The NiMi-iSC 16 bit Instruction-Set architecture

Revision 1

# NiMi-iSC 16 bit Instruction Set overview

This instruction set is meant to be a middle ground between overly generalized architectures such as RiSC-16[[1]](#footnote-1) and overly specific architectures such as x86. NiMiiSC-16 is an 8-register, 16-bit computer. The word size is 16 bits and all buses. All addresses are word-addresses (i.e., address 0 corresponds to the first two bytes of main memory, address 1 corresponds to the second two bytes of main memory, etc.). In each instruction 5 bits are dedicated to the opcode. Big endian will be used throughout the instruction set.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**Bit:**

**Formats:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**RRR**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | Immediate |

**RI**

|  |  |
| --- | --- |
| Opcode | Data |

**D**

|  |  |  |  |
| --- | --- | --- | --- |
| Opcode | Reg a | Reg b | 0 |

**RR**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | 0 |

**R**

|  |  |
| --- | --- |
| Opcode | 0 |

**N**

**Instructions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**ADD**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**SUB**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | Data |

**ADDI**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | Data |

**SUBI**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | Data |

**SUBII**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**OR**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**AND**

|  |  |  |  |
| --- | --- | --- | --- |
| Opcode | Reg a | Reg b | 0 |

**NOT**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**XOR**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**EQ**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**NEQ**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**LESS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**LOE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**GRE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**GOE**

|  |  |  |  |
| --- | --- | --- | --- |
| Opcode | Reg a | Reg b | 0 |

**STR**

|  |  |  |  |
| --- | --- | --- | --- |
| Opcode | Reg a | Reg b | 0 |

**LDR**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | 0 |

**PUSH**

|  |  |  |
| --- | --- | --- |
| Opcode | Reg a | 0 |

**POP**

|  |  |
| --- | --- |
| Opcode | Addr. |

**CALL**

|  |  |
| --- | --- |
| Opcode | 0 |

**RET**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**BITL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Opcode | Reg a | Reg b | Reg c | 0 |

**BITR**

|  |  |
| --- | --- |
| Opcode | 0 |

**HTL**

|  |  |
| --- | --- |
| Opcode | Data |

**IMM**

|  |  |  |  |
| --- | --- | --- | --- |
| Opcode | Reg a | Reg b | 0 |

**MOV**

## The following table describes the different instruction operators

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mnemonic** | **Name and format** | **Opcode (Binary)** | **Assembly format** | **Description** |
| ADD | Add  RRR-type |  | add rA, rB, rC | Add rA with rB and store in rC |
| SUB | Subtract  RRR-type |  | sub rA, rB, rC | Subtract rB from rA and store in rC |
| ADDI | Add Immediate  RI-type |  | addi rA, Imm | Add rA with Imm, store in reg 3 |
| SUBI | Subtract Immediate  RI-type |  | subi rA, Imm | Subtract Imm from rA |
| SUBII | Subtract Immediate 2  RI-type |  | subii rA, Imm | Subtract rA from Imm. |
| OR | Or  RRR-type |  | or rA, rB, rC | Or the contents of rA with rB, store result in rC. |
| AND | AND  RRR-type |  | and rA, rB, rC | And the contents of rA with rB, store result in rC. |
| NOT | NOT  RRR-type |  | not rA, rB | Not the contents of rA, store result in rB. |
| XOR | Exclusive OR RRR-type |  | xor rA, rB, rC | Xor the contents of rA with rB, store result in rC. |
| EQU | Equal  RRR-type |  | eq rA, rB, rC | If the contents of rA and rB are the same, jump to the address stored in rC. |
| NEQ | Not Equal RRR-type |  | neq rA, rB, rC | If the contents of rA and rB are not the same, jump to the address stored in rC. |
| LES | Less  RRR-type |  | les rA, rB, rC | If the contents of rA are less than rB, jump to the address stored in rC. |
| LOE | Less Or Equal RRR-type |  | loe rA, rB, rC | If the contents of rA are less or equal to rB, jump to the address stored in rC. |
| GRE | Greater  RRR-type |  | gre rA, rB, rC | If the contents of rA are greater than rB, jump to the address stored in rC |
| GOE | Greater Or Equal  RRR-type |  | goe rA, rB, rC | If the contents of rA are greater or equal to rB, jump to the address stored in rC |
| STR | Store  RR-type |  | str rA, rB | Store contents of rA in the ram address located at rB |
| LDR | Load  RR-type |  | ldr rA, rB | Load contents into rA from the ram address located at rB |
| PUSH | Push  R-type |  | push rA | Push contents of rA onto the stack |
| POP | Pop  R-type |  | pop rA | Pop contents of stack onto rA |
| CALL | Call  D-type |  | call imm | Call function with address at |
| RET | Return  N-type |  | ret | Return from function call |
| BITL | Bitwise left  RRR-type |  | bitl rA, rB, rC | Bitwise left rA by rB bits (max 16), store in rC |
| BITR | Bitwise right  RRR-type |  | bitr rA, rB, rC | Bitwise right rA by rB bits (max 16), store in rC |
| HLT | Halt clock  N-type |  | hlt | Stop the clock |
| IMM | Immediate  D-type |  | imm | Immediate imm into reg 0 |
| MOV | Move  RR-type |  | mov rA, rB | Move contents of rA into rB |

## Registers

1. Reg0 \*
2. Reg1
3. Reg2
4. Reg3 \*\*
5. Reg4
6. Reg5
7. Counter
8. I/O \*\*\*

\* Reg0 Stores Immediate value when Imm instruction is used

\*\* Reg3 stores the output when immediate calculate functions are used (e.g., ADDI)

\*\*\* I/O register will receive user input when it is placed in an input position, and it will output to user when put in a output register position.

1. (Jacob) [↑](#footnote-ref-1)