
**Prelim Examination #1
(100 points)
16 October 2008**

- (1) Topology expresses the spatial relationships between features (points, lines, or polygons) on a map. List and briefly describe the three major spatial relationships expressed in polygon-arc and arc-node topologies. **(6 points)**
- (2) What are the distinguishing characteristics of a “large-scale” map and a “small-scale” map? **(6 points)**
- (3) Assuming the elevation in the Dryden topographic quadrangle map ranges from a minimum of 300 meters to a maximum 650 meters, what is the elevation range per class if you classified the elevation data into five equal-interval classes? **(3 points)**
- (4) List below the data table the field names that correspond to the type of measurement values (interval/ratio, ordinal, or nominal) tabulated. **(15 points)**

Trail Name	Features	Length_km	Difficulty	Elevation Gain, m
Interloken	Lake Vistas	10.5	Easy	75
Backbone	Old Growth	5.7	Moderate	200
Gorge	Riparian	2.5	Difficult	550
Lakeshore	Beach	12.0	Easy	0
Devonian Cliff	Fossils	0.5	Extreme	100

Interval/Ratio:

Ordinal:

Nominal:

(5) Briefly define the following terms. **(20 points)**

Digitizing:

Conformal Projection:

Euclidean Distance:

Entity:

Raster Data Model:

Attribute Table (Feature):

False Easting:

Edge-Matching:

Developable Surface:

Flattening Factor:

(6) Use the attached map of Bahir Dar, Ethiopia, to answer questions 6a-g. Assume that the map is 5 arc-minutes of latitude by 5 arc-minutes of longitude, the UTM grid can be superimposed on the graticule (i.e. there is no convergence of meridians), the ground surface dimensions of the map from west to east and north to south are 10,000 meters, respectively; and the map is drawn to scale. Ethiopia is north of the Equator and east of the Greenwich Meridian.

6a. Complete the list of geographic coordinates in degrees, minutes, seconds (DMS) and decimal degrees (DD) and UTM grid coordinates for Points A-D given the coordinate values for Point A and Point C, below (**12 points**).


Point	Graticule		UTM Grid	
	Latitude (N)	Longitude (E)	Easting (E)	Northing (N)
A	DMS: 12° 45' 00"	38° 30' 00"		
	DD:			
B	DMS:			
	DD:			
C	DMS:		430,000m E	1,570,000 m N
	DD:			
D	DMS:			
	DD:			

6b. What is the area of the map, expressed in square kilometers (km²) and hectares? (**4 points**)

6c. In what UTM zone is this map? (**8 points**)

6d. What are the forward **azimuth** (in arc-degrees), and **bearing** from Point C to Point E, assuming the Euclidean distances from C to C2 and C to C3 are equal? (**4 points**)

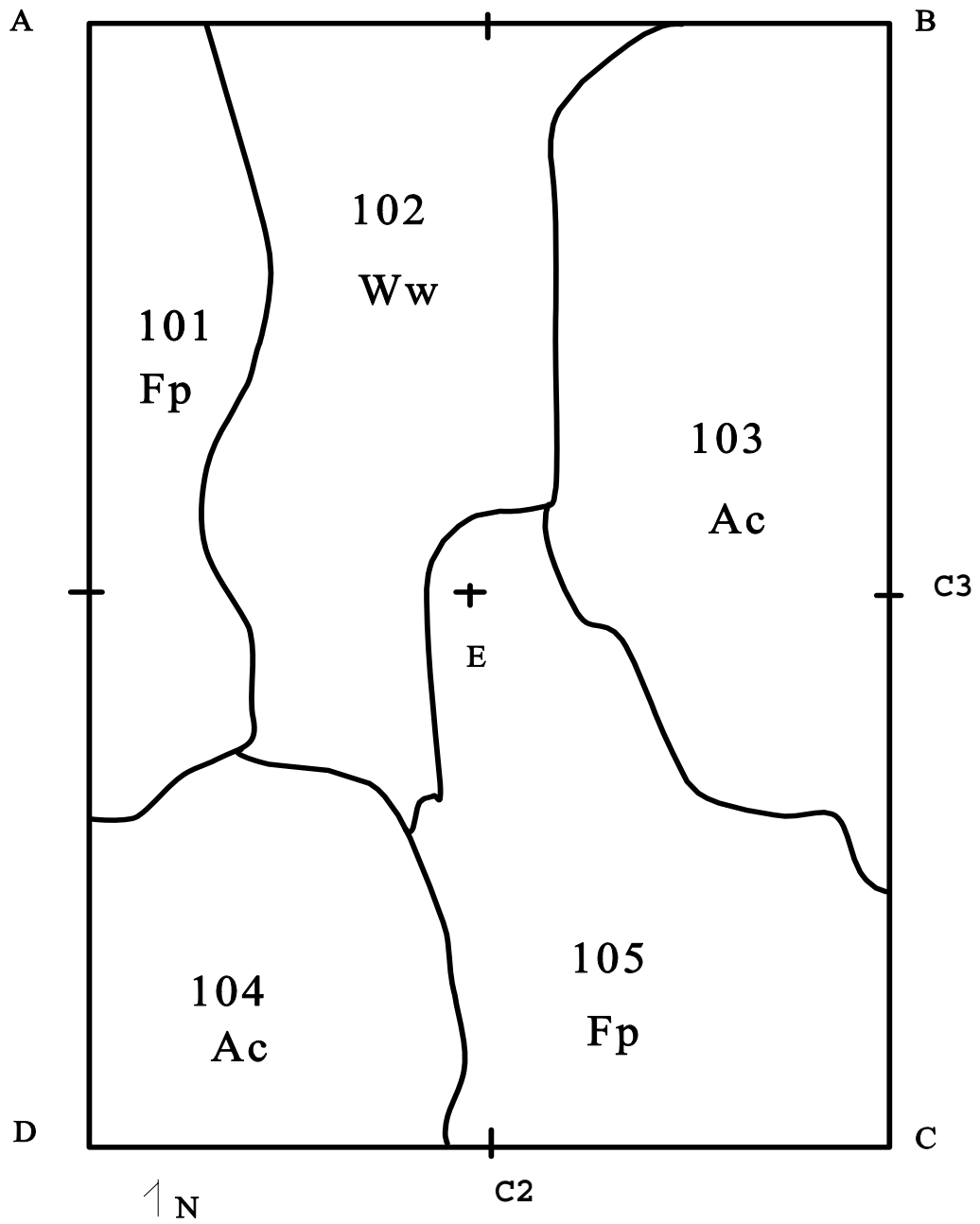
- 6e.** Construct a feature attribute table with five items (or fields): Polygon number, area (hectares), perimeter, land cover symbol, land cover type. Assume: a) a vector data coverage of the Bahir Dar map was built as polygons; b) each polygon is of equal area; c) the perimeter of each polygon equals 15,000 m; and d) the land cover symbol for each land cover type is Ac = Cropland, Fp=Forest, and Ww = Wetland. **(8 points)**



- 6f.** Construct a raster attribute table assuming you gridded the map using a 10-meter by 10-meter grid cell and using a many-to-one relationship on the land cover type field. Assume the resulting grid map has an equal number of cells per polygon. Add two fields to the attribute table to add area (ha.) and percent of each land cover type. **(8 points)**



- 6g.** What is the scale of the map, expressed as a representative fraction (or ratio), assuming the map distance from Point A to Point D is 20cm? **(6 points)**



Prelim Exam #1 Map*
(Bahir Dar, Ethiopia)

*You may detach map for each of use. Return the page with your exam.

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- (1) Topology expresses the spatial relationships between features (points, lines, or polygons) on a map. List and briefly describe the three major spatial relationships expressed in polygon-arc and arc-node topologies. (6 points)

*Connectivity: expressing the connection or flow of material within and between features.
Containment: defining area of polygonal features
Contiguity: expressing adjacency of features*

- (2) What are the distinguishing characteristics of a “large-scale” map and a “small-scale” map? (6 points)

*Large-scale maps represent small land areas but map entities and features are shown in more detail.
Small-scale maps represent large land areas but map entities and features are shown in less detail.*

- (3) Assuming the elevation in the Dryden topographic quadrangle map ranges from a minimum of 300 meters to a maximum 650 meters, what is the elevation range per class if you classified the elevation data into five equal-interval classes? (3 points)

$(650 - 300) / 5 \text{ intervals} = 350m / 5 \text{ intervals} = 70 \text{ m elevation range per interval}$

- (4) List below the data table the field names that correspond to the type of measurement values (interval/ratio, ordinal, or nominal) tabulated. (15 points)

Trail Name	Features	Length_km	Difficulty	Elevation Gain, m
Interloken	Lake Vistas	10.5	Easy	75
Backbone	Old Growth	5.7	Moderate	200
Gorge	Riparian	2.5	Difficult	550
Lakeshore	Beach	12.0	Easy	0
Devonian Cliff	Fossils	0.5	Extreme	100

Interval/Ratio: *Length_km, Elevation Gain, m*

Ordinal: *Difficulty*

Nominal: *Trail Name, Features*

(5) Briefly define the following terms. (20 points)

Digitizing:

the process of converting analog data to a digital, or computer-compatible, format for manipulation, storage, and management.

Conformal Projection:

a mathematical transformation of 3D space to 2D space that optimizes feature or entity shape while sacrificing accuracy of area, distance, and direction.

Euclidean Distance:

linear distance between two features as measured using a Cartesian, or planar, coordinate system.

Entity:

a real world object or phenomenon whose dimensions and description are encoded in a GIS using point, line, or polygon features, or rasters.

Raster Data Model:

a geographic spatial representation of entities as grid cells, or rasters, arranged in rows and columns rather than points, line, or polygons.

Attribute Table (Feature):

a data table comprised of records (rows) and fields (columns) containing non-spatial data that describe spatial features using nominal, ordinal, or interval/ratio measurement values.

False Easting:

an x-axis coordinate assigned to the origin of a planar coordinate system to ensure all values are positive along the x-axis.

Edge-Matching:

a process used to ensure that digital cartographic and taxonomic features and descriptions on individual maps or tiles will correspond when the individual maps or tiles are joined electronically.

Developable Surface:

a graphical or mathematical surface used to convert entities or objects represented in three dimensions to be represented in two dimensions.

Flattening Factor:

the ratio of the semi-minor (polar) axis and the semi-major (equatorial) axis of an ellipsoid.

(6) Use the attached map of Bahir Dar, Ethiopia, to answer questions 6a-g. Assume that the map is 5 arc-minutes of latitude by 5 arc-minutes of longitude, the UTM grid can be superimposed on the graticule (i.e. there is no convergence of meridians), the ground surface dimensions of the map from west to east and north to south are 10,000 meters, respectively; and the map is drawn to scale. Ethiopia is north of the Equator and east of the Greenwich Meridian.

6a. Complete the list of geographic coordinates in degrees, minutes, seconds (DMS) and decimal degrees (DD) and UTM grid coordinates for Points A-D given the coordinate values for Point A and Point C, below (12 points).

Point	Graticule		UTM Grid	
	Latitude (N)	Longitude (E)	Easting (E)	Northing (N)
A	DMS: 12° 45' 00" DD: 12.75°	38° 30' 00" 38.50°	420,000m E	1,580,000 m N
B	DMS: 12° 45' 00" DD: 12.75°	38° 35' 00" 38.58°	430,000m E	1,580,000 m N
C	DMS: 12° 40' 00" DD: 12.67°	38° 35' 00" 38.58°	430,000m E	1,570,000 m N
D	DMS: 12° 40' 00" DD: 12.67°	38° 30' 00" 38.50°	420,000m E	1,570,000 m N

6b. What is the area of the map, expressed in square kilometers (km²) and hectares? (4 points)

10 km x 10 km = 100 km² or 10,000 ha

6c. In what UTM zone is this map? (8 points)

From 180 to 174 degrees west longitude is Zone 1. From 180 to the Greenwich Meridian is 180 deg/6 deg zone⁻¹ = 30 zones. There are six zones from GM to 36 deg east longitude. The map is located at 38.5 east longitude. Therefore, the map is within UTM Zone 37 and is north of the equator. Therefore, the map is in UTM Zone 37N. Or, (180 + 38)/6 = 36.333, which is in Zone 37N

6d. What are the forward **azimuth** (in arc-degrees), and **bearing** from Point C to Point E, assuming the Euclidean distances from C to C2 and C to C3 are equal? (4 points)

Point E is at a 45 deg angle from Point C. Therefore, 270 deg + 45 deg = 315 deg azimuth, and bearing N45W.

- 6e. Construct a feature attribute table with five items (or fields): Polygon number, area (hectares), perimeter, land cover symbol, land cover type. Assume: a) a vector data coverage of the Bahir Dar map was built as polygons; b) each polygon is of equal area; c) the perimeter of each polygon equals 15,000 m; and d) the land cover symbol for each land cover type is Ac = Cropland, Fp=Forest, and Ww = Wetland. **(8 points)**

Poly #	Area_ha	Perimeter	LC_symbol	LC_type
101	2,000	15,000	Fp	Forest
102	2,000	15,000	Ww	Wetland
103	2,000	15,000	Ac	Cropland
104	2,000	15,000	Ac	Cropland
105	2,000	15,000	Fp	Forest

- 6f. Construct a raster attribute table assuming you gridded the map using a 10-meter by 10-meter grid cell and using a many-to-one relationship on the land cover type field. Assume the resulting grid map has an equal number of cells per polygon. Add two fields to the attribute table to add area (ha.) and percent of each land cover type. **(8 points)**

Object_ID	Count	LC_symbol	LC_type	Area_ha	Percent
1	400,000	Ac	Cropland	4,000	40
2	400,000	Fp	Forest	4,000	40
3	200,000	Ws	Wetland	2,000	20

- 6g. What is the scale of the map, expressed as a representative fraction (or ratio), assuming the map distance from Point A to Point D is 20cm? **(6 points)**

$$1 / x = 0.20m / 10,000m$$

$$0.20x = 10,000m$$

$$x = 10,000/0.20$$

$$x = 50,000$$

Therefore the map scale is 1/50,000, or 1:50,000