CANDIDATE

DIT633-0037-DJW

TEST

DIT633 Development of embedded and Real-Time Systems, 2023-03-16 NOTE START TIME IS 14:00, EXAM OPENS AT 12:00 ONLY FOR STUDENTS WITH EXTRA TIME AIDS

Subject code	--
Evaluation type	--

Test opening time	16.03.2023 11:00
End time	16.03.2023 17:00
Grade deadline	--
PDF created	03.06.2023 13:24

Foundations and theory

Question	Question title	Question type
i	Instructions for the exam	Information or resources
1	Reading pointers	Multiple Response
2	Boards	Matching
3	Sustainability	Essay

C programming

Question	Question title	Question type
4	Arrays	Programming
5	Code quality	Programming

Arduino and embedded systems

Question	Question title	Question type
6	Locker	Programming
7	Bits and bytes	Programming

1 Reading pointers

W

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 function that takes two parameters and returns a char.
- [ ] Foo is a pointer to a pointer to a function that takes two parameters and returns a char
- [x] 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;

- [ ] a variable of type char
- [x] a pointer of a variable of type char
- [ ] pointer to a variable that points to a variable of type char
- [ ] variable that points to a pointer of type char

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

- [x] pointer to a function that returns a pointer to an int
- [ ] function that returns a pointer to an int
- [ ] function that returns a pointer to a pointer to an int
- [ ] pointer to a pointer to a function that returns 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;
- [x] char *p; int *x; p = x;
- [ ] char *p; char &x; p = x;

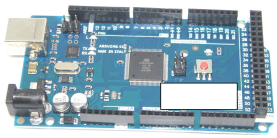
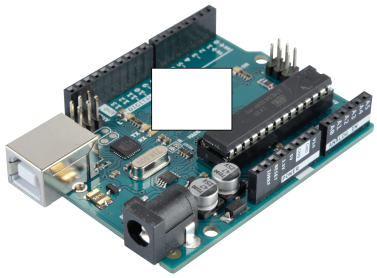
Maximum marks: 4

2 Boards

Ersätt med din uppgiftstext...

Which board is presented in the picture



Raspberry Pi	○	◉	○	○
Arduino uno	○	○	○	◉
Arduino Mega	○	○	◉	○
Arduino nano	◉	○	○	○

Maximum marks: 4

3 Sustainability

W

Please describe two ways in which a software (and hardware) system can impact environment. For each of the ways, please describe how to reduce the environmental impact of the software.

In this question, you can relate to either the embedded part of the system or the front-end part (as it was discussed in the lecture).

Skriv in ditt svar här

- Excessive use of energy such as electricity.

- Waste of product such as malfunctioning hardware: it is important to use a resistor when dealing with sensitive hardware in order to ensure it lasts long and does not malfunction quickly to reduce waste.

Words: 43

Maximum marks: 4

4 Arrays

W

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

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

```
1
2  #include <stdio.h>
3  #include <string.h>
4
5  //function to remove string
6  char removeString(char *string[]){
7
8  }
9
10 //function to find shortest string
11 char shortestString(char *string[]){
12     for (int i = 0; i<=10; i++){ //loop 10 times
13         int current = strlen(string[i]); //assigning the length of the current strir
14         int next = strlen(string[i+1]); //assigning the length of the next string to
15         int prev = strlen(string[i-1]); //assigning the length of the previous strir
16         if(current < prev && current<next){ //checking if the current string's lengt
               less than the next string
17            removeString(string[i]); //if it is then execute the removeString() metho
                  array
18         }
19         if(current == prev){ //checks if the string are the same size
20             printf("2 strings of the same size exist in this array"); //printing a m
21             return 1; //exiting the program
22         }
23     }
24     return string[]; //return the string array without the shortest string
25 }
26
```

```c
int main(int argc, char *argv[])
{
    if (argc>10 | argc<10){ //checks if the user gave too many/little argumements
        printf("Error: too many/little number of arguements"); //informing the user
        return 1; //exiting the program
    }
    //assigning the arguements to a variable
    char string = *argv[1];
    char string2= *argv[2];
    char string3= *argv[3];
    char string4= *argv[4];
    char string5= *argv[5];
    char string6= *argv[6];
    char string7= *argv[7];
    char string8= *argv[8];
    char string9= *argv[9];
    char string10= *argv[10];

    //saving the arguements to an array
    char *strings[10] = {string, string2, string3, string4, string5, string6, string

    //calling the shortestString() function
    shortestString(&strings[10]);

    return 0;
}
```

Maximum marks: 12

5 Code quality

W

One of my colleagues wrote this program. However, I do not understand what it does.

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 program so that it uses meaningful names of the functions and variables (4 points)
3) Comment each statement - 2 points
4) Expand the main() function to test the rewritten function in a loop - 2 points

You can use the online compiler for this question: www.onlinegdb.com

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

```
#include <stdio.h>

int foo(int x)
{
   for (int i = 2; i <= x / 2; i++) {
      if (x % i != 0)
         continue;
      else
         return 1;
   }
   return 0;
}

int main()
{
   int a = 7, b = 0;

   b = foo(a);

   if (b == 0)
      printf("%d --- explain what it is --- ", a);
   else
      printf("%d --- explain what the opposite condition is ---", a);
}
```

Skriv in ditt svar här

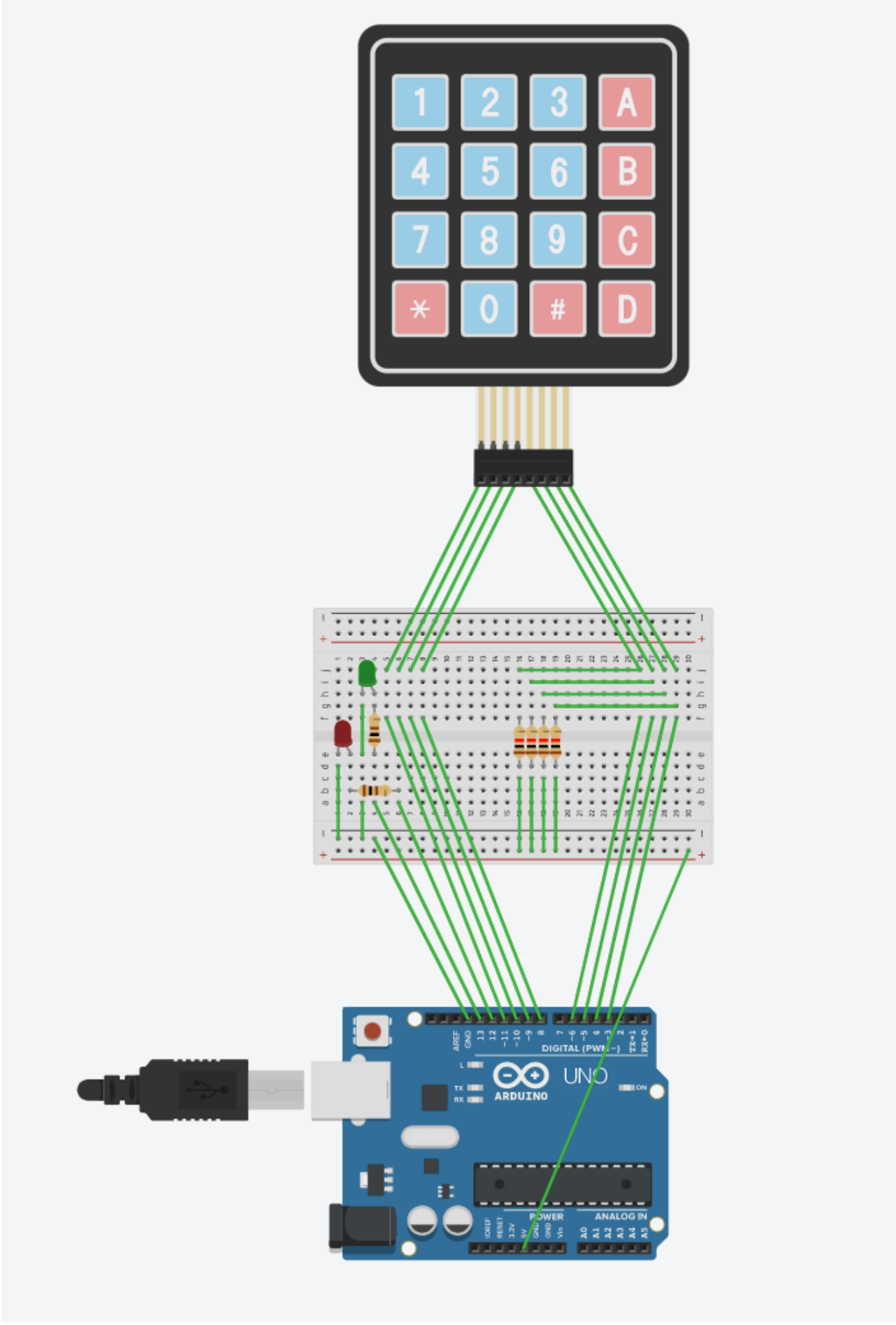
```
1  /*
2  this algorithm checks if a number is divisable by itself only, if it is then it retu
       other than itself then the function returns 1.
3  */
4
5  #include <stdio.h>
6
7  //takes an integer to check if it is divisable anything other than itself
8  int divisable(int x)
9  {
10     for (int i = 2; i <= x / 2; i++) { //loop until i is less than or equal to x/2
```

```
        if (x % i != 0)  //checks if x modulos i is not equal to 0
            continue; //loop again until the iteration is over
        else //if it is equal to 0 then exit the loop and return 1
            return 1;
    }
    return 0; //otherwise return 0
}

//main function
int main()
{
    int number = 7, returnVal = 0; //variable declaration

    returnVal = divisable(number); //b = return value of divisable()

    if (returnVal == 0) //if divisable() returns 0 then print the value of number
        printf("%d --- is divisable by itself only --- ", number);
    else //else print the value of number
        printf("%d --- is divisable by numbers other than itself ---", number);
}
```

Maximum marks: 8

6 Locker

W



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 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

```
#include <Keypad.h>

const byte ROWS = 4; //defining many rows in the keypad
const byte COLS = 4; //defining many cols in the keypad

int greenLed = 13;
int redLed = 12;

//giving the keys values (4 rows, 4 columns)
char keys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};

byte row[ROWS] = {11, 10, 9, 8}; //assigning the digital pins for the rows to a row[
byte column[COLS] = {6, 5, 4, 3}; //assigning the digital pins for the columns to a

//making the keypad
Keypad keypad = Keypad(makeKeymap(keys), row, column, ROWS, COLS);

void setup()
{
  Serial.begin(9600);
  pinMode(greenLed, OUTPUT);
  pinMode(redLed, OUTPUT);
```

W

```
}

void loop()
{
  char pressedKey = keypad.getKey(); //getting the key being pressed and assigning i
  bool locked = true; // boolean variable initialization

  const char code [6] = {'1', '2', '3', '4', '5', '6'};  //saving the code into an a
  while (pressedKey != 0){ //while keys are being pressed
    Serial.println(pressedKey); //print the value of these keys in the serial (to ch
    for (int i = 0; i<6; i++){ //loop 6 times
    if(pressedKey = code[i]){ //if keys pressed are equal to the code
      locked = false; //lock unlocks
      digitalWrite(greenLed, HIGH); //turn on green led
      digitalWrite(redLed, LOW); //turn off red led

    } else if(pressedKey != code[i]){ //if not equal to code
      locked = true; //stays locked
      digitalWrite(greenLed, LOW); //turn off green led
    }
  }

  while(locked = true){
    if (pressedKey = 'C'){ //if C is pressed
      Serial.print("Input cleared, try again!"); //reset input and inform user
    }
    for(int i=0; i<6; i++){ //loop 6 times
      if (pressedKey != code[i]){ //if pressed key not equal to code
        digitalWrite(redLed, HIGH); //red led is on
        digitalWrite(greenLed, LOW); //green led is off
        Serial.print("Wrong code, try again!"); //inform user that they put the wror
      }
    }
  }
  }


}
```

Maximum marks: 13

7 Bits and bytes

W

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 for this question. Please remember to paste the code back to the form below!

Skriv in ditt svar här

```
1
```

Maximum marks: 15