

IT FUNDAMENTALS

Week 2 – Digital Circuits

Assignment 2.1: Parking lot

Er zijn **3 parkeerplaatsen**.

Als **alle 3 bezet zijn**, moet het bord **FULL** laten zien.

a) What logic gate(s) do you need to make this circuit?

Hiervoor heb je een **AND-gate** nodig.

Uitleg:

Alleen als **parking lot 1, parking lot 2 én parking lot 3 bezet zijn** (allemaal 1), mag de uitkomst **FULL = 1** zijn.

b) Truth table

Parking lot 1	Parking lot 2	Parking lot 3	Result (FULL)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Alleen wanneer **alle drie** de parkeerplaatsen bezet zijn, is de parkeerplaats **vol**.

Assignment 2.2: Android phone or iPhone?

Een werknemer kan **maar één telefoon** kiezen:

- Android **of**
- iPhone
Niet allebei tegelijk.

a) What logic gate do you need to make this circuit?

Hiervoor gebruik je een **XOR-gate**.

Uitleg:

Een XOR-gate geeft alleen een **1** als **exact één** invoer 1 is.

b) Truth table

Android phone	iPhone	Result (phone in possession)
0	0	0
0	1	1
1	0	1
1	1	0

Als beide 1 zijn, is de uitkomst 0, omdat je **niet beide telefoons tegelijk** mag hebben.

Assignment 2.3: Four NAND gates

Een NAND-gate is het tegenovergestelde van een AND-gate.

Truth table

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

Simplification of the chip design

Een circuit dat bestaat uit **meerdere NAND-gates** kan vaak worden vereenvoudigd tot:

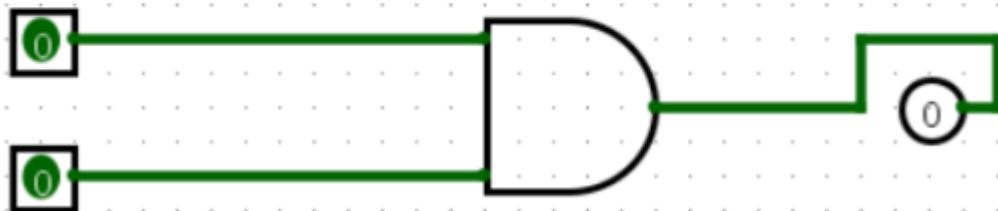
- een **AND-gate**
- een **OR-gate**
- of een **NOT-gate**

Dit is mogelijk omdat **NAND-gates universeel zijn**:
je kunt **alle andere logic gates** bouwen met alleen NAND-gates.

Assignment 2.4: Becoming familiar with Logisim Evolution

Screenshot of the design with your name and student number in it:

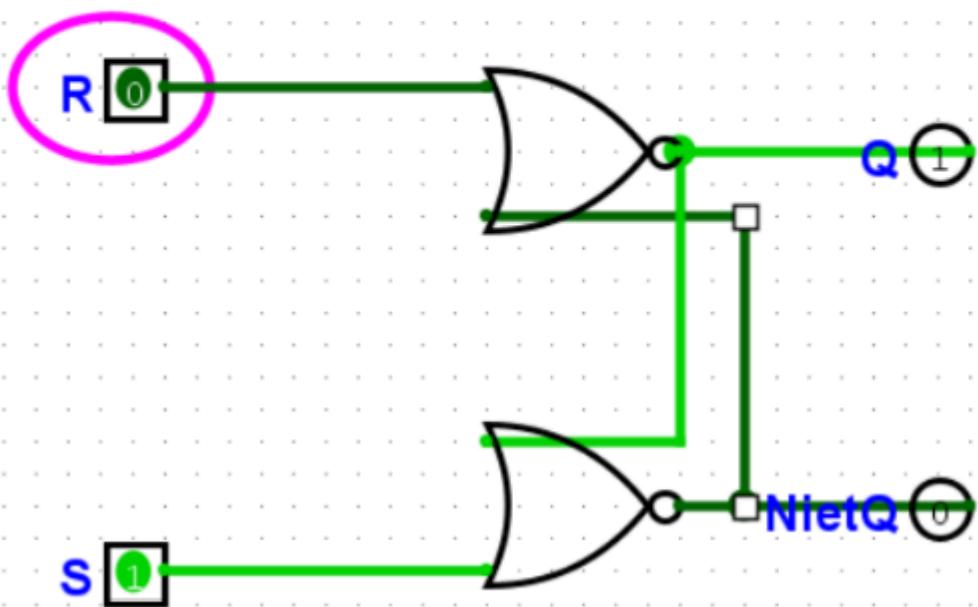
Nabil Elbaze 572191



Assignment 2.5: Create an SR Latch in Logisim

Screenshot of the design with your name and student number in it:

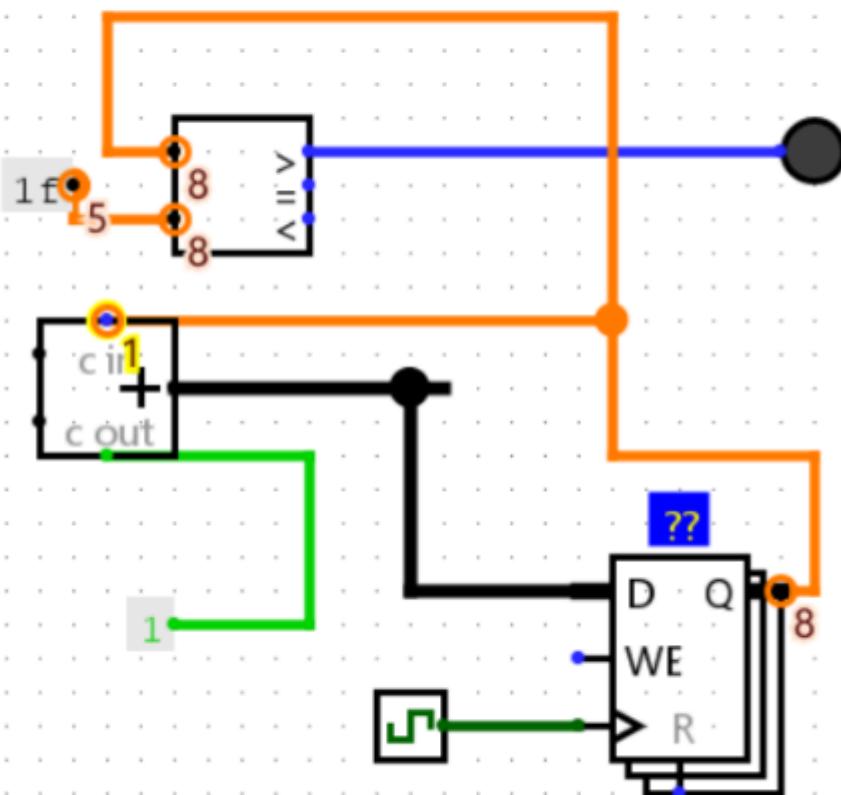
Nabil Elbaze 572191



Assignment 2.6: Create a Vending Machine

Screenshot of the design with your name and student number in it:

Nabil Elbaze 572191



Assignment 2.7: Bitwise operators

Complete the java source code for bitwise operators. Put the source code here.

```
public class BitwiseAssignment {  
  
    public static void main(String[] args) {  
  
        int studentNumber = 572191;  
  
        int example = 0b1111; // as a example  
  
        // Bitwise AND  
  
        int andResult = studentNumber & example;  
  
        // Bitwise OR  
  
        int orResult = studentNumber | mask;  
  
        // Bitwise XOR  
  
        int xorResult = studentNumber ^ mask;  
  
        System.out.println("AND result: " + andResult);  
  
        System.out.println("OR result: " + orResult);  
  
        System.out.println("XOR result: " + xorResult); } }
```

Assignment 2.8: Java Application Bit Calculations

Create a java program that accepts user input and presents a menu with options.

1. Is number odd?
2. Is number a power of 2?
3. Two's complement of number?

Implement the methods by using the bitwise operators you have just learned.

Organize your source code in a readable manner with the use of control flow and methods.

Paste source code here, with a screenshot of a working application.

```
import java.util.Scanner;
```

```
public class Main {  
    public static void main(String[] args) {  
        Scanner scanner = new Scanner(System.in);  
  
        System.out.println("\nMenu:");  
  
        System.out.println("1. Is number odd?");  
        System.out.println("2. Is number a power of 2?");  
        System.out.println("3. Two's complement of number");  
        System.out.println("4. Exit");  
  
        System.out.print("Enter your choice: ");  
  
        int choice = scanner.nextInt();  
  
        if (choice == 4) {  
  
            System.out.println("Exiting the program. Goodbye!");  
            return;  
        }  
  
        System.out.print("Enter a number: ");  
  
        int number = scanner.nextInt();  
  
        if (choice == 1) {  
  
            boolean isOdd = (number & 1) == 1;  
  
            System.out.println("The number " + number + (isOdd ? " is odd." : " is even."));  
        } else if (choice == 2) {  
  
            boolean isPowerOfTwo = number > 0 && (number & (number - 1)) == 0;  
  
            System.out.println("The number " + number + (isPowerOfTwo ? " is a power of 2." : " is not a  
power of 2."));  
        } else if (choice == 3) {  
  
            int twosComplement = ~number + 1;  
  
            System.out.println("The two's complement of " + number + " is: " + twosComplement);  
        }  
    }  
}
```

```

} else {

System.out.println("Invalid choice. Please try again.");

}

scanner.close();

}

```

Screenshot optie 1:

```

public class Main {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);

        System.out.println("Menu:");
        System.out.println("1. Is number odd");
        System.out.println("2. Is number a power of 2?");
        System.out.println("3. Two's complement of number");
        System.out.println("4. Exit");
        System.out.print("Enter your choice: ");

        int choice = scanner.nextInt();

        if (choice == 4) {
            System.out.println("Exiting the program. Goodbye!");
            return;
        }

        System.out.print("Enter a number: ");
        int number = scanner.nextInt();

        if (choice == 1) {
            System.out.println((number & 1) == 1 ? "The number " + number + " is odd." : "The number " + number + " is even.");
        } else if (choice == 2) {
            System.out.println((number > 0 && (number & (number - 1)) == 0) ? "The number " + number + " is a power of 2." : "The number " + number + " is not a power of 2.");
        } else if (choice == 3) {
            int twoComplement = -number;
            System.out.println("The two's complement of " + number + " is: " + twoComplement);
        }
    }
}

```

Run Main

```

$C:\Programeren - Jaar 1\jdk-21.0.1\bin\java.exe" --javafxagent:D:\Programeren - Jaar 1\IntelliJ IDEA 2024.2.1\lib\idea_rt.jar=1884:3:\Programeren - Jaar 1\IntelliJ IDEA 2024.2.1\bin" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8
1. Is number odd
2. Is number a power of 2?
3. Two's complement of number
4. Exit
Enter your choice: 1
ENTER a number: 8
The number 8 is even.

Process finished with exit code 0

```

screenshot 2:

The screenshot shows an IDE interface with a Java project named "untitled". The code in Main.java is as follows:

```
public class Main {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);

        System.out.print("What's your name?");
        System.out.println("Is number odd?");
        System.out.println("Is number a power of 2?");
        System.out.println("Is number's complement of number");
        System.out.println("Exit");

        int choice = scanner.nextInt();

        if (choice == 1) {
            boolean isOdd = (number & 1) == 1;
            System.out.println("The number " + number + " is odd." + " : " + isOdd);
        } else if (choice == 2) {
            boolean isPowerOfTwo = number > 0 && (number & (number - 1)) == 0;
            System.out.println("The number " + number + " is a power of 2." + " : " + isPowerOfTwo);
        } else if (choice == 3) {
            int twoComplement = ~number + 1;
            System.out.println("The two's complement of " + number + " is: " + twoComplement);
        } else {
            System.out.println("Invalid choice. Please try again.");
        }
    }
}
```

The Run tab shows the output of the program:

```
*$'Programmeren - Jaar 1\jok-21.0.1\bin\java.exe' *-javagent:S:\Programmeren - Jaar 1\intelliJ IDEA 2024.2.1\lib\idea_rt.jar\1893:5:\Programmeren - Jaar 1\intelliJ IDEA 2024.2.1\bin' -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8
Main
Menu:
1. Is number odd?
2. Is number a power of 2?
3. two's complement of number
4. Exit
Enter your choice: 2
Enter a number: 8
The number 8 is a power of 2.

Process finished with exit code 0
```

screenshot 3:

The screenshot shows an IDE interface with a Java project named "untitled". The code in Main.java has been modified to fix a bug in the menu logic:

```
public class Main {
    public static void main(String[] args) {
        int choice = scanner.nextInt();

        if (choice == 1) {
            boolean isOdd = (number & 1) == 1;
            System.out.println("The number " + number + " is odd." + " : " + isOdd);
        } else if (choice == 2) {
            boolean isPowerOfTwo = number > 0 && (number & (number - 1)) == 0;
            System.out.println("The number " + number + " is a power of 2." + " : " + isPowerOfTwo);
        } else if (choice == 3) {
            int twoComplement = ~number + 1;
            System.out.println("The two's complement of " + number + " is: " + twoComplement);
        } else {
            System.out.println("Invalid choice. Please try again.");
        }
    }
}
```

The Run tab shows the output of the program, identical to screenshot 2.

```
*$'Programmeren - Jaar 1\jok-21.0.1\bin\java.exe' *-javagent:S:\Programmeren - Jaar 1\intelliJ IDEA 2024.2.1\lib\idea_rt.jar\1891:5:\Programmeren - Jaar 1\intelliJ IDEA 2024.2.1\bin' -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8
Main
Menu:
1. Is number odd?
2. Is number a power of 2?
3. two's complement of number
4. Exit
Enter your choice: 2
Enter a number: 8
The number 8 is a power of 2.

Process finished with exit code 0
```