



Academic Reference Standards (ARS)

For

Artificial Intelligence Program

تم مراجعته بواسطة لجنة تطوير البرامج التعليمية بوحدة ضمان
الجودة بالكلية.



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Preface

Based on the requirements of the faculty of Information Systems and Computer Science – October 6 University to develop an artificial intelligence program to achieve the country's trends in the field of information technology, academic reference standards have been set for this program to ensure the achievement of learning outcomes and the attributes of artificial intelligence graduates.

Higher educational institutions must reform their programs and courses to meet the demands of the labor market. In addition, graduates should acquire the flexibility that enables them to adapt to the future needs of the labor market.

The international rapid development in technology leads to changes in social and economic conceptions obliged development in education as the main gate for human resources development, in turn, one of the most important fields of technology development is the artificial intelligence.

Artificial Intelligence (AI) is a field that has a long history but is still constantly and actively growing and changing. Since the global adoption of technology in higher education is transforming the way, we teach and learn. Artificial Intelligence is one of the advanced techniques to customize the experience of different learning groups and teachers.

This academic reference standards (ARS) are intended to set out clearly the graduate attributes and academic characteristics expected to be achieved in the artificial intelligence program.

**Quality Assurance Unit (QAU)
faculty of Information Systems and Computer Science (FISCS) -
October 6 University (O6U)**

Methodology

QAU of FISCS-O6U has invited a group of education experts, in artificial intelligence, from different Universities to develop a general framework of the guide for the academic reference standards (ARS) in the artificial intelligence. The steps proceeded as follows:

1. Brain Storming

The authority held several workshops for expert groups to discuss the general framework and elements/contents of the ARS guide and Standardization of concepts and terms used in the ARS within a definite timetable.

2. Reviewing of the NAQAA National Academic Reference Standards

Experts' groups have reviewed the first edition of NAQAA national academic reference standards applied in the computing and information issued in October 2010.

3. Reviewing by Technical Committee

Standard first drafts were reviewed by internal and external reviewer, to ensure that standards meet the agreed essential elements as well as the technical editing of the draft.

4. Stakeholders Approval

After the completion of the draft of academic reference standards, it was presented to representatives from stakeholders and faculty members to take appropriate action.

5. Dissemination

ARS is posted on FISCS page through the university website (o6u.edu.eg), to receive feedback from students, faculty members and stakeholders.

6. Endorsement of Standards

The draft was revised from QAU according to the feedback received and introduced to faculty Board for approval.

Artificial Intelligence

1- Introduction to Artificial Intelligence

Artificial Intelligence is a branch of science producing and studying the machines aimed at the stimulation of human intelligence processes. The main objective of AI is to optimize the routine processes, improving their speed and efficiency.

AI tools mostly comply with 3 basic principles:

Learning: Acquiring and processing the new experience, creating new behavior models

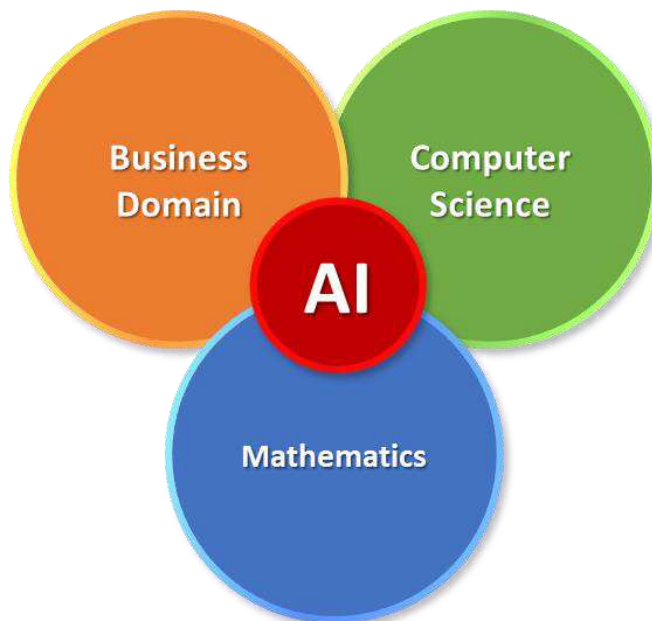
Self-correction: Refining the algorithms to ensure the most accurate results

Reasoning: Picking up the specific algorithms to resolve a specific task.

All students must be taught specific technical skills which will allow them to program and interact with Artificial Intelligence in the future. Subjects and courses in ethics and philosophy as well as a focus on skills where AI is less likely to have an advantage such as complex decision making, critical thinking, entrepreneurship, and emotional intelligence will become part of a basic education to provide tools that will help them live and work with Artificial Intelligence.

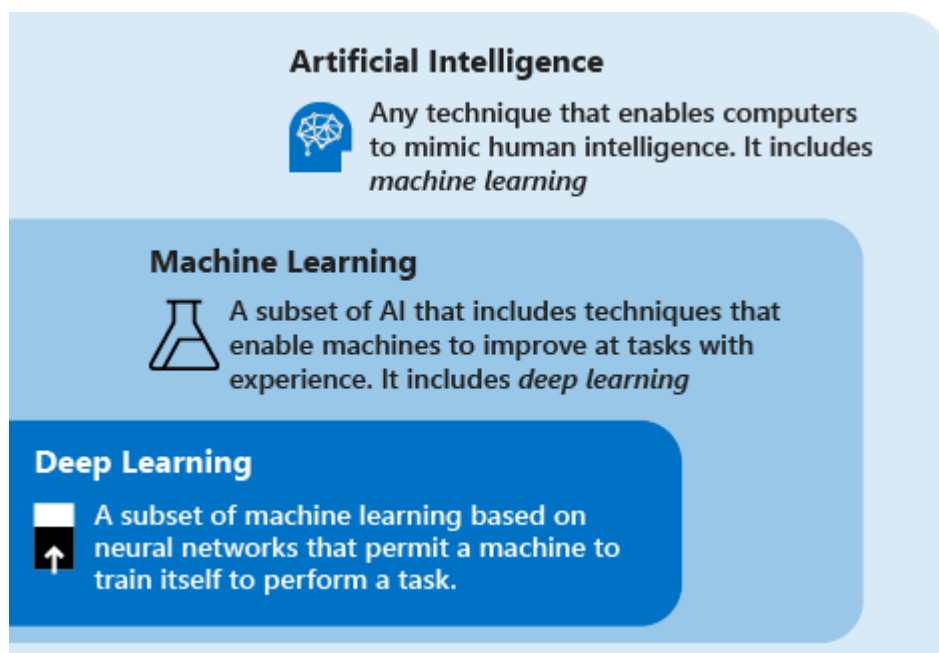
The AI discipline is important for the community because:

1. Skills in AI enables the graduates to solve complex, challenging problems.
2. AI can automate a repetitive task that was previously done manually, without feeling any fatigue or having to take breaks like a human employee would need to do.
3. AI can make products and services smarter and more effective, improving experiences for end-users, via capabilities like optimizing conversation bots or customer service menus, and delivering better product recommendations.
4. AI can analyze data at a much faster rate than humans, allowing it to find patterns much more quickly, and it can also analyze much larger datasets than humans, allowing it to uncover patterns humans would simply miss.
5. AI can be trained to become more accurate than humans, utilizing its ability to harvest and interpret data to come up with better decisions for tasks.
6. AI jobs are among the highest paid and have the highest job satisfaction.
7. Having an AI major will provide student with a foundation of knowledge, problem solving and logical thinking that will serve as a competitive advantage to him in his career, in whatever field he chooses.
8. Creating high-quality AI is a highly creative activity, and computing supports creative work in many other fields.



2- The Study of Artificial Intelligence

The reason for studying AI can impact every aspect of life. The field of AI tries to understand patterns and behaviors of entities. With AI, we want to build smart systems and understand the concept of intelligence as well. The intelligent systems that we construct are very useful in understanding how an intelligent system like our brain goes about constructing another intelligent system.



3- Career Paths

Let us consider what is involved in a career path in each area.

Big Data Analyst: Find meaningful patterns in data by looking at the past to help make predictions about the future.

User Experience (UX) Designer/Developer: Work with products to help customers understand their function and can use them easily. Understand how people use equipment and how computer scientists can apply that understanding to produce more advanced software.

Natural Language Processing Engineer :Explore the connection between human language and computational systems; this includes working on projects like chatbots and virtual assistants.

Researcher: Work with computer science and AI research Discover ways to advance AI technology

Research Scientist: Expert in applied math, machine learning, deep learning, and computational stats. Expected to have an advanced degree in computer science or an advanced degree in a related field supported by experience.

Software Engineer: Develop programs in which AI tool's function. The role may also be referred to as a Programmer or Artificial Intelligence Developer.

AI Engineer: Build AI models from scratch and help product managers and stakeholders understand results.

Data Mining and Analysis: Finding anomalies, patterns, etc. within large data sets to predict outcomes.

Machine Learning Engineer: Using data to design, build and manage ML software applications.

Data Scientist: Collect, analyze, and interpret data sets.

Business Intelligence (BI) Developer: Analyze complex data sets to identify business and market trends

Big Data Engineer/Architect: Develop systems that allow businesses to communicate and collect data.

Robotics Engineer: Design, build and test robots or robotic systems.

Computer Vision Engineer: Develop and work on projects and systems involving visual data.

4- Academic Reference Standards for Artificial Intelligence

4.1 Attributes of Artificial Intelligence Program Graduates

The graduates of the Artificial Intelligence programs should be able to:

1. Apply the fundamental theories and principles of Artificial Intelligence applications.

2. Integrate and evaluate the computing tools and facilities.
3. Apply knowledge of mathematics and science.
4. Design a computing system, component, and process to meet the required needs within realistic constraints
5. Exploit the techniques, skills, and up-to-date computing tools, necessary for computing and information practice.
6. Display professional responsibilities and ethical, societal, and cultural concerns
7. Use, compare and evaluate a range of formal and informal techniques, theories, and methods to develop computing and information applications.
8. Consider and deal with the individual, social, environmental, organizational, and economic implications of the application of Artificial Intelligence.
9. Carry out a work plan with minimal supervision.
10. Communicate effectively.
11. Hold knowledge and skills required by the Artificial Intelligence industry.
12. Engage in self and life-long learning and research in computing and information.
13. Fulfill requirements of potential employers.
14. Apply the principles and techniques of data and knowledge representation, search, reasoning and learning with different data types.
15. Analyze real world problems, utilizing different problem-solving methods, and apply computational mechanisms.
16. Apply basics of mathematical science, computation theory, and modeling in solving real world problems.
17. Utilize fundamental and modern Artificial Intelligence techniques to develop computer applications in different domains.
18. Understand and apply a wide range of principles and tools of natural language processing and data mining.
19. Demonstrate an understanding of algorithms and data structures, programming language concepts, networks, artificial intelligence, graphics, and databases, and identify and define the computing requirements for its solution.
20. Select and use the appropriate visualization technique for visualizing numerical data

4.2 Academic Reference Standards for AI Program.

Graduates are expected to develop a wide range of abilities and skills. These may be divided into four broad categories:

- Knowledge and Understanding
- AI -related cognitive abilities and skills, i.e. abilities and skills relating to intellectual tasks;
- AI -related practical skills.
- Additional transferable skills that may be developed in the context of AI, but which are of a general nature and applicable in many other contexts

Knowledge and understanding, cognitive, practical, and generic skills need to be placed in the context of the program of study as designed by the institution and/or the possible pathways selected by the individual student.

a- Knowledge and Understanding

The graduates of the AI program should acquire the knowledge and understanding of:

1. Essential facts, concepts, principles, and theories relating to computing and information and computer applications as appropriate to the program of study.
2. Modeling and design of computer-based systems bearing in mind the trade-offs.
3. Tools, practices and methodologies used in the specification, design, implementation and evaluation of computer software systems.
4. Criteria and specifications appropriate to specific problems, and plan strategies for their solution.
5. The extent to which a computer-based system meets the criteria defined for its current use and future development.
6. The current and underlying technologies that support computer processing and inter-computer communication.
7. Principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.
8. Management and economics principles relevant to computing and information disciplines.
9. Professional, moral and ethical issues involved in the exploitation of computer technology and be guided by the appropriate professional, ethical and legal practices relevant to the computing and information industry.
10. Current developments in computing and information research.
11. Requirements, practical constraints, and computer-based systems

12. Understand the essential mathematics relevant to AI.
13. Use high-level programming languages.
14. Demonstrate basic knowledge and understanding of a core of analysis, algebra, applied mathematics and statistics.
15. Interpret and analyzing data qualitatively and/or quantitatively.
16. Know and understand the principles and techniques of a number of application areas informed by the research directions of the subject, such as artificial intelligence, natural language processing, data mining, databases and computer graphics.
17. Show a critical understanding of the principles of artificial intelligence, image, and pattern recognition.
18. Identify and recognize a broad range of Artificial intelligence areas as machine learning, data preparation, pattern recognition, and natural language processing.
19. Select advanced topics to provide a deeper understanding of some aspects of the subject, such as hardware systems design, object-oriented analysis and design, and artificial intelligence, and parallel and concurrent computing.

b- Intellectual Skills

The graduates of the AI program should be able to:

1. Analyze computing problems and provide solutions related to the design and construction of computing systems.
2. Realize the concepts, principles, theories and practices behind computing and information as an academic discipline.
3. Identify criteria to measure and interpret the appropriateness of a computer system for its current deployment and future evolution.
4. Analyze, propose, and evaluate alternative computer systems and processes taking into account limitations, and quality constraints.
5. Make ideas, proposals and designs using rational and reasoned arguments for presentation of computing systems.
6. Evaluate the results of tests to investigate the functionality of computer systems.
7. Achieve judgments considering balanced costs, benefits, safety, quality, reliability, and environmental impact
8. Familiar with the professional, legal, moral, and ethical issues relevant to the computing industry.
9. Evaluate research papers in a range of knowledge areas.
10. Provide an appropriate performance metric for evaluating AI algorithms/tools for a given problem.

11. Select a broad range of Machine Learning tools to real data.
12. Define traditional and nontraditional problems, set goals towards solving them, and. observes results.
13. Perform comparisons between (algorithms, methods, techniques...etc).
14. Perform classifications of (data, results, methods, techniques, algorithms, etc.).
15. Identify attributes, components, relationships, patterns, main ideas, and errors.
16. Summarize the proposed solutions and their results.
17. Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.
18. Predict best solution, source of errors, etc...
19. Restructure solution methodologies up on their results.
20. Verify solutions.

c- Professional / Practical

The graduates of the AI programs should be able to:

1. Operate computing equipment, recognizing its logical and physical properties, capabilities, and limitations.
2. Implement comprehensive computing knowledge and skills in projects and in deployment of computers to solve position practical problems.
3. Deploy the equipment and tools used for the construction, maintenance, and documentation of computer applications.
4. Apply computing information retrieval skills in computing community environment and industry.
5. Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material
6. Design, implement, maintain, and manage software systems.
7. Assess the implications, risks or safety aspects involved in the operation of computing equipment within a specific context.
8. Handle a mass of diverse data, assess risk, and draw conclusions.
9. Apply an appropriate method for data preprocessing and raise quality.
10. Use appropriate programming languages, design methodologies, and knowledge and database systems.
11. Use scientific visualization packages to visualize complex scientific datasets.
12. Design, and implement computer-based systems.
13. Evaluate models and systems in terms of general quality attributes and possible tradeoffs presented within the given problem.
14. Prepare technical reports, and a dissertation, to a professional standard.

15. Examine, implement, adapt Artificial intelligence, evolutionary, machine learning algorithms and analysis methods.
16. Compare analytical techniques and design tools in the development of AI software.
17. Use of standard numerical recipes and mathematical libraries in problem solving.
18. Using tools to automate AI model.

d- Transferable skills

Graduates of the computing and information programs should be able:

1. Demonstrate the ability to make use of a range of learning resources and to manage one's own learning.
2. Demonstrate skills in group working, team management, time management and organizational skills.
3. Show the use of information-retrieval.
4. Use an appropriate mix of tools and aids in preparing and presenting reports for a range of audiences, including management, technical, users, industry or the academic community.
5. Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.
6. Reveal communication skills, public speaking and presentation skills, and delegation, writing skills, oral delivery, and effectively using various media for a variety of audiences.
7. Show the use of general computing facilities.
8. Demonstrate an appreciation of the need to continue professional development in recognition of the requirement for life-long learning.

5- Curricula Contents for Artificial Intelligence Program

Table 1: Indicative curricula content by subject area

	Subject Area	Tolerance %
A	Humanities, ethical and Social Sciences (Univ. Req.)	8-10
B	Mathematics and Basic Sciences	16-18
C	Basic Computing Sciences (institution req.)	26-28
D	Applied Computing Sciences (specialization)	28-30
E	Training	3-5
F	Projects	3-5
	Subtotal	84-96
G	Optional (Institution character-identifying subjects)	16-4
	Total	100

Glossary

1. Institution

A University, faculty or higher institute providing education programs leading to a first university degree or a higher degree (Master's or Doctorate).

2. Graduate Attributes

Competencies expected from the graduate based on the acquired knowledge and skills gained upon completion of a particular program.

3. Academic Standards

Reference points prescribed (defined) by an institution comprising the collective knowledge and skills to be gained by the graduates of a particular program.

4. The Program

A set of educational courses and activities designed by the institution to determine the systematic learning progress. The program also imparts the intended competencies required for the award of an academic degree.

5. Intended Learning Outcomes (ILOs)

Subject-specific knowledge, understanding and skills intended by the institution to be gained by the learners completing a particular educational activity. The ILOs emphasize what is expected that learners will be able to do because of a learning activity.

6. Knowledge and Understanding

Knowledge is the intended information to be gained from an educational activity including facts, terms, theories and basic concepts. Understanding involves comprehending and grasping the meaning or the underlying explanation of scientific objects.

7. Intellectual Skills

Learning and cognitive capabilities that involve critical thinking and creativity. These include application, analysis, synthesis and evaluation of information.

8. Professional and Practical Skills

Application of specialized knowledge, training and proficiency in a subject or field to attain successful career development and personal advancement.

9. General and Transferable Skills

Skills that are not subject-specific and commonly needed in education, employment, life-long learning, and self-development. These skills include communication, teamwork, numeracy, independent learning, interpersonal relationship, and problem solving... etc.

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