Lab Exercise

1. **What does the following code? (There are 3 instructions.)**

0011000000000000
1001001001111111
0001010001100001
0001010000000010

1001001001111111: NOT R1, R1
0001010001100001: ADD R2, R1, #1
0001010000000010: ADD R2, R0, R2

2. Input the following code and try to understand what it does by executing it step by step. (There are 6 instructions.)

0011000000000000
1110001111111101
0001010001101110
0101010010100000
0001010010100101
0111010001001110
1010011111110111

Analyze and explain what these instructions do one by one. You need to explain the opcode, the addressing mode and the meaning and function of these instructions.

	0x	Label	Hex	Instruction
▼	x3000		xE3FD	LEA R1, x2FFE
▼	x3001		x146E	ADD R2, R1, #14
▼	x3002		x54A0	AND R2, R2, #0
▼	x3003		x14A5	ADD R2, R2, #5
▼	x3004		x744E	STR R2, R1, #14
▼	x3005		xA7F7	LDI R3, x2FFD

1. **1110001111111101: LEA R1, x2FFE**
   Opcode: LEA (Load Effective Address)
   Addressing Mode: Direct Addressing Mode (with an immediate value)
   Meaning: Load the effective address x2FFE into register R1

2. **0001010001101110：ADD R2, R1, #14**
   Opcode: ADD (Add)
   Addressing Mode: Register Addressing Mode with an Immediate Operand
   Meaning: Add the value of R1 and 14 (immediate) and store the result in R2.
3. **0101010010100000：AND R2, R2, #0**
   Opcode: AND (Logical AND)
   Addressing Mode: Register Addressing Mode with an Immediate Operand
   Meaning: Perform a bitwise AND operation between R2 and 0 (effectively clearing R2).
4. **0001010010100101：ADD R2, R2, #5**
   Opcode: ADD (Add)
   Addressing Mode: Register Addressing Mode with an Immediate Operand
   Meaning: Add 5 (immediate) to the value in R2 and store the result back into R2.
5. **0111010001001110：STR R2, R1, #14**
   Opcode: STR (Store)
   Addressing Mode: Indexed Addressing Mode
   Meaning: Store the value in R2 into memory at the address R1 + 14.
6. **1010011111110111：LDI R3, x2FFD**
   Opcode: LDI (Load Indirect)
   Addressing Mode: Indirect Addressing Mode
   Meanign: Load the value from the memory address x2FFD into register R3.

3. Write a LC3 machine code program to print out “Hello World!”. Hint: consider to use Trap instruction PUTS.

```
0011000000001010

0101001001100000
1110000000000010
1111000000100010
1111000000100101

0000000001001000
0000000001100101
0000000001101100
0000000001101100
0000000001101111
```

```
0000000000100000
0000000001010111
0000000001101111
0000000001110010
0000000001101100
0000000001100100
0000000000100001
```