CONS 340 (final exam review)

vertical deflection = difference between geoid & ellipsoid approx.

geoidal undation = difference btwn geoidal & spheroid approx.

significance of Tropics of cancer & capricorn → areas where sun can be directly ahead

WORLD SCALE (small) 1: 40 M ⟷ SCALE (metropolitan) 1: 50,000

— file types —
1). shapefile (.shp + .shx) + .dbf (main + index) + table
2). coverage
3). topology
4). geodatabase (gdb)

field-based (RASTER)	(VECTOR) object-based
◦ implicit position	◦ point/line/polygon = familiar
◦ discrete, continuous data	◦ easy to retrieve objects → processing → easy to add attribute data
◦ compatible w/ remotely sensed data → easy analysis	◦ geographic coordinates
◦ large storage requirements → depends on data's given resolution	◦ less storage space (usually) b/c do not store surrounding cell data as well.
◦ rasterization (vector → raster)	◦ vectorization (raster → vector)

RASTER ANALYSIS (local/global/focal/zonal)

base → derived → classified → combined data

"Reclassify" into <7 classes for understanding

low vs. high pass filtering: low = passes over values of freq. which are lower than a sp. cutoff frequency → "mean filter"; high = passes over values higher than sp. cutoff frequency → "edge enhancement"

used to create TINs (enforced over triangulated mass pts + breaklines) → denser in areas w/ lots of height variability

Breakline enforcement → (HARD): rivers/roads; (SOFT): defining study area/ whistler bounds

(FAULT): 2 z-values for one (x,y); not recordable →

GPS 1978 = constellation of 21/24 us govt. satellites

- NAVSTAR sys. first launched in 1978 & was declassified in 1983
  Precise Positioning v. Standard (civ.) w/ selected Availability → disabled ◦May 2, 2000
- User + Control + Space Components

① Reciever detects 1-way signals from (at least 3) satellites
② time of arrival & transmission → compared
③ ΔT * speed of light = range
④ each range calculated
⑤ triangulation → intersection → position

** 4 satellites are necessary for travel time

Ephemeris v. Almanac data
Satellite Clocks: 2 Cesium + 2 Rubidium
Receiver Clocks: ∞ quartz watch

Pseudorandom #: sent to reciever → calc. distance from 2 satellites (difference)

Dilution of Precision (types) = Position, Vertical, Horizontal, Geometric, Time
* Consider Ionosphere-based error (b/c the atmosphere is a giant lens

Differential Correction: use base station w/ known location to correct for measurements from remote receivers, thus increasing accuracy.

Dual Frequency technology inc. submeter accuracy in CDGPS

Spatial Data Error

=RMSE

① Positional accuracy/precision ② Attribute accuracy/position ③ Logical Consistency = relationship fidelity + hierarchy

Positional Error:
U.S./Canada accuracy standards 1:1,200 (±1m) ↔ 1:100,000 (±50m
Accuracy = classification
+ Precision = delineation [where]

SOURCES OF DATA ERROR
① data fidelity ② natural var. ③ measurement (systematic) ④ processing

Obvious sources of error
> age > map scale
> aerial cover > format
> observation density > cover
> cost > accessibility

sharing data collected @ different scales → reformat to lowest common denom.
GPS = buildings (surface)
LiDar = forests

ERROR PROPAGATION + CASCADES:
1 error leads to another → accumulating errors
additive/multiplicative

1). Numerical error (e.g. integers have 0 decimal places; single precision = 8 dig.; 2x precision = 16 dig.)
2). Topographical analysis (slivers/pseudo nodes/overshoots)
3). Classification (→ possible generalization)
4). Digitization (human misstep) dangles/switchbacks/knots/loops

Always state uncertainty w/ map

Canadian history of Open-Source GIS

SAGA: System for Advanced Geoscientific Analysis
> vectors/rasters > spatial stats
> projections > mapping
> surfaces > digitizing + editing

GRASS

first computerized GIS → forestry (CGIS); 1st dig. maps → ag. potential; NEPA impact assessment; MOSS (U.S.D.I) vector + public; object AND field-based

1960s '65 '69 '70 '78 1934

TIN (Triangulated Irregular Networks)
- functional surfaces have continuous fields + attribute variance
- represent surface morphology w/ points + edges
- irregular nodes → higher variation → inc. resolution

Surface models:
1). TIN 2). Terrain dataset 3). LAS dataset

PROJECTION SHAPES & TYPES

(shapes) cylindrical, conic, planar → (types)

conformal (preserves angles)
equivalent (preserves area - land)
equidistant (eg. distance from origin)
compromise — aphylactic (Robinson: results in no metrics (ka no applicability)

problems w/ each projection type:

pole distortion
useful for sections of Earth
edge distortion

Integrating Data

* use horizontal/vertical integration to transform data *

HORIZONTAL:
> "merge" - adjacency + "dissolve" + "split" tools to correct distortion
> "affine" - polynomials → georegisten + drag fudge to apply
> "projective" - projection → "Project" tool
> "differential" - ctrl points → use displacement links to stretch (rubbersheet) map locations to fit ground ctrl data

VERTICAL: to layer common boundaried areas
> layer stacking
> raster & vector integration

Terrain Modeling

DEM (elevation)
DSM (surface) → Earth + objects
DTM → just Earth (terrain = ridges + breaklines)

"Flow Direction" → 8 neighbor aspects
"Flow Accumulation" → "# upstream pixels than flow to each pixel
"Flow Length" (dwn)
all of these help to delineate watershed

Sinks/Peaks/Saddles

Thermal Belt
inversion → fire danger (danger highest in midslope)

EFFECT OF TERRAIN → FIRES
high slope = high potential
aspect → drying rate → veg. Ψ
slope → runoff rate → resources pollution to marsh

digitization & topological error (human v. processing error) = slivers, pseudonodes, overshoots, switchbacks, knots, loops, dangles

"Eliminate" → adds sliver area to longer polygon

Remote Sensing

"Overwrite outputs" rewrites derived data layers to avoid data over accumulation

analog/digital frame camera = detectors v. silver halide
→ pushbroom/whiskbroom sensors
mx1 1x1xb

Spatial/Temporal/Radiometric/Spectral Resolution
(area) (time) (#greyvals) (wavelength intervals)

Active vs. Passive Remote Sensing?
Active sensing = emit pulse + collect data
Passive = absorbs reflections

LiDar (light)
RaDAR (radio waves)
SONAR (sound nav.)
Satellite orbit
near-polar: return to the same place in the same time
geostationary: stay in same place
lg temporal + sm. spatial scale
sm. temporal & lg. spatial scale

Why Active Sensing?

+	Δ
independent from: > weather > sunlight > cover	• no spectral signatures
→ WIDE APPLICATIONS	• costly + complex analysis
	• low-powered pulse → easily influenced by other radiation

Image Transformations v. classification
1). use a combo of bands to highlight features
2). categorize multispectral data into themes

Time-series analysis: images from several diff. times → Raster Analysis

NAVIGATION

- a rhumb line / constant azimuth / loxodrome spirals from (0,0) → pole
- great circles divide Earth into equal portions
- small circle " " " plane

DATABASE MANAGEMENT SYSTEMS

Entity-Relationship model: entity sets compose table

E-R model	RDBMS	MS access	object-based
Entity set	Relation	Table	Class
Instance	Tuple	Record	Object
Attribute	Attribute	Field	Property

RULES FOR MODELBUILDER

NAME: no spaces, elements file name (IS #123)
LABEL: appearance in Toolbox / "Nickname" spaces ✓
RELATIVE PATHS + DESCRIPTION: good for sharing data

"Overwrite outputs" rewrites derived data layers to avoid data over accumulation

CARTOGRAPHIC MODELLING

= when one models a spatial decision process w/ raw & derived data
+ decreases complexity + planning/organizing
+ documented steps

Georegistration
① derivative modelling (new data based on topology rules created by user) vs. ② process/systems modelling (add knowledge/processes to use GIS as a surrogate env.)

Capability vs. Suitability: ID possible support areas (OR) ordinal classification (1-100) of relative fulfillment

"union" & Weighted Overlay using cost surface (= variable x weight)

* Candidate/Primary/Foreign/Super-Keys

METADATA

- describes data quality, accuracy, and scale
- reuse + updates → ease of interpretation
- document sources + quality of sources

WHO? WHAT WHERE WHEN WHY

(1) PROTECT DATA INVESTMENT
(2) DATA DICTIONARY = terminology → INC. UNDERSTANDING
(3) ENABLE DISCOVERY → aggregate trends
(4) LIMIT COST/LIABILITY → make intended use clear

format = .html, .txt, .xml

[e.g: E.A.S.E] Essential Annotation Schema for Ecology framework vocab: time, space, sphere, biome, organism, process, method, chem

Fed. Geospatial Data Committee (Sections)
1). ID 2). quality
3). internal structure 4). spatial ref.
5). entity + attribute (data's meaning)
6). distribution (format/size/access)
7). Metadata reference

Dublin Core ≈ 15 elements
FGDC CSDGM ≈ 300 elements
NBII ≈ > 400 elements

Atmospheric Datasets:
> Satellite (NOAA)
> Historical
> Real-time

Post-Processed LANDSAT
1). Bulk Ordering (list of scenes → processing (ex. 1)) used for historical analysis
2). Bulk Ordering API (programming language)
3). Land Product Characterization (statistical comparison) disparate data:

LANDSAT = cover, floodmaps
MODIS = albedo + cover

linear referencing

- Route info = at least 2 attributes/section
Point-event tables: 2 req fields (ID + measure)
Line-event tables: 3 req. fields
dynamic segmentation allows u to assign many attribute sets to one routes)
Overlay: union of 2 event tables
→ line-line → point-line → point-point

NETWORK ANALYSIS

access ⇄ rarity → biodiversity

Graphs (points = (V, E)) = vertices + edges
+ weighted edges → directionality = cost raster
Island Biogeography = thresholds v. oceans (for large ranged animals) (dispersal) (inhabitable)
model connectivity w/ removal scenarios
Cost Raster based upon terrain, predation, shelter, food
→ horizontal/vertical directionality = #/div by 2
→ diagonal directionality = #/div by 2 * √2
(target cells = 'NoData'
Range of Patches — meaningful threshold, so route occurs where cumulative cost < threshold value

OpenTopography

high resolution data for easy access → scalable, extensible, innovative

A. LiDAR
B. Google Earth
C. Data Search

Map Symbology (types):

- Chloropleth
- Isoline
- Dot
- Cartogram
- Movement
- Proportional Symbols

+ essential symbology
> title
> legend
> uncertainty
> scale + arrow
> author
> data
> projection