NTNU – Trondheim
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Department of Geography

Examination paper for GEOG3524 - Raster Based GIS

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Informasjon om trykking av eksamensoppgave
Originalen er:

1-sidig ☐ **2-sidig** ☐

sort/hvit ☐ **farger** ☐

skal ha flervalgskjema ☐

Checked by:

Date Signature

GEOG3524 Raster Based GIS – exam autumn 2016

There are **four tasks** for this exam. It is expected that you do all. The four tasks are weighted as indicated in brackets.

Task 1: Explain short but concise the following concepts (15%)

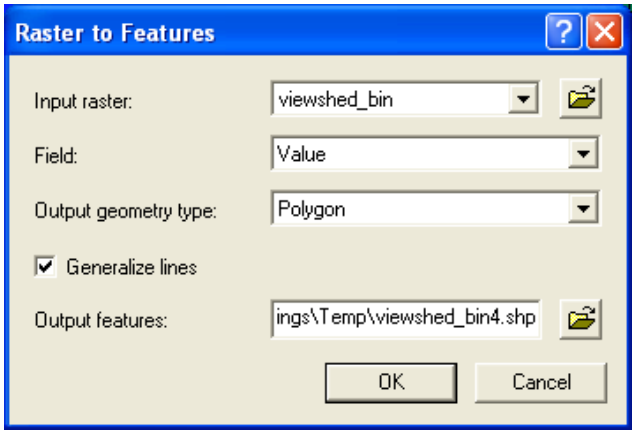
a. Hillshade
b. Sink
c. Discrete thematic raster versus continuous thematic raster

Task 2: Representation (35%)

A four column data table with 16 rows is to be imported into a GIS. Units are in meter.

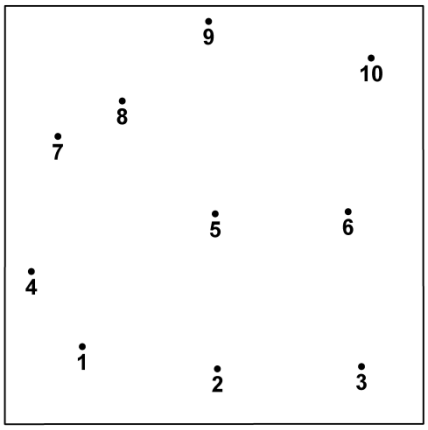
ID	x	y	z
1	5	5	2
2	5	10	3
3	5	15	5
4	5	20	6
5	10	5	3
6	10	10	4
7	10	15	5
8	10	20	7
9	15	5	5
10	15	10	5
11	15	15	6
12	15	20	7
13	20	5	6
14	20	10	7
15	20	15	7
16	20	20	8

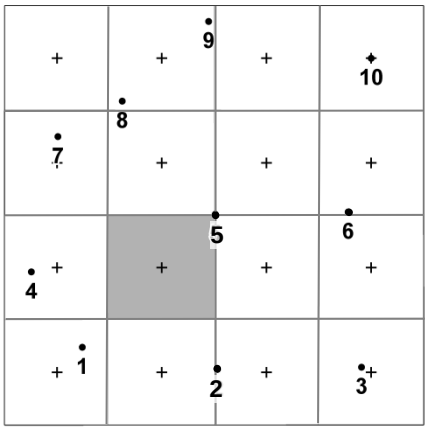
a. Demonstrate how this table could look like when stored as a point feature layer. Draw a map and its attribute table. Use the ID numbers as labels in the map.
b. Make a contour map with a 4 meter and a 6 meter contour.
c. Demonstrate how this table could look like when stored as a raster DEM.
d. For the raster DEM (question 2c) what is its spatial resolution?
e. Based on the raster DEM created (question 2c) one could generate an aspect layer. Given that the x-coordinates give position along an east-west axis and the y-coordinates give position along a north-south axis, what would the dominant compass direction of the aspect layer be?
f. Sometimes you may need to convert from raster to vector. In a raster to vector conversion using ArcGIS you may be prompted the dialog shown below. Notice that you have the option on whether or not you want to generalize lines. What would the difference mean?



Task 3: Spatial Interpolation (30%)

Shown right is a framed area measuring 80 by 80 meters. The numbers represent the number of frogs (*Rana temporaria*) counted at each sample point location. You are asked to help a biologist to make a frog density population map using spatial interpolation.





a. Most of the spatial interpolation methods take benefit of spatial autocorrelation when generating statistical surfaces. What is spatial autocorrelation?
b. The study area is divided into 4 x 4 grids. What is the spatial resolution of the individual grid cells?
c. The grid lattice and their center points are shown in the lower illustration. What is the col and row reference to the raster cell highlighted?
d. For the highlighted raster cell, demonstrate how the z-value for this location is calculated using Inverse Distance Weighting (IDW). As inclusion criteria for sample points, use a fixed search radius. The search radius should be twice the pixel resolution. For the demonstration, include an illustration and a formula populated with numbers.

The formula for the IDW is:

$$z(x) = \frac{\sum w_i z_i}{\sum w_i}$$

$$w_i = \frac{1}{d_i^2}$$

where $z(x)$ is the z-value for position x, z_i is a known z value at location x_i with weight w_i, d is the distance between the known point x_i to the unknown point x.

Task 4: Raster aggregation (20%)

Aggregate is a generalization function used for raster data.

InputGrid

1	1	1	1	1	2	4	6	7
1	3	3	2	5	6	6	7	8
1	1	3	2	2	2	4	5	6
1	2	2	2	2	4	4	5	6
1		1	2	2	2	4	5	6
1		1	2	2	3	4	5	6
1	1	1	1	1	2	3	4	5
0	0	1	1	1	2	4	4	5
0	1	1	1	1	2	3	4	4

In the left figure the raster dataset called InputGrid is shown. InputGrid has nine rows and nine columns. Each raster cell covers an area on 10 x 10 meters. InputGrid need to be generalized so that each raster cell covers an area of 30 x 30 meters. For this purpose, an aggregate function will be used. The result of this operation will be a new raster layer called OutputGrid.

Missing value

The aggregate function uses map algebra according to the formula:

OutputGrid = Aggregate (*Input*, *cell_factor*, *function*)

Where:
- *Input* is the name for the raster data set that will be generalized (i.e. “InputGrid”)
- *cell_factor* is an integer value for the number of raster cells in horizontal and vertical direction that will be consolidated (merged) into one single raster cell in order to obtain the desired resolution (i.e. 30 x 30 meters)
- *function* is the applied aggregation function.

Write the map algebra formula expression that will aggregate InputGrid into a 30 x 30 meters resolution

a. using the aggregation function *maximum*. Draw the result.
b. using the aggregation function *mean*. Draw the result.

Dana Tomlin has classified map algebraic functions as four types: local functions, focal functions, zonal functions, and global functions.

c. To which of these four map algebraic function would you say aggregation belong? Underlie your answer.