

计算机组成原理 Project 6 cpu 流水线

一. 设计说明

1. 处理器应支持 MIPS-C3 指令集

MIPS-C3={LB、LBU、LH、LHU、LW、SB、SH、SW、ADD、ADDU、SUB、SUBU、MULT、MULTU、DIV、DIVU、SLL、SRL、SRA、SLLV、SRLV、SRAV、AND、OR、XOR、NOR、ADDI、ADDIU、ANDI、ORI、XORI、LUI、SLT、SLTI、SLTIU、SLTU、BEQ、BNE、BLEZ、BGTZ、BLTZ、BGEZ、J、JAL、JALR、JR、MFHI、MFLO、MTHI、MTLO}

所有运算类指令均不考虑因溢出而产生的异常。

2. 处理器为**流水线**设计

3. 需要考虑**延迟槽**

二. 设计要求

1. 流水线的设计以追求性能为第一目标，因此必须尽最大可能**支持转发**以解决数据冒险。这一点在本 project 的最终成绩中所占比重较大，课上测试时会通过测试程序所跑的**总周期数**进行判定，望大家慎重对待。

2. 对于 b 类和 j 类指令，流水线设计必须**支持延迟槽**，因此设计需要注意使用 PC+8。

3. 为了解决数据冒险而设计的转发数据来源必须是**某级流水线寄存器**，**不允许**对功能部件的输出直接进行转发。

4. PC 的初始地址为 0x0000_3000，和 Mars 中我们要求设置的代码初始地址相同。

5. 程序中无论模块名还是变量名都应该有意义、有规律，并且要保持在前后实验中的一致性，最好不要随意更改，不然改起来会非常麻烦，而且很容易出错。

指令存储器(IM, instruction memory)和数据存储器(DM, data memory)要求如 下：

- IM：容量为 **16KB**(32bit/word×**4096word**)。
- DM：容量为 **16KB**(32bit/word×**4096word**)。

6. 需有单独的乘除法模块与数据扩展模块

三. 模块定义

1. PC

表 1. PC

序号	功能名称	功能描述
1	newPC(in)	从外部读入更新后的 PC
2	clk(in)	时钟信号
3	clr(in)	还原信号
4	PC(out)	输出当前 PC，供外部电路使用

功能定义：从外部读入新的 PC，并在时钟上升沿更新 PC 并输出

2. IM

表 2. IM

序号	功能名称	功能描述
1	PC(in)	从外部读入 PC
2	IFUOUT(out)	根据 PC 读取对应位置的指令并输出

功能定义：从外部读取当前 PC，并输出对应位置的指令

3. GRF

表 3. GRF

序号	功能名称	功能描述
1	A1(in)	从外部读入更新后的 PC
2	A2(in)	时钟信号
3	A3(in)	还原信号
4	WD(out)	更新寄存器的值
5	clk(in)	时钟信号

6	clr(in)	还原信号
7	Pc4_W(in)	当前 pc 值
8	RegWrite(in)	寄存器写使能
9	D1(out)	输出第一个寄存器的值
10	D2(out)	输出第二个寄存器的值

功能定义：从外部读入 A1，A2 两个地址，分别找到对应的两个寄存器并输出，从外部读入 A3 地址和 WD 数据，在时钟上升沿来临时，若写使能有效，则将 WD 存入 A3 对应的寄存器中。输入的 PC 为满足输出格式。

4. ALU

表 4. ALU

序号	功能名称	功能描述
1	ALUA(in)	从外部读入第一个运算数
2	ALUB(in)	从外部读入第二个运算数
3	control(in)	ALU 控制信号
4	A0(out)	输出运算结果

功能定义：从外部读入两个操作数，根据 ALU 控制信号进行运算，并由 out 输出运算结果。

- ALU 控制信号
- 000：加法运算
 - 001：减法运算
 - 010：或运算
 - 011：lui 指令拼接运算

5. DM

表 5. DM

序号	功能名称	功能描述
1	AO_M(in)	从外部读入地址
2	MFRTMOUT(in)	从外部读入数据
3	clr(in)	还原信号
4	clk(out)	时钟信号
5	MemWrite	内存写使能
6	Pc4(in)	输入当前 pc
7	DR(out)	输出地址 A 所对应的数据

功能说明：从外部读取地址 AO_M，并输出 AO_M 地址对应数据。在时钟上升沿来临时，若写使能有效，则将地址 AO_M 对应数据改写为 D。输入当前 PC 用作 display 指令输出使用

MemWrite 信号详细说明：

000：无写入操作

001：写入字符

010：写入半字

011：写入字节

6. Extend

表 6. Extend

序号	功能名称	功能描述
1	Data(in)	从外部读入扩展数据
2	extender(in)	符号扩展信号
3	out(out)	数据输出

从外部读入 16 位立即数，根据 extender 信号进行扩展，extender 为 0 进行符号扩展，extender 为 1 进行无符号扩展，并将结果由 out 输出

7. MULT

表 7. MULT

序号	功能名称	功能描述
1	A1(in)	第一个运算数
2	A2(in)	第二个运算数
3	start(in)	计算 Start 信号
4	busy(out)	工作信号
5	MULTsle	运算选择信号
6	MULTOUT	运算结果输出

功能说明：从外部读入两个操作数，并进行运算及输出。若为运算操作，则使 busy 信号有效

MULTsle：000：符号乘法

001：无符号乘法

- 010: 符号除法
- 011: 无符号除法
- 100: 读 hi
- 101: 读 lo
- 110: 写 hi
- 111: 写 lo

8. BE

表 7. BE

序号	功能名称	功能描述
1	A(in)	第一个运算数
2	DR_W(in)	第二个运算数
3	kuo(in)	计算 Start 信号
4	BEOUT(out)	工作信号

功能说明：放在 W 级寄存器之后，根据 ld 指令不同产生不同控制信号，对于从 DM 中读取的数据进行数据扩展

kuo: 000;不扩展

- 001: 无符号半字扩展
- 010: 符号半字扩展
- 011: 无符号字节扩展
- 100: 符号字节扩展

9. control

表 7. control

序号	功能名称	端口定义
1	MUX_WDOUT_sle(out)	寄存器写回数据信号
2	MemWrite(out)	内存写使能
3	Branch(out)	判定 beq 指令
4	MUX_ALU_B_sle(out)	ALU 运算数选择信号
5	RegWrite(out)	寄存器写使能
6	MUX_A3_sle(out)	寄存器存入地址选择信号
7	EXTsle(out)	符号扩展信号
8	npcsle(out)	Npc 计算选择信号
9	ifj(out)	判断 j 指令
10	ALUsle(out)	ALU 控制信号
11	Opcode(in)	Opcode 字段
12	Func(in)	Func 字段

表 8. 真值表

Func	100001	100011	Null					000000
Op	000000	000000	001101	100011	101011	000100	001111	000000
指令	addu	subu	ori	lw	sw	beq	lui	Nop
MUX_WDOUTsle	0	0	0	1	x	x	0	X
MemWrite	0	0	0	0	1	0	0	0
Branch	0	0	0	0	0	1	0	0
ALUsle	00	01	10	00	00	01	11	X
ALU_B_sle	0	0	1	1	1	0	1	X
RegWrite	1	1	1	1	0	0	1	0
MUX_A3_sle	1	1	0	0	X	X	0	X
Extender	X	X	1	0	0	0	1	X
npcsle	0	0	0	0	0	1	0	0
ifj	0	0	0	0	0	0	0	0
Start	0	0	0	0	0	0	0	0
Kuo	0	0	0	0	0	0	0	0
MULTsle	0	0	0	0	0	0	0	0

Func	NULL		001000	000111	101010	011000	011001	011010
Op	000011	000010	000000	000000	000000	000000	000000	000000
指令	jal	j	jr	srav	slt	mult	mflo	mtlo
MUX_WDOUTsle	2	0	2	0	0	0	0	0
MemWrite	0	0	0	0	0	0	0	0
Branch	0	0	0	0	0	0	0	0
ALUsle	4	0	X	14	15	0	0	0

ALU_B_sle	X	0	X	0	0	0	0	0
RegWrite	1	0	0	1	1	0	1	0
MUX_A3_sle	2	0	X	1	1	0	0	0
Extender	0	0	0	0	0	0	0	0
npcsle	2	2	3	0	0	0	0	0
ifj	1	1	1	0	0	0	0	0
Start	0	0	0	0	0	1	0	0
Kuo	0	0	0	0	0	0	0	0
MULTsle	0	0	0	0	0	0	6	7

功能详细说明：与 datapath 模块共同形成 CPU 整体，从 datapath 中读取 opcode 以及 func，判断指令内容，并返回各个控制信号

MUX_WDOUTsle：选择写回寄存器的值是来自 ALU 计算结果来自哪里，0 为 ALU，1 为内存，2 为 pc+4

MemWrite：内存写使能，时钟上升沿来临时若有效，则写入数据

Branch：判断此时的指令是否为 beq 指令

ALUsle：ALU 计算控制信号，具体细节在 ALU 模块有详细说明

ALU_B_sle：判断参与 ALU 计算的操作数来自寄存器堆还是来自立即数，0 为寄存器堆，1 为立即数

RegWrite：寄存器写使能，时钟上升沿来临时若有效，则写入数据

Extender：扩展信号，为 0 时进行符号扩展，为 1 时进行无符号扩展，集体功能在 extender 模块有详细描述

MUX_A3_sle：判断写入寄存器时使用的地址，0 时为指令的 20 到 16 位，1 时为指令的 15 到 11 位

ifj：判断是否为 j 类指令

npcsle：选择 npc 计算方法，具体在 npc 模块有叙述

10.npc

表 9. npc

序号	功能名称	功能描述
1	Pc4_D(in)	从外部读入地址
2	D1(in)	第一个寄存器的值
3	i26(in)	26 位立即数
4	npcsle(in)	计算方法信号
5	CMPOUT(out)	输入比较结果

6	NPCout (in)	输出 NPC
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Npc 控制信号 : 00 pc+8
01 \$signed(pc4_D)+\$signed({{14{i26[15]}},i26[15:0],2'b00})
02 {{pc[31:28]},{i26},{2'b00}}
03 D1

11.cmp

表 10. cmp

序号	功能名称	功能描述
1	D1 (in)	第一个比较数
2	D2 (in)	第二个比较数
3	CMPsle (in)	比较选择器
4	CMPOUT (out)	输入比较结果

CMPsle : 0 : 相等则置 1

1 : 不相等则置 1

2 : 大于等于 0 则置 1

3 : 小于等于 0 则置 1

4 : 大于则置 1

5 : 小于则置 1

12.Hazard

表 9. hazard

序号	功能名称	功能描述
1	IR_D(in)	D 级指令
2	IR_E(in)	E 级指令
3	IR_M(in)	M 级指令
4	IR_W(in)	W 级指令
5	FRSD(out)	转发信号
6	FRTD(out)	转发信号
7	FRSE(out)	转发信号
8	FRTE(out)	转发信号
9	FRTM(out)	转发信号
10	Stall	暂停信号

四. 冲突分析

1. cal_r

类型	前序	冲突位置	冲突寄存器	测试样例
R-E-RS	subu	E	rs	subu \$1,\$2,\$3 addu \$4,\$1,\$2
R-E-RT	subu	E	rt	subu \$1,\$2,\$3 addu \$4,\$2,\$1
R-M-RS	subu	M	rs	subu \$1,\$2,\$3 nop addu \$4,\$1,\$2
R-M-RT	subu	M	rt	subu \$1,\$2,\$3 nop addu \$4,\$2,\$1
R-W-RS	subu	W	rs	subu \$1,\$2,\$3 nop nop addu \$4,\$2,\$1
R-W-RT	subu	W	rt	subu \$1,\$2,\$3 nop nop addu \$4,\$2,\$1
I-E-RS	ori	E	rs	ori \$1,1 addu \$4,\$1,\$2
I-E-RT	ori	E	rt	ori \$1,1 addu \$4,\$2,\$1
I-M-RS	ori	M	rs	ori \$1,1 nop addu \$4,\$1,\$2
I-M-RT	ori	M	rt	ori \$1,1 nop addu \$4,\$2,\$1
I-W-RS	ori	W	rs	ori \$1,1 nop nop addu \$4,\$1,\$2
I-W-RT	ori	W	rt	ori \$1,1 nop nop addu \$4,\$2,\$1
LW-E-RS	lw	E	rs	lw \$1,0(\$0)

				addu \$4,\$1,\$2
LW-E-RT	lw	E	rt	lw \$1,0(\$0) addu \$4,\$2,\$1
LW-M-RS	lw	M	rs	lw \$1,0(\$0) nop addu \$4,\$1,\$2
LW-M-RT	lw	M	rt	lw \$1,0(\$0) nop addu \$4,\$2,\$1
LW-W-RS	lw	W	rs	lw \$1,0(\$0) nop nop addu \$4,\$1,\$2
LW-W-RT	lw	W	rt	lw \$1,0(\$0) nop nop addu \$4,\$2,\$1
J-E-RS	Jal	E	rs	jal loop addu \$1,\$31,\$2 loop:
J-E-RT	Jal	E	rt	jal loop addu \$1,\$2,\$31 loop:
J-M-RS	Jal	M	rs	jal loop nop loop: addu \$1,\$31,\$2
J-M-RS	jal	M	rt	jal loop nop loop: addu \$1,\$2,\$31

2.cal_i

类型	前序	冲突位置	冲突寄存器	测试样例
R-E-RS	subu	E	rs	subu \$1,\$2,\$3 ori \$4,\$1,\$2
R-M-RS	subu	M	rs	subu \$1,\$2,\$3 nop ori \$4,\$2,\$1
R-W-RS	subu	W	rs	subu \$1,\$2,\$3 nop nop ori \$4,\$2,\$

I-E-RS	ori	E	rs	ori \$1,\$2,1 ori \$3,\$1,1
I-M-RS	ori	M	rs	ori \$1,\$2,1 nop ori \$3,\$1,1
I-W-RS	ori	W	rs	subu \$1,\$2,\$3 nop nop ori \$3,\$2,\$1
LW-E-RS	lw	E	rs	lw \$1,0(\$0) ori \$3,\$2,\$1
LW-M-RS	Lw	M	rs	lw \$1,0(\$0) nop ori \$3,\$2,\$1
LW-W-RS	Lw	W	rs	lw \$1,0(\$0) nop nop ori \$3,\$2,\$1
J-E-RS	Jal	E	rs	Jal loop Loop:ori \$4,\$2,\$1
J-M-RS	Jal	M	rs	Jal loop nop Loop:ori \$4,\$2,\$1
J-W-RS	jal	W	rs	Jal loop nop Loop:nop ori \$4,\$2,\$1

4.lw

类型	前序	冲突位置	冲突寄存器	测试样例
R-E-RS	subu	E	rs	subu \$1,\$2,\$3 lw \$4,0(\$1)
R-M-RS	subu	M	rs	subu \$1,\$2,\$3 nop lw \$4,0(\$1)
R-W-RS	subu	W	rs	subu \$1,\$2,\$3 nop nop lw \$4,0(\$1)
I-E-RS	ori	E	rs	ori \$1,\$2,1 lw \$4,0(\$1)

I-M-RS	ori	M	rs	ori \$1,\$2,1 nop lw \$4,0(\$1)
I-W-RS	ori	W	rs	subu \$1,\$2,\$3 nop nop lw \$4,0(\$1)
LW-E-RS	lw	E	rs	lw \$1,0(\$0) lw \$4,0(\$1)
LW-M-RS	Lw	M	rs	lw \$1,0(\$0) nop lw \$4,0(\$1)
LW-W-RS	Lw	W	rs	lw \$1,0(\$0) nop nop lw \$4,0(\$1)
J-E-RS	Jal	E	rs	Jal loop Loop: lw \$4,0(\$1)
J-M-RS	Jal	M	rs	Jal loop nop Loop: lw \$4,0(\$1)
J-W-RS	jal	W	rs	Jal loop nop Loop:nop lw \$4,0(\$1)

5 . sw

类型	前序	冲突位置	冲突寄存器	测试样例
R-E-RS	subu	E	rs	subu \$1,\$2,\$3 sw \$4,0(\$1)
R-E-RT	subu	E	rt	subu \$1,\$2,\$3 sw \$1,0(\$4)
R-M-RS	subu	M	rs	subu \$1,\$2,\$3 nop sw \$4,0(\$1)
R-M-RT	subu	M	rt	subu \$1,\$2,\$3 nop sw \$1,0(\$4)
R-W-RS	subu	W	rs	subu \$1,\$2,\$3 nop nop sw \$4,0(\$1)

R-W-RT	subu	W	rt	subu \$1,\$2,\$3 nop nop sw \$1,0(\$4)
I-E-RS	ori	E	rs	ori \$1,1 sw \$4,0(\$1)
I-E-RT	ori	E	rt	ori \$1,1 sw \$1,0(\$4)
I-M-RS	ori	M	rs	ori \$1,1 nop sw \$4,0(\$1)
I-M-RT	ori	M	rt	ori \$1,1 nop sw \$1,0(\$4)
I-W-RS	ori	W	rs	ori \$1,1 nop nop sw \$4,0(\$1)
I-W-RT	ori	W	rt	ori \$1,1 nop nop sw \$1,0(\$4)
LW-E-RS	lw	E	rs	lw \$1,0(\$0) nop nop nop sw \$4,0(\$1)
LW-E-RT	lw	E	rt	lw \$1,0(\$0) sw \$1,0(\$4)
LW-M-RS	lw	M	rs	lw \$1,0(\$0) nop sw \$4,0(\$1)
LW-M-RT	lw	M	rt	lw \$1,0(\$0) nop sw \$1,0(\$4)
LW-W-RS	lw	W	rs	lw \$1,0(\$0) nop nop sw \$4,0(\$1)
LW-W-RT	lw	W	rt	lw \$1,0(\$0) nop nop sw \$1,0(\$4)

J-E-RS	Jal	E	rs	jal loop sw \$4,0(\$1) loop:
J-E-RT	Jal	E	rt	jal loop sw \$1,0(\$4) loop:
J-M-RS	Jal	M	rs	jal loop nop loop: sw \$4,0(\$1)
J-M-RS	jal	M	rt	jal loop nop loop: sw \$4,0(\$1)
J-W-RS	jal	W	rs	jal loop nop loop:nop sw \$4,0(\$1)
J-W-RS	jal	W	rt	jal loop nop loop: nop sw \$4,0(\$1)

6.beq

类型	前序	冲突位置	冲突寄存器	测试样例
R-E-RS	subu	E	rs	subu \$1,\$2,\$3 beq \$1,\$4
R-E-RT	subu	E	rt	subu \$1,\$2,\$3 beq \$4,\$1
R-M-RS	subu	M	rs	subu \$1,\$2,\$3 nop beq \$1,\$4
R-M-RT	subu	M	rt	subu \$1,\$2,\$3 nop beq \$4,\$1
R-W-RS	subu	W	rs	subu \$1,\$2,\$3 nop nop beq \$1,\$4
R-W-RT	subu	W	rt	subu \$1,\$2,\$3 nop nop beq \$4,\$1
I-E-RS	ori	E	rs	ori \$1,1 beq \$1,\$4

I-E-RT	ori	E	rt	ori \$1,1 beq \$4,\$1
I-M-RS	ori	M	rs	ori \$1,1 nop beq \$1,\$4
I-M-RT	ori	M	rt	ori \$1,1 nop beq \$4,\$1
I-W-RS	ori	W	rs	ori \$1,1 nop nop beq \$1,\$4
I-W-RT	ori	W	rt	ori \$1,1 nop nop beq \$4,\$1
LW-E-RS	lw	E	rs	lw \$1,0(\$0) nop nop nop beq \$1,\$4
LW-E-RT	lw	E	rt	lw \$1,0(\$0) beq \$4,\$1
LW-M-RS	lw	M	rs	lw \$1,0(\$0) nop beq \$1,\$4
LW-M-RT	lw	M	rt	lw \$1,0(\$0) nop beq \$4,\$1
LW-W-RS	lw	W	rs	lw \$1,0(\$0) nop nop beq \$1,\$4
LW-W-RT	lw	W	rt	lw \$1,0(\$0) nop nop beq \$4,\$1
J-E-RS	Jal	E	rs	jal loop beq \$1,\$4 loop:
J-E-RT	Jal	E	rt	jal loop beq \$4,\$1 loop:
J-M-RS	Jal	M	rs	jal loop nop

				loop: beq \$1,\$4
J-M-RT	jal	M	rt	jal loop nop loop: beq \$4,\$1
J-W-RS	jal	W	rs	jal loop nop loop: nop beq \$1,\$4
J-W-RS	jal	W	rt	jal loop nop loop:nop beq \$4,\$1

7.jr

类型	前序	冲突位置	冲突寄存器	测试样例
R-E-RS	subu	E	rs	subu \$1,\$2,\$3 jr \$1
R-M-RS	subu	M	rs	subu \$1,\$2,\$3 nop jr \$1
R-W-RS	subu	W	rs	subu \$1,\$2,\$3 nop nop jr \$1
I-E-RS	ori	E	rs	ori \$1,\$2,1 jr \$1
I-M-RS	ori	M	rs	ori \$1,\$2,1 nop jr \$1
I-W-RS	ori	W	rs	subu \$1,\$2,\$3 nop nop jr \$1
LW-E-RS	lw	E	rs	lw \$1,0(\$0) jr \$1
LW-M-RS	Lw	M	rs	lw \$1,0(\$0) nop jr \$1
LW-W-RS	Lw	W	rs	lw \$1,0(\$0) nop nop jr \$1

J-E-RS	Jal	E	rs	Jal loop Loop: jr \$31
J-M-RS	Jal	M	rs	Jal loop nop Loop: jr \$31
J-W-RS	jal	W	rs	Jal loop nop Loop:nop jr \$31

五. 思考题

1. 为什么需要有单独的乘除法部件而不是整合进 ALU? 为何需要有独立的 HI、LO 寄存器?

答: 首先, 乘法指令需要更多周期去计算, 如果融入进 ALU, 则其他需要使用 ALU 的指令无法运行, 大大降低 CPU 运行效率。另一方面, 乘法器有特殊寄存器 HI, LO, 放进 ALU 中会产生时序逻辑相关内容, 加大设计难度, 所以会选择放在外面。

2. 参照你对延迟槽的理解, 试解释“乘除槽”

答: 乘除槽的存在是为了提高代码运行效率, 在等待结果时可并行其余不使用乘法器的指令, 和延迟槽一样可提高 CPU 运行效率。另一方面, 当能够判断该指令为乘法类指令时, 另一条 pc+4 的指令已经顶在了 D 级寄存器的边上, 从而必进入 D 级流水线。

3. 为何上文文末提到的 lb 等指令使用的数据扩展模块应在 MEM/WB 之后, 而不能在 DM 之后?

答: 一方面可以避免因模块延迟而造成的 bug, 另一方面, 由于流水线最慢的一级为 M 级, 若放在 M 级, 则更加降低 CPU 的效率, 所以会选择放在 W 级

4. 举例说明并分析何时按字节访问内存相对于按字访问内存性能上更有优势。(Hint: 考虑 C 语言中字符串的情况)

答: C 语言中字符串都是以字节存储的, 当有大量字符串操作时, 按字读入会造成数据的浪费, 此时按照字节读取会增加效率与准确性。

5. 如何概括你所设计的 CPU 的设计风格？为了对抗复杂性你采取了哪些抽象和规范手段？

答：PLANNER 型，将指令进行分类，如 cal_r 型，cal_i 型，其本质即对于寄存器的读取及写入，按照 rs, rt, rd 域进行分类，并编写暂停转发条件，这样做，后续代码及新加指令便会简单许多。

6. 你对流水线 CPU 设计风格有何见解？

答：利用 PLANNER 进行流水线设计时，有大量重复的枯燥工作，但代码整齐，且容易找出 bug，有新指令后，分析清楚新指令的类别，便可轻松加入。但如果出现一条行为特殊的指令，则会对修改工作带来很大的负担。相比之下，DETECTOR 就要简单许多，但并不直观，debug 并没有 PLANNER 容易

六. 测试代码

1.

```
ori $1, $1, 30063
ori $2, $2, 32090
mthi $1
mtlo $2
slti $0, $1, 20
mthi $0
mfhi $4
sw $4, 0($0)
mflo $5
sw $5, 4($0)
slti $0, $1, 10
nop
mthi $0
mfhi $4
sw $4, 8($0)
mflo $5
sw $5, 12($0)
slti $0, $1, 13
nop
nop
mthi $0
mfhi $4
```

```
sw $4, 16($0)
mflo $5
sw $5, 20($0)
sltiu $0, $1, 2
mthi $0
mfhi $4
sw $4, 24($0)
mflo $5
sw $5, 28($0)
sltiu $0, $1, 20
nop
mthi $0
mfhi $4
sw $4, 32($0)
mflo $5
sw $5, 36($0)
sltiu $0, $1, 30
nop
nop
mthi $0
mfhi $4
sw $4, 40($0)
mflo $5
sw $5, 44($0)
sltu $0, $1, $2
mthi $0
mfhi $4
sw $4, 48($0)
mflo $5
sw $5, 52($0)
sltu $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 56($0)
mflo $5
sw $5, 60($0)
sltu $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 64($0)
mflo $5
```

```
sw $5, 68($0)
mfhi $0
mthi $0
mfhi $4
sw $4, 72($0)
mflo $5
sw $5, 76($0)
mfhi $0
nop
mthi $0
mfhi $4
sw $4, 80($0)
mflo $5
sw $5, 84($0)
mfhi $0
nop
nop
mthi $0
mfhi $4
sw $4, 88($0)
mflo $5
sw $5, 92($0)
mflo $0
mthi $0
mfhi $4
sw $4, 96($0)
mflo $5
sw $5, 100($0)
mflo $0
nop
mthi $0
mfhi $4
sw $4, 104($0)
mflo $5
sw $5, 108($0)
mflo $0
nop
nop
mthi $0
mfhi $4
sw $4, 112($0)
mflo $5
sw $5, 116($0)
lb $0, 68($0)
```

```
mthi $0
mfhi $4
sw $4, 120($0)
mflo $5
sw $5, 124($0)
lb $0, 15($0)
mthi $0
mfhi $4
sw $4, 128($0)
mflo $5
sw $5, 132($0)
lb $0, 97($0)
mthi $0
mfhi $4
sw $4, 136($0)
mflo $5
sw $5, 140($0)
lbu $0, 89($0)
mthi $0
mfhi $4
sw $4, 144($0)
mflo $5
sw $5, 148($0)
lbu $0, 17($0)
mthi $0
mfhi $4
sw $4, 152($0)
mflo $5
sw $5, 156($0)
lbu $0, 87($0)
mthi $0
mfhi $4
sw $4, 160($0)
mflo $5
sw $5, 164($0)
lh $0, 126($0)
mthi $0
mfhi $4
sw $4, 168($0)
mflo $5
sw $5, 172($0)
lh $0, 172($0)
mthi $0
mfhi $4
```

```
sw $4, 176($0)
mflo $5
sw $5, 180($0)
lh $0, 78($0)
mthi $0
mfhi $4
sw $4, 184($0)
mflo $5
sw $5, 188($0)
lhu $0, 48($0)
mthi $0
mfhi $4
sw $4, 192($0)
mflo $5
sw $5, 196($0)
lhu $0, 164($0)
mthi $0
mfhi $4
sw $4, 200($0)
mflo $5
sw $5, 204($0)
lhu $0, 108($0)
mthi $0
mfhi $4
sw $4, 208($0)
mflo $5
sw $5, 212($0)
lw $0, 196($0)
mthi $0
mfhi $4
sw $4, 216($0)
mflo $5
sw $5, 220($0)
lw $0, 76($0)
mthi $0
mfhi $4
sw $4, 224($0)
mflo $5
sw $5, 228($0)
lw $0, 120($0)
mthi $0
mfhi $4
sw $4, 232($0)
mflo $5
```

```
sw $5, 236($0)
add $0, $1, $2
mtlo $0
mfhi $4
sw $4, 240($0)
mflo $5
sw $5, 244($0)
add $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 248($0)
mflo $5
sw $5, 252($0)
add $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 256($0)
mflo $5
sw $5, 260($0)
addu $0, $1, $2
mtlo $0
mfhi $4
sw $4, 264($0)
mflo $5
sw $5, 268($0)
addu $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 272($0)
mflo $5
sw $5, 276($0)
addu $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 280($0)
mflo $5
sw $5, 284($0)
sub $0, $1, $2
```

```
mtlo $0
mfhi $4
sw $4, 288($0)
mflo $5
sw $5, 292($0)
sub $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 296($0)
mflo $5
sw $5, 300($0)
sub $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 304($0)
mflo $5
sw $5, 308($0)
subu $0, $1, $2
mtlo $0
mfhi $4
sw $4, 312($0)
mflo $5
sw $5, 316($0)
subu $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 320($0)
mflo $5
sw $5, 324($0)
subu $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 328($0)
mflo $5
sw $5, 332($0)
sll $0, $1, 30
mtlo $0
mfhi $4
```



```
sw $4, 336($0)
mflo $5
sw $5, 340($0)
sll $0, $1, 8
nop
mtlo $0
mfhi $4
sw $4, 344($0)
mflo $5
sw $5, 348($0)
sll $0, $1, 9
nop
nop
mtlo $0
mfhi $4
sw $4, 352($0)
mflo $5
sw $5, 356($0)
srl $0, $1, 26
mtlo $0
mfhi $4
sw $4, 360($0)
mflo $5
sw $5, 364($0)
srl $0, $1, 21
nop
mtlo $0
mfhi $4
sw $4, 368($0)
mflo $5
sw $5, 372($0)
srl $0, $1, 14
nop
nop
mtlo $0
mfhi $4
sw $4, 376($0)
mflo $5
sw $5, 380($0)
sra $0, $1, 24
mtlo $0
mfhi $4
sw $4, 384($0)
mflo $5
```

```
sw $5, 388($0)
sra $0, $1, 3
nop
mtlo $0
mfhi $4
sw $4, 392($0)
mflo $5
sw $5, 396($0)
sra $0, $1, 24
nop
nop
mtlo $0
mfhi $4
sw $4, 400($0)
mflo $5
sw $5, 404($0)
sllv $0, $1, $2
mtlo $0
mfhi $4
sw $4, 408($0)
mflo $5
sw $5, 412($0)
sllv $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 416($0)
mflo $5
sw $5, 420($0)
sllv $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 424($0)
mflo $5
sw $5, 428($0)
srlv $0, $1, $2
mtlo $0
mfhi $4
sw $4, 432($0)
mflo $5
sw $5, 436($0)
srlv $0, $1, $2
```

```

nop
mtlo $0
mfhi $4
sw $4, 440($0)
mflo $5
sw $5, 444($0)
srlv $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 448($0)
mflo $5
sw $5, 452($0)
srav $0, $1, $2
mtlo $0
mfhi $4
sw $4, 456($0)
mflo $5
sw $5, 460($0)
srav $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 464($0)
mflo $5
sw $5, 468($0)
srav $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 472($0)
mflo $5
sw $5, 476($0)
and $0, $1, $2
mtlo $0
mfhi $4
sw $4, 480($0)
mflo $5
sw $5, 484($0)
and $0, $1, $2
nop
mtlo $0
```

```
mfhi $4
sw $4, 488($0)
mflo $5
sw $5, 492($0)
and $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 496($0)
mflo $5
sw $5, 500($0)
or $0, $1, $2
mtlo $0
mfhi $4
sw $4, 504($0)
mflo $5
sw $5, 508($0)
or $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 512($0)
mflo $5
sw $5, 516($0)
or $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 520($0)
mflo $5
sw $5, 524($0)
xor $0, $1, $2
mtlo $0
mfhi $4
sw $4, 528($0)
mflo $5
sw $5, 532($0)
xor $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 536($0)
```

```
mflo $5
sw $5, 540($0)
xor $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 544($0)
mflo $5
sw $5, 548($0)
nor $0, $1, $2
mtlo $0
mfhi $4
sw $4, 552($0)
mflo $5
sw $5, 556($0)
nor $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 560($0)
mflo $5
sw $5, 564($0)
nor $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 568($0)
mflo $5
sw $5, 572($0)
addi $0, $1, 12
mtlo $0
mfhi $4
sw $4, 576($0)
mflo $5
sw $5, 580($0)
addi $0, $1, 13
nop
mtlo $0
mfhi $4
sw $4, 584($0)
mflo $5
sw $5, 588($0)
```

```
addi $0, $1, 0
nop
nop
mtlo $0
mfhi $4
sw $4, 592($0)
mflo $5
sw $5, 596($0)
addiu $0, $1, 16
mtlo $0
mfhi $4
sw $4, 600($0)
mflo $5
sw $5, 604($0)
addiu $0, $1, 22
nop
mtlo $0
mfhi $4
sw $4, 608($0)
mflo $5
sw $5, 612($0)
addiu $0, $1, 20
nop
nop
mtlo $0
mfhi $4
sw $4, 616($0)
mflo $5
sw $5, 620($0)
andi $0, $1, 27
mtlo $0
mfhi $4
sw $4, 624($0)
mflo $5
sw $5, 628($0)
andi $0, $1, 16
nop
mtlo $0
mfhi $4
sw $4, 632($0)
mflo $5
sw $5, 636($0)
andi $0, $1, 7
nop
```

```

nop
mtlo $0
mfhi $4
sw $4, 640($0)
mflo $5
sw $5, 644($0)
ori $0, $1, 14
mtlo $0
mfhi $4
sw $4, 648($0)
mflo $5
sw $5, 652($0)
ori $0, $1, 4
nop
mtlo $0
mfhi $4
sw $4, 656($0)
mflo $5
sw $5, 660($0)
ori $0, $1, 22
nop
nop
mtlo $0
mfhi $4
sw $4, 664($0)
mflo $5
sw $5, 668($0)
xori $0, $1, 19
mtlo $0
mfhi $4
sw $4, 672($0)
mflo $5
sw $5, 676($0)
xori $0, $1, 16
nop
mtlo $0
mfhi $4
sw $4, 680($0)
mflo $5
sw $5, 684($0)
xori $0, $1, 6
nop
nop
mtlo $0
```

```
mfhi $4
sw $4, 688($0)
mflo $5
sw $5, 692($0)
lui $0, 18
mtlo $0
mfhi $4
sw $4, 696($0)
mflo $5
sw $5, 700($0)
lui $0, 25
nop
mtlo $0
mfhi $4
sw $4, 704($0)
mflo $5
sw $5, 708($0)
lui $0, 15
nop
nop
mtlo $0
mfhi $4
sw $4, 712($0)
mflo $5
sw $5, 716($0)
slt $0, $1, $2
mtlo $0
mfhi $4
sw $4, 720($0)
mflo $5
sw $5, 724($0)
slt $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 728($0)
mflo $5
sw $5, 732($0)
slt $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 736($0)
```



```
mflo $5
sw $5, 740($0)
slti $0, $1, 25
mtlo $0
mfhi $4
sw $4, 744($0)
mflo $5
sw $5, 748($0)
slti $0, $1, 10
nop
mtlo $0
mfhi $4
sw $4, 752($0)
mflo $5
sw $5, 756($0)
slti $0, $1, 25
nop
nop
mtlo $0
mfhi $4
sw $4, 760($0)
mflo $5
sw $5, 764($0)
sltiu $0, $1, 27
mtlo $0
mfhi $4
sw $4, 768($0)
mflo $5
sw $5, 772($0)
sltiu $0, $1, 26
nop
mtlo $0
mfhi $4
sw $4, 776($0)
mflo $5
sw $5, 780($0)
sltiu $0, $1, 29
nop
nop
mtlo $0
mfhi $4
sw $4, 784($0)
mflo $5
sw $5, 788($0)
```

```
sltu $0, $1, $2
mtlo $0
mfhi $4
sw $4, 792($0)
mflo $5
sw $5, 796($0)
sltu $0, $1, $2
nop
mtlo $0
mfhi $4
sw $4, 800($0)
mflo $5
sw $5, 804($0)
sltu $0, $1, $2
nop
nop
mtlo $0
mfhi $4
sw $4, 808($0)
mflo $5
sw $5, 812($0)
mfhi $0
mtlo $0
mfhi $4
sw $4, 816($0)
mflo $5
sw $5, 820($0)
mfhi $0
nop
mtlo $0
mfhi $4
sw $4, 824($0)
mflo $5
sw $5, 828($0)
mfhi $0
nop
nop
mtlo $0
mfhi $4
sw $4, 832($0)
mflo $5
sw $5, 836($0)
mflo $0
mtlo $0
```

```
mfhi $4
sw $4, 840($0)
mflo $5
sw $5, 844($0)
mflo $0
nop
mtlo $0
mfhi $4
sw $4, 848($0)
mflo $5
sw $5, 852($0)
mflo $0
nop
nop
mtlo $0
mfhi $4
sw $4, 856($0)
mflo $5
sw $5, 860($0)
lb $0, 341($0)
mtlo $0
mfhi $4
sw $4, 864($0)
mflo $5
sw $5, 868($0)
lb $0, 554($0)
mtlo $0
mfhi $4
sw $4, 872($0)
mflo $5
sw $5, 876($0)
lb $0, 342($0)
mtlo $0
mfhi $4
sw $4, 880($0)
mflo $5
sw $5, 884($0)
lbu $0, 200($0)
mtlo $0
mfhi $4
sw $4, 888($0)
mflo $5
sw $5, 892($0)
lbu $0, 60($0)
```

```
mtlo $0
mfhi $4
sw $4, 896($0)
mflo $5
sw $5, 900($0)
lbu $0, 464($0)
mtlo $0
mfhi $4
sw $4, 904($0)
mflo $5
sw $5, 908($0)
lh $0, 382($0)
mtlo $0
mfhi $4
sw $4, 912($0)
mflo $5
sw $5, 916($0)
lh $0, 524($0)
mtlo $0
mfhi $4
sw $4, 920($0)
mflo $5
sw $5, 924($0)
lh $0, 244($0)
mtlo $0
mfhi $4
sw $4, 928($0)
mflo $5
sw $5, 932($0)
lhu $0, 0($0)
mtlo $0
mfhi $4
sw $4, 936($0)
mflo $5
sw $5, 940($0)
lhu $0, 310($0)
mtlo $0
mfhi $4
sw $4, 944($0)
mflo $5
sw $5, 948($0)
lhu $0, 846($0)
mtlo $0
mfhi $4
```

```
sw $4, 952($0)
mflo $5
sw $5, 956($0)
lw $0, 396($0)
mtlo $0
mfhi $4
sw $4, 960($0)
mflo $5
sw $5, 964($0)
lw $0, 216($0)
mtlo $0
mfhi $4
sw $4, 968($0)
mflo $5
sw $5, 972($0)
lw $0, 928($0)
mtlo $0
mfhi $4
sw $4, 976($0)
mflo $5
sw $5, 980($0)
```

```
2.
ori $1, $1, 5066
ori $2, $2, 599
mthi $1
mtlo $2
ori $0, $1, 8
divu $0, $2
mfhi $4
sw $4, 0($0)
mflo $5
sw $5, 4($0)
ori $0, $1, 26
nop
divu $0, $2
mfhi $4
sw $4, 8($0)
mflo $5
sw $5, 12($0)
ori $0, $1, 7
nop
nop
divu $0, $2
```

```
mfhi $4
sw $4, 16($0)
mflo $5
sw $5, 20($0)
ori $0, $1, 8
divu $1, $0
mfhi $4
sw $4, 24($0)
mflo $5
sw $5, 28($0)
ori $0, $1, 28
nop
divu $1, $0
mfhi $4
sw $4, 32($0)
mflo $5
sw $5, 36($0)
ori $0, $1, 9
nop
nop
divu $1, $0
mfhi $4
sw $4, 40($0)
mflo $5
sw $5, 44($0)
xori $0, $1, 17
divu $0, $2
mfhi $4
sw $4, 48($0)
mflo $5
sw $5, 52($0)
xori $0, $1, 0
nop
divu $0, $2
mfhi $4
sw $4, 56($0)
mflo $5
sw $5, 60($0)
xori $0, $1, 20
nop
nop
divu $0, $2
mfhi $4
sw $4, 64($0)
```

```
mflo $5
sw $5, 68($0)
xori $0, $1, 6
divu $1, $0
mfhi $4
sw $4, 72($0)
mflo $5
sw $5, 76($0)
xori $0, $1, 21
nop
divu $1, $0
mfhi $4
sw $4, 80($0)
mflo $5
sw $5, 84($0)
xori $0, $1, 4
nop
nop
divu $1, $0
mfhi $4
sw $4, 88($0)
mflo $5
sw $5, 92($0)
lui $0, 14
divu $0, $2
mfhi $4
sw $4, 96($0)
mflo $5
sw $5, 100($0)
lui $0, 30
nop
divu $0, $2
mfhi $4
sw $4, 104($0)
mflo $5
sw $5, 108($0)
lui $0, 24
nop
nop
divu $0, $2
mfhi $4
sw $4, 112($0)
mflo $5
sw $5, 116($0)
```

```
lui $0, 27
divu $1, $0
mfhi $4
sw $4, 120($0)
mflo $5
sw $5, 124($0)
lui $0, 11
nop
divu $1, $0
mfhi $4
sw $4, 128($0)
mflo $5
sw $5, 132($0)
lui $0, 2
nop
nop
divu $1, $0
mfhi $4
sw $4, 136($0)
mflo $5
sw $5, 140($0)
slt $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 144($0)
mflo $5
sw $5, 148($0)
slt $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 152($0)
mflo $5
sw $5, 156($0)
slt $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 160($0)
mflo $5
sw $5, 164($0)
slt $0, $1, $2
divu $1, $0
```



```
mfhi $4
sw $4, 168($0)
mflo $5
sw $5, 172($0)
slt $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 176($0)
mflo $5
sw $5, 180($0)
slt $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 184($0)
mflo $5
sw $5, 188($0)
slti $0, $1, 22
divu $0, $2
mfhi $4
sw $4, 192($0)
mflo $5
sw $5, 196($0)
slti $0, $1, 29
nop
divu $0, $2
mfhi $4
sw $4, 200($0)
mflo $5
sw $5, 204($0)
slti $0, $1, 14
nop
nop
divu $0, $2
mfhi $4
sw $4, 208($0)
mflo $5
sw $5, 212($0)
slti $0, $1, 27
divu $1, $0
mfhi $4
sw $4, 216($0)
```

```
mflo $5
sw $5, 220($0)
slti $0, $1, 9
nop
divu $1, $0
mfhi $4
sw $4, 224($0)
mflo $5
sw $5, 228($0)
slti $0, $1, 14
nop
nop
divu $1, $0
mfhi $4
sw $4, 232($0)
mflo $5
sw $5, 236($0)
sltiu $0, $1, 1
divu $0, $2
mfhi $4
sw $4, 240($0)
mflo $5
sw $5, 244($0)
sltiu $0, $1, 25
nop
divu $0, $2
mfhi $4
sw $4, 248($0)
mflo $5
sw $5, 252($0)
sltiu $0, $1, 13
nop
nop
divu $0, $2
mfhi $4
sw $4, 256($0)
mflo $5
sw $5, 260($0)
sltiu $0, $1, 10
divu $1, $0
mfhi $4
sw $4, 264($0)
mflo $5
sw $5, 268($0)
```

```
sltiu $0, $1, 24
nop
divu $1, $0
mfhi $4
sw $4, 272($0)
mflo $5
sw $5, 276($0)
sltiu $0, $1, 12
nop
nop
divu $1, $0
mfhi $4
sw $4, 280($0)
mflo $5
sw $5, 284($0)
sltu $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 288($0)
mflo $5
sw $5, 292($0)
sltu $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 296($0)
mflo $5
sw $5, 300($0)
sltu $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 304($0)
mflo $5
sw $5, 308($0)
sltu $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 312($0)
mflo $5
sw $5, 316($0)
sltu $0, $1, $2
nop
```

```
divu $1, $0
mfhi $4
sw $4, 320($0)
mflo $5
sw $5, 324($0)
sltu $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 328($0)
mflo $5
sw $5, 332($0)
mfhi $0
divu $0, $2
mfhi $4
sw $4, 336($0)
mflo $5
sw $5, 340($0)
mfhi $0
nop
divu $0, $2
mfhi $4
sw $4, 344($0)
mflo $5
sw $5, 348($0)
mfhi $0
nop
nop
divu $0, $2
mfhi $4
sw $4, 352($0)
mflo $5
sw $5, 356($0)
mfhi $0
divu $1, $0
mfhi $4
sw $4, 360($0)
mflo $5
sw $5, 364($0)
mfhi $0
nop
divu $1, $0
mfhi $4
```

```
sw $4, 368($0)
mflo $5
sw $5, 372($0)
mfhi $0
nop
nop
divu $1, $0
mfhi $4
sw $4, 376($0)
mflo $5
sw $5, 380($0)
mflo $0
divu $0, $2
mfhi $4
sw $4, 384($0)
mflo $5
sw $5, 388($0)
mflo $0
nop
divu $0, $2
mfhi $4
sw $4, 392($0)
mflo $5
sw $5, 396($0)
mflo $0
nop
nop
divu $0, $2
mfhi $4
sw $4, 400($0)
mflo $5
sw $5, 404($0)
mflo $0
divu $1, $0
mfhi $4
sw $4, 408($0)
mflo $5
sw $5, 412($0)
mflo $0
nop
divu $1, $0
mfhi $4
sw $4, 416($0)
mflo $5
```

```
sw $5, 420($0)
mflo $0
nop
nop
divu $1, $0
mfhi $4
sw $4, 424($0)
mflo $5
sw $5, 428($0)
lb $0, 84($0)
divu $0, $2
mfhi $4
sw $4, 432($0)
mflo $5
sw $5, 436($0)
lb $0, 339($0)
divu $0, $2
mfhi $4
sw $4, 440($0)
mflo $5
sw $5, 444($0)
lb $0, 0($0)
divu $0, $2
mfhi $4
sw $4, 448($0)
mflo $5
sw $5, 452($0)
lb $0, 450($0)
divu $1, $0
mfhi $4
sw $4, 456($0)
mflo $5
sw $5, 460($0)
lb $0, 164($0)
divu $1, $0
mfhi $4
sw $4, 464($0)
mflo $5
sw $5, 468($0)
lb $0, 331($0)
divu $1, $0
mfhi $4
sw $4, 472($0)
mflo $5
```

```
sw $5, 476($0)
lbu $0, 175($0)
divu $0, $2
mfhi $4
sw $4, 480($0)
mflo $5
sw $5, 484($0)
lbu $0, 247($0)
divu $0, $2
mfhi $4
sw $4, 488($0)
mflo $5
sw $5, 492($0)
lbu $0, 372($0)
divu $0, $2
mfhi $4
sw $4, 496($0)
mflo $5
sw $5, 500($0)
lbu $0, 370($0)
divu $1, $0
mfhi $4
sw $4, 504($0)
mflo $5
sw $5, 508($0)
lbu $0, 504($0)
divu $1, $0
mfhi $4
sw $4, 512($0)
mflo $5
sw $5, 516($0)
lbu $0, 288($0)
divu $1, $0
mfhi $4
sw $4, 520($0)
mflo $5
sw $5, 524($0)
lh $0, 2($0)
divu $0, $2
mfhi $4
sw $4, 528($0)
mflo $5
sw $5, 532($0)
lh $0, 494($0)
```

```
divu $0, $2
mfhi $4
sw $4, 536($0)
mflo $5
sw $5, 540($0)
lh $0, 234($0)
divu $0, $2
mfhi $4
sw $4, 544($0)
mflo $5
sw $5, 548($0)
lh $0, 528($0)
divu $1, $0
mfhi $4
sw $4, 552($0)
mflo $5
sw $5, 556($0)
lh $0, 426($0)
divu $1, $0
mfhi $4
sw $4, 560($0)
mflo $5
sw $5, 564($0)
lh $0, 362($0)
divu $1, $0
mfhi $4
sw $4, 568($0)
mflo $5
sw $5, 572($0)
lhu $0, 158($0)
divu $0, $2
mfhi $4
sw $4, 576($0)
mflo $5
sw $5, 580($0)
lhu $0, 236($0)
divu $0, $2
mfhi $4
sw $4, 584($0)
mflo $5
sw $5, 588($0)
lhu $0, 2($0)
divu $0, $2
mfhi $4
```



```
sw $4, 592($0)
mflo $5
sw $5, 596($0)
lhu $0, 2($0)
divu $1, $0
mfhi $4
sw $4, 600($0)
mflo $5
sw $5, 604($0)
lhu $0, 326($0)
divu $1, $0
mfhi $4
sw $4, 608($0)
mflo $5
sw $5, 612($0)
lhu $0, 516($0)
divu $1, $0
mfhi $4
sw $4, 616($0)
mflo $5
sw $5, 620($0)
lw $0, 172($0)
divu $0, $2
mfhi $4
sw $4, 624($0)
mflo $5
sw $5, 628($0)
lw $0, 516($0)
divu $0, $2
mfhi $4
sw $4, 632($0)
mflo $5
sw $5, 636($0)
lw $0, 96($0)
divu $0, $2
mfhi $4
sw $4, 640($0)
mflo $5
sw $5, 644($0)
lw $0, 568($0)
divu $1, $0
mfhi $4
sw $4, 648($0)
mflo $5
```

```
sw $5, 652($0)
lw $0, 604($0)
divu $1, $0
mfhi $4
sw $4, 656($0)
mflo $5
sw $5, 660($0)
lw $0, 188($0)
divu $1, $0
mfhi $4
sw $4, 664($0)
mflo $5
sw $5, 668($0)
add $0, $1, $2
mthi $0
mfhi $4
sw $4, 672($0)
mflo $5
sw $5, 676($0)
add $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 680($0)
mflo $5
sw $5, 684($0)
add $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 688($0)
mflo $5
sw $5, 692($0)
addu $0, $1, $2
mthi $0
mfhi $4
sw $4, 696($0)
mflo $5
sw $5, 700($0)
addu $0, $1, $2
nop
mthi $0
mfhi $4
```

```
sw $4, 704($0)
mflo $5
sw $5, 708($0)
addu $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 712($0)
mflo $5
sw $5, 716($0)
sub $0, $1, $2
mthi $0
mfhi $4
sw $4, 720($0)
mflo $5
sw $5, 724($0)
sub $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 728($0)
mflo $5
sw $5, 732($0)
sub $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 736($0)
mflo $5
sw $5, 740($0)
subu $0, $1, $2
mthi $0
mfhi $4
sw $4, 744($0)
mflo $5
sw $5, 748($0)
subu $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 752($0)
mflo $5
```

```
sw $5, 756($0)
subu $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 760($0)
mflo $5
sw $5, 764($0)
sll $0, $1, 11
mthi $0
mfhi $4
sw $4, 768($0)
mflo $5
sw $5, 772($0)
sll $0, $1, 28
nop
mthi $0
mfhi $4
sw $4, 776($0)
mflo $5
sw $5, 780($0)
sll $0, $1, 25
nop
nop
mthi $0
mfhi $4
sw $4, 784($0)
mflo $5
sw $5, 788($0)
srl $0, $1, 31
mthi $0
mfhi $4
sw $4, 792($0)
mflo $5
sw $5, 796($0)
srl $0, $1, 10
nop
mthi $0
mfhi $4
sw $4, 800($0)
mflo $5
sw $5, 804($0)
srl $0, $1, 6
```

```

nop
nop
mthi $0
mfhi $4
sw $4, 808($0)
mflo $5
sw $5, 812($0)
sra $0, $1, 11
mthi $0
mfhi $4
sw $4, 816($0)
mflo $5
sw $5, 820($0)
sra $0, $1, 2
nop
mthi $0
mfhi $4
sw $4, 824($0)
mflo $5
sw $5, 828($0)
sra $0, $1, 30
nop
nop
mthi $0
mfhi $4
sw $4, 832($0)
mflo $5
sw $5, 836($0)
sllv $0, $1, $2
mthi $0
mfhi $4
sw $4, 840($0)
mflo $5
sw $5, 844($0)
sllv $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 848($0)
mflo $5
sw $5, 852($0)
sllv $0, $1, $2
nop
nop
```

```
mthi $0
mfhi $4
sw $4, 856($0)
mflo $5
sw $5, 860($0)
srlv $0, $1, $2
mthi $0
mfhi $4
sw $4, 864($0)
mflo $5
sw $5, 868($0)
srlv $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 872($0)
mflo $5
sw $5, 876($0)
srlv $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 880($0)
mflo $5
sw $5, 884($0)
srav $0, $1, $2
mthi $0
mfhi $4
sw $4, 888($0)
mflo $5
sw $5, 892($0)
srav $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 896($0)
mflo $5
sw $5, 900($0)
srav $0, $1, $2
nop
nop
mthi $0
mfhi $4
```

```
sw $4, 904($0)
mflo $5
sw $5, 908($0)
and $0, $1, $2
mthi $0
mfhi $4
sw $4, 912($0)
mflo $5
sw $5, 916($0)
and $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 920($0)
mflo $5
sw $5, 924($0)
and $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 928($0)
mflo $5
sw $5, 932($0)
or $0, $1, $2
mthi $0
mfhi $4
sw $4, 936($0)
mflo $5
sw $5, 940($0)
or $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 944($0)
mflo $5
sw $5, 948($0)
or $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 952($0)
mflo $5
```

```
sw $5, 956($0)
xor $0, $1, $2
mthi $0
mfhi $4
sw $4, 960($0)
mflo $5
sw $5, 964($0)
xor $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 968($0)
mflo $5
sw $5, 972($0)
xor $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 976($0)
mflo $5
sw $5, 980($0)
nor $0, $1, $2
mthi $0
mfhi $4
sw $4, 984($0)
mflo $5
sw $5, 988($0)
nor $0, $1, $2
nop
mthi $0
mfhi $4
sw $4, 992($0)
mflo $5
sw $5, 996($0)
nor $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 1000($0)
mflo $5
sw $5, 1004($0)
addi $0, $1, 20
```



```
mthi $0
mfhi $4
sw $4, 1008($0)
mflo $5
sw $5, 1012($0)
addi $0, $1, 31
nop
mthi $0
mfhi $4
sw $4, 1016($0)
mflo $5
sw $5, 1020($0)
addi $0, $1, 8
nop
nop
mthi $0
mfhi $4
sw $4, 1024($0)
mflo $5
sw $5, 1028($0)
addiu $0, $1, 1
mthi $0
mfhi $4
sw $4, 1032($0)
mflo $5
sw $5, 1036($0)
addiu $0, $1, 13
nop
mthi $0
mfhi $4
sw $4, 1040($0)
mflo $5
sw $5, 1044($0)
addiu $0, $1, 20
nop
nop
mthi $0
mfhi $4
sw $4, 1048($0)
mflo $5
sw $5, 1052($0)
andi $0, $1, 9
mthi $0
mfhi $4
```

```
sw $4, 1056($0)
mflo $5
sw $5, 1060($0)
andi $0, $1, 29
nop
mthi $0
mfhi $4
sw $4, 1064($0)
mflo $5
sw $5, 1068($0)
andi $0, $1, 29
nop
nop
mthi $0
mfhi $4
sw $4, 1072($0)
mflo $5
sw $5, 1076($0)
ori $0, $1, 22
mthi $0
mfhi $4
sw $4, 1080($0)
mflo $5
sw $5, 1084($0)
ori $0, $1, 18
nop
mthi $0
mfhi $4
sw $4, 1088($0)
mflo $5
sw $5, 1092($0)
ori $0, $1, 23
nop
nop
mthi $0
mfhi $4
sw $4, 1096($0)
mflo $5
sw $5, 1100($0)
xori $0, $1, 10
mthi $0
mfhi $4
sw $4, 1104($0)
mflo $5
```

```
sw $5, 1108($0)
xori $0, $1, 31
nop
mthi $0
mfhi $4
sw $4, 1112($0)
mflo $5
sw $5, 1116($0)
xori $0, $1, 1
nop
nop
mthi $0
mfhi $4
sw $4, 1120($0)
mflo $5
sw $5, 1124($0)
lui $0, 12
mthi $0
mfhi $4
sw $4, 1128($0)
mflo $5
sw $5, 1132($0)
lui $0, 10
nop
mthi $0
mfhi $4
sw $4, 1136($0)
mflo $5
sw $5, 1140($0)
lui $0, 2
nop
nop
mthi $0
mfhi $4
sw $4, 1144($0)
mflo $5
sw $5, 1148($0)
slt $0, $1, $2
mthi $0
mfhi $4
sw $4, 1152($0)
mflo $5
sw $5, 1156($0)
slt $0, $1, $2
```

```
nop
mthi $0
mfhi $4
sw $4, 1160($0)
mflo $5
sw $5, 1164($0)
slt $0, $1, $2
nop
nop
mthi $0
mfhi $4
sw $4, 1168($0)
mflo $5
sw $5, 1172($0)
```

```
3.
ori $1, $1, 6670
ori $2, $2, 23722
mthi $1
mtlo $2
sltu $0, $1, $2
div $1, $0
mfhi $4
sw $4, 0($0)
mflo $5
sw $5, 4($0)
sltu $0, $1, $2
nop
div $1, $0
mfhi $4
sw $4, 8($0)
mflo $5
sw $5, 12($0)
sltu $0, $1, $2
nop
nop
div $1, $0
mfhi $4
sw $4, 16($0)
mflo $5
sw $5, 20($0)
mfhi $0
div $0, $2
mfhi $4
```

```
sw $4, 24($0)
mflo $5
sw $5, 28($0)
mfhi $0
nop
div $0, $2
mfhi $4
sw $4, 32($0)
mflo $5
sw $5, 36($0)
mfhi $0
nop
nop
div $0, $2
mfhi $4
sw $4, 40($0)
mflo $5
sw $5, 44($0)
mfhi $0
div $1, $0
mfhi $4
sw $4, 48($0)
mflo $5
sw $5, 52($0)
mfhi $0
nop
div $1, $0
mfhi $4
sw $4, 56($0)
mflo $5
sw $5, 60($0)
mfhi $0
nop
nop
div $1, $0
mfhi $4
sw $4, 64($0)
mflo $5
sw $5, 68($0)
mflo $0
div $0, $2
mfhi $4
sw $4, 72($0)
mflo $5
```

```
sw $5, 76($0)
mflo $0
nop
div $0, $2
mfhi $4
sw $4, 80($0)
mflo $5
sw $5, 84($0)
mflo $0
nop
nop
div $0, $2
mfhi $4
sw $4, 88($0)
mflo $5
sw $5, 92($0)
mflo $0
div $1, $0
mfhi $4
sw $4, 96($0)
mflo $5
sw $5, 100($0)
mflo $0
nop
div $1, $0
mfhi $4
sw $4, 104($0)
mflo $5
sw $5, 108($0)
mflo $0
nop
nop
div $1, $0
mfhi $4
sw $4, 112($0)
mflo $5
sw $5, 116($0)
lb $0, 9($0)
div $0, $2
mfhi $4
sw $4, 120($0)
mflo $5
sw $5, 124($0)
lb $0, 101($0)
```

```
div $0, $2
mfhi $4
sw $4, 128($0)
mflo $5
sw $5, 132($0)
lb $0, 18($0)
div $0, $2
mfhi $4
sw $4, 136($0)
mflo $5
sw $5, 140($0)
lb $0, 57($0)
div $1, $0
mfhi $4
sw $4, 144($0)
mflo $5
sw $5, 148($0)
lb $0, 119($0)
div $1, $0
mfhi $4
sw $4, 152($0)
mflo $5
sw $5, 156($0)
lb $0, 121($0)
div $1, $0
mfhi $4
sw $4, 160($0)
mflo $5
sw $5, 164($0)
lbu $0, 163($0)
div $0, $2
mfhi $4
sw $4, 168($0)
mflo $5
sw $5, 172($0)
lbu $0, 61($0)
div $0, $2
mfhi $4
sw $4, 176($0)
mflo $5
sw $5, 180($0)
lbu $0, 93($0)
div $0, $2
mfhi $4
```

```
sw $4, 184($0)
mflo $5
sw $5, 188($0)
lbu $0, 157($0)
div $1, $0
mfhi $4
sw $4, 192($0)
mflo $5
sw $5, 196($0)
lbu $0, 40($0)
div $1, $0
mfhi $4
sw $4, 200($0)
mflo $5
sw $5, 204($0)
lbu $0, 68($0)
div $1, $0
mfhi $4
sw $4, 208($0)
mflo $5
sw $5, 212($0)
lh $0, 190($0)
div $0, $2
mfhi $4
sw $4, 216($0)
mflo $5
sw $5, 220($0)
lh $0, 38($0)
div $0, $2
mfhi $4
sw $4, 224($0)
mflo $5
sw $5, 228($0)
lh $0, 132($0)
div $0, $2
mfhi $4
sw $4, 232($0)
mflo $5
sw $5, 236($0)
lh $0, 40($0)
div $1, $0
mfhi $4
sw $4, 240($0)
mflo $5
```



```
sw $5, 244($0)
lh $0, 134($0)
div $1, $0
mfhi $4
sw $4, 248($0)
mflo $5
sw $5, 252($0)
lh $0, 52($0)
div $1, $0
mfhi $4
sw $4, 256($0)
mflo $5
sw $5, 260($0)
lhu $0, 206($0)
div $0, $2
mfhi $4
sw $4, 264($0)
mflo $5
sw $5, 268($0)
lhu $0, 70($0)
div $0, $2
mfhi $4
sw $4, 272($0)
mflo $5
sw $5, 276($0)
lhu $0, 218($0)
div $0, $2
mfhi $4
sw $4, 280($0)
mflo $5
sw $5, 284($0)
lhu $0, 134($0)
div $1, $0
mfhi $4
sw $4, 288($0)
mflo $5
sw $5, 292($0)
lhu $0, 54($0)
div $1, $0
mfhi $4
sw $4, 296($0)
mflo $5
sw $5, 300($0)
lhu $0, 4($0)
```

```
div $1, $0
mfhi $4
sw $4, 304($0)
mflo $5
sw $5, 308($0)
lw $0, 128($0)
div $0, $2
mfhi $4
sw $4, 312($0)
mflo $5
sw $5, 316($0)
lw $0, 148($0)
div $0, $2
mfhi $4
sw $4, 320($0)
mflo $5
sw $5, 324($0)
lw $0, 204($0)
div $0, $2
mfhi $4
sw $4, 328($0)
mflo $5
sw $5, 332($0)
lw $0, 332($0)
div $1, $0
mfhi $4
sw $4, 336($0)
mflo $5
sw $5, 340($0)
lw $0, 80($0)
div $1, $0
mfhi $4
sw $4, 344($0)
mflo $5
sw $5, 348($0)
lw $0, 176($0)
div $1, $0
mfhi $4
sw $4, 352($0)
mflo $5
sw $5, 356($0)
add $0, $1, $2
divu $0, $2
mfhi $4
```

```
sw $4, 360($0)
mflo $5
sw $5, 364($0)
add $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 368($0)
mflo $5
sw $5, 372($0)
add $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 376($0)
mflo $5
sw $5, 380($0)
add $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 384($0)
mflo $5
sw $5, 388($0)
add $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 392($0)
mflo $5
sw $5, 396($0)
add $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 400($0)
mflo $5
sw $5, 404($0)
addu $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 408($0)
mflo $5
```

```
sw $5, 412($0)
addu $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 416($0)
mflo $5
sw $5, 420($0)
addu $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 424($0)
mflo $5
sw $5, 428($0)
addu $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 432($0)
mflo $5
sw $5, 436($0)
addu $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 440($0)
mflo $5
sw $5, 444($0)
addu $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 448($0)
mflo $5
sw $5, 452($0)
sub $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 456($0)
mflo $5
sw $5, 460($0)
sub $0, $1, $2
```

```

nop
divu $0, $2
mfhi $4
sw $4, 464($0)
mflo $5
sw $5, 468($0)
sub $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 472($0)
mflo $5
sw $5, 476($0)
sub $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 480($0)
mflo $5
sw $5, 484($0)
sub $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 488($0)
mflo $5
sw $5, 492($0)
sub $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 496($0)
mflo $5
sw $5, 500($0)
subu $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 504($0)
mflo $5
sw $5, 508($0)
subu $0, $1, $2
nop
divu $0, $2
```

```
mfhi $4
sw $4, 512($0)
mflo $5
sw $5, 516($0)
subu $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 520($0)
mflo $5
sw $5, 524($0)
subu $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 528($0)
mflo $5
sw $5, 532($0)
subu $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 536($0)
mflo $5
sw $5, 540($0)
subu $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 544($0)
mflo $5
sw $5, 548($0)
sll $0, $1, 30
divu $0, $2
mfhi $4
sw $4, 552($0)
mflo $5
sw $5, 556($0)
sll $0, $1, 4
nop
divu $0, $2
mfhi $4
sw $4, 560($0)
```

```
mflo $5
sw $5, 564($0)
sll $0, $1, 28
nop
nop
divu $0, $2
mfhi $4
sw $4, 568($0)
mflo $5
sw $5, 572($0)
sll $0, $1, 9
divu $1, $0
mfhi $4
sw $4, 576($0)
mflo $5
sw $5, 580($0)
sll $0, $1, 23
nop
divu $1, $0
mfhi $4
sw $4, 584($0)
mflo $5
sw $5, 588($0)
sll $0, $1, 31
nop
nop
divu $1, $0
mfhi $4
sw $4, 592($0)
mflo $5
sw $5, 596($0)
srl $0, $1, 1
divu $0, $2
mfhi $4
sw $4, 600($0)
mflo $5
sw $5, 604($0)
srl $0, $1, 26
nop
divu $0, $2
mfhi $4
sw $4, 608($0)
mflo $5
sw $5, 612($0)
```

```
srl $0, $1, 3
nop
nop
divu $0, $2
mfhi $4
sw $4, 616($0)
mflo $5
sw $5, 620($0)
srl $0, $1, 26
divu $1, $0
mfhi $4
sw $4, 624($0)
mflo $5
sw $5, 628($0)
srl $0, $1, 15
nop
divu $1, $0
mfhi $4
sw $4, 632($0)
mflo $5
sw $5, 636($0)
srl $0, $1, 20
nop
nop
divu $1, $0
mfhi $4
sw $4, 640($0)
mflo $5
sw $5, 644($0)
sra $0, $1, 7
divu $0, $2
mfhi $4
sw $4, 648($0)
mflo $5
sw $5, 652($0)
sra $0, $1, 27
nop
divu $0, $2
mfhi $4
sw $4, 656($0)
mflo $5
sw $5, 660($0)
sra $0, $1, 3
nop
```



```
nop
divu $0, $2
mfhi $4
sw $4, 664($0)
mflo $5
sw $5, 668($0)
sra $0, $1, 20
divu $1, $0
mfhi $4
sw $4, 672($0)
mflo $5
sw $5, 676($0)
sra $0, $1, 23
nop
divu $1, $0
mfhi $4
sw $4, 680($0)
mflo $5
sw $5, 684($0)
sra $0, $1, 22
nop
nop
divu $1, $0
mfhi $4
sw $4, 688($0)
mflo $5
sw $5, 692($0)
sllv $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 696($0)
mflo $5
sw $5, 700($0)
sllv $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 704($0)
mflo $5
sw $5, 708($0)
sllv $0, $1, $2
nop
nop
divu $0, $2
```

```
mfhi $4
sw $4, 712($0)
mflo $5
sw $5, 716($0)
sllv $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 720($0)
mflo $5
sw $5, 724($0)
sllv $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 728($0)
mflo $5
sw $5, 732($0)
sllv $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 736($0)
mflo $5
sw $5, 740($0)
srlv $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 744($0)
mflo $5
sw $5, 748($0)
srlv $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 752($0)
mflo $5
sw $5, 756($0)
srlv $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 760($0)
```

```
mflo $5
sw $5, 764($0)
srlv $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 768($0)
mflo $5
sw $5, 772($0)
srlv $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 776($0)
mflo $5
sw $5, 780($0)
srlv $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 784($0)
mflo $5
sw $5, 788($0)
srav $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 792($0)
mflo $5
sw $5, 796($0)
srav $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 800($0)
mflo $5
sw $5, 804($0)
srav $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 808($0)
mflo $5
sw $5, 812($0)
```

```
srav $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 816($0)
mflo $5
sw $5, 820($0)
srav $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 824($0)
mflo $5
sw $5, 828($0)
srav $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 832($0)
mflo $5
sw $5, 836($0)
and $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 840($0)
mflo $5
sw $5, 844($0)
and $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 848($0)
mflo $5
sw $5, 852($0)
and $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 856($0)
mflo $5
sw $5, 860($0)
and $0, $1, $2
divu $1, $0
```

```
mfhi $4
sw $4, 864($0)
mflo $5
sw $5, 868($0)
and $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 872($0)
mflo $5
sw $5, 876($0)
and $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 880($0)
mflo $5
sw $5, 884($0)
or $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 888($0)
mflo $5
sw $5, 892($0)
or $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 896($0)
mflo $5
sw $5, 900($0)
or $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 904($0)
mflo $5
sw $5, 908($0)
or $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 912($0)
```

```
mflo $5
sw $5, 916($0)
or $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 920($0)
mflo $5
sw $5, 924($0)
or $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 928($0)
mflo $5
sw $5, 932($0)
xor $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 936($0)
mflo $5
sw $5, 940($0)
xor $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 944($0)
mflo $5
sw $5, 948($0)
xor $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 952($0)
mflo $5
sw $5, 956($0)
xor $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 960($0)
mflo $5
sw $5, 964($0)
```

```
xor $0, $1, $2
nop
divu $1, $0
mfhi $4
sw $4, 968($0)
mflo $5
sw $5, 972($0)
xor $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 976($0)
mflo $5
sw $5, 980($0)
nor $0, $1, $2
divu $0, $2
mfhi $4
sw $4, 984($0)
mflo $5
sw $5, 988($0)
nor $0, $1, $2
nop
divu $0, $2
mfhi $4
sw $4, 992($0)
mflo $5
sw $5, 996($0)
nor $0, $1, $2
nop
nop
divu $0, $2
mfhi $4
sw $4, 1000($0)
mflo $5
sw $5, 1004($0)
nor $0, $1, $2
divu $1, $0
mfhi $4
sw $4, 1008($0)
mflo $5
sw $5, 1012($0)
nor $0, $1, $2
nop
```

```
divu $1, $0
mfhi $4
sw $4, 1016($0)
mflo $5
sw $5, 1020($0)
nor $0, $1, $2
nop
nop
divu $1, $0
mfhi $4
sw $4, 1024($0)
mflo $5
sw $5, 1028($0)
addi $0, $1, 17
divu $0, $2
mfhi $4
sw $4, 1032($0)
mflo $5
sw $5, 1036($0)
addi $0, $1, 9
nop
divu $0, $2
mfhi $4
sw $4, 1040($0)
mflo $5
sw $5, 1044($0)
addi $0, $1, 28
nop
nop
divu $0, $2
mfhi $4
sw $4, 1048($0)
mflo $5
sw $5, 1052($0)
addi $0, $1, 31
divu $1, $0
mfhi $4
sw $4, 1056($0)
mflo $5
sw $5, 1060($0)
addi $0, $1, 15
nop
divu $1, $0
mfhi $4
```



```
sw $4, 1064($0)
mflo $5
sw $5, 1068($0)
addi $0, $1, 1
nop
nop
divu $1, $0
mfhi $4
sw $4, 1072($0)
mflo $5
sw $5, 1076($0)
addiu $0, $1, 25
divu $0, $2
mfhi $4
sw $4, 1080($0)
mflo $5
sw $5, 1084($0)
addiu $0, $1, 29
nop
divu $0, $2
mfhi $4
sw $4, 1088($0)
mflo $5
sw $5, 1092($0)
addiu $0, $1, 24
nop
nop
divu $0, $2
mfhi $4
sw $4, 1096($0)
mflo $5
sw $5, 1100($0)
addiu $0, $1, 1
divu $1, $0
mfhi $4
sw $4, 1104($0)
mflo $5
sw $5, 1108($0)
addiu $0, $1, 14
nop
divu $1, $0
mfhi $4
sw $4, 1112($0)
mflo $5
```

```
sw $5, 1116($0)
addiu $0, $1, 0
nop
nop
divu $1, $0
mfhi $4
sw $4, 1120($0)
mflo $5
sw $5, 1124($0)
andi $0, $1, 10
divu $0, $2
mfhi $4
sw $4, 1128($0)
mflo $5
sw $5, 1132($0)
andi $0, $1, 24
nop
divu $0, $2
mfhi $4
sw $4, 1136($0)
mflo $5
sw $5, 1140($0)
andi $0, $1, 28
nop
nop
divu $0, $2
mfhi $4
sw $4, 1144($0)
mflo $5
sw $5, 1148($0)
andi $0, $1, 21
divu $1, $0
mfhi $4
sw $4, 1152($0)
mflo $5
sw $5, 1156($0)
andi $0, $1, 17
nop
divu $1, $0
mfhi $4
sw $4, 1160($0)
mflo $5
sw $5, 1164($0)
andi $0, $1, 22
```

```
nop
nop
divu $1, $0
mfhi $4
sw $4, 1168($0)
mflo $5
sw $5, 1172($0)
```