



Graduation Project

General-Purpose Computer and Game Console

MIPS-I Instruction Set Architecture

Student:

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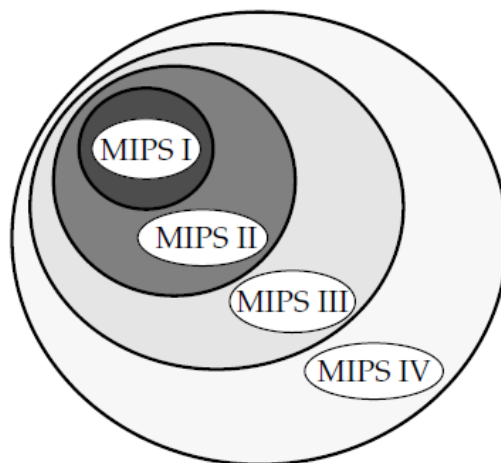
Supervisor:

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Introduction:

This document contains a summary for MIPS-I instruction set, as well as pointers to related parts in “*MIPS IV Instruction Set*.”

There are several versions of MIPS, as MIPS-I ISA was extended three times. The newer MIPS instruction sets are backward compatible with MIPS-I instruction set, as seen in the figure below.



MIPS Architecture Extensions

Instruction Set:

Instructions are divided into several groups:

- Load and Store
- ALU
- Jump and Branch
- Miscellaneous
- Coprocessor

Following is a listing for instructions with references to pages in “MIPS IV Instruction Set” that describe the instructions.

<u>Load and Store Instructions</u>		
Mnemonic	Description	Page
LB	Load Byte	A-80
LBU	Load Byte Unsigned	A-81
SB	Store Byte	A-123
LH	Load Halfword	A-91
LHU	Load Halfword Unsigned	A-92
SH	Store Halfword	A-139
LW	Load Word	A-98
SW	Store Word	A-152
LWL	Load Word Left	A-101
LWR	Load Word Right	A-104
SWL	Store Word Left	A-155
SWR	Store Word Right	A-158
<u>ALU Instructions</u>		
Mnemonic	Description	Page
ADDI	Add Immediate Word	A-29
ADDIU	Add Immediate Unsigned Word	A-30
SLTI	Set on Less Than Immediate	A-143
SLTIU	Set on Less Than Immediate Unsigned	A-144
ANDI	And Immediate	A-33
ORI	Or Immediate	A-119
XORI	Exclusive OR Immediate	A-179

LUI	Load Upper Immediate	A-97
ADD	Add Word	A-28
ADDU	Add Unsigned Word	A-31
SUB	Subtract Word	A-150
SUBU	Subtract Unsigned Word	A-151
SLT	Set on Less Than	A-142
SLTU	Set on Less Than Unsigned	A-145
AND	And	A-32
OR	Or	A-118
XOR	Exclusive Or	A-178
NOR	Nor	A-117
SLL	Shift Word Left Logical	A-140
SRL	Shift Word Right Logical	A-148
SRA	Shift Word Right Arithmetic	A-146
SLLV	Shift Word Left Logical Variable	A-141
SRLV	Shift Word Right Logical Variable	A-149
SRAV	Shift Word Right Arithmetic Variable	A-147
MULT	Multiply Word	A-115
MULTU	Multiply Unsigned Word	A-116
DIV	Divide Word	A-60
DIVU	Divide Unsigned Word	A-62
MFHI	Move From HI	A-109
MTHI	Move To HI	A-113
MFLO	Move From LO	A-110
MTLO	Move To LO	A-114
<u>Jump and Branch Instructions</u>		
Mnemonic	Description	Page
J	Jump	A-76
JAL	Jump and Link	A-77
JR	Jump Register	A-79
JALR	Jump and Link Register	A-78
BEQ	Branch on Equal	A-34
BNE	Branch on Not Equal	A-50

BLEZ	Branch on Less Than or Equal To Zero	A-43
BGTZ	Branch on Greater Than Zero	A-41
BLTZ	Branch on Less Than Zero	A-45
BGEZ	Branch on Greater Than or Equal To Zero	A-36
BLTZAL	Branch on Less Than Zero and Link	A-46
BGEZAL	Branch on Greater Than or Equal To Zero and Link	A-37
Miscellaneous Instructions		
Mnemonic	Description	Page
SYSCALL	System Call	A-165
BREAK	Breakpoint	A-52

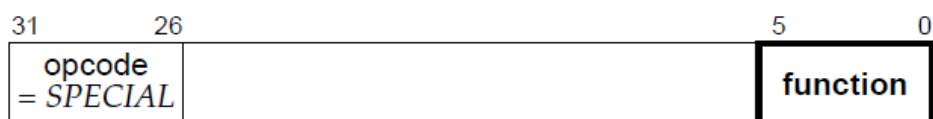
Instruction Encoding:

Page A-177 summarizes CPU instruction encoding for MIPS-I instruction set. Instructions are grouped in three classes based on their opcode.



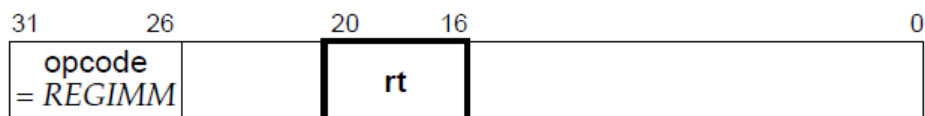
opcode		Instructions encoded by opcode field.							
bits		bits 28..26							
31..29		0	1	2	3	4	5	6	7
		000	001	010	011	100	101	110	111
0	000	<i>SPECIAL</i> δ	<i>REGIMM</i> δ	J	JAL	BEQ	BNE	BLEZ	BGTZ
1	001	ADDI	ADDIU	SLTI	SLTIU	ANDI	ORI	XORI	LUI
2	010	<i>COP0</i> δ, π	<i>COP1</i> δ, π	<i>COP2</i> δ, π	<i>COP3</i> δ, π, κ	*	*	*	*
3	011	*	*	*	*	*	*	*	*
4	100	LB	LH	LWL	LW	LBU	LHU	LWR	*
5	101	SB	SH	SWL	SW	*	*	SWR	*
6	110	*	LWC1 π	LWC2 π	LWC3 π, κ	*	*	*	*
7	111	*	SWC1 π	SWC2 π	SWC3 π, κ	*	*	*	*

Class A Instructions



function	bits 2..0	Instructions encoded by function field when opcode field = SPECIAL.							
bits	0	1	2	3	4	5	6	7	
5..3	000	001	010	011	100	101	110	111	
0	000	SLL	*	SRL	SRA	SLLV	*	SRLV	SRAV
1	001	JR	JALR	*	*	SYSCALL	BREAK	*	*
2	010	MFHI	MTHI	MFLO	MTLO	*	*	*	*
3	011	MULT	MULTU	DIV	DIVU	*	*	*	*
4	100	ADD	ADDU	SUB	SUBU	AND	OR	XOR	NOR
5	101	*	*	SLT	SLTU	*	*	*	*
6	110	*	*	*	*	*	*	*	*
7	111	*	*	*	*	*	*	*	*

Class B Instructions



<div>rt</div>		Instructions encoded by the rt field when opcode field = REGIMM.							
bits 18..16									
bits		0	1	2	3	4	5	6	7
20..19		000	001	010	011	100	101	110	111
0	00	BLTZ	BGEZ	†	†	†	†	†	†
1	01	†	†	†	†	†	†	†	†
2	10	BLTZAL	BGEZAL	†	†	†	†	†	†
3	11	†	†	†	†	†	†	†	†

Class C Instructions