Advanced Software Security

1. Introduction

Kihong Heo

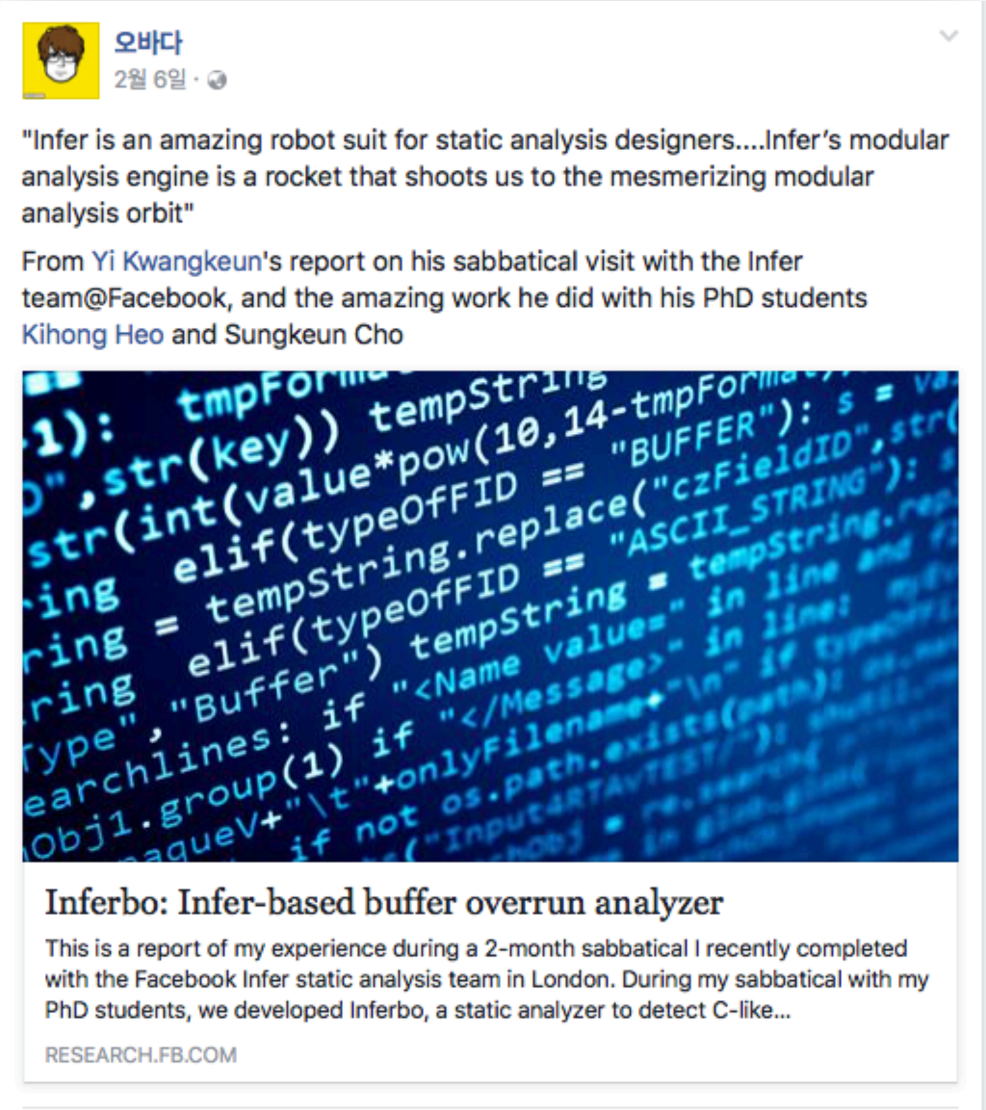
KAIST

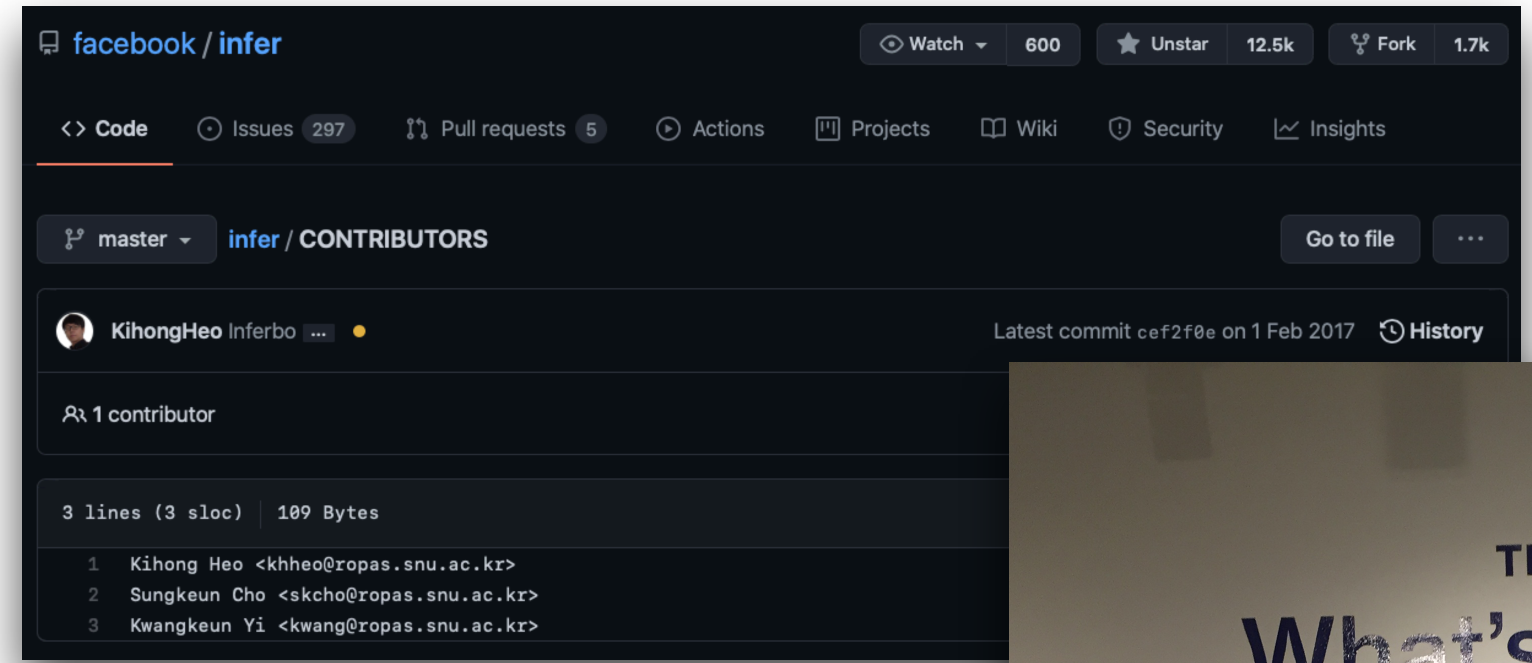
About Me

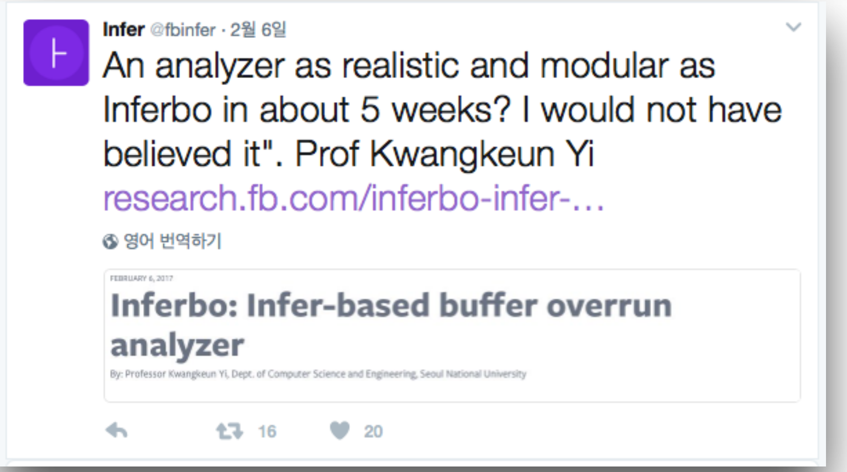
- Instructor: Kihong Heo (허기홍, kihong.heo@kaist.ac.kr)
- KAIST CS / GSIS / Programming Systems Lab.
- Homepage: https://kihongheo.kaist.ac.kr / https://prosys.kaist.ac.kr
- Office: N5 2321

My Research

- Goal: solid PL theories $\Longleftrightarrow$ powerful programming systems
- Keywords: program analysis, programming language, SW engineering, SW security
- Good (also fierce) memories:

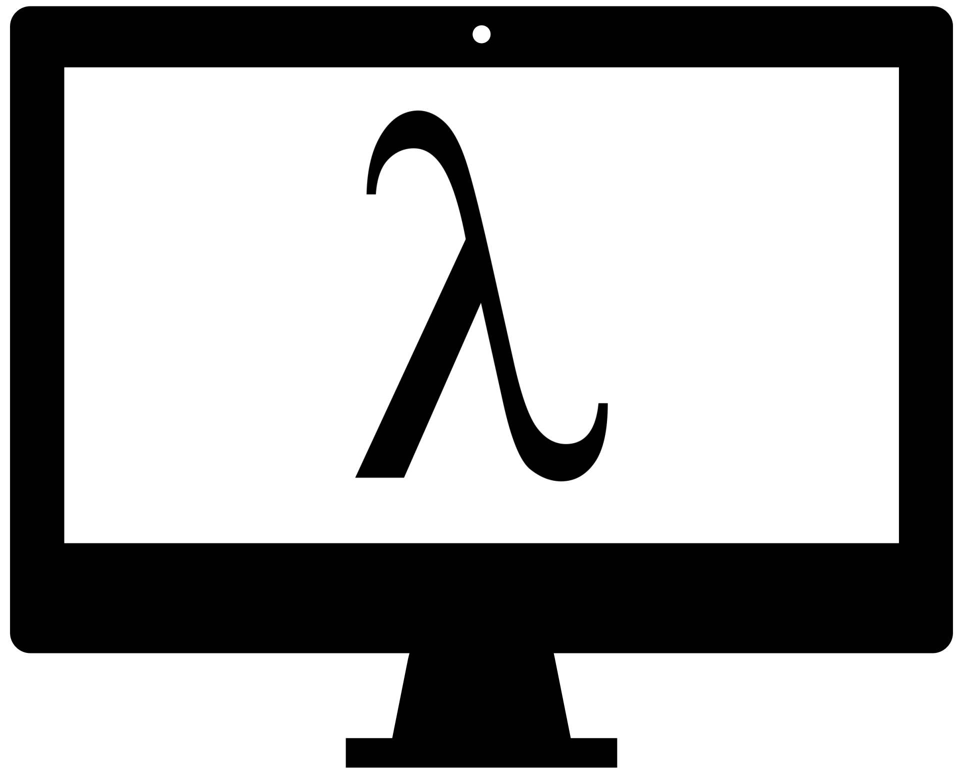






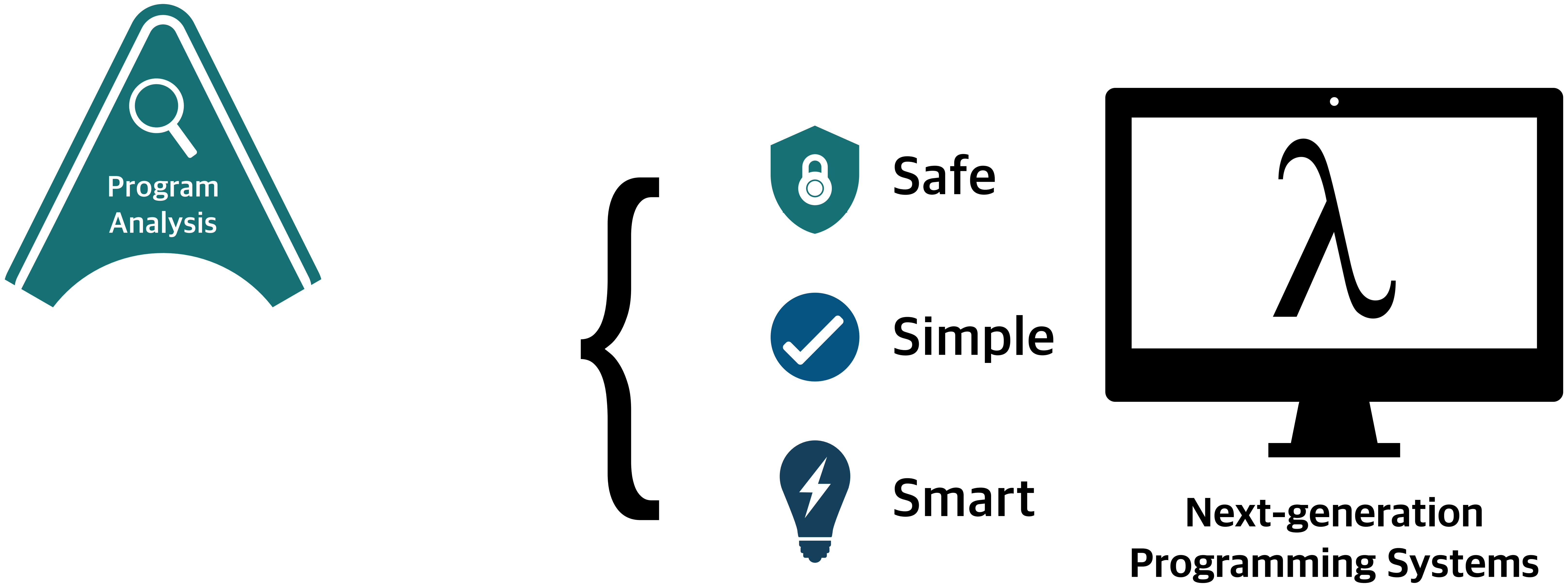
*https://research.fb.com/blog/2017/02/inferbo-infer-based-buffer-overrun-analyzer/

My Research

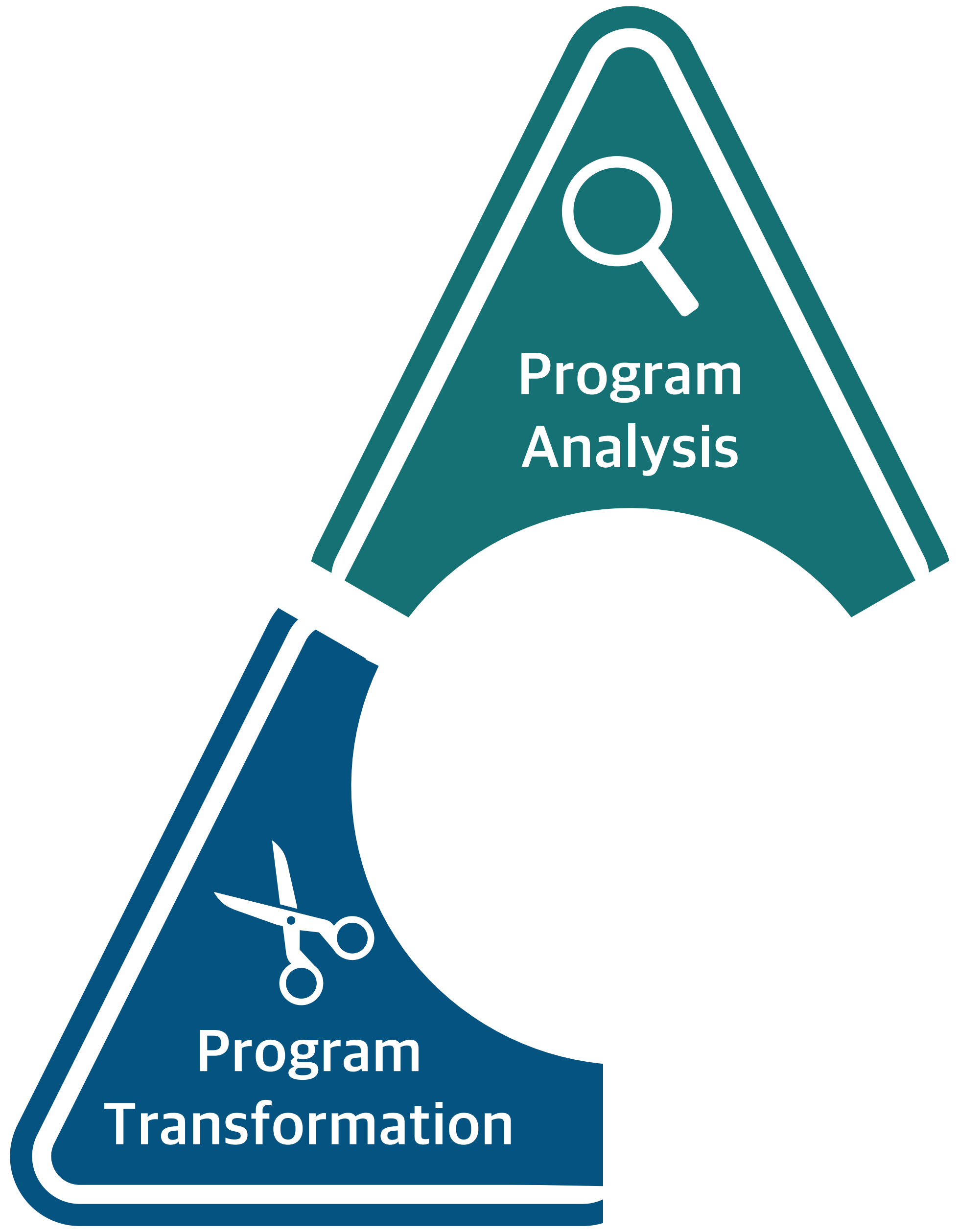


Next-generation
Programming Systems

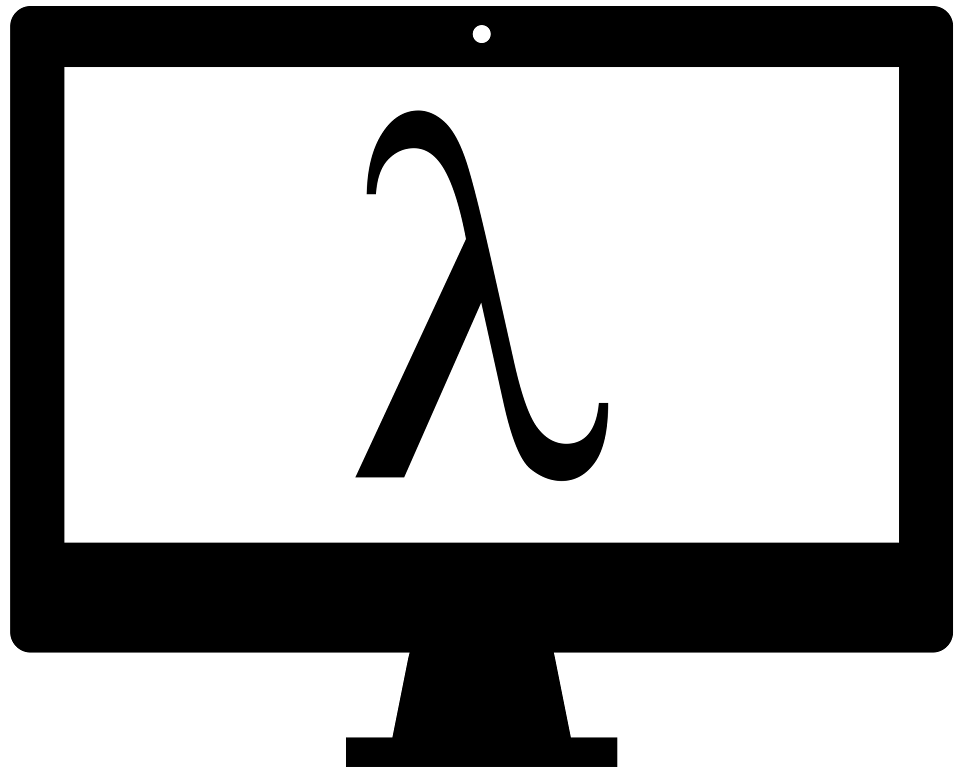
My Research


Program
Analysis
Safe
Simple
Smart
λ
Next-generation
Programming Systems

My Research

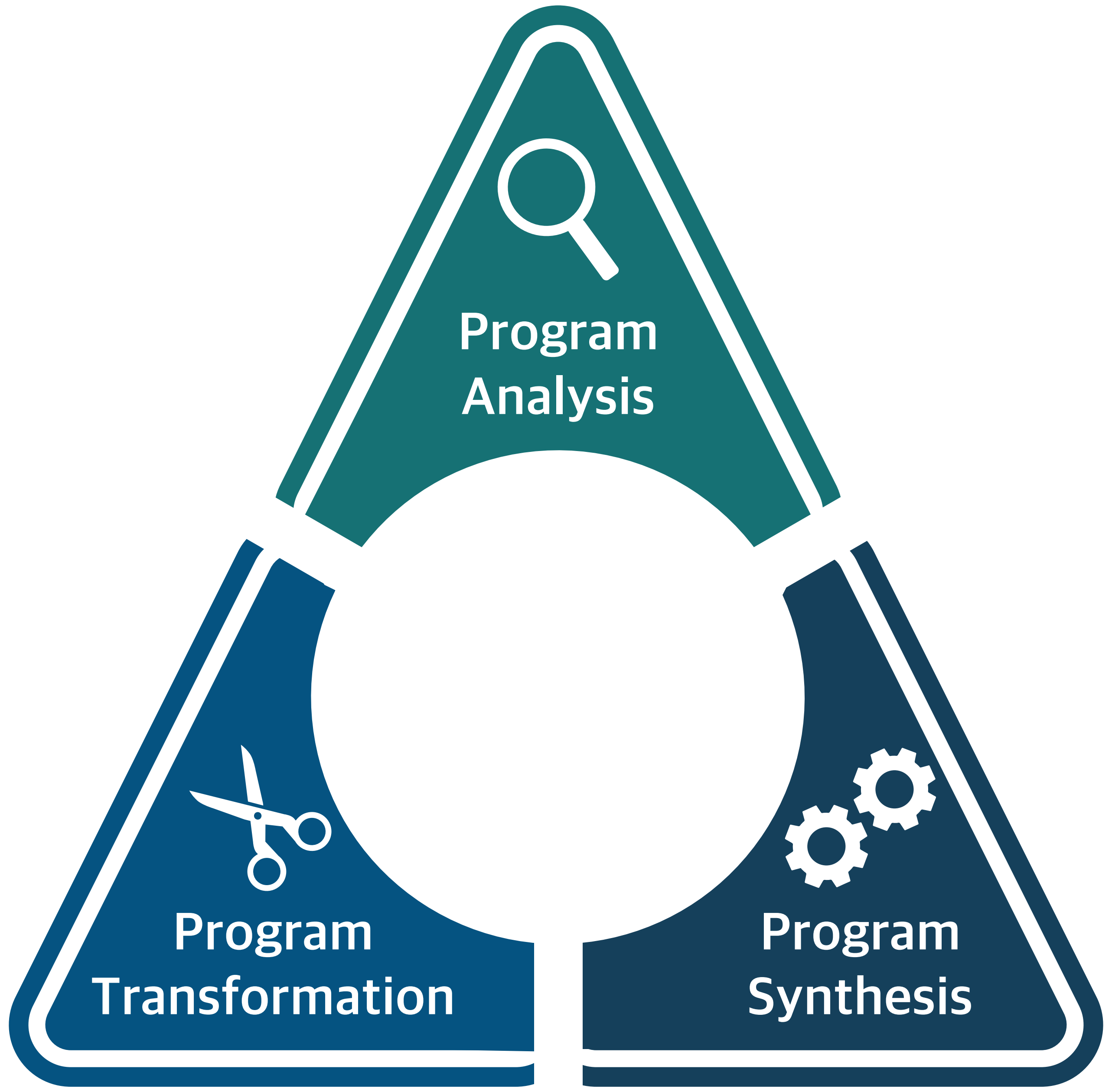


- Safe
- Simple
- Smart



Next-generation Programming Systems

My Research



- Safe
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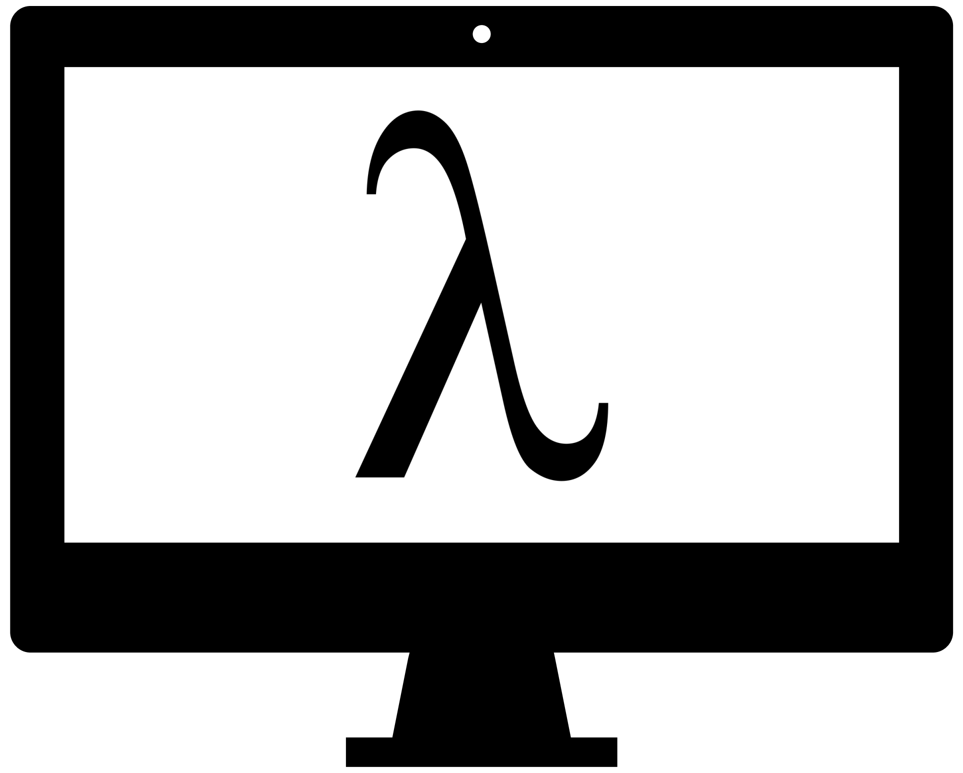
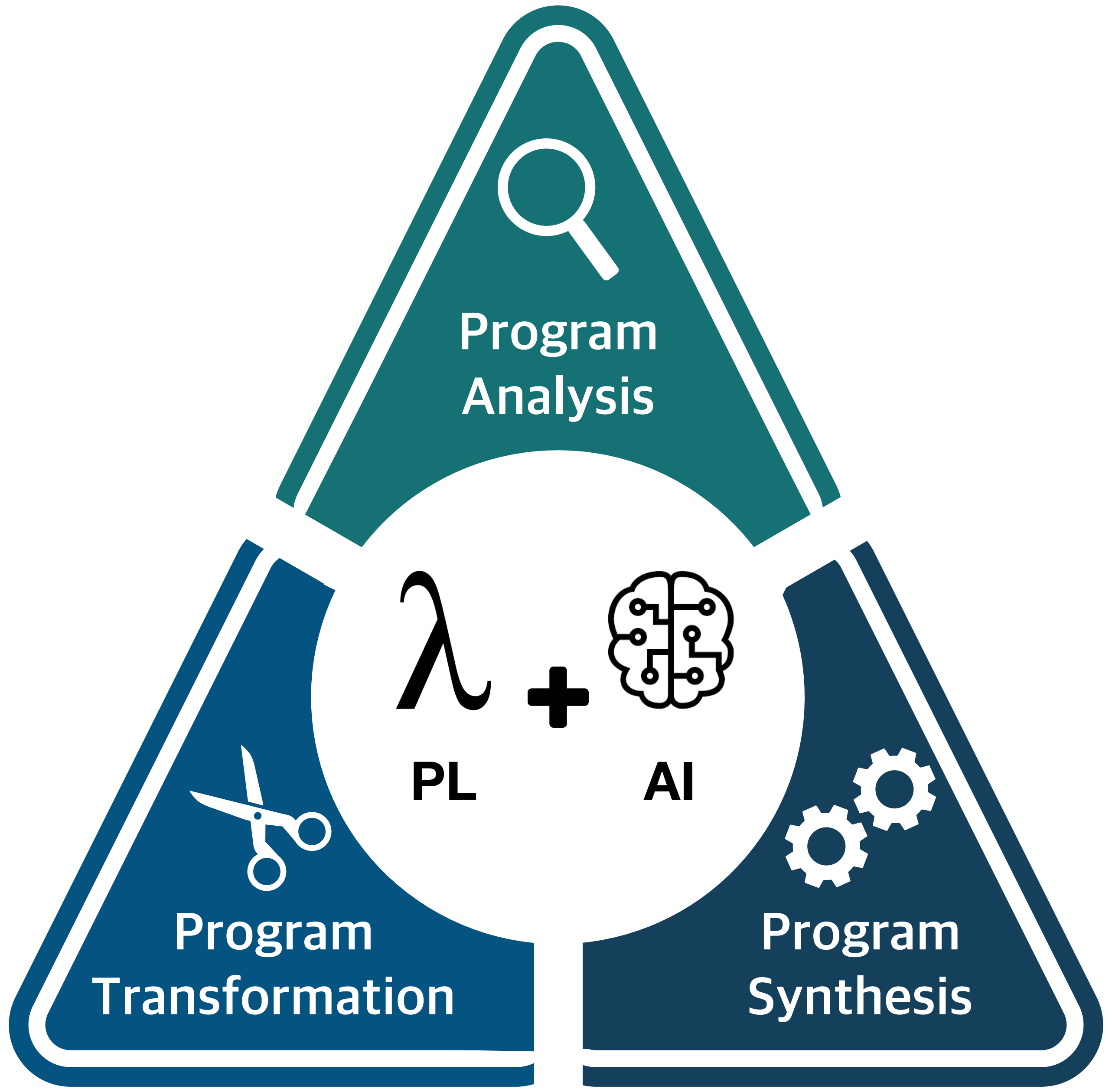


Next-generation
Programming Systems

My Research



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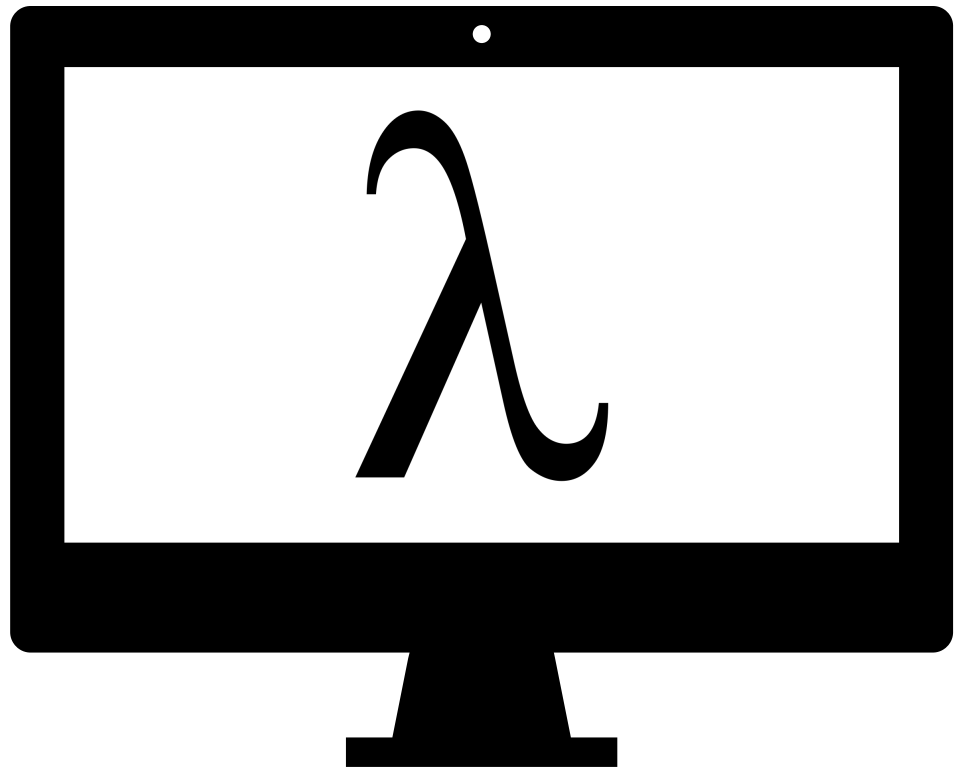


Next-generation
Programming Systems

Course Information

- Course Website: https://github.com/prosyslab-classroom/is661-advanced-software-security
- Q&A Board: https://github.com/prosyslab-classroom/is661-advanced-software-security/issues
- TAs (mailing list: is661.ta@prosys.kaist.ac.kr)
    - Yeonhee Ryou (류연희)
    - Jaeseong Kwon (권재성)

Important Notice (1): Academic Integrity

- DO NOT share the course contents (e.g., assignments or exams) with others
  - Esp., Github public repository, chegg.com, etc
- DO NOT discuss the details of solutions with others
- Any integrity violation: at LEAST F
  - See the KAIST CS honor code
- If you have questions: QnA board > TAs > instructor

전산학부 명예규정 2022 봄학기 / School of Computing Honor Code 2022 Spring

카이스트 전산학부가 운영하는 모든 수업에 참여하는 학생은 개인의 명예와 타인의 권리를 함께 존중하며 성실성과 정직성을 지키기 위하여 최선을 다합니다. 모든 시험 및 과제물 작성에 있어 허가되지 않은 어떤 형태의 도움도 받지 않습니다. 다음의 행위들은 학업의 성실성과 정직성을 위반하는 것으로 간주됩니다:

- 본인 이외의 사람/기관이 작성한 답안지, 숙제, 프로그램 소스 코드, 보고서 등을 참고 및 이용하는 행위
- 시험 및 과제물과 관련해 chegg.com과 같이 정답을 공유하는 온라인 서비스를 이용하는 행위
- GitHub 등의 코드 저장소에 본인의 과제 답안을 공개하거나, 타인이 공개된 답안을 참고 및 이용하는 행위
- 다른 학생이 본인이 작성한 답안지, 숙제, 프로그램 소스 코드, 보고서 등을 참고하도록 용인하는 행위
- 다른 학생이 작성한 결과물을 자신의 것인 양 제출하는 행위
- 다른 학생을 대신해 시험을 치루는 행위
- 개인이 수행하도록 되어있는 take-home 시험이나 과제물 작성에 있어 허락 없이 공동 작업을 하거나 부적절한 도움을 받는 행위
- 표절: 길이와 무관하게 적절한 인용이나 언급 없이 타인의 창작물(참고서적, 문헌, 온라인상의 자료)을 무단으로 사용하는 행위

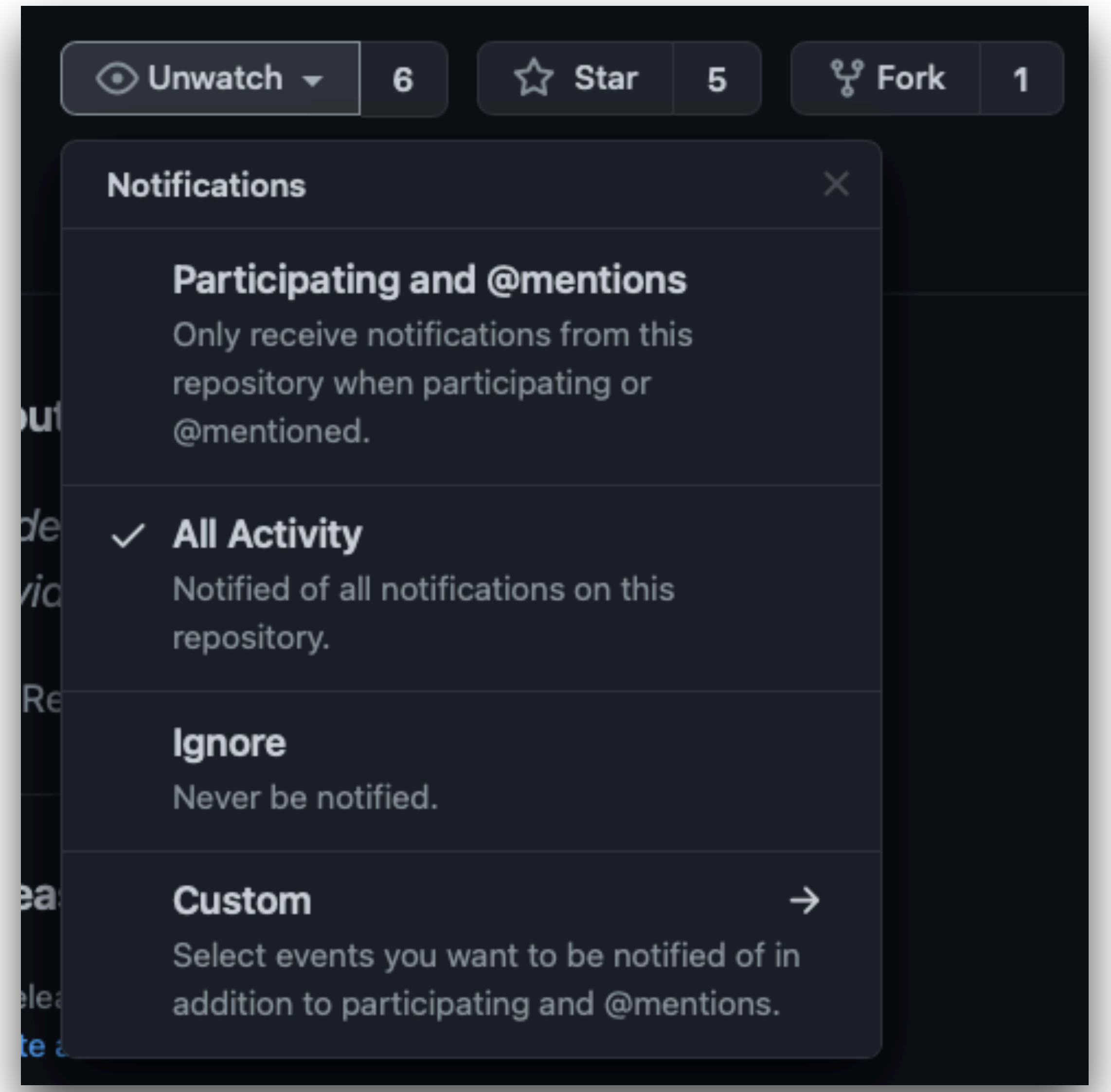
규정 위반 여부의 판단과 처벌 수위는 교과목 담당 교수에 의해 결정됩니다. 모든 부정행위는 전산학부 학사주임 교수 및 학부장님께 보고되며, 적발시 전산학부 내부적으로 아래와 같은 제약을 받습니다.

- 향후 2학기 동안 모든 포상 및 장학금 수여/추천 대상에서 제외함
- (주전공이 전산학부가 아닌 경우) 향후 2학기 동안 전산학부로의 전과 금지

위반의 심각성에 따라 학교 전체의 상벌위원회에 회부될 수 있습니다. 카이스트 학사규정이 허용하는 징계의 범위는 아래 첨부된 학생 징계 양형 기준을 참고하세요 (학생 핸드북 한글판 67페이지 , 다운로드는 https://portal.kaist.ac.kr/ennotice/student_notice/11614934649338)

Important Notice (2): Out-of-class

- All Q&A and public notices: Github issue board
  - “Watch” all notifications
- Private notices (grading, etc): KLMS
- Questions are always welcome except for
  - Too detailed ones (TAs are not debuggers!)
  - Directly related to the solutions



Goal

How to Be a Successful Grad Student in
Software Security, Programming Language, Software Engineering?

Course Objective (1): Communication

- Science is communication!
  - Read (research papers, textbooks, etc)
  - Write (research proposals, papers, etc)
  - Talk (conference talk, etc)
  - Ask
  - Think
- Never become an “armchair hacker” (방구석 해커)

Topic and Activities

- Why do you do research?
- How to write scientific articles?
- How to give research talks?
- How to write a proposal?

Schedule

Date	Topics	Watching	Homework
2/27	Introduction		
2/29	You and Your Research		
3/5	Discussion		HW1: Essay (due: 3/3 23:59:59)
3/7	How to Write a Great Research Paper		
3/12	How to Write Papers So People Can Read Them		
3/14	Discussion		HW2: Your quick sort paper (due: 3/12 23:59:59)
3/19	How to Give a Great Research Talk		
3/21	Research Talk 1		HW3: Essay (due: 3/19 23:59:59)
3/26	Research Talk 2		
3/28	Research Talk 3		
4/2	How to Write a Grant Proposal Talk		
4/4	Project Proposal Talk 1		HW4: Project Proposal (due: 4/2 23:59:59)
4/9	Project Proposal Talk 2		
4/11	Project Proposal Talk 3		

Writing

- Main communication tool in academia
- Basic principle: top-down (두괄식) and short sentence
- Citation: acknowledge someone else’s work
- Other details will be discussed later

Writing In Korean (국문 글쓰기)

- Roles of KAIST folks
  - World-leading researcher (in English)
  - Inspiring communicator to the community (in Korean)
    - For newcomers, public officials, etc
- Idiot's transition algorithm

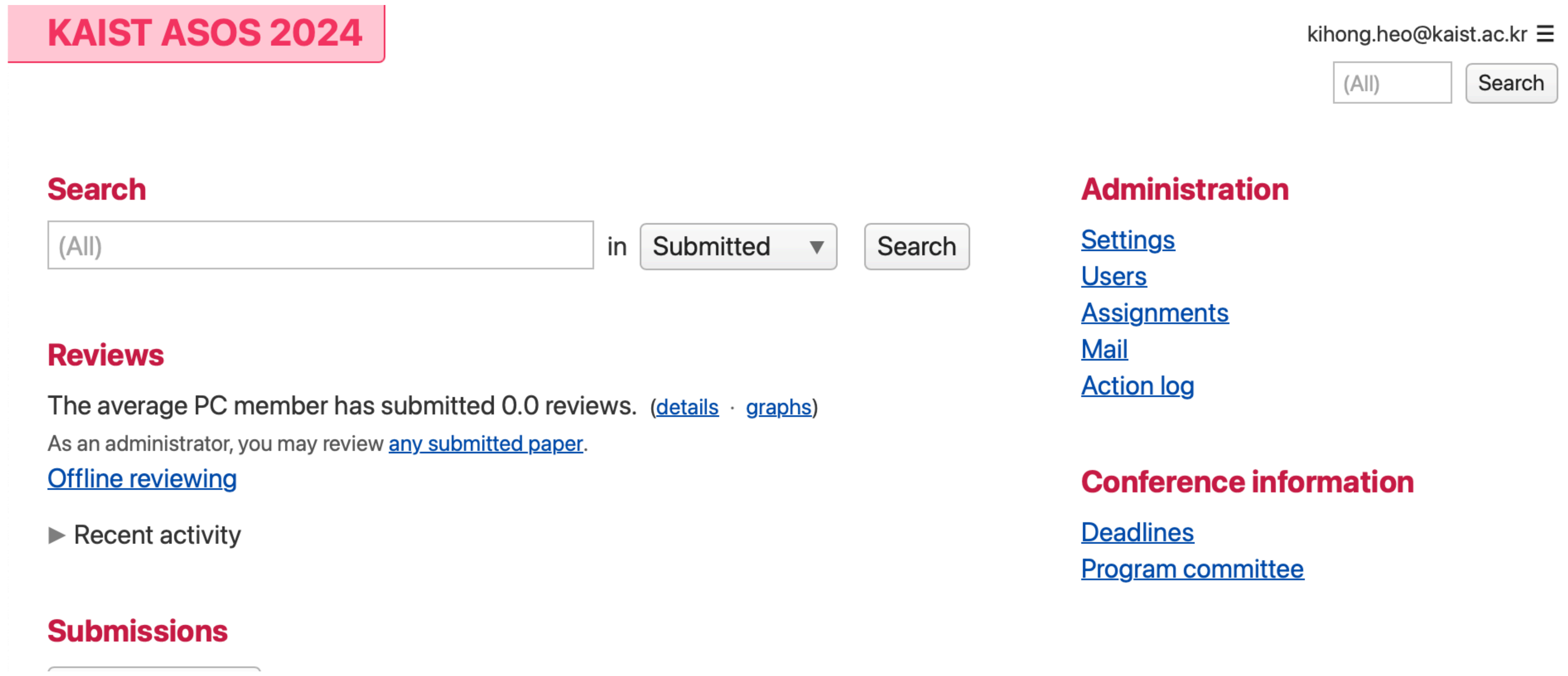
```
String.split_on_char ' ' word
|> List.map translate_word
|> String.concat " "
```

Course Objective (2): Critical Thinking

- Do not blindly accept someone else’s arguments
  - Paper, proposal, etc
- Why is this problem important and challenging?
- What do they assume?
- What would happen if this technique is applied to my problem?
- How is this related to X?

Paper Review

- Read research papers and write reviews
  - What is this paper about?
  - What is your opinion? (accept or reject)
  - Why do you think so? (persuade other reviewers and authors)
- The same review process of major CS conferences

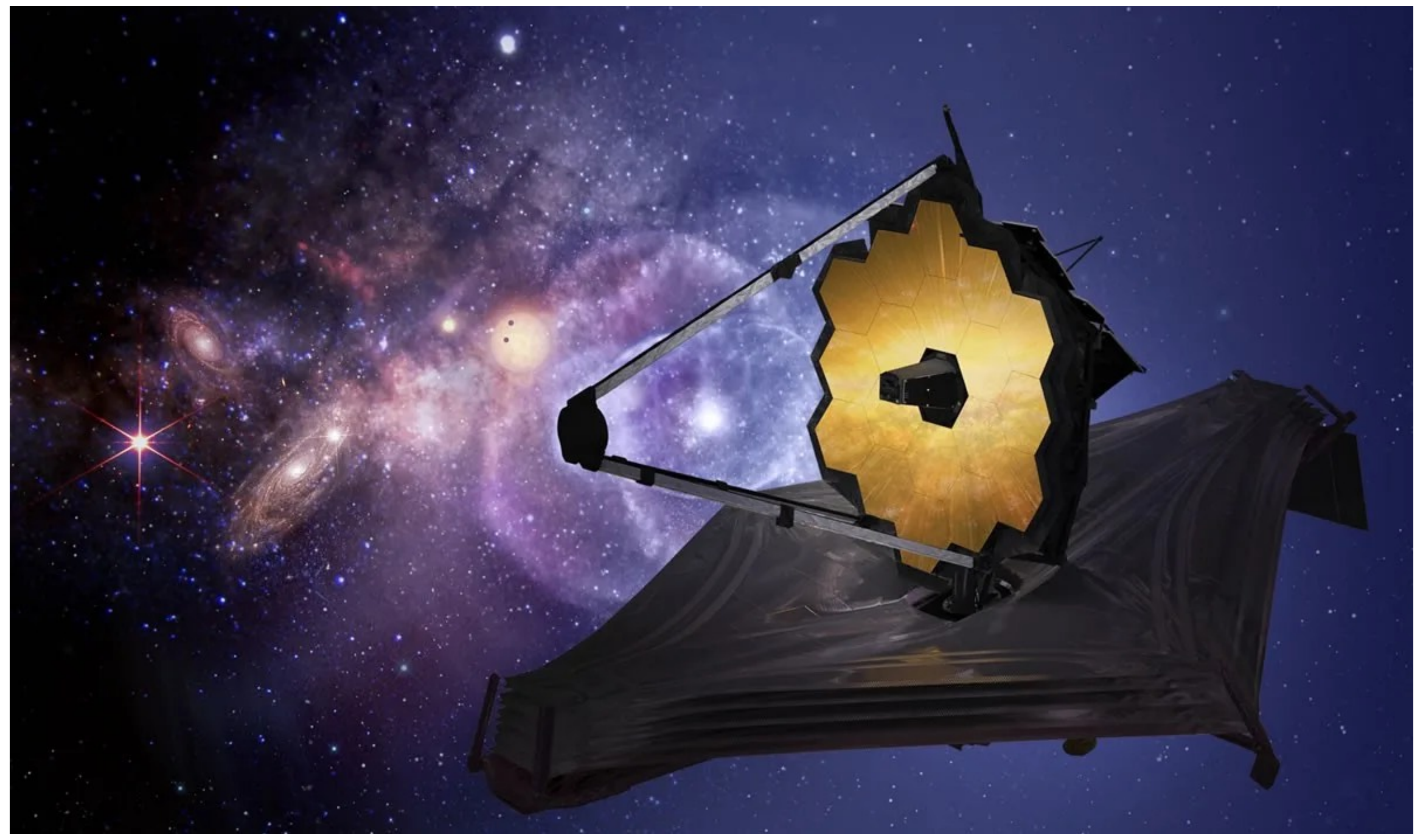


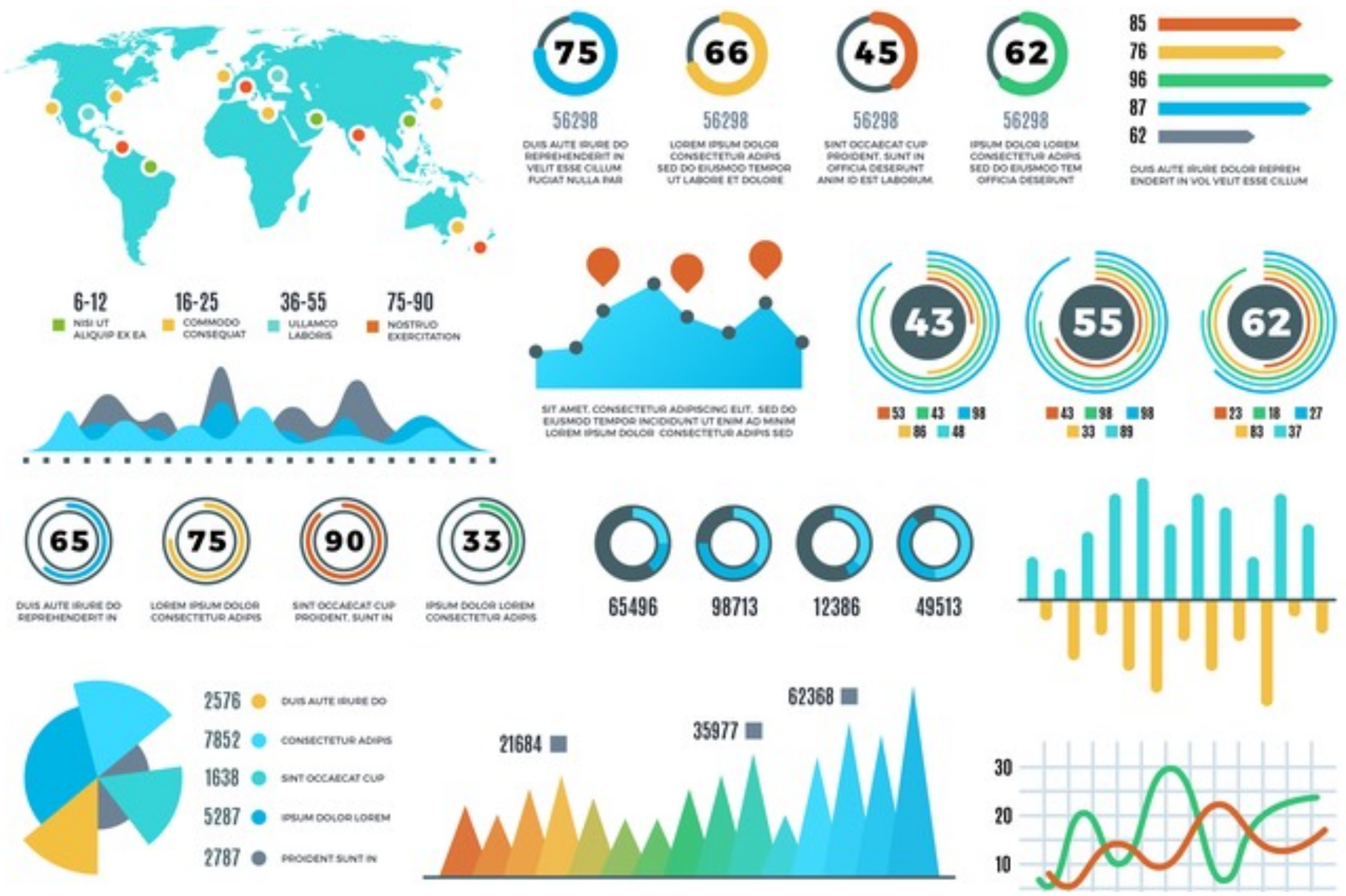
Course Objective (3): Finding Your Problem

- Problem-finding is much more important than problem-solving
  - Undergrad: solve a given problem
  - Grad: find your own problem, solve it, and argue that the problem/solution is great
- How to find a good research problem?

Observation

- Beginning of all sciences



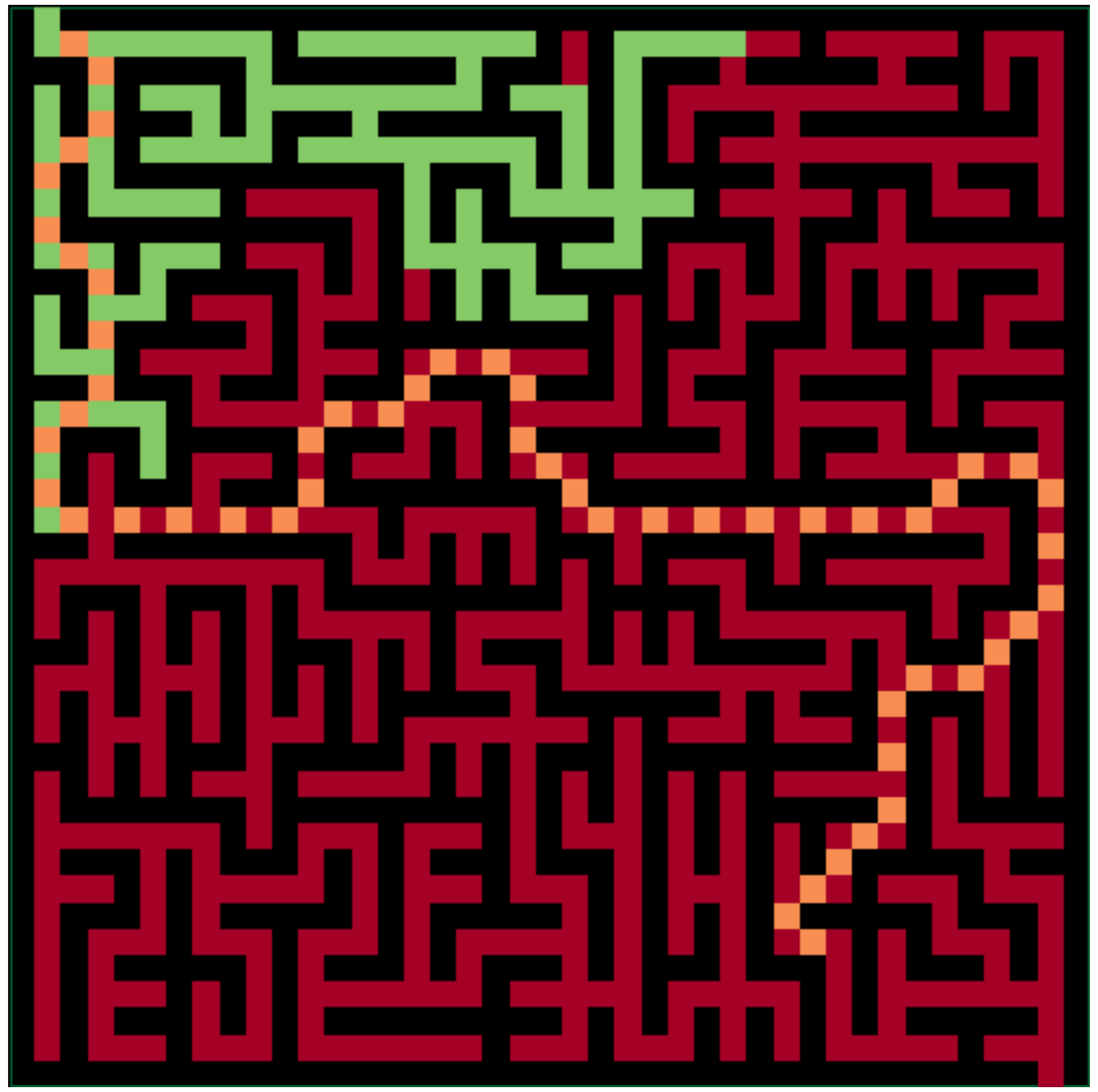


Project

- Make a visualizer for any programming system (hopefully, related to your thesis topic)
  - e.g., program analyzer, fuzzer, synthesizer, compiler, etc
- Clearly shows the behavior of the chosen tool for some aspects using the visualizer
- Argue why this observation is necessary
- See the schedule and prepare your topic in advance

Example

- A visualizer for fuzzer by Haeun Lee, Soomin Kim and Sang Kil Cha. KAIST



Course Activities

- Online lecture: YouTube
- Discussion (mandatory)
  - At least one question or comment for each student

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Grading

- Homework, discussion, presentation: 60%
  - HW1: Essay & discussion,
  - HW2: Paper & discussion
  - HW3: Review
  - HW4: Essay & research talk
  - HW5: Project proposal & talk
  - HW6: Project proposal review
  - HW7: Paper review & presentation
- Project: 30%
  - Paper
  - Presentation
- Participation: 10%

Homework 1: Writing a Critique

- Watch/read “You and Your Research” on the course webpage
- Write a critique in
  - Korean if you are a native Korean speaker
  - English otherwise
- Read carefully the syntactic and semantic requirements
- Must: proper title (NOT “hw1”, “critique 1” etc), your name and email
- Must NOT: student ID
- All articles will be publicized via the course webpage later

Discussion

- Next class: 3/5
- Topics:
  - Why do you do research rather than any other things?
  - What is great research?
  - What skill sets are needed to do great research?
  - How would you find an important problem?
  - Etc.