COMP3516: Data Analytics for IoT

Lecture 0: Course Logistics

Chenshu Wu

Department of Computer Science

2025 Spring

香 港 大 學
THE UNIVERSITY OF HONG KONG

HKU AIoT LAB
香港大學人工智能物联网實驗室

Course Information

- Time & Location:
  - Time: Tue 12:30-13:20, Fri 12:30-14:20
  - Location: **CBA**
- Instructor
  - Dr. Chenshu Wu
  - Email: chenshu@cs.hku.hk
  - Office: Rm 315B, CYC Building
  - Office hours
    - Fri: 9:00 am-10:30 am
    - **By appointment:** https://calendly.com/cswu-1/comp3516-office-hours

- Tutor
  - Mr. Sheng Lyu
    - Email: shenglyu@connect.hku.hk
    - Office: HW101
  - Office hours
    - See Moodle

Moodle Course Site

- Homepage
  - https://moodle.hku.hk/course/view.php?id=116889

  - Course Information
  - Teaching plan
  - Lecture Notes
  - Lecture/tutorial Videos
  - Assignments information
  - Announcements and Updates

  - Discussion Forum
    - Peer to peer discussions & asking questions
    - **Ask questions on Moodle** (Questions by email will be redirected to Moodle)

Course Format

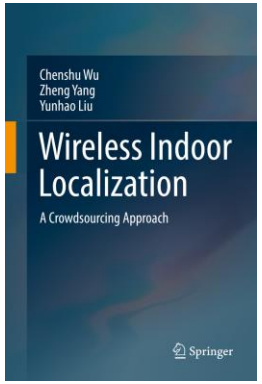
- Lectures and tutorials will be delivered *f2f* in teaching venues.
  - No real-time online streaming

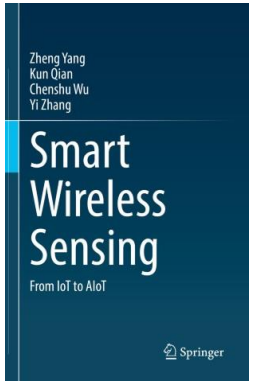
- Video-recording of lectures/tutorials
  - Will be provided during the add/drop period
  - Will be provided if I remember to do so, at best-effort (i.e., no QoS guarantee, not for every lecture)

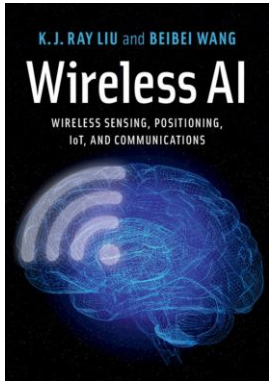
Course Information

- Material
  - Lectures: Slides, notes, research papers
  - Moodle for discussions and questions
  - No textbook is required

- Reference Books
  - Smart Wireless Sensing: From IoT to AIoT
  - Wireless Indoor Localization: A Crowdsourcing Approach
  - Wireless AI: Wireless Sensing, Positioning, IoT, and Communications

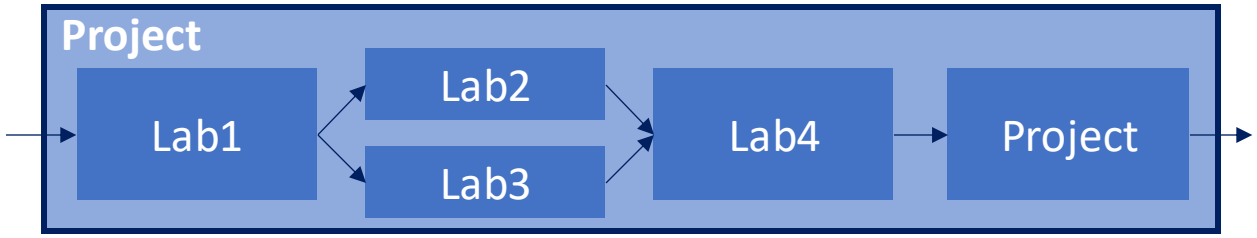






Exams and Assignments

- Two problem sets (individual assignments) [10%]
- Four labs (individual assignments) [20%]
  - Lab 1: Signal Basics
  - Lab 2: Fast Fourier Transform
  - Lab 3: Correlation
  - Lab 4: Filtering
- Course Project (group task) [30%] – NO slip days allowed.
  - Wi-Fi sensing on ESP32
  - On-campus and in-class competition!
- Final Exam [40%]
- Bonus (The Takeaway Talk) [1%]
  - Sign up on Moodle Forum



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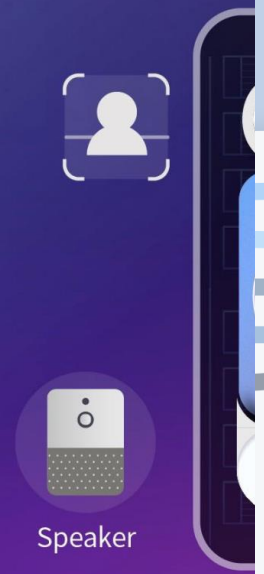
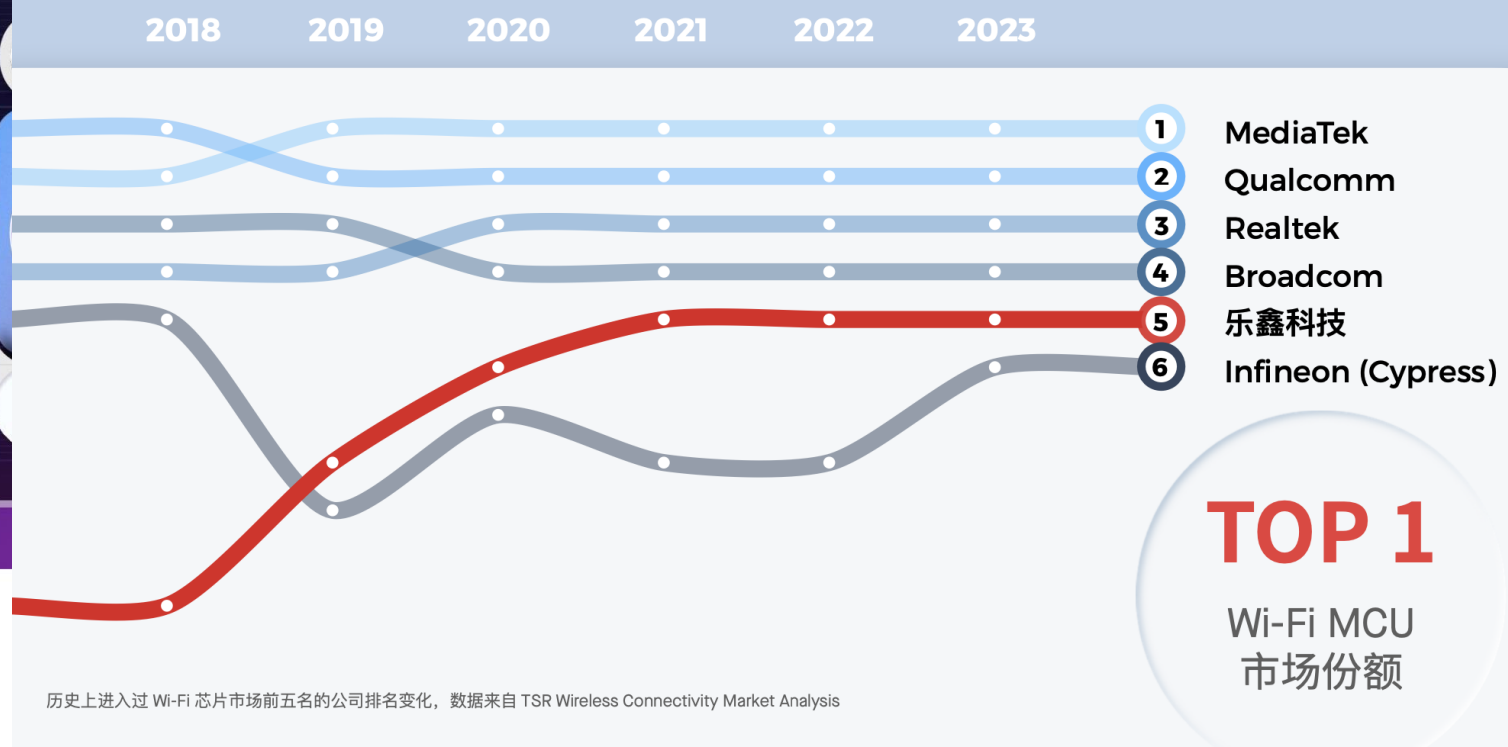


Wi-Fi 芯片市场份额



历史上进入过 Wi-Fi 芯片市场前五名的公司排名变化，数据来自 TSR Wireless Connectivity Market Analysis

TOP 1

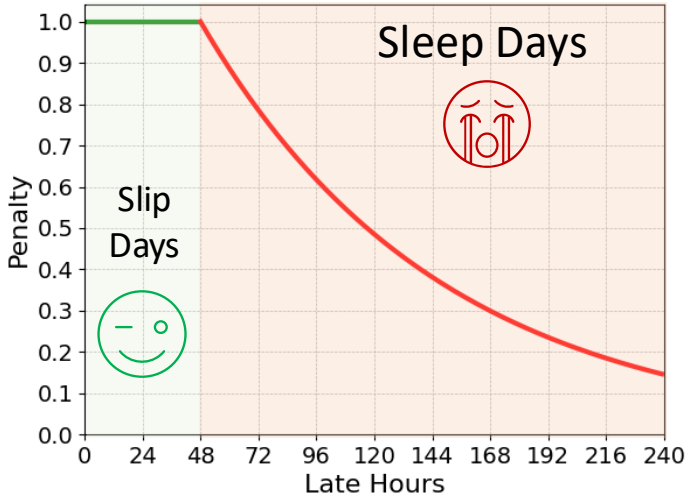
Wi-Fi MCU
市场份额

Late Submission: Slip Days Policy

- Each assignment has a due date and a due time, which will be posted on the course web page. For assignments, we will use a system of "slip days" to give you some flexibility with the assignment deadlines. **Each student starts the term with 5 slip days**, which can be used to push back assignment deadlines. Slip days work as follows:
    1) Pushing an assignment deadline back by one day (24 hours) costs one slip day.
    2) An assignment deadline can be pushed back at most three days.
    3) Partial slip days are not allowed, e.g., it is not possible to use part of a slip day to push a deadline back by six hours.
    4) Slip days are not transferable from one student to another.
    5) The slip days will be applied automatically* as is needed according to the exact timestamp of submission.
    6) A **FREE late window of 30 minutes** is allowed to accommodate potential technical issues upon submission. In other words, submissions made within 30 minutes after the deadline need no slip days to cover them.
    7) **All the thresholds will be observed strictly**. For example, a submission that is late for 1801 seconds (i.e., 30 minutes plus 1 second) will use one slip day.
- **Assignments that are submitted late (with not enough slip days to cover them or more than 3 days) will still be accepted, but deducted to $p = 0.99^t$, where t is the uncovered late time rounded up in hours.**

* Let D be the deadline, and T your submission timestamp. The number of slip days that will be used for a submission, noted as SD, is calculated as follows:

```
if (T - D) <= 30 minutes, SD = 0;
else if (T - D) <= 24 hours, SD = 1;
else if (T - D) <= 48 hours, SD = 2;
else if (T - D) <= 72 hours, SD = 3;
else SD = 0 & mark *= p.
```



Example: If you have 2 remaining slip days, and are late for four days, you still get 60% of your original score.

v3.0 2024 Spring

Plagiarism

- Plagiarism is a disciplinary offence. Any student who commits the offence is liable to disciplinary action
  - https://tl.hku.hk/plagiarism/
- We will make use of software tools to check against your submitted assignments
  - If we identify any suspicious cases, we will invite you to explain to us
  - Both the student who copies other's work and the student who offers his/her work for copying shall be penalized.
- We will follow the departmental guidelines on handling any cases relating to the practice of plagiarism
  - "Both the student who copies other's work and the student who offers his/her work for copying shall be penalized."
- **AIGC/ChatGPT Policy**
  - You are **allowed, and encouraged**, to use any AIGC tools including ChatGPT.
  - You must acknowledge every single place where you use AIGC tools, including the mini-exercises, problem sets, programming assignments.

Course Information

- Prerequisites: MATH1853 or MATH2014; and COMP2119
  - This is an undergraduate course
  - Basic math and signal processing: probability, matrix, complex numbers, …
  - Undergraduate courses on networking, DSP, wireless communications are a plus
  - Python programming (for labs) and others (depending on your project)

Scope of this course

- This course is about …
  - … concepts, technologies, and applications of IoT and AIoT
  - … learning how to sense signals from the physical world
  - … developing sensing and learning solutions to extract information
  - … designing IoT systems that solve practical problems

- Warning 1: The course will be in general challenging for most HKU CS students without relevant background and/or strong motivation to learn.
- Warning 2: The workload is HIGH (but FUN too)!!
- Warning 3: Difficult at the beginning, but gets better when going deeper.

Scope of this course

- This course is NOT about …
  - … machine learning or deep learning
  - … data science
  - … theories in digital signal processing, statistics, wireless communications, computer networks, …
  - … building hardware/circuits
- (instead, we may use these as tools)

Topics

- Introduction
- Connectivity
  - Wireless networks
  - Wireless protocols
  - Wireless communication
- IoT Signals & Data
  - Signal basics
  - Time-frequency
  - Periodicity/Correlation
  - Detection
  - Filtering
  - Similarity
- Radio Analytics: mmWave Sensing
  - Range Estimation
  - Doppler Estimation
  - Angle Estimation
- Radio Analytics: Wi-Fi Sensing
  - Channel State Information
  - Signal modeling
  - Motion detection
  - Breathing rate estimation
  - Speed estimation
- Mobile Analytics: Mobile sensing
  - Inertial sensors
  - Sensing applications
- Location Analytics: Localization
  - Fingerprinting
  - Triangulation/Trileteration
  - Inertial Tracking
- Edge AI
  - Deep Wireless Sensing
  - Edge Learning
- Selected advanced topics

Teaching Plan & Schedule

Week	Mon	Tue (CBA)	Wed	Thu	Fri (CBA)
01		21/01 Course Overview, Intro			24/01 Introduction to IoT
02	27/01 *Happy*	28/01 *Chinese*	29/01 *New*	30*/01 Year*	31/01 *!*
03	03/02 Labs Release	04/02 Wireless Communication			07/02 Basics of Signals
04		11/02 Lab 1&2 Tutorials		13/02 Lab 1 Due	14/02 mmWave Sensing
05	17/02 Problem Sets Release	18/02 mmWave Sensing		20/02 Lab 2 Due	21/02 *Wireless Channel and CSI*
06		25/02 Lab 3&4 Tutorials		27/02 Lab 3 Due	28/02 WiFi Sensing
07	03/03 Project Release	04/03 WiFi Sensing		06/03 Lab 4 Due	07/03 Sensing Systems
08	10/03 Reading	11/03 Week	12/03 Enjoy	13/03 Or	14/03 Work?
09		18/03 Sensing Systems			21/03 Mobile Sensing
10		25/03 Indoor Localization		27/03 Problem Set 1 Due	28/03 Indoor Localization
11		01/04 Thermal Sensing			04/04 *No class*
12		08/04 Deep Wireless Sensing		10/04 Problem Set 2 Due	11/04 Deep Wireless Sensing
13		15/04 Edge AI			18/04 *No class*
14		22/04 Edge AI		24/04 Project Due	25/04 Advanced Topics
15		29/04 Course Summary			02/05 Project Presentation/Competition

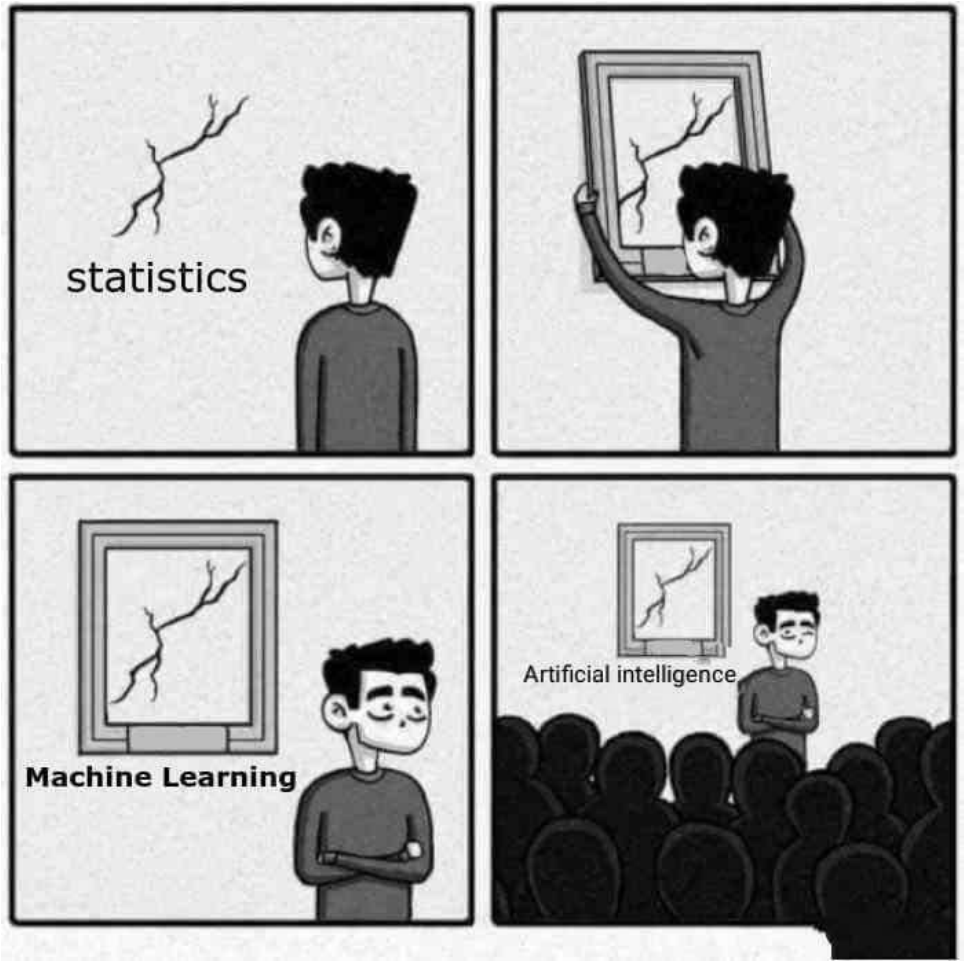
* Schedule and topics may be subject to changes.

Why invest time on this course?

- (1) Want to know my world

Why invest time on this course?

- (2) Want to learn a bit more about machine intelligence beyond computer vision



Why invest time on this course?

- (3) Want to join industry?

IoT Statistics: What is the IoT Market Size?

5. Companies Could Invest Up to $15 Trillion in IoT by 2025

Many companies have already identified IoT devices as a clear value-add for their business. Far from just the technology sector, clothing manufacturers, healthcare providers, and municipalities around the world are investing in new ways to leverage the potential of interconnected devices.

With so much capital pouring into research and development, it's safe to assume that the IoT market size of the next decade will look very different

Reference: https://www.vxchnge.com/blog/iot-statistics

Why invest time on this course?

- (3) Want to join industry?

8. By 2024, the Global IoT Healthcare Market is Expected to Reach $140 Billion

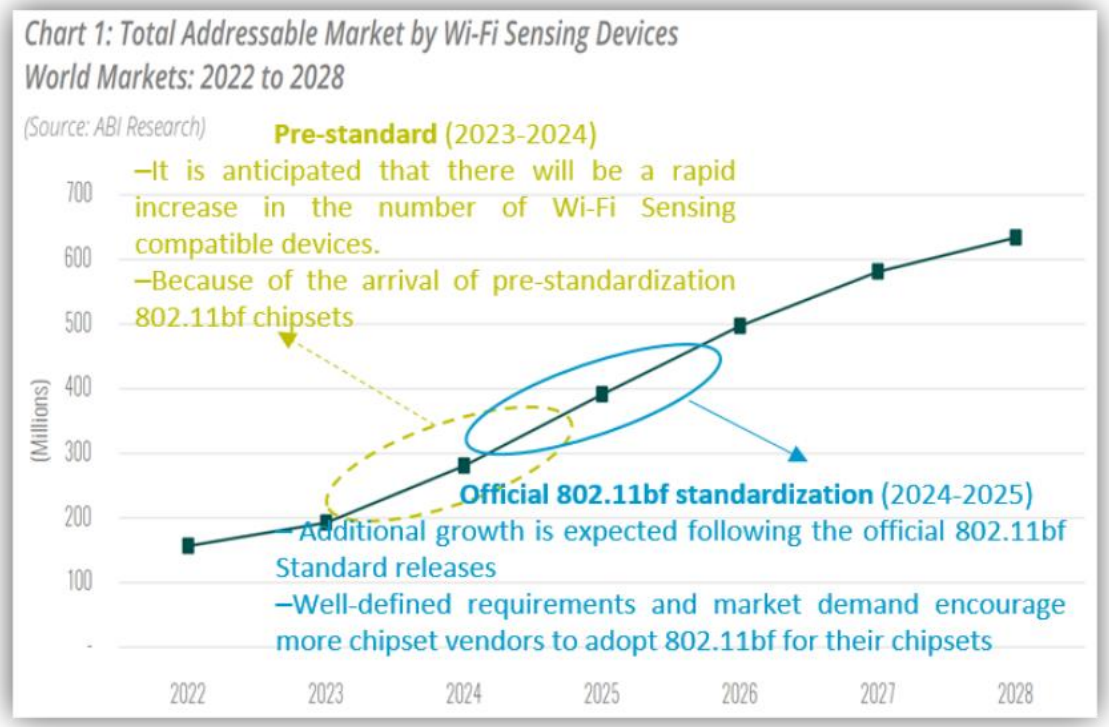
Healthcare is one of the most exciting use cases for IoT technology, which is why the market in that sector is expected to grow by 12 percent annually from 2017 to 2023. The potential of telemedicine and wearable sensors will make it possible for medical professionals to better monitor and treat patients, especially in traditionally difficult-to-reach regions. Although the healthcare sector faces unique challenges owing to the compliance demands of HIPAA/HITECH requirements, improvements in IoT security will help the technology to be applied more broadly in the coming years.

Reference: https://www.vxchnge.com/blog/iot-statistics

Why invest time on this course?

- (3) Want to join industry?

Total addressable market [1]

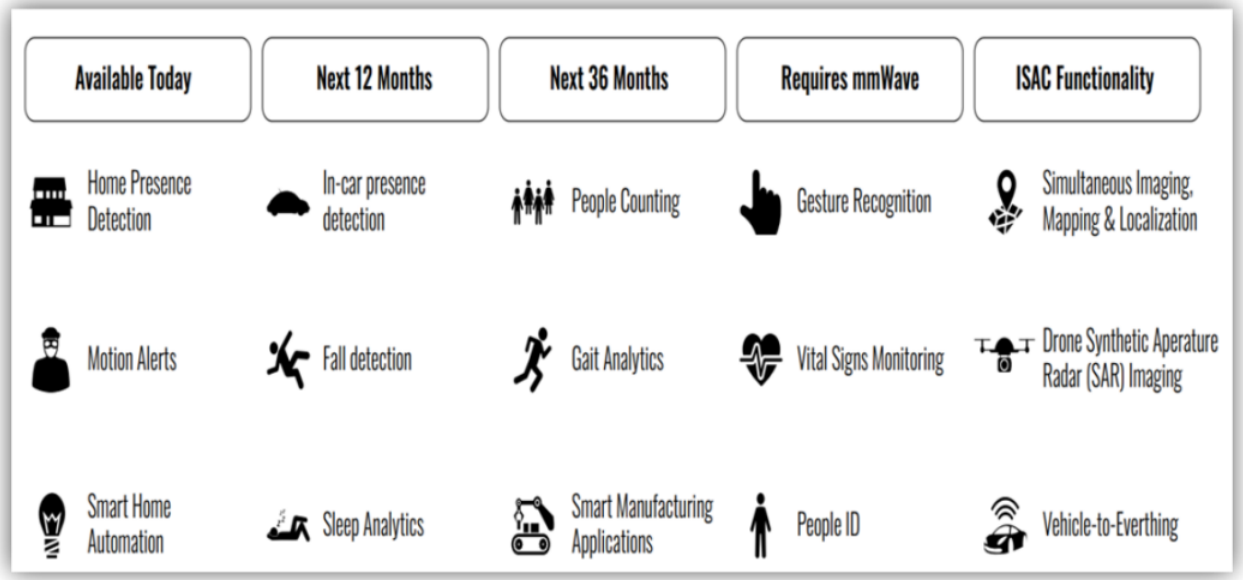


Promising technology and Market !!!

Awards ¥720,000

https://competition.huaweicloud.com/information/1000041958/introduction

Roadmap of use cases for Wi-Fi sensing [1]



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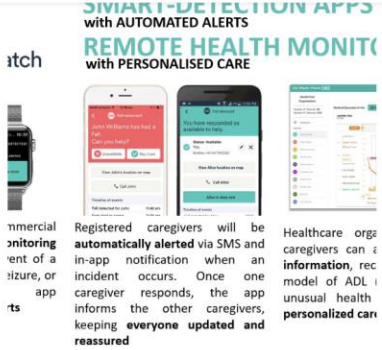
FABRIC FLOOR
Japan - France Bed Co., Ltd.

Fadelisy - AI Fall Detection System
HKSTP - BNET-TECH Company Limited



Fall Alert - My Medic Watch
Australia NSW - My Medic Watch

Fall Detection Devices and System
Kerry Medical Limited

Fall Detection System

Fall Detection System
HANSHIN TECHNOLOGY LIMITED

Fall detection System
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Why invest time on this course?

- (4) Looking for a research direction

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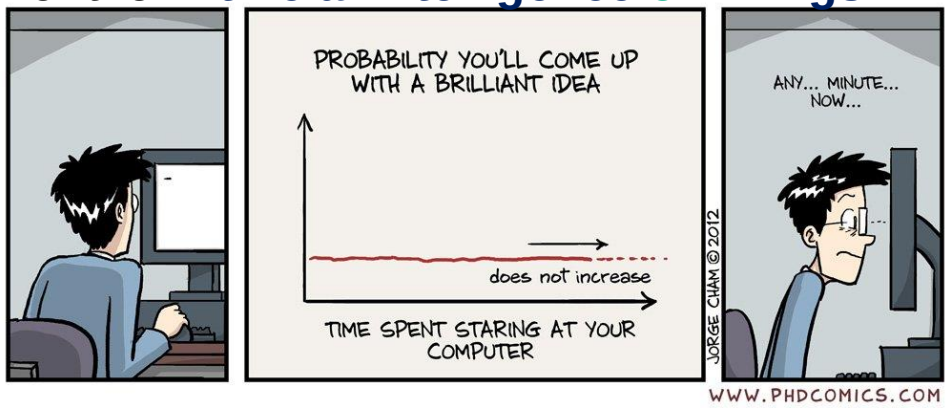
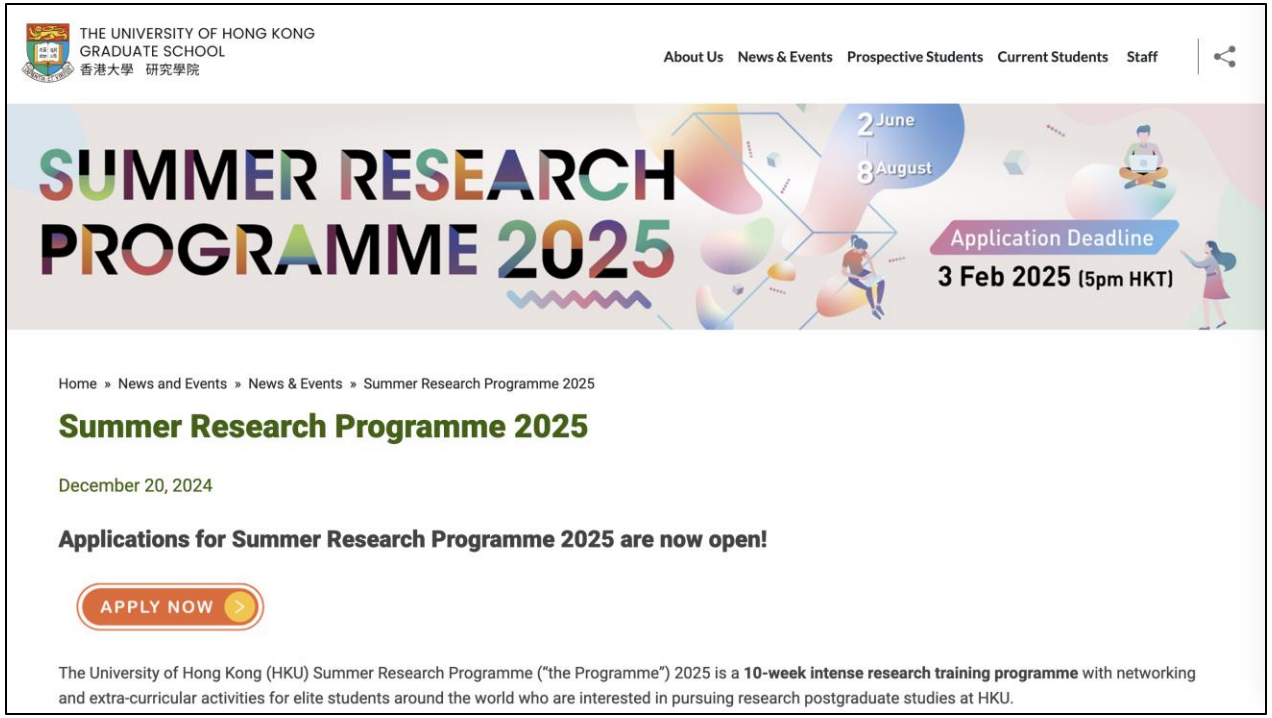
working on **A**dvanced **I**nnovations **o**f **T**echnologies
for the **A**rtificial **I**ntelligence **o**f **T**hings





Two successful cases (100% success rate for HKU UG) in our lab

Why invest time on this course?

- (5) Just have FUN!!
- Course project 2024S

Questions?

- Welcome aboard!