



MMI 406 – DL 55 Syllabus
Fall 2010 (September 23rd – December 2nd 2010)
Decision Support Systems and Health Care

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Preferred means of contact is email. If the matter is extremely time-sensitive, students should call our cell phones. We intend to have a close interaction with students and any opportunity to speak is given the highest level of importance and priority. Please note that all appointment times, sync sessions and scheduled calls will be in the Central Time Zone.

Course Description

This course provides a practical survey and examination of clinical decision support systems over the past 20 years, along with how to apply the science of decision analysis with an emphasis on medical decision-making. The course also provides the foundation needed to apply clinical decision support in both patient care and clinical research settings. Students become familiar with the basic requirements for decision support systems, the graphical display of medical information to enhance decision-making, the application of rule-based systems, controlled medical terminologies, data standardization, clinical coding, structured data entry, natural language processing and data mining techniques. *Prerequisite: None. However, Med_inf 409 highly recommended.*

Text Books

1. Decision Making in Health and Medicine, Hunink et al, Cambridge University Press, ISBN: 9780521770293. (Initial printing was in 2001 and 6th printing in 2007)
2. Clinical Decision Support Systems: Theory and Practice, Berner, Eta S. (Ed.), 2nd ed., 2007, Springer, Health Informatics Series, XIV, 269 p., Hardcover, ISBN: 978-0-387-33914-6. Note that this text can be accessed for free as an e-book through the Galter Health Sciences Library (GHSL). Students can access it through the SpringerLink gateway. If off-campus, need to log into the GHSL web site first so that the system authenticates (through the proxy server) that you are a registered student before accessing library-licensed/subscribed online materials. If you are comfortable reading e-books online, you may consider this option as an alternative before you invest in a paper copy. Please visit <http://www.galter.northwestern.edu/>, sign in with your username (email address) and password, go to the *Medical Informatics* list to find an electronic copy of the book (should be #4 on the list).



3. OPTIONAL: Improving Outcomes with Clinical Decision Support: An Implementer's Guide, Osheroff et al, HIMSS, ISBN: 0-9761277-2-5
4. Select Articles: There will be assigned readings throughout the class, most of which are referenced in this syllabus.

Software

It is recommended to purchase the decision tree software TreeAge Pro Suite before the course begins. Please refer to the Assignment #1 in class lecture for details. Students need to provide their student ID number for the discounted student version at <http://server.treeage.com/treeagepro/purchase/stu.asp>

Pre-requisites

Interest in being stimulated and participating in an online course whose instructors' goal is to be the best Clinical Decision Support course in the world. There are no formal prerequisites for the course, but Med Inf 409 Biostatistics and Medical Informatics is highly recommended to be taken before this course. It is assumed that the students have taken their required entry-level courses or the equivalent.

Student Learning Goals

Upon completion of this course, the student will be able to:

1. Describe past and current uses of decision support systems in health care.
2. Explain the benefits and limitations of medical decision-making techniques.
3. Explain why clinical decision support systems are not in widespread use but that the demand and supply for them are increasing.
4. Identify the basic features, benefits, and limitations of machine learning and intelligent decision support methods in the healthcare environment.
5. Develop a decision-tree to model and address a healthcare problem.

Evaluation

Three Individual Assignments [30%]
Group Presentation [25%]
Final Exam [25%]
Class & Discussion Board Participation [20%]

Note that there is no mid-term. Assignments will be evaluated on the quality of the content and the adherence to the assignment requirements. Final exam will be a combination of multiple choice, True/False and short essay questions to be answered by integrating and applying knowledge learned in the course.

Grading Scale (subject to change based on actual student scores): A (91-100%), B (81-90%), C (71-80%), D (61-70%), Failure (0-60%)

Teaching Method

Classroom learning experiences are developed for each weekly session to help students achieve the learning goals. Some classes will consist of guest lecturers who are experts in their field will be invited to present for a part of most classes. The instructor and teaching assistant are experienced with teaching in previous courses and pull examples and examples from the real-world settings in which they currently work.

Discussion boards are provided to assure that students have achieved the learning objectives and challenge students to apply what they are learning. Selected external experts may teach and/or augment specific sessions. Classroom material will be augmented with discussions, in-class experiential learning exercises, assignments and a group project. This class will be very introspective, drawing experiences from students' existing experience and interest in the health care or technology field. About 15 articles will serve as the main reading material, with the 2 text books providing background information.

Discussion Board Etiquette

The purpose of Discussion Boards is to allow students to freely exchange ideas and participation is highly encouraged. It is important that we always remain respectful of one another's viewpoints and positions and, when necessary, agree to disagree, respectfully. While active and frequent participation is encouraged, cluttering a Discussion Board with inappropriate, irrelevant, or insignificant material will not earn additional points and may result in receiving a poor survey result from your student and teacher peers. Please remember to cite all sources – when relevant – in order to avoid plagiarism.

Proctored Assessment

There is a proctored assessment requirement in this course. For additional information, please go to the Assignment section in Blackboard and scroll to the Proctored Exam Approval Application item.

Attendance

This course will meet every Thursday from 7 – 9:30 PM CST, from September 23rd – December 2nd, 2010. The last class will take place on December 2nd (there is no class on November 25th). The final week of the course, from **December 3rd – December 8th, 2010**, will be allocated for a proctored final exam. Your attendance in both the class and discussion boards is mandatory, and will be included as part of the grading. Participation in classes and discussion boards will be assessed and reflected in the surveys distributed by the instructors for rating by the students and instructors.

Late Work

Any special circumstances for late work must have prior approval (at least 3 business days before due date) from the Instructor and/or Teaching Assistant. Failure to submit work on time without prior approval may result in lowering your assignment grade.



Academic Integrity at Northwestern: Students are required to comply with University regulations regarding academic integrity. If you are in doubt about what constitutes academic dishonesty, speak with your instructor or graduate coordinator before the assignment is due and/or examine the University web site. Academic dishonesty includes, but is not limited to, cheating on an exam, obtaining an unfair advantage, and plagiarism (e.g., taking material from readings without citation or copying another student's paper). Failure to maintain academic integrity will result in a grade sanction, possibly as severe as failing and being required to retake the course, and could lead to a suspension or expulsion from the program. Further penalties may apply. For more information, visit: http://www.scs.northwestern.edu/student/issues/academic_integrity.cfm

Plagiarism is one form of academic dishonesty. Students can familiarize themselves with the definition and examples of plagiarism, by visiting the site <http://www.northwestern.edu/uacc/plagiar.html>. Myriad other sources can be found online, as well.

Some assignments in this course may be required to be submitted through SafeAssign, a plagiarism detection and education tool. You can find an explanation of the tool [here](#). In brief, SafeAssign compares the submitted assignment to millions of documents in very large databases. It then generates a report showing the extent to which text within a paper is very similar or identical to pre-existing sources. The user can then see how or whether the flagged text is cited appropriately, if at all. SafeAssign also returns a percentage score, indicating the percentage of the submitted paper that is similar or identical to pre-existing sources. High scores are not necessarily bad, nor do they necessarily indicate plagiarism, since the score doesn't take into account how or whether material is cited. (If a paper consisted of just one long quote that was cited appropriately, the score would be 100%. This wouldn't be plagiarism, due to the appropriate citation. However, just submitting one long quote would probably be a pretty bad paper.) Low scores are not necessarily good, nor do they necessarily indicate a lack of plagiarism. (If a 50-page paper had all original material, except for one short quote that was not cited, the score might be around 1%. But, not citing a quotation would still be plagiarism.)

SafeAssign includes an option in which the student can submit a paper and see the resultant report before submitting it to the instructor as a final copy. This ideally will help students better understand and avoid plagiarism.

Other Processes and Policies: Please refer to your SCS student handbook at <http://www.scs.northwestern.edu/grad/information/handbook.cfm> for additional course and program processes and policies.

Course Schedule

Important Notes:

1. **Changes may occur to the syllabus** at the instructor's discretion. When changes are made, students will be notified during the quarter.
2. **Discussion Board posts:** Each Session you are required to participate in at least one Discussion Board thread. Your participation in both posting and responding to other students' comments will be considered in the grading.

WEEK 1 – September 23, 2010
Clinical Decision Support Systems

The framework for the course, from which greater detail will follow in subsequent classes, will be provided. An overview of decision support systems in general will be presented, along with examples of clinical decision support systems. Foundations of decision support will be discussed.

Learning goals:

- Compare and contrast information systems, decision support systems and expert systems
- Compare and contrast rule-based learning vs. machine based learning
- Provide examples of rule-based and machine based decision support systems
- Identify the knowledge base, inference engine and interface for various clinical systems
- Identify the 5 requirements of a DSS used for patient care

Readings required prior to class:

- Clinical Decision Support Systems: Chapters 8, 9, 10
- Articles:
 - 1) Sittig et al. Computerized screening for identification of ARDS patients
 - 2) East et al. Implementation issues and challenges for computerized clinical protocols for management of mechanical ventilation in ARDS patients
 - 3) Evans et al. A computerized approach to monitor prophylactic antibiotics
 - 4) Classen et al. Description of a computerized adverse drug event monitor using a hospital information system.
 - 5) Seger et al. Development of a Computerized Adverse Drug Event (ADE) Monitor in the Outpatient Setting.
- <http://www.coiera.com/aimd.htm> excerpt from Enrico Coiera's "Guide to Health Informatics 2nd Edition" Chapter 25 - Clinical Decision Support Systems
- Decision Making in Health and Medicine, Hunink et al: 1.1 – 1.5, 4.1, 4.2, 4.3, 4.5, 4.6
- Articles announced via Blackboard and available within the library system.

Assignments:

- Assignments 1, 2 & 3 will be posted to the course site and due dates are as follows:
 - a. Assignment 1: Due by Session 3: Decision Trees
 - b. Assignment 2: Due by Session 5: EHR Meaningful Use and CDS Rules
 - c. Assignment 3: Due by Session 7: Criticism of Petratos et al.'s Applied Clinical Informatics Paper
 - Students will be grouped into teams and assigned topics for their Group Projects. Group projects will consist of student teams mastering the material for their selected topic and presenting to the class during weeks 8 and 9.
- Begin to form groups for Group Project and submit names in week 2 along with 1 paragraph description of Group Project by week 4** (which will not be graded and feedback will be provided by instructors to ensure alignment with requirements of the project).

WEEK 2 – September 30, 2010

Planning, implementation and operation of systems

In this session, a practical overview of topics critical to the planning, implementation, and operation of decision support systems will be presented. Strategies for improving medical decisions with computer-based systems will be discussed. A framework for designing appropriate tests of clinical impact of decision support systems will be provided.

Introduction to **Decision Analysis** Assignment #1.

Learning goals:

- Analyze data and knowledge representation in decision support systems
- Explain the key issues in implementing clinical decision support systems
- Explain the methodology for systematic evaluation of decision support interventions

Readings required prior to this class:

- Clinical Decision Support Systems: Chapter 4
- Articles:
 - 1) Gesteland et al. Automated Syndromic Surveillance for the 2002 Winter Olympics
 - 2) Cimino, James. Desiderata for Controlled Medical Vocabularies in the Twenty-First Century
 - 3) Embi et al. Effect of a Clinical Trial Alert System on Physician Participation in Trial Recruitment

WEEK 3 – October 7, 2010

Quantitative Decision Making; Meaningful Use

In this session, we build on advanced topics like the characteristics of diagnostic tests, likelihood ratios, sensitivity and specificity, Bayes theorem, predictive values, post test probabilities and interval likelihood ratios. We will compare tests using ROC curves, and discuss sources of bias and critical appraisal of studies of diagnostic tests and integrate principles of decision making to medical decisions.

Introduction to **EHR Meaningful Use and CDS Rules** Assignment #2.

Learning goals:

- Develop and interpret Bayesian probabilities for healthcare applications
- Explain the relationship between Bayesian logic and clinical decision support systems
- Explain the measurement of operating characteristics of diagnostic tests
- Analyze the implications of bayes theorem

Readings required prior to this class:

- Clinical Decision Support Systems: Bayes Rule (Pages 31-33), Rule-Based and Early Bayesian Systems (Pages 72-74), Probabilistic Reasoning (Page 76), Historical Survey of Diagnostic Decision Support Systems (Pages 107-111).
- Decision Making in Health and Medicine, Hunink et al: 5.1, 5.2, 6, 7.3, 7.4

WEEK 4 – October 14, 2010

Modeling Uncertainty

This session will cover the more advanced concepts of in decision-making. Essential probability theory will be reviewed and applications to modeling uncertainty in medical decision-making will be discussed. Decision trees, utility theory and sensitivity analysis will be presented and applied to clinical situations. A review of sensitivity, specificity and independence will be covered.

Learning goals:

- Explain conditional, joint and marginal probability
- Identify and analyze the subjective issues and biases with decision-making
- Explain how to characterize the performance of decision models

Readings required prior to this class:

- Decision Making in Health and Medicine, Hunink et al: Chapter 2 (all), 5.5, 7.6.1, 8.5, 8.4

WEEK 5 – October 21, 2010

Legacy CDSS and their Inception

This session will cover the classic Decision Support Systems used in medicine over the past 20 years. The systems will be examined in depth, with the logic and practicality of each system assessed.

Introduction to **Dr. Petratos Criticism Paper** Assignment #3.

Learning goals:

- Interpret and apply the rationale behind putting together a system for decision support
- Evaluate how modeling uncertainty becomes the basis for decision support systems

Readings required prior to this class:

- Articles:
 - 1) Miller et al. Clinical decision support and electronic prescribing systems
 - 2) Evans et al. A decision support tool for antibiotic therapy
 - 3) Pryor et al. HELP—A total hospital information system

WEEK 6 – October 28, 2010

The Business of Decision Support

This class will cover the real-world politics, funding, development and marketing of decision support. OpenClinical, HL7, and other organizations will be discussed as enablers of decision support.

Learning goals:

- Explain the relationship between evidence-based medicine and clinical decision support systems
- Evaluate the policies needed to implement clinical decision support systems to improve healthcare outcomes

- Identify the challenges associated with implementing clinical decision support systems to significantly improve patient outcomes
- Explain the supply and demand of the decision support field

Readings required prior to this class:

- www.openclinical.org/docs/whitepaper.pdf

WEEK 7 – November 4, 2010

Health Information Exchanges and the Role of the RHIO; Ethical and Legal Issues

In this session we will discuss the emergence of Health Information Exchanges (HIE) and the role of the Regional Health Information Organization (RHIO) for sharing clinical data and providing decision support across the continuum of the healthcare system.

We will discuss trends in decision support systems in healthcare including the secondary use of healthcare data, creation of data warehouses and statistical and artificial intelligence data mining techniques. Ethical and legal issues will be presented and discussed.

Learning goals:

- Explain an HIE and RHIO
- Evaluate several HIE and/or RHIO
- Evaluate the ramifications of future decision support systems that will allow for customized diagnosis and treatment
- Analyze the role of regulation and accountability in clinical decision support systems

Readings required prior to this class:

- Articles:
 - 1) General Principles of Software Validation; Final Guidance for Industry and FDA Staff
 - 2) Ostler et al. A Medical Decision Support System for the Space Station Health Maintenance Facility.
 - 3) <http://www.calrhio.org/crweb-files/docs-hie/White%20Paper%20-%20Statewide%20California%20HIE.pdf>
- Clinical Decision Support Systems: Chapter 6
- Clinical Decision Support Systems: Chapter 11

WEEKS 8 – November 11, 2010 and 9 – November 18, 2010

Group Presentations

Final Project Papers will be due on November 24th, 2010 at 5pm CST.

WEEK 10 – DECEMBER 2ND, 2010

Course Final Review and Final Exam Preparation

This will be a closed-book, closed-notes 2-hours and 30 minutes exam. Guidelines will be provided ahead of time. The open date and time for the exam is December 3, 2010 at 9am CST and the close date and time is Wednesday December 8th at 10 PM CST.

Links for above Article Citations:

Cimino, James J.

Desiderata for Controlled Medical Vocabularies in the Twenty-First Century

Methods of Information in Medicine, Vol. 37 Issue 4-5 (November 1998), pp. 394-403.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/511.pdf>

Classen, David C.; Pestotnik, Stanley L., Evans, R. Scott, Burke, John P.

Description of a Computerized Adverse Drug Event Monitor Using a Hospital Information System

Hospital Pharmacy, Vol. 27, Issue 9 (September 1992), pp. 774, 776-9, 783.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/528.pdf>

East, Thomas D.; Susan Henderson; Alan H. Morris; Reed M. Gardner

Computerized Screening for Identification of Adult Respiratory Distress Syndrome (Ards) Patients

Proceedings of the Annual Symposium on Computer Application in Medical Care, November 8, 1989, pp. 583-587.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/509.pdf>

Embi, Peter J.; Jain Anil; Clark, Jeffrey; Bizjack, Susan; Hornung, Richard; Harris, C. Martin

Effect of a Clinical Trial Alert System on Physician Participation in Trial Recruitment

Archives of Internal Medicine, Vol. 165 Issue 19 (October 24, 2005), pp. 2272-2277.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/512.pdf>

Evans, R. Scott; David Classen; Stanley Pestotnik; Terry Clemmer; Lindell Weaver; John Burke

A Decision Support Tool for Antibiotic Therapy

Proceedings of the Annual Symposium on Computer Application in Medical Care (1995), pp. 651-655

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/517.pdf>

Evans, R. Scott; Reed M. Gardner; John P. Burke; Stanley L. Pestotnik; Robert A. Larsen; David C. Classen; Paul D. Clayton

A Computerized Approach to Monitor Prophylactic Antibiotics

Proceedings of the Annual Symposium on Computer Application in Medical Care, November 4, 1987, pp. 241-245.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/519.pdf>

Gesteland, Per H.; Reed M. Gardner; Fu-Chiang Tsui; Jeremy U. Espino; Robert T. Rolfs; Brent C. James; Wendy W. Chapman; Andrew W. Moore; Michael M. Wagner

Automated Syndromic Surveillance for the 2002 Winter Olympics

Journal of the American Medical Informatics Association, Vol. 10, Issue 6 (November/December 2003), pp. 547-554.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/515.pdf>

Miller, Randolph A.; Reed M. Gardner; Kevin B. Johnson; George Hripcsak

Clinical Decision Support and Electronic Prescribing Systems: A Time for Responsible Thought and Action



Journal of the American Medical Informatics Association, Vol. 12, Issue 4 (July-August 2005), pp. 365-495.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/513.pdf>

Pryor, T. Allan; Homer R. Warner; Reed M. Gardner

HELP-- A Total Hospital Information System

Proceedings of the Annual Symposium on Computer Application in Medical Care, November 5, 1980, pp. 3-7.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/518.pdf>

Seger, Andrew C. ; Gandhi, Tejal K. ; Hope, Carol ; Overhage, J. M. ; Murray, Michael D. ; Weber, David ; Fiskio, Julie ; Teal, Evgenia ; Bates, David W.

Development of a Computerized Adverse Drug Event (ADE) Monitor in the Outpatient Setting

Rockville, MD: Agency for Healthcare Research and Quality (AHRQ), pp. 173-183.

<http://handle.dtic.mil/100.2/ADA434018>

Sittig, Dean F.; C. Gregory Elliott; C. Jane Wallace; Polly Bailey; Reed M. Gardner

Computerized Screening for Identification of Adult Respiratory Distress Syndrome (Ards) Patients

Proceedings of the Annual Symposium on Computer Application in Medical Care, November 8, 1988, pp. 698-702.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/510.pdf>

Ostler, David V.; Reed M. Gardner; James S. Logan

A Medical Decision Support System for the Space Station Health Maintenance Facility

Proceedings of the Annual Symposium on Computer Application in Medical Care, November 9, 1988, pp. 43-47.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/520.pdf>

U.S. Department of Health and Human Services; Food and Drug Administration; Center for Devices and Radiological Health; Center for Biologics Evaluation and Research

General Principles of Software Validation; Final Guidance for Industry and FDA Staff

U.S. Department Of Health and Human Services, January 11, 2002, pp. i-43.

<http://turing.library.northwestern.edu/login?url=http://www.library.northwestern.edu/ers/529.pdf>

These items are accessible only to members of the NU community. New Electronic Reserve URLs are routed through Northwestern's EZProxy system, which automatically prompts users for their netid and password for each session in which they access restricted materials from outside the Library or off-campus. Virtual Private Networking (VPN) is also an effective solution for off-campus access. You or your students can find more information here:

<http://www.library.northwestern.edu/help/proxy/index.html>

Please note that Blackboard may currently be unable to recognize EZProxy URLs as valid links when pasted into the "Course Documents" area of your Blackboard page. Instead, enter these URLs into your Blackboard page as "External Links."