INFO I501 Introduction to Informatics for BioHealth Informatics

Fall 2015

Course Info
3 Credit Hours | Room: IT 255 | Each Thursday: 6:00 pm to 8:40 pm

Instructor
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Email / Phone
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Office Hours
By appointment

Class Schedule:
6:00 – 6:10 Weekly quiz
6:15 – 6:45 BioHealth informatics theory presentations
6:45 – 7:15 Discussion on a seminal paper in BioHealth informatics
7:15 – 7:30 Break
7:30 – 8:15 Databases theory and application lecture
8:15 – 8:40 Lab work and project work

Prerequisites: None

COURSE DESCRIPTION
Basic information representation and processing; searching and organization; evaluation and analysis of information. Internet-based information access tools; ethics and economics of information sharing.

EXTENDED COURSE DESCRIPTION
This course introduces the most central technical tools of informatics in the context of biomedical informatics, which encompasses bioinformatics and health informatics.

Bioinformatics focuses on translational research that uses computational means to transform biological data into discoveries that help us better understand and improve life. Health informatics enhances human health and well-being through the use of information technology, computer science, and knowledge management to deliver more efficient and safer patient care as well as improve patient and population outcomes. Electronic health records, telemedicine applications, mobile health (m-health) applications, and clinical decision support are among the many technologies found in health informatics.

Thus, the course covers some important theoretical and seminal paper in these fields. We will perform database management functionality, learn data analysis algorithms, understand informatics research methods, and apply some quantitative techniques to get similar results to the papers.
TEXTBOOKS AND PAPERS
It is suggested that students get a copy of the textbooks. Other course materials will be made available in the Files folder of Canvas. Reading each week will focus on two categories of research theory and methods. Part one focuses on theory, research, and methods in one of the subdomains of informatics and part two focuses on application, methods, and lab work. Throughout the semester the interrelationship between data use and management will be tied directly to the broader use and relevance within bio- and health informatics. Please refer to the weekly schedule below for details about the papers, theories, and applications that will be covered in the lectures.

GENERAL GUIDELINE TO THE SYLLABUS
Students are responsible for familiarizing themselves with the syllabus. The instructor is responsible for being responsive to the diverse needs of the enrolled students and for making necessary modifications to this syllabus, which is to be treated as a living document.

Part One: Health Informatics: Theory and Methods
Weekly reading: PDFs will be placed in the Files section of Canvas.

Part Two: Database Theory and Application

Title: Database Fundamentals
Author: Sharma, N., Perniu, L., Chong, F., R. et al.
Copyright: 2010, Edition: 1st
Publisher: IBM Canada
Chapters: 1-5

Title: Think Stats – Probability & Statistics for Programmers
Author: Allen B. Downey
Copyright: 2014, v2.0.27
Publisher: Green Tea Press
Chapters: 1-6
Link: http://greenteapress.com/thinkstats2/thinkstats2.pdf

Title: Data Mining: Practical Machine Learning Tools & Techniques
Author: Witten, I., Frank, E. & Hall, M.
Copyright: 2011, Edition: 3rd
Publisher: Morgan Kaugmann
Chapters: 1-4, 6, 11, 17

SOFTWARE
1. phpMyAdmin (a GUI to practice MySQL): [Online-No Cost]
   This is not a web programming or client-server programming course. phpMyAdmin is a free software tool written in PHP, intended to handle the administration of MySQL over the Web. Students will access and run queries on their database account on the school’s server using their IU Network ID.

2. MySQL Workbench (WB) (a desktop MySQL client): [Installation at no cost]
This is a free and open-source desktop application that is used to access IU-hosted MySQL server. This can be installed on Windows, Linux or Mac OSX, but not on ChromeOS. For working with WB, please download the zip package that can be used without admin rights to the operating system.

3. **Putty** or another SSH terminal: [Workstation- No cost].
   This should already be installed on the IUPUI workstations (please install if using your own laptops). Putty is used to connect to the IU-hosted server for the class to run Python programs for data processing, data munging and basic stats and probability.

4. **Weka** – [Workstation-No Cost]
   Needs to be installed on the workstations, including your laptops. Instructions will be provided in class for installation as well as use of the application. Weka is a GUI tool for data mining and analysis. It has built in algorithms for mining text inputs.

**LEARNING OUTCOMES:** Upon completion of this course, students will

1. Acquire an in-depth knowledge of
   a. Different subdomains of biomedical informatics
   b. Understand the skills required for research in biomedical informatics
   c. How to apply quantitative skills to analyze data for research in informatics

2. Analyze critically and speak publically about
   a. The research performed by scholars in subfields of informatics
   b. Your own projects executed in class
   c. Data management issues and their relationship to biomedical informatics

3. Inform the design of health informatics applications from user data by storing and manipulating large amounts of data in a relational database. In that context, students will
   a. Design a relational database, namely:
      i. Define attributes, tuples, relations, domains, schemas, and keys in a relational database management system (RDBMS).
      ii. Apply relational model constraints and relational algebra operations.
      iii. Model real-world objects into relational tables.
      iv. Identify problems and minimizing redundancy in an RDBMS.
      v. Identify data dependencies and incorporate them into the relational database design.
      vi. Refine relational tables to have the most optimal database design using normalization.
   b. Investigate specific research questions, design and apply SQL (and MySQL) queries. Specifically:
      i. Define a relational database schema in SQL.
      ii. Manipulate data with SQL.
      iii. Apply relation operations with SQL.
      iv. Generate SQL sub-queries.
   c. Extract data that matches certain assumptions, using Python and apply quantitative analysis to test hypothesis, test predictability and validity. In that context, understand and implement the following concepts in Python, namely:
      i. Data structures.
      ii. String manipulation using regular expressions.
      iii. Control statements and file handling.
   d. Perform data mining on clinical notes and summarizing data using Weka.
e. Understand the information out of the collected data; analyze it using Weka.
f. Understand basic statistical concepts like Mean, averages, variance, distributions. Write Python programs to plot histograms, PMF, CDF.
g. Understand probability and Bayes theorem.

**WEEKLY SCHEDULE**

<table>
<thead>
<tr>
<th>Week</th>
<th>Papers and Reading</th>
<th>Assessment</th>
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<tbody>
<tr>
<td>1</td>
<td>Sharma et al. (2010). Chapter 1: Databases and information models</td>
<td>Paper presentations</td>
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<td>Papers – Actor-network theory in healthcare</td>
<td>Quiz 1</td>
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<td>Lab: install WB</td>
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<td>Lab: ERD, create DB</td>
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<td>3</td>
<td>Sharma et al. (2010). Chapter 3: Conceptual data model</td>
<td>Paper presentations</td>
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<td>Sharma et al. (2010). Chapter 4: Relational DB design</td>
<td>Quiz 3</td>
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<td>Sharma et al. (2010). Chapter 5: Intro to SQL – till 5.2 only</td>
<td>Lab: relationships, DDL</td>
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<td>Papers – on ICT for development</td>
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<td>4</td>
<td>Sharma et al. (2010). Chapter 5: Intro to SQL – 5.3 only</td>
<td>Paper presentations</td>
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<td></td>
<td>Additional SQL function resources on Canvas</td>
<td>Quiz 4</td>
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<td>Papers – on EHR for drug safety monitoring</td>
<td>Lab: Import data, DML</td>
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<td>5</td>
<td>Sharma et al. (2010). Chapter 5: Intro to SQL – 5.4 onwards</td>
<td>Paper presentations</td>
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<td>Papers – on Technology acceptance model</td>
<td>Quiz 5</td>
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<td>Project proposal</td>
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<td>Lab: Adv SQL</td>
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<td>6</td>
<td>Downey (2014). Chapter 1: Exploratory data analysis</td>
<td>Paper presentations</td>
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<td></td>
<td>Downey (2014). Chapter 2: Distributions</td>
<td>Quiz 6</td>
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<td>Papers – on mobile health (mHealth)</td>
<td>Lab: installing puTTY</td>
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<td>7</td>
<td>Bayes theorem, Probability</td>
<td>Paper presentations</td>
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<td>Downey (2014). Chapter 3: Probability mass functions (PMF)</td>
<td>Quiz 7</td>
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<td>Papers – ethnography/auto-ethnography in health care</td>
<td>Lab: Python data structures, string manipulations</td>
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<td>8</td>
<td>Downey (2014) Chapter 4: Cumulative distribution function (CDF)</td>
<td>Class debate</td>
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<td>Discussion – relationship between ANT, ethnography</td>
<td>Quiz 8</td>
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<td>Lab: PMFs, CDFs</td>
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<td>9</td>
<td>Downey (2014). Chapter 5: Modeling distributions</td>
<td>Paper presentations</td>
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<td>Papers – social network analysis in health care</td>
<td>Quiz 9</td>
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<td>Lab: Pareto, Poisson, Exponential, Log</td>
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<td>10</td>
<td>Downey (2014). Chapter 6: Probability density functions (PDF)</td>
<td>Class debate</td>
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<td>Papers – randomized controlled trials in HIT</td>
<td>Essay: Debate review</td>
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<td>Lab: PDFs</td>
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<td>11</td>
<td>Witten et al. (2011). Chapter 1: Intro to data mining</td>
<td>Paper presentations</td>
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<td>Papers – randomized controlled trials in HIT</td>
<td>Quiz 10</td>
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<td>Lab: Installing Weka</td>
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<td>12</td>
<td>Witten et al. (2011). Chapter 2: Input to data mining</td>
<td>Paper presentations</td>
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<td>Papers – on Classification rules</td>
<td>Lab: Importing data to Weka</td>
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<td>13</td>
<td>Witten et al. (2011). Chapter 3: Output to data mining</td>
<td>Quiz 11</td>
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<td>Papers – on Information infrastructure and standardization</td>
<td>Lab: classification rules</td>
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<td>Witten et al. (2011). Chapter 4: algorithms and methods</td>
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<td>Witten et al. (2011). Chapter 6: real machine learning schemes</td>
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<td>Quiz 12 Lab: nearest neighbor using Weka</td>
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<td>Witten et al. (2011). Chapter 11: Weka explorer</td>
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<td>Witten et al. (2011). Chapter 17: Tutorial exercise for Weka</td>
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<td>Project demos Lab: Data classifiers in Weka</td>
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**READINGS, CLASS DISCUSSIONS, and ASSIGNMENTS**

As outlined above, each week students will have assigned readings from papers and course texts. These readings will include theories and research that will introduce the field of informatics and in depth the field of BioHealth informatics. We will read material related to two languages: SQL and Python. Students with no (or little) programming background are encouraged to go through the supplementary materials (videos/manuals/articles) that will be posted in the Resources section of Canvas. Four measures will be used to assess the learning competency from the weekly readings:

**Part One—Class Presentation, Q&A, Discussion, and Highlights**

1. Each week, one student will give a presentation on a research paper. Students must read the weekly assigned papers to grasp an in-depth understand of the content and participate in the discussion about the paper in class.

2. Assignment for presenting student:
   a. The paper to be presented will be uploaded to the Files section in Canvas.
   b. Each student will have 10 minutes to present the paper as a power point presentation.
   c. The presenter MUST upload their presentation in a folder called Weekly PPs before class begins. The PP file MUST be labeled with this configuration: WK3-Smith-Jones.ppt.
   d. The presentation will be in the form of a power point, maximum of 10 slides, including the cover slide.
   e. The presentation must begin at 6.45pm
   f. The presentation should focus on these 7 areas (Approximately 1 slide per point.):
      i. Title: Title of paper, its authors and publishing date.
      ii. Purpose: What is the purpose of study and the question and hypothesis being presented?
      iii. Background: What is the background/context of the study and how is theory being applied?
      iv. Findings: What are the findings? (Re-state the question/hypothesis and then the findings.)
      v. Impact: What are the long-term impact/effect of the findings for society, if any?
      vi. Implications: What are the implications of the research for the BioHealth/informatics community?
      vii. Conclusion: Main points of enlightenment that the presenter gained from reading the paper?

3. Assignment for None-Presenting Students:
   a. Approximately 10 minutes will be allowed for Q&A after the presentation
   b. All NONE-presenting students MUST upload their comments and discussion points in the Weekly discussion folder by Wed of the same week of the discussion in class. If you are late in submitting your question, you are still responsible to have your question by class time, otherwise you will receive a zero for class participation.
   c. All students MUST be prepared to ask their question and to engage the class. All questions should help to give more insight into the focus and purpose of the research.

**Part Two—Data Management**

1. Weekly quizzes on the data readings and slides will be given to assess learning and comprehension. Quizzes will be available on Canvas just before the class under ‘Quizzes’ section. Students will have one minute per
question. Immediately following the quiz, Canvas will provide the score, indicating right and wrong answers. Quizzes will be available from 6 pm to 6:10 pm on the day of the lecture.

2. Lab assignments are practical deliverables that have to be done by the next week. Questions will be made available in class during the database theory and application lecture. These have to be completed using phpMyAdmin, Python or Weka by Sunday 11:59 pm of the following week.

3. A final project involving data collection, data storage, data extraction and data analysis will be assigned to teams of students. Work on the project is expected to begin during the first week of February. At the conclusion of the project, students will present their findings in a class presentation summarizing how they have applied the tools and techniques of Informatics in a BioHealth research project.

4. Team Evaluation of the project presentation: All teams (including the team giving the presentation) will grade the presentation using the following five parameters below.
   a. Goal setting and appropriate planning (20%)
   b. Technical complexity and implementation (20%)
   c. Research design (20%)
   d. Project presentation (20%)
   e. Project report (20%)

COURSE GRADE BREAKDOWN Part 1
   • Paper presentation .......................................................... 10%
   • Class participation, discussion, debate ............................ 15%

Part 2
   • Quizzes ................................................................. 15%
   • Lab assignments ........................................................ 10%
   • Final project ............................................................. 50%

Grading Scale:
A+ 97 – 100    Outstanding achievement, given at the instructor’s discretion
A  93 – 100    Excellent achievement
A– 90 – 92.99  Very good performance and quality of work
B+ 87 – 89.99  Good performance and quality of work
B  83 – 86.99  Modestly acceptable performance and quality of work
B– 80 – 82.99  Marginal acceptable performance and quality of work
C+ 77 – 79.99  Unacceptable work (Core course must be repeated for credit)
C  73 – 76.99  Unacceptable work (Core course must be repeated for credit)
C– 70 – 72.99  Unacceptable work (Course must be repeated for credit)
D+ 67 – 69.99  Unacceptable work (Course must be repeated for credit)
D  63 – 66.99  Unacceptable work (Course must be repeated for credit)
D– 60 – 62.99  Unacceptable work (Course must be repeated for credit)
F Below 60    Unacceptable work (Course must be repeated for credit)

ATTENDANCE
1. Basic Policy
   a. All attendance and assignment deadline policies are in place to protect student educational rights, maintain grading equity, and promote team morale.
   b. Attendance shall be taken in every class. If you do not sign the attendance sheet while in class, you shall be marked absent. Signing the attendance sheet for another student is prohibited.
c. Students are allowed a maximum of two absences. However, missing class does NOT excuse any student from weekly assignment deliverables. On the third absence, a student’s final grade will be reduced by 10-points. And on the fourth absence an additional 10-points will be subtracted from the final grade, and so on.

d. If a student uses up their two absences, then has a serious event (forcing them to miss class), they will still receive a 10-point reduction in their grade. For this reason, we strongly recommend that students do not miss any classes, unless for unusually serious and documented reasons.

2. Administrative Withdrawal [University Policy]
   a. A basic requirement of this course is that you will participate in all class meetings and conscientiously complete all required course activities and/or assignments. Keep in touch with the instructor if you are unable to attend, participate, or complete an assignment on time.
   b. If you miss more than half of the required activities within the first 25% of the course without contacting the instructor, you may be administratively withdrawn from this course by the instructor. For example: This course meets once per week; thus if you miss more than two classes in the first four weeks, you may be withdrawn by the instructor. Administrative withdrawal may have academic, financial, and financial aid implications. Administrative withdrawal will take place after the full refund period, and if you are administratively withdrawn from the course you will not be eligible for a tuition refund.
   c. If you have questions about the administrative withdrawal policy at any point during the semester, please contact the instructor. See campus policy in detail here: http://registrar.iupui.edu/withdrawal-policy.html

ASSIGNMENT DEADLINES

1. Late Assignments
   a. All project stages and assignments have due dates and times. All late assignments (even one minute) will receive a 10% reduction on that particular assignment. Assignments later than 24 hours will receive an additional 10% reduction. Assignments later than 48 hours will receive a zero.

2. Team Responsibility
   a. If a late assignment is due to the action of one team member, the entire team will reap the negative results. Only in extreme cases, unless tangible evidence suggests otherwise, will the late assignment policy be deferred. For this reason, it is imperative that team members establish a self-monitoring system that includes regular communication via email, text or phone. If a team has a team member who is not acting responsibly, the team may petition the instructor for a solution.
   b. If a student misses class on the day of their presentation, they will need to give a separate presentation without their team at another time within one week or receive a zero for that assignment.

CODE OF CONDUCT

1. All students should aspire to the highest standards of academic integrity. Using another student’s work on an assignment, cheating on a test, not quoting or citing references correctly, or any other form of dishonesty or plagiarism shall result in a grade of zero on the item and possibly an F in the course. Incidences of academic misconduct shall be referred to the Department Chair and repeated violations shall result in dismissal from the program.

2. All students are responsible for reading, understanding, and applying the Code of Student Rights, Responsibilities and Conduct and in particular the section on academic misconduct. Refer to The Code > Responsibilities > Academic Misconduct at http://www.indiana.edu/~code/. All students must also successfully complete the Indiana University Department of Education “How to Recognize Plagiarism” Tutorial and Test. https://www.indiana.edu/~istd

3. You must document the difference between your writing and that of others. Use quotation marks in addition to a citation, page number, and reference whenever writing someone else’s words (e.g., following the

ACADEMIC MISCONDUCT

1. Cheating
   a. Cheating is considered to be an attempt to use or provide unauthorized assistance, materials, information, or study aids in any form and in any academic exercise or environment.

2. A student must not:
   a. Use external assistance on any “in-class” or “take-home” examination, unless the instructor specifically has authorized external assistance. This prohibition includes, but is not limited to, the use of tutors, books, notes, calculators, computers, and wireless communication devices.
   b. Use another person as a substitute in the taking of an examination or quiz, nor allow other persons to conduct research or to prepare work, without advanced authorization from the instructor to whom the work is being submitted.
   c. Use materials from a commercial term paper company, files of papers prepared by other persons, or submit documents found on the Internet.
   d. Collaborate with other persons on a particular project and submit a copy of a written report that is represented explicitly or implicitly as the student’s individual work.
   e. Use any unauthorized assistance in a laboratory, at a computer terminal, or on fieldwork.
   f. Steal examinations or other course materials, including but not limited to, physical copies and photographic or electronic images.
   g. Submit substantial portions of the same academic work for credit or honors more than once without permission of the instructor or program to whom the work is being submitted.
   h. Without authorization, alter a grade or score in any way, nor alter answers on a returned exam or assignment for credit.

3. Plagiarism
   a. Plagiarism is defined as presenting someone else’s work, including the work of other students, as one’s own.
   b. Any ideas or materials taken from another source for either written or oral use must be fully acknowledged, unless the information is common knowledge. What is considered “common knowledge” may differ from course to course.
   c. A student must not adopt or reproduce ideas, opinions, theories, formulas, graphics, or pictures of another person without acknowledgment.
   d. A student must give credit to the originality of others and acknowledge indebtedness whenever: 1) Directly quoting another person’s actual words, whether oral or written; 2) Using another person’s ideas, opinions, or theories; 3) Paraphrasing the words, ideas, opinions, or theories of others, whether oral or written; 4) Borrowing facts, statistics, or illustrative material; or 5) Offering materials assembled or collected by others in the form of projects or collections without acknowledgment

4. Fabrication
   a. A student must not falsify or invent any information or data in an academic exercise including, but not limited to, records or reports, laboratory results, and citation to the sources of information.

5. Interference
   a. A student must not steal, change, destroy, or impede another student’s work, nor should the student unjustly attempt, through a bribe, a promise of favors or threats, to affect any student’s grade or the evaluation of academic performance.
   b. Impeding another student’s work includes, but is not limited to, the theft, defacement, or mutilation of resources so as to deprive others of the information they contain.
6. **Facilitating Academic Dishonesty**
   
a. Any student who intentionally or knowingly helps (or attempts to helping) another student to commit an act of academic misconduct (as outlined in this syllabus) or who allows another student to use his or her work or resources to commit an act of misconduct will face immediate academic discipline.

7. **Violation of Course Rules/Policies/Instructions**
   
a. Student are strongly encouraged to adhere to all course rules, policies, and instructions as outlined in the course syllabus, verbal/written instructions, or the course materials that are rationally related to the content of the course or to the enhancement of the learning process in the course.

**OTHER POLICIES**

1. **IUPUI course policies:** A number of campus policies governing IUPUI courses may be found at the following link: [http://registrar.iupui.edu/course_policies.html](http://registrar.iupui.edu/course_policies.html)

2. **Classroom civility:**
   
a. IUPUI nurtures and promotes “a campus climate that seeks, values, and cultivates diversity in all of its forms and that provides conditions necessary for all campus community members to feel welcomed, supported, included, and valued” (IUPUI Strategic Initiative 9).
   
b. IUPUI prohibits “discrimination against anyone for reasons of race, color, religion, national origin, sex, sexual orientation, marital status, age, disability, or [veteran] status” (Office of Equal Opportunity). Profanity or derogatory comments about the instructor, fellow students, invited speakers or other classroom visitors, or any members of the campus community shall not be tolerated. A violation of this rule shall result in a warning and, if the offense continues, possible disciplinary action.
   
c. The School of Informatics and Computing holds that to maintain an effective and inclusive learning environment, it is important to be an attentive and respectful participant in lectures, discussions, group work, and other classroom exercises. Thus, unnecessary disruptions should be avoided, such as: ringing cell phones, engagement in private conversations and other unrelated activities, either face-to-face or electronically. Texting, surfing the Internet, and posting to Facebook, Twitter, or other social media during class are generally not permitted.
   
d. Students are strongly encouraged to switch their cell phones to vibrant during class time. If students receive what they believe to be an urgent call, they may quietly leave the classroom to address the matter.

3. **Bringing children to class:** To ensure an effective learning environment, children are not permitted to attend class with their parents, guardians, or childcare providers according to IUPUI policy.

4. **Disabilities Policy:** In compliance with the Americans with Disabilities Act (ADA), all qualified students enrolled in this course are entitled to reasonable accommodations. Please notify the instructor during the first week of class of accommodations needed for the course. Students requiring accommodations because of a disability must register with Adaptive Educational Services (AES) and complete the appropriate AES-issued before receiving accommodations. The AES office is located at UC 100, Taylor Hall (Email: aes@iupui.edu, Tel. 317 274-3241). Visit [http://aes.iupui.edu](http://aes.iupui.edu) for more information.

**MISSION STATEMENT & STATEMENT OF VALUES**

1. The Mission of IUPUI is to provide for its constituents excellence in: Teaching and Learning; Research, Scholarship, and Creative Activity; and Civic Engagement.

2. With each of these core activities characterized by: Collaboration within and across disciplines and with the community; A commitment to ensuring diversity; and Pursuit of best practices.

3. IUPUI’s mission is derived from and aligned with the principal components—Communities of Learning, Responsibilities of Excellence, Accountability and Best Practices—of Indiana University’s Strategic Directions Charter.
4. IUPUI values the commitment of students to learning; of faculty to the highest standards of teaching, scholarship, and service; and of staff to the highest standards of service. IUPUI recognizes students as partners in learning. IUPUI values the opportunities afforded by its location in Indiana’s capital city and is committed to serving the needs of its community. Thus, IUPUI students, faculty, and staff are involved in the community, both to provide educational programs and patient care and to apply learning to community needs through service. As a leader in fostering collaborative relationships, IUPUI values collegiality, cooperation, creativity, innovation, and entrepreneurship as well as honesty, integrity, and support for open inquiry and dissemination of findings. IUPUI is committed to the personal and professional development of its students, faculty, and staff and to continuous improvement of its programs and services.