WHAT CAN WE REALLY DO WITH INPUTS AND OUTPUTS?

- How can we read a button?
- How are outputs usually employed?
- What are inputs and outputs really used for?
- What is the difference between digitalWrite() and writing directly to a port register?

ALTERNATIVE PORT FUNCTIONS

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INTERRUPTS

How do we react to external signals?

INTERRUPTS

- We are going back to the analogies: think about you in an evening having lots of stuff to do, you have no food in the fridge and you choose to cook some rice.
- The rice needs to cook for a few minutes, but you do not know the exact time it will take, so you need to keep an eye on the pot in order not to eat burnt rice.
- We will call this: *Polling*.

INTERRUPTS

- The *event* that we are expecting is the rice being cooked, an event that we can recognize because the water in the pot has all evaporated.
- *Polling* refers to the action of taking a look at something every so often, and an *event* is that something that we are expecting to happen.
- When we do this with the rice, if we do not check the rice at the right time, it might get burnt.

TOGGLE

- Let us try to read a button input.
- You will to create a new program in which you will configure a pin as an input and connect a pushbutton to that pin.
- You will also have to configure another pin as an output and connect an LED (with a resistor) to it.
- Your task is to toggle the LED each time you press the pushbutton.

TOGGLE

- To make things easier, let us review what the XOR bitwise operator does.
- The XOR operator outputs 1 if a single input (any of the two) is 1, but outputs 0 if both inputs are 1 or 0. In other words, outputs 1 when their inputs are different, and 0 when they are equal.
- If we apply an XOR operation to a byte with a mask, we will toggle the bits selected by the mask in the byte we are operating. Let us see some examples.

TOGGLE

- Check example
  - I7266/mega32A/003_Toggle/001

TOGGLE WITH BUTTON

TOGGLE WITH BUTTON

- We just saw how to toggle an output periodically. But how can we toggle an output on-demand?
- This seems like an easy problem, so let us tackle this problem and see what we come up with.
- Hint: can we use *polling* to achieve this?

TOGGLE WITH BUTTON

- Check examples
  - I7266/mega32A/003_Toggle/002
  - I7266/mega32A/003_Toggle/003
  - I7266/mega32A/003_Toggle/004
  - I7266/mega32A/003_Toggle/005
  - I7266/mega32A/003_Toggle/006

INTERRUPTS

- Let us think of another analogy: what happens if you are at home doing your homework and suddenly you feel the urge to go to the bathroom?
- In this case, the event is emptying your bladder, but this time you are not checking how full bladder is every so often. When nature calls, you have to go.
- This situation is the counterpart for *polling* an event, this is an event-driven routine, A.K.A. an *interrupt*.

INTERRUPTS

- This is, however, just one kind of interrupt, we call it *internal interrupt*, since the event or the signal triggers the interrupt comes from inside our system (your body).
- Now think the same scenario of the rice, but this time imagine you say “alexa, set a timer for 12 minutes” when your rice starts cooking. This way we know we will have a signal coming from the exterior when the rice is done.

INTERRUPTS

- In these new examples, we are waiting for an *external interrupt*, since the signal that triggers the interrupt comes from the exterior.
- Internal interrupts are also called *software interrupts*.
- External interrupts are also called *hardware interrupts*.
- In short, interrupts make us stop whatever we are doing to switch to another task that needs our attention.

EXTERNAL INTERRUPTS

EXTERNAL INTERRUPTS

- Let us check the datasheed and look for information about external interrupts.

INTERNAL INTERRUPTS

INTERNAL INTERRUPTS

- Loren ipsum dolet...
- Blablablabla
  - Bla bla bla
- Afsdkfjashd
  - Akfashdfksjdfsi

TIMERS

Solving another question

DATATYPES

DATATYPES

- Datatypes are our way to tag some characteristics about the 1’s and 0’s we are manipulating in memory.
- In C we often find integers, characters, floating point, double floating point and void types.
- If we use C in a computer, we can ask the system to tell us what the size of certain variable or datatype is.
  - Check I7266/004_Examples/C/001_Datatypes

DATATYPES

- In embedded systems, however, we have certain constrains. To understand why let us explore in more detail what a datatype means.
- Datatypes are usually classified like this:
  - Built-in or primitive: These are datatypes defined by the language, and there are certain modifiers that we can use to further detail for what and how we want to use these variables.

NOTICES!

THANKS!

Please feel free to ask any related questions at any time.

TOPIC 1.1

Solving another question

TOPIC 1.1.1

Solving another question

TOPIC 1.1.1.1

Solving another question

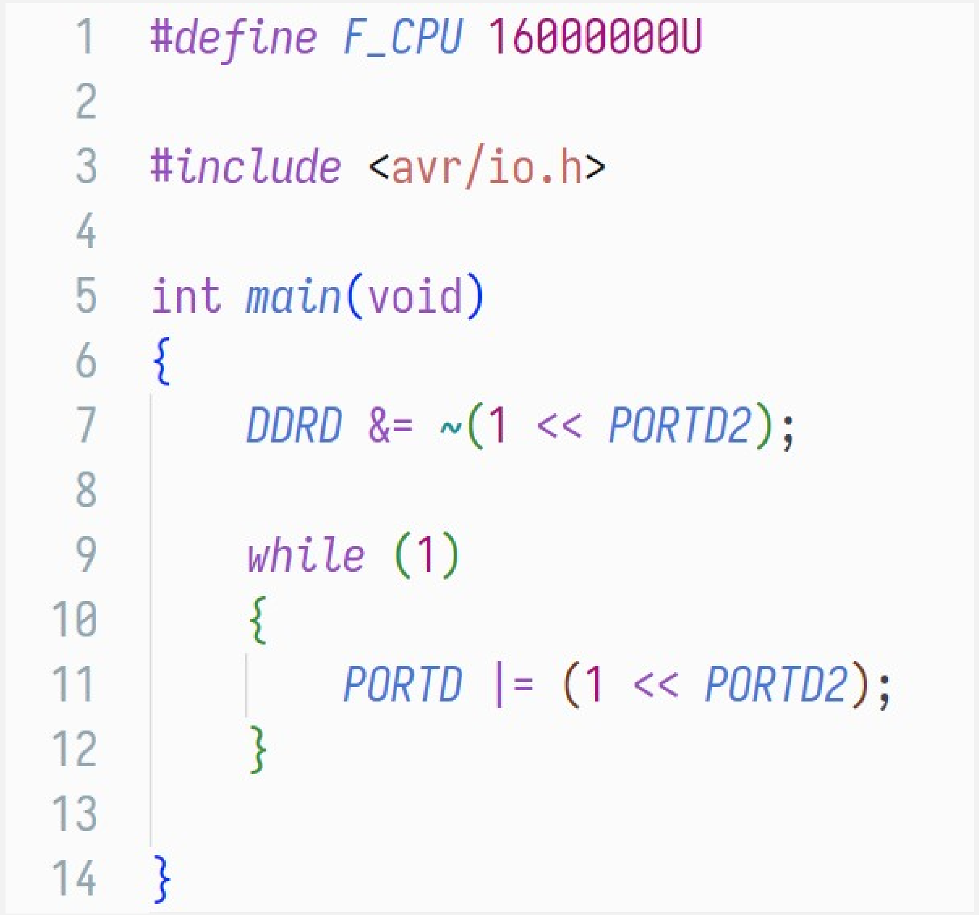
TOPIC DEVELOPMENT

- Loren ipsum dolet...
- Blablablabla
  - Bla bla bla
- Afsdkfjashd
  - Akfashdfksjdfsi

- Just content
  - Bla bla bla
- Afsdkfjashd
  - Akfashdfksjdfsi

TOPIC WITH IMAGE

...



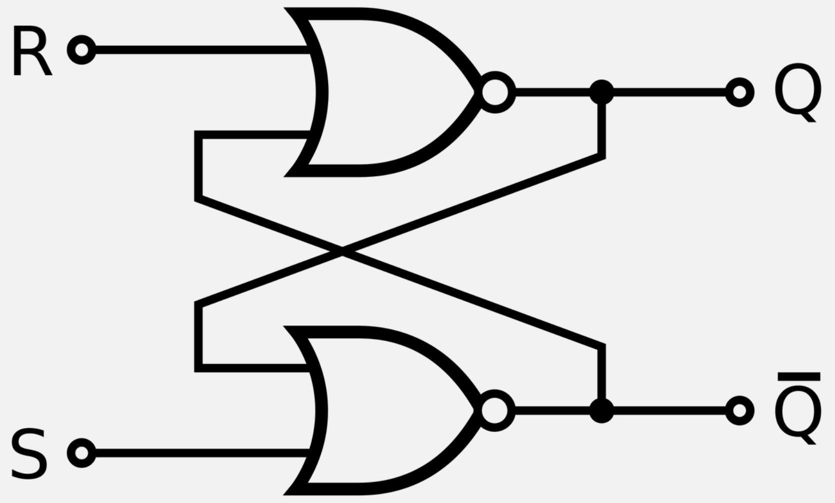
```c
#define F_CPU 16000000U

#include <avr/io.h>

int main(void)
{
    DDRD &= ~(1 << PORTD2);

    while (1)
    {
        PORTD |= (1 << PORTD2);
    }

}
```

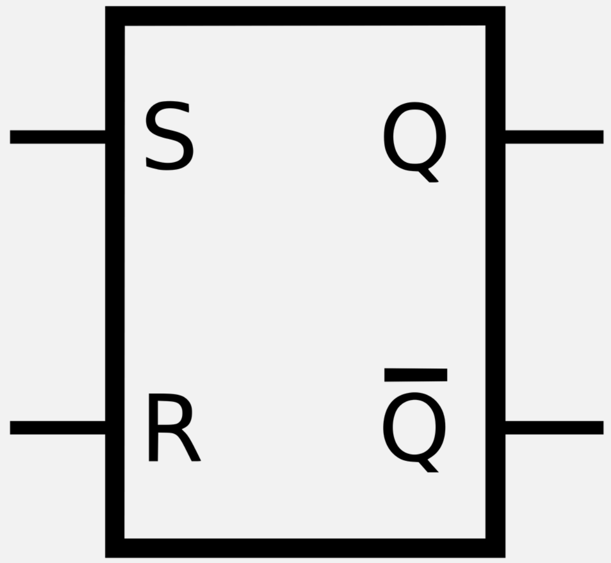
TOPIC WITH TEXT

...

- Lorem ipsum

PICTURE(S)





Just insert an image here :)

NOTICES!

THANKS!

Please feel free to ask any related questions at any time.