

# MIPS Reference Sheet

## Arithmetic and Logical Instructions

Instruction	Operation
add \$d, \$s, \$t	\$d = \$s + \$t
addu \$d, \$s, \$t	\$d = \$s + \$t
addi \$t, \$s, i	\$t = \$s + SE(i)
addiu \$t, \$s, i	\$t = \$s + SE(i)
and \$d, \$s, \$t	\$d = \$s & \$t
andi \$t, \$s, i	\$t = \$s & ZE(i)
<del>div \$d, \$s, \$t</del>	<del>lo = \$s / \$t; hi = \$s % \$t</del>
<del>divu \$d, \$s, \$t</del>	<del>lo = \$s / \$t; hi = \$s % \$t</del>
<del>mult \$d, \$s, \$t</del>	<del>hi:lo = \$s * \$t</del>
<del>multu \$d, \$s, \$t</del>	<del>hi:lo = \$s * \$t</del>
nor \$d, \$s, \$t	\$d = ~( \$s   \$t )
or \$d, \$s, \$t	\$d = \$s   \$t
ori \$t, \$s, i	\$t = \$s   ZE(i)
sll \$d, \$t, a	\$d = \$t << a
sllv \$d, \$t, \$s	\$d = \$t << \$s
sra \$d, \$t, a	\$d = \$t >> a
srav \$d, \$t, \$s	\$d = \$t >> \$s
srl \$d, \$t, a	\$d = \$t >>> a
srlv \$d, \$t, \$s	\$d = \$t >>> \$s
sub \$d, \$s, \$t	\$d = \$s - \$t
subu \$d, \$s, \$t	\$d = \$s - \$t
xor \$d, \$s, \$t	\$d = \$s ^ \$t
xori \$d, \$s, i	\$d = \$s ^ ZE(i)

## Constant-Manipulating Instructions

Instruction	Operation
lhi \$t, i	HH(\$t) = i
llo \$t, i	LH(\$t) = i

## Comparison Instructions

Instruction	Operation
slt \$d, \$s, \$t	\$d = (\$s < \$t)
sltu \$d, \$s, \$t	\$d = (\$s < \$t)
slti \$t, \$s, i	\$t = (\$s < SE(i))
sltiu \$t, \$s, i	\$t = (\$s < SE(i))

## Branch Instructions

Instruction	Operation
beq \$s, \$t, label	if (\$s == \$t) pc += i << 2
bgtz \$s, label	if (\$s > 0) pc += i << 2
blez \$s, label	if (\$s <= 0) pc += i << 2
bne \$s, \$t, label	if (\$s != \$t) pc += i << 2

## Jump Instructions

Instruction	Operation
j label	pc += i << 2
jal label	\$31 = pc; pc += i << 2
jalr \$s	\$31 = pc; pc = \$s
jr \$s	pc = \$s

## Load Instructions

Instruction	Operation
lb \$t, i(\$s)	\$t = SE (MEM [\$s + i] : 1)
lbu \$t, i(\$s)	\$t = ZE (MEM [\$s + i] : 1)
lh \$t, i(\$s)	\$t = SE (MEM [\$s + i] : 2)
lhu \$t, i(\$s)	\$t = ZE (MEM [\$s + i] : 2)
lw \$t, i(\$s)	\$t = MEM [\$s + i] : 4

## Store Instructions

Instruction	Operation
sb \$t, i(\$s)	MEM [\$s + i] : 1 = LB (\$t)
sh \$t, i(\$s)	MEM [\$s + i] : 2 = LH (\$t)
sw \$t, i(\$s)	MEM [\$s + i] : 4 = \$t

## Data Movement Instructions

Instruction	Operation
mfhi \$d	\$d = hi
mflo \$d	\$d = lo
mtthi \$s	hi = \$s
mtlo \$s	lo = \$s

## Exception and Interrupt Instructions

Instruction	Operation
trap 1	Print integer value in \$4
trap 5	Read integer value into \$2
trap 10	Terminate program execution
trap 101	Print ASCII character in \$4
trap 102	Read ASCII character into \$2

**Note:** Detailed encoding reference on reverse.

### Instruction Encodings

Register	000000ss sssttttt ddddaaaa aaffffff
Immediate	ooooooss sssttttt iiiiii iiiiii
Jump	oooooii iiiiii iiiiii iiiiii

### Instruction Syntax

Syntax	Template	Encoding	Comments
ArithLog	f \$d, \$s, \$t	Register	
DivMult	f \$s, \$t	Register	
Shift	f \$d, \$t, a	Register	
ShiftV	f \$d, \$t, \$s	Register	
JumpR	f \$s	Register	
MoveFrom	f \$d	Register	
MoveTo	f \$s	Register	
ArithLogI	o \$t, \$s, i	Immediate	
LoadI	o \$t, immed32	Immediate	i is high or low 16 bits of immed32
Branch	o \$s, \$t, label	Immediate	i is calculated as (label-(current+4))>>2
BranchZ	o \$s, label	Immediate	i is calculated as (label-(current+4))>>2
LoadStore	o \$t, i(\$s)	Immediate	
Jump	o label	Jump	i is calculated as label<<2
Trap	o i	Jump	

### Opcode Table

Instruction	Opcode/Function	Syntax	Instruction	Opcode/Function	Syntax
add	100000	ArithLog	slt	101010	ArithLog
addu	100001	ArithLog	sltu	101001	ArithLog
addi	001000	ArithLogI	slti	001010	ArithLogI
addiu	001001	ArithLogI	sltiu	001001	ArithLogI
and	100100	ArithLog	beq	000100	Branch
andi	001100	ArithLogI	bgtz	000111	BranchZ
div	011010	DivMult	blez	000110	BranchZ
divu	011011	DivMult	bne	000101	Branch
mult	011000	DivMult	j	000010	Jump
multu	011001	DivMult	jal	000011	Jump
nor	100111	ArithLog	jalr	001001	JumpR
or	100101	ArithLog	jr	001000	JumpR
ori	001101	ArithLogI	lb	100000	LoadStore
sll	000000	Shift	lbu	100100	LoadStore
sllv	000100	ShiftV	lh	100001	LoadStore
sra	000011	Shift	lhu	100101	LoadStore
srav	000111	ShiftV	lw	100011	LoadStore
srl	000010	Shift	sb	101000	LoadStore
srlv	000110	ShiftV	sh	101001	LoadStore
sub	100010	ArithLog	sw	101011	LoadStore
subu	100011	ArithLog	mfhi	010000	MoveFrom
xor	100110	ArithLog	mflo	010010	MoveFrom
xori	001110	ArithLogI	mthi	010001	MoveTo
lhi	011001	LoadI	mtlo	010011	MoveTo
llo	011000	LoadI	trap	011010	Trap

**Note:** Operation details on reverse.