Finally after 50 Years: Star Trek[1] for the HP-85

Martin Hepperle, December 2015

Background

The program described here was derived from the source code for a HP-2000 version of Star Trek in a file named "BIGMES". The original source code is a good example of spaghetti code and (as the name implies) contains a few programming errors, like jumps into the middle of for-next loops, dead code and similar things. I tried to fix and clean many things to obtain a playable game. There still seem to be some bugs in the code. In retrospect, it might have been easier to rewrite the code completely from scratch.

Other Implementations

A quite large number of implementations of the Star Trek theme exist for almost all computer platforms.

It must have been around 1983 when I first came across the game on a CDC 6600 mainframe (or was it the Cyber 174?) at the Computer Center at the University of Stuttgart in Germany.

Playing games on the expensive super-computers was, of course, officially frowned upon, so that this game was one of the "secrets" leaking out only to a few.

But you did not need a super-computer for this - even for the HP-67 and the HP-41C calculators you can find many variants of the theme.

Only after I almost finished the port, I discovered that the Games Pak II for the HP-85 includes a variant of a Star Trek game named "SPACE". An earlier version can be found in the file "STREK". The implementation in the Games Pak II uses the graphics screen and also makes exclusive use of the function keys. It does not have the "animation" features of the version presented here, but also nice to play. You control the "Capricorn" and destroy "Lubach" ships. These names relate to the development name of the HP-85 and the location of Hewlett Packard's rival Texas Instruments.

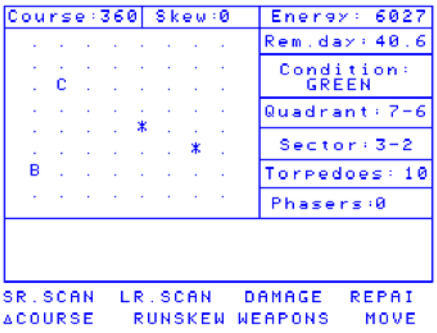

Figure 1 Typical graphical display of "SPACE" from the Games Pac II.

[1] StrarTrek™ is a registered trademark of CBS Studios Inc. All rights are acknowledged. In 2015 the Star Trek television series had its 50th anniversary.

The Game

Mission

Your mission is to travel the Galaxy and destroy all Klingon ships. For this purpose you have been equipped with a fine product of the local industry, the spaceship “Enterprise”. You move through the Galaxy to find and destroy Klingon ships. You must maneuver around vast areas of space, avoid hitting stars and refuel at Star Bases when you are low on energy, torpedoes or your favorite computer journal.

The following sections describe the major terms used throughout the game.

Galaxy

The *Galaxy* is divided into a set of 8 by 8 *Quadrants*. The *Quadrants* are numbered by a pair of vertical and horizontal coordinates ranging from 1 to 8. A valid *Quadrant* would be (1, 1), but not (0, 9). A Galaxy map is provided to maintain a global overview of the whole space. It can be updated by a Long-Range scan.

Quadrant

Each *Quadrant* is again divided into a grid of 8 by 8 Sectors. Like the *Quadrants*, the *Sectors* are also numbered by a pair of vertical and horizontal coordinates ranging from 1 to 8. The Quadrant map shows details about the occupation of each *Sector* in the current *Quadrant*. It can be updated by a Short-Range scan.

Sector

A *Sector* can contain one object at a time. Objects are

The Enterprise	<@>	This is your ship, Captain. It is equipped with Impulse Engines and Warp Drive, Photon torpedoes and, Phase beam cannons.
Star	*	*Stars* are mostly a nuisance. They block direct travel and weapon courses
Star Base	>*<	The Enterprise can dock at a *Star Base* for refueling and re-stocking torpedoes. The base must be approached slowly by maneuvering to the adjacent Sector to avoid destruction.
Klingon Ship	+++	Your enemy. Shoot them or ram whenever you can.

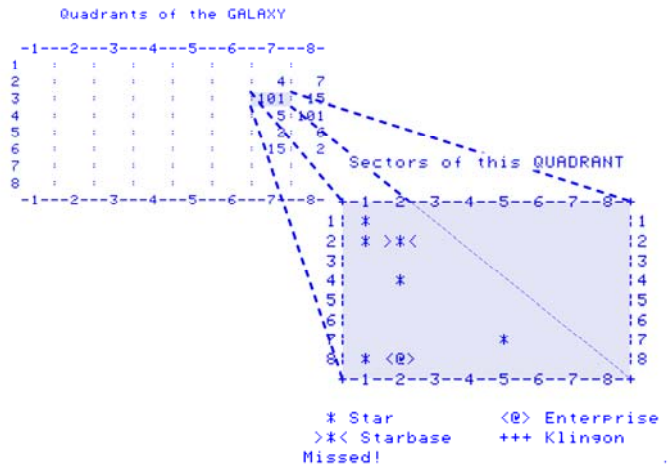

Figure 2 The Galaxy and a selected Quadrant with its Sectors.

Energy

One of the most important things to monitor is the energy available. If the energy level reaches zero the ship is lost and a new game is automatically initiated.

Display

The original game was obviously written for an ADM-3 type terminal having a resolution of about 132 columns by 25 character rows. It took me a while to find documentation about the escape sequences used in the game.

The screen of the HP-85 is slightly smaller, offering a mere 16 lines of 32 characters. However, this resolution is available on 4 screen pages, which makes it possible to rearrange the display and use the four command keys “k1” to “k4” to switch between the pages. The additional graphics screen is not (yet) used.

A Note of Porting to the HP-85

A major difficulty for porting programs to the HP-85 are the limited options for naming variables. Variables in the HP-85 BASIC must consist of a single letter, optionally followed by a digit. In addition to scalar numeric variables arrays and string variables are available. Thus it is possible to have a variable “A”, and array “A(N) and a string “A$” at the same time. Furthermore names like “A0”, “A1” etc. are possible.

In order to translate a BASIC program using longer names, a practical solution proved to compose a translation table of all variables in Excel. Thus it was possible to avoid duplicates and to apply search and replace commands in a text editor to modify the source code. Such a list is also useful to document the meaning of the short variable names.

Porting the Output Routines

The original version used escape sequences to control positioning and to clear areas on the terminal screen. My first action was to isolate all screen related commands into common subroutines for positioning and text output. This allows for easy adaptation of the output to other devices, terminals, printers in the future. It was also a invaluable help for debugging and for performing the adaptation to the HP-85. In order to understand the initial arrangement of the output screen and to modify it, the screen commands were additionally written to a file. This file was later read by an Excel macro to mimic the behavior of the terminal and to replay whole recorded games.

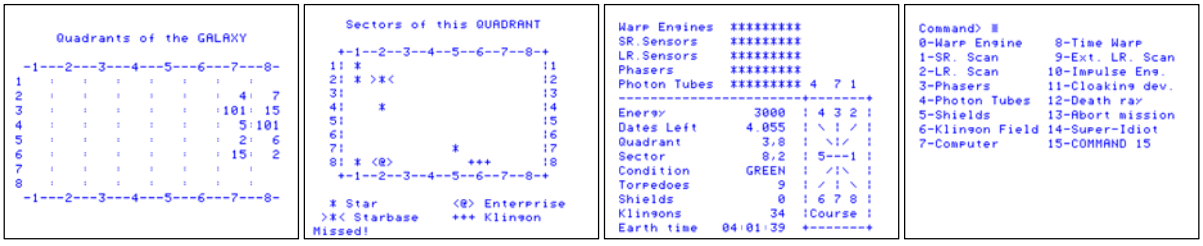

Figure 3 The four screens used for this implementation of Star Trek. Galaxy map, Quadrant map, Status screen and Command screen.

System Requirements

In order to maximize the available program memory no binary programs are used for screen access. Instead the ALPHA and AWRIT commands in the Advanced Programming ROM are used to output text to the screen and to switch pages.

Therefore you need these two things

- HP 85A with 16 KB Memory Extension or HP-85B
- Advanced Programming ROM

Quadrant Map (*k1*)

The Quadrant Map shows details about the current Quadrant where the Enterprise is located.

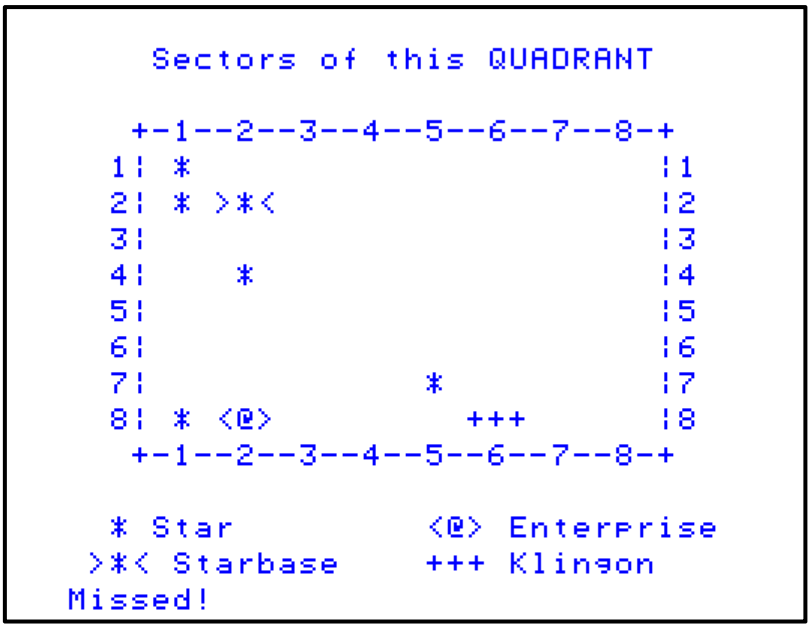

Figure 4 **A Quadrant map shows the objects in the current Quadrant. The map can be updated by a Short Range Scan, but is automatically updated when the Enterprise moves by Warp or Impulse Engines.**
This example shows the Enterprise in Sector (8,2). Stars in Sectors (1,1), (2,1), (8,1), (4,2) and (7,5). A star base can be seen in Sector (2,2) and a Klingon ship is lurking in Sector (8,6).

Information Screen (*k2*)

The Information Screen shows the condition of your ship and contains a compass to remind you of the travel directions. The upper part shows the state of the engines, sensors and weapons in form of bar displays. The area below shows numeric data for the situation, including the location in the Galaxy.

In the area above the compass you can see three numbers. After firing a weapon or moving to a new quadrant the strength and position of the Klingon ships in the current Quadrant are briefly shown there (only if the Enterprise in uncloaked). Note that the presence of Klingon ships reduces the strength of the Enterprise's shields during each turn.

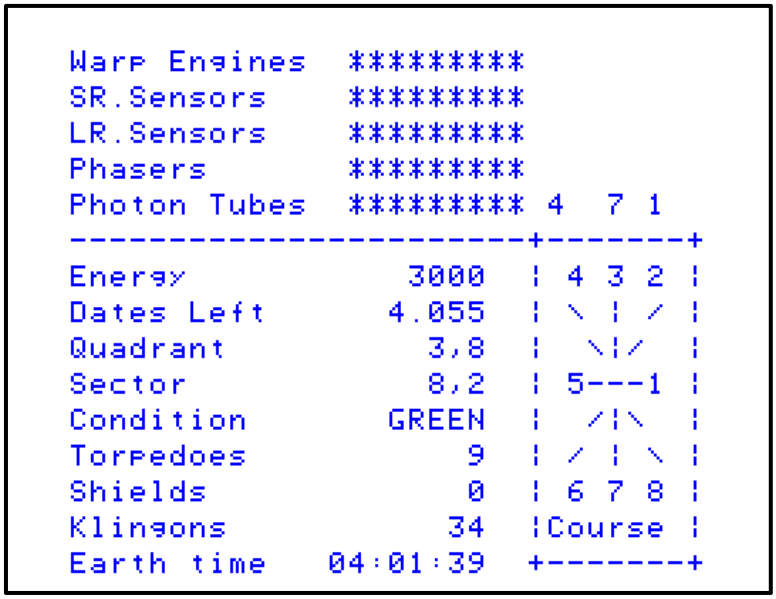

Figure 5 The Information Screen shows all relevant parameters about the state of the Enterprise.

Command Screen (*k3*)

The Command Screen prompts you to enter commands by their appropriate numbers. Pressing the [END LINE] key shows a list of all commands and their number.

You can use the digit keys and terminate the command by pressing the [END LINE] key. Numbers for directions and propulsion system power or energy can contain a decimal point. You can separate multiple numbers, e.g. when entering quadrant and sector coordinates by a space or comma character. A set of Quadrant and Sector coordinates could be entered as “1,2 3,4”.

The [BACK] key deletes the rightmost character, the arrow, insert or delete keys are not working.

Results of the execution of a command are shown on the various screens. Text printed to the Command screen stays there until the next command is issued.

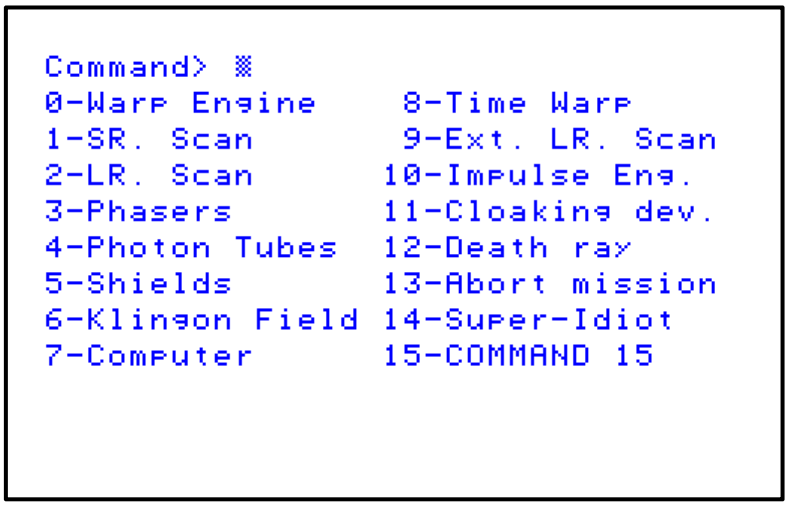

Figure 6 The Command Screen with a list of available commands obtains by pressing the [END LINE] key without a command number. These are the commands you issue to your crew composed of Lieutenants and Idiots.

Star Trek understands the following Main Commands:

0	Warp Drive	Specify the course (1…9) (may contain fractional digits) and the Warp factor (0…8). A Warp factor of 1 moves the width of one quadrant.
1	Short Range Scan	Updates the Quadrant Map. If the SR sensors are damaged (OUT of order) this command may lead to further damage due to overload of the ships systems.
2	Long Range Scan	Updates the Galaxy Map. If the LR sensors are damaged (OUT of order) this command may lead to further damage due to overload of the ships systems.
3	Phasers	Use the Phasers to attack all Klingon ships in the current Quadrant. You specify the amount of energy to apply to the Phasers. Depending on the distance from the Enterprise the energy of the Phasers is distributed over the Klingon ships and reduces their strength. If the strength of a Klingon ship falls below zero, it is destroyed.

		After firing the Phasers the strength and position of the Klingon ships remaining in the Quadrant are briefly shown on the status screen above the compass (only if the Enterprise in uncloaked). If the Phasers are damaged (OUT of order) this command may lead to further damage due to overload of the ships systems.	
4	Photon Tubes	The Photon Tubes (or Photon Torpedoes) must be aligned with the targeted Klingon ship by specifying the course of the torpedo (1…9). You specify the course to send the torpedo to. You can use the Computer Library (command 2) to accurately calculate the course. Note that a Star would block the straight path of a torpedo and that a Klingon ship can intersect the torpedo. After firing a torpedo the strength and position of the Klingon ships remaining in the Quadrant are briefly shown on the status screen above the compass (only if the Enterprise in uncloaked). If the Photon Tubes are damaged (OUT of order) this command may lead to further damage due to overload of the ships systems.	
5	Shields	Energizing the shields provides some protection for your ship.	
6	Klingon Field Sensor	Allows you to sense Klingons without performing a Long Range scan. If no Klingons are near, no output will be produced.	
7	Computer	Offers three subcommands. Pressing [END LINE] without entering a command number lists the available Computer Commands. You must use Computer Command #0 to return to the main Command Menu.	
7	0	Return to Main	Return to the Main Command Screen
7	1	Status Report	Outputs the total number of Klingons, Star Bases
7	2	Photon Tubes Data	Calculates the courses required to send Photon torpedoes to the Klingon ships in the current Quadrant (if any). Useful before issuing the Main Command #4
7	3	Autopilot	You specify the quadrant and sector coordinates and the computer steers the required course, provided that you have enough energy to reach the destination.
8	Time Warp	Warps the Enterprise to an arbitrary Quadrant. Can be used as a rescue in a difficult situation, but may bring you into an even more difficult situation	
9	Extended Long Range Scan	DUNNO	
10	Impulse Engines	These engines are much more fuel efficient than the Warp engines but have limited power. They are useful to maneuver slowly inside a Quadrant, e.g. when approaching a Star Base for docking. You specify course (1…9) and the thrust (0…0.2)	

11	Cloaking Device	Can be reset only at a Star Base.
12	Death Ray	A dangerous, experimental system to kill Klingon ships. May backfire and destroy the Enterprise.
13	Abort Mission	Nah, you do not want to use this command.
14	Super-Idiot	Who would ever use this command?
15	Command 15	Another one, which sometimes kills Klingons, but not always.

Galaxy Map (*k4*)

The Long Range scan allows to scan the Quadrants located around the current Quadrant. The result is presented in form of a 3 digit number “KBS” for each Quadrant covered. The digits are named “KBS”. The leftmost (100) digit stands for the number of Klingons “K”. The next (10) digit represents the number of Star Bases “B” in the Quadrant, while the last digit (1) stands for the number of Stars “S”. Each time a long range scan is performed, the Galaxy map is updated accordingly. Note, however, that the Klingons move and each Long Range Scan only updates the Quadrants allocated round the current Quadrant. Quadrants farther away may show the outdate information obtained in previous scans.

The map shown below indicates that there are Klingon ships in the Quadrants (3, 7) and (4, 8). Star Bases are in Quadrants (6, 7) and (3, 8). The number of Stars varies between 1 and 6.

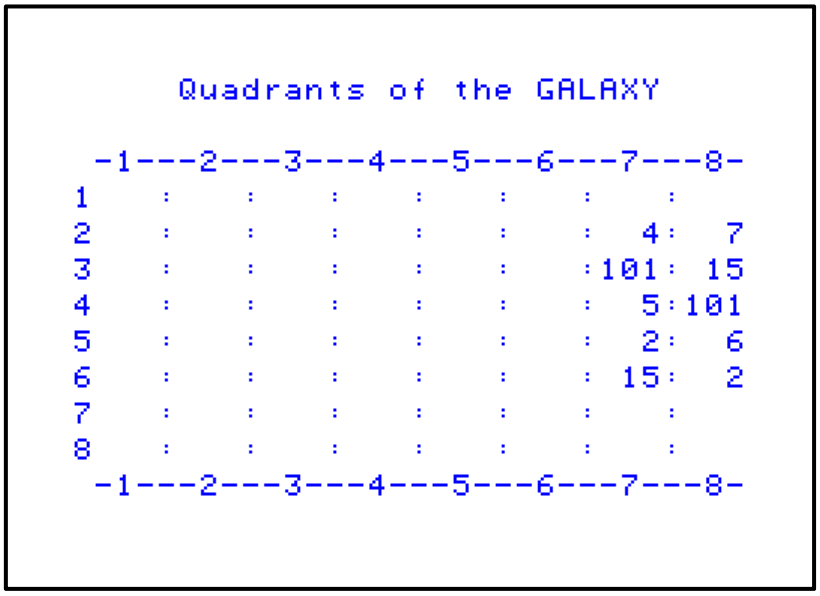

Figure 7 **A Galaxy map with the results of a Long Range Scan. While the Enterprise was moving through the Quadrants (3,8) ands (5,8) two Long Range Scans have been performed. Therefore only information about the surrounding Quadrants are shown.**

The Cloaking Device

Can only be reset by docking at a Star Base. Usage costs 1000 energy units and 100 units per turn.

Using Phasers:

Phasers take the specified units from your energy and target it at the Klingons in the current Quadrant. They reduce the strength of Klingons in the Sector by this amount of energy.

if uncloaked: The strength and position of all Klingons in the Quadrant is briefly shown on the Status page, above the navigation compass.

Klingons in the Quadrant reduce the strength of shield in each turn.

Variables and Data Structures

While rewriting the code the following data items have been documented

The array indices are organized in the order (vert, horz), i.e. X is vertical and Y is horizontal. This corresponds to a Row, Column order.

Klingons, stars and star bases are distributed anew when entering a quadrant. Thus they will differ each time you leave and return to a quadrant (Klingons and stars move in space)

Klingons

Symbol in Short Range map: "+++"

There is a total of K Klingons in the Galaxy and the array K(8,8) specifies the number per quadrant.

In each Quadrant a maximum of 9 Klingons can be present. For the current quadrant, their strength is stored in C(9) and their position by row in in E(9), and by column in F(9).

Star Bases

Symbol in Short Range map: ">*<"

There is a total of B in the Galaxy and their number per quadrant is given in B(8,8)

Stars

Symbol in Short Range map: "*"

There is a total of R stars in the Galaxy and their number per Quadrant is given in S(8,8)

Enterprise

Symbol in Short Range map: “<@>”

E energy available, S energy in shields

F=1: docked, I1=1: cloaked

The array R() is used to draw the bar charts on the Sate screen. Its content represents:

- R(1)>1: Warp Engines OK
- R(2)>1: SR sensors OK
- R(3)>1: LR sensors OK
- R(4)>1: Phasers OK
- R(5)>1: Photon Tubes OK

X,Y: indicate the row, column of the current Quadrant (in the Galaxy)

X1,Y1: give the row, column position of the Sector where the Enterprise is (in the current Quadrant)

Data Allocation in the Galaxy

The array L(8,8) contains the number of Klingons, Star bases and Stars per Quadrant in the Galaxy. The content is encoded as KBS = 100*K + 10*B + S per quadrant

The number of Stars per quadrant is given in S(8,8). The total number in the Galaxy is S.

The number of Star Bases per quadrant is given in B(8,8) The total number in the Galaxy is B.

The number of Klingons per quadrant is given in K(8,8). The total number in the Galaxy is K.

Data Allocation in the current Quadrant

The array A(8,8) specifies the objects distributed in the current quadrant. The value contained in A() corresponds to:0=empty, 1=Enterprise, 2=Klingon, 3=star base, 4=star

In each Quadrant a maximum of 9 Klingons can be present. For the current quadrant, the strength of the Klingons is stored in the array C(9) and their position in in E(9) (row), and in F(9) (column). Klingon entry is valid only if the strength in C(I) is greater than zero.

The arrays G(8) and H(8) is used to temporarily store and later erase a torpedo trace in rows (G) and columns (H).

Flags and More

P0 is used by the key input routine. If P0=1 a prompt (cursor) is shown, if P=0 no cursor is shown.

S0 controls the sound, S0=0: sound OFF, S0=1: sound ON