National Centre for Computing Education

Raspberry Pi

Homework – Solutions

Task

The logical variable `raining` is true when it is raining outside and false otherwise. The logical variable `homework` is true when you have finished your homework and false otherwise.

The expression below determines if you are allowed to play outside:

`homework` **`and not`** `raining`

The table below contains different combinations of the possible values for `homework` and `raining`. For each of these combinations, fill in the table with the missing Boolean values (i.e. true/false).

homework finished **`homework`**	raining outside **`raining`**	value of expression **`not raining`**	value of expression **`homework and not raining`**
false	false	true	false
false	true	false	false
true	false	true	true
true	true	false	false

Task The Hierarchy

The Pattern on the Stone is a book written by Daniel Hillis. The (edited) incomplete text below is from the section entitled *The Hierarchy.*

> The work performed by the computer is specified by a (1) program , which is written in a programming language. The (2) instructions of the (1) program , which are stored in the (3) memory of the computer, define the operations to be performed on (4) data , which are also stored in the computer's (3) memory . The (5) processor fetches and executes these (2) instructions . The operation of the computer is controlled via a predefined set of subroutines called the (6) operating system .
>
> The (2) instructions as well as the (4) data are represented by patterns of (7) bits .
>
> Both the (5) processor and the (3) memory are built of (8) logic circuits and the latter are based on simple (9) logic operations , such as And, Or, and Invert (Not). These (9) logic operations are implemented by (10) switches and these (10) switches control electricity, which is used to send one of two possible signals from one (10) switch to another: 1 or 0.
>
> This is the hierarchy of abstraction that makes computers work.

Match the numbered gaps with the words in the right-hand column.

	Gaps
(1)	program
(2)	instructions
(3)	memory
(4)	data
(5)	processor
(6)	operating system
(7)	bits
(8)	logic circuits
(9)	logic operations
(10)	switch(es)

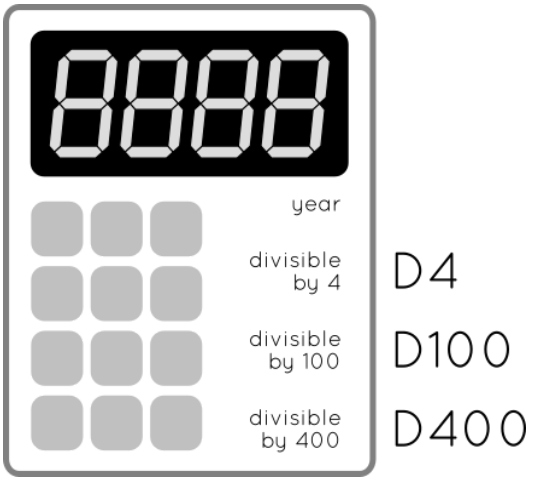
Words to complete the gaps with

Processor
Memory
Data
Program
Instructions
Operating system
Bits (binary digits)
Switch/Switches
(Boolean) logic operations
(Boolean) logic circuits

Explorer task Leap year

This is a calendar device, where the user enters a year and the device generates three 0/1 output signals:

- Output D4 indicates if the year is divisible by 4
- Output D100 indicates if the year is divisible by 100
- Output D400 indicates if the year is divisible by 400



You can use the outputs of this device to build a logic circuit that computes whether or not a year is a **leap year**, i.e. a year that has 366 days, instead of 365.

- Any year that can be divided by 400 is a leap year.

  Example: 2000 is a leap year.

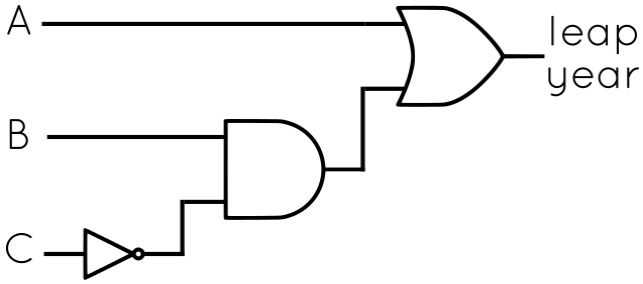
- Any year that can be divided by 4 but cannot be divided by 100 is a leap year.

  Examples: 2016, 2020, and 2024 are leap years.

  1900 is **not** a leap year. It is divisible by 4, but it is also divisible by 100. (Unlike 2000, 1900 is not also divisible by 400, so the previous rule cannot apply).

- Any other year is a common year.

This is the logic circuit that performs this computation. In order for it to work, you need to connect the outputs D4, D100, and D400 from the device to the inputs of the logic circuit.



Connect D4 to input B (select A, B, or C)
Connect D100 to input C (select A, B, or C)
Connect D400 to input A (select A, B, or C)

Resources are updated regularly — the latest version is available at: ncce.io/tcc.