

EES9900A: Mobile Computing, Sensing, Learning, and Interactions



Logistics





Course info

- **When:** Mon & Wed 1:00 – 2:15 PM
- **Where:** Here 😊 N1, Room #111
 - We will be **offline only** (or online only when necessary)
- Course website: <http://mobility101.org> (or <https://nmsl.kaist.ac.kr/courses/ee59900a/>)
- Teaching staff mailing list (Prof & TAs): ee59900a@nmsl.kaist.ac.kr
- Q&A, discussion: <https://campuswire.com/p/G06180F78>





Accessing CampusWire

- <https://campuswire.com/p/G06180F78>
- Use code 4645
- Must use your **@kaist.ac.kr** email to join
- Use CampusWire for questions related to course and course content; use course email only for personal questions or issues





HELLO!

I am Sung-Ju Lee

PhD in Computer Science, UCLA (2000)

Worked in the Silicon Valley for 15 years

Became a professor at KAIST in 2015

Research in mobile computing, AI, HCI, security





Teaching Avengers!



Hyunhee
Cho



Adiba
Orzikulova
(Head TA)



Doyun Park



Seokwon
Yang





Office Hours

- Professor
 - By appointment: put “[ee59900a]” on email subject
 - We can meet or zoom
- TAs
 - By appointment
 - Email to ee59900a@nmsl.kaist.ac.kr to arrange





Prerequisite

- Basic programming skills
- General understanding of networking, systems, machine learning
- Passion and interest in mobility and research
- Strong work ethic





About this course

- This is an advanced course on a subject that changes rapidly
- You will read lots of papers
- You will write and present
- You will design and deliver a project
- You will think a lot





No Textbook

- There is no required textbook
- We will read many seminal papers and recent trend setting papers in mobile computing, sensing, machine learning, wearables, mobile health, interactions, etc.





How we'll run this course

- I will lecture the initial part of the course on
 - The fundamentals and history of mobile computing
 - Wireless connectivity (for in-depth, take Prof. Song Min Kim's companion course)
 - TCP over wireless
 - Wireless network architectures
 - On-device AI & federated learning
 - etc.





How we'll run this course

- Students will present papers and project
 - Preliminary paper list on the webpage
 - I update the list of papers every course
- Lots of discussion



Grading

Quizzes	15%
Assignments	30%
Project	25%
Presentations	20%
Participation	10%





Quizzes [15%]

- No midterm or final exams 😊
- There will be quizzes throughout the semester
 - They may be announced or *unannounced*
 - There will be many *open ended* questions
 - Some might be “take home” quizzes





Assignments [30%]

- Reading assignments and essays (6 to 8 essays)
- Essays
 - Max 500 words
 - *Not just a summary*, but your opinion of the paper (e.g., what you like/dislike about the paper, what you think are the strengths and shortcomings of the paper, how it inspires you, your idea on follow on work, etc.)
- Android & on-device AI programming assignments (2)
 - Mobile app development tutorial on **September 22**
 - On-device AI tutorial on **November 3**
- No late submissions [I am very strict about this]



Programming assignments



1. **Mobile app development (weather app)**
 - Released: Sep 22 (Mon)
 - Due: Oct 6 (Mon) 11:59AM

2. **On-device Human Activity Recognition on Smartphones (sensing + machine learning)**
 - Released: Nov 3 (Mon)
 - Due: Nov 17 (Mon) 11:59AM





Project [25%]

- A research term project that involves implementation (e.g., an Android or IoT App)
- Team: 2~3 people. Form teams by **September 10**
- Evaluation criteria:
 - *Novelty*: is it new? Does it improve existing solutions?
 - *Usefulness*: does it solve an important problem? Would people use it?
 - *Teamwork*: who did what? How was team chemistry?
- Make multiple project presentations (more on this later)
- Submit a conference style term paper and running code at the end of the course





Advice on projects

- Please start early; elevator pitch on **September 24**
- Do something you need/like/want
- Pick a partner with complementary skills
- Think big, but also be realistic
- Get your hands dirty





Project ideas

- When you have ideas, google/GPT them to see if there are related apps/products/research
- Browse many recent papers from related conferences (MobiSys, MobiCom, UbiComp, CHI, UIST, NeurIPS, ICML, etc.)
- Discuss your ideas with me and the TAs





More on projects

- Smartphone Apps
 - Android, iOS, etc.
 - You should have the devices you could demo with





Presentations [20%]

- Each project team makes 3 presentations
 - **September 24:** Elevator pitch
 - **October 15:** Half presentation
 - **December 8, 10:** Final presentation/demo

- Each individual will present 2–3 research papers and lead the discussion
 - Tentative paper list on course webpage
 - Final list of papers and presentation schedule will be announced after course registration is finalized





Paper presentation

- You must read the paper and fully understand it (obviously!)
- First present the paper: the motivation, the problem, the main idea, evaluation, etc.
- Then provide your critique (strengths, weaknesses, limitations, ideas for improvements, etc.) that can lead the class discussion
- OK to use authors' (or others) slides, but acknowledge it
- If available, use the research video to your advantage
- Presentation + discussion = max 35 min
 - Leave enough time for discussion and Q&A





Participation [10%]

- Actively participate in discussions
 - Both during class and on CampusWire
- Ask questions, tells us your thoughts, share your experience, etc.
- More participation → more fun!





Attendance

- I don't waste time by checking attendance
- Still, if you have a legitimate reason for not attending class, provide me with the reason and proof *in advance*
 - You still need to submit your homework
 - If there is a quiz on the day of excused absence, you are waived
- Remember that there might be unannounced quizzes





Course policy

- In all your writing, including homework essays, reports, and presentations, **acknowledge** the source if you use someone else's slides, quotes, figures, text, etc.
- Submit your essays and quizzes in **PDF**
- Try your absolute best to ask questions in **English**
- Again, I don't take late submissions. Not even 1 second late
- No auditing. Either you're in or you're out





Guest Lectures

- KAIST and Korea are very strong in the field of Mobile Computing!
- KAIST authors of top conference papers will present cutting edge research
- Quiz questions are frequently from guest lectures



How to read papers

- <https://cseweb.ucsd.edu/~wgg/CSE210/howtoread.html>
- <http://ccr.sigcomm.org/online/files/p83-keshavA.pdf>
- <http://web.cs.wpi.edu/~rich/courses/howto.html>
- <http://www.eecs.harvard.edu/~michaelm/postscripts/ReadPaper.pdf>



How to give tech talks

- <https://www.microsoft.com/en-us/research/academic-program/give-great-research-talk/>
- <https://homes.cs.washington.edu/~mernst/advice/giving-talk.html>
- <http://www.inf.ethz.ch/personal/markusp/teaching/guides/guide-presentations.pdf>
- <http://www.computersciencestudent.com/resources/ResearchTalkJohnFarrell.html>





Michael Ernst's advice

- “For an in-class presentation, you will be judged on how well other people understand the material at the end of the class”
- “When you present someone else's paper in class, you should cover not only the technical details, but also what is novel and why others didn't do it before. Focus on what is important about the paper”
- “Encourage questions – it's the best way to deepen understanding – and be able to answer them”



Motivation & Overview



Mobile computing has enriched our lives





Why wireless?

- Easy of deployment
- Cost effective
- Mobility
- Ubiquity





Challenges of mobility

- Battery powered
- Limited spectrum
- Range
- Reliability
- Security



Let's review some history

- First cell phone prototype developed by Martin Cooper of Motorola at 1973
- 1.1kg, 23cm×13cm×4.45cm
- 30 minute talk time after 10 hours re-charging

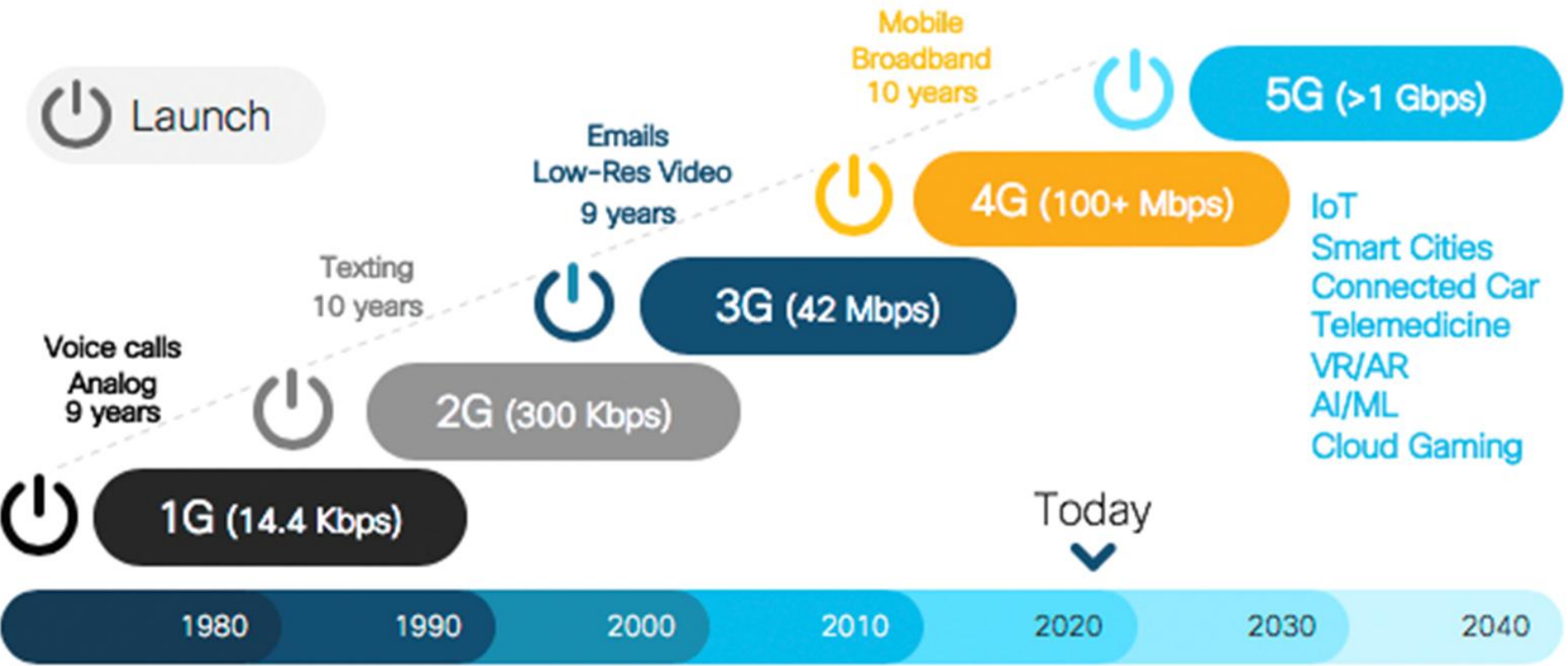




Major breakthroughs since 80s

- First analog cellular system deployed in Tokyo in 1979
- First in North America in 1983 (AMPS)
- Price of a cell phone then: \$4,000





Source: Cisco VNI Global Mobile Data Traffic Forecast, 2017-2022





Advent of WLANs

- Norman Abramson developed ALOHAnet in 1971 using low cost ham-like radios
- US FCC releases ISM band for *unlicensed* use in 1985
- WaveLAN: 1991, a precursor to 802.11
- Legacy 802.11: 1997, 2 Mb/s

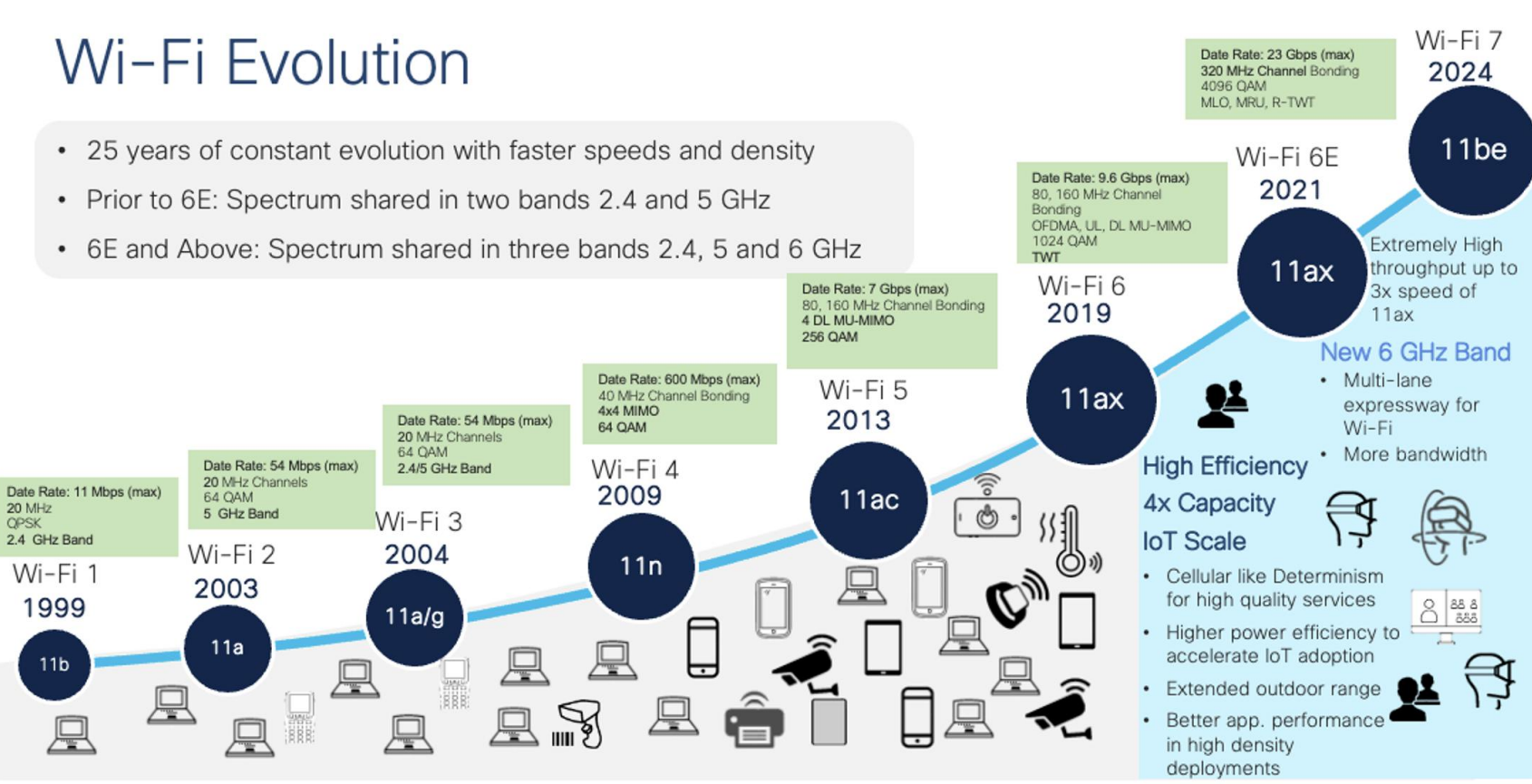




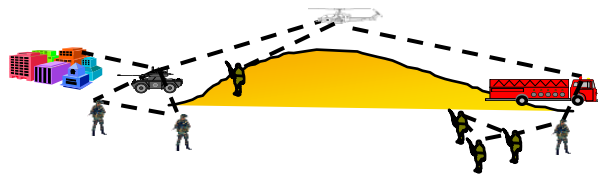
Wi-Fi evolution

Wi-Fi Evolution

- 25 years of constant evolution with faster speeds and density
- Prior to 6E: Spectrum shared in two bands 2.4 and 5 GHz
- 6E and Above: Spectrum shared in three bands 2.4, 5 and 6 GHz



WLAN architectures



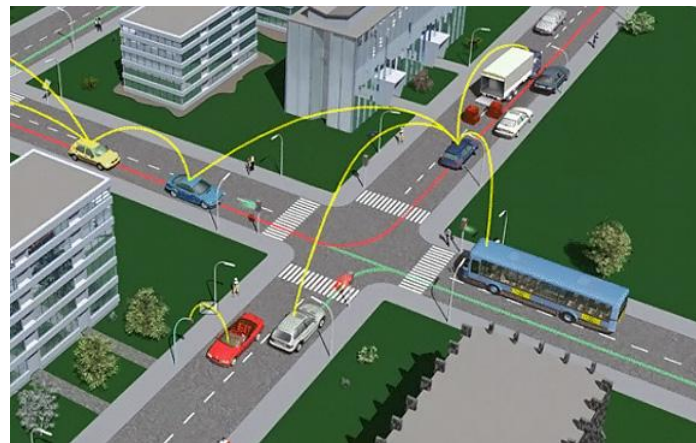
Ad hoc networks



Wireless mesh networks



Wireless sensor networks



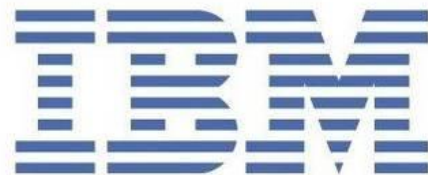
Vehicular networks





Smartphones

- IBM Simon: first smartphone prototyped in 1992 and released as product in 1994
- 20cm×6.4cm×3.8cm, 510g
- Memory 1MB, storage 1MB



World's First
Smartphone:
IBM Simon.
Founder-IBM



IBM Simon



<https://youtu.be/7PT9dc3IDN4>





iPhone & Android

- The first iPhone released by Apple on June 2007
- HTC Dream is the first Android phone released in October 2008





What make smartphones smart?

- Touchscreens, accelerometers, gyroscopes, GPS, cameras, etc ...
- Allowed cellphones explode into different markets
- R.I.P. Garmin, Tomtom, Blackberry, Palm, Kodak...
- Instead of carrying around 10 separate devices, now you just need one!



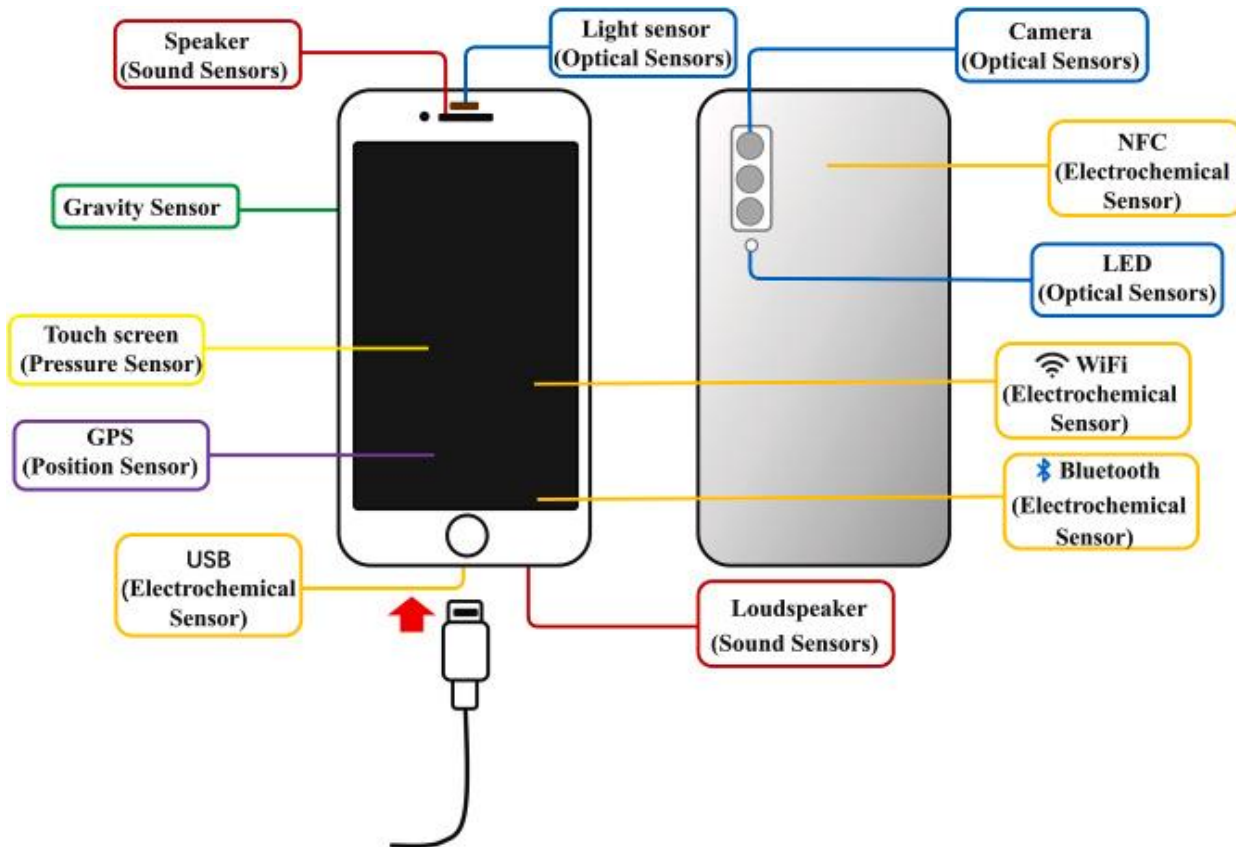


Smartphone is a game changer

- Small, powerful, lots of sensors, *with us always*
- Applications, services, user experience
- Cloud
- Technology advances in processing, storage, camera, display, touchscreen, battery, speech recognition, etc.
- Different wireless technologies now co-exist
- Mobility + HCI / ML / Security / Vision / Social, etc.



Sensors on smartphones





Course content

- Wireless networking protocols: LTE, Wi-Fi, Bluetooth, ZigBee, RFID, etc.
- WLAN architectures: ad hoc, mesh, sensors, vehicular
- Localization
- Energy efficient computing
- Smartphones, sensing, and applications
- Cloud for mobile computing
- Digital wellbeing & mobile health
- Mobile HCI (novel interaction methods)
- Wearable computing
- On-device AI, federated learning, LLMs for mobile



MouthIO



<https://youtu.be/quO1pxEIP2s?si=bd5JgYrB7IKufoqK>



IRIS



<https://youtu.be/OGPSiZtvnal?si=RGLoAS5e4QCgOuz3>





Course content

- We cover from physical layer up to application layer
- Lots of things happening in this space in a very fast pace
- **Breadth** over depth
 - Want you to learn many interesting research work
 - *If interested in specific topics, come see me*
- Will also have a case study on Meraki: from MIT project to startup and \$1.2B Cisco acquisition
- This is not a course on Android & Arduino programming. You have to learn it on the fly, with help from the TA



My thoughts & advice





Why take this class?

- This area is in high demand from the industry
- Still a hot research field
- You will get a better sense of how **world class** research is done
- Your project could lead to research publication or even a start-up!
- You will improve your **English** skills
- You will improve your **presentation** and **writing** skills





Who should *NOT* take this class

- You're a passive person
- You want an easy class with low load
- You don't like reading, writing, listening, or speaking in English. You want to avoid using English at all cost
- English or Korean, you have no intention of speaking in class
- You have absolutely no interest in doing (high quality) research





Feedback from previous students

- The course helped me improve **presentation skills** and mobile development. I really enjoyed this course
- Lots of reading, lots of participation, **interesting** lectures and overall a very **fun** course
- I think the course is good and I hope to see more course like that as it is focusing on both **practical** and **research** sense





Feedback from previous students

- 제가 카이스트에서 들었던 강의 중 가장 유익하고 체계적이었습니다. 교수님께서 학생들의 입장에서 진지하게 고민해 주셨다는 것, 가르치고 싶은 열정을 느낄수 있었습니다.
- 강의 대부분이 학생들의 프레젠테이션이었음에도 불구하고 교수님의 역할은 빛났고 조교님들 또한 항상 친절하게 도와주셨습니다.
- 대부분의 강의를 학생을 수동적으로 만드는 반면에 이 강의는 저희가 직접 만들고, 공부하고, 커뮤니케이션 하도록 유도했습니다





My advice

- Don't worry about grades
 - It doesn't really matter in the end
 - What matters is your skill
 - You will get a good grade *as long as you try*
- Mobile computing affects all of us
 - Learn and gain insights
 - You can contribute and be a game changer
- Be active! Participate! **Have fun!**



Questions?





Next lecture (Sep 3)

- Vision & challenges of mobile computing
 - G. H. Forman and J. Zahorjan, "The Challenges of Mobile Computing," IEEE Computer, April 1994.
 - M. Satyanarayanan, "Pervasive Computing: Vision and Challenges," IEEE Personal Communications, August 2001.
- Mobile sensing
 - E. Miluzzo, et al., "Darwin Phones: the Evolution of Sensing and Inference on Mobile Phones," ACM MobiSys 2010.



To do



- Register at [CampusWire](#) (Use code 4645)

- Register at <https://bit.ly/ee59900a-register>



Scan to Register

- HW#0: Go to CampusWire and write a self intro for project team grouping (category Self-intro). Your name, major (submajor, double major), what you offer to the team, and what you are looking for in a project teammate. (Due: Sep 8 (Mon) 11:59PM)

