CS 399 NETWORKS & SYSTEMS SPRING 2022 MIDTERM II
Instructor Calvin Deutschbein

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This exam will be timed for 60 minutes, with a no-excuse 30 minute extension.

It will be scored out of 200 Points.

It will make up 20% of Final Grade.

SECTION I: C LANGUAGE **60 Points**

Part 1: Multiple Choice: *4 Questions @ 5 Points each =* *20 Points*

The C pre-compiler provides the #define macro. What is **NOT** an appropriate use of #define?

A. Creating a value to be used and updated throughout the program.
B. Encoding a special value used throughout the program, like port number.
C. Encoding a special value intended to be changeable by user, like verbose mode
D. Setting the size of a buffer, array, or other memory region of some common size.

Which of the following format strings prints a void *'s location in hex?

A. %x
B. %d
C. %p
D. %s

Which of the following format strings prints an int's value in hex?

A. %x
B. %d
C. %p
D. %s

What is the value of x?

```
x = 1 << 8;
```

A. 0x100
B. 0x10
C. 0xA0
D. 0xFF

Part 2: Short Response: 4 Questions @ 10 Points each = 40 Points

The C language offers a number of techniques for providing time-outs to blocking I/O calls. Describe one that you have used and some benefits of this technique.

Explain the usefulness of infinite loops in network or I/O based programs.

What is printed by this program and why? Show work but also clearly specify your answer.

```
int fun(int *x) {*x <<= 1;}

int main()
{
      int x = 1, i = 4;
      while(i--) {fun(&x);}
      printf("%x\n", x);
}
```

What is printed by this program and why? Show work but also clearly specify your answer.

```
int fun(int x) {x &= 1;}

int main()
{
      int x = 4;
      while(x) {fun(x);}
      printf("%x\n", x);
}
```

SECTION II: SYSTEMS **50 Points**

Part 3: Multiple Choice: *4 Questions @ 5 Points each =* *20 Points*

When setting up a server, which of the following calls must come first?

A. accept()
B. bind()
C. connect()
D. listen()

What is the difference between sock_addr_in and sock_addr_in6?

A. *_in6 corresponds to multiple sockets but a single address
B. *_in6 corresponds to a single socket but multiple address
C. *_in6 corresponds to a specific internet subdomain
D. *_in6 corresponds to a specific method of specifying internet addresses

System calls often return with some value even when called other than to return some value. How should these values be treated?

A. Captured in a variable to be studied conditionally.
B. Compared to 0 in all cases.
C. Ignored, such as by prefixing with a (void) cast.
D. Used to debug during code development then discarded in finished programs.

Which of the following best describes a well formed infinite loop?

A. A program blocks on some blocking call.
B. A program can consume an infinite amount of resources over infinite time.
C. A program consumes all available system resources at all times.
D. A program consumes all available resources up to completion of some task.

Part 4: Debugging: *30 Points*

This program may cause errors. Describe what, if any, and how to fix them.

```
int main()
{
      int *var;
      var = 0;
      var += 0xFF;
      printf("%x\n", *var);
      return 0;
}
```

SECTION III: ENGINEERING **90 Points**

Part 5: True/False *4 Questions @ 5 Points each =* *20 Points*

Explaining the usefulness of the following library functions.

Which if the following function is only called once to configure latter number generation.

A. fcntl()
B. perror()
C. srand()
D. setsockopt()

Which of the following prints error handling information about failed system calls?

A. fcntl()
B. perror()
C. srand()
D. setsockopt()

Which of the following can be called on some file pointer to change the behavior of read calls to the file.

A. fcntl()
B. perror()
C. srand()
D. setsockopt()

Which of the following allows any generated server to have special features, such as ease of reuse for testing.

A. fcntl()
B. perror()
C. srand()
D. setsockopt()

Part 6: True/False *4 Questions @ 5 Points each =* *20 Points*

The standard IO library <stdio.h> allows programs to read text input immediately from the console.

A. True
B. False

There are fewer devices connected to the internet than 2^32.

A. True
B. False

Two socket based programs may both use the function connect() to create a socket interface where they may communicate with one another.

A. True
B. False

The costs of memory management are unique to the C language, and do not apply to higher level languages such as Python or JavaScript.

A. True
B. False

Part 7: System Engineering *50 Points*

The core challenge of snek.c is to implement a program with both interrupt driven and schedule driven tasks that most run concurrently, but it is considerably simplified with the use of a game state preserving server and single user interface.

One suggested extension to snek is to support multiple players. This would come with a number of complications to socket interface, internal data management, and implementation of timing.

Provide a sketch, similar to the different functions and their descriptions given to implement snek.c, for a high level approach to implement a multi_snek.c that supports multiple players on different devices. You may assume you have sample code to transmit simple messages between devices. Specify which functions block, on what, and for how long if applicable.