


**Flow Direction and Flow Accumulation**

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**+ Flow Direction**

- Water flows downhill
- Direction of flow can be determined using a DTM
- Use the z-value of each raster to determine its value

78	72	69	71	58	49
74	67	56	49	46	50
69	53	44	37	38	48
64	58	55	22	31	24
68	61	47	21	16	19
74	53	34	12	11	12



## + Two approaches:

- Single-Flow Direction: all flow from a cell goes in one direction to a single adjacent cell
- Multiple-Flow Direction: flow from a single cell is distributed to all neighboring cells with lower values

SFD: D4

78	72	69
74	67	56
69	53	44

↓

SFD: D8

78	72	69
74	67	56
69	53	44

↘

MFD

78	72	69
74	67	56
69	53	44

↓ ↘ ↙

## + Multi-Directional Flow

- Direction of flow is determined by slope and flow width
- The following equation is used to determine how much flow goes to each adjacent cell:

$$F_i = \frac{L_i \times \tan \alpha_i}{\sum_{i=1}^n L_i \times \tan \alpha_i}$$

- $F_i$  is the proportional flow to a neighboring cell
- $L_i$  is the flow width and
- $\alpha_i$  is the slope angle of the cell

## + D8-Method

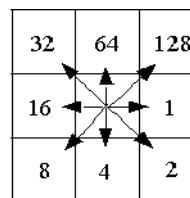
### Deterministic eight-node

- Simple and widely used method for determining flow direction.
- However, may produce “unacceptable errors”, so care should be taken when using this method.
  - Flow can only occur in 1 of 8 directions
  - Flow must follow the largest down slope
- Slope is measured as the distance-weighted drop
  - The height difference between two locations divided by the horizontal distance
    - Two adjacent cells have a horizontal distance of 1, two diagonal cells have a horizontal distance of  $\sqrt{2}$

## + Coding Flow Direction

- ESRI software uses a code to specify which direction water will flow from a cell.
- These numbers aren't elevations, but they represent a direction of flow and can be used to create a flow direction grid.

2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16



## + Flow Accumulation



- A flow accumulation grid displays how many cells contents flow through each cell.
- A value of 0 means no water flowed through that cell.
- The higher the value in the cell the lower the elevation.

0	0	0	0	1	0
0	1	1	2	2	0
0	3	7	5	4	1
0	0	0	50	0	1
0	0	0	1	24	1
0	2	4	7	35	1