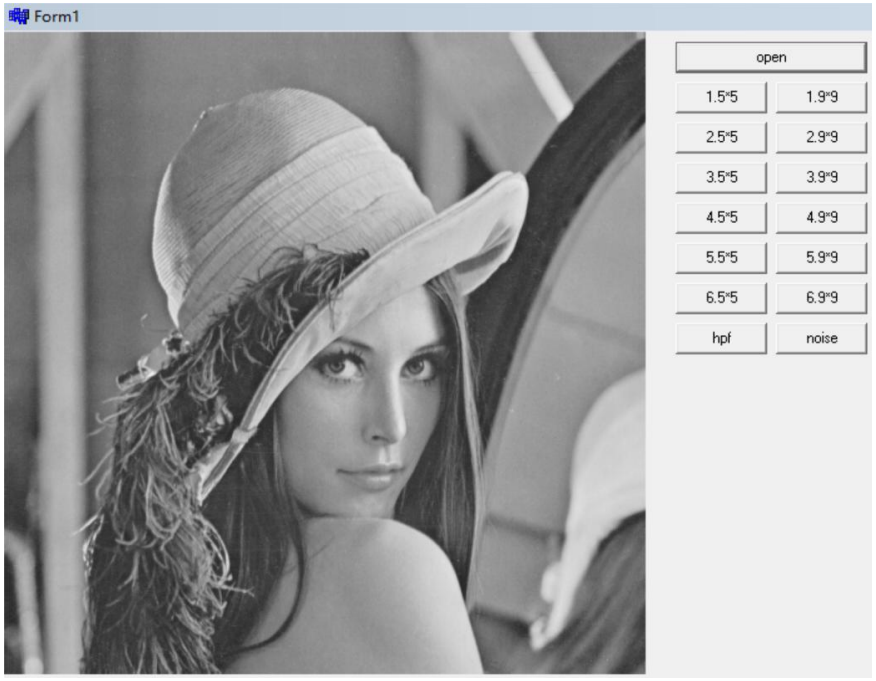
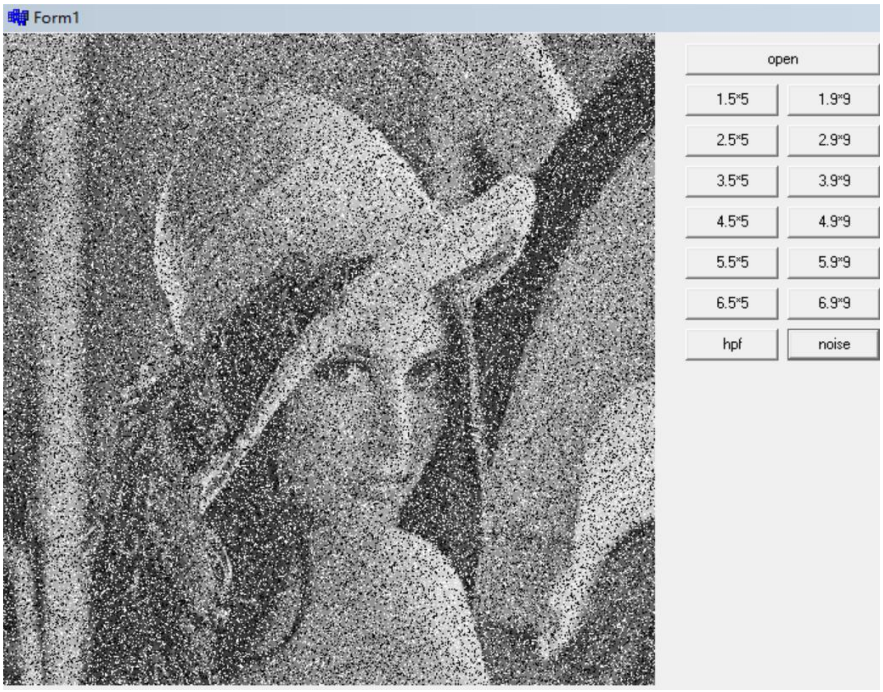
一、執行結果:

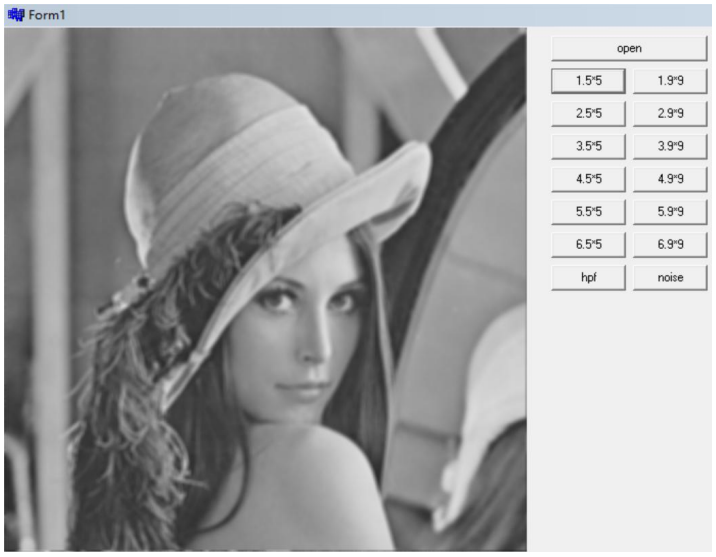
原图：

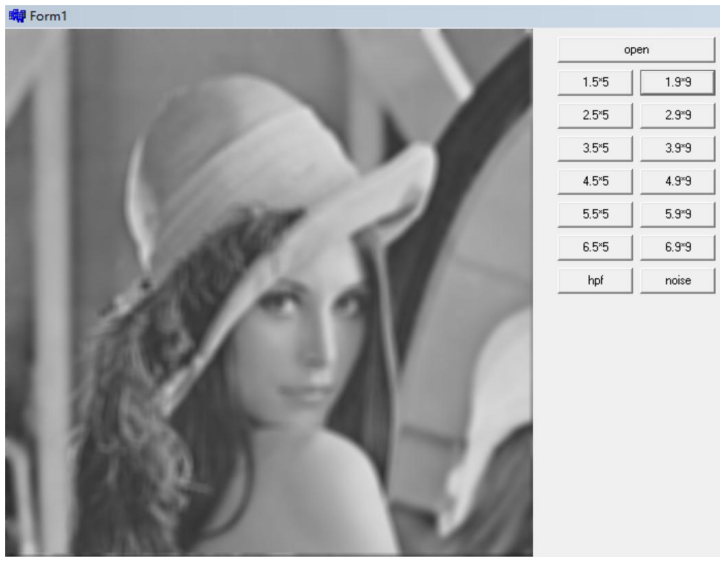

Form1
open
1.5*5
1.9*9
2.5*5
2.9*9
3.5*5
3.9*9
4.5*5
4.9*9
5.5*5
5.9*9
6.5*5
6.9*9
hpf
noise

盐胡椒：

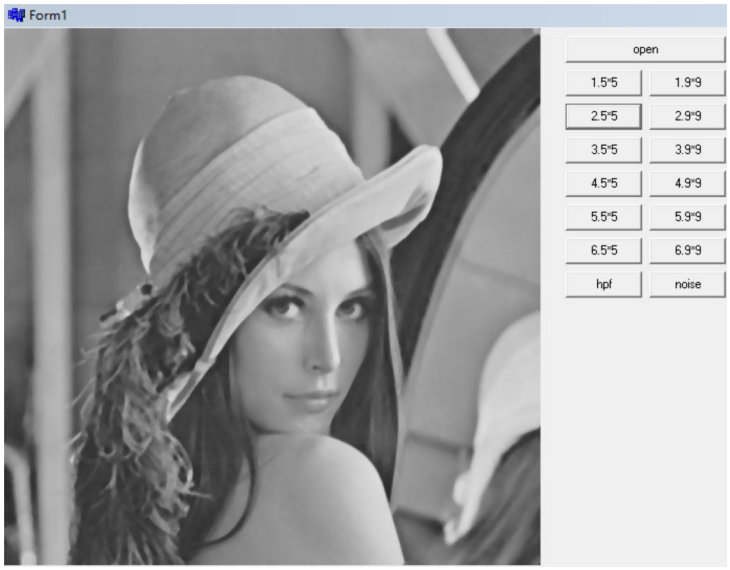

Form1
open
1.5*5
1.9*9
2.5*5
2.9*9
3.5*5
3.9*9
4.5*5
4.9*9
5.5*5
5.9*9
6.5*5
6.9*9
hpf
noise

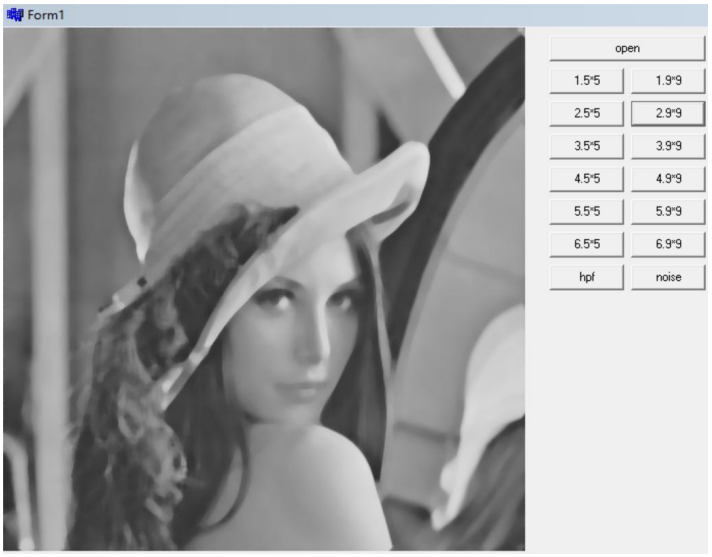
1、Mean filter to original image (5x5, 9x9)



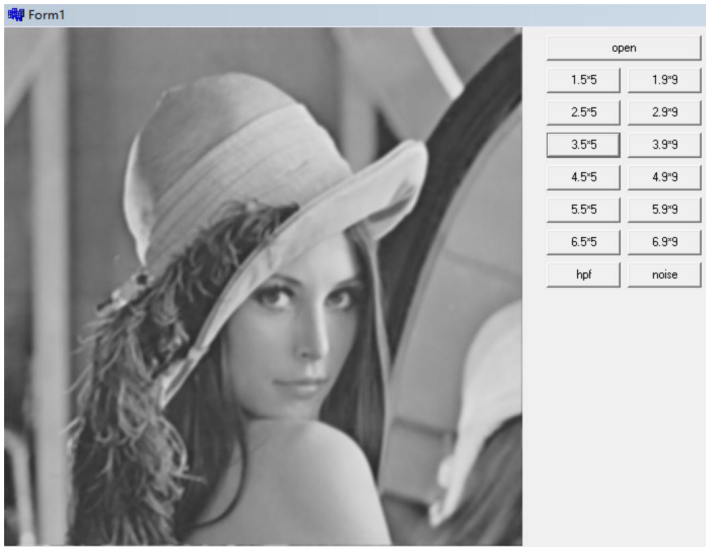


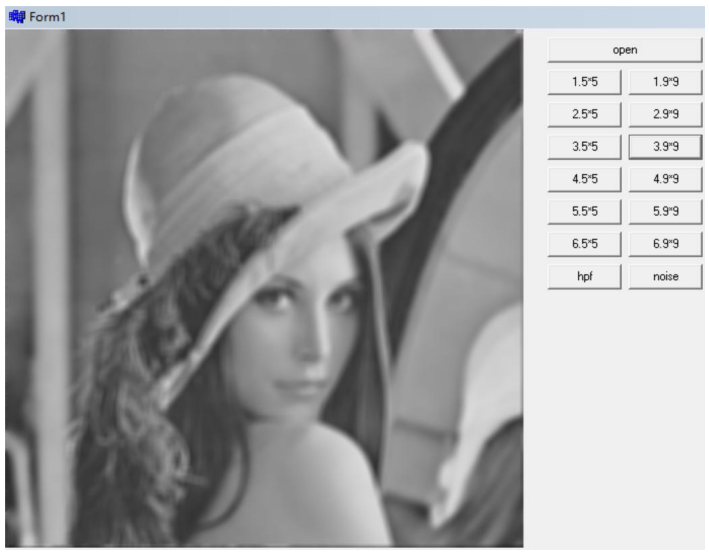
2、Median filter to original image (5x5, 9x9)



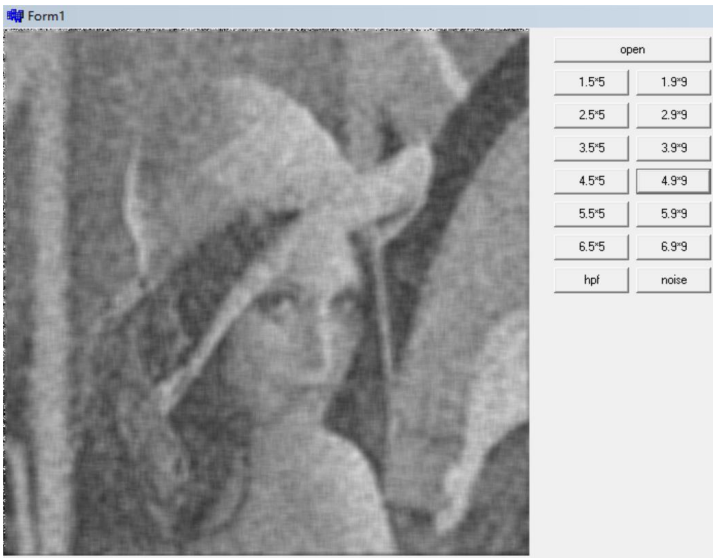


3、Alpha-trimmed mean filter to original image (T=2) (5x5, 9x9)

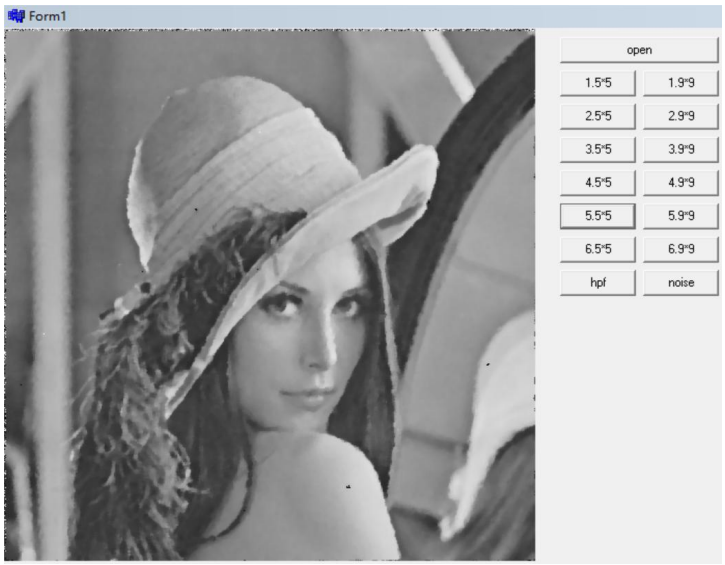


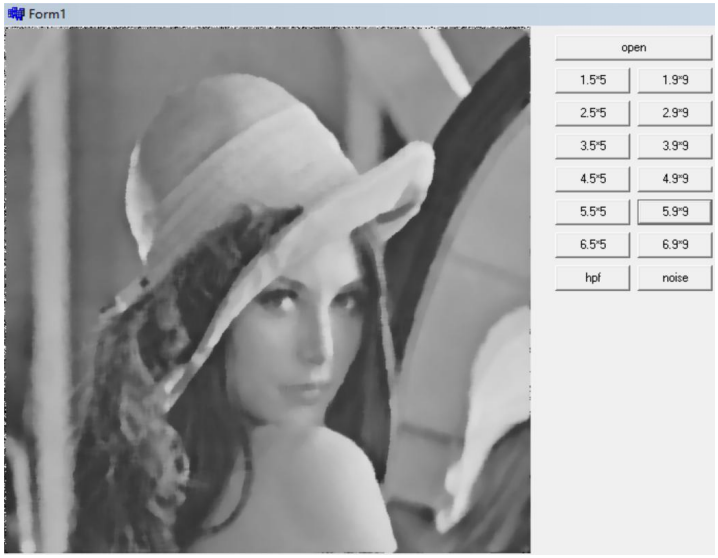


4、Noise Reduction (35% salt and pepper noise image) by mean filter (5x5, 9x9)

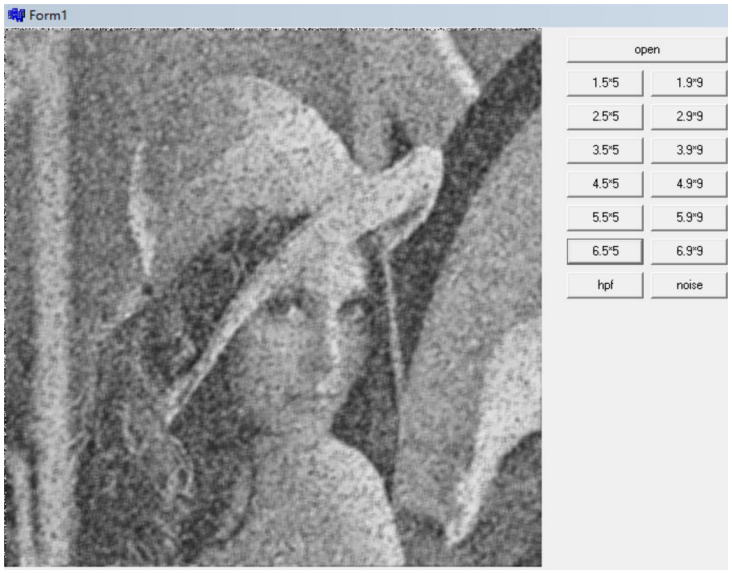


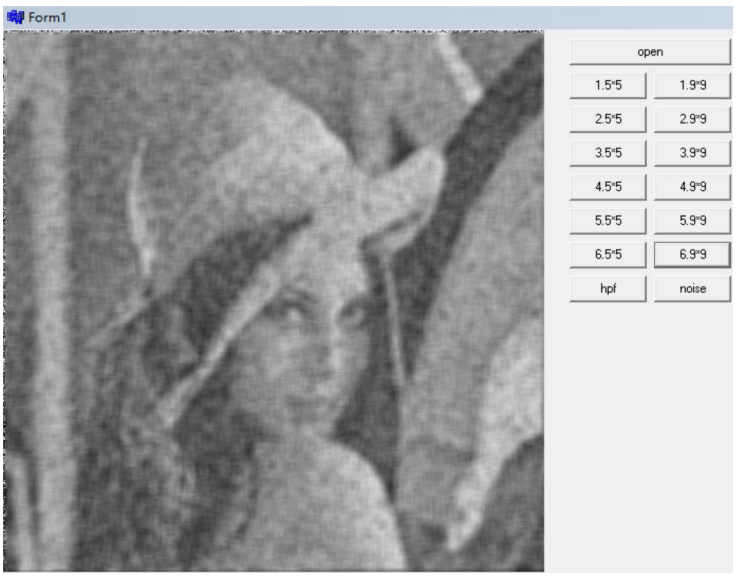
5、Noise Reduction (35% salt and pepper noise image) by median filter (5x5, 9x9)



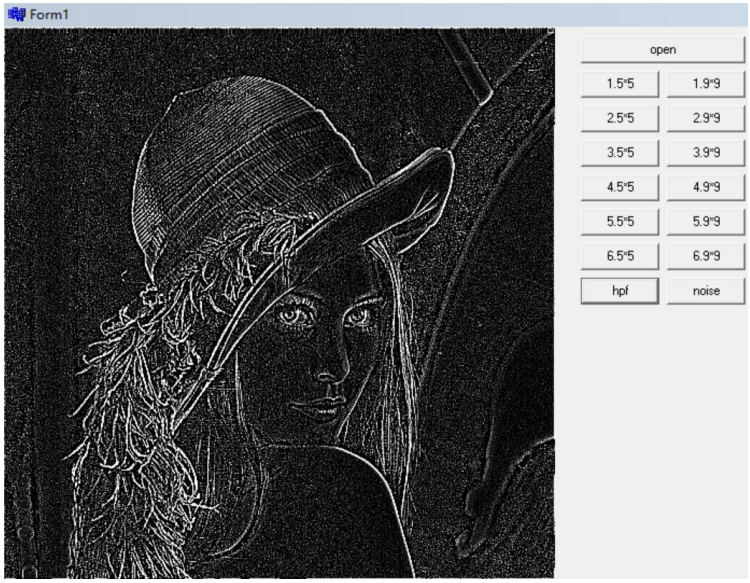


6、Noise Reduction (35% salt and pepper noise image) by Alpha-trimmed mean filter (T=2) (5x5, 9x9)





7、High-pass filter



二、程式碼：

```
//---------------------------------------------------------------------
#include <vcl.h>
#pragma hdrstop
#include <stdio.h>
#include <time.h>
#include "Unit1.h"
//---------------------------------------------------------------------
#pragma package(smart_init)
#pragma resource "*.dfm"
TForm1 *Form1;
unsigned char image_array[512][512];
int height;
int width;
int sizeofimage;
//---------------------------------------------------------------------
__fastcall TForm1::TForm1(TComponent* Owner)
        : TForm(Owner)
{
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button1Click(TObject *Sender)//open
{
        height = 512;
        width = 512;
        sizeofimage = height*width;
```

```
	FILE *file_open;
	String image_name;
	if(OpenDialog1->Execute())
	{
		image_name = ExtractFilePath(OpenDialog1->FileName);
		image_name = image_name +
ExtractFileName(OpenDialog1->FileName);
		file_open = fopen(image_name.c_str(),"rb");
		fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
		for(int y = 0;y < 512;y++)
		{
			for(int x = 0;x < 512;x++)
			{
				int pic = image_array[y][x];

PaintBox1->Canvas->Pixels[x][y]=RGB(pic,pic,pic);
			}
		}
		fclose(file_open);
	}
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button2Click(TObject *Sender)//mean 5*5
{
	height = 512;
	width = 512;
	sizeofimage = height*width;

	FILE *file_open;
	String image_name;
	if(OpenDialog1->Execute())
	{
		image_name = ExtractFilePath(OpenDialog1->FileName);
		image_name = image_name +
ExtractFileName(OpenDialog1->FileName);
		file_open = fopen(image_name.c_str(),"rb");
		fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
		int a = 0;
		for(int y=0;y<512;y++)
		{
		    for(int x=0;x<512;x++)
		    {
```

```
                    for(int j=y;j<y+5;j++)
                    {
                        for(int k=x;k<x+5;k++)
                        {
                            a = a + image_array[j][k];
                        }
                    }

PaintBox1->Canvas->Pixels[x+2][y+2]=RGB(a/25,a/25,a/25);
                    a = 0;
                }
            }
       fclose(file_open);
       }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button3Click(TObject *Sender)//mean 9*9
{
       height = 512;
       width = 512;
       sizeofimage = height*width;

       FILE *file_open;
       String image_name;
       if(OpenDialog1->Execute())
       {
              image_name = ExtractFilePath(OpenDialog1->FileName);
              image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
              file_open = fopen(image_name.c_str(),"rb");
              fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
              int a = 0;
              for(int y=0;y<512;y++)
              {
                  for(int x=0;x<512;x++)
                  {
                      for(int j=y;j<y+9;j++)
                      {
                          for(int k=x;k<x+9;k++)
                          {
                              a = a + image_array[j][k];
                          }
                      }
```

```
PaintBox1->Canvas->Pixels[x+4][y+4]=RGB(a/81,a/81,a/81);
                    a = 0;
                }
            }
       fclose(file_open);
       }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button4Click(TObject *Sender)//medium 5*5
{
       height = 512;
       width = 512;
       sizeofimage = height*width;

       FILE *file_open;
       String image_name;
       if(OpenDialog1->Execute())
       {
              image_name = ExtractFilePath(OpenDialog1->FileName);
              image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
              file_open = fopen(image_name.c_str(),"rb");
              fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
              int a[25] = {0};
              int i = 0;
              for(int y=0;y<512;y++)
              {
                  for(int x=0;x<512;x++)
                  {
                      for(int j=y;j<y+5;j++)
                      {
                          for(int k=x;k<x+5;k++)
                          {
                              a[i] = image_array[j][k];
                              i++;
                          }
                      }
                      int temp = 0;
                      for(int n=0;n<24;n++)
                      {
                          for(int m=1;m<25;m++)
                          {
```

```
                            if(a[m]<a[n])
                            {
                                temp = a[m];
                                a[m] = a[n];
                                a[n] = temp;
                            }
                        }
                    }

PaintBox1->Canvas->Pixels[x+2][y+2]=RGB(a[12],a[12],a[12]);
                    i = 0;//i 要重新赋值为 0
                }
            }
        }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button5Click(TObject *Sender)//medium 9*9
{
        height = 512;
        width = 512;
        sizeofimage = height*width;

        FILE *file_open;
        String image_name;
        if(OpenDialog1->Execute())
        {
                image_name = ExtractFilePath(OpenDialog1->FileName);
                image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
                file_open = fopen(image_name.c_str(),"rb");
                fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
                int a[81] = {0};
                int i = 0;
                for(int y=0;y<512;y++)
                {
                    for(int x=0;x<512;x++)
                    {
                        for(int j=y;j<y+9;j++)
                        {
                            for(int k=x;k<x+9;k++)
                            {
                                a[i] = image_array[j][k];
                                i++;
```

```
                    }
                }
                int temp = 0;
                for(int n=0;n<80;n++)
                {
                    for(int m=1;m<81;m++)
                    {
                        if(a[m]<a[n])
                        {
                            temp = a[m];
                            a[m] = a[n];
                            a[n] = temp;
                        }
                    }
                }

PaintBox1->Canvas->Pixels[x+4][y+4]=RGB(a[40],a[40],a[40]);
                i = 0;//i 要重新赋值为 0
            }
        }
    }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button6Click(TObject *Sender)//alpha 5*5
{
    height = 512;
    width = 512;
    sizeofimage = height*width;

    FILE *file_open;
    String image_name;
    if(OpenDialog1->Execute())
    {
        image_name = ExtractFilePath(OpenDialog1->FileName);
        image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
        file_open = fopen(image_name.c_str(),"rb");
        fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
        int a[25] = {0};
        int i = 0;
        for(int y=0;y<512;y++)
        {
            for(int x=0;x<512;x++)
```

```
                    {
                        for(int j=y;j<y+5;j++)
                        {
                            for(int k=x;k<x+5;k++)
                            {
                                a[i] = image_array[j][k];
                                i++;
                            }
                        }
                        int temp = 0;
                        int b = 0;
                        for(int n=0;n<24;n++)
                        {
                            for(int m=1;m<25;m++)
                            {
                                if(a[m]<a[n])
                                {
                                    temp = a[m];
                                    a[m] = a[n];
                                    a[n] = temp;
                                }
                            }
                        }
                        for(int n=2;n<23;n++)
                        {
                            b = b + a[n];
                        }

PaintBox1->Canvas->Pixels[x+2][y+2]=RGB(b/21,b/21,b/21);
                        i = 0;
                    }
                }
        }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button7Click(TObject *Sender)//alpha 9*9
{
        height = 512;
        width = 512;
        sizeofimage = height*width;

        FILE *file_open;
        String image_name;
        if(OpenDialog1->Execute())
```

```
       {
              image_name = ExtractFilePath(OpenDialog1->FileName);
              image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
              file_open = fopen(image_name.c_str(),"rb");
              fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
              int a[81] = {0};
              int i = 0;
              for(int y=0;y<512;y++)
              {
                  for(int x=0;x<512;x++)
                  {
                      for(int j=y;j<y+9;j++)
                      {
                          for(int k=x;k<x+9;k++)
                          {
                              a[i] = image_array[j][k];
                              i++;
                          }
                      }
                      int temp = 0;
                      int b = 0;
                      for(int n=0;n<80;n++)
                      {
                          for(int m=1;m<81;m++)
                          {
                              if(a[m]<a[n])
                              {
                                  temp = a[m];
                                  a[m] = a[n];
                                  a[n] = temp;
                              }
                          }
                      }
                      for(int n=2;n<79;n++)
                      {
                          b = b + a[n];
                      }

PaintBox1->Canvas->Pixels[x+4][y+4]=RGB(b/77,b/77,b/77);
                      i = 0;
                  }
              }
```

```
	}
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button8Click(TObject *Sender)//mean 5*5 with
pepper salt
{
	height = 512;
	width = 512;
	sizeofimage = height*width;
	srand((unsigned)time(NULL));
	int rh,rw,flag;
	int rnum = height * width * 35 / 100;
	FILE *file_open;
	String image_name;
	if(OpenDialog1->Execute())
	{
		image_name = ExtractFilePath(OpenDialog1->FileName);
		image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
		file_open = fopen(image_name.c_str(),"rb");
		fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
		for (int i=0;i<rnum;i++)
		{
		    rh = rand() % (height);
		    rw = rand() % (width);
		    int flag = rand() % 2;
		    if(flag == 0)
		    {
		        image_array[rh][rw] = 0;
		    }
		    else
		    {
		        image_array[rh][rw] = 255;
		    }
		}
		for(int y = 0;y < 512;y++)
		{
			for(int x = 0;x < 512;x++)
			{
				int pic = image_array[y][x];

PaintBox1->Canvas->Pixels[x][y]=RGB(pic,pic,pic);
			}
```

```
            }
            int a = 0;
            for(int y=0;y<512;y++)
            {
                for(int x=0;x<512;x++)
                {
                    for(int j=y;j<y+5;j++)
                    {
                        for(int k=x;k<x+5;k++)
                        {
                            a = a + image_array[j][k];
                        }
                    }

PaintBox1->Canvas->Pixels[x+2][y+2]=RGB(a/25,a/25,a/25);
                    a = 0;
                }
            }
       fclose(file_open);
       }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button9Click(TObject *Sender)//mean 9*9 with
pepper salt
{
       height = 512;
       width = 512;
       sizeofimage = height*width;
       srand((unsigned)time(NULL));
       int rh,rw,flag;
       int rnum = height * width * 35 / 100;
       FILE *file_open;
       String image_name;
       if(OpenDialog1->Execute())
       {
              image_name = ExtractFilePath(OpenDialog1->FileName);
              image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
              file_open = fopen(image_name.c_str(),"rb");
              fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
              for (int i=0;i<rnum;i++)
              {
                  rh = rand() % (height);
```

```
                rw = rand() % (width);
                int flag = rand() % 2;
                if(flag == 0)
                {
                    image_array[rh][rw] = 0;
                }
                else
                {
                    image_array[rh][rw] = 255;
                }
            }
            int a = 0;
            for(int y=0;y<512;y++)
            {
                for(int x=0;x<512;x++)
                {
                    for(int j=y;j<y+9;j++)
                    {
                        for(int k=x;k<x+9;k++)
                        {
                            a = a + image_array[j][k];
                        }
                    }

PaintBox1->Canvas->Pixels[x+4][y+4]=RGB(a/81,a/81,a/81);
                    a = 0;
                }
            }
       fclose(file_open);
       }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button10Click(TObject *Sender)//medium 5*5
with pepper salt
{
 height = 512;
       width = 512;
       sizeofimage = height*width;
       srand((unsigned)time(NULL));
       int rh,rw,flag;
       int rnum = height * width * 35 / 100;
       FILE *file_open;
       String image_name;
       if(OpenDialog1->Execute())
```

```
       {
              image_name = ExtractFilePath(OpenDialog1->FileName);
              image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
              file_open = fopen(image_name.c_str(),"rb");
              fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
              for (int i=0;i<rnum;i++)
              {
                  rh = rand() % (height);
                  rw = rand() % (width);
                  int flag = rand() % 2;
                  if(flag == 0)
                  {
                      image_array[rh][rw] = 0;
                  }
                  else
                  {
                      image_array[rh][rw] = 255;
                  }
              }
              int a[25] = {0};
              int i = 0;
              for(int y=0;y<512;y++)
              {
                  for(int x=0;x<512;x++)
                  {
                      for(int j=y;j<y+5;j++)
                      {
                          for(int k=x;k<x+5;k++)
                          {
                              a[i] = image_array[j][k];
                              i++;
                          }
                      }
                      int temp = 0;
                      for(int n=0;n<24;n++)
                      {
                          for(int m=1;m<25;m++)
                          {
                              if(a[m]<a[n])
                              {
                                  temp = a[m];
                                  a[m] = a[n];
```

```
                                a[n] = temp;
                            }
                        }
                    }

PaintBox1->Canvas->Pixels[x+2][y+2]=RGB(a[12],a[12],a[12]);
                    i = 0;
                }
            }
        }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button11Click(TObject *Sender)//medium 9*9
with pepper salt
{
height = 512;
        width = 512;
        sizeofimage = height*width;
        srand((unsigned)time(NULL));
        int rh,rw,flag;
        int rnum = height * width * 35 / 100;
        FILE *file_open;
        String image_name;
        if(OpenDialog1->Execute())
        {
                image_name = ExtractFilePath(OpenDialog1->FileName);
                image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
                file_open = fopen(image_name.c_str(),"rb");
                fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
                for (int i=0;i<rnum;i++)
                {
                    rh = rand() % (height);
                    rw = rand() % (width);
                    int flag = rand() % 2;
                    if(flag == 0)
                    {
                        image_array[rh][rw] = 0;
                    }
                    else
                    {
                        image_array[rh][rw] = 255;
                    }
```

```
            }
            int a[81] = {0};
            int i = 0;
            for(int y=0;y<512;y++)
            {
                for(int x=0;x<512;x++)
                {
                    for(int j=y;j<y+9;j++)
                    {
                        for(int k=x;k<x+9;k++)
                        {
                            a[i] = image_array[j][k];
                            i++;
                        }
                    }
                    int temp = 0;
                    for(int n=0;n<80;n++)
                    {
                        for(int m=1;m<81;m++)
                        {
                            if(a[m]<a[n])
                            {
                                temp = a[m];
                                a[m] = a[n];
                                a[n] = temp;
                            }
                        }
                    }

PaintBox1->Canvas->Pixels[x+4][y+4]=RGB(a[40],a[40],a[40]);
                    i = 0;
                }
            }
       }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button13Click(TObject *Sender)//alpha 5*5
with pepper salt
{
height = 512;
       width = 512;
       sizeofimage = height*width;
       srand((unsigned)time(NULL));
       int rh,rw,flag;
```

```
        int rnum = height * width * 35 / 100;
        FILE *file_open;
        String image_name;
        if(OpenDialog1->Execute())
        {
                image_name = ExtractFilePath(OpenDialog1->FileName);
                image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
                file_open = fopen(image_name.c_str(),"rb");
                fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
                for (int i=0;i<rnum;i++)
                {
                    rh = rand() % (height);
                    rw = rand() % (width);
                    int flag = rand() % 2;
                    if(flag == 0)
                    {
                        image_array[rh][rw] = 0;
                    }
                    else
                    {
                        image_array[rh][rw] = 255;
                    }
                }
                int a[25] = {0};
                int i = 0;
                for(int y=0;y<512;y++)
                {
                    for(int x=0;x<512;x++)
                    {
                        for(int j=y;j<y+5;j++)
                        {
                            for(int k=x;k<x+5;k++)
                            {
                                a[i] = image_array[j][k];
                                i++;
                            }
                        }
                        int temp = 0;
                        int b = 0;
                        for(int n=0;n<24;n++)
                        {
                            for(int m=1;m<25;m++)
```

```
                        {
                            if(a[m]<a[n])
                            {
                                temp = a[m];
                                a[m] = a[n];
                                a[n] = temp;
                            }
                        }
                    }
                    for(int n=2;n<23;n++)
                    {
                        b = b + a[n];
                    }

PaintBox1->Canvas->Pixels[x+2][y+2]=RGB(b/21,b/21,b/21);
                    i = 0;
                }
            }
        }
}
//---------------------------------------------------------------------
void __fastcall TForm1::Button14Click(TObject *Sender)//alpha 9*9
with pepper salt
{
        height = 512;
        width = 512;
        sizeofimage = height*width;
        srand((unsigned)time(NULL));
        int rh,rw,flag;
        int rnum = height * width * 35 / 100;
        FILE *file_open;
        String image_name;
        if(OpenDialog1->Execute())
        {
                image_name = ExtractFilePath(OpenDialog1->FileName);
                image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
                file_open = fopen(image_name.c_str(),"rb");
                fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
                for (int i=0;i<rnum;i++)
                {
                    rh = rand() % (height);
                    rw = rand() % (width);
```

```
            int flag = rand() % 2;
            if(flag == 0)
            {
                image_array[rh][rw] = 0;
            }
            else
            {
                image_array[rh][rw] = 255;
            }
        }
        int a[81] = {0};
        int i = 0;
        for(int y=0;y<512;y++)
        {
            for(int x=0;x<512;x++)
            {
                for(int j=y;j<y+9;j++)
                {
                    for(int k=x;k<x+9;k++)
                    {
                        a[i] = image_array[j][k];
                        i++;
                    }
                }
                int temp = 0;
                int b = 0;
                for(int n=0;n<80;n++)
                {
                    for(int m=1;m<81;m++)
                    {
                        if(a[m]<a[n])
                        {
                            temp = a[m];
                            a[m] = a[n];
                            a[n] = temp;
                        }
                    }
                }
                for(int n=2;n<79;n++)
                {
                    b = b + a[n];
                }

PaintBox1->Canvas->Pixels[x+4][y+4]=RGB(b/77,b/77,b/77);
```

```
                    i = 0;
                }
            }
        }
}
//---------------------------------------------------------------
void __fastcall TForm1::Button12Click(TObject *Sender)//pepper salt
noise
{
        height = 512;
        width = 512;
        sizeofimage = height*width;
        srand((unsigned)time(NULL));
        int rh,rw,flag;
        int rnum = height * width * 35 / 100;
        FILE *file_open;
        String image_name;
        if(OpenDialog1->Execute())
        {
                image_name = ExtractFilePath(OpenDialog1->FileName);
                image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
                file_open = fopen(image_name.c_str(),"rb");
                fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
                for (int i=0;i<rnum;i++)
                {
                    rh = rand() % (height);
                    rw = rand() % (width);
                    int flag = rand() % 2;
                    if(flag == 0)
                    {
                        image_array[rh][rw] = 0;
                    }
                    else
                    {
                        image_array[rh][rw] = 255;
                    }
                }
                for(int y = 0;y < 512;y++)
                {
                        for(int x = 0;x < 512;x++)
                        {
                            int pic = image_array[y][x];
```

```
PaintBox1->Canvas->Pixels[x][y]=RGB(pic,pic,pic);
                    }
             }
       fclose(file_open);
       }
}
//---------------------------------------------------------------
void __fastcall TForm1::Button15Click(TObject *Sender)//high-pass
filter
{
       height = 512;
       width = 512;
       sizeofimage = height*width;
       int hpf[9] = {-2,-5,-2,-5,28,-5,-2,-5,-2};

       FILE *file_open;
       String image_name;
       if(OpenDialog1->Execute())
       {
             image_name = ExtractFilePath(OpenDialog1->FileName);
             image_name          =          image_name          +
ExtractFileName(OpenDialog1->FileName);
             file_open = fopen(image_name.c_str(),"rb");
             fread(image_array,sizeof(unsigned
char)*512*512,1,file_open);
             int a = 0;
             int i = 0;
             for(int y=0;y<512;y++)
             {
                 for(int x=0;x<512;x++)
                 {
                     for(int j=y;j<y+3;j++)
                     {
                         for(int k=x;k<x+3;k++)
                         {
                             a = a + image_array[j][k] * hpf[i];
                             i++;
                         }
                     }
                     if(a < 0)
                     {
                         a = 0;
                     }
```

```
                    if(a > 255)
                    {
                        a = 255;
                    }

PaintBox1->Canvas->Pixels[x+1][y+1]=RGB(a,a,a);
                    a = 0;
                    i = 0;
                }
            }
            fclose(file_open);
        }
}
//---------------------------------------------------------------------
```