

Create Cupid Arrow into Two Love Hearts Image Using SAS®

PROC TEMPLATE --- For the Valentine's Day

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ABSTRACTS

Each year, for all of our SAS programmers, we may be struggling on how to make our girlfriends happy. Buy a luxurious gift? Or give them a special gift? I would like to suggest to create something special to show our true heart and at the same time, show them our power on technical skills and intelligence.

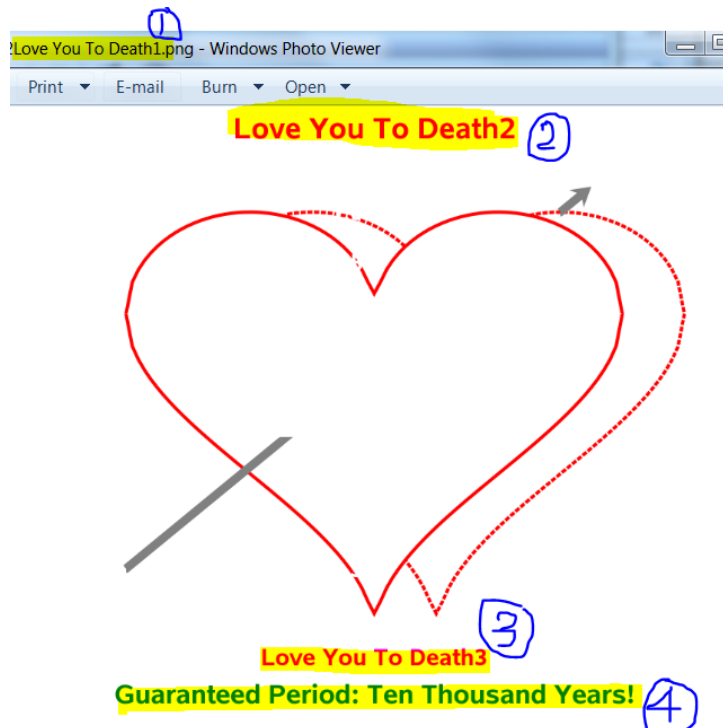
Here is a good engine that using SAS skills to create a Cupid Arrow into Two Love Heart. This is a very special gift. You can also use it to create a single love heart with arrow.

Key words: SAS Enterprise Guide, PROC TEMPLATE, SERIESPLOT STATEMENT, Cupid Arrow with love hearts, Valentine 's Day

INTRODUCTION

Each year, for all of our SAS programmers, we may be struggling on how to make our girlfriends happy. Buy a luxurious gift? Or give them a special gift? I would like to suggest to create something special to show our true heart and at the same time, show them our power on technical skills and intelligence.

Here is a good idea that using SAS skills to create a Cupid Arrow into Two Love Heart. This is a very special gift. Don't want to say too much useless words, let me show the image first:



①, ②, ③ and ④ are the macro variables of imagename, entry label, xaxis label and footnotes in the SAS engine of Cupid Arrow into Two Love Hearts.

HOW TO CREATE THE DATA FOR ANY SPECIFIED GRAPHICS USING ITS MATHEMATICAL FORMULA

1, to create the data for two hearts, you can find lots of solutions [1], one of the most popular love formula is the following, in which only contains x and y within formula, it is a pretty easy formula:

$$Y = \sqrt{1 - (|x| - 1)^2} \text{ for } y \geq 0,$$

And

$$Y = \arccos(1 - |x|) - \pi \text{ for } y < 0,$$

For a 2D graph. You can find the formula from Quora website [2]. I used this data for the first heart.

2, I shifted the x to the right with 0.5 distance to create x1, and create y1 = y for the second heart; we can shift y1 to up or down if we plus or minus one positive number here.

3, how to remove the overlaid lines from the second love heart and the arrow is full of tricks, we should be careful to think about how to decide these intersection points from heart1, heart2 and arrow data. We can try mathematical equations to decide the intersections and their values.

4, don't believe the values in .sas7bdat files. For example, -0.75 in FOR_CUPID_HEART_DATA.sas7bdat is not -0.75, actually it is -0.749999999999999, so we would be carefully to use them to decide the x2 and y2, x3 and y3 arrows' data.

		A	B
25	-0.8	0.9797	0.988685997
26	-0.75	0.9682	0.979795897
27	-0.7	0.9539	0.968245837
28	-0.65	0.9367	0.953939201
29	-0.6	0.916	0.9367497
30	-0.55	0.893	0.916515139
31	-0.5	0.8660	0.893028555
32	-0.45	0.8351	0.866025404
33			0.835164654
34			0.8

I use the intervals based on do looping interval 0.05 to decide their values as following:

```

data for_cupid_heart_data;
retain x y x1 y1 x2 y2;
set cupid_heart_data;
if -1.97 > x > -2.03 then x2 = -2;
if -0.72 > x > -0.78 then x2 = -0.75;
if -0.49 > x > -0.51 then x2 = -0.5;
if 0.74 > x > 0.75 then x2 = 0.75;
if 1.03 > x1 > 0.97 then x2 = 1;
if 1.53 > x1 > 1.49 then x3 = 1.5;
if 1.78 > x > 1.72 then x3 = 1.75;
if x2 = -2 then y2 = -2.5;
if x2 = -0.75 then y2 = -1.25;

```

```

if x2=-0.5      then y2=-1;
if x2=0.75     then y2=0.25;
if x2=1        then y2=.5;
if x3=1.5      then y3=1;
if x3=1.75     then y3=1.25;
if 0.26<x1<1.24 and y1>0      then y1=.;
if (x1<-0.74 and y>=0) or (x1<0.24 and y<0) then y1=.;
if -0.51 <x2      then y2=.;
if x3< 1.49      then y3=.;
run;

```

5, In order to position the arrowheads properly, the data must be sorted in ascending order by y3 for arrow head. [3] If not sorted, the arrow head would be hard to decide, you may see the arrow heads on the both ends of top right arrow line although you set **ARROWHEADPOSITION= END** in the code. We cannot sort the whole data of `for_cupid_heart_data.sas7bdat`, but only pick x3 and y3 out, after sorting by y3, then put it back into the data.

```

proc sort data=for_cupid_heart_data(keep=x3 y3)
out=x3y3;
by y3;
run;

data for_heart;
set for_cupid_heart_data(drop=x3 y3);
set x3y3;
run;

```

HOW TO USE THE SELF-CREATED DATA AND PROC TEMPLATE TO PLOT THE EXPECTED IMAGE

The `for_heart` data file is the created data for our expected image. I am using the following **PROC TEMPLATE** procedure to plot the expected image. In the expected image, we only want to keep the clean image, but not the y-axis and x-axis, and boards, and others.

```

data for_heart;
set for_cupid_heart_data(drop=x3 y3);
set x3y3;
run;

ods _all_ close;
options number nodate;
goptions reset=all device=png gsfname=graphout xpixels=1000 ypixels=400;
ods graphics on/reset imagename="Love You To Death1"
imagefmt=png width=20in height=15in scale=off border=off;
ods listing gpath="&path.";
ods path reset;
ODS path (PREPEND) a.TEMPLAT(update);

proc template;
define statgraph a.class;
begingraph;
discreteattrvar attrvar=classfill var=fore_sce attrmap='colors';
legendItem type=Line name="x" / lineattrs=(color=red pattern=solid THICKNESS=8)
labelattrs=(size=22pt) label="Heart1";
legendItem type=Line name="x1" / lineattrs=(color=red pattern=Solid THICKNESS=8)
labelattrs=(size=22pt) label="Heart2";
legendItem type=Line name="x2" / lineattrs=(color=grey pattern=solid THICKNESS=8)
labelattrs=(size=22pt) label="Arrow1";
legendItem type=Line name="x3" / lineattrs=(color=grey pattern=solid THICKNESS=8)
labelattrs=(size=22pt) label="Arrow2";

layout lattice/border=FALSE BORDERATTRS=(color=white) columns=1 rows=1

```

```

COLUMNGUTTER=2cm ROWGUTTER=2cm AUTOALIGN=(TOPRIGHT BOTTOMLEFT) SKIPEMPTYCELLS=TRUE;

cell;
cellheader;
entry "Love You To Death2"/border=FALSE BORDERATTRS=(color=white)
      textattrs=(size=50pt weight=bold color=red);
endcellheader;

layout overlay /border=false WALLCOLOR=white WALLDISPLAY=(FILL)
xaxisopts=(display=(label tickvalues)
  linearopts=(origin=0 THRESHOLDMIN=1 THRESHOLDMAX=1)
  label="Love You To Death3" griddisplay=off
  labelattrs=(weight=bold size=40pt color=magenta)
  tickvalueattrs=(weight=bold size=22pt color=white) discreteopts=(
  tickdisplaylist=(-2" "-1.5" "-1" "-0.5" "0" "0.5" "1" "1.5" "2")
  tickvaluelist =(-2" "-1.5" "-1" "-0.5" "0" "0.5" "1" "1.5" "2")
  TICKVALUEFITPOLICY=ROTATEALWAYS TICKVALUEROTATION=VERTICAL))

yaxisopts=(display=(label tickvalues) label=" "
  labelattrs=(weight=bold size=22pt color=white) griddisplay=off
  tickvalueattrs=(weight=bold size=40pt color=white)
  linearopts=(integer=FALSE origin=-3 viewmin=-3 tickvalueformat=9.1
  tickvaluelist=(-2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5) TICKVALUEPRIORITY=TRUE)
  gridattrs=(pattern=dash THICKNESS=2 color=white));

seriesplot x=x y=y /BREAK=TRUE LEGENDLABEL="Heart1"
  PRIMARY=TRUE lineattrs=(color=red pattern=solid THICKNESS=8);
seriesplot x=x1 y=y1/BREAK=TRUE LEGENDLABEL="Heart2"
  PRIMARY=TRUE lineattrs=(color=red pattern=MediumDash THICKNESS=8);
seriesplot x=x2 y=y2/BREAK=TRUE LEGENDLABEL="Arrow1"
  PRIMARY=TRUE lineattrs=(color=grey pattern=solid THICKNESS=20);
seriesplot x=x3 y=y3/BREAK=TRUE LEGENDLABEL="Arrow2"
  PRIMARY=TRUE lineattrs=(color=grey pattern=solid THICKNESS=20)
  ARROWHEADPOSITION=END ARROWHEADSCALE=20 ARROWHEADSHAPE=BARBED;

referenceline y=0/curvelabel="" curvelabelattrs=(size=22pt weight=bold color=white)
  clip=true curvelabelposition=min lineattrs=(pattern=dash THICKNESS=2 color=white);
endlayout;

endcell;
endlayout;

entryfootnote halign=center TEXTATTRS=(size=45pt weight=bold color=green)
  "Guaranteed Period: Ten Thousand Years!";
layout globallegend/border=false type=COLUMN weights=uniform;

discretelegend "Heart1" "Heart2" "Arrow"/border=false
  across=1 down=1 autoalign=(CENTER) ORDER=COLUMNMAJOR;
endlayout;
endgraph;
end;
run;

proc sgrender data=for_heart template=a.class;
Run;

ods graphics off;
ods listing;

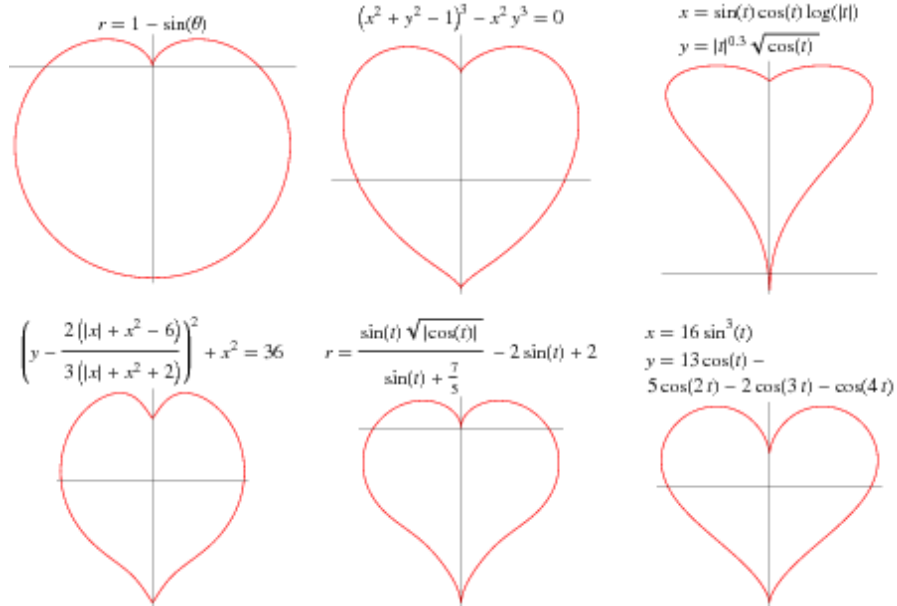
```

CONCLUSIONS

1, There are many ways to create an image of cupid arrow with one or two love hearts. I prefer to choose PROC TEMPLATE with SERIESPLOT statement because PROC TEMPLATE procedure is very dynamic and powerful.

Robert Allison chose to use PROC GPLOT and PROC GMAP to create cupid arrow with one heart [3].

2, we can also try through the following formula [1] to create love heart data based on your appetite:



From: <http://mathworld.wolfram.com/HeartCurve.html>

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

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REFERENCES

[1]

<http://mathworld.wolfram.com/HeartCurve.html>

[2]

<https://www.quora.com/What-is-the-equation-that-gives-you-a-heart-on-the-graph>

[3]

<http://documentation.sas.com/?docsetId=grstatgraph&docsetTarget=n0828kpaepwjmrn1u5xko4cjlqln.htm&docsetVersion=9.4&locale=en>

<http://documentation.sas.com/?docsetId=grstatgraph&docsetTarget=n0828kpaepwjmrn1u5xko4cjlqln.htm&docsetVersion=9.4&locale=en#n1dj4e3av8buxan1rtp1sgfh2lq2>

[4]

<https://blogs.sas.com/content/sastraining/2015/02/12/have-a-traditional-sasgraph-valentines-day/>

APPENDIX:

```
%let path = /sas/just_for_fun/love_heart;
```

```
data cupid_heart_data1;
do x=-2 to 2 by .05;
  y=sqrt(1-(abs(x)-1)**2);
  output;
end;
do x=2 to -2 by -.05;
  y=arccos(1-abs(x))-3.14;
  output;
end;
run;
```

```
data cupid_heart_data;
set cupid_heart_data1;
if y=. then y=0;
if round(x*100)=0 then y=y+.2;
x1=x+0.5;
y1=y;
run;
```

```
data for_cupid_heart_data;
retain x y x1 y1 x2 y2;
set cupid_heart_data;
if -1.97>x>-2.03 then x2=-2;
if -0.72>x>-0.78 then x2=-0.75;
if -0.49>x>-0.51 then x2=-0.5;
if 0.74>x>0.75 then x2=0.75;
if 1.03>x1>0.97 then x2=1;
if 1.53>x1>1.49 then x3=1.5;
if 1.78>x>1.72 then x3=1.75;
if x2=-2 then y2=-2.5;
if x2=-0.75 then y2=-1.25;
if x2=-0.5 then y2=-1;
if x2=0.75 then y2=0.25;
if x2=1 then y2=.5;
if x3=1.5 then y3=1;
if x3=1.75 then y3=1.25;
```

```

if 0.26<x1<1.24 and y1>0 then y1=.;
if (x1<-0.74 and y>=0) or (x1<0.24 and y<0) then y1=.;
if -0.51 <x2 then y2=.;
if x3< 1.49 then y3=.;
run;

proc sort data=for_cupid_heart_data(keep=x3 y3) out=x3y3;
by y3;
run;

data for_heart;
set for_cupid_heart_data(drop=x3 y3);
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legenditem type=Line name="x1" / lineattrs=(color=red pattern=Solid THICKNESS=8)
labelattrs=(size=22pt) label="Heart2";
legenditem type=Line name="x2" / lineattrs=(color=grey pattern=solid THICKNESS=8)
labelattrs=(size=22pt) label="Arrow1";
legenditem type=Line name="x3" / lineattrs=(color=grey pattern=solid THICKNESS=8)
labelattrs=(size=22pt) label="Arrow2";

layout lattice/border=FALSE BORDERATTRS=(color=white) columns=1 rows=1
COLUMNGUTTER=2cm ROWGUTTER=2cm AUTOALIGN=(TOPRIGHT BOTTOMLEFT) SKIPEMPTYCELLS=TRUE;

cell;
cellheader;
entry "Love You To Death2"/border=FALSE BORDERATTRS=(color=white)
textattrs=(size=50pt weight=bold color=red);
endcellheader;

layout overlay /border=false WALLCOLOR=white WALLDISPLAY=(FILL)
xaxisopts=(display=(label tickvalues)
linearopts=(origin=0 THRESHOLDMIN=1 THRESHOLDMAX=1)
label="Love You To Death3" griddisplay=off
labelattrs=(weight=bold size=40pt color=magenta)
tickvalueattrs=(weight=bold size=22pt color=white)
discreteopts=(
tickdisplaylist=("-2" "-1.5" "-1" "-0.5" "0" "0.5" "1" "1.5" "2")
tickvaluelist =("-2" "-1.5" "-1" "-0.5" "0" "0.5" "1" "1.5" "2")
TICKVALUEFITPOLICY=ROTATEALWAYS TICKVALUEROTATION=VERTICAL))

yaxisopts=(display=(label tickvalues) label=" "
labelattrs=(weight=bold size=22pt color=white) griddisplay=off
tickvalueattrs=(weight=bold size=40pt color=white)
linearopts=(integer=FALSE origin=-3 viewmin=-3 tickvalueformat=9.1
tickvaluelist=(-2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5) TICKVALUEPRIORITY=TRUE)
gridattrs=(pattern=dash THICKNESS=2 color=white));

seriesplot x=x y=y /BREAK=TRUE LEGENDLABEL="Heart1"
PRIMARY=TRUE lineattrs=(color=red pattern=solid THICKNESS=8);

```

```

seriesplot x=x1 y=y1/BREAK=TRUE LEGENDLABEL="Heart2"
  PRIMARY=TRUE lineattrs=(color=red pattern=MediumDash THICKNESS=8);
seriesplot x=x2 y=y2/BREAK=TRUE LEGENDLABEL="Arrow1"
  PRIMARY=TRUE lineattrs=(color=grey pattern=solid THICKNESS=20);
seriesplot x=x3 y=y3/BREAK=TRUE LEGENDLABEL="Arrow2"
  PRIMARY=TRUE lineattrs=(color=grey pattern=solid THICKNESS=20)
  ARROWHEADPOSITION=END ARROWHEADSCALE=20 ARROWHEADSHAPE=BARBED;

referenceline y=0/curvelabel="" curvelabelattrs=(size=22pt weight=bold color=white)
  clip=true curvelabelposition=min lineattrs=(pattern=dash THICKNESS=2 color=white);
endlayout;
endcell;
endlayout;
entryfootnote halign=center
  TEXTATTRS=(size=45pt weight=bold color=green)
  "Guaranteed Period: Ten Thousand Years!";
layout globallegend/border=false type=COLUMN weights=uniform;

discretelegend "Heart1" "Heart2" "Arrow"/border=false
  across=1 down=1 autoalign=(CENTER) ORDER=COLUMNMAJOR;
endlayout;
endgraph;
end;
run;

proc sgrender data=for_heart template=a.class;
Run;
ods graphics off;
ods listing;

```