The University of Calgary
Faculty of Environmental Design
EVDS 611 - Winter 2012
Time: Friday 9-12:00 AM
Location: PFA 2165/ PC LAB

Course Title: Geographic Information Systems for Environmental Design

Instructors: Dr. Richard M. Levy

Course Calendar Description

Introduction to the use of GIS in urban planning and environmental management. Discussions on GIS modeling focus on population projection, location theory, land use modeling and environmental and ecological management. Case studies from both the public and private sector provide the basis of assignments. Emphasis given to developing a sensitivity to the application appropriate for specific GIS problems.

Course Goals

Students in the course will have an opportunity to develop an understanding of the theory and practice of GIS and remote sensing. In addition to class lectures and discussions, guest lectures and lab sessions will introduce students to both raster and vector based GIS applications used by professionals in environmental management and urban planning. Several assignments will be given during the term. A goal of these assignments will be to develop a sensitivity to the application appropriate for solving specific GIS problems. Many of the lectures will be illustrated by actual problems encountered in practice. Topics that will be discussed during the term include:

- GIS and mapping
- Decision support and GIS
- Sources for GIS and remote sensing data
- Data structures and data management
- Interpretation of multi-spectral, radar and other remote sensing data
- Land use classification
- Topographical analysis
- Design and implementation of GIS
- Modeling with GIS
- Biodiversity Monitoring and Habitat Modeling
- Spatial Analysis with GIS
- Data visualization

Labs are an integral component of the course. During the semester you will have an opportunity to work with the two most popular desktop GIS applications in the market place: ArcGIS and MapInfo. In addition to acquiring experience with GIS software, you will learn how to utilize ACCESS as a database management tool. This will be a particularly important skill for those who plan to acquire field data as part of your graduate research. During the course you will also be introduced to EXCEL as a tool for data organization and statistical analysis.

Students should have a basic understanding of EXCEL for this course. If you have any questions about this course please contact the instructor at rmlevy@ucalgary.ca

Readings:

Links to articles will be available from Blackboard.

General References:
Antennucci,J.C., Geographic Information Systems, A Guide to the Technology, New York, New York: Van Nostrand Reinhold, 1991.
Berry, J. Beyond Mapping: Concepts: Algorithms and Issues in GIS, N.Y.: John Wiley & Sons.
Huxhold, William E., An Introduction to Urban Geographic Information Systems, New York, New York: Oxford University Press, 1991.
Lillesand, Thomas and Ralph W. Kiefer, Remote Sensing and Image Interpretation, New York, New York: John Wile & Sons, Inc., 1994.

WebSources:
www.GIS.Com (ESRI supported website)
www.esri.com (ESRI home page)
http://www.gislounge.com/ (GIS portal)
http://www.csiss.org/ (GIS portal sponsored by a grant from NSF)
http://www.urisa.org/ (The Assoiciation for GIS Professionals http://www.freegis.org/
(Portal to free GIS software, documents and other
http://www.innovativegis.com/basis/ (Corporate website for Berry &Associates)

Software: MapInfo, ArcGIS, Google Earth, ACCESS, EXCEL

Assignments
Students will be asked to submit a research proposal as their first assignment. Those working on an MDP or thesis are encouraged to pursue their research as part of the course requirements.

1) Assignment 1: Research Proposal on a GIS topic (3-4 doubled spaced typed pages) -10%
2) Assignment 2: Urban Planning Study – (4-5 page double spaced report and map output) - 20% (total)
    i) Part a : Land Use Classification – 10%
    ii) Part b: Analysis of Land Use Patterns – 10%
3) Assignment 3: Urban Modeling – 15%
4) Assignment 4: Regional Planning – 15%
5) Assignment 5: Research Project (40%) – (10-12 page double spaced (3000-5000 words) – this project is based on your research proposal.

Late Assignments
All late assignments will be subject to a grade reduction. For each two days late, your grade will be reduced by . 33/ 4.00.

University Grading Policy
It is a University requirement to address the following aspects of course evaluation in a course outline: whether or not a passing grade on any particular component of a course is essential if the student is to pass the course as a whole; whether or not there will be a final examination and if an examination is held, whether the use of aids such as open book, etc. are permitted; the weights to be assigned to the various components which are to be considered in determining the final grade (term papers, laboratory work, class participation, tests, final examinations, etc.). This weighting may not be changed during the session or at the time of grade reporting; when writing and the grading thereof is a factor in the evaluation of the student's work. (Note: EVDS courses do not have "Registrar Scheduled" final exams.)

Grading Scale

Letter Grade	4-Point Scale	4-Point Range	Percent	Description
A+	4.00	4.00	92.5-100	Outstanding - evaluated by instructor
A	4.00	3.85-4.00	85-92.49	Excellent - superior performance showing comprehensive understanding of the subject matter
A-	3.70	3.50-3.84	80-84.99	Very good performance
B+	3.30	3.15-3.49	76-79.99	Good performance
B	3.00	2.85-3.14	73-75.99	Satisfactory performance
B-	2.70	2.50-2.84	70-72.99	Minimum pass for students in the Faculty of Graduate Studies
C+	2.30	2.15-2.49	66-69.99	All final grades below B- are indicative of failure at the graduate level and cannot be counted toward Faculty of Graduate Studies course requirements.
C	2.00	1.85-2.14	63-65.99	
C-	1.70	1.50-1.84	60-62.99	
D+	1.30	1.15-1.49	56-59.99	
D	1.00	0.50-1.14	50-55.99	
F	0.00	0-0.49	0-49.99	

Note: A student who receives a B- or lower in two or more courses will be required to withdraw regardless of their grade point average unless the program recommends otherwise. Individual programs may require a higher minimum passing grade. A grade point value of 3.0 on the 4-Point Scale is the minimum acceptable average that a graduate student must maintain throughout the program as computed at the end of each registration anniversary year of the program. A student who receives a grade of F will normally be required to withdraw unless the program recommends otherwise.

Schedule (Last updated December 28, 2011)

1. Introduction - Why GIS? - Jan.13

Course Goals and Objectives
GIS and RS
The Direction of the Industry
GIS as a Management Tool
GIS: A Historical Perspective
The Need for Data

Types of Spatial Data: Raster vs. Vector - Jan 13

Spatial Data Models
- Object Classes
- Raster and Vector

Projection
Storing Geometric Data and Images
- Points, Lines, Polygons
- Data Storage and Manipulation

Comparison of Raster and Vector systems
Image Compression
Analogue vs. Digital
Raster Vector Conversion

Readings
Introduction - Why GIS? - Jan.13

Drummond, William and Steven P. French, The Future of GIS in Planning, Converging Technologies and Divergent Interests, APA Journal; Spring 2008 74:2, pp 161-174.

http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdweb?index=0&did=1542879691&SrchMode=1&sid=9&Fmt=6&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1324745709&clientId=12303

http://ezproxy.lib.ucalgary.ca:2048/login?url=http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdweb?did=1542879691&sid=9&Fmt=6&clientId=12303&RQT=309&VName=PQD

Goodchild, Michael, Dondald G. Janelle, Toward Critical thinking in the social Sciences and Humanities Geo Journal 2010, 75:3-13

http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdweb?index=1&did=1967489111&SrchMode=1&sid=3&Fmt=6&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1325087552&clientId=12303
http://ezproxy.lib.ucalgary.ca:2048/login?url=http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdweb?did=1967489111&sid=3&Fmt=6&clientId=12303&RQT=309&VName=PQD

GIS Database concepts, A Tutorial, 1998 Sections 1 URISA
http://www.urisa.org/files/publications/gis_database_concepts/gis_db_concepts.PDF

Census Data Description
Henry A. Puderer STANDARD GEOGRAPHIC AREAS FOR THE 2001 CANADIAN CENSUS, URISA Proceedings, 2001
http://downloads2.esri.com/campus/uploads/library/pdfs/20053.pdf

Case Studies
Rina Ghose and William E. Huxhold The Role of Multi-scalar GIS-based Indicators Studies in Formulating Neighborhood Planning Policy, URISA Journal, 2002, 14: 2: 5- 17
http://downloads2.esri.com/campus/uploads/library/pdfs/24708.pdf

Suggested Readings
Berry, Joseph K, Beyond Mapping, Concepts, Algorithms, and Issues in GIS, Chapt. 5,6.

Hiller, Amy 2010, Invitation to Mapping: How GIS Can Facilitate New Discoveries in Urban and Planning History, Journal of Planning History
http://jph.sagepub.com.ezproxy.lib.ucalgary.ca/content/9/2/122.full.pdf+html

2. Photographic Data, Surveying, Land Use Classification – Jan. 20

What is Data what is Image
The History and Science of Photography
Mechanics of Photography
Photographic Distortion
Land Use Classification
Introduction to Surveying Principles
GPS

Readings
Aerial Imagery Guidelines, URISA 1999
http://www.urisa.org/files/publications/aerial_imagery_guidelines/aerial_imagery.pdf

Nigam, R. K. Application of Remote Sensing and Geographical Information System for Land Use/Land Cover Mapping and Change Detection in Rural Urban Fringe Area of Enschede City, The Netherlands, URISA URISA Proceedings 2002

http://downloads2.esri.com/campus/uploads/library/pdfs/24017.pdf

Readings Available on Blackboard
Rajan, K.S. and R. Shibasaki, (2001) A GIS Based Integrated Land Use/Cover Change Model to Study Agricultural and Urban Land Use Changes, 22nd Asian Conference on Remote Sensing, Proceedings, 5-9 November, Singapore,

Suggested Readings
Lillesand, Thomas and Ralph W. Kiefer (1994) Remote Sensing and Image Interpretation, New York, New York: John Wile & Sons, Inc.
Jensen, John R, Remote Sensing of the Environment, Chapter 12, Remote Sensing the Urban Landscape, pp. 407-417

3. Introduction to Remote Sensing – Jan 27

Electromagnet Spectrum
Reflectivity, Absorption
Data Types:
- Multispectral
- Panchromatic
- Radar
- Lidar

Data Sources:
- Satellite
  - Landsat TM, RadarSAT, Ikonos, Airborne

Readings

Jensen, John R, Michale E Hodgson, Jason A. Tullis and George T. Raber, Geo-spatial technologies in urban environments 2005, 2, ISBN 3540222634, xvi, 176 p.
http://www.springerlink.com.ezproxy.lib.ucalgary.ca/content/q52182m5274w0238/fulltext.pdf

Palmer, Trent C. And Jeffrey Shan, A Comparatitive Study on Urban Visualization Using LIDAR Data in GIS 2-URISA Journal. 2002
http://downloads2.esri.com/campus/uploads/library/pdfs/24709.pdf

Mayfield, Brian, Demystifying Advanements in Digital Orthophotography, URISA Proc. 2002
http://downloads2.esri.com/campus/uploads/library/pdfs/11745.pdf

Richards, J. A and Jia, Xiuping 2006, Engineering, Geographical Information Systems/Cartography, Digital techniques, Ecotoxicology, Remote sensing Sources and Characteristics of Remote Sensing Image Data 4th Edition, ISBN 3540251286, Chapter 1 only
http://www.springerlink.com.ezproxy.lib.ucalgary.ca/content/q522t637tw493971/fulltext.pdf

Case Studies

S. Farooq . S. Ahmad, Urban Sprawl Development Around Aligarh City: A Study Aided by Satellite Remote Sensing and GIS, J Indian Soc. Remote Sens March 2008, 36:77-88.
http://www.springerlink.com.ezproxy.lib.ucalgary.ca/content/8828n6588563166g/
http://www.springerlink.com.ezproxy.lib.ucalgary.ca/content/8828n6588563166g/fulltext.pdf

Henry, Bob The Potential of Lidar in Urban And Regional Development, URISA Proceedings. 2000.
http://downloads2.esri.com/campus/uploads/library/pdfs/12769.pdf

Kaya, S., T. J. Pultz, C. M. Mbogo, J. C. Beier, and E. Mushinzimana. 2002. The use of radar remote sensing for identifying environmental factors associated with malaria risk in coastal Kenya. International Geoscience and Remote Sensing Symposium (IGARSS '02), Toronto, June 24-28, 2002. (PDF on Blackboard)

References

Lillesand, Thomas and Ralph W. Kiefer. 1994. Remote Sensing and Image Interpretation, New York, New York: John Wile & Sons, Inc, Chapter 1.

4. Lab – Urban Planning Study – Feb 3

5 . Introduction to Modeling – Prof. Levy – Feb. 10

Quantitative Modeling vs. Qualitative Modeling
Prediction and Statistical Inference
The Demands of Modeling
Modeling and GIS

Lee, Douglas , 'Retrospective on Large Scale Urban Models', APA Journal, 1994: Vol. 60, No. 1, pp. 35-40.

http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdlink?vinst=PROD&fmt=6&startpage=-1&vname=PQD&RQT=309&did=135253&scaling=FULL&vtype=PQD&rqt=309&TS=1322780353&clientId=12303

http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdlink?vinst=PROD&fmt=6&startpage=-1&ver=1&clientid=12303&vname=PQD&RQT=309&did=135253&exp=11-29-2016&scaling=FULL&vtype=PQD&rqt=309&TS=1322782012&clientId=12303

Britton Harris The Real Issues Concerning Lee's Requiem, APA Journal, Winter 1994 60:,1:31-34/
http://ucalgary.summon.serialssolutions.com/search?s.q=+&t.AuthorCombined=Britton+Harris&t.TitleCombined=The+Real+ISsues

http://ezproxy.lib.ucalgary.ca:2048/login?url=http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdweb?did=2391&Fmt=2&clientId=12303&RQT=309&VName=PQD

http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdlink?vinst=PROD&fmt=6&startpage=-1&vname=PQD&RQT=309&did=2391&scaling=FULL&vtype=PQD&rqt=309&TS=1325092917&clientId=12303

6 . Urban Modeling - Feb. 17

Historical Development of Cities
Econometric Modeling
Land Use Modeling
Transportation Studies

Readings
Landis, John and Ming Zhang Modeling Urban Land Use Change: The Next Generation of the California Urban Futures Model 1997.

http://www.ncgia.ucsb.edu/conf/landuse97/papers/landis_john/paper.html
David Martin, Directions in Population GIS Geography Compass 2011 655-665

http://onlinelibrary.wiley.com.ezproxy.lib.ucalgary.ca/doi/10.1111/j.1749-8198.2011.00440.x/pdf

Michael D. Walls, Data Modeling, Second Addition URISA, 2007
http://www.urisa.org/files/publications/data_modeling/data_modelingII.pdf

Census Data Description
Henry A. Puderer STANDARD GEOGRAPHIC AREAS FOR THE 2001 CANADIAN CENSUS, URISA Proceedings, 2001
http://downloads2.esri.com/campus/uploads/library/pdfs/20053.pdf

Suggested Readings:

Azad, Bijan, (1995) 'Theory and Measurement in GIS Implementation Research: Critique and Proposals', Third International Conference on Computers in Urban Planning and Urban Management, Vol. 1: 51-87.

Catanese, Anthony J.,(1972) Scientific Methods of Urban Analysis, Chicago: University of Illinois Press, pp 3-20.

Freund, Introduction to Statistics Chapt. 14, 359-398.

Harris,B., 'Quantitative Models of Urban Development: Their Role in Metropolitan Decision-Making in Decision-Making in Urban Planning, Ira Robinson, ed., Beverly Hills, California: Sage Publications Inc., pp.115-138, 1972.

Harris, B. GIS and Urban Models: Cooperation Through the Division of Labor, http://downloads2.esri.com/campus/uploads/library/pdfs/6291.pdf

Landis, John D. (1995) 'Imagining Land Use Futures, Applying the California Urban Futures Model', APA Journal, Vol.61, 4, Autumn: 438-457.
http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdweb?index=9&did=8642359&SrchMode=3&sid=2&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1325094446&clientId=12303&aid=1

Case Studies:

Black, Alan (1989) 'Analysis of Trends in Transit Work Trips', APA Journal, Winter:38-43.

Diamond, Douglas B.,Jr. (1982) 'The Economic Role of Urban Amenities', Ch. 1, Academic Press.

Demery, Leory, Jr. W., 'Supply-Side Analysis and Verification of Ridership Forecasts for Mass Transit Capital Projects', APA Journal, 1994: Vol. 60, No. 3, pp. 355-371.

Gomez-Ibanez, Jose A. (1996) 'Big-City Transit Ridership, Deficits, and Politics, Avoiding Reality in Boston, APA Journal, Vol 61, 1, Winter:30-50.

Tony Giarrusso,Combating Urban Sprawl Center for Geographic Information Systems, Georgia Institute of Technology Atlanta, Georgia, Dec. 2003.
http://www.esri.com/news/arcuser/1003/sprawl1of2.html

Landis, John D. 'Imagining Land Use Futures, Applying the California Urban Futures Model', APA Journal, Vol.61, 4, Autumn, 1995, pp. 438-457

Pijanowski, B. C., et.al, (1997) 'A Land Transformation Model: Conceptual Elements, Spatial Object Class Hierarchies,' GIS Command Syntax and Application for Michigan's Saginaw Bay Watershed ,Land Use Modeling Workshop, EROS Data Centre, Sioux Falls, SD.

Roakes, Susan L., Richard Barrows and Harvey M. Jacobs (1994) 'The Impact of Land Value and Real Property Taxation on the Timing of Central City Redevelopment', Journal of Planning Education and Research, Vol. 13, No. 3: 174-184.

Torrens, Palu, M. (2000) 'How Cellular Models of Urban Systems Work (1. Theory), CASA Paper 28.

Weber, Eleanor and Peter H. Rossi (1996) 'The Social Benefits of Homeownership: Empirical Evidence from National Surveys, Housing Policy Debate, Vol. 7, No. 1: 1-35.

Mizuki Kawabata Urisa Journal (conference) Spatial Temporal Analysis of Job Access Inequality Between Cars and Public Transit
http://downloads2.esri.com/campus/uploads/library/pdfs/63732.pdf

7. Block Week - No Class - Feb 24

8. Urban Modeling Lab – March 2

9. Data Structures, Database Management - March 9

Flat Files
Data structures
Relational Databases
Building a Database: Design, Implementation and Management
Database Development and Corporate Culture

Readings:

Harris, Britton GIS and Urban Models: Cooperation Through the Division of Labor URISA Proceedings, 1999
http://downloads2.esri.com/campus/uploads/library/pdfs/6291.pdf

GIS Database concepts, A Tutorial, 1998 Sections 2-6 URISA
http://www.urisa.org/files/publications/gis_database_concepts/gis_db_concepts.PDFDavid J. Martin and

Davide W. Reid, The Internet, Web and E-Commerce, URISA, 2000
http://www.urisa.org/files/publications/internet_web_ecommerce/internet_web_ecommerce.pdf

Census Data Description

Henry A. Puderer STANDARD GEOGRAPHIC AREAS FOR THE 2001 CANADIAN CENSUS, URISA Proceedings, 2001
http://downloads2.esri.com/campus/uploads/library/pdfs/20053.pdf

Suggested Readings

Huxhold,W.E., (1991) An Introduction to Urban Geographic Information Systems, New York, New York: Oxford University Press, 1991, chpt 1,2.
Cowen,D. and W.L.Shirley. (1991) 'Integrated Planning Information Systems', in Geographical Information Systems, David Maguire, ed., John Wiley & Sons, Inc., 297-310.
Parr, Daniel, (1994) 'Geographic Data or Information, You Make the Choice', GIS World, Vol. 7, No.4:50-52.
Korte, George, 'Garbe In, GEOWORLD, October 2000, pp. 42-46

10 3D Data: GIS and the 3D World - March 16

Representing the 3D world
Points
Contours
DEMS
TINS
GRIDS
Sources of Topographic Data
Modeling Topography
Building a 3D model for Visual Impact Assessment

Esnard, Ann-Margaret Urban Modeling with ArcGIS 3D Analyst and SketchUp, Director, Visual Planning Technology Lab Florida Atlantic University.
http://www.esri.com/news/arcuser/0207/urban.html

Mak, Ann Shuk-Han, Ernest Kin-Man Yip, and Poh-Chin Lai , Developing a City Skyline for Hong Kong Using GIS and Urban Design Guidelines URISA Journal 2005 17, 1: 33-42
http://downloads2.esri.com/campus/uploads/library/pdfs/119148.pdf

Case Studies
Guiding Growth in Booming Las Vegas
http://www.esri.com/news/arcuser/0704/boominglv.html

Kenichic Sugihara, Amin Hammad, Yoshituga Hayashi, GIS Based Systems for Automatic Generation of 3D Urban Models and Its Applications. URISA Proceedings 2000.

Mak, Ann Shuk-Han, Ernest Kin-Man Yip, and Poh-Chin Lai , Developing a City Skyline for Hong Kong Using GIS and Urban Design Guidelines URISA Journal 2005 17, 1: 33-42
http://downloads2.esri.com/campus/uploads/library/pdfs/119148.pdf

Suggested Readings
Wagner, Mary Jo (1995) 'Seeing in 3-D without the Glasses', Earth Observation Magazine, July,:51-53.
Berry. GIS in 3D, Visualization Shines in Divers Applications, GEOWORLD, October 2001, pp. 30-45.

11. Regional Planning and Bio Physical Assessment – March 23

Readings
Zhanli Sun, Brian Deal http://www.leam.uiuc.edu ,A Spatially Explicit Urban Sprawl Simulation Model: Land-use Evolution and Impact Assessement Model (LEAM) URISA Proceedings. 2004.
http://downloads2.esri.com/campus/uploads/library/pdfs/35942.pdf

Karin Pfeffer*, Edzer J. Pebesma and Peter A. Burrough, Mapping alpine vegetation using vegetation observations and topographic Attributes, Landscape Ecology, 2003 759-776
http://www.springerlink.com.ezproxy.lib.ucalgary.ca/content/n231351m7j773823/fulltext.pdf

Suggested Readings: Water Modeling
Y.B. Liu a, F. De Smedt a, L. Hoffmannb and L. Pfister Assessing land use impacts on flood processes in complex terrain by using GIS and modeling approach, Environmental Modeling and Assessment 2004 9: 227–235.
http://proquest.umi.com.ezproxy.lib.ucalgary.ca/pqdlink?vinst=PROD&fmt=6&startpage=-1&vname=PQD&RQT=309&did=802805491&scaling=FULL&vtype=PQD&rqt=309&TS=1323046808&clientId=12303

Schill, Steven and John Jenson, Modeling to predict Stomrwater Runaoff in Withers Swash Murtle Beach, SC. URISA Proceedings, 1998
http://downloads2.esri.com/campus/uploads/library/pdfs/6046.pdf

Case Studies:
Conway, Katie Wolf Recovery, (1996) Wolf Recovery: GIS Facilitates Habitat Mapping in the Great Lake States', GIS World, Nov.:54-57.
Krisp, J. M., S. Vare, J. Dame, and K. Virrantaus. 2004. Visualizing moose habitat changes due to infrastructure construction in Southern Finland. XXth ISPRS Congress, 12-23 July 2004, Istanbul, Turkey, Commission 4. (See Blackboard site for EVDS 667 for publication).
Peterson, Darrel E. 'Grizzly Country, GPS/GIS Help Monitor the Great Bear's Fragile Ecosystem', (1996) GIS World, April,:52-55.
Prasad, P. Rama Chandra Prasad, K. S. Rajan C. B. S. Dutt , P. S. Roy A conceptual framework to analyse the land-use land-cover changes and its impact on phytodiversity:a case study of North Andaman Islands, India Biodivers Conserv (2010) 19:3073–3087
http://www.springerlink.com.ezproxy.lib.ucalgary.ca/content/h48n576106k09485/fulltext.pdf

Province of British Columbia. 2000. Moose in British Columbia. From British Columbia Ministry of Water, Land, and Air Protection web site: http://www.fmf.ca/publications.html#HabitatSuitability.
Romito, T., K. Smith, B. Beck, J. Beck, M. Todd, R. Bonar, and R. Quinlan. 1999. Moose winter habitat. Available from the Foothills Model Forest website.

12. Guest Lecturer – March 30

13. Good Friday – April 6 (NO CLASS)

14. Class Presentation – April 13

15. Final Project Due – April 20