ثالثا: المقررات الدراسية بمراحل الدراسات العليا

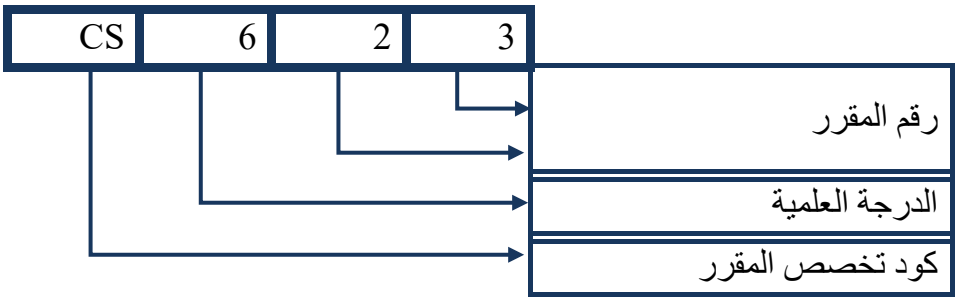
قواعد النظام الكودي للمقررات الدراسية:

- يتكون كود أي مقرر (Course Code) من حرفين أقصى اليسار يُمثلان الرمز الكودي للتخصص أو القسم، كما هو موضح بالجدول التالي:

جدول 1: الرمز الكودي للتخصصات

Group / Department	Code	التخصص أو القسم
Computer Science	CS	علوم الحاسب
Information Systems	IS	نظم المعلومات
Scientific computing	SC	الحسابات العلمية
Artificial intelligence	AI	الذكاء الاصطناعي
Research Methods	RM	طرق بحثية

- يتبع مجموعة الحروف رقم مكون من ثلاث خانات.
- الرقم في خانة المئات يمثل الدرجة العلمية، يدل الرقم 6 على مقررات الماجســـتير والرقم 7 على مقررات الدكتوراة.
- الرقمان في خانة العشرات وخانة الآحاد يمثلان رقم المقرر.
- والشكل التالي يوضح هذا النظام



مقررات ماجستير علوم الحاسب

القسم المسؤول: قسم علوم الحاسب

1- مقررات إجبارية 4 مقررات (11 ساعة معتمدة)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
CS611	Machine Learning Algorithms and Applications	3	AI or any equivalent course
CS612	Advanced Computer and Network Security	3	Computer Networks or any equivalent course
CS613	Advanced Image and Video Processing	3	Image Processing or any equivalent course
RM611	Research Tools and Methods	2	-

2- مقررات اختيارية

يتم اختيار 4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
CS614	Natural Language Processing with Deep Learning	3	AI or any equivalent course
CS615	Biologically Inspired Multi-Agent Systems	3	-
CS616	Cryptography	3	-
CS617	Wireless Network	3	Computer Networks or any equivalent course
CS618	Advanced Computer Vision Algorithms and Systems	3	Image Processing or any equivalent course
CS619	Advanced Algorithms and Data Structure	3	Algorithms or any equivalent course
CS620	Advanced Computer Architecture	3	Computer Architecture or any equivalent course
CS621	Advanced Operating Systems	3	Operating Systems or any equivalent course
CS622	Advanced Software Engineering	3	Software Engineering or any equivalent course

Human Computer Interaction or any equivalent course	3	Advanced Human Computer Interaction	CS623
Varies with the topics	3	Advanced Topics in Computer Science 1	CS624
Varies with the topics	3	Advanced Topics in Computer Science 2	CS625

محتوى مقررات ماجستير علوم الحاسب

CS611 Machine Learning Algorithms and Applications

This course enables students to analyze machine learning algorithms, focus on implementing and applying machine learning algorithms to real-world problems, and modify the methods to analyze practical datasets and convey the results. Topics may include probability distributions; linear models for regression; linear models for classification; deep learning; kernel methods; kernel machines; graphical models; clustering; mixture models and expectation maximization; approximate inference; continuous latent variables; sequential data; ensemble methods; and reinforcement learning.

CS612 Advanced Computer and Network Security

The following topics are covered in this course: Broadcast authentication ; Group key management: Basic concepts in group key management, Group key agreement protocols (GDH, B-D protocols, TGDH), Group key distribution protocols (LKH, secret-sharing based protocols, SDR); Security in wireless sensor networks: Key pre-distribution, Message specific puzzle, Secure and resilient clock synchronization, Secure location verification; wireless physical layer security: Recent advances in anti-jamming wireless communication, Wireless link signature; Cloud computing infrastructure security.

CS613 Advanced Image and Video Processing

This course focuses on advanced methods and research topics of current interest in processing and analysis of both image and video. The topics may include but not limited to: image segmentation, image registration, Camera models, camera calibration, Advanced image pre-processing, Image Compression, Mathematical Morphology, Video indexing, summarization, and retrieval, Video meta-data extraction and representation, video semantic analysis.

RM611 Research Tools and Methods

This course will provide an opportunity for students to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. The course introduces the language of research, ethical principles and challenges, and the elements of the research process within quantitative, qualitative, and mixed methods approaches. Participants will use these theoretical underpinnings to begin to critically review literature relevant to their field or interests and determine how research findings are useful in forming their understanding of their work, social, local and global environment.

CS614 Natural Language Processing with Deep Learning

Computational properties of natural languages. Coreference, question answering, and machine translation. Processing linguistic information. Syntactic and semantic processing. Modern quantitative techniques in NLP. Neural network models for language understanding tasks.

CS615 Biologically Inspired Multi-Agent Systems

This course will survey bio-inspired approaches to understanding and designing collective intelligence in different domains, and usually include: swarm intelligence: social insects and animal groups, with applications to networking and robotics, evolutionary computation and its application to optimization and design. On occasion we cover topics like synthetic biology, DNA self-assembly, human collective behavior, etc. The class is primarily based on discussions of research papers.

CS616 Cryptography

This course covers topics including web security, denial-of-service, email security, routing security, sensor network security, firewalls, wireless security, security analysis, side and covert channels, intrusion detection and prevention, and software security, security protocols, packet sniffing, password cracking, and transport-layer security protocol. It also covers symmetric and asymmetric cryptography algorithms, block ciphers, secure hash functions and data integrity.

CS617 Wireless Network

This course will cover the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. Various aspects of wireless networking will be covered including: fundamentals of cellular communication, mobile radio propagation, multiple access techniques, mobility support, channel allocation, Wireless PAN/LAN/MAN standards, mobile ad-hoc networks, wireless sensor networks, and routing in wireless and mobile networks. The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures. We will introduce the students to wireless networking research and guide them to investigate novel ideas in the area via semester-long research projects. We will also look at industry trends and discuss some innovative ideas that have recently been developed. Some of the course material will be drawn from research papers, industry white papers and Internet RFCs.

CS618 Advanced Computer Vision Algorithms and Systems

This course covers advanced research topics in computer vision. It will prepare graduate students in both the theoretical foundations of computer vision as well as the practical approaches to building real Computer Vision systems. This course investigates current research topics in computer vision with an emphasis on recognition tasks and deep learning. We will examine data sources, features, and learning algorithms useful for understanding and manipulating visual data. The goal of this course is to give students the background and skills necessary to perform research in computer vision and its application domains such as robotics, healthcare, 3D computer vision, surveillance and biometrics.

CS619 Advanced Algorithms and Data Structure

This course covers major results and current research directions in data structures: time travel, geometry, dynamic optimality, memory hierarchy, integers, dynamic graphs, strings and succinct.

CS620 Advanced Computer Architecture

This course aims to introduce the state-of-the-art architectural advances underlying the current generation of computing systems. A review of pipelined processor design and hierarchical memory design is followed by advanced topics including exploitation of instruction-level parallelism through dynamic instruction scheduling and speculation, exploiting thread-level parallelism through multiprocessors, and optimizations for memory and storage subsystems. Throughout the module, particular emphasis will be placed on cost-performance-power-reliability trade-offs in designing the different architectural components.

CS621 Advanced Operating Systems

This course aims to study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems); Hardware and software features that support these systems.

CS622 Advanced Software Engineering

This course covers advanced topics in software engineering including the following topics. Types of software architecture; model-based and component-based software; software engineering best practices; software migration and maintenance; software quality, web-based systems development methodologies; software project management; and software security.

CS623 Advanced Human Computer Interaction

This course aims to introduce software infrastructures for the user interfaces, 3D user interfaces, mobile user interfaces, virtual and augmented reality user interfaces, user modeling and its applications to adaptive user interfaces, major user interface paradigms, including anthropomorphic interfaces, User interface evaluation.

CS624 Advanced Topics in Computer Science 1

Advanced topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the CS Department and approved by the department council and listed under this course number.

CS625 Advanced Topics in Computer Science 2

Advanced topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the CS Department and approved by the department council and listed under this course number.

مقررات دكتوراة علوم الحاسب

القسم المسؤول: قسم علوم الحاسب

1- مقررات اختيارية

يتم اختيار 4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
CS711	Research Topics in Communications & Networking	3	CS612 or any equivalent course
CS712	Research Topics in Computer Graphics	3	Computer Graphics or any equivalent course
CS713	Research Topics in Image\Video Processing	3	CS613 or any equivalent course
CS714	Research Topics in Computer Vision	3	CS618 or any equivalent course
CS715	Research Topics in Computer Security	3	CS616 or any equivalent course
CS716	Research Topics in Embedded System	3	CS620 or any equivalent course
CS717	Research Topics in Theoretical Computer Science	3	CS611 or any equivalent course
CS718	Research Topics in Computational Intelligence	3	CS611 or any equivalent course
CS719	Research Topics in Software Engineering	3	CS622 or any equivalent course
CS720	Research Topics in Operating Systems	3	CS621 or any equivalent course
CS721	Research Topics in Computer Science 1	3	Varies with the topics
CS722	Research Topics in Computer Science 2	3	Varies with the topics

محتوى مقررات دكتوراة علوم الحاسب

CS711 Research Topics in Communications & Networking

It is an advanced course concentrating on current research topics in Communications & Networking. Topics may include but not limited to: protocols/algorithms/systems/architecture, software-defined networking, theory of networks, online social networks, wireless networks, data center networks, rate control, quality of service and pricing. Network Control & Management, Wireless Sensor Networks, Network Security, Cloud Computing, Optical Networks, Wireless Networks.

CS712 Research Topics in Computer Graphics

It is an advanced course concentrating on current research topics in computer graphics. Topics may include but not limited to: Virtual Reality & Augmented Reality, Visualization, Rendering, 3D Geometric Modeling, Computer Animation, Computer Aided Design, Human Interaction System, Real-Time Stereographics.

CS713 Research Topics in Image\Video Processing

It is an advanced course concentrating on current research topics in Image\Video Processing. Topics may include but not limited to: Image Segmentation, Image Classification, Image Reconstruction, Image Compression, Image Watermarking, Image Based Retrieval, Video Coding, Video Segmentation, Object detection and tracking in video, Multi-view video processing, 3D video, Video Enhancement, Video quality evaluation, Content-based Video Retrieval.

CS714 Research Topics in Computer Vision

It is an advanced course concentrating on current research topics in Computer Vision. Topics may include but not limited to: Image Segmentation, Image Classification, Image Reconstruction, Image Compression, Image Watermarking, Image Based Retrieval, Video Coding, Video Segmentation, Object detection and tracking in video, Multi-view video processing, 3D video, Video Enhancement, Video quality evaluation, Content-based Video Retrieval.

CS715 Research Topics in Computer Security

It is an advanced course concentrating on current research topics in Computer Security. Topics may include but not limited to: Cryptology, Steganography, Digital Forensics, Cybersecurity, Intrusion Detection, Blockchain, Data Privacy & User Data Control, Verification, and Validation of Policies, Authentication, Hardware Security, Software Security, Web Security and Privacy.

CS716 Research Topics in Embedded System

Topics may include but not limited to: Principles of embedded system design. Focus on design methodologies and foundations. Platform-based and communication-based design and their relationships with design time, re-use, and performance. Models of computation and their use in design capture, manipulation, verification, Mapping into architecture and system platforms. Performance estimation. Scheduling and real-time requirements. Application on Internet-of-things devices (IoTs) and autonomous vehicles (self-driving cars).

CS717 Research Topics in Theoretical Computer Science

It is an advanced course concentrating on current research topics in theoretical computer science. Topics may include but not limited to: Algorithms, Automata theory, Coding theory, Computational biology, Computational complexity theory, Computational geometry, Computational learning theory, Computational number theory, Data structures, Distributed computation, Information-based complexity, Formal methods, Information theory, Parallel computation, Program semantics, Quantum computation, Symbolic computation

CS718 Research Topics in Computational Intelligence

It is an advanced course concentrating on current research topics in computational intelligence. The aim of this course is to provide the students with the knowledge and skills required to design and implement effective and efficient Computational Intelligence solutions to problems for which a direct solution is impractical or unknown. Topics may include but not limited to: Artificial Neural Networks, Support Vector Machines, Machine Learning & Deep Learning, Cluster Analysis, Fuzzy Logic, Natural Language Processing (NLP), Genetic Algorithms, Expert Systems, Optimization, Evolutionary Computation, Swarm intelligence and Hybrid Intelligent Methods. The student will also apply this knowledge to solve some real case studies.

CS719 Research Topics in Software Engineering

It is an advanced course concentrating on current research topics in Software Engineering. The course covers advanced theoretical and technical issues of software engineering. It will focus on some selected topics, such as software requirements, software design, software construction, software testing and management, software configuration management, software engineering management, software engineering process, software engineering tools and methods, and software quality. The students shall acquire advanced theoretical knowledge and technical competences about the topics covered in the course as well as some research methods that are relevant for these topics.

CS720 Research Topics in Operating Systems

It is an advanced course concentrating on current research topics in operating systems. Topics may include but not limited to: Intelligent I/O, Multiprocessor Systems, Locality-Aware Scheduling, Unified I/O Buffering, Resource Management, Kernel Structure, Real-Time Issues in OS, Distributed Shared Memory, Distributed File Systems, Fault Tolerance in Distributed Systems, Distributed Servers

CS721 Research Topics in Computer Science 1

Topics are selected from different areas in computer science that are not covered in the description of the courses listed in the curriculum. This course will cover recent trends and issues in the field of computer science and will be chosen at the discretion of the Department Council.

CS722 Research Topics in Computer Science 2

Topics are selected from different areas in computer science that are not covered in the description of the courses listed in the curriculum. This course will cover recent trends and issues in the field of computer science and will be chosen at the discretion of the Department Council.

مقررات ماجستير نظم المعلومات

القسم المسؤول: قسم نظم المعلومات

1- مقررات إجبارية 4 مقررات (11 ساعة معتمدة)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
IS611	Advanced Decision Support Systems and Intelligent Systems	3	Artificial Intelligence or any equivalent course
IS612	Advanced Database Management	3	Database Management Systems or any equivalent course
IS613	Modeling Enterprise Architectures	3	Modeling and Simulation or any equivalent course
RM611	Research Tools and Methods	2	-

2- مقررات اختيارية

يتم اختيار4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
IS614	Advanced Big Data Analytics	3	Information Storage and Management or any equivalent course
IS615	Advanced Distributed Databases	3	Distributed Databases or any equivalent course
IS616	Advanced Database Systems and Data Warehouse(s)	3	Data Warehouse or any equivalent course
IS617	Advanced Topics on Data Mining	3	Data Mining or any equivalent course
IS618	Topics in Information Retrieval	3	Data Structures and Algorithms or any equivalent course

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
IS619	Knowledge Engineering	3	Artificial Intelligence or any equivalent course
IS620	Advanced Topics in Simulation and Modeling	3	Modeling Enterprise Architectures or any equivalent course
IS621	Quantitative Methods	3	-
IS622	Advanced Multimedia Information Systems	3	Multimedia Information Systems or any equivalent course
IS623	Advanced Software Engineering	3	Software Engineering or any equivalent course
IS624	Software Testing and Quality Assurance	3	Advanced Software Engineering or any equivalent course
IS625	Advanced Topics on Geographic Information System	3	Geographic Information System or any equivalent course
IS626	Selected Topics on Medical and Bio Informatics	3	Data Mining or any equivalent course
IS627	Service Oriented Architecture and Web Service	3	Web programming or any equivalent course
IS628	Enterprise Security & Risk Management	3	Information Security or any equivalent course
IS629	Advanced Information Systems Security	3	Information Security or any equivalent course
IS630	IT Architecture and Cloud Computing	3	Cloud Computing or

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
			any equivalent course
IS631	Digital Enterprise Systems	3	Enterprise Systems or any equivalent course
IS632	Advanced Topics in Information Systems 1	3	Varies with The Topics
IS633	Advanced Topics in Information Systems 2	3	Varies with The Topics

محتوى مقررات ماجستير نظم المعلومات

IS611 Advanced Decision Support Systems & Intelligent Systems

An overview of management support systems. Decision-making systems modeling and support. DSS. Modeling and analysis. Business intelligence. Decision support systems development. Group decision support systems (GDSS). Knowledge-based decision support. Inference techniques. Expert systems development. Statistical decision making. Neural networks and DSS applications. Genetic algorithms for DSS. Intelligent software and DSS agents.

IS612 Advanced Database Management

This course allows the introduction of material relating to current database research topics, and current advances in database technology. It will thus provide a foundation for understanding advanced topics, such as Distributed Database Systems, Data Warehouse and OLAP, Data Mining, Web Databases and XML, Object Database, Active, Temporal, Intelligent and Deductive Databases, Heterogeneous Databases, Digital Library, Multimedia Databases, and Mobile Databases.

IS613 Modeling Enterprise Architectures

The course focuses on various components of modeling an Enterprise Architecture. It deals with modeling the business and the underlying information and software system to support the business. It follows the object-oriented paradigm for the development lifecycle and utilizes UML as the modeling language. Indicative contents include aspects of enterprise architectures, business analysis, business modeling, business process reengineering, requirements engineering, object-oriented concepts and principles and UML. Focus throughout is on large-scale software development as seen in industry. Introduces object-oriented principles and key web-based system development tools. Topics include object-oriented modeling, object-oriented programming languages, and advanced user interface design. Students will learn to use object analysis and design, modern programming languages, and advanced database technology to develop business applications.

IS614 Advanced Big Data Analytics

An overview of advanced machine learning, data mining and statistical techniques that arise in data analytic applications. practice advanced data analytic techniques, including: parallel algorithms, online

algorithm, locality sensitive hashing, topic modeling, structure learning, and time-series analysis. One or more applications associated with each technique will also be discussed. Data plays an increasingly important role in business decision making. This course introduces the key concepts and applications of business analytics in the world of Big Data. Example business problems to be solved analytically include customer relationship management, financial trading, social media marketing, search engine strategy, etc. Hands-on experience with popular data analytical tools will be included.

IS615 Advanced Distributed Databases

The course covers new advanced concepts in distributed databases including: databases on mobile and wireless networks, database for peer-to-peer systems, databases in the cloud computing environments.

IS616 Advanced Database Systems and Data Warehouse(s)

Extends and enhances understanding of enterprise databases to design, implement, and support business intelligence (BI) solutions. Topics include DBMS extensions for data warehousing, data warehouse and data mart design, loading and extracting data, performance tuning, and cloud-based Bi application design. Emphasizes agile techniques to efficiently produce optimal solutions that meet business requirements and increase competitive advantage.

IS617 Advanced Topics on Data Mining

The course focuses on two subjects the essential data mining and knowledge representation techniques used to extract intelligence from data and expense and common problems from the fields of finance marketing, and operations/ service that demonstrate the use of the various techniques and the tradeoffs involved in choosing form among them. The area explicitly covered in the course is OLAP, Neural networks, Genetic algorithms, rule induction, fuzzy logic, Case- based reasoning, thrush labs. and rule-bases systems. Advanced topics in data mining, with a special focus on unstructured data; web mining; text mining. Students will learn and apply unstructured data mining tools on real-world unstructured data.

IS618 Advanced Topics in Information Retrieval

Architecture of information storage and retrieval systems (IRS), models of IRS, IR systems, user interface in IRS, text analysis, the world wide web, spiders, ranking algorithms, digital libraries. The course introduces advanced topics and research advancements in information retrieval. It includes: Indexing for information retrieval, evaluation of IR systems, relevance feedback and query expansion, recommendation in IR systems, probabilistic information retrieval, clustering and classification in information retrieval.

IS619 Knowledge Engineering

Focuses on current methods of implementing AI expert systems. Topics include the structure of problem, methods to automate the acquisition of human experiential knowledge, methods to automate the explanation of problem- solving behaviors Architectures of Knowledge-based systems and expert systems, knowledge elicitation, knowledge representation and knowledge management issues. The nature of intelligent agents and techniques such as fuzzy logic, neural networks and automated reasoning with applications to databases and web-based information retrieval and indexing will be introduced. Emphasis will be given to the role that such technologies play in supporting business and advanced information systems applications.

IS620 Advanced Topics Simulation and Modeling

Time management in simulation models (concepts of timing routine). Stochastic versus deterministic models. Discrete versus continuous simulation. Deterministic fixed time advance simulation. Stochastic discrete event simulation (event, activity and process-based models). Random sampling on computers. A study of statistical methods in simulation experiments. Introduction to software tools for simulation purposes. The development of simulation models using procedural and simulation programming languages is stressed throughout the course.

IS621 Quantitative Methods

The purpose of this course is to develop an understanding of the more advanced concepts of quantitative methods and their applications in the information systems domain. Dynamic programming, nonlinear programming, games, queuing, and management games.

IS622 Multimedia Information Systems

This course discusses the past, present, and future of the theory and practice of multimedia information systems. We will explore the concepts and methods of the multimedia production cycle comprising the creation, description, retrieval, editing, management, distribution, and reuse of digital media. Students will gain theoretical background and practical experience to help them design, innovate, critique, and assess digital multimedia information systems.

IS623 Advanced Software Engineering

This course introduces students to problems that occur in large scale software production. The course examines technical aspects of software development life cycle and stresses a model driven approach to software engineering. Formal (mathematical and logic based) approaches to software modeling are covered and emphasized. A number of advanced software engineering topics will be studied.
This course shows how to apply the main Software Engineering Models in real software projects through a number of case studies. The student will study the latest models in software engineering and how could it be used in his research work. The latest in cost estimation, productivity, quality, reuse and software reengineering models are studied and discussed.

IS624 Software Testing and Quality Assurance

Software quality models, Software quality assurance, software testing, CMM and its methodology. The aim of this course is to apply quality assurance requirements in all the systems development life cycle phases: IS planning – IS detailed analysis – IS design – IS construction & Software Engineering – IS implementation – IS testing – IS documentation – IS installation – IS maintenance & Follow-up. Also, the course will cover the Capability Maturity Model (CMM) requirements regarding quality assurance. This course introduces students to Software testing, giving them an overview of software validation and verification and testing techniques. The course addresses such important issues as testing principles and test-case design; module testing; domain testing; high-order testing; and object-oriented testing. Other subjects that will be covered during the course include: formal methods; reliability validation; safety assessment; software metrics; quality concepts and quality assurance; software reviews; formal technical reviews; formal approaches to SQA; software reliability; quantity standards; and the SQA plan.

IS625 Advanced Topics on Geographic Information System

The purpose of this course is to introduce the student to more advanced topics in Geographic Information System Sciences (GIS), for example and not limited to: more advanced discussions on spatial interpolation, error and uncertainty, advanced knowledge of GIS theory and science, adjustment theory in GIS data, analysis of adjustment results, error propagation, least squares adjustment techniques, Digital Terrain Modeling (DTM), Digital Elevation Models (DEM), Digital Surface Modeling (DSM) theory and concepts and their implementation and applications in GIS and other disciplines, and other recent topics, mobile GIS, virtual earth modeling, location based services, geographic simulators.

IS626 Selected Topics on Medical and Bio Informatics

This course provides the foundation for graduate study in medical and bio informatics and covers topics such as medical records, clinical information systems (hospital, outpatient, nursing, laboratory, pharmacy, radiology, etc.), Integration of computer systems in biological structure/sequence/function analysis and comparison, data/information modeling, storage and retrieval. The focus of the class content is on the Egyptian system of health care delivery and the role of informatics within this system.

IS627 Service Oriented Architecture and Web Services

Principles of SOA, Software as a Service (SaaS), SOAP, Web service description, Web service discovery, Web service composition, Web service security, Cloud computing and Web services

IS628 Security Engineering

This course introduces students to foundational concepts pertaining to the broad area of security engineering. It starts with the central concept of a security protocol, and proceeds to human-computer interface issues, access control, crypto, and distributed system security. The course considers security from the viewpoint of different interest groups such as companies, consumers, criminals, police, and spies. Students also partake in a study of at least one of a number of important application areas, such as, for example, military communications, medical record systems, cash machines, and mobile phones.

IS629 Enterprise Security & Risk Management

Secure enterprise-wide data and processes through risk assessment, cryptography, design, and access control techniques combined with integrated security architecture. The Enterprise Security & Risk Management (ESRM) concentration emphasizes the role of cyber security in the industry while focusing on ethical hacking and infrastructure security. You'll gain an understanding of the broad array of security features and practices that can help mitigate risk in an enterprise.

IS630 Information Systems Security

The objectives of this course are to examine the security challenges and threats in database systems and provide an understanding of the state-of-the art security technologies. The course discusses policies, Models and mechanisms to ensure confidentiality, Integrity and availability. In particular. Students will study about models and mechanisms for access control, Integrity models and mechanisms, multi- level sewer database architectures, Inference problem, Distributed transaction processing, Recovery and fault tolerance, and security problems raised by data warehousing and data mining. Recent correlated software packages should be used through labs.

IS631 IT Architecture and Cloud Computing

The focus of this course will be on the technical architecture of information systems including component architecture, network architecture, integration architecture, and solution architecture. Thus this module will cover topics ranging from the components in a computer system to service oriented architecture and cloud computing. The foundational concepts underlying enterprise architecture will also be examined. The focus of this module will be on the technical architecture of information systems including component architecture, network architecture, integration architecture, and solution architecture. Thus, this module will cover topics ranging from the components in a computer system to service oriented architecture and cloud computing. The foundational concepts underlying enterprise architecture will also be examined.

IS632 Digital Enterprise Systems

Enable the digital transformation of businesses by learning to use a two-speed model of IT that utilizes next generation ERP, Big Data analytics, and cloud-based systems. The Digital Enterprise Systems (DES) concentration blends business understanding with analytical thinking, enabling you to develop skills in data management, Big Data, and visualizations. You'll gain hands-on experience and in-depth understanding of business processes by configuring an end-to-end SAP system. You'll also meet and learn from industry professionals who will introduce you to emerging technologies like artificial intelligence, Internet of Things (IoT), mixed reality, and many more.

IS633 Advanced Topics in Information Systems 1

Advanced topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the IS Department and approved by the department council and listed under this course number.

IS624 Advanced Topics in Information Systems 2

Advanced topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the IS Department and approved by the department council and listed under this course number.

مقررات دكتوراة نظم المعلومات

القسم المسؤول: قسم نظم المعلومات

1- مقررات اختيارية

يتم اختيار 4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

الكود	اسم المقرر	عدد الساعات	المتطلب القبلي
IS711	Research Topics in Information Systems- 2	3	or Information Systems any equivalent course
IS712	Research topics in system analysis and design	3	system analysis and design or any equivalent course
IS713	Systems and Information Integration	3	Enterprise Systems or any equivalent course
IS714	Business Intelligence	3	AI Enterprise Systems or any equivalent course
IS715	Research topics in Business Process Modeling	3	Modeling and simulation or any equivalent course
IS716	Knowledge Management	3	AI or any equivalent course or any equivalent course
IS717	Research topics in Information Security Risk Management	3	Information Security or any equivalent course
IS718	Advanced Systems Engineering	3	Software Engineering 2 or any equivalent course
IS719	IOT and Big Data & Analytics	3	data mining IOT or any equivalent course
IS720	Research topics in geographic information systems	3	geographic information systems or any equivalent course
IS721	Research topics in information retrieval	3	Topics in Information Retrieval or any equivalent course
IS722	Research topics in data mining and knowledge discovery	3	data mining or any equivalent course
IS723	Research topics in cloud computing and distributed system	3	cloud computing distributed system or any equivalent course

محتوى مقررات دكتوراة نظم المعلومات

IS711 Research Topics in Information Systems- 2

This course aims at introducing students to novel topics in information systems that need to be identified in a responsive manner as technology and its use evolve and develop. This course is essentially a flexibility enhancing will be filled on a year-by-year basis.

IS712 Research topics in system analysis and design

This course is focused on the analysis and logical design of computer-based information systems. The course is designed to be especially useful to those who wish to become object-oriented systems developers. Emphasis is placed upon the development of requirements specifications that serve the business needs of the organization and provide the necessary base for subsequent systems development. Information systems development is a process in which technical, organizational, and human aspects of a system are analyzed and changed in the hope of creating an improved system. In spite of the advanced technology that surrounds computer-based information systems, the process of systems analysis and design is still largely an art. There is a high dependence on the skills of individual analysts and designers even though there are principles, methods, techniques and tools to guide and assist in the processes involve

IS713 Systems and Information Integration

The integration of systems and the seamless exchange of information stored in them provides an answer to a very common problem when organizations merge and inherit information systems that are not compatible with each other. Data systems and information should easily interoperate for the success of the organization. This course investigates the various technologies in the field of information integration with an emphasis on semantic interoperation of systems. Topics that are covered include: Modeling Data Semantics, Semantic Interoperability, Metadata, Semantic Integration Patterns, Context-Awareness, Semantic Networks, Mediation and Wrapper techniques, Data Warehouses, Integration Servers, etc. Students will keep abreast of the latest technologies and research on data semantics, information integration, and also gain practical experience integrating information from disparate and heterogeneous systems.

IS714 Business Intelligence

This course highlights advances in research, technologies, systems, and applications as related to intelligent digital enterprises such as smart cities, smart towns, smart healthcare, smart islands, industry4.0, and automated planning environments. Principles and techniques relating to applications of analytics for organizational problem solving. The focus is on current research in analytics and business intelligence. Topics include optimization models for prescriptive analytics, machine learning techniques for predictive analytics, and analysis and design of business intelligence applications.

IS715 Research topics in Business Process Modeling

In-depth coverage of current practical, conceptual, and theoretical techniques of process modeling, simulation, and intelligence. Primary emphasis will be given to understanding and applying various modeling techniques and languages (such as BPEL), types of simulations (such as discrete event simulation), and to using various techniques and tools (such as PROM) to develop data-driven models/prescriptions of process models. All of the foregoing will be considered within the context of the development of solutions to both practical and cutting-edge problems. Students will conduct a focused literature review on some advanced aspect of the studied material and issues.

IS716 Knowledge Management

Acquire advanced knowledge and deeper understanding of knowledge management including theories and studies related to knowledge management and knowledge management systems. Review of relevant research in the area of locating, evaluating, disseminating, and using information as well as knowledge. Review of studies and theories relevant to knowledge acquisition, information sharing, information ownership, knowledge process, knowledge integration, knowledge gathering, knowledge repositories, and knowledge reuse. Additionally, review of current research in knowledge management and knowledge management systems.

IS717 Research topics in Information Security Risk Management

Study of the theory and practice of information security risk management. This course will focus on the research related to current tools, best practices, theories, and frameworks available in mitigating system vulnerabilities and the accepted methodologies for managing residual risks. Topics include exploring risk management theories in information security, the role of risk management theories from other fields on research in this field, understanding quality research in risk management, techniques to develop stronger research proposals in the context of cybersecurity and information security risk management with emphasis on developmental research. An emphasis will be placed on current issues and future directions of research related managing information systems security risk

IS718 Advanced Systems Engineering

This course wills introduce students to the discipline of “Large Scale Systems Engineering”. Also referred to as “Requirements Driven Development” as well as “Systems Engineering”, it represents a disciplined technical and management process by which abstract complex problem descriptions are successfully transformed into fully developed, tested and deployed systems. We will discuss the “art” and “science” of the Large-Scale Systems Engineering discipline. Evolution of Systems Engineering and Advances in Systems Science are discussed. Specialized concepts involved in developing human-engineered complex systems are reinforced primarily through student research and writings. This is a research-focused course that demands extensive student research and academic writing as well as advanced mathematical techniques such as optimization and stochastic processes..

IS719 IOT and Big Data & Analytics

IoT Fundamentals curriculum provides students with a comprehensive understanding of the Internet of Things (IoT). It develops foundational skills using hands-on lab activities that stimulate the students

in applying creative problem-solving and rapid prototyping in the interdisciplinary domain of electronics, networking, security, data analytics, and business.

IS720 Research topics in geographic information systems

The aim of this course is to allow students to discover new research topics in this field. Students prepare review and seminars to discuss recent research in geographic information systems (GIS).

IS721 Research topics in information retrieval

The aim of this course is to allow students to discover new research topics in this field. Students prepare review and seminars to discuss recent research in information retrieval.

IS722 Research topics in data mining and knowledge discovery

The aim of this course is to allow students to discover new research topics in this field. Students prepare review and seminars to discuss recent research in data mining and knowledge discovery.

IS723 Research topics in cloud computing and distributed system

The aim of this course is to allow students to discover new research topics in this field. Students prepare review and seminars to discuss recent research in cloud computing and distributed system

مقررات ماجستير الذكاء الاصطناعي

القسم المسؤول: قسم الذكاء الاصطناعي

1- مقررات إجبارية 4 مقررات (11 ساعة معتمدة)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
AI611	Advanced Topics in Artificial Intelligence	3	AI or any equivalent course
AI612	Advanced Machine Learning Applications	3	Machine Learning or any equivalent course
AI613	Deep Learning with Large Datasets	3	Machine Learning or any equivalent course
RM611	Research Tools and Methods	2	-

2- مقررات اختيارية

يتم اختيار4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

	كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
	AI614	Artificial intelligence for advanced problem solving techniques	3	AI or any equivalent course
	AI615	Applied Data Science	3	Data Science or any equivalent course
	AI616	Semantic knowledge representation techniques.	3	Knowledge Representation or any equivalent course
	AI617	Theories of Signal Processing	3	Digital Signal Processing or any equivalent course
	AI618	Speech and Voice Recognition	3	Digital Signal Processing or any equivalent course
	AI619	Advanced Topics in Robotics Kinematics and Dynamics	3	Robotics or any equivalent course
	AI620	Robotic Balance control	3	Robotics or any equivalent course
	AI621	Advanced Fuzzy Logic Approaches in Engineering Science	3	Machine Learning or any equivalent course
	AI622	Bioinformatics and Computational Biology Methods	3	Machine Learning or any equivalent course

Internet of Things or any equivalent course	3	Sensing, Sensors and IoT	AI623	
Natural Language Processing or any equivalent course	3	Selected applications of Natural Language Processing	AI624	
AI or any equivalent course	3	Artificial Intelligence and Future Markets	AI625	
AI or any equivalent course	3	Artificial Intelligence in Health Care Systems	AI626	
Varies with The Topics	3	Advanced Topics in Artificial Intelligence 1	AI627	
Varies with The Topics	3	Advanced Topics in Artificial Intelligence 2	AI628	

محتوى مقررات ماجستير الذكاء الاصطناعي

AI 611 Advanced Topics in Artificial Intelligence

This course is devoted to building artificial intelligence and deep learning applications using Python and other languages. Topics include advanced applications of supervised, unsupervised, and reinforcement learning models. Also, it includes how to use flow graphs, dynamic computational graphs, convolutional neural networks and recurrent neural networks to solve real life problems. Students will use high-level tools to engineer functioning machine learning models.

AI 612 Advanced Machine Learning Applications

This course aims at offering a self-contained account of computer vision and its underlying concepts, including the recent use of deep learning. An overview of existing and emerging applications that need computer vision. Image discretization, pre-processing steps, that enhance image quality. Linear and non-linear filters. Approaches for the recognition of specific objects. Image formation and representation, camera geometry, and calibration, computational imaging, multi-view geometry, stereo, 3D reconstruction from images, motion analysis, physics-based vision, image segmentation and object recognition. Deep learning and AI-based approaches to image analysis, object recognition and image processing using deep neural nets.

AI 613 Deep Learning with Large Datasets

This course is intended to provide a student practical knowledge of, and experience with, the issues involving large datasets. Among the issues considered are: scalable learning techniques, such as streaming machine learning techniques; parallel infrastructures such as map-reduce; practical techniques for reducing the memory requirements for learning methods, such as feature hashing and Bloom filters; and techniques for analysis of programs in terms of memory, disk usage, and (for parallel methods) communication complexity.

AI 614 Artificial intelligence for advanced problem solving techniques

This course focuses on the development of software systems designed to find solutions to problems. These systems utilize a search space and algorithms in order to reach a solution. It also, offers scholars and practitioners cutting-edge research on algorithms and techniques such as search, domain

independent heuristics, scheduling, constraint satisfaction, optimization, configuration, and planning, and highlights the relationship between the search categories and the various ways a specific application can be modeled and solved using advanced problem solving techniques.

AI 615 Applied Data Science

This course provides a practical introduction to the "full stack" of data science analysis, including data collection and processing, data visualization and presentation, statistical model building using machine learning, and big data techniques for scaling these methods. Topics covered include: collecting and processing data using relational methods, time series approaches, graph and network models, free text analysis, and spatial geographic methods; analyzing the data using a variety of statistical and machine learning methods include linear and non-linear regression and classification, unsupervised learning and anomaly detection, plus advanced machine learning methods like kernel approaches, boosting, or deep learning; visualizing and presenting data, particularly focusing the case of high-dimensional data; and applying these methods to big data settings, where multiple machines and distributed computation are needed to fully leverage the data.

AI 616 Semantic knowledge representation techniques.

In this course a survey of issues and techniques of representing knowledge, belief, and information in artificial intelligence. It also represents the syntax and semantics of various representational formalisms. Classic papers will be read and current research issues discussed. It also, contains a brief review of logic and automated theorem proving (unification and resolution) and of the SNePS knowledge-representation, reasoning, and acting system. Remaining topics will include ontologies, semantic networks, production systems, frames, description logics, inheritance networks, default reasoning, and modal and epistemic logics.

AI 617 Theories of Signal Processing

This course discusses the use of machine learning techniques to process signals. We cover a variety of topics, from data driven approaches for characterization of signals such as audio including speech, images and video, and machine learning methods for a variety of speech and image processing problems. Signal Processing is the science that deals with extraction of information from signals of various kinds. This has two distinct aspects -- characterization and categorization. Traditionally, signal characterization has been performed with mathematically-driven transforms, while categorization and classification are achieved using statistical tools Machine learning aims to design algorithms that learn about the state of the world directly from data. An increasingly popular trend has been to develop and apply machine learning techniques to both aspects of signal processing, often blurring the distinction between the two.

AI 618 Speech and Voice Recognition

This course focuses on methods for recording speech and other vocal signals, for processing and modifying such recordings, and for synthesizing artificial speech. Necessary background in speech science is provided. In addition to class discussion and short, hands-on exercises, each student develops, executes, and presents a hands-on term project. It also includes, theories of Perception, Mid-level Vision, Object and Scene Recognition, Action Recognition, Contextual Reasoning, Image Parsing, Joint Language and Vision Models, etc. A wide range of supervised, semi-supervised and unsupervised approaches for each of the topics above will be covered.

AI 619 Advanced Topics in Robotics Kinematics and Dynamics

Kinematics, Dynamic Systems, and Control is a graduate level introduction to robotics. The course covers fundamental concepts and methods to analyze, model and control robotic mechanisms which move in the physical world and manipulate it. Main topics include the fundamentals of kinematics, dynamics and control applied to the kinematics, dynamics and control of rigid body chains. Additional topics include state estimation and dynamic parameter identification.

AI 620 Robotic Balance control

This course presents the implementations of robotics in practice and research with topics including vision, motion planning, mobile mechanisms, kinematics, inverse kinematics, and sensors. In course projects, students construct robots which are driven by a microcontroller, with each project reinforcing the basic principles developed in lectures. This course will also expose students to some of the contemporary happenings in robotics, which includes current robot lab research, applications, robot contests and robots in the news.

AI 621 Advanced Fuzzy Logic Approaches in Engineering Science

This course provides innovative insights into a comprehensive range of soft fuzzy logic techniques applied in various fields of engineering problems like fuzzy sets theory, adaptive neuro fuzzy inference system, and hybrid fuzzy logic genetic algorithms belief networks in industrial and engineering settings. It also, represents the work of particle swarms, fuzzy computing, and rough sets. It includes coverage on topics centered on the applications of fuzzy logic in high-tech industrial processes.

AI 622 Bioinformatics and Computational Biology Methods

This course introduces some of the most fundamental algorithmic approaches in analyzing the large datasets generated from experiments in molecular biology. Identifying replication origins in bacterial genomes Randomized algorithms for motif finding in DNA sequences. Graph-based algorithms for genome assembly. Brute-force algorithms for antibiotic analysis. Dynamic programming algorithms for sequence alignment. Combinatorial algorithms for genome rearrangement analyses. Evolutionary tree construction algorithms. Clustering algorithms for gene expression analyses. Combinatorial pattern matching algorithms applied to DNA read mapping. Hidden Markov models for comparing rapidly mutating genetic sequences. Statistical analysis for computational proteomics.

AI 623 Sensing, Sensors and IoT

This course introduces the principles and practices of quantitative perception (sensing) illustrated by the devices and algorithms (sensors) that implement them. Learn to critically examine the sensing requirements of robotics applications, to specify the required sensor characteristics, to analyze whether these specifications can be realized even in principle, to compare what can be realized in principle to what can actually be purchased or built, to understand the engineering factors that account for the discrepancies, and to design transducing, digitizing, and computing systems that come tolerably close to realizing the actual capabilities of available sensors. Grading will be based on homework assignments, class participation, and a final exam. Three or four of the homework assignments will be hands-on take-home labs done with an Arduino kit that students will purchase in lieu of purchasing a textbook. Top-level course modules will cover (1) sensors.

AI 624 Selected Applications of Natural Language Processing

This course is about a variety of ways to represent human languages (like Arabic, English and etc.) as computational systems, and how to exploit those representations to write programs that do neat stuff with text and speech data, like translation, summarization, extracting information, question answering, natural interfaces to databases, and conversational agents. Computational treatments of words, sounds, sentences, meanings, and conversations. This course will therefore include some ideas central to Machine Learning and to Linguistics.

AI 625 Artificial Intelligence and Future Markets

This course focuses on applications of artificial intelligence and their role in shaping or disrupting new and existing markets. Students will work in teams to identify, analyze, and synthesize emerging trends and perform detailed studies of how these trends can influence and create markets. The teams will also assess artificial intelligence technologies and potential applications to create solutions that address identified market opportunities. A major objective of this course is for the teams to develop viable product ideas ultimately leading to innovative projects.

AI 626 Artificial Intelligence in Health Care Systems

This course examines computational methods that enhance our ability to diagnose, treat, and understand human diseases. Topics will include techniques for learning models from clinical data types, including: proteomics, genomics, metabolomics, transcriptomics, imaging, and electronic medical records. Most of the techniques will involve Machine Learning. The course is organized into modules. The first module will be an introduction to the field of Medicine, and how it differs from basic research. Subsequent modules will focus specific clinical tasks, including: phenotyping, biomarker discovery, predictive and causal modeling, and optimizing medical interventions. Personalized and precision medicine will also be discussed. Class sessions will consist of lectures. Students will be graded based on homework and a course project.

AI 627 Advanced Topics in Artificial Intelligence 1

Advanced topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the AI Department and approved by the department council and listed under this course number.

AI 628 Advanced Topics in Artificial Intelligence 2

Advanced topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the AI Department and approved by the department council and listed under this course number.

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مقررات دكتوراة الذكاء الاصطناعي

القسم المسؤول: قسم الذكاء الاصطناعي

1- مقررات اختيارية

يتم اختيار 4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
AI711	Research Directions in Artificial Intelligence 1	3	AI or any equivalent course
AI712	Research Directions in Artificial Intelligence 2	3	AI or any equivalent course
AI713	Research Topics in Natural Language Processing	3	Natural Language Processing or any equivalent course
AI714	Research Topics in Image Processing and Computer Vision	3	Image processing or any equivalent course
AI715	Research Topics in Robotics	3	Robotics or any equivalent course
AI716	Research Topics in Machine and Deep Learning	3	Machine Learning or any equivalent course
AI717	Research Topics in Audio, Speech, and Language Processing	3	Digital Signal Processing or any equivalent course
AI718	Research Topics in Biologically Inspired Computing	3	AI or any equivalent course
AI719	Research Topics in Real Time and Embedded Data Systems	3	Introduction to Embedded Systems or any equivalent course
AI720	Research Topics in Reinforcement Learning and Decision Making Under Uncertainty	3	Machine Learning or any equivalent course
AI721	Research Topics in High Performance Computing in Bioinformatics	3	Data Science or any equivalent course
AI722	Research Topics in Distributed Blockchain Technologies	3	Computer Security or any equivalent course
AI723	Research Topics in Autonomous Vehicles Technologies	3	Introduction to Embedded Systems or any equivalent course

محتوى مقررات دكتوراة الذكاء الاصطناعي

AI 711 Research Directions in Artificial Intelligence 1

The course goes in depth on selected topics and methods within artificial intelligence (AI) and their recent applications that include computational intelligence algorithms in search, optimization and classification. Besides, the relevant applications include industry, business, health and medicine. The course syllabus will continuously be updated with methods from state-of-the-art research.

AI 712 Research Directions in Artificial Intelligence 2

The course goes in depth on novel, and recent AI algorithms and techniques of knowledge-based systems and knowledge representation.

AI 713 Research Topics in Natural Language Processing

This course presents selected advanced topics within NLP. The topics vary from time to time due to the subjects' development, but may be within Natural language understanding, language representation, multitask learning, learning from multiple modalities, deep generative models.

AI 714 Research Topics in Image Processing and Computer Vision

This course addresses advanced topics related to image processing and computer vision. These topics include video surveillance, 3D vision, 3D reconstruction using convolutional neural networks (CNN), vision for autonomous vehicles, hand gesture recognition, image segmentation and classification.

AI 715 Research Topics in Robotics

This course covers methods for planning with symbolic, numerical, geometric and physical constraints. Topics will range from classical and stochastic planning to continuous robot domains and hybrid control of dynamic systems. Advanced computer vision topics should be introduced with robotics applications.

AI 716 Research Topics in Machine and Deep Learning

This course covers advanced research topics in machine and deep learning. These topics include machine learning for medical diagnosis and analysis, multimodal machine learning, federated learning, distributed machine learning, reinforcement learning, and deep neural network optimization.

AI 717 Research Topics in Audio, Speech, and Language Processing

This course addresses advanced topics related to audio, speech and language, and their applications. This includes analysis, synthesis, enhancement, transformation, classification and interpretation of such signals as well as the design, development, and evaluation of associated signal processing systems. Machine and deep learning applied to any of the above areas is also addressed.

AI 718 Research Topics in Biologically Inspired Computing

An introduction to self-adapting methods also called artificial intelligence or machine learning. Schemes for classification, search and optimization based on bio-inspired mechanisms are introduced. This includes evolutionary computation; artificial neural networks and more specialized approaches like e.g., swarm intelligence and artificial immune systems.

AI 719 Research Topics in Real Time and Embedded Data Systems

This course introduces the design of digital and embedded systems using programmable logic (FPGA technology). This includes hardware description language (VHDL), verification and testing of digital designs, implementation of embedded systems in FPGAs, and the basic properties of Real-time operating systems. In addition, Steam data processing, learning from Concept-Drifting Data Streams, and their applications are introduced. Self-Driving Cars, autonomous vehicles routing, and optimization in real time are introduced.

AI 720 Research Topics in Reinforcement Learning and Decision Making Under Uncertainty

This course gives a firm foundation to reinforcement learning and decision theory from mainly a statistical, but a philosophical perspective. The aim of the course is two-fold. Firstly, to give a thorough understanding of statistical decision-making, Markov decision processes, automatic experiment design, and the relation of statistical decision making to human decision making. Secondly, to relate the theory to practical problems in reinforcement learning and artificial intelligence through algorithm design, implementation and a group project in reinforcement learning.

AI 721 Research Topics in High Performance Computing in Bioinformatics

This course focuses on the application of high-performance computing (HPC) to bioinformatics analysis. The main target is to provide a background on how to effectively use HPC clusters for running computationally or data intensive bioinformatics applications. The course will mainly include teaching students selected bioinformatics tools and workflows, and how to use HPC platforms to speed up and maximize the overall throughput of intensive bioinformatics analysis. This would include, e.g., how to optimize the use of available compute nodes, and how to adapt the application to the available resources on each compute node. The course will cover both how to efficiently use parallelism when writing your own programs, as well as how to adapt and wrap existing tools in manner that efficiently exploits resources available on parallel architectures.

AI 722 Research Topics in Distributed Blockchain Technologies

We are witnessing an explosive rise in the popularity of the blockchain paradigm, the technology that enables cooperative economic models without a central administrator. While originally inspired by Bitcoin, Ethereum, and generally cryptocurrency, the paradigm has since found many additional applications and become a hot topic in both industry and research. This research-oriented seminar explores state-of-the art advances, principles, and techniques in the area. In particular, the seminar covers: Bitcoin and origins of blockchain, Blockchain storage technologies, Scalability of the data update (consensus) protocols, and Security and privacy aspects.

AI 723 Research Topics in Autonomous Vehicles Technologies

This course covers the research topics and technologies utilized in autonomous vehicles. The topics include: vehicle control, computer vision, navigation, sensor fusion, LiDAR object detection and tracking, security, and Internet of Things (IoT) technologies used in autonomous vehicles.

مقررات ماجستير الحسابات العلمية

القسم المسؤول: قسم الحسابات العلمية

1- مقررات إجبارية 4 مقررات (11 ساعة معتمدة)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
SC611	Applications of High-Performance Computing	3	Distributed Computing or Any Equivalent Course
SC612	Applications of Big Data	3	Big Data Analytics or Any Equivalent Course
SC613	Advanced Date Science	3	Data Science or Any Equivalent Course
RM611	Research Tools and Methods	2	-

2- مقررات اختيارية

يتم اختيار4 مقررات من المقررات الآتية: (12 ساعات معتمدة بواقع 3 ساعات لكل مقرر)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
SC614	Computational Intelligence	3	Big Data or Any Equivalent Course
SC615	Mathematical Programming	3	Design and Analysis of Algorithms or Any Equivalent Course
SC616	Global Optimization	3	Optimization Methods or Any Equivalent Course
SC617	Scientific Computing and Visualization	3	Design and Analysis of Algorithms or Any Equivalent Course
SC618	Advanced Optimization	3	Optimization Methods or Any Equivalent Course
SC619	Graph Theory	3	Design and Analysis of Algorithms or Any Equivalent Course
SC620	Advanced Application in Modeling and Simulation	3	Modeling and Simulation or Any Equivalent Course
SC621	Advanced Statistical Analysis	3	Statistical Analysis or Any Equivalent Course
SC622	Numerical Linear Algebra	3	Linear Algebra and Numerical Methods or Any Equivalent Courses
SC623	Computational Nonlinear Dynamics (Differential Equations; Chaos; Solitons; Fractals)	3	Differential Equations and Numerical Methods or Any Equivalent Courses
SC624	Advanced Computational Methods	3	Design and Analysis of Algorithms or Any Equivalent Course
SC625	Advanced Topics in Scientific Computing (1)	3	Varies with The Topics
SC626	Advanced Topics in Scientific Computing (2)	3	Varies with The Topics

محتوى مقررات ماجستير الحسابات العلمية

SC611 Applications of High-Performance Computing

This course stresses the need for and the design of high-performance computing (HPC) systems. It covers the state-of-the-art processor architectures such as the IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture, and Intel Nehalem microarchitecture. Cluster computing and cluster-based systems are also covered. Evaluation of power, memory and ILP challenges from the perspectives of Programming Model, Computational Model, Processor Architecture Model, Threading Model, Memory Model and Power Model. Applications of linear algebra, graph theory, Integer/linear programming, numerical analysis …etc, on HPC systems are covered. In addition, the parallel computation models, parallel algorithm design and programming issues for HPC systems are also studied.

SC612 Applications of Big Data

This course provides big data and corresponding quantitative research methods. The objective of the course is to familiarize students with different applications of big data analysis as a tool for addressing substantive research questions. Technical, conceptual and ethical challenges. Strength and limitations of big data research are discussed in depth using real-world examples. Students then engage in case study exercises in which small groups of students develop and present a big data concept for a specific real-world case. This includes practical exercises to familiarize students with the format of big data. It also provides a first hands-on experience in handling and analyzing large, complex data structures. The course is designed as a primer for anyone interested in attaining a deep understanding of what big data analysis entails.

SC613 Advanced Date Science

The course will focus on the analysis of messy, real life data to perform predictions using statistical and machine learning methods. Material covered will integrate the five key facets of an investigation using data: (1) data collection - data wrangling, cleaning, and sampling to get a suitable data set; (2) data management - accessing data quickly and reliably; (3) exploratory data analysis – generating hypotheses and building intuition; (4) prediction or statistical learning; and (5) communication – summarizing results through visualization, stories, and interpretable summaries. Moreover, the course may introduce advanced methods for data wrangling, data visualization, and statistical modeling or prediction. Topics may include big data and database management, interactive visualizations, nonlinear statistical models, or deep learning.

SC614 Computational Intelligence

This course is designed for those who are interested in designing and developing intelligent systems and/or are about to start research in computational intelligence. The course will focus on the main CI approaches and methodologies, namely artificial neural networks, genetic algorithms, swarm optimization, and fuzzy systems. The course is a research-based course and therefore focuses on leading students to investigate the current state of research in CI areas as well as to gain comprehensive theoretical knowledge from scientific research about the basic concepts and features of CI methodologies and approaches. The course is very practical-oriented and hands-on since it focuses on

showing students real world applications of CI approaches and guides them to use their theoretical knowledge to design and build CI algorithms for solving real world problems. Furthermore, the course aims at encouraging students to critically think and reflect about the learned concepts and algorithms as well as emphasizes discussions among students on CI related topics.

SC615 Mathematical Programming

The course material will partly be decided based on the background, experience and research interest of the students. Examples of themes that may be included are: Advanced linear programming theory, Mixed integer linear programming formulations and reformulations, Valid inequalities and cuts, Decomposition methods for linear and nonlinear optimization, and Heuristics.

SC616 Global Optimization

Global optimization problems appear in a wide range of applications in operations research, economics, statistics, medicine, engineering, and computer sciences. In this course, we introduce the student to the main concepts and techniques of global optimization. Topics to be covered include: Properties of Nonconvex Functions, Convex Envelopes, Duality, Complexity, Applications and Software Issues, Algorithms for Quadratic Programming, Concave Minimization, D.C. Programming, Lipschitz Optimization, Nonconvex Network Flow Problems and Decomposition Algorithms.

SC617 Scientific Computing and Visualization

Particle and continuum simulations are used as a vehicle to learn basic elements of high-performance scientific computing and visualization. Students will obtain hands-on experience in: 1) formulating a mathematical model to describe a physical phenomenon; 2) discrediting the model, which often consists of continuous differential or integral equations, into algebraic forms in order to allow numerical solution on computers; 3) designing/analyzing numerical algorithms to solve the algebraic equations efficiently on parallel computers; 4) translating the algorithms into a program; 5) performing a computer experiment by executing the program; 6) visualizing simulation data in an immersive and interactive virtual environment; and 7) managing/mining large datasets.

SC618 Advanced Optimization

This course builds upon a solid background in linear, network, non-linear. Starting with topics relating to mathematical programming, including path-following interior point methods, semi-definite and cone programming, and convex optimization, an exposition of advance concepts in multi-objective and network optimization will be made. Throughout the course, implementation issues will be addressed, including stability and convergence properties.

SC619 Graph Theory

Graphs, Blocks, Paths and circuits, Trees, fundamental circuits, Connectivity, Menger's theorem, partitions, Eulerian and Hamiltonian graphs, Line graphs, tournaments, Factorization, Coverings, Directed graphs, Capacitated directed networks, Max flow-Min cut theorem, Matrices, Planar graphs, Four color problem. Basic Diagraph Models and properties. Application to Time Tabeling, Perfect Graph, Distance in Graphs, Band width, Searching, Dynamic Graph algorithm, Algorithm on recursively constructed graphs maximum flows, minimum cost flow matching and assignment network design model.

SC620 Advanced Application in Modeling and Simulation

Mathematical Modeling: Principle of modeling, Elementary models, Models by nature of environment, Models by the Extent of generality, Solution method for models, Characteristics, Advantages and Limitations of a model, Discrete and continuous dynamical system modeling, Modeling from input/output data, Stochastic Modeling, Queuing system modeling, Single server, Unlimited queue model, Service in random order, Single server, Finite queue model, Multi- channel queuing model.
Simulation: Introduction to simulation, General concept in discrete event simulation, Random number generation, Nature of Simulation, Simulation models, Event type simulation, Demand pattern Simulation, Simulation in inspection work, Simulation of queuing models, Simulation of job sequencing, Advantage of simulation, Limitations of simulation.

SC621 Advanced Statistical Analysis

Create and interpret data visualizations using the Python programming language and associated packages & libraries. Apply statistical modeling techniques to data (ie. linear and logistic regression, linear models, multilevel models, Bayesian inference techniques). Throughout the course, students will learn the importance of and be able to connect research questions to the different statistical and data analysis methods.

SC622 Numerical Linear Algebra

We teach how to solve practical problems using modern numerical methods and computers. Central concepts are convergence, stability, and complexity (how accurate the answer will be and how rapidly it is computed). Other tools include matrix factorization and orthogonalization. Algorithms covered can, among other things, be used to solve very large systems of linear equations that arise when discretizing partial differential equations, and to compute eigenvalues.

SC623 Computational Nonlinear Dynamics (Differential Equations; Chaos; Solitons; Fractals)

This course will study the nonlinear dynamics of applied problem using computational methods. It examines differential equations from a geometric point of view and involves significant use of phase-plane diagrams and associated concepts, including equilibrium points, orbits, limit cycles, and domains of attraction. Various methods are discussed to determine existence and stability of equilibrium points and closed orbits. Methods are discussed for analyzing nonlinear differential equations (e.g., linearization, perturbation, and bifurcation analysis). An introduction to chaos theory, soliton and fractals is also presented. The learned techniques will be applied to equations from physics, engineering, biology, ecology, neural networks, and others.

SC624 Advanced Computational Methods

Solution of ordinary differential equations (odes) for the initial value problem, Solution of the system of odes, Solution of the system of odes, The stiff odes, The solution of the value boundary problem using the linear shooting, finite difference, and non-linear shooting methods, Applications to mechanical, hydraulic, and thermal system design, The finite difference approximation, Numerical solution of partial differential equation (PDEs) using finite difference method, Application on elliptic, parabolic, and hyperbolic PDEs, Direct and iterative methods of solution, Solution of PDEs using the finite volume method. Solution of PDEs using the finite element method, Applications to problem in

fluid mechanics, steady and transient conduction heat transfer, elastic deformation of solid element, and stress analysis, Case study using MATLAB programming and available software and modules.

SC625 Advanced Topics in Scientific Computing (1)

Topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the scientific computing department.

SC626 Advanced Topics in Scientific Computing (2)

Topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the scientific computing department.

RM601 Research Tools and Methods

This course is designed to provide a general appreciation of workplace and communication skills pertinent to computer science. Inter-personal and personal transferable skills will be given emphasis in an effort to better equip the student for the workplace, as well as interaction with staff and students while attending their master's course. Contemporary skills of scientists including hypothesis development, experimental control, data management, project organization and monitoring, cooperative work habits, and effective communication. This course also introduces the main tools used in information management and explores why they are of importance to the research methodology. This includes the following topics: Searching for information and appraisal skills, Qualitative methods, Quantitative assessment, and questionnaire design, needs assessment - and tools to achieve this, Requirement's analysis, Modelling - testing hypothesis, Research statistics, and Audit. Cases in information systems will be used to demonstrate these concepts.

مقررات دكتوراة الحسابات العلمية

القسم المسؤول: قسم الحسابات العلمية

1- مقررات اختيارية

يتم اختيار 4 مقررات من المقررات الآتية: (12 ساعة معتمدة بواقع 3 ساعات لكل مقرر)

كود المقرر	اسم المقرر	عدد الساعات المعتمدة	المتطلب القبلي
SC711	Research Topics in Parallel and Distributed Computing	3	SC611 or any equivalent course
SC712	Mathematical Foundation for Robotics	3	Artificial Intelligence or any equivalent course
SC713	Research Topics in Machine Learning	3	Machine Learning or any equivalent course
SC714	Research Topics in Data Science	3	SC613 or any equivalent course
SC715	Research Topics in Computational Intelligence	3	SC614 or any equivalent course
SC716	Algorithmic Graph Theory	3	SC619 or any equivalent course
SC717	Sensing and Sensors	3	SC618 or any equivalent course
SC718	Research Topics in Scientific Computing (1)	3	Varies with The Topics
SC719	Research Topics in Scientific Computing (2)	3	Varies with The Topics

محتوى مقررات دكتوراة الحسابات العلمية

SC711 Research Topics in Parallel and Distributed Computing

The advent of multicore processors has completely changed the landscape of computing. The serial computing era when programmers could transparently and automatically take advantage of the microprocessors' performance improvement that follows the Moore's law has gone. Instead, parallel computing has now become universal, from the multicore computing on chip to the large-scale cluster computing, Grid computing, and Cloud computing. This course introduces the principles of parallel computing and covers parallel and concurrent programming. In details, it has Overview of parallel computing, Performance metrics and evaluation for parallel systems, Shared memory parallel architectures and multithreaded programming, Distributed memory parallel architectures and communications, Message passing programming, parallel algorithms design and applications, Latest advancements in parallel processing and open research discussions.

SC712 Mathematical Foundation for Robotics

This course covers selected topics in applied mathematics. Topics covered in the past have included: polynomial interpolation and approximation; solution of nonlinear equations; roots of polynomials; approximation by orthogonal functions such as Fourier series; optimization; calculus of variations; probability; numerical solution of differential equations.

SC713 Research Topics in Machine Learning

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practice of machine learning from a variety of perspectives. Topics covered include learning decision trees, neural network learning, statistical learning methods, genetic algorithms, Bayesian learning methods, explanation-based learning, and reinforcement learning. The course covers theoretical concepts such as inductive bias, the PAC and Mistake-bound learning frameworks, minimum description length principle, and Occam's Razor. Programming assignments include hands-on experiments with various learning algorithms. Typical assignments include neural network learning for face recognition, and decision tree learning from databases of credit records.

SC714 Research Topics in Data Science

Research topics in data science includes scientific understanding of learning, especially deep learning algorithms, computing systems for data-intensive applications, automating front-end stages of the data life cycle, the process of data mining, dimension reduction methods and techniques, data classification methods, logistic regression modeling, smoothing methods approaches, and data engineering techniques.

SC715 Research Topics in Computational Intelligence

This course is designed for those who are interested in designing and developing intelligent systems and/or are about to start research in computational intelligence. The course will focus on the main CI approaches and methodologies, namely artificial neural networks, genetic algorithms, swarm optimization, and fuzzy systems. The course is a research-based course and therefore focuses on leading students to investigate the current state of research in CI areas as well as to gain comprehensive theoretical knowledge from scientific research about the basic concepts and features of CI methodologies and approaches. The course is very practical-oriented and hands-on since it focuses on showing students real world applications of CI approaches and guides them to use their theoretical knowledge to design and build CI algorithms for solving real world problems. Furthermore, the course aims at encouraging students to critically think and reflect about the learned concepts and algorithms as well as emphasizes discussions among students on CI related topics.

SC716 Algorithmic Graph Theory

Algorithmic graph theory is the study of graph traversal and generation and the complexity of these operations. topics in algorithmic graph theory include graphs and algorithmic complexity, Eulerian and Hamiltonian cycles, (sub)graph isomorphism, graph matching, algorithms on trees, network flow problems, and graph coloring, multiple source shortest path on planar graphs, ball growing and graph partitioning.

SC717 Sensing and Sensor

The principles and practices of quantitative perception (sensing) illustrate by the devices and algorithms (sensors) that implement them. Learn to critically examine the sensing requirements of proposed applications of robotics to real problems, to specify the required sensor characteristics, to analyze whether these specifications can be realized even in principle, to compare what can be realized in principle to what can actually be purchased, to understand the engineering factors that account for the discrepancies, and to design transducing, digitizing, and computing systems that come tolerably close to realizing the actual capabilities of available sensors.

SC718 Research Topics in Scientific Computing (1)

Research topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the SC Department and approved by the department council and listed under this course number.

SC719 Research Topics in Scientific Computing (2)

Research topics which are not included in the curriculum and seems to be needed should be suggested as an elective course by the SC Department and approved by the department council and listed under this course number.