CS6265: Information Security Lab

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CS6265: Info. Security Lab

- A special course: supervised, **hands-on laboratory**
- Focusing on *reverse engineering* and *binary exploitation*
- Designed for seniors and above (including InfoSec MS, fresh PhDs)
  - Prerequisite: OS, system programming, architecture
  - Background: low-level programming (e.g., C, asm)

Learning via Capture-the-flag

CTF: Cyber War Game

- Jeopardy
- Attack and defense

Topics

- Reverse engineering
- Binary exploitation
- Bug finding
- Memory forensic
- etc.

Schedule: https://tc.gts3.org/cs6265/2023-fall/cal.html

Big Picture: Course Structure

- Total 9 labs (week/bi-weekly)
- **Event 1**. In-class, 24h TKCTF Dec 01 at 3pm (Fri) - Dec 02 at 3pm (Sat)
  - CS6265-hosted CTF event plus **Prizes ($1,000)**
  - Each team prepares one challenge for other teams
- **Event 2**. NSA Codebreaker Challenge

Event 1: TKCTF

Event 2: NSA Codebreaker

Weekly Structure (for Lab)

- Fri : Cover a single topic/theme (e.g., stack overflow)
- Optional recitations
  - Tue/Wed 4:00pm - 5:00pm
  - Location: CODA C1015
- Thu : Deadline for the current week's problem set (i.e., 10 challenges)

In-class Meeting (on Fri)

- 30 min: discus last week’s challenges (you will be asked to explain)
- 30 min: cover this week’s topic
- 30-60 min: **in-class tutorial (so bring your laptop!)**
- 30-60 min: TA-ing

Course Grading

- *100% Lab* (no single lab returned → F)
- No midterm/final exams
- 9 labs + 3-lab worth events = 12 labs
  - In-class CTF (2-lab worth)
  - NSA Codebreaker (1-lab worth)

Scoring in Each Lab (Game Rules)

- **10 challenges** (20pt x 10 = 200pt) + **1 in-class tutorial** (20pt) = 220pt
- Need to submit flag , write-up w/ an exploit of each challenge
- Bonus : two fastest solvers (aka, first/second bloods) → +2pt/+1pt
- Hint :: each challenge has 1-2 hints → -1pt x #hints revealed
- Late policy : 50% of the original points (one extra week)

Ref. Check Submission Site!

Grading Scheme (Expected)

- Grading Scheme (expected):
  - A: Average 7+ challenges per lab (7/10 x 200pt + 20pt = **160pt+**)
  - B: Average 6+ challenges per lab (6/10 x 200pt + 20pt = **140pt+**)
  - C: Average 5+ challenges per lab (5/10 x 200pt + 20pt = **120pt+**)
  - D: Average 5- challenges per lab
  - F: Below or zero flag submitted for at least one lab.
- Expected distribution: 40%: A, 30-40%: B, 30-20%: C and below
- **If you don't turn in at least one flag for every lab, you will get an F**
- See Game Rules!

Online Competition

Class | Problems | Scoreboard | Status | Chart New api-key

lab11

Name	Points	Release	Deadline	Solved	Flag	Exploits
sandbox-ptrace	20	11-18-2016 00:00:00	12-01-2016 00:00:00	9	Submit	Submit
sandbox-seccomp	20	11-18-2016 00:00:00	12-01-2016 00:00:00	4	Submit	Submit
sandbox-ptrace2	20	11-18-2016 00:00:00	12-01-2016 00:00:00	8	Submit	Submit
srop	20	11-18-2016 00:00:00	12-01-2016 00:00:00	7	Submit	Submit
simple-aeg	20	11-18-2016 00:00:00	12-01-2016 00:00:00	3	Submit	Submit
sandbox-pin	20	11-18-2016 00:00:00	12-01-2016 00:00:00	1	Submit	Submit
kproc-zeropage	20	11-18-2016 00:00:00	12-01-2016 00:00:00	2	Submit	Submit
kproc-bufovfl	20	11-18-2016 00:00:00	12-01-2016 00:00:00	1	Submit	Submit
kproc-ret2dir	20	11-18-2016 00:00:00	12-01-2016 00:00:00	0	Submit	Submit
kproc-uaf	20	11-18-2016 00:00:00	12-01-2016 00:00:00	0	Submit	Submit

lab10

Name	Points	Release	Deadline	Solved	Flag	Exploits
dlmalloc	20	11-11-2016 00:00:00	12-01-2016 00:00:00	20	Submit	Submit
ptmalloc	20	11-11-2016 00:00:00	12-01-2016 00:00:00	14	Submit	Submit
uaf-basic	20	11-11-2016 00:00:00	12-01-2016 00:00:00	23	Submit	Submit
heap-spray	20	11-11-2016 00:00:00	12-01-2016 00:00:00	20	Submit	Submit

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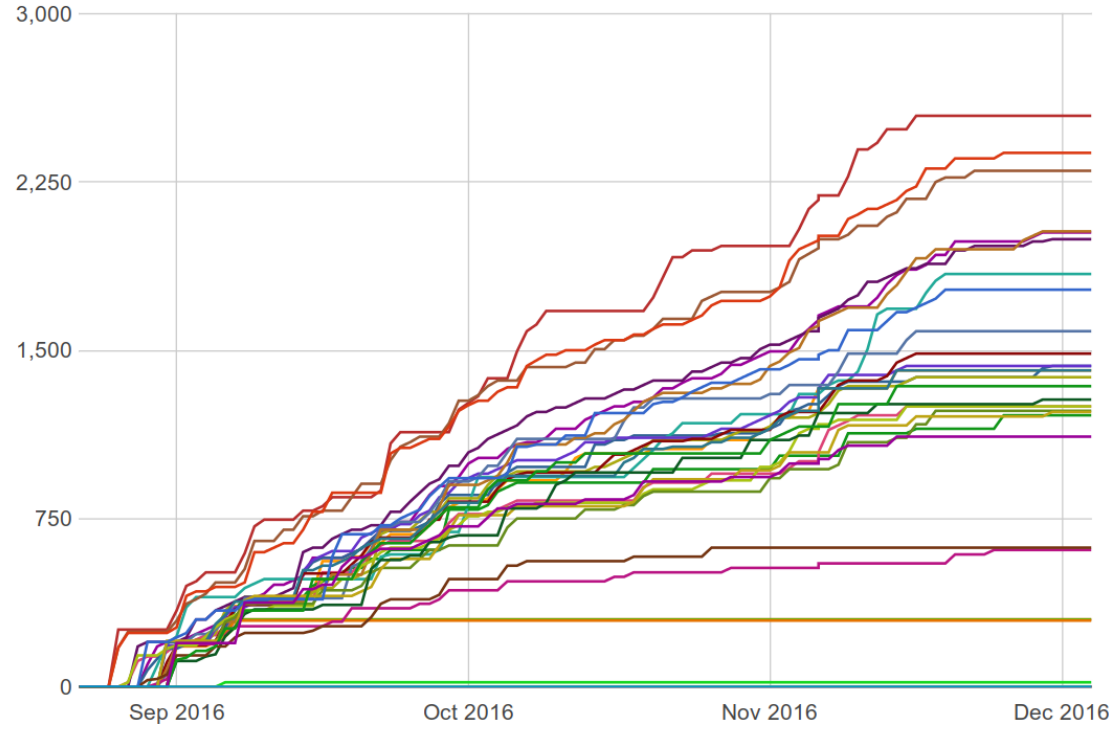
Score Charts



Tips for CS6265

- Study in group (e.g., discussion)!
- Come to the recitation (Tue/Wed)!
- Understand your time budget!
- Tackle challenges in order!
- Learn basic tools next two weeks (e.g., editor, debugger, python)!

Misconduct Policy

- Cheating vs. collaboration
- Refer GT's Academic Misconduct Policy
- ***Never ever*** use/copy other students' code/write-up
- Please ***write down names*** of your collaborators

About Course Material

- You should ***never*** share exploits/write-up online
- Once found → F (even after the semester is over)
- We are checking your submission against past years' submissions

Team

- TA: Seulbae Kim and Fabian Fleischer
- Contact: 6265-staff@cc.gatech.edu
- Website: https://tc.gts3.org/cs6265/2023/
- Ed Discussion: https://edstem.org/us/courses/43826/discussion/

TA Rules

- Please come to the recitation (Tue/Thu 5-6pm, TBD)
- Please post your questions on Ed Discussion
- Feel free to **answer other students' questions** (bonus points)?!
- Please proactively participate in the online discussion
- Contact 6265-staff@cc.gatech.edu as a last resort (slowest)!

Next Two Weeks

Monday	Tuesday	Wednesday	Thursday	Friday
Aug 21 First day of class (**No class**)	Aug 22	Aug 23	Aug 24	Aug 25 **LEC:** Warm-up: x86, Tools [slides] **TUT:** Tut01: GDB/x86 [video] **Preparation:** Read asm **Assigned:** Lab01: Bomb Lab1
Aug 28	Aug 29	Aug 30	Aug 31 **DUE:** Lab 01	Sep 01 **LEC:** Warm-up: x86_64, Shellcode, Tools [slides] **TUT:** Tut02: Pwndbg, Ghidra, Shellcode [video1], [video2], [video3] **Preparation:** Read x86_64 **Assigned:** Lab02: Bomb Lab2 / Shellcode
Sep 04 Labor Day	Sep 05	Sep 06	Sep 07 **DUE:** Lab 02	Sep 08 **LEC:** Writing exploits [slides] **TUT:** Tut03: Writing Your First Exploit [video] **Preparation:** Read Phrack #49-14 **Assigned:** Lab03: Stack Overflow

Today’s Topics

- This week: Bomblab !
- Quick introduction to GDB
- In-class tutorial
  - Walk over x86 asm and tools
  - Be familiarized with GDB and x86 (32-bit)
  - Let’s crack crackme0x00–crackme0x03 binaries

Note on Flag

- Random looking bytes, but be careful. It is designed to include tons of information unique to you, so we can easily check plagiarism

```
$ cat /proc/flag
CB25682B33EF8BF23545A767562A1D5AA33C88EEACC1AE562D950CB9F1E5725D
864725DB51460902ECBD52BA4CBED86A10F3A98A35F6FB71871019702A0E9199
5BC59332C390A3C27D0EC2CE85BC13E956A6027E3171352F90467A8C12346D9A
2A26EE914B3078ED031FDB14BB6224C3D743D79A733FB49EB4E9C1F383CF810E
F6841EE935FE2DA2C57DB4804B6823884B36AE62B08848486918C120E4C2AA94
E1D3F8A6E9E2251AC39E5F37971FB07DFF839E0BC1C4E6C1D4A24E0948F8751B
25BFFE854CD84A8D8E28814398FF192CD9AD37150D83DA872E944DF1552F97DD
...
```

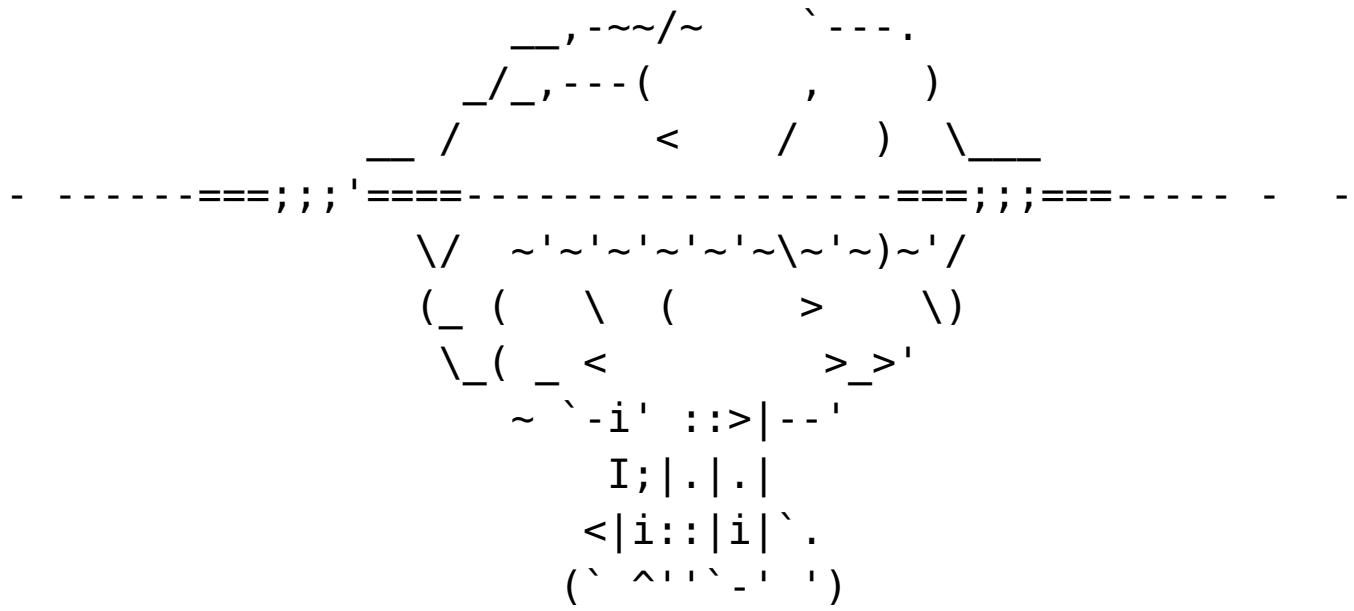
Note on Bomblab

```
$ ./bomb
Enter your api-key: <paste-your-api-key>

         ,--.!,   ____                  _     _        _
      __/   -*-  | __ )  ___  _ __ ___ | |__ | | __ _| |__
     ,d08b.  '|`  |  _ \ / _ \| '_ ` _ \| '_ \| |/ _` | '_ \
    0088MM        | |_) | (_) | | | | | | |_) | | (_| | |_) |
     `9MMP'       |____/ \___/|_| |_| |_|_.__/|_|\__,_|_.__/
           cs6265

Welcome to my fiendish little bomb. You have N? phases with
which to blow yourself up. See you alive!
(hint: security question)
>
```

Be Cautious!



WARNING!

- **Don’t send us email to restore scores!**
- Be extra cautious about what you are typing..
- But think about how to defeat? (i.e., cheating our server?)
- **ANY** techniques are acceptable and be imaginative!
- Read the binary, check how it works internally, tinker it locally!

DEMO: GDB Summary

- run/continue
- break/tbreak/rbreak/delete
- stepi/nexti/finish
- info reg/proc/break
- backtrace/examine
- gdbinit
- python
- etc.

In-class Tutorial

- Step 1: Setup the game environment
  - https://tc.gts3.org/cs6265/2023/rules.html
- Step 2: Tutorial (in CTF servers)
  - https://tc.gts3.org/cs6265/2023/tut/tut01-warmup.html

```
$ ssh lab01@54.88.195.85
password: 45009fac

$ cat README
$ cd tut01-crackme
$ cat README
```

References

- GDB tutorial
- x86 instructions
- x86 architecture