Introduction to Information Security

1. Introduction

Kihong Heo

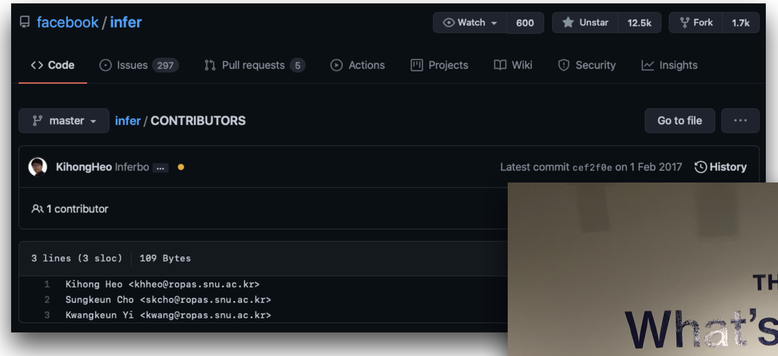
KAIST

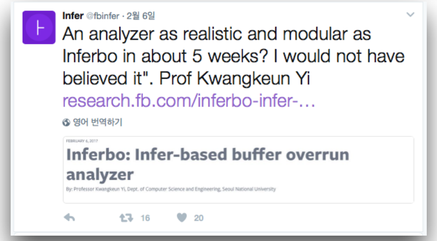
About Me

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

My Research

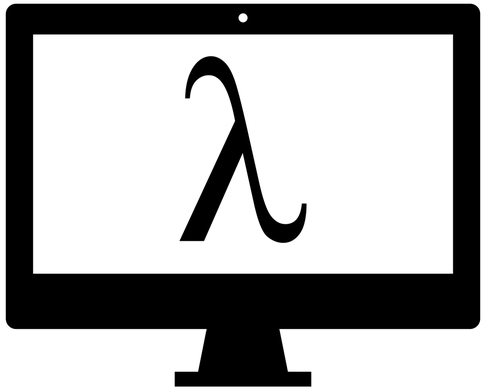
- Goal: solid PL theories $\Longleftrightarrow$ powerful programming systems
- Keywords: programming language, program analysis, SW engineering, SW security
- Good memories:





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

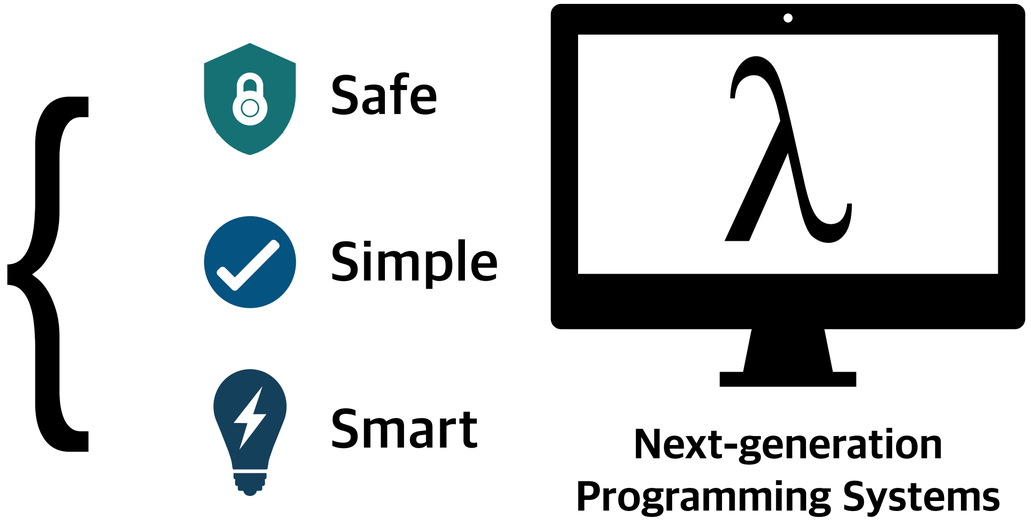
My Research



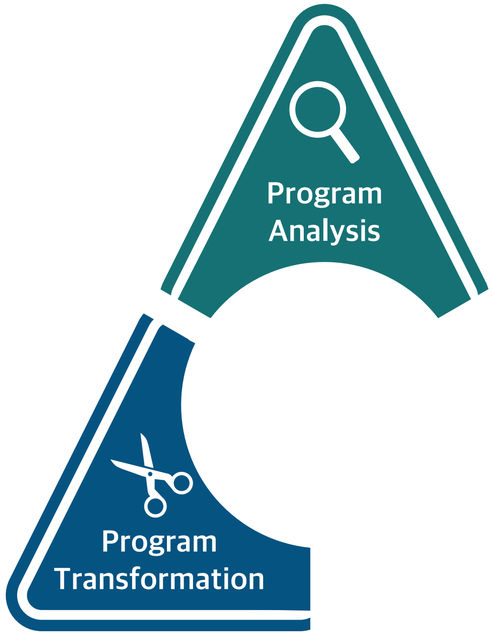
Next-generation
Programming Systems

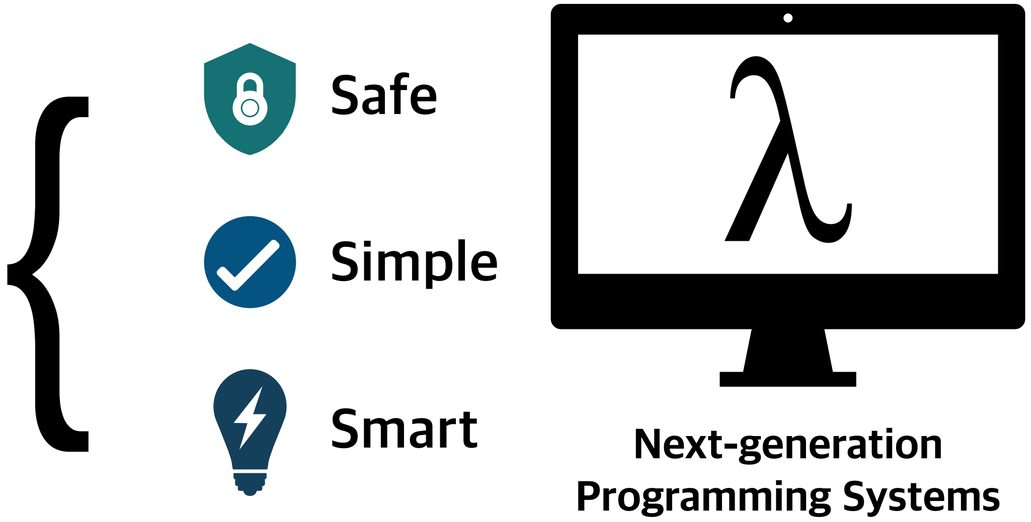
My Research

Program
Analysis


Safe
Simple
Smart
λ
Next-generation
Programming Systems

My Research


Program
Analysis
Program
Transformation


Safe
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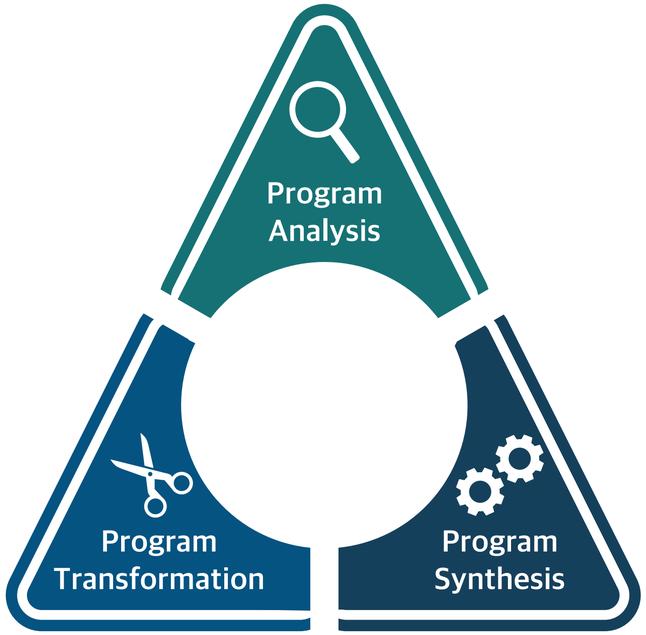
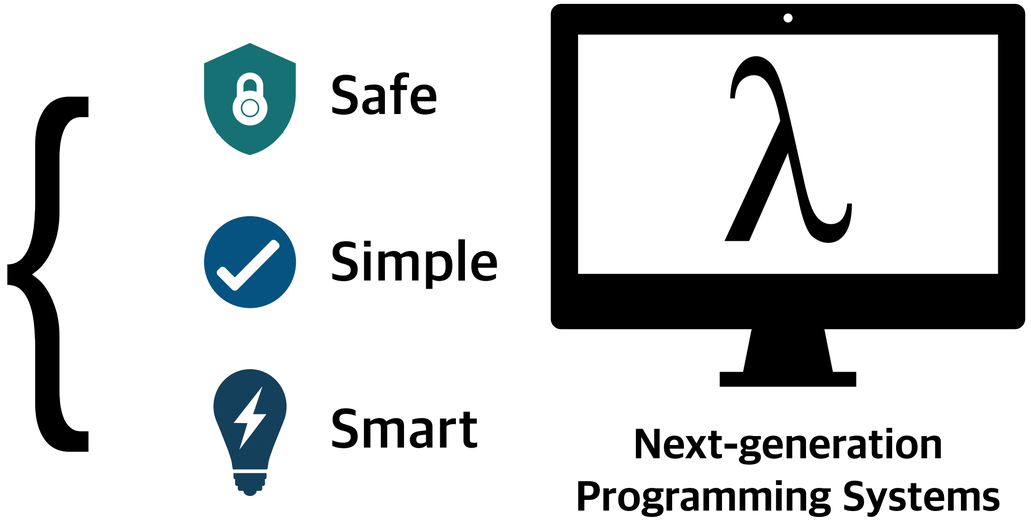
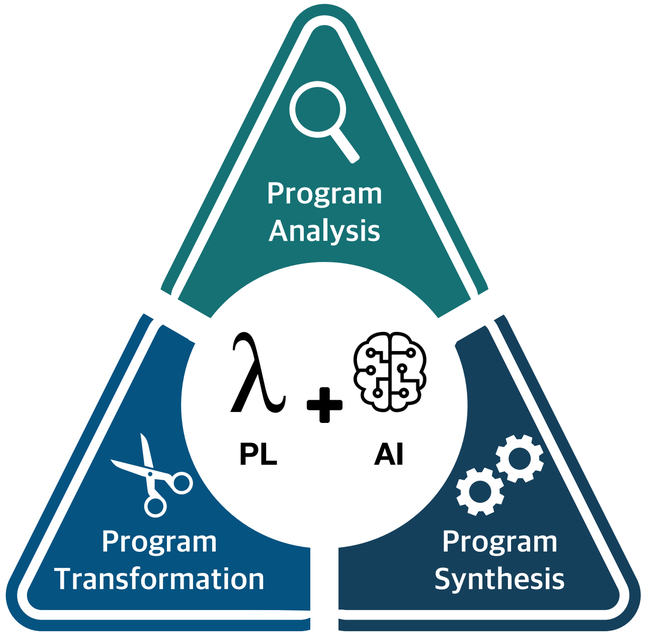
Next-generation
Programming Systems

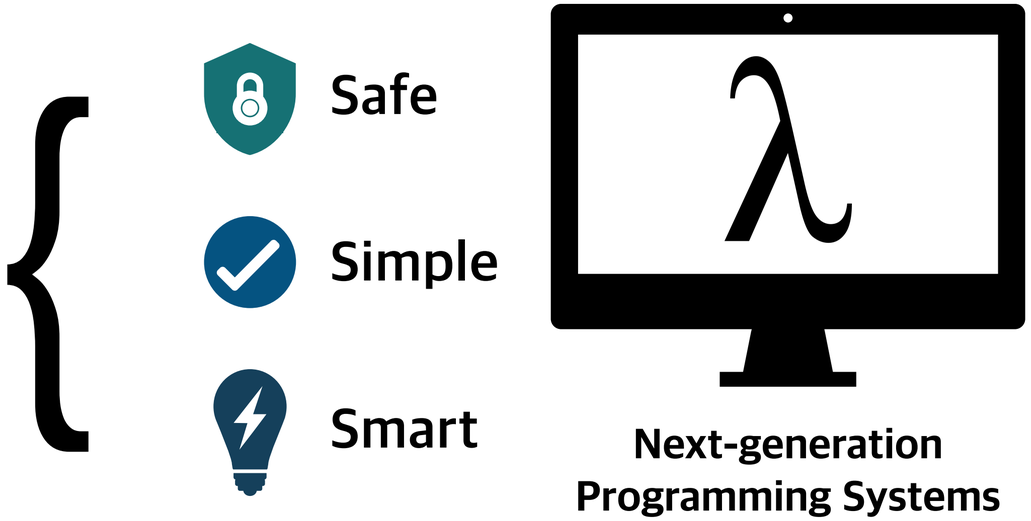
My Research


Program Analysis
Program Transformation
Program Synthesis


Safe
Simple
Smart
λ
Next-generation Programming Systems

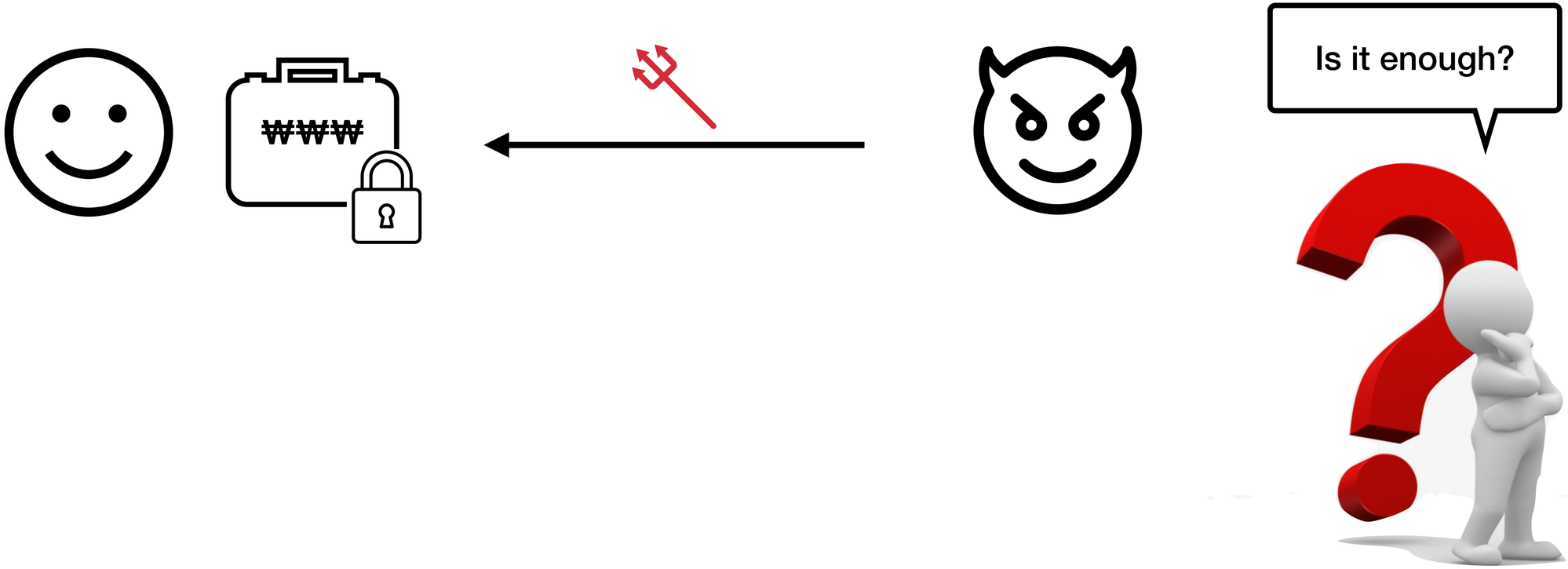
My Research


Program Analysis
λ
PL
AI
Program Transformation
Program Synthesis


Safe
Simple
Smart
λ
Next-generation Programming Systems

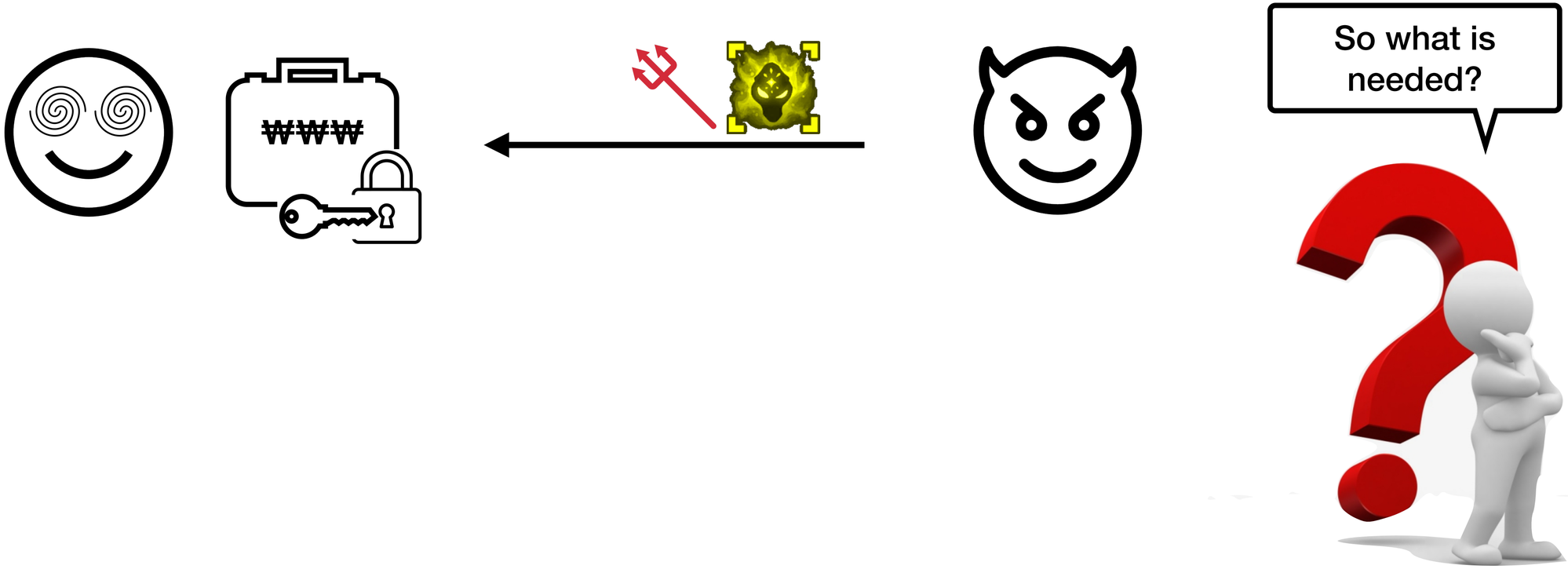
Security in a Nutshell (1)

- What to protect and how?



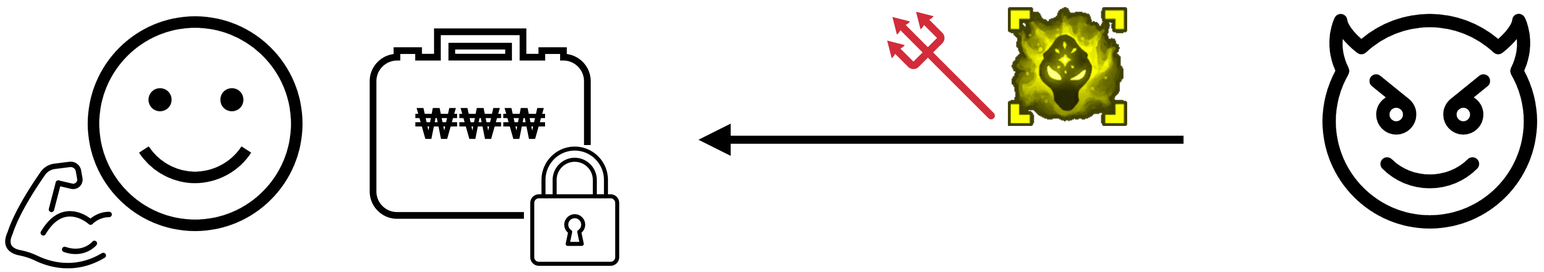
Security in a Nutshell (2)

- What to protect and how?



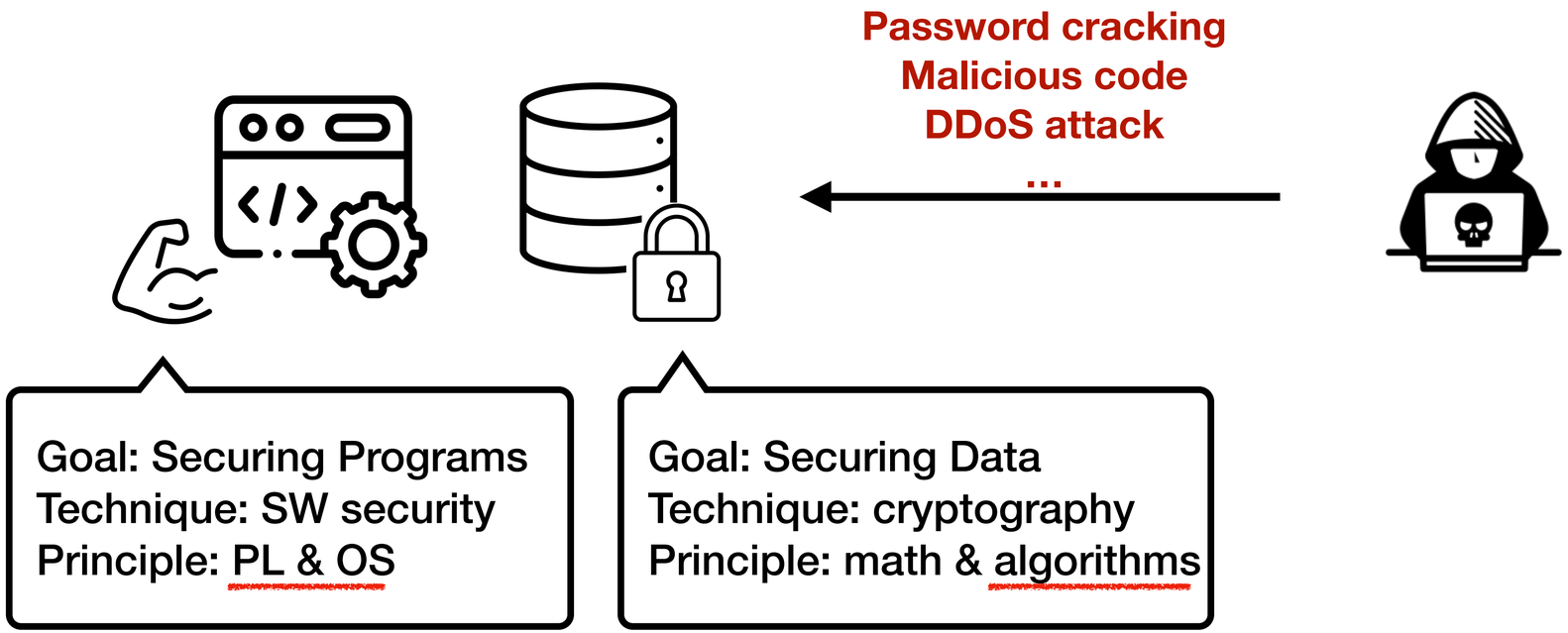
Security in a Nutshell (3)

- What to protect and how?



Security in a Nutshell (4)

- What to protect and how?



Course Information

- Course Website: https://github.com/prosyslab-classroom/cs348-information-security
- Q&A Board: https://github.com/prosyslab-classroom/cs348-information-security/issues
- TAs (mailing list: cs348.ta@prosys.kaist.ac.kr)
  - Yeonhee Ryou (류연희, yeonhee.ryou@prosys.kaist.ac.kr)
  - Jongchan Park (박종찬, jongchan.park@prosys.kaist.ac.kr)
  - Sujin Jang (장수진, sujin.jang@prosys.kaist.ac.kr)
- Textbook:
  - Lecture slides will be provided
  - See more in the course website

Grading

- Homework: 50%
- Final exam: 40%
- Participation: 10%
  - Active participation including questions, discussions, and activities (online or offline)
- NOTE: nonnegotiable!
  - DO NOT send an email for a negotiation (cheating)

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
- DO NOT plagiarize
  - We keep all the submissions from previous years!
  - We are programming language experts!
- Any integrity violation: at LEAST F
- If you have questions: QnA board > TAs > instructor

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

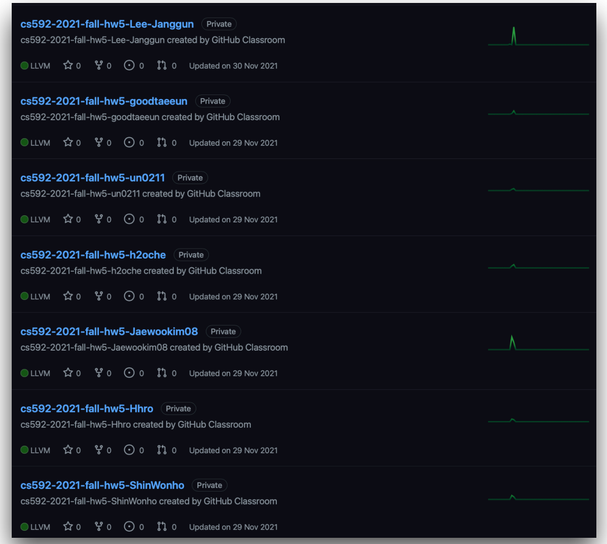
카이스트 전산학부가 운영하는 모든 수업에 참여하는 학생은 개인의 명예와 타인의 권리를 함께 존중하며 성실성과 정직성을 지키기 위하여 최선을 다합니다. 모든 시험 및 과제물 작성에 있어 허가되지 않은 어떤 형태의 도움도 받지 않습니다. 다음의 행위들은 학업의 성실성과 정직성을 위반하는 것으로 간주됩니다:

- 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: 깊이와 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)



cs592-2021-fall-hw5-Lee-Janggun Private
cs592-2021-fall-hw5-Lee-Janggun created by GitHub Classroom
LLVM 0 0 0 0 Updated on 30 Nov 2021

cs592-2021-fall-hw5-goodtaeeun Private
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cs592-2021-fall-hw5-Hhro Private
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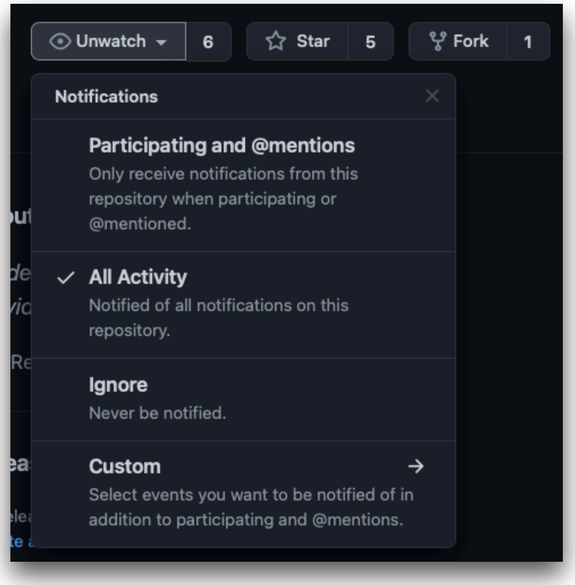
cs592-2021-fall-hw5-ShinWonho Private
cs592-2021-fall-hw5-ShinWonho created by GitHub Classroom
LLVM 0 0 0 0 Updated on 29 Nov 2021

Important Notice (2): In-class

- Language: English (default), Korean (supplementary)
- Attendance: always (default), absence (if necessary)
  - No quantified attendance score
  - “What is essential is invisible to the eye” - The Little Prince
  - I expect you to be here, as you expect me to be here!
- Questions & discussion (either in Korean or in English): highly encouraged

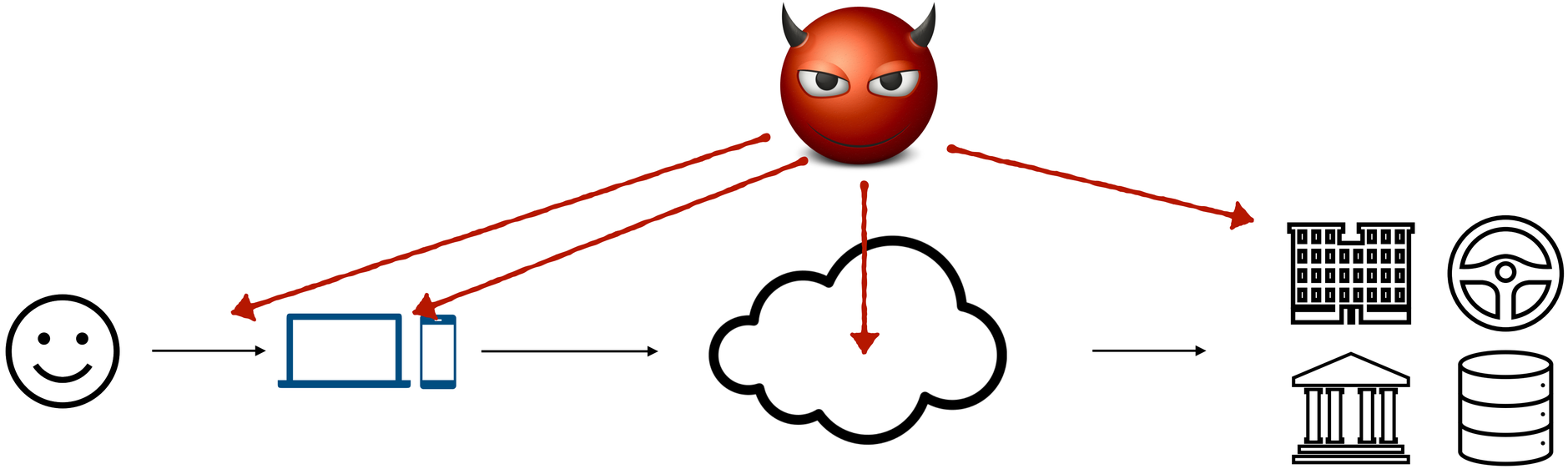
Important Notice (3): Out-of-class

- 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
- Actively discuss with your classmates



Course Objectives: Principles

- What kinds of threats exist in computer systems?
- Why do the threats exist?
- How to design and implement secure computer systems?



Course Objectives: Practice & Challenge

- Homework: **design** & **implement** program analyzers
  - 7 (main) + 2 (dummy) assignments
- Programming assignments in OCaml
  - Cryptography algorithm, SW bug detector, etc
- Why OCaml? (https://ocaml.org)

The OCaml Language

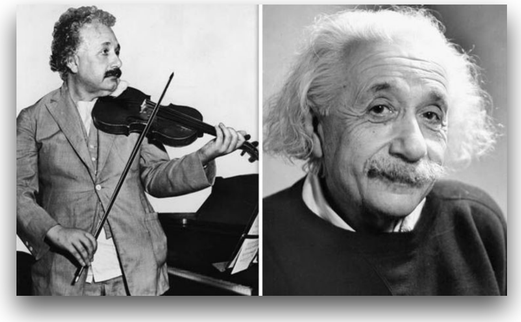
- Simple, safe, and realistic programming language
  - Strong type system, higher-order functions, etc
- A lot of growing demands from academia and industry
- See the materials on the course webpage

Course Objectives: Active Learning

- The era of AI: NO free lunch and requires more creative thinking
  - Naively understanding & memorizing knowledge becomes obsolete
  - Creativity comes from “pain” (창의력은 노가다에서 나온다)
    - Training GPT-3: 355 yrs on a single GPU (2020)
- Three levels of knowledge
  - Understandable knowledge (이해 가능)
  - Explainable knowledge (설명 가능)
  - Artifiable knowledge (예술로 승화 가능)

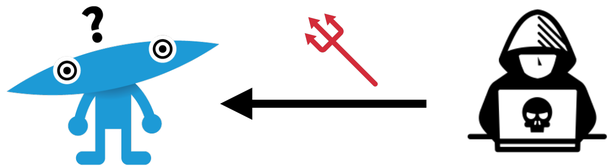
by lecture, exam, programming assignment

by various activities



“The greatest scientists are artists as well”
- A. Einstein

Activity (1): Threat Hunt



- Save KAIST!
- If you find any security problems on campus, report them to me!
  - Physical (e.g., building) or cyber (e.g., portal, klms, email, etc)
- Depending on the severity, bonus points will be given
  - E.g., A+ > 1 letter grade up > 10% score up > … > 1 drink > …
- **DO NOT** try anything illegal
  - “REAL” education (참교육) will be given instead
  - If you cannot decide by yourself, discuss it with us first!
- Detailed instructions will be announced later

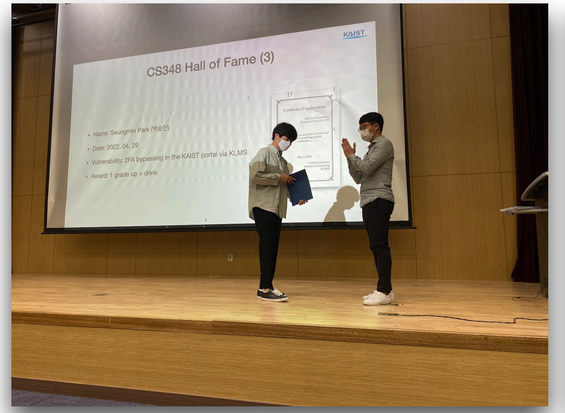
Hall of Fame

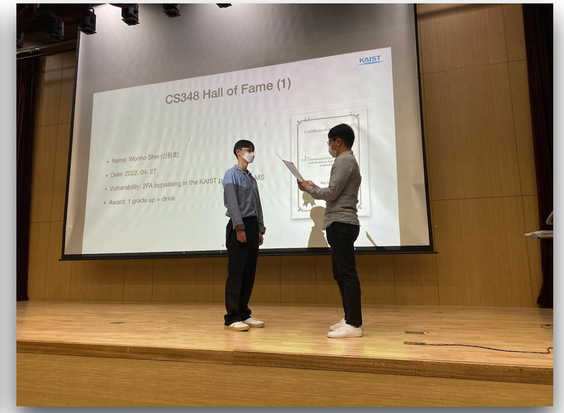
CS348 Hall of Fame

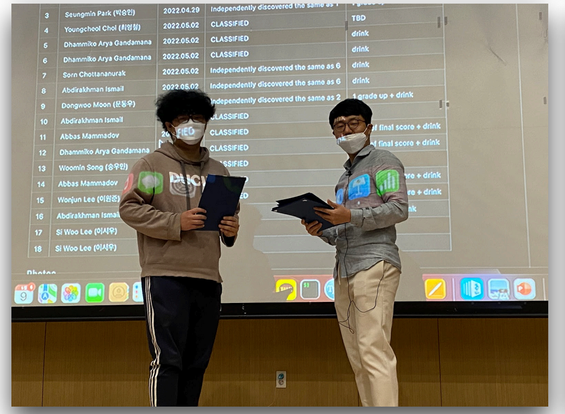
We appreciate the following students for their outstanding participation in CS348 and contribution to making KAIST a safer place.

The description of the vulnuerabilities will be disclosed until they are patched.

No	Name	Date	Vulnerability	Award
1	Wonho Shin (신원호)	2022.04.27	2FA bypassing	1 grade up + drink
2	Jun Cho (조준)	2022.04.27	Access control bypassing	1 grade up + drink
3	Seungmin Park (박승민)	2022.04.29	Independently discovered the same as 1	1 grade up + drink
4	Youngcheol Choi (최영철)	2022.05.02	Access control bypassing	2 grade up
5	Dhammiko Arya Gandamana	2022.05.02	Unauthorized request	drink
6	Dhammiko Arya Gandamana	2022.05.02	Access control bypassing	drink
7	Sorn Chottananurak	2022.05.02	Independently discovered the same as 6	drink
8	Abdirakhman Ismail	2022.05.02	Independently discovered the same as 6	drink
9	Dongwoo Moon (문동우)	2022.05.02	Independently discovered the same as 2	1 grade up + drink
10	Abdirakhman Ismail	2022.05.06	Breaking 2FA	1 grade up
11	Abbas Mammadov	2022.05.06	Denial-of-service	+5% of final score + drink
12	Dhammiko Arya Gandamana	2022.05.06	Access control bypassing	+1% of final score + drink
13	Woomin Song (송우민)	2022.05.06	Physical access control bypassing	drink
14	Abbas Mammadov	2022.05.06	Access control bypassing	+1% of final score + drink
15	Wonjun Lee (이원준)	2022.05.06	Access control bypassing	+1% of final score + drink
16	Abdirakhman Ismail	2022.05.06	XSS + CSRF	1 grade up + drink
17	Si Woo Lee (이시우)	2022.05.06	Unauthorized request	drink
18	Si Woo Lee (이시우)	2022.05.06	Not using HTTPS	drink
19	Murad Aghazada	2022.05.16	Access control bypassing	drink
20	Jiyeon Kim (김지연)	2022.05.16	2FA bypassing	+1% of final score + drink
21	Jiyeon Kim (김지연)	2022.05.16	Denial-of-service	drink
22	Aziz Huseynov	2022.05.16	Access control bypassing	drink
23	Moon Dongwoo (문동우)	2022.05.16	XSS	1 grade up + drink
24	Aziz Huseynov	2022.05.20	Authentication bypassing	3 grade up
25	Minhee Kim (김민희)	2022.05.27	2FA bypassing	drink
26	Seungjin Yu (유승진)	2022.05.30	Functional incorrectness	drink

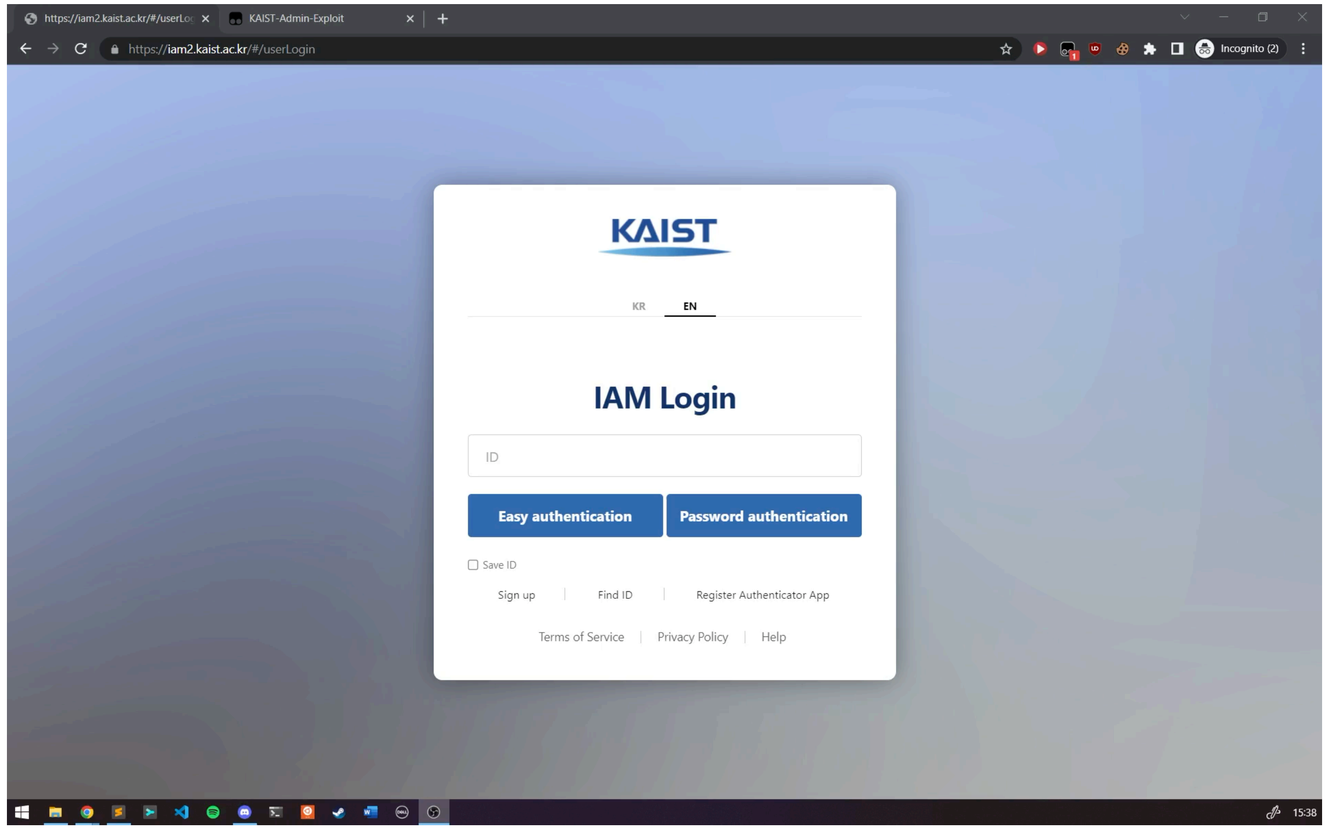






https://github.com/prosyslab-classroom/cs348-information-security/blob/main/hof.md

Top Secret



Certificate of Appreciation

School of Computing

For outstanding participation in CS348 and contribution to making KAIST a safer place.

May 2, 2022

CS348 Instructors
School of Computing
KAIST

By Aziz Huseynov, 2022 Spring

Hacking Ethics

- Hacking: seek to compromise computer systems or networks by exploiting vulnerabilities
  - E.g., stealing confidential data, DDoS
- White hackers: hired for penetration testing to find vulnerabilities
  - Give contributions to the society
  - DO NOT disclose the bug publicly before the fix is released
  - DO NOT exploit
- Be careful! KAIST is a national institute

Agreement

보 안 서 약 서

(학생용)

본인은 년 월 일 부터 년 월 일 까지 한국과학기술원 _____ _____ 학과의 _____ 과목에서 _____ 과제를 수행함에 있어, 다음과 같이 1)한국과학기술원의 규정과 통제절차 및 상급기관의 2)법적 보안사항을 준수할 것을 엄숙히 서약 합니다.

1. **나는 상기한 과제를 수행하며, 습득한 IT 정보 및 보안관련 사항 등의 기관정보와 관련된 어떠한 정보도 외부에 일체 발설하거나 노출 또는 반출하지 않을 것을 서약한다.**
   - 가. 네트워크/시스템/보안 등 IT인프라 관련구성 일체
   - 나. 시스템 접근권한 정보 일체
   - 다. 한국과학기술원 내에 있는 모든 개인정보 일체
   - 라. DB 정보 일체
   - 마. 정보시스템 취약점 등의 정보 일체
   - 바. 기타 한국과학기술원 정보보안 관련 대외비, 비밀 일체
2. **나는 위의 사항을 위반했거나 기밀을 누설한 경우, 아래의 관계 법규에 따라 엄중한 처벌을 받을 것을 서약한다.**
   - 가. 『형법』 및 『개인정보 보호법』
   - 나. 『정보통신망 이용촉진 및 정보보호 등에 관한 법률』
   - 다. 한국과학기술원 『학칙』 제59조
   - 라. 한국과학기술원 『학생 징계지침』 별표 제2호
3. **서약자 연명부**

연번	소속	연락처(Tel)	성명	서명	서명(강의교수)

제출일: 년 월 일

수 신 : 정보보안담당관(정보보안담당자)

1) 한국과학기술원『정보보안지침』(https://rule.kaist.ac.kr)
2) 과학기술정보통신부『정보보안 기본지침』및 국가정보원『국가정보보안기본지침』

Information Security Agreement

(for students)

From YYYY-MM-DD to YYYY-MM-DD, I solemnly pledge to comply with the regulations and control procedures of KAIST, the Ministry of Science and ICT, and the National Information Security Guidelines in carrying out the _____ course _____ project of _____ department.

1. I pledge not to disclose, expose or take out any information related to KAIST institutional information, such as acquired IT information and security related matters included but not limited to
   - A. All IT infrastructure-related configurations, including network/system/security
   - B. All system access information
   - C. All personal information in KAIST
   - D. All DB information
   - E. All information, such as information system weaknesses, etc
   - F. All other confidential information related to KAIST
2. I pledge to be severely punished in accordance with the relevant laws and regulations below in case of violations regarding the above.
   - A. Korean Criminal Law, Personal Information Protection Act
   - B. Korea Information and Communication Network Act
   - C. Article 59 of the KAIST School Regulations
   - D. KAIST Student Disciplinary Guidelines Appended Table 2
3. A List of vows

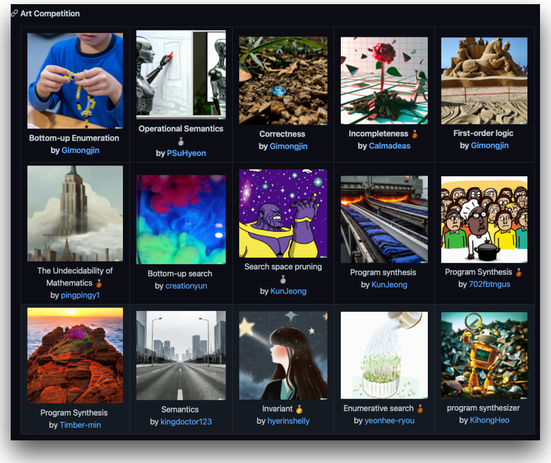
No.	Dept.	Contacts.	Name.	Signature.	Signature. (Prof.)

Date of Agreement : YYYY-MM-DD

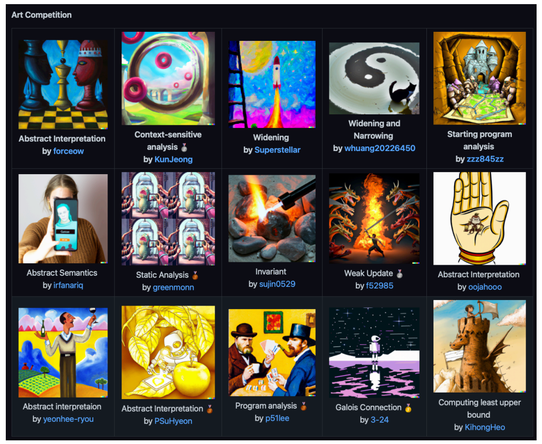
A Recipients : Information Security Officer

Activity (2): Art Competition (천하제일 그림대회)

- What does X mean to you?
- Pick a concept X you have learned in this class such as cryptography, program analysis
- Draw a picture that succinctly represents the concept using DALL-E
- Detailed instructions will be announced later

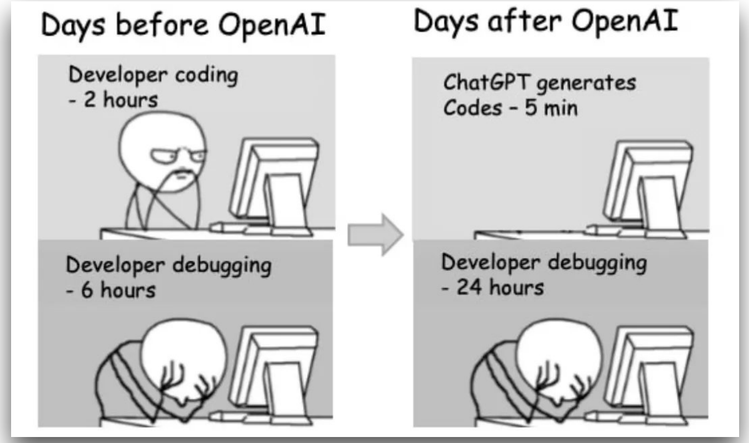


CS492: Program Reasoning, 2022



CS524: Program Analysis, 2022

Activity (3): HackGPT



- Does ChatGPT become a friend or villain?
- Detect when ChatGPT becomes HackGPT!
- Report NEW security threats that can be caused by ChatGPT
  - Read “Large Language Models like ChatGPT say The Darnedest Things” [CACM’23]
  - DO NOT report known issues (e.g., generating buggy code): a lot of studies already done
  - Describe a concrete and detailed scenario
- Detailed instructions will be announced later

Homework

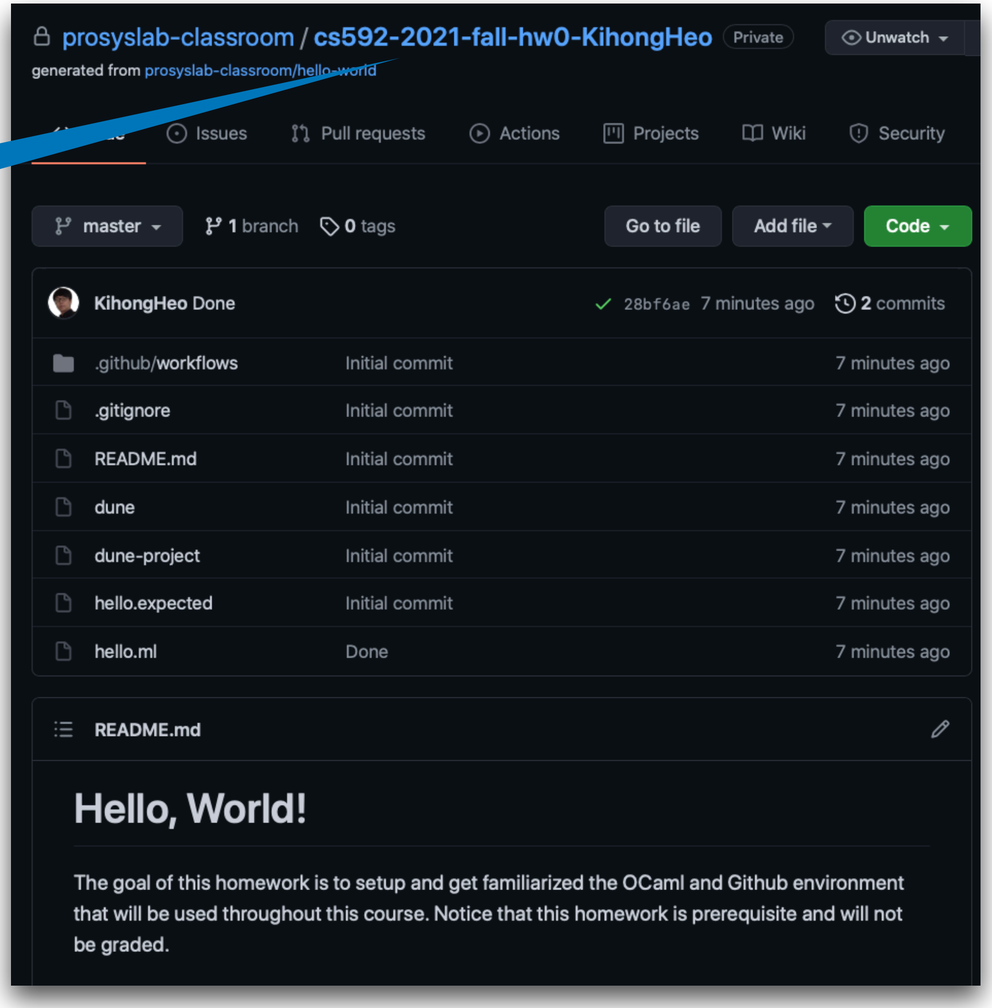
- All submissions will be managed using Github / Github Classroom
  1. For each HW, a unique invitation URL will be posted on the issue board
  2. Once you accept, a private repo for your assignment will be created
  3. You can push as many commits as you want before the deadline
  4. The final commit of your main branch will be graded
- Gradescope will be used for written assignments and exams
- 80% credit for 1-day late, 50% credit for 2-days late, NO credit otherwise

Homework 0.1: Hello, World!

- Goal: setting up and getting familiarized with OCaml and Git environments
  - Implement your “hello-world” program in OCaml
  - Test on your machine
  - Push to your Github repository
  - See the result in Github Action
- The invitation URL will be posted on the course webpage
- Will not be graded

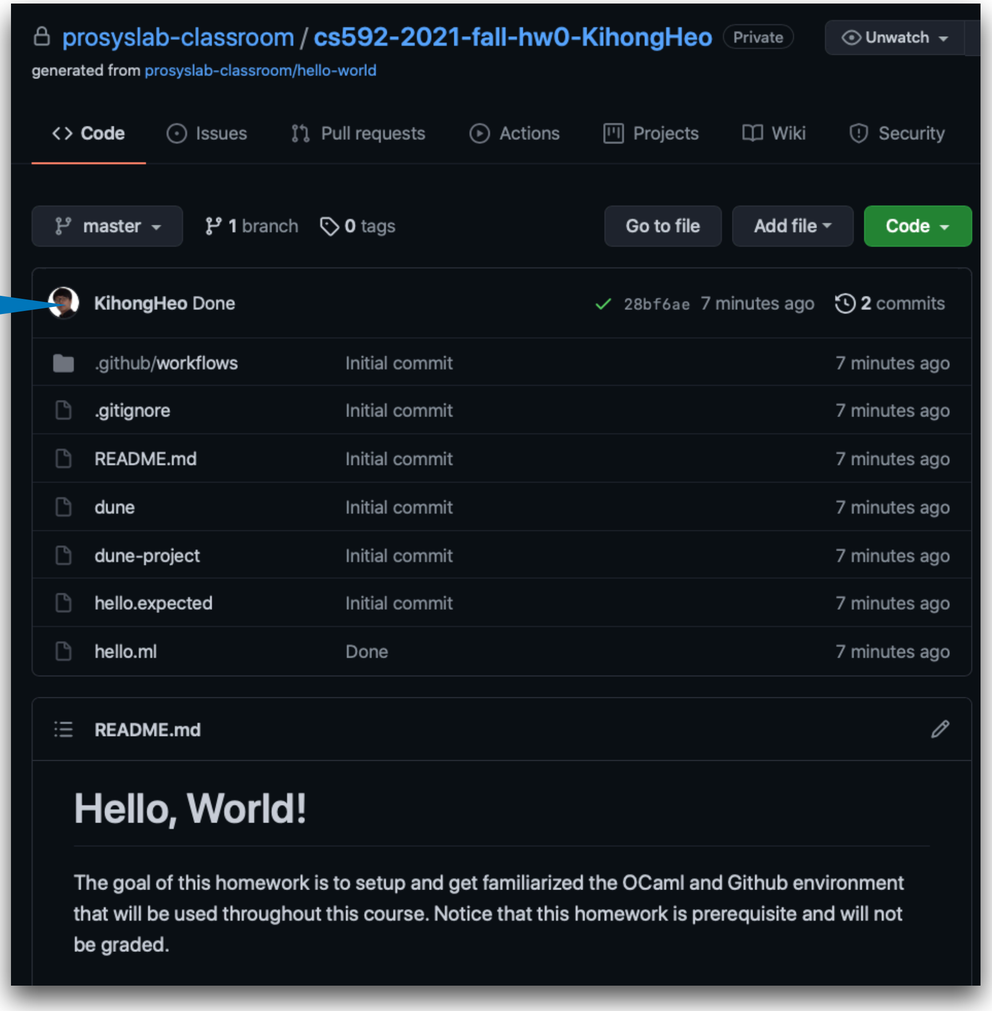
Homework 0.1: Hello, World!

1. Accept the invitation and have your repository



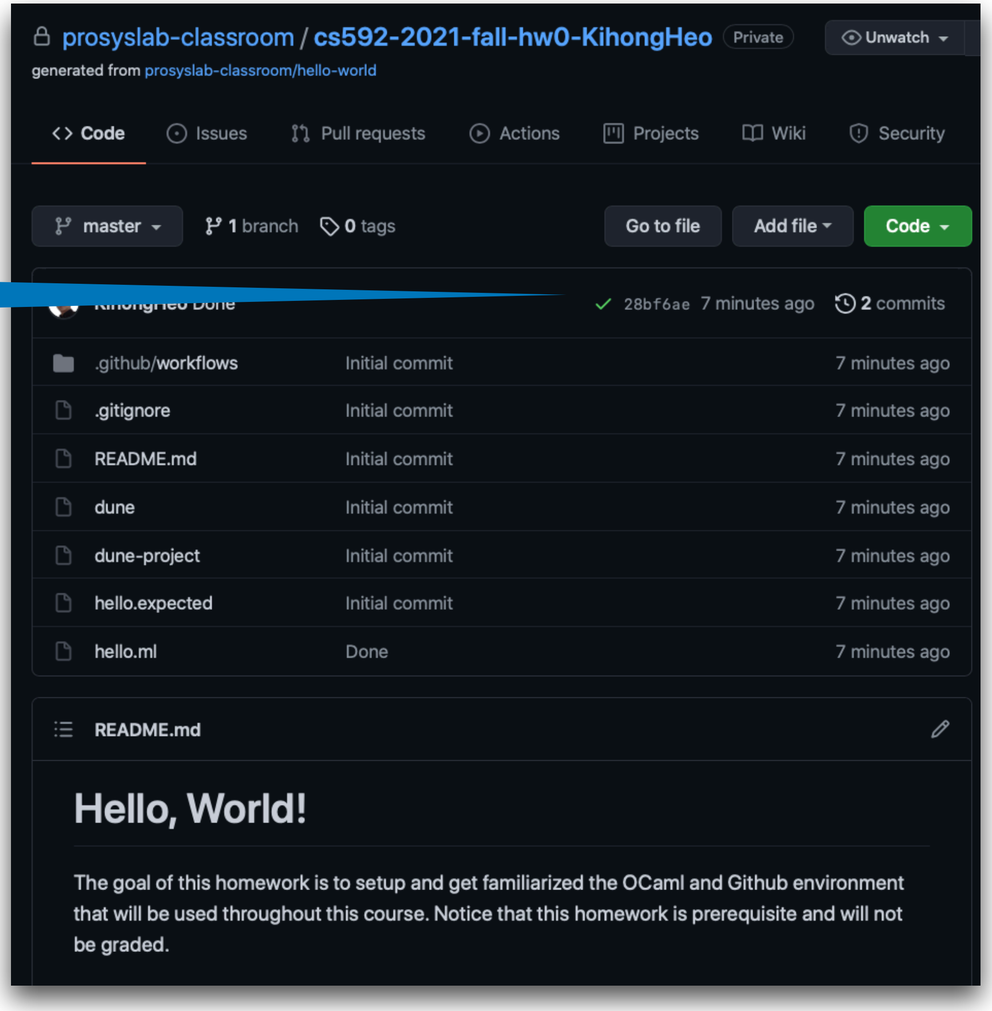
Homework 0.1: Hello, World!

2. Commit your code



Homework 0.1: Hello, World!

3. See your result



Homework 0.2: OCaml Programming

- Goal: getting familiarized with basic OCaml programming
  - Solve a few programming problems in OCaml
  - Test on your machine
  - Push to your Github repository
  - See the result in Github Action
- The invitation URL will be posted on the course webpage
- Will not be graded but highly recommended if you are not familiar with OCaml

Misc

- Submit your Github account via the google form (see the Github issue board)
- Join Gradescope (see the Github issue board)
  - For some assignments and the final exam
- Rules for programming assignments
  - Preserve the structures (directories, files, types, etc)
  - Don’t install further Github App

FAQ

Q	A
Is it okay to send an email at midnight?	Of course! No one cares. (Do you send it to the US at 3 am?)
I am not familiar with OCaml programming	Your main goal: Learn how to learn new things. There are a lot of materials, kind TAs, and AI!
Is it ok to use ChatGPT or Copilot for the programming assignment?	Your sub-goal: Learn how to use AI ethically & constructively
What happens if I submit AI-generate code?	If unlucky, detected by our clone checker. You will get F. If lucky, you get a high score. But will be naturally selected soon.