Midterm Review

COS 217 Midterm: Thu Oct 24

When/where?

- In class, Thu. Oct 24; split between *Friend 101* (P01, P02, P03, P04, P04A) and *CS 104* (P05, P05A, P06, P06A)

What?

- C programming, including string and stdio
- Numeric representations and types in C
- Programming in the large: modularity, building, testing, debugging
- Readings, lectures, precepts, assignments, through *last Tuesday*
- Mixture of short-answer questions and writing snippets of code

How?

- Closed book and notes
- No electronic anything
- Interfaces of relevant functions will be provided

Old exams and study guide are posted on schedule page

Fall 2015, Question 1d

What does `printf(“%d”, (0532 << 3)/64)` print to stdout?

- << 3 shifts *left* by three bits
- /64 is dividing by 2^6, or shifting *right* by six bits
- So, the result is shifting right by three bits

- 0532 is an octal number (three bits per digit)
- Shifting right by three bits is 053
- Converting to decimal (“%d”) is 5*8 + 3, or 43

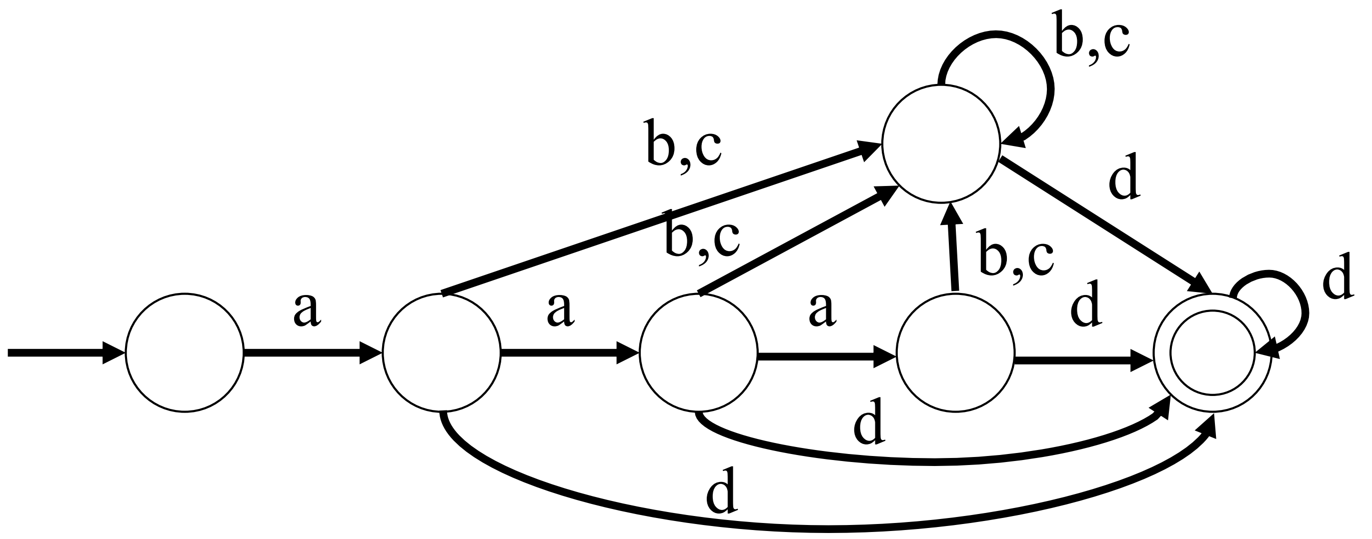
Spring 2015, Question 1

Indicate which of these expressions evaluates to true or false

1a) ~1 && 1	TRUE (note *logical* AND)
1b) 512 - 01000	FALSE (note *octal* number)
1c) 0x2B | (! 0x2B)	TRUE (note *bitwise* OR)
1d) 16 >> 4	TRUE (10000_2 >> 4 is 1)
1e) sizeof(5) > sizeof(2L)	FALSE (int not bigger than long)
1f) -10 < i < -1	FALSE (left-to-right associativity)

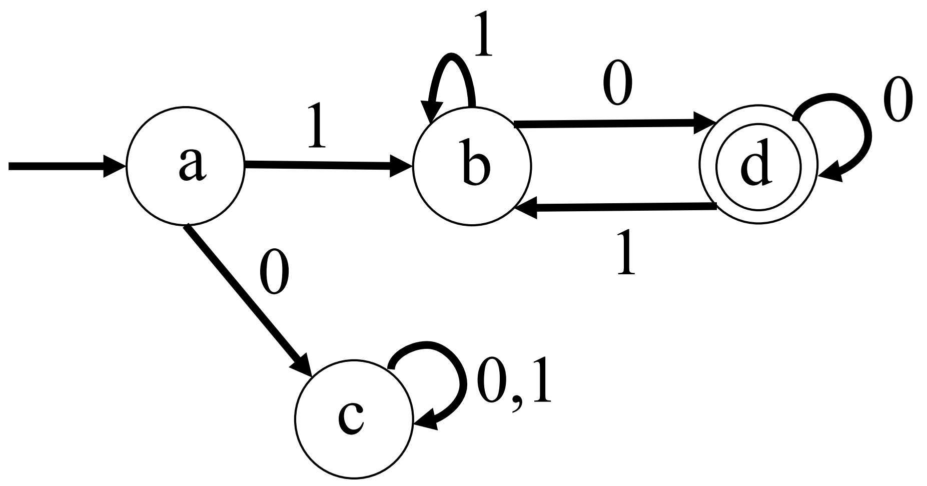
Fall 2012, Question IV(d)

Draw a DFA that accepts legal strings defined as follows (and only such legal strings): A legal string is a string that begins with 1 to 3 a's, is followed by 0 or more b's or c's, and ends with at least one d.



Spring 2015, Question 3(e)

Consider the DFA shown below on 0/1 inputs, i.e., it accepts or rejects binary words. The start state is the state labeled a, and the only accepting state is the state labeled d (shown as a double circle). State in one sentence the set of words accepted by the DFA.


$$\begin{tikzcd}
\arrow[r] & a \arrow[r, "1"] \arrow[d, "0"] & b \arrow[loop above, "1"] \arrow[r, bend left, "0"] & d \arrow[loop right, "0"] \arrow[l, bend left, "1"] \\
& c \arrow[loop right, "{0,1}"] & &
\end{tikzcd}$$

Start with a 1,
end with a 0

Fall 2012, Question IV(b)

What is the risk with having the following line of code in a C program:

```
assert (f() == 0);
```

How would you rewrite the code to eliminate the risk?

- Assert statements can be disabled in compilation (NDEBUG macro)

- We do not know what calling f() might do
- E.g., side effects like changing a global variable

- Instead, do

```
int i;
i = f();
assert(i == 0);
```

Spring 2014, Question 2(d)

Assuming y is valid, what would you put in the body of the function if the function is to return zero if and only if first parameter is equal to the integer value accessible through the second parameter.

```
struct z {int x;};
typedef struct z z;
static int Func(int x, z *y) {
   return y->x != x;
}
```

Spring 14, Question 3

What does this code do? (In parts)

```
int main(int argc, char *argv[]) {
    char *a = argv[1]; /* gets first arg */
    char *b;
    int k, i, tuk;

    assert(a != NULL);
    for (k = 0; a[k] != '\0'; k++)
        ;
```

Computes length of string and stores in k

Spring 14, Question 3

What does this code do? (In parts)

```
assert(a != NULL);
for (k = 0; a[k] != '\0'; k++)
  ;

tuk = k<<1;
b = malloc(tuk + 1);
b[tuk] = '\0';
```

Allocates space for string twice the size, and terminates the string

Spring 14, Question 3

What does this code do? (In parts)

```
assert(a != NULL);
for (k = 0; a[k] != ’\0’; k++)
  ;

tuk = k<<1;
b = malloc(tuk + 1);
b[tuk] = ‘\0’;

for (i = 0; i < k; i++)
   b[i] = a[i];
```

Copies the original string in the first half of the new space

Spring 14, Question 3

What does this code do? (In parts)

```
tuk = k<<1;
b = malloc(tuk + 1);
b[tuk] = ‘\0’;

for (i = 0; i < k; i++)
    b[i] = a[i];

for (i = 0; i < k; i++)
    b[i+k] = a[k-1-i];
```

Copies reversed version of the string into the second half of the new space

Spring 14, Question 3

What does this code do? (In parts)

```
tuk = k<<1;
b = malloc(tuk + 1);
b[tuk] = '\0';

for (i = 0; i < k; i++)
   b[i] = a[i];

for (i = 0; i < k; i++)
   b[i+k] = a[k-1-i];

printf("%s\n", b);
```

In total: creates a palindrome and prints it!

Fall 2015, Question 2(b)

This function should print every other character of the input (i.e., for an input of "0123...", the output should be "13..."). When does it produce the wrong answer? Rewrite the code to fix the bug.

```
void q2b(void) {
    while (getchar() != EOF)
        putchar(getchar());
}
```

Wrong when number of characters is odd.

Fall 2015, Question 2(b)

Rewrite the code to fix the bug.

```
void q2b(void) {
   int c;
   for (;;) {
      c = getchar();
      if (c == EOF)
        return;
      c = getchar();
      if (c == EOF)
        return;
      putchar(c);
   }
}
```

Fall 2015, Question 2(c)

This function should return the maximum value in an array a of n integers. When does this code return the wrong value? Modify the code to correct the bug.

```
int q2c(int *a, int n) {
    int currmax = 0, i;
    assert(a != NULL);
    assert(n > 0);
    for (i = 0; i < n; i++)
         if (a[i] > currmax)
              currmax = a[i];
    return currmax;
}
```

Negative numbers!

Fall 2015, Question 2(c)

This function should return the maximum value in an array a of n integers. When does this code return the wrong value? Modify the code to correct the bug.

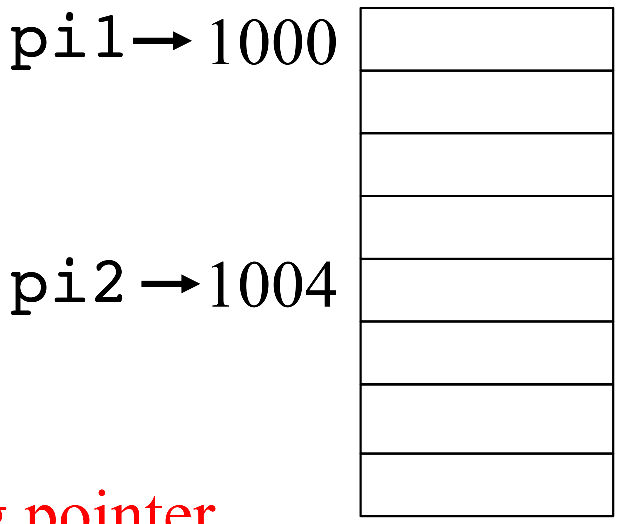
```
int q2c(int *a, int n) {
    int currmax, i;
    assert(a != NULL);
    assert(n > 0);

    currmax = a[0];
    for (i = 1; i < n; i++)
         if (a[i] > currmax)
              currmax = a[i];
    return currmax;
}
```

Spring 2018, Question 4

Assume that each of the following snippets of code is run with these variables defined:

```
int *pi1 = (int *) malloc(2 * sizeof(int));
int *pi2 = pi1 + 1;
int i = 1;
```



What memory management error(s) result from each code snippet?

```
free(pi1);
*(pi2 - 1) = i;   ←  Dangling pointer
free(pi2);        ←  Free of unallocated memory
```

Spring 2018, Question 4

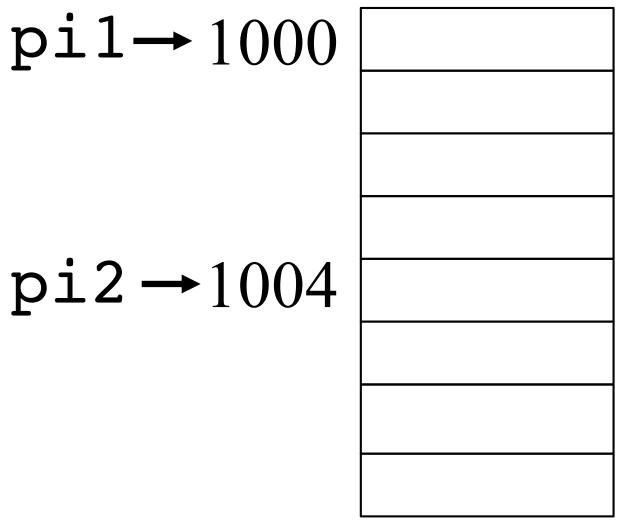
Assume that each of the following snippets of code is run with these variables defined:

```
int *pi1 = (int *) malloc(2 * sizeof(int));
int *pi2 = pi1 + 1;
int i = 1;
```

What memory management error(s) result from each code snippet?

```
free(pi1);
pi2 -= 1;
free(pi2);
```

$\longleftarrow$ Double free



Fall 2012, Question 1(g)

You have written a module to implement a queue, and published an interface for it in a .h file. A colleague reviews it and suggests you add a function to the interface. What are the two questions you ask yourself to decide whether or not to include the new function in the module interface?

Is the function necessary to make the module complete?

Is the function convenient for many clients?

See you on Thursday!