الوسائط المتعددة و برمجتها

السنة الثالثة

قسم تقنيات الحاسوب

المحاضرة الثالثة

إعداد

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Chapter 2

Digital Image Fundamentals

Digital Image Fundamentals

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2.5 Some basic Relations Between Pixels:

- An image will be denoted by f(x,y).when referring to a particular pixel, we lowercase letters, such as p and q. A subset of pixels of f(x,y) will be denoted be S.

Neighbors of a pixel :

- a pixel p at coordinates (x, y) has the following neighbors:

(x-1,y-1), (x,y-1), (x+1,y-1), (x-1,y) (x+1,y),
(x-1,y+1), (x,y+1), and (x+1,y+1)

x (column)

y (row)

(x-1, y-1)	(x, **y-1**)	(x+1, y-1)
(x-1, y)	(x, y)	(x+1, y)
(x-1, y+1)	(x, y+1)	(x+1, y+1)

4-neighbors

- 4-neighbors of p $N_4(p)$ is the set of pixels, in horizontal and vertical neighbor have the coordinates:

  (x,y-1), (x-1,y) (x+1,y), and (x,y+1).

- It is noted that each of these pixels is a unit distance from (x, y) and also some of the neighbors of p will be outside the digital image if (x, y) is on the border of the image.

D-neighbors

- D-neighbors of p $D_4(p)$ is the set The four diagonal neighbors of p have coordinates:

  (x-1,y-1), (x-1,y +1), (x+1,y+1), (x+1,y-1)

- It is noted that each of these pixels is a unit distance from (x, y) and also some of the neighbors of p will be outside the digital image if (x,y) is on the border of the image.
- and will be denoted by ND(p). these points, together with the 4-neighbors are called the 8-neighbors of p, denoted by N8(p).

8-neighbors

- **8-neighbors of p $D_8(p)$ is the set The eight neighbors of p that is:**
- **$N_8(p)=N_D(p) + N_4(p)$.**

- **It is noted that each of these pixels is a unit distance from (x, y) and also some of the neighbors of p will be outside the digital image if (x,y) is on the border of the image.**

Adjacency, Connectivity, Regions, and Boundaries:

- The adjacent pixels are the two pixels which are neighbor.
- Connectivity between pixels is an important concept used in establishing boundaries of objects and components of regions in an image.
- To establish whether two pixels are connected :
- we must determine if they are adjacent (if they are neighbors) and if their gray levels satisfy a specific criterion of similarity (if they are equal).
- Example, in binary image with values 0 and 1, two pixels may be 4-neighbors, but they are not said to be connected unless they have the same value.

Connectivity type

Let V be the set of gray – level values to define connectivity, for example if only connectivity if pixels with intensities of 59, 60, and 61 is important, then V={59, 60, 61}.

We consider three types of connectivity:

4-connectivity. Two pixels p and q with values from V are 4-connected if q is in the set N4(p).

8-connectivity. Two pixels p and q with values from V are 8-connected if q is in the set N8(p).

m-connectivity. Two pixels p and q with values from V are m- connected if :

i- q is in the set N4(p), or

ii- q is in ND(p) and the set N4(p)∩N4(q) is empty. (this is the set of pixels that are 4-neighbors of both p and q and whose values are from V).

Problem 2.11

Consider the two image subsets, *S*1 and *S*2, shown in the following figure. For V={1}, determine whether these two subsets are :

(a) 4-adjacent, (b) 8-adjacent, or (c) m-adjacent.

		S_1				S_2			
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1	1	0	0	0
0	0	1	1	1	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

- **NOTE**

Two images S1 and S2 are adjacent if some pixel in S1 is adjacent to some pixel in S2.

Solution

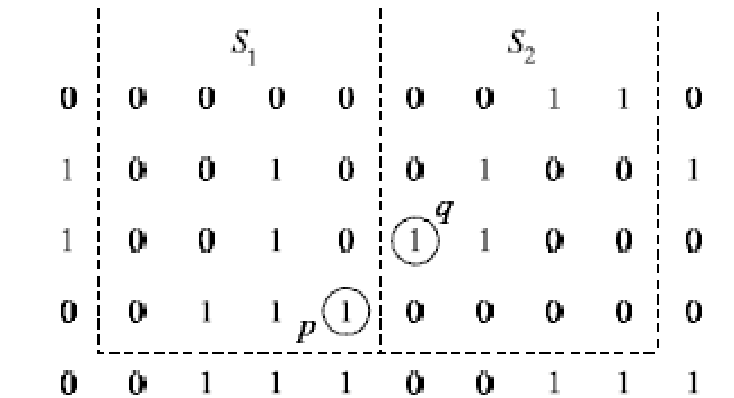

Figure P2.11

Let p and q be as shown in Fig. P2.11. Then,

(a) S1 and S2 are not 4 connected because q is not in the set $N_4(p)$;

(b) S1 and S2 are 8 connected because q is in the set $N_8(p)$;

(c) S1 and S2 are *m* connected because (i) q is in $N_D(p)$, and (ii) the set $N_4(p) \cap N_4(q)$ is empty.

Problem 2.15

2.15 Consider the image segment shown.

(a) Let $V = \{0, 1\}$ and compute the lengths of the shortest 4-, 8-, and m-path between p and q. If a particular path does not exist between these two points, explain why.

(b) Repeat for $V = \{1, 2\}$.

$$\begin{array}{ccccc} & 3 & 1 & 2 & 1\,(q) \\ & 2 & 2 & 0 & 2 \\ & 1 & 2 & 1 & 1 \\ (p) & 1 & 0 & 1 & 2 \end{array}$$

(a) When V = {0, 1}, 4-path does not exist between p and q because it is impossible to get from p to q by traveling along points that are both 4-adjacent and also have values from V .

Figure P2.15(a)

shows this condition it is not possible to get to q.

The shortest 8-path is shown in Fig. P2.15(b); its length is 4.

The length of shortest m-path (shown dashed) is 5. Both of these shortest paths are unique in this case.

(b) One possibility for the shortest 4-path when V = {1; 2} is shown in Fig. P2.15(c); its length is 6.

It is easily verified that another 4-path of the same length exists between p and q.

One possibility for the shortest 8path (it is not unique) is shown in Fig. P2.15(d)u its length is 4. The length of a shortest *m*-path (shown dashed) is 6. This path is not unique.

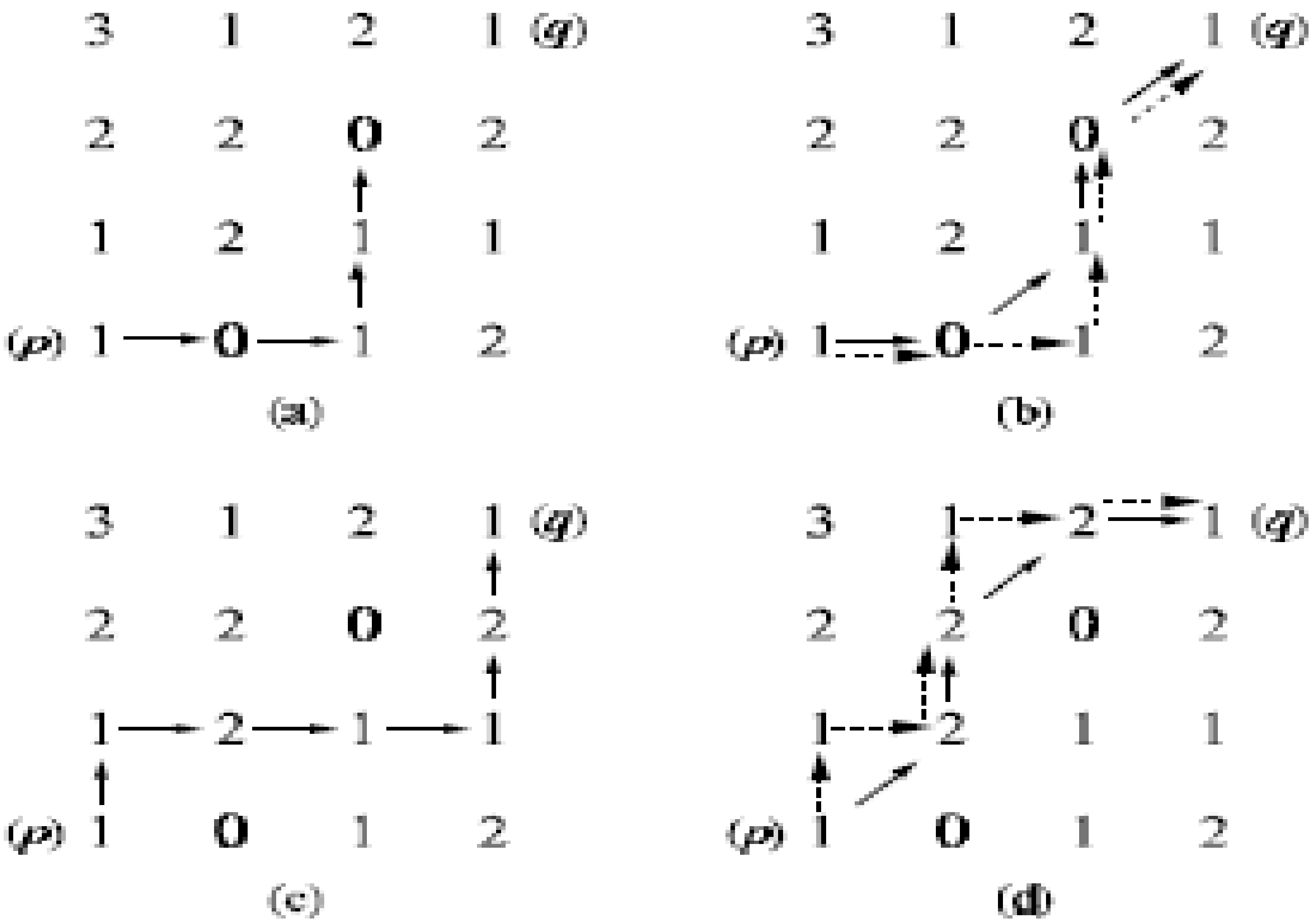
3 1 2 1 (q)
2 2 0 2
1 2 1 1
(p) 1 0 1 2
(a)
3 1 2 1 (q)
2 2 0 2
1 2 1 1
(p) 1 0 1 2
(b)
3 1 2 1 (q)
2 2 0 2
1 2 1 1
(p) 1 0 1 2
(c)
3 1 2 1 (q)
2 2 0 2
1 2 1 1
(p) 1 0 1 2
(d)

Figure P2.15