

### [4.3] Truth plots

A truth plot is a graphic plot of a function such that a display pixel is turned on when the function is true, and turned off when the function is false. This type of plot is built in to the HP48/49 series, but not the TI89/92+.

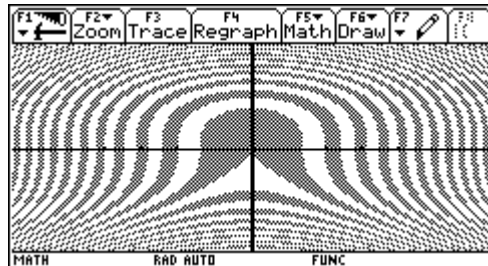
This is Andrew Cacovean's version of a program to make a truth plot for an expression:

```
truth(exp1)
Prgm
Local tlist,xlist,exp2
ClrDraw
DispG
DelVar τy1,τy2
exp1|y=τy2→exp2
exp1|y=τy1→exp1

augment(seq(expr("&string(exp1|x=xx)&",τy1,0)),xx,xmin,xmax,Δx*2),seq(exp
r("&string(exp2|x=xx)&",τy2,0)),xx,xmin+Δx,xmax,Δx*2)→tlist

augment(seq(x,x,xmin,xmax,2*Δx),seq(x,x,xmin+Δx,xmax,2*Δx))→xlist
For τy1,ymin,ymax,Δy*2
  τy1+Δy→τy2
  PtOn xlist,tlist
EndFor
DelVar τy1,τy2
EndPrgm
```

*exp1* is the expression to be plotted, which must evaluate to true or false. The window variables *xmin*, *xmax*, *ymin* and *ymax* must be set before this program is called. This program will work on both the 89 and the 92+, since the program plots to view window coordinates, not absolute pixel coordinates. This program has a hard-coded plot resolution of 2, which means that the function is evaluated at every other y- and x-coordinate. This results in a plot that looks like this, for the expression  $\text{mod}(x^2 + y^3, 4) < 2$  for *x* from -6.5 to 6.5, and for *y* from -3.1 to 3.2,



Press ON while the program is running to stop it. When the program finishes, the plot is shown until you press [HOME].

Here is a minor variation of the program that sets the window limits as arguments, and also lets you set the plot resolution.

```
truthd(exp1,xxmin,xxmax,yymin,ymax,res)
Prgm
©Truth plot
©Minor change to Andrew Cacovean's truth() program
©12jan00/dburkett@infinet.com
```

```
Local tlist,xlist,exp2
```

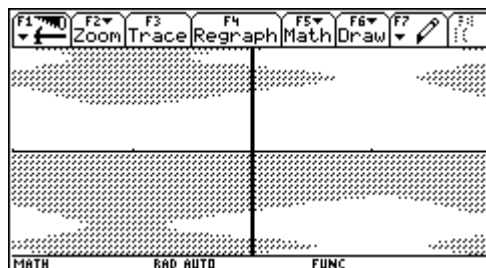
```
xxmin→xmin  
xxmax→xmax  
yymin→ymin  
ymax→ymax
```

```
ClrDraw  
DispG  
DelVar τy1,τy2  
exp1|y=τy2→exp2  
exp1|y=τy1→exp1  
augment(seq(expr("&string(exp1|x=xx)&",τy1,0)),xx,xmin,xmax,Δx*res),seq(e  
xpr("&string(exp2|x=xx)&",τy2,0)),xx,xmin+Δx,xmax,Δx*res)→tlist  
augment(seq(x,x,xmin,xmax,res*Δx),seq(x,x,xmin+Δx,xmax,res*Δx))→xlist  
For τy1,ymin,ymax,Δy*res  
  τy1+Δy→τy2  
  PtOn xlist,tlist  
EndFor  
DelVar τy1,τy2  
EndPrgm
```

This varies from Andrew's original program only in that the window corner coordinates are passed as arguments, and the plot resolution can be set as a function argument as well. Specifically:

exp1: Expression to be plotted  
xxmin, xmax: Minimum and maximum x-coordinates  
yymin, ymax: Minimum and maximum y-coordinates  
res: Resolution for both x- and y-axes. res = 1 plots every display point, res = 2 plots every other point, etc.

Either version of the truth plot program can be very slow, especially when every pixel is tested using  $res = 1$  in *truthd()*. The 92+ LCD has 24,617 pixels, and the 89 display has 12,243 pixels. *truth()* is slow because the function has to be evaluated for each pixel. Setting  $res = 2$  cuts the time in half, and larger values of  $res$  reduce the time even more. This plot is for the function  $\sin(x^2)/x + \cos(y^3)/y < 0$ , for  $x$  and  $y$  from -2 to 2, with  $res = 3$ . This plot finishes in a few minutes.



(Credit to Andrew Cacovean)