. The information from these sources requires effective visualization methods to extract meaningful information from the data and facilitate the interpretation of very complex phenomena. The objective of the course is to present an overview of basic methods and visualization techniques for effective presentation of information from different sources: structured data (relational hierarchies, trees), relational data (social networks), temporal data, spatial data and data space-time. We will present and discuss several case study scenarios with the existing methods and tools.

Syllabus
Visual Metaphors for Information
– Hierarchical and structured data.
– Relational and graph-based data.
– Temporal Data.
– Spatial data.
– Spatio-temporal data.
– Unstructured information (text).
Methods and Tools
– Overview of existing visual analytics environments.
Visual Analytics Process
– Definition of a Knowledge Discovery process.
– Framework for VA.
– Visual exploration and analytics of data.
– Case studies.

A.3 Elective subjects from the GR2 group

Statistical methods for data science (500PP) (6 ECTS)
Title in Italian: Statistical methods for data science
Semester: 2
Contact Person: Prof. Fabrizio LILLO (fabrizio.lillo@sns.it)

Objectives
The course presents the main concepts and techniques of statistics, probability and time series, which can be useful for the data analysis and data science. After consolidating the knowledge in probability theory, the course is aimed at presenting the main methods and concept of estimation theory and hypothesis testing. The second part of the course introduces stochastic processes and time series, focusing on the ARMA framework and Markov chains, and considering estimation and forecasting issues. The last part of the course introduces the application of more advanced statistical techniques, such as MCMC and EM.

Syllabus
– Brief review on probability theory, random variables and convergence theorems for sequences of random variables.
– Exploratory data analysis: graphical and numerical summaries.
– Basic statistical models.
– The bootstrap.
– Estimation: unbiased estimators, efficiency and mean squared error, maximum likelihood.
– Least squares estimation and regression.
– Confidence intervals and hypotheses testing.
– Brief introduction to stochastic processes and linear time series analysis.
– Markov Chains.
– Monte Carlo Markov Chain for Bayesian inference: Metropolis-Hastings and Gibbs Sampling.
– The EM algorithm and its generalizations.

A.4 Elective subjects from the GR3 group

Model-driven decision-making methods (601AA) (6 ECTS)
Title in Italian: Metodi decisionali guidati dai modelli
Semester: 2
Contact Person: Prof. Antonio FRANGIONI (frangio@di.unipi.it)
Web Page: www.di.unipi.it/optimize/Courses/MDBsM/

Objectives
The course will enable the student to produce and/or appropriately use software tools for the support to complex decisions (mainly at the corporate/industrial level) based on mathematical optimization techniques. The course is focussed on practical aspects of these tools. The main aim is to familiarize the students with the specific computer science aspects of these activities, such as data preparation and validation, the development of complex mathematical models, the knowledgeable use of the corresponding solution algorithms, the impact on this process of data uncertainty and the available methodologies to tackle this problem.

Syllabus
– Decision theory, decision processes.
– Architecture of decision support systems.
– Reminds to the theory of Linear Programming and Integer Linear Programming problems.
– Solvers of Linear Programming and Integer Linear Programming problems.
– Methodologies for improving performances of the algorithms.
– Data uncertainty issues within optimization methods.

THIS COURSE WILL NOT BE ACTIVE IN THE A.Y. 2016/17

Network optimization methods (433AA) (6 ECTS)
Title in Italian: Metodi di ottimizzazione delle reti
Semester: 2
Contact Person: Prof. Maria Grazia SCUTELLÀ (scut@di.unipi.it)
Web Page: didawiki.di.unipi.it/doku.php/magistraleinformaticanetworking/mor/

Objectives

The course presents the main modeling techniques and the main algorithmic methodologies for managing communication networks both at a design and at an operational level. Relevant design and operational problems for communication networks will be considered, such as QoS routing problems, location problems and resiliency problems. Then, modeling techniques and algorithmic approaches will be considered for both basic problems and NP-Hard problems.

Syllabus
- Basic network optimization problems: Models and Algorithms, Minimum Cost Flow, Multicommodity Flows.
- NP-Hard Network Optimization Problems: Models and Algorithms, Routing Models, Network Design Models. Main Heuristic Techniques, Exact Approaches.
- Applications: QoS Routing, Location Problems, Resiliency Problems.

Statistical methods for data science (500PP) (6 ECTS)
See on page 33.

A.5 Elective subjects from the Table 2.4 group

The subjects from Table 2.4 are offered by the Department of Economics and Management. Detailed information will be available at the website:

http://www.ec.unipi.it/international-programmes/incoming/courses.html

Important notice: the timetable of these subjects will not be included in the official timetable of the Business Informatics Programme. Please, check the website above for timetables.

Corsi in Italiano per l'AA 2016/17

B.1 Attività formative a scelta del gruppo GR2

Analisi e gestione dei costi (265PP) (9 ECTS)
Title in English: Cost Analysis and Management
Semestre: 2
Docente: Prof. Riccardo GIANNETTI (riccardo.giannetti@unipi.it)
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=169754::::&ri=9747

Obiettivi
Il corso esamina le principali tecniche utilizzate nelle organizzazioni per creare valore per i clienti a costi più bassi. Gli obiettivi del corso sono: fornire i concetti base per la gestione dei costi; illustrare le principali tecniche di analisi e gestione dei costi.

Syllabus
– L'analisi e la gestione dei costi e il processo decisionale.
– Approfondimenti sull'ActivityBased Costing.
– L'ActivityBased Management.
– La gestione della profittabilità del cliente.
– I costi ambientali.
– I costi della qualità.
– Il target costing.

Analisi e ricerche di marketing (202PP) (9 ECTS)
Title in English: Marketing Research
Semestre: 1
Docente: Prof. Alessandro GANDOLFO (alessandro.gandolfo@unipi.it)
Web Page: moodle.ec.unipi.it
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=168905::::&ri=8511

Obiettivi
Il corso illustra i principali strumenti e le metodologie di analisi impiegate dalle imprese per ottenere informazioni utili per il processo decisionale di marketing. In particolare, sono approfondite le fasi attraverso le quali vengono condotte le ricerche di marketing: pianificazione preliminare, scelta del disegno di ricerca, definizione delle modalità di acquisizione e di raccolta delle informazioni, applicazione delle tecniche di analisi e di elaborazione dei dati, presentazione dei risultati. L'obiettivo del corso è fornire le conoscenze di base in relazione ai processi informativi di marketing e sulle principali tecniche di analisi del mercato. Viene data particolare enfasi agli aspetti che riguardano il processo di ottenimento dei dati e delle informazioni riguardanti il mercato. Alle lezioni teoriche corrisponderanno anche esercitazioni pratiche, in cui saranno applicati i concetti generali svolti a lezione. Le lezioni saranno integrate anche da interventi seminariali da parte di professionisti esterni.

Syllabus
– Introduzione alle ricerche di marketing.
– La definizione del progetto di ricerca.
– Il concetto di research design.
– Ricerche esplorative, descrittive e causali.
– Le ricerche qualitative.
– I focus group.
– Le interviste in profondità.
– Le tecniche proiettive.
– Raccolta, preparazione ed analisi dei dati nelle ricerche qualitative.
– Le ricerche quantitative.
– La progettazione del lavoro on field.
– I sondaggi di mercato: tipologia, confronto e individuazione del metodo appropriato.
– Le tecniche di osservazione: tipologia, confronto e individuazione del metodo appropriato.
– Applicazione dei concetti di misure e di scale alle ricerche di marketing.
– La progettazione e la codifica del questionario.
– Raccolta, preparazione ed analisi dei dati nelle ricerche quantitative.
– Modalità di reporting e tecniche di presentazione.
– Impostazione e struttura del report della ricerca.
– Modalità di presentazione dei risultati della ricerca.

Note
È possibile inserire ulteriori 3 ECTS tra i crediti liberi del proprio piano di studi (codice esame 1301Z) a coprire un'estensione del programma relativa alla presentazione della piattaforma LimeSurvey.

Data science for quantitative finance (501PP) (6 ECTS)
Title in Italian: Data science for quantitative finance
Semester: 1
Contact Person: Prof. Davide FIASCHI (davide.fiaschi@unipi.it)
Web Page: moodle.ec.unipi.it
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=169349::::&ri=9235

Obiettivi

Il Corso presenta gli elementi principali per la comprensione dei mercati finanziari, della loro struttura, e della infrastruttura tecnologica sottostante. Nello specifico, il corso fornisce un background sulla modellazione empirica delle serie temporali finanziarie, sia a bassa che alta frequenza, identificando gli aspetti chiave per la scienza dei dati tra cui: storage dei dati, latenza, inferenza in spazio ad elevato numero di dimensioni, ecc. Il corso copre anche l'analisi semantica dei testi da flussi di notizie e da reti sociali a scopo di predizione finanziaria. Infine, il corso introduce alcuni elementi di applicazioni computazionali e numeriche a problemi finanziari, quali la determinazione del prezzo, l'ottimizzazione delle operazioni, e l'ottimizzazione del portafoglio.

Syllabus
– Introduzione ai mercati finanziari.
– Struttura del mercato e tipologie di asset.
– Modelli statistici per le serie temporali finanziarie.
– High frequency finance: modellazione e aspetti tecnologici.
– Reti finanziarie.
– Text mining e sentiment analysis per la finanza.
– Finanza computazionale.
– Librerie numeriche per l'analisi finanziaria.

Note
Per l'AA 2016/17, l'insegnamento sarà mutuato su *Economia dei mercati finanziari* del Corso di Laurea Triennale in Banca, Finanza e Mercati.

Economia aziendale II (018PP) (9 ECTS)
Title in English: Business Administration
Semestre: 1
Docente: Prof. Riccardo GIANNETTI (rgiannet@ec.unipi.it)
Web Page: moodle.ec.unipi.it
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=169753::::&ri=9747

Obiettivi
L'obiettivo formativo è quello di favorire l'acquisizione di conoscenze di base mirate alla costruzione ed all'interpretazione del bilancio di esercizio, nonché al controllo della gestione aziendale.

Syllabus
– Bilancio di esercizio: ruolo e finalità, normativa civilistica, schemi di redazione,
– criteri di valutazione, informazioni integrative diffuse agli stakeholder.
– Dinamiche dei processi di pianificazione e controllo.
– Il ruolo, le finalità e le caratteristiche essenziali dei principali strumenti
– di programmazione e controllo della gestione aziendale, come il budget, i costi,
– l'analisi delle performance.

Note
All'inizio delle lezioni verranno riassunti gli elementi utili dell'insegnamento di *Economia Aziendale I*, il quale non fa parte del curriculum di studi della Laurea Magistrale in Business Informatics.

Economia e gestione delle imprese (049PP) (9 ECTS)
Title in English: Business Management
Semestre: 2
Docente: Prof.ssa Antonella ANGELINI (antonella.angelini@unipi.it)
Web Page: moodle.ec.unipi.it
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=171604::::&ri=9797

Obiettivi
Il corso fornisce gli elementi analitici di base per comprendere il comportamento d'impresa. Tratta le principali tematiche economicomanageriali, le logiche di base e gli strumenti relativi alla gestione strategica delle imprese e all'analisi dell'ambiente competitivo. Gli obiettivi formativi sono:

- Conoscere le principali teorie che spiegano i fattori che influenzano la redditività di impresa. Acquisire una conoscenza introduttiva delle dinamiche di organizzazione della produzione industriale, e di come essa sia cambiata nel tempo.
- Acquisire conoscenze di base degli strumenti di marketing che le imprese hanno a disposizione per aumentare la propria competitività.
- Sviluppare o rafforzare la capacità critica e di pensiero individuale. Il corso intende infatti evitare l'apprendimento passivo e acritico dei temi oggetto di studio.

Syllabus
Parte I (L'analisi di settore e del sistema competitivo)
- L'analisi di settore.
- L'analisi dei concorrenti.
- I gruppi strategici.
- Le risorse e le competenze nella formulazione strategica.
- L'analisi del vantaggio competitivo (il vantaggio di costo e di differenziazione).

Parte II (L'analisi dell'impresa e delle sue funzioni.
Un focus su produzione e marketing)
- Produzione.
- Strategia innovativa e flessibilità dell'impresa.
- Il modello di flessibilità dei sistemi tecnicoproduttivi.
- Marketing.
- Il processo di marketing management.
- La segmentazione del mercato.
- Il marketing mix (prodotto, promozione, distribuzione e prezzo).

Organizzazione aziendale (096PP) (6 ECTS)
Title in English: Business Organization
Semestre: 2
Docente: Prof. Marco GIANNINI (marco.giannini@unipi.it)
Web Page: moodle.ec.unipi.it
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=173880::::&ri=6078

Obiettivi
Lo scopo di questo corso è di fornire una spiegazione realistica di come funziona una moderna organizzazione. L'obiettivo formativo è di sviluppare un pensiero critico, un atteggiamento interrogativo e una capacità analitica riguardo ai problemi organizzativi.

Syllabus
– Strategia e risposte all'incertezza ambientale.
– Variabili strutturali per la progettazione organizzativa in differenti contesti empirici.
– Relazioni interorganizzative.
– Impatto della tecnologia sull'organizzazione.
– Ciclo di vita di una organizzazione.
– Meccanismi di controllo organizzativo.
– Cultura ed etica organizzativa.

Note
L'insegnamento ha anche una versione estesa da 9 ECTS che è possibile inserire tra i crediti liberi del proprio piano di studi (codice esame 357PP).

Pianificazione e controllo gestionale (278PP) (9 ECTS)
Title in English: Management Control
Semestre: 1
Docente: Prof. Luciano MARCHI (lmarchi@ec.unipi.it)
Web Page: moodle.ec.unipi.it
Registro: http://unimap.unipi.it/registri/dettregistriNEW.php?re=168246:::&ri=6848

Obiettivi
Lo scopo del corso è di illustrare i principi e le tecniche della pianificazione e del controllo, a partire dai sistemi di analisi, previsione e simulazione economicofinanziaria.

Syllabus
– Analisi economica e finanziaria.
– Previsione.
– Analisi whatif e simulazione.
– Pianificazione a lungo termine.
– Budgeting.
– Analisi degli scostamenti.
– Reporting.

B.2 Attività formative a scelta del gruppo GR3

Algoritmica e laboratorio (008AA) (12 ECTS)
Title in English: Algorithms: Theory and practice
Semestre: 2
Docente: Prof.ssa Anna BERNASCONI (annab@di.unipi.it)
Web Page: didawiki.cli.di.unipi.it/doku.php/informatica/all-a/

Obiettivi
Progettazione e analisi di algoritmi. Risoluzione di problemi con strutture dati. Attività di programmazione in laboratorio.

Syllabus
– Breve introduzione a problemi computazionali, indecidibilità, e trattabilità.
– Complessità computazionale: limiti superiori e inferiori.
– Tecniche di analisi: Relazioni di Ricorrenza, analisi ammortizzata e analisi competitiva.
– Tecniche algoritmiche: Divide et Impera, Programmazione Dinamica, Greedy.
– Algoritmi per Sequenze: ricerca e ordinamento.
– Algoritmi per Alberi: ricorsione, visite, e rappresentazioni.
– Dizionari: Alberi bilanciati, Tabelle hash, Trie.
– Algoritmi e strutture di dati randomizzate.
– Algoritmi per Grafi: rappresentazione, algoritmi di visita, Albero di Copertura Minimo, Cammini Minimi (Dijkstra).

Note
Le lezioni video-registrate sono disponibili sul sito mediateca.unipi.it.

Basi di dati (244AA) (6 ECTS)
Title in English: Databases
Semestre: 2
Docente: Prof. Giorgio GHELLI (ghelli@di.unipi.it)
Web Page: www.di.unipi.it/∼ghelli/bd1/lucidi.html

Obiettivi
Fornire le basi scientifiche e metodologiche per la progettazione, la realizzazione e l'uso di basi di dati relazionali.

Syllabus
– I sistemi informativi e informatici. Funzionalità dei sistemi per la gestione di basi di dati (DBMS).
– I meccanismi di astrazione dei modelli dei dati a oggetti. La progettazione di basi di dati usando il modello a oggetti.
– Il modello dei dati relazionale. La trasformazione di schemi a oggetti in schemi relazionali.
– Il linguaggio SQL per creare e usare basi di dati. Interrogazioni semplici, giunzioni, quantificazioni esistenziali ed universali, raggruppamento.
– La teoria relazionale delle basi di dati. Le dipendenze fra i dati.
– Decomposizioni di schemi relazionali. Forme normali.
– Architettura dei DBMS.

Data science for quantitative finance (501PP) (6 ECTS)
See on page 41.

Decisioni in situazioni di complessità e di conflitto (488AA) (6 ECTS)
Title in English: Decisions, complexity and conflicts
Semestre: 1
Docente: Prof. Giorgio Angelo GALLO (gallo@di.unipi.it)
Web Page: polo4.elearning.unipi.it/extra/index.php?c=H15_7796

Obiettivi
Fornire strumenti formali, di tipo sia quantitativo che qualitativo, per affrontare problemi decisionali e gestionali in sistemi complessi di tipo sociale, politico, ambientale o economico. Ci si propone di sviluppare negli studenti e studentesse che seguiranno il corso la capacità di formulare e strutturare, utilizzando un approccio sistemico, un problema, di costruirne dei modelli, di analizzare e valutare le possibili soluzioni alternative, e di gestire le attività necessarie alla messa in atto delle decisioni prese.

Syllabus
Problemi e loro strutturazione
– Processi decisionali
– Analisi dei sistemi e pensiero sistemico
– Analisi dinamica dei sistemi.
– Cicli causali, variabili di flusso e di livello.
La Dinamica dei Sistemi
– Il linguaggio della dinamica dei sistemi.
– Livelli, flussi e ritardi.
– Esempi (sostenibilità ambientale, processi di azione-reazione,
un modello di ”guerra dei prezzi”, ...).
Cooperazione, competizione e sfruttamento
– Un modello di produzione ed allocazione di risorse.
– Cenni di teoria dei giochi, equilibrio di Nash.
– Il dilemma del prigioniero.
– La tragedia dei Commons.
“Social Choice” e votazioni
– Ordinamenti e preferenze.
– Metodi di Condorcet e di Borda e loro varianti.
– Il teorema di impossibilità di Arrow e sue conseguenze.
– Il metodo del consenso.
Sistemi elettorali
– Distribuzione dei seggi fra liste e distretti (metodi dei resti, metodi del divisore, ...).
– Definizione dei distretti elettorali.
– Alcuni paradossi.
– Analisi di alcuni sistemi elettorali.
Valutazione di progetti
– Analisi costi benefici: varianti e limiti.
– Analisi costi efficacia.
– Analisi multicriteria.
– Metodo ELECTRE.
Indici e misure
– Qualità, incertezza e soggettività nelle misure.
– Indici di sviluppo.
– Indici di disuguaglianza.
– Indice dello sviluppo umano.

Note
L’insegnamento è erogato dal Corso di Laurea Triennale in Scienze per la Pace. Il calendario accademico delle lezioni e degli esami potrebbe differire lievemente.

Diritto dell'informatica (058NN) (6 ECTS)
Title in English: Law and Computer Science
Semestre: 1
Docente: Prof.ssa Dianora POLETTI (dianora.poletti@unipi.it)
Web Page: moodle.ec.unipi.it
Registro: unimap.unipi.it/registri/dettregistriNEW.php?re=168584::::&ri=8043

Obiettivi
L'avvento delle tecnologie informatiche ha sollevato problemi per la regolamentazione giuridica delle attività compiute loro tramite. Il corso si propone di analizzare queste problematiche, considerando sia le regole giuridiche specifiche per l'era digitale sia la possibilità di impiego del diritto generale. In particolare, il corso si propone di esaminare, tra alcune grandi tematiche del diritto nell'era digitale, quelle più proprie del contesto aziendale, ossia la contrattazione telematica, il documento informatico, il trattamento dei dati personali e le responsabilità in Internet.

Syllabus
– Il commercio elettronico. Conclusione, validità, forma e prova del contratto concluso via email e tramite point and click: applicabilità delle regole generali, deroghe e regole speciali. La Direttiva europea sul commercio elettronico e la sua attuazione: il d.lgs. n. 70/2003. I contratti ad oggetto informatico.
– La tutela del consumatore e il regime delle informazioni in rete: informazioni generali, commerciali e pubblicitarie non sollecitate ("spamming"). Le informazioni pubblicitarie nelle professioni regolamentate.
– La disciplina del trattamento dei dati personali (d.lgs. n. 196/2003). Il trattamento dei dati personali: nozione di trattamento, dato personale, titolare, responsabile, incaricato, interessato. L'informativa e il consenso. Il trattamento effettuato con l'ausilio degli strumenti elettronici. La sicurezza dei dati: il documento programmatico sulla sicurezza e il disciplinare tecnico. Il regime sanzionatorio civile, amministrativo e penale. Il trattamento in outsourcing dei dati personali.
– Firma digitale, firma elettronica e documento informatico: questioni di forma, validità e prova. La posta elettronica certificata. La trasmissione telematica dei documenti. I certificatori.
– I domain names. I nomi di dominio aziendali. Le regole della Registration Authority.
– Gli illeciti in Internet e la responsabilità dei providers.
– La tutela del software. Software libero e software proprietario. Il diritto di autore all'epoca di Internet.
– L'elaboratore e l'adempimento dell'obbligazione: la moneta elettronica e i mezzi di pagamento in Internet.

Ingegneria del software (271AA) (6 ECTS)
Title in English: Software Engineering
Semestre: 2
Docente: Prof.ssa Laura SEMINI (semini@di.unipi.it)
Web Page: didawiki.cli.di.unipi.it/doku.php/informatica/is-a

Obiettivi
Fornire le metodologie e strumenti per la progettazione, realizzazione, verifica, validazione e misurazione di sistemi software.

Syllabus
– Processo di sviluppo software: problemi della produzione del software, modelli di ciclo di vita.
– Analisi del dominio: modelli statici (classi e associazioni) e dinamici (attività, macchine a stati).
– Analisi dei requisiti: modello statico (casi d'uso) e dinamici (narrative, diagrammi di robustezza).
– Progettazione architettonica: modelli statici (viste strutturali e logistiche) e dinamici (vista componenti/connettori).
– Progettazione di dettaglio: modello statico delle componenti (strutture composite) e modello dinamico (interazioni).
– Verifiche e prove: obiettivi e pianificazione delle verifiche, progettazione e valutazione delle prove.

Introduzione all'Intelligenza Artificiale (596AA) (6 ECTS)
Title in English: Introduction to Artificial Intelligence
Semestre: 2
Docente: Prof. Alessio MICHELI (micheli@di.unipi.it)
Web Page: www.di.unipi.it/∼micheli/DID/IIA-2016/

Obiettivi
Apprendere i concetti principali e i metodi che stanno alla base della progettazione e sviluppo di sistemi di intelligenti.

Syllabus
– Risoluzione dei problemi come ricerca.
– Rappresentazione della conoscenza e ragionamento.
– Ragionamento incerto e probabilistico.
– Apprendimento automatico.
– Applicazioni e prospettive.

Laboratorio di basi di dati (254AA) (6 ECTS)
Title in English: Database Programming Lab
Semestre: 2
Docente: Prof.ssa Giovanna ROSONE (giovanna.rosone@unipi.it)
Web Page: TBA

Obiettivi
Il laboratorio si propone l'obiettivo di completare le nozioni relative ad analisi e progettazione di dati, procedure ed interfacce di applicazioni per basi di dati, ed alla loro realizzazione. Tutte le nozioni introdotte vengono immediatamente sperimentate dagli studenti, utilizzando notazioni standard ed un sistema commerciale, quale ad esempio ORACLE DBMS ed ORACLE WebServer, sviluppando un case study che si conclude, alla fine del corso, con la realizzazione da parte degli studenti di un sistema funzionante.

Logica per la programmazione (009AA) (6 ECTS)
Title in English: Logic of Programs
Semestre: 1
Docente: Prof. Andrea CORRADINI (andrea@di.unipi.it)
Web Page: www.di.unipi.it/∼andrea/Didattica/LPP-15/

Obiettivi
Obiettivo del corso è la presentazione del calcolo proposizionale e del calcolo del primo ordine e la loro applicazione alla specifica di programmi e alla dimostrazione di correttezza dei programmi in base alla logica di Hoare.

Syllabus
– Il concetto di enunciato dichiarativo.
– Sintassi della logica proposizionale.
– Semantica della logica proposizionale (tabelle di verità).
– Leggi per il calcolo proposizionale e dimostrazioni.
– Sintassi della logica del primo ordine.
– Semantica della logica del primo ordine (interpretazioni, modelli ecc.).
– Leggi per il calcolo del primo ordine e dimostrazioni.
– Specifica di proprietà di programmi.
– Prova di correttezza di programmi mediante il calcolo delle triple di Hoare.

Matematica discreta (597AA) (6 ECTS)
Title in English: Discrete Mathematics
Semestre: 2
Docente: Prof. Giovanni GAIFFI (gaiffi@dm.unipi.it)
Web Page: www.dm.unipi.it/∼gaiffi/MatDisc2015/

Obiettivi
Introdurre i concetti di base della matematica discreta.

Syllabus
– Insiemi, relazioni, funzioni.
– Principio di induzione e definizioni per ricorrenza.
– Il concetto di cardinalità e calcolo combinatorio.
– Aritmetica e congruenze.
– Polinomi e fattorizzazione.

Note
L'insegnamento è il primo modulo di *Matematica Discreta e Algebra Lineare* (cod. 585AA) erogato dal Corso di Laurea Triennale in Informatica.

Organizzazione aziendale (096PP) (6 ECTS)
Si veda a pag. 50.

Programmazione I e laboratorio (007AA) (12 ECTS)
Title in English: Introduction to programming.
Semestre: 1
Docente: Prof. Paolo MANCARELLA (paolo.mancarella@unipi.it)
Web Page: www.di.unipi.it/∼paolo/PRL/

Obiettivi
Introduzione alla risoluzione di problemi e alla programmazione con esercitazioni in laboratorio.

Syllabus
– Grammatiche libere.
– Presentazione del Linguaggio funzionale Caml.
– Programmazione funzionale.
– Presentazione del Linguaggio imperativo C (rappresentazione numerica, funzioni, procedure, parametri, puntatori).
– Programmazione imperativa (array, liste, ecc.).
– Definizione di un interprete in Caml del Linguaggio Imperativo.

Note
Le lezioni video-registrate sono disponibili sul sito mediateca.unipi.it.

Ricerca operativa (029AA) (6 ECTS)
Title in English: Mathematical Programming
Semestre: 1
Docente: Prof. Massimo PAPPALARDO (massimo.pappalardo@unipi.it)
Web Page: pages.di.unipi.it/mpappalardo/#inf

Obiettivi
L'insegnamento ha l'obiettivo di fornire gli strumenti per costruire modelli matematici di ottimizzazione, l'analisi di tali modelli e i metodi risolutivi.

Syllabus
– Modelli matematici della ricerca operativa.
– Programmazione lineare.
– Programmazione lineare su reti.
– Programmazione lineare intera.