Academic Reference Standards (ARS)

for

Bioinformatics Program

BSc Program

Faculty of Computer and Information Sciences,

Ain Shams University

Contents

Introduction

We developed our own Academic Reference Standards (ARS) for Bioinformatics specialization, which is based on the National Academic References Standards (NARS) for Computing Academic Programs, developed by Computing and Engineering Sector in the Supreme Council of Universities.

National Academic reference Standards (NARS) for Computing and Information

1-Attributes of the Graduates

The graduates of the computing and Information programs should be able to:

1.1 Apply the fundamental theories and principles of computing and information applications.

1.2. Integrate and evaluate the computing tools and facilities.

1.3. Apply knowledge of mathematics and science.

1.4. Design a computing system, component and process to meet the required needs within realistic constraints

1.5. Exploit the techniques, skills and up-to-date computing tools, necessary for computing and information practice.

1.6. Display professional responsibilities and ethical, societal and cultural concerns

1.7. Use, compare and evaluate a range of formal and informal techniques, theories and methods to develop computing and information applications.

1.8. Consider and deal with the individual, social, environmental, organizational and economic implications of the application of computing and information.

1.9. Carry out a work plan with minimal supervision.

1.10. Communicate effectively.

1.11. Hold knowledge and skills required by the computing and information industry.

1.12. Engage in self and life-long learning and research in computing and information.

1.13. Fulfill requirements of potential employers.

2- Intended Learning Outcomes (ILOs)

2.1- Knowledge and Understanding

The graduates of the computing and information programs should acquire the knowledge and understanding of:

2.1.1. Essential facts, concepts, principles and theories relating to computing and information and computer applications as appropriate to the program of study.

2.1.2. Modeling and design of computer-based systems bearing in mind the trade-offs.

2.1.3. Tools, practices and methodologies used in the specification, design, implementation and evaluation of computer software systems.

2.1.4. Criteria and specifications appropriate to specific problems, and plan strategies for their solution.

2.1.5. The extent to which a computer-based system meets the criteria defined for its current use and future development.

2.1.6. The current and underlying technologies that support computer processing and inter-computer communication.

2.1.7. Principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.

2.1.8. Management and economics principles relevant to computing and information disciplines.

2.1.9. 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.

2.1.10. Current developments in computing and information research.

2.1.11. Requirements, practical constraints and computer-based systems

2.2. Intellectual skills

The graduates of the computing and Information programs should be able to:

2.2.1 Analyze computing problems and provide solutions related to the design and construction of computing systems.

2.2.2. Realize the concepts, principles, theories and practices behind computing and information as an academic discipline.

2.2.3. Identify criteria to measure and interpret the appropriateness of a computer system for its current deployment and future evolution.

2.2.4. Analyze, propose and evaluate alternative computer systems and processes taking into account limitations, and quality constraints.

2.2.5. Make ideas, proposals and designs using rational and reasoned arguments for presentation of computing systems.

2.2.6. Evaluate the results of tests to investigate the functionality of computer systems.

2.2.7. Achieve judgments considering balanced costs, benefits, safety, quality, reliability, and environmental impact

2.2.8. Familiar with the professional, legal, moral and ethical issues relevant to the computing industry.

2.2.9. Evaluate research papers in a range of knowledge areas

2.3. Professional / Practical

The graduates of the computing and information programs should be able to:

2.3.1. Operate computing equipment, recognizing its logical and physical properties, capabilities and limitations.

2.3.2. Implement comprehensive computing knowledge and skills in projects and in

deployment of computers to solve position practical problems.

2.3.3. Deploy the equipment and tools used for the construction, maintenance and documentation of computer applications.

2.3.4. Apply computing information retrieval skills in computing community environment and industry.

2.3.5. Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material

2.3.6. Design, implement, maintain, and manage software systems.

2.3.7. Assess the implications, risks or safety aspects involved in the operation of computing equipment within a specific context.

2.5.8. Handle a mass of diverse data, assess risk and draw conclusions.

2.4. Transferable skills

Graduates of the computing and information programs should be able:

2.4.1. Demonstrate the ability to make use of a range of learning resources and to manage one's own learning.

2.4.2. Demonstrate skills in group working, team management, time management and organizational skills.

2.4.3. Show the use of information-retrieval.

2.4.4 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.

Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.

2.4.5. Reveal communication skills, public speaking and presentation skills, and delegation, writing skills, oral delivery, and effectively using various media for a variety

of audiences.

2.4.6. Show the use of general computing facilities.

2.4.7. Demonstrate an appreciation of the need to continue professional development in recognition of the requirement for life-long learning.

Academic Reference Standards (ARS)
for Bioinformatics Program

1-Attributes of the Graduates

In addition to the attributes of the undergraduate degree, the Bioinformatics Program graduates should be able to:

1.1 Apply the fundamentals of data structures, database design and concepts of programming.

1.2 Apply mathematical foundations, algorithmic principles, software engineering, design and development principles, data mining in the modeling and design of computational systems of varying complexity.

1.3 Identify different terminology used in Bioinformatics and its relation to biosciences including biology, biophysics, biotechnology, molecular genetics, genetic engineering and genomics.

1.4 Use current techniques, skills, and tools necessary to analyze a problem, and identify and define the computing requirements appropriate to Bioinformatics solution.

1.5 Manage different performance tradeoffs involved in design and utilization of cloud computing resources whenever needed to solve large-scale problems.

1.6 Reuse publicly available software (such as APIs or open source materials) and engage effectively in open-source projects.

1.7 Peruse a continual learning process to maintain their skills as the field evolves

rapidly.

1.8 Work effectively as a member of a team to accomplish a common goal.

1.9 Understand professional, ethical, legal, and social issues and responsibilities.

1.10 Make effective presentations to explain the quantitative dimensions of technical problems and their solutions.

1.11 Use appropriate computational techniques and software packages for reporting and visualizing results.

1.12 Apply knowledge of gene structure-function relationships and incorporate statistical methodology to set problems and case studies.

1.13 Analyze the concepts and approaches to characterizing genes and genomes.

1.14 Analyze the impact of bioinformatics and emerging technologies on current and future biological research.

1.15 Design and develop systems that depend on medical data such as radiology images, magnetic resonance and laboratory measurements.

1.16 Master advanced professional practices as bioinformatician or data scientist in bio-related fields.

2- Intended Learning Outcomes (ILOs)

2.1. Knowledge and understanding

In addition to the Knowledge and understanding, the Bioinformatics Program graduates should be able to:

2.1.1 Understand terminology used in bioinformatics and its relation to biosciences.

2.1.2 Recognize high-level programming languages.

2.1.3 Demonstrate basic knowledge and understanding of mathematics, probability and statistics.

2.1.4 Understand the basic physical and chemical concepts used in bioinformatics

2.1.5 Demonstrate strong knowledge of computational methods.

2.1.6 Recognize effectively mathematical and computational modeling techniques to bioinformatics and biomedical fields.

2.1.7 Understand different types of bioinformatics data with different techniques.

2.1.8 Recognize cloud computing and information visualization tools and techniques.

2.1.9 Understand current developments in bioinformatics research.

2.1.10 Understand the legal, ethical, and social responsibility of bioinformaticians and data scientists.

2.2. Intellectual Skills

In addition to the Intellectual Skills, the Bioinformatics Program graduates should be able to:

2.2.1 Analyze computing problems and provide solutions related to the design and construction of bioinformatics and biomedical systems.

2.2.2 Realize the concepts, principles, theories and practices behind bioinformatics as an academic discipline.

2.2.3 Identify criteria to measure and interpret the appropriateness of a bioinformatics system for its current deployment and future evolution.

2.2.4 Analyze, propose, and evaluate alternative computer systems and processes taking into account limitations, and quality constraints.

2.2.5 Evaluate the results of test to investigate the functionality of bioinformatics systems.

2.2.6 Judge costs, benefits, safety, quality, reliability, and environmental impact.

2.2.7 Familiar with the professional, legal, moral, and ethical issues relevant to the Bioinformatics industry.

2.2.8 Evaluate research papers in a range of knowledge areas.

2.2.9 Compare and contrast algorithms, methods, and techniques.

2.2.10 Classify data, results, methods, techniques and algorithms.

2.2.11 Evaluate the performance and complexity of large-scale applications.

3. Practical and Professional Skills

In addition to Practical and Professional Skills, the Bioinformatics Program graduates should be able to:

2.3.1 Use large scale computing to solve problems related to bioinformatics.

2.3.2 Select appropriate techniques to solve bioinformatics and biomedical problems.

2.3.3 Use of standard numerical recipes and mathematical libraries in problem solving.

2.3.4 Use scientific visualization packages to visualize complex bioinformatics data sets.

2.3.5 Handle a mass of diverse data, assess risk and draw conclusions.

2.3.6 Apply cloud computing techniques to solve computationally intensive problems.

2.3.7 Design, develop, maintain, and manage bioinformatics applications.

2.4. General and Transferable Skills

In addition to General and Transferable Skills, the Bioinformatics Program graduates should be able to:

2.4.1 Work efficiently in a team.

2.4.2 Work in stressful environment and within constraints.

2.4.3 Communicate effectively.

2.4.4 Demonstrate efficient IT capabilities.

2.4.5 Lead and motivate individuals.

2.4.6 Manage tasks and resources.

2.4.7 Gather information and master self-learning.

2.4.8 Acquire entrepreneurial skills.

2.4.9 Demonstrate communication and problem-solving skills.

Curriculum Structure

	Subject Area	Number of Credit Hours	Number of Courses	Percentage of Credit Hours	Tolerance % in NARS
A	University Requirements (Humanities, ethical and Social Sciences)	12	6	8.6%	8-10%
B	Mathematics and Basic Sciences	22	7	15.6	16-18%
C	Faculty Requirements (Basic Computing Sciences)	48	16	34	26-28%
D G	Program Requirements (specialization) + Optional (Institution character-identifying subjects)	49	18	34.8	28-30% + 16-4%
E	Training	4	-	2.8	3-5%
F	Projects	6	-	4.3	3-5%
	Total	141	47	100%	

Curricular Component	Credit Hours	Percentage of Total Credits
University Requirement Course List	12	8.6%
Faculty Requirement Course List	70	49.6%
Program Requirement Course List	59	41.8%
Total	141	**100%**

Glossary

1. **Institution**

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

2. **Attributes of the Graduates**

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

3. **National Academic Reference Standards (NARS)**

   Reference points designed by NAQAAE to outline/describe the expected minimum knowledge and skills necessary to fulfill the requirements of a program of study.

4. **Academic Standards**

   Reference points defined by an institution comprising the collective knowledge and skills to be gained by the graduates of a particular program. The academic standards should surpass the NARS and be approved by NAQAAE.

5. **Subject Benchmark Statements**

   Guideline statements that detail what can be expected of a graduate in terms of the learning outcomes to satisfy the standards set for the program. They enable the outcomes to be compared, reviewed and evaluated against agreed upon standards.

6. The Program

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

7. 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 as a result of a learning activity.

8. 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.

9. Intellectual Skills

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

10. Professional and Practical Skills

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

11. 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.