# THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
## Approval of Undergraduate Course

### Section 1: Academic Administration [1]

#### *1.1 Catalog*

a) Course to be effective from: Academic Year 2021-22 Term Fall

b) Department Code[3]: CSE Subject Area[3]: COMP Course Number [4]: 2211

Previous Course Code[5]:

c) Full Title[6] *(max. 100 characters)*: Exploring Artificial Intelligence

d) Abbreviated Title[7] *(max. 30 characters)*: Exploring AI

e) Course Credits[8]: ● Fixed: 3 ○ Range: From To

f) Catalog Description[9] *(word limit = 150)*:

This course aims to give a gentle introduction to the basic elements of artificial intelligence (AI) through understanding examples from various applications and hands-on experimentation using AI software tools. In addition to covering the technical aspect of AI through such topics as search and problem solving, knowledge representation, probabilistic reasoning, machine learning, computer vision and image processing, speech and language processing, and robotics, this course will also study the historical perspective, social and ethical implications, as well as potential and limitations of AI.

g) Grading Type[10]: ● Letter Grades ○ Distinction/Credit/Pass/Fail ○ Pass/ Fail ○ Distinction/Pass/Fail ☐ Others *(please specify)*:

h) ■ Prerequisites[11]:

| Course Code / Public Exam | Course Title / Exam Subject and Level / Grade attained |
|---|---|
| COMP 1021 OR | Introduction to Computer Science |
| COMP 1029P | Python Programming Bridging Course |

i) ☐ Corequisites[12]:

| Course Code | Course Title |
|---|---|
| | |
| | |

j) ■ Exclusions[13]:

| Course Code / Public Exam | Course Title / Exam Subject and Level / Grade attained |
|---|---|
| COMP 3211 | Fundamentals of Artificial Intelligence |
| COMP 4211 | Machine Learning |
| COMP 4221 | Introduction to Natural Language Processing |
| COMP 4331 | Data Mining |
| COMP 4332 | Big Data Mining and Management |
| COMP 4421 | Image Processing |
| COMP 4471 | Deep Learning in Computer Vision |
| COMP 4901K | Machine Learning for Natural Language Processing |
| COMP 4901L | Foundations of Computer Vision |
| ELEC 4130 | Digital Image Processing |
| ELEC 4230 | Deep Learning for Natural Language Processing |
| IDPO 4110 | Practical Machine Learning |
| | |

| | |
|---|---|
| ISOM 3360 | Data Mining for Business Analytics |
| MATH 4336 | Introduction to Mathematics of Image Processing |
| MATH 4432 | Statistical Machine Learning |
| RMBI 4310 | Advanced Data Mining for Risk Management and Business |
| COMP 5211 | Advanced Artificial Intelligence |
| COMP 5331 | Knowledge Discovery in Databases |
| COMP 5212 | Machine Learning |
| COMP 5213 | Introduction to Bayesian Networks |
| COMP 5221 | Natural Language Processing |
| COMP 5222 | Statistical Learning Models for Text and Graph Data |
| COMP 5223 | Perception and Information Processing for Robotics |
| COMP 5421 | Computer Vision |

k) ☐ Co-listing[14]: ☐ Multi-coding[14]:

| Course Code | Course Title |
|---|---|
| | |
| | |

l) Other Enrollment Restrictions[15] ● No ○ Yes

☐ Instructor's approval required

☐ Restricted to specified student group(s)
*(please specify, e.g. year and program of study):* _____

☐ Others *(please specify):* _____

m) Medium of Instruction/Materials[16]: ● English ○ Others, (Pls specify and provide a justification in Section 1.3):

_____

n) Allow course repetition for credit[17]: ● No ○ Yes

### 1.2 *Contribution of course to Programs of Study [Check all appropriate boxes below]*

■ Major

| Program of Study | As | | |
|---|---|---|---|
| COMP, COSC, COGBM, CPEG, CPGBM | ☐ Required Course | ■ Elective | ☐ Prerequisite |

☐ Minor

| Program of Study | As | | |
|---|---|---|---|
| | ☐ Required Course | ☐ Elective | ☐ Prerequisite |

☐ Common Core

■ Others (pls specify):

| Program of Study | As | | |
|---|---|---|---|
| Extended Major in AI (Major + AI) | ☐ Required Course | ■ Elective | ☐ Prerequisite |

### 1.3 *Rationale for Introducing this course and other relevant information[18]*

Although there is plenty of hype from mass media about artificial intelligence (AI), the unprecedented successes of AI in a number of real-world applications are undeniable. This 2000-level course serves to give a gentle introduction to both the technical and non-technical aspects of AI suitable for most if not all students at HKUST. No prerequisites will be required for students to understand the conceptual aspects of the course. However, prior experience in basic Python programming gained from an introductory course such as COMP 1021 (Introduction to Computer Science) or COMP 1029P (Python Programming Bridging Course) will allow students to make use of AI software tools to build interesting applications. Incorporating this practical facet as an integral part of the course will help students get more excited about the subject and practise AI thinking through realistic

examples. With this course serving to give a quick overview of some basic elements of AI, we hope to inspire and encourage students to learn more later by taking more specialized, advanced AI courses.
The reason of including the list of advanced courses as **one-way exclusion** is to prevent students who have taken advanced AI courses to take COMP2211 for easy credits, and we will not change exclusions of these advanced AI courses, so students who have taken COMP2211 can still go on to take these advanced courses. In addition, we intend to include COMP2211 as alternative required course in the curriculum of Major+AI after launching it at least once.

## Section 2A: Learning Outcomes and Alignment *(for courses not proposed to be Common Core Courses)*

### 2.1 *Key Course Intended Learning Outcomes (Should not normally exceed six or eight outcomes)*

Upon completion of this course, students are expected to be able to do the following:

| | **Course ILOs** | **Nature of the learning outcomes** *( A - Knowledge/Content Related; B - Academic Skills/Competencies; C - Others )* |
|---|---|---|
| 1 | Demonstrate general understanding of the historical perspective and development of artificial intelligence (AI) | A |
| 2 | Demonstrate fundamental understanding of the basic elements of AI thinking | B |
| 3 | Demonstrate proficiency in applying basic principles and techniques of AI and using AI software tools to solve problems in a range of applications | B |
| 4 | Demonstrate awareness of the social and ethical implications as well as potential and limitations of AI | A |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |

### 2.2 *Contribution of Learning Outcomes to Programs of Study identified in Section 1.2*

*(Please also complete Section 4.1)*

| | **Program of study 1: COMP/COSC**<br><br>**Program ILOs** | **To be achieved through these course ILOs** *(Write CILO-1, CILO-2, etc.)* |
|---|---|---|
| 1 | #1 An ability to apply knowledge of computing and mathematics appropriate to the discipline | CILO-3 |
| 2 | #2 An ability to apply knowledge of a computing specialization, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models | CILO-2, CILO-3 |
| 3 | #3 An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution | CILO-2, CILO-3 |
| 4 | #4 An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs | CILO-2, CILO-3 |
| 5 | #6 An understanding of professional, ethical, legal, security and social issues and responsibilities | CILO-4 |
| 6 | #7 An ability to communicate effectively with a range of audiences | CILO-3 |
| 7 | #8 An ability to analyze the local and global impact of computing on individuals, organizations, and society | CILO-4 |
| 8 | #10 An ability to use current techniques, skills, and tools necessary for computing practices | CILO-2, CILO-3 |

| | **Program of study 2: CPEG**<br><br>**Program ILOs** | **To be achieved through these course ILOs** *(Write CILO-1, CILO-2, etc.)* |
|---|---|---|
| 1 | #1 An ability to apply knowledge of mathematics, science, and computer engineering | CILO-3 |
| 2 | #2 An ability to analyze an engineering problem and identify the hardware and/or software requirements appropriate to its solution | CILO-2, CILO-3 |
| 3 | #3 An ability to design and implement a computer-based system including embedded systems encompassing hardware and/or software to meet desired needs | CILO-2, CILO-3 |
| 4 | #5 An ability to identify, formulate and solve computer engineering problems subject | CILO-2, CILO-3 |

| | | |
|---|---|---|
| | to practical constraints | |
| 5 | #6 An ability to understand professional and ethical responsibility | CILO-4 |
| 6 | #7 An ability to communicate effectively with a range of audience | CILO-3 |
| 7 | #8 An ability to understand the local and global impact of computer engineering solutions on individuals, organizations, and society | CILO-4 |
| 8 | #9 An ability to understand contemporary global, economic, environmental, and societal issues, and their potential connection with computer engineering | CILO-4 |
| 9 | #11 An ability to use the techniques, skills, and modern engineering tools necessary for solving computer engineering problems | CILO-2, CILO-3 |
| 10 | #12 An ability to use hardware and/or software tools to effectively solve engineering problems with an understanding of their processes and limitations | CILO-2, CILO-3 |

| | **Program of study 3: Major + AI**<br><br>**Program ILOs** | **To be achieved through these course ILOs**<br>*(Write CILO-1, CILO-2, etc.)* |
|---|---|---|
| 1 | Identify emerging technology and innovations that will create opportunities and values for people, business and society | CILO-1, CILO-2, CILO-4 |
| 2 | Integrate knowledge and mindset drawn from different disciplines | CILO-2, CILO-3 |
| 3 | Apply innovative knowledge and practical problem-solving skills to tackle real business, scientific or socio-economic problems relevant to their Major areas | CILO-3 |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |

## Section 2B: Additional Information[2] *(for courses not proposed to be Common Core Courses)*

### 2.3 *Planned Teaching & Learning Arrangement*

| | Teaching & Learning Arrangement | Weekly Scheduled Hours/ Estimated Weekly Learning Hours | Indicate which course ILOs this activity serves to achieve *(Write CILO-1, CILO-2, etc.)* | Additional Information *(optional)* |
|---|---|---|---|---|
| *Face-to face activities* | ■ Lecture* | 3 | CILO-1, CILO-2, CILO-3, CILO-4 | |
| | ☐ Tutorial* | | | |
| | ☐ Seminar/Small-class* | | | |
| | ■ Laboratory* | 1 | CILO-3 | |
| | *Does the above scheduled component(s) involve structured active learning activities? [19]<br>● No<br>○ Yes *If yes, please specify for each scheduled component, the percentage and the type of active learning involved in the "Additional Information" column.* | | | |
| | ☐ Others (e.g. fieldtrip, visit, etc.), *pls specify:* _____ | | | |
| *Online activities* | ☐ Online lecture videos | | | |
| | ☐ Other online learning tasks, *pls specify:* _____ | | | |

**The total learning hours of the course# is equivalent to 120 hours [8]**
*# including both scheduled instructional hours and hours for self-study activities & assessment*

- *For course adopting a pedagogic approach other than lecture, tutorial and laboratory, please indicate the pedagogy used:*

○ Blended learning [20] ○ Pure online delivery [21]
○ Experiential learning [22] ○ Others, *pls specify:*_____

### 2.4 *Planned Assessment Weightings*

| Assessment Task | Proportion of Final Grade (%) | Indicate which course ILOs this task is to assess *(Write CILO-1, CILO-2, etc.)* | Additional Information *(optional)* |
|---|---|---|---|
| ☐ In-class test | | | |
| ■ Mid-term test | 15% | CILO-1, CILO-2, CILO-3, CILO-4 | |
| ■ Final exam | 40% | CILO-1, CILO-2, CILO-3, CILO-4 | |
| ☐ Written assignment | | | |
| ■ Project report | 30% | CILO-2, CILO-3 | 2-3 programming projects |
| ■ Presentation | 5% | CILO-2, CILO-3 | |
| ☐ Learning portfolio | | | |
| ■ Course participation | 5% | CILO-1, CILO-2, CILO-3, CILO-4 | |
| ■ Peer evaluation | 5% | CILO-2, CILO-3 | |
| ☐ Others (e.g. proctored online exam, etc.), *pls specify:* _____ | | | |

**2.5 *Course Duration***

● 1 term ○ 2 terms ○ Others, *pls specify:* _____

**2.6 *Planned Frequency of Offerings*** *[Check all appropriate boxes]:*

■ Every Fall ☐ Every Winter

■ Every Spring ☐ Every Summer

☐ No fixed pattern

☐ Other *(pls specify):* _____

**2.7 *Course outline attached*** ○ No ● Yes

- **Internationalization:**

*Internationalization in a course refers to course content and/or pedagogic approaches which incorporate an intercultural and international perspective. Examples may include:*

*- Collaboration with overseas institutions to develop and adopt international course content, or to arrange international field trip*
*- Insertion of international theme as part of the course*
*- Integrating the course content with international material as examples or case studies*
*- Elements to provide global diversified perspectives and/or practices around the world*

*Please briefly list or summarize any component(s) in the course that contributes to internationalizing the curriculum:*

| |
|---|
| |

**2.8 *Resources***

Request extra resources for teaching this course? ● No ○ Yes

**COMP 2211: Exploring Artificial Intelligence**

**Catalog Description**

This course aims to give a gentle introduction to the basic elements of artificial intelligence (AI) through understanding examples from various applications and hands-on experimentation using AI software tools. In addition to covering the technical aspect of AI through such topics as search and problem solving, knowledge representation, probabilistic reasoning, machine learning, computer vision and image processing, speech and language processing, and robotics, this course will also study the historical perspective, social and ethical implications, as well as potential and limitations of AI.

**Learning Outcomes**

Upon successful completion of this course, students will be able to:

- Demonstrate general understanding of the historical perspective and development of artificial intelligence (AI).
- Demonstrate fundamental understanding of the basic elements of AI thinking.
- Demonstrate proficiency in applying basic principles and techniques of AI and using AI software tools to solve problems in a range of applications.
- Demonstrate awareness of the social and ethical implications as well as potential and limitations of AI.

**Major Topics**

Brief history
Search and problem solving
Knowledge representation
Probabilistic reasoning
Machine learning
Computer vision and image processing
Speech and language processing
Robotics
Social and ethical implications
Potential and limitations

An innovative approach will be adopted to cover some basic elements of the technical topics through interesting examples. Specifically, the topics will not be covered one-by-one separately. Instead, real-world examples that require integrative use of multiple topics will be chosen for illustration. For example, AI for games will be used to illustrate search and problem solving, knowledge representation, and machine learning; AI for autonomous vehicles to illustrate computer vision, machine learning, and robotics; AI for conversational agents (or chatbots) to illustrate speech/language processing and machine learning; AI for healthcare to illustrate image processing and machine learning; etc.

**Reference Books**

Hadelin de Ponteves. ***AI Crash Course****: A fun and hands-on introduction to machine learning, reinforcement learning, deep learning, and artificial intelligence with Python.* Packt Publishing. 2019.

Denis Rothman, Matthew Lamons, Rahul Kumar, Abhishek Nagaraja, Amir Ziai, and Ankit Dixit. ***Python: Beginner's Guide to Artificial Intelligence****: Build applications to intelligently interact with the world around you using Python.* Packt Publishing. 2018.

Online courses:

- AI for Everyone (https://www.coursera.org/learn/ai-for-everyone)
- AI Foundations for Everyone Specialization (https://www.coursera.org/specializations/ai-foundations-for-everyone)
- Machine Learning for All (https://www.coursera.org/learn/uol-machine-learning-for-all)
- Artificial Intelligence A-Z: Learn How to Build an AI (https://www.udemy.com/course/artificial-intelligence-az/)

## Section 4: Development, Concurrence and Approval

### 4.1 *Contribution to the Program Learning Outcomes*

*(To be completed by EACH of the program(s) of study noted under Section 1.2)*

■ The course contributes to this Major/~~Minor~~* Program: COMP/COSC

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached**.

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | please refer to the below signature | | |

■ The course contributes to this Major/~~Minor~~* Program: CPEG

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached**.

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | please refer to the signature in page 16 | | |

■ The course contributes to this Major/~~Minor~~* Program: Extended Major in AI (Major + AI)

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached**.

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | please refer to the signature in page 11 | | |

### 4.2 *Approvals*

Department/Program unit level Recommendation

| | Position / Name: | Signature | Date |
|---|---|---|---|
| ■ Offering Department/Program Unit: *(Please specify unit):* CSE | UG coordinator/ Dr. Qiong Luo | | 12-Nov-2020 |
| [X] Recommending School/IPO: *(Please specify):* SENG | Prof. Philip K. T. MOK Assoc. Dean of Engineering | | 14 Dec 2020 |

School-level Concurrence

| | Name of School/Unit | Position / Name | Signature | Date |
|---|---|---|---|---|
| ☐ | *IPO* | | | |
| ☐ | *DDP* | | | |
| ☐ | ECE | | | |
| ☐ | ISOM | | | |
| ☐ | | | | |

## Section 4: Development, Concurrence and Approval

### 4.1 *Contribution to the Program Learning Outcomes*

*(To be completed by EACH of the program(s) of study noted under Section 1.2)*

■ The course contributes to this Major/~~Minor~~* Program: COMP/COSC

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached.**

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | | | |

■ The course contributes to this Major/~~Minor~~* Program: CPEG

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached.**

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | | | |

■ The course contributes to this Major/~~Minor~~* Program: Extended Major in AI (Major + AI)

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached.**

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | | | |

### 4.2 *Approvals*

Department/Program unit level Recommendation

| | Position / Name: | Signature | Date |
|---|---|---|---|
| ■ Offering Department/Program Unit: *(Please specify unit):* CSE | UG coordinator/ Dr. Qiong Luo | | 12-Nov-2020 |
| ☐ Recommending School/IPO: *(Please specify):* | | | |

School-level Concurrence

| Name of School/Unit | Position / Name | Signature | Date |
|---|---|---|---|
| ☑ IPO | Prof. Jimmy Fung, Chair of IMSC | | 11-11-2020 |
| ☐ DDP | | | |
| ☐ ECE | | | |
| ☐ ISOM | | | |
| ☐ | | | |

| | | | |
|---|---|---|---|
| CPEG | | | |
| RMBI | | | |
| MATH | | | |
| ISOM - IS | Deputy Head / Hui Kai Lung | | Nov 20, 2020 |
| | | | |

## Section 4: Development, Concurrence and Approval

### 4.1 *Contribution to the Program Learning Outcomes*

*(To be completed by EACH of the program(s) of study noted under Section 1.2)*

■ The course contributes to this Major/~~Minor~~* Program: COMP/COSC

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached.**

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | | | |

■ The course contributes to this Major/~~Minor~~* Program: CPEG

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached.**

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | | | |

■ The course contributes to this Major/~~Minor~~* Program: Extended Major in AI (Major + AI)

*(* Delete as appropriate)*

☐ The relevant **program learning outcomes are attached.**

☐ On behalf of this program of study, I confirm that the course will contribute appropriately to overall program learning outcomes.

| | Position / Name: | Signature | Date |
|---|---|---|---|
| Program Director / Head of Department: | | | |

### 4.2 *Approvals*

Department/Program unit level Recommendation

| | Position / Name: | Signature | Date |
|---|---|---|---|
| ■ Offering Department/Program Unit: *(Please specify unit):* CSE | UG coordinator/ Dr. Qiong Luo | | 12-Nov-2020 |
| ☐ Recommending School/IPO: *(Please specify):* | | | |

School-level Concurrence

| | Name of School/Unit | Position / Name | Signature | Date |
|---|---|---|---|---|
| ☐ | *IPO* | | | |
| ☐ | *DDP* | UGC/Betty Lin | | 13 Nov 2020 |
| ☐ | ECE | ~~Professor Weichuan YU~~ | | 16 NOV 2020 |
| ☐ | ISOM (IS) | | | |
| ☐ | | | | |

| | Position/name | Signature | Date |
|---|---|---|---|
| CPEG | | | |
| RMBI | UG coordinator/Dr. Jiying WANG | | Nov 17, 2020 |
| MATH | | | |
| ~~XSOMX~~ X | | | |
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|---|---|---|---|
| ~~XXXX~~ | | | |
| RMBI | | | |
| MATH | UGC / Tsz-Kin Lam | Tsz-Kin Lam | 16 Nov 2020 |
| ~~XXXXXXX~~ | | | |
| CPEG | | | |

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|---|---|---|---|
| ~~IOPX~~ | | | |
| RMBI | | | |
| MATH | | | |
| ~~ISBMXXMX~~ | | | |
| CPEG | Director/Prof. Wilfred Ng | | 17 NOV 2020 |