



Al-Ahliyya Amman University
Faculty of Information Technology

**Bachelor of Science in Data Science and Artificial
Intelligence**
Course Description



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A0111101 Mathematics (1)

Functions: Intervals, Inequalities, and Absolute Values, New Functions from Old Functions, Exponential Functions, Inverse Functions and Logarithms, The Limit of a Function; Derivatives: Derivatives of Trigonometric Functions, The Chain Rule, Implicit Differentiations, Derivatives of Logarithmic Functions, Linear Approximations and Differentials, Optimization Problems; Integrals: The definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Net Change Theorem, The Substitution Rule.

Prerequisite: None

A0311101 Discrete Mathematics

Introduction to Propositional Logic: Propositions, Logical operations, Predicates Quantification, Mathematical induction; Basic Structures: Sets, Functions, Sequences, Sums; Relations; Recursion; Counting Techniques; Graphs: Euler Circuit, Hamilton Circuit, Planar Graphs, and Coloring Graph.

Prerequisite: None

A0311201 Introduction to Information Technology

Basic elements of computing: programming, computer, program, operating environment, data, file; Number systems: decimal, binary, conversion; Describing problem solution using standard flowcharting notation; Linux basics: basic commands, working with files, working with directories, file name substitution, input/output and I/O redirection; Linux shell: overview, programming tools; User-defined commands and shell variables: command files, variables, integer arithmetic; Passing arguments: $\$#$, $\$*$, $\${n}$; Decisions: exit status, test command, else, elif, Null, $\&\&$ and $\|\|$ constructs; Loops: for, while, until, breaking a loop, skipping commands in a loop; Git: installation and configuration, basic commands, branching.

Concurrent: A0331700 Computer Skills (Remedial)

A0311202 Introduction to Programming

Sequential execution: program structure, command line arguments, string literals, output, Limerick layout; Program errors: syntactic errors, semantic errors, compile time errors, runtime errors; Types, variables and expressions: string, double and integer types, hard-coded data, assignment statement, arithmetic expressions and associativity, type conversions, parsing input data, integer division, grouping expression terms and long statements layout; Conditional and repeated execution: choice and iteration statements, Boolean expressions, relational



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operators, program design using pseudo code, lists of command line arguments, comments, standard classes; Control statements nested in loops: declaring variables in compound statements, conditional expression operator; Separate methods: private methods, accepting parameters, void methods, returning value, changing parameters does not affect arguments, local and class variables, logical operators, Boolean type, Boolean variables; Program design concepts: designing data, designing algorithm.

Prerequisite: A0311201 Introduction to Information Technology

A0311203 Introduction to Programming Lab

A set of 25-35 practical tasks integrated with and supporting concepts presented in the course. These tasks are outlined in the theory course and detailed in separate worksheets that students do individually at their pace during weekly laboratory sessions, using the Java language and its tools. Sessions are controlled via a platform designed to track students' work originality and manage submissions for assessment.

Concurrent: A0311202 Introduction to Programming

A0312101 Data Structures

Lists: static allocation, dynamic allocation; Stacks: static implementation, linked implementation, operations, applications; Recursion: applications, program stack; Queues: static implementation, linked implementation, operations, applications; General Trees; Binary Trees; Binary Search Trees: traversal, search, add and delete operations; Files: input, output; Graphs: traversal, adjacency matrix, and adjacency list.

Prerequisite: A0312201 Object Oriented Programming

A0312201 Object Oriented Programming

Introduction to Object Oriented Programming Concepts using Java language: Classes, Objects, Constructors, Encapsulation: Visibility Modifiers; Packages; Overloading; using **this** keyword; using **static** keyword; Array of objects: Store and Process objects in array; Relationships between Classes: Composition, Inheritance: Superclasses and Subclasses, using **super** keyword, Constructor Chaining, Overriding, Polymorphism, Preventing Extending and Overriding, The Object Class and its toString() Method; Abstract Classes; Interfaces; Exception Handling; introduction to GUI programming.

Prerequisite: A0311202 Introduction to Programming



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A0312202 Object Oriented Programming Lab

A set of 25-35 practical tasks integrated with and supporting concepts presented in the course. These tasks are outlined in the theory course and detailed in separate worksheets that students do individually at their pace during weekly laboratory sessions, using the Java language and its tools. Sessions are controlled via a platform designed to track students' work originality and manage submissions for assessment.

Concurrent: A0312201 Object Oriented Programming

A0314501 Ethical and Professional Issues in Computing

An overview of ethics, Professional ethics of workers and users in the field of information technology, Cyberattacks and Cybersecurity, Privacy, Intellectual property, Ethical decisions in software development.

Prerequisite: Passing 80 credit hours

A0111103 Statistics and Probability

Data collections; Sampling; Measure of central tendency; Measures of dispersions; Probability: Rules of probability, Counting rules; Discrete random variables; Binomial distributions; Poisson distributions; Normal distributions; Linear regression and correlation; Applications using software packages.

Prerequisite: A0111101 Mathematics (1)

A0112101 Linear Algebra

Systems of linear equations: Homogeneous and non-homogeneous systems ; Matrices: operations on matrices ; Determinants: Operations on Determinates ; Vector spaces ; Method for solving systems of linear equations: Case study ; Eigenvalues and Eigenvectors ; Error norms of vector and matrix ; Applications using software packages.

Prerequisite: A0111101 Mathematics (1)

A0311301 Digital Logic Design

Binary Systems: Digital Computers & Systems Binary numbers, Number Base Conversion: Octal & Hexadecimal Numbers, 1's & 2's Complements Binary codes; Boolean Algebra & Logical Gates: Basic Definitions of Boolean Algebra, Theorems of Boolean Algebra, Boolean Functions Digital Logic Gates, IC Digital Logic Families; Simplification of Boolean Function:



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Karnaugh Map Method with 3 variable , 4 variable, 5 variable Map. Sum of Products, Product of Sums, Don't care; Combinational Logic: Integrated combinatorial circuits, Sequential circuits, Flip-flops, registers, counters, memory units.

Prerequisite: A0311101 Discrete Mathematics

A0312203 Visual Programming

Introduction to Visual Programming; Creating Applications with Visual C#; Processing Data; Making Decisions; Loops; File Access: reading and writing; Random Numbers; Methods; Arrays and Lists; Multiform Projects; Databases.

Prerequisite: A0312201 Object Oriented Programming

A0312301 Computer Organization and Architecture

Components of a computer: Performance, Technology and Delay Modeling, Intro to Instruction Set Architecture (ISA) Design: MIPS ISA, Translation of High-Level C Constructs into MIPS, Assemblers, Object Code Generation, Linking and Executable Loading, Run-time Execution Environment; Computer Arithmetic and ALU Design, Digital-Logic Design for Sequential Circuits, Register-Transfer Level Description of Systems; Single-Cycle Datapath and Control; Multi-cycle Datapath and Control: Micro-programming and Hard-wired Control Units; Pipelining: Pipelined MIPS Datapath; Pipeline Hazards: Structural, Control, Data; Hazard Detection and Resolution; Pipelining control; Exceptions Handling; SRAM and DRAM Design, Memory Hierarchy, Cache memory design, Virtual memory.

Prerequisite: A0311301 Digital Logic Design

A0312401 Fundamentals of Databases

Database Concepts; Database Design Methodologies; Data Modeling using ER and EER; Database Integrity Constraints; Relational Model: Relational algebra, Relational Calculus; Functional Dependencies and Normalization.

Prerequisite: A0311202 Introduction to Programming

A0312402 Fundamentals of Databases Lab

Introduction and Practice on Structural Query Language (SQL): Creating tables, Querying Data Dictionary, Inserting data, Deletion of data, Updating data, Data retrieval, Limiting selected rows, Single row functions, Group functions, Table Joining commands, Subqueries. A set of worksheets covering these topics are distributed which students do individually at their



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pace during weekly laboratory sessions, using the SQL language. Sessions are controlled via a platform designed to track students' work originality and manage submissions for assessment.

Concurrent: A0312401 Fundamentals of Databases

A0312403 Systems Analysis and Design

Introduction to systems development: System development life cycle, System Development feasibility; Development of fact finding methods: Context diagram, Data flow diagram, Decision tables and trees, Data dictionary; Conceptual design: DB design, Normalization; System Implementation: Installation, System conversion, Training, Development Tools, Documentation.

Prerequisite: A0312401 Fundamentals of Databases

A0313101 Algorithms Analysis and Design

Introduction: Asymptotic Behavior, O, Omega , Thata notation, analysis of algorithms complexity, proving algorithm correctness with loop invariant, solving recurrences; Sorting: insertion, quick, merge, heap; Advanced Algorithm Analysis and Design: amortized analysis, dynamic programming; Graph: breadth first search, depth first search, Topological sort, minimum spanning tree, shortest path; Advanced data structures: B-trees; String matching: naive, KMP; NP-Completeness: P, NP, NP-Complete classes, proving NP-completeness.

Prerequisite: A0312101 Data Structures

A0313201 Internet Applications Development (1)

An overview of the Internet and the World Wide Web (WWW); Hyper Text Markup Language (HTML) to structure web pages; Cascading Style Sheets (CSS) to style web pages; JavaScript (Client-Side) to enhance the user experience: control Statements, operators, functions, arrays; Ajax to build rich webpages: XML, JSON.

Prerequisite: A0312401 Fundamentals of Databases

A0313202 Internet Applications Development (1) Lab

A set of practical tasks integrated with and supporting concepts presented in the course. These tasks are outlined in the theory course and detailed in separate worksheets that students do individually at their pace during weekly laboratory sessions, using HTML, CSS, JavaScript, Ajax to design and implement web sites. Sessions are controlled via a platform designed to track students' work originality and manage submissions for assessment.



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Concurrent: A0313201 Internet Applications Development (1)

A0313203 Internet Applications Development (2)

Introduction to ASP.NET to build Web Application using the MVC pattern: the .NET Framework, ASP.NET & MVC Pattern; URL Routing; Controllers and Actions; Views – Razor Engine; Model Binding; Database Access; Cookies; Sessions; Authentication; Web Services.

Prerequisite: A0313201 Internet Applications Development (1)

A0313301 Operating Systems

Fundamental Concepts of Operating Systems; Evolution of Operating System; Operating System Structure; Process: Process Management, Inter-process Communication, Process Scheduling, Deadlocks, Process Synchronization; Memory Management; File System Management; I/O Management; Secondary Storage Management; Case Studies.

Prerequisite: A0312301 Computer Organization and Architecture

A0314301 Parallel Computing and Distributed Systems

Distributed Systems: definition, types, goals, hardware concepts; Communication: layered protocols, remote procedure call, remote method invocation, synchronous /asynchronous persistent/transient communication, stream based communication; Processes: threading in the server side, threading in the client side, code migration; Naming: name Spaces, locating mobile entities, removing unreferenced entities; Synchronization: physical clock synchronization, logical Clocks, global State, election algorithms, mutual exclusion algorithms, distributed transactions; Consistency and Replication: reasons for replication, consistency protocols; Fault Tolerance: introduction, process resilience, reliable client server communication, distributed Commit protocols, recovery.

Prerequisite: A0313301 Operating Systems

A0341301 Networks and Information Security Essentials

The course studies the basic of computer networks: types of networks, main devices, Ethernet technology, principles and structure of IP addressing; overview of the common protocols such as: TCP, UDP, HTTP, HTTPS, POP, IMAP, SMTP, DNS, FTP, DHCP; basic security measures and tools: malware, general means of authentication, password-based authentication,



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physical security, firewall basics; cryptography: symmetric and asymmetric algorithms, hash functions, basics of digital signature and steganography.

Prerequisite: A0311201 Introduction to Information Technology

A0372401 Introduction to Data Science

This course introduces the basic concepts of data science and analytics and its applications. Topics covered in this course are data acquisition, cleaning, aggregation, exploratory data analysis and visualization, feature engineering, model creation and validation, basic statistical and mathematical foundations for data science.

Prerequisite: A0311202 Introduction to Programming

A0372402 Statistics and Probability for Data Science

This course includes an introduction to probability and statistics with a focus on data science. The topics covered include fundamentals of probability theory and statistical inference, including: probabilistic models, random variables, useful distributions, expectations, the law of large numbers, the central limit theorem, point and confidence interval estimation, maximum likelihood methods, hypothesis tests, and linear regression

Prerequisite: A0111103 Statistics and Probability

A0373401 Data Engineering

In this course, students will get an introduction to the fundamental building blocks of big data engineering, and learn the foundational concepts of distributed computing, distributed data processing, data management and data pipelines. Students will discover how to build an effective data architecture, streamline data processing, and maintain large-scale data systems.

Prerequisite: A0312401 Fundamentals of Databases

A0373402 Data Engineering Lab

A set of practical integrated assignments with and supporting course concepts. All of them are briefly and detailed in the course in a separate worksheet. Where the student implements it individually according to his abilities in weekly laboratory sessions. Organized, Python, Matlab, R-language Students will discover how to build an efficient architecture, and simplify data.

Concurrent: A0373401 Data Engineering



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A0373403 Data Mining

Areas covered include data preprocessing, predictive modeling, association analysis, cluster analysis, anomaly detection, classification, and avoiding false discoveries. The course introduces basic concepts, representative algorithms, and evaluation techniques. The course also covers foundational concepts and techniques of data warehousing that serves big-data mining applications

Prerequisite: A0372401 Introduction to Data Science

A0373501 Artificial Intelligence

This course introduces to the basic principles, techniques, and applications of Artificial Intelligence. The course covers the following topics: knowledge representation, logic, inference, problem solving, search algorithms, game theory, perception, learning, planning, and agent design. Some programming languages including Python and R will be introduced.

Prerequisite: A0311202 Introduction to Programming

A0373502 Machine Learning and Deep Learning

This an introductory course that give and overview of many concepts, techniques, and algorithms in machine learning, beginning with topics such as classification and linear regression and ending up with more recent topics such as statistical pattern recognition, boosting, supervised and unsupervised learning, support vector machines, neural networks, hidden Markov models, and Bayesian networks.

Prerequisite: A0373501 Artificial Intelligence

A0374401 Big Data

An enormous amount of data is now being collected through websites, mobile apps, credit cards, and many other everyday tools that we use on a massive scale. This course will explore the logic behind the complex methods used in this field, as well as how research is modeled on big data with real-life examples. By the end of the course, students will be familiar with this field and be able to conduct research design using big data. They will gain the benefits of business data analytics, which includes the use of data, statistical and quantitative analysis, exploratory and predictive models, and evidence-based methods for making business decisions.



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Prerequisite: A0373401 Data Engineering

A0374402 Data Visualize

Data visualization is one of the most powerful tools to explore, understand and communicate patterns in quantitative information. At the same time, good data visualization is a surprisingly difficult task and demands three quite different skills: substantive knowledge, statistical skill, and artistic sense. The course is intended to introduce participants to key principles of analytic design and useful visualization techniques for the exploration and presentation of univariate and multivariate data. This course is highly applied in nature and emphasizes the practical aspects of data visualization in the social sciences. Students will learn how to evaluate data visualizations based on principles of analytic design, how to construct compelling visualizations using several tools, and how to explore and present their data with visual methods.

Prerequisite: A0373401 Data Engineering

A0374501 Natural Language Processing

The course introduces the linguistic (knowledge-based) and statistical approaches to language processing in the three major subfields of NLP: syntax (language structures), semantics (language meaning), and pragmatics/discourse (the interpretation of language in context). The course will also cover the applications of NLP such as information extraction, machine translation, automatic summarization, question-answering, and interactive dialogue systems.

Prerequisite: A0373502 Machine Learning and Deep Learning

A0374502 Pattern Recognition

This course introduces the basic principles of pattern recognition algorithms and applications, such as faces, letter recognition. The course covers topics such as, pattern representation, pattern recognition systems, preprocessing and feature extraction, theories of supervised and unsupervised learning, object classification and recognition.

Prerequisite: A0373502 Machine Learning and Deep Learning

A0374503 business intelligence

This course explores how business problems can be solved effectively by using operational data to create data warehouses, and then applying data mining tools and analytics to gain new



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insights into organizational operations. Topics will be covered: the differences between types of reporting and analytics, enterprise data warehousing, data management systems, decision support systems, knowledge management systems, big data and data/text mining. Case studies are used to explore the use of application software, web tools, success and limitations of BI as well as technical and social issues.

Prerequisite: A0374402 Data Visualize

A0374601 Practical Training

The student is required to do practical training in a well known company for period of (2) months with at least (15) hours per week. For the training, the student is allowed to register no more than (12) Credit Hours: in the first or in the second semester, or (6) Credit Hours: for the summer semester. The student is asked to perform there some tasks that are related to his major, such as developing a software, or learning some new skills, technologies and capabilities.

Prerequisite: Passing 90 Credit Hours

A0374602 Graduation Project (1)

This course is the first of two courses for the development of significant software system and employing the knowledge gained from courses throughout the program. Students may follow any suitable process model, must pay attention to quality issues, and must manage the project themselves, following all appropriate project management techniques. Success of the project is determined in large part by whether students have adequately solved their customer's problem. A project should be performed by a group of students under the supervision of a faculty member. Students are required to focus on the early stages of the software development process such requirements analysis and design, and submit a report. Project must be presented to a committee of the faculty.

Prerequisite: Passing 90 Credit Hours

A0374603 Graduation Project (2)

This course is the second of two courses for the development of significant software system, employing the knowledge gained from courses throughout the program. A project should be performed by a group of students under the supervision of a faculty member. Students are required to develop a complete implementation fulfilling the project objectives and submit a final report. Project must be presented to a committee of the faculty.

Prerequisite: A0374602 Graduation Project (1)



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A0344301 Internet of Things and Security

IoT architecture: devices, networking, cloud computing, and big data analysis; Real-time data collection in IoT ; Data analytics in IoT ; IoT applications and requirements ;Security threats and techniques in IoT ; IoT challenges: computation and communication constraints, power constraints, maintenance cost, reliability, data trustworthiness, security, and privacy.

Prerequisite: A0341301 Networks and Information Security Essentials