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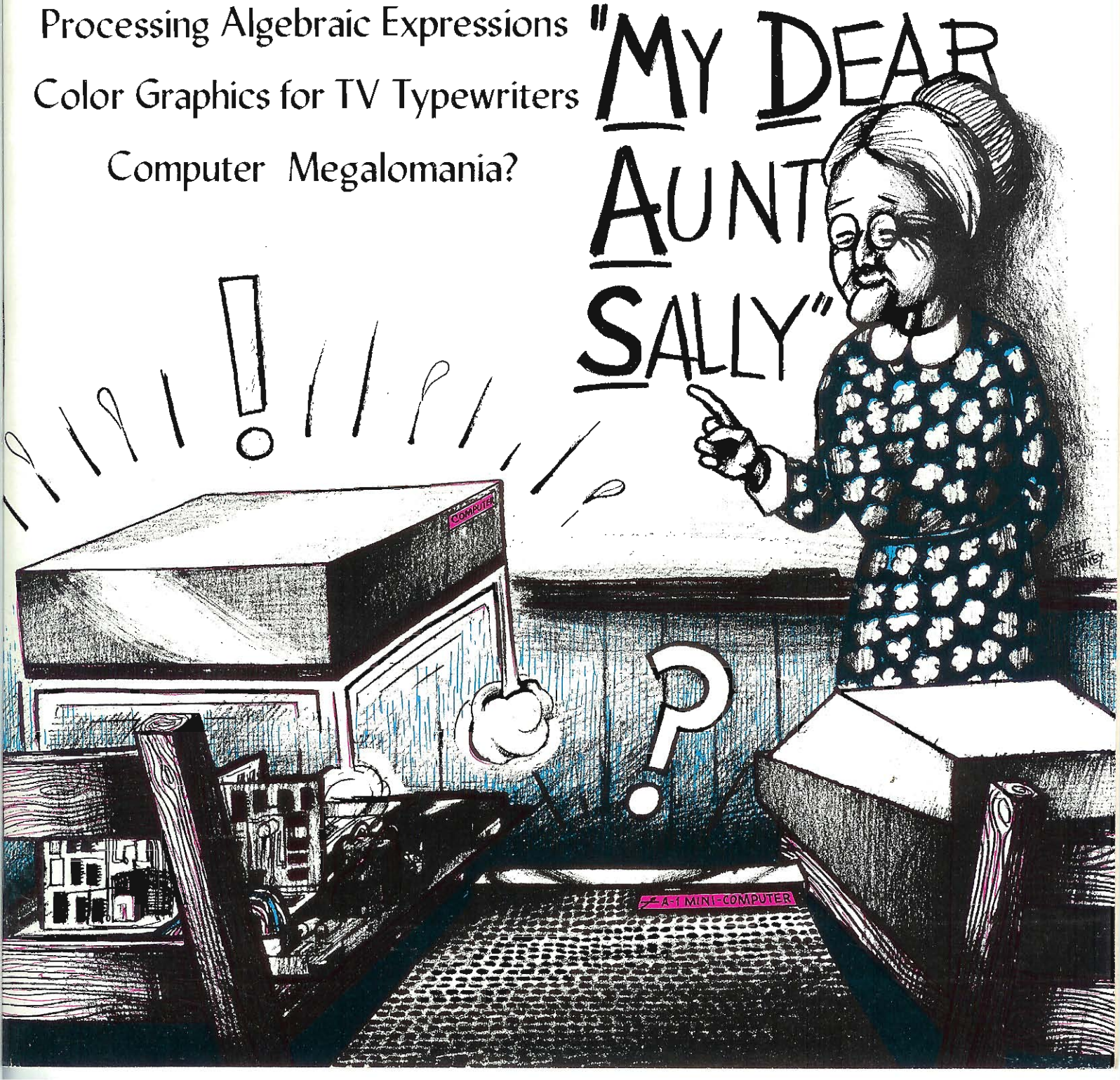
BYTE

the small systems journal

Processing Algebraic Expressions

Color Graphics for TV Typewriters

Computer Megalomania?



In the Queue

BYTE #6
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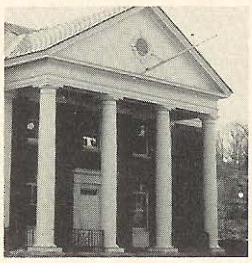
Foreground

Background

Nucleus



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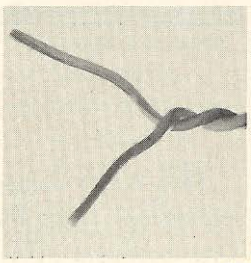

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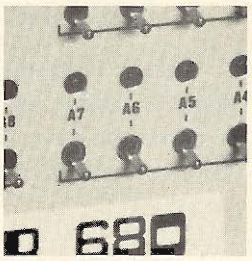

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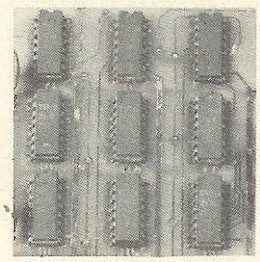

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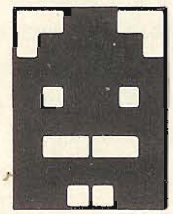

DISPLAY
QUEEN

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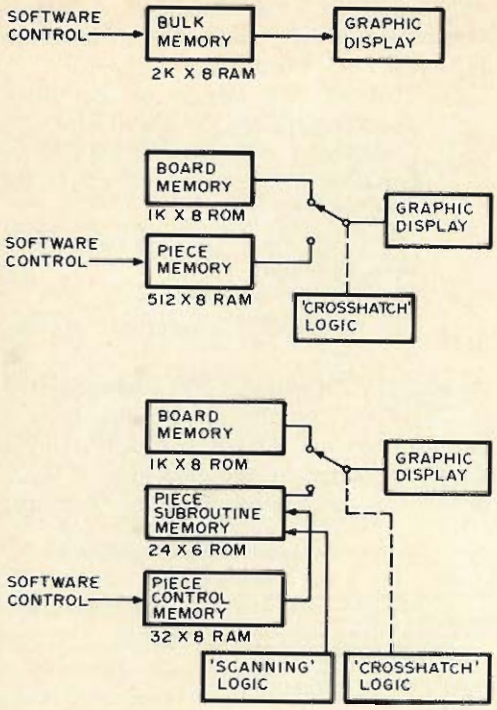

Figure 12: Three ways of organizing the refresh logic. At A, the most general approach is taken, with a full refresh memory for the entire screen. In this approach, computer software completely controls placement of patterns. At B, the memory is reduced slightly by partitioning it into two segments: One segment has the fixed "board layout" which is set up at the start of a game (or burned into the ROM of a commerial product); the second segment has the varying information on placement of the game pieces, and a crosshatch switch electronically combines them. Finally at C, even further specialization is introduced with three segments. The board memory remains, as in option B. Each piece of a chess grid is presented as a special ROM which is fixed with the bit patterns needed to generate any one of the 6 possible chess men. The placement and color are specified by a final RAM segment which changes during the game.

needed to specify any chessman or blank of either color. Here we trade the simple generality of a 2 K by 8 refresh memory off against the specific optimization of the 3-tiered memory for board games. Only a small amount of dedicated logic is needed for this specialization.

In a Pong style game, the ball is specified as four bits of the six bit word, making it twice the size of the background, foul, and goal lines. Ball motion can usually be computed during the vertical retrace time. For instance, if our microprocessor has a 10 microsecond cycle time, and we have around 4 milliseconds of vertical retrace time, up to 400 machine cycles are available to compute the new ball location.

The 96 by 96 format seems to lend itself well to game graphics and seems easy and reasonable to build. It is by no means the only possible organization for graphic displays. The basic partitioning problems will change for different types of graphic displays.■

NUMBERS

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Hidden in the matrix are 39 words related to numbers. Find a word, circle it or color it in, and cross it off the list. Words may be forward, backwards, up, down, or diagonally but always in a straight line; never skipping letters. However, some letters are used more than once. After circling all the words on the list, the unused letters will spell the name of one of the holidays this month. The answer key will follow in next month's BYTE.

BILLION
BINARY
COMPLEX
DECIMAL
EIGHT
ELEVEN
EXPONENT
FIFTEEN
FIFTY
FIVE
FORTY
FOUR
FRACTION
HUNDRED
IMAGINARY
INTEGER
LOGARITHM
MILLION
MODULUS
NEGATIVE
NINE
ONE
POSITIVE
RADIX
RATIONAL
REAL
ROOT
SEVEN
SIX
TEN
THIRTEEN
THIRTY
THOUSAND
THREE
TRILLION
TWELVE
TWENTY
TWO
ZERO

G M N E G A T I V E L E V E N
X I D A R P O S I T I V E R D
N L Y T A M H T I R A G O L E
O L T R T N O Y T N E W T I R
I I F I I E O D E V I F M D D
T O I L O E C W U Y O A U N N
C N F L N T N O T L G D E A U
A T T I A R N R M I U V I S H
R E E O L I I O N P L S G U L
F N E N N H T A I E L H H O A
S O N I T T R H W L Y E T H E
B I N A R Y O T R O L T X T R
G E X P O N E N T E R I R O U
D A D E C I M A L Y E E B O O
N E V E S I N T E G E R Z R F

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An 8080 Microprocessor Op Code Table

Here is another way of looking at the operation codes of the 8080 microprocessor, useful when you attempt to read the octal dump of a program stored in memory. Use the first two octal digits of the op code to pick a line in the table. Then scan across to the column underneath the third octal digit to find the corresponding mnemonic for the octal code. For example, if the dump says 324, look at line 32 and across column 4, where you find the mnemonic CNC (call a subroutine if the carry flag is false) followed by two asterisks indicating that two operand bytes are associated with this instruction. One asterisk is used for each additional byte required for the operand of the instruction. Unimplemented instruction codes are indicated by a dash (–) in place of a mnemonic.■

	0	1	2	3	4	5	6	7
00	NOP	LXI B **	STAX B	INX B	INR B	DCR B	MVI B *	RLC
01	–	DAD B	LDAX B	DCX B	INR C	DCR C	MVI C *	RRC
02	–	LXI D **	STAX D	INX D	INR D	DCR D	MVI D *	RAL
03	–	DAD D	LDAX D	DCX D	INR E	DCR E	MVI E *	RAR
04	–	LXI H **	SHLD **	INX H	INR H	DCR H	MVI H *	DAA
05	–	DAD H	LHLD **	DCX H	INR L	DCR L	MVI L *	CMA
06	–	LXI SP**	STA **	INX SP	INR M	DCR M	MVI M *	STC
07	–	DAD SP	LDA **	DCX SP	INR A	DCR A	MVI A *	CMC

	0	1	2	3	4	5	6	7
10	MOV B,B	MOV B,C	MOV B,D	MOV B,E	MOV B,H	MOV B,L	MOV B,H	MOV B,A
11	MOV C,B	MOV C,C	MOV C,D	MOV C,E	MOV C,H	MOV C,L	MOV C,M	MOV C,A
12	MOV D,B	MOV D,C	MOV D,D	MOV D,E	MOV D,H	MOV D,L	MOV D,M	MOV D,A
13	MOV E,B	MOV E,C	MOV E,D	MOV E,E	MOV E,H	MOV E,L	MOV E,M	MOV E,A
14	MOV H,B	MOV H,C	MOV H,D	MOV H,E	MOV H,H	MOV H,L	MOV H,M	MOV H,A
15	MOV L,B	MOV L,C	MOV L,D	MOV L,E	MOV L,H	MOV L,L	MOV L,M	MOV L,A
16	MOV M,B	MOV M,C	MOV M,D	MOV M,E	MOV M,H	MOV M,L	HLT	MOV M,A
17	MOV A,B	MOV A,C	MOV A,D	MOV A,E	MOV A,H	MOV A,L	MOV A,M	MOV A,A

	0	1	2	3	4	5	6	7
20	ADD B	ADD C	ADD D	ADD E	ADD H	ADD L	ADD M	ADD A
21	ADC B	ADC C	ADC D	ADC E	ADC H	ADC L	ADC M	ADC A
22	SUB B	SUB C	SUB D	SUB E	SUB H	SUB L	SUB M	SUB A
23	SBB B	SBB C	SBB D	SBB E	SBB H	SBB L	SBB M	SBB A
24	ANA B	ANA C	ANA D	ANA E	ANA H	ANA L	ANA M	ANA A
25	XRA B	XRA C	XRA D	XRA E	XRA H	XRA L	XRA M	XRA A
26	ORA B	ORA C	ORA D	ORA E	ORA H	ORA L	ORA M	ORA A
27	CMP B	CMP C	CMP D	CMP E	CMP H	CMP L	CMP M	CMP A

	0	1	2	3	4	5	6	7
30	RNZ	POP B	JNZ **	JMP **	CNZ **	PUSH B	ADI *	RST 0
31	RZ	RET	JZ **	–	CZ **	CALL **	ACI	RST 1
32	RNC	POP D	JNC **	OUT *	CNC **	PUSH D	SUI *	RST 2
33	RC	–	JC **	IN *	CC **	–	SBI *	RST 3
34	RPO	POP H	JPO **	XTHL	CPO **	PUSH H	ANI *	RST 4
35	RPE	PCHL	JPE **	XCHG	CPE **	–	XRI *	RST 5
36	RP	POP PSW	JP **	DI	CP **	PUSH PSW	ORI	RST 6
37	RM	SPHL	JM **	EI	CM **	–	CPI *	RST 7

(each * indicates an extra instruction word)