

EncoderDecoder

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1 Encoder Decoder

Transferring MIPS assembly code to machine code and reverse.

1.1 Assemble the code: XOR \$s7, \$a3, \$t5

XOR:

- Type: R format instruction
- opcode: 000000
- funct: 100110

\$s7:

- Type: Saved register from \$s0 (\$16) to \$s7 (\$23)
- Number: \$23

\$a3:

- Type: Procedure Argument register from \$a0 (\$4) to \$a3 (\$7)
- Number: \$7

\$t5:

- Type: Temporary register from \$t0 (\$8) to \$t7 (\$15)
- Number: \$13

Every instruction in MIPS assembly language is 32 bit, all of them are equal in length. R format instructions are divided into these segments:

opcode	rs		rt		rd sham funct

000000	5 bit		5 bit		5 bit 5 bit 6 bit

1.1.1 Solution

Human readable format of the machine code of the command is:

- $(000000)_{\text{two}}$ $(23)_{\text{ten}}$ $(7)_{\text{ten}}$ $(13)_{\text{ten}}$ $(00000)_{\text{two}}$ $(100110)_{\text{two}}$

Full binary format:

- 000000 10111 00111 01101 00000 100110

Compact:

- 00000010111001110110100000100110

Hex format

	0000		0010		1110		0111		0110		1000		0010		0110	
	0		2		e		7		6		8		2		6	

- 0x2e76826

1.2 Disassemble the code: 0x288900F8

First we should transfer this hex value into a binary format

1.2.1 Bin format

$(2)_{\text{hex}} \rightarrow (0010)_{\text{bin}}$

$(8)_{\text{hex}} \rightarrow (1000)_{\text{bin}}$

$(9)_{\text{hex}} \rightarrow (1001)_{\text{bin}}$

$(0)_{\text{hex}} \rightarrow (0000)_{\text{bin}}$

$(F)_{\text{hex}} \rightarrow (1111)_{\text{bin}}$

$(00101000100010010000000011111000)_{\text{bin}} \rightarrow 32 \text{ bit}$

All MIPS instructions have an opcode section which is 6 bit long, so the opcode of this instructions is: 001010. If we check the MIPS Reference card, this opcode belongs to: *slti set less than immediate*.

This is an **I format** instruction. So let's disassemble it into its parts:

	opcode		rs		rt		immediate	
	000000		5 bit		5 bit		16 bit	

So according to the instruction format and instruction parts:

- Opcode: 001010
- rs: $(00100)_{\text{bin}} = (4)_{\text{decimal}} \rightarrow \$a0$
- rt: $(01001)_{\text{bin}} = (9)_{\text{decimal}} \rightarrow \$t1$
- immediate: $(0000000011111000)_{\text{bin}} = (248)_{\text{decimal}}$