



Intel 286 Emulator on Fruit Jam

Created by Tim C



<https://learn.adafruit.com/intel-286-emulator-on-fruit-jam>

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Table of Contents

Overview	3
<ul style="list-style-type: none">• Parts	
Install Emulator	6
<ul style="list-style-type: none">• Prepare DOS Floppy .img File• Install Emulator UF2	
Usage	10
<ul style="list-style-type: none">• Connect Hardware• DOS & Floppy Images• QBasic• Hard Disk Image• Map Drive• Learning More About Disk Images	

Overview

Here be dragons: This emulator overclocks the Fruit Jam's RP2350 to 378MHz, which is outside of the range officially supported by the chip. We have not seen any problems arise from this with short term usage, but there is always a risk to the hardware when operating outside of spec.



This project emulates the [Intel 80826](https://adafru.it/1auG) processor as well as some of the prior releases in the same line of chips. [FruitJam-286](https://adafru.it/1auH) is a fork of the open source [Pico-286](https://adafru.it/1aul) emulator that has been updated to work with the hardware on the Adafruit Fruit Jam. Source code for FruitJam-286 is available on [GitHub](https://adafru.it/1auH). It supports sound with the built-in DAC, video over the HSTX/DVI output, USB keyboard input from the USB Host ports, and reads `.img` files from the SD Card, which are treated as floppy drives and hard drives.

Parts



[Adafruit Fruit Jam - Mini RP2350 Computer](https://www.adafruit.com/product/6200)

We were catching up on a recent hackaday hackchat with eben upton and learned some fun facts...

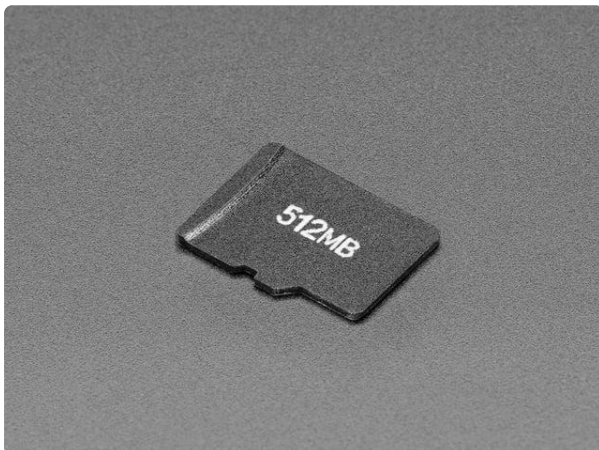
<https://www.adafruit.com/product/6200>



[Mini Chiclet Keyboard - USB Wired - Black](https://www.adafruit.com/product/1736)

Add a good quality, slim keyboard to your Raspberry Pi, Beagle Bone Black, or other single-board-computer with this sleek black chiclet keyboard. It's a full QWERTY keyboard...

<https://www.adafruit.com/product/1736>



[512MB micro SD Memory Card](https://www.adafruit.com/product/5252)

Add storage in a jiffy using this 512MB microSD card. Preformatted to FAT32, so it works out of the packaging with our projects. Works great with any device in the...

<https://www.adafruit.com/product/5252>



USB Powered Speakers

Add some extra boom to your audio project with these powered loudspeakers. We sampled half a dozen different models to find ones with a good frequency response, so you'll get...

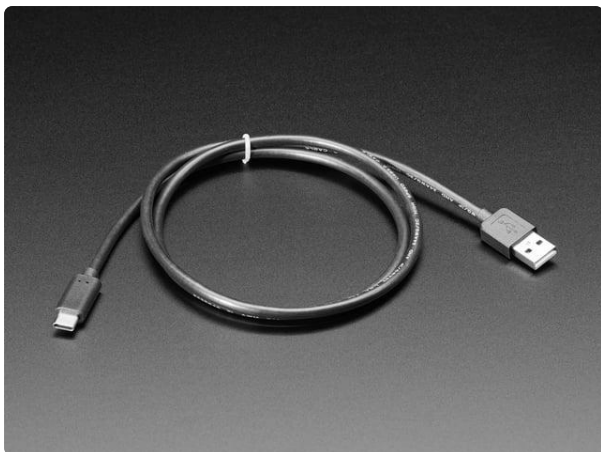
<https://www.adafruit.com/product/1363>



HDMI Cable - 1 meter

Connect two HDMI devices together with this basic HDMI cable. It has nice molded grips for easy installation, and is 1 meter long (about 3 feet). This is a HDMI 1.3...

<https://www.adafruit.com/product/608>



USB Type A to Type C Cable - approx 1 meter / 3 ft long

As technology changes and adapts, so does Adafruit. This USB Type A to Type C cable will help you with the transition to USB C, even if you're still...

<https://www.adafruit.com/product/4474>



7" Display 1280x800 (720p) IPS + Speakers - HDMI/VGA/NTSC/PAL

Yes, this is an adorable small HDMI television with incredibly high resolution and built in 3W stereo speakers! We tried to get the smallest possible HDMI/VGA display with...

<https://www.adafruit.com/product/1667>

Install Emulator

Here be dragons: This emulator overclocks the Fruit Jam's RP2350 to 378MHz, which is outside of the range officially supported by the chip. We have not seen any problems arise from this with short term usage, but there is always a risk to the hardware when operating outside of spec.

Prepare DOS Floppy .img File

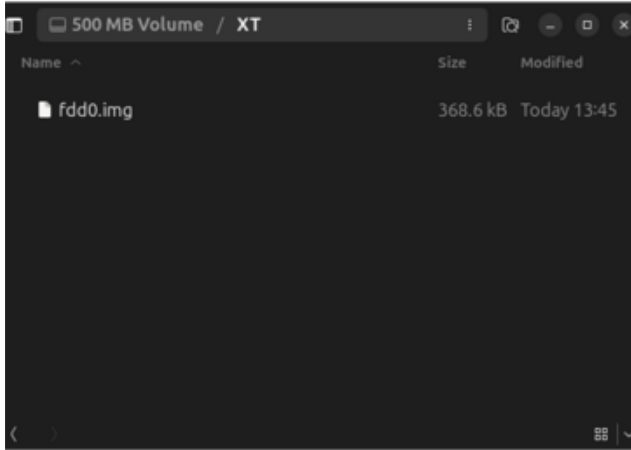
By default the emulator won't do anything without a bootable floppy disk image to load. This page will document how to load a DOS floppy into slot 1. See the [Usage \(https://adafru.it/1auJ\)](https://adafru.it/1auJ) page for details on loading other software.

First download the DOS floppy disk `dos6-fdd0.img` file by clicking the button below.

[Download DOS Floppy Disk Image](https://adafru.it/1avh)

<https://adafru.it/1avh>

Create a folder named **XT** at the root of a blank FAT formatted SD Card [such as the ones we stock \(http://adafru.it/5252\)](http://adafru.it/5252).



Inside of the **XT** folder paste the DOS disk image file downloaded from the button above.

Rename it to **fdd0.img**

Use the eject, unmount, or safely remove action in your OS to disconnect the microSD drive from the host OS, then unplug the microSD card from the computer.

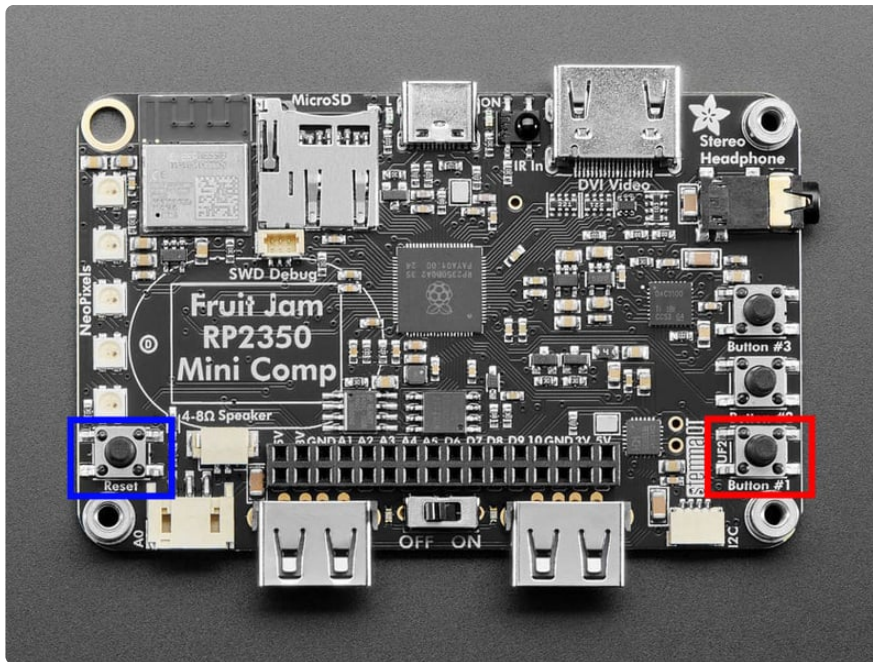
Power off your Fruit Jam and insert the microSD card into the Fruit Jam's microSD card slot.

Install Emulator UF2

The FruitJam-286 Emulator is released as a UF2 file that is ready for loading onto the Adafruit Fruit Jam. Click the button below to download the latest release of the emulator.

[Download the 286 Emulator for Adafruit Fruit Jam](https://adafru.it/1auL)

<https://adafru.it/1auL>



Plug your Fruit Jam into your computer with a known good USB (data+power) cable.

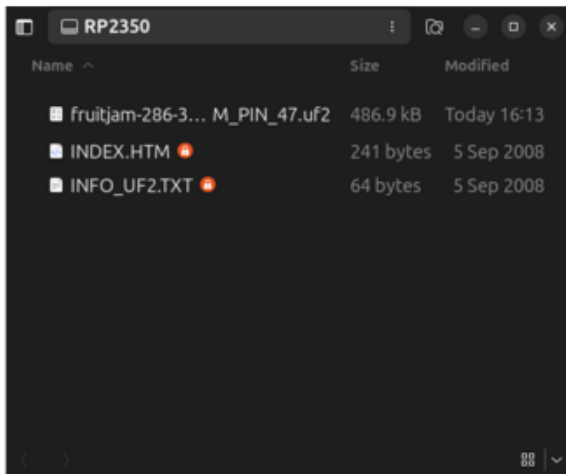
To enter the bootloader, hold down the **BOOT/BOOTSEL** button (highlighted in red above), and while continuing to hold it (don't let go!), press and release the **reset** button (highlighted in blue above). **Continue to hold the BOOT/BOOTSEL button until the RP2350 drive appears on your Computer (in Finder or File Explorer depending on your operating system)!**

If the drive does not appear, release all the buttons, and then repeat the process above.

You can also start with your board unplugged from USB, press and hold the **BOOTSEL** button (highlighted in red above), continue to hold it while plugging it into USB, and wait for the drive to appear before releasing the button.

A lot of people end up using charge-only USB cables and it is very frustrating! **Make sure you have a USB cable you know is good for data sync.**

You will see a new disk drive appear called **RP2350**.

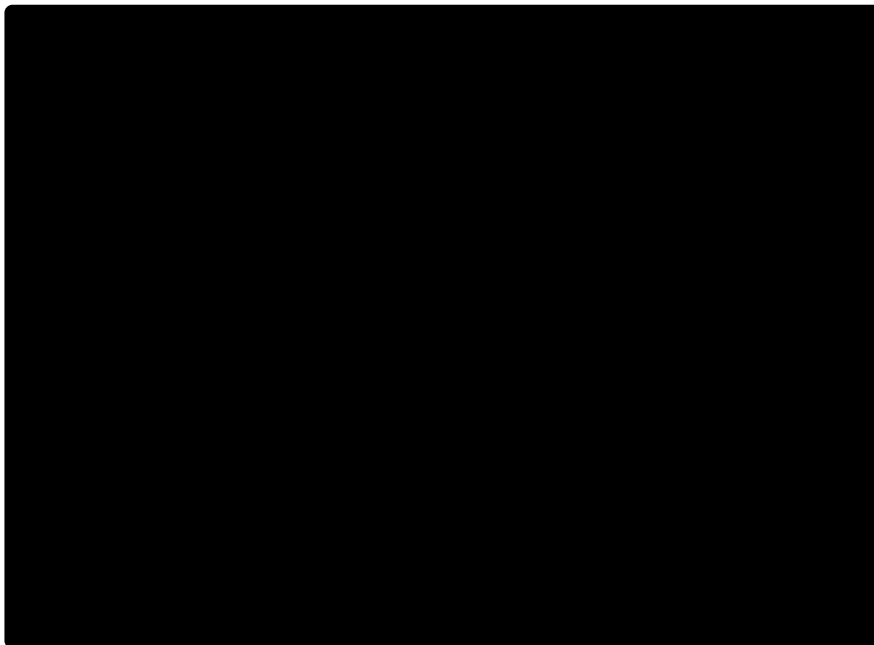


Drag the **fruitjam-286-378MHz-HDMI-I2S-ONBOARD_PSRAM_PIN_47.uf2** file downloaded from the green button above to the **RP2350** drive.

After the file copy is complete, the Fruit Jam will reset and begin running the 286 emulator, and boot to the DOS disk.

With a DVI compatible display connected, it will show the boot sequence below.

If there are speakers or headphones connected to the 3.5mm audio jack, a beep sound will play during the boot sequence.



Usage

Connect Hardware

Connect a USB keyboard to one of the USB Host ports. Connect the Fruit Jam to a DVI compatible display using a standard HDMI cable. Optionally connect speaker(s) or headphones to the JST speaker connector or 3.5mm jack.

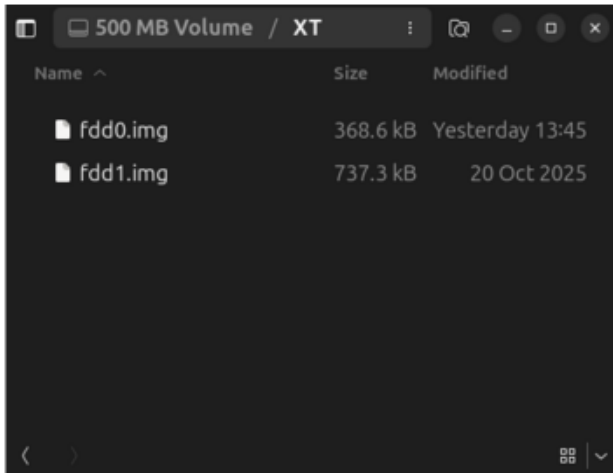
DOS & Floppy Images

After following the instructions from the [Install page \(https://adafru.it/1auM\)](https://adafru.it/1auM), the 286 emulator will boot into DOS 6.22. Type commands with the connected USB keyboard and press **enter** to run them. Use commands like `dir` and `cd` to navigate the filesystem. There is a scanned copy of the [DOS Manual on archive.org \(https://adafru.it/1auN\)](https://adafru.it/1auN) that contains a comprehensive list of available commands.

By default, the boot disk that has DOS on it is drive **A:**. It's possible to connect a second floppy **.img** file that will show up as drive **B:** in DOS. There are screenshots, details, and a link to download an image file that we tested below. You can also search around archive.org or other places online to find downloadable copies of **.img** files for disks from this era. It is possible to create your own **.img** files that contain **.exe**'s and other files, but it's rather involved, a simpler method of using regular programs and files is shown in the [Map Drive section \(https://adafru.it/1auJ\)](https://adafru.it/1auJ).

Supported floppy disk image sizes are: 360KB, 720KB, 1.2MB, 1.44MB

To insert an optional second floppy to the emulator:

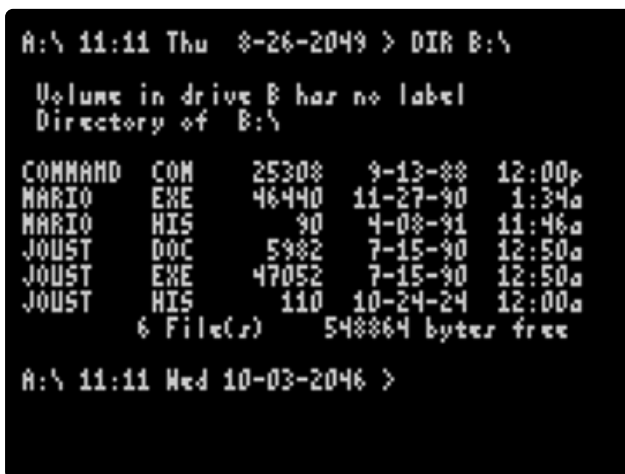


Unplug the Fruit Jam from power to shut it off

Remove the micro SD card from the Fruit Jam and connect it to a computer
Paste a floppy disk image into the **XT/** folder at the root of the SD.

Rename the new disk image file **fdd1.img**. There will already be a **fdd0.img** file which is the DOS disk that was setup on the installation page. The full file path within the SD should be exactly **XT/fdd1.img**. Use the eject, unmount, or safely remove action in your OS to disconnect the microSD drive from the host OS, then unplug micro SD card from the computer. Insert the micro SD back into the Fruit Jam and plug it back in to power

With the **XT/fdd1.img** file present on the SD card, the files from that **.img** will be available inside of DOS in **B:**. To see what is on the disk use this command **DIR B:**



The **DIR B:** command will list all of the files on the disk. Any files that are **EXE** executables or **COM** command files can be run by typing their full path and pressing enter. For example **B:\Joust** to launch the Joust game shown in the **DIR** output screenshot to the left.

You can move the shell into the drive by typing it's drive letter and colon then pressing enter i.e. **B:** to navigate to the second floppy drive.

Joust & Mario Disk

Click the button below to download a disk image containing the games Joust and Super Mario Bros VGA.

[Download Joust & Mario Floppy Disk Image](https://adafru.it/1auO)

<https://adafru.it/1auO>

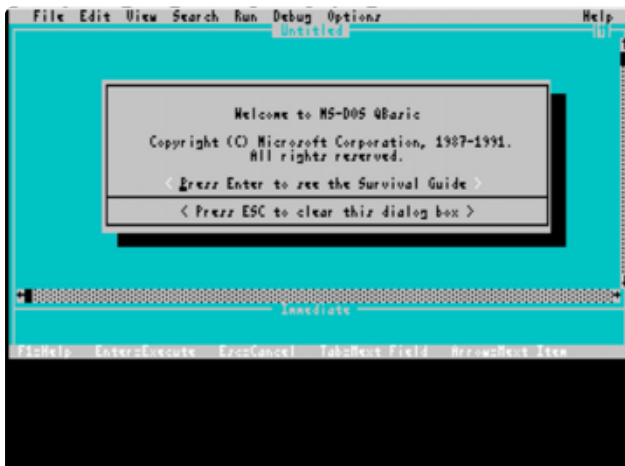


In [Joust](https://adafru.it/1auP) (<https://adafru.it/1auP>), the player takes the role of a knight riding a flying Ostrich carrying a lance. The goal is to fly around and battle enemies with your lance. The controls and a few other aspects are customizable from the menu screen, there are instructions and keys documented at the bottom of the menu.



Mario Bros is set in a similar 2d environment with platforms to run and jump on. In this game the enemy turtles come out of the pipes at the top of the screen. The player must try to jump and hit the platform while a turtle is on the ground above to bounce it up and gain points.

QBasic



DOS 6.2 comes with [QBasic \(https://adafruit.it/1auQ\)](https://adafruit.it/1auQ) pre-loaded. To access it run the command `qbasic` from the `A:\>` drive prompt. There are a handful of BASIC games and programs included in a folder named **QBFILES**.

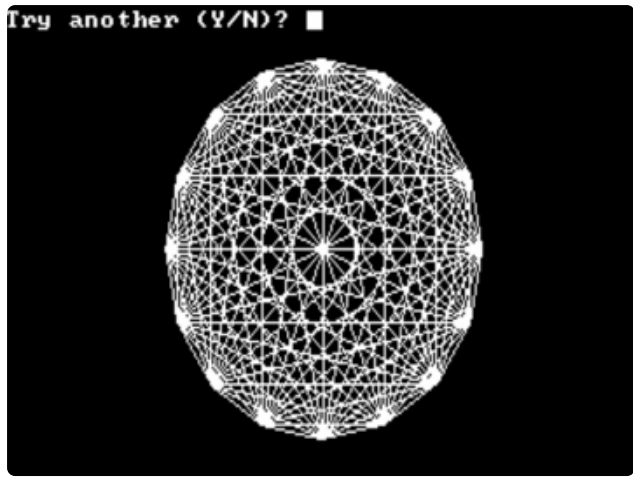


To access the included programs, press **Alt+F** to open the File menu, then press **O** for Open. Press **tab** to move the selector to the list of directories and drives on the right, then press **down arrow** to select the **QBFILES** and press **enter**. Press **tab** to move the selector to the list of files on the left, then use the **arrow keys** to navigate up and down through the list of files and press **enter** on whichever file you want to open.



When you open a **.bas** files it will load the file into the main editor for you to view/modify the code. When you want to run the program press **F5**.

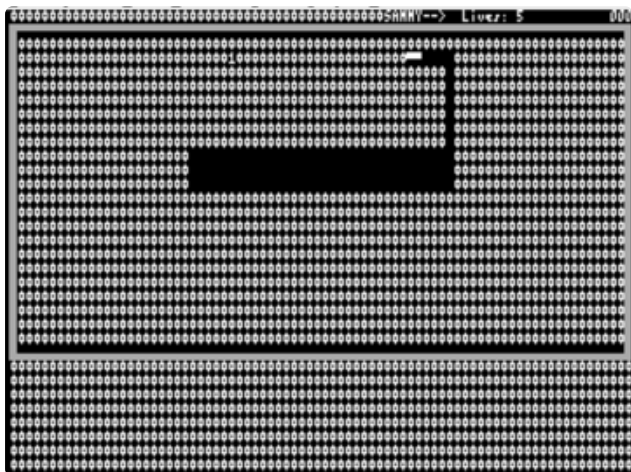
Aside from the games, there are a few programs that play jingles from the attached speaker, a copy of Money, an old Microsoft accounting utility, **HGCTEST.BAS** a graphics test that draws polygons, and **REMLINE.BAS** a tool for removing line numbers that aren't explicitly used within BASIC code files.





QBasic Games

Included in the **QBFILES** directory are **GORILLA.BAS** and **NIBBLES.BAS** files which contain playable games.



Gorilla pits two players against each other as gorillas throwing bananas back and forth at each other over a city skyline. Players take turns entering an angle and velocity to launch their banana.



Nibbles has the player control Sammy, the snake, with arrow keys. Attempt to collect the numbers and avoid the walls. During the first life of play, the field seems to get filled with a repeated character, I think that may be a bug but I never played the original and am not certain. After the player loses a life, the field resets and looks correct with blank areas and the numbers to eat being much easier to see.

Hard Disk Image

The author of the pico-286 project has shared a hard disk image that contains several other games and programs. Many aren't working inside of the emulator, but some do and there is plenty of nostalgia and fun to be had.

Adafruit's Anne Barela has taken the disk and removed many of the programming tools, leaving MS-DOS 6.22 and the GAMES directory. Also the image is bootable, unlike the Pico-286 image.

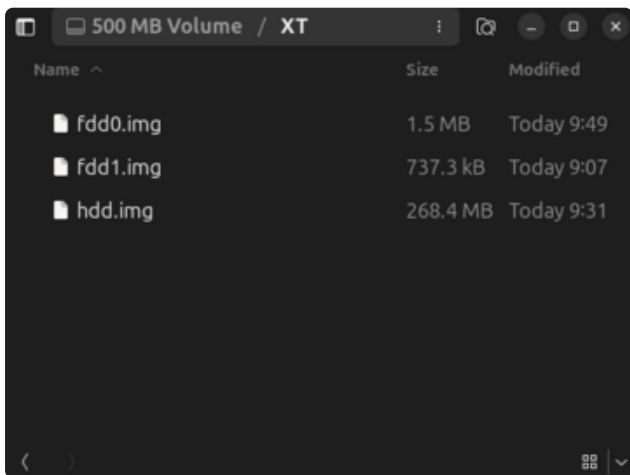
Mounting hard disk images inside the emulator is very similar to mounting floppy images. The emulator will look for the file **XT/hdd.img** on the SD card, if it exists it will be made available to DOS as the **C:** drive.

Click the button below to download the hard disk image file.

[Download Hard Disk Image](#)

<https://adafru.it/1avi>

To insert a hard disk image to the emulator:



Unplug the Fruit Jam from power to shut it off

Remove the micro SD card from the Fruit Jam and connect it to a computer

Paste a hard disk image into the **XT/** folder at the root of the SD.

Rename the disk image file **hdd.img**. It should be next to any existing **fdd#.img** files. Note that the main **hdd.img** file has no number in it like the floppy ones. The exact file path should be **XT/hdd.img**

Use the eject, unmount, or safely remove action in your OS to disconnect the microSD drive from the host OS, then unplug micro SD card from the computer.

Insert the micro SD back into the Fruit Jam and plug it back in to power

```
A:\>cd c:
C:\>cd games
C:\GAMES>
```

With the **XT/hdd.img** file present on the SD card, the emulator will see the contents of the hard disk image as the C drive. Move to it by entering the command **c: .** Feel free to use **dir /p** to look around at the included files. The **/p** argument tells **dir** to paginate the results so that they can be viewed one page at a time rather than scrolling off the top of the screen.

There is a **games** folder on the drive which contains many games. Use **cd games** to move inside of it. Then **dir /p** to list the available games.

To launch a game, type the name of its EXE or COM file and press **enter**.

Some of the games don't work inside the emulator but we found others that do and included them in the gallery below. We didn't test every game, so there are likely others that work not included in the gallery.

If you have a bootable hard disk image such as the one linked above you can also boot directly to the hard drive by placing the **hdd.img** file inside of the **XT** folder without any **fdd#.img** files.

Secondary Hard Drives and More Software

You can have a second hard disk image file named **hdd2.img**. The second disk will get mounted as drive **D:**. If you have one, place it in the **XT** folder also along with the other images.

[Here is a link to a hard drive img \(https://adafru.it/1auR\)](https://adafru.it/1auR) that was originally provided by the author of the Pico 286 project. It contains the same games and qbasic files as the hard disk image linked above as well as some additional software to explore if you like. This image is not bootable, so you must have either a bootable floppy disk img at **fdd0.img** or a bootable hard disk at **hdd.img** to use this drive image as **hdd2.img**.

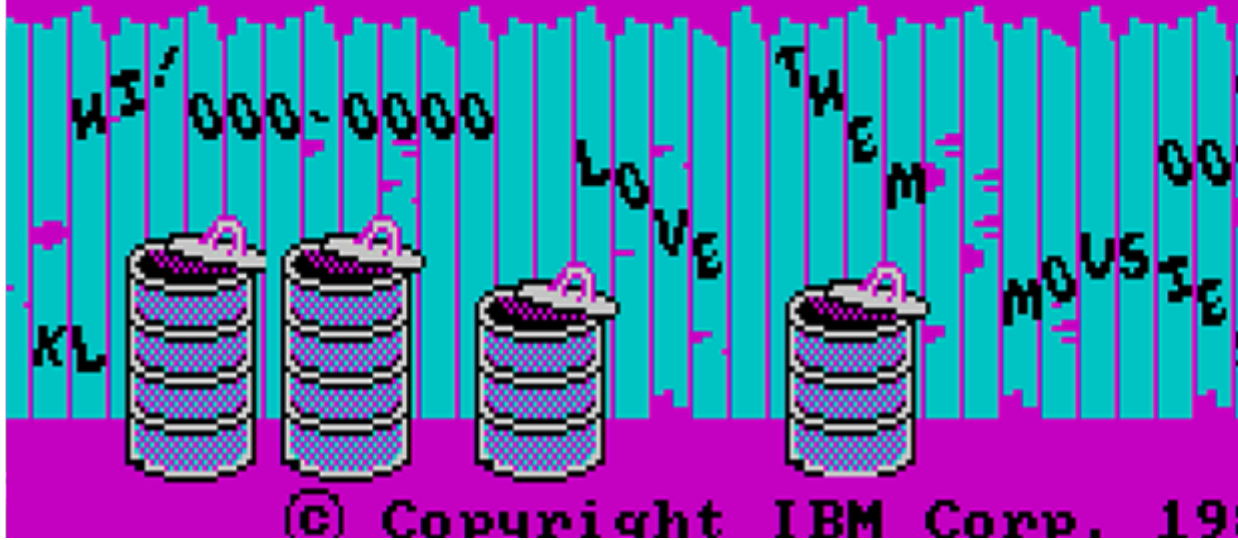
Adding a second hard disk also gives you additional storage space to use inside of the DOS environment.



IBM
PRESENTS

*Alley Cat*TM

By
Bill Williams



0

Arcade Volleyball

Play

PL1 Keyboard

PL2 Keyboard

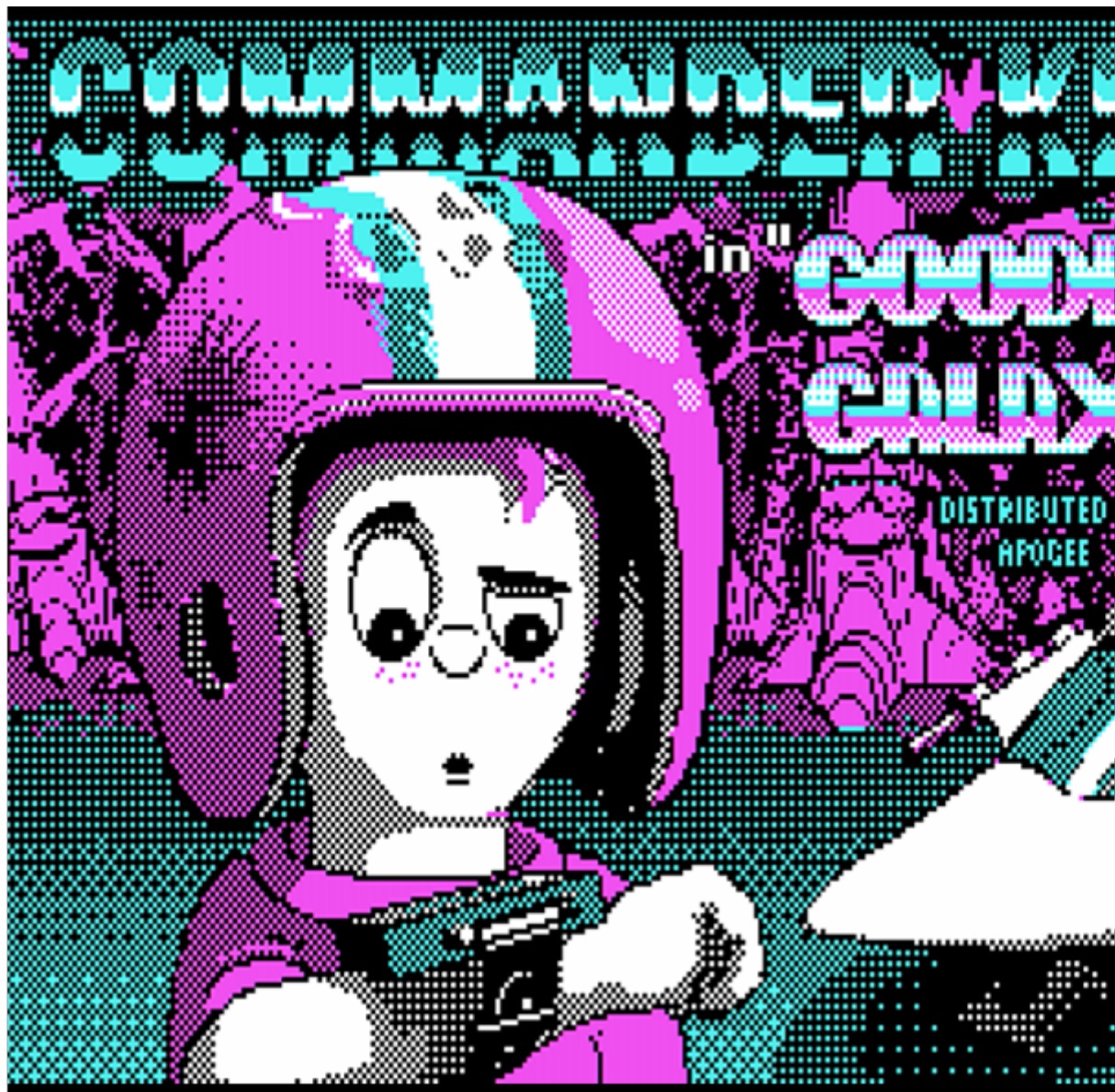
Sound On

Define Keys

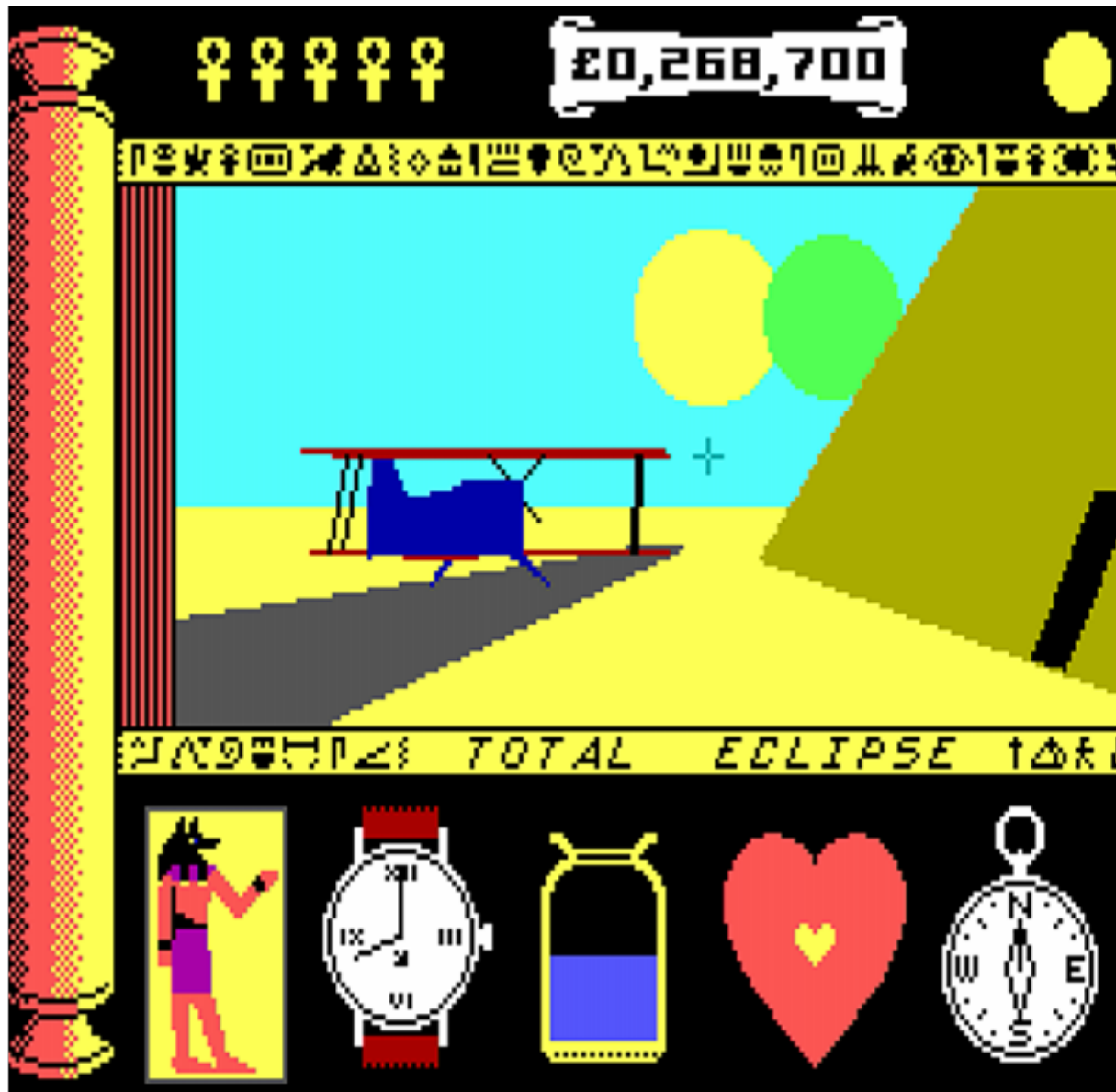
Set Joystick

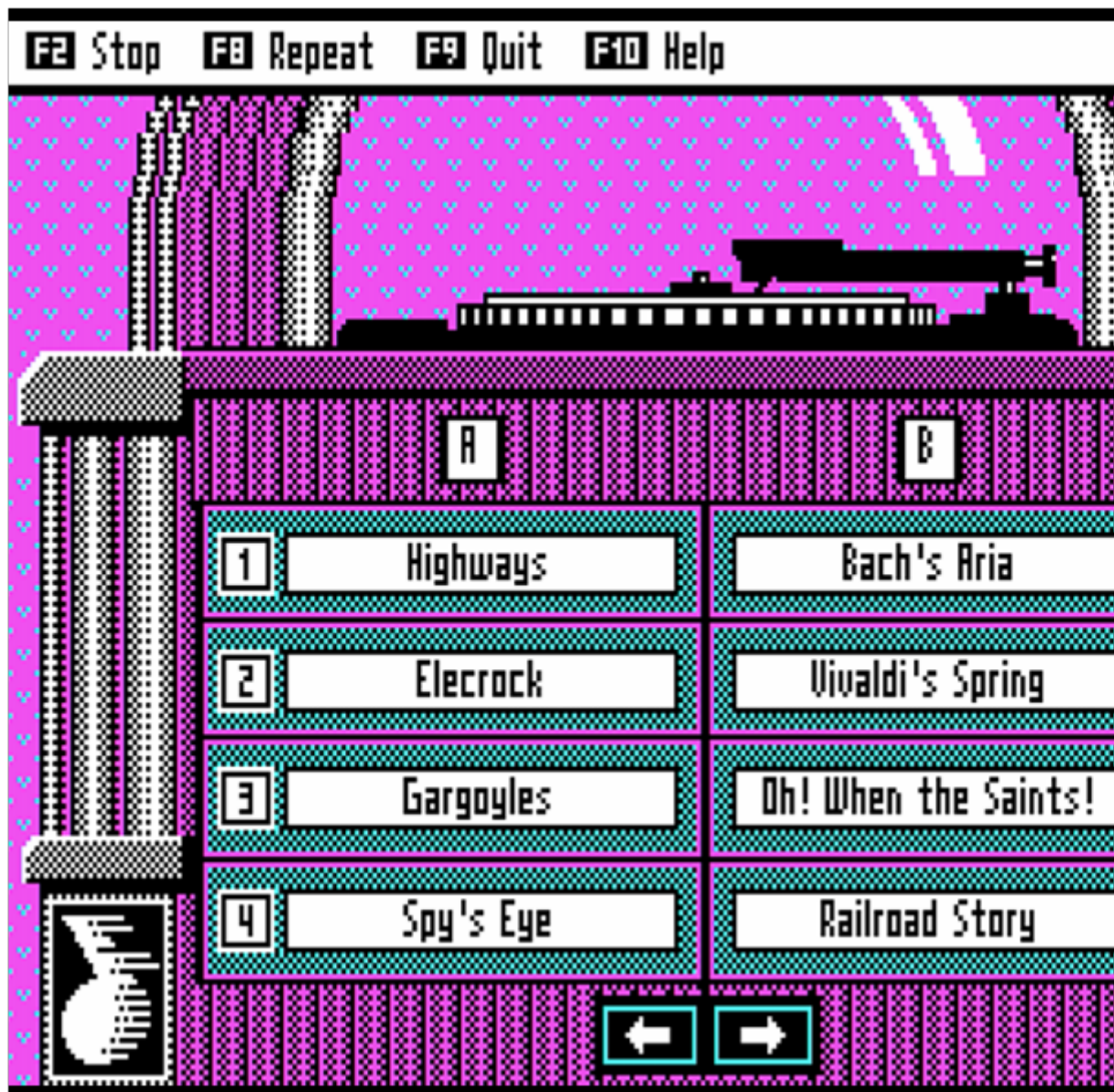
Exit



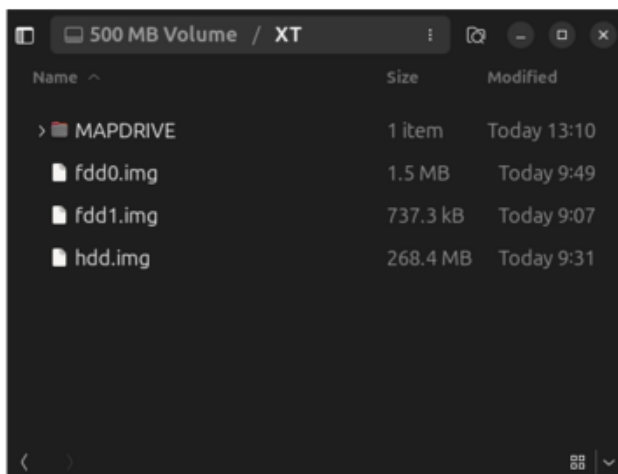








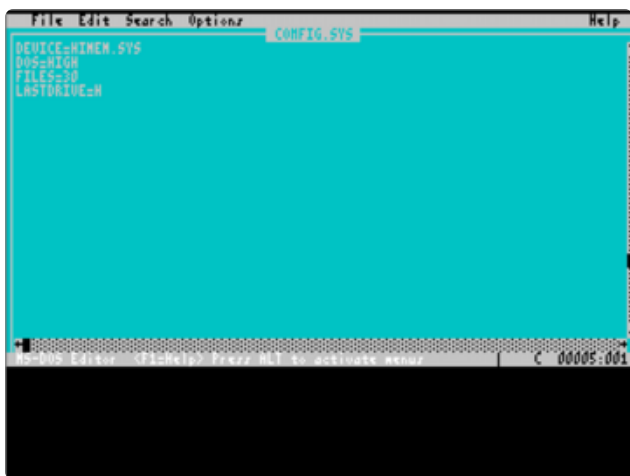
Map Drive



It can be kind of a hassle to get your files into a .img file of a floppy or hard disk. The emulator provides a convenient alternative called Map Drive. You can put COM, EXE, and other files on the SD card in the **XT/ MAPDRIVE/** folder and they can be made available as the **H:** drive inside of DOS.

The DOS 6 floppy disk and hard drive img files linked in this guide have the MAPDRIVE configuration done already inside of **config.sys**, and set to auto launch in **autoexec.bat**. The directions below are only needed if you're using your own img files that don't already have it set up.

Once you've got files loaded into the **XT/MAPDRIVE/** folder on the SD card, you also need to set **LASTDRIVE=H** inside of the **config.sys** file.



You can edit **config.sys** using the QBasic file editor with this command:

```
qbasic /editor config.sys
```

The **config.sys** file will open inside of a basic text editor. Move the cursor to the end of the file and add **LASTDRIVE=H** to an empty line.

After editing the file, press **Alt+F** to open the File menu, then press **S** to save the changes.

Once the file is saved, press the reset button on the Fruit Jam to reboot the emulator with the new system config.

```
A:\>mapdrive
Drive H: successfully mapped as a host drive.
H:\>
H:\>dir
Volume in drive H is HDLIP
Directory of H:\

<DIR>          10-23-25   6:32p
1 file(s)
0 bytes
0 bytes free
H:\>
```

After the system config is updated and the system boots up, run the `mapdrive` to mount the files from `XT/MAPDRIVE/` folder on the SD card to the `H:` drive inside of DOS. You can add `mapdrive` to the `autoexec.bat` file if you want it to run automatically on every boot.

Once `mapdrive` completes successfully, you can move to the `H:` drive by typing the command `h:` and pressing enter. Then use the `dir` command to list files that are present inside of `XT/MAPDRIVE/`.

EXE and COM files in this folder can be executed by typing their name and pressing enter, just like they can on the other drives.

Learning More About Disk Images

You can learn more about what disk images are and how to use them in an Adafruit Playground Note written by Anne Barela.

[MS-DOS Disk Images](https://adafru.it/1avj)

<https://adafru.it/1avj>