Name: UID#: DirectoryID:

CMSC216: Practice Exam 1A

Spring 2025

University of Maryland

Exam period: 20 minutes *Points available:* 40 *Weight:* 0% of final grade

Background: Noel Pwanter is experimenting with a linked list application using code shown nearby. The function `list_init()` takes a pointer to a `list_t` struct as its argument. Noel thinks the OLD VERSION, shown below commented, could be improved by directly declaring a pointer as shown in the NEW VERSION. Noel is surprised when Valgrind identifies problems and the program crashes.

```
1  #include "list.h"
2
3  int main(int argc, char *argv[]){
4    // ...
5    // list_t list;       // OLD VERSION
6    // list_init(&list);
7    list_t *listptr;      // NEW VERSION
8    list_init(listptr);
9    // ...
10   return 0;
11 }
12
13 // initialize list
14 void list_init(list_t *list){
15   list->head = NULL;
16   list->size = 0;
17   return;
18 }
```

```
1  >> gcc -g list_main.c
2  >> valgrind ./a.out
3  ==4529== Use of uninitialised value of size 8
4  ==4529==    at 0x109147: list_init (list_main.buggy.c:15)
5  ==4529==    by 0x109133: main (list_main.buggy.c:8)
6  ==4529==
7  ==4529== Invalid write of size 8
8  ==4529==    at 0x10914F: list_init (list_main.buggy.c:15)
9  ==4529==    by 0x10913B: main (list_main.buggy.c:8)
10 ==4529==  Address 0x0 is not stack'd, malloc'd or free'd
11 ==4529==
12 ==4529== Process terminating with default action of
13 ==4529==  signal 11 (SIGSEGV): dumping core
14 ==4529==  Access not within mapped region at address 0x0
15 ==4529==
16 ==4529== HEAP SUMMARY:
17 ==4529==   in use at exit: 0 bytes in 0 blocks
18 ==4529== total heap usage: 0 allocs, 0 frees
```

Problem 1 (15 pts): Answer the following questions about Noel's code.

(A) Describe the problems that Valgrind identifies and what they mean about Noel's code.

(B) Reverting the code to the OLD VERSION will fix this problem. Describe in which Logical Region of memory the `list` is allocated in the OLD VERSION and WHEN the memory associated with `list` will be de-allocated.

(C) Noel wants her `listptr` as a pointer to the `list` struct to avoid needing to use the `&list` syntax at later points in her code. What code should she write to achieve this? Indicate if your answer would keep the memory for the `list_t struct` in the same place as the OLD VERSION or move it to a different logical region of memory.

Problem 2 (15 pts): Nearby is a description of the function `equiv_exchange()` along with a `main()` function demonstrating with example calls. Write this function to meet the specification given.

```
#include "equiv_exch.h"
typedef struct {
  char x[128];
  char y[128];
} strpair_t;

int equiv_exchange(strpair_t *strpair);
// If the x/y fields are strings of
// equal length, swap them and return 1.
// Otherwise do nothing and return 0.
// CONSTRAINT: does NOT use strcpy() or
// memcpy() functions.

int main(){
  int ret;
  strpair_t elrics = {
    .x="Ed", .y="Al"
  };
  ret = equiv_exchange(&elrics);
  printf("ret:%d  x/y: %s %s\n",
         ret, elrics.x, elrics.y);
  // ret:1  x/y: Al Ed

  strpair_t side = {
    .x="Winry", .y="Mustang"
  };
  ret = equiv_exchange(&side);
  printf("ret:%d  x/y: %s %s\n",
         ret, side.x, side.y);
  // ret:0  x/y: Winry Mustang

  strpair_t homonc = {
    .x="Lust", .y="Envy"
  };
  ret = equiv_exchange(&homonc);
  printf("ret:%d  x/y: %s %s\n",
         ret, homonc.x, homonc.y);
  // ret:1  x/y: Envy Lust
  return 0;
}
```

Note CONSTRAINTs: does not use `strcpy()` / `memcpy()`

YOUR CODE HERE

Problem 3 (10 pts): Fill in the following table of equivalent ways to write these 8 bit quantities. There are a total of 9 blanks to fill in and the first column indicates which blanks occur in which lines. Assume two's complement encoding for the signed decimal column.

Blank #s	Binary	Hex	Octal	Unsigned Decimal	Signed Decimal
#1 #2 #3	0001 1011		0033		
#4 #5 #6		0xA5	0245		
#7 #8 #9		0xC7			-57