2019

Unit 1

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Introduction to GIS (NRC 585, GEOGRAPH 593G, SPP 697B)

Forrest J. Bowlick

University of Massachusetts – Amherst

Agenda for the Day

- Syllabus Review
- GIS Mythbusting
- Course resources, details, etc.
- Semester run-through
- Questions/Comments?

But First!

- Throughout this course, I will ask you questions about content, gather thoughts on instruction, and otherwise engage you.

- I expect you will have some kind of device (phone, laptop, paper, rock art) to answer questions.

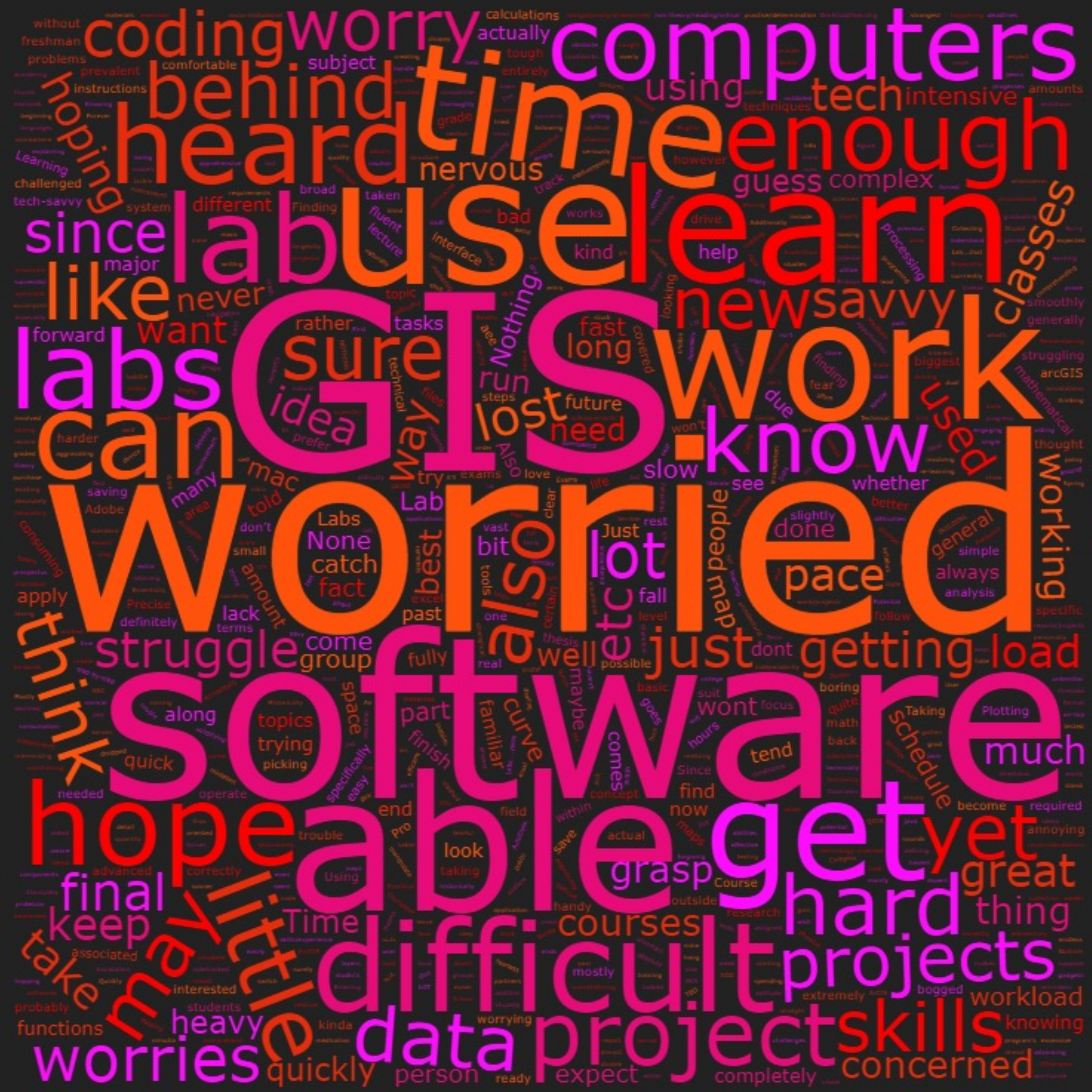
Why are you here anyway?

Tx.ag/GIS1

tx.ag/GIS1

- What do you need out of this course?
  - You're enrolled, so what do you need while you're here?
- What do you want to learn or explore?
  - Are there any topics or specific areas you'd like to have some GIS context?
- What are you worried about?
  - Thinking ahead, what topic or task worries you in this course?

Worries


worried
software
GIS
able
difficult
use
learn
work
time
computers
heard
lab
labs
can
enough
worry
coding
behind
hope
get
project
projects
skills
data
worries
little
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think
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lost
new
savvy
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lot
just
hard
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great
struggle
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heavy
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workload
thing
courses
grasp
pace
getting
load
much
schedule
working
used
classes
tech
using
nervous
guess
complex
intensive
idea
way
need
future
fast
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run
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map
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done
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always
whether
slow
help
kind
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never
want
forward
different
hoping
Learning
challenged
tech-savvy
subject
actually
calculations
comfortable
instructions
prevalent
problems
freshman
without
Labs
None
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fact
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bit
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topics
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find
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Time
Course
extremely
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fall
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analysis
simple
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mathematical
arcGIS
struggling
biggest
generally
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interface
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fluent
Finding
broad
taken
works
bad
system
harder
saving
Adobe
many
mac
told
Lab
area
lack
terms
apply
Precise
definitely
consuming
excel
past
amount
vast
try
love
exams
prefer
files
technical
steps
covered
finding
curve
familiar
space
finish
maybe
goes
comes
hours
concept
within
actual
Using
taking
save
handy
outside
research
mostly
bogged
worrying
kinda
ready
trouble
field
Pro
easy
specifically
picking
operate
needed
advanced
correctly
real
possible
basic
suit
focus
thesis
level
one
fully
entirely
tough
amounts
techniques
however
track
processing
looking
slightly
rest
follow
clear

Who am I?

- Forrest J. Bowlick
- Lecturer, GIST
  - Department of Geosciences and Department of Environmental Conservation
- PhD, Geography, Texas A&M University
  - MS Geography, University of Idaho
  - BA Geography, – GIS University of Northern Colorado
- GIS interests include GIS and Geography Ed.

Syllabus

- Available online!
- Not printing out ~100 copies

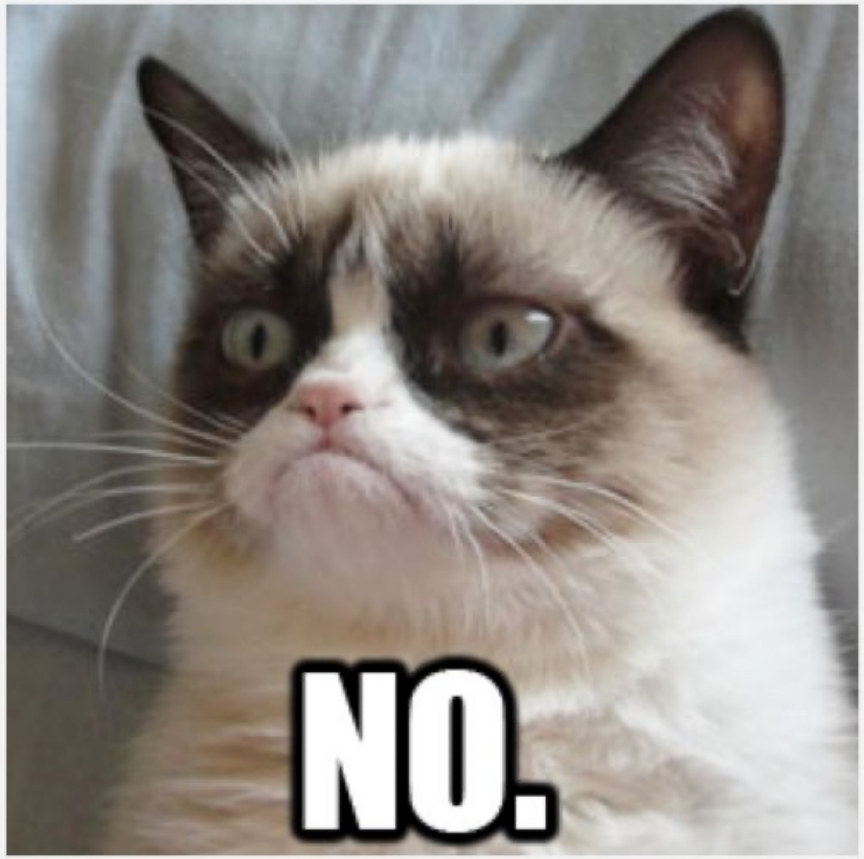
You Will be Overwhelmed

http://www.phdcomics.com/comics/archive/phd020507s.gif

"Piled Higher and Deeper" (PhD) is the comic strip about life (or the lack thereof) in academia by Jorge Cham.

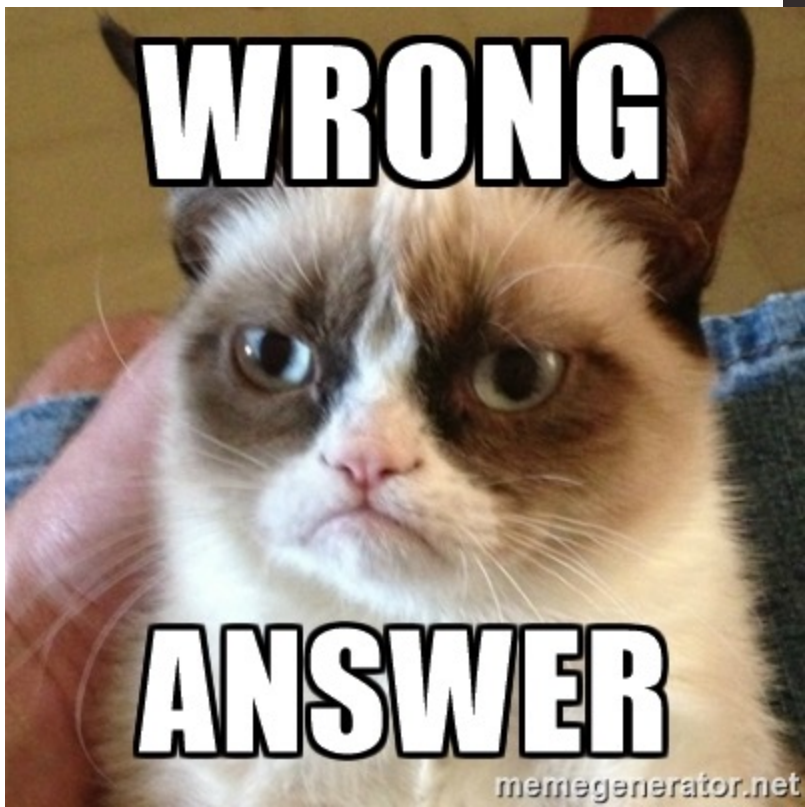
GIS Myths I

- MYTH: ‘This course is titled ‘Introduction to GIS’, it’s going to be easy!”



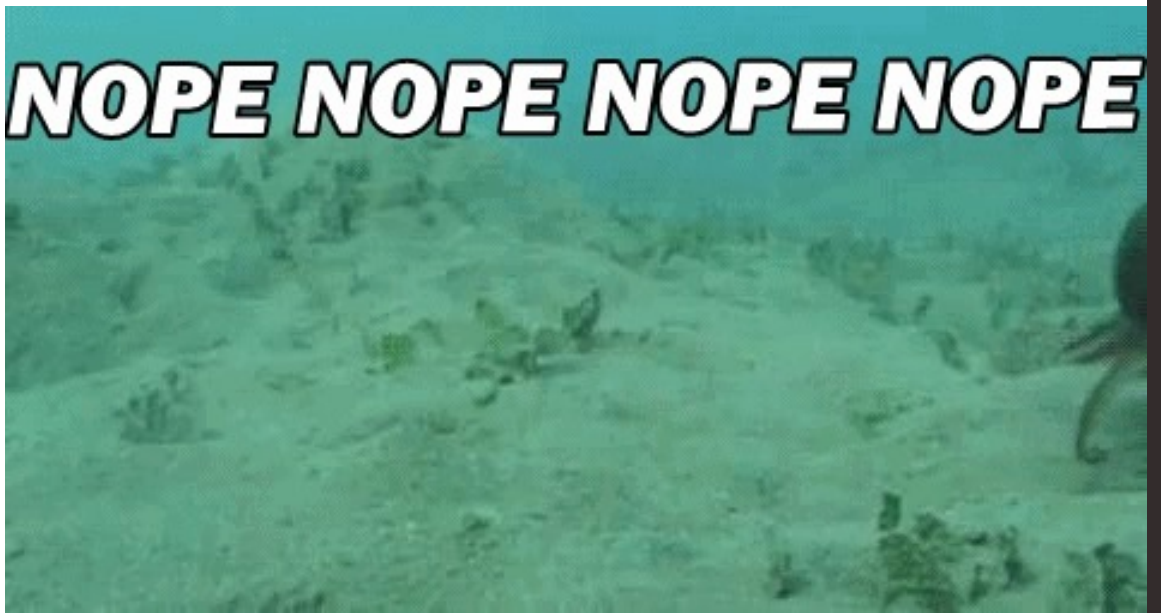
GIS Myths II

- MYTH: ‘We have three hours in lab each week, I’ll never have to work on GIS on my own!’



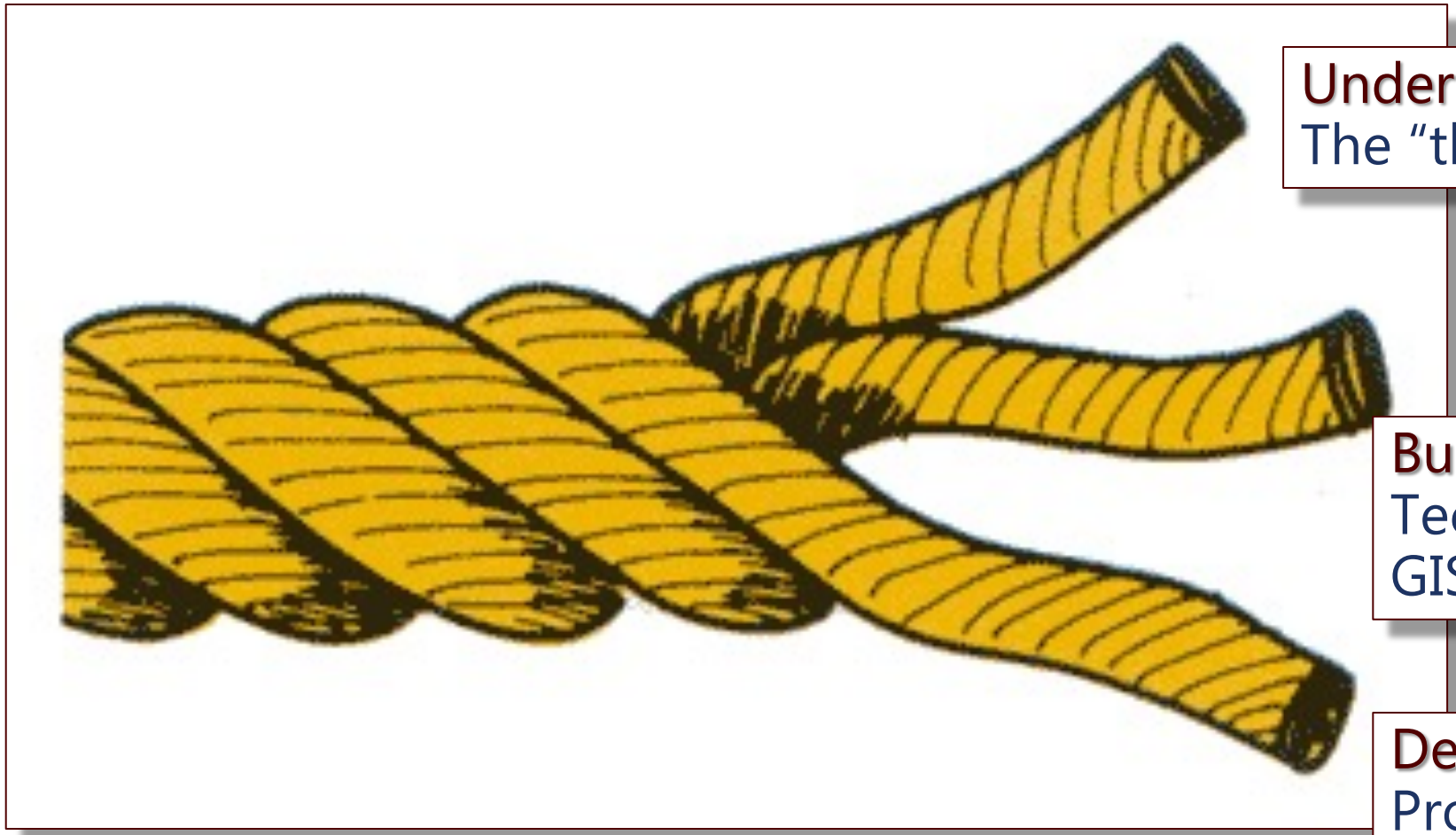
GIS Myths III

- Myth: ‘This class is just about learning a software package; I’ll always be told exactly what to do’



So, What is GIS?

Three Big Themes



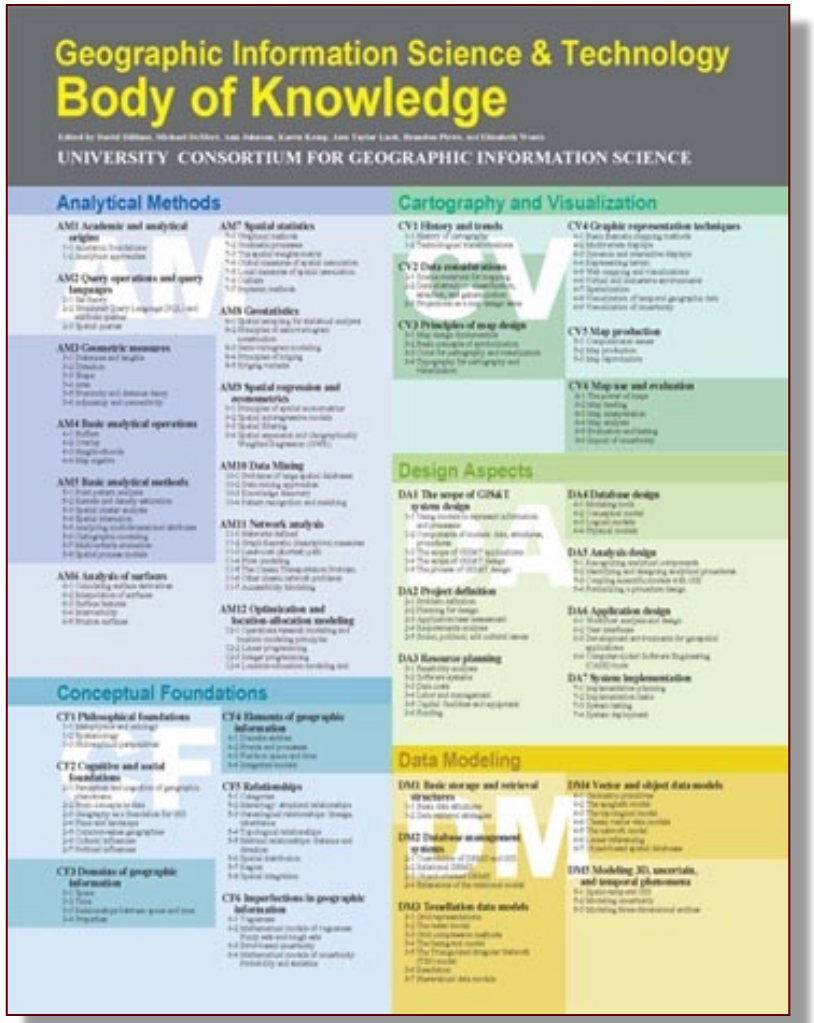
Understanding
The "theory" behind GIS

Building
Technical Competency in GIS

Developing
Professionalism

http://www.nobles.com.au/media/11106/para_900_10x23x200215631pm.gif

Learning Objectives I



R:\agk_storage\education\GEOG390-GIS\lectures\lecture01 - Introduction\BOK1.jpg

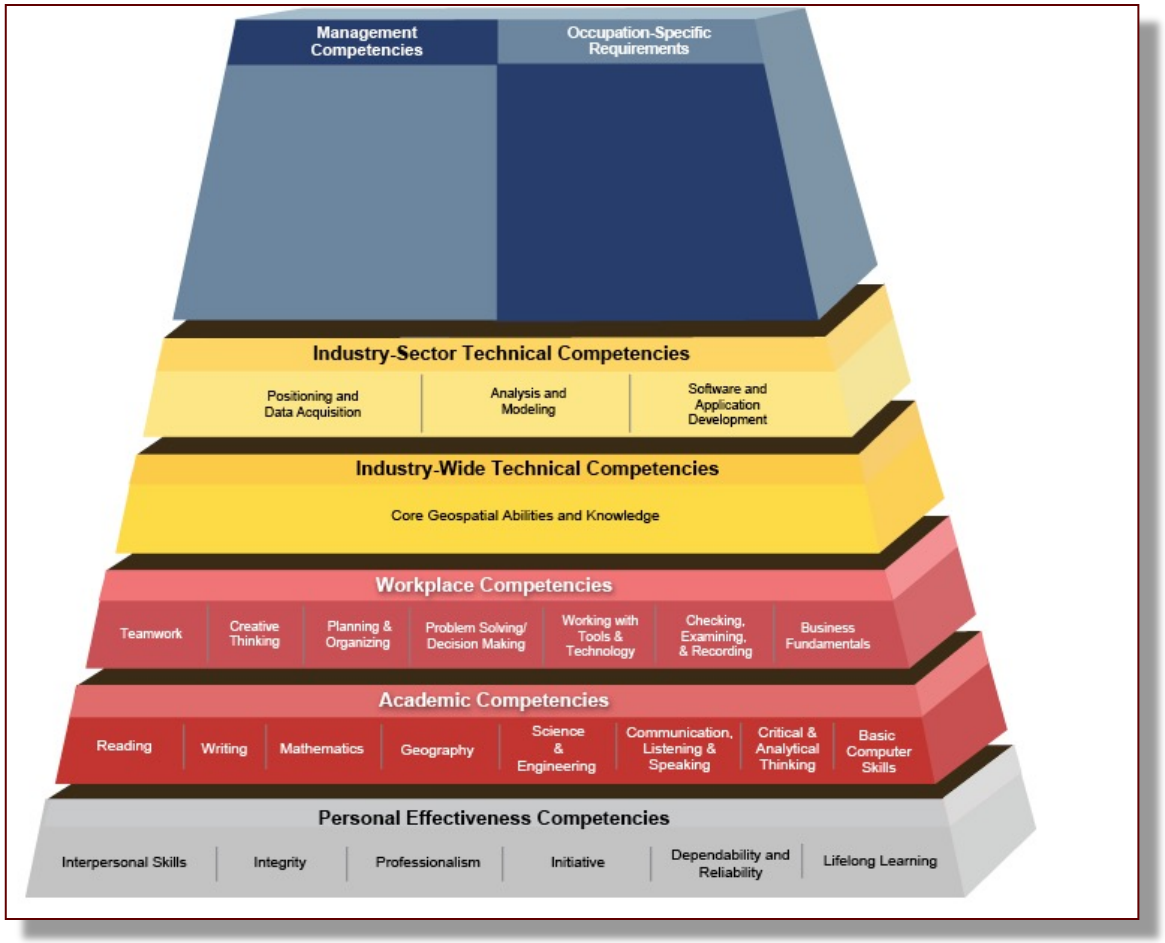
The course is aligned with the Learning Objectives set forth in the

Geographic Information Science & Technology Body of Knowledge

which

"specifies what aspiring geospatial professionals need to know and be able to do."

Learning Objectives II



This course will help provide you with the competencies expected of a Geospatial Professional as specified in the ***Geospatial Technology Competency Model (GTCM)***

Not Like This

What you need to succeed (with GIS)

- Be organized!
  - It's likely that you'll create a lot of similar files as you're working with lab data and your own data
  - You will not remember what you did to create the 'temp1' file the day after you create it. Keep notes, name things in ways that you'll remember
  - Keep a log of useful tools – ArcGIS naming conventions are not always intuitive

What you need to succeed (with GIS) I

- Be organized!
- Try not to get frustrated
  - Get started early
  - Save your work often
  - Use Google instead of ArcGIS help
  - Ask someone if you can't solve it yourself

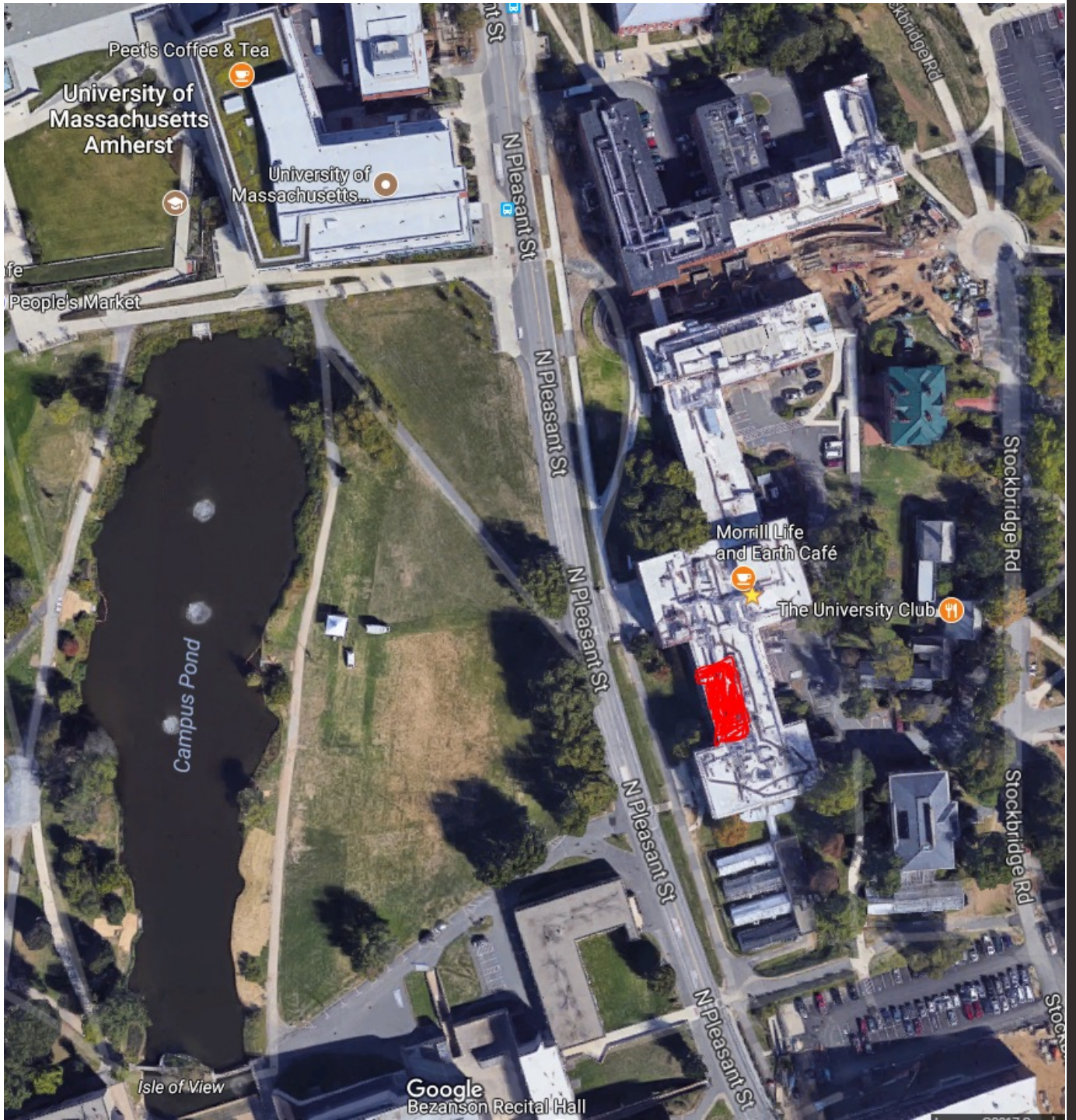
What you need to succeed (with GIS) II

- Be organized!
- Try not to get frustrated
- In GIS, there are many paths to the same answer

Lab Logistics

- Labs are located in Morrill III 212
- OIT computers all have ArcGIS installed – as long as you've saved your work to your USB, you can work on labs from anywhere on campus

The lab is roughly in the red area on Morrill ->



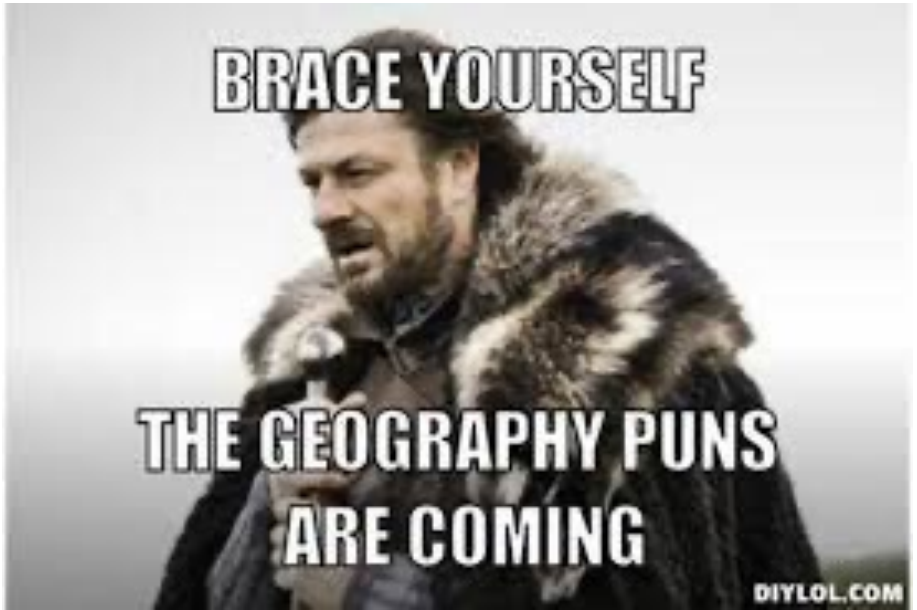
Semester in Twenty Minutes (ish)

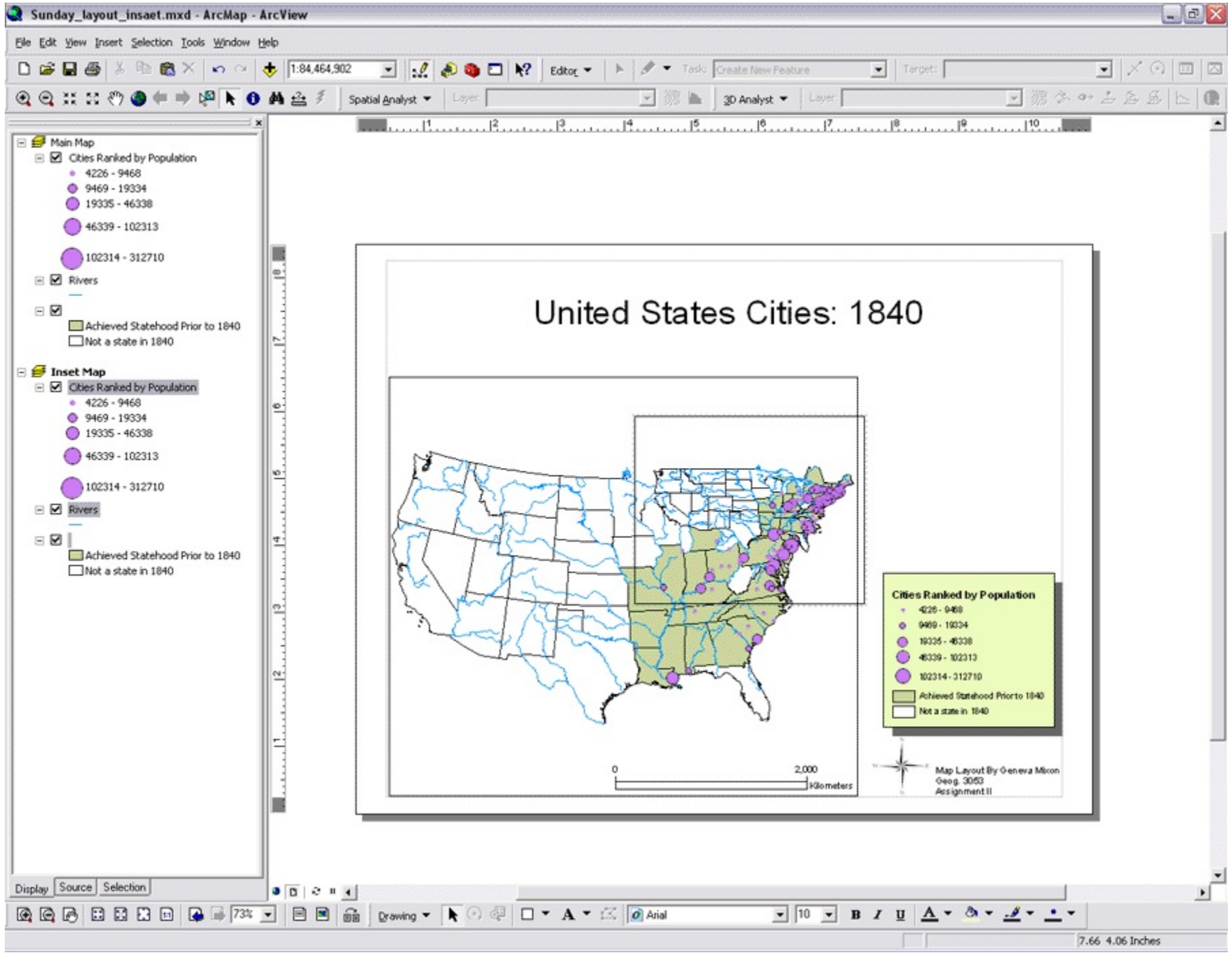
- A run through of our semester ahead.
- Focus on big topics and important dates.
- Should feel overwhelming (it is!)

Thursday 9/5 and Friday 9/6 **LECTURE:** Course overview, So what is this GIS thing, anyway?	N/A
LAB 1: Visualization	


GO HOME ARCMAP
YOU ARE DRUNK
quickmeme.com


ON SECOND THOUGHT LET'S NOT GO TO ARCMAP
'TIS A SILLY PLACE
memegenerator.net


BRACE YOURSELF
THE GEOGRAPHY PUNS ARE COMING
DIYLOL.COM


Sunday_layout_insaet.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
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Editor
Task: Create New Feature
Target:
Spatial Analyst
3D Analyst
Main Map
Cities Ranked by Population
4226 - 9468
9469 - 19334
19335 - 46338
46339 - 102313
102314 - 312710
Rivers
Achieved Statehood Prior to 1840
Not a state in 1840
Inset Map
Cities Ranked by Population
4226 - 9468
9469 - 19334
19335 - 46338
46339 - 102313
102314 - 312710
Rivers
Achieved Statehood Prior to 1840
Not a state in 1840
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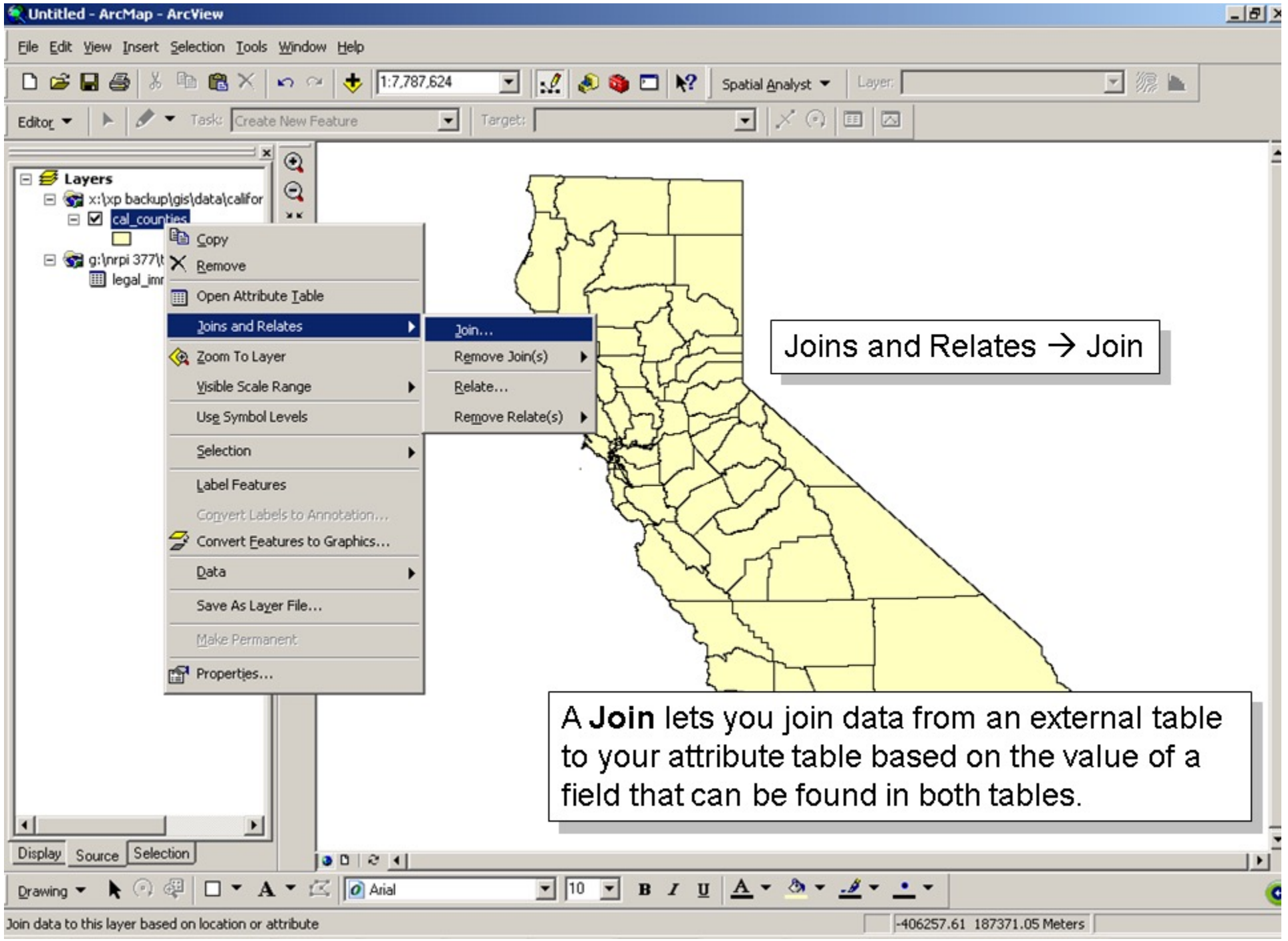
United States Cities: 1840
Cities Ranked by Population
4226 - 9468
9469 - 19334
19335 - 46338
46339 - 102313
102314 - 312710
Achieved Statehood Prior to 1840
Not a state in 1840
0
2,000
Kilometers
Map Layout By Geneva Mixon
Geog. 3053
Assignment II
Drawing
Arial
10
7.66 4.06 Inches

Thursday 9/12 and Friday 9/13 **LECTURE:** Data formats, querying, shapefile basics	**Lab 1: Visualization <u>due</u>.** Upload assignment by the beginning of the lab period.
LAB INTRO: Cartographic Design **LAB 2:** Joins & Selects	


Untitled - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
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Spatial Analyst
Editor
Task: Create New Feature
Target:
Layers
x:\xp backup\gis\data\califor
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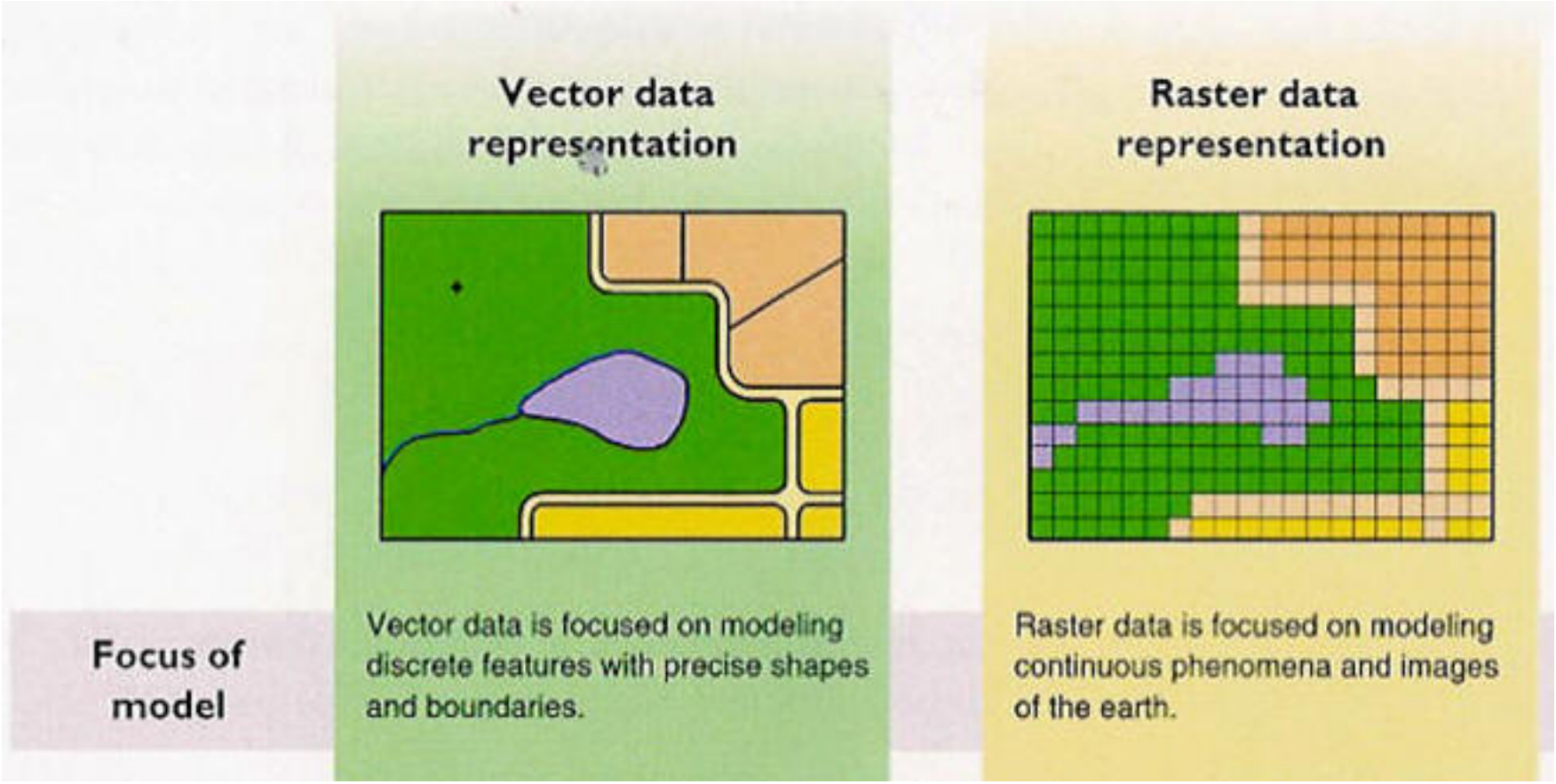
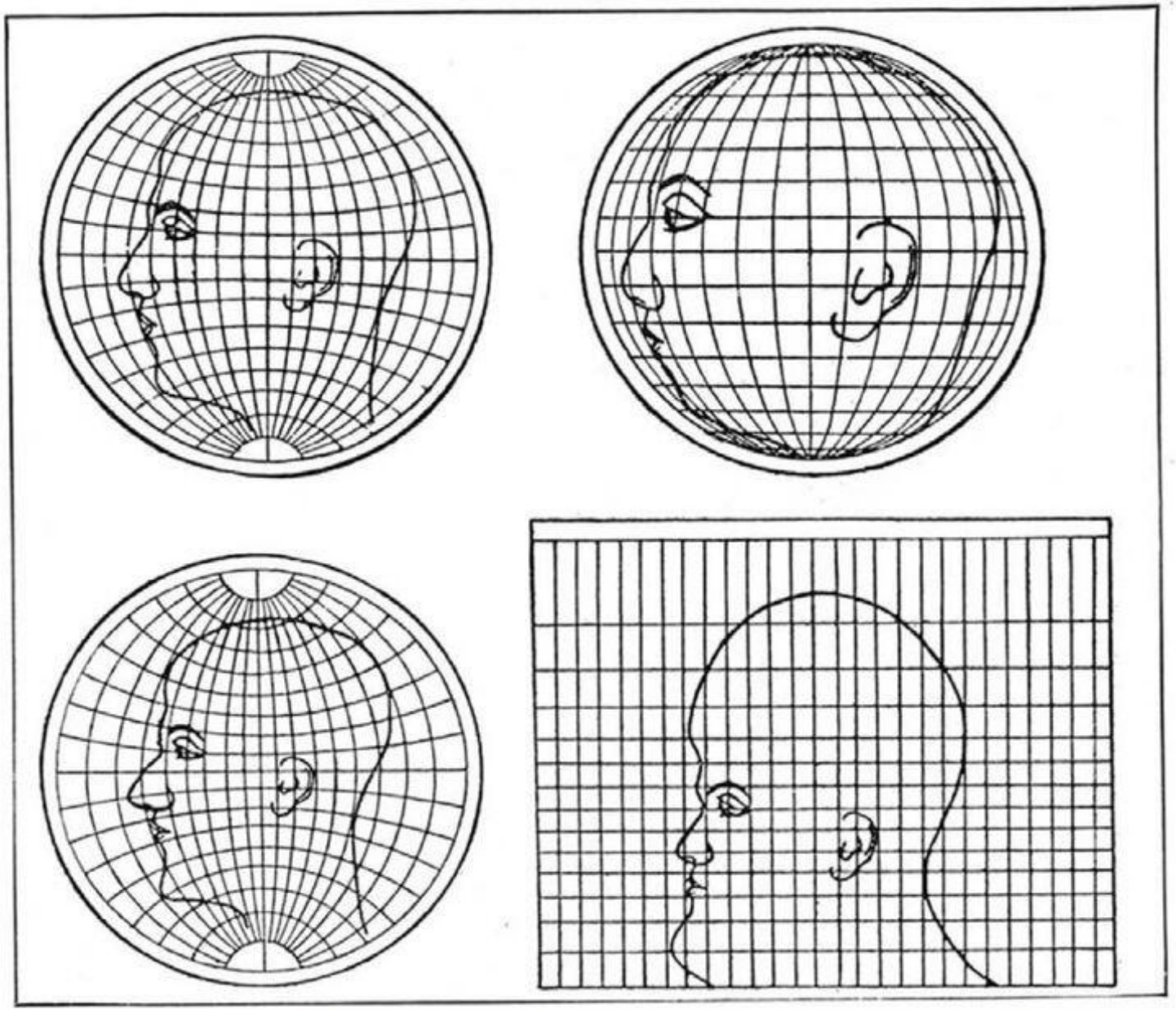
Copy
Remove
Open Attribute Table
Joins and Relates
Zoom To Layer
Visible Scale Range
Use Symbol Levels
Selection
Label Features
Convert Labels to Annotation...
Convert Features to Graphics...
Data
Save As Layer File...
Make Permanent
Properties...
Join...
Remove Join(s)
Relate...
Remove Relate(s)
Joins and Relates → Join
A Join lets you join data from an external table to your attribute table based on the value of a field that can be found in both tables.
Display
Source
Selection
Drawing
Arial
10
Join data to this layer based on location or attribute
-406257.61 187371.05 Meters

Thursday 9/19 and Friday 9/20 **LECTURE:** Vector data analysis	**Lab 2: Joins & Selects** **due.** Upload assignment by the beginning of the lab period.
LAB INTRO: Cartographic Design **LAB 3:** Vector Analysis	



http://map.sdsu.edu/geog104/lecture/unit-2.htm

Thursday 9/26 and Friday 9/27 **LECTURE:** Projections	**Lab 3: Vector Analysis** **due.** Upload assignment by the beginning of the lab period.
LAB INTRO: Bonus Projections **LAB 4:** Projections	



Upper left: Globular. *Upper right:* Orthographic. *Lower left:* Stereographic. *Lower right:* Mercator

What four commonly used projections do, as shown on a human head

Thursday 10/3 and Friday 10/4 **LECTURE:** GIS Applications	**Lab 4: Projections <u>due</u>.** Upload assignment by the beginning of the lab period.
LAB INTRO: Global Positioning **GPS Scavenger Hunt**	

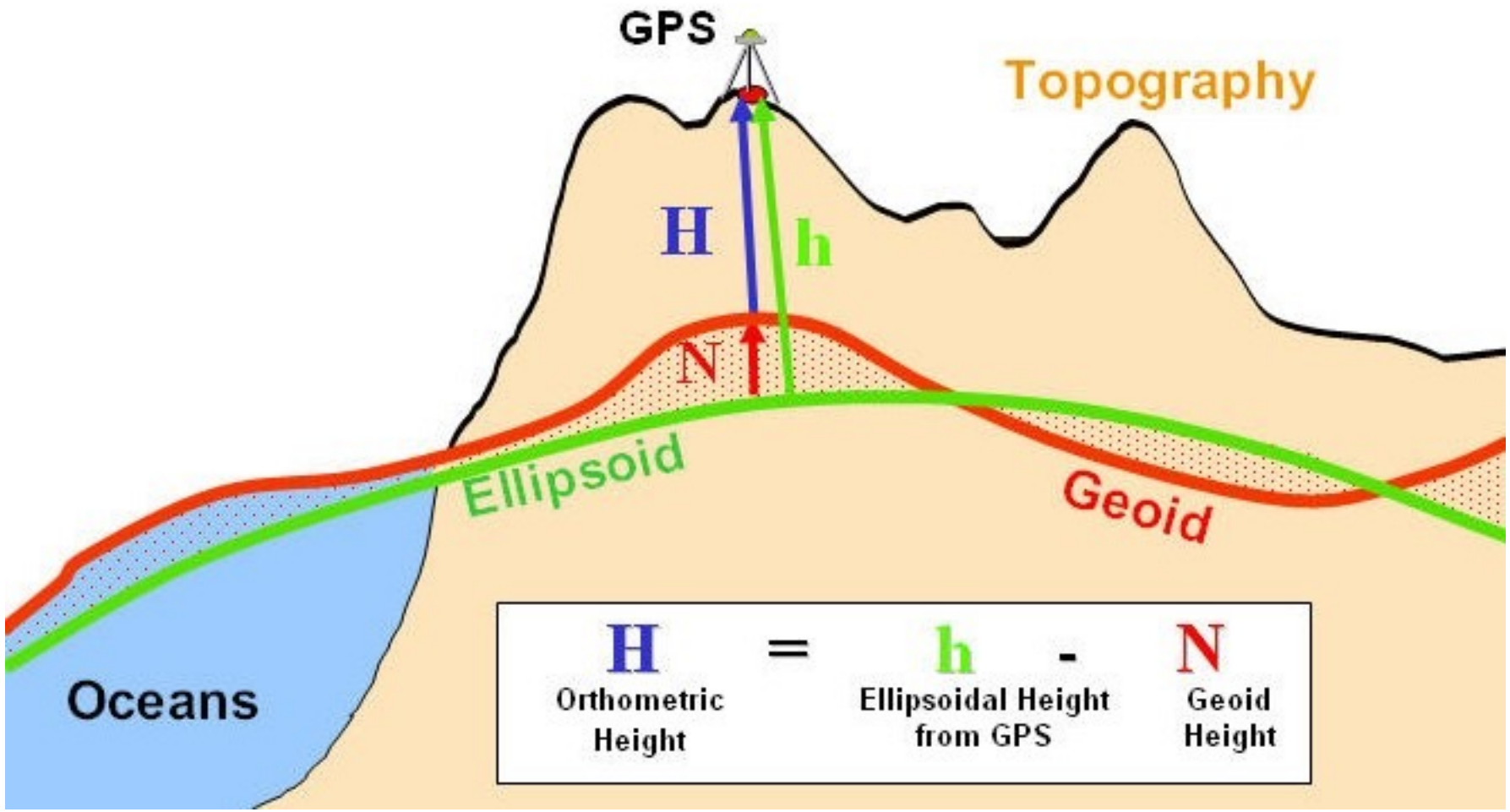
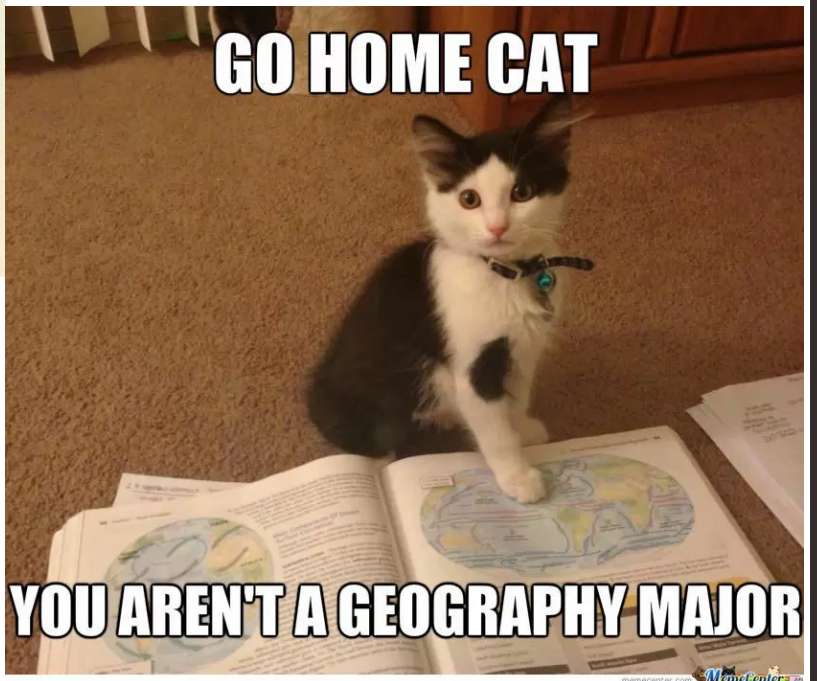


Image via University of Oklahoma at http://principles.ou.edu/earth_figure_gravity/geoid/

Thursday 10/10 and Friday 10/11 **LECTURE:** Practical Exam Q & A	**The Lab Practical Exam will be completed during your lab period this week.**
Lab Practical Exam	

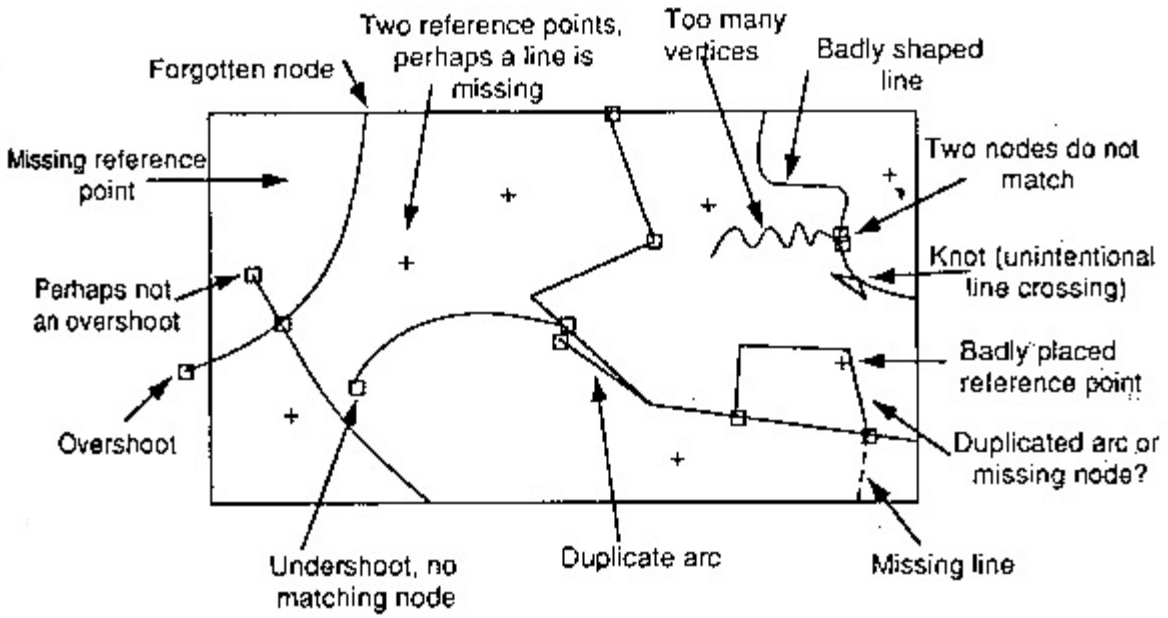

We are bound for the land of good-fortune.

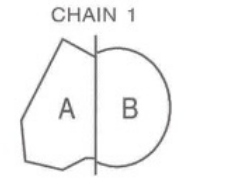

GO HOME CAT
YOU AREN'T A GEOGRAPHY MAJOR
memecenter.com
MemeCenter

Thursday 10/17 and Friday 10/18 **LECTURE:** Data creation and editing	**Bring GPS scavenger hunt to class.**
LAB INTRO: Global Positioning **LAB 5:** Editor	

TOPOLOGY

SPATIAL RELATIONSHIPS

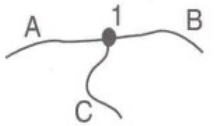




LEFT POLY = A

RIGHT POLY = B

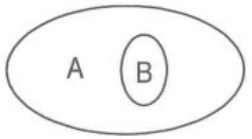
ADJACENCY



NODE 1 = CHAINS A, B, C

CHAIN A IS CONNECTED TO CHAINS B and C

CONNECTIVITY



POLY B CONTAINED WITHIN POLY A

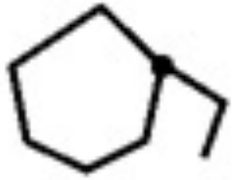
CONTAINMENT

a. Polygon is not closed (start and end points do not overlap)

b. Polygon intersects itself (a 'bow-tie')

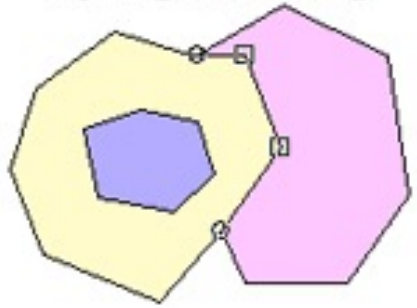
c. Segments forming polygon are not all oriented in the same direction

d. Polygon is oriented in anti-clockwise direction rather than clockwise

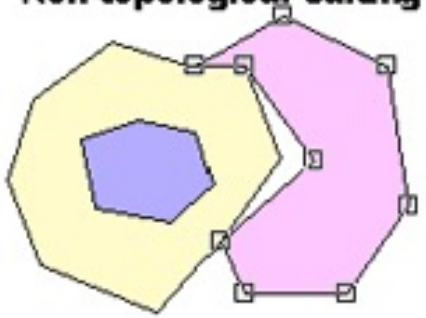


e. Polygon has a dangling segment (dead-end)

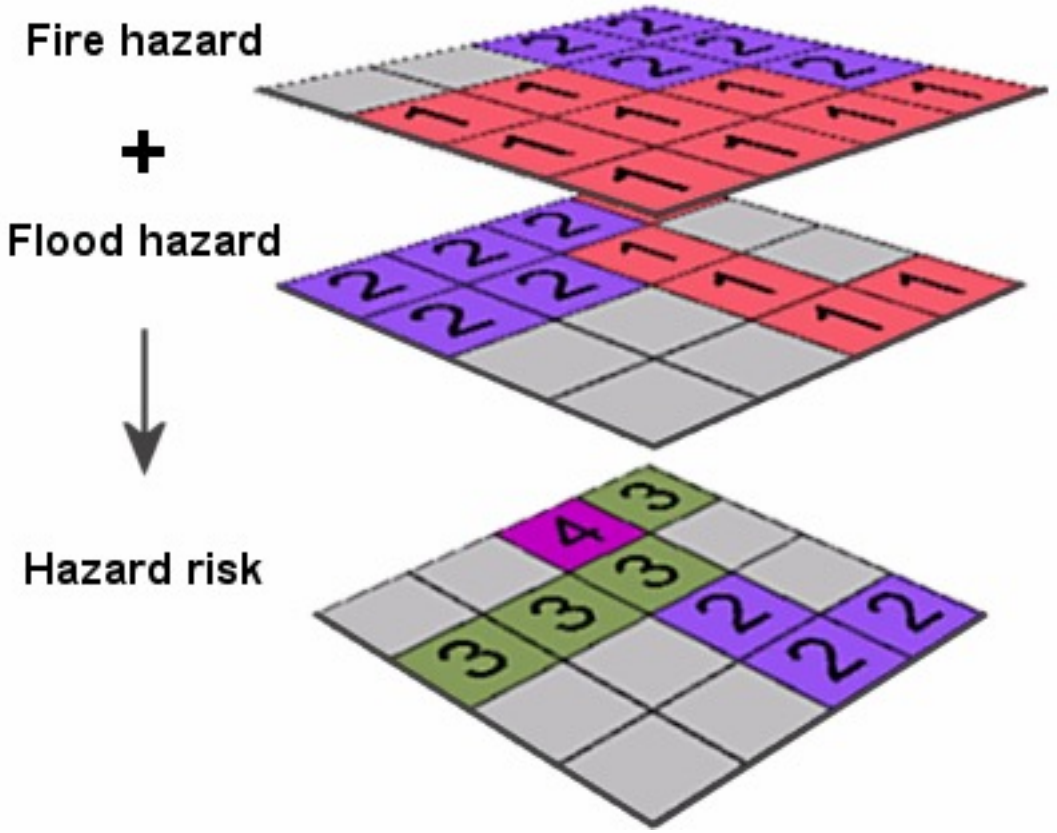
Topological editing



Non-topological editing



Thursday 10/24 and Friday 10/25 **LECTURE:** Raster data and analysis	**Lab 5: Editor <u>due</u>.** Upload assignment by the beginning of the lab period.
LAB 6: Raster Analysis	



http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture11/concepts/Working%20with%20NoData.htm

Thursday 10/31 and Friday 11/1 **LECTURE:** Remote Sensing and GIS	**N/A**
LAB INTRO: Project work and troublesome topic review **(Work day)**	

Geographic Inquiry Process

From: http://www.esri.com/Industries/k-12/education/~/media/Files/Pdfs/industries/k-12/pdfs/geoginquiry.pdf

Thursday 11/7 and Friday 11/8 **LECTURE:** Geostatistics	**Lab 6: Raster Analysis due.** Upload assignment by the beginning of the lab period.
LAB 7: Geostatistics	

TABLE 1-1 Basic Identities of Boolean Algebra

(1) $x + 0 = x$	(2) $x \cdot 0 = 0$
(3) $x + 1 = 1$	(4) $x \cdot 1 = x$
(5) $x + x = x$	(6) $x \cdot x = x$
(7) $x + x' = 1$	(8) $x \cdot x' = 0$
(9) $x + y = y + x$	(10) $xy = yx$
(11) $x + (y + z) = (x + y) + z$	(12) $x(yz) = (xy)z$
(13) $x(y + z) = xy + xz$	(14) $x + yx = (x + y)(x + z)$
(15) $(x + y)' = x'y'$	(16) $(xy)' = x' + y'$
(17) $(x')' = x$	

http://www.cs.science.cmu.ac.th/person/chumphol/204231/Basic%20Identities%20of%20Boolean%20Algebra.jpg

The Moran's I statistic for spatial autocorrelation is given as:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2} \quad (1)$$

where z_i is the deviation of an attribute for feature i from its mean $(x_i - \bar{X})$, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features, and S_0 is the aggregate of all the spatial weights:

$$S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} \quad (2)$$

The z_I-score for the statistic is computed as:

$$z_I = \frac{I - \mathrm{E}[I]}{\sqrt{\mathrm{V}[I]}} \quad (3)$$

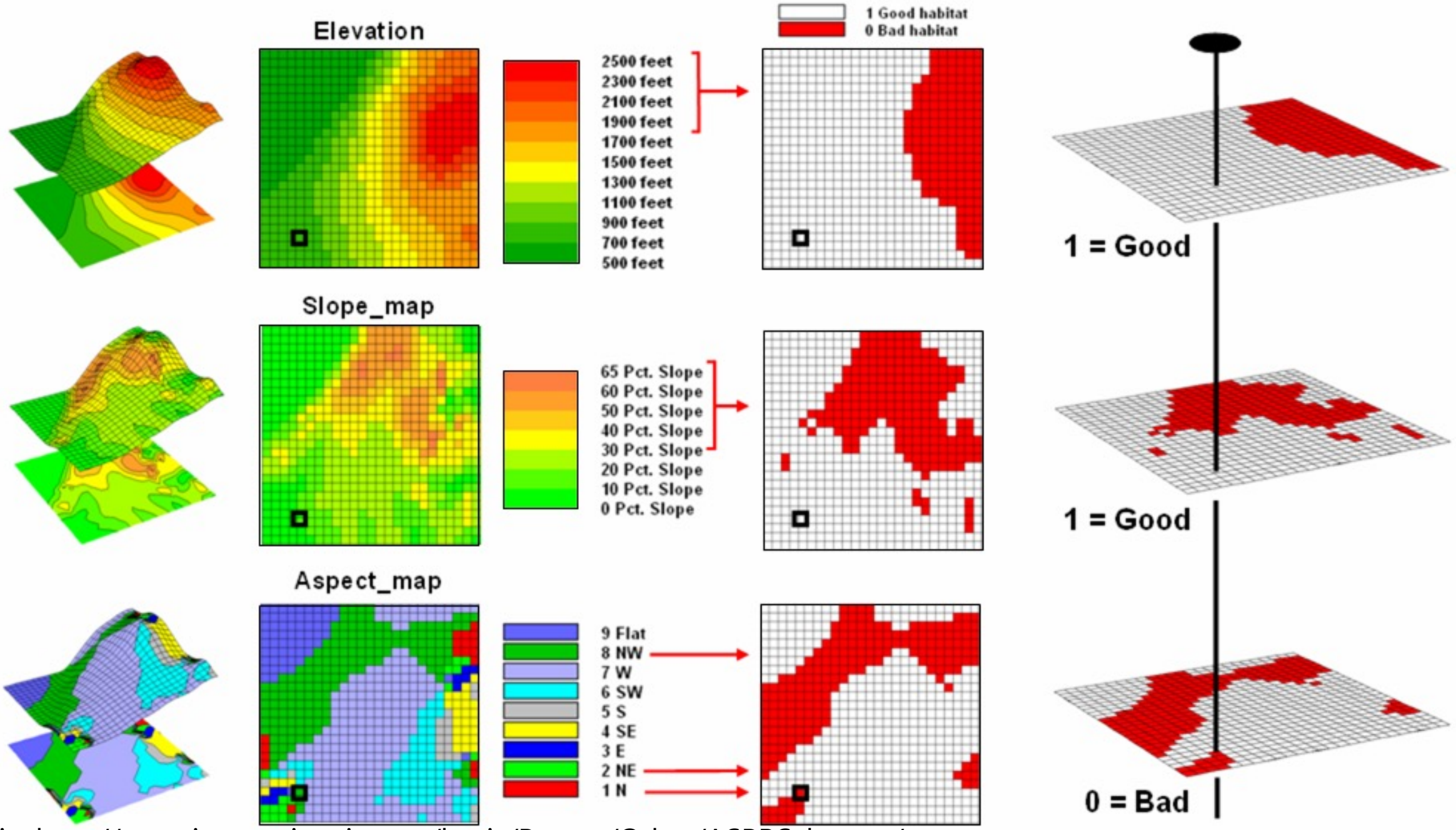
where:

$$\mathrm{E}[I] = -1/(n-1) \quad (4)$$

$$\mathrm{V}[I] = \mathrm{E}[I^2] - \mathrm{E}[I]^2 \quad (5)$$

http://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/h-how-spatial-autocorrelation-moran-s-i-spatial-

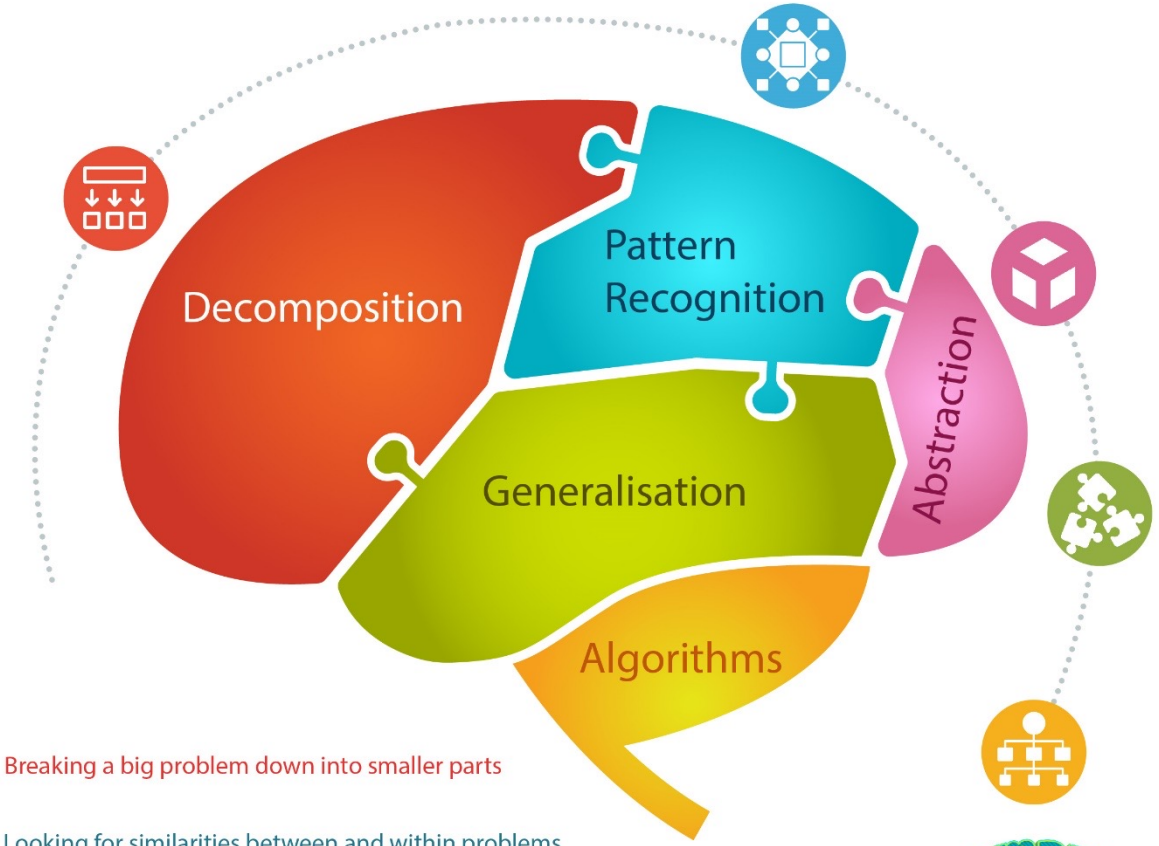
Thursday 11/14 and Friday 11/15 LECTURE: Modeling	**Methods outline & Study Area Map <u>due</u>.** Upload methods outline by 11:59p, 11/15.
LAB INTRO: Poster layouts and final projects **(work day)**	



Via: http://www.innovativegis.com/basis/Papers/Other/ASPRSchapter/

Thursday 11/21 and Friday 11/22 LECTURE: Computational thinking	**Lab 7: Geostatistics <u>due</u>.** Upload assignment by the beginning of the lab period.
Work on Final Projects	

Computational Thinking



- Breaking a big problem down into smaller parts
- Looking for similarities between and within problems
- Taking the detail out of a problem and ignoring irrelevant information
- Adapting solutions to other problems to solve new ones
- Simple rules to follow that solve the problem

https://www.icompute-uk.com/Downloads/icompute-computational-thinking-infographic-

NO CLASS 11/28 and 11/29: Thanksgiving Recess	
Thursday 12/5 and Friday 12/6 LECTURE: GIS frontiers **Work on final projects**	N/A
TENTATIVE Thursday 12/12 *TENTATIVE* **POSTER CONFERENCE** 9am to 11am or 1pm to 3pm Holdsworth 203	Don't forget to upload your final posters in PDF format to Moodle! Upload poster by 5pm.

Overwhelmed yet?

- Good!
- Attend labs this week or face consequences.