





# PROGRAM DESCRIPTION I

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**Program Title** Submarine Hunt  
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**Program Description, Equations, Variables** You are the captain of a destroyer with orders to seek out and destroy enemy submarines. The destroyer manuevers on a 10 x 10 grid and searches for the submarine via sonar. The closer you are to the submarine the higher will be the pitch of the sonar's echo and the greater chance you will have of sinking it when you drop your depth charge. However if you are inept, the submarine might torpedo you. Two levels of play are available.

The game is played on a 10 x 10 grid numbered as shown in the grid on the next page. The submarine is hiding somewhere within the grid's outer boundaries. The captain may manuever his destroyer to the center of each box by inputting the grid number (0-99) when requested with ORDERS. Each time the destroyer moves, it sends out a sonar pulse with a range of  $2\frac{1}{2}$  units. If the sub is within range of the sonar an echo will be returned; the closer the sub, the higher pitched will be the

**Necessary Accessories** Memory Module or HP-41CV

**Operating Limits and Warnings**

**Reference(s)** This program is a further development of the HP Users' Library program 41-00539-4, Search & Destroy (W/Out Wand), by Richard Altman.

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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0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Sonar Grid

echo. The highest pitch (Tone 9) indicates that the sub is within  $\frac{1}{2}$  unit. The captain attacks by moving the destroyer as close over the sub as he can then dropping a depth charge. The probability of a kill decreases with the distance that the sub is from the destroyer, and is zero if the sub is more than 1 unit away (Tone 1, 3, or 5). A kill is indicated by BOOM appearing on the display. Otherwise MISSED will be displayed and the sub will move to a new location within a radius of 1 unit from its previous position.

Warning: As long as the destroyer is close enough to the sub to receive an echo, the sub also hears the sonar blips. The closer the destroyer comes to the sub and the longer it "hangs around", the more annoyed the sub captain becomes with the destroyer's presence until at last he counter attacks if he can do so without endangering his own ship. For the sub captain to be able to use his torpedoes he must be at least 1 unit away but closer than  $2\frac{1}{2}$  units. The torpedo's

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accuracy also decreases with distance. Torpedos are very powerful! If the torpedo misses, the sub again moves as described previously.

The object of the game is to kill each sub with as few scans and depth charges (cans) as possible. At any time the status of the game may be obtained and after each game the best, worst and average scores may be obtained.

The advanced level of play is the same except that the captain has only 1 second to decide each move after he is prompted with ORDERS, and the probability of a kill with the depth charges is reduced. The advanced play is activated by setting Flag 01 before starting the game.

An auxiliary program, GRID, is included which will print practice grids as shown below.

```
0==0-1-2-3-4-5-6-7-8-9  
10==0-1-2-3-4-5-6-7-8-9  
20==0-1-2-3-4-5-6-7-8-9  
30==0-1-2-3-4-5-6-7-8-9  
40==0-1-2-3-4-5-6-7-8-9  
50==0-1-2-3-4-5-6-7-8-9  
60==0-1-2-3-4-5-6-7-8-9  
70==0-1-2-3-4-5-6-7-8-9  
80==0-1-2-3-4-5-6-7-8-9  
90==0-1-2-3-4-5-6-7-8-9
```

# PROGRAM DESCRIPTION II

**Sample Problem** (Sketch if Desired) Clear area represents possible location of submarine.

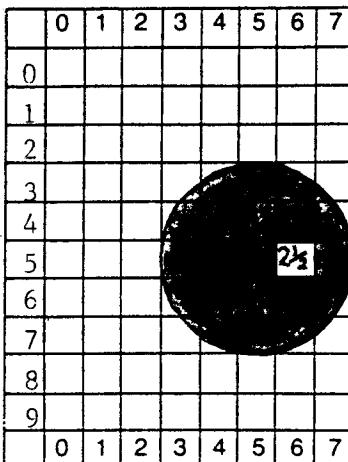


Figure 1

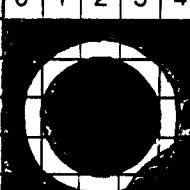


Figure 2

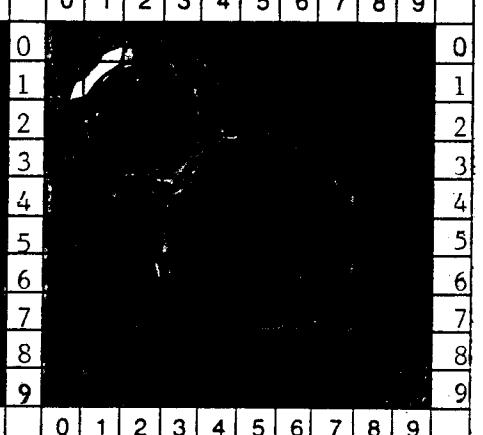


Figure 3

## SOLUTION:

Input	Function	Display	Comments
		CF 01	Choose beginning level of play.
SEED? ORDERS 0	73 (1st move) 55	[XEQ] SCAN [R/S] [R/S]	Seed for random number generator. Destroyer starts at location 00. Since there was no echo, the sub is not within the sonar's range (figure 1).
--SCANNING-- ORDERS 55	(2nd move) 22	[R/S]	A TONE 3 echo indicates that the sub's range is $1\frac{1}{2}$ -2 units away. Areas closer to or further from the destroyer can be eliminated (figure 2).
--SCANNING-- --CONTACT-- low pitch echo (Tone 3) ORDERS 22	(3rd move) 0	[R/S]	A TONE 5 echo indicates that the sub is closer, $1-1\frac{1}{2}$ units away. Eliminating the areas closer and further away leaves only a small area (figure 3).
--SCANNING-- --CONTACT-- middle pitch echo (Tone 5) ORDERS 0	(4th move) 10	[R/S]	A TONE 7 indicates that the sub is between $\frac{1}{2}$ -1 unit away, close enough to use depth charges.
--SCANNING-- --CONTACT-- high pitch echo (Tone 7) ORDERS 10 (depth charge dropping)		[A]	Drop a depth charge.
BOOM 1 CAN 4 SCANS GOOD JOB NEW GAME?<E>			

# USER INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	SIZE: (HP-41C) 011
				DISPLAY
1	Load program SCAN			
2a	For beginner's level game		CF 01	
2b	For advanced level game		SF 01	
3	Start game		[XEQ] SCAN	SEED?
4	Key in any number (0-100)	SEED	[R/S]	ORDERS 0
5	Enter a grid number  If sub is within $2\frac{1}{2}$ units an echo (Tone)  will be heard and --CONTACT-- will  flash on the display	n	[R/S]*	--SCANNING--  --CONTACT--  ORDERS n
6	Repeat step 5 until you are close to the sub (high pitched echo)			
7	Then drop a depth charge		[A]	depth charge BOOM or MISSED
8a	If BOOM then sub is sunk			x CANS y SCANS NEW GAME?<E>
8b	If MISSED then sub moves up to 1 unit from previous position. Go to step 5			ORDERS n

# USER INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
9	Optional: Display Status		[C]	x CANS y SCANS ORDERS n
10	Optional: Display Totals  (after the completion of a game)		[D]	NO./GAMES=n WORST GAME= x CANS, y SCANS BEST GAME= x CANS, y SCANS AVERAGE= x.x CANS, y.y SCANS NEW GAME?<E>
11	For a new game keeping old scores  intact, go to step 5		[E]	ORDERS 0

\*When the advanced level of play is selected, the player has only 1 second to respond after ORDERS is displayed. Otherwise, the previous orders will be re-executed. The player does NOT press [R/S] after giving his orders.

# USER INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
	To print practice grids using the HP-41C Printer/Plotter			
1	Load program GRID			
2	Turn on Printer		[XEQ] GRID	

# PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01♦LBL "SCA N"			Program Submarine Hunt	46 XEQ 02			- Calc. sub's dist.
02♦LBL 15				47 ST+ X			
03 SF 27				48 INT			
04 CF 29				49 ST+ X			Put sub's dist.
05 CLX			Initialization	50 9			into odd-number-
06 STO 00				51 X<>Y			ed bins
07 STO 01				52 -			
08 STO 08				53 X<=0?			If sub undetected
09 1 E9				54 GTO 16			- Go to Orders
10 STO 09				55 ---CONTA			
11 DEG				CT---"			
12 "SEED?"				56 TONE IND			- Tone indicates
13 PROMPT				X			sub's range
14 SIN				57 AVIEW			
15 ABS				58 ST+ 10			- Increase sub
16 STO 04				59 RCL 10			capt. annoyance
17♦LBL E			Start New Game	60 XEQ 01			
18 SF 08				61 15			Sub captain may
19 CF 21				62 X>Y?			launch torpedo if
20 CLX				63 GTO 16			his annoyance is
21 STO 05			Zero statuses,	64 3			≥ 15 and TONE
22 STO 06			destroyer's pos.	65 RT			is 1 or 3
23 STO 07			& sub captain's	66 X>Y?			
24 STO 10			annoyance level	67 GTO 16			If no attack
25 FIX 0				68 " ALER			- Go to Orders
26 10				T"			
27 XEQ 01				69 AVIEW			Torpedo Attack
28 STO 02				70 TONE 8			
29 10				71 TONE 8			
30 XEQ 01				72 TONE 8			
31 STO 03				73 TONE 8			
32♦LBL 16				74 TONE 8			
33 "ORDERS			Orders	75 "TORPEDO			
"				ATTACK"			
34 RCL 07				76 AVIEW			
35 ARCL X				77 9			
36 AVIEW			Prompt for ORDERS	78 XEQ 01			Calc. chance
37 FS? 01			for destroyer's	79 PSE			factor for hit
38 PSE			position	80 X>Y?			
39 FC? 01				81 GTO 18			If torpedo misses
40 STOP				82 " * KABL			- Go to Sub Moves
41 "---SCANN				AM *"			
ING--"				83 AVIEW			Torpedo hits
42 AVIEW				84 PSE			destroyer
43 STO 07				85 " GLUB			
44 ISG 06			- Incr. no. scans	GLUB"			Destroyer sinks
45 CLX				86 AVIEW			

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
87	TONE	8		133	XEQ	04	- Display status
88	TONE	6		134	12		
89	TONE	4		135	RCL	06	
90	TONE	2		136	X>Y?		If > 12 scans
91	TONE	0		137	GTO	17	-Exit
92	CF	08		138	"GOOD	J0	
93	SF	11	Captain goes down with ship. All scores are cleared on restart.	B"			Display GOOD JOB
94	PSE			139	AVIEW		
95	OFF			140	BEEP		
96	GTO	15		141	PSE		
97	LBL	A	Drop Depth Charge	142	LBL	17	
98	FC?	08	If between games	143	"NEW	GRM	End-of-Game Exit
99	GTO	17	- Exit	E?<E>"			
100	"			144	AVIEW		
	*	"		145	TONE	8	
101	"	"	Depth charge display	146	TONE	5	
				147	CF	08	
102	AVIEW			148	STOP		
103	ISG	05	- Incr. no. cans	149	GTO	E	-Go to New Game
104	CLX			150	LBL	18	
105	XEQ	02	- Calc. sub's dist.	151	"MISSSED"		Sub Moves Routine
106	FC?	01	If easy game	152	AVIEW		
107	X†2		- increase hit prob.	153	TONE	0	
108	1			154	TONE	0	
109	XEQ	01		155	360		Calc. movement
110	X<=Y?		If can misses	156	XEQ	01	
111	GTO	18	- Go to Sub Moves	157	ENTER†		-Direction of move
112	"BOOM"			158	FRC		-Distance moved
113	AVIEW			159	P-R		
114	TONE	5	Depth charge	160	ST+	02	
115	TONE	5	sinks sub	161	X<>Y		Update sub's position
116	TONE	5		162	RCL	03	
117	TONE	4		163	+		
118	ISG	00	- Incr. game count	164	XEQ	03	
119	CLX			165	STO	03	Insure that row & col. position
120	RCL	08		166	RCL	02	of sub is within bounds
121	RCL	06		167	XEQ	03	
122	RCL	05	Encode scans & cans into scans.cans for	168	STO	02	
123	1	E5		169	GTO	16	-Go to Orders
124	/		R <sub>01</sub>	170	LBL	01	
125	+			171	RCL	04	Subroutine
126	ST+	01	- Add to total	172	9821		Random Number
127	X>Y?			173	*		returns random
128	STO	08	- Update worst game	174	.211327		number between
129	RCL	09		175	+		0 and R <sub>X</sub>
130	X<>Y			176	FRC		
131	X<=Y?			177	STO	04	
132	STO	09	- Update best game	178	*		
				179	RTN		

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
180♦LBL	02		-----	229♦LBL	D		Summary Routine
181 RCL	07		Subroutine	230 FS?	08		If during game
182 10			Distance to Sub	231 GTO	16		- Exit
183 /				232 FIX	0		
184 INT				233 "NO./GAM			
185 RCL	03			ES=			
186 -				234 ARCL	00		
187 RCL	07			235 XEQ	08		- NO./GAMES #
188 10				236 "WOR"			
189 MOD				237 RCL	08		
190 RCL	02			238 XEQ	06		- WORST GAME #
191 -				239 " BE"			
192 .5				240 RCL	09		
193 ST+ Z				241 XEQ	06		- BEST GAME #
194 +				242 " AVERAG			
195 R-P				E=			
196 RTN				243 AVIEW			
197♦LBL	03		-----	244 FIX	1		
198 10			Subroutine	245 RCL	01		
199 X>Y?			Insure x is with-	246 INT			
200 X<>Y			in plot boundar-	247 LASTX			
201 X<0?			ies $0 \leq x \leq 10$	248 FRC			
202 CLX				249 RCL	00		
203 RTN				250 ST/ Z			- Average scans
204♦LBL	C		-----	251 /			- .00001*avg. cans
205 FIX	0		Status Routine	252 XEQ	07		- Display averages
206 XEQ	04			253 GTO	17		- Exit
207 FS?	08		If during game				
208 GTO	16		- Go to Orders	80			
209 GTO	17		- Otherwise Exit				
210♦LBL	04		-----				
211 SF	07		Subroutine				
212 RCL	05		CANS/SCANS				
213 XEQ	05						
214 RCL	06		- Display CANS #				
215♦LBL	05		-----				
216 CLA			Routine to				
217 ARCL	X		format & display				
218 "F"			CANS # or SCANS #	90			
219 FC?C	07						
220 "FS"							
221 "FCAN"							
222 1							
223 X≠Y?							
224 "FS"							
225 AVIEW							
226 PSE							
227 PSE				00			
228 RTN							

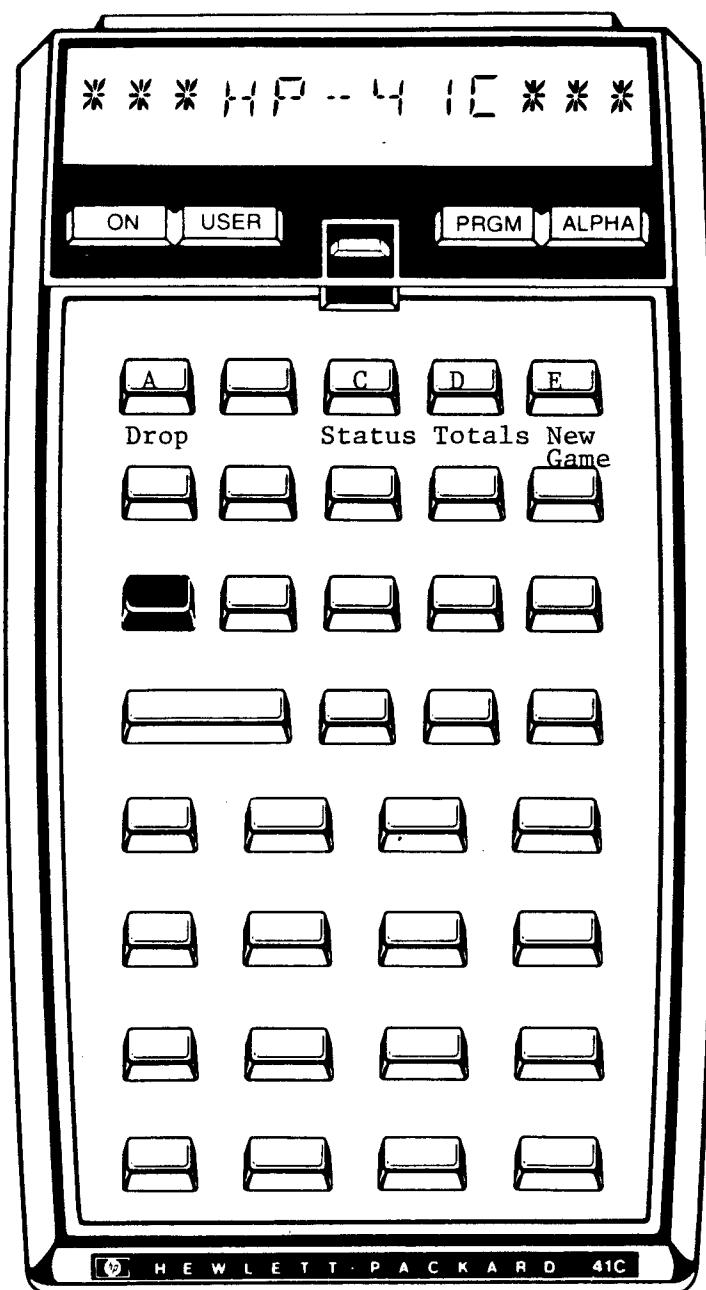
## PROGRAM LISTING

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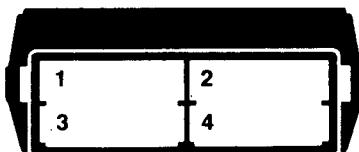
## REGISTERS, STATUS, FLAGS, ASSIGNMENTS

# KEYBOARD CARD LABELING

## KEYBOARD



## SYSTEM CONFIGURATION



**CARD**

