Science is always wrong. It never solves a problem without creating ten more.

We need science to help us solve all the problems we wouldn’t have if there were no science.

George Bernard Shaw
A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts.
Relay - what is it good for

In general, the point of a relay is to use a small amount of power in the electromagnet - coming, say, from a small dashboard switch or a low-power electronic circuit - to move an armature that is able to switch a much larger amount of power.

E.g. You can use 1W to switch 10000W (10kW).

Additionally, thanks to auxiliary contacts (normally opened or normally closed) can be used to implement additional logic.
Coil excited – boolean value „1”
Coil not excited – boolean value „0”
Opened contact – value „0”  
Closed contact – value „1”

Relay with normally open[ed] contact NO

Relay with normally closed contact NC
Relay with NO and NC contacts

Input

Coil

Output 1

Output 2

In

Out 2

Out 1

Relay with multiple NO and NC contacts

.............
Coil

"Normal" relay

Input

Coil

Output

In

Out

Time-delay relay (normally-open, time-closed)

Input

Coil

Output

We

Wy

$\Delta T$ – sec, min, hours

$\Delta T$ – sec, min, hours
Time-delay relays (four basic devices)

**NOTC**

- Normally-open, timed-closed
- Closes 5 seconds after coil energization
- Opens immediately upon coil de-energization

**NOTO**

- Normally-open, timed-open
- Closes immediately upon coil energization
- Opens 5 seconds after coil de-energization

**NCTO**

- Normally-closed, timed-open
- Opens 5 seconds after coil energization
- Closes immediately upon coil de-energization

**NCTC**

- Normally-closed, timed-closed
- Opens immediately upon coil energization
- Closes 5 seconds after coil de-energization

More at www.allaboutcircuits.com/vol_4
Relay (an example)

- Coil
- Main contacts
- Auxiliary contacts
Napięcie zasilania 24...240VAC, 24...48VDC
Zakres czasowy 0.05s...10h
6 podzakresów czasowych
1s, 10s, 1min, 10min, 1h, 10h
4 funkcje czasowe
11, 12, 21, 42
Rodzaj wyjścia 1P
Zdolność łączniowa Ith=5A/U=250VAC
Szerokość obudowy 17...5mm (1 moduł)
Montaż na szynie 35mm
Certyfikaty B, CE, GL
Exercise 1

You’ve got:
2 relays with 3-f main contacts and with as many auxiliary contacts as you want :)
2 push button switches NO (green ones)
1 push button switch NC (red one)
1 induction motor

Your goal is to operate drive in two directions safely (without a risk of short circuiting the mains)

Let the competition begin!
A
B
C

Right (clockwise)

Start left

Start left

Left (counter-clockwise)

Stop

A
B
C

Induction
motor

24V
24V

Stop

Start right

Start left

Right (clockwise)

Induction motor

Left (counter-clockwise)
There are 2 errors:

1. If someone presses both green buttons, the mains is short circuited!
2. The voltage is not sustained at motor terminals - you have to keep pressing the button to run motor!!!

Let’s solve the first one…
Still you have to keep pressing the button to run motor!!!
Induction motor

Start right

Start left

Right (clockwise)

Left (counter-clockwise)

Now it’s OK.!
On delay relay

Input

Coil

Output

\[ \Delta T \rightarrow \text{sec, min, h} \]

Function block

\[ X \Rightarrow I, M, Q \quad Y \Rightarrow M, Q \]

\[ XW \Rightarrow MW, IW, KW \quad \times 100 \text{ ms} \]
List of instructions

TR1

[S]: X1
[Stop]: X2
[I]: KW 100
[Q]: Y1

\[ \Delta T = t_1 + t_2 \]
A set of such blocks…

…that can be freely *programmed* to give *logic* needed to *control* a given process…

…makes a PLC
(=Programmed Logic Controller, Sterownik Swobodnie Programowalny).
Exercise 2

You’ve got:
2 relays with 3-f main contacts and WITHOUT auxiliary contacts
2 push button switches NO (green ones)
1 push button switch NC (red one)
1 induction motor
Your goal is to operate drive in two directions safely (without a risk of short circuiting the mains). Write an appropriate code for a PLC from previous slide.

Let the competition continue!