

# Course Summary

2023 Fall COMP3230A

# Assignment Review

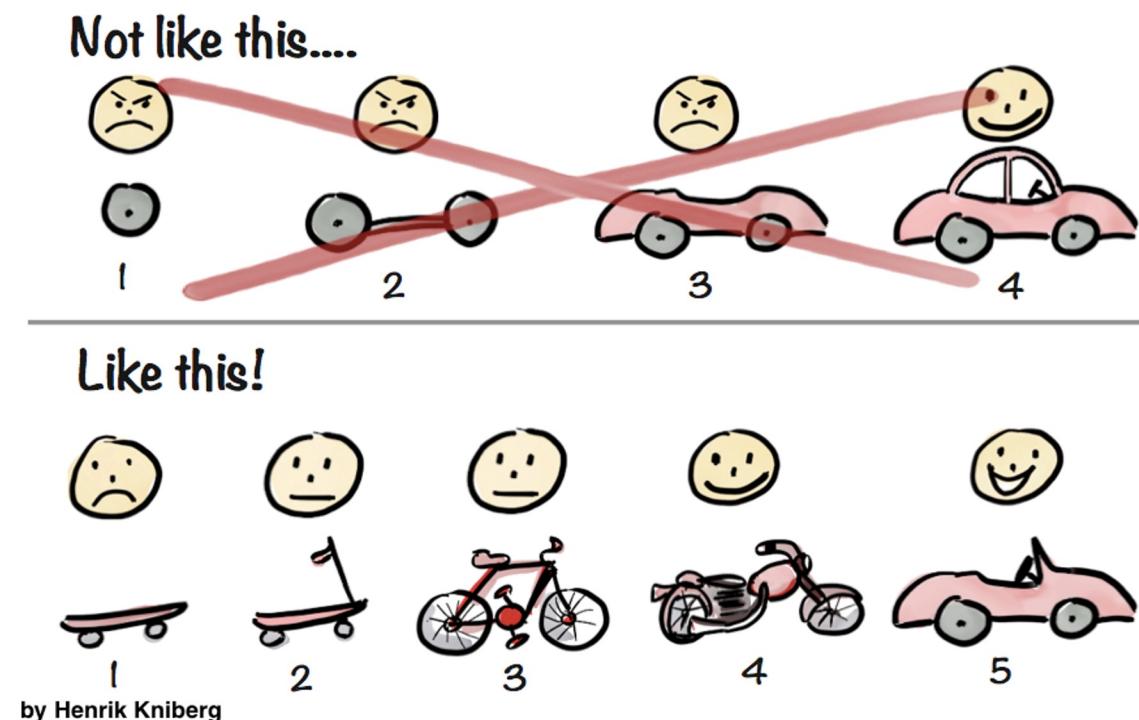
- Problem Set #1
- Problem Set #2
- Midterm
  - Highest: 97.5
  - Average: 64
  - Median: 62
- Problem Set #3
  - **Deadline:** November 30, 2023, 23:59
  - Answers to be released three days after the set deadline: 4<sup>th</sup> December, 2023

# Final Exam Arrangement

- Time: **Dec 13, Wed 2:30 pm - 5:30 pm**
- Location: **CPD-LG.07-10, Centennial Campus**
- Format: **Open book**
  - This is an open book examination.
  - Candidates may bring to their examination any **printed/written** materials (No computer/Internet is allowed).
  - Tips: Print lecture slides in proper size...

# Final Exam Arrangement

- 7 questions totaling 100 points
  - ~~1 T/F question (10) + 1 Multiple-choice question (10) + 5 short answer questions~~
  - 1 Multiple-choice question (5) + 6 short answer questions
  - NOT (necessarily) arranged in increasing difficulty; some easier questions may appear later!
- Answer ALL questions!

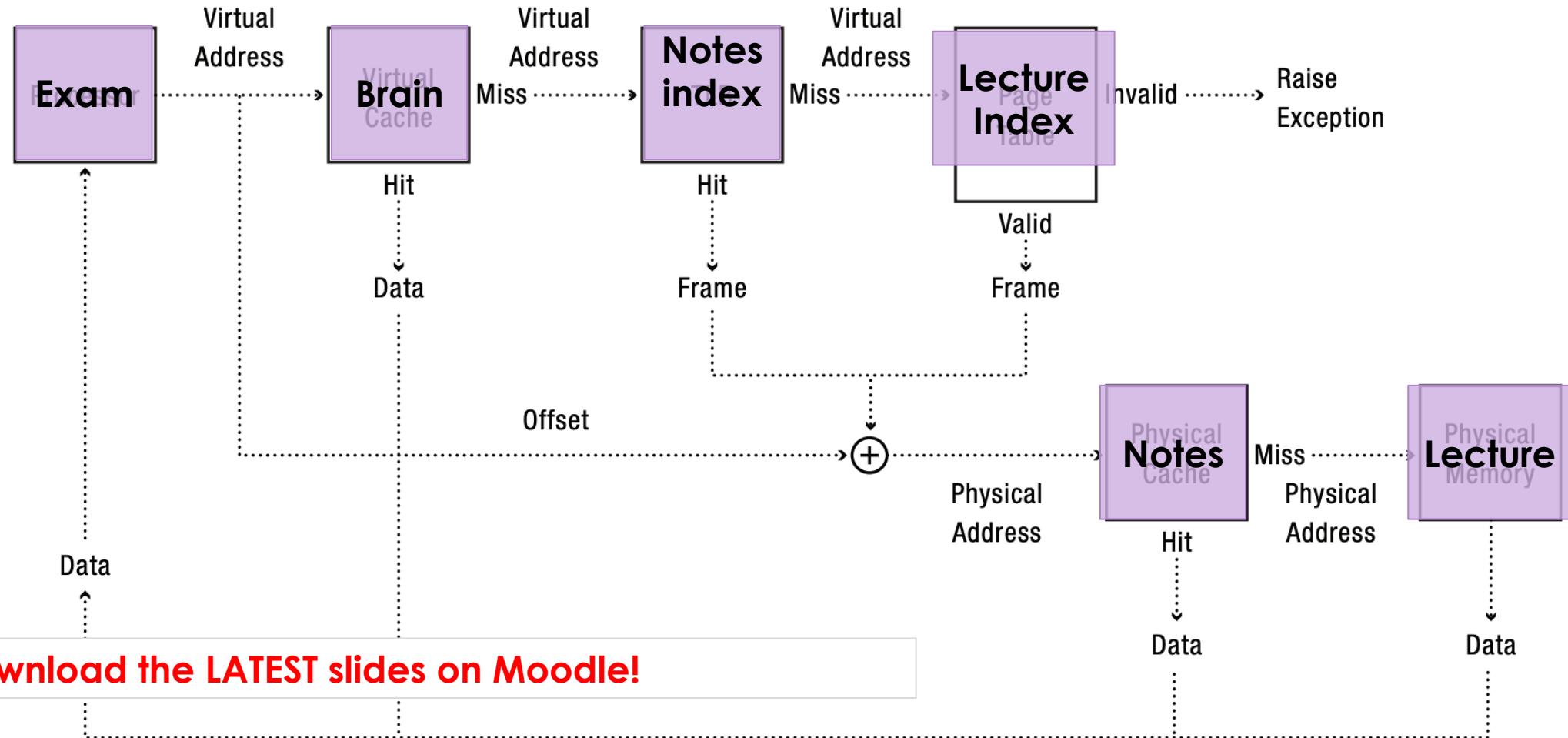


Best “Scheduling” policy for final?

# We've learned a lot about OS!

- OS Concepts, core services, architectures
- **Virtualization**
  - CPU Virtualization
    - Process Abstract
      - Address space
      - Process states
      - Process control block
      - Process operations API
      - Signals
    - Limited Direct Execution
      - System calls
      - Context switch
      - Interrupts
    - Scheduling
      - Scheduling metrics
      - FIFO, SJF, HRRN, STCF, RR, MLFQ
      - Multi-core scheduling, Linux CFS
  - Memory Virtualization
    - Address space
    - Address translation: dynamic relocation
    - Segmentation
    - Paging
    - TLB
    - Multi-level paging
    - Inverted page table
    - Swap space
    - Page replacement policy: FIFO, LFR, LRU, Clock
    - Thrashing
- **Concurrency**
  - Thread
    - POSIX threads (pthreads)
    - Race conditions, critical sections, mutual exclusion, atomic operations, synchronization
  - Locks
    - Atomic instructions: test-and-set, compare-and-swap
    - Mutex locks
  - Condition Variables
    - Pthread CVs
    - Producer-Consumer problem
  - Semaphores
    - Binary Semaphores
    - Counting Semaphores
    - Ordering
    - Readers-Writers problem
  - Deadlock
    - Dining philosophers' problem
    - Four necessary conditions
    - Deadlock prevention, avoidance, detection&recovery
- **Persistence**
  - I/O devices (HDD, SSD)
  - Files and Directories
    - Inode
    - File descriptor
    - Hard/Symbolic links
  - File System Implementation
    - On-disk data structure
      - Superblock, Bitmap, Inodes, Data blocks
    - Free space management
      - Bitmap, linked-list, block-list
    - Caching and buffering
    - Access control and protection
    - Journaling file system
      - Data journaling
      - Metadata journaling
- **Advanced Topics**
  - ~~Processing-In-Memory~~
  - ~~OS Security~~
  - ~~Mobile and embedded OS~~

# Tips for Final: Recall the VM System



# Again, really, why do we learn OS?

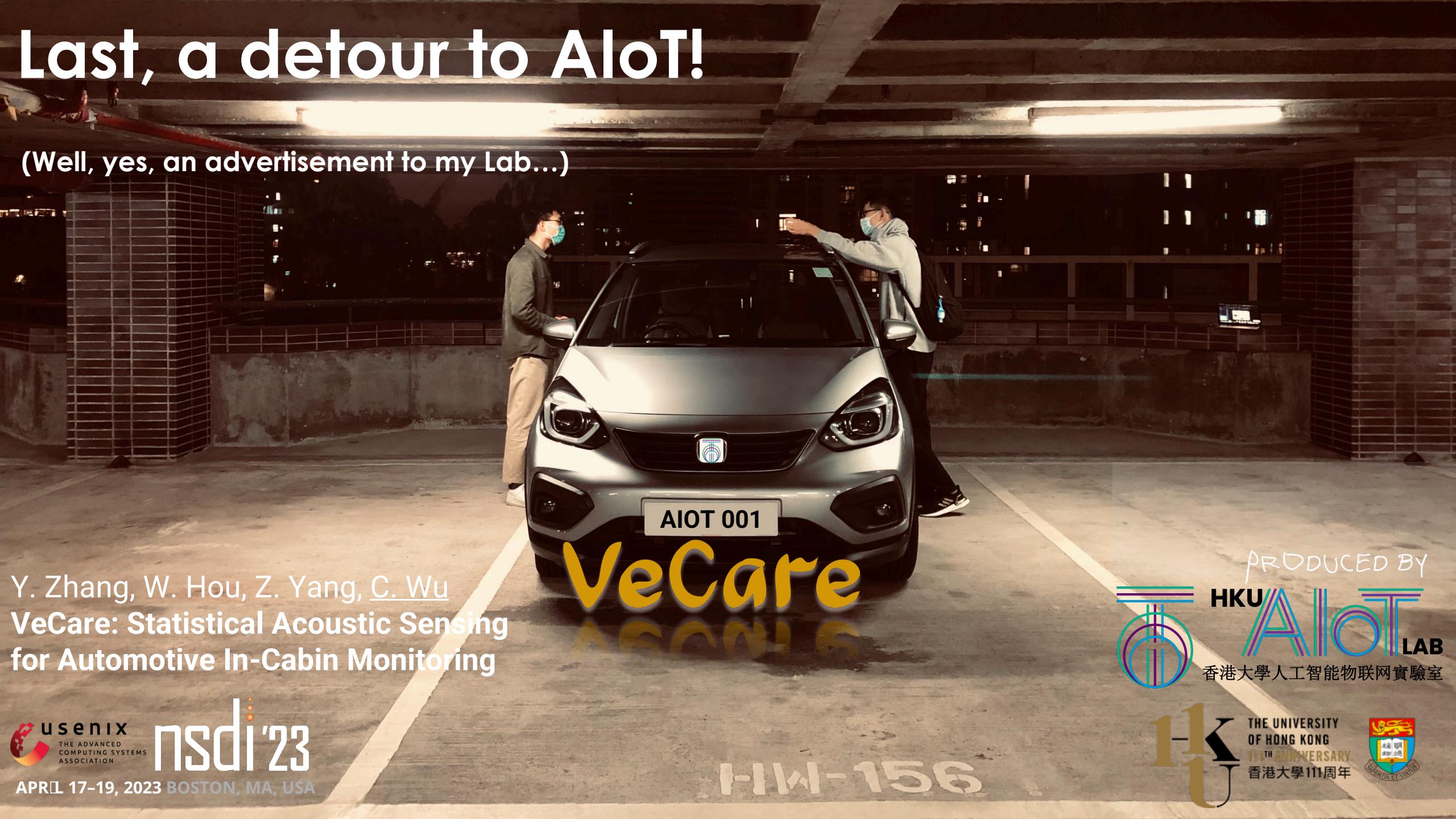
- Voices from past students (in jobs/job interviews):
  - “What happens inside the OS when you run “./a.out” from the shell?”
  - “I did my internship at xxx, a cryptocurrency exchange in Hong Kong as a Full Stack Developer. During that time, I realised how important the concepts of the OS course were in the real world. There were many instances about handling multithreaded and concurrency which I faced.”
- (You're more than welcome to email me if you encounter OS-related questions in your job/job interviews!)

# **Wait, I'm not gonna join the IT industry...**

- Engineering is nothing but trade-off.
- There is no perfect solution, but there is always a solution.
- May the SYSTEMS THINKING be with you!

# Last, a detour to AloT!

(Well, yes, an advertisement to my Lab...)



Y. Zhang, W. Hou, Z. Yang, C. Wu  
**VeCare: Statistical Acoustic Sensing  
for Automotive In-Cabin Monitoring**

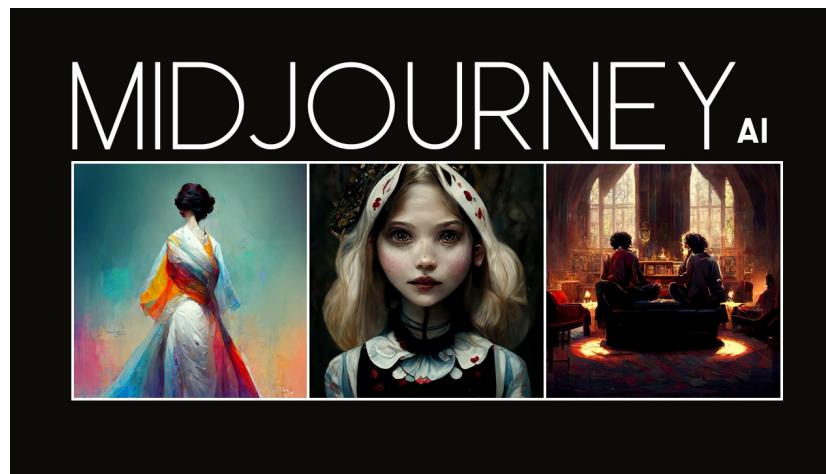
**nsdi'23**  
APRIL 17-19, 2023 BOSTON, MA, USA

PRODUCED BY  
**HKU AloT LAB**  
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**111** THE UNIVERSITY  
OF HONG KONG  
111TH ANNIVERSARY  
香港大學111周年



# Today's AI Has Achieved Big Success



Cannot see in the dark or through the wall

# AI Also Has “Big” Problems...

A detailed 3D rendering of a Tyrannosaurus Rex standing in a prehistoric landscape. The dinosaur is shown from the waist up, facing slightly to the left. Its skin is textured with scales and has reddish-brown spots. The background features rolling green hills under a clear blue sky.

GET SMALL, GET PHYSICAL

TOO BIG

VIRTUAL

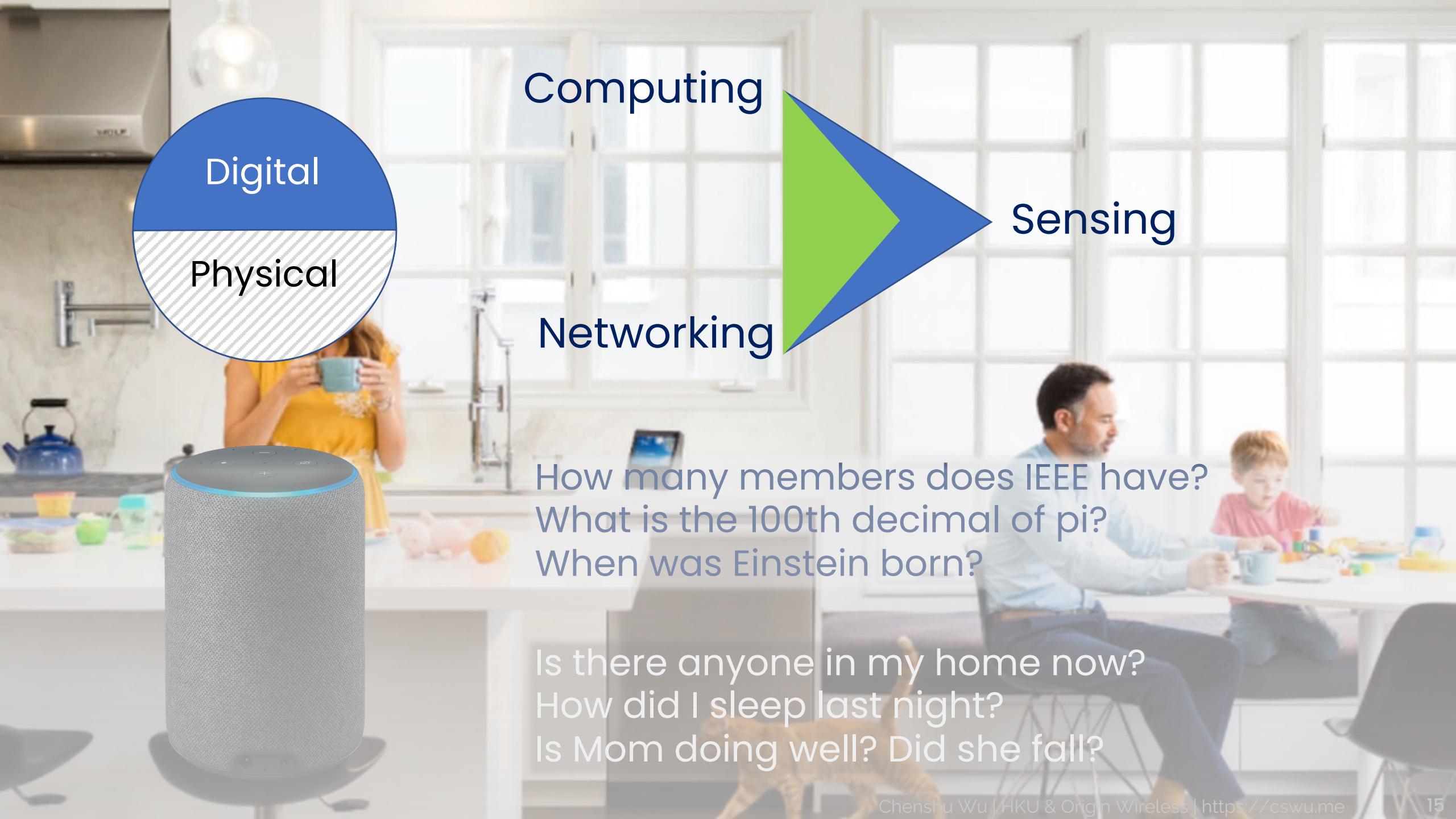
**Still using Wi-Fi for the Internet ONLY?**

**You are missing a lot!**

# Wireless Sensing AI

Sensing the Physical World by  
Leveraging Pervasive Wireless Signals

Wi-Fi All-in-one Sensor



Computing

Digital

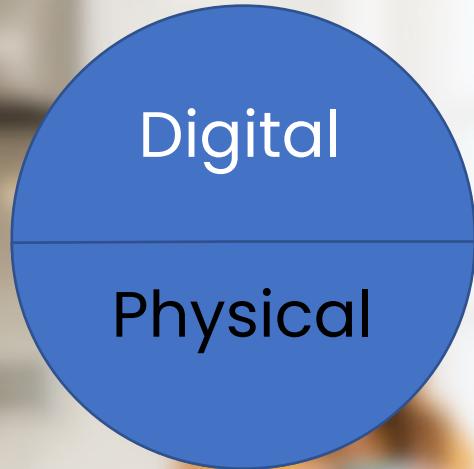
Physical

Sensing

Networking

How many members does IEEE have?  
What is the 100th decimal of pi?  
When was Einstein born?

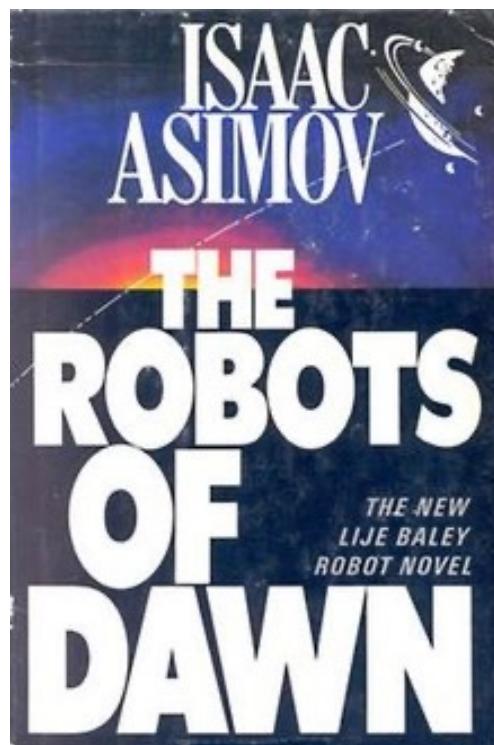
Is there anyone in my home now?  
How did I sleep last night?  
Is Mom doing well? Did she fall?



## Wireless Sensing AI

Equip connected devices with sensing AI  
to bridge the cyber and physical spaces

# 40 years ago...



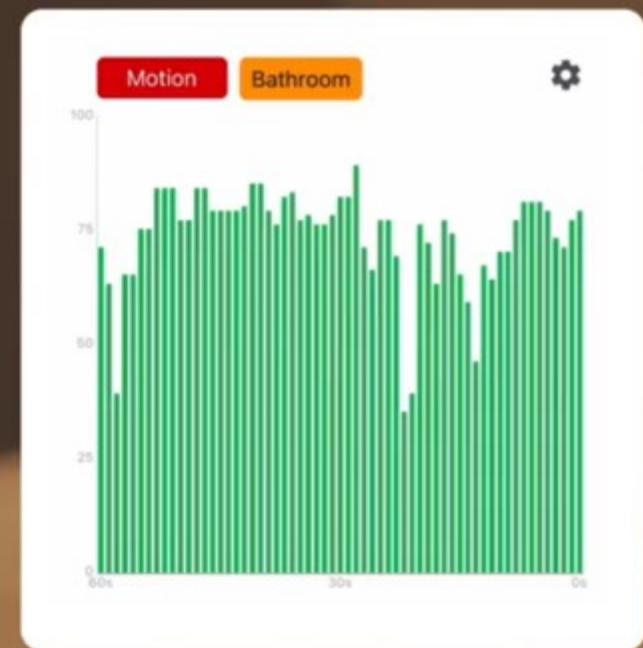
“

You lift your arm whenever you want something, and the robots always know what it is. How did this one know you wanted tea served?"

"Every time I lift my arm, it distorts a small EM field that is maintained continuously across the room. Slightly different positions of my hand and fingers produce different distortions, and my robots can interpret these distortions as orders."

-- Isaac Asimov, "The Robots of Dawn", 1983

**Wireless Sensing AI**





# WiFi Sensing is LIVE!

10/10/2022 | Products & Plans | Home & Entertainment

**Verizon launches new tech to monitor activity on home WiFi**

Media contact(s)

Caroline Brooks  
908-809-2678  
[caroline.brooks@verizon.com](mailto:caroline.brooks@verizon.com)

Home Awareness and Device Identification offer customers enhanced visibility and sense of security in the home



**3.5M**  
**verizon**✓  
**Routers**

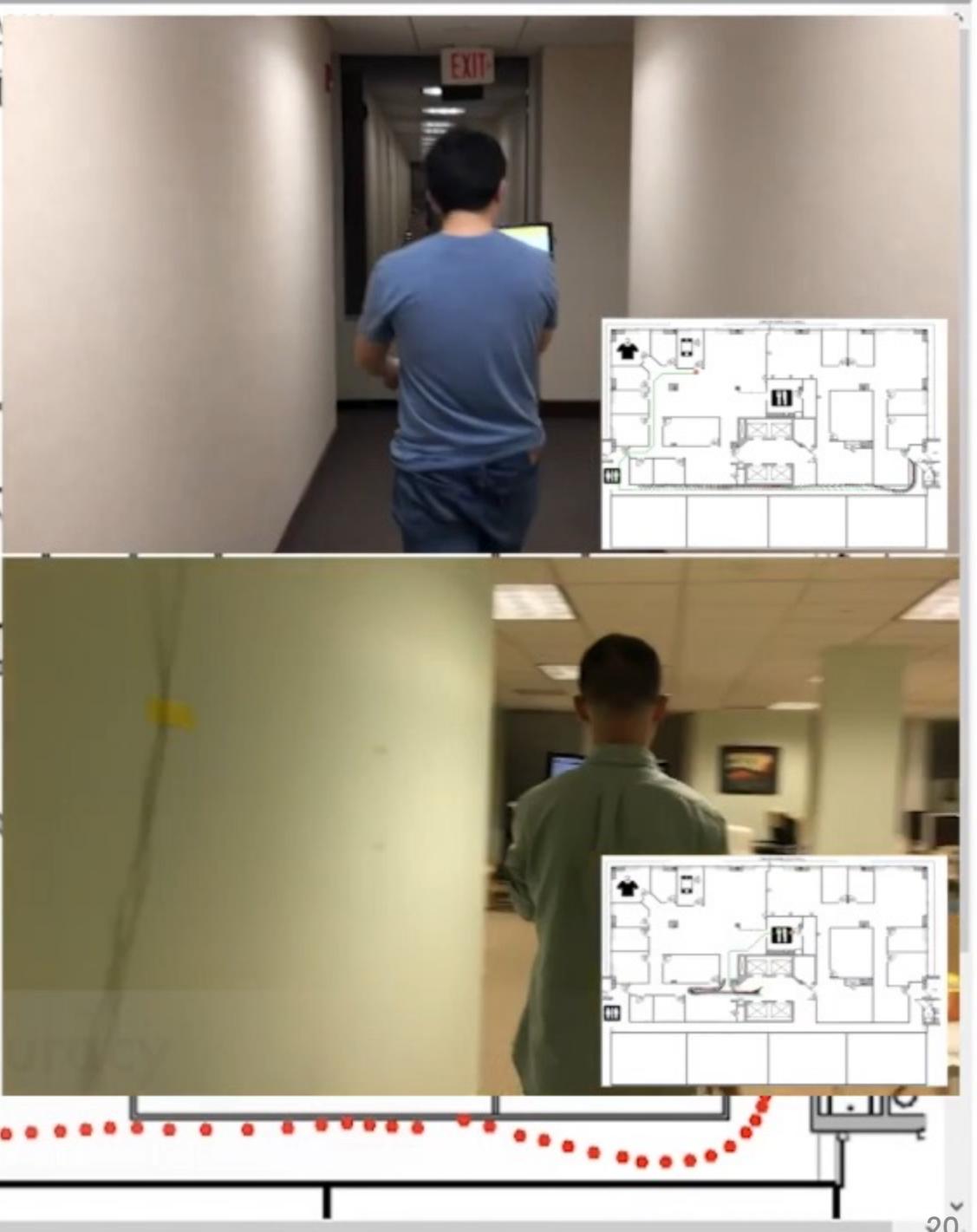
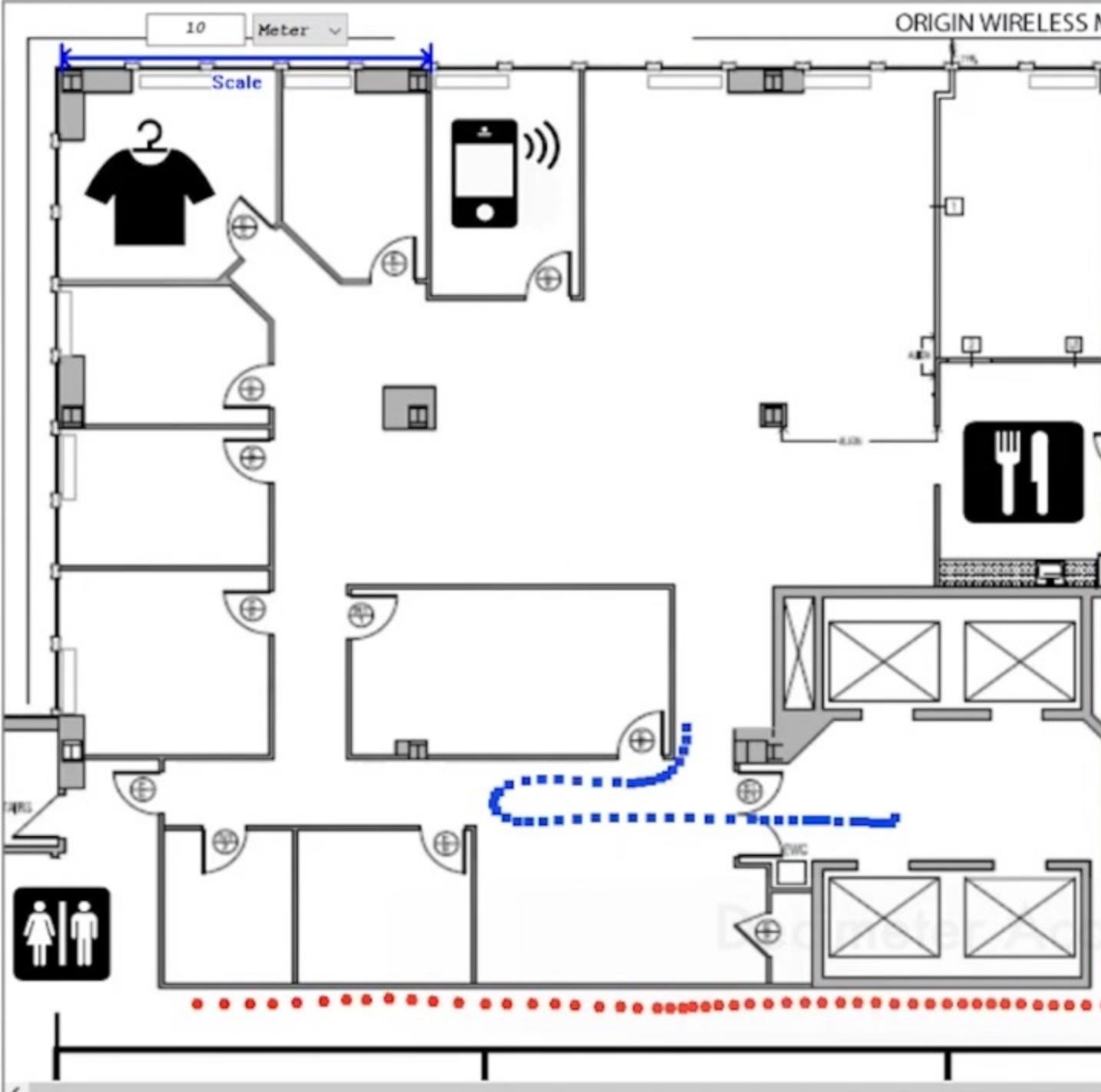
Largest wireless carrier in the United States

**150M**  
**Signify**

**IoT Devices**  
One of the world's largest lighting company  
Formerly known as Philips Lighting

**YOUR LIGHTS ACT AS MOTION SENSORS**

WiZ SpaceSense™ works wonders for smart home lighting





The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.  
-- Mark Weiser (1991)



# What can be done further?



JOIN US!

🏠 <https://aiot.hku.hk/>

🏠 <https://cswu.me>

✉️ [chenshu@cs.hku.hk](mailto:chenshu@cs.hku.hk)



# Student Feedback on Teaching and Learning (SFTL) Exercise

<http://sftl.hku.hk/>



Thank you!

**Message from Faculty of Engineering**

We value your opinion. Please spend a few minutes to complete the SFTL survey. Your feedback and suggestions are important to our ongoing efforts to enhance the quality of your learning experiences.

**Survey Period**

November 6, 2023 (00:00) - December 4, 2023 (23:59)

**Gift Exercise**

As a token of appreciation, we will offer you a HK\$25 coffee shop gift certificate if you participate in this gift exercise and complete 75% or more of your total SFTL forms during the survey period mentioned above. The detailed arrangement for gift collection will be announced by the Faculty Office.

I would like to participate in the gift exercise and give my consent to the Teaching and Learning Innovation Centre (TALIC) to inform the Faculty of Engineering of my SFTL completion rate for gift arrangement if I complete 75% or above of my total SFTL forms.

Kindly note that the anonymity of your survey responses is assured regardless of your choice for this item.

**Submit**

The Faculty of Engineering will give out a \$25 Starbucks coupon to each UG student who has completed 75% or above of the total SFTL form.

# Thank You for a great semester!

- Thank you all for your efforts and dedication to the course!
- Thanks to everyone who has managed to attend in-person class all/most of the time!
- Thanks also go to those who could have but seldomly/never appeared in class!
  - By giving up your “CPU cycles/memory space”, you kindly allowed us a more spacious and potentially safer classroom!
- Bye!