

Ministry of Education
King Saud University (KSU)
Deanship of Graduate Studies



College of Computer & Information
Sciences
Department of Computer Science

Master of Science in Artificial Intelligence

(Non-thesis Option)

Academic Year

1443 AH / 2021 G

Master of Science in Artificial Intelligence (Non-thesis) option, Department of Computer Science, College of Computer &
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- **Introduction:**

The department of Computer Science (CSC) was established in 1984 with a Bsc. program intended to prepare highly competent creative workforce in the field of Computer Science. The Master of Science in Computer Science program was established in 1990 to prepare graduates able to effectively contribute in the domiciliation and development of computing and IT technologies. Later in 2005, the CSC department established a Ph.D. in Computer Science program to meet its research objectives and fulfill the growing need for creative minds for the forthcoming knowledge society. The programs offered by the Computer Science department satisfy the ACM/IEEE recommendations for Computer Science curriculum (<http://www.acm.org/education/CS2013-final-report.pdf>) and take into account the community needs. Currently, 65 Male and Female students are enrolled in the Msc. of Science in Computer Science program, and 104 Male and Female students are enrolled in the Ph.D. in Computer Science program.

The CSC department is privileged to have competent academic staff who earned their PhD degrees from internationally recognized universities. The faculty members are active researchers in a variety of Computer Science fields such as Artificial Intelligence, Data Science, Pattern Recognition, Networks, Security, Distributed Systems etc... Besides, they are actively involved in teaching and administration of the department activities.

Artificial Intelligence (AI) is an area of Computer Science that aims to develop computer systems able to simulate human intelligence and autonomously perform tasks originally restricted to humans. Nowadays, AI is perceived as a productivity stimulator and economic growth engine. In particular, it has drastically improved the decision making processes by exploiting the exponentially increasing amount of data. In addition, it has promoted novel services and products, industries and markets through offering new revenue streams and boosting consumer demand. Typically, the design of cutting edge Intelligent solutions relies on data science to effectively exploit existing data and transform it into relevant knowledge. In fact, Data Science can be defined as a computer science field which aims to mine meaningful insights and knowledge from large amount of data. Specifically, it leans on machine learning techniques to extract relevant hidden patterns and/or information from any data modality.

- **Degree's Name:**
 - ❖ Master of Science in Artificial Intelligence.
- **Program's Language:**
 - ❖ English.
- **Significance and Justifications of Program Creation**
 1. The Kingdom of Saudi Arabia witnesses the most enthusiastic economic shift and reform program in its rich history. Artificial intelligence (AI) is a key enabler of a wide and diverse range of initiatives being deployed to attain the objectives of KSA Vision 2030.
 2. A Master of science in Artificial Intelligence would reinforce the contribution of King Saud University to the achievement of KSA Vision 2030.
 3. Specifically, it would support King Saud University mission in providing distinctive education, producing creative research and participating in building the knowledge economy and community.
 4. Moreover, it will provide the national and international IT market with Artificial Intelligence professionals ready to take research and development jobs or managerial positions as well as entrepreneurship opportunities.
 5. The results of the job market survey (program beneficiaries) showed that the proposed program would fulfill the needs in qualified manpower. Moreover, the findings of this survey proved that the program meets the future aspirations of the relevant job market sector. Moreover, the employers have found the curriculum of the proposed program in line with their strategic visions.
- **Program's Vision**

National, regional and global leadership and excellence in the field of Artificial Intelligence.
- **Program's Mission**

Preparing highly qualified specialists in Artificial Intelligence as contribution to the edification of the knowledge economy and to the achievement of the objective set by KSA vision through fostering an academic environment ideal for knowledge development, research, and innovation in the fields of Artificial Intelligence.
- **Program's Objectives**

1. Preparing students to work as Artificial Intelligence specialist in Saudi Arabia and abroad.
2. Preparing highly qualified students ready to pursue further graduate studies in relevant fields.
3. Promoting AI industry by preparing knowledgeable and highly skilled researchers.
4. Bridging the gap between the department and Artificial Intelligence industrial and technological environment.

- **Program's Outcomes**

A- Knowledge and Comprehension:

- ❖ An ability to apply breadth knowledge of Computer Science relevant to Artificial Intelligence.
- ❖ An ability to apply in-depth knowledge of the most recent techniques in Artificial Intelligence to solve a given problem.
- ❖ An ability to apply design principles when building up an Artificial Intelligence based solution to a given problem.

B- Mental Skills:

- ❖ An ability to function effectively on teams to accomplish a common goal.
- ❖ An ability to handle the pressure of deadlines.

C- Professional and Practical Skills:

- ❖ An ability to implement the most recent techniques in Artificial Intelligence.
- ❖ An ability to design Artificial Intelligence based solutions or systems to meet desired needs.
- ❖ An ability implement Artificial Intelligence based solutions or systems.
- ❖ An ability to evaluate Artificial Intelligence based solutions or systems.
- ❖ An ability to engage in continuing professional development.

D- General Skills:

- ❖ An ability to implement understanding of professional, ethical, legal, security, and social issues and responsibilities.
- ❖ An ability to communicate effectively with a range of audiences.

- **Program Beneficiaries:**

- ❖ The Master of science in Artificial Intelligence is designed for Bsc. degree in computing holders looking for a Master of science degree to become Artificial Intelligence specialist.
- ❖ In particular, candidates from the IT industry who are interested in learning key Artificial Intelligence concepts, techniques, algorithms, and practical examples are typical beneficiaries.
- ❖ Besides professionals searching a deeper understanding and a hands-on experience of applied AI and/or better understanding of the opportunities offered by the Artificial Intelligence solutions represent another profile of the program beneficiaries.

- **Admission Requirements**

1. The applicant should have a bachelor's degree in computer science obtained with a (regular) mode of study from King Saud University or other universities recommended by the Saudi Ministry of Education, with a grade of no less than (Very Good) with a cumulative GPA of no less than (3.75 out of 5) or its equivalent.
2. It is permissible to accept non-specialists in computer science from computer engineering, information systems, software engineering, information technology, non-educational computing, Electrical Engineering, Mathematics, Statistics and Operations Research disciplines, from King Saud University or other universities recommended by the Saudi Ministry of Education, obtained with a (regular) mode of study, with a grade of no less than (Very Good) and a cumulative GPA of no less than (3.75 out of 5) or its equivalent.
3. Studying a bachelor's degree through (affiliation) mode is not accepted, nor any of the educational or management computing specializations, nor specializations of information studies, libraries, or management information systems
4. The applicant must have a score of no less than (53) in the TOEFL-IBT test or its equivalent.
5. The applicant must obtain a minimum score of (70) in the quantitative part of the Qudurat test or (144) in the quantitative part of the GRE test.

- **Requirements for obtaining the Degree:**

- ❖ **Non-thesis option**

- Passing (33) study units of Master's courses including the research project.

- **Program General Structure:**

- ❖ **Non-thesis Option**

- Number of units required is (33) including the Research project as follows:

Type of Courses	No. of Courses	No. of Units Required
Core courses	(6)	(18) Study units
Elective courses	(3)	(9) Study units
Research project	(2)	(6) Study units
Total	(11)	(33) Study units

Program's Study Plan:

○ First Level:

#	Course Code	Name	No. of Study Units	Activity	Assessment GPA: (incl./excl.)	Pre-requisite
1	CSC 512	Algorithm Analysis and Design	3 (3+0)	Lecture	GPA: incl.	-
2	CSC 562	Artificial Intelligence	3 (3+0)	Lecture	GPA: incl.	-
3	CSC 582	Database Systems for Data Science	3 (3+0)	Lecture	GPA: incl.	-
Total			(9) Study Units			

○ Second Level:

#	Course Code	Name	No. of Study Units	Activity	Assessment GPA: (incl./excl.)	Pre-requisite
1	CSC 564	Machine Learning	3 (3+0)	Lecture	GPA: incl.	CSC 512
2	CSC 588	Data Warehouse and Mining Systems	3 (3+0)	Lecture	GPA: incl.	CSC 512
3	CSC 596	Seminar and Discussion in Artificial Intelligence	3 (3+0)	Lecture	GPA: incl.	CSC 562
Total			(9) Study Units			

○ Third Level:

#	Course Code	Name	No. of Study Units	Activity	Assessment GPA: (incl./excl.)	Pre-requisite
1	CSC ...	Elective course (1)	3 (3+0)	Lecture	GPA: incl.	CSC ...
2	CSC ...	Elective course (2)	3 (3+0)	Lecture	GPA: incl.	CSC ...
3	CSC 591	Research Project (1)	3 (6+0)	Research Project	GPA: incl.	CSC 596
Total			(9) Study Units			

○ Fourth Level & following levels:

#	Course Code	Name	No. of Study Units	Activity	Assessment GPA: (incl./excl.)	Pre-requisite
1	CSC ...	Elective course (3)	3 (3+0)	Lecture	GPA: incl.	CSC ...
2	CSC 592	Research Project (2)	3 (6+0)	Research Project	GPA: incl.	CSC 591
Total			(6) Study Units			

○ **List of elective courses: student must select (3) courses from the following**

#	Course Code	Name	No. of Study Units	Activity	Assessment GPA: (incl./excl.)	Pre-requisite
1	CSC 514	Optimization for Artificial Intelligence	3 (3+0)	Lecture	GPA: incl.	CSC 512
2	CSC 516	Evolutionary Computation	3 (3+0)	Lecture	GPA: incl.	CSC 512
3	CSC 519	Computer Security	3 (3+0)	Lecture	GPA: incl.	
4	CSC 530	High Performance Computing	3 (3+0)	Lecture	GPA: incl.	
5	CSC 558	Pattern Recognition and Image Processing	3 (3+0)	Lecture	GPA: incl.	
6	CSC 559	Computer Vision	3 (3+0)	Lecture	GPA: incl.	CSC 564
7	CSC 560	Knowledge Representation and Reasoning	3 (3+0)	Lecture	GPA: incl.	CSC 562
8	CSC 565	Deep Learning	3 (3+0)	Lecture	GPA: incl.	CSC 564
9	CSC 566	Advanced Applications of Pattern Recognition and Machine Learning	3 (3+0)	Lecture	GPA: incl.	
10	CSC 568	Reinforcement Learning	3 (3+0)	Lecture	GPA: incl.	CSC 564
11	CSC 569	Selected topics in Artificial Intelligence	3 (3+0)	Lecture	GPA: incl.	
12	CSC 570	Selected topics in Data Science	3 (3+0)	Lecture	GPA: incl.	CSC 582
13	CSC 572	Advanced Computer Graphics	3 (3+0)	Lecture	GPA: incl.	
14	CSC 583	Natural Language Processing	3 (3+0)	Lecture	GPA: incl.	CSC 564
15	CSC 585	Data analytics and Visualization	3 (3+0)	Lecture	GPA: incl.	CSC 582

16	CSC 587	Web Databases and Information Retrieval	3 (3+0)	Lecture	GPA: incl.	
17	CSC 594	Ethical Issues in Artificial Intelligence	3 (3+0)	Lecture	GPA: incl.	CSC 562

• **Program Courses Description:**

CSC 512	Algorithm Analysis and Design	3 (3+0)
<p>In this course, the students undertake the design and analysis of efficient algorithms. The course focuses on the state of the art techniques for the design and analysis of algorithms. The topics it covers are: Review of major data structures – Basic design techniques – Divide and conquer – Greedy method – Backtracking – Dynamic programming – Heuristics – Parallel algorithms – Analysis of algorithms – Orders of magnitude – Lower bound theory – Time and space complexity – NP-hard and NP-complete problems – applications and examples – Correctness of algorithms – Structure of algorithms.</p>		
CSC 562	Artificial Intelligence	3 (3+0)
<p>This course outlines Artificial Intelligence knowledge and skills necessary to proceed with more advanced theoretical and/or applied courses in AI. Namely, it covers the following topics: Introduction to AI problem solving – Knowledge representation – Automatic theorem proving – Learning by example – Learning by analogy – Learning by discovery – Self-reference and Self-production – Reasoning: causal reasoning – commonsense reasoning – default reasoning – measure-based approaches – reasoning with uncertainty – Confirmation theory – Belief theory – Necessity and possibility theory – Theory of endorsements – Spatial and temporal reasoning.</p>		
CSC 582	Database Systems for Data Science	3 (3+0)
<p>This course aims to expose students to relational and NoSQL database concepts with focus on both theoretical and practical learning. In particular, it provides knowledge of the SQL language and the implementation skills relevant to relational and NoSQL database systems (DBMS). Platforms such as MySQL, SQL Server, Amazon Redshift, Google BigQuery and MongoDB are considered for the creation of database instances in the cloud for Both relational and NoSQL database systems. Furthermore, students are expected to implement SQL scripts and Python/Java codes through hands-on projects.</p>		
CSC 564	Machine Learning	3 (3+0)

<p>In this course, the students undertake machine learning concepts and techniques. The covered topics are: Approaches to machine learning: Explanation-based learning – Learning by observation and discovery – Analogical and Case-based Learning – Learning Models – Evaluation of Learning Algorithms – Experimental Methodology – Empirical Learning – Reinforced Learning and Genetic algorithms – Neural Computations: examples and applications – History of Artificial Neural System development – Fundamental Concepts and Models of Artificial Neural systems.</p>		
CSC 588	Data Warehouse and Mining Systems	3 (3+0)
<p>This course covers the theory and methods for data warehouses design as well as data mining concepts and techniques. It covers the following topics: Introduction to Decision Support Systems (DSS) – Development of DSS – Data Modeling Techniques and Development of Data Warehouse in an architected Environment – Data cube design – Study of different Data Warehouse Architectures and Development Techniques – User-Interface for Data Warehouses – Data Mining – Application Domains for Data Warehouse and Mining. More focus will be made on developing student self-learning skill through independent research assignments.</p>		
CSC 596	Seminar and Discussions in Artificial Intelligence	3 (3+0)
<p>This course enable student to carry out theoretical and technical survey study on AI advanced topics. The student has to present and discuss his findings in a written report and in a seminar.</p>		
CSC 591	Research Project (1)	3 (6+0)
<p>In this research project, the students undertake a research project in an area of AI. The research project can be either a study of a theoretical topic or a practical (development) one. The student presents his findings in a written report that conforms to the requirements and specifications set up by the department. This course is dedicated to the first part of the project, the analysis and design part.</p>		
CSC 592	Research Project (2)	3 (6+0)
<p>This research project is a continuation of the research work carried out in project I. The students are expected to deliver a (public) presentation and a report on the research outcomes at the end of the semester.</p>		
CSC 514	Optimization for Artificial Intelligence	3 (3+0)
<p>This course outlines the algorithms, theory and applications of convex optimization used in most Artificial Intelligence and machine learning solutions. Specifically, it provides the students with the background needed to recognize, formulate, and solve convex optimization problems. The topics covered in this course include: Recall on Vector spaces and subspaces, fundamental matrices properties</p>		

<p>(determinants, inverse matrices, matrix factorizations, eigenvalues), linear transformations, and linear systems of equations, convex sets and functions, linear and quadratic optimization, geometric and semidefinite programming, and algorithms for constrained and unconstrained problems.</p>		
CSC 516	Evolutionary Computation	3 (3+0)
<p>This course covers evolutionary computation in the context of Artificial Intelligence and optimization problems with NP complexity. Its content spans over: Paradigm of genetic algorithms, evolutionary strategy, genetic programming and various evolutionary heuristics. In particular, it focuses on theory and practice of standard evolutionary computation. In addition, it exposed the students to advanced evolutionary algorithms based on graphic probabilistic models (Estimation of Distribution Algorithms (EDA)). Moreover, it tackles parallel evolutionary algorithms and techniques of rapid prototyping of evolutionary algorithms.</p>		
CSC 519	Computer Security	3 (3+0)
<p>In this course, the students get exposed to state of the art computer security problems. The topics covered in this course are: Threats and vulnerabilities – Identification and authentication – Access control – Intrusion detection – Encryption and privacy – Security policies and their evaluation.</p>		
CSC 530	High Performance Computing	3 (3+0)
<p>The course gives an overview on HPC architectures in addition to a clear emphasis on performance tuning and algorithmic implementation. It provides the students with a hands-on experience in developing scalable efficient parallel algorithms suitable for most AI applications. Namely, the course covers: Review of major causes of performance degradation in scientific computing – The scheduling problem: classification and solutions – Task scheduling – Load balancing algorithms – Deadline scheduling for real-time systems. The collaboration between students to achieve a common goal will be encouraged through group assignments/project.</p>		
CSC 558	Pattern Recognition and Image Processing	3 (3+0)
<p>In this course, the students undertake pattern recognition methods and concepts. In addition, it outlines the image processing techniques necessary to design and implement image based pattern recognition systems. The topics covered in this course are: Digital Image fundamentals – Images enhancement in spatial and frequency domain – Images degradation and restoration – Detection of discontinuities in images – Images segmentation – Representation of objects – Boundary, Regional, and Relational descriptors – Patterns and Pattern Classes – Recognition based on Decision Theoretic and Structural Methods – new topics in pattern recognition and image processing.</p>		

CSC 559	Computer Vision	3 (3+0)
<p>This course provides the students with the knowledge and skills necessary for the computer vision tasks in academia and industry. It covers the following topics: Computer vision fundamentals, Computational models and methodologies for solving computer vision problems, real-world application design and implementation of real-world applications related to visual data analytics.</p>		
CSC 560	Knowledge Representation and Reasoning	3 (3+0)
<p>In this course, the students undertake knowledge representation and reasoning. The topics covered include: Techniques of knowledge representation and reasoning using first-order logic. Key reasoning techniques of Resolution theorem-proving. Object-oriented approach to knowledge representation and reasoning. Uncertain knowledge and reasoning. Probabilistic reasoning over time. Making simple decisions. Making complex decisions</p>		
CSC 565	Deep Learning	3 (3+0)
<p>This course studies various deep architectures concepts. Typical deep learning models such as CNN, RNN, auto-encoders and their variants will be outlined. The student will be familiarized with the optimization and regularization methods used in deep learning framework. Furthermore, open-source deep learning platforms will be introduced. Hands-on experiences to solve AI problems using deep learning represents a main component of the course. Teamwork skill will be promoted through group project assignment.</p>		
CSC 566	Advanced Applications of Pattern Recognition and Machine Learning	3 (3+0)
<p>This course aims to expose the students to advanced concepts and methods typically used for pattern recognition in any type of data. This is achieved through the study of the underlying algorithmic knowledge and theory relevant to characterize and detect patterns in real data. The course covers: Image processing and analysis – Speech processing – Geographical Information System – Fuzzy reasoning – Computer vision – perception and any other emerging relevant topic(s).</p>		
CSC 568	Reinforcement Learning	3 (3+0)

<p>This course presents the main Reinforcement Learning approaches and challenges such as generalization and exploration. In particular, an emphasis will be made on deep reinforcement learning. The course topics include: Bandit problems and online learning, Markov decision processes, Solution methods such as dynamic programming, Temporal difference learning, Monte Carlo learning, state of the art RL systems.</p>		
CSC 569	Selected topics in Artificial Intelligence	3 (3+0)
<p>This course aims to expose the students to cutting edge topics in Artificial Intelligence. This is achieved by undertaking state of the art AI concepts, methods, techniques and tools.</p>		
CSC 570	Selected topics in Data Science	3 (3+0)
<p>This course aims to expose the students to cutting edge topics in Data Science. This is achieved by undertaking state of the art Data Science methods, techniques and tools.</p>		
CSC 572	Advanced Computer Graphics	3 (3+0)
<p>Mathematics for computer graphics in three dimensions – Hierarchical representation and basic shapes – Surfaces and curves in three dimensions – Three dimensional modeling – Solid bodies modeling – Three dimensional viewing – Visible surface – Illumination and shades – Texture mapping – Computer Graphics Systems: Open GL – Animation techniques – Case Study.</p>		
CSC 583	Natural Language Processing	3 (3+0)
<p>In this course, the students undertake the steps typically required for Natural Language Processing. In addition, it exposes the students to the ambiguous challenges in NLP. Moreover, suitable standard platforms and libraries for processing real-world data will be introduced and used in this course. The topics covered in this course include: Text processing applications, ambiguity in natural languages, The Natural Language Toolkit, N-gram language models, Text Classification, Part-of-Speech Tagging, Syntactic and Statistical Parsing, Semantic Analysis and Information Extraction.</p>		
CSC 585	Data analytics and Visualization	3 (3+0)
<p>This course provides the students with data analytics and visualization principles. The course covers the complete data science cycle and covers a wide range of topics related to data analytics including experimental design; data collection and preprocessing; exploratory data analysis; association rules; statistical inferencing; model fitting and selection; data clustering; evaluations; hypothesis testing; analysis of variance; correlation and causality; data visualization rules and guidelines; data abstraction and visual encoding; tabular data visualization; spatial data visualization; networks and trees visualization; and interactive visualization.</p>		

CSC 587	Web Databases and Information Retrieval	3 (3+0)
<p>In this course, the students undertake advanced techniques required for the design and implementation of text based information systems. It covers: Text indexing, Boolean and vector-space retrieval models, IR techniques for the web, link-based algorithms, metadata usage and crawling, Document classification and clustering, Machine learning based ranking.</p>		
CSC 594	Ethical Issues in Artificial Intelligence	3 (3+0)
<p>This course provides the students with discussions on the issues that are raised by the recent advances in artificial intelligence (AI) and robotics systems. The course examines the history and the current state of AI and discusses a number of ethical concerns of AI including biases in AI systems; robot ethics; machine ethics; accountability and transparency; legal issues of AI; economic and social impacts of AI systems; and unintended consequences resulting from adapting AI in traffic, medical, financial, and security applications. The course will focus on presenting and analyzing several case studies from each domain where AI is being used.</p>		