Health Informatics

CS580C1/EL
Course Format (On Campus/Blended)

Course Description

The CS580 course presents the fundamental principles, concepts, and technological elements that make up the building blocks of Health Informatics. It introduces fundamental characteristics of data, information, and knowledge in the domain, the common algorithms for health applications, and IT components in representative clinical processes. It also introduces the conceptual framework for handling the collection, storage and the optimal use of biomedical data. It introduces the concepts of population health and precision medicine and the information systems that support them. It covers basic principles of knowledge management systems in biomedicine, various aspects of Health Information Technology standards, and IT aspects of clinical process modeling. There is also a term project to access students' ability to understand and implement simple Health Informatics solutions. One or two guest speakers with many years of experience in health IT will be invited to share their first-hand experience with us.

Course Overview

Health informatics is a multi-disciplinary field at the intersection of information science, computer science, and health care. Health informatics is growing at a rapid pace and will continue to grow well into the future. A brief introduction to health informatics covers the key concepts, background disciplines, historical overview, and challenges ahead. Students will be introduced to the definitions and concepts of knowledge hierarchy: data, information, knowledge and wisdom, and the building blocks of Health Informatics: algorithms, medical decision-making, and clinical process modeling. Knowledge management systems and health IT standards will be also covered. A selection of case studies will be used to illustrate the applications of the concepts and algorithms.

The assessment will consist of weekly assignments, quizzes, and discussions that will test students' familiarity with study material and understanding of the concepts addressed in the materials and case studies. A final project tests students' overall understanding of the course content and requires students to develop a specific Health Informatics solution. The final exam will be based on the material covered in the course.

This course has been designed in accordance with Master's Degree curriculum requirements within the Accreditation Standards for Health Informatics and Health Information Management educational programs.

Course Objectives

This course will enable you to:

- Become familiar with the basic definitions, key concepts, terminology, and historical context of Health Informatics
- Understand fundamental characteristics of data, information, and knowledge in the Health Informatics domain
- Become familiar with common algorithms for health applications and IT components in representative clinical processes
- Develop understanding of population health and precision medicine
- Understand basic principles of knowledge management systems in biomedicine
- Develop understanding of various aspects of Health Information Technology standards
- Become familiar with IT aspects of clinical process modeling and health information systems

Prerequisites

NO

Course Outline

This course is presented as a series of weekly modules. The course material is grouped in six modules. The seventh module represents the week of the Final Examination. Each of the Module has one or two lectures, one discussion topic, one quiz, and one assignment. There is also a term project to access the students' ability to understanding and implement simple Health Informatics solutions.

Readings - Each week there are book chapters and research paper readings. Your professor may suggest additional readings during the running of the course.

Discussions - There will be graded discussions between you and your classmates. These discussions are moderated by professors. Postings for each discussion should be completed by the assigned due dates. Again, check the calendar for these due dates. There are also general discussions boards, which are not graded, for you to use to discuss any issues with your classmates. Please see the Discussion module on the home page for more details.

Assignments - There will be assignments throughout the course. Please check the Study Guide for due dates.

Assessments - The quizzes they will be listed in the Study Guide. Be sure to check it to ensure that you complete them before the due date. Quizzes may be a combination of True/False, single/multiple choice, and short essay questions.

Module One – Introduction to Health Informatics & Data, Information, and Knowledge

Readings:

Required Readings:

Chapter 2: Health Care Data (Wager, et al, 2017)

Recommended readings:

Chapter 1 The US Healthcare System (Braunstein, 2014)

Haux R. Medical informatics: past, present, future. Int J Med Inform. 2010, 79(9):599-610.

Fridsma DB. The scope of health informatics and the Advanced Health Informatics Certification. J Am Med Inform Assoc. 2016, 23(4):855-6.

Lecture One:

- Introduction to health informatics and its significance
- Definitions and key concepts in health informatics
- Background disciplines, historical overview, and future challenges

Lecture Two:

- Introduction to knowledge hierarchy: Data, information, and knowledge
- The definitions of healthcare data and information
- Types of healthcare information (internal versus external data and information)
- The major purposes of maintain patient records
- The content and uses of patient records and claim content
- The common issues related to healthcare data quality
- The challenges associated with measuring and ensuring healthcare data quality
- Quality assessment including total quality management and data quality
- Introduction to biomedical research and publicly available resources

Module Two – The National Landscape of Healthcare IT & History of Healthcare Information System

Readings:

Required readings:

Chapter 1: The National Health Information Technology landscape (Wager, et al, 2017)

Chapter 3: Health Care Information Systems (Wager, et al, 2017)

Appendix A: Overview of the Healthcare IT industry (Wager, et al, 2017)

Recommended readings:

Wetterneck, T. B., Walker, J. M., Blosky, M. A., Cartmill, R. S., Hoonakker, P., Johnson, M. A., ... & Carayon, P. (2011). Factors contributing to an increase in duplicate medication order errors after CPOE implementation. Journal of the American Medical Informatics Association, 18(6), 774-782.

Kuperman, G. J., Bobb, A., Payne, T. H., Avery, A. J., Gandhi, T. K., Burns, G., ... & Bates, D. W. (2007). Medication-related clinical decision support in computerized provider order entry systems: a review. Journal of the American Medical Informatics Association, 14(1), 29-40.

Lecture Three:

- The major influences shaping the health IT landscape in the US
- The roles played by the major government initiatives and private sectors in advancing health IT in the US
- The major events that have influences the adoption of health IT and systems

Lecture Four:

- History and evolution of healthcare information systems (HCIS)
- The major advances in information technology and significant federal initiatives that influenced the adoption of healthcare information systems
- The major types of administrative and clinical information systems used in healthcare
- Current issues pertaining to the use HCIS

Module Three – Medical Algorithms & Medical Decision Making

Readings:

Recommended readings:

Fitzmaurice, J. M., Adams, K., & Eisenberg, J. M. (2002). Three decades of research on computer applications in health care: medical informatics support at the Agency for Healthcare Research and Quality. Journal of the American Medical Informatics Association, 9(2), 144-160.

Djulbegovic, B., & Guyatt, G. H. (2017). Progress in evidence-based medicine: a quarter century on. The Lancet.

Sheridan, D. J., & Julian, D. G. (2016). Achievements and limitations of evidence-based medicine. Journal of the American College of Cardiology, 68(2), 204-213.

Lecture Five:

- Various ways to describe algorithms, such as flowchart, pseudocode, and conceptual graph
- Introduction to medical algorithms
- Algorithms in computer science, such as decision tree and regression
- Calculation of measurements of classification performance—sensitivity and specificity
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Lecture Six:

- Decision-making process
- Medical decision-making process (diagnosis, treatment, monitoring, prognosis)
- Informatics in clinical decision-making
- Introduction to evidence-based medicine

Module Four – Modeling and Simulations & Population Health and Precision Medicine

Readings:

Required readings:

Chapter 4: Information Systems to Support Population Health Management (Wager, et al, 2017)

Recommended readings:

Chapter 8 Population Health Management (Braunstein, 2014)

Kindig, D., & Stoddart, G. (2003). What is population health?. American journal of public health, 93(3), 380-383.

König, I. R., Fuchs, O., Hansen, G., von Mutius, E., & Kopp, M. V. (2017). What is precision medicine? European Respiratory Journal, 50(4), 1700391.

Lecture Seven:

- Develop understanding of modeling and simulation
- Become familiar with applications of modeling and simulation in biomedicine

Lecture Eight:

- Data and information needs of health systems in managing population health
- Key health IT tools and strategies for population health management
- Concepts of precision medicine

Module Five – Standards in Health Informatics

Readings:

Required readings:

Chapter 11: Health Care Information System Standards (Wager, et al, 2017)

Recommended readings:

Chapter 5: Data and Interoperability Standards (Braunstein, 2014)

Chapter 11: Interoperability (Trotter and Uhlman, 2011)

Chapter 12: HIPAA: the far-reaching healthcare regulation (Trotter and Uhlman, 2011)

Lecture Nine:

- Introduction to standards
- The Need for Health Informatics Standards
- The role of federal initiative and legislation that that have significant impact on the adoption of healthcare information standards in the United States
- Major types of healthcare information standards and the organization that develop or approve them

- The importance of healthcare IT standards to the future of the US health care delivery system

Module Six – Knowledge management system & Organizing Health IT services

Readings:

Required readings:

Chapter 8 Organizing Information Technology Services (Wager, et al, 2017)

Chapter 12 IT Alignment and Strategic Planning (Wager, et al, 2017)

Lecture Ten:

- Introduction to knowledge management
- Knowledge discovery, data mining and text mining
- Knowledge management and decision making support in biomedicine

Lecture Twelve:

- The roles, responsibilities, and major functions of the IT department in healthcare organizations
- The roles, responsibilities, and major functions of the IT leaders
- The various ways to organize IT services
- The key attributes of highly effective IT departments
- The role and major function of the data analytics department
- Developing plans for evaluating the effectiveness of the IT function
- The components of an IT strategic plan
- How to develop an IT strategic plan
- The Gartner Hype Cycle

Instructor

Guanglan Zhang, PhD

808 Commonwealth Avenue, Room 250
Boston, MA 02215
(617) 358-5688
guanglan@bu.edu
Office hours: Thursday 2–5pm or by appointment

Dr. Guanglan Zhang received her Ph.D. from School of Computer Engineering, Nanyang Technological University, Singapore for doctoral work in bioinformatics. She is an Assistant Professor in Computer Science at Boston University Metropolitan College. She is also holding an adjunct position at Dana-Farber Cancer Institute and Harvard Medical School.

Dr. Zhang has worked in the data mining and data analytics field since 1998. The most important aspects of her work include biomedical data analysis, development and implementation of biomedical databases, computational simulations of laboratory experiments, development of diagnostic methods for tissue typing, and computational support for vaccine development. Computational tools that she developed are used in the study of immunology, vaccinology, infectious disease, and cancer. She has authored more than 50 peer-reviewed scientific journal publications and developed dozens of biomedical and computational systems.
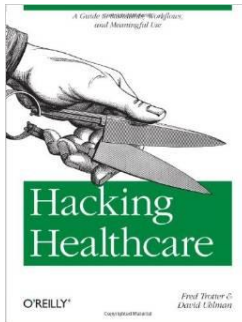
## Course Resources

Required textbook:
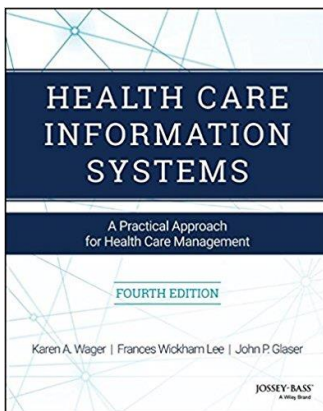
Wager, K. A., Lee, F. W., & Glaser, J. P. (2017). Health care information systems: A practical approach for health care management - 4th Edition. Jossey-Bass. ISBN-13: 978-1119337188. ISBN-10: 1119337186. (This is also the required textbook for CS781.) This textbook can be purchased from Barnes & Noble at Boston University.

Recommended textbook:

Trotter, F. and Uhlman, D. (2011). Hacking healthcare: A guide to standards, workflows, and meaningful use. O'Reilly Media. ISBN 9781449305024. This textbook can be purchased from Barnes & Noble at Boston University.
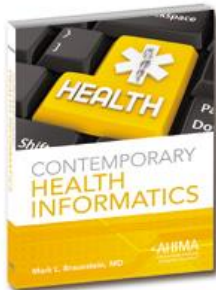
Braunstein, M.L. (2014) Contemporary Health Informatics. AHIMA press.

Boston University Library Information

Boston University has created a set of videos to help orient you to the online resources at your disposal. An introduction to the series is below:

All of the videos in the series are available on the Online Library Resources page, which is also accessible from the Campus Bookmarks section of your Online Campus Dashboard. Please feel free to make use of them.

As Boston University students, you have full access to the BU Library. From any computer, you can gain access to anything at the library that is electronically formatted. To connect to the library, use the link http://www.bu.edu/library. You may use the library's content whether you are connected through your online course or not, by confirming your status as a BU community member using your Kerberos password.

Once in the library system, you can use the links under "Resources" and "Collections" to find databases, eJournals, and eBooks, as well as search the library by subject. Some other useful links follow:

Please note that you are not to post attachments of the required or other readings in the water cooler or other areas of the course, as it is an infringement on copyright laws and department policy. All students have access to the library system and will need to develop research skills that include how to find articles through library systems and databases.

Course Grading Information

Course Structure

This course is presented as a series of weekly modules. The course material is grouped in six modules. Each module consists of two lectures. There are four discussion topics, five quizzes, and four assignments. There is also a term project to assess students' understanding and implementing simple Health Informatics solutions.

Reading materials —Introduced in each module.

Assignments —This course will have four graded assignments.

Discussions —There are four graded discussion forums that involve posting and reviewing the answers to the discussion topics. Each posting should be completed during the weeks when the material is covered. Please see the discussion module on the home page for more details.

Quizzes —This course will have five online quizzes.

Term Project—The term project will test students' overall understanding and grasp of the course content.

Final Examination—The final exam will be comprehensive and will cover material from the entire course. It will be an open-book proctored exam consisting of questions similar to the ones in the quizzes and assignments.

Grade Weighting

The final grade for this course will be based on the following:

Deliverable	Weight
Class Participation	5%
Quizzes	15%
Discussions	15%
Assignments	15%
Term Project	20%
Final Exam	30%