

## Operating Systems & C – Fall 2018

# Exam Hand-in

This is the hand-in for the exam for the OS and C, fall 2018. You will get your grade based on your written answers to the questions below.

This hand-in exam is composed of four questions, with equal weight. Each question contains several sub-questions. The first three questions concern the assignments. The fourth question concerns concepts and techniques introduced in class.

### Question 1 (25%): Data Lab

Consider the following C function:

```
int f(int x, int y) {
    int a = x+~y+1;
    int b = x>>31;
    int c = y>>31;
    int d = a>>31;
    return !((b ^ ~c) & (b ^ d));
}
```

- A. Explain what the function  $f$  does (in a few sentences).
- B. Write a test function for  $f$  in C. Explain why it works.

### Question 2 (25%): Attack Lab

- A. Give your solution to Part 1, Level 1 in attack lab and explain it in two paragraphs:
  - a. The first paragraph describes why your exploit string is able to corrupt the stack.
  - b. The second paragraph documents your exploit string in details.
- B. Explain in details, possibly based on your experience from attack lab, the difference between simple code-injection attacks (part 1) and return-oriented programming (part 2).

### Question 3 (25%): Malloc Lab

- A. What is a heap checker? Why is it relevant for dynamic memory allocation?
- B. Describe your design and implementation of the *free* function. Choose one version if you have implemented several.

### Question 4 (25%): Topics from the class

- A. What is locality? Why is it important?
- B. How can you estimate the sizes of the caches on your system? Explain your answer.
- C. Give an example of a C program with undefined behavior. Explain your answer.
- D. Give an example of a C program that generates a segmentation fault. Explain your answer.