

THE IBM System/360 INSTRUCTION SET PRESENTED AS A PERIODIC SYSTEM

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The IBM System/360 instruction set belongs to the simplest and clearest processor instruction sets in past and present computers. This is because of three main reasons: (A) there are only four addressing modes; (B) there is no hardware stacking mechanism; (C) there is a strong orthogonal aspect as regards the actual operation (arithmetical, logical) on the one hand and the kinds of operands and addressing modes on the other hand.

A knowledge of the System/360 architecture as defined in the *IBM System/360 Principles of Operation* ([WWW link](#)) is assumed in what follows.

- (A) the addressing modes are register-to-register (RR), register-to-storage (RX and RS), instruction-to-storage (SI) and storage-to-storage (SS).
- (B) Stacking operations, necessary in the correct treatment of subroutines and interrupt routines within subroutines and interrupt routines, have to be implemented entirely in software.
- (C) Machine operation codes take one byte in storage. In many instructions the front half-byte represents the addressing mode, while the rear half-byte represents the specific operation to be performed, for instance, the four *Compare Logical* operations, with opcodes X'15', X'55', X'95' and X'D5', are in the same column; all full-word RX operations, with X'5' as their leftmost half-bytes, are in the same row; on the intersection of column and row we find the opcode X'55', mnemonic *CL*, *Compare logical register and full word in main storage*.

It is foremost this orthogonal design, the separation of addressing modes from functions performed, that gives the instruction set the looks of a *periodic system*, very much like the periodic system of chemical elements (my favourite [WWW link](#) - JEM).

In the first table below the opcodes are arranged in ascending order row-wise; so the rows are numbered by the front half-byte of the opcode, running from 0- to F- , and the columns by the rear half-byte of the opcode, running from -0 to -F. The grey cells represent invalid operation codes.

The second table is the first table transposed, so the opcodes are ordered column-wise, in line with the IBM handbooks and reference cards.

The tables are based on the pocket reference card on the System/360 and the supplementary card on the Model 67, affectionately known as the *Green Card* ([WWW link](#)) and *Blue Card* ([WWW link](#)), and for the Model 44 information on the *Model 44 Functional Characteristics* handbook ([WWW link](#)).

NOTES on the Model 44: (a) storage protection (controlled by the SSK and ISK instructions) is not standard but is an optional feature; (b) none of the decimal and variable-field instructions (rows D- and F- in the first table below) are available.

tooltips: roll the mouse cursor over the mnemonic to read the name of the

instruction in full

ORDERED ROW-BY-ROW, LIKE THE PERIODIC SYSTEM OF CHEMICAL ELEMENTS

COLOR CODES:	Standard: on all System/360 models except Model 44	Not on Model 44; standard on all other models	Model 67 only	Floating-point feature	Extended-floating-point feature	Privileged instructions: on all System/360 models	Additional privileged instructions for the Model 67	Decimal Arithmetic feature; not available on Model 44
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	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F	
0-					SPM	BALR	BCTR	BCR	SSK	ISK	SVC			BASR			0-
1-	LPR	LNR	LTR	LCR	NR	CLR	OR	XR	LR	CR	AR	SR	MR	DR	ALR	SLR	1-
2-	LPDR	LNDR	LTDR	LCDR	HDR	LRDR	MXR	MXDR	LDR	CDR	ADR	SDR	MDR	DDR	AWR	SWR	2-
3-	LPER	LNER	LTER	LCER	HER	LRER	AXR	SXR	LER	CER	AER	SER	MER	DER	AUR	SUR	3-
4-	STH	LA	STC	IC	EX	BAL	BCT	BC	LH	CH	AH	SH	MH	BAS	CVD	CVB	4-
5-	ST				N	CL	O	X	L	C	A	S	M	D	AL	SL	5-
6-	STD							MXD	LD	CD	AD	SD	MD	DD	AW	SW	6-
7-	STE								LE	CE	AE	SE	ME	DE	AU	SU	7-
8-	SSM		LPSW	(diagn)	WRD	RDD	BXH	BXLE	SRL	SLL	SRA	SLA	SRDL	SLDL	SRDA	SLDA	8-
9-	STM	TM	MVI	TS	NI	CLI	OI	XI	LM				SIO	TIO	HIO	TCH	9-
A-			SLT														A-
B-	STMC	LRA							LMC								B-
C-																	C-
D-		MVN	MVC	MVZ	NC	CLC	OC	XC					TR	TRT	ED	EDMK	D-
E-																	E-
F-		MVO	PACK	UNPK					ZAP	CP	AP	SP	MP	DP			F-
	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F	

ORDERED COLUMN-BY-COLUMN, LIKE ON THE IBM SYSTEM/360 REFERENCE CARD

	0-	1-	2-	3-	4-	5-	6-	7-	8-	9-	A-	B-	C-	D-	E-	F-	
-0		LPR	LPDR	LPER	STH	ST	STD	STE	SSM	STM		STMC					-0
-1		LNR	LNDR	LNER	LA					TM		LRA		MVN		MVO	-1
-2		LTR	LTDR	LTER	STC				LPSW	MVI	SLT			MVC		PACK	-2
-3		LCR	LCDR	LCER	IC				(diagn)	TS				MVZ		UNPK	-3

-4	SPM	NR	HDR	HER	EX	N			WRD	NI				NC			-4
-5	BALR	CLR	LRDR	LRER	BAL	CL			RDD	CLI				CLC			-5
-6	BCTR	OR	MXR	AXR	BCT	O			BXH	OI				OC			-6
-7	BCR	XR	MXDR	SXR	BC	X	MXD		BXLE	XI				XC			-7
-8	SSK	LR	LDR	LER	LH	L	LD	LE	SRL	LM		LMC				ZAP	-8
-9	ISK	CR	CDR	CER	CH	C	CD	CE	SLL							CP	-9
-A	SVC	AR	ADR	AER	AH	A	AD	AE	SRA							AP	-A
-B		SR	SDR	SER	SH	S	SD	SE	SLA							SP	-B
-C		MR	MDR	MER	MH	M	MD	ME	SRDL	SIO				TR		MP	-C
-D	BASR	DR	DDR	DER	BAS	D	DD	DE	SLDL	TIO				TRT		DP	-D
-E		ALR	AWR	AUR	CVD	AL	AW	AU	SRDA	HIO				ED			-E
-F		SLR	SWR	SUR	CVB	SL	SW	SU	SLDA	TCH				EDMK			-F
	0-	1-	2-	3-	4-	5-	6-	7-	8-	9-	A-	B-	C-	D-	E-	F-	

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