Mittuniversitetet
MID SWEDEN UNIVERSITY

Försättsblad Prov Original

Kurskod	Provkod	Tentamensdatum
ET095G	T103	2019-01-12

Kursnamn	Elektroteknik GR (B), Introduktion till programmering av...
Provnamn	Skriftlig tentamen
Ort	Sundsvall
Termin	
Ämne	

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Exam: Introduction to Embedded System Programming (HT2018)

Course code:	ET095G
Date:	2019-01-12
Duration:	3 hours
Examiner:	Sebastian Bader
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Aids (Hjälpmedel):	none
Marking:	Each question is graded on a scale from 0–5. In order to pass the exam, a minimum of 1 point per question is required. If passed, the exam will be marked with the average of the points achieved in each question.

Instructions

- Begin the answer to every question on a separate sheet of paper.
- Do not write in red color.
- For calculations, the way towards the result has to be clearly understandable.
- Direct citations from lecture slides will not be accepted as an own contribution.

Questions

Question 1: (0–5 points)

(a) In your own words, describe what an embedded system is.

(b) A washing machine is a typical application example for embedded systems. An embedded system, inside the washing machine, might for example be responsible to control the chosen washing program. Describe an input and output to/from such an embedded system that is not human-centric. What type of peripheral devices could be used to generate these inputs and outputs?

(c) Provide an own example of an embedded system. Describe its function, input(s), output(s) and potential peripheral device that can generate the inputs and outputs.

(d) An embedded system is in many cases considered to be more cost sensitive than a general purpose computer (for example, a PC). Motivate why this is the case. You can use the washing machine application as a concrete example.

(e) Describe what consequence (d) has on the implementation of an embedded system.

Question 2: (0-5 points)

(a) List the essential components of a computer system.

(b) Describe the difference between program memory and data memory.

(c) Describe what a microcontroller is.

(d) Explain the term "instruction set" and how an instruction is executed.

Question 3: (0-5 points)

Consider the two code snippets in Figure 1.

```
int x;
int i = 6;
float a[5] = {3.14, 2.45, 1,
    7.23, 1.99};

int main() {
    x = 0x13 % 5;

    for ( int c=1; c<x; c++ ) {
        i--;
    }

    printf("%.2f", a[i]);
}
```

(a)

```
uint8_t a = 12;
float b = 2.745;
float c = a >> 3;
float *p = &c;

int main() {
    printf( "%d", a );
    printf( "%f", b );
    printf( "%f", c );
    printf( "%f", p );
}
```

(b)

Figure 1: Code snippets for Question 3.

(a) In code (a), what is the output of the printf-statement? Motivate.

(b) In code (b), provide the output of each printf-statement. Shortly motivate each answer.

(c) Describe the difference between a compiler and an assembler.

(d) The build process starts with source code written in a programming language. What is the final output of the build process and what is this output used for?

Question 4: (0-5 points)

(a) Describe which two operating modes a GPIO pin can be configured to and what differentiates these two modes.

(b) An LED could be connected to a GPIO pin in order to control the LED's state. Describe how the LED's state can be controlled by using the GPIO pin.

(c) A microcontroller manufacturer will provide you with a value for V_{OH}. Explain what this parameter represents and in what way its value can be significant for you.

Question 5: (0-5 points)

(a) An I2C interface contains (besides GND) two other connections. Describe what these two connections are used for.

(b) I2C is referred to as a master-slave interface. Describe what this means.

(c) Explain why I2C is suitable to connect multiple sensor devices to the same microcontroller.

(d) Describe the difference between serial and parallel communication interfaces.

(e) Motivate why serial interfaces are more commonly used in embedded systems than parallel interfaces.