EE5470 Computer Vision Lab 2
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Binary Image Processing

Lab 2 Questions

1. Description of my program for image bounding (Section 4).

When iterate through all image pixels from ylo to yhi and xlo to xhi, I classify each pixel into 3 kinds of pixels: 1, pixel has graylevel greater than 0; 2, pixel has graylevel equals 0 but its 4 neighbors contain graylevel greater than 0; 3, pixel has graylevel equals and all of its 4 neighbors' graylevels equal to 0. As we defined above, the first type of pixels, I need to mark its graylevel to 128 as they are interior pixels; the second type of pixels, I classify them as the boarder pixel and mark its graylevel to 255 since they are adjacent to interior pixels; for the third type of pixels, I classify them as the general background therefore leave its graylevel to 0.

2. Code for image bounding.

```
/*******************************************************************/
/* vtemp      Compute local max operation on a single byte image   */
/*******************************************************************/

#include "VisXV4.h"           /* VisionX structure include file    */
#include "Vutil.h"            /* VisionX utility header files      */

VXparam_t par[] =             /* command line structure            */
{ /* prefix, value,   description                         */
{    "if=",    0,   " input file  vtemp: local max filter "},
{    "of=",    0,   " output file "},
{     0,       0,   0}  /* list termination */
};
#define  IVAL   par[0].val
#define  OVAL   par[1].val

main(argc, argv)
int argc;
char *argv[];
{
Vfstruct (im);                      /* i/o image structure          */
Vfstruct (tm);                      /* temp image structure         */
int        y,x;                    /* index counters               */
```

```
  VXparse(&argc, &argv, par);       /* parse the command line       */

  Vfread(&im, IVAL);                /* read image file              */
  Vfembed(&tm, &im, 1,1,1,1);       /* image structure with border  */
  if ( im.type != VX_PBYTE ) {      /* check image format           */
     fprintf(stderr, "vtemp: no byte image data in input file\n");
     exit(-1);
  }
  for (y = im.ylo ; y <= im.yhi ; y++) {  /* compute the function */
     for (x = im.xlo; x <= im.xhi; x++)  {     /************************/
          if (im.u[y][x] > 0){
             im.u[y][x] = 128;
          }else if(im.u[y][x] == 0 && (tm.u[y - 1][x] > 0 || tm.u[y][x - 1] > 0 || tm.u[y][x + 1] > 0 || tm.u[y
+ 1][x] > 0)){
             im.u[y][x] = 255;
          }
          else{
             im.u[y][x] = 0;
          }
     }
   }

   Vfwrite(&im, OVAL);              /* write image file              */
   exit(0);
}
```

3. Typescript copy for small image bounding.

Input small Image:

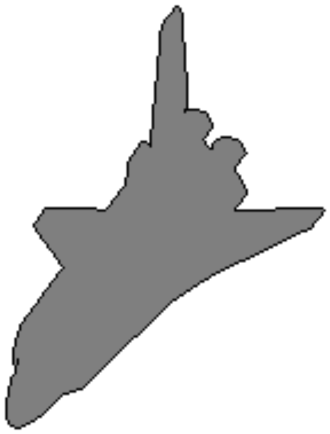
```
    0  1  2  3  4  5  6
 5  0  0  0  0  0  0  0
 4  0  1  1  0  0  0  0
 3  0  0  1  0  0  0  0
 2  0  0  0  0  3  3  0
 1  0  0  0  3  3  3  0
 0  0  0  0  0  0  0  8
```

Output small Image

```
    0     1    2    3     4    5     6
 5   0   255 255   0     0    0     0
 4 255 128 128 255   0    0     0
 3   0   255 128 255 255 255   0
 2   0     0   255 255 128 128 255
 1   0     0    255 128 128 128 255
 0   0     0      0   255 255 255 128
```

4. Full size image bounding

input image shuttle.vx



bound processed image shuttle.vx

5. Description of image labeling (Section 5)

For this part, I used DFS (Depth First Search) procedure. When iterate through all pixels in a given image. Once we encounter a non-background pixel (with graylevel above 0), I will call a separate function to change its value to a label value starts from 1. Then I will use the copy of the original image as a reference to mark its value to 0. And call label function to its 4 neighbors and so on, until the recursive call encounters a background value. Then return to iteration once again and increase the label value until we iterate through all given image pixels.

6. Code for image labeling

```
/*********************************************************************/
/* vtemp      Compute local max operation on a single byte image   */
/*********************************************************************/

#include "VisXV4.h"          /* VisionX structure include file    */
```

```
#include "Vutil.h"           /* VisionX utility header files      */

VXparam_t par[] =            /* command line structure            */
{ /* prefix, value,   description                        */
{    "if=",    0,   " input file  vtemp: local max filter "},
{    "of=",    0,   " output file "},
{     0,       0,   0}  /* list termination */
};
#define  IVAL   par[0].val
#define  OVAL   par[1].val
void mark_region(int, int, int);
Vfstruct (im);                   /* i/o image structure         */
Vfstruct (tm);                   /* temp image structure        */

main(argc, argv)
int argc;
char *argv[];
{
int       y,x;                   /* index counters              */
  VXparse(&argc, &argv, par);      /* parse the command line       */

  Vfread(&im, IVAL);              /* read image file             */
  Vfembed(&tm, &im, 1,1,1,1);      /* image structure with border  */
  int i = 1;                      /* region sequence             */
  if ( im.type != VX_PBYTE ) {      /* check image format          */
    fprintf(stderr, "vtemp: no byte image data in input file\n");
    exit(-1);
  }
  for (y = im.ylo ; y <= im.yhi ; y++) {
    for (x = im.xlo; x <= im.xhi; x++)  {
        if(tm.u[y][x] == 0) {continue; }
        mark_region(x, y, i);
        i++;
    }
   }

   Vfwrite(&im, OVAL);           /* write image file             */
   exit(0);
}

/* function to mark the region */
void mark_region(int x, int y, int cnt)
```

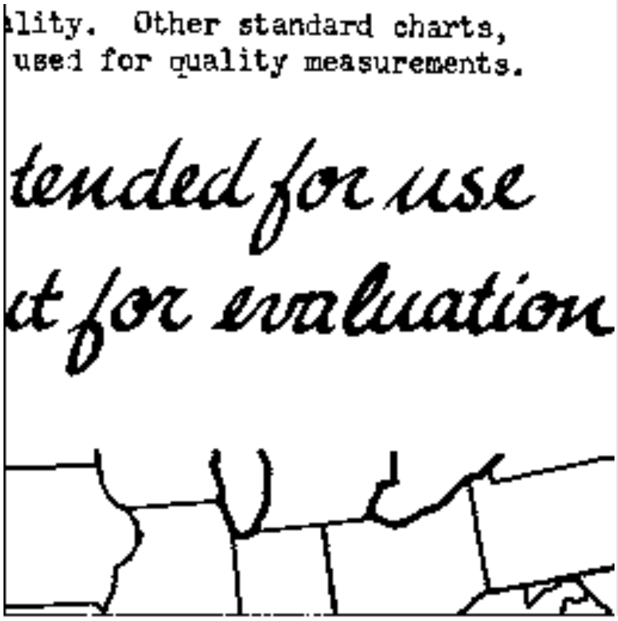
```
{
  if (tm.u[y][x] == 0) {return; }
  im.u[y][x] = cnt;
  tm.u[y][x] = 0;              /* tag the visited pixel         */
  mark_region(x + 1, y, cnt);
  mark_region(x - 1, y, cnt);
  mark_region(x, y + 1, cnt);
  mark_region(x, y - 1, cnt);
}
```

7. Typescript copy for small image labeling

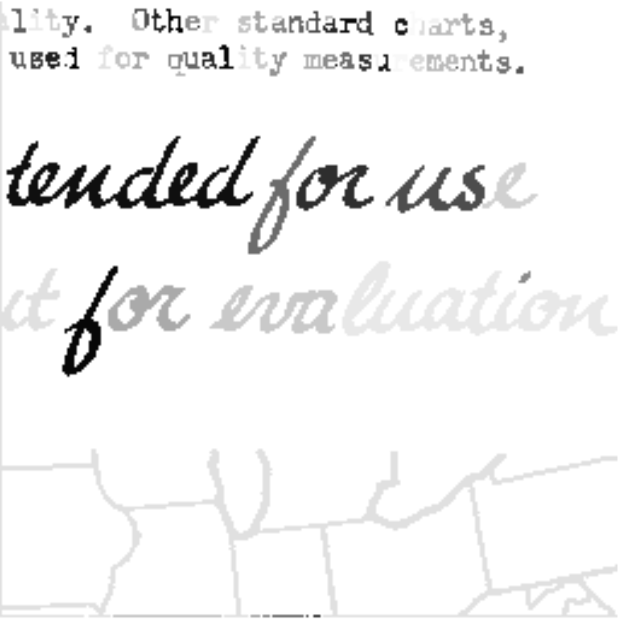
```
Input image
     0    1    2    3    4    5    6    7    8    9
 9   0    0    0    0    0    0    0    0    0    0
 8   0  255  255  255  255    0    0    0    0    0
 7   0    0    0    0  255    0    0    0    0    0
 6   0  255  255    0  255  255    0    0  255    0
 5   0  255  255    0  255  255    0    0  255    0
 4   0  255  255    0    0    0    0    0  255    0
 3   0  255  255    0    0  255  255  255  255    0
 2   0    0    0    0  255  255    0    0    0    0
 1   0    0    0  255    0    0  255  255  255    0
 0   0    0    0    0    0    0  255  255  255    0
Output image
     0  1  2  3  4  5  6  7  8  9
 9   0  0  0  0  0  0  0  0  0  0
 8   0  5  5  5  5  0  0  0  0  0
 7   0  0  0  0  5  0  0  0  0  0
 6   0  4  4  0  5  5  0  0  3  0
 5   0  4  4  0  5  5  0  0  3  0
 4   0  4  4  0  0  0  0  0  3  0
 3   0  4  4  0  0  3  3  3  3  0
 2   0  0  0  0  3  3  0  0  0  0
 1   0  0  0  2  0  0  1  1  1  0
 0   0  0  0  0  0  0  1  1  1  0
```

8. Full size image labeling

For output image, I used vx tf=31 operation to multiply each pixel value by 31 times to make it more easy to spot different regions (Since the original difference is 1 in my program, it is hard to spot difference between adjacent regions). Then I used vx bf=30 operation to offset the background to white since the previous multiply operation will change the background to grey.ß



input image im3.vx



label processed image im3.vx