In assembly, replace the value in X0 with its absolute value.

Review Problem 5
```
B: loop

ADDI x0, x0, #1

Next:

SUBI x1, x1, #32

BGT NEXT

CMP x1, #122

BEQ x0, [x0, #07]

// Load body index

ldur x0, [x31, #80]  // x0=idx, a = 65, b = 97, z = 122

// string is a pointer held at Memory[80]

{ }

for (idx = 0; idx < n; idx++)

    (a, b, c) = x0 = x1 = x2

while (idx < n) {

    char *str = string;

    Convert a string to all upper case

    String Toupper

    index
```
Machine Language vs. Assembly Language

Almost 1-to-1 with machine language
Easier for programmers
Labels instead of fixed addresses
Mnemonic for easy reading
Branch offset positive \( \rightarrow \) branch downward, negative \( \rightarrow \) branch upward.

\[
Pc = Pc + 4 \times (\text{BranchOffset})
\]

Branches are Pc-relative

Instructions are 4 bytes

Notes:

I:

next iteration

++

ADDI X2, X2, #1

I =

ADDI X1, X1, X2

end when i \( \geq \) (i > N)

N

check i vs N

TOP

I =

ADDI X2, X31, X31

0 =

ADDI X1, X31, X31

X2 =

X0 = N, X1 = sum, X2 = I

Insertion of instructions doesn't require changing entire code

Programmer doesn't have to count line numbers

Labels specify the address of the corresponding instruction
```
    LDRB X1, [XO, #0]
[                ]

    SUBI X1, X1, #32

    CMPI X1, #122

    CMPI X1, #97

    CBZ X1, END

    LDRB X1, [XO, #0]

    LDRR X0, [X31, #100]

    // Program starts at address 100

Branches: PC = PC + 4*(BranchOffset)
Compute the value of the labels in the code below.
```

Labels Example
Can group instructions by # of operands

Instruction Types
### Instruction Formats

- **Memory (D-Type)**
  - Instruction: \([31:21] = 1C0-1C2, \text{7CC-7C2}\)

- **Immediate (I-Type)**

- **Register (R-Type)**

- **Conditional Branch (CB-Type)**
  - Instruction: \([31:21] = 2A0-2A7, \text{5AD-5AF}\)

- **Branch (B-Type)**
  - Instruction: \([31:21] = \text{0A0-0BF}\)

All instructions encoded in 32 bits (operation + operand/immediates).
- 3 = - (3) = -(011) = (100 + 1) = 101

Used for unconditional branches

B-Type