NS2003: INTRODUCTION TO ARTIFICIAL INTELLIGENCE WITH BRAIN COMPUTING AND APPLICATION

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Introduction to Artificial Intelligence with Brain Computing and Application

Subject Code
NS - Neuroscience
Course Number
2003

Academic Unit
Neuroscience (NS)

College/School
Jockey Club College of Veterinary Medicine and Life Sciences (VM)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

Brain computation is one of the important topics for scientists and engineers. Through understanding brain cells and synapses, many mathematical models for neurons and synapses are proposed. In addition, interesting dynamic pictures of networks of neurons show their potential for computations. For scientists, numerical exploration is an essential tool to understand how interactions of neurons support brain computations and functionalities. For engineers, understanding how the brain computes will be helpful for innovations. This course will begin with a brief introduction to differential equations and numerical methods. After that, this course will cover a collection of neuronal models and synaptic models. Then, the course will introduce techniques to construct random networks. Also, this course will include how artificial neuronal networks perform machine learning tasks. In addition, other computational issues related to Neuroscience, e.g., data analysis, will also be covered.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Briefly understand the mathematics and numerical methods used to build mathematical neural models	20	x	x	
2	Understand the working principle and restrictions of various neural models	40	x	x	x
3	Able to use neural models to reproduce experimental findings and perform further explorations	40	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	The primary form of teaching; Systematic presentation of class content	1, 2, 3	
2	Laboratory and Computing Assignment	Learning and practicing computing tools to implement neural models; Initiating discussion among students and encouraging explorations in computational models	1, 2, 3	In or after classes

3	Hand-in Assignment	Helping the students to continuously check their understanding of class content	1, 2, 3	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Midterm	1, 2, 3	30	
2	Laboratory Computing Assignment	1, 2, 3	15	
3	Hand-in Assignment	1, 2, 3	15	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Assessment Rubrics (AR)

Assessment Task

Laboratory Computing Assignment

Criterion

Based on the submitted programming codes and laboratory reports to evaluate whether the students can apply the knowledge and skills to address the computational problems.

Excellent (A+, A, A-)

The student is able to finish the numerical assignment without any assistance and submit a clearly written and grammatically correct laboratory report without error.

Good (B+, B, B-)

The student is able to finish the numerical assignment with little assistance and submit a clearly written and grammatically correct laboratory report with only minor errors.

Fair (C+, C, C-)

The student is able to finish the numerical assignment with moderate assistance and submit a clearly written and grammatically correct laboratory report without significant errors.

Marginal (D)

The student is able to finish only some parts of the numerical assignment and submit a basic laboratory report.

Failure (F)

The student fails to finish any part of the numerical assignment and is unable to produce a basic laboratory report.

Assessment Task

Hand-in Assignment

Criterion

Based on the submitted written assignment to evaluate whether the students can understand the concepts of the models and skills they learned in lessons.

Excellent (A+, A, A-)
The student submits the clearly written assignment without any error.

Good (B+, B, B-)
The student submits the clearly written assignment with minor errors.

Fair (C+, C, C-)
The student submits the assignment without significant errors.

Marginal (D)
The student submits a partially finished assignment without significant error.

Failure (F)
The student fails to submit the assignment. Or the student submits a partially finished assignment with significant errors.

Assessment Task
Midterm and Final Examinations

Criterion
Able to show the understanding of concepts and applications of numerical methods and models.

Excellent (A+, A, A-)
Students achieve a 86% or greater on the examination

Good (B+, B, B-)
Students achieve a 65% or greater on the examination

Fair (C+, C, C-)
Students achieve a 50% or greater on the examination

Marginal (D)
Students achieve between 40% to 50% on the examination

Failure (F)
Students achieve less than 40% on the examination

Part III Other Information

Keyword Syllabus
Basic differential equations and numerical methods; mathematical models for neurons and synapses; networks of neurons; analyzing numerical data

Reading List

Compulsory Readings

	Title
1	Thomas Trappenberg (2010) Fundamentals of Computational Neuroscience

Additional Readings

	Title
1	Daniel Durstewitz (2018) Advanced Data Analysis in Neuroscience: Integrating Statistical and Computational Models (Bernstein Series in Computational Neuroscience)