

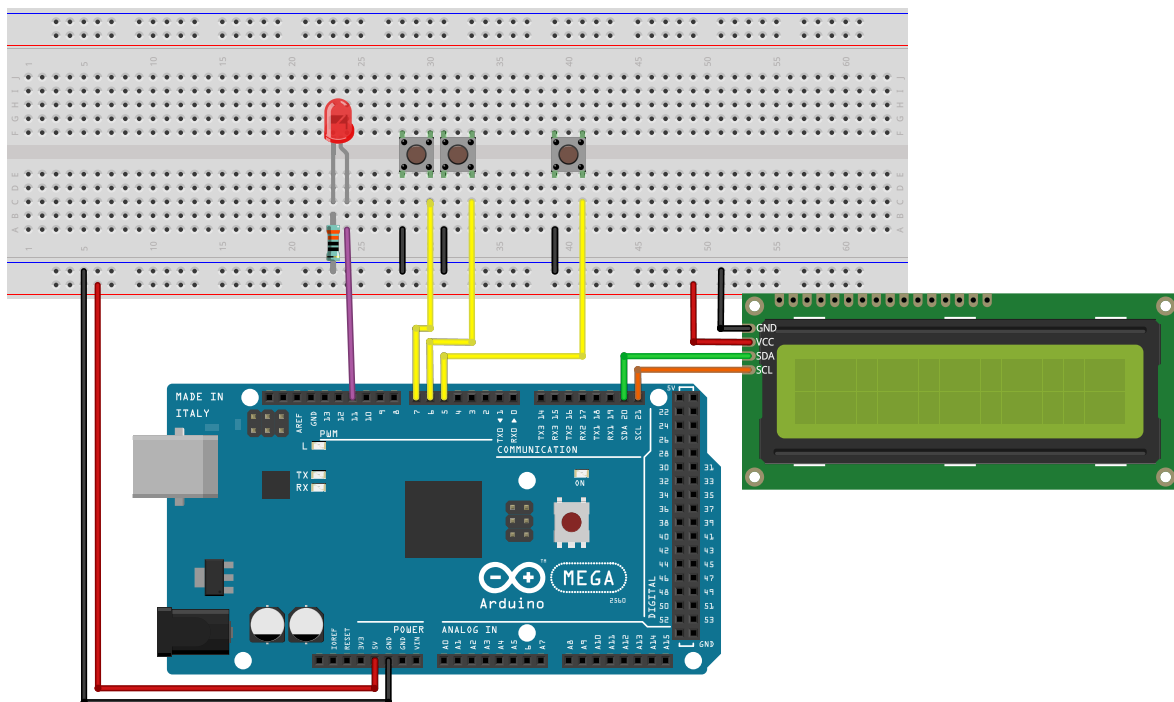
Deadline	December 22th, 12 p.m.
	Send as email to your tutor
Mail Subject	<i>[PFE15][Assignment4]\$matriculationnumber</i>
Accepted Formats	PDF, txt
File Name Convention	<i>PFE15_Assignment4_\$matriculationnumber.\$format</i>
Remark	You are supposed to include all code examples into your document

0 Setup [0 Points]

0.1 Circuit for a vending machine

Assemble the circuit as depicted in the figure. The first two push-buttons should be used to navigate up and down in the menu. The third pushbutton acts as confirmation button.

Please consider that the depicted circuit must use different pin numbers than the ones shown in the lecture.



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0.2 Controlling the LCD

Use the following code snippet to get familiar with controlling the LCD. Please consider that you have to install the library *LiquidCrystal_I2C2004V1*:

1. Download the ZIP archive *LiquidCrystal_I2C2004V1.zip* from the web page.
2. In the *Arduino* application, choose *Sketch* → *Include Library* → *Add .ZIP Library* from the menu and select the just downloaded ZIP file in the dialog.
3. Finally you can select the library *LiquidCrystal_I2C2004V1* from *Sketch* → *Include Library*.

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,16,2); // set the LCD address to 0x27 for a 16
    chars and 2 line display

void setup() {
    lcd.init();
    lcd.backlight();
    lcd.setCursor(1,0);
    lcd.print("Hello , world!");
    lcd.setCursor(0,1);
    lcd.print("dlrow , olleH!");
}

void loop() {
}
```

1 Payment process [26 Points]

After setting up the environment as described in 0, implement a payment functionality that satisfies the following requirements:

- After selecting a beverage, the payment should begin by pressing the third push-button.
- During the payment process, the name of the selected beverage, the already payed amount and the remaining amount should be displayed.
- The payment of the beverage should be simulated by pressing the first two push-buttons. The first push-button represents the insertion of a 0,50€ coin in the coin slot, the second one of a 1€ coin respectively.
- After the payment has been completed, the red LED flashes continuously. By pressing the third push-button as a confirmation of the successful payment process, the vending machine transitions back to the main menu.

2 Spot the bug [6 x 4 Points]

- What happens during the compilation process of the programs depicted below?
- Did you receive any error messages? If yes, what kind of error do these refer to?
- In case the compilation process terminated without error messages: Does the program behave as specified?
- How can the bugs be fixed?

Listing 1: A buggy program

```
// Specified behaviour: Append the string to itself
void setup() {
  char[] str = {'a', 'b', 'c', 'd'};
  strcat(str, str);
}
```

Listing 2: Another buggy program

```
int button = 2;
int led = 3;
int buttonPressed = 0;

// Specified behaviour: LED flashes continuously if
// the push-button has been pressed between
// 6 (inclusive) and 9 (inclusive) times
void loop() {
  buttonPressed = digitalRead(button);

  if (buttonPressed = 1) { counter++; }

  if (5 < counter < 10) {
    digitalWrite(led, HIGH);
  } else {
    digitalWrite(led, LOW);
  }
}
```

Listing 3: Yet another buggy program

```
int led = 3;
int nextChange = 0;

void setup() { nextChange = millis + 300; }

// Specified behaviour: LED flashes without using delay()
void loop() {
  if (millis > nextChange) {
    digitalWrite(!digitalRead(led));
    nextChange = millis + 300;
  }
}
```

Listing 4: Still another buggy program. Uhm.. Deja-vue?

```
int button = 2;
int led = 3;

// Specified behaviour: LED flashes if the push-button is pressed
void loop() {
  if (button == HIGH) {
    led = HIGH;
  } else {
    led = LOW;
  }
}
```

Listing 5: Another buggy...Nobody will read this description anyway!

```
int ledFlashes = 0;
int nextChange = 0;

// Specified behaviour: LED flashes without using delay()
void loop() {
  while (millis() <= nextChange) {
    if (millis() > nextChange) {
      digitalWrite(led, !ledFlashes);
      nextChange = millis() + 300;
    }
  }
}
```

Listing 6: This is getting ridiculous. By now you should know the drill...

```
int leds[] = {7, 8, 9};

// Specified behaviour: Pins 7-9 should be initialized as OUTPUT
// The pins to be initialized are contained in an array
void setup() {
  int i = 7;
  while (i < 9) {
    pinMode(leds[i++], OUTPUT);
  }
}
```