

31	27	26	25	24	20	range1915	range1412	range117	range60	
funct7				rs2		rs1	funct3	rd	opcode	R-type
imm[11:0]						rs1	funct3	rd	opcode	I-type
imm[11:5]				rs2		rs1	funct3	imm[4:0]	opcode	S-type
imm[12 10:5]				rs2		rs1	funct3	imm[4:1 11]	opcode	SB-type
imm[31:12]								rd	opcode	U-type
imm[20 10:1 11 19:12]								rd	opcode	UJ-type

RV32I Base Instruction Set

imm[31:12]					rd	0110111	LUI rd,imm
imm[31:12]					rd	0010111	AUIPC rd,imm
imm[20 10:1 11 19:12]					rd	1101111	JAL rd,imm
imm[11:0]			rs1	000	rd	1100111	JALR rd,rs1,imm
imm[12 10:5]		rs2	rs1	000	imm[4:1 11]	1100011	BEQ rs1,rs2,imm
imm[12 10:5]		rs2	rs1	001	imm[4:1 11]	1100011	BNE rs1,rs2,imm
imm[12 10:5]		rs2	rs1	100	imm[4:1 11]	1100011	BLT rs1,rs2,imm
imm[12 10:5]		rs2	rs1	101	imm[4:1 11]	1100011	BGE rs1,rs2,imm
imm[12 10:5]		rs2	rs1	110	imm[4:1 11]	1100011	BLTU rs1,rs2,imm
imm[12 10:5]		rs2	rs1	111	imm[4:1 11]	1100011	BGEU rs1,rs2,imm
imm[11:0]			rs1	000	rd	0000011	LB rd,rs1,imm
imm[11:0]			rs1	001	rd	0000011	LH rd,rs1,imm
imm[11:0]			rs1	010	rd	0000011	LW rd,rs1,imm
imm[11:0]			rs1	100	rd	0000011	LBU rd,rs1,imm
imm[11:0]			rs1	101	rd	0000011	LHU rd,rs1,imm
imm[11:5]		rs2	rs1	000	imm[4:0]	0100011	SB rs1,rs2,imm
imm[11:5]		rs2	rs1	001	imm[4:0]	0100011	SH rs1,rs2,imm
imm[11:5]		rs2	rs1	010	imm[4:0]	0100011	SW rs1,rs2,imm
imm[11:0]			rs1	000	rd	0010011	ADDI rd,rs1,imm
imm[11:0]			rs1	010	rd	0010011	SLTI rd,rs1,imm
imm[11:0]			rs1	011	rd	0010011	SLTIU rd,rs1,imm
imm[11:0]			rs1	100	rd	0010011	XORI rd,rs1,imm
imm[11:0]			rs1	110	rd	0010011	ORI rd,rs1,imm
imm[11:0]			rs1	111	rd	0010011	ANDI rd,rs1,imm
0000000		shamt	rs1	001	rd	0010011	SLLI rd,rs1,shamt
0000000		shamt	rs1	101	rd	0010011	SRLI rd,rs1,shamt
0100000		shamt	rs1	101	rd	0010011	SRAI rd,rs1,shamt
0000000		rs2	rs1	000	rd	0110011	ADD rd,rs1,rs2
0100000		rs2	rs1	000	rd	0110011	SUB rd,rs1,rs2
0000000		rs2	rs1	001	rd	0110011	SLL rd,rs1,rs2
0000000		rs2	rs1	010	rd	0110011	SLT rd,rs1,rs2
0000000		rs2	rs1	011	rd	0110011	SLTU rd,rs1,rs2
0000000		rs2	rs1	100	rd	0110011	XOR rd,rs1,rs2
0000000		rs2	rs1	101	rd	0110011	SRL rd,rs1,rs2
0100000		rs2	rs1	101	rd	0110011	SRA rd,rs1,rs2
0000000		rs2	rs1	110	rd	0110011	OR rd,rs1,rs2
0000000		rs2	rs1	111	rd	0110011	AND rd,rs1,rs2
0000	pred	succ	00000	000	00000	0001111	FENCE
0000	0000	0000	00000	001	00000	0001111	FENCE.I
000000000000			00000	000	00000	1110011	SCALL
000000000001			00000	000	00000	1110011	SBREAK
110000000000			00000	010	rd	1110011	RDCYCLE rd
110010000000			1 00000	010	rd	1110011	RDCYCLEH rd
110000000001			00000	010	rd	1110011	RDTIME rd
110010000001			00000	010	rd	1110011	RDTIMEH rd
110000000010			00000	010	rd	1110011	RDINSTRET rd
110010000010			00000	010	rd	1110011	RDINSTRETH rd

31	27	26	25	24	20	range1915	range1412	range117	range60	
funct7				rs2		rs1	funct3	rd	opcode	R-type
imm[11:0]						rs1	funct3	rd	opcode	I-type
imm[11:5]				rs2		rs1	funct3	imm[4:0]	opcode	S-type

RV64I Base Instruction Set (in addition to RV32I)

imm[11:0]				rs1	110	rd	0000011	LWU rd,rs1,imm
imm[11:0]				rs1	011	rd	0000011	LD rd,rs1,imm
imm[11:5]			rs2	rs1	011	imm[4:0]	0100011	SD rs1,rs2,imm
000000			shamt	rs1	001	rd	0010011	SLLI rd,rs1,shamt
000000			shamt	rs1	101	rd	0010011	SRLI rd,rs1,shamt
010000			shamt	rs1	101	rd	0010011	SRAI rd,rs1,shamt
imm[11:0]				rs1	000	rd	0011011	ADDIW rd,rs1,imm
0000000			shamt	rs1	001	rd	0011011	SLLIW rd,rs1,shamt
0000000			shamt	rs1	101	rd	0011011	SRLIW rd,rs1,shamt
0100000			shamt	rs1	101	rd	0011011	SRAIW rd,rs1,shamt
0000000			rs2	rs1	000	rd	0111011	ADDW rd,rs1,rs2
0100000			rs2	rs1	000	rd	0111011	SUBW rd,rs1,rs2
0000000			rs2	rs1	001	rd	0111011	SLLW rd,rs1,rs2
0000000			rs2	rs1	101	rd	0111011	SRLW rd,rs1,rs2
0100000			rs2	rs1	101	rd	0111011	SRAW rd,rs1,rs2

RV32M Standard Extension

0000001			rs2	rs1	000	rd	0110011	MUL rd,rs1,rs2
0000001			rs2	rs1	001	rd	0110011	MULH rd,rs1,rs2
0000001			rs2	rs1	010	rd	0110011	MULHSU rd,rs1,rs2
0000001			rs2	rs1	011	rd	0110011	MULHU rd,rs1,rs2
0000001			rs2	rs1	100	rd	0110011	DIV rd,rs1,rs2
0000001			rs2	rs1	101	rd	0110011	DIVU rd,rs1,rs2
0000001			rs2	rs1	110	rd	0110011	REM rd,rs1,rs2
0000001			rs2	rs1	111	rd	0110011	REMU rd,rs1,rs2

RV64M Standard Extension (in addition to RV32M)

0000001			rs2	rs1	000	rd	0111011	MULW rd,rs1,rs2
0000001			rs2	rs1	100	rd	0111011	DIVW rd,rs1,rs2
0000001			rs2	rs1	101	rd	0111011	DIVUW rd,rs1,rs2
0000001			rs2	rs1	110	rd	0111011	REMW rd,rs1,rs2
0000001			rs2	rs1	111	rd	0111011	REMUW rd,rs1,rs2

RV32A Standard Extension

00010	aq	rl	00000	rs1	010	rd	0101111	LR.W rd,rs1
00011	aq	rl	rs2	rs1	010	rd	0101111	SC.W rd,rs1,rs2
00001	aq	rl	rs2	rs1	010	rd	0101111	AMOSWAP.W rd,rs1,rs2
00000	aq	rl	rs2	rs1	010	rd	0101111	AMOADD.W rd,rs1,rs2
00100	aq	rl	rs2	rs1	010	rd	0101111	AMOXOR.W rd,rs1,rs2
01100	aq	rl	rs2	rs1	010	rd	0101111	AMOAND.W rd,rs1,rs2
01000	aq	rl	rs2	rs1	010	rd	0101111	AMOOR.W rd,rs1,rs2
10000	aq	rl	rs2	rs1	010	rd	0101111	AMOMIN.W rd,rs1,rs2
10100	aq	rl	rs2	rs1	010	rd	0101111	AMOMAX.W rd,rs1,rs2
11000	aq	rl	rs2	rs1	010	rd	0101111	AMOMINU.W rd,rs1,rs2
11100	aq	rl	rs2	rs1	010	rd	0101111	AMOMAXU.W rd,rs1,rs2

31	27	26	25	24	20	range1915	range1412	range117	range60	
funct7				rs2		rs1	funct3	rd	opcode	R-type
rs3		funct2		rs2		rs1	funct3	rd	opcode	R4-type
imm[11:0]						rs1	funct3	rd	opcode	I-type
imm[11:5]				rs2		rs1	funct3	imm[4:0]	opcode	S-type

RV64A Standard Extension (in addition to RV32A)

00010	aq	rl	00000	rs1	011	rd	0101111	LR.D rd,rs1
00011	aq	rl	rs2	rs1	011	rd	0101111	SC.D rd,rs1,rs2
00001	aq	rl	rs2	rs1	011	rd	0101111	AMOSWAP.D rd,rs1
00000	aq	rl	rs2	rs1	011	rd	0101111	AMOADD.D rd,rs1,rs2
00100	aq	rl	rs2	rs1	011	rd	0101111	AMOXOR.D rd,rs1,rs2
01100	aq	rl	rs2	rs1	011	rd	0101111	AMOAND.D rd,rs1,rs2
01000	aq	rl	rs2	rs1	011	rd	0101111	AMOOR.D rd,rs1,rs2
10000	aq	rl	rs2	rs1	011	rd	0101111	AMOMIN.D rd,rs1,rs2
10100	aq	rl	rs2	rs1	011	rd	0101111	AMOMAX.D rd,rs1,rs2
11000	aq	rl	rs2	rs1	011	rd	0101111	AMOMINU.D rd,rs1,rs2
11100	aq	rl	rs2	rs1	011	rd	0101111	AMOMAXU.D rd,rs1,rs2

RV32F Standard Extension

imm[11:0]			rs1	010	rd	0000111	FLW rd,rs1,imm
imm[11:5]		rs2	rs1	010	imm[4:0]	0100111	FSW rs1,rs2,imm
rs3	00	rs2	rs1	rm	rd	1000011	FMADD.S rd,rs1,rs2,rm
rs3	00	rs2	rs1	rm	rd	1000111	FMSUB.S rd,rs1,rs2,rm
rs3	00	rs2	rs1	rm	rd	1001011	FNMSUB.S rd,rs1,rs2,rm
rs3	00	rs2	rs1	rm	rd	1001111	FNMADD.S rd,rs1,rs2,rm
0000000		rs2	rs1	rm	rd	1010011	FADD.S rd,rs1,rs2
0000100		rs2	rs1	rm	rd	1010011	FSUB.S rd,rs1,rs2
0001000		rs2	rs1	rm	rd	1010011	FMUL.S rd,rs1,rs2
0001100		rs2	rs1	rm	rd	1010011	FDIV.S rd,rs1,rs2
0101100		00000	rs1	rm	rd	1010011	FSQRT.S rd,rs1
0010000		rs2	rs1	000	rd	1010011	FSGNJ.S rd,rs1,rs2
0010000		rs2	rs1	001	rd	1010011	FSGNJN.S rd,rs1,rs2
0010000		rs2	rs1	010	rd	1010011	FSGNJX.S rd,rs1,rs2
0010100		rs2	rs1	000	rd	1010011	FMIN.S rd,rs1,rs2
0010100		rs2	rs1	001	rd	1010011	FMAX.S rd,rs1,rs2
1100000		00000	rs1	rm	rd	1010011	FCVT.W.S rd,rs1
1100000		00001	rs1	rm	rd	1010011	FCVT.WU.S rd,rs1
1110000		00000	rs1	000	rd	1010011	FMV.X.S rd,rs1
1010000		rs2	rs1	010	rd	1010011	FEQ.S rd,rs1,rs2
1010000		rs2	rs1	001	rd	1010011	FLT.S rd,rs1,rs2
1010000		rs2	rs1	000	rd	1010011	FLE.S rd,rs1,rs2
1110000		00000	rs1	001	rd	1010011	FCLASS.S rd,rs1
1101000		00000	rs1	rm	rd	1010011	FCVT.S.W rd,rs1
1101000		00001	rs1	rm	rd	1010011	FCVT.S.WU rd,rs1
1111000		00000	rs1	000	rd	1010011	FMV.S.X rd,rs1
000000000011			00000	010	rd	1110011	FRCSR rd
000000000010			00000	010	rd	1110011	FRRM rd
000000000001			00000	010	rd	1110011	FRFLAGS rd
000000000011			rs1	001	rd	1110011	FSCSR rd,rs1
000000000010			rs1	001	rd	1110011	FSRM rd,rs1
000000000001			rs1	001	rd	1110011	FSFLAGS rd,rs1
000000000010			00000	101	rd	1110011	FSRMI rd,imm
000000000001			00000	101	rd	1110011	FSFLAGSI rd,imm

31	27	26	25	24	20	range1915	range1412	range117	range60	
funct7				rs2	rs1	funct3	rd	opcode	R-type	
rs3	funct2			rs2	rs1	funct3	rd	opcode	R4-type	
imm[11:0]					rs1	funct3	rd	opcode	I-type	
imm[11:5]				rs2	rs1	funct3	imm[4:0]	opcode	S-type	

RV64F Standard Extension (in addition to RV32F)

1100000	00010	rs1	rm	rd	1010011	FCVT.L.S rd,rs1
1100000	00011	rs1	rm	rd	1010011	FCVT.LU.S rd,rs1
1101000	00010	rs1	rm	rd	1010011	FCVT.S.L rd,rs1
1101000	00011	rs1	rm	rd	1010011	FCVT.S.LU rd,rs1

RV32D Standard Extension

imm[11:0]			rs1	011	rd	0000111	FLD rd,rs1,imm
imm[11:5]		rs2	rs1	011	imm[4:0]	0100111	FSD rs1,rs2,imm
rs3	01	rs2	rs1	rm	rd	1000011	FMADD.D rd,rs1,rs2,rm
rs3	01	rs2	rs1	rm	rd	1000111	FMSUB.D rd,rs1,rs2,rm
rs3	01	rs2	rs1	rm	rd	1001011	FNMSUB.D rd,rs1,rs2,rm
rs3	01	rs2	rs1	rm	rd	1001111	FNMADD.D rd,rs1,rs2,rm
0000001		rs2	rs1	rm	rd	1010011	FADD.D rd,rs1,rs2
0000101		rs2	rs1	rm	rd	1010011	FSUB.D rd,rs1,rs2
0001001		rs2	rs1	rm	rd	1010011	FMUL.D rd,rs1,rs2
0001101		rs2	rs1	rm	rd	1010011	FDIV.D rd,rs1,rs2
0101101		00000	rs1	rm	rd	1010011	FSQRT.D rd,rs1
0010001		rs2	rs1	000	rd	1010011	FSGNJ.D rd,rs1,rs2
0010001		rs2	rs1	001	rd	1010011	FSGNJN.D rd,rs1,rs2
0010001		rs2	rs1	010	rd	1010011	FSGNJX.D rd,rs1,rs2
0010101		rs2	rs1	000	rd	1010011	FMIN.D rd,rs1,rs2
0010101		rs2	rs1	001	rd	1010011	FMAX.D rd,rs1,rs2
0100000		00001	rs1	rm	rd	1010011	FCVT.S.D rd,rs1
0100001		00000	rs1	rm	rd	1010011	FCVT.D.S rd,rs1
1010001		rs2	rs1	010	rd	1010011	FEQ.D rd,rs1,rs2
1010001		rs2	rs1	001	rd	1010011	FLT.D rd,rs1,rs2
1010001		rs2	rs1	000	rd	1010011	FLE.D rd,rs1,rs2
1110001		00000	rs1	001	rd	1010011	FCLASS.D rd,rs1
1100001		00000	rs1	rm	rd	1010011	FCVT.W.D rd,rs1
1100001		00001	rs1	rm	rd	1010011	FCVT.WU.D rd,rs1
1101001		00000	rs1	rm	rd	1010011	FCVT.D.W rd,rs1
1101001		00001	rs1	rm	rd	1010011	FCVT.D.WU rd,rs1

RV64D Standard Extension (in addition to RV32D)

1100001	00010	rs1	rm	rd	1010011	FCVT.L.D rd,rs1
1100001	00011	rs1	rm	rd	1010011	FCVT.LU.D rd,rs1
1110001	00000	rs1	000	rd	1010011	FMV.X.D rd,rs1
1101001	00010	rs1	rm	rd	1010011	FCVT.D.L rd,rs1
1101001	00011	rs1	rm	rd	1010011	FCVT.D.LU rd,rs1
1111001	00000	rs1	000	rd	1010011	FMV.D.X rd,rs1

Table 1: Instruction listing for RISC-V