MATLAB PROGRAM LISTING

To find wavelet coefficients run the function FindC.m by writing [CX,CY,DX,DY] = FindC(j) at MATLAB prompt, at "j" write the number of levels.

For smoothing operation run the function Cplot.m by writing Cplot(CX,CY,j) at MATLAB prompt, at "j" write the same number of level as given to the function FindC.m.

To edit the sweep and character of a curve, run the functions esweep.m and echaracter.m by writing esweep(CX,CY,j) and echaracter(CX,CY,j) respectively at the MATLAB prompt, j must be same.

The functions along with their working are given below:

Function No.	saved under	Purpose
1	FindC.m	Calculates average and detail coefficients
2	CPlot.m	Plots the average and detail coefficients
3	esweep.m	Edits the sweep of the curve
4	echaracter.m	Edits the character of the curve
5	edit10.m	Sub function called by echaracter.m
6	edit2.m	Sub function called by esweep.m
7	claa1.m	Sub function called by CPlot.m
8	claa2.m	Sub function called by CPlot.m
9	claa3.m	Sub function called by CPlot.m
10	claa4.m	Sub function called by CPlot.m
11	spline2d1.m	Sub function called by FindC.m
12	splineInterpolation.m	Sub function called by Cplot.m
13	splineInterpolation1.m	Sub function called by claa1.m
14	splineInterpolation2.m	Sub function called by claa2.m

Function No.	saved under	Purpose
15	splineInterpolation3.m	Sub function called by claa3.m
16	splineInterpolation4.m	Sub function called by claa4.m
17,18,19,20	Bernstein.m,	Functions used to calculate splines
21,22,23 & 26	BernsteinInner.m,	
	BernsteinWeights.m,	
	CheckInt.m, Choose.m,	
	EvalComco.m,	
	Factorial.m,	
	Greville.m, respectively	
24	FindP.m	Calculates "P" filter
25	FindQ.m	Calculates "Q" filter

Function No.1

```
% saved under FindC.m
function [CX,CY,DX,DY]=FindC(j)

% Calculates x & y coefficients for different levels of degree d
% ADIL RAUF 09-03-2001
d=3;
d = fix(d);
if d < 0,
  error('FindC: Must have d >= 0.');
end;
j = fix(j);
if j < 1
  error('FindC: Must have j >= 1.');
end
clc;
xuseraxis=input('ENTER MAXIMUM VALUE OF +VE X-COORDINATE= ');
yuseraxis=input('ENTER MINIMUM VALUE OF +VE Y-COORDINATE= ');
if xuseraxis < 0
   error('Xaxis must be >= 0.');
end
if yuseraxis < 0
   error('Yaxis must be >= 0.');
end
% j=level, m=no. of coefficients
% xx=x-coordinates picked from mouse
% yy=y-coordinates picked from mouse
% CX=X-coordinate coefficients of the curve
% CY=Y-coordinate coefficients of the curve

m=2^j+d;
clc;
```

```
disp([' '])
disp(['YOU HAVE TO ENTER "',num2str(m),'" POINTS'])
disp([' '])
disp(['P R E S S   A N Y   K E Y   T O   C O N T I N U E']);
pause;
xx=[];yy=[];
[sx,sy]=size(xx);
sx=m+2;
while sx~=m
[xx,yy]=spline2d1(xuseraxis,yuseraxis,m);
[sx,sy]=size(xx);
end;
close;
[yy11]=yy';
[xx11]=xx';
xx1=xx11;
yy1=yy11;
CX(j+1,:)=xx1;
CY(j+1,:)=yy1;

        % d=Basis function degree used for their corresponding
          functions
        % d=0 Haar basis function, d=1 Linear basis function
        % d=2 Quadratic basis function, d=3 Cubic basis function
        %#########################

        for n=j:-1:1
        P=FindP(d,n);
        Q=FindQ(d,n);
        b=[(CX(n+1,1:(d+2^(n))))' (CY(n+1,1:(d+2^(n))))'];
  PIV=[P Q];
[L,U]=lu(PIV);
z=inv(L)*b;
C_D=inv(U)*z;
[mc_d,nc_d]=size(C_D);

for rows=1:2^(n-1)+d
    Cint(rows,:)=C_D(rows,:);
end

C=Cint';
CX(n,1:2^(n-1)+d)=C(1,1:2^(n-1)+d);
CY(n,1:2^(n-1)+d)=C(2,1:2^(n-1)+d);

for rows=2^(n-1)+d+1:mc_d
   Dint(rows-2^(n-1)+d,:)=C_D(rows,:);
end

D=Dint';
DX(n,1:2^(n-1))=D(1,1:2^(n-1));
DY(n,1:2^(n-1))=D(2,1:2^(n-1));

end

return
```

Function No.2

```
% saved under Cplot.m
function Cplot(CX,CY,j)
d=3;
sub=0;
countfigwindows=0;
check=0;
for n=(j+1):-1:1  %1
      if fix((abs(n-(j+1)))/4)==(abs(n-(j+1)))/4 %2
      h=figure('visible','off','position',[5,30,632,410]);
          end %2

   if 2^(n-1)+d~=1 %3
      [CX1,CY1]=SplineInterpolation(n,d,CX,CY);
   end %3

   if 2^(n-1)+d==1 %4
CX1 = CX(n,1:2^(n-1)+d);
CY1 = CY(n,1:2^(n-1)+d);
   end %4

subplot(2,2,(abs(n-(j+1))+1)-sub*4),plot(CX1,CY1,'-',CX(n,1:2^(n-
1)+d),CY(n,1:2^(n-1)+d),'ro');
xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);

if n~=j+1 %5
 coordinate=(abs(n-(j+1))+1)-sub*4;

if  coordinate==1 %6
   CXF1=CX;
   CYF1=CY;
   [r1,c1]=size(CXF1);
   nF1=zeros(r1,1);
   dF1=zeros(r1,1);
   jF1=zeros(r1,1);
   box1=zeros(r1,1);
   cF1=zeros(r1,1);
   nF1(1,1)=n;
   dF1(1,1)=d;
   jF1(1,1)=j;
   box1(1,1)=coordinate;
   cF1(1,1)=c1;

   a1=uicontrol(h,'Style','Slider','SliderStep',[0.1 0.2],
'Position',[40 245 15 100],'Callback','claa1','UserData',[cF1 CXF1
CYF1 nF1 dF1 jF1 box1]);
b1=uicontrol(h,'Style','text','Position',[40-2 245+115 20
15],'String','0');
end%6

if  coordinate==2%7

   CXF2=CX;
   CYF2=CY;
   [r2,c2]=size(CXF2);
```

```
   nF2=zeros(r2,1);
   dF2=zeros(r2,1);
   jF2=zeros(r2,1);
   box2=zeros(r2,1);
   cF2=zeros(r2,1);
   nF2(1,1)=n;
   dF2(1,1)=d;
   jF2(1,1)=j;
   box2(1,1)=coordinate;
   cF2(1,1)=c2;

  b2=uicontrol(h,'Style','text','Position',[320-2 245+115 20
15],'String','0');
   a2=uicontrol(h,'Style','Slider','SliderStep',[0.1
0.2],'Position',[320 245 15
100],'Callback','claa2','UserData',[cF2 CXF2 CYF2 nF2 dF2 jF2
box2]);
end%7
if  coordinate==3%8
   CXF3=CX;
   CYF3=CY;
   [r3,c3]=size(CXF3);
   nF3=zeros(r3,1);
   dF3=zeros(r3,1);
   jF3=zeros(r3,1);
   box3=zeros(r3,1);
   cF3=zeros(r3,1);
   nF3(1,1)=n;
   dF3(1,1)=d;
   jF3(1,1)=j;
   box3(1,1)=coordinate;
   cF3(1,1)=c3;

a3=uicontrol(h,'Style','Slider','SliderStep',[0.1
0.2],'Position',[40 45 15 100],'Callback','claa3','UserData',[cF3
CXF3 CYF3 nF3 dF3 jF3 box3]);
b3=uicontrol(h,'Style','text','Position',[40-2 45+115 20
15],'String','0');
end%8

if  coordinate==4%9
   CXF4=CX;
   CYF4=CY;
   [r4,c4]=size(CXF4);
   nF4=zeros(r4,1);
   dF4=zeros(r4,1);
   jF4=zeros(r4,1);
   box4=zeros(r4,1);
   cF4=zeros(r4,1);
   nF4(1,1)=n;
   dF4(1,1)=d;
   jF4(1,1)=j;
   box4(1,1)=coordinate;
   cF4(1,1)=c4;
```

```
a4=uicontrol(h,'Style','Slider','SliderStep',[0.1
0.2],'Position',[320 45 15 100],'Callback','claa4','UserData',[cF4
CXF4 CYF4 nF4 dF4 jF4 box4]);
b4=uicontrol(h,'Style','text','Position',[320-2 45+115 20
15],'String','0');
end%9

end %5
% Calculating no. of pages
 if (j+1)/4==fix((j+1)/4)%10
    countfigwindows=((j+1)/4);
 end%10

if (j+1)/4~=fix((j+1)/4)%11
    countfigwindows=fix((j+1)/4)+1;
 end%11

 currentpage=fix(((j-n))/4)+1;

if fix((abs(n-(j+1))+1)/4)==(abs(n-(j+1))+1)/4 %12
    sub=(abs(n-(j+1))+1)/4;
   if n~=1%13
      set(h,'visible','on');
   end%13
    pause;
 end %12
end  %1
 set(h,'visible','on');
 pause;

  for windowclose=1:countfigwindows %17
     close;
 end%17

return
```

Function No. 3

```
% saved under esweep.m
% Calls function edit2.m
function esweep(CX,CY,j)
d=3;
sub=0;
countfigwindows=0;
check=0;

   [r2,c2]=size(CX);
   figurehandles=zeros(r2,1);
   axishandles=zeros(r2,1);
   editbuttonhandles=zeros(r2,1);
   cancelbuttonhandles=zeros(r2,1);

for n=(j+1):-1:1  %1
   if fix((abs(n-(j+1)))/4)==(abs(n-(j+1)))/4 %2
      nm=fix((abs(n-(j+1)))/4)+1;
```

```
h=figure('visible','off','position',[5,30,632,410],'name',num2str(
nm));
      end %2

   if 2^(n-1)+d~=1 %3
      [CX1,CY1]=SplineInterpolation(n,d,CX,CY);
   end %3

   if 2^(n-1)+d==1 %4
      CX1 = CX(n,1:2^(n-1)+d);
      CY1 = CY(n,1:2^(n-1)+d);
   end %4


 coordinate=(abs(n-(j+1))+1)-sub*4;

serial=(j+1)-n+1;
figurehandles(serial:serial,1:1)=h;
if  coordinate==1 %6
   CXF1=CX;
   CYF1=CY;
   [r1,c1]=size(CXF1);
   nF1=zeros(r1,1);
   dF1=zeros(r1,1);
   jF1=zeros(r1,1);
   box1=zeros(r1,1);
   cF1=zeros(r1,1);
   nF1(1,1)=n;
   dF1(1,1)=d;
   jF1(1,1)=j;
   box1(1,1)=coordinate;
   cF1(1,1)=c1;

   ax1=axes('parent',h,'visible','on','position',[0.13 0.581098
0.327023 0.343902]);

   subplot(ax1),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
   xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   if n~=j+1
  a1=uicontrol(h,'Style','pushbutton','position',[30 235 25
15],'String','edit','Callback','edit2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF1 CXF1 CYF1
nF1 dF1 jF1 box1]);

b1=uicontrol(h,'Style','pushbutton','visible','off','position',[25
255 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF1 CXF1 CYF1
nF1 dF1 jF1 box1]);
  axishandles(serial,1)=ax1;
  editbuttonhandles(serial,1)=a1;
  cancelbuttonhandles(serial,1)=b1;
  set(a1,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF1 CXF1 CYF1 nF1 dF1 jF1 box1 ]);
```

```
   end

end%6

if  coordinate==2%7

   CXF2=CX;
   CYF2=CY;
   [r2,c2]=size(CXF2);
   nF2=zeros(r2,1);
   dF2=zeros(r2,1);
   jF2=zeros(r2,1);
   box2=zeros(r2,1);
   cF2=zeros(r2,1);
   nF2(1,1)=n;
   dF2(1,1)=d;
   jF2(1,1)=j;
   box2(1,1)=coordinate;
   cF2(1,1)=c2;

   ax2=axes('parent',h,'visible','on','position',[0.577977
0.581098 0.327023 0.343902]);
   subplot(ax2),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
   xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   a2=uicontrol(h,'Style','pushbutton','position',[313 235 25
15],'String','edit','Callback','edit2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF2 CXF2 CYF2
nF2 dF2 jF2 box2 ]);

b2=uicontrol(h,'Style','pushbutton','visible','off','position',[31
0 255 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF2 CXF2 CYF2
nF2 dF2 jF2 box2 ]);
 axishandles(serial,1)=ax2;
  editbuttonhandles(serial,1)=a2;
  cancelbuttonhandles(serial,1)=b2;
  set(a2,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF2 CXF2 CYF2 nF2 dF2 jF2 box2 ]);

end%7

if  coordinate==3%8
   CXF3=CX;
   CYF3=CY;
   [r3,c3]=size(CXF3);
   nF3=zeros(r3,1);
   dF3=zeros(r3,1);
   jF3=zeros(r3,1);
   box3=zeros(r3,1);
   cF3=zeros(r3,1);
   nF3(1,1)=n;
   dF3(1,1)=d;
   jF3(1,1)=j;
   box3(1,1)=coordinate;
```

```
   cF3(1,1)=c3;

ax3=axes('parent',h,'visible','on','position',[0.13 0.11 0.327023
0.343902]);
   subplot(ax3),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   a3=uicontrol(h,'Style','pushbutton','position',[30 35 25
15],'String','edit','Callback','edit2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF3 CXF3 CYF3
nF3 dF3 jF3 box3 ]);

b3=uicontrol(h,'Style','pushbutton','visible','off','position',[25
55 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF3 CXF3 CYF3
nF3 dF3 jF3 box3 ]);
   axishandles(serial,1)=ax3;
  editbuttonhandles(serial,1)=a3;
  cancelbuttonhandles(serial,1)=b3;
  set(a3,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF3 CXF3 CYF3 nF3 dF3 jF3 box3 ]);

end%8

if  coordinate==4%9
   CXF4=CX;
   CYF4=CY;
   [r4,c4]=size(CXF4);
   nF4=zeros(r4,1);
   dF4=zeros(r4,1);
   jF4=zeros(r4,1);
   box4=zeros(r4,1);
   cF4=zeros(r4,1);
   nF4(1,1)=n;
   dF4(1,1)=d;
   jF4(1,1)=j;
   box4(1,1)=coordinate;
   cF4(1,1)=c4;
ax4=axes('parent',h,'visible','on','position',[0.577977 0.11
0.327023 0.343902]);

   subplot(ax4),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   a4=uicontrol(h,'Style','pushbutton','position',[313 40 25
15],'String','edit','Callback','edit2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF4 CXF4 CYF4
nF4 dF4 jF4 box4 ]);

b4=uicontrol(h,'Style','pushbutton','visible','off','position',[31
0 60 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF4 CXF4 CYF4
nF4 dF4 jF4 box4 ]);
```

```
   axishandles(serial,1)=ax4;
  editbuttonhandles(serial,1)=a4;
  cancelbuttonhandles(serial,1)=b4;
  set(a4,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF4 CXF4 CYF4 nF4 dF4 jF4 box4 ]);

end%9

% Calculating no. of pages
 if (j+1)/4==fix((j+1)/4)%10
    countfigwindows=((j+1)/4);
 end%10

if (j+1)/4~=fix((j+1)/4)%11
    countfigwindows=fix((j+1)/4)+1;
 end%11

 currentpage=fix(((j-n))/4)+1;

if fix((abs(n-(j+1))+1)/4)==(abs(n-(j+1))+1)/4 %12
    sub=(abs(n-(j+1))+1)/4;
   if n~=1%13
      set(h,'visible','on');
   end%13
    pause;
 end %12
end  %1
 set(h,'visible','on');
 pause;

  for windowclose=1:countfigwindows %17
     close;
 end%17

return
```

Function No. 4

```
% saved under echaracter.m
% Calls function edit10.m
%
function echaracter(CX,CY,DX,DY,j)
d=3;
sub=0;
countfigwindows=0;
check=0;

   [r2,c2]=size(CX);
   figurehandles=zeros(r2,1);
   axishandles=zeros(r2,1);
   editbuttonhandles=zeros(r2,1);
   cancelbuttonhandles=zeros(r2,1);

for n=(j+1):-1:1  %1
   if fix((abs(n-(j+1)))/4)==(abs(n-(j+1)))/4 %2
      nm=fix((abs(n-(j+1)))/4)+1;
```

```
h=figure('visible','off','position',[5,30,632,410],'name',num2str(
nm));
      end %2

   if 2^(n-1)+d~=1 %3
      [CX1,CY1]=SplineInterpolation(n,d,CX,CY);
   end %3

   if 2^(n-1)+d==1 %4
      CX1 = CX(n,1:2^(n-1)+d);
      CY1 = CY(n,1:2^(n-1)+d);
   end %4


 coordinate=(abs(n-(j+1))+1)-sub*4;

serial=(j+1)-n+1;
figurehandles(serial:serial,1:1)=h;
if  coordinate==1 %6
   CXF1=CX;
   CYF1=CY;
   [r1,c1]=size(CXF1);
   nF1=zeros(r1,1);
   dF1=zeros(r1,1);
   jF1=zeros(r1,1);
   box1=zeros(r1,1);
   cF1=zeros(r1,1);
   nF1(1,1)=n;
   dF1(1,1)=d;
   jF1(1,1)=j;
   box1(1,1)=coordinate;
   cF1(1,1)=c1;
ax1=axes('parent',h,'visible','on','position',[0.13 0.581098
0.327023 0.343902]);

   subplot(ax1),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
   xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   if n~=j+1
  a1=uicontrol(h,'Style','pushbutton','position',[30 235 25
15],'String','edit','Callback','edit10','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF1 CXF1 CYF1
nF1 dF1 jF1 box1]);

b1=uicontrol(h,'Style','pushbutton','visible','off','position',[25
255 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF1 CXF1 CYF1
nF1 dF1 jF1 box1]);
  axishandles(serial,1)=ax1;
  editbuttonhandles(serial,1)=a1;
  cancelbuttonhandles(serial,1)=b1;
  set(a1,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF1 CXF1 CYF1 nF1 dF1 jF1 box1 ]);
```

```
  end

end%6

if  coordinate==2%7

   CXF2=CX;
   CYF2=CY;
   [r2,c2]=size(CXF2);
   nF2=zeros(r2,1);
   dF2=zeros(r2,1);
   jF2=zeros(r2,1);
   box2=zeros(r2,1);
   cF2=zeros(r2,1);
   nF2(1,1)=n;
   dF2(1,1)=d;
   jF2(1,1)=j;
   box2(1,1)=coordinate;
   cF2(1,1)=c2;

   ax2=axes('parent',h,'visible','on','position',[0.577977
0.581098 0.327023 0.343902]);
   subplot(ax2),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
   xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   a2=uicontrol(h,'Style','pushbutton','position',[313 235 25
15],'String','edit','Callback','edit10','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF2 CXF2 CYF2
nF2 dF2 jF2 box2 ]);

b2=uicontrol(h,'Style','pushbutton','visible','off','position',[31
0 255 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF2 CXF2 CYF2
nF2 dF2 jF2 box2 ]);
 axishandles(serial,1)=ax2;
  editbuttonhandles(serial,1)=a2;
  cancelbuttonhandles(serial,1)=b2;
  set(a2,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF2 CXF2 CYF2 nF2 dF2 jF2 box2 ]);

end%7

if  coordinate==3%8
   CXF3=CX;
   CYF3=CY;
   [r3,c3]=size(CXF3);
   nF3=zeros(r3,1);
   dF3=zeros(r3,1);
   jF3=zeros(r3,1);
   box3=zeros(r3,1);
   cF3=zeros(r3,1);
   nF3(1,1)=n;
   dF3(1,1)=d;
   jF3(1,1)=j;
   box3(1,1)=coordinate;
```

```
   cF3(1,1)=c3;
ax3=axes('parent',h,'visible','on','position',[0.13 0.11 0.327023
0.343902]);
   subplot(ax3),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   a3=uicontrol(h,'Style','pushbutton','position',[30 35 25
15],'String','edit','Callback','edit10','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF3 CXF3 CYF3
nF3 dF3 jF3 box3 ]);

b3=uicontrol(h,'Style','pushbutton','visible','off','position',[25
55 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF3 CXF3 CYF3
nF3 dF3 jF3 box3 ]);
   axishandles(serial,1)=ax3;
  editbuttonhandles(serial,1)=a3;
  cancelbuttonhandles(serial,1)=b3;
  set(a3,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF3 CXF3 CYF3 nF3 dF3 jF3 box3 ]);
end%8

if  coordinate==4%9
   CXF4=CX;
   CYF4=CY;
   [r4,c4]=size(CXF4);
   nF4=zeros(r4,1);
   dF4=zeros(r4,1);
   jF4=zeros(r4,1);
   box4=zeros(r4,1);
   cF4=zeros(r4,1);
   nF4(1,1)=n;
   dF4(1,1)=d;
   jF4(1,1)=j;
   box4(1,1)=coordinate;
   cF4(1,1)=c4;
ax4=axes('parent',h,'visible','on','position',[0.577977 0.11
0.327023 0.343902]);

   subplot(ax4),plot(CX1,CY1,'b-',CX(n,1:2^(n-1)+d),CY(n,1:2^(n-
1)+d),'bo');
xlabel(['Level=',num2str(n),',Points=2^',num2str(n-
1),'+',num2str(d),'=',num2str(2^(n-1)+d)]);
   a4=uicontrol(h,'Style','pushbutton','position',[313 40 25
15],'String','edit','Callback','edit10','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF4 CXF4 CYF4
nF4 dF4 jF4 box4 ]);

b4=uicontrol(h,'Style','pushbutton','visible','off','position',[31
0 60 37
15],'String','cancel','Callback','ok2','UserData',[figurehandles
axishandles editbuttonhandles cancelbuttonhandles cF4 CXF4 CYF4
nF4 dF4 jF4 box4 ]);
   axishandles(serial,1)=ax4;
  editbuttonhandles(serial,1)=a4;
```

```
  cancelbuttonhandles(serial,1)=b4;
  set(a4,'Userdata',[figurehandles axishandles editbuttonhandles
cancelbuttonhandles cF4 CXF4 CYF4 nF4 dF4 jF4 box4 ]);

end%9

%#######

% Calculating no. of pages
 if (j+1)/4==fix((j+1)/4)%10
    countfigwindows=((j+1)/4);
 end%10

if (j+1)/4~=fix((j+1)/4)%11
    countfigwindows=fix((j+1)/4)+1;
 end%11

 currentpage=fix(((j-n))/4)+1;

if fix((abs(n-(j+1))+1)/4)==(abs(n-(j+1))+1)/4   12
    sub=(abs(n-(j+1))+1)/4;
   if n~=1%13
      set(h,'visible','on');
   end%13
    pause;
 end %12
end  %1
 set(h,'visible','on');
 pause;

  for windowclose=1:countfigwindows %17
     close;
 end%17
 return
```

Function No. 5

```
% saved under edit10.m
function edit10

object2 = gcbo;
fh=gcf;
ch=get(fh,'children');
[r21,c21]=size(ch);

for loop1=1:r21%1
 set(ch(loop1:loop1,1:1),'visible','off');
end%1
if fh>1
   for loop2=fh-1:-1:1%2
      set(loop2,'SelectionHighlight','off');
   end%2
end

l2= get(object2,'Userdata');
[r22,c22]=size(l2);
ad=4;
```

```
c2=l2(1:1,1+(ad):1+(ad));
CX2=l2(:,2+(ad):c2+1+(ad));
CY2=l2(:,2+c2+(ad):2*c2+1+(ad));
n2=l2(1:1,2*c2+2+(ad):2*c2+2+(ad));
d2=l2(1:1,2*c2+3+(ad):2*c2+3+(ad));
j2=l2(1:1,2*c2+4+(ad):2*c2+4+(ad));
box2=l2(1:1,2*c2+5+(ad):2*c2+5+(ad));
if box2==1
   [ahh] = findobj('Position',[0.13 0.581098 0.327023 0.343902]);
   [ebh] = findobj('position',[30 235 25 15]);
   end

if box2==2
   [ahh] = findobj('Position',[0.577977 0.581098 0.327023
0.343902]);
   [ebh] = findobj('position',[313 235 25 15]);
   end

if box2==3
   [ahh] = findobj('Position',[0.13 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[30 35 25 15]);
   end

if box2==4
   [ahh] = findobj('Position',[0.577977 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[313 40 25 15]);

end
      set(ahh(1:1,1:1),'visible','on');
      set(ahh(1:1,1:1),'XGrid','on');
      set(ahh(1:1,1:1),'YGrid','on');
      subplot(ahh(1:1,1:1)),title('change the detail coefficients
in the text window');
         position=n2;
        disp('THE DETAIL COEFFICIENTS ARE=');
        disp(DX);
        disp(DY);
        disp(DX(position:position,1:2^(position-1)+d2));
        disp(DY(position:position,1:2^(position-1)+d2));

        DX2=DX(position:position,1:2^(position-1)+d2);
               [dxrow,dxcol]=size(DX2);
        disp(dxcol);
        for loop300=1:dxcol
         disp(['Column ',num2str(loop300),' is
',num2str(DX2(dxrow:dxrow,loop300:loop300))]);
         DX2(1:1,loop300:loop300)=input('Change to ');
        end
        disp(DX2);

        DY2=DY(position:position,1:2^(position-1)+d2);
        [dyrow,dycol]=size(DX2);
        disp(dycol);
        for loop300=1:dycol
         disp(['Column ',num2str(loop300),' is
',num2str(DX2(dyrow:dyrow,loop300:loop300))]);
```

```
          DX2(1:1,loop300:loop300)=input('Change to ');
        end
        disp(DY2);


          c23=2^(n2-1)+d2;

    CXhigher2= CX2(n2:n2,1:2^(n2-1)+d2);
    CYhigher2= CY2(n2:n2,1:2^(n2-1)+d2);
    DXhigher2= DX2(1:1,1:2^(n2-1)+d2);
    DYhigher2= DY2(1:1,1:2^(n2-1)+d2);

[r24,c24]=size(CXhigher2);% ########3
if c23~=1%5
[CX12,CY12]=SplineInterpolation2(n2,d2,CXhigher2,CYhigher2);
end%5
if c23==1%6
    CX12 = CXhigher2;
    CY12 = CYhigher2;
end%6


set(ahh(1:1,1:1),'xgrid','off');
set(ahh(1:1,1:1),'ygrid','off');
title('                  ');

box22=box2;
boxrem=box22;
position2=position;
savegcfcurrent=gcf;
display(box22);
display(position);
display(j2+1);
display(gcf);

total=box22+(gcf-1)*4;
total22=total;
if box22==1 & gcf>1 %7
    box22=5;
end%7

box22=box22-1;
calplus=1;

for loop7=position:position%8  % 2 : 5
    display(total);
    if fix((total-1)/4)==(total-1)/4
        index=fix((total-1)/4);
    end
    if fix((total-1)/4)~=(total-1)/4
        index=fix((total-1)/4)+1;
    end
    display(index);
    if gcf==index
        pick=gcf;
    end
    if gcf~=index
```

```
      pick=index;
   end

   if box22==1
   [ahh] = findobj('Position',[0.13 0.581098 0.327023 0.343902]);
   [ebh] = findobj('position',[30 235 25 15]);
   end

   if box22==2
   [ahh] = findobj('Position',[0.577977 0.581098 0.327023
0.343902]);
   [ebh] = findobj('position',[313 235 25 15]);
   end

   if box22==3
   [ahh] = findobj('Position',[0.13 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[30 35 25 15]);
   end

   if box22==4
   [ahh] = findobj('Position',[0.577977 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[313 40 25 15]);
   end

   display(size(CXhigher2));
   display(size(CYhigher2));

   CNX= (FindP(d2,position)*CXhigher2')' +
(FindQ(d2,position)*DXhigher2')';
   CNY= (FindP(d2,position)*CYhigher2')' +
(FindQ(d2,position)*DYhigher2')';

  [r222,c222]=size(CNX);
  if c222~=1%10
   [CX12,CY12]=SplineInterpolation2(n2,d2,CNX,CNY);
   end%10

   if c222==1%11
   CX12 = CNX;
   CY12 = CNY;
   end%11

   tot2=n2;
   n222=log(c222+calplus-d2)/log(2);

   [ahhrow,ahhcol]=size(ahh);
   if (ahhrow>1 & gcf>1)
      for loop100=ahhrow:-1:1
         ahh22(ahhrow-loop100+1:ahhrow-
loop100+1,1:1)=ahh(loop100:loop100,1:1);
      end

   end

    if (ahhrow==1 & gcf>1)
       ahh22=ahh;
    end
```

```
   if ahhrow==1 & gcf==1
      ahh22=ahh;
   end

   if ahhrow>1 & gcf==1
      ahh22=ahh;
   end

   set(ahh22(pick:pick,1:1),'Nextplot','add');
   set(ahh22(pick:pick,1:1),'visible','on');

   plot(CX12,CY12,'r',CNX,CNY,'ro','Parent',ahh22(pick:pick,1:1));
         if box22==1 & gcf>1 %12
    box22=5;
      end%12

      box22=box22-1;
      end%8
arem=rem(total22,4);
if fix((total22)/4)==(total22)/4
   totaxes=4;
end
if fix((total22)/4)~=(total22)/4
   totaxes=arem;
end

step=totaxes-boxrem;
for loop10=boxrem+step:-1:1%13
   if loop10==1
   [ahh] = findobj('Position',[0.13 0.581098 0.327023 0.343902]);
   [ebh] = findobj('position',[30 235 25 15]);
   [cbh] = findobj('position',[25 255 37 15]);
   end

   if loop10==2
   [ahh] = findobj('Position',[0.577977 0.581098 0.327023
0.343902]);
   [ebh] = findobj('position',[313 235 25 15]);
   [cbh] = findobj('position',[310 255 37 15]);
   end

   if loop10==3
   [ahh] = findobj('Position',[0.13 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[30 35 25 15]);
   [cbh] = findobj('position',[25 55 37 15]);
   end

   if loop10==4
   [ahh] = findobj('Position',[0.577977 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[313 40 25 15]);
   [cbh] = findobj('position',[310 60 37 15]);
   end

   set(ahh(1:1,1:1),'visible','on');

end%13
```

```
return
```

Function No. 6

```
% saved under edit2.m
function edit2
% Calls function splineinterpolation2.m
object2 = gcbo;
fh=gcf;
ch=get(fh,'children');
[r21,c21]=size(ch);

for loop1=1:r21%1
 set(ch(loop1:loop1,1:1),'visible','off');
end%1
if fh>1
   for loop2=fh-1:-1:1%2
      set(loop2,'SelectionHighlight','off');
   end%2
end

l2= get(object2,'Userdata');
[r22,c22]=size(l2);
ad=4;

c2=l2(1:1,1+(ad):1+(ad));
CX2=l2(:,2+(ad):c2+1+(ad));
CY2=l2(:,2+c2+(ad):2*c2+1+(ad));
n2=l2(1:1,2*c2+2+(ad):2*c2+2+(ad));
d2=l2(1:1,2*c2+3+(ad):2*c2+3+(ad));
j2=l2(1:1,2*c2+4+(ad):2*c2+4+(ad));
box2=l2(1:1,2*c2+5+(ad):2*c2+5+(ad));
if box2==1
   [ahh] = findobj('Position',[0.13 0.581098 0.327023 0.343902]);
   [ebh] = findobj('position',[30 235 25 15]);
end

if box2==2
   [ahh] = findobj('Position',[0.577977 0.581098 0.327023
0.343902]);
   [ebh] = findobj('position',[313 235 25 15]);
end

if box2==3
   [ahh] = findobj('Position',[0.13 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[30 35 25 15]);
end

if box2==4
   [ahh] = findobj('Position',[0.577977 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[313 40 25 15]);
end
      set(ahh(1:1,1:1),'visible','on');
      set(ahh(1:1,1:1),'XGrid','on');
      set(ahh(1:1,1:1),'YGrid','on');
      subplot(ahh(1:1,1:1)),title('select a coefficient to edit');
```

```
      [x,y]=ginput(1);
            position=n2;
         for loop5=1:2^j2+d2%3

distance(1:1,loop5:loop5)=sqrt((CX2(position:position,loop5:loop5)
-x)^2+(CY2(position:position,loop5:loop5)-y)^2);
         end%3
         Mindistance=min(distance);
         for loop6=1:2^j2+d2%4
            if distance(1:1,loop6:loop6)==Mindistance
               savecol=loop6;
            end
         end%4
         ff=CX2(position:position,savecol:savecol);
         gg=CY2(position:position,savecol:savecol);
         set(ahh,'Nextplot','add');
         subplot(ahh(1:1,1:1)),plot(ff,gg,'gd');
         subplot(ahh(1:1,1:1)),title('replace with new
coefficient');
         [x2,y2]=ginput(1);
         CX2(position:position,savecol:savecol)=x2;
         CY2(position:position,savecol:savecol)=y2;
         c23=2^(n2-1)+d2;

   CXhigher2= CX2(n2:n2,1:2^(n2-1)+d2);
   CYhigher2= CY2(n2:n2,1:2^(n2-1)+d2);

[r24,c24]=size(CXhigher2);%3
if c23~=1%5
[CX12,CY12]=SplineInterpolation2(n2,d2,CXhigher2,CYhigher2);
end%5
if c23==1%6
   CX12 = CXhigher2;
   CY12 = CYhigher2;
end%6

   tot2=n2;
   n222=log(c23-d2)/log(2);
subplot(ahh(1:1,1:1)),plot(CX12,CY12,'r-
',CXhigher2,CYhigher2,'ro');
xlabel(['Level=',num2str(tot2),',Points=2^',num2str(n222),'+',num2
str(d2),'=',num2str(c23)]);
set(ahh(1:1,1:1),'xgrid','off');
set(ahh(1:1,1:1),'ygrid','off');
title('                    ');
box22=box2;
boxrem=box22;
position2=position;
savegcfcurrent=gcf;
display(box22);
display(position);
display(j2+1);
display(gcf);

total=box22+(gcf-1)*4;
total22=total;
if box22==1 & gcf>1 %7
```

```
   box22=5;
end%7

box22=box22-1;
calplus=1;

for loop7=position:j2%8
   display(total);
   if fix((total-1)/4)==(total-1)/4
      index=fix((total-1)/4);
   end
   if fix((total-1)/4)~=(total-1)/4
      index=fix((total-1)/4)+1;
   end
   display(index);
   if gcf==index
      pick=gcf;
   end
   if gcf~=index
      pick=index;
   end

   if box22==1
   [ahh] = findobj('Position',[0.13 0.581098 0.327023 0.343902]);
   [ebh] = findobj('position',[30 235 25 15]);
      end

   if box22==2
   [ahh] = findobj('Position',[0.577977 0.581098 0.327023
0.343902]);
   [ebh] = findobj('position',[313 235 25 15]);
      end

   if box22==3
   [ahh] = findobj('Position',[0.13 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[30 35 25 15]);
   end

   if box22==4
   [ahh] = findobj('Position',[0.577977 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[313 40 25 15]);
   end

   CXhigher2= CX2(position:position,1:2^(position-1)+d2);
   CYhigher2= CY2(position:position,1:2^(position-1)+d2);

         [m1,n1]=size(CXhigher2);
   CXhigher2=zeros(1,n1);
   CYhigher2=zeros(1,n1);
      CXhigher2(1:1,savecol:savecol)=ff;
      CYhigher2(1:1,savecol:savecol)=gg;
   display(size(CXhigher2));
   display(size(CYhigher2));
   display(ff);
   display(gg);

   for cal=1:calplus%9
```

```
      CXhigher2=(FindP(d2,position+cal-1)*CXhigher2')'; % check

      CYhigher2=(FindP(d2,position+cal-1)*CYhigher2')';
      display(CXhigher2);
      display(CYhigher2);
   end%9

   CNX=
CX2(position+calplus:position+calplus,1:2^(position+calplus-
1)+d2);
   CNY=
CY2(position+calplus:position+calplus,1:2^(position+calplus-
1)+d2);
   CXhigher2=CNX+CXhigher2;
   CYhigher2=CNY+CYhigher2;


  [r222,c222]=size(CXhigher2);
  if c222~=1%10
   [CX12,CY12]=SplineInterpolation2(n2,d2,CXhigher2,CYhigher2);
   end%10

   if c222==1%11
   CX12 = CXhigher2;
   CY12 = CYhigher2;
   end%11

   tot2=n2;
   n222=log(c222+calplus-d2)/log(2);

   [ahhrow,ahhcol]=size(ahh);
   if (ahhrow>1 & gcf>1)
      for loop100=ahhrow:-1:1
         ahh22(ahhrow-loop100+1:ahhrow-
loop100+1,1:1)=ahh(loop100:loop100,1:1);
      end

   end

    if (ahhrow==1 & gcf>1)
       ahh22=ahh;
    end

   if ahhrow==1 & gcf==1
      ahh22=ahh;
   end

   if ahhrow>1 & gcf==1
      ahh22=ahh;
   end


   set(ahh22(pick:pick,1:1),'Nextplot','add');
   set(ahh22(pick:pick,1:1),'visible','on');
```

```
plot(CX12,CY12,'r',CXhigher2,CYhigher2,'ro','Parent',ahh22(pick:pi
ck,1:1));
         if box22==1 & gcf>1 %12
    box22=5;
      end%12

      box22=box22-1;
      calplus=calplus+1;
      total=total-1;
end%8
arem=rem(j2+1,4);
if fix((j2+1)/4)==(j2+1)/4
   totaxes=4;
end
if fix((j2+1)/4)~=(j2+1)/4
   totaxes=arem;
end

step=totaxes-boxrem;
for loop10=boxrem+1:j2+1%13
   if loop10==1
   [ahh] = findobj('Position',[0.13 0.581098 0.327023 0.343902]);
   [ebh] = findobj('position',[30 235 25 15]);
   [cbh] = findobj('position',[25 255 37 15]);
   end

   if loop10==2
   [ahh] = findobj('Position',[0.577977 0.581098 0.327023
0.343902]);
   [ebh] = findobj('position',[313 235 25 15]);
   [cbh] = findobj('position',[310 255 37 15]);
   end

   if loop10==3
   [ahh] = findobj('Position',[0.13 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[30 35 25 15]);
   [cbh] = findobj('position',[25 55 37 15]);
   end

   if loop10==4
   [ahh] = findobj('Position',[0.577977 0.11 0.327023 0.343902]);
   [ebh] = findobj('position',[313 40 25 15]);
   [cbh] = findobj('position',[310 60 37 15]);
   end

   set(ahh(1:1,1:1),'visible','on');

end%13

return
```

Function No. 7

```
% saved under claa1.m
function claa1
object1 = gcbo;
```

```
v1=get(object1,'value');
 h3 = findobj('Position',[40-2 245+115 20 15]);
 set(h3,'string',v1);
l1= get(object1,'Userdata');

c1=l1(1:1,1:1);
display(c1);
CX1=l1(:,2:c1+1);
CY1=l1(:,2+c1:2*c1+1);

n1=l1(1:1,2*c1+2:2*c1+2);
display(n1);
d1=l1(1:1,2*c1+3:2*c1+3);
display(d1);
j1=l1(1:1,2*c1+4:2*c1+4);
display(j1);
box1=l1(1:1,2*c1+5:2*c1+5);

c11=2^(n1-1)+d1;

if v1~=0
CXhigher1=v1*CX1(n1+1:n1+1,1:2^(n1)+d1)+(1-v1)*CX1(n1:n1,1:2^(n1-
1)+d1)*FindP(d1,n1)';
CYhigher1=v1*CY1(n1+1:n1+1,1:2^(n1)+d1)+(1-v1)*CY1(n1:n1,1:2^(n1-
1)+d1)*FindP(d1,n1)';
end

if v1==0
   CXhigher1= (1-v1)*CX1(n1:n1,1:2^(n1-1)+d1);
   CYhigher1= (1-v1)*CY1(n1:n1,1:2^(n1-1)+d1);
end
[r111,c111]=size(CXhigher1);

display(CXhigher1);
display(CYhigher1);

if c11~=1
[CX11,CY11]=SplineInterpolation1(n1,d1,CXhigher1,CYhigher1);
end
if c11==1
   CX11 = CXhigher1;
   CY11 = CYhigher1;
   end
   tot1=n1+v1;
   n111=log(c111-d1)/log(2);
subplot(2,2,box1),plot(CX11,CY11,'-',CXhigher1,CYhigher1,'ro');
xlabel(['Level=',num2str(tot1),',Points=2^',num2str(n111),'+',num2
str(d1),'=',num2str(c111)]);

return
```

Function No. 8

```
% saved under claa2.m
function claa2
object2 = gcbo;
v2=get(object2,'value');
```

```
 h3 = findobj('Position',[320-2 245+115 20 15]);
 set(h3,'string',v2);

l2= get(object2,'Userdata');

c2=l2(1:1,1:1);
display(c2);
CX2=l2(:,2:c2+1);
CY2=l2(:,2+c2:2*c2+1);

n2=l2(1:1,2*c2+2:2*c2+2);
display(n2);
d2=l2(1:1,2*c2+3:2*c2+3);
display(d2);
j2=l2(1:1,2*c2+4:2*c2+4);
display(j2);
box2=l2(1:1,2*c2+5:2*c2+5);

c22=2^(n2-1)+d2;

if v2~=0
CXhigher2=v2*CX2(n2+1:n2+1,1:2^(n2)+d2)+(1-v2)*CX2(n2:n2,1:2^(n2-
1)+d2)*FindP(d2,n2)';
CYhigher2=v2*CY2(n2+1:n2+1,1:2^(n2)+d2)+(1-v2)*CY2(n2:n2,1:2^(n2-
1)+d2)*FindP(d2,n2)';
end

if v2==0
   CXhigher2= (1-v2)*CX2(n2:n2,1:2^(n2-1)+d2);
   CYhigher2= (1-v2)*CY2(n2:n2,1:2^(n2-1)+d2);
end
[r222,c222]=size(CXhigher2);

display(CXhigher2);
display(CYhigher2);

if c22~=1
[CX12,CY12]=SplineInterpolation2(n2,d2,CXhigher2,CYhigher2);
end
if c22==1
   CX12 = CXhigher2;
   CY12 = CYhigher2;
   end

   tot2=n2+v2;
   n222=log(c222-d2)/log(2);
subplot(2,2,box2),plot(CX12,CY12,'-',CXhigher2,CYhigher2,'ro');
xlabel(['Level=',num2str(tot2),',Points=2^',num2str(n222),'+',num2
str(d2),'=',num2str(c222)]);

return
```

Function No. 9

```
% saved under claa3.m
function claa3
object3 = gcbo;
```

```
v3=get(object3,'value');
 h3 = findobj('Position',[40-2 45+115 20 15]);
 set(h3,'string',v3);
l3= get(object3,'Userdata');

c3=l3(1:1,1:1);
display(c3);
CX3=l3(:,2:c3+1);
CY3=l3(:,2+c3:2*c3+1);

n3=l3(1:1,2*c3+2:2*c3+2);
display(n3);
d3=l3(1:1,2*c3+3:2*c3+3);
display(d3);
j3=l3(1:1,2*c3+4:2*c3+4);
display(j3);
box3=l3(1:1,2*c3+5:2*c3+5);

c33=2^(n3-1)+d3;

if v3~=0
CXhigher3=v3*CX3(n3+1:n3+1,1:2^(n3)+d3)+(1-v3)*CX3(n3:n3,1:2^(n3-
1)+d3)*FindP(d3,n3)';
CYhigher3=v3*CY3(n3+1:n3+1,1:2^(n3)+d3)+(1-v3)*CY3(n3:n3,1:2^(n3-
1)+d3)*FindP(d3,n3)';
end

if v3==0
   CXhigher3= (1-v3)*CX3(n3:n3,1:2^(n3-1)+d3);
   CYhigher3= (1-v3)*CY3(n3:n3,1:2^(n3-1)+d3);
end
[r333,c333]=size(CXhigher3);

display(CXhigher3);
display(CYhigher3);

if c33~=1
[CX13,CY13]=SplineInterpolation3(n3,d3,CXhigher3,CYhigher3);
end
if c33==1
   CX13 = CXhigher3;
   CY13 = CYhigher3;
   end
   tot3=n3+v3;
   n333=log(c333-d3)/log(2);
subplot(2,2,box3),plot(CX13,CY13,'-',CXhigher3,CYhigher3,'ro');
xlabel(['Level=',num2str(tot3),',Points=2^',num2str(n333),'+',num2
str(d3),'=',num2str(c333)]);

return
```

Function No. 10

```
% saved under claa4.m
function claa4
object4 = gcbo;
v4=get(object4,'value');
```

```
 h3 = findobj('Position',[320-2 45+115 20 15]);
 set(h3,'string',v4);
l4= get(object4,'Userdata');

c4=l4(1:1,1:1);
display(c4);
CX4=l4(:,2:c4+1);
CY4=l4(:,2+c4:2*c4+1);

n4=l4(1:1,2*c4+2:2*c4+2);
display(n4);
d4=l4(1:1,2*c4+3:2*c4+3);
display(d4);
j4=l4(1:1,2*c4+4:2*c4+4);
display(j4);
box4=l4(1:1,2*c4+5:2*c4+5);
c44=2^(n4-1)+d4;
if v4~=0
CXhigher4=v4*CX4(n4+1:n4+1,1:2^(n4)+d4)+(1-v4)*CX4(n4:n4,1:2^(n4-
1)+d4)*FindP(d4,n4)';
CYhigher4=v4*CY4(n4+1:n4+1,1:2^(n4)+d4)+(1-v4)*CY4(n4:n4,1:2^(n4-
1)+d4)*FindP(d4,n4)';
end
if v4==0
   CXhigher4= (1-v4)*CX4(n4:n4,1:2^(n4-1)+d4);
   CYhigher4= (1-v4)*CY4(n4:n4,1:2^(n4-1)+d4);
end
[r444,c444]=size(CXhigher4);

display(CXhigher4);
display(CYhigher4);

if c44~=1
[CX14,CY14]=SplineInterpolation4(n4,d4,CXhigher4,CYhigher4);
end
if c44==1
   CX14 = CXhigher4;
   CY14 = CYhigher4;
   end
   tot4=n4+v4;
   n444=log(c444-d4)/log(2);
subplot(2,2,box4),plot(CX14,CY14,'-',CXhigher4,CYhigher4,'ro');
xlabel(['Level=',num2str(tot4),',Points=2^',num2str(n444),'+',num2
str(d4),'=',num2str(c444)]);

return
```

Function No. 11

```
% saved under spline2d1.m
function [xx,yy]=spline2d1(xuseraxis,yuseraxis,m)

clf reset
axis([0 xuseraxis 0 yuseraxis])
hold on
view(0,90)
```

```
echo on
title('CLICK THE MOUSE BUTTON WITHIN THE AREA FOR POINT
SELECTION');
grid on;

xx = [];
yy = [];
n = 0;
% Loop, picking up the points.
but = 1;
echo off;
while but == 1
   xlabel(['WHEN POINTS ARE ',num2str(m),', STOP, AND PRESS ANY
KEY']);
   [xi,yi,but] = ginput(1);
   if length(but)==0,
    if n<2
     but=1;
     disp('Pick at least two points please.')
    else
     but=2;
    end
   elseif but~=1
    if n<2
     but=1;
     disp('Pick at least two points please.')
    end

  else
   plot(xi,yi,'go')

   n = n + 1;
   text(xi,yi,[' ' int2str(n)],'Erase','back');
   xx = [xx; xi];
   yy = [yy; yi];
  end
end
echo on;


disp('End of data entry')




return
```

Function No. 12

```
% saved under splineInterpolation.m
function [CX1,CY1]=SplineInterpolation(n,d,CX,CY)
t = 1:2*(n-1)+d;
ts = 1:1/10:2*(n-1)+d;
CX1 = interp1(t,CX(1:n),1:2*(n-1)+d,ts,'spline');
CY1 = interp1(t,CY(1:n),1:2*(n-1)+d,ts,'spline');
```

```
return
```

Function No. 13

```
% saved under splineInterpolation1.m
function [CX11,CY11]=
SplineInterpolation(n1,d1,CXhigher1,CYhigher1)
[rowcount,colcount]=size(CXhigher1);
t = 1:colcount;
ts = 1:1/10:colcount;
display(CXhigher1);
display(CYhigher1);
display(n1);
display(d1);
display(colcount);
CX11 = interp1(t,CXhigher1,ts,'spline');
CY11 = interp1(t,CYhigher1,ts,'spline');
return
```

Function No. 14

```
% saved under splineInterpolation2.m
function [CX12,CY12]=
SplineInterpolation(n2,d2,CXhigher2,CYhigher2)
[rowcount,colcount]=size(CXhigher2);
t = 1:colcount;
ts = 1:1/10:colcount;
display(CXhigher2);
display(CYhigher2);
display(n2);
display(d2);
display(colcount);
CX12 = interp1(t,CXhigher2,ts,'spline');
CY12 = interp1(t,CYhigher2,ts,'spline');
return
```

Function No. 15

```
% saved under splineInterpolation3.m
function [CX13,CY13]=
SplineInterpolation(n3,d3,CXhigher3,CYhigher3)
[rowcount,colcount]=size(CXhigher3);
t = 1:colcount;
ts = 1:1/10:colcount;
display(CXhigher3);
display(CYhigher3);
display(n3);
display(d3);
display(colcount);
CX13 = interp1(t,CXhigher3,ts,'spline');
CY13 = interp1(t,CYhigher3,ts,'spline');
return
```

Function No. 16

```
% saved under splineInterpolation4.m
function [CX14,CY14]=
SplineInterpolation(n4,d4,CXhigher4,CYhigher4)
[rowcount,colcount]=size(CXhigher4);
t = 1:colcount;
ts = 1:1/10:colcount;
display(CXhigher4);
display(CYhigher4);
display(n4);
display(d4);
display(colcount);
CX14 = interp1(t,CXhigher4,ts,'spline');
CY14 = interp1(t,CYhigher4,ts,'spline');
return
```

Function No. 17

```
% saved under Bernstein.m
function b = Bernstein(d, i, u)

% b = Bernstein(d, i, u) returns the value of the i'th Bernstein
polynomial
% of degree d at u.  Here d >= 0, 0 <= i <= d, and 0 <= u <= 1.

b = Choose(d, i)*u.^i.*(1-u).^(d-i);
return;
```

Function No. 18

```
% saved under BernsteinInner.m
function I = BernsteinInner(d)

% I = BernsteinInner(d) returns the matrix of inner products of
Bernstein
% polynomials of degree d.

i = ones(d+1, 1)*[0:d];
j = i';
I = Choose(d, i).*Choose(d, j)./(Choose(2*d, i+j)*(2*d + 1));
return;
```

Function No. 19

```
% saved under BernsteinWeights.m
function w = BernsteinWeights(d, j)

% w = BernsteinWeights(d, j) returns a matrix of B-spline scaling
function
% weights for Bernstein polynomials of degree d, level j.

w = eye(2^j + d);
if d == 0
  return;
```

```
end;
u = Knots(d, j);
g = Greville(d, u);

for i = 1:2^j-1
  for r = 1:d
    [u, g, w] = InsertKnot(d, u, g, w, i/2^j);
  end;
end;
return;
```

Function No. 20

```
% Saved under CheckInt.m
% CheckInt checks integer versions of Q's for orthogonality to
P'*I.

for d = 0:3
  for j = 1:4
    disp(['---------- d = ' num2str(d) ', j = ' num2str(j) ' -----
------']);
    P = FindP(d, j);
    P_denom = LCD(P);
    P = round(P*P_denom);
    disp(['P = 1/' num2str(P_denom)]);
    disp(P);
    I = Inner(d, j);
    I_denom = LCD(I);
    I = round(I*I_denom);
    disp(['I = 1/' num2str(I_denom)]);
    disp(I);
    Q = FindQ(d, j, 'lcd')
    ip = P'*I*Q;
    if all(all(ip == 0))
      disp('******* Passed orthogonality test.');
    else
      disp('******* FAILED!');
    end;
    disp('Press a key...');
    pause;
  end;
end;
return;
```

Function No. 21

```
% saved under Choose.m
function c = Choose(n, r)

% c = Choose(n, r) returns (n choose r) = n! / (r! (n-r)!).

c = Factorial(n)./(Factorial(r).*Factorial(n-r));
return;
```

Function No. 22

```
% saved under EvalCombo.m
function f = EvalCombo(d, j, c, n)

% EvalCombo(d, j, c, n) evaluates a linear combination of B-spline
scaling
% functions of degree d, level j, using coefficients c, at n
points per
% interval.

w = BernsteinWeights(d, j) * c;
u = [0:n-1]/(n-1);
f = zeros(1, n*2^j);
p = 1;
for inter = 1:2^j
  for i = 0:d
    f(p:p+n-1) = f(p:p+n-1) + w(i+1+(d+1)*(inter-1)) *
Bernstein(d, i, u);
  end;
  p = p + n;
end;
return;
```

Function No. 23

```
% saved under Factorial.m
function f = Factorial(m)

% f = Factorial(m) returns the matrix of factorials of entries of
m.

[r,c] = size(m);
f = zeros(r, c);
for i = 1:r
  for j = 1:c
    f(i,j) = prod(2:m(i,j));
  end;
end;
return;
```

Function No. 24

```
% Saved under FindP.m
function P = FindP(d, j)

% P = FindP(d, j) returns the P matrix for B-spline scaling
functions of
% degree d, level j.

d = fix(d);
if d < 0,
  error('FindP: Must have d >= 0.');
end;
j = fix(j);
if j < 1
```

```
  error('FindP: Must have j >= 1.');
end;

if d == 0
  P = [1; 1];
  for i = 2:j
    P = [P zeros(size(P)); zeros(size(P)) P];
  end;
else
  u = Knots(d, j - 1);
  g = Greville(d, u);
  P = eye(2^(j-1) + d);
  for k = 0:2^(j-1)-1
    [u, g, P] = InsertKnot(d, u, g, P, (2*k+1)/2^j);
  end;
end;
return;
```

Function No. 25

```
% saved under FindQ.m
function Q = FindQ(d, j, normalization)

% Q = FindQ(d, j, normalization) returns the Q matrix for B-spline
scaling
% functions of degree d, level j.  If normalization is 'min' (or
is not
% specified) then the smallest entry in each column is made 1.  If
% normalization is 'max' then the largest entry in each column is
made 1.
% If normalization is 'L2' then the L_2 norm of each wavelet is
made 1.

if nargin < 3
  normalization = 'min';
elseif ~strcmp(normalization, 'min') & ~strcmp(normalization,
'max') ...
      & ~strcmp(normalization, 'L2') & ~strcmp(normalization,
'lcd')
  error('FindQ: normalization must be ''min'', ''max'', or
''L2''.');
end;

P = FindP(d, j);
I = Inner(d, j);
if ~strcmp(normalization, 'L2')
%  P = round(P*LCD(P));
%  I = round(I*LCD(I));
end;

M = P'*I;
[m1, m2] = size(M);
n = m2 - rank(M);
Q = zeros(m2, n);
found = 0;
start_col = 0;
while (found < n/2) & (start_col < m2)
```

```
  start_col = start_col + 1 + (found > d);
  width = 0;
  rank_def = 0;
  while ~rank_def & (width < m2 - start_col + 1)
    width = width + 1;
    submatrix = M(:,start_col:start_col+width-1);
    rank_def = width - rank(submatrix);
  end;
  if rank_def
    % find null space of submatrix (should be just one column)
    q_col = null(submatrix);

    if strcmp(normalization, 'min')
      % normalize column so smallest nonzero entry has magnitude 1
      q_col = q_col/min(abs(q_col + 1e38*(abs(q_col) < 1e-10)));
    elseif strcmp(normalization, 'max')
      % normalize column so largest entry has magnitude 1
      q_col = q_col/max(abs(q_col));
    elseif strcmp(normalization, 'lcd')
      % normalize column to get all integers
      q_col = q_col/min(abs(q_col + 1e38*(abs(q_col) < 1e-10)));
      q_col = q_col*LCD(q_col);
    end;

    % change sign to give consistent orientation
    q_col = q_col*(-1)^(start_col + floor((d+1)/2) + (q_col(1,1) >
0));

    % correct any slight error for answers that should be integers
    if all(abs(submatrix*round(q_col)) < 1e-10) & any(round(q_col)
~= 0)
      q_col = round(q_col);
    end;

    % put column into left half of Q
    found = found + 1;
    Q(start_col:start_col+width-1,found) = q_col;

    % use symmetry to put column into right half of Q in reverse
order
    % and negated if degree is even
    Q(:,n-found+1) = flipud(Q(:,found))*(-1)^(d+1);
  end;
end;

if strcmp(normalization, 'L2')
  % normalize matrix so each column has L_2 norm of 1
  ip = Q'*I*Q;
  Q = Q*diag(1./sqrt(diag(ip)));
end;
return;
```

Function No. 26

```
% saved under Greville.m
function x = Greville(d, u)
```

```
% x = Greville(d, u) returns the vector of Greville abscissa
values
% corresponding to degree d and knot vector u.

l = length(u);
x = u(1:l-d+1);
for k = 2:d
  x = x + u(k:l-d+k);
end;
x = x / d;
return;
```