Los Alamos,

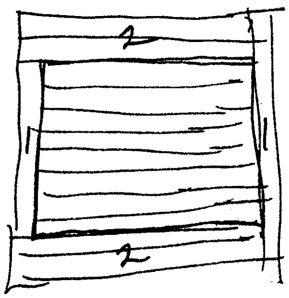
Stretch Meeting Aug 20, 1957

Problem to be examined - ~~[illegible]~~ properties?

1. Typical and important
2. Will take ~ 8 hrs on Stretch (now 704 takes 100 hrs. - 1600 hrs)
3. easily describable
4. if possible - declassified.
5. well understood numerically.
6. numerical data - available or obtainable,

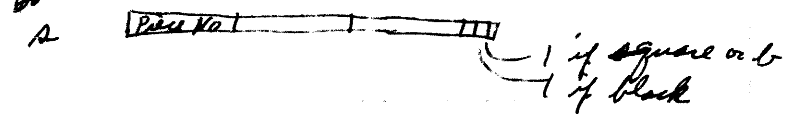
Mark Wells:

Chess Problem

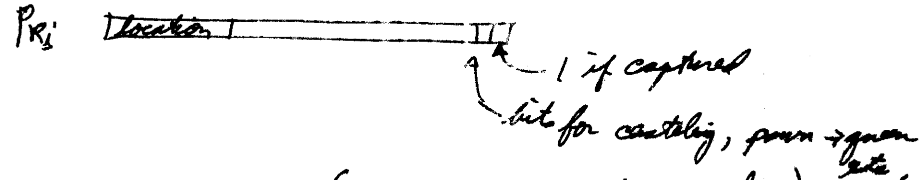


array in mem.

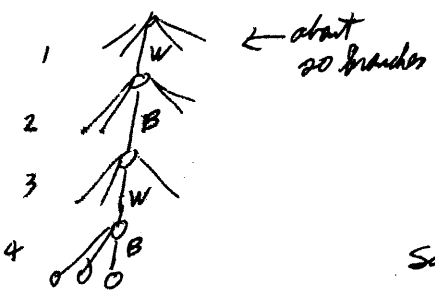
Board Words



piece words.



k moves ahead: all replys on each (goes up about 20^k).

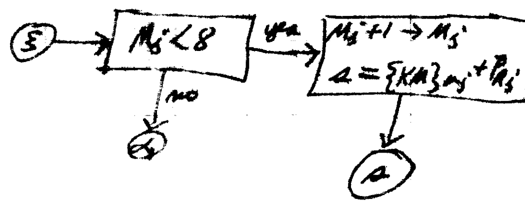


Then make evaluation at end of k moves.

Move M_j

Piece R_j

Subroutine for Knight



go down to bottom, exhaust last loop, drop back one level + go thru.

Fastest way go to s which transfers dep. on PT bits

To Make move: Transfer

$C_j = C(s)$ — capture storage
$c(P_{R_j}) \rightarrow s$
$0 \rightarrow P_{R_j}$
$s \rightarrow P_{R_j}$
mark P_{C_j} captured

$N_j + 1 \rightarrow N_j$ ← no. moves made. "Mobility"

method: undo moves
not save whole previous board

about 15 ms per move on 704.

"count ones mask", "Tr 0."

Fred Brooks, variable field length operation

1. What is the fundamental unit of data?

floating point : complex structure, fairly long, constrained format

fixed binary opn: simple nos., vary widely in length (1-30 bits)

fixed decimal opn: single no. " (1-16 dec) . multiples of characters. (usually 4 bits) - over a narrow range but uniformly 1-10 dec

alphabetic : single field, multiples of characters, 5 or 6 bit char → 7-8

length range, extremely wide range - 2-30

binary logic field : 1 bit elements (independent), usually short

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can settle for 6 bits for alphabetic sub-elements
4 bits for numerics "

2. "String of bits memory" ⋯⋯⋯ 0 L { 2 ends; others are all alike. very efficient for tape handling.

can't do this economically, how far can we go?

- table lookup is very much easier - conversion of character codes, - can make any power of 2 the function length.

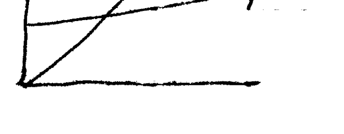
- change of modulus if word length is not a power of 2 (eg. 45 bits) - get carries

- Serial Binary Machine - costs nothing.

- Serial-Parallel -- switch matrix.

  - data no longer maps directly to memory

(64 × 64 switch - for 2 adjacent words ← most powerful
very costly

cost


crossover ~16-30 bits

— suppose we restrict crossing word boundaries —

— now need to specify length of field. — a unique marking symbol } one and only

— "procrustean bed"

— no. of bits long + starting bit.

takes 26 bits + 6 bits.

Program Control

1. Pieces of words — many of 704 orders are piece manipulation

in 709 of 180 orders 49 are piece manipulation.

bit addressing gives these generally (not masking easily however)

2. logical tests

Connect 16

connect to Mem. 16

connect + count in another reg. 16

all ones - left zeros

connect immediate. 16

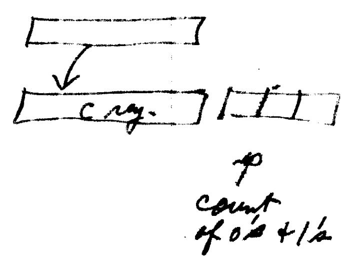
connect + count immediate. 16

5×16 connects

Br. on indicator on 4 (leave, invert, set 1, set 0)

Br. on ind. off 4

eg. test 63rd bit   X.63 CCT 1



3. General flexible scheme going from one format to other. (editing)

- more eff. use of memory
- faster for smaller records

commercial
- passing files
- making logical decisions.

Example for Harvest: composing music by markov chains. (hymns)

1/8 note intervals – pitch 18 19 19 19, etc.

use all 4 notes of 4 voices

e.g.

18	24	38	48
19	25	40	49
20	~~24~~	38	48
⋮			

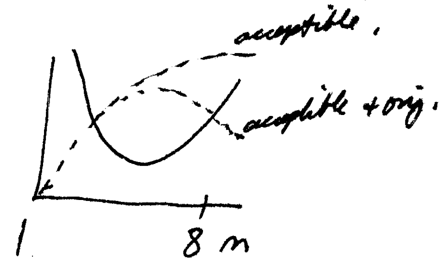
melody 64 meters

put 7 rests between hymns – make table of note sequences

digrams, trigrams, etc. n-grams.

get distributions – may random nos.

yield of songs



at 8 orig. half hymns. combined

$\varphi_{i,j}^{n+1} = \alpha[\varphi_{i+1,j}^{n} + \varphi_{i-1,j}^{n} + \varphi_{i,j+1}^{n} + \varphi_{i,j-1}^{n}] + (1-4\alpha)\varphi_{i,j}^{n}$

SOLUTION OF $\nabla^2\varphi$ PROB BY 2ND ORDER RICHARDSON METHOD: CHAIN INDEXING

[illegible signature]

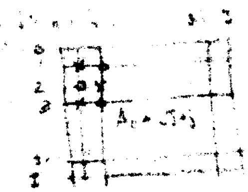
SEQ	OPN (OP / SCT)	A (OA / OAC)	X (X / YZ)	SA (SA / SAD)	COMMENTS
0	TS	α+1	2,3 G	R_3	
α+ 1	TS	α+2	4	R_4	
2	TS	α+3	5	R_5	
3	TS	α+4	6	R_6	
4	TS	α+5	7	R_7	
5	SWAP	R_1		R_2	
6	[illegible]	α+7	1	R_2	
7	[illegible] S	L(c)		Σ	
8	A L	(A_0) 1	(1,2,3) G	(A_0) 1	(1,2,4) -
9	A	(A_0) 1	(1,2,6) G		
10	A	(A_0) 1	(1,2,5) G		
11	M S	L(d)		T_0	
12	M L	(A_0) 1	(1,2) G	L(1-4α)	
13	A	T_0			
14	SWAP	(A_0) 1	(1,2) G	A(UR)	
15	S	(A_0)	(1,2) G		
16	MD				
17	A S	Σ		Σ	
18	[illegible]	α+2	[illegible]	2	
19	IBC	α+7	2	R_3 1	
20	IBC	α+8	7	1	
21	S	L(ε)			
22	BB	α+5		#2	
23	(MESH HAS CONVERGED)				
24					

COMMENTS:

	R_1	1	[illegible]	[illegible]
	R_2	2	[illegible]	[illegible]
2, 3	R_3	(J+1)	(J-1)	K_2
4	R_4	-(J+1)	—	—
5	R_5	+1	—	—
6	R_6	-1	—	—
7	R_7	0	2	—

NOTES

1. THE MESH [illegible]



2. $\varphi_{i,j}^{n+1} = \alpha(\varphi_{i+1,j}^{n} + \varphi_{i-1,j}^{n} + \varphi_{i,j+1}^{n} + \varphi_{i,j-1}^{n}) + (1-4\alpha)\varphi_{i,j}^{n}$

3. α IS THE SMALLER ROOT OF
$\alpha^2 t^2 - 4\alpha + 1 = 0$
WHERE $t = [\cos(\pi/I) + \cos(\pi/J)]$

4. WE COMPUTE [illegible]
[illegible]

5. [illegible] $\frac{I}{2} - 1$ FOR EVEN I
$\frac{I-1}{2}$ FOR ODD I

6. [illegible] $\frac{I}{2} - 1$ FOR EVEN I
$\frac{I-3}{2}$ FOR ODD I

$\varphi_{i,j}^{n+1} = \alpha\left[\varphi_{i+1,j}^{n} + \varphi_{i-1,j}^{n} + \varphi_{i,j+1}^{n} + \varphi_{i,j-1}^{n}\right] + (1-4\alpha)\varphi_{i,j}^{n}$

A(1 [illegible]

SOLUTION OF $\nabla^2\varphi = 0$ BY 2ND ORDER RICHARDSON METHOD: CHAIN INDEXING

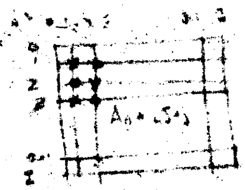
William J. [illegible]

SEQ	OPN	A	X	SA	COMMENTS
α	TS	$\alpha+1$	2,3 G	R_3	
$\alpha+1$	TS	$\alpha+2$	4	R_4	
2	TS	$\alpha+3$	5	R_5	
3	TS	$\alpha+4$	6	R_6	
4	TS	$\alpha+5$	7	R_7	
[illegible]	SWAP	R_1		R_2	
[illegible]	TS	$\alpha+7$	1	R_2	
7	L S	L(0)		Σ	
8	A L	(A_0) 1	(1,2,3) G	(A_0) 1	(1,2,4) L
9	A	(A_0) 1	(1,2,6) G		
10	A	(A_0) 1	(1,2,5) G		
11	M S	$L(\alpha)$		T_0	
12	M L	(A_0) 1	(1,2) G	$L(1-4\alpha)$	
[illegible]	A	T_0			
14	SWAP	(A_0) 1	(1,2) G	A(UR)	
15	S	(A_0) 1	(1,2) G		
16	MP				
17	A S	Σ		Σ	
18	[illegible]	$\alpha+2$	1	2	
19	IBC	$\alpha+8$	2	R_0 1	
20	IBR	$\alpha+8$	7	1	
21	S	L(5)			
22	BB	$\alpha+5$		#2	
23	(MESH HAS CONVERGED)				
24					

1	R_1	1	h	R_2
	R_2	2	ℓ	R_1
2,3	R_3	(J+1)	(J-1)	R_3
4	R_4	-(J+1)	—	—
5	R_5	+1	—	—
6	R_6	-1	—	—
7	R_7	0	2	—

NOTES

1. THE MESH [illegible]



2. $\varphi_{i,j}^{n+1} = \alpha\left(\varphi_{i+1,j}^{n} + \varphi_{i-1,j}^{n} + \varphi_{i,j+1}^{n} + \varphi_{i,j-1}^{n}\right) + (1-4\alpha)\varphi_{i,j}^{n}$

3. α IS THE SMALLER ROOT OF
$\alpha^2 t^2 - 4\alpha + 1 = 0$
WHERE $t = \left[\cos(\pi/J) + \cos(\pi/J)\right]$

4. WE COMPUTE [illegible] [illegible]

5. $h = \frac{J}{2} - 1$ FOR EVEN J
$\frac{J-1}{2}$ FOR ODD J

6. $\ell = \frac{J}{2} - 1$ FOR EVEN J
$\frac{(J-3)}{2}$ FOR ODD J