DAY 4

The Stack, Registers, and Beginning Programming

Where are we?

You have read to and worked all the examples up to p. 59 in the *Owner's Handbook*. For now, we are going to skip most of the rest of Section 4. What we are skipping is HMS conversion, which is some stuff for converting things like 12h 15m 30s to 12.25833333h and back, polar coordinate conversion, and finally, some handy and sophisticated stuff for statistics using the $\Sigma+$ and $\Sigma-$ keys. As we are doing applications later in the course, we will get back to those things.

However, some things buried in the pages we are skipping that we should learn are logarithms, exponentials, and powers. The calculator has base 10 logarithms and exponentials, it has natural logarithms and exponentials (base e), and if that isn't enough it will raise any base to any power using the y^x key. So read pp. 63-65 starting with "Logarithmic and Exponential Functions" and finishing with the horribly complicated formula for Mach number on p. 65. Key the whole thing in and make sure you get the expected answer.

The reason we are skipping most of pp. 60-71 is that we want to get to programming!

The Stack and Registers

We have the stack (X, Y, Z, and T), Last X, and REG 0, REG 1, REG 2, ..., REG 7 at our disposal. We have these both when we are doing calculations manually and when we are programming the calculator. It is extremely common, when running a program, to have to enter initial values into one or more of these locations before starting the program.

Our First Program

We will do the program alluded to in the reading: the area of a sphere. The formula is $A = 4\pi r^2$.

Your Second Program

To test yourself that you know how to do another simple program, do a program for $V = \frac{4}{3}\pi r^3$.

Your Third Program: Nimb

Key in and play the attached program. People in the combinatorics class call this "Baby Nim." We just call it Nimb. Find somebody in the combinatorics class and show it to them.

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NIMB

The game of Nimb begins with a collection of N objects, or as the calculator plays it, with the positive number N. Each player alternately subtracts one, two, or three from the total until only one is left. The player forced to take the last one loses.

To begin the game, you must tell the machine how many objects to start with, i.e., the value of N. A reasonable number is 15. After each move the machine will display the remaining total. A negative sign indicates that it is the user's move next, while a positive display indicates that it is the HP-25's move.

As the challenger you are allowed to make the first move. It is possible to win but of course the HP-25 is a master player: it will not let you make an error and win. (Not, that is, unless you cheat and take a number other than 1, 2, or 3—a contingency so far beyond the realm of the HP-25's naive faith in humankind that the unsuspecting calculator has no way of knowing if you do or don't.)

DISPLAY		KEY ENTRY
LINE	CODE	
00		
01	31	↑
02	01	1
03	23 02	STO 2
04	22	R↓
05	23 41 00	STO − 0
06	24 00	RCL 0
07	15 71	g x=0
08	13 42	GTO 42
09	23 61 02	STO x 2
10	24 02	RCL 2
11	74	R/S
12	21	x⇄y
13	15 51	g x ≥ 0
14	13 17	GTO 17
15	21	x⇄y
16	13 02	GTO 02
17	01	1
18	32	CHS
19	23 02	STO 2
20	00	0
21	23 01	STO 1
22	24 01	RCL 1
23	03	3
24	14 71	f x=y

DISPLAY		KEY ENTRY
LINE	CODE	
25	13 40	GTO 40
26	01	1
27	23 51 01	STO + 1
28	32	CHS
29	24 00	RCL 0
30	51	+
31	24 01	RCL 1
32	41	−
33	04	4
34	71	÷
35	15 01	g FRAC
36	15 61	g x≠0
37	13 22	GTO 22
38	24 01	RCL 1
39	13 05	GTO 05
40	01	1
41	13 05	GTO 05
42	24 02	RCL 2
43	15 41	g x < 0
44	13 47	GTO 47
45	24 03	RCL 3
46	13 00	GTO 00
47	24 04	RCL 4
48	14 11 01	f FIX 1
49	13 00	GTO 00

REGISTERS
R_0 Total
R_1 Machine move
R_2 ± Total
R_3 55178
R_4 3507.1
R_5
R_6
R_7

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS				OUTPUT DATA/UNITS
1	Key in program						
2	Initialize	55178	STO	3			
		3507.1	STO	4	f	PRGM	
3	Store total number of objects						
	(usually 15) and set display	N	STO	0	CHS	f	
			FIX	0			-N.
4	If number in display is negative,						
	key in your move	Your move	R/S				+ Total
5	If number in display is positive,						
	let HP-25 move		R/S				- Total
6	Perform steps 4 and 5 until game						
	is over						
7	At end of game, turn calculator						
	upside down to read message						
8	For another game, go to step 3.						

Example:

Perform the initialization with N = 15.

User takes 3.

3 [R/S] ⟶ 12.

[R/S] ⟶ -9.

HP-25 takes 3.

User takes 2.

2 [R/S] ⟶ 7.

[R/S] ⟶ -5.

HP-25 takes 2.

User takes 3.

3 [R/S] ⟶ 2.

[R/S] ⟶ -1.

HP-25 takes 1.

User takes last 1.

1 [R/S] ⟶ 55178.

Turn calculator upside down for message (BLISS).