

Program Description I

Program Title ADVANCED BATTLESHIPContributor's Name MARK W. McNAIRAddress 5204 15th N.E. #204City SEATTLEState WASHZip Code 98105

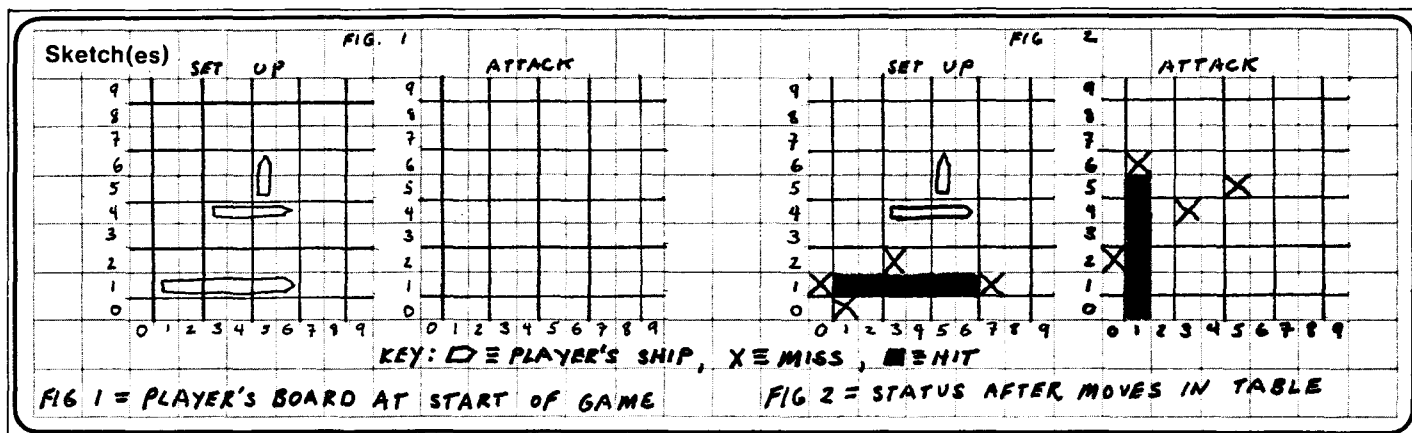
Program Description, Equations, Variables BASED ON THE ORIGINAL GAME OF 'BATTLESHIP',
PLAYED ON A 10 X 10 BOARD. IN THE STANDARD GAME EACH FLEET CONSISTS OF
5 VESSELS, ONE OF WHICH OCCUPIES 5 SQUARES, ONE 4 SQUARES AND SO ON
DOWN TO ONE. VESSELS MAY BE AT ANY ANGLE. YOU MAY LIMIT ANGLES
TO ONLY HORIZONTAL AND VERTICAL AND MAY ALTER THE SIZE AND
NUMBER OF VESSELS. THE MACHINE WILL NOT REPEAT SHOTS AND
WILL SEARCH OUT A SHIP FROM ONE HIT.

LIMITING ANGLES TO HORIZONTAL AND VERTICAL GIVES YOU AN
ADVANTAGE AS THE ATTACK PROGRAM ASSUMES THAT ALL ANGLES
ARE ALLOWED. ELIMINATING THE VESSEL WHICH OCCUPIES ONE SQUARE
GIVES YOU AN ADVANTAGE AS THIS SHIP IS JUST AS HARD FOR
YOU TO FIND AS FOR THE MACHINE. ELIMINATING OTHER SHIPS
GIVES ESSENTIALLY NO ADVANTAGE TO EITHER "PLAYER" BUT DOES
ALLOW FOR DIVERSITY.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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GAME
Sample Problem(s) PLAY A GAME WITH 3 SHIPS OF LENGTHS 6, 4 AND 2. TO SET UP:
 (1) LOAD SIDES 1 AND 2 OF CARD I, (2) PRESS [B] FOR HORIZ. AND VERT. ONLY,
 (3) ENTER 6 AND PRESS [D] (6, [D]) FOR MAX $n = 6$, (4) ELIMINATE SHIPS
 OF LENGTHS 5, 3 AND 1 (5, [C], 3, [C], 1, [C]), (5) INPUT $S = 0.654321$ AND START
 (0.654321, [A]). RUNNING TIME ≈ 80 SEC. PLACE CARD II IN READER AND SET
 YOUR SHIPS ON PAPER (FIG. 1) WHILE RUNNING. TO PLAY: LOAD SIDES 1 AND
 2 OF CARD II THEN TRY ROW 5, COLUMN 5 AS YOUR FIRST SHOT (5.5, [A])
 OUTPUT IS 0.0 (A MISS) THEN 0.1 (H.P.'S SHOT), H.P. HAS TRIED ROW 0, COLUMN 1;
 TELL IT THIS IS A MISS ([C]). TRY 4X3 (4.3, [A]) OUTPUT IS 0.0 (ANOTHER MISS)
 THEN 1.4 (H.P.'S SHOT). H.P. HAS A HIT, TELL IT ([E]). CONTINUE MOVES IN TABLE:

PLAYER'S SHOT	RESULT	H.P.'S SHOT	TELL H.P. RESULT
2.1, [A]	1.0 (HIT)	2.3	(MISS) [C]
2.0, [A]	0.0 (MISS)	1.3	(HIT) [E]
3.1, [A]	1.0 (HIT)	1.2	(HIT) [E]
4.1, [A]	1.0 (HIT)	1.1	(HIT) [E]
5.1, [A]	1.0 (HIT)	1.0	(MISS) [C]
6.1, [A]	0.0 (MISS)	1.5	(HIT) [E]
1.1, [A]	1.0 (HIT)	1.6	(HIT) [E]
0.1, [A]	1.0 (HIT)	1.7	(MISS) [C] (SEE FIG. 2)

THE REST OF THE GAME IS LEFT FOR YOU TO FINISH, HAVE FUN!

Reference(s)

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	x LBL B	31 25 12	FOR HORIZ. & VERT. ONLY, SET FLAG 0		GSB a	32 22 11	GET RANDOM #, 0 < # < 1
	SFO	35 51 00			RCL C	34 13	DETERMINE CODE FOR SHIP ANGLE; 0 = VERT, 1 = HORIZ, 2 = DIAG. UP RT, 3 = DIAG. UP LEFT
	I	01			X	71	
	RTN	35 22		060	INT	31 83	ANGLE CODE → R5
x	LBL C	31 25 13	RECORD #'S OF SHIPS NOT TO BE SET IN FRAC PART OF R9 IN FORM 10 ⁿ FOR EACH n ENTERED		STO I	35 33	GET RANDOM #
	CHS	42			GSB a	32 22 11	
	10 ^x	32 53			EEX	43	
	STO + 9	33 61 09			2	02	
	CLX	44			X	71	
010	RTN	35 22			INT	31 83	
x	LBL D	31 25 14	MAX n ≠ 5, STORE NEW MAX n IN RA AND SET FLAG 1		I	01	
	STO A	33 11			0	00	
	SF 1	35 51 01			÷	81	
	RTN	35 22		070	STO B	33 12	RANDOM SQUARE R.C → R8
x	LBL A	31 25 11	BEGIN SET UP		GTO (i)	22 24	ACCORDING TO ANGLE CODE
	5	05		x	LBL O	31 25 00	LBL'S 0-3:
	F? 1	35 71 01	IF MAX n ≠ 5 USE VALUE IN RA		INT	31 83	DETERMINE IF R.C IS WITHIN BOUNDS FOR SHIP n & ANGLE CHOSEN; IF SO STORE APPROPRIATE CONSTANT IN R8 IF NOT, DETERMINE NEW ANGLE CODE AND R.C (LBL 7) (R.C = ROW. COLUMN)
	RCL A	34 11			GSB 4	31 22 04	
	RCL 9	34 09			I	01	
020	FRAC	32 83			STO D	33 14	
	+	61	X = MAX n. SHIPS NOT TO BE SET		GTO 5	22 05	
	CL REG	31 43		x	LBL 1	31 25 01	
	P=S	31 42	CLEAR ALL R		FRAC	32 83	
	CL REG	31 43		080	I	01	
	STO 9	33 09	X → R9		0	00	
	A R4	35 53			X	71	
	F? 1	35 71 01			GSB 4	31 22 04	
	R4	35 53			□	83	
	STO E	33 15	S → R8		I	01	
030	4	04	4 → R2, OR IF FLAG 0, 2 → R2		STO D	33 14	
	F? 0	35 71 00			GTO 5	22 05	
	2	02		x	LBL 2	31 25 02	
	STO C	33 13			INT	31 83	
x	LBL 6	32 25 12	DETERMINE IF SHIP OF CURRENT n (n = INT. PART R9) IS TO BE SET	090	GSB 4	31 22 04	
	RCL 9	34 09			RCL B	34 12	
	INT	31 83			FRAC	32 83	
	I	01			I	01	
	-	51			0	00	
	10 ^x	32 53			X	71	
040	RCL 9	34 09			GSB 4	31 22 04	
	FRAC	32 83			I	01	
	X	71			□	83	
	FRAC	32 83			I	01	
	I	01		100	STO D	33 14	
	0	00			GTO 5	22 05	
	X	71		x	LBL 3	31 25 03	
	INT	31 83	IF X ≠ 0 DO NOT SET SHIP n; GTO 6 FOR LOOP CONTROL		FRAC	32 83	
	X ≠ 0	31 61			I	01	
	GTO 6	22 06			0	00	
050	RCL 9	34 09	KEEP TOTAL OF # OF SQUARES USED FOR SHIPS IN FRAC. PART OF R0 IN FORM 0.nn		X	71	
	INT	31 83			GSB 4	31 22 04	
	EEX	43			RCL B	34 12	
	2	02			INT	31 83	
	÷	81		110	RCL 9	34 09	
	STO + 0	33 61 00			INT	31 83	
x	LBL 7	31 25 07			X > Y	32 81	

REGISTERS

0 USED	1 ←	2	3 TENTATIVE	4 SHIP	5 LOCATIONS	6	7	8 →	9 USED
S0	← S1	S2	S3 SET	S4 UP	S5 BOARD	S6	S7	S8	→ S9
A USED	B USED	C 4 OR 2	D USED	E RANDOM #	F	G	H	I CONTROL	

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
	GTO 7	22 07			1	01	
	☐ 83			170	0	00	
	9	09			X	71	
	CHS	42			INT	31 83	
	STO D	33 14			X ≠ 0	31 61	IF X ≠ 0 THIS SQUARE IS ALREADY USED, GTO 7
	GTO 5	22 05			GTO 7	22 07	
x	LBL 4	31 25 04	TEST (X) VS n		0	00	
120	RCL 9	34 09			STO I	35 33	
	INT	31 83			DSZ (i)	32 33	
	1	01			GTO f d	22 31 14	LOOP FOR NEXT
	-	51			RCL 0	34 00	
	X < Y	32 71	IF n ≤ (X), RTN	180	FRAC	32 83	RECORD THE SQUARES USED FOR SHIP n, FOR EACH SQUARE R.C (ROW, COLUMN) ADD 1 X 10 ^C TO R _{SR}
	RTN	35 22			RCL 9	34 09	
	GTO 7	22 07	IF NOT, GTO 7		INT	31 83	
x	LBL a	32 25 11	RANDOM # GENERATOR		+	61	
	RCL E	34 15			STO 0	33 00	
	π	35 73		x	LBL e	32 25 15	
130	X ²	32 54			RCL 0	34 00	
	X	71			STO I	35 33	
	FRAC	32 83			RCL (i)	34 24	
	STO E	33 15			1	01	
	RTN	35 22		190	0	00	
x	LBL 5	31 25 05	DETERMINE ALL SQUARES TO BE OCCUPIED BY SHIP, STORE IN R ₁ -R _n (R _{n-1} = R _n - R _D)		+	61	
	RCL 9	34 09			STO I	35 33	
	STO I	35 33			FRAC	32 83	
	RCL B	34 12			1	01	
x	LBL c	32 25 13			0	00	
140	STO (i)	33 24			X	71	
	RCL D	34 14			CHS	42	
	-	51			10 ^X	32 53	
	DSZ I	31 33			STO + (i)	33 61 24	
	GTO f c	22 31 13	LOOP FOR NEXT	200	0	00	
	RCL 0	34 00			STO I	35 33	
	FRAC	32 83			DSZ (i)	32 33	
	RCL 9	34 09			GTO f e	22 31 15	LOOP FOR NEXT
	INT	31 83			LBL 6	31 25 06	CONTROL, LOOP FOR NEXT n
	+	61			9	09	
150	STO 0	33 00			STO I	35 33	
x	LBL d	32 25 14	DETERMINE IF ANY SQUARE TO BE OCCUPIED BY NEW SHIP IS ALREADY OCCUPIED		DSZ (i)	32 33	
	RCL 0	34 00			GTO f b	22 31 12	
	STO I	35 33			RCL 0	34 00	
	RCL (i)	34 24		210	FRAC	32 83	X = 0, SUM OF n's S CLEAR PRIMARY R's PRESERVE S → R _E
	1	01			RCL E	34 15	
	0	00			CL REG	31 43	
	+	61			STO E	33 15	
	STO I	35 33			R ₊	35 53	
	FRAC	32 83			ENT A	41	
160	1	01			ENT A	41	
	0	00			EEX	43	
	X	71			2	02	
	1	01			X	71	
	-	51		220	+	61	X = Σ n's, Σ n's X → R _D
	10 ^X	32 53			STO D	33 14	
	RCL (i)	34 24			CL X	44	
	X	71			ENT A	41	
	FRAC	32 83			R/S	84	END

LABELS					FLAGS	SET STATUS		
A	B HORIZ. & VERT. ONLY	C DON'T SET SHIP # n	D MAX n ≠ 5	E	OVERT & HORIZ ONLY	FLAGS	TRIG	DISP
SET UP						ON OFF		
a RAND. # GENERATOR	b USED	c USED	d USED	e USED	1 MAX n ≠ 5	0 ☐ ☒	DEG ☒	FIX ☒
0 USED	1 USED	2 USED	3 USED	4 USED	2	1 ☐ ☒	GRAD ☐	SCI ☐
5 USED	6 USED	7 USED	8	9	3	2 ☐ ☒	RAD ☐	ENG ☐
						3 ☐ ☒		n <u>9</u>

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	X LBL A	31 25 11	PLAYER'S SHOT		GTO 0	22 00	YES - SET FLAGS & TRY AGAIN
	I	01			RCL B	34 12	NO - SHOT IS O.K.
	0	00			GSB a	32 22 11	RECORD SHOT
	+	61		060	RCL B	34 12	DISPLAY SHOT
	GSB 9	31 22 09	CHECK FOR HIT OR MISS		R/S	84	STOP
	X ≠ 0	31 61	IF X ≠ 0, A HIT		X LBL e	32 25 15	"TRY AGAIN" VIA
	GSB b	32 22 12	IF A HIT, RECORD IT		GSB C	31 22 13	"MISS" SUBR
	-X-	31 84	DISPLAY HIT OR MISS		GTO D	22 14	
	X LBL D	31 25 14	H.P.'s SHOT		X LBL 0	31 25 00	SET FLAGS AND
010	F? I	35 71 01	WORKING ON A HIT?		SF 0	35 51 00	TRY AGAIN
	GTO I	22 01	YES - GTO I		SF 2	35 51 02	
	RCL E	34 15	NO - RANDOMLY		GTO D	22 14	
	π	35 73	DETERMINE NEXT		X LBL 4	31 25 04	LBLS 1-8:
	X ²	32 54	SHOT		GSB 8	31 22 08	FROM STEP #39;
	X	71			CHS	42	ACCORDING TO
	frac	32 83			RTN	35 22	INDEX IN R _C & I,
	STO E	33 15			X LBL 5	31 25 05	SUPPLY APPROPRIATE
	FEX	43			I	01	CONSTANT
	2	02			CHS	42	
020	X	71			RTN	35 22	
	INT	31 83			X LBL 6	31 25 06	
	I	01			GSB 2	31 22 02	
	0	00			CHS	42	
	÷	81		080	RTN	35 22	
	STO A	33 11			X LBL 7	31 25 07	
	GSB 9	31 22 09	HAS THIS SHOT BEEN		GSB 3	31 22 03	
	X ≠ 0	31 61	TRIED BEFORE?		CHS	42	
	GTO D	22 14	YES - TRY AGAIN AT D		RTN	35 22	
	RCL A	34 11	NO - RECORD SHOT		X LBL 8	31 25 08	
030	GSB a	32 22 11			□	83	
	RCL A	34 11	DISPLAY SHOT		9	09	
	R/S	84	STOP		RTN	35 22	
	X LBL I	31 25 01	WORKING ON A HIT.		X LBL 1	31 25 01	
	RCL C	34 13	RCL INDEX	090	I	01	
	STO I	35 33	INDEX → I		RTN	35 22	
	RCL A	34 11			X LBL 2	31 25 02	
	F? 0	35 71 00	A 2nd HIT ADJACENT?		I	01	
	RCL B	34 12	YES - USE R _B		□	83	
	GSB (i)	31 22 24	GET APPROPRIATE CONST.		I	01	
040	+	61	CALCULATE NEXT SHOT		RTN	35 22	
	STO B	33 12	TO BE TRIED.		X LBL 3	31 25 03	
	9	09			□	83	
	□	83			I	01	
	9	09		100	RTN	35 22	
	RCL B	34 12			X LBL 9	31 25 09	GIVEN R.C (ROW, COLUMN)
	X > Y	32 81	TO BIG (>9.9)?		STO I	35 33	DETERMINE STATUS
	GTO fe	22 31 15	YES - TRY AGAIN		RCL (i)	34 24	OF THIS SQUARE,
	X < 0	31 71	TO SMALL (<0)?		RCL I	35 34	0 ⇒ EMPTY
	GTO fe	22 31 15	YES - TRY AGAIN		frac	32 83	≠ 0 ⇒ FULL
050	GSB 9	31 22 09			I	01	(SNIP, HIT OR MISS)
	I	01			0	00	
	X = Y	32 51	ALREADY TRIED AND		X	71	
	GTO fe	22 31 15	A MISS?		I	01	
	X ≠ Y	35 52	YES - TRY AGAIN		-	51	
	2	02		110	10 ^x	32 53	
	X = Y	32 51	ALREADY TRIED AND		X	71	
			A HIT?				

REGISTERS

0	←	1	2	3	H. P.'s	4	ATTACK	5	BOARD	6	7	8	9	→	
S0	←	S1	S2	S3	H. P.'s	S4	SET	S5	UP	S6	BOARD	S7	S8	S9	→
A		B			C			D			E		F		
LAST H.P. SHOT		SECONDARY HIT BY H.P.			INDEX			SUM OF n's			RAND #		CONTROL		