CSC 209H5 S 2015 Midterm
Duration — 50 minutes
Aids allowed: none

Student Number: |_|_|_|_|_|_|_|_|_|_|_|

Last Name: _____ **First Name:** _____

Lecture Section: 1 **Instructor: Daniel Zingaro**

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*Do **not** turn this page until you have received the signal to start.*
(Please fill out the identification section above, **write your name on the back of the test**, and read the instructions below.)
Good Luck!

This midterm consists of 4 questions on 10 pages (including this one). *When you receive the signal to start, please make sure that your copy is complete.* If you use any space for rough work, indicate clearly what you want marked.

1: _____/ 6

2: _____/ 5

3: _____/ 6

4: _____/ 3

TOTAL: _____/20

Question 1. [6 MARKS]

For each code snippet, do one of two things:

- If the code runs and is well-defined, give its output.
- Otherwise, state the problem, and explain why the code is not well-defined or does not run.

Part (a) [2 MARKS]

```
#include <stdlib.h>
#include <stdio.h>

int main(void) {
  char *p;
  // assume malloc succeeds and returns address 1234
  p = malloc(sizeof(char));
  *p = 0;
  p++;
  free(p);
  printf("hello\n");
  return 0;
}
```

Part (b) [2 MARKS]

```
#include <stdio.h>
#include <string.h>

int main(void) {
  char s[5];
  strncpy(s, "abcdefghij", 5);
  s[strlen(s) - 1] = '\0';
  printf("%s\n", s);
  return 0;
}
```

Part (c) [2 MARKS]

```
#include <stdio.h>
#include <string.h>

struct person {
  char first[10], last[10];
};

struct marriage {
  struct person person1, person2;
};

int main(void) {
  struct marriage m;
  strcpy(m.person1->first, "a");
  strcpy(m.person1->last, "b");
  printf("hello\n");
  return 0;
}
```

Question 2. [5 MARKS]

Part (a) [3 MARKS] I type this command at the shell:

```
sort <junk > result
```

Explain what the shell has to do to execute this command. Refer to specific system calls in your answer.

Part (b) [2 MARKS] Write a `makefile`, to be processed by `make`, that prints the word `hello` iff the file `dan` does not exist.

Question 3. [6 MARKS]

Here is the `struct block` from Assignment 2.

```
struct block {
  void *addr; /*start address of memory for this block */
  int size;
  struct block *next;
};
```

Suppose `freelist` is already initialized and contains zero or more blocks, and that `freelist` is sorted by increasing `addr` values.

One thing we might like to do is **coalesce** blocks of free memory into larger blocks, so that future calls to `smalloc` are more likely to succeed.

For example, suppose that the first block in `freelist` has `addr = 500` and `size = 100`. Suppose also that the second block in `freelist` has `addr = 600` and `size = 50`. What we can do is replace this by a single block with `addr = 500` and `size = 150`.

Write function `coalesce` below that coalesces all possible blocks in `freelist`. For full marks, you must not have any memory leaks.

```
void coalesce (struct block *freelist) {
```

[more space for your `coalesce` function]

Question 4. [3 MARKS]

Write the following function that copies all bytes from `infd` to `outfd`.

```
int copy_fd(int infd, int outfd) {
  //infd and outfd are properly-opened FDs.
  //Copy all bytes from infd to outfd.
  //Return number of bytes copied.
```

Function Prototypes

```
int printf(const char *format, ...);

size_t strlen(const char *s);
char *strcpy(char *dest, const char *src);
char *strncpy(char *dest, const char *src, size_t n);

ssize_t read(int fd, void *buffer, size_t maxbytes);
ssize_t write(int fd, void *buffer, size_t maxbytes);

size_t fread(void *ptr, size_t elem_size,
             size_t num_elem, FILE *stream);

size_t fwrite(const void *ptr, size_t elem_size,
              size_t num_elem, FILE *stream);
```

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

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