

# Using GraphTab

## Using GraphTab for Medium Resolution Graphics on Dumb Terminals

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### Introduction

Text and graphics are two ways to display information to users. Graphics applications can display pictures, logos, and different typefaces, but aren't as portable as text. Alphanumeric displays are universally available, but limited to text.

There are times when it would be useful to display a logo, graphic, banner message, or picture, but it has to go into a text file for display on an unknown terminal or printer. For example, electronic mail is generally restricted to alphanumeric contents. Tools have been written to draw pictures made up of ordinary printing text. For example, the banner command shows big letters made up of identical characters.

\$ banner UNIX # (R) of USL

```
#####
# # # # # # # #
# # # # # # # #
# # # # # # # #
# # # # # # # #
# # # # # # # #
# # # # # # # #
# # # # # # # #
#####
```

Programs to plot functions on Teletype printers or to draw Snoopy calendars using block letters were very popular in the 1970s. Suns and BSD systems have programs for very large signs. However, such displays are often too large to fit on a screen, requiring the user to print the message on paper and hang it up on the wall sideways. This is great for signs, but not so good for signature files and logo displays when software starts up. It turns out it is possible to do considerably better than the display of large block letters, using only plain mixed case text. On an ordinary CRT screen, it is possible to display 98x160 graphics with a resolution good enough for many applications. If you have a Sun running SunOS 4.1 (or an earlier version) try typing:

\$ /usr/lib/vfontinfo -m cm.i.11 UNIX

```
wggw: wggw wggg . :wgg: wggw :wggp: wgggw
j| .M' jPM# . .M' .M| !M| .dP"
,M dI ,P 'M# dI dP !M|/'
dP P dI 'ML, P MI ,PM|
M| .dI P |MdI ,P ,/F vM,
'MxxpP' x+|x qP xx+|x xd+Fx xM#xx
```

There are many fonts available in different styles and sizes. In place of cm.r.12 try any font from except those ending in "r". The number in the font name represents the "point size" which is larger for bigger text. Here are some examples, showing the versatility of different fonts:

\$ /usr/lib/vfontinfo -m B.14 Kludge

```
--gg-- .gg--gg --gg --gg
MM .gP' MM MM --xx --,xx ,,xx,MM ,xx, ,xx ,x,x,
MM ,dI' MM MM --xx --,xx ,,xx,MM ,xx, ,xx ,x,x,
MMd00b MM MM |MM ,+P' 'MM ,+P' 'MP' ,+P' 'M
MM' 'M| MM MM |MM MM' 'MM |M| MM MM;---|
MM 'M| MM MM |MM MM. MM dPbc,+P' MM.
MM vM| MM MM |MM .x+MM 'Mb, ,bM |M| .x/
*****
vM. jM
*****
```

Larger fonts have more bits and so they tend to look somewhat better.

\$ /usr/lib/vfontinfo -m bocklin.28 Hack

```
xsgggggg+00000000b
M00TY000M' 'vM0T
'!ld*'!! '***
?IM!gggbcx, .
M!fg. "vM000g. .xxxxxxdgggx. .,dgM!ggb,
M000| 'vM000| ,+M00' "'vM000b .dMPP"'M00M| M00M .xdqMgpx.
M000| 'M000| 'M000000gblM000| .M0P dM000M| M000g/P' 'vM00|
M000| M000M '****=dM| |M000| jM' "'!P' M000M ..,M00P
M000| M000M ,gM' |M000| M0M| M000M |M000| M000' M00'****
M000| M00P db00' |M000| M0M| M000M 'vMgx,
M000| M0M' jM000| |M000| qM0M, .x. M000M 'vM00|,
M000| jM0M| M000M|xxxxdM000M| 'M0000gbcxxdggM| M000M T00M|
.d+M00000b MM' qM000000000000M|, YM0000000000M' M000M 'M00M|
***** M| M000000P!|!M00M| 'vM000P|M00M| jM0000M| vM000M|
MM M0M!gg,
*****
```

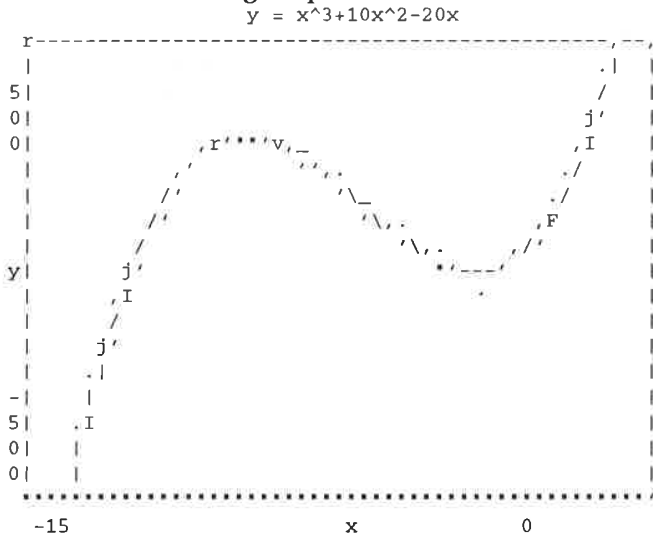
Smaller fonts can be used to create legible text using less space than the banner command  
\$ /usr/lib/vfontinfo -m nonie.r.10 HELLO

```
gl jg gpwww: gl gl .xpw b,
M| |M M| M| M| jP' Y#
M+www+M M+www M| M| M| M
M| |M M| M| M| q| ,M
M| |M M|xxxx, M|xxxx M|xxxx 'bbxpP'
```

### GraphTab

It is possible to create graphical displays for ordinary alphanumeric displays. In addition to the obvious use of Xs and blanks to get 24x80 resolution, finer resolutions are possible by making clever use of the shapes of the alphanumeric characters that are available. GraphTab is a technology to create such medium resolution graphical displays using only alphanumeric text. Since most characters are nearly twice as tall as they are

wide, a simple approach is to display a 2x1 rectangle (2 pixels) in a single character position. A blank represents both pixels being empty, a I or M shows both pixels being full, a " or ' shows the upper pixel only, and a , " or ." shows the lower pixel only. Even higher resolution is possible. A single character position can represent a 4x2 rectangle, or 8 pixels. Since there are 256 possible patterns and only 95 printing characters, the display will be ambiguous, but usually the overall shape is more important than being able to pick out individual pixels. The GraphTab table was generated by considering each of the 256 possible 4x2 patterns and choosing an alphanumeric character that most closely resembles the shape of the desired pattern. While GraphTab images are not as sharp as images created with true graphics hardware, they can be much better than images drawn with large blocks of X's. The usual problem with low resolution graphics, legibility of the text drawn using graphics, is not necessarily a problem, since text labels can be drawn using real text. For example, consider a plot of a cubic function drawn using GraphTab:



Another use of GraphTab is to include digitized photos of people. This can be useful, for example, to include with email when it is not possible to meet the other person face-to-face. Some GUI systems, such as the AT&T DMD series, show a 48x48x1 picture of the people who recently sent mail to you. GraphTab can display these images at different resolutions, occupying either 12 or 24 lines on the screen.

Ken Thompson, at zoom level 2:

```

:      ;
d;          7,
IM_._. _ .xgM
MM/cq;PF]MPPMMI
MT|'";' T?:+MM.
:M|;;;gg+MMgMM
jMM/6MMMMMMMMMM#.
j#MMMMMM#c+MMMMMM#,
T#MMMMMMgM+MMMMMM+I
.,+MMMMMMMMMMMMMMMM+R,
_1|[?MMMMMMMMMMMMMM#M]>
qj)/+#MMMMMMMMMMMMMM[F

```

Dennis Ritchie, at zoom level 1

```

MMMM, M, MM" MM, ,,
, MMMMMMMMM " " " " " "
, MMMM " " " " " " " "
, MMM " " " " " " " "
MMM " " " " " " " "
MM " " " " " " " "
MM " " " " " " " "
M " " " " " " " "
M " " " " " " " "
"MMMM" M, MMMMM " M " M " M " M "
"MMMM" MM " MM " " M " MMMM " M " M
" M M M, M M " " M " " M " M "
M, M, " " M " " " " " " "
M " M " MMM " " M, M, " " " " " "
" " " " " MMMMMMMM " " " "
, M, " " M, MMMMMMMMM, M " " "
, MM, MMMMMMMMMMMMMMMM, " " M,
M, M, MM " M " M " " " M " MM, M M
, MMMMM M, MMMMM " M MM " M
M MMMMM, M M " M " " M MMMM "
" M " MMMMMMMMM " M, MMMMM M
" MMMMMMM, M, MM, M, , , MMMM M
" " " " " " " " " " " " " " "
" " " " " " " " " " " " " " "
M " " " " " " " " " " " " " "
MMMM, MMMM " M " M, MMMMM, M, M
MMMM, MMMM " M " M, MM, M, "

```

### Using the vfontinfo Command

The /usr/lib/vfontinfo command, present in 4.2BSD and SunOS 4.1, incorporates the GraphTab technology to display the characters from bit-mapped fonts. (This is perhaps not the best use of GraphTab, but I am describing it here because it is widely available today.) Of course, Suns have real graphics hardware, but this command can be used from any ASCII terminal, over the network, and included in email.

You may find it in other systems derived from 4.2BSD. Not all Suns have vfontinfo ; it is optionally loaded from the standard distribution as part of the Versatec package, and your administrator may or may not have installed it when the system was brought up. The command and font library is not present in SunOS 5.0. There are several undocumented options to vfontinfo that can be used to create examples. Without any options, the command displays numeric data about each character in a particular font file from . For example:

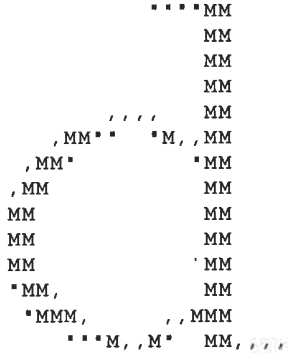
```

$ /usr/lib/vfontinfo R.14
Font R.14, raster size 7594, max width 64, max height 40, xtend 24
      ASCII  offset  size  left  right  up    down  width
R.14  41  |     1221   26   -5    8    25     1    12
R.14  42  "     1247   18   -4   17    26   -17    19
R.14  43  #     1265  105   -3   23    25    10    26
...

```

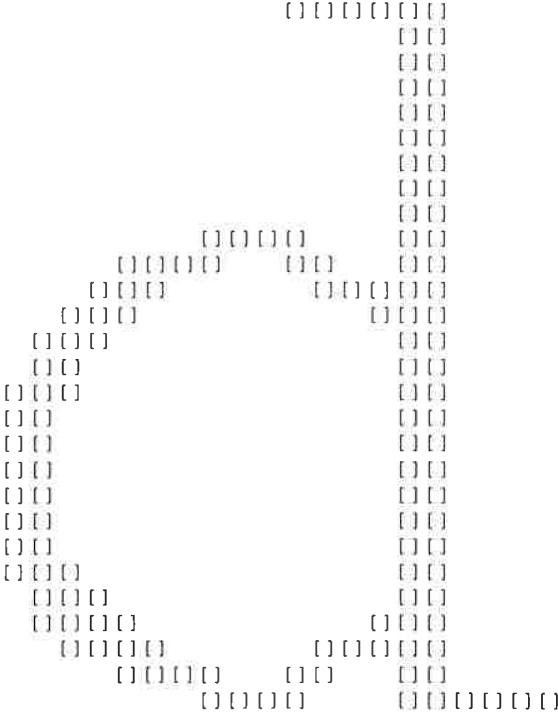
Adding the -v (verbose) option causes vfontinfo to also show the bits of each character. (We can also add another argument to choose a few characters of interest.) This option uses GraphTab's 2 pixels/character method to show the bits.

```
$ /usr/lib/vfontinfo -v R.14 d|
tail +5 | sed 's/./&& /g'
```



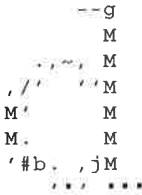
The tail command skips the headers, which may not be interesting. The sed command works around a bug in the command; at zoom level 1 it skips every other column. (A fixed and enhanced version of the vfontinfo source and man page can be found on ftp.uu.net in the directory which can be retrieved from the Internet with anonymous FTP. This version makes the above sed command unnecessary. The output shown here is from the new version.) The vfontinfo program has an undocumented zoom option to control the pixel size. The default zoom level, 1, uses 2 pixels/character. Zoom level 0 uses 2 characters/pixel. Zoom level 2 uses 8 pixels/character. Level 0 produces displays of big pixels. (GraphTab would use the sequence MM for each pixel, but vfontinfo uses to show the individual pixels more clearly for the font application.)

```
$ /usr/lib/vfontinfo -z0 -v R.14 d
```



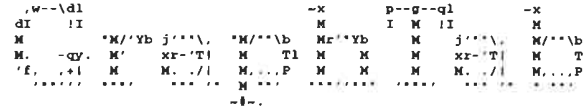
Zoom level 2 is used to display small pixels. Each character represents an area of the graphics display four pixels high by two pixels wide. The same character fits into a much smaller space while retaining approximately the same shape.

```
$ /usr/lib/vfontinfo -z2 -v R.14 d
```



More usefully, the vfontinfo command has a message option to use the small pixel code to display banners.

```
$ /usr/lib/vfontinfo -m R.10 GraphTab
```



The message option can be useful for creating compact banners in a wide variety of fonts. Inspecting `/usr/lib/vfont` and experimenting with different fonts and type sizes is both fun and useful. (Avoid fonts whose names end in "r"; these fonts have been rotated and cannot be directly displayed.) The ASCII file sent via E-Mail to ClariNet customers includes the graphic:

```

..xgm-vqk. -gg          xx  -qgb. -qg-          xx
dN'  I I I  MM          |MM|  IM          |MM|
MM   MM   I I' qI.  HMP' I I  MM   |M' MM|  IM   dMP' 'Nb  MM
MM.   MM   MM  dgP' TM|  MM'   MM   IM   'qM+M  MM-----' MM
MM'   +P  MM   MM. dM|  MM   MM   IM   YMM  vNb..gy  qMLjq

```

This graph was generated with a command called `vbanner` which is similar to

```
$ /usr/lib/vfontinfo -m B.10 ClariNet
```

### More Examples

To find create a nice banner, you may need to try several things. Many of the fonts are already quite ragged, and the GraphTab process aggravates the raggedness. Some messages step on bugs in `vfontinfo`; it is necessary to keep the message to within 80 characters of output, and in some cases the last column may be cut off. (This bug has been fixed in the version available on UUNET.) Here are some examples of fonts that look relatively nice.

```
$ /usr/lib/vfontinfo -m shadow.16 USENIX
```

```

.d---q.d---q          |.d-----q          |.d---v.d---q          |.y---q          |.[-q.d---
dXX  IMX  |  /  |  |MMMMMM?|  dXX  .....j  dXX  YMX  | +M|  |MMML 'LjMF ./
MMX  IMX  | dM|  |MMMMMM?|  MMX  |MMMMMP' MMX  YM  |MM|  |MMML 'MP ./
MMX  IMX  | MM|  |MM|  |MMX  |  MMX  |b  '  |MM|  | 'MMML /
MMX  IMX  |MM|xxxxxxx|  MMX  jgg'  MMX  |MM|  |MM|  | 'MP' . Y.
MMX  ***  | I I P'*****|  MMX  '-----q  MMX  |MM|  |MM|  | dP' jMI. Y.
MMX  |  +|  |  /  |  |MMX  |  |MMX  |MMX  |MMX  | dP' jMMX  Y
MMMMMMMMMMMMMP'  MMMMMMMMMMMMP'  MMMMMMMMMMMMP'  MMMMMMP'  |MMMMMP'  |MMMMMP'  dMMMP'  qMMMMP

```

```
$ /usr/lib/vfontinfo -m I.18 Hello
```

```

..gy--          -gz-          -.x.          -.x.
.M'   IP          jM'   jM'
+|          .M'          .MT          .MT
jP          jT          |dw--wb-          jM'   jM'          |dw-wb-
jP          |M'   +P'   x|          |MT          |MT          +P'   'M
ML          d|          +P          |MM          |MM          +P          |
.M'   jP          M: xjM'***          |MI          |MI          M'   .M
dM'          +I          M:          +P  d:          +P  d:          M'   +P
.M'   IP          'vb..x//Z'          YI.x//          YI.x//          'vb..d/P

```

```
$ /usr/lib/vfontinfo -m mona.24 UNIX .d.
```

```

.d+Mlb          ,gMfgg/          xgMlb          d#xxxxxp'          ,xxxxg+          d+Mlb.          |ggbdg
|MM|          |MM|          |MM|          |MM|          |MM|          |MM|          |MM|
|MM|          |MM|          |MM|          |MM|          |MM|          |MM|          |MM|
|MM|          |MM|          |MM|          |MM|          |MM|          |MM|          |MM|
|MM|          |MM|          |MM|          |MM|          |MM|          |MM|          |MM|
jMMMMMM| MM|          +MMX  'MMML  IM          |gMMMM          |dMMMMMMMMMP'
|MM|          |MM|          P'  TH  'MMML  IM          |//|MMX          |dMMMMMMMMMP'
|MM|          |MM|          IM          qMMb  IM          |MM          |MM          d'  'IqMM,
|MM|          |MM|          IM          qMM|IM          |MM          |MM          /  'MM|
|MM|          |MM|          IM          YMMMM          |MM          |MM          'MM|
.x+MMMMMMgzr/MMMb..          .x+MMMMMP'  YMMMbxx:          .d+MMMM          |dggg/          'MM|xxd
/P'***IM'..          'vPP'..          /P'***vP'..          'MMMP'..          .d+MMMP          /I'IMM'          'MM|

```

```
$ /usr/lib/vfontinfo -m script.18 UNIX
```

```

..          //MI //TI          'F'          'MI          .dP
.d' |I  +P  jP' M'  '  +P          +*  I|          'MI          .dP
.M' +P  jM' jP' jP  '  jMI          +I  dP          TM.  //
v' jM'  jP  '  MI'  '  +P          IM  MI          MI.  //
MT  .M'  dP:  IM'          'M  jM'          IM.  //
IM'  +I  jM'  .MT          Y.  MT          IM.  //
MI  //jP  +L'  jP          +MP.          //MI
IM  .MI  jM  .MI          +P          P  MI
|I .x'  jP  '  +P          |I...xj...  //  IM:
..          VI

```

A copy of volume 2C of the 4.1BSD or 4.2BSD manual includes the Berkeley Font Catalog, which includes samples of the fonts in this directory. To create your own sampler of 12 point typefaces, try

```

cd /usr/lib/vfont
for i in `bin/ls | sed 's/\.[0-9].*//' | uniq`
do
    echo $i
    /usr/lib/vfontinfo -m $i.12 UNIX
done | more

```

### Conclusion

GraphTab is a useful technique for displaying medium resolution graphics in situations that were intended for only alphanumeric text, such as E-Mail and Netnews. One widely available tool that uses GraphTab is the `vfontinfo` command. Beware, however, that SunOS 5.0/Solaris 2.0/System V release 4 does not have the `vfontinfo` command.

If you need the command, you might want to save the program and the fonts for future use, or get the version on UUNET. Other applications using GraphTab can make better use of the technology. A companion paper to this one is in preparation, describing the implementation of GraphTab and illustrating more general use of the technology.