

## Example / Study Questions for Final Exam

The final exam will consist of two sets of questions: (1) 50 questions on topics covered since the second midterm, and (2) 50 comprehensive questions from any part of the semester.

The following questions from part I of a recent exam should give you a good idea of the nature of questions, as well as a sample of the concepts that will be covered on of the exam. To help prepare for the comprehensive part you might revisit the review questions for exams 1 and 2, as well these. However, the exam will have different questions, so preparation for it should be more than finding the answers to these particular questions. But, many of the exam questions will be related to these questions, so likely good to be familiar with the concepts in these questions.

1. Hyperspectral sensing
  - a. combines imaging and spectroscopy
  - b. enables direct identification using diagnostic absorption and reflection features of materials
  - c. applications include determination of atmospheric aerosols and water vapor, monitoring chlorophyll (in both vegetation and water), and mapping minerals
  - d. all of the above
2. Lidar systems include a
  - a. laser scanner and a precise clock to measure times of laser pulse returns
  - b. differential GPS and an inertial navigation system to determine exact position of airplane
  - c. computer system capable of rapidly recording large amounts of data (e.g., up to 30,000 measurements per second)
  - d. all of the above
3. Contemporary lidar systems differentiate between primary and secondary returns to determine ground elevation and heights of trees.
  - a. true
  - b. false
4. Lidar has the potential to provide better maps of heights of both the ground surface and forest canopies than photogrammetry of stereo photography.
  - a. true
  - b. false
5. Applications of lidar include
  - a. measuring forest timber heights and volume
  - b. mapping landslide hazards
  - c. assessing streambank erosion
  - d. creation of virtual landscapes that can be viewed from any perspective
  - e. all of the above
6. Lidar and radar
  - a. are both active remote sensing systems which can be used to collect data at night, but only radar can "see through" clouds
  - b. are both passive remote sensing systems capable of providing accurate elevation and height data
  - c. both depend on the precise measurements of time between the transmission and return of energy pulses to determine distance to the surface
  - d. a and c

7. Radar images display gray tones that are proportional to
  - a. the surface color
  - b. the amount of backscatter of the surface
  - c. the azimuth and zenith angles of the surface and the radar antenna
8. Radarsat imagery may be acquired at spatial resolutions and swath widths of
  - a. 10 meters and 50 km
  - b. 30 meters and 100 km
  - c. 50 meters and 150 km
  - d. 100 meters and 500 km
  - e. all of the above
9. Radar data is readily available in multi-frequency and multi-polarization modes that can be classified by the same methods used for optical multispectral data
  - a. true
  - b. false
10. Which of the following “make sense” and take advantage of information available in radar data?
  - a. combining Landsat and Radarsat data as a potential means to increase the accuracy of land cover classification
  - b. mapping vegetation fluorescence
  - c. using Radarsat data to monitor lake water clarity
  - d. all of the above
11. The Shuttle Radar Topography Mission
  - a. used radar signals collected at two antennas and a process known as interferometry (somewhat similar to stereo imaging) to determine topographic height
  - b. is providing more precise topographic maps and digital elevation models than previously available for much of the world
  - c. a and b
12. The fundamental components of information needed to identify/describe any mapped feature in a GIS are its:
  - a. vegetation type, soils, topography, and hydrology characteristics
  - b. geographic position, attributes, spatial relationships to other features
  - c. environmental characteristics
  - d. economic and social characteristics
  - e. all of the above
13. Map layers in a GIS that have been derived from digitized aerial photos will contain geometric errors unless the photos were ortho-photographs.
  - a. true
  - b. false
14. Digital orthophoto quads (DOQ's) are digital *representations* of aerial photos with ground features located in their true map positions (i.e., displacements caused by camera tilt, sensor orientation and terrain relief have been removed).
  - a. true
  - b. false
15. The basis of the Global Positioning System (GPS) is
  - a. triangulation of the signals from at least three satellites for which the location is precisely known
  - b. precise measurements of laser signals from at least three GPS satellites
  - c. reflection of GPS signals from the ground to at least three satellites whose locations are precisely known

16. A critical component of how the GPS works is the synchronization of signals from the satellites and ground receivers so that they are
  - a. received at exactly the same time
  - b. generated at exactly the same time
17. GPS provides capability to
  - a. help navigate airplanes on predetermined flightlines and precisely control where aerial photo centers are located
  - b. acquire X and Y coordinates
  - c. acquire X, Y, and Z coordinates
  - d. acquire data used in photogrammetry
  - e. a, c and d
18. Differential GPS uses two GPS receivers with one at a fixed, known location which is used to compare the calculated location and known location to determine the amount error, which is then used to correct measurements from the second receiver
  - a. true
  - b. false
19. The combination of GPS, GIS software and digital imagery on a field computer
  - a. has been used by U of M researchers to acquire field data needed for classification of wetlands and aquatic vegetation, forest regeneration surveys, and urban forest health research
  - b. may be possible on future computer systems, but is not possible today
20. Advantages of the commercial satellites include
  - a. acquisition of four bands of multispectral imagery, plus a higher resolution panchromatic band
  - b. spatial resolution approaching that of medium scale aerial photography such as NAPP
  - c. timely delivery of data in digital, GIS-compatible formats
  - d. all of the above
  - e. a, b, c, plus geographic coverage (swath widths) similar to Landsat
21. Pointable viewing of the sensors on the IKONOS and QuickBird satellites
  - a. enables (potential) acquisition of imagery at 3 to 5 day intervals instead of the 20 or so it might be if imagery could only be acquired at nadir view angles
  - b. introduces possible geometric errors, but this can be corrected for in the image processing
  - c. at certain combinations of view angle and sun angle causes specular reflection off of water, making lakes look like clouds, making it impossible to extract useful information about the water properties
  - d. all of the above
22. High-resolution satellite systems such as IKONOS and QuickBird
  - a. extend satellite remote sensing to applications beyond what has traditionally been done with aerial photography, but the applications are probably best restricted to local areas
  - b. will likely replace systems such as Landsat because of their much higher spatial resolution
  - c. both a and b
23. "Pan-sharpening" of imagery
  - a. refers to merging coarser resolution multispectral (color) bands with a higher resolution panchromatic band to simulate higher resolution multispectral imagery
  - b. provides a means to obtain imagery of higher resolution than aerial photography
  - c. increases contrast by reducing atmospheric effects (i.e., haze)
  - d. all of the above

24. The combination of pointable viewing and pan-sharpening of IKONOS and QuickBird imagery ensures acquisition of cloud-free imagery.
- true
  - false
25. Which of the following sensor systems does not belong with the others (i.e., is from a different “family” of sensors than the others)?
- ASTER
  - MISR
  - MOPITT
  - MODIS
  - SPOT
26. Relationships to parameters such as impervious surface area and lake water clarity that have been developed with Landsat TM data have also been found with high resolution IKONOS data, but using the same methods (e.g., supervised training and per pixel maximum likelihood classification) as used with Landsat data for land cover classification may be difficult.
- true
  - false
27. MODIS, one of several sensors on the Earth Observing System (EOS) Terra satellite,
- has three scanners operating in the reflective, thermal and microwave regions at 50-meter resolution
  - is a 36-channel imaging spectrometer with resolution of 250 to 1000 meters which collects data over geographic areas similar to NOAA AVHRR coverage
  - collects data at 36 different view angles from -60 to +60 degrees in 3 spectral bands
28. MODIS includes spectral bands to sense the atmosphere which can be used for correcting for atmospheric effects in
- MODIS imagery
  - Landsat 5 TM and AVHRR data
  - Landsat 7 ETM+ data (because the orbit and time of data acquisition are very similar to Terra’s)
  - all of the above
  - only a and c
29. Potential applications (and standard data products) of MODIS data relate to
- land cover type mapping
  - monitoring biological productivity of vegetation and oceans
  - monitoring sea surface temperature
  - mapping snow cover and sea-ice
  - all of the above
30. The MISR sensor on the Terra satellite collects data with
- 4 spectral bands and 9 view angles
  - 9 spectral bands and 3 view angles
  - 36 spectral bands with nadir (0 degrees) view angle
31. The characteristic that distinguishes ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) from Landsat TM or ETM+ data is its
- multispectral thermal data (5 thermal infrared bands)
  - 24-bit radiometric and 5-meter spatial resolutions
  - daily coverage of the entire globe
  - all of the above (in other words, higher spectral, radiometric, spatial and temporal resolutions and geographic coverage)
32. What is Aqua?
- the second Earth Observing System (EOS) satellite, following Terra, with a suite of sensors for long term monitoring of oceans, land and atmosphere
  - a new blue-green spectral band for monitoring algae growth

33. What is EnviSat?
- the European counterpart to EOS that was launched in 2002 with an even larger suite of sensors that includes a radar
  - a new high-resolution satellite to be launched by ORBIMAGE later this year
  - a new subsidiary of ComSat that will place environmental sensors on communications satellites
34. The examples of land cover classification presented in class suggest that it is reasonably possible to obtain classification accuracies of Landsat TM data of Level I land cover classes of
- 65-75%
  - 75-85%
  - 85-95%
  - 95-100%
35. If two classifications of 90% accuracy are used to generate a difference map, the expected accuracy of the resulting change detection map will be
- 90%
  - 81%
  - 99%
36. If the NDVI is strongly related to the amount of green vegetation, it is also strongly related to the amount of impervious surface (i.e., absence of green vegetation) enabling the percent of impervious surface area to be estimated and mapped at the pixel level.
- true
  - false
37. Classification of lake water clarity requires a “pre-classification” to separate water from land and vegetation and is used to mask out the non-water pixels.
- true
  - false
38. Landsat monitoring of the clarity of Minnesota lakes
- is based on a strong relationship between the ratio of blue and red bands of Landsat TM and ETM+ data and Sechhi depth transparency
  - requires clear imagery in May or June
  - is not likely to ever be a routine or operational application of satellite remote sensing because of its high cost
39. Temporal changes or trends, as well as geographic patterns, in lake clarity can be monitored with the Landsat TM data that have been acquired over the past 20 years, as long as *in-situ* measurements of clarity to calibrate the Landsat data are also available.
- true
  - false
40. The Earth Observatory is
- the next generation of satellite remote sensing system being planned by NASA for launch in 2010
  - a NASA Internet website with information about Earth Science observations and missions focusing on climate and environmental change
  - the satellite recently launched by the European Space Agency
41. Significant environmental phenomena that have been identified and analyzed by satellite remote sensing in recent years include
- the increasing amounts and duration of green vegetation in the boreal forest regions of Asia, Europe and North America
  - tropical deforestation, fires and smoke
  - changes in lake levels and retreating glaciers
  - atmospheric sulfur dioxide and ash plumes released from volcano eruptions
  - all of the above