The Software Toolworks
Walt Bilofsky, Prop.

OFFICIAL FAA
(Fly-by-night Aviation Administration)
AIR TRAFFIC CONTROLLER'S MANUAL

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1. Description

Airport is a real-time action game running under the HDOS or
CP/M (ORG 0) operating system for the Heath H89 or H8+H19
computers. You are an air traffic controller managing the area
around two airports. You must issue commands to the 26 airplanes
that will appear during the course of the game, guiding each to
the destination listed on its flight plan, while maintaining a
high level of safety (i.e. observing all the relevant FAA
regulations). Your traffic sector is an airspace 23 miles square
from ground level to 5000 feet, and includes two navaids
(navigational aids or radio beacons) and five airways. Airport
simulates the controller's radar terminal on the H19/H89 screen,
using cursor positioning to move the planes, and inverse video
and graphics characters to add clarity and realism. Airport is
based on a game by David Mannering, a former air traffic
controller.

2. Usage

To start Airport from system command level, give the command
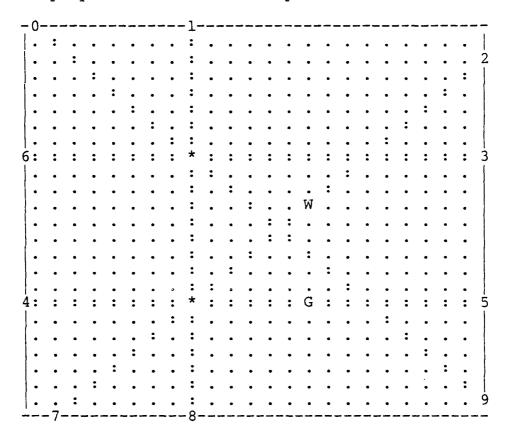
    airport

This will bring the simulated radar display to the screen.
Airport will move planes around more or less at random until you
tell it how many minutes the game will last. It prompts with:

    Length of game (minutes):

Enter the time in minutes - the value must be between 16 and 99.
In a 99 minute game the planes will be spaced out rather well; a
30 minute game is difficult, even for an experienced player.
Airport will continually display the amount of time remaining.

3. Reading the Radar

The display of the initial airspace looks like this:

```
    -0---------------1------------------------------
   |. : . . . . . : . . . . . . . . . . . : . . . |
   |. . : . . . . : . . . . . . . . . . . . . . . 2
   |. . . : . . . : . . . . . . . . . . . . . : . |
   |. . . . : . . . : . . . . . . . . . . . . : . |
   |. . . . : . . . : . . . . . . . . . . . . . . |
   |. . . . . : . . : . . . . . . . . : . . . . . |
   |. . . . . . . . : : . . . . . . . : . . . . . |
   6: : : : : : : : * : : : : : : : : : : : : : : 3
   |. . . . . . . . : : . . . . . . : . . . . . . |
   |. . . . . . . . : . : . . . : . . . . . . . . |
   |. . . . . . . : . . . : . . W . . . . . . . . |
   |. . . . . . . . : : . . . . . . . . . . . . . |
   |. . . . . . . . : : . . . . . . . . . . . . . |
   |. . . . . . . : . . : . . . . : . . . . . . . |
   |. . . . . . . . : . . . . . : . . . . . . . . |
   |. . . . . . . : : : . . . . : . . . . : . . . |
   4: : : : : : : * : : : : : G : : : : : : : : : 5
   |. . . . . . : . . . . . . . . . : . . . . . . |
   |. . . . . : . . : . . . . . . . . . : . . . . |
   |. . . . : . . . : . . . . . . . . : . . . . . |
   |. . . : . . . . : . . . . . . . . . . . : . . |
   |. . : . . . . . : . . . . . . . . . . . . : . |
   |. : . . . . . . : . . . . . . . . . . . . . 9
    ---7---------------8------------------------------
```


    W and G indicate the airports: W for White Airport and G for
Gray Airport. On the H19/H89 screen White Airport shows up as a
white block, and Gray Airport as a gray block. Navaids are
indicated with an "*", and airways show up as lines of colons
with entry/exit fixes on each end indicated by the digits 0-9.
Note that numbers on the ends of each airway add up to 9, to make
them easier to locate. The distance between adjacent dots is one
mile -- horizontally, vertically, or diagonally.

    Airplanes are indicated by the call letter of the plane (A
through Z) followed by its altitude in thousands of feet. For
example, the symbol "X3" on the screen means that airplane X is
in the location shown, and is flying at 3000 feet. An airplane
identifier in inverse video means that there is another airplane
at about the same location, but your radar can only display the
one shown -- be careful.

4. Airplane Types

There are two kinds of planes: jets and props (light propeller planes). Jets travel at 240 knots (i.e. one mile every 15 real seconds) and props travel at 120 knots. A jet turns at the rate of three degrees per second. Since the screen updates every 15 seconds, it will turn 45 degrees each tick. Props turn half as fast, so that they also turn 45 degrees each time they are updated (a prop takes 30 seconds to move one mile). Each has sufficient fuel to get to any destination: jets have fuel for 15 minutes of real time, and props have 21 minutes of fuel. Note, however, that a plane sitting on the runway burns fuel at the same rate as a plane in the air.

5. Object of the Game

To complete your shift successfully, you must handle all 26 airplanes without running out of time, violating FAA regulations, letting any plane run out of fuel, or sending any plane out the wrong destination or at the wrong altitude. This means either landing each plane at its desired airport, or sending it out the desired fix in the right direction (i.e. along the airway) at 5000 feet.

The FAA requires planes to be separated either by three miles horizontal distance or 1000 feet of altitude. If they come closer it is logged as a "system error" and you are in deep yogurt. NOTE that a plane changing altitude is considered (by FAA regs) to be at both its old and new altitudes; thus two planes may be 2000 feet apart, but still cause a system error because they were at the same altitude on the previous tick, where one was climbing and the other descending.

The game will terminate if a plane runs out of fuel, either on the runway or in the air. Planes on the runway burn fuel at the same rate as when they are airborne.

The game terminates with a "boundary error" if a plane is sent out at the wrong fix, or if it is headed out in the wrong direction. A plane must be headed out the exit fix in the direction opposite to that fix's entry direction. This will be along the airway connecting the exit fix to its complement. All planes leaving your airspace must be at 5000 feet, so controllers of neighboring airspaces will know what to expect.

6. Basic Flight Plans

The right side of the screen is reserved for flight plans. A typical flight plan looks like:

        Fj 7->3   4   NE   +

The first letter is the aircraft ID, which can be any letter from A through Z. The next letter is the airplane type: either "j"

for jet or "p" for propeller.

The next field (e.g. 7->3) gives the plane's intentions: this one is entering at (or is now at) fix 7 and leaving at fix 3. A plane will enter your airspace on a course from one fix toward the 9's complement of that fix; that is, a plane entering at 7 will initially be heading toward 2; a plane entering at 4 will be heading toward 5; and so on. You may need to give course corrections (below) to enable the plane to exit at the desired fix. Either the origin or destination (or both) can be the symbol for an airport, indicating that this plane will be taking off or landing. The "origin" character is the entry fix if the plane has not yet entered your airspace; otherwise it is a symbol for the plane's location on the screen: "*" if it is over a beacon, "." if it is in some random location, ":" if it is on an airway, or the appropriate airport symbol if it is flying over an airport.

Next is the altitude in thousands of feet. Plane F in this example is at 4000 feet.

The bearing is given as a compass direction: N, S, E, W, NE, NW, SE, or SW, with north at the top of the radar screen. The plane in the example above is headed northeast.

The final character is the amount of fuel left. If it is a "+", as here, the plane has more than 10 minutes of fuel left; otherwise it shows the number of minutes of fuel remaining.

The flight plans are separated into two groups: the top group previews the planes that will become active within the next minute, and the bottom group is for planes that are now in your airspace. Planes may be cleared for takeoff as soon as they appear in the preview area.

7. Airplane Commands

In order to maintain safety and route the planes to their designated goals, you will need to issue commands telling the pilots to turn, change altitude, take off, and land. Each command is terminated by a <RETURN>. <BACK SPACE> may be used to correct errors on the command line. Either upper or lower case is allowed. The radar screen is updated every 15 seconds; if the update occurs while you are typing a command a beep will let you know that your command may no longer be timely.

7.1 Command Summary

The following kinds of commands can be issued. Each is described in more detail below.

```
$         End the game and exit to the operating system.
W         Print flight strip for airplane W
XA3       X will change altitude to 3000 feet
QA0       Q will land (go to 0 feet altitude)
HRE       H will turn right until it is heading east
ALNW      A will turn left until it is heading northwest
CTS       C will turn south through the smallest angle
T*7       T will take exit bearing for fix 7 at next navaid
P*W       P will take landing bearing for White at next navaid
DH        D will circle (hold) at next navaid
MR0       Aborts pending hold, clearance, or turn for plane M
<SPACE>   Speed up the game by advancing 15 seconds
```

7.2 Terminating the Game

The command "$" terminates the game and restores the terminal to its normal state, removing the 25th line. If you forget the "$", CTRL-C will also get you out, but will leave the 25th line on the screen. If you play the game to completion (either success or failure) Airport will start over.

7.3 Information

If there are a lot of planes on the flight strip listing, you can pick one out by typing the ID of the plane followed by a <RETURN>. The command "g<RETURN>" will print the flight strip for plane G under the command line.

7.4 Changing Altitude

Airplanes normally enter the airspace at 6000 feet. If two or more planes are entering from a fix in a short period, they will be separated by 1000 feet, and all will be at 6000 feet or above. Airplanes taking off from an airport are at 0 feet. Planes will stay in level flight unless told to change altitude. They climb or descend at the rate of 1000 feet per mile.

To change altitude, give the plane's ID followed by the letter "a" followed by the desired new altitude. For example,

        <18> Command: XA5

tells plane X to go to 5000 feet.

Taking off and landing are special cases of the altitude command. If the plane is waiting to take off its altitude is 0. Giving it any change of altitude will cause it to take off in the normal direction for that airport. The takeoff/landing direction

is shown for each airport in the bottom right section of the screen.

To land a plane, make sure it is (or will be) heading toward the correct airport in the correct direction, then send it to altitude 0. This is the last command you can give to the airplane, since you are passing control to the airport tower, so be sure that it is heading correctly before you try to land it. To land, the plane must be at 0 altitude one mile before the airport. If the plane flies over the airport at altitude 0 from the wrong direction, it will go back up to 1000 feet and you will have another chance to land it.

The flight strip reflects changing altitude. For example,

        Dp :−>2 7v3 S   9

indicates that plane D is now at altitude 7000 feet and is descending to 3000.

7.5 Turning

Turning planes will turn at the rate of 45 degrees per mile. To turn a plane, give the plane's ID, the direction of turn, and the new bearing. The direction of turn is one of the letters "l", "r", or "t". "l" and "r" specify a turn to the pilot's left or right, and "t" means to turn through the minimum angle to reach the specified bearing. ("t" is useful for people who have trouble with left and right.) For example,

        <47> Command: ULNE

tells the pilot of plane U to turn to his left until he is heading northeast. If plane Y is heading north, the command

        <47> Command: YTE

will cause the plane to turn right 90 degrees; if it is heading south the same command will cause it to turn left 90 degrees.

Changes of direction are indicated in the flight strip. For example,

        Nj :−>5 5 S r W   +

indicates that jet N is heading south, and will turn 90 degrees to the right.

To cancel the remaining part of a turn, give the command (for plane N):

        <23> Command: NR0

7.6 Using Navaids

Navaids (navigational aids, VORs, or radio beacons) are very useful for giving longer-range plans to the pilot. All incoming planes are on airways that will intersect one or both of the two navaids. The navaids may be used to tell the plane where to "hold", or to vector it toward an airport or an exit fix. "Holding" means continuously making left turns, which will cause the plane to pass over the navaid every eight updates until it is given a direction or runs out of fuel.

Any plane can be told to hold at the next navaid it encounters by giving it the command (for airplane A):

        <18> Command: AH

This will show up on the flight strip as

        Ap :->2   5   S   *   7

After beginning to hold, the "*" will change to an "h" and the direction of turn will be indicated. To override the automatic hold give the command (for plane N)

        <23> Command: NRO

This is the same command used to cancel a turn.

Every incoming plane that will be landing will automatically hold at a navaid unless you (the controller) give it other instructions.

An airplane can be told to proceed toward any known fix when it reaches the next navaid. This is called "clearing" the plane. To clear plane X for the approach to Gray Airport, give the command

        <18> Command: X*G

Use W for White Airport, or the number of an exit fix to vector the plane in that direction. A plane cleared to turn at a navaid will turn sharply.

If a plane is cleared through a navaid, it will show up with an asterisk on the flight strip. For example,

        Hj .->2   5   S   *5   +

indicates that plane H will head in the exit direction for fix 5 when it encounters a navaid. Note that H must encounter a navaid for the command to take effect.

A holding aircraft given a clearance will continue around to the navaid, then immediately assume the specified bearing. If a cleared aircraft is given a turn, any clearance or hold is immediately cancelled.

7.7 Speeding up the clock

During quiet spells when everything is under control, typing a space followed by return advances the clock to the next 15-second tick.

8. Transferring to a Different Airport

For the experienced air traffic controller, there are four other airspaces, each with different arrangements of airports, navaids, and airways. The other four may be selected by starting up Airport by the command

```
airport -a3
```

where the "3" may be any number from 0 to 4 (0 is the default airspace).

9. Certification

Having read and understood this entire manual, you are now certified as a trainee. You may fill in the certificate below with your name and the date. Congratulations and good luck in your first assignment!

This certifies that

_____

has qualified as a trainee

AIR TRAFFIC CONTROLLER

_____, 198___
Dr. James J. Gillogly
Chairman
AIRPORT Training Committee