Aarch64 V8 most common instructions (Work in Progress - V4.0)

General conventions

rd, rn, rm: W or X registers; op2: register or #imn (n-bit immediate)	if {S} is present flags will be affected

Instruction	Mnemonic	Syntax	Explanation	Flags
Addition	ADD{S}	ADD{S} rd, rn, op2	rd = rn + op2	{Yes}
Subtraction	SUB{S}	SUB{S} rd, rn, op2	rd = rn - op2	{Yes}
Negation	NEG{S}	NEG{S} rd, op2	rd = -op2	{Yes}
with carry	NGC{S}	NGC{S} rd, rm	rd = -rm - ~C	{Yes}
Unsigned multiply	MUL	MUL rd, rn, rm	rd = rn x rm	
Unsigned multiply long	UMULL	UMULL xd, wn, wm	xd = wn x wm	
Unsigned multiply high	UMULH	UMULH xd, xn, xm	xd = <127:64> of xn x xm	
Signed multiply long	SMULL	SMULL xd, wn, wm	xd = wm x wn (signed operands)	
Signed multiply high	SMULH	SMULL xd, wn, wm	xd = <127:64> of xn x xm (signed operands)	
Multiply and add	MADD	MADD rd, rn, rm, ra	rd = ra + (rn x rm)	
Multiply and sub	MSUB	MSUB rd, rn, rm, ra	rd = ra - (rn x rm)	
Multiply and neg	MNEG	MNEG rd, rn, rm	Rd = -(rn x rm)	
Unsigned multiply and add long	UMADDL	UMADDL xd, wn, wm, xa	xd = xa + (wm x wn)	
Unsigned multiply and sub long	UMSUBL	UMSUBL xd, wn, wm, xa	xd = xa - (wm x wn)	
Unsigned multiply and neg long	UMNEGL	UMNEGL xd, wn, wn	Xd = -(wm x wn)	
Signed multiply and add long	SMADDL	SMADDL xd, wn, wm, xa	xd = xa + (wm x wn)	
Signed multiply and sub long	SMSUBL	SMSUBL xd, wn, wm, xa	xd = xa - (wm x wn)	
Signed multiply and neg long	SMNEGL	SMNEGL xd, wn, wm	Xd = - (wm x wn)	
Unsigned divide	UDIV	UDIV rd, rn, rm	rd = rn / rm	
Signed divide	SDIV	UDIV rd, rn, rm	rd = rn / rm	
Note: the remainder may be computed using the MSUB instruction as numerator - (quotient x denominator)				
Bitwise logical operations	AND	AND{S} rd, rn, op2	rd = rn & op2	{Yes}
	BIC	BIC{S} rd, rn, op2	rd = rn & ~op2	{Yes}
	ORR	ORR rd, rn, op2	rd = rn | op2	
	ORN	ORN rd, rn, op2	rd = rn | ~op2	
	EOR	EOR rd, rn, op2	rd = rn ⊕ op2	
	EON	EON rd, rn, op2	rd = rn ⊕ ~op2	
	LSL	LSL rd, rn, op2	Logical shift left (stuffing zeros enter from right)	
	LSR	LSR rd, rn, rm	Logical shift right (stuffing zeros enter from left)	
	ASR	ASR rd, rn, op2	Arithmetic shift right (preserves sign)	
	ROR	ROR rd, rn, op2	Rotate right	
	MOV	MOV rd, op2	rd = op2	
	MVN	MVN rd, op2	rd = ~op2	
	TST	TST rn, op2	rn & op2	Yes
Bitfield operations	BFI	BFI rd, rn, #lsb, #width	Moves a bitfield of #width bits starting at source bit 0 to destination starting at bit #lsb	
	UBFX	UBFZ rd, rn, #lsb, #width	Moves a bitfield of #width bits starting at source bit #lsb to destination starting at bit 0; clears all other rd bits	
	SBFX	SBFZ rd, rn, #lsb, #width	Moves a bitfield of #width bits starting at source bit #lsb to destination starting at bit 0; sign extends the result	
Bit/Byte operations	CLS	CLS rd, rm	Count leading sign bits	
	CLZ	CLZ rd, rm	Count leading zero bits	
	RBIT	RBIT rd, rm	Reverse bit order	
	REV	REV rd, rm	Reverse byte order	
	REV16	REV16 rd, rm	Reverse byte order on each half word	
	REV32	REV32 xd, xm	Reverse byte order on each word	
Store single register	STR	rt, [addr]	Mem[addr] = rt	
Subtype byte	STRB	wt, [addr]	Byte[addr] = wt<7:0>	
Subtype half word	STRH	wt, [addr]	HalfWord[addr] = wt<15:0>	
Store register pair	STP	STP rt, rm, [addr]	Stores rt and rm in consecutive positions starting at addr	
Load single register	LDR	LDR rt, [addr]	rt = Mem[addr]	
Sub-type byte	LDRB	LDRB wt, [addr]	wt = Byte[addr] (only 32-byte containers)	
Sub-type signed byte	LDRSB	LDRSB rt, [addr]	rt = Sbyte[addr] (signed byte)	
Sub-type half word	LDRH	LDRH wt, [addr]	wt = HalfWord[addr] (only 32-byte containers)	
Sub-type signed half word	LDRSH	LDRSH rt, [addr]	rt = Mem[addr] (load one half word, signed)	
Sub-type signed word	LDRSW	LDRSW xt, [addr]	xt = Sword[addr] (signed word, only for 64-byte containers)	
Load register pair	LDP	LDP rt, rm, [addr]	Loads rt and rm from consecutive positions starting at addr	

Instruction	Mnemonic	Syntax	Explanation	Flags
Branch	B	B target	Jump to target	
Conditional branch	B.CC	B.cc target	If (cc) jump to target	
Compare and branch if zero	CBZ	CBZ rd, target	If (rd=0) jump to target	
Compare and branch if not zero	CBNZ	CBNZ rd, target	If (rd≠0) jump to target	
Conditional select	CSEL	CSEL rd, rn, rm, cc	If (cc) rd = rn else rd = rm	
with increment,	CSINC	CSINC rd, rn, rm, cc	If (cc) rd = rn else rd = rm+1	
with negate,	CSNEG	CSNEG rd, rn, rm, cc	If (cc) rd = rn else rd = −rm	
with invert	CSINV	CSINV rd, rn, rm, cc	If (cc) rd = rn else rd = ~rm	
Conditional set	CSET	CSET rd, cc	If (cc) rd = 1 else rd = 0	
with mask,	CSETM	CSETM rd, cc	If (cc) rd = −1 else rd = 0	
with increment,	CINC	CINC rd, rn, cc	If (cc) rd = rn+1 else rd = rn	
with negate,	CNEG	CNEG rd, rn, cc	If (cc) rd = −rn else rd = rn	
with invert	CINV	CINV rd, rn, cc	If (cc) rd = ~rn else rd = rn	
Compare	CMP	CMP rd, op2	Rd − op2	Yes
with negative	CMN	CMN rd, op2	rd − (−op2)	Yes
Conditional compare	CCMP	CCMP rd, rn, #im4, cc	If (cc) NZCV = CMP(rd,rn) else NZCV = #imm4	Yes
with negative	CCMN	CCMP rd, rn, #im4, cc	If (cc) NZCV = CMP(rd,−rn) else NZCV = #imm4	Yes
Note: for these instructions rn can also be an #im5 (5-bit unsigned immediate value 0..32)				

Aarch64 V8 accessory information

Condition codes (magnitude of operands)		
LO	Lower, unsigned	C = 0
HI	Higher, unsigned	C = 1 and Z = 0
LS	Lower or same, unsigned	C = 0 or Z = 1
HS	Higher or same, unsigned	C = 1
LT	Less than, signed	N != V
GT	Greater than, signed	Z = 0 and N = V
LE	Less than or equal, signed	Z = 1 and N != V
GE	Greater than or equal, signed	N = V

Condition codes (direct flags)		
EQ	Equal	Z = 1
NE	Not equal	Z = 0
MI	Negative	N = 1
PL	Positive or zero	N = 0
VS	Overflow	V = 1
VC	No overflow	V = 0
CS	Carry	C = 0
CC	No carry	C = 1

Sub types (suffix of some instructions)		
B	byte	8 bits
SB	signed byte	8 bits
H	Half word	16 bits
SH	signed half word	16 bits
W	word	32 bits
SW	signed word	32 bits

Flags set to 1 when:	
N	the result of the last operation was negative, cleared to 0 otherwise
Z	the result of the last operation was zero, cleared to 0 otherwise
C	the last operation resulted in a carry, cleared to 0 otherwise
V	the last operation caused overflow, cleared to 0 otherwise

Containers	
Xn	64 bit register
Wn	32 LSB of Xn

Addressing modes (base: register; offset: register or immediate)		
[base]	MEM[base]	
[base, offset]	MEM[base+offset]	
[base, offset]!	MEM[base+offset] then base = base + offset	(pre indexed)
[base], offset	MEM[base] then base = base + offset	(post indexed)

Sizes, Assembly and C		
8	byte	char
16	Half word	short int
32	word	int
64	double word	long int
128	quad word	-

Op2 processing (applied to Op2 before anything else)	
LSL|LSR|ASR #imm	
SXTW	Sign extension
SXTB {#imm2}	Sign extension after LSL #imm2

Calling convention (register use)
Params: X0..X7; Result: X0
Reserved: X8, X16..X18 (do not use these)
Unprotected: X9..X15 (callee may corrupt these)
Protected: X19..X28 (callee must preserve these)