Simple Spatial Analysis Based on Raster Data Structure

Geography 359 - Introduction to GIS

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The purposes of this exercise are:

(1) To understand the limitations of a raster data structure
(2) To be familiar with the basic operations of spatial analysis: buffer and overlay.

We will determine the population at risk in an area if the gas pipe lines should rupture in an earthquake. As a simplification, the following criteria are used to determine the risk:

(A) any pipe line within 500 meters of a fault is at risk of rupture
(B) people within 500 meters of rupturing pipe line are at risk of injury.

(1) The data layers needed for this analysis are attached. Assume that the shape of the cell is square and each side is 500 m. To make it simpler, let's also assume that the space is 4-connected (i.e., we will ignore the diagonal directions). Please recode (color code is OK), spread (buffer), overlay operations to manually produce a raster map showing areas that are at risk and calculate the population that are at risk. Show your work. (Some blank work sheets are provided. Light table may be helpful for overlay.)
(2) Discuss the advantages and limitations of raster structure that you find during this exercise.

LAYER 1: FAULT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1						1												
2							1											
3							1							1				
4							1						1					
5								1				1						
6									1		1							
7									1	1								
8								1		1								
9							1			1								
10						1					1							
11												1						
12												1						
13												1						
14																		

1 = FAULT = OTHER

LAYER 2: GAS PIPE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					1				1				1					
2					1				1				1					
3	1	1	1	1	1	1	1	1	1	1	1	1	1					
4					1				1				1					
5					1				1				1	1	1	1	1	1
6					1				1				1					
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8					1				1				1					
9					1				1				1					
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11					1				1				1					
12					1				1				1					
13					1				1				1					
14					1				1				1					

1 = GAS PIPE = OTHER

LAYER 3: POPULATION

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1	3	2	1	1	1	3	2	1	2	3	2	1	2	3	2	1	2
2	1	3	2	2	1	2	3	3	2	2	1	1	1	2	3	2	1	1
3	1	2	2	3	1	1	1	1	1	1	1	1	3	1	1	1	2	1
4	2	2	1	1	2	2	1	1	1	2	3	2	2	1	1	1	1	1
5	1	2	1	1	1	1	1	1	2	2	2	2	1	2	3	2	1	1
6	1	2	2	2	2	2	3	3	1	1	1	1	1	2	2	2	2	2
7	1	2	1	1	1	1	1	2	1	2	3	3	3	3	1	2	2	3
8	1	2	2	3	1	1	1	2	1	2	2	2	2	3	3	3	3	1
9	1	1	1	1	2	2	2	1	1	1	1	1	2	2	2	2	1	1
10	3	2	1	1	1	1	2	2	2	2	2	1	1	2	2	2	3	3
11	2	2	1	1	1	1	2	2	2	3	2	1	2	2	2	2	2	1
12	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
13	3	2	2	2	1	1	1	1	2	2	3	3	3	3	2	1	1	1
14	1	2	2	2	3	3	3	1	2	2	1	3	2	1	2	3	2	1

1 = 10 people 2 = 20 people 3 = 30 people

Buffer Around FAULT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1						1												
2							1											
3							1							1				
4							1						1					
5								1				1						
6									1		1							
7									1	1								
8								1		1								
9							1			1								
10						1					1							
11												1						
12												1						
13												1						
14																		

1 = FAULT = OTHER

Overlay of Fault Buffer and GAS PIPE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					1				1				1					
2					1				1				1					
3	1	1	1	1	1	1	1	1	1	1	1	1	1					
4					1				1				1					
5					1				1				1	1	1	1	1	1
6					1				1				1					
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8					1				1				1					
9					1				1				1					
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11					1				1				1					
12					1				1				1					
13					1				1				1					
14					1				1				1					

1 = GAS PIPE = OTHER

Gas Pipe Segment at Risk of Rupture

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					1													
2																		
3						1	1	1						1				
4														1				
5									1									
6									1									
7								1	1	1	1							
8									1									
9									1									
10						1	1	1			1	1	1					
11														1				
12														1				
13														1				
14																		

Buffer Around Gas Segment at Risk of Rupture

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					1													
2					1	1	1											
3					1	1	1	1					1	1				
4					1	1	1	1					1	1				
5						1	1	1										
6						1	1	1										
7							1	1	1	1								
8							1	1	1	1								
9						1	1	1	1	1								
10				1	1	1		1	1	1			1					
11					1	1	1						1	1				
12													1	1				
13													1					
14																		

1 = GAS PIPE = OTHER

Over Lay of Gas Pipe Segment at Risk of Rupture with Population

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	1	3	2	1	1	1	3	2	1	2	3	2	1	2	3	2	1	2	3
2	1	3	2	2	1	2	3	3	2	2	1	1	1	2	3	2	1	1	10
3	1	2	2	3	1	1	1	1	1	1	1	1	3	1	1	1	2	1	10
4	2	2	1	1	2	2	1	1	1	2	3	2	2	1	1	1	1	1	7
5	1	2	1	1	1	1	1	1	2	2	2	2	1	2	3	2	1	1	5
6	1	2	2	2	2	2	3	3	1	1	1	1	1	2	2	2	2	2	6
7	1	2	1	1	1	1	1	2	1	2	3	3	3	3	1	2	2	3	12
8	1	2	2	3	1	1	1	2	1	2	2	2	2	3	3	3	3	1	7
9	1	1	1	1	2	2	2	1	1	1	1	1	2	2	2	2	1	1	11
10	3	2	1	1	1	1	2	2	2	2	2	1	1	2	2	2	3	3	14
11	2	2	1	1	1	1	2	2	2	3	2	1	2	2	2	2	2	1	14
12	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	6
13	3	2	2	2	1	1	1	1	2	2	3	3	3	3	2	1	1	1	9
14	1	2	2	2	3	3	3	1	2	2	1	3	2	1	2	3	2	1	2

1 = 10 people 2 = 20 people 3 = 30 people

total: 116*10 = 1160