|  |  |
| --- | --- |
| A picture containing diagram  Description automatically generated | **AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)**  Faculty of Science and Technology (FST)  Department of Computer Science (CS)  Undergraduate Program |

|  |  |
| --- | --- |
| **COURSE PLAN** | **SEMESTER: Spring 2024-2025** |
| 1. **Course Core and Title**   CSC 3217 Artificial Intelligence and Expert System   1. **Credit**   3 credit hours (3 hours of Lab & 2 hour theory per week)   1. **Nature**   Core Course for CS, CSE, CSSE, SE, CIS   1. **Prerequisite**   CSC 2211 Algorithms | 1. **Vision:**   Our vision is to be the preeminent Department of Computer Science through creating recognized professionals who will provide innovative solutions by leveraging contemporary research methods and development techniques of computing that is in line with the national and global context.   1. **Mission:**   The mission of the Department of Computer Science of AIUB is to educate students in a student-centric dynamic learning environment; to provide advanced facilities for conducting innovative research and development to meet the challenges of the modern era of computing, and to motivate them towards a life-long learning process. |

# VII - Course Description

* Analyze four different types of intelligent agents and their environment.
* Explain and compare different searching techniques using BFS, DFS, UCS, DLS, and IDS.
* Illustrate informed search and exploration methods like A\* and Hill Climbing.
* Explain Constraint satisfaction problems and search techniques in game playing.
* Discuss Probability, Bayes Theorem and Bayes Networks for problem solving.
* Explain Genetic Algorithm for problem solving.
* Illustrate Neural Network notations and architectures and solve problems using perception learning rules.
* Explain Expert System for problem solving.

# VIII – Course outcomes (CO) Matrix

By the end of this course, students should be able to:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **COs**\* | **CO Description** | **Level of Domain\*\*\*** | | | **PO**  **Assessed \*\*\*\*** |
| **C** | **P** | **A** |
| CO1 | **Express** various concepts from Artificial Intelligence and Expert System research domain using various complex problems considering experimental design, data analysis and interpretation and information synthesis to provide valid conclusions. |  |  | 3 | PO-f-1 |
| CO2 | **Explain** basic ideas of artificial intelligence so that students will be able to know about the metrics related to performance which will help them to differentiate between different types of Expert systems. |  |  | 3 | PO-f-1 |
| CO3  \*\* | **Demonstrate** different Artificial Intelligence techniques such as search algorithms, genetic algorithm, CSP and uncertainty etc. to solve different real-life problems. |  |  | 3 | PO-f-1 |
| CO4  \*\* | **Justify** different AI techniques to provide valid conclusions in real life problem solving. | 5 |  |  | PO-f-2 |
| *C: Cognitive; P: Psychomotor; A: Affective Domain*  *\* CO assessment method and rubric of COs assessment is provided in later section*  *\*\* COs will be mapped with the Program Outcomes (POs) for PO attainment \*\*\* The numbers under the ‘Level of Domain’ columns represent the level of Bloom’s Taxonomy each   CO corresponds to.*  *\*\*\*\* The numbers under ‘PO Assessed’ column represent the POs each CO corresponds to.* | | | | | |

# IX – Topics to be covered in Theory class\*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Time Frame** | **CO**  **Mapped** | **Topics** | **Teaching**  **Activities** | **Assessment Strategy(s)** |
| Week 1 | CO1, CO2 | OBE Discussion. Introduction to AI: Definition of AI, Approaches of AI, Turing Test, Foundation of AI. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 2 | CO1, CO2 | Intelligent Agent: Agent and Environment, Types of Agents, Learning agent Concept of Rationality, Components of Agent Program. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 3 | CO1, CO2, CO3 | Uninformed Search: Problem-solving agent, Formulating problems, BFS, Uniform Cost Search, DFS. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 4 | CO1, CO2, CO3 | Uninformed Search: Depth-limited search, Iterative deepening search, Bi-directional search.  Informed Search: Best first search. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 5 | CO1, CO2, CO3 | Informed Search: Greedy search, A\* search, Heuristic functions, IDA\* search, Iterative improvement algorithms. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 6 | CO3, CO4 | Adversarial search: Games, optimal strategies, the min-max algorithm, optimal decisions in multiplayer games. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 7 | CO3, CO4 | Adversarial search: Alpha-beta pruning, Evaluation functions, cutting off search.  Midterm Revision. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Midterm (Week 8) | | | | |
| Week 9 | CO1, CO2, CO3, CO4 | Local Search Algorithms: Hill-climbing Search, Simulated Annealing, Local Beam Search.  Genetic Algorithm: Biological Background, Basic Outline, Encoding system, Crossover, Mutation, Selection. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 10 | CO1, CO2, CO3, CO4 | Genetic Algorithm: Solving Example Problems using GA.  Constraint Satisfaction Problems: Defining CSPs, Backtracking search for CSPs. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 11 | CO1, CO2,  CO3, CO4 | Constraint Satisfaction Problems: Variable and value ordering, propagating information through constraints, Intelligent backtracking. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 12 | CO3, CO4 | Statistical Reasoning: Probability, Bayes Theorem, Bayes Network, Application of Bayes Theorem, Hidden Markov Model(HMM). | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 13 | CO3, CO4 | Introduction to Artificial Neural Networks: Objectives, History,  Applications and Biological  Inspiration of Artificial Neural  Networks (ANN), ANN Architecture. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 14 | CO3, CO4 | Introduction to Artificial Neural Networks: Backpropagation Algorithm, Learning using Backpropagation. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Week 15 | CO3, CO4 | Expert System: Introduction,  Architecture, Participants, and Components of Expert System.  Review, Discussion, Open problems, and Brainstorming. | Lecture, Question-answer, Lab Practice | Assignment/Project,  Quiz, Term Exam |
| Final term (Week 16) | | | | |
| Makeup Evaluation (Week 17) | | | | |

*\* The faculty reserves the right to change, amend, add or delete any of the contents.*

.

# X – Mapping of PO/PLO and K, P, A of this course:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PO Indicator ID | PO Indicators Definition (As per the requirement of WKs) | Domain | K | P | A |
| PO-f-1 | Apply information and concepts in natural science with the familiarity of issues. | Affective Level 3 (Valuing) |  |  |  |
| PO-f-2 | Formulate solutions, procedures, and methods using first principles of mathematics for engineering sciences. | Cognitive Level 5 (Evaluating) | K7 | P1 P3 P7 |  |

# XI – K, P, A Definitions

|  |  |  |
| --- | --- | --- |
| **Indicator** | **Title** | **Description** |
| K7 | Comprehension of engineering in society | Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer’s professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability. |
| P1 | Depth of knowledge required | Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach. |
| P3 | Depth of analysis required | Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models. |
| P7 | Interdependence | Are high level problems including many component parts or sub-problems. |

# XII – Mapping of CO Assessment Method and Rubric

The mapping between Course Outcome(s) (COs) and the Selected Assessment method(s) and the mapping between Assessment method(s) and Evaluation Rubric(s) is shown below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **Description** | **Mapped POs** | **Assessment Method** | **Assessment Rubric** |
| CO1 | **Express** various concepts from Artificial Intelligence and Expert System research domain using various complex problems considering experimental design, data analysis and interpretation and information synthesis to provide valid conclusions. | PO-f-1 | Quiz / Term Exam | Rubric for Quiz / Term Exam |
| CO2 | **Explain** basic ideas of artificial intelligence so that students will be able to know about the metrics related to perform which will help them to differentiate between different types of Expert systems. | PO-f-1 | Quiz / Term Exam | Rubric for Quiz / Term Exam |
| CO3 | **Demonstrate** different Artificial Intelligence techniques such as search algorithms, genetic algorithm, CSP and uncertainty etc. to solve different real-life problems. | PO-f-1 | Assignment / Project / Term Exam | Rubric for Assignment / Project / Term Exam |
| CO4 | **Justify** different AI techniques to provide valid conclusions in real life problem solving. | PO-f-2 | Assignment / Project / Term Exam | Rubric for Assignment / Project / Term Exam |

**XIII – Evaluation and Assessment Criteria**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO1: Express** various concepts from Artificial Intelligence and Expert System research domain using various complex problems considering experimental design, data analysis and interpretation and information synthesis to provide valid conclusions. | | | | |
| **Assessment**  **Attribute/Criteria** | **Missing/ Incorrect (0)** | **Inadequate  (1-3)** | **Satisfactory (4-7)** | **Excellent (8-10)** |
| **Problem Understanding** | Not answered or the presented description is incorrect. | The problem is understaood, but the terminologies are not used correctly. | The problem is explained with correct information containing little mistakes. | The problem is understood and presented correctly with all required information. |
| **Demonstration**  **with examples** | The relevant example is not shown or explained. | The given example does not fit for the problem but has some relevances. | The given example is relevant but lacks adequate explanation. | The given example is relevant and demonstrated with a proper interpretation. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO2: Explain** basic ideas of artificial intelligence so that students will be able to know about the metrics related to perform which will help them to differentiate between different types of Expert systems. | | | | |
| **Assessment Criteria** | **Missing/ Incorrect (0)** | **Inadequate  (1-3)** | **Satisfactory (4-7)** | **Excellent (8-10)** |
| **Explanation** | No/wrong explanation is given. | The explanation is not sufficient to illustrate the understanding of the given problem. | A correct explanation is provided but has little issues. | The given explanation is correct and appropriately presented to understand the problem. |
| **Demonstration**  **with examples** | The relevant example is not shown or explained. | The given example does not fit for the problem but has some relevances. | The given example is relevant but lacks adequate explanation. | The given example is relevant and demonstrated with a proper interpretation. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO3:** **Demonstrate** different Artificial Intelligence techniques such as search algorithms, genetic algorithm, CSP and uncertainty etc. to solve different real-life problems. | | | | |
| **Assessment Attribute/Criteria** | **Missing/ Incorrect (0)** | **Inadequate  (1-3)** | **Satisfactory (4-7)** | **Excellent (8-10)** |
| **Applicability** | An incorrect method or no method is selected to solve the problem. | The problem is solved using the required method with major mistakes. | There are minor mistakes in the presented solution that is using a proper method. | An appropriate method is applied with all given requirements. |
| **Demonstration** | The demonstration is not provided or irrelevant for the given problem. | There is a little relevancy between the problem and the provided demonstration. | The relevant demonstration is given with little missing information or steps. | The demonstration is given with all the relevant information. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO4:** **Justify** different AI techniques to provide valid conclusions in real life problem solving. | | | | |
| **Assessment Attribute/Criteria** | **Missing/ Incorrect (0)** | **Inadequate  (1-3)** | **Satisfactory (4-7)** | **Excellent (8-10)** |
| **Methodology** | No appropriate method is used. | A proper method is used to solve the problem, but not presented in a correct way. | The used method is correct, but it is not complete and not fully understandable. | The used method is appropriate, complete and satisfy all requirements. |
| **Justification** | A wrong or no justification is presented. | The justification is given without a proper description. | An appropriate justification is provided with minor issues. | The justification is given with an appropriate description. |

# XIV- Course Requirements

* Students are expected to attend at least 80% class.
* Students are expected to participate actively in the class.
* For both terms, there will be at least 2 quizzes based on the theoretical knowledge and conceptual understanding of the topic covered discussed in the classes.
* Submit report based on the given course related problems.
* Submission of assignment and projects should be in due time.

# XV – Evaluation & Grading System\*

The following grading system will be strictly followed in this class:

**Mid Term Exam:**Term Exam: 50%  
Quizzes: 20%  
Attendance & Performance: 10%

Lab Evaluation: 20%

**Final Term Exam:**Term Exam: 50%  
Quizzes: 20%  
Attendance & Performance: 10%

Lab Evaluation: 20%

**Semester grade:** 40% midterm + 60% final term

|  |  |  |
| --- | --- | --- |
| **Letter** | **Grade Point** | **Numerical %** |
| A+ | 4.00 | 90-100 |
| A | 3.75 | 85 - < 90 |
| B+ | 3.50 | 80 - < 85 |
| B | 3.25 | 75 - < 80 |
| C+ | 3.00 | 70 - < 75 |
| C | 2.75 | 65 - < 70 |
| D+ | 2.50 | 60 - < 65 |
| D | 2.25 | 50 - < 60 |
| F | 0.00 | < 50 |
| I |  | Incomplete |
| W |  | Withdrawal |
| UW |  | Unofficially Withdrawal |

*\* The evaluation system will be strictly followed as par the AIUB grading policy.*

*\* CO attainment will be achieved with 60% of the evaluation marks.*

# XII – Textbook/ References

1. Stuart J. Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach,” Fourth Edition, 2021.
2. John Paul Mueller , Luca Massaron, “Artificial Intelligence For Dummies”, 2021.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning”, Springer, Cham, 2018.
4. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, “Neural Network Design,” 2014.
5. Randy L. Haupt and Sue Ellen Haupt, “Practical Genetic Algorithms,” Second Edition, 2004.
6. J. Ross Quinlan, “Programming for machine learning,” Morgan Kaufmann, 1993.
7. David E. Goldberg, “Genetic Algorithms in Search, optimization and Machine learning,” Pearson Education, 1989.
8. <http://www.perfectlogic.com/articles/AI/ExpertSystems/ExpertSystems.html>

# XIII - List of Faculties Teaching the Course

|  |  |
| --- | --- |
| **FACULTY NAME** | **SIGNATURE** |
| DR. ASHRAF UDDIN |  |
| DR. ABDUS SALAM |  |
| DR. MOUSHUMI ZAMAN BONNY |  |
| SUPTA RICHARD PHILIP |  |
| MD. REAZUL ISLAM |  |
| SHAHNAJ PARVIN |  |
| ATKIA AKILA KARIM |  |
| RAHUL BISWAS |  |
| SAZIA SHARMIN |  |
| SHAIKAT DAS JOY |  |

# XVIII – Verification

|  |  |  |
| --- | --- | --- |
| **Prepared by:**  Text, letter  Description automatically generated  ---------------------------------  **Dr. Abdus Salam**  *Course Convener*  Date:......................................... | **Moderated by:**  ---------------------------------  **Dr. M. Mahmudul Hasan**  *Point Of Contact*  *OBE Implementation Committee*  Date:......................................... | **Checked by:**  ---------------------------------  **Dr. Akinul Islam Joney**  *Head (Undergraduate Program) Department of Computer Science*  Date:......................................... |
| **Verified by:**  ....................................................  **Dr. Md. Abdullah-Al-Jubair**  *Director*  *Faculty of Science & Information Technology*  Date:.......................................... | **Certified by:**  .....................................................  **Prof. Dr. Dip Nandi**  *Associate Dean*,  *Faculty of Science & Information Technology*  Date:............................................ | **Approved by:**  .........................................................  **Mr. Mashiour Rahman**  *Dean*,  *Faculty of Science & Information Technology*  Date:............................................... |