|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

0-Fetch:

0.AdR 🡨 PC inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

1.IR 🡨 M[AdR] U MAP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0110 | 0000 | 0 | 0 | 00 | 1111 | 001 | 11 | 0000000000 |

1-IADD: 0x60 E6D0

0.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

1.DR1 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

2.DR2 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.M[AdR] 🡨 OutR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1100 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

2-ISUB: 0x64 E6D4

0.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

1.DR2 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

2.DR1 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR2 - DR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 0001 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.M[AdR] 🡨 OutR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1100 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

3-NOP: 0x00 E0D0

0.NOP U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

-LoadOffset:

0.AdR 🡨 PC inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

1.OffsetUp 🡨 M[AdR] inc(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1010 | 0000 | 0 | 0 | 00 | 0001 | 000 | 00 | 0000000000 |

2.OffsetDown 🡨 M[AdR] inc(PC) U RET

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1010 | 0000 | 1 | 0 | 00 | 0010 | 001 | 10 | 0000000000 |

-Branch:

0.DR1 🡨 Offset(notAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

1.DR2 🡨 PC

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0010 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

2.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.PC 🡨 OutR U RET

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0010 | 1100 | 0 | 0 | 00 | 1111 | 001 | 10 | 0000000000 |

4-GOTO offset 0xA7 E10D7

0.NOP U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

1.NOP U CALL Branch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

2.NOP U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

5-IFEQ offset 0x99 E9D9

0.NOP U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

1.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

2.DR1 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 0000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.NOP Z CALL Branch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 010 | 01 | 0000000000?? |

5.NOP U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

6-IFLT offset 0x9B E9D11

0.NOP U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

1.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

2.DR1 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 0000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.NOP N CALL Branch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 011 | 01 | 0000000000?? |

5.NOP U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

7-IF\_ICMPEQ offset 0x9F E9D15

0.NOP U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

1.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

2.DR1 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

3.DR2 🡨 M[AdR] dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0000 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

4.NOP Z CALL Branch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 010 | 01 | 0000000000?? |

5.NOP U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

8-BIPUSH byte 0x10 E1D0

0.NOP W JMP wBIPUSH

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 100 | 00 | 0000000000?? |

1.AdR 🡨 PC inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

2.ByteR 🡨 M[AdR] inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0111 | 0000 | 0 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

3.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.M[AdR] 🡨 ByteR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 0111 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

wBIPUSH:

5.AdR 🡨 SP, toggle(W) U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 1 | 00 | 1111 | 001 | 01 | 0000000000?? |

6.M[AdR] 🡨 Offset(notAddress) U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1010 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

9-ILOAD varnum 0x15 E1D5

0.NOP W JMP wILoad

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 100 | 00 | 0000000000?? |

1.AdR 🡨 PC inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

2.VarnumR 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1001 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.DR1 🡨 VarnumR \* 4

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1001 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.DR2 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

5.OutR 🡨 DR1 + DR2 inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

6.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

7.TR 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

8.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

9.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

wILOAD:

10.NOP, toggle(w) U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 1 | 00 | 1111 | 001 | 01 | 0000000000?? |

11.DR1 🡨 Offset(isAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

12.DR2 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

13.OutR 🡨 DR1 + DR2 inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

14.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

15.TR 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

16.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

17.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

10-ISTORE varnum 0x36 E3D6

0.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

1.TR 🡨 M[AdR] W JMP wISTORE

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 00 | 1111 | 100 | 00 | 0000000000?? |

2.AdR 🡨 PC inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

3.VarnumR 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1001 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.DR1 🡨 VarnumR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1001 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

5.DR2 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

6.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

7.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

8.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

wISTORE:

9.NOP, toggle(w) U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 1 | 00 | 1111 | 001 | 01 | 0000000000?? |

10.DR1 🡨 offset(isAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

11.DR2 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

12.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

13.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

14.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

11-IINC varnum const 0x84 E8D4

0.NOP W JMP wIINC

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 100 | 00 | 0000000000?? |

1.AdR 🡨 PC inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

2.VarnumR 🡨 M[AdR] inc(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1001 | 0000 | 0 | 0 | 00 | 0001 | 000 | 00 | 0000000000 |

3.ConstR 🡨 M[AdR] inc(PC)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1000 | 0000 | 0 | 0 | 00 | 0010 | 000 | 00 | 0000000000 |

4.DR1 🡨 Varnum \* 4

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1001 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

5.DR2 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

6.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

7.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

8.DR1 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

9.DR2 🡨 ConstR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 1000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

10.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

11.M[AdR] 🡨 OutR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1100 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000 |

wIINC:

12.NOP, toggle(W) U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 1 | 00 | 1111 | 001 | 01 | 0000000000?? |

13.AdR 🡨 PC

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0010 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

14.ConstR 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1000 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

15.DR1 🡨 Offset(isAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

16.DR2 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

17.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

18.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

19.DR1 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

20.DR2 🡨 ConstR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 1000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

21.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

22.M[AdR] 🡨 OutR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1100 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

12-DUP 0x59 E5D9

0.AdR 🡨 SP inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

1.TR 🡨 M[AdR] inc4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 01 | 0001 | 000 | 00 | 0000000000 |

2.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

13-IAND 0x7E E7D14

0.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

1.DR1 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

2.DR2 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1 and DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 0111 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.M[AdR] 🡨 OutR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1100 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

14-INVOKEVIRTUAL disp 0xB6 E11D6

0.NOP U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

1.DR1 🡨 Offset(isAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

2.DR2 🡨 CPP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0011 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

5.AdR 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

6.OffsetUp 🡨 M[AdR] inc(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1010 | 0000 | 0 | 0 | 00 | 0001 | 000 | 00 | 0000000000 |

7.OffsetDown 🡨 M[AdR] inc(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1010 | 0000 | 1 | 0 | 00 | 0001 | 000 | 00 | 0000000000 |

8.TR 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

9.DR2 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

10.DR1 🡨 Offset(isAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

11.OutR 🡨 DR2 – DR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 0001 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

12.LV 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0100 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

13.OffsetUp 🡨 M[AdR] inc(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1010 | 0000 | 0 | 0 | 00 | 0001 | 000 | 00 | 0000000000 |

14.OffsetDown 🡨 M[AdR] inc(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1010 | 0000 | 1 | 0 | 00 | 0001 | 000 | 00 | 0000000000 |

15.DR1 🡨 Offset(isAddress) inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

16.DR2 🡨 SP inc4(LV)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0101 | 0 | 0 | 01 | 0100 | 000 | 00 | 0000000000 |

17.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

18.SP 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0101 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

19.AdR 🡨 SP inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

20.M[AdR] 🡨 PC inc4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 0010 | 0 | 0 | 01 | 0001 | 000 | 00 | 0000000000 |

21.M[ AdR] 🡨 TR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

22.PC 🡨 AdR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0010 | 0001 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

15-IOR 0x80 E8D0

0.AdR 🡨 SP dec4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 11 | 0101 | 000 | 00 | 0000000000 |

1.DR1 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

2.DR2 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1 or DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1001 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.M[AdR] 🡨 OutR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1100 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

16-IRETURN 0xAC E10D12

0.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

1.TR 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

2.SP 🡨 LV

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0101 | 0100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.LV 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0100 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

4.PC 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0010 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

5.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

6.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

17-LDC\_W index 0x13 E1D3

0.NOP U CALL LoadOffset

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 00 | 1111 | 001 | 01 | 0000000000?? |

1.DR1 🡨 Offset(isAddress)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 1010 | 1 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

2.DR2 🡨 CPP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1101 | 0011 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.OutR 🡨 DR1 + DR2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 1 | 1000 | 1111 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

4.AdR 🡨 OutR

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 1100 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

5.TR 🡨 M[AdR] inc4(SP)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 01 | 0101 | 000 | 00 | 0000000000 |

6.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

7.M[AdR] 🡨 TR U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

18-POP 0x57 E5D7

0.NOP dec4(SP) U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 0 | 11 | 0101 | 001 | 00 | 0000000000?? |

19-SWAP 0x5F E5D15

0.AdR 🡨 SP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0001 | 0101 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

1.TR 🡨 M[AdR] dec4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1110 | 0000 | 0 | 0 | 11 | 0001 | 000 | 00 | 0000000000 |

2.DR1 🡨 M[AdR]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1011 | 0000 | 0 | 0 | 00 | 1111 | 000 | 00 | 0000000000 |

3.M[AdR] 🡨 TR inc4(AdR)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1110 | 0 | 0 | 01 | 0001 | 000 | 00 | 0000000000 |

4.M[AdR] 🡨 DR1 U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 0000 | 1011 | 0 | 0 | 00 | 1111 | 001 | 00 | 0000000000?? |

20-WIDE 0xC4 E12D4

0.NOP, toggle(W) U JMP Fetch

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | Load/ALU | BUS | OffsetControl | W | OP | OpReg | CD | BR | Address |
| 0 | 1111 | 1111 | 0 | 1 | 00 | 1111 | 001 | 00 | 0000000000?? |