Write a short (1000 word) essay summarizing what you learned in this course. Include a paragraph (100-words) suggesting specific improvements to future offerings.

From Michael

**What I Learned**

My only previous experience with GIS before this course was implementing Google Maps on websites, so there was a lot of new material covered.

A lot of the technical differences between raster and vector data was familiar to me because of my background working with graphics. What I was missing though was the differences in application and appropriate use cases for the two data formats in the GIS context.

A similar experience arose when discussing GIS databases. I have been using and administering relational databases in a desktop and website context for a long time, but the opportunity to work with Oracle Spatial and to learn more about the fundamentals of storing GIS data expanded my horizons appreciably. It was also good to learn about B-Trees, R-Trees and indexing methods again.

Since this was one of my first GIS courses, the fact that we covered a lot of basics like geometric operations and correlation was helpful. I also didn't know about focal, local or zonal operations. I have since used these operations in other classes. It would have been interesting to have a tighter connection between labs and class work, and to be able to learn how to do these operations in Oracle or something like that.

One of the areas I was especially interested in was spatiotemporal databases. I had done some research on genealogy databases and knew that there aren't any advanced spatiotemporal databases in use in the genealogy field. I was surprised to learn that this area (spatiotemporal databases) is still an area of active research and that there are still questions about how to define and store temporal data. This is an area I would've been interested in discussing more in class.

Lastly, I found the discussions about routing methods very interesting. I had heard computer science friends discuss dijkstra's algorithm and the A* algorithms, but hadn't ever learned of them before. Although it's more likely that I will use a pre-built tool to use those sorts of analysis, I appreciate understanding at some level what is happening behind the scenes.

**Suggestions for Future Offerings**

I think the biggest problem is that it seemed the course couldn't decide if it wanted to be an introduction to GIS (in the book, slides), to explore new topics in GIS (with news, discussion), or offer practical hands-on experience (the labs, homework). About ½ of the material covered in this course was also covered in GEOG 3561/5561 *Principles of Geographic Information Science* this semester as well.

I would recommend assuming a basis GIS experience and replace the GIS introduction with more advanced topics or more labs.

Lastly, I liked my team mate, but would have liked the opportunity to work with more people and get to know other students.
From Tim
Course Summary

**Knowledge learn from textbook:**

I have got an overview of the researches in the geo-information filed from both theoretical perspective and practical perspective. The contents involves with both geography and computer science.

The spatial field firstly provides me with important notions in discrete mathematics and topology. In order to represent the state space, such as the objects in it and the relationship between them, we need to do abstraction by mathematical definitions. The principles in different kinds of representations are clarified, the variables used to indicate the points, lines and polygons as well as computation operations are also elaborated. I now know the techniques for representations in Euclidean geometry, Set theory, Topology, Graph and Network, Metric and Fractal, the transformations and properties in each of them, the advantages and disadvantages compared among them.

Then, the models to representation are introduced. The modeling process consists of different conversion stages from the 'application domain' to the 'physical computational model'. To complete such a process two strategies are proposed, namely, field-based modeling and object-orientated modeling. The former one is focus the collection of attributes and contains 'Local', 'Focal', 'Zonal' operations whereas the latter one decomposes the information space into entities and defines lots of spatial operations(equals, union, overlaps, closure, distance, centroid etc.)

The third topic is the spatial reasoning and uncertainty. Some examples of logical inferences are given here, but they are useful only under some conditions. In fact, the uncertainty of spatial data arises due to the imperfection of knowledge base, so the qualitative approaches(possible worlds, belief revision, fuzzy sets, rough sets) and the quantitative approaches(Bayesian probability, Dempster-Shafer theory of evidence) are used to handle the uncertainty.

The last part introduces the spatiotemporal information system which concentrates on the 'Time' factor. From static representation, snapshot metaphor to object lifeline then the dominant events, actions and processes, we gradually combine the time attribute with the original geo-information. Then I learned the 'transaction time references' and 'valid time references' on which the so-called bi-temporal system is based, and arrays can be applied to implement the spatial modeling in bi-temporal system. Finally, we studied on some new data storage structures(overlapping B-tree, segment tree), new index and queries methods(bi-temporal MBBs, historical R-tree)

From the computer science area, the course mainly covers the knowledge of database data structures and algorithms. I gained from following 4 aspects:

(a) Fundamental concepts and principles in rational database and object-oriented database. DBMS, SQL, conceptual data modeling, extended-entities-relationship model, database design,etc.

(b) The hybrid, integrated, and composable architectures of the GIS system. How to tackle the syntactic and semantic heterogeneity issues in spatial data integration. Usage of distributed systems, distributed databases and distributed DBMS. The relationship among 'location-aware computing', 'pervasive computing' and 'mobile computing'.

(c) The representations used in Euclidean plane and the design and implementation of three representations used in spatial object domain(Spaghetti, arc-node-area, doubly connected edge list). Representations for field-based models(tessellation, triangulation, Voronoi diagrams). Also lots of basic algorithms in Euclidean geometry, Set theory, Topology, Graph and Network, tree search algorithms, shortest-path algorithms. The time complexity comparison among them.

(d) B-tree and tree are the basic data structures used in one-dimensional data indexing. The properties of the raster data, point object data, linear/vector object data, collections of objects, spherical data. Data structure for efficient indexing operation for each of them(Region Quadtree) (Point
Quadtree, 2D tree) (PM tree) (R-tree, tree) (Quaternary triangular mesh)

Knowledge learn from labs, course project, trends, news and web experiments:

(1) Learn to use some spatial indexing functions and queries sentences to accomplish certain data processing tasks in the Oracle database.
(2) Learn to programming with Google Map API, Google Calender API, php, javascript
(3) Learn the latest innovations in GIS related researches and newest information about the GIS related software products.
(4) Learn to use html5, Google Fusion Table.