GEOM1033 SIS Fundamentals
GEOM1159 GIS Fundamentals

Practical Exercise 2 – (6%)
Introduction to Geodatabases and Raster Geographic Data & Analysis

Aim

The aim of this exercise is to expand the concepts introduced in the last practical exercise, specifically in the areas of raster (grid cell) geographic data and analysis. You will be introduced to the concept of raster data in addition to common raster analysis functions. Youi will also be introduced to creating a geodatabase. At the completion of this exercise, you should have an appreciation for the way in which raster data is stored and analysed within a GIS.

Data

The dataset you will be using for this practical exercise is available from Canvas (Assigments > Prac 2). Extract all files from the .zip file and save everything in a folder called 'Prac2' to your "H" drive. **Use "7-Zip" ** and "extract here" to unzip the file.

What to submit

The submission for this practical exercise consists of written answers to **Questions 1** to **6**. Each answer is worth **1 point** (total of **6 points**). Download the word file labelled 'Practical 2 – Submission document' and type in your answers to the space provided. Fill in your information (student number, name, and lab letter from the list below), convert it to PDF, and then **submit online** through the link on Canvas.

GEOM1033

- Fri 12:30 – **Lab C**

GEOM1159

- Wed 16:30 – **Lab A**
- Fri 11:30 – **Lab B**

When to submit

Please submit within **2 weeks** from the time you received the Practical. See below for the specific dates:

GEOM1033

- **Lab C** must submit by **Thursday, 16 April, 23:59** (due to Easter break).

GEOM1159

- **Lab A** must submit by **Tuesday, 31 March, 23:59.**
- **Lab B** must submit by **Thursday, 2 April, 23:59.**

A Simple Raster GIS Project and Geodatabase Creation

We will explore some of the fundamental operations of a raster GIS. Two of these fundamental operations are **(i) Map Algebra** and **(ii) Zone analysis**. We will also create a file **geodatabase**, which is a family of formats that allows for more flexibility with a variety of data types and for optimized performance.

1) If you have not done so already, copy the directory available from Canvas (Assigments > Prac 2) to your work area on your "H: drive".
   Remember to use 7-zip to extract the data

2) Open a new (blank) ArcMap™ document (File > New).

3) In ArcCatalog (within ArcMap) navigate to the directory where you copied the data for this project. Remember, you might need to use the "Connect to Folder" button.

4) Right mouse click and create a new geodatabase: New > File geodatabase at the folder level.

5) Rename your geodatabase to something more meaningful (eg. Sorghum_Geodatabase.gdb).

6) Now import the two grid files into your geodatabase. To do this, right mouse click over your geodatabase file in the ArcCatalog window and select "Import Raster datasets", and then select the two raster files. Leave "Configuration Keyword" blank. Click "OK".

7) You can now add your geodatabase to the ArcMap project and select the two raster files.

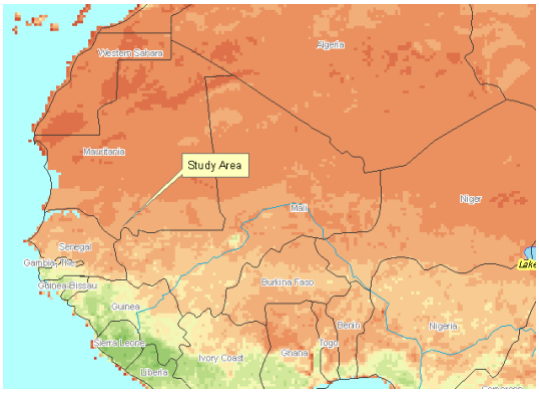
8) We will now set this new geodatabase to be the default geodatabase for this project, so that all outputs will be automatically directed into it. Right mouse click over your new geodatabase in ArcCatalog and select "Make Default Geodatabase".

9) Right mouse click over the SG_DEM raster layer and select Properties > Symbology and in the "Show" window select "Unique Values". Build the attribute table when prompted. Change the symbology to something appropriate for the display of elevation data (hint – select one of the colour schemes from the bottom of the colour schemes drop down list on the symbology tab of the layer properties dialog).

10) Use the Identify tool to query cell values at different locations.

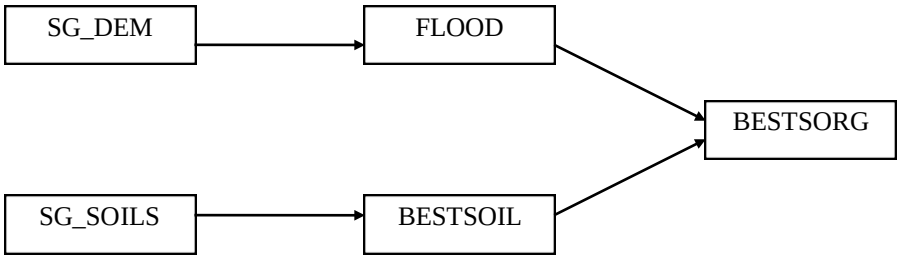
Question 1
What information do the "value" and "count" fields contain? What could we interpret about a raster layer if the all of the count values were equal to 1?

This grid (raster layer) is a digital elevation model (DEM) of an area along the Senegal River in Mauritania. The area to the south of the river is not included in the analysis as it is in Senegal. This area is subject to flooding each year during the rainy season. Since the area is normally very dry, local farmers practice what is known as "recessional agriculture" by planting in the flooded areas after the waters recede. The crop that is normally grown in this fashion is the cereal crop *sorghum*.



A project has been proposed to place a dam along the north bank at the northern most part of the bend in this river. The intention is to let the flood waters enter this area as usual, but then raise a dam to hold the waters in place for a longer period of time. This would allow more water to soak into the soil, increasing sorghum yields. The annual flood level is nine meters above normal river height.

In addition to water availability, soil type is an important consideration in sorghum agriculture because some soils retain moisture better than others. In this area, only clay soil is suitable for this kind of agriculture. The aim of the project is to determine how many hectares of land are suitable for sorghum agriculture. Below is a flow chart of the cartographic modelling (map algebra) process needed to complete the project.



11) Determine the maximum and minimum elevation values for the SG_DEM grid (hint – use the source tab from the layer properties dialog).

12) The first step in this project is to create a layer showing areas prone to flooding. Reclassify the SG_DEM layer and call the output raster FLOOD. To do this open the ArcToolbox > Spatial Analyst Tools > Reclass > Reclassify. Use the following data ranges for your reclassification. **Ensure that your file is correctly pathed to add the output to your geodatabase.**

Assign a new value of: 1
To values from: 0 to 9

Assign a new value of: 0
To values from: 10 or more

Question 2
What do the values of "1" in the FLOOD raster layer represent? What is the reason that we use zero for the rest of the original raster layer*?*

13) Use the information below to show the SG_SOILS raster layer to update the legend under "Label" in Layer Properties > Symbology. Make sure you also change the colours for each type of soil to something appropriate. You may need to select "unique" to show all individual values.

0	No Data
1	Heavy Clay
2	Clay
3	Sandy Clay
4	Levee Material
5	Stony Ground

14) We know that clay soil is the best for growing sorghum so we will now create a raster layer that identifies only areas of clay soil. Reclassify the SG_SOILS layer using the following values and call your output raster layer BestSoil:

Old Value	New Value
0	0
1	0
2	1
3	0
4	0
5	0

Question 3
What do the values in the BestSoil raster layer represent?

15) Our next task is to create a raster layer representing areas that are prone to flooding and have clay soil. We will use the "Math" functions under the "Spatial Analyst" Tools. Open the ArcToolBox and select the "Times" option (Spatial Analyst Tools > Math > Times) and use the two input layers (Flood and BestSoil). Call the output map BestSorg.

Question 4
Show using matrices (such as the matrix shown below) the process of a simple raster overlay using map algebra and explain why the use of "zero's" is important?

1	1	0	1
1	0	0	1
0	1	0	0
1	0	1	0

16) We now will calculate the total number of hectares for all regions that meet our criteria as well as the individual area of each "zone".

17) Use Region Group (Spatial Analyst Tools > Generalisation > Region Group) to uniquely identify the "zones" (contiguous cells that contain the same value). The input raster should be "Bestsorg". Accept the default values in the Region Group dialog. Output to a file called "sorg_regions".

Question 5
In the context of this project, what do each of the values contained in the raster layer called "sorg_regions" represent as a result of the region groups function? How many individual regions are there?

18) Now we will determine the area of each region in the sorg_regions layer. Select the Zonal Geometry tool (Spatial Analyst Tools > Zonal > Zonal Geometry) and use sorg_regions as the input raster and value as the zone field. Make sure that Area is the selected geometry type. The resultant grid which you should call "sorg_areas" represents area in square metres. (To find area in square meters go into Layer Properties > Symbology and select Unique Values first).

19) You now need to multiply sorg_areas by BestSorg to remove unwanted regions (that are not useful for Sorghum cultivation). Call the output "Best_sorg_areas".

20) Then use the Math "Divide" function to divide by 10000 to convert the area to hectares Call the output raster "Best_sorg_areas_ha".

21) We will now convert this raster layer to an integer grid – use the Math function "INT" to convert areas to integers. Call the output "FinalAreas".

Question 6
Only areas larger than 10 hectares are considered to be useful for sorghum cultivation. List the area values for all zones larger than 10 hectares.