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| **Instruction** | **Functionality** | **Opcode** |
| init *Rx, imm* | $R1 = imm | 000 iiii |
| base *Rx, [Mem]* | Rx = [Mem]? | 001 xx yy |
| load *imm* | $R1 = imm | 100 11 ii |
| store *Rx, Ry* | Mem[Ry] = Rx | 011 xx ii |
| shl *Rx* | Rx shift left one bit, 0 shifted into LSB | 100 00 xx |
| sll *Rx, Ry* | Rx = Rx \* (2^Ry) | 100 xx yy |
| slt *Rx, Ry* | $R0 = 1 if Rx < Ry | 101 xx yy |
| Use sub instruction to see if numbers are matching |  |  |
| BezDec *imm* | If $R0 == 0, then PC = PC + imm, else $R0 = $R0 – 1, PC = PC + 1 | 100 01 ii #change so that opcode is 3 bits |
| BnezDec *imm* | If $R0 != 0, then PC = PC + imm, else $R0 = $R0 – 1, PC = PC + 1 | 100 10 ii |
| xori *Rx, imm* | $R0 = Rx (EXCL) with imm | 110 imm |
| andi *Rx, imm* | $R0 = Rx (AND) with imm | 111 xx ii |
| jump *‘branch’* | PC = PC + imm | 010 iiii |
| addi *Rx, imm* | Rx = Rx + imm | 001 xx yy select range: signed/unsigned |
| halt | Stop | 000 00 00 |

**Machine Code for Program 1:**

#Assume everything is equal to zero at first

#$t1 = 00

#$t4 = 01

#$t5 = 10

#$t6 = 11

#$t7 = 5

#$t9 = 6

#$s0 = 7

addi $t6, $0, 1 001 11 10 #initialize register to equal to one

lw $t1, P($0) 100 11 00 #load variable value into register $t1

loop:

slt $t1, $0

beq $t1, $0, exit 100 01 ?? #end program

addi $t7, $0, -1 001 ?? 11 #-1 in 2s complement

addi $t5, $0, 5 001 10 ?? #5 value?

addi $t9, $0, 17 #add multiple times 001 ?? ?? #need 4 bits of 17

next:

beq $t5, $0, next2 100 01 ?? #jump to loop

add $t6, $t6, $t4 001 11 01 #store new value of $t6 as sum of $t6

and $t4

add $t5, $t5, $t7 001 10 ?? #store new value of $t5 as sum of $t5 and $t7

j next 010 ???? #jump to PC location of next

next2:

slt $s0, $t6, $t9 101 11 ?? # check if $t6 < $t9 and store result in $s0

bne $s0, $0, down 100 10 ?? #if $t6 < $t9, jump to down

subi $t6, $t6, 17 001 11 ?? #add $t6 to negative 2’s complement of 17 (so $t6 – 17)

j next2 010 ???? #jump to PC location of next2

down:

add $t5, $0, 5 001 10 ?? #set register $t5 to 5

add $t1, $t1, $t7 001 00 ?? #set $t1 = $t1 + $t7

add $t4, $0, $t6 001 01 11 #set register $t4 to $t6

j loop 010 ?? ?? #jump to PC location of loop

exit: sw $t6, R($0) 011 11 00 #store final result into R variable

000 00 00 #end program