Artificial Intelligence: Systems and Technologies (JS4468)
‘With the omnipresence and power of AI clearly in sight and within our reach, how should humans co-exist and manage this new “being” as a benevolent partner? This is particularly relevant to Hong Kong as it is actively striving for the advancement of Innovation and Technology.’

- Prof. Rocky S. TUAN, Vice-Chancellor and President of CUHK

Ai has been transforming the way we live!!!

Many disciplines are changing

A – Automotive
B – Bioscience
C – Creative Services
D – Data
E – Education
F – Finance
G – Gaming
H – Healthcare
I – Internet of Things

... ...

AI in Automobile

Computer vision enables

• Road line detection
• Traffic sign recognition
• Vehicle / pedestrian detection

... 

References: KITTI dataset
http://www.cvlibs.net/datasets/kitti/eval_object.php?obj_benchmark=3d
AI in Bioscience

Prof. P.-A. Heng

Pathology (病理)

不用耗時識別癌症，醫生可專注治療

参考：
AI in Creative Services

References:
https://hk.on.cc/hk/bkn/cnt/aeanews/20200208/bkn-20200208180001681-0208_00912_001.html
https://www.cse.cuhk.edu.hk/~ttwong/papers/screenstyle/screenstyle.html
AI in Data

AI can help find insights in data, e.g., **social media data**, and relate different kinds of data.

Can we predict a series of keyphrases for a social media post with both texts and images?

References:
https://www.cse.cuhk.edu.hk/lyu/students/phd
AI in Finance

Citi turns to AI for the early work in approval of corporate loans – and chooses Hong Kong for first testing

- Earlier, AI has been tapped to help out on retail consumer loans
- AI will free up time for bank staff to focus on whether to actually give the green light to corporate loans

References:

http://startupbeat.hkej.com/?p=91478
AI in Gaming

Some games start to use AI:
• To bring non-player characters (NPC) to life
• To adapt to each player’s gameplay
• To create stronger AI players, e.g., E-sport in Starcraft II (not only chess games)
• To create a more dynamic virtual world

References:
https://www.nature.com/articles/d41586-019-03630-0
https://www.nature.com/articles/d41586-019-03298-6
AI in Healthcare

- Radiology
- Imaging
- Disease Diagnosis
- Telehealth
- Electronic Health Records
- Drug Interactions
- Creation of New Drugs

Reference:
https://inews.hket.com/article/2572760/

Reference:
http://startupbeat.hkej.com/?p=102056/

Prof. Dou Qi
Growing Demand and Opportunities

- **Expect more than 50,000 jobs** for high-tech industries with the HKSAR government’s policies in innovation and technology.

- **AI Specialist is the most popular among the top 15 emerging jobs** with annual growth of 74% in demand in USA, according to LinkedIn 2020 Emerging Jobs Report.

Reference: 
Growing Demand and Opportunities

• Many industries are now looking for the use and advancement of **AI to boost up the work efficiency**
  » Opportunities for you to **innovate and change the world**!

• Many other possible occupations
  » AI Specialist
  » Data Scientist
  » Software Developer
  » Computer Engineer
  » R&D for AI
  » ...


The AIST Programme
中文大學首創人工智能課程 為未來創科五萬職位提供人才

人工智能無疑是近年非常熱門的新科技潮流，其應用範圍之廣，甚至可以取代真人的工作，影響就業市場。不過也有意見認為人工智能的普及會為求職市場增加需求，在香港新增達五萬個職位。香港中文大學就看準這個機會，開辦人工智能課程培育相關人才。
Special Features

• 1\textsuperscript{st} Bachelor of Engineering programme in AI in Hong Kong

• 4 specialized streams
  » Biomedical Intelligence
  » Intelligent Multimedia Processing
  » Large-scale Artificial Intelligence
    – Theory and Systems
  » Intelligent Manufacturing and Robotics
Mission

• **Enable students to develop cutting-edge AI solutions** that are of practical interest to academics, industry, and society

• **Nurture local talents in AI related applications** to meet today’s tremendous need of well-trained talents in AI and related specializations
Programme Objective

• Backed by rigorous foundations like data structures, statistics, machine learning and distributed computing

• Equip students with the capabilities of building AI systems that can analyze and infer knowledge from massive information

• Emphasize solid trainings on
  » Mathematical analysis and reasoning on massive data
  » Large-scale system design and implementation for processing massive data
Department of Computer Science and Engineering
Let’s take a look at our department

https://www.youtube.com/watch?v=fTq4tUMftw0
The First BEng in “AI Programme” in HK

- The first computer science department in HK
- Offering AIST, CENG and CSCI programmes
- A strong alumni network
**Turing Award Recipient**
Prof. Andrew Yao

**Seven ACM Fellows**
Prof. Martin Wong, Prof. Irwin King, Prof. Michael Lyu, Prof. John Lui, Prof. Yufei Tao, etc.

**Six IEEE Fellows**
Prof. Irwin King, Prof. John Lui, Prof. Leo Jia, etc.

**AI 2000 Most Influential Scholar Annual List (2021)**
Prof. Irwin King, Prof. Jiaya Jia, Prof. Yufei Tao, and some professors are named in the list, recognizing their research excellence in AI fields

**CUHK University Education Award 2020**
Prof. Irwin King

**Vice-Chancellor’s Exemplary Teaching Award 2019**
Mr. Michael Fung, Senior Lecturer
Recent Achievements in Intl’/local Competitions

International Collegiate Programming Contest (ICPC)
(formerly named as ACM Programming Competition)

2019: ranked 12th (over 3000 universities)
2012: ranked 8th
2011: ranked 13th
2001: ranked 8th

PwC’s HackaDay 2019
2nd place
Student Training

CUHK Amazon Deep Learning Workshop 2019

& AWSome Day 2020

Cooperated with Amazon to offer student training in deep neural networks and machine learning

City Challenge – Bridge to a Smarter City 2016

Designed technology-based living applications for the elderly and won the second runner-up
Industrial Visits

• Visit to companies to learn latest development in industry
Work-Study Programme

• One-year placement and internship for students to gain practical experience in a real working environment

Example of Previous Opportunities in CSE

Google
Microsoft
HP
HSBC
恒生银行 HANG SENG BANK
Sun Hung Kai Properties
ASM Pacific Technology
HKSTP
Fujitsu

More details will be announced when places are available!
Strong Alumni Network

IT Industry:
- Microsoft
- Google
- IBM
- NOKIA
- amazon.com
- facebook

Education:
- University of Cambridge
- National University of Singapore
- Nanyang Technological University
- City University of Hong Kong

Banking:
- HSBC
- CitiBank
- Morgan Stanley
- Deutsche Bank
- Goldman Sachs
What’s More?

• Chances to create your own project and innovation with support and advice from CSE teachers

• Exchange opportunities to world-class universities

• High competitiveness in job market with 90% of CSE graduates employed within one month of graduation

• CSE teachers usually have the highest teaching evaluation scores
Why CSE Department?

Because it is fun!
# AIST Admission Requirements (2021 Entry)

<table>
<thead>
<tr>
<th>HKDSE Subject</th>
<th>Minimum Level</th>
<th>Subject Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HKDSE Core Subjects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English Language</td>
<td>4</td>
<td>1.25</td>
</tr>
<tr>
<td>Chinese Language</td>
<td>3</td>
<td>1.25</td>
</tr>
<tr>
<td>Mathematics (Compulsory Part)</td>
<td>5(^\wedge)</td>
<td>1.75</td>
</tr>
<tr>
<td>Liberal Studies</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>HKDSE Elective Subjects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any two subjects</td>
<td>3</td>
<td>#</td>
</tr>
</tbody>
</table>

\(^\wedge\) Applicants with level 4 in Mathematics (Compulsory Part) and good results in other HKDSE subjects will be exceptionally considered on a case-by-case basis.

\(#\) The AIST programme accepts any subject as elective, with subject weighting of **1.75** for Mathematics M1/M2; **1.5** for Biology, Chemistry, Physics, Combined Science and ICT; and **1** for any other subjects.

Selection is based on the Best 5 HKDSE subjects with subject weighting applied. Bonus points will be awarded to the 6\(^{\text{th}}\) and 7\(^{\text{th}}\) subjects, if any.
# AIST Admission Grades (2020 Entry)

<table>
<thead>
<tr>
<th>Percentile</th>
<th>CHI</th>
<th>ENG</th>
<th>MATHS</th>
<th>LS</th>
<th>M1/M2</th>
<th>1st Elective</th>
<th>2nd Elective</th>
<th>3rd Elective</th>
<th>Total Reference Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Quartile</td>
<td>4</td>
<td>5</td>
<td>5**</td>
<td>5</td>
<td>5**</td>
<td>5*</td>
<td>5</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Median</td>
<td>4</td>
<td>5</td>
<td>5**</td>
<td>5**</td>
<td>5</td>
<td>5*</td>
<td>5</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Lower Quartile</td>
<td>4</td>
<td>4</td>
<td>5**</td>
<td>4</td>
<td>5*</td>
<td>5*</td>
<td>4</td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

^ The Total Reference Score is the total score of the applicant calculated based on the best 5 subjects in Category A or Category C of HKDSE:

where lv 5** = 7, lv 5* = 6, lv 5 = 5, lv 4 = 4, lv 3 = 3, lv 2 = 2, lv 1 = 1 for Category A subjects;

and Grade A = 5, Grade B = 4, Grade C = 3, Grade D = 2, Grade E = 1 for Category C subjects.

Admission is not based on public examination results alone, and the overall scores of students admitted vary from year to year. The information provided is for reference only and should not be used to predict the chance of admission in subsequent years.

Admission Requirements for Non-JUPAS Applicants
AIST Admission Requirements (Non-JUPAS)

- Applicants seeking admission on the strength of qualifications other than HKDSE examination results (e.g. IB, GCE-AL, overseas qualifications) can apply through Non-JUPAS channels.

- Will be considered on the basis of their education background and academic achievements.

- Will be expected to demonstrate outstanding abilities in English, Mathematics and science subjects.
**Curriculum – Overview**

- **1st Year**:  
  - Faculty Package  
  - Major Practicum

- **2nd Year**:  
  - Major Foundation
  - Major Core

- **3rd Year**:  
  - Major Core
  - Major Electives
  - University Common Core (Languages, GE, PE) (39 Units)

- **4th Year**:  
  - Final Year Project
  - Major Electives

- **Free Electives (9 Units)**
Curriculum – Major Requirements

1. Faculty Package
2. Major Foundation
3. Major Core
4. Final Year Project

Major Electives

Major Practicum

Major Core

75 units
Curriculum – Faculty Package and Foundation

1. Faculty Package
   - Practicum
   - Major Core

2. Major Foundation
   - Major Core
   - Major Electives

3. Major Core
   - Major Electives

4. Final Year Project
   - Major Electives

Faculty Package and Foundation (15 units)

- Programming (ENGG1110)
- Linear Algebra (ENGG1120)
- Multivariable Calculus (ENGG1130)
- Calculus for Engineers (MATH1510)
- General Physics (PHYS1003)
Curriculum – Major Practicum

Major Practicum (3 units)

» Technology, Society and Engineering Practice (AIST2601)
» Engineering Practicum (AIST2602)
Curriculum – Major Foundation

Major Foundation (10 units)

- Intro to Computing Using Python (AIST1110)
- Discrete Maths (ENGG2440)
- Probability (ENGG2760)
- Statistics (ENGG2780)
Curriculum – Major Core

**Major Core (18 units)**

- Intro to AI and Machine Learning (AIST1000)
- Numerical Optimization (AIST3010)
- Intro to Computer Systems (AIST3020)
Curriculum – Major Core

Major Core (18 units)

- Data Structure (CSCI2100)
- Design and Analysis of Algorithms (CSCI3160)
- Fundamentals of Artificial Intelligence (CSCI3230)
- Fundamentals of Machine Learning (CSCI3320)
Curriculum – Major Electives

Major Electives (23 units)

Streams
1. Biomedical Intelligence
2. Intelligent Multimedia Processing
3. Large-scale Artificial Intelligence – Theory and Systems
4. Intelligent Manufacturing and Robotics

Non-Stream
5. General Artificial Intelligence: Systems and Technologies
• Study how to build **intelligent biomedicine** and healthcare applications

• Two emerging markets:
  » **Personalized genomics** and precision medicine (**e.g.** disease prevention, prediction, early diagnosis and treatment)
  » **Clinical record systems** (**e.g.** electronic medical records and pharmacy prescription information and insurance records)
Stream 2: Intelligent Multimedia Processing

• Study how to bridge AI and human brain functions and design models, algorithms, and systems for multimedia processing with high performance and high accuracy.

• Areas: digital image processing, face recognition, computer animation, human-computer interactions, speech and audio processing, computational linguistics
Stream 3: Large-scale AI – Theory and Systems

• Study the **advanced techniques** of realizing large-scale artificial intelligence from both theory and system perspectives
  » **Theory**: machine learning theory, statistical inference, online algorithms, *etc.*
  » **Systems**: high performance computing, distributed storage, big data management, *etc.*
Stream 4: Intelligent Manufacturing & Robotics

• Study **how to integrate manufacturing and robotics with AI** for different aspects of human activities.

• Focus on the topics of **mechanics**, sensing and control, design & manufacturing, **human-robot interactions**, etc.
Distinct Topics

• Many other practical and interesting courses in AI:
  » Machine Learning
  » Deep Learning
  » Large Scale Distributed Computing
  » Intelligent Embedded Systems
  » Knowledge Representation/Inference
  » Human-Computer Interactions
  » Natural Language Processing
  » Big Data Analytics

... ...
**Final Year Project (FYP)**

- **Final Year Project (6 units)**
  - Pick an interesting topic
  - Interdisciplinary nature
  - Apply the knowledge learnt in the previous courses
  - Many open topics. Your creativity and discussion with the supervisor
  - Complete a project under the supervision of an advisor
FYP (AI + Bioinformatics)

• Apply machine learning to predict RNA-protein interaction

RNA folds to a specific structure to fit into the protein binding site

RNA-binding protein (RBP)

Sample from current students (FYP KY1804)
FYP (AI + Multimedia)

• Design a neural network that learns to produce a tiling
FYP (AI + Computer Vision)

• Chinese Medicinal Herb Recognizer

Sample from current students (FYP MHW1804)
FYP (AI + 3D Vision)

• Design the best neural network for 3D car detection

Sample from FYP CWF2002 (The UG student co-authored “research papers” in AAAI 2021 & CVPR 2021)
Q: Will there be any interview for JUPAS applicants?
Interview Arrangement (for JUPAS Applicants)

- We plan to arrange interviews in mid-/late June, 2021.
- We only consider Band A applications for shortlisting.
- Shortlisted applicants will receive an invitation email for the details, e.g., date, time, format, etc.
- Stay tuned! Check your email regularly for the latest update!
Q: Will there be any exchange opportunity?
Exchange to Overseas Universities

• You are encouraged to join the exchange programme to **broaden your horizon and learn with peers from diverse background**

• List of some overseas universities for the exchange
  » Macquarie University, Australia
  » University of Toronto, Canada
  » Shanghai Jiao Tong University, China
  » Telecom & Management SudParis, France
  » Royal Institute of Technology (KTH), Sweden
  » University of California, Davis, USA
  ...

Submit your application via Office of Academic Links (OAL)!
Q: What are the differences between AIST and CSCI?
AIST vs CSCI?

- AIST and CSCI have related foundation & basic theories.
- AIST requires stronger Math foundation since it involves statistics, probability, calculus, linear algebra, etc., which are basis for machine learning and deep learning.
- CSCI focuses more on software design and computing solutions, taking care of coding and software architecture.
Q: Can I transfer to or from Computer Science (CSCI) or other majors in Year 2?
If you look for CSCI / other majors instead...

• You may submit application for **change of major** (to CSCI or other majors), subject to prevailing regulations stipulated by RES and approval by relevant unit(s).

• If you are determined to go for CSCI, you may choose **Engineering (JS4401 / BERGN)** as your choice, and select CSCI during Major Allocation when promoting to Year 2.
Q: Will AI replace us in the near future?
Humans in Future AI Era

• Umm... there may not be a perfect answer at the moment

• From what can be observed recently: **routine** jobs are more easily replaced by AI, while **others** are more likely to go into a “**human-in-the-loop**” model, where AI and humans work together to boost performance, e.g., creative media

Image source: https://hai.stanford.edu/blog/humans-loop-design-interactive-ai-systems?sf110985109=1
See you in Fall 2021!