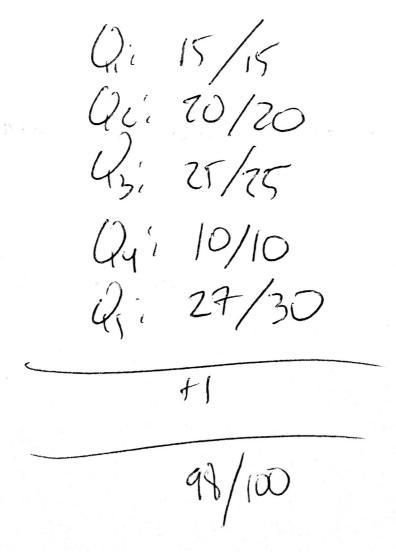
ECE471: Embedded Systems Fall 2018 Midterm Exam

Name: Spencer Groulette

Closed Book, Closed Notes.

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15/15

1. Embedded Systems

For each of the following, state whether the device described is an embedded system, and why. For each answer use at least one of the characteristics of embedded systems as described in class in your answer.

(a) A high-end smartphone (iPhone 8, Galaxy Note 8, etc.)

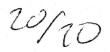
Not an embedded system because it has more than one purpose and doesn't use low resources.

(b) The controller inside of a washing machine that controls the front panel display and all of the various motors and timers.

Is an embedded system because all of it is within the washing machine and is destayed for one purpose which is to wash your clothes properly.

(c) Sunway TaihuLight, the second fastest computer on the Top500 Supercomputers in the world list. It has 40,960 nodes with 10,649,000 cores, 1.3 PetaBytes of RAM and calculates at 93 petaFLOP/s while drawing 15.37 Megawatts of power.

Not an embedded system since it doesn't use low resources. I mean with all that no wonder it is a super computer.



2. Operating Systems

(a) What is one benefit of using an operating system on an embedded device?

Time to Market

More explanation would be nice

(b) What is one drawback of using an operating system on an embedded device?

Timing and over head

(c) Your company is designing a wall thermostat using a microcontroller that has a small LCD display, 4 buttons, and a temperature sensor. This is all controlled by an 8-bit CPU with 8kB of flash storage. Would you recommend using an operating system on this device? Why or why not?

No, the overhead of the operating system would be too much. Not really onough resources

(d) Your company also offers an advanced thermostat with a 640x480 graphical display, a touch screen, wi-fi connectivity, and the ability to download the local weather report (to auto-set the temperature settings). This is all powered by a 32-bit ARM CPU with 256MB of RAM and 1GB of flash storage. Would you recommend an operating system for this device? Why or why not?

Yes, there are a lot of resources that'll allow you to have an Os, plus It'll make handling these applications easier.

3. C Coding

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25/25

(a) As part of your job you come across the below piece of code that is missing some comments. Place meaningful comments next to the code where indicated, describing what the code is doing.

```
void temp_loop(int fd) {

unsigned char buffer[4], output_buffer[2];
int temperature, output_fd;

while(1) {

read(fd, buffer, 4);

memcpy(&temperature, buffer, 4);

// copy raw value into an integer

// the value is temp in degrees C

// set output as ASCII '0'

if (temperature>100) {

output_buffer[0]='0';

if (temperature>100) {

output_buffer[0]+;

}

output_fd=open("/sys/class/gpio/gpiol3/yalue", O_WRONLY);

// prepare gpiol3 for writing

write(output_fd, output_buffer, 1);

// writes I or O to aprol3

close(output_fd);

usleep(100);

// Wart / Sleep For 100 Asse
```

(b) Briefly describe in one sentence what the above code is doing.

The code checks to see of the temperature is above look and then pulls gpio13 high if it is.

10/10

4. Code Density

(a) Name one of the many changes in instruction encoding made between ARM32 and THUMB that allowed the instructions to fit in 16 (rather than 32) bits.

no conditionals and less registers

(b) Describe a benefit (when designing embedded systems) of using an instruction set with better code density.

Smaller size, which helps if it is space constrained

5. GPIO / I²C

27/30

(a) Your boss wants you to design a device that can output a complex pattern of '1' and '0' with 1ns this? Why or why not?

1 GHz No Tech able to get that resolution

and about Sympo

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(b) You are designing an embedded system that controls the various per-floor displays for an elevator. An LED display is placed above the elevator doors on each floor (the building has 5 stories). Your boss wants to use a Raspberry Pi to control the displays, with the Pi in the basement, and an i2c bus (4 wires) connecting the Pi to the displays on all 5 floors. Will this setup work? Why or why not?

length of a couple meters. Anything longer will not work properly.

(c) There are numerous errors in the following GPIO code that is trying to set GPIO17 to a high output. Circle at least 4 of the errors and for each give a brief explanation of what the error is.

/* Open GPIO17 direction file */
fd=open("/sys/class/gpio/gpio17/direction", O_WRONLY);
if (fd<\(\frac{7}\)) fprintf(stderr, "Error!\n");

/* Change direction to output */
write(fd, "out", \(\frac{7}\)); more than a
close(fd);

/* Open GPIO17 value file */
fd=open("/sys/class/gpio/gpio17/value", O_RDONLY)
if (fd<0) fprintf(stderr, "Error opening!\n");

/* Set GPIO17 to high */

/* Set GPIO17 to high */
write(fd,'1',1);
close(fd);

6. Bonus Linux Question

You are planning a party for the end of October so you run the command cal 10 18 to get a quick calendar. You end up confusing everyone by having the invitations list the wrong day of the week. What happened?

When clong cal 10 18, you are chosens the year 12, instead of 2018, which is why the dates are wrong. Instead, is should have done cal 10 2018.