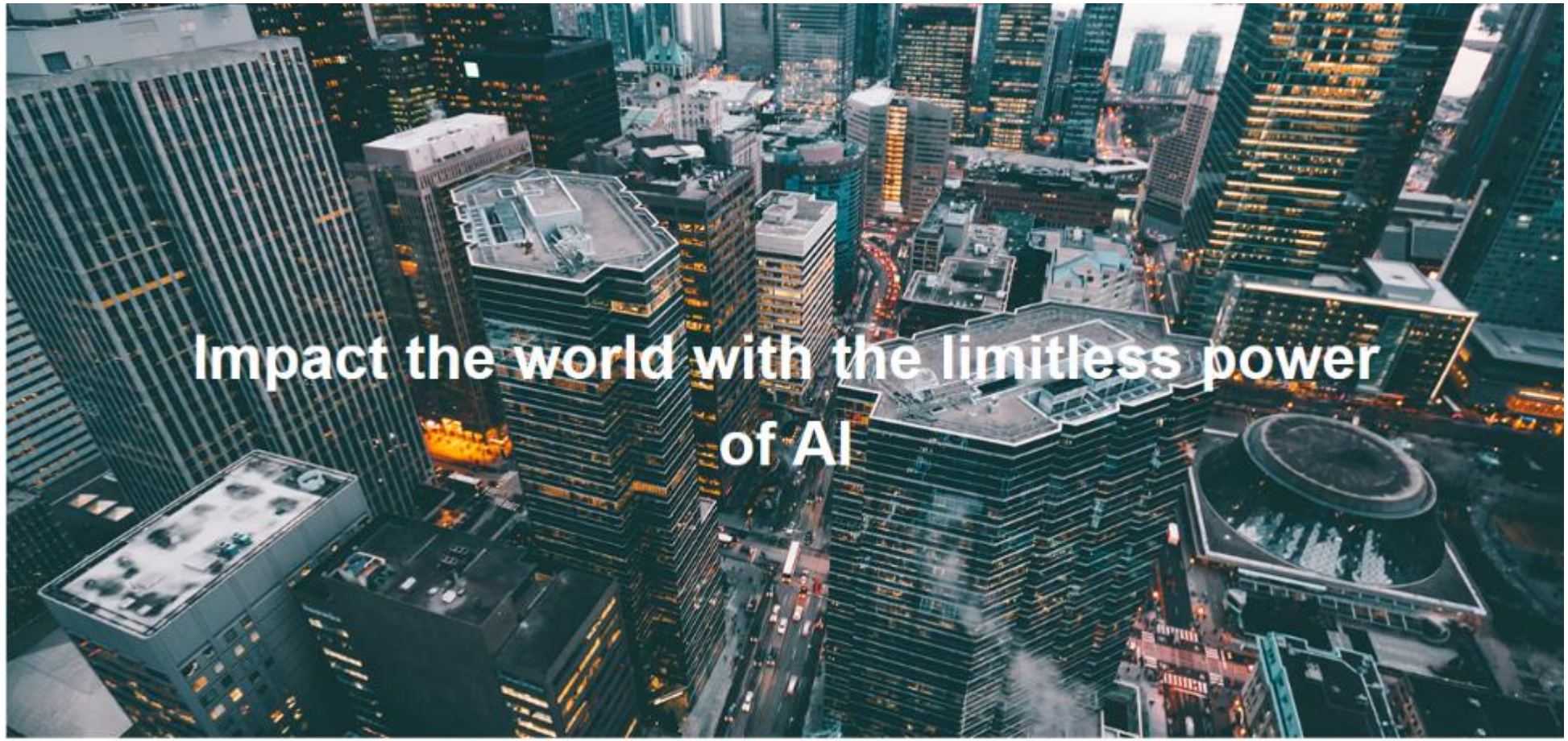
6224 BASc(Applied AI)

Bachelor of Arts & Sciences in Applied Artificial Intelligence



BASc Bachelor of Arts & Sciences

香 港 大 學
THE UNIVERSITY OF HONG KONG

AI AppliedAI

AppliedAI

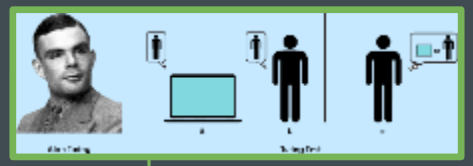
BASc | HKU
Bachelor of Arts & Sciences

Bachelor of Arts & Sciences in

Applied Artificial Intelligence

- Focusing on AI applications in diverse areas, with a philosophical and ethical dimension
- Providing fundamental and practical knowledge for the design and construction of intelligent systems
- Emphasizing problem-based learning

AI History



1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955
A.I. BORN
Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

1966
SHAKEY
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998
KISMET
Cynthia Breazeal at MIT introduces KISmet, an emotionally intelligent robot insofar as it detects and responds to people's feelings

1999
AIBO
Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time

2002
ROOMBA
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S

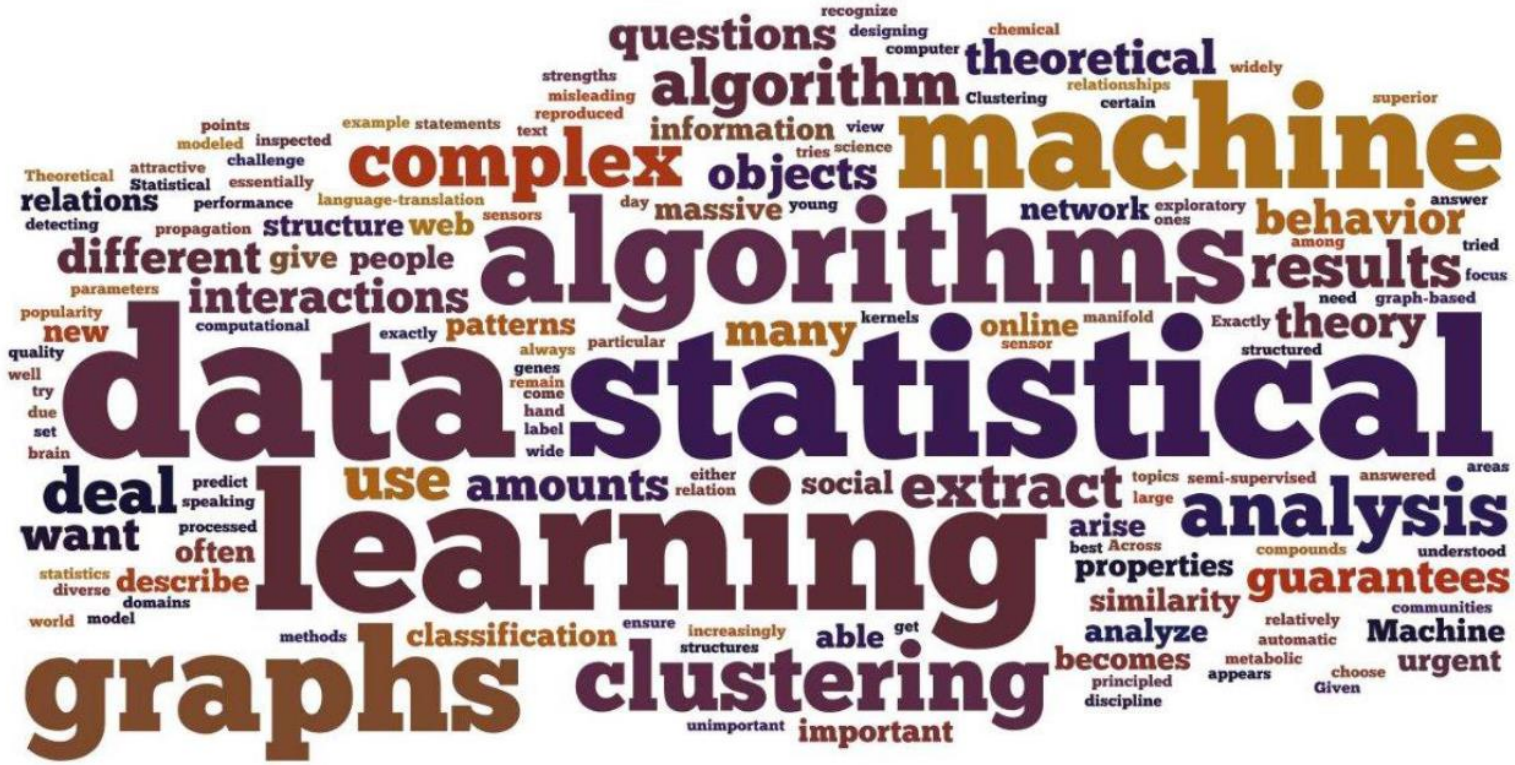
2011
WATSON
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show *Jeopardy*

2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human

2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks

2016
TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments

2017
ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions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questions
designing
chemical
computer
theoretical
widely
strengths
misleading
reproduced
algorithm
Clustering
relationships
certain
superior
machine
points
example
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information
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performance
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propagation
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patterns
kernels
online
manifold
Exactly
theory
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quality
always
particular
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deal
predict
speaking
use
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either
relation
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topics
semi-supervised
answered
areas
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analysis
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processed
arise
often
best
Across
compounds
understood
properties
guarantees
statistics
describe
similarity
diverse
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Machine
methods
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principled
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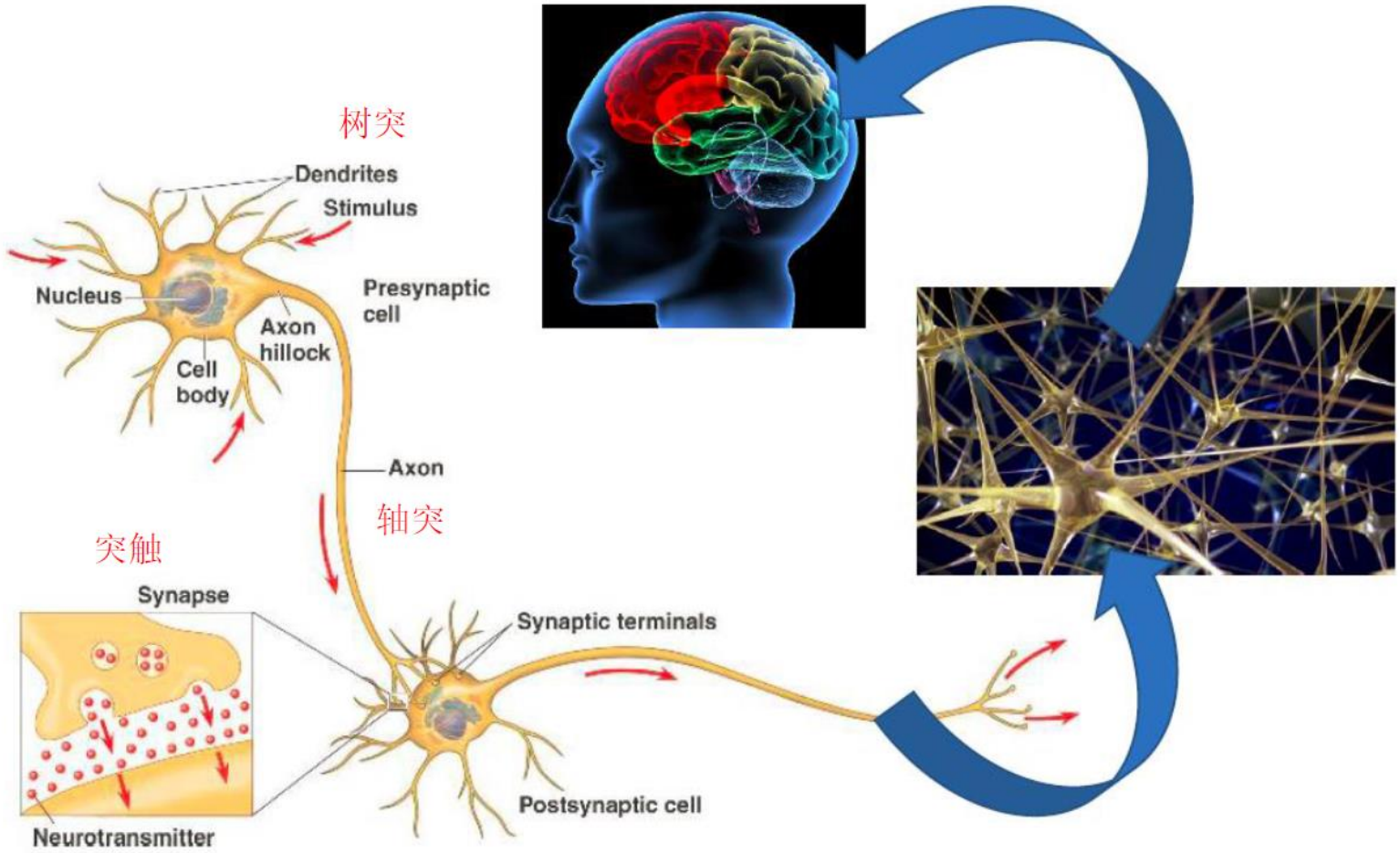
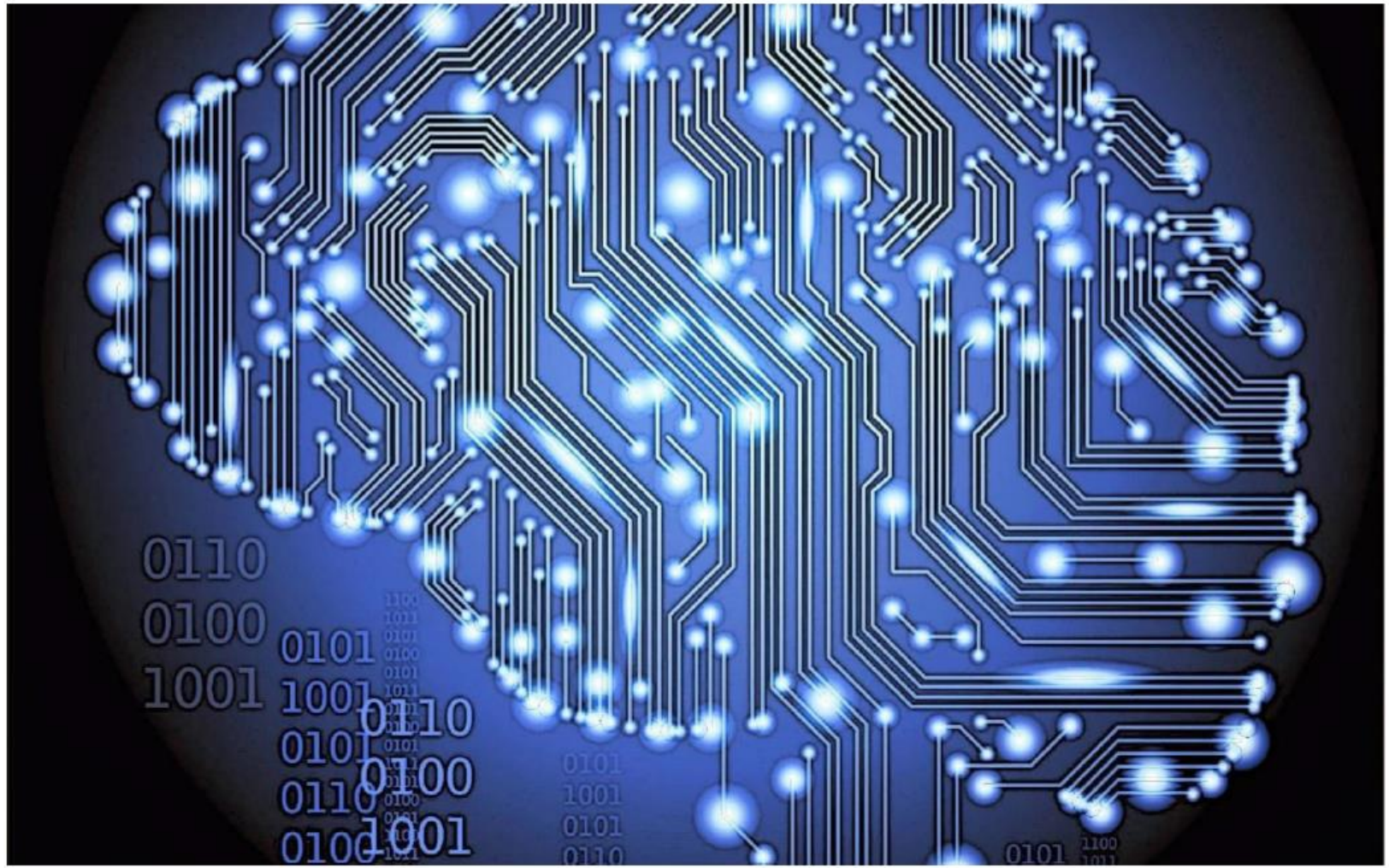
choose
discipline
Given
unimportant
important

GOVERNMENT
TECHNOLOGIES
PROCESS
SOCIAL
SAN
NAS
VOLUME
SIZE
SOFTWARE
MANAGEMENT
EXABYTES
ANALYSIS
LARGE
BIG
INFORMATION
RESEARCH
STORAGE
LEARNING
PETABYTES
DATA
INTERNET
MILLION
SETS
DEVELOPMENT
EVERY
WORLD
TECHNOLOGY
BASED
SEARCH
SCIENCE
FUTURE
BILLION
NEW

How our brain works

Connection and message passing!

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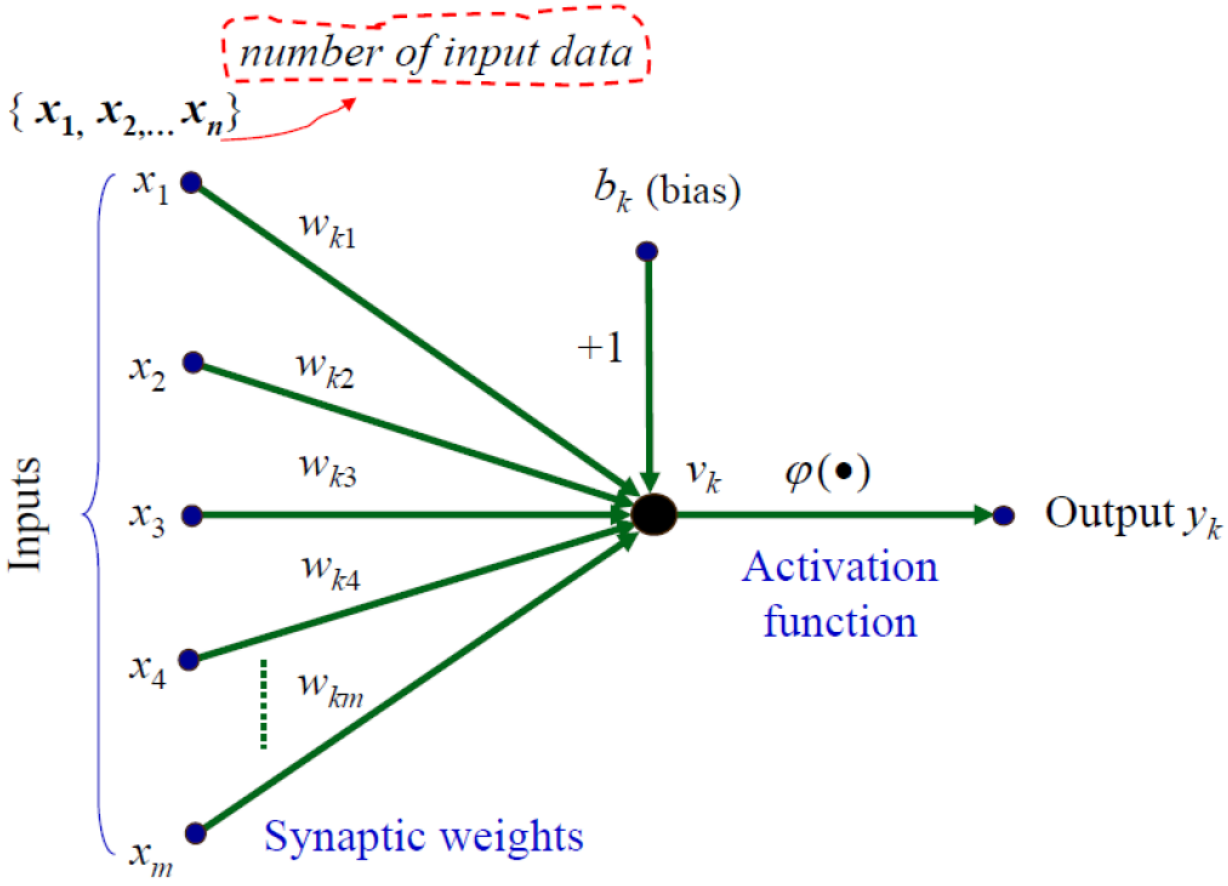
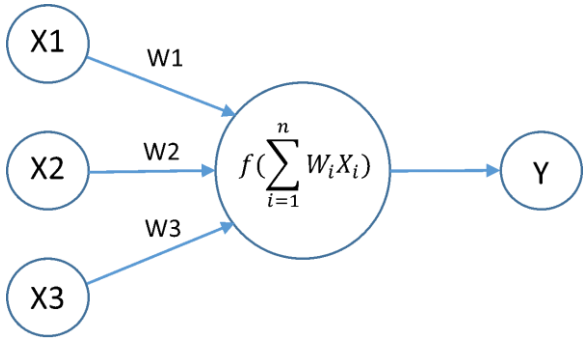
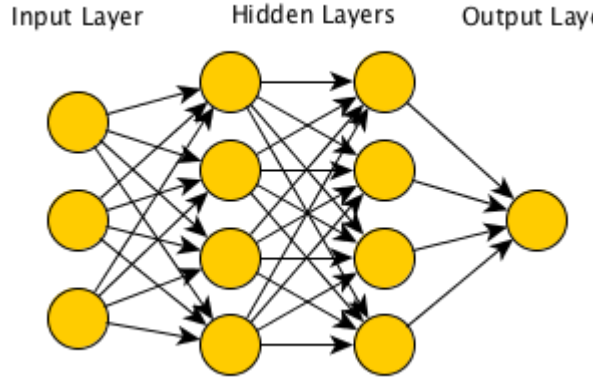
Neural Network

- Model of a neuron

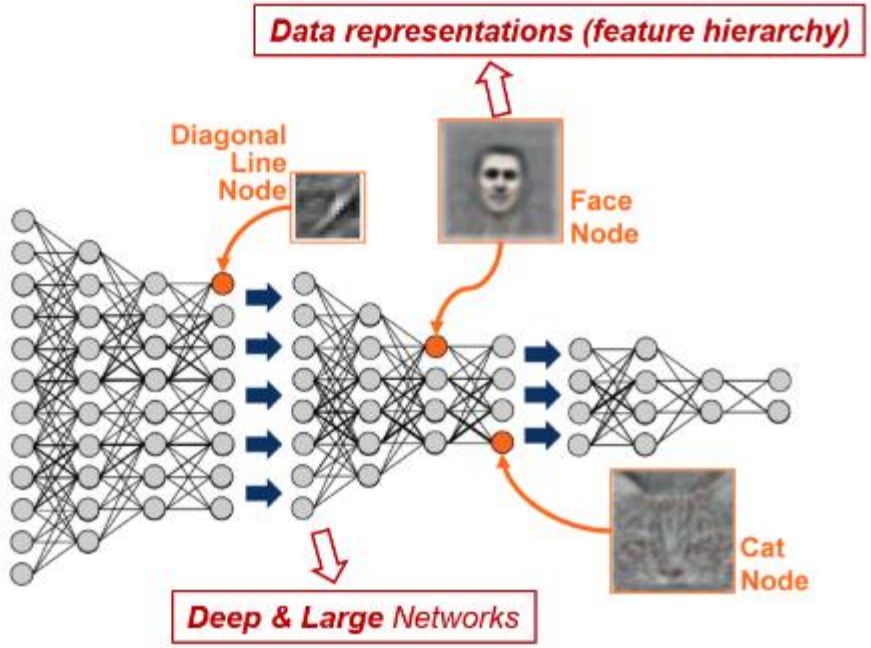






Neural Network

GPU V100



Deep Learning

Turing Award Won by 3 Pioneers of Deep Learning

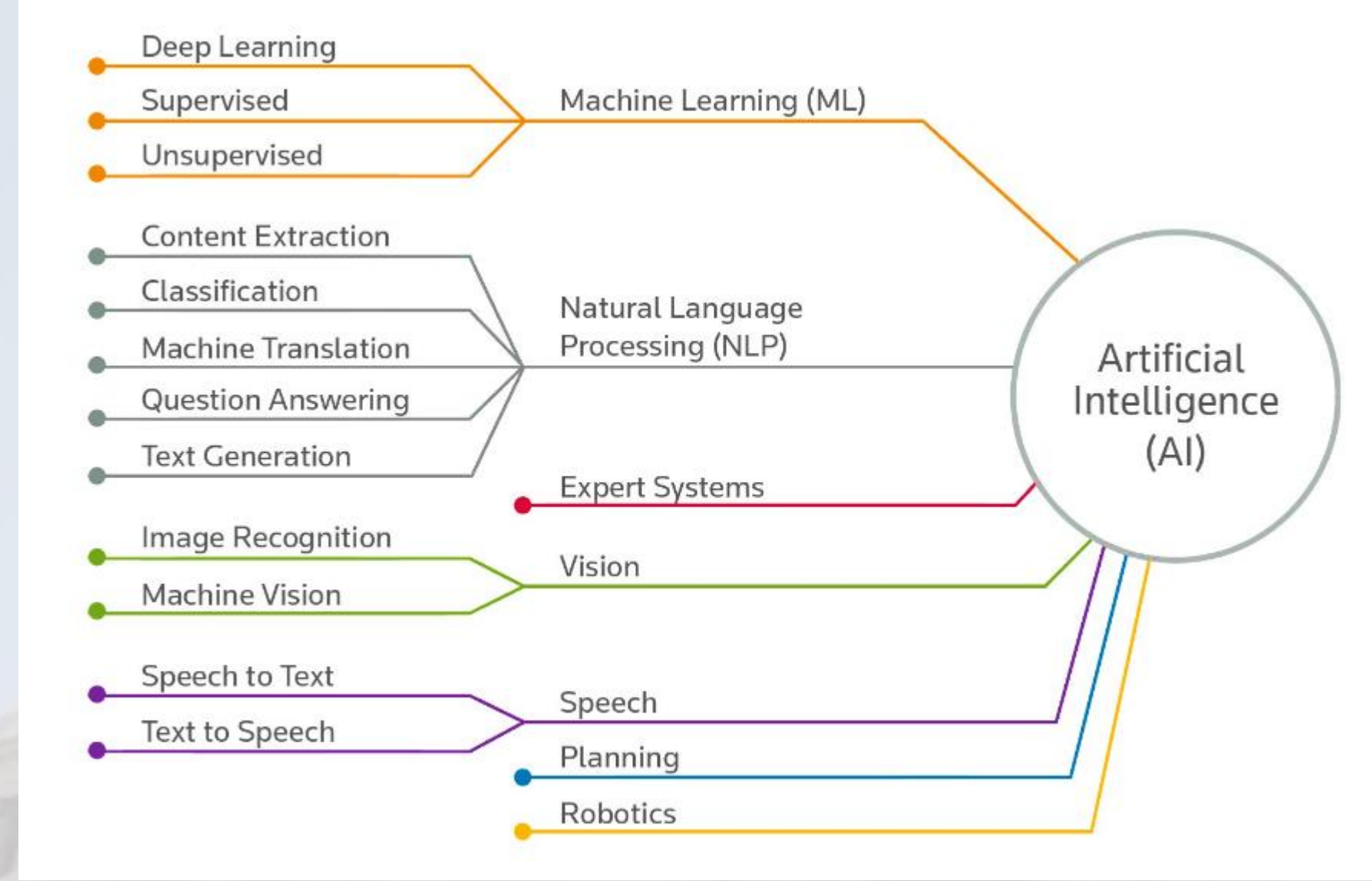
From left, Yann LeCun, Geoffrey Hinton and Yoshua Bengio.

2018 ACM A.M. Turing Award for conceptual and engineering breakthroughs that have made deep neural networks a critical component of computing.

Source: https://www.nytimes.com/2019/03/27/technology/turing-award-ai.html

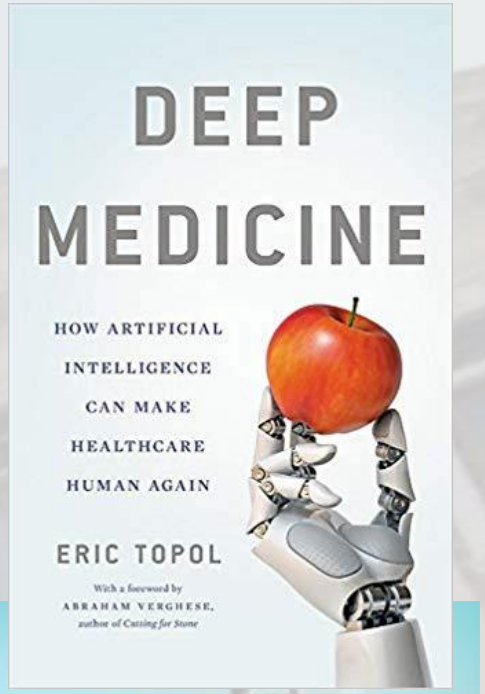
AI is Transforming
the World

AI Technology



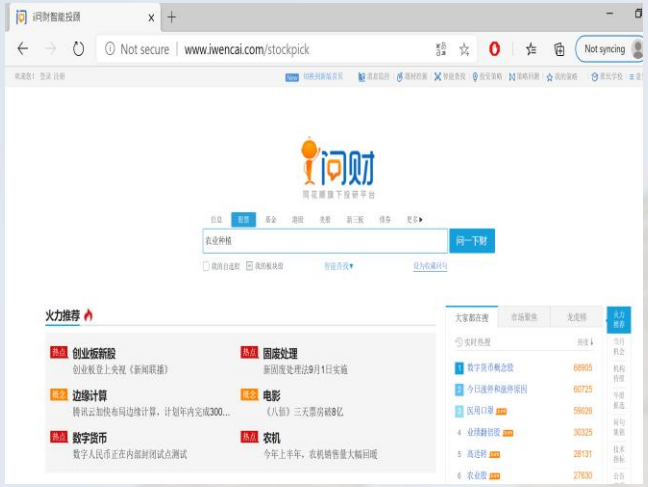
AI in Medicine

Diagnostics in radiology, e.g., X-ray, CT, MRI images. Accurate diagnostics of these images can help expedite the process of treatment and improve disease cure probabilities and life savings.



Utilization of the electronic health record data using NLP is another area that can boost health care for patients and reduce medical errors.

AI in Finance



Robot advisors

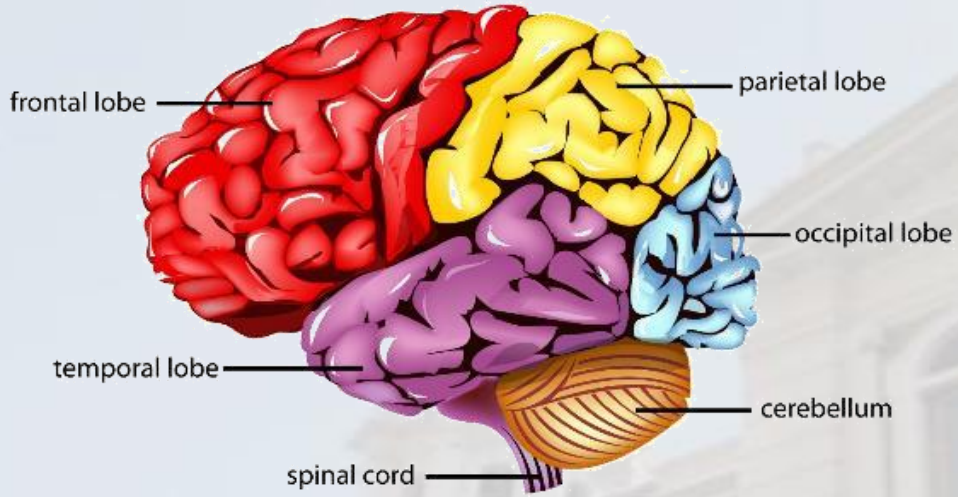
Financial News Analytics

AI in Smart City

Self-driving Car

AI in Neurocognitive Science

Understanding your brain



Cognition

Memory

Perception

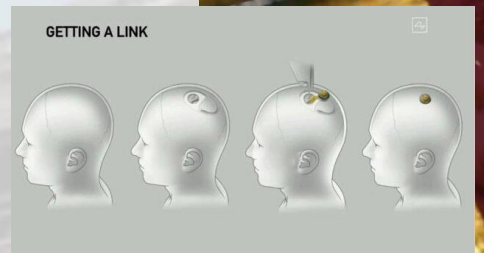
Behaviour

Brian disorder

Parkinson's disease

Alzheimer's disease

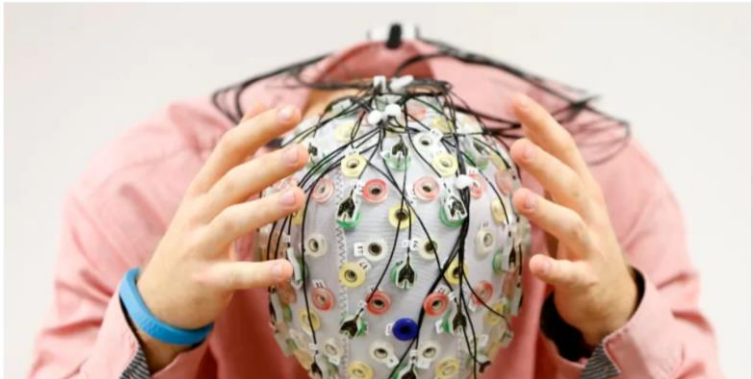
Neuralink's technology to build a digital link between brains and computers



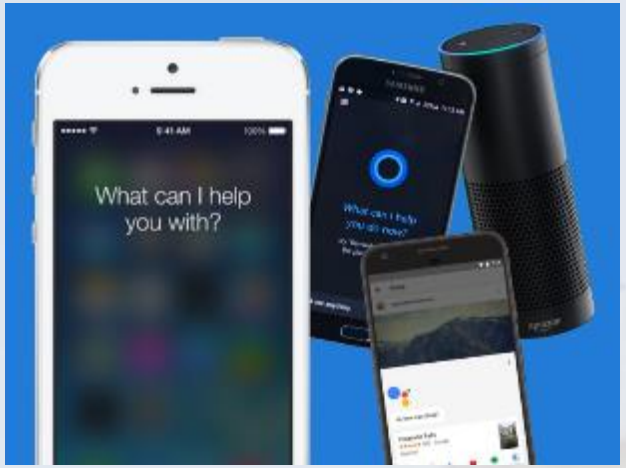
Artificial intelligence, human brain to merge in 2030s, says futurist Kurzweil

Ray Kurzweil, Google's director of engineering, says we're close to linking our brain with AI

Solomon Israel · CBC News · Posted: Jun 05, 2015 5:00 PM ET | Last Updated: June 9, 2015



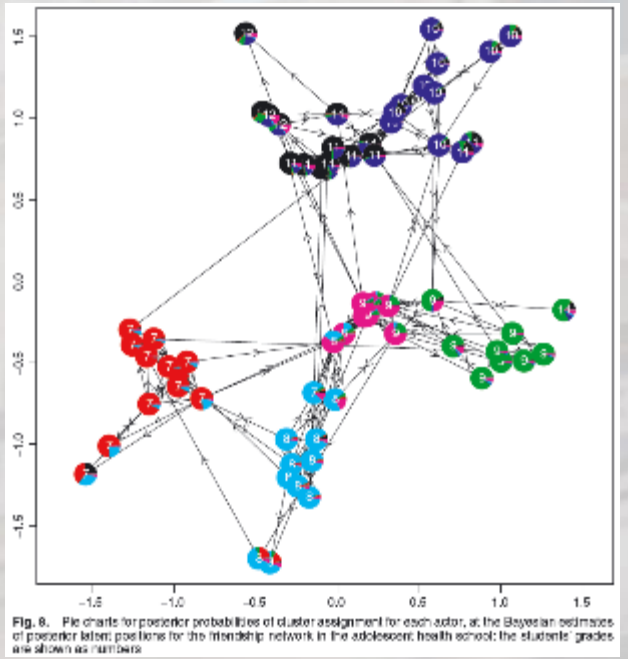
Many More…



Apple SIRI
Amazon Alexa
Google Assistant
Microsoft Cortana

E-commerce

Entertainment



Social network
Social media

Example of AI Application:
Autonomous Mapless Robot Navigation in Crowded Scenarios

- **PI: Dr. Jia Pan* from Computer Science department**, in collaboration with Baidu

- Navigation is an essential capability for mobile robots.
- A generalized yet effective 3M (i.e., multi-robot, multi-scenario, and multi-stage) training framework is proposed, which uses a robust policy gradient algorithm.
- The method enables different types of mobile platforms to navigate safely in complex and highly dynamic environments, such as pedestrian crowds.

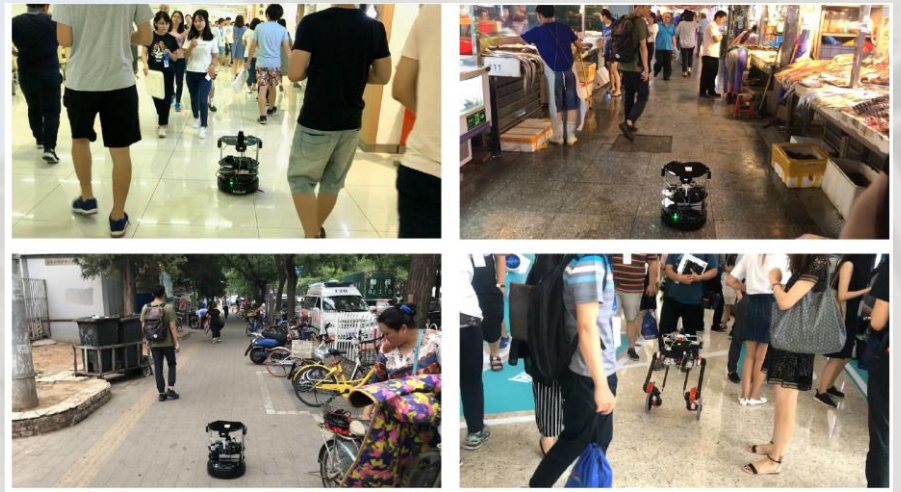


Fig. 1: Mapless navigation in complex and highly dynamic environments using different mobile platforms.

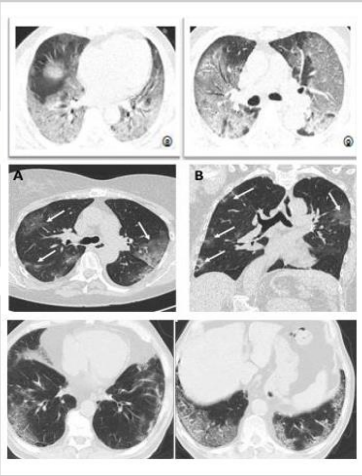
Autonomous Social Distancing in Urban Environments using a Quadruped Robot

Fig. 9: Examples from the real-world experiment. The top and bottom images describes two different scenarios. Left: The robot detected and approached the crowds, then persuaded them to keep social distance. Right: The crowds density decreased.

Example of AI Application:
A Fast Online COVID-19 Diagnostic System with Chest CT Scans

PI: Prof. Guosheng Yin* from Statistics and Actuarial Science department

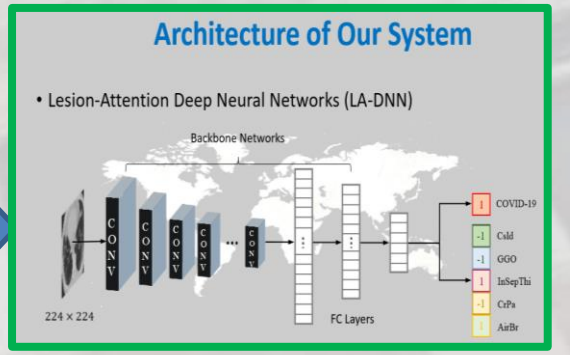
- CT scanning has an advantage on early COVID-19 detection
- Five lesion descriptions about COVID-19 positive cases:
  - ground glass opacities (GGO)
  - consolidation (Csld),
  - crazy paving appearance (CrPa)
  - air bronchograms (AirBr)
  - interlobular septal thickening (InSepThi)

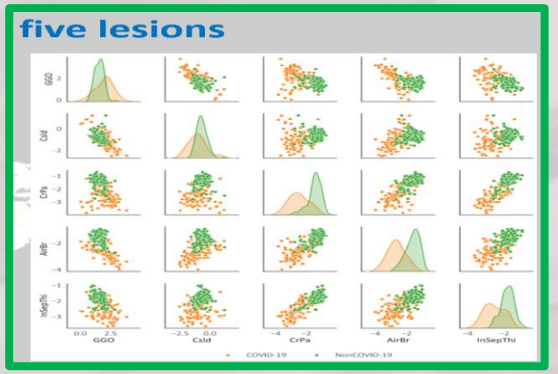


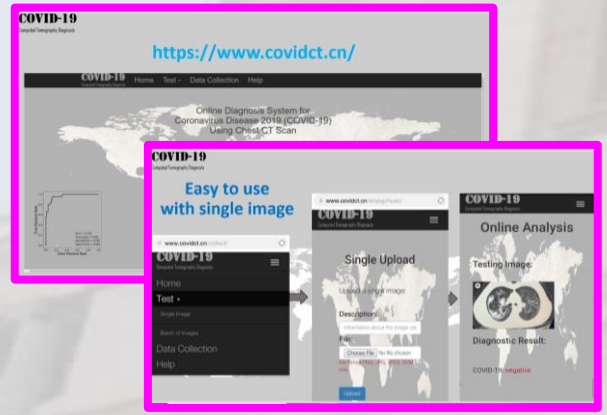
Top: CT images with various radiographic abnormalities: bilateral diffuse consolidation with air bronchograms.

Middle: COVID-19 positive with clinical and CT findings, but with repeated negative RT-PCR tests. Axial (A) and coronal (B) CT images show typical bilateral subpleural areas of GGO.

Bottom: Progress of CT findings in a COVID-19 patient, showing an increase of extent of GGO with crazy paving appearance.







Results from Testing Set

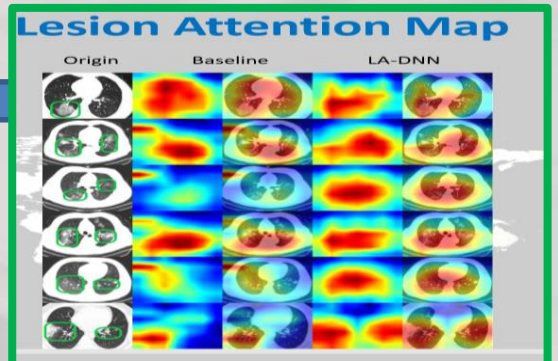
- The experimental results show that the sensitivity (recall), area under the curve (AUC), F1 score, and accuracy for COVID-19 diagnosis are 88.8%, 94.7%, 87.9%, and 89.0%, respectively.

$$\text{Sensitivity} = \frac{\#\text{True Positive}}{\#\text{True Positive} + \#\text{False Negative}},$$

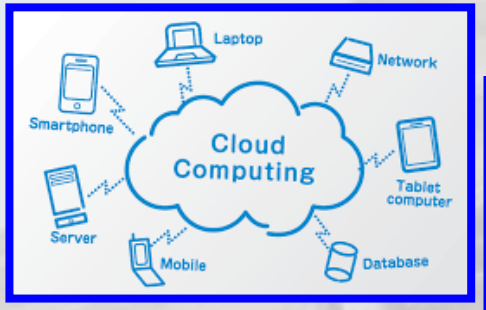
$$\text{F1} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}},$$

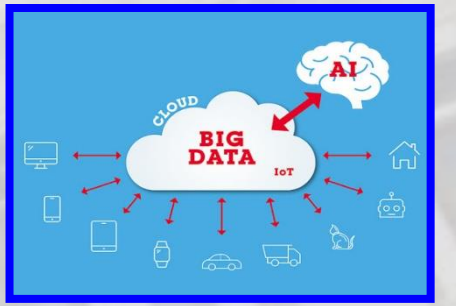
$$\text{Precision} = \frac{\#\text{True Positive}}{\#\text{True Positive} + \#\text{False Positive}},$$

$$\text{Accuracy} = \frac{\#\text{True Positive} + \#\text{True Negative}}{\#\text{Positive} + \#\text{Negative}}.$$



Example of AI Application:
Optimization Problems in AI Cloud Computing





- **PI: Prof. Xiaoming Yuan from Mathematics department,** in collaboration with Huawei
- A very important problem in Cloud Computing is scheduling of various resources such as bandwidth and computing facilities (CPU, Memory, etc.).
- It turns out that a fundamental common mathematical model for these technological problems is the assignment problem (with some generalizations), which is classic in the Operational Research domain and well known to be “NP Hard” difficult (because of its integer variables).
- Additionally, the assignment problems arising in Cloud Computing are much more challenging because they are large-scale, and there are many variables and constraints in the models.

- Currently, these problems are mainly solved by standard generic algorithms in Operational Research textbooks and the efficiency is not satisfactory at all.
- Prof. Yuan developed a new and faster solver for these assignment problems in Cloud Computing based on his work on separable convex minimization models.
- The new and faster solver for generalized assignment problems in Cloud Computing showed high commercial values.

Google Cloud Platform amazon web services Microsoft Azure Alibaba Cloud

New Interdisciplinary Programmes

6224

BASc Bachelor of Arts & Sciences

AI AppliedAI

Bachelor of Arts and Sciences in Applied Artificial Intelligence BASc(Applied AI)

*Impacts the world with the limitless power of **AI***

Curriculum Structure

Forty 6-credit courses spanning over 4 years of full-time study

(240 Credits)

UNIVERSITY EDUCATION
Language Courses
Common Core Courses
(36 credits)

+

BASc CORE COURSES
Horizontals
(18 credits)

+

APPLIED AI PROGRAMME CORE
Core Courses
Concentration & Electives
Capstone Course
(96 credits)

+

2nd MAJOR / MINOR(S) / ELECTIVES
(90 credits)

New Interdisciplinary Programmes

6224

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Bachelor of Arts and Sciences in Applied Artificial Intelligence BASc(Applied AI)

*Impacts the world with the limitless power of **AI***

FACULTY OF SCIENCE
THE UNIVERSITY OF HONG KONG
香港大學理學院

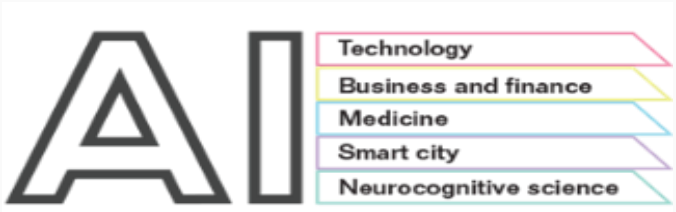
SHKU Science

+ Faculty of Engineering
THE UNIVERSITY OF HONG KONG

+ THE UNIVERSITY OF HONG KONG
faculty of architecture

+ Faculty of Social Sciences
The University of Hong Kong
香港大學社會科學學院

- **New option for elite students**
  Formal training to elite students who wish to join the AI profession
- **Interdisciplinary training**
  Provides a wide range of courses in mathematics, statistics, computer science, geography, psychology, and urban studies
- **Featured concentrations:**



New Interdisciplinary Programmes

BASc Bachelor of Arts & Sciences

Bachelor of Arts and Sciences in Applied Artificial Intelligence BASc(Applied AI)

6224

AI AppliedAI

Impacts the world with the limitless power of AI

<table>
<tr><td><u>Core Courses</u>
(66 credits)</td><td colspan="5">Introductory Level Courses (48 credits):
o Foundations of artificial intelligence
o Computer programming
o Computer organization
o Data structures and algorithms
o University mathematics II
o Multivariate calculus and linear algebra
o Probability and statistics I
o Probability and statistics II

Advanced Level Courses (18 credits):
o Deep learning
o Introduction to optimization
o Statistical machine learning</td></tr>
<tr><td rowspan="2"><u>Elective Courses</u>
(24 credits)</td><td>AI Technology (18+ credits):
o Computer graphics
o Robotics
o Natural language processing
o Image processing and computer vision
o High-performance computing
o Special topics of applied AI</td><td>AI in Business and Finance (18+ credits):
o Marketing analytics
o Operation research I
o Financial calculus
o Time series analysis
o E-commerce technology
o Special topics of applied AI</td><td>AI in Medicine (18+ credits):
o Survival analysis
o Modern biostatistics
o Bayesian learning
o Omics data analysis
o Medical image analysis
o Special topics of applied AI</td><td>AI in Smart City (18+ credits):
o Urban & regional development I
o Urban & regional development II
o Introduction to geographic information systems
o Environmental GIS
o Transport and society
o Special topics of applied AI</td><td>AI in Neurocognitive Science (18+ credits):
o Introduction to psychology
o Perception
o Foundations of cognitive science
o Foundations of neuroscience
o Human neuropsychology
o Special topics of applied AI</td></tr>
<tr><td colspan="4">Other Elective Courses: (6 credits)
o Design and analysis of algorithms (CS)
o Database management system (CS)
o Computer and network security (CS)
o Numerical analysis (MATH)
o Game theory and strategy (MATH)
o Network models in operations research (MATH)
o Data visualization (SAAS)
o Linear modeling (SAAS)
o Multivariate modeling (SAAS)</td></tr>
<tr><td><u>Capstone Requirement</u>
(6 credits)</td><td colspan="5">Directed studies/project/internship in Applied AI</td></tr>
</table>

Welcome to HKU !

2021 QS WORLD UNIVERSITY RANKINGS

#22 World	#4 Asia	#1 HK	HKU

2020 QS WORLD UNIVERSITY RANKINGS by subject

#50 World	#9 Asia	#2 HK	Statistics & OR
#43 World	#8 Asia	#3 HK	Mathematics
#38 World	#10 Asia	#3 HK	Computer Science
#14 World	#3 Asia	#1 HK	Architecture
#12 World	#2 Asia	#1 HK	Geography
#31 World	#2 Asia	#1 HK	Psychology

High-dimensional data analysis

Scientific computation

Statistical learning

Machine/Deep learning

Big data optimization

Time series forecasting

Transportation

Risk management

Speech/NLP/Text analytics

Computer vision

GIS

Game theory

Information security

Financial and actuarial applications

Robotics

Neuropsychology

Operational research

DNA profiling, forensic statistics

Tam Wing Fan Innovation Wing (ready in Sep 2020, open to all Engineering as well as Applied AI students)

Maker studio

Glass facade

Research showcase

Discussion rooms

Brainstorming area

Specialized equipment

Multi-purpose room

Career Prospects

- The programme connects the exploding demand of the AI market in diverse areas, such as:
  - Business
  - Banking & finance
  - Science & technology
  - Environmental protection
  - Urban development
  - Medical informatics
  - Healthcare
  - Neurocognitive science

HUAWEI Microsoft

醫院管理局 HOSPITAL AUTHORITY

數碼港 Cyberport

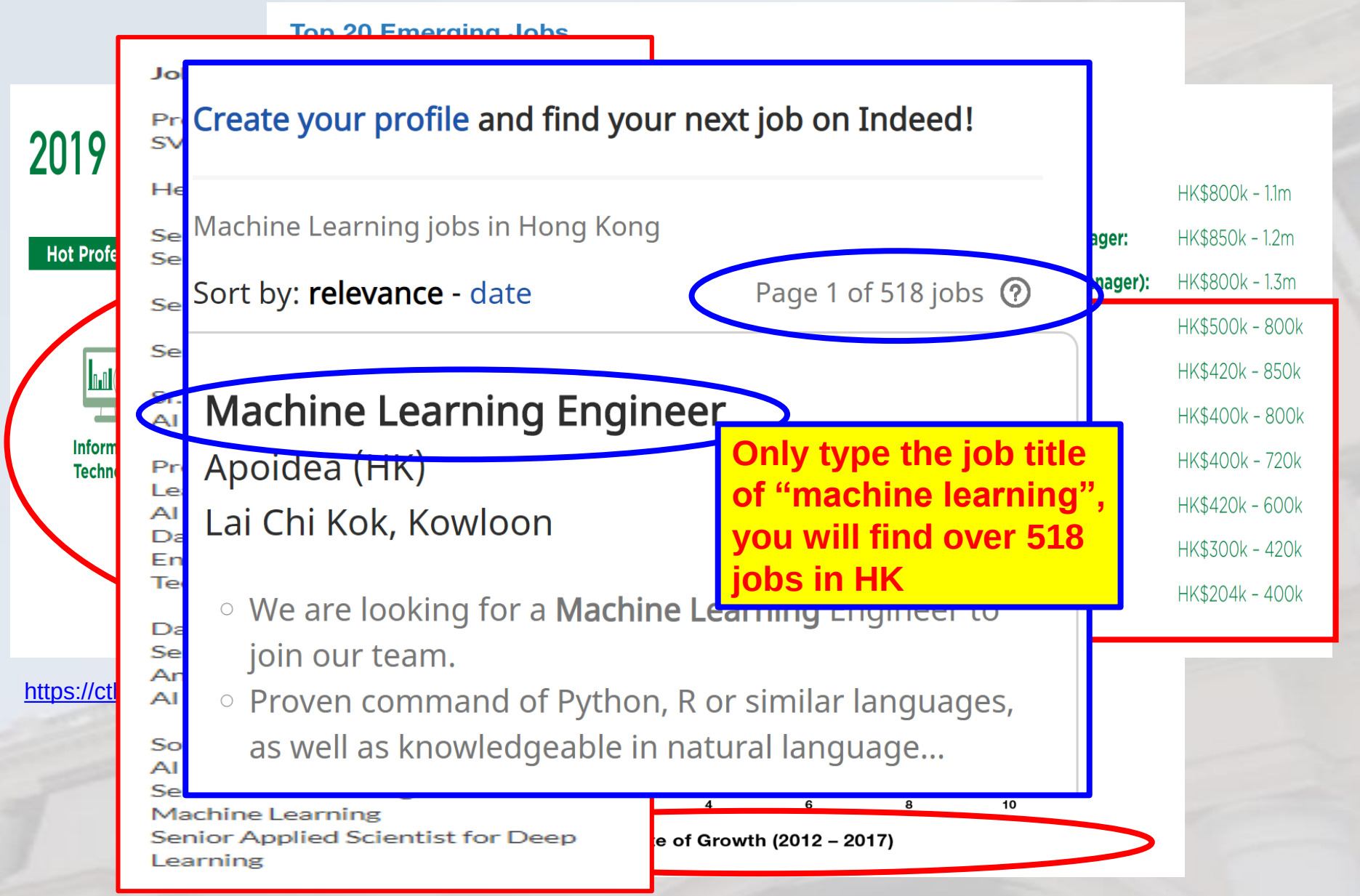
NVIDIA

SET SAIL SOFTWARE CLICKFUL SMARTRETAI

Fund3 Clare.AI ANIWEAR iMSIGHT 视见科技

FANO Labs LEXICA Emotics Analytics for Compliance eLearning 商汤 sensetime

Career Opportunities



Internship Opportunities

(in year 3 or year 4)

Potential collaboration company

MTR

PCCW

HUAWEI

ASTRI Hong Kong Applied Science and Technology Research Institute 香港應用科技研究院

TCL

WeBank 微众银行

SFC 證監會

Alibaba Cloud aliyun.com

醫院管理局 HOSPITAL AUTHORITY

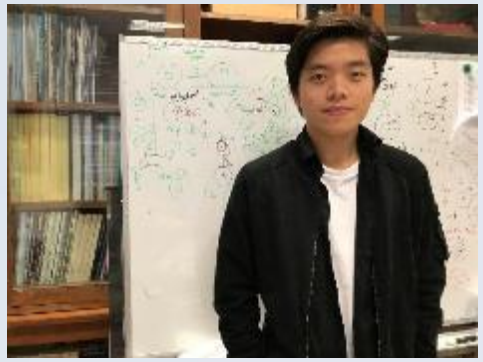
八達通 Octopus

中国银行 BANK OF CHINA

HSBC

pwc

AI Internships Experience in our Graduate Programs



Chi Chiu So, 2018 BSc(Mathematics)
PhD Student and Research Intern
at NVIDIA AI Technology Center
Hong Kong

Research Intern at NVIDIA

Internship Project:

- Using deep learning to build models on stocks, and derivative pricing and optimization
- Math requirement: Optimization and Machine Learning, Information Theory, Scientific Computing, Financial Calculus and Numerical Analysis

Associate Data Scientist at Asia Miles

Job Description:

- Use key tools of analytics and data science to come up with tangible, sustainable solutions
- Evaluate model performance and iterate to optimize

Yeung Wong, 2019 BSc(Decision Analytics), 2020 Master of Data Science (Part-time)
Associate Data Scientist at Asia Miles
1st Prize & Wisers AI Innovation Award - Data and Media Hack 2019
Grand Prize & Ontology Task Winner - TechCrunch Shenzhen Hackathon 2018

Career Advising Programme (CAP)

- Professional Preparation Programme (PPP)
- Individual consultation on cover letter, CV and interview skills
- Corporate Mentorship Programme (CMP)
- Market information workshop
- Firm visits and alumni sharing
- SAAS Career Fair

JUPAS Applicants Admissions Requirements

2020 Admission Quota
15 - 25

6224 BASc (Applied AI)

- Mathematics — Level 4
- Liberal Studies — Level 2
- Chinese Language — Level 3
- English Language # — Level 5
- Elective subject — Level 3
- Extended module 1 or 2 in Mathematics — Level 4
- Elective subject — Level 3

Candidates with level 4 in English Language and good results in other HKDSE subjects will be considered on a case by case basis.

Admissions Formula for 6224 BASc(AppliedAI)

6224

JUPAS

English

Mathematics

Extended module 1 or 2 in Mathematics

The BEST 3 of remaining Category A subjects

DSE Subjects | **Weighting**

- ✓ English language
- ✓ Mathematics
- ✓ Extended module 1 or 2 in Mathematics

× 2

- ✓ Science subject (Biology, Chemistry, Physics, Combined Science or Integrated Science)

× 1.5

- ✓ Other Category A subjects

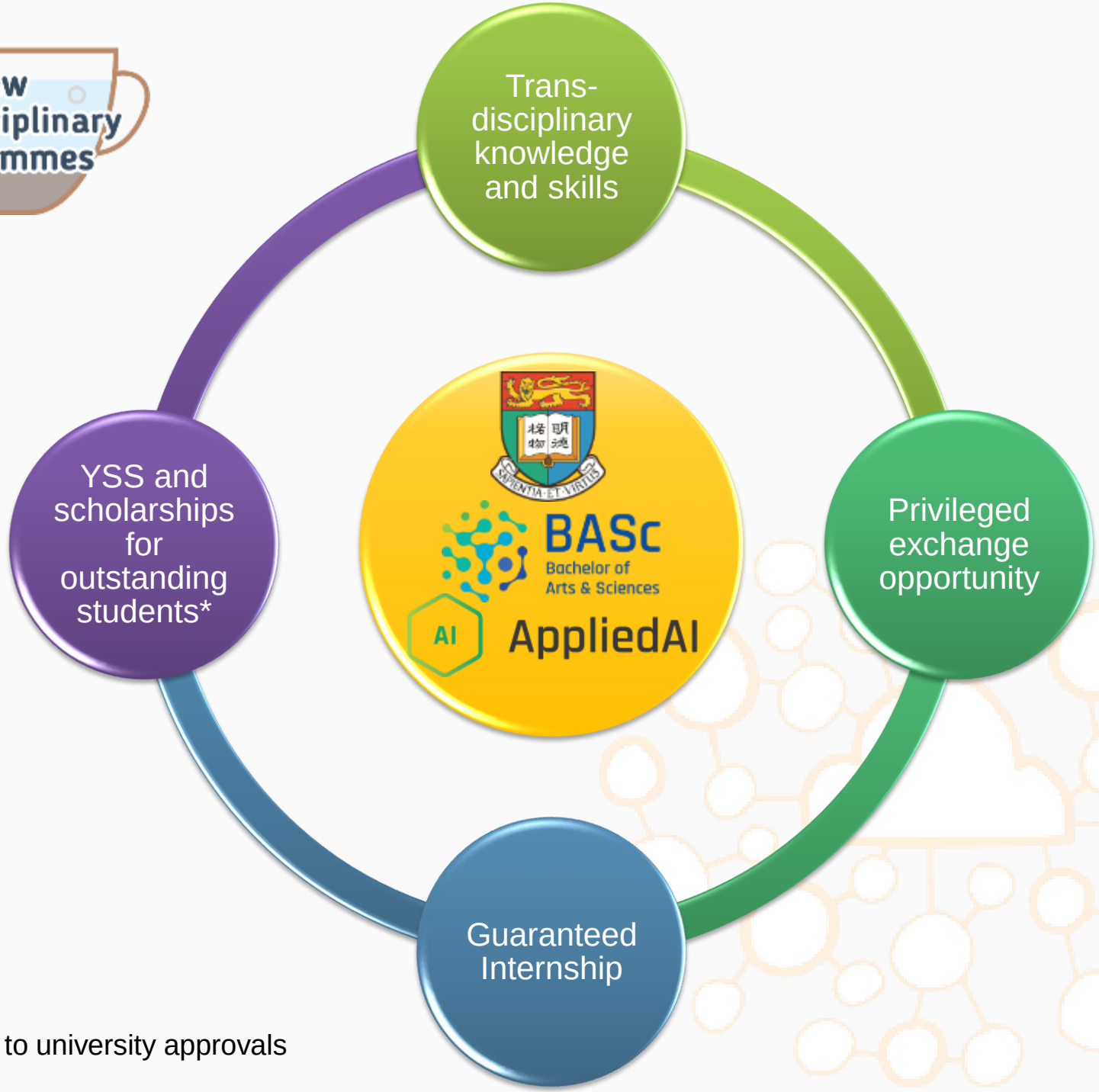
× 1

Non-JUPAS

Expected lower boundary score

- IB Diploma: 37
- GCE A-Level: 2A*, 1A
- SAT: 1350

New Interdisciplinary Programmes



* Subject to university approvals

Further Information

BASc(Applied AI) website:

https://saasweb.hku.hk/programme/ai.php

(or Google with “hku applied ai”)

- Programme
- Co-Directors

Prof. Jeff YAO
(Statistics, RRS 220)

Prof. Patrick NG
(Mathematics, RRS 424)

- Course Selection Advisers

Q&A
Email: science@hku.hk
Phone: (852) 3917 2683

Administration
General Office
Department of Statistics & Actuarial Science
Run Run Shaw Building, 3rd Floor