



# SULTAN QABOOS UNIVERSITY

## COLLEGE OF SCIENCE

### DEPARTMENT OF COMPUTER SCIENCE

#### BACHELOR OF SCIENCE IN COMPUTER SCIENCE

#### COURSE OUTLINE

#### I. COURSE INFORMATION

<b>COURSE CODE</b>	COMP4609		
<b>COURSE TITLE</b>	DEEP LEARNING FUNDAMENTALS		
<b>OMAN QUALIFICATION FRAMEWORK (OQF) LEVEL</b>	8		
<b>CREDIT HOURS</b>	3		
<b>CONTACT HOURS</b>	4		
<b>PRE-REQUISITES</b>	COMP4603		
<b>CO-REQUISITES</b>			
<b>EQUIVALENT COURSES</b>	COMP4601		
<b>INCOMPATIBLE COURSES</b>			
<b>COURSE CATEGORY</b>	<input type="checkbox"/> University Requirement	<input type="checkbox"/> University Elective	
	<input type="checkbox"/> College Requirement	<input type="checkbox"/> College Elective	
	<input type="checkbox"/> Department Requirement	<input type="checkbox"/> Department Elective	
	<input type="checkbox"/> Major Requirement	<input type="checkbox"/> Major Elective	
	<input checked="" type="checkbox"/> Specialization Requirement	<input type="checkbox"/> Specialization Elective	
	<input type="checkbox"/> Other (specify):		
<b>COURSE OWNER</b>	College: Science	Department: Computer Science	
	Center:	Unit:	
<b>DELIVERY MODE</b>	<input checked="" type="checkbox"/> Face to Face	<input type="checkbox"/> Blended	<input type="checkbox"/> Online
<b>COURSE TYPE</b>	<input type="checkbox"/> Lecture	<input checked="" type="checkbox"/> Lecture/Lab	
	<input type="checkbox"/> Lecture/Seminar	<input type="checkbox"/> Lecture/Studio	
	<input type="checkbox"/> Lecture/Tutorial	<input type="checkbox"/> Lecture/Lab/Tutorial or Seminar	
	<input type="checkbox"/> Tutorial	<input type="checkbox"/> Laboratory (Practical)	
	<input type="checkbox"/> Field or Work Placement	<input type="checkbox"/> Studio	
	<input type="checkbox"/> Seminar	<input type="checkbox"/> Internship	
	<input type="checkbox"/> Workshop	<input type="checkbox"/> Project	
	<input type="checkbox"/> Thesis	<input type="checkbox"/> Other (specify):	

<b>LANGUAGE OF INSTRUCTION</b>	English		
<b>COURSE DESCRIPTION</b>	This course is an introduction to Deep Learning, a branch of machine learning particularly suitable for machine translation, speech recognition, visual object identification, object detection and many other domains such as drug discovery, and genetics. Deep learning methods build representations from raw data through the use of multiple layered neural networks. In this course we cover topics from basic neural networks, convolutional and recurrent network structures, deep unsupervised and reinforcement learning, and applications to various Artificial Intelligence tasks.		
<b>TEACHING AND LEARNING STRATEGIES</b>	<input type="checkbox"/> Augmented Reality <input type="checkbox"/> Blended Learning <input type="checkbox"/> Discovery-Based Learning <input type="checkbox"/> Student-Led Learning <input checked="" type="checkbox"/> Work-Based Learning	<input type="checkbox"/> Flipped Classroom <input type="checkbox"/> Problem-Based Learning <input checked="" type="checkbox"/> Project-Based Learning <input type="checkbox"/> Team-Based Learning <input type="checkbox"/> Other (specify):	
<b>ASSESSMENT COMPONENT AND WEIGHT</b>	<input checked="" type="checkbox"/> In-term examination(s) (15 %) <input checked="" type="checkbox"/> Homework assignments (15 %) <input checked="" type="checkbox"/> Final examination (40%)	<input type="checkbox"/> Quizzes <input checked="" type="checkbox"/> Project (15%) <input checked="" type="checkbox"/> Practical/ Lab (15%)	<input type="checkbox"/> Other (specify): ( %)
<b>TEXTBOOKS AND EDUCATIONAL MATERIAL</b>	1. <a href="https://www.deeplearningbook.org/">https://www.deeplearningbook.org/</a> 2. Goldberg, Yoav and Hirst, Graeme, Neural Network Methods in Natural Language Processing 2017 3. <a href="http://neuralnetworksanddeeplearning.com/">http://neuralnetworksanddeeplearning.com/</a>		
<b>GRADING METHOD</b>	<input checked="" type="checkbox"/> A-F Scale	<input type="checkbox"/> Pass/Not Pass	<input type="checkbox"/> Other (specify):
<b>GRADING METHOD DESCRIPTION</b>			
<b>A-F GRADING SCALE:</b>	Range	Letter Grade	Description
	90 – 100	A	<b>Exceptional performance:</b> All course objectives were achieved and met in a consistently outstanding manner.
	86 – 89.9	A-	
	81– 85.9	B+	<b>Very Good Performance:</b> The majority of the course <b>objectives</b> were achieved (the majority being at least two-thirds) and met in a consistently thorough manner.
	77 – 80.9	B	
	73 – 76.9	B-	
	68 – 72.9	C+	<b>Satisfactory Performance:</b> At least most of the course objectives have been achieved and met satisfactorily.
	64 – 67.9	C	
	60 – 63.9	C-	
	55 – 59.9	D+	<b>Minimally Acceptable Performance:</b> The course <b>objectives</b> met at a minimally acceptable level.
	50 – 54.9	D	
	0 – 49.9	F	<b>Unacceptable performance:</b> The course objectives were not met at a minimally acceptable level
<b>PASS/NOT PASS:</b>			
<b>OTHER:</b>			

**II. SEMESTER INFORMATION**

<b>SEMESTER/YEAR</b>	<b>Spring 2025</b>	<b>SECTION(S)</b>	10
<b>DAY AND TIME</b>	<b>Tue 10:00AM/ Thu 8:00AM</b>	<b>VENUE(S)</b>	<b>Lab 22</b>
<b>COURSE COORDINATOR</b>	Dr. Abdulrahman AAlAbdulsalam	<b>COURSE TEAM</b>	
<b>COORDINATOR OFFICE</b>	0086	<b>OFFICE HOURS</b>	Tue 8-10
<b>COORDINATOR EXTENSION</b>	2246	<b>COORDINATOR EMAIL</b>	a.aalabdulsalam@squ.edu.om

**III. ALIGNMENT OF COURSE LEARNING OUTCOMES (CLO), PROGRAM LEARNING OUTCOMES (PLO),****GRADUATE ATTRIBUTES (GA), AND OMAN QUALIFICATION FRAMEWORK (OQF) CHARACTERISTICS**

<b>CLO</b>	<b>PLO</b>	<b>SQU GA</b>	<b>OQF CHARACTERISTICS</b>
1. Describe the different Deep Neural Network architectures and their usage	1, 3	A, C	1, 3
2. Explore in depth backpropagation algorithms	1	A	1
3. Use cutting edge libraries to train, implement, and evaluate Deep Learning models	1, 2	A, B	1, 2
4. Design and implement Deep Learning models that analyze visual data	1, 2, 6	A, B, D, F	1, 2, 4, 6
5. Design and implement Deep Learning models for language processing	1, 2, 6	A, B, D, F	1, 2, 4, 6
6. Demonstrate understanding of the Attention Mechanisms and Transformers and use them	1, 2, 3	A, B, C	1, 2, 3
7. Describe the fundamentals of Reinforcement Learning	1, 3	A, C	1, 3
8. Describe the architecture of Generative Adversarial Networks and their applications	1, 3	A, C	1, 3
9. Communicate Effectively the proposed Deep Learning solution	3	C	3

#### IV. COURSE LEARNING OUTCOMES (CLOS) AND ASSESSMENT CRITERIA AND METHODS (FOR EACH CLO)

**CLO1: Describe** the different Deep Neural Network architectures and the their usage

ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		ASSESSMENT METHODS
A)	Describe Multi-Layer Perceptron and its usage	Midterm, Final Exam
B)	Describe Convolutional Neural Networks and their usage	
C)	Describe Recurrent Neural Networks and their usage	
D)	Describe Generative Adversarial Networks a and their use	

**CLO2: Explore** in depth common optimization algorithms

ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		ASSESSMENT METHODS
A)	Describe the Gradient Descent algorithm approaches	Midterm, Final Exam
B)	Explore the different update rules	Midterm, Final, Lab test

**CLO3: Use** cutting edge libraries to implement, train, and evaluate Deep Learning models

ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		ASSESSMENT METHODS
A)	Implement, and train Deep Learning Models using cutting-edge libraries	Homework Assignments, Lab test, Project
B)	Evaluate the performance of deep Learning models using cutting-edge libraries	

**CLO4: Design and implement** Deep Learning models that analyze visual data

ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		ASSESSMENT METHODS
A)	Design, implement, and train Convolutional Neural Networks that analyze visual data	Homework Assignments, Lab test, Project
B)	Evaluate the performance of developed CNNs for visual data analysis tasks	

**CLO5: Design and implement** Deep Learning models for language processing

ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		ASSESSMENT METHODS
A)	Design, implement, and train Recurrent Neural Networks for language processing	Homework Assignments, Lab test, Project
B)	Evaluate the performance of developed models for language processing tasks	

CLO6: Demonstrate understanding of the Attention Mechanisms and Transformers and use them		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		
A)	Explain the advantage of using Transformers compared to non-attention-based models	Final Exam
B)	Design, implement, and train Transformers for specific tasks	Homework Assignments, Project
C)	Compare the performance of developed transformer-based solution against non-attention-based solution	
CLO7: Describe the fundamentals of Reinforcement Learning		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		
A)	Formulate Reinforcement Learning using Markov Decision processes	Final Exam
B)	Discuss algorithms for decision selection	
CLO8: Describe the architecture of Generative Adversarial Networks and their applications		
A)	Explain how the generator and discriminator concurrently generate data	Final Exam
B)	Explain how to train Generative Adversarial Networks	
CLO9: Communicate effectively the proposed Machine Learning solution		
A)	Clearly describe, orally and in writing, the addressed problem	Project
B)	Explain, orally and in writing, the functionality of the proposed solution	
C)	Discuss, orally and in writing, the limitations of the proposed solution	

<b>V. COURSE CONTENT AND SCHEDULE</b>				
<b>WEEK</b>	<b>LECTURES #</b>	<b>TOPICS/ SUBJECTS</b>	<b>READINGS/ CHAPTERS</b>	<b>REMARKS (e.g., ASSESSMENTS)</b>
1	Lecture#1	Introduction to Deep Learning	Chap 1	MT, Final
2	Lecture#2	Multilayer Perceptron	Chap 5	HW1, MT, LT, Final
3	Lecture#3	Multilayer Perceptron	Chap 6	HW1, MT, LT, Final
4	Lecture#4	Convolutional Neural Networks	Chap 7	MT, LT, PRJ, Final
5	Lecture#5	Modern Convolutional Neural Networks	Chap 8	MT, LT, PRJ, Final
6	Lecture#6	Recurrent Neural Networks	Chap 9	HW3, MT, LT, PRJ, Final
7	Lecture#7	Modern Recurrent Neural Networks	Chap 10	HW3, MT, LT, PRJ, Final

8	Lecture#8	Attention Mechanism & transformers	Chap 11	LT, PRJ, Final
9	Lecture#9	Optimization Algorithms	Chap 12	LT, PRJ, Final
10	Lecture 10	Hyper-parameter Optimization	Chap 19	LT, PRJ, Final
11	Lecture#11	Application to Computer Vision: Image Classification	Chap 14	PRJ, Final
12	Lecture#12	Application to Natural Language Processing	Chap 15	PRJ, Final
13	Lecture#13	Reinforcement Learning	Chap 17	PRJ, Final
14	Lecture#14	Generative Adversarial Networks	Chap 20	PRJ, Final
15	Lecture#15	Project Presentations	-	

## VI. ADDITIONAL INFORMATION (e.g., RUBRICS, etc.)

### **Assessment Plan (tentative):**

Item	Date Out	Due Date	Weight
Homework1	Week 3	Week 5	5%
Project Part 1		Week 6	2%
Homework2	Week 11	Week 13	5%
Midterm	Week 9	(TBD)	15%
Project Part2		Week 10	3%
Labtest	Week 14	(TBD)	10%
Project Part 3	Week15 Demo and Final Deliverable		10%
Final			50%

### **Department's Late Submission Policy:**

(a) 1-24 hours: 25% of the mark will be deducted.

(b) > 24 hours: Not accepted.

### **Department's Policy for Dealing with Cheating:**

It is essential that each student solves all programming assignments, lab tests and exams individually unless instructed otherwise, e.g., for group projects. Copying, plagiarism, collusion, switching, and falsification are violations of the university academic regulations. Students involved in such acts will be severely penalized. The department has adopted a firm policy on this issue. A zero mark will be assigned the first time a student is caught involved in copying and his/her name will be added to a watch list maintained by the Head of Department. Further repeated involvements in copying will cause the student to get an F grade in that course. This is in line with the university academic regulations.

## VII. STUDENTS RESPONSIBILITIES

It is the student's responsibility to know and comply with all University Academic Regulations relevant to participation in this course. These regulations specifically include attendance requirements and student academic code of conduct.

<b>ACADEMIC INTEGRITY</b>	The University expects the students to approach their academic endeavors with the highest academic integrity. Please refer to the <b>Undergraduate Academic Regulations</b> .
<b>ADD AND DROP</b>	Students who wish to drop or add the course should review the <b>Undergraduate Academic Regulations</b> .
<b>ATTENDANCE</b>	Sultan Qaboos University has a clear requirement for students to attend courses, detailed in the <b>Undergraduate Academic Regulations</b> .
<b>ASSESSMENT AND GRADING</b>	To ensure the provision of a sound and fair assessment and grading, please review the <b>Undergraduate Academic Regulations</b> .
<b>GRADE APPEAL</b>	Students who wish to appeal their grades should review the <b>Undergraduate Academic Regulations</b> .
<b>CLASSROOM POLICIES</b>	Students are expected to dress professionally during class time as required by the University. Use of phones or any other electronic devices in the classroom during class time is strictly prohibited. Unauthorized use may lead to faculty member confiscation of the device for the remainder of the class. Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. A student responsible for disruptive behavior may be required to leave the class.
<b>LATE AND MAKE-UP WORK</b>	Students are required to meet the course objectives by submitting coursework no later than the assigned due date. Students may be allowed to submit late work if approved by the course coordinator. Assignments submitted after the due date may be penalized.
<b>MISSED EVALUATIONS</b>	All quizzes, tests, clinical evaluations, and exams must be completed by the date they are assigned. If a quiz, test, or exam is missed due to a documented emergency situation (e.g., medical emergency, death in the immediate family), it is the student's responsibility to contact the instructor.
<b>OTHER</b>	

## Course Outline Appendix

### 1. PROGRAM LEARNING OUTCOMES

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program discipline.
6. Apply computer science theory, software development fundamentals to produce computing-based solutions.

### 2. SQU Graduate Attributes and Competencies for Undergraduate Studies

GRADUATE ATTRIBUTES	GRADUATE COMPETENCIES FOR UNDERGRADUATE STUDIES
<b>A. Cognitive Capabilities:</b> The graduate has sufficient general and specialized theoretical knowledge that enables him/her to deal well with his/her specialty and other related fields.	1. Demonstrates familiarity and works with advanced specialized knowledge in the area of specialization.
	2. Demonstrates a general understanding of the relationship of advanced specialized knowledge with knowledge in other relevant professional fields and aspects.
	3. Demonstrates a comprehensive understanding of the theories, principles, and methods used in his/her specialty, and how to create and apply new knowledge.
	4. Demonstrates general knowledge of the legal environment and necessary relevant regulatory frameworks.
	5. Shows awareness of contemporary literature and research.
<b>B. Skill and Professional Capability:</b> The graduate has sufficient skill and practical experience that enables him/her to perform all tasks related to the specialization and other related fields.	1. Applies concepts, theories, and investigative methods to synthesize and interpret information to evaluate conclusions.
	2. Applies appropriate research methods and techniques and employs digital knowledge
	3. Evaluates and critiques information independently
	4. Uses cognitive and technical skills to analyze complex issues and develop appropriate solutions.
	5. Initiates new ideas or processes in the professional, educational or research context.



<b>C. Effective Communication:</b> The graduate has the ability to communicate effectively with others to achieve the desired results	1. Explains, presents, and adapts information to suit the recipients.
	2. Employs appropriate information and communication technology to collect and analyze information.
<b>D. Autonomy and Leadership:</b> The graduate has the ability to lead, make decisions and take responsibility for decisions.	1. Performs advanced professional activities independently.
	2. Demonstrates leadership skills.
	3. Takes professional responsibility.
	4. Assumes full accountability for the tasks and their output.
<b>E. Responsibility and Commitment:</b> The graduate appreciates the importance of available resources and deals with them effectively and is committed to the ethics of the profession and society.	1. Manages time and other resources assigned to accomplishing tasks effectively and responsibly.
	2. Demonstrates effective practices when working in teams.
	3. Demonstrates advanced levels of understanding of values and ethics relevant to the specialization, profession and local and international society and promotes them among others.
	4. Works within the professional, institutional, and specialization guiding frameworks and strategic plans.
	5. Interacts with community affairs positively and preserves national identity.
<b>F. Development and Innovation:</b> The graduate has a passion for development and innovation in the field of specialization.	1. Demonstrates the ability to independently manage learning tasks, with an awareness of how to develop and apply new knowledge.
	2. Utilizes specialized knowledge and skills for entrepreneurship.
	3. Utilizes creative and innovative skills in the field of specialization.

### 3. OQF CHARACTERISTICS

1. Knowledge
2. Skills
3. Communication, Numeracy, and Information and Communication Technology Skills.
4. Autonomy and Responsibility
5. Employability and Values
6. Learning to learn