Instruction <Condition Field> {S} Rd, Rn, < shifter_operand >

Mnemonic	Instruction	Action
ADC	Add with carry	Rd: = Rn + Op2 + Carry
ADD	Add	Rd: = Rn + Op2
AND	AND	Rd: = Rn AND Op2
B	Branch	R15: = address
BIC	Bit Clear	Rd: = Rn AND NOT Op2
BL	Branch with Link	R14: = R15, R15: = address
BX	Branch and Exchange	R15: = Rn, T bit: = Rn[0]
CDP	Coprocessor Data Processing	(Coprocessor-specific)
CMN	Compare Negative	CPSR flags: = Rn + Op2
CMP	Compare	CPSR flags: = Rn - Op2
EOR	Exclusive OR	Rd: = (Rn AND NOT Op2)
LDC	Load coprocessor from memory	Coprocessor load
LDM	Load multiple registers	Stack manipulation (Pop)
LDR	Load register from memory	Rd: = (address)
MCR	Move CPU register to coprocessor register	cRn: = rRn {<op>cRm}
MLA	Multiply Accumulate	Rd: = (Rm x Rs) + Rn
MOV	Move register or constant	Rd: = Op2
MRC	Move from coprocessor register to CPU register	Rn: = cRn {<op>cRm}
MRS	Move PSR status/flags to register	Rn: = PSR
MSR	Move register to PSR status/flags	PSR: = Rm
MUL	Multiply	Rd: = Rm x Rs
MVN	Move negative register	Rd: = 0 x FFFFFFFF EOR Op2
ORR	OR	Rd: = Rn OR Op2
RSB	Reverse Subtract	Rd: = Op2 - Rn
RSC	Reverse Subtract with Carry	Rd: = Op2 - Rn - 1 + Carry
SBC	Subtract with Carry	Rd: = Rn - Op2 - 1 + Carry
STC	Store coprocessor register to memory	address: = CRn
STM	Store Multiple	Stack manipulation (Push)
STR	Store register to memory	<address>: = Rd
SUB	Subtract	Rd: = Rn - Op2
SWI	Software Interrupt	OS call
SWP	Swap register with memory	Rd: = [Rn], [Rn] := Rm
TEQ	Test bitwise equality	CPSR flags: = Rn EOR Op2
TST	Test bits	CPSR flags: = Rn AND Op2

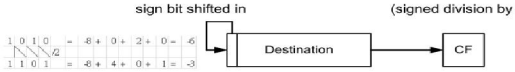
Code	Suffix	Flags	Meaning
0	EQ	Z set	equal
1	NE	Z clear	not equal
10	CS	C set	unsigned higher or same
11	CC	C clear	unsigned lower
100	MI	N set	negative
101	PL	N clear	positive or zero
110	VS	V set	overflow
111	VC	V clear	no overflow
1000	HI	C set and Z clear	unsigned higher
1001	LS	C clear or Z set	unsigned lower or same
1010	GE	N equals V	greater or equal
1011	LT	N not equal to V	less than
1100	GT	Z clear AND (N equals V)	greater than
1101	LE	Z set OR (N not equal to V)	less than or equal
1110	AL	(ignored)	always

LSL shift left by n bits (multiplication by 2^n)

LSR logical shift right by n bits (unsigned division by 2^n)

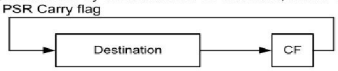
ASR arithmetic shift right by n bits. The bits fed into the top end of the operand are copies of the original top—or sign—bit.

sign bit shifted in (signed division by 2^n)



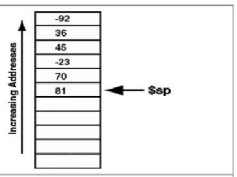
ROR rotate right by n bits

RRX rotate right extended by 1 bit. This is a 33-bit rotate, where the 33rd bit is the PSR Carry flag



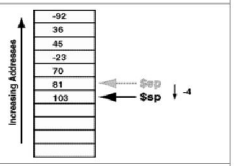
ADR/ADRL	Loading Address / Long Address into register	same as LDR Rd, =(address)
LDR	[H | SH | SB]	[Halfword ‖ SignedHalfword ‖ Signed Byte]
STR	[H]	[Halfword] --only storing UNSIGNED data
LDR ‖ STR	R0 , [R1 , #offset_12/8 ‖ R2]	Run(R1+offset)
+12 with	R0 , [R1 , #offset_12/8 ‖ R2] !	R1 += offset --> Run(R1)
[H..]+8	R0 , [R1] , #offset_12/8 ‖ R2	Run(R1) --> R1 += offset
LDM | STM	[IA | IB | DA | DB]	I = Increment ; D = Decrement ; A = After
	[FD | ED | FA | EA]	E = Empty ; F = Full ; B = Before
STM FA	r13!, {r0-r5}; Push onto a Full Ascending Stack	
LDM FA	r13!, {r0-r5}; Pop from a Full Ascending Stack	ascending stack: from low -> higher address
STM FD	r13!, {r0-r5}; Push onto a Full Descending Stack	descending stack: from high -> lower address
LDM FD	r13!, {r0-r5}; Pop from a Full Descending Stack	
STM EA	r13!, {r0-r5}; Push onto an Empty Ascending Stack	SP can point to the last used location (full stack)
LDM EA	r13!, {r0-r5}; Pop from an Empty Ascending Stack	or the first unused location (empty stack)
STM ED	r13!, {r0-r5}; Push onto Empty Descending Stack	
LDM ED	r13!, {r0-r5}; Pop from an Empty Descending Stack	<-- example: r13 is a (stack pointer)

Conventionally, a SP (stack pointer) always points to the top of the stack. The stack grows downward (in terms of memory addresses).



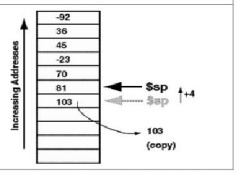
Adding a data to the stack represents a **push** operation.

To **push** a data onto the stack, first **subtract** 4 from the stack pointer, then store the data at the address in the stack pointer.



Removing an item from a stack is called a **pop** operation.

To **pop** a data from a stack, copy the data pointed at by the SP, then **add 4** to the SP.



Note that the data size of the stack is 4-byte for ARM processor.

Normal multiply (produce 32-bit result):		
MUL	MUL<cc>{S} Rd, Rm, Rs	Rd := Rm x Rs
MLA	MLA<cc>{S} Rd, Rm, Rs, Rn	Rd := (Rm x Rs) + Rn
Long Unsigned Multiply (produce 64-bit result):		
UMULL	UMULL<cc>{S} RdLo, RmHi, Rm, Rs	[RmHi, RdLo] = Rm x Rs
	UMULL r6, r8, r0, r1	r8, r6 = r0 x r1
Unsigned Multiply Accumulate long(produce 64-bit result):		
UMLAL	UMLAL<cc>{S} RdLo, RmHi, Rm, Rs	[RmHi, RdLo] = [RmHi, RdLo]+ Rm x Rs
	UMLAL r5, r8, r0, r1	Action: [r8, r5] = [r8, r5] + r0 x r1
SMULL Signed Multiply Long(produce 64-bit result):		
SMULL	SMULL<cc>{S} RdLo, RmHi, Rm, Rs	[RmHi, RdLo] = Rm x Rs
SMLAL Signed Multiply Accumulate Long(produce 64-bit result):		
SMLAL	SMLAL<cc>{S} RdLo, RmHi, Rm, Rs	[RmHi, RdLo] = [RmHi, RdLo]+ Rm x Rs

BX	Branch and Exchange	BX{cond} Rn

If bit0 of Rn = 1, switch to THUMB state.
If bit0 of Rn = 0, switch to ARM state.
If Rn = R15 (i.e., PC), the behavior is undefined.

CLZ	Count Leading Zeros	CLZ<CC> Rd, Rm

It counts the number of binary zero bits before the first binary 1 bit in Rm and store the result in Rd. (only for certain ARM architectures)

bit-31-> [N,Z,C,V] [···] [···] [···] [···] [I,F,T,M4] [M3,M2,M1,M0] -> bit-0

Move PSR (CPSR or SPSR) to general register:	
MRS<cc> Rd, CPSR	Rd = CPSR
MRS<cc> Rd, SPSR	Rd = SPSR
Move to CPSR or SPSR from register or an immediate operand:	
MSR<cc> CPSR, (#<immediate> ‖ Rm)	CPSR = #<immediate> ‖ Rm
MSR<cc> SPSR, (#<immediate> ‖ Rm)	SPSR = #<immediate> ‖ Rm
Example: For pre-setting condition flags in user mode.	
MRS R0, CPSR	; Read the CPSR
BIC R0, R0, #0xF0000000	; Clear the N, Z, C and V bits
MSR CPSR, R0	; Update the flag bits in the CPSR [N, Z, C, V]
	; flags now all clear
Example: For pre-setting modes, interrupt bits and state bit in privileged mode.	
MRS R0, CPSR	; Read the CPSR
ORR R0, R0, #0x80	; Set the interrupt disable bit
MSR CPSR, R0	; Update the control bits in the CPSR
	; interrupts (IRQ) now disabled

Swap a byte or word quantity between a register and external memory

<SWP>{cond}{B} Rd,Rm,[Rn]

SWP R0,R1,[R2]
;Load R0 with the word stored at an addressed indicated by R2, and store the content in R1 at address indicated by R2.

SWPB R2,R3,[R4]
;Load R2 with the byte addressed by R4, and store bits 0 to 7 of R3 at address indicated by R4.

If Rd and Rm are the same register, this instruction swaps the value of the register and the value at the memory address.

SWI –	Software Interrupt		SWI<CC> expression
item	now	save location	return
PC	0x08	R14_svc	MOVS PC,R14_svc
CPSR	new	SPSR_svc	