You are responsible for all lecture materials since mid semester.

Reading: The exam will focus on Longely et al. Chapters 8 - 13, but be sure to have read Chapters 1 through 5 as many of the ideas, definitions and concepts are cumulative.

You may find that UNITS 10, 11, 12, 13 and 17 from the NCGIA Core Curriculum (also on course home page) help with the major points – specifically if you use the headings and subheadings to assign priority.

Understand the basic structure and functions of ARCGIS from your lab exercises. Make sure you have read Chapters 1 and 2. Review exercises 11 through 12 of Getting to Know ARCGIS, especially the short introduction to each section.
ANSWER ALL QUESTIONS
(QUESTIONS 1-30 are each worth 2 points)

1) TIGER data are the product of
   a) Graphic User Interface
   b) Topological overlay
   c) US Geological Survey
   d) US Census Bureau
   e) Environmental Systems Research Institute

2) A term describing the use of colors in a natural or acceptable manner on a map symbol
   a) Hue, Saturation, Intensity
   b) cartographic convention
   c) thematic map
   d) realistic perspective
   e) RGB

3) Polygon defined by the minimum and maximum x and y coordinates
   a) Buffer
   b) Bounding rectangle
   c) Contour interval
   d) Map layer
   e) Coordinate system

4) A line that begins and ends at topologically significant locations
   a) 0-cell
   b) buffer
   c) arc
   d) node
   e) Scale bar

5) A collection of data organized in a systematic way to provide access on demand
   a) Database
   b) Data structure
   c) Data Model
   d) Data Analysis
   e) Record

6) Complete the sentence: Topology matters because complete topology
   a) Create structures called arrays
   b) Make vector map overlay possible
   c) Became a federal standard (FIPS 173) in 1992
   d) Is the only way to represent maps in a computer system
   e) Stores data as cells, each storing one data value.

7) Map classifying numerical data into regions, and shading the resulting areal classes

8) A general reference map depicting terrain (contours), roads, streams, boundaries and towns
   a) Symbol map
   b) Area qualitative map
   c) Isoline map
   d) Choropleth map
   e) Topographic map

9) Map where symbols are used to represent elevation
   a) Isoline map
   b) Topographic map
   c) Simulated hill shading map
   d) Hypsometric map
   e) All of the above

10) Index information pertaining to the entire data set rather than to the individual attributes, usually include map projection, scale, data, resolution and accuracy.
    a) Metadata
    b) Missing data
    c) Metric system
    d) Coordinate system
    e) Relational model
    f) Topological model

11) A graphic depiction of a geographic realm in which symbols in their correct spatial location at a reduced scale represent real-world features.
    a) symbol
    b) cartographic element
    c) realistic perspective
    d) map
    e) cartographic convention

12) Which of the following is not one of the major GIS software vendors or packages (the Big 8)
    a) ARCVIEW
    b) Microsoft
    c) IDRISI
    d) ARC/INFO
    e) Intergraph MGE
    f) Maptitude
13) Computer languages and databases that support standard classes that contain all the properties of an object
   a) Relational data model
   b) Object-oriented
   c) Data structure
   d) Logical structure
   e) Spatial distribution

14) A map that is an air photo corrected for topographic and other effects
   a) Map layer
   b) Coverage
   c) Geocoding
   d) Address matching
   e) Orthophoto quad

15) A system with an origin, unit distance, and axes to locate a position in two- or three-dimensional space.
   a) Geographic Information System
   b) Coordinate system
   c) Database management system
   d) Design loop system
   e) Spatial system

16) Visual expression of the relationship of distance on the ground (earth) coordinate space and length on the map (page space)
   a) Inset
   b) Border
   c) Title
   d) Scale bar
   e) North Arrow
   f) Legend

17) A turntable in a GIS context is

18) A data model based on multiple flat files for records connected by common key attributes.
   a) Remotely sensed data
   b) Software package
   c) Bounding rectangle
   d) Planar enforcement
   e) Topological structure
   f) Relational model

19) The visual frame for a map
   a) Title
   b) Legend
   c) Scale bar
   d) Inset
   e) Figure
   f) Neat line

20) Placing two or more thematic maps in precise registration to construct a compound view is …
   a) Map layer
   b) Map projection
   c) Map overlay
   d) Map design
   e) Geocoding

Identify the following acronyms:

21) NSDI
22) DLG
23) SQL
24) WIMP
25) DOQQ
26) GUI
27) DBMS
28) DEM
29) SDTS
30) UTM

31) Identify six essential capabilities of a GIS (12 pts.)

32) (12 points)
   a) Identify any four major objects (components) of an ARCGIS Project.
b) Describe the principal purpose of each of the **four** components, specifying two typical operations in each area.

33) (8 points)
   a) Compare and contrast the strengths and weaknesses of **two** principal data models used in GIS.
   b) Provide **one** real world example of a problem that would be best solved by each of the two models.
   c) Why has the selection of a data model in GIS analysis become less important in the late nineties?

34) (8 points)
   a) Using well-labeled diagrams, illustrate the difference between UNION and INTERSECTION used in a vector GIS.
   b) What is the generic term for this type of operation? ________________

35) **BONUS - 6 points**
   a) Identify three principal ways GIS will effect environment, technology, and institutions in the near future?
   b) Assess whether the effects of GIS in society will be positive or negative overall

Describe the relationship and provide an example for each of the spatial relationships indicated in the table:

<table>
<thead>
<tr>
<th>POINT</th>
<th>LINE</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT</td>
<td>(a)</td>
<td></td>
</tr>
<tr>
<td>LINE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AREA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example: relationship (a) could be "Point to point; airline routes between Chicago O'Hare and other US destinations".
KEY TERMS for Final Exam Fall 2003 (from Clarke Chapters 7-10)

**address matching**: Address matching means using a street address such as 123 Main Street in conjunction with a digital map to place the street address onto the map in a known location. Address matching a mailing list, for example, would convert the mailing list to a map and allow the mapping of characteristics of the places on the list.

**area qualitative map**: A type of map that shows the existence of a geographic class within areas on the map. Colors, patterns, and shades are generally used. Examples are geology, soils, and land-use maps.

**background image**: A satellite image or air photo that serves as a backdrop for display and registration purposes only rather than as a layer for analysis with the GIS.

**base layer or map**: A GIS data layer of reference information, such as topography, road network, or streams, to which all other layers are referenced geometrically.

**big eight**: The eight most popular GIS packages, established by the number of users, particularly among people getting started with GIS, at any given time.

**buffer**: A zone around a point, line, or area feature that is assumed to be spatially related to the feature.

**CGIS (Canadian Geographic Information System)**: An early national land inventory system in Canada that evolved into a full GIS.

**choropleth map**: A map that shows numerical data (but not simply "counts") for a group of regions by (1) grouping the data into classes, and (2) shading each class on the map.

**compression**: Any technique that reduces the physical file size of data in a spatial or other data format.

**contour interval**: The vertical difference in measurement units such as meters or feet between successive contour lines on a contour map.

**contour map**: An isoline map of topographic elevations.

**critical six**: The GIS functional capabilities included in Dueker’s GIS definition: map input, storage, management, retrieval, analysis, and display.

**data exchange format**: The specific physical data format in which exchange of data between similar GIS packages takes place.

**data mining**: Revisiting existing data to explore for new relationships using new and more powerful tools for analysis and display.

**DBMS (Database Management System)**: Part of a GIS, the set of tools that allows the manipulation and use of files containing attribute data.

**digital orthophoto quad (DOQ)**: One element of a national mapping effort to cover the lower 48 United States at a 1-meter ground resolution with monochrome air photos in digital format with a 1:12,000 equivalent ground extent. Collections of DOQs are distributed compressed on CD-ROM.

**distributed network**: A network-connected set of locations, each storing one element of a system. A distributed GIS may have the GIS software running on a workstation but use data dispersed at many computer storage locations over a local or wide area network.

**dissolve**: Eliminating a boundary formed by the edge or boundary of a feature that becomes unnecessary after data have been captured: for example, the edges of sheet maps.

**Dueker’s definition of GIS**: "A special case of information systems where the database consists of observations on spatially distributed features, activities or events, which are definable in space as points, lines, or areas. A geographic information system manipulates data about these points, lines, and areas to retrieve data for ad hoc queries and analyses."

**figure**: The part of a map that is both referenced in the map coordinate system rather than the page layout coordinates and that is the center of the map reader’s attention. The figure is contrasted against the ground, or background. For example, on a map of New York State, the state is the figure, and surrounding states, though shown and labeled, are part of the ground and may be toned down.

**file server**: A computer whose primary function is to store data and make them available on a network as part of a distributed system.

**FIPS 173**: The federal information processing standard maintained by the USGS and the National Institute of Standards and Technology, which specified a standard organization and mechanism for the transfer of GIS data between dissimilar computer systems. FIPS 173 specifies terminology, features types, and accuracy specifications, as well as a formal file transfer method.
fuzzy tolerance: Linear distance within which points should be snapped together.

generalization: The process of moving from one map scale to a smaller (less detailed) scale, changing the form of features by simplification, and so on.

geographic information science (GISc): The scientific use and study of methods and tools for the capture, storage, distribution, analysis, display, and exploitation of geocoded information.

generalization: A test to establish the spatial relationship between features. For example, a point feature can be given a point-in-polygon test to find if it is "contained" by an area.

GRASS: A GIS software package (see Section 8.5).

ground: The part of the body of the map that is not featured in the figure. This area can include neighboring areas, oceans, and so on. The ground should fall lower than the figure in the visual hierarchy.

GUI (Graphical User Interface): The set of visual and mechanical tools through which a user interacts with a computer, consisting of windows, menus, icons, and pointers.

hue: A color as defined by the wavelength of the light reflected or emitted from the map surface.

hypertext: Textual information in which direct links can be made between related text through "hot links," where pointing to a highlighted term moves the user to the text context for that term in the same or a different document.

image map: A map that in two dimensions shares many of the characteristics of a map, that is, cartographic geometry, some symbols, a scale and projection, and so on, but is a continuous image taken from an air photo, a satellite image, or a scanner.

interoperability: The extent to which users, software, and data can move between computer environments without change or retraining. In a fully interoperable GIS, the user interface will look and feel the same in two different environments (say, a microcomputer and a Unix workstation), and the same set of functions will have the same effect on the same data.

in-vehicle navigation system: A navigation aid allowing the driver of a car, pilot of a plane, or navigator of a boat direct assistance during operation. Combinations of GPS, on-board digital maps, GIS functions such as routing, and voice information are common in these systems. Most use outside aids. Those using the sensed motion of the vehicle are called inertial.

isoline map: A map containing continuous lines joining all points of identical value.

Landsat: A U.S. government satellite program collecting data about the earth's surface in the visible and infrared parts of the spectrum. Two instruments, the multi-spectral scanner (79-meter resolution) and the thematic mapper (30-meter resolution), have been used. Landsat 7 is the next to be launched, for which the data will return to the public domain.

local area network (LAN): An arrangement of computers into a cluster, with network linkages between computers but no external link. Usually, this allows sharing data and software licenses, or the use of a file server.

macro: A command language interface allowing a "program" to be written, edited, and then submitted to the GIS user interface.

map algebra: Tomlin's terminology for the arithmetic of map combination for coregistered layers with rasters of identical size and resolution.

map overlay: Placing multiple thematic maps in precise registration, with the same scale, projections, and extent, so that a compound view is possible.

Maptitude: A GIS software package (see Section 8.5).

mask: A map layer intended to eliminate or exclude areas not needed for mapping and analysis.

metadata: Data about data. Index-type information pertaining to the entire data set rather than the objects within the data set. Metadata usually includes the date, source, map projection, scale, resolution, accuracy, and reliability of the information, as well as data about the format and structure of the data set.

multimedia: The use of multiple simultaneous means of communication in a single "document," normally including sound, graphics, animation, and hypertext.

multitask: The ability of a computer's operating system or GIS to handle more than one process at once: for example, editing and running a command sequence while extracting data from the database and displaying a map.

National Spatial Data Clearinghouse: A World Wide Web resource that serves as a cross-reference point for the distributed database of all U. S. government public-domain and other geographic information.
National Spatial Data Infrastructure (NSDI): The set of base geographic data necessary for effective operation of the federal government and its suppliers, made accessible as a distributed database.

Object-oriented: Computer programming languages and databases that support "objects." Objects are standard "classes" that contain all the properties of an object. As a simple example, an object class could be a point and will contain the latitude and longitude of the point, a feature code for the point, such as "radar beacon," and any necessary text to describe the object.

Open/GIS: An active effort to assure interoperability among GIS software packages by specifying a standard set of functions and a common user interface.

Operating system: The suite of software programs and utilities necessary for the control and use of a computer, including as a minimum the management of files and the use of the computer's processor.

Parallel processing: A computer or workstation configured with multiple microcircuits, each functioning as a separate computer but usable in tandem. Either each computer can handle a separate task or each computer can hold data to which a uniform process is applied.

Parcel: A land surface partition recognized by law for the purpose of ownership.

PCMCIA: A credit-card-like device interface for microcomputers and other devices, such as GPS receivers, that meets the standards of the Personal Computer Memory Card International Association. PCMCIA cards can act as memory, connectors to disk drives, and links to other types of devices, perform many other functions, and are interoperable across computers.

Public domain: Information that has been made available to the general public and is distributed and redistributed without copyright or patent.

Radar mapping system: An active form of remote sensing in which a radar beam is transmitted to earth and the reflected signals are detected and stored. These systems have the distinct advantage of being operable at night, through clouds, and through vegetation and therefore are used extensively for mapping in the tropics and for mapping terrain. For example: LIDAR

Raster: A data structure for maps based on grid cells.

Remotely sensed data: Data collected by a sensor that is not in direct contact with the area being mapped. Active remote sensing involves transmitting a beam that is detected after reflection; passive remote sensing simply measures light from the sun being reflected by objects being sensed. Similar instruments for remote sensing can operate from aircraft or satellites.

RGB: The system of specifying colors by their red, green, and blue saturations.

Scale: The part of the map display that shows the scale of the map figure as either an expression of values (the representative fraction as a number) or as a graphic, usually a line on the map labeled with an equivalent and whole-number length on the ground, such as 1 kilometer or 1 mile.

Scientific visualization: Use of the human visual processing system assisted by computer graphics, as a means for the direct analysis and interpretation of information.

Shareware: Data or software placed in the public domain for distribution, whose use or support involves the payment of a (usually token) fee to the author.

Spatial data transfer standard (SDTS): The formal standard specifying the organization and mechanism for the transfer of GIS data between dissimilar computer systems. Adopted as FIPS 173 in 1992, SDTS specifies terminology, feature types, and accuracy specifications as well as a formal file transfer method for any generic geographic data. Subsets for the standard for specific types of data, vector, and raster, for example, are called profiles.

SPOT (Systeme Proprietaire pour l'Observation de la Terre): A French remote sensing satellite system with 10- and 20-meter resolution and stereo capability.

TCP/IP: A network communications protocol that forms the basis of most communications on the Internet.

TIGER: A map data format based on zero, one, and two cells, used by the U.S. Census Bureau in street-level mapping of the United States.

Topographic map: A map type showing a limited set of features but including at the minimum information about elevations or landforms. Examples: contour maps. Topographic maps are common for navigation and for use as reference maps.

Topologically clean: The status of a digital vector map when all arcs that should be connected are connected at nodes with identical coordinates and the polygons formed by connected arcs have no duplicate, disconnected, or missing arcs.
Unix: A computer operating system that has been made workable on virtually every possible computer and has become the operating system of choice for workstations and science and engineering applications.

user interface: The physical means of communication between a person and a software program or operating system. At its most basic, this is the exchange of typed statements in English or a program-like set of commands.

UTM (Universal Transverse Mercator): A standardized coordinate system based on the metric system, and a division of the earth into sixty 6-degree-wide zones. Each zone is projected onto a transverse Mercator projection, and the coordinate origins are located systematically. Both civilian and military versions exist.

vector: A map data structure using the point or node and the connecting segment as the basic building block for representing geographic features.

visual hierarchy: The perceptual organization of cartographic elements such that they appear visually to lie in a set of layers of increasing importance as they approach the viewer.

WIMP: A GUI term reflecting the primary user interface tools available: windows, icons, menus, and pointers.

workstation: A computing device that includes as a minimum a microprocessor, input and output devices, a display, and hardware and software for connecting to a network. Workstations are designed to be used together on local area networks, and to share data, software, and so on.

World Wide Web (WWW or W3): A distributed database of information connected by the Internet and special-purpose software for browsing, searching, and downloading.