

## i Instructions for the exam

# DIT 633 - Development of Embedded and Real-time systems

This exam should be an individual work for you. You are not allowed to use any outside help.

If you are allowed to use a compiler, there is a link to an online one, which will open in a separate window. You can test the code in the online compiler, but **you must remember to copy-paste it back to the exam**, otherwise your code will disappear once you close the window.

The same is true for TinkerCad, please remember to copy-paste the code from TinkerCad to the exam.

If you access the code from your saved documents in TinkerCad, and use it in the exam, you **MUST** reference that code and describe clearly what you copied to the exam.

You are not allowed to copy code from your colleagues or any other external source.

**Remember: In programming questions, if the code does not compile, you get 0 points for the question!**

Grading scale:

50% correct - 3

65% correct - 4

80% correct - 5

Good luck!

/Miroslaw

031 772 1081

# 1 Reading pointers

**What is foo in the following expression: `char (**foo)(int *, int*)`**

- ☐ Foo is a pointer to a function that takes two parameters and returns a pointer to a char
- ☐ Foo is a pointer to a pointer to a function that takes two parameters and returns a char.
- ☐ Foo is a pointer to a function that takes two parameters and returns a char
- ☐ Foo is a function that has two parameters and returns a pointer to a char

**What is x in the following statement: `int *a, b; char *y, *x;`**

- ☐ pointer to a variable that points to a variable of type char
- ☐ variable that points to a pointer of type char
- ☐ a variable of type char
- ☐ a pointer of a variable of type char

**foo in the expression: `int *(*foo)(int *)` is:**

- ☐ pointer to a pointer to a function that returns an int
- ☐ pointer to a function that returns a pointer to an int
- ☐ function that returns a pointer to a pointer to an int
- ☐ function that returns a pointer to an int


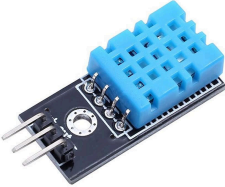
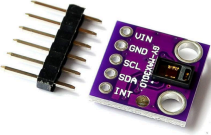

**Which of the following expressions is allowed (and correct) in C:**

- ☐ `char *p; char &x; p = x;`
- ☐ `char *p; char x[]; p = &x;`
- ☐ `char *p; int *x; p = -x;`
- ☐ `char *p; char x; p = &x;`

2 Kopia av Boards

Ersätt med din uppgiftstext...

Which sensor is presented in the picture



Moisture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pulse oximeter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Radar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### 3 Sustainability

Based on the course literature we've learned that Java, as a language, leave more carbon footprint than C. It is quite reasonable, given the presence of Java Virtual Machine.

Please write 2-3 arguments why Java can have more carbon footprint. In your argument please make sure that you can use metrics discussed in the course, to support your arguments.

Please design a small experiment (including a source code) that would allow us to test the hypothesis that Java has more carbon footprint. The experiment does not have to be full and the code does not have to compile. However, you need to provide 2-3 measures/metrics to use for measuring the footprint.


**Skriv in ditt svar här**

Teckenf... ▾

↺

✎

Σ



Ord: 0



## 4 Arrays

Write a program in C that reads 10 strings from a console, stores them in an array and finds the shortest string in the array.

The program should contain a function that takes as parameter the array, find the shortest string, remove it and return the array that is shorter by one element.

The program should read the strings from the console.

The program should have a separate function for finding and removing the string.

The program should write the string that has been removed to the console. The program should also write all elements of the array before and after removal of the shortest string.

You can use the online compiler for this question here: [www.onlinegdb.com](http://www.onlinegdb.com)

The program should contain the following:

- \* correct functionality (as specified above) - 3 points
- \* comments - 3 points
- \* function to find and remove the element - 2 points
- \* main to test the program - 2 points
- \* safety checks - 2 points

Please remember to paste the code from onlinegdb to the form below.

**Skriv in ditt svar här**

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Totalpoäng: 12

## 5 Code quality

One of my colleagues wrote this program. However, I do not understand what it does and I do not know how to test it.

Your task is to:

- 1) Comment the code explaining what the code does - in terms of the algorithm, not what each statement does (2 points)
- 2) Rewrite this function so that it uses meaningful names of the functions and variables (4 points)
- 3) Comment each statement - 1 point
- 4) Write the main() function to test the rewritten function - 3 points

You can use the online compiler for this question: [www.onlinegdb.com](http://www.onlinegdb.com)

Please remember to paste the code back to the form below!

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```
#include <stdio.h>
void foo(int *A, int len) {
    if (len < 2) return;
    int pivot = A[len / 2];
    int i, j;
    for (i = 0, j = len - 1; ; i++, j--) {
        while (A[i] < pivot) i++;
        while (A[j] > pivot) j--;
        if (i >= j) break;
        int temp = A[i];
        A[i] = A[j];
        A[j] = temp;
    }
    foo(A, i);
    foo(A + i, len - i);
}
```

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**Skriv in ditt svar här**

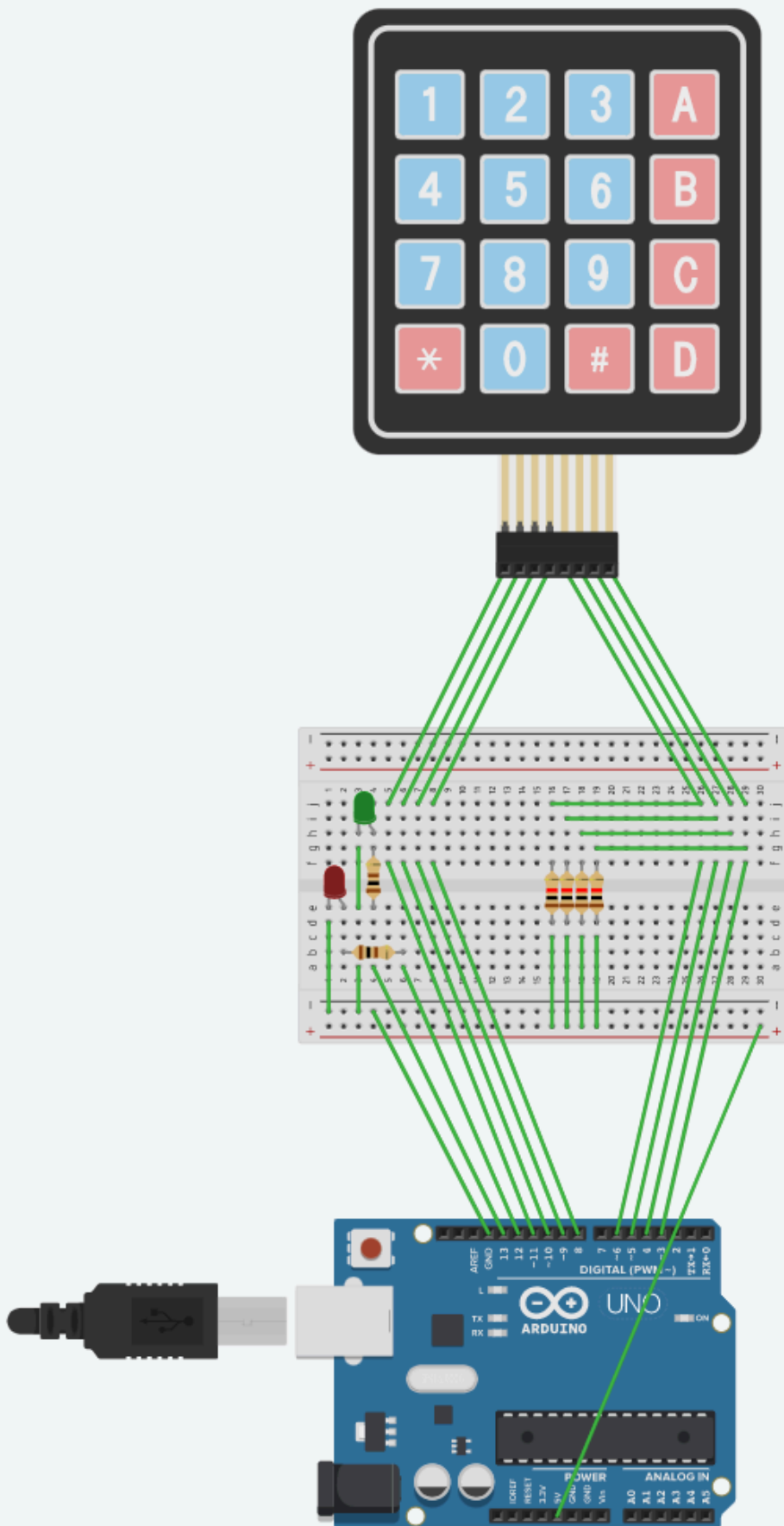
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Totalpoäng: 10

## 6 Locker



The figure above contains the circuit of a locker system. You should write the software that will provide the functionality for this system.

The program should do the following. The user should be able to provide a 6 digit code. If the code is correct, then the system should unlock - this means that the green LED should turn on.

If the code is incorrect, then red LED should turn on.

If the user enters incorrect code three times, the system should lock for 30 seconds. During that time, the red LED should be turned on.

The user should be able to cancel entering of the code if the user makes a mistake. For example, if the user enters 3 digits and notices that he/she made a mistake). This should be done by pressing the button "C". Once the user presses "C", he/she should be able to start entering the code again.

When the system is unlocked, the user should lock it again by pressing the button "D".

You can use [tinkercad.com](https://tinkercad.com) for this question. Please remember to copy the code from tinkercad.com into the form below.

Your program should:

- 1) unlock the system - 3 points
- 2) lock the system - 1 point
- 3) reset entering of the code - 2 points
- 4) handle 3x incorrect code - 2 points
- 5) be commented - 2 points
- 6) use #define or const for defining which code unlocks the system - 1 point
- 7) use separate functions whenever possible - 2 points

**Skriv in ditt svar här**

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Totalpoäng: 13

## 7 Bits and bytes

Write a program that sets and unsets bits in a specific number.

The program should take three arguments:

- the number where the bits are to be set/unset
- the command to set or unset the bits
- the number of the bit to set/unset, where 1 means the least significant bit, 2 the second least significant, and so on.

The program should print the value of the number in both binary and hexadecimal form.

For example:

Calling **main.exe 0xFF00 set 1**

Should result in printing: **0xFF01 === 0b111111110000001**

Your program should:

- 1) contain the function to set/unset the bit - 3 points
- 2) contain the function to print the binary number - 2 points
- 3) use the smallest possible dataset, e.g. for 0xFF - char, for 0xFFFF - int, etc. - 3 points
- 4) be commented - 3 points
- 5) be fail-safe - 4 points

You can use [onlinegdb.com](http://onlinegdb.com) for this question. Please remember to paste the code back to the form below!

**Skriv in ditt svar här**

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Totalpoäng: 15