Bachelor's Degree Study Plan

1.	School	King Abdullah II School for Information Technology
2.	Department	Artificial Intelligence Department
3.	Program title (Arabic)	علم البيانات
4.	Program title (English)	Data Science

5. Components of Curriculum:

The curriculum for the bachelor's degree in **Data Science Program** consists of (132) credit hours distributed as follows:

Number	Type of Requirements	Credit Hours
First	University Requirements	27
Second	School Courses	24
Third	Specialization Requirements (**81 Credit Hours**)	
	(Obligatory Courses)	69
	(Elective Courses)	12
Total		132

6. Numbering System:

A- Department Numbers

Department No.	Department Name	Program No.	Program Name
1	Computer Science (CS)	01	Computer Science (CS)
2	Computer Information Systems (CIS)	02	Computer Information Systems (CIS)
3	Business Information Systems (BIS)	03	Business Information Systems (BIS)
4	Information Technology (IT)	04	Information Technology (IT)
5	Artificial Intelligence (AI)	05	Artificial Intelligence (AI)
		15	Data Science (DS)

B- Course number

Domain Number	Domain Title	Domain Number	Domain title
0	General	5	Applications
1	Programming Languages	6	Distributed Computing
2	Fundamentals of AI and Data Science	7	Machine Learning
3	Databases and Data Engineering	8	Frameworks and Tools
4	Computational Sciences and Algorithms	9	Special Topics and Project

C- Course number consists of 7 digits:

School		Department/Program		Level	Area	Serial number
1	9	1	5	1	X	X

First: University Requirements (27) credit hours distributed as follows:

Preparation Program Requirements						

<table>
<tr><td colspan="6">Preparation Program Requirements
All students admitted to the university must apply for a degree examination in Arabic and English and the computer is prepared or approved by the university to determine their level. Based on the results of the examinations, either the student will study one or more of the requirements of the preparatory program.
(0 - 15 Credit Hours)</td></tr>
<tr><td>No.</td><td>Course Title</td><td>Course No.</td><td>Credit Hours</td><td>Prerequisites</td><td>Notes</td></tr>
<tr><td>1</td><td>Community Service</td><td>0300150</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>Computer Skills Placement Test</td><td>1902098</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>3</td><td>Basics of Computing</td><td>1932099</td><td>3</td><td>1902098</td><td>Pass/Fail</td></tr>
<tr><td>4</td><td>Arabic Placement Test</td><td>3201098</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>5</td><td>Basics of Arabic</td><td>3201099</td><td>3</td><td>3201098</td><td>Pass/Fail</td></tr>
<tr><td>6</td><td>Arabic Languages Skills</td><td>3201100</td><td>3</td><td>3201099</td><td>Pass/Fail</td></tr>
<tr><td>7</td><td>English Placement Test</td><td>3202098</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>8</td><td>Basics of English</td><td>3202099</td><td>3</td><td>3202098</td><td>Pass/Fail</td></tr>
<tr><td>9</td><td>English Language Skills</td><td>3202100</td><td>3</td><td>3202099</td><td>Pass/Fail</td></tr>
<tr><td colspan="6">Compulsory Requirements
(18 Credit Hours)</td></tr>
<tr><td>No.</td><td>Course Title</td><td>Course No.</td><td>Credit Hours</td><td>Prerequisites</td><td>Notes</td></tr>
<tr><td>1</td><td>Military Sciences</td><td>2220100</td><td>3</td><td></td><td></td></tr>
<tr><td>2</td><td>National Culture</td><td>3400100</td><td>3</td><td></td><td></td></tr>
<tr><td>3</td><td>Ethics and Humans Values</td><td>3410100</td><td>3</td><td></td><td></td></tr>
<tr><td>4</td><td>Entrepreneurship Innovation and Scientific Research</td><td>3410101</td><td>3</td><td>3410100/1932099</td><td></td></tr>
<tr><td>5</td><td>Life And Practical Skills</td><td>3410102</td><td>3</td><td>3410100/1932099</td><td></td></tr>
<tr><td>6</td><td>Introduction to Philosophy and Critical Thinking</td><td>3400103</td><td>3</td><td>3410100/1932099</td><td></td></tr>
</table>

C. Electives University Requirements (9 Credit Hours): Elective courses are to be chosen from the first, second and third groups mentioned below. The student has to choose one course from each of the groups.

<table>
<tr><td colspan="6">C- Electives
(9 Credit Hours)
Elective courses: (9) credit hours to be chosen from the first, second and third groups mentioned below. The student has to choose one course from each of the groups.</td></tr>
<tr><td colspan="6" align="center">(First Group)</td></tr>
<tr><th>No.</th><th>Course Title</th><th>Course No.</th><th>Credit Hours</th><th>Prerequisites</th><th>Notes</th></tr>
<tr><td>1</td><td>Islam and Contemporary Issues</td><td>0400101</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>Arab-Islamic Civilization</td><td>2300101</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>3</td><td>Jordan: History and Civilization</td><td>2300102</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>4</td><td>Great Books</td><td>3400107</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>5</td><td>Jerusalem</td><td>3400108</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td colspan="6" align="center">Electives
(Second Group)</td></tr>
<tr><th>No.</th><th>Course Title</th><th>Course No.</th><th>Credit Hours</th><th>Prerequisites</th><th>Notes</th></tr>
<tr><td>1</td><td>Environmental Culture and Development</td><td>0310102</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>Islamic Culture</td><td>0400102</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>3</td><td>Health Culture</td><td>0720100</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>4</td><td>Legal Culture</td><td>1000102</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>5</td><td>Physical Fitness Culture</td><td>1100100</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td colspan="6" align="center">Electives
(Third Group)</td></tr>
<tr><th>No.</th><th>Course Title</th><th>Course No.</th><th>Credit Hours</th><th>Prerequisites</th><th>Notes</th></tr>
<tr><td>1</td><td>Electronic Commerce</td><td>1600100</td><td>3</td><td></td><td></td></tr>
<tr><td>2</td><td>Social Media</td><td>1900101</td><td>3</td><td></td><td></td></tr>
<tr><td>3</td><td>Appreciation of Arts</td><td>2000100</td><td>3</td><td></td><td></td></tr>
<tr><td>4</td><td>Foreign Language</td><td>2200103</td><td>3</td><td></td><td></td></tr>
<tr><td>5</td><td>Special Subject</td><td>3400106</td><td>3</td><td></td><td></td></tr>
</table>

Second: School courses: distributed as follows:

A. Obligatory school courses: (24) credit hours

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
1901101	Discrete Mathematics	3	-	3	-
1931102	Computer Skills for Scientific Faculties	3	-	3	Pass Qualifications Exam or 1932099
1904101	Fundamentals of Information Technology	3	-	3	-
1904120	Web Applications Development	3		3	1931102
1902110	Object-Oriented Programming	3		3	1931102
1901242	Data Structures	3	-	3	1902110
1902224	Database Management Systems	3	-	3	1902110
1915101	Linear Algebra for Computational Sciences	3	-	3	0301101
1902390	Seminar-Road to Software Industry	2	-	0	Passing 45 hours

B. Elective school courses: (0) credit hours:

Third: Specialty courses: (81) credit hours distributed as follows:

A. Obligatory specialty courses: (69) credit hours:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
0301131	Principles of Statistics	3	-	3	-
0301101	Calculus 1	3	-	3	-
1915111	AI Programming	3	-	3	1931102
1915121	Principles of Data Science	3	-	3	-
1905222	Data Mining	3	-	3	1902224
1915231	Data Engineering and Analytics	3	-	3	1915121 + 1915111
1915251	Applied Statistics	3	-	3	0301131
1905220	Ethics of AI and Data Science	3	-	3	1915121
1911322	Information Security and Privacy	3	-	3	1901363 + 1902224
1905320	Artificial Intelligence	3	-	3	1901242
1915331	NoSQL Databases	3	-	3	1902224
1901341	Theory of Algorithms	3	-	3	1901242
1915370	Machine Learning and Neural networks	3	-	3	1905222
1915371	Pattern Recognition and Information Analysis	3	-	3	1905222
1901363	Computer Networks	3	-	3	1901242
1902372	Software Engineering	3	-	3	1902224
1905380	Natural Language Processing	3	-	3	1905320
1915441	Data Visualization	3	-	3	1915370
1915461	Cloud Computing	3	-	3	1905222 + 1901363
1915431	Big Data	3		3	1915461
1915471	Deep Learning	3	-	3	1915370
1915481	Model Deployment Frameworks	3	-	3	1915370
1915490	Training	6 Weeks		0	Success 90 hours
1915491	Project -1	-	-	0	Success 90 hours
1915492	Project -2	-	-	3	1915491

B. Elective specialty courses: (12) credit hours:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
1915342	Bioinformatics	3	-	3	1905222
1915252	Financial and Business Data Analytics	3	-	3	1905222
1915232	Data Management and Governance	3	-	3	1905222
1905310	Advance AI programming	3	-	3	1905111
1915341	Social Network Analysis	3	-	3	1915222 + 1901341
1915352	Healthcare and Medical Data Analytics	3	-	3	1905222
1915353	Mining Software Repositories	3	-	3	1902372 + 1905222
1902383	Information Technology Entrepreneurship and Innovation	3	-	3	1902224
1915442	Time Series Analysis	3	-	3	1915370
1904472	IT Project Management	3	-	3	1902372
1905322	Computer Vison	3	-	3	1915370
1905382	Digital Speech Processing	3	-	3	1905320
1905480	Arabic Language Engineering	3	-	3	1905380
1901444	Computational Problems and Techniques	3	-	3	1901341
1904253	Web Server Programming	3	-	3	1904120
1905330	Embedded Systems	3	-	3	1905320 + 1901242
1905431	Intelligent Robotics	3	-	3	1905320
1905453	Virtual Reality	3	-	3	1915441
1915494	Special Topics in Data Science	3	-	3	1915370

Fourth: Courses offered by other faculties and departments

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
0301131	Principles of Statistics	3	-	3	-
0301101	Calculus 1	3	-	3	-
1911322	Information Security and Privacy	3	-	3	1901363 + 1902224
1902372	Software Engineering	3	-	3	1902224
1901341	Theory of Algorithms	3	-	3	1901242
1901363	Computer Networks	3	-	3	1901242
1904472	IT Project Management	3	-	3	1902372
1901444	Computational Problems and Techniques	3	-	3	1901341
1904253	Web Server Programming	3	-	3	1904120
1902390	Seminar-Road to Software Industry	2	-	0	Passing 45 hours

Fifth: Advisory Study Plan

First Year

First Semester			Second Semester		
Course No.	*Course Name*	*Credit Hours*	*Course No.*	*Course Name*	*Credit Hours*
0301101	Calculus 1	3	1902110	Object-Oriented Programming	3
1904101	Fundamentals of Information Technology	3	0301131	Principles of Statistics	3
1901101	Discrete Mathematics	3	1904120	Web Application Development	3
1931102	Computer Skills for Scientific Faculties	**3**	1915121	Principles of Data Science	3
-	University Requirement	3	1901242	Data Structures	3
		15			15

*** All Students need to take the Ethics and skills of university life (1900010) course during the first year.

Second Year

First Semester			Second Semester		
Course No.	*Course Name*	*Credit Hours*	*Course No.*	*Course Name*	*Credit Hours*
1915111	AI Programming	3	1901341	Theory of Algorithms	3
1902224	Database Management Systems	3	1905222	Data Mining	3
1915101	Linear Algebra for Computing Sciences	3	1915231	Data Engineering and Analytics	3
-	University Requirement	3	1915251	Applied Statistics	3
-	University Requirement	3	-	University Requirement	3
-	Major elective requirement	3	-	University Requirement	3
		18			18

Third Year

First Semester			Second Semester		
Course No.	*Course Name*	*Credit Hours*	*Course No.*	*Course Name*	*Credit Hours*
1902372	Software Engineering	3	1901363	Computer Networks	3
1911322	Information Security and Privacy	3	1915371	Pattern Recognition and Information Analysis	3
1915370	Machine Learning and Neural networks	3	1915331	NoSQL Databases	3
1905320	Artificial Intelligence	3	1905220	Ethics of Artificial Intelligence and Data Science	3
-	Major elective requirement	3	1902399	Seminar-Road to Software Industry	0
-	University Requirement	3	-	Major elective requirement	3
			-	University Requirement	3
		18			18

Fourth Year

First Semester			Second Semester		
Course No.	*Course Name*	*Credit Hours*	*Course No.*	*Course Name*	*Credit Hours*
1905380	Natural Language Processing	3	1915441	Data Visualization	3
1915461	Cloud Computing	3	1915471	Deep Learning	3
1915481	Model Deployment Frameworks	3	1915431	Big Data	3
1915491	Project 1	0	1915492	Project 2	3
-	University Requirement	3	-	Major elective requirement	3
-	University Requirements	3	1915490	Training	0
		15			15

*** *Student can take training (1915490 with 0 credit hours) after completing 90 credit hours.*

A. Obligatory School Courses Description

Course Number 1901101	Course Title Discrete Mathematics	Credit Hours 3
Prerequisite: (None)		

Course Description

This course studies the mathematical elements of computer science and their applications. Topics include propositional logic; predicate logic; mathematical reasoning; techniques of proof; mathematical induction; set theory; number theory; matrices; sequences and summations; functions, relations and their properties, elementary graph theory, and tree (graph theory). In each subject, its characteristics, forms, ways of representing it, the operations used in it, and ways of linking these subjects together are studied. Homework will be assigned.

Course Number 1931102	Course Title Computer Skills for Scientific Faculties	Credit Hours 3
Prerequisite: (Pass Qualifications Exam or 1932099)		

Course Description

This course studies the fundamental concepts of programming using C++. Topics includes: basic structures of programming tools, like: variable names, data types, input and output statements, and output formatting. Files. Selection statements structures. Repetition statements structures. Functions. Enumeration datatype and strings data type. Arrays; 1D and 2D. The lectures will be provided in the lab through active teaching methodologies individually or within groups.

Course Number 1904101	Course Title Fundamentals of Information Technology	Credit Hours 3
Prerequisite: (None)		

Course Description

This course will introduce the fundamental knowledge of information technologies, and it works as an introductory course for computer-related courses. It is a combination between a theoretical and a practical course. In particular, the course provides students with a grounding knowledge on several areas of information technologies including cutting edge technologies, careers in IT, basic concepts of cloud computing and web technologies, and a general perceptive of project management. Students are also going to be introduced practically to hardware maintenance, software diagnostics and technical support. In addition, critical thinking methodologies and techniques will be discussed, including numbering systems, flowcharts and related case studies. Operating systems such as

LINUX/UNIX with, memory allocation, and an introduction to networks and security, and block chain concepts. The final part is concerned with technical applications needed such as excel, advanced excel, technical writing, report generating and type writing. Technical sections will be taught on lab sessions and group works. Active learning methodologies will be applied through role playing, presentations and problem solving exercises.

Course Number 1904120	Course Title Web Application development	Credit Hours 3
Prerequisite: (1931102)		

Course Description

This course aims to improve students' ability in Front-End Web applications development using client-side programming such as HTML 5, Cascading Style Sheet (CSS3), JavaScript. In addition, the students will learn the fundamental concepts of front-end web development frameworks such as Bootstrap and React front-end frameworks. The course will cover the Bootstrap framework, which is the most popular CSS framework for creating responsive mobile-first websites. This course will teach you how to create pages of a website using the Bootstrap v5 framework. In addition, the course also covers the basic concepts of the React framework such as Communicating with Props, Class-Based Components, State in React Components, Lifecycle Methods, Handling User Input with Forms and Events, Making API Requests with React, and Single Page Application Development. This course uses active teaching methodologies, such as weekly lab applied sessions, group work and technical projects.

Course Number 1902110	Course Title Object-Oriented Programming	Credit Hours 3
Prerequisite: (1931102)		

Course Description

The course aims to cover the fundamental concepts of OOP, such as Encapsulation and Information-Hiding, Inheritance, Polymorphism, and Abstraction. The course uses Java Programming language starting from the basic Java syntax based on Eclipse IDE. It focuses on the understanding and practical mastery of OOP principles and Java components, such as classes, objects, input/output, scanner objects (to read either from the keyboard or a file), loops, decision-making, array and multidimensional array, data abstraction, methods, method overloading, objects garbage-collector, an introduction to exception-handling, etc. Finally, it presents an introduction to JavaFX and its hierarchy based on Java inheritance OOP concepts, for developing rich client applications. Lectures will be given in the lab for practical application. This course is assessed through exams, practical tests and assignments.

Course Number 1901242	Course Title Data Structures	Credit Hours 3
Prerequisite: (1902110)		

Course Description

This Course introduces the students to the concepts of data structures. Topics includes: Pointers, and pointer operations. Array implementation of lists, stacks, and queues. Dynamic implementation of lists (singly, doubly, circular), stack operations and queue operations (and their implementation as linked lists). STL, like: vectors, pairs, maps, sets, lists, stacks, queue. Recursion. Tree dynamic, like binary search trees, segment, red-black, AVL trees. Hash Table and Collision resolution. Weekly lab assignments will be given to the students and to be discussed thourhg active teaching methodologies, in addition to problem solving tasks.

Course Number 1902224	Course Title Database Management Systems	Credit Hours 3
Prerequisite: (1902110)		

Course Description

The course aims to provide students with an overview of database management system architecture and environment, an understanding of the basic database design and implementation techniques, and a practical experience of designing and building relational databases. Furthermore, it enables applying conceptual design methodologies for databases and learning about the architecture and environments of the database management system. Students will practice using database tools to create and manage database schemas systems and formulate DDL, DML commands and run SQL queries. Advanced SQL topics such as creating database functions, database Stored Procedures and database Triggers will be covered. Also, students will learn how to manage database privileges and design suitable security and integrity constraints for database schemas. Furthermore, the course will provide the students with practice project to connect a relational DB using a programming language, in addition to practice using basic Oracle Forms and Oracle Reports. This course will use a combination of traditional lectures, active teaching methodologies, and hands-on lab lectures.

Course Number 1915101	Course Title Linear Algebra for Computational Sciences	Credit Hours 3
Prerequisite: (0301101)		

Course Description

The course uses linear algebra as one of the most important tools in applied mathematics, data science, and artificial intelligence to help students learn how to handle vectors and matrices, solve matrix-vector equations, perform Eigen value and Eigen vector and diagonalization analyses and use principal component analysis to do dimension reduction on real-world datasets. It covers topics such as: solving systems of linear equations; matrices and matrix operations; homogeneous and non-homogeneous systems; Gaussian elimination; elementary matrices and a method for finding $A-1$; determinants; Euclidean vector spaces; linear transformations from Rn to Rm and their properties; general vector spaces; subspaces; basis; dimension; row space; column space; null space of a matrix; rank and nullity; and inner product spaces. All analysis will be performed in python or any similar popular programming language. Lectures will be given in the lab for practical application. This course is assessed through exams, practical tests and assignments.

Course Number 1902390	Course Title Seminar-Road to Software Industry	Credit Hours 0
Prerequisite: (Passing 45 hours)		

Course Description

IT students increasingly demand and require coverage of emerging technologies to prepare themselves for subsequent employment and research. Industry and professional bodies are also concerned that IT education does not always prepare students adequately for the world of work. This professional practice seminar course aims to contribute to solving these two issues by providing real-world experiences, inspiring students to choose their career path, and exposing them to the trends, methods, and techniques that are of current interest in software industry through a weekly seminar series. Professionals from software companies are invited to present different aspects of their companies and to share their first-hand experience with students. This course can enhance IT education and motivate students by covering leading-edge technologies and practices. After each seminar, students will submit a personal evaluation and short reports relevant to the seminar's presentation. Attendance and participation in 8 seminars, including the evaluation of each seminar and the short reports are the minimum requirements to pass the course.

B- Obligatory Courses Description

Course Number 0301131	Course Title Principles of Statistics	Credit Hours 3
Prerequisite: (None)		

Course Description

Describing statistical data by tables, graphs and numerical measures, Chebychev's inequality and the empirical rule, counting methods, combinations, permutations, elements of probability and random variables, the binomial, the Poisson, and the normal distributions, sampling distributions, elements of testing hypotheses, statistical inference about one and two populations parameters

Course Number 0301101	Course Title Calculus-1	Credit Hours 3
Prerequisite: (None)		

Course Description

Functions: domain, operations on functions, graphs of functions; trigonometric functions; limits: meaning of a limit, computational techniques, limits at infinity, infinite limits; continuity; limits and continuity of trigonometric functions; the derivative: techniques of differentiation, derivatives of trigonometric functions; the chain rule; implicit differentiation; differentials; Roll's Theorem; the mean value theorem; the extended mean value theorem; L'Hopital's rule; increasing and decreasing functions; concavity; maximum and minimum values of a function; graphs of functions including rational functions (asymptotes) and functions with vertical tangents (cusps); antiderivatives; the indefinite integral; the definite integral; the fundamental theorem of calculus ; the area under a curve; the area between two curves; transcendental functions: inverse functions, logarithmic and exponential functions; derivatives and integrals; limits (the indeterminate forms); hyperbolic functions and their inverses; inverse trigonometric functions.

Course Number 1915111	Course Title AI Programming	Credit Hours 3
Prerequisite: (1931102)		

Course Description

This course builds programming skills for students which is required develop and implement applications and algorithms of Artificial Intelligence and data science. This course will focus on programming using Python 3 https://www.python.org/. Python is high-level programming language like Java, C++, or C#. This course provides students with the required skills to solve problems by implementing programs using Python. Topics include: fundamentals of Python programming, Object-Oriented programming using Python, Data Structures and Algorithms, and Python packages. This course is a lab-based course which includes in-class practical assignments and tasks. The course will also briefly introduce other programming languages such as Lisp and Prolog. This course will use a combination of lectures, group discussions, case studies analysis, and hands-on work.

Course Number 1915121	Course Title Principles of Data Science	Credit Hours 3
Prerequisite: (None)		

Course Description

This will be an introductory course in data science and data analytics. The objective of the course is to give students a broad overview of the various aspects of data science such as accessing, cleansing, modelling, visualizing, and interpreting data. Students will perform hands-on learning of data analytic topics, using technologies such as Python, and open-source analytic tools. The focus in the treatment of these topics will be on breadth rather than depth. The student acquires the concepts and skills needed for programming in the Python language as well as statistical inference, and related mathematics along with the practical analysis of real-life data sets. The course briefly addresses the social and legal issues surrounding data analysis, including privacy and data ethical issues. This course will use a combination of lectures, group discussions, programming assignments, case studies analysis, and hands-on work.

Course Number 1905222	Course Title Data Mining	Credit Hours 3
Prerequisite: (1902224)		

Course Description

This course provides the students with an introduction to data mining and knowledge discovery (KDD). The course will focus on issues relating to the feasibility, usefulness, effectiveness, and scalability of techniques for the discovery of patterns hidden in large data sets. The students will learn the basic concepts of data pre-processing, frequent pattern mining and association rules, sequential patterns, and sub-graph patterns; and explore their applications, Classification methods, such as decision trees, k-nearest neighbour, and Naïve Bayes, ensemble learning methods such as random forest …etc., outlier detection methods, such as Simple Statistical Methods and local outlier factor (LOF), cluster analysis techniques, such as k-means, hierarchical methods, and density-based methods. Active learning methodologies will be applied through role playing, presentations and problem-solving exercises.

Course Number 1915231	Course Title Data Engineering and Analytics	Credit Hours 3
Prerequisite: (1915121 + 1915111)		

Course Description

This course will examine the typical Data Engineering pipeline includes architecting data platforms, designing data stores, ETL, data collection, importing, wrangling, querying, and analysing data. It also includes performance monitoring and finetuning to ensure systems are performing at optimal levels. In addition, Data modelling and design techniques, Data storage and warehousing. Also, the course will discuss the popular data engineering tools such as Airflow. Furthermore, this course introduces you to the core concepts, processes, and tools you need to know to get a foundational knowledge of data engineering. You will gain an understanding of the modern data ecosystem and the role Data Engineers, Data Scientists, and Data Analysts play in this ecosystem. This course will discuss the exploratory data analysis, feature generation and extraction. The course also includes hands-on labs and assignments that guide you to create and load data into the different types of databases, and perform some basic querying operations that help you understand your dataset. Lectures will be given in the lab for practical application. This course is assessed through exams, practical tests and assignments.

Course Number 1915251	Course Title Applied Statistics	Credit Hours 3
Prerequisite: (0301131)		

Course Description

This course is an introduction to practical applied statistics with R, a programming language and software environment for statistical computing, and with RStudio, an integrated development environment for R. Topics include introduction to R programming, summarizing data, probability and statistics in R, simple and multiple linear regression, categorical predictors and interactions, model diagnostics, collinearity, variable selection and model building, selected data analyses. The course graphically introduces those concepts utilizing R as a programming environment for applying statistical/probabilistic methods and techniques. This course is a practical course and will contain small projects and programming assignments for specific problems using R programming language.

Course Number 1905220	Course Title Ethics of Artificial Intelligence and Data Science	Credit Hours 3
Prerequisite: (1915121)		

Course Description

This course focuses on ethical issues in computing special in Artificial Intelligence (AI) and Data Science (DS). The main themes are privacy, fairness/bias, and explainability in AI and DS. The objectives are to learn how to identify and measure these aspects in the outputs of algorithms, and how to build algorithms that correct these issues. The course will follow a case-study-based approach, where we will examine these aspects by considering real-world case studies for each of these ethical issues. It is intended to give students a chance to reflect on the ethical, social, and cultural impact of AI by focusing on the issues faced by and brought about by professionals in AI but also by citizens, institutions, and societies. Specific topics addressed in the course include the technical, safety-related, and economic implications of AI-enabled automation. Specific sub-areas include transportation, manufacturing, journalism, legal advising, and military applications; AI-endowed advisory tools in areas such as environmental and resource planning; biases and mediocrities in AIs, which can reinforce human prejudice. Furthermore, this course covers ethical writing through many practical skills including referencing styles, citation (i.e., Endnote, Mendeley, RefWorks, and Zotero), quotation, and also through the awareness of the good document requirements, plagiarism forms, copyrights, fair use, creative commons, and intellectual property rights. This course will use a combination of lectures, class discussions, reading and writing assignments, case studies analysis, and hands-on work.

Course Number 1911322	Course Title Information Security and Privacy	Credit Hours 3
Prerequisite: (1901363 + 1902224)		

Course Description

This course introduces information security and privacy. The course covers topics related to cryptography such as symmetric and asymmetric encryptions, hash functions, digital signatures, key management, and public key infrastructures. Also, the course covers topics related to network security as packet sniffing, spoofing, TLS, IPSec, Firewalls, wireless networks security. Furthermore, topics related to Authentication, Authorization, Web security and Steganography will be covered. Risk analysis and ethics, and their applications to the development of a secure healthcare systems as a case study will be presented. Practical hands-on will be provided.

Course Number 1905320	Course Title Artificial Intelligence	Credit Hours 3
Prerequisite: (1901242)		

Course Description

The aim of the course is to enable students to solve problems using explicit knowledge and reasoning techniques and to develop expert systems for simple problems. Students will be able (1) to express knowledge of a simple domain in propositional and/or first-order predicate calculus, (2) to design and develop expert solutions to simple problems where AI techniques can be employed, and (3) to write simple programs in Prolog that reason about the available knowledge to achieve their goals. Furthermore, students will learn some simple blind and heuristic search algorithms such as depth-first, breadth-first, best-first, hill climbing, and simulated annealing and techniques on how to control search using production systems. They will also have the ability to decide the appropriate search techniques (blind or heuristic) for some problems. The students will also be given some grounding in the principal techniques of data mining and be introduced to some applications of data mining. Students will be introduced to some learning techniques to help obtain a clear picture of the concepts of machine learning. This course will use a combination of lectures, class discussions, reading and writing assignments, case studies analysis, and hands-on work.

Course Number 1915331	Course Title NoSQL Databases	Credit Hours 3
Prerequisite: (1902224)		

Course Description

This course explores the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems. Core concepts of NoSQL databases will be presented, followed by an exploration of how different database technologies implement these core concepts. It gives a closer look at 1-2 databases from each of the four main NoSQL data models (key-value, column family, document, and graph), highlighting the business needs that drive the development and use of each database. This course will introduce some examples of NoSQL databases such as Cassandra, MongoDB, Apache Hive, HBase, and Neo4j. Finally, it presents criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases. The course contains a practical application on NoSQL databases through small projects and weekly assignments.

Course Number 1901341	Course Title Theory of Algorithms	Credit Hours 3
Prerequisite: (1901242)		

Course Description

This is the first course in algorithms. The main goal is to introduce complexity analysis of algorithms with an emphasis on efficient design techniques for solving various computational problems. Topics include complexity analysis including big O, big omega, and big theta notations. Recurrence equations and recursive algorithms. Algorithm design techniques include sequential, divide-and-conquer, greedy, and dynamic programming. Sorting algorithms include insertion sort, merge sort, heap sort, and quicksort. Searching algorithms include breadth-first search and depth-first search. Graph-based algorithms including Kruskal's algorithm. Optimization problems include minimum spanning tree and multistage graph problems. Implementation of several algorithms. The assessment of this course is through exams, quizzes, and assignments.

Course Number 1915370	Course Title Machine Learning and Neural networks	Credit Hours 3
Prerequisite: (1905222)		

Course Description

This course will help students to develop basic understanding of principles of learning theory, theoretical and mathematical foundations of the machine learning and derive practical solutions using predictive analytics. In addition, it explains what machine learning is and how it is related to statistics and data analysis. The class will cover topics in regression, classification, mixture models, neural networks, basic deep learning, ensemble methods and reinforcement learning, hidden Markov models, and Bayesian networks, generative/discriminative learning, parametric/non-parametric learning, support vector machines, unsupervised learning, expectation maximization, dimensionality reduction, and kernel methods. The course will also discuss recent applications of machine learning, autonomous navigation, bioinformatics, speech recognition, and text and web data processing. Delivery will combine traditional lectures with other active teaching methodologies, such as group discussions, group solving problems, analysis of cases and debates, case study from different domains, and assignments.

Course Number 1915371	Course Title Pattern Recognition and Information Analysis	Credit Hours 3
Prerequisite: (1905222)		

Course Description

The course aims to cover a wide understanding of different related topics, such as pattern recognition systems, pre-processing, and feature extraction from images and documents, supervised and unsupervised learning, object classification and recognition. In addition, the course aims at studying the concepts of information retrieval, and text and document mining. Furthermore, the course will introduce the recommendation systems based on pattern recognition such as collaborative and content-based recommendation systems. Active learning methodologies will be applied through role-playing, presentations and problem-solving exercises. Moreover, hands-on practice on developing and modelling knowledge graphs will be weekly practiced in the lab.

Course Number 1901363	Course Title Computer Networks	Credit Hours 3
Prerequisite: (1901242)		

Course Description

This course explores key concepts and essential technologies of computer networks and broad range of topics in networking. It includes general overview, networks applications, network classifications and topologies, network layers, channel performance measures, transmission media, communication network protocols and architecture; Data link layer: framing, error detection and correction, CSMA/CD, LAN IEEE standards; Network layer: IP service model, IP addressing, subnetting, host configuration DHCP, ARP Protocol, ICMP protocol; Transport layer: UDP protocol, TCP protocol, TCP reliable transfer and sliding window, TCP flow and congestion control; Application layer: DNS protocol, NAT protocol, HTTP protocol, persistent and non-persistent HTTP connection. Weekly practice in the lab.

Course Number 1902372	Course Title Software Engineering	Credit Hours 3
Prerequisite: (1902224)		

Course Description

This course aims is to present software engineering as a body of knowledge. The course is designed to present software engineering concepts and principles in parallel with the Software Development Life Cycle (SDLC). The course will begin with an introduction to software engineering, giving students a definition of this body of knowledge, as well as a discussion of the main methodologies of software engineering including agile methods i.e., XP. Students will then learn about the five major phases of the SDLC: requirements gathering and analysis, design, coding/implementation, validation, and evolution. This includes software modelling using Unified Modelling Language (UML), a standardized general-purpose modelling language used to create visual models of object-oriented software, for requirements gathering and analysis, and design. Students will also learn about project management and quality management for the purpose of delivering high-quality software that satisfies customer needs and is within budget and schedule. Delivery will be by in-class lectures, recorded lectures, practical sessions in the lab, case studies from different domains (i.e., healthcare domain), and assignments. Assignments will include a term project illustrative of professional practice in developing computer information systems. One or two guest speakers with many years of experience in software engineering will be invited to share their first-hand experience with students.

Course Number 1905380	Course Title Natural Language Processing	Credit Hours 3
Prerequisite: (1905320)		

Course Description

The aim of the course is to introduce students to the concepts of Natural Language Processing and its applications. It discusses linguistic theories and computational techniques. The course covers the topics of Origins of Natural Language Processing (NLP); Language structure representation; The role of knowledge; Knowledge representation; Parsing techniques; Finite-state techniques; Recursive and augmented transition networks; Language ambiguity; Well-Formed constructs; Features and the lexicon; Language semantics; and Applications. Examples of NLP applications that are covered by this course include; machine translation, information retrieval, text summarization, reference resolution, question answering, parsing, sense disambiguation, morphological analysis, speech analysis and synthesis. Active learning methodologies will be applied through role playing, presentations and problem-solving exercises. Moreover, hands-on practice on using NLTK (Natural Language Toolkit) is weekly practiced in the lab. In addition, guest speakers belonging to the Jordan's ICT will demonstrate state-of-the-art practices and application of NLP.

Course Number 1915431	Course Title Big Data	Credit Hours 3
Prerequisite: (1915461)		

Course Description

This course shall first introduce the overview Big Data applications, market trend, and the things to learn. Then, will introduce the fundamental platforms, such as MapReduce, Hadoop ecosystem, Spark, H2O Framework, Apache Storm, and other tools. Afterwards, the course will introduce several data storage methods and how to upload, distribute, and process them. This shall include HDFS, HBase, Pig, and Hive, document database, and graph database. The course will go on to introduce different ways of handling data analytics algorithms on different platforms. Then, the course will introduce visualization issues on Big Data. It also provides a first hands-on experience in handling and analyzing large, complex structured, semi-structured, and unstructured data. Students will then have fundamental knowledge on Big Data to handle various real-world challenges. The course will zoom in to discuss large-scale machine learning methods, and related big data frameworks. The course contains a set of homeworks and weekly tasks. The course hosts several experts in the field of big data from the local market to cover the practical side of the course and to share their first-hand experience with students.

Course Number 1915441	Course Title Data Visualization	Credit Hours 3
Prerequisite: (1915370)		

Course Description

This course will give you the skills you need to leverage data to reveal valuable insights and advance your career. The course will focus on studying algorithms for creating effective visualizations capable of promoting data comprehension and analysis. The course discusses the key techniques and theory used in visualization, including data models, graphical perception, and visual encoding and interaction. Students will learn about the variety of existing approaches and systems in data visualization and develop skills in evaluating different visualization techniques as applied to particular tasks. Also, these visualization techniques will be used to display data through static and interactive forms and graphics that help in understanding relationships and communicating with non-specialists. The course also discusses visual representation methods, such as graph drawing, parallel coordinates, tree mapping, and encourages students to design new innovative visualizations and experiment their potentials on case studies of various data sources. In addition, the course will introduce the popular packages in python programming and other open sources visualization tools. Delivery will combine traditional lectures with other active teaching methodologies, such as group discussions, group solving problems, analysis of cases and debates, case study from different domains, and assignments.

Course Number 1915461	Course Title Cloud Computing	Credit Hours 3
Prerequisite: (1905222 + 1901363)		

Course Description

The course discusses the basic APIs used in the Microsoft and Amazon Clouds, including the techniques for building, deploying, and maintaining machine images and applications. Student will learn how to use Cloud as the infrastructure for existing and new services. They will use open source implementations of highly available clustering computational environments, as well as the Representational State Transfer Web Services called (RESTful), to build very powerful and efficient applications. Also, students will learn how to deal with not trivial issues in the Cloud, such as load balancing, caching, distributed transactions, and identity and authorization management. It is expected that students will become familiar with Linux OS. In addition, the course will cover Container Orchestration, Docker, Kubernetes, Cloud-based File System, Cloud-based Databases, Scalable Data Storage, Cloud based Machine Learning, Cloud based Analytics, Graph Processing, Graph Databases on the Cloud, introduction to Big Data Programming frameworks such as MapReduce, Spark, and Hadoop. It covers topics of data centers, virtualization, cloud storage, and programming models. The course also addresses the motivating factors, benefits, challenges and the service model. The course introduces several concepts in the design and management of data centers. It also presents concepts such data distribution, robustness, consistency and redundancy.

Delivery will combine traditional lectures with other active teaching methodologies, such as group discussions, group solving problems, analysis of cases and debates, case study from different domains, and assignments.

Course Number 1915471	Course Title Deep Learning	Credit Hours 3
Prerequisite: (1915370)		

Course Description

This course will introduce students to the concept of Deep learning, and it will help students to understand its key principles. The course covers feed-forward neural networks, convolutional neural networks, recurrent neural network, deep reinforcement learning, and other fundamental concepts and techniques. This course will also teach the students the mathematical foundation underlying deep learning. It is expected by the end of the course, students will be able to build, train and apply fully connected deep neural networks, and to know how to implement efficient deep neural networks using the most popular libraries for Deep Learning such as Keras, PyTorch, and TensorFlow. The course will introduce students also to a wide spectrum of deep learning applications in real-word problems.

Delivery will combine traditional lectures with other active teaching methodologies, such as group discussions, group solving problems, analysis of cases and debates, case study from different domains, and assignments.

Course Number 1915481	Course Title Model Deployment Frameworks	Credit Hours 3
Prerequisite: (1915370)		

Course Description

In this course, the student will learn how to deploy ML models and make them available to end-users. In addition, the student will learn about the Model Deployment Platforms such as Django and Flask, and others. The student will build scalable and reliable infrastructure to deliver inference requests both in real-time and batch depending on the use case. Student will also implement workflow automation and progressive delivery that complies with current MLOps practices to keep your production system running. Additionally, you will continuously monitor your system to detect model decay, remediate performance drops, and avoid system failures so it can continuously operate at all times. Delivery will combine traditional lectures with other active teaching methodologies, such as group discussions, group solving problems, analysis of cases and debates, case study from different domains, and assignments.

Course Number 1915490	Course Title Training	Credit Hours 0
Prerequisite: (Success 90 hours)		
Course Description		

The student must be trained in an institution, for at least 6 weeks. The student must provide a report from the institution/enterprise that shows the efficiency of this training according to the regulations of the Dean's Council of the Faculty's Departments or get a certificate in one of the information technology fields from a recognized institute.

Course Number 1915491	Course Title Project-1	Credit Hours 0
Prerequisite: (Success 90 hours)		
Course Description		

Project includes theoretical and practical aspects in Computer Science; the first stage of the graduation project, includes project proposal, analysis and preparation, and project design stages. A report at the end of each stage should be delivered to the department and the supervisor.

Course Number 1915492	Course Title Project- 2	Credit Hours 3
Prerequisite: (1915491)		
Course Description		

It includes the second stage of the graduation project, which covers the implementation, testing and evaluation stages, and completing the project in its final version. A documentation of the whole project should be delivered to the department and the supervisor. Finally, the project should be submitted for presentation and final examination.

C - Elective Courses Description

Course Number 1915342	Course Title Bioinformatics	Credit Hours 3
Prerequisite: (1905222)		

Course Description

This course explores how the integration of computer science, statistics and mathematics knowledge can be used to tackle complex life sciences problems. It covers several topics like: general genomics, cells and DNA sequence features; sequence alignment; sequence motifs; search sequence databases; phylogenetic trees; Hidden Markov Models, and microarray data analysis: normalization and clustering; other emerging topics. Active learning methodologies will be applied through role-playing, presentations and problem-solving exercises. The students are required to present case studies on one of the related topics.

Course Number 1915252	Course Title Financial and Business Data Analytics	Credit Hours 3
Prerequisite: (1905222)		

Course Description

This course reveals the reality of the data analytics world and outlines clear and actionable steps that will equip the student with the tools needed for this next phase of business evolution. It will help you understand the basic concepts in data analytics as well as financial and business applications. It contains proven steps and strategies on how to use everyday data analytics for financial services to increase profitability and customer satisfaction. Furthermore, the student will apply the data mining concepts on different types of financial and business datasets. In addition, the students will learn about the business intelligence concepts and the popular BI tools such as power BI, and Tableau.

Course Number 1915232	Course Title **Data Management and Governance**	Credit Hours 3
Prerequisite: (1905222)		

Course Description

This course introduces the fundamentals of data governance, and management, creating a data governance strategy, benefits from data governance, data governance implementations, managing, monitoring, and measuring data governance efforts. The student will learn about the roles & responsibilities in a data Governance, data Governance challenges, the difference between data governance and data Management, setting up a data governance Framework, data governance tools and techniques, data governance implementations, and best practices of data governance and data management. Delivery will combine traditional lectures with other active teaching methodologies, such as group discussions, group solving problems, analysis of cases and debates, case study from different domains, and assignments. In addition, The course will host a number of experts in the field of data management from the local market to cover the practical side of the course and share their first-hand experience with students.

Course Number 1905310	Course Title **Advance AI programming**	Credit Hours 3
Prerequisite: (1915111 + 1902110)		

Course Description

This course will focus on understanding of how to perform Machine Learning with Python. In this course, student will learn to understand and format problems to be solved using ML techniques. They will also gain knowledge representation skills for preparing data to be used in prediction tasks and they will acquire expertise in creating models by combing the data with algorithms in that can predict the future. Students will learn how to use Python and libraries such as it scikit-learn to create Machine Learning solutions. This course will cover an introduction to ML and applications, setting up a Python development environment correctly, complete machine learning tool sets, the various regression, classification and other ML algorithms performance metrics such as R-squared, MSE, accuracy, confusion matrix, precision, recall, etc., unsupervised Machine Learning (ML) algorithms such as Hierarchical clustering, k-means clustering etc., Jupyter (IPython) notebook, Spyder and various IDE, Communicating visually and effectively with Matplotlib and Seaborn, using of train/test, K-fold and Stratified K-fold cross validation to select correct model and predict model perform with unseen data, and much more. Active learning methodologies will be applied through role-playing, presentations and problem-solving exercises. Moreover, hands-on practice on developing real-world IoT applications will be weekly practiced in the lab.

Course Number 1915341	Course Title Social Network Analysis	Credit Hours 3
Prerequisite: (1915222 + 1901341)		

Course Description

This course gives a basic understanding of what social network analysis is and how it can be applied. The course will cover recent information on the structure and analysis of large social and information networks and on models and algorithms that abstract their basic properties. In this course student will learn about social networks structure and evolution, and how to practically analyze large-scale network data and how to reason about it. Topics covered in this course includes graph theory, link prediction, recommendation systems, graph mining, network community detection, graph visualization, graph data science, information propagation on the web, and connections with work in the social sciences and economics.

Course Number 1915352	Course Title Healthcare and Medical Data Analytics	Credit Hours 3
Prerequisite: (1905222)		

Course Description

This course introduces the characteristics of medical data and associated data mining challenges on dealing with such data. It focuses on studying those data science techniques in the context of concrete healthcare analytic applications such as predictive modelling, computational phenotyping and patient similarity, diseases detection. In this course, the students will learn how can the application of data analytics improve health and health care and how the data analytics-based solutions can result in better diagnosis, and better care. In healthcare, large amounts of heterogeneous medical data have become available in various healthcare organizations (payers, providers, pharmaceuticals). This data could be an enabling resource for deriving insights for improving care delivery and reducing waste. The enormity and complexity of these datasets present great challenges in analyses and subsequent applications to a practical clinical environment. The basics of data mining within the context of a wide variety of health care settings, and the types of data and data analysis challenges that you will likely encounter by gathering the data, move on to classifying, analyzing and finally visualizing medical data. The course will host a number of experts in the field of IT operations and related healthcare sector from the local market to cover the practical side of the course and share their first-hand experience with students.

Course Number 1915353	Course Title Mining Software Repositories	Credit Hours 3
Prerequisite: (1915370)		

Course Description

This course introduces the methods and tools of mining software repositories and artifacts used by software developers and researchers. Students will learn to extract and abstract data from software artifacts and repositories such as source code, version control systems and revisions, mailing-lists and discussions, and issue-trackers and issues. The students will learn how to use machine learning to solve many problems in software Engineering. Students will also learn about various techniques of analyzing this data to identify meaningful relationships, patterns and trends, to recover behaviours and software development processes from evidence, or to empirically test hypotheses about software development.

Course Number 1902383	Course Title Information Technology Entrepreneurship and Innovation	Credit Hours 3
Prerequisite: (1902224)		

Course Description

This course is to introduce students to new and innovative technologies and examine how these powerful systems have fundamentally reshaped modern organizations. These new information technologies are being used to change how organizations operate, produce products and services, and communicate both internally and as well as with external partners. Using online collaborative technologies that were developed in the context of social networking and online communities and data-driven and Artificial Intelligence technologies, corporations are reengineering both internal business processes and those related to customers, suppliers, and business partners. Developing innovative ways to communicate and collaborate can lead to new business opportunities and new efficiencies. This course investigates the technologies, methods, and practices of developing new innovations such as online communities, data revolution, and the Artificial Intelligence paradigms to reengineer business processes and develop innovative, value-adding, and sustainable business activities within existing corporations and new start-ups. The students will learn how to translate innovative, data-driven, and AI ideas into concrete project requirements, develop technological solutions, launch a business venture, and assess its effectiveness. Delivery will combine traditional lectures with other active teaching methodologies. A case study of innovative Healthcare Information Systems (HCIS) is selected for discussion throughout the course to highlight basic concepts of innovative HCIS project development. Students are advised to develop innovative solutions for simple problems in HCIS.

Course Number 1915442	Course Title Time Series Analysis	Credit Hours 3
Prerequisite: (1915370)		

Course Description

This course introduces time series analysis using modern methodologies. Topics covered are: descriptive methods, plots, smoothing, differencing; the autocorrelation function, the correlogram and variogram, the periodogram; estimation and elimination of trend and seasonal components; stationary processes, modelling and forecasting with autoregressive moving average (ARMA) models; spectral analysis, the fast Fourier transform, periodogram averages and other smooth estimates of the spectrum; time-invariant linear filters; non-stationary and seasonal time series models; ARIMA processes, identification, estimation and diagnostic checking, and forecasting. In addition, forecasting using Machine learning, forecasting using Deep learning (ANNs, CNNs, RNNs, and LSTMs) for time series data sets will be discussed. The course will discuss many applications such as stock prices forecasting, annual rainfall forecasting, sunspot activity forecasting, the price of agricultural products forecasting, electricity consumption forecasting, and more.

Course Number 1904472	Course Title IT Project Management	Credit Hours 3
Prerequisite: (1902371)		

Course Description

Students are expected to explore the processes, procedures, tools and techniques and results to create and execute an integrated project plan; it also expected to create project charter, determine requirements, defining creating and managing the project scope, and validating the deliverables. IT project managers are responsible for planning, organizing, allocating resources, budgeting and successfully executing organizations' specific IT goals. This course uses active teaching methodologies, such as weekly lab applied sessions, group work and technical projects. In addition, speakers from the industry will be invited to discuss case studies and show the latest trends on the industry.

Course Number 1905322	Course Title Computer Vison	Credit Hours 3
Prerequisite: (1915370)		

Course Description

This course introduces the students to the fundamental techniques and concepts of computer vision and image processing. This course will cover the following topics: image formation and representation, image enhancement in spatial and frequency domain, image morphological processing, image registration, edge detection and segmentation, feature detection and matching, object recognition and classification, object detection and tracking, 3D vision, and application to models of human and machine vision. This course will use a combination of lectures, class discussions, reading and writing assignments, case studies analysis, and hands-on work. Practical hands-on computer vision best practices will be given in Lab weekly.

Course Number 1905382	Course Title Digital Speech Recognition	Credit Hours 3
Prerequisite: (1905320)		

Course Description

This course aims to provide students with the foundation knowledge on speech production and perception along with processing of speech signal in digital domain. It helps students to design, develop, and evaluate intelligent systems that are based on human speech biometric. Various applications will be taught in this course including Automatic Speech Recognition, Automatic Speech Synthesis, Automatic Speaker Recognition, Automatic Dialects Recognition, Automatic Emotions Recognition, Automatic Speech to Speech Translation, Conversational Agents, and many others. The state-of-the-art digital speech processing tools and algorithms, and written and spoken language resources will be covered in this course. Active learning methodologies will be applied through role playing, presentations and problem-solving exercises. Moreover, hands-on practice on developing automatic Speech processing applications will be weekly practiced in the lab.

Course Number 1905480	Course Title Arabic Language Engineering	Credit Hours 3
Prerequisite: (1905380)		

Course Description

Arabic Language Engineering course is an interdisciplinary course concerned with the use of Natural Language Processing tools and techniques to analyze and generate Arabic language in the forms of text and speech. It investigates the challenges of processing Arabic language. It discusses the linguistic theories and computational techniques for machine translation, information retrieval, text summarization, reference resolution, question answering, parsing, sense disambiguation, morphological analysis, speech analysis and synthesis. Active learning methodologies will be applied through role playing, presentations and problem-solving exercises. Moreover, hands-on practice on developing NLP applications for Arabic will be weekly practiced in the lab. In addition, guest speakers belonging to the Jordan's ICT will demonstrate state-of-the-art practices on Arabic NLP applications.

Course Number 1901444	Course Title Computational Problems and Techniques	Credit Hours 3
Prerequisite: (1901341)		

Course Description

The main goal of this course is to enable the students to solve classical computational problems, such as 0-1 knapsack, rod cutting, matrix chain multiplication, N-queens, and sudoku, using various computational techniques. The students will be introduced to the theoretical concepts for the computational problems and techniques and their implementations. The course covers various computational techniques such as complete search, iterative (all subsets and all permutations), backtracking, greedy approach, dynamic programming, and divide-and-conquer (binary search technique). Also, the course covers two-pointers and range queries including static (partial and prefix sums) and dynamic (segment tree) with their implementations and usage. Weekly problems will be presented in the lab either individually or within groups.

Course Number 1904253	Course Title **Web Server Programming**	Credit Hours 3
Prerequisite: (1904120)		

Course Description

This course is intended to teach students the skills and techniques required to create fully functioning websites. Students will learn how to configure Internet services, design and publish dynamic and interactive web pages, implement both client and server-side scripting, and use data access technologies to manipulate databases.

Specifically, students are introduced to the Visual Web Developer, and how to use it to design, build, configure server side websites built using ASP.Net. In addition, the VWD is used to introduce building DB-based web applications, and introduce the concepts of client state management and web services. This course uses active teaching methodologies, such as weekly lab applied sessions, group work and technical projects. In addition, speakers from the industry will be invited to discuss case studies and show the latest trends on the industry.

Course Number 1905330	Course Title **Embedded Systems**	Credit Hours 3
Prerequisite: (1901242 and 1905320)		

Course Description

The course aims to introduce students to basic logic design system, logic gates, combinational and sequential logic circuits. Then basic input and output devices, after that microcontroller-based embedded systems design, development and implementation with focus on real-time applications. Topics to be covered include, basic logic design, basic input and output systems. Embedded system types, microcontroller architecture, programming (Embedded C), interrupt management and other related topics. This course will use a combination of lectures, class discussions, reading and writing assignments, case studies analysis, and hands-on work. Practical hands-on computer vision best practices will be given in Lab weekly.

Course Number	Course Title	Credit Hours
1905431	**Intelligent Robotics**	**3**
Prerequisite: (1905320)		

Course Description

The aim of this course is to introduce students to the basic principles of robotics. It covers the assembly, programming, and control of a simple robot. Students are expected to (1) know and understand key concepts relating to robots and robotics systems, (2) identify examples of robots, (3) identify the main parts of a robot and their function, including microcontrollers, actuators, sensors, and power sources, (4) understand the elements of a simple control system, and test a control system, (5) understand basic programming concepts, and create and execute a program, and (6) set up a robot, implement robotic motion, and control a robot in an environment. Active learning methodologies will be applied through role-playing, presentations and problem-solving exercises. Moreover, hands-on practice on developing real-world IoT applications will be weekly practiced in the lab. In addition, guest speakers belonging to the Jordan's ICT will demonstrate state-of-the-art practices and robot development.

Course Number	Course Title	Credit Hours
1905453	**Virtual Reality**	**3**
Prerequisite: (1915441)		

Course Description

This course introduces the basic principles of Virtual Reality and its applications. The necessary hardware and software components of interactive 3D systems as well as human factors are discussed. The material is reinforced by practical assignments and projects. The topics will be as follows: applications, human sensory/motor system & capabilities. History of VR and AR, differences between VR/AR and normal experience. Virtual Reality Technology (VR): VR input devices, filtering & tracking, VR output devices, Augmented Reality (AR) hardware, spatial audio, and haptic. This course aims to make students know the basic concept and framework of virtual reality, teach students the principles and multidisciplinary features of virtual reality, teach students the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behaviour, and provide students with an introduction to the VR system framework and development tools. Active learning methodologies will be applied through role playing, presentations and problem-solving exercises. Moreover, hands-on practice on virtual reality applications will be weekly practiced in the lab.

Course Number 1915494	Course Title Special Topics in Data Science	Credit Hours 3
Prerequisite: (1915370)		

Course Description
Selected Topics in advanced areas of data science technologies. Department committee should make the formal approval for the selected topic.