TEXAS INSTRUMENTS
Calculator Products Division

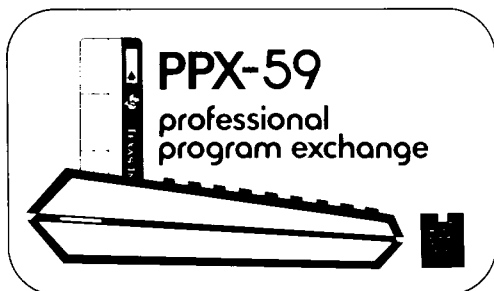
Submission Abstract

Program Title HEXPAWN		Rev.	
Abstract of Program The game of hexpawn is played on a 3 x 3 board, with 3 chess pawns on each side. Player plays against the calculator in an attempt to capture all enemy pieces, reach the other side of the board, or block all legal moves. But there's a catch: the calculator improves its strategy each game, selectively "remembering" only the winning moves.			
Original SR-52 program by B. R. Kelso, New York, N. Y.			
User Benefits: Entertainment.			
Category Number <u>91</u>	Required Progs. _____	Prog. Steps <u>183</u>	PC-100A Needed <input type="checkbox"/> Library Module ID _____
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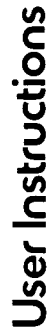
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Program Description

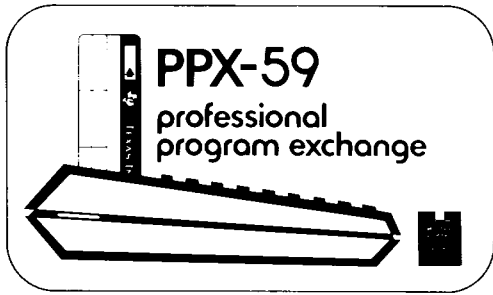
Program Title:	HEXPAWN	Rev.
<p>Method, Equations, Sketches, Limitations, References, Error Recovery: Only 2 types of moves are allowed: (1) a pawn may advance 1 square straight forward to an empty space; (2) a pawn may capture an enemy pawn by moving one square diagonally, left or right, to a square occupied by the enemy. The captured piece is removed from the board. A game is won by any one of 3 ways: (1) by advancing a pawn to the 3rd row; (2) by capturing all enemy pieces; (3) by achieving position in which the enemy cannot move, the human player moves first. There are 3 possible opening moves, but 2 are mirror images of each other, so only 1 of these is allowed. There are 24 possible board positions after the human player has moved. These are shown on the board position diagram. After the human player makes his move he enters a number from 1 to 24 corresponding to the board position shown on the diagram. The TI-59 responds with a number from 1 to 3 showing you its move choice. These are shown also on the diagram. If the human player wins, he tells this to the TI-59 by pressing B. This will cause the program to remove the last move it made from its memory. Eventually only the best moves will remain in memory and the TI-59 will be unbeatable.</p> <p>The method the TI-59 uses for "learning" is as follows: After registers 1, 2 and 3 are initialized, they contain all valid moves for each of the 24 board positions. R01 contains all moves numbered 1; R2 contains all moves numbered 2, etc. The program considers each of these registers to contain a string of bits (binary digits) which are shifted right (i.e., divided by a power of 2) until the board position bit in question is immediately to the right of the decimal (or binary) point. This bit can now be tested by seeing if the fractional part is less or greater than 0.5. If less than 0.5, this is considered a "0" and no move is permitted; a random number generator is used to select R1, R2, or R3 for testing described above. If the TI-59 loses a game the last move is deleted from either R1, R2 or R3 by subtracting a power of 2 from the corresponding register.</p> <p>References:</p> <ol style="list-style-type: none"> 1. Gardner, M., "How to Build A Game-Learning Machine and Then Teach It To Play And To Win", <u>Scientific American</u>, March, 1962, pages 138-153. 2. Jacobs, Jacob R., "Hexpaw", HP-65 User's Library, Program 01120A. 		
<input type="checkbox"/> See Continuation Sheet		



[INV]	[INX]	[CE]	[CLR]	[x:t]	[x ²]
[√]	[1/x]	[STO]	[RCL]	[SUM]	[y ^x]
[EE]	[C]	[]	[÷]	[GTO]	[X]
[SBR]	[−]	[RST]	[+]	[R/S]	[•]
[+/-]	[=]	[CLR]	[INV]	[log]	[DP]
[tan]	[Pgm]	[P→R]	[sin]	[COS]	[CMs]
[Arc]	[P/d]	[Z]	[log]	[F/A]	[int]
[Deg]	[Pause]	[Σ+]t	[MOP]	[DP]	[Reg]
[DB]	[Σ+t]	[Σ+	[Σ]	[Dad]	[Stng]
[Hfng]	[DMS]	[π]	[List]	[Write]	[DS]
[Adr]	[Pri]				

STEP	PROCEDURE	ENTER	PRESS	OUTPUT/MODE (see legend below)
1	Enter program			
2	Initialize		E	Load card side 1
3	Select Opening Move	1 or 2	A	524413
4	Determine machine's move by matching displayed number to the corresponding numbered black piece move within the box which is numbered according to the selected opening move.			TI-59's move
5	Select next move			
6	Find resulting board pattern	Move #	A	
7	Determine machine's move as in Step 4 above.			TI-59's move
8	Go back to Step 6 and repeat until you or the machine win. If the machine loses, Press B. If you lose, do not press B and go back to Step 3 to start a new game.		B	Ignore display
Note: On rare occasions the program will enter an infinite loop when the calculator cannot find a valid move. In such cases the machine forfeits that game. Press R/S CLR. Go to step 3 for a new game.				

☐ See Continuation Sheet



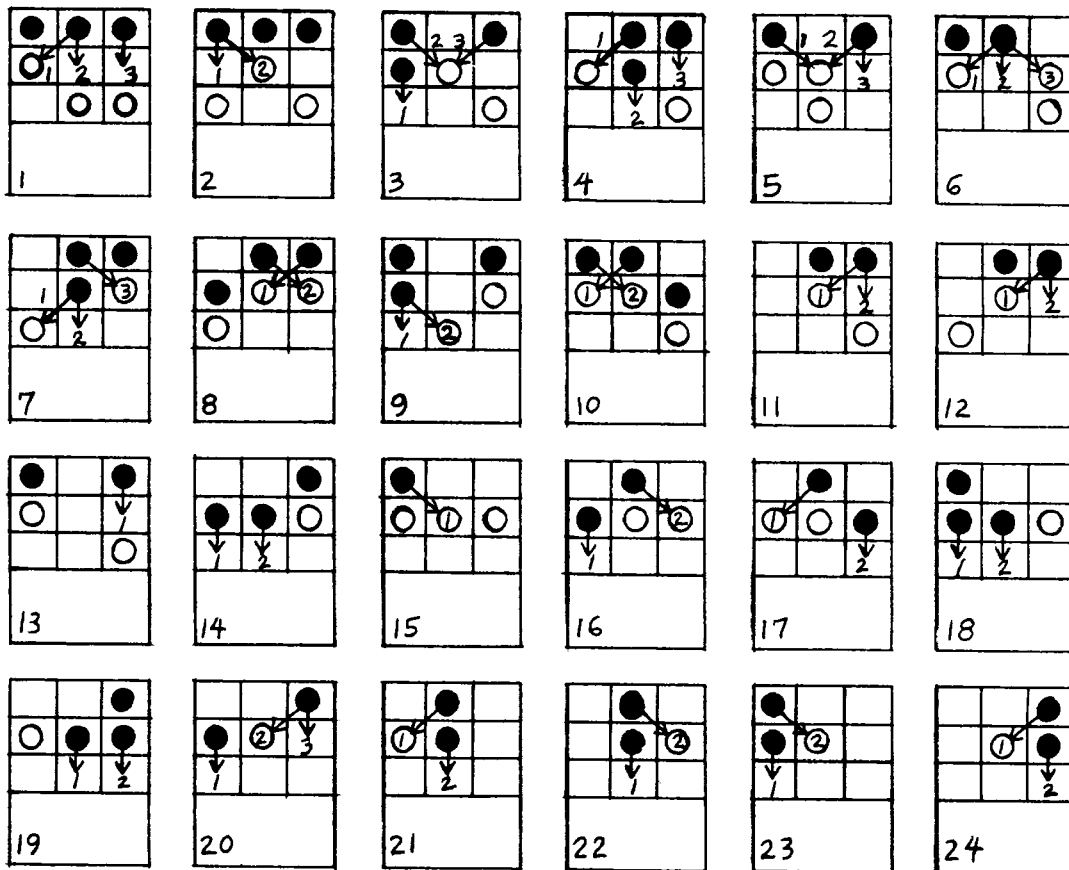
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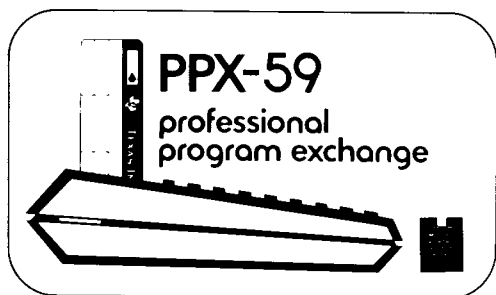
Continuation Sheet

Continued From: ☐ Program Description ☐ User Instructions ☐ Stmt. of Example

Program Title: HEXPAWN	Rev.
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BOARD POSITION DIAGRAM



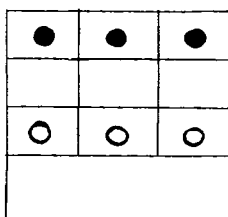


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Sample Problem

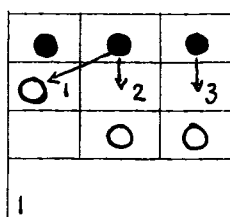
Statement of Example

Fig. #1



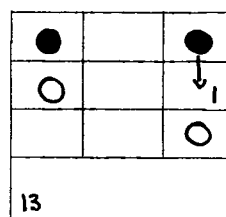
Initial
Board
Position

Fig. #2



Board after
players move
(Board Position 1)

Fig. #3



Board after
players move
(Board Position 13)

☐ See Continuation Sheet

ENTER	PRESS	OUTPUT/MODE (see legend below)	COMMENT
	E	524413	Initialize* See fig. #1
Game One			
1. Player moves to board position 1:			
1	A	3	TI-59 chooses move 3. See fig. #2.
2. Player captures machine's center man and wins:			Tell TI-59 it lost.
	B		
Game Two			
1. Player moves to board position 1:			See fig. #1 TI-59 chooses move 1. See fig. #2.
1	A	1	
2. Player move: Board 13			TI-59 wins. See fig. #3.
13	A	1	
*This removes any accumulated "knowledge" of the TI-59			
Modes: n* - Printed only; (n) - Displayed Briefly (Pause); (n) - Printed and displayed			

☐ Over

PPX-59 Professional Program Exchange

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9 1 8 0 4 9

For TI use only

LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS
000	76	LBL		055	75	-		110	04	04	
001	11	A		056	93	.		111	75	-	
002	42	STD		057	05	5		112	93	.	
003	05	05		058	95	=		113	05	5	
004	76	LBL		059	22	INV		114	95	=	
005	38	SIN		060	77	GE		115	58	FIX	
006	43	RCL		061	38	SIN		116	00	00	
007	08	08		062	43	RCL		117	52	EE	
008	85	+		063	06	06		118	22	INV	
009	89	π		064	85	+		119	44	SUM	
010	95	=		065	01	1		120	04	04	
011	33	X²		066	95	=		121	22	INV	
012	71	SBR		067	91	R/S		122	52	EE	
013	65	X		068	76	LBL		123	22	INV	
014	43	RCL		069	12	B		124	58	FIX	
015	04	04		070	02	2		125	92	RTN	
016	42	STD		071	22	INV		126	76	LBL	
017	08	08		072	49	PRD		127	39	CDS	
018	65	X		073	07	07		128	43	RCL	
019	03	3		074	43	RCL		129	06	06	
020	95	=		075	06	06		130	75	-	
021	71	SBR		076	67	EQ		131	01	1	
022	65	X		077	88	DMS		132	95	=	
023	42	STD		078	01	1		133	22	INV	
024	06	06		079	75	-		134	67	EQ	
025	22	INV		080	43	RCL		135	30	TAN	
026	67	EQ		081	06	06		136	43	RCL	
027	39	CDS		082	95	=		137	02	02	
028	43	RCL		083	67	EQ		138	42	STD	
029	01	01		084	89	π		139	09	09	
030	42	STD		085	43	RCL		140	61	GTD	
031	09	09		086	07	07		141	87	IFF	
032	76	LBL		087	22	INV		142	76	LBL	
033	87	IFF		088	44	SUM		143	30	TAN	
034	02	2		089	03	03		144	43	RCL	
035	45	YX		090	91	R/S		145	03	03	
036	43	RCL		091	76	LBL		146	42	STD	
037	05	05		092	88	DMS		147	09	09	
038	85	+		093	43	RCL		148	61	GTD	
039	93	.		094	07	07		149	87	IFF	
040	05	5		095	22	INV		150	76	LBL	
041	95	=		096	44	SUM		151	15	E	
042	71	SBR		097	01	01		152	29	CP	
043	65	X		098	91	R/S		153	47	CMS	
044	42	STD		099	76	LBL		154	01	1	
045	07	07		100	89	π		155	06	6	
046	35	1/X		101	43	RCL		156	07	7	
047	65	X		102	07	07		157	07	7	
048	43	RCL		103	22	INV		158	07	7	
049	09	09		104	44	SUM		159	02	2	
050	95	=		105	02	02		160	01	1	
051	71	SBR		106	91	R/S		MERGED CODES 62 Pgm Ind 72 STD Ind 83 GTD Ind 63 Exc Ind 73 RCL Ind 84 Op Ind 64 Prd Ind 74 SUM Ind 92 INV SBR			
052	65	X		107	76	LBL					
053	43	RCL		108	65	X					
054	04	04		109	42	STD					

PPX-59 Professional Program Exchange

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For TI use only

LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS
161	05	5									
162	42	STD									
163	01	01									
164	01	1									
165	06	6									
166	07	7									
167	05	5									
168	06	6									
169	07	7									
170	03	3									
171	05	5									
172	42	STD									
173	02	02									
174	05	5									
175	02	2									
176	04	4									
177	04	4									
178	01	1									
179	03	3									
180	42	STD									
181	03	03									
182	91	R/S									

62

Pgm

Ind

63

Exc

Ind

64

Prd

Ind

72

STO

Ind

73

RCL

Ind

74

SUM

Ind

83

GTO

Ind

84

Op

Ind

92

INV

SBR

MERGED CODES