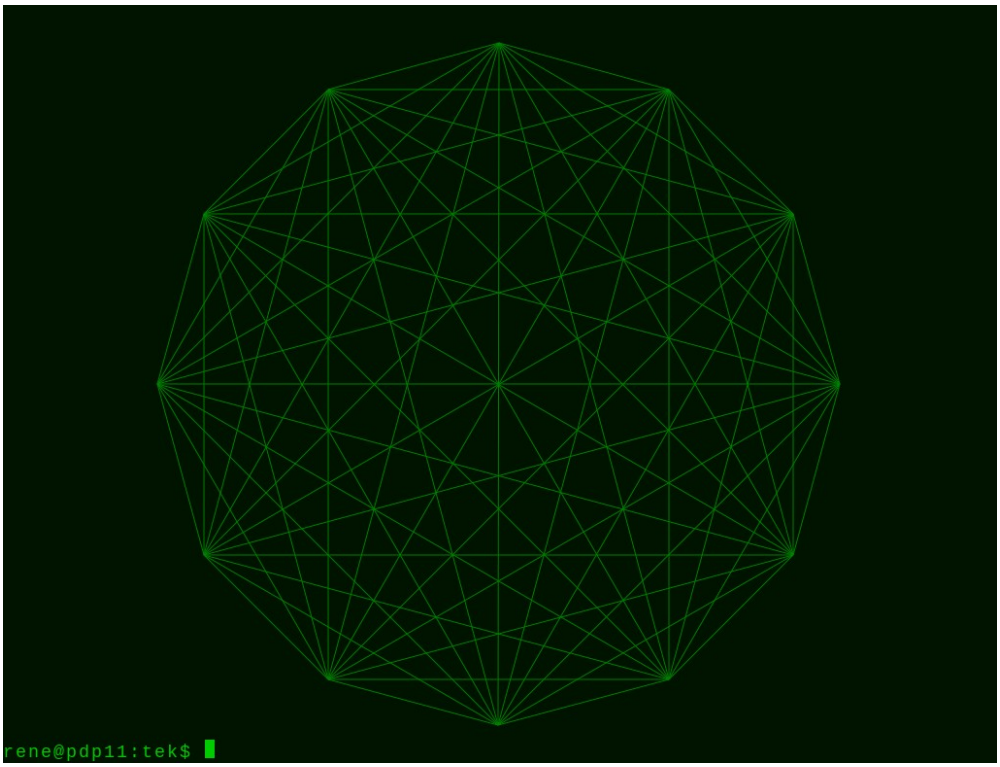
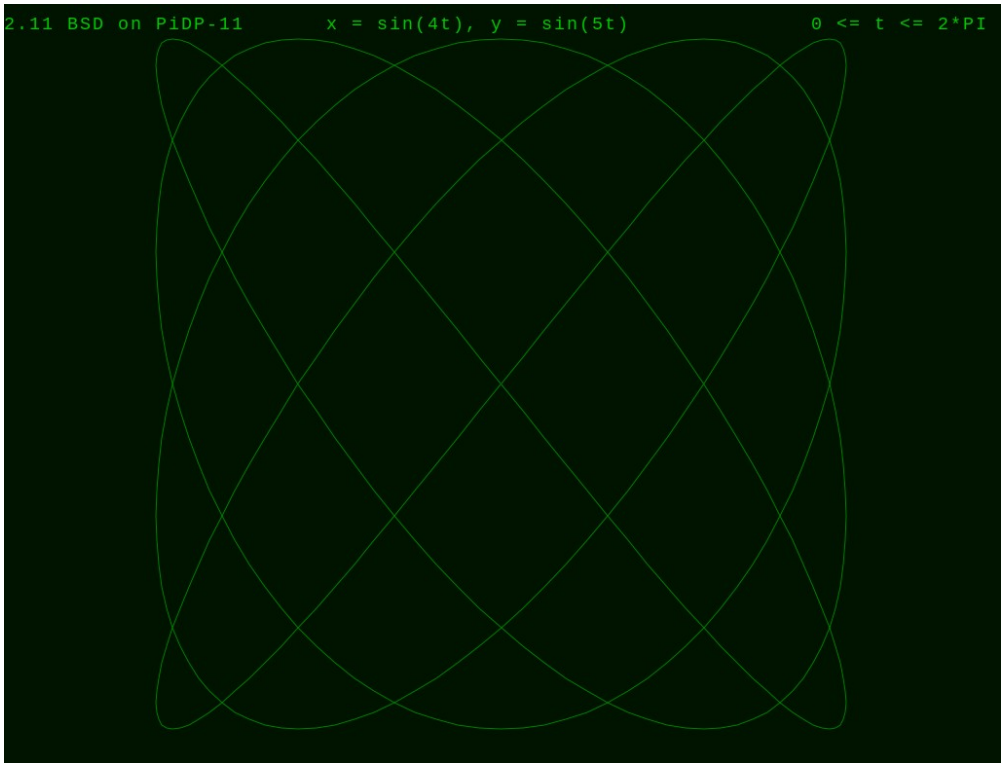
2.11 BSD on PiDP-11

Using a Tektronix 4010 graphics terminal emulator





We are here really in 1970s territory. Is it possible to use a Tektronik 4010 storage tube graphics terminal emulator with 2.11 BSD on the PiDP-11?

First, I propose that you read about the 4010 at

https://en.wikipedia.org/wiki/Tektronix_4010

Is is important to understand what one has to expect. Very important at that time, nice vector graphics, but awful text handling without scrolling.

Next, you have to choose the machine on which you want to emulate the terminal. I think xterm and rsh are available on all major systems. I decided to use a Raspberry Pi running Raspbian, because I do not want to install any potentially insecure software on my Mac. Using the approach described here I had to use a second Raspberry Pi, not the one on which the PiDP-11 was running.

We will need to login directly into 2.11 BSD, not using the console and screen, because screen refuses to talk to such as dumb terminal as the 4010. In the setup described here we will use rsh to login directly into 2.11BS:

```
sudo apt-get install rsh-client
sudo apt-get install xterm
```

Now, use whatever means you normally use to transfer the directory tek from this repository into your home directory in 2.11 BSD. It contains the programs tek and thome, which we will use. Use “make” in this directory to compile all programs there:

```
cd
cd tek
touch *.c
make
```

You are all set to login into 2.11 BSD. Open a terminal and type

```
xterm -t -fg green
```

This will start up a xterm shell window with 4010 emulation and green characters.

Login into the pdp11. I put the IP address of 2.11 BSD into /etc/hosts. If you have not done that, use the IP address instead of *pdp11*. Note, this is not the IP address of the Raspberry Pi on which the PiDP-11 is running! *yourname* is the user name you want to use.

```
rsh -l yourname pdp11
```

You should get a 2.11 BSD login prompt asking for your password.

It is also possible to combine the xterm and rsh commands as follows in a shell script or desktop entry (see man xterm for details):

```
xterm -t -fg green -n Tektronix -e “rsh -l yourname pdp11”
```

The Tektronik 4010 terminal had a Page button, which did not transfer any character to the host, but instead cleared the screen. To emulate this button, I made the thome command, which will erase the screen. You have to use it often because the terminal has no scrolling and after a while you will have a mess on the screen. Don’t even think about using vi, and just type thome before the screen gets full.

```
cd tek
thome
tek
```

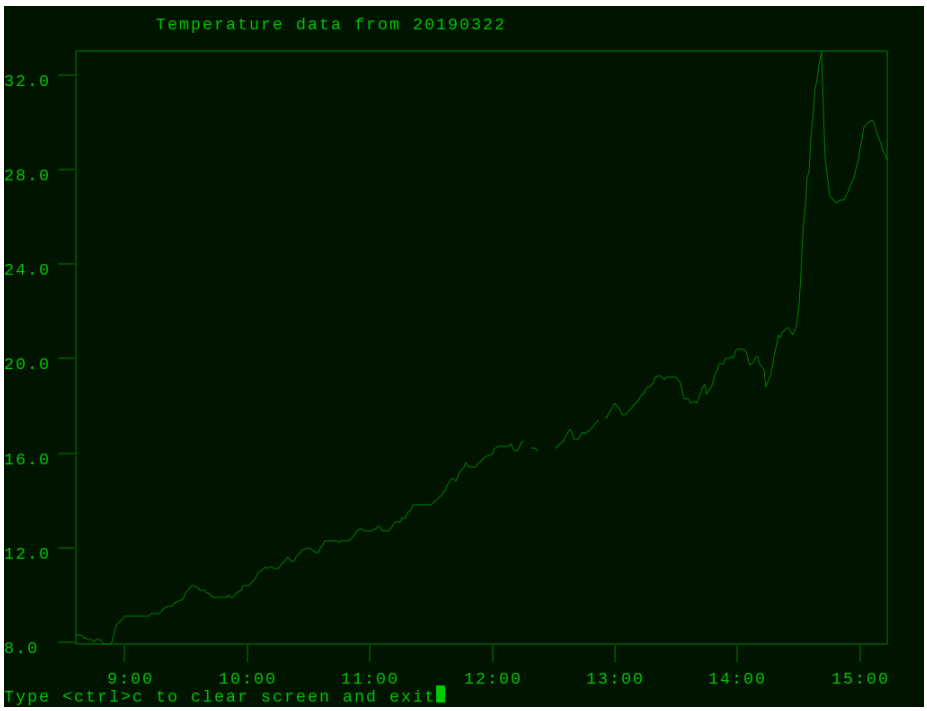
Can it get any better than that?

Of course! Instead of using xterm, you can use my own Tektronix 4010 emulator tek4010. It makes an effort to simulate the appearance of the orginal storage tube 4010 with its bright drawing spot and flashing screen when erased. Now the 1970's feeling is complete! See

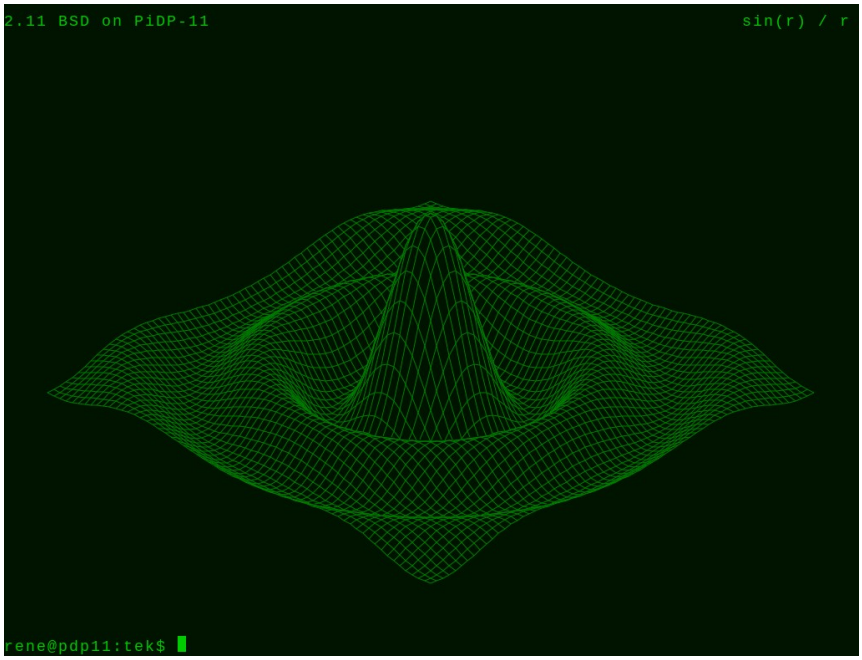
https://github.com/rricharz/Tek4010

Using this emulator the graphics also look better because the vectors are drawn using antialiasing. Also, it supports the write-through mode for animations.

There is also a small program tgraph.c in the tek directory. It allows to display the temperature data acquired with the cool-retro-weatherstation as a very simple example on how to display scientific data using 2.11 BSD and a Tektronix terminal:



Other examples in the tek directory are dodekagon, mathdemo and mathdemo2.



Also, you can find animation there. Animation uses the write-through mode for a nice little bouncing ball animation. It can only be used with the tek4010 terminal emulator, not with xterm. On a real Tektronix 4014 directly attached to a PDP-11 one had much better control over the timing of little animated displays as compared to what is possible today using simh and the tek4010 emulator on a Raspberry Pi running Linux, but the animation program gives a good impression of what was possible.

Early Plotlib and Graph on 2.11 BSD

There is a early version of plotlib included on the 2.11 BSD image. See

```
man 3 plot
man 5 plot
```

I have included the small programs test4010.c and test4014.c, which demonstrate the use of this library. The algorithm to draw a circle in this library is far from being perfect. It is interesting to see that 4K resolution was already available with the Tek 4014 in 1974, but the plot library included in 2.11 BSD was still very crude as compared to modern standards.

There is also a graph program in the 2.11 BSD distribution. Call it using something like

```
graph < yourdata.txt | t4013
```

For the options, see

```
man graph
```

But I remember that we were writing our own graphics functions at that time for serious scientific work. tekio.c and tekio.h in the tek directory are such functions for the Tektronix 4014, but unfortunately what I had written in the late 1970s and early 1980s has been lost.