Syllabus: Course M18 BMI 5303
Spring, 2019
Introduction to Biomedical Informatics: Methods
Mondays 4 – 7 pm

Course Master
Preferred method of contact: email
Office Hours: By appointment

Randi Foraker, PhD, MA
Randi.foraker@wustl.edu

Guest Lecturers

Joanna Abraham, PhD
joannaa@wustl.edu

Aditi Gupta, PhD
agupta24@wustl.edu

Thomas Kannampallil, PhD
thomas.k@wustl.edu

Albert Lai, PhD
amlai@wustl.edu
Fuhai Li, PhD  
fuhai.li@wustl.edu

Philip Payne, PhD, FACMI  
prpayne@wust.edu

Tara Payne, MA  
tara.payne@wustl.edu

Po-Yin Yen, RN, PhD  
yenp@wustl.edu

Course Support

Sean Yu  
Teaching Assistant  
sean.yu@wustl.edu

Andrea Krussel  
Course Manager  
krussela@wustl.edu

About This Course

Journal publications and/or equivalent readings will be posted in blackboard at least 1-week prior to the lectures for which they are relevant.
BIO — Dr. Foraker

Randi Foraker, PhD, is the Director of the Center for Population Health Informatics at the Institute for Informatics (I2) and an Associate Professor of General Medical Sciences at Washington University School of Medicine in St. Louis. Dr. Foraker also serves as Director of the Data and Training Center for the Institute for Public Health. Dr. Foraker specializes in the design of population-based studies and the integration of electronic health record data with socioeconomic indicators, and is well recognized in the field of cardiovascular disease epidemiology. Her recent research has focused on the application of clinical decision support to complement risk scoring in primary care, cardiology, and oncology. Her research portfolio has been supported by a combination of governmental and industry grants and contracts. Previously, Dr. Foraker served as an Associate Professor of Epidemiology at The Ohio State University College of Public Health.

Dr. Foraker received her PhD in epidemiology from The University of North Carolina at Chapel Hill, where her research focused on evaluating the impact of socioeconomic status on incident cardiovascular disease, receipt of cardiovascular treatments, and the progression of heart failure. Dr. Foraker also received her undergraduate and graduate degrees in education and health promotion, respectively, from The University of Iowa.

RESEARCH INTERESTS

- Approaches for the integration of socioeconomic and patient-reported outcome data with electronic health record data
- Interventional approaches to the use of electronic health records in order to address modifiable risk factors for disease and enable patient-centered decision making
- Study design methodology and data analysis

Course Description:

This course introduces students to the methods needed in order to apply the foundational theories covered in Biomedical Informatics I. The course will cover a broad spectrum of such methods including both computational and quantitative science techniques that can be employed in the design, conduct, and analysis of basic science, clinical, and translational research programs. This course is intended to enable individuals to critically select such methods and evaluate their results as part of both the design of new project as well as the review of results available in the public domain (e.g., literature, public data sets, etc.).

Core concepts to be reviewed during this course include:

- Foundations of biomedical computation
- Data modelling, codification and integration
- Domain-specific knowledge representation
- Decision science and computational reasoning (including heuristics, logical operation and probability theory)
- Quantitative data analysis
- Data presentation and visualization
- Systems evaluation
- Critical thinking skills surrounding the ability to ask and answer questions about complex and heterogeneous biomedical data

Prerequisite: M18-5302 or instructor permission
Course Objectives:
The objectives of this course are to provide trainees with a solid understanding of core biomedical and quantitative science principles used in the design and execution of basic, clinical, and translational research programs. By the end of the class, trainees should be able to:

- Utilize common computational tools and methods for data capture, storage, and manipulation;
- design, implement, and employ data structures and database management systems suitable for use in the biomedical domain;
- understand and leverage common knowledge representation schemas and constructs in order to annotate or reason upon biomedical data;
- apply in silico hypothesis generation methods to identify and quantify high-order patterns or motifs of interest in complex biomedical data sets;
- apply Bayesian methods to explore probabilistic interconnections between data elements comprising large-scale and complex biomedical data sets;
- use state-of-the-art methods to summarize data and contextualize it relative to targeted samples/populations and observed probabilistic relationships between data of interest; and
- ask and answer questions relative to various types of quantitative relationships between and among data elements making up larger experimental data sets.

Daily Work/Homework:
Each week, students will be expected to turn in a write-up based off of the previous lecture and in-class discussions. Write-ups should incorporate theories and principles learned in the readings, lecture materials, and addressed in the in-class discussions.

Major Assignment Descriptions:
The course will culminate with a written and technical project, as well as an in-person presentation and final exam. This written and technical project will include:

1) The selection of driving biological or clinical problem that can be addressed using biomedical informatics theories and methods as presented in this course;
2) The selection of one or more corresponding public data set(s) that can be used to inform a partial or complete solution to the selected driving problem;
3) The development of a protocol document (2-3 pages) describing how a data analysis script and/or application that utilizes appropriate biomedical informatics theories, applied to the selected public data set(s), can serve to generate one or more data or analytics products that inform a partial or complete solution to your driving biological or clinical problem and how such an outcome will be evaluated;
4) The implementation and evaluation of the data analysis script and/or application as is formalized in the aforementioned protocol document;
5) The preparation of a report (3-5 pages) concerning the outcomes of the preceding implementation and evaluation process, formulated as a case study; and
6) The preparation of a 15m presentation that summarizes the lessons learned from items 1-5 above.

Technology Requirements:
All the class materials, as well as the assignments and communications will be done through Canvas (found at mycanvas.wustl.edu).

Students will be expected to bring a laptop to class for the experiential learning components of the course. Problems with your computer or other technology issues are not a reason for delays in meeting expectations and
missed deadlines for the course. If you have a problem, get help in solving it immediately. At a minimum, you will need the following software/hardware to participate in this course:

1. A laptop computer with a current operating system (e.g. Windows, Mac OS, Linux)
   a. You will need appropriate privileges on this computer to be able to install additional, open-source software packages as assigned by the instructors throughout the class
2. An up-to-date internet browser (preferably Google’s Chrome or Apple’s Safari)
3. An active WUSTL key (such that you can log-into the wireless network and/or other university computing resources)
4. The ability to access and use the Canvas Learning Management System (https://mycanvas.wustl.edu/)
5. Access to a high-speed internet connection

In addition, all students will be expected to obtain a username and password for the National Library of Medicine’s (NLM) terminology services. This requires the completion of an account request and user license at the following web-site: https://uts.nlm.nih.gov/home.html

**Time Requirements**

For face-to-face courses in the CRTC program, it is expected that you will be in class 1 hour per week for each credit of the course a week plus travel time (i.e. this is a 3-credit course so that is 3 hours a week). In addition, it is assumed you will be doing homework and reading assignments that take at least double that time. You should anticipate your time commitment for this course to be at least 9 hours a week.

**Course Schedule** (subject to modification)

<table>
<thead>
<tr>
<th>Dates</th>
<th>Topic</th>
<th>Instructor(s)</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/14</td>
<td>Course Logistics, Overview &amp; Intro</td>
<td>Foraker</td>
<td>Chapter 1</td>
</tr>
<tr>
<td>1/21</td>
<td>MLK Day – NO CLASS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/28</td>
<td>Informatics Methods Supporting Personalized Medicine</td>
<td>P. Payne</td>
<td>Chapter 11</td>
</tr>
<tr>
<td>2/4</td>
<td>Linking Data Across Scales</td>
<td>F. Li</td>
<td>Chapter 12</td>
</tr>
<tr>
<td>2/11</td>
<td>Hypothesis Generation and Classifiers</td>
<td>F. Li</td>
<td>Chapter 4, Chapter 9</td>
</tr>
<tr>
<td>2/18</td>
<td>Asking and Answering Questions about Data</td>
<td>Foraker</td>
<td>Assigned Readings</td>
</tr>
<tr>
<td>2/25</td>
<td>Data Summarization</td>
<td>Foraker</td>
<td>Assigned Readings</td>
</tr>
<tr>
<td>3/4</td>
<td>Data Visualization</td>
<td>Kannampallil</td>
<td>Assigned Readings</td>
</tr>
<tr>
<td>3/11</td>
<td>NO CLASS, SPRING BREAK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/18</td>
<td>Software Engineering and Technology Deployment</td>
<td>Lai</td>
<td>Chapter 10</td>
</tr>
<tr>
<td>3/25</td>
<td>Knowledge-Based Systems and Biomedical Ontologies</td>
<td>T. Payne &amp; Gupta</td>
<td></td>
</tr>
<tr>
<td>4/1</td>
<td>NLP</td>
<td>Lai</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>4/8</td>
<td>Usability, Task Analyses, Walk-Through, Eye-Tracking</td>
<td>Kannampallil &amp; Abraham</td>
<td>Assigned Readings</td>
</tr>
<tr>
<td>4/15</td>
<td>Social Technical Theory and Workflow Analysis</td>
<td>Yen</td>
<td></td>
</tr>
<tr>
<td>4/22</td>
<td>Review/Discussion</td>
<td>Foraker/Yen</td>
<td>Chapter 13</td>
</tr>
<tr>
<td>4/29</td>
<td>Final Projects Due and In-Person Presentations</td>
<td>Foraker/Yen</td>
<td></td>
</tr>
</tbody>
</table>
Assessment/Grading

Grade Composition:

Summary of Course Assignment Point Values:

Weekly Lab write-ups (grades as Pass/Fail)) 15%
Final Project (25% paper/15% presentation) 40%
Final Exam 30%
Attendance, Participation, and Professionalism 15%

100

Grading Scale:

<table>
<thead>
<tr>
<th>Grades/sub-grades</th>
<th>Course Points</th>
<th>4-point scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+ (98% to 100%)</td>
<td>98-100</td>
<td>4.00</td>
</tr>
<tr>
<td>A  (93% to 97%)</td>
<td>93-97</td>
<td>4.00</td>
</tr>
<tr>
<td>A- (90% to 92%)</td>
<td>90-92</td>
<td>3.7</td>
</tr>
<tr>
<td>B+ (88% to 89%)</td>
<td>87-89</td>
<td>3.3</td>
</tr>
<tr>
<td>B  (83% to 87%) – minimum for Core courses</td>
<td>83-86</td>
<td>3.00</td>
</tr>
<tr>
<td>B- (80% to 82%)</td>
<td>80-82</td>
<td>2.7</td>
</tr>
<tr>
<td>C+ (77% to 79%)</td>
<td>77-79</td>
<td>2.3</td>
</tr>
<tr>
<td>C  (73% to 77%) – minimum for Electives</td>
<td>73-76</td>
<td>2.00</td>
</tr>
<tr>
<td>C- (70% to 72%)</td>
<td>70-72</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Penalties for Late Work:
Late work will not be accepted, unless in the event of unforeseen circumstances. If these situations arise, students must receive written approval from the course master. If you must miss a class, please email a copy of the weekly assignment to Andrea Krussel prior to the start of the class when it is due.

Attendance Requirement:
In-class participation is an important part of the coursework taken as part of the BMI, MSCI or AHBR programs and the clinical research training programs within the CRTC. Students are expected to physically attend at least 75% of class sessions for each course they take. Watching the videotaped class presentations, if available, is helpful to keep up with missed sessions, but is not a substitute for class attendance. Students whose professional duties or personal circumstances prevent them from meeting this program attendance requirement must receive prior written approval of the course-master, and agree on an alternate plan to achieve course objectives and earn academic credit.

Canvas Support
If you have any technical problems accessing Canvas, please e-mail krussela@wustl.edu. Note, this mailbox is not monitored in the evening or on weekends. If you need immediate help after hours please put a service request into https://wusm.service-now.com. Canvas, please e-mail. Note, this mailbox is not monitored in the evening or on weekends. If you need immediate help after hours please put a service request into.

Course Policies

Participation:
- It is vitally important that our classroom environment promote the respectful exchange of ideas. This entails being sensitive to the views and beliefs expressed during discussions whether in class or online.
- Your success in this course will heavily depend on your ability to communicate, engage and participate in all course activities. Successful completion of this course requires that a student keep up with all assignments and prep work for the lab components.

If you are unable to participate in the scheduled class activity or discussions you must notify the course-master within the week of that class module or discussion. An unexcused failure to engage or participate with the class will be counted as an absence; unexcused absences may result in failure. The course-master reserves the right to make judgment to accept and/or make-up assignments missed because of failed participation in the course activities.

Drop Dates:
If the occasion should arise that you want or need to drop this class, please see me first. You can drop for any reason during the course of the semester, however you may only receive a partial or no tuition reimbursement depending upon how far into the semester you drop the course. See the Academic Calendar for your program for specific dates and reimbursement policies. Note, late withdrawals will also appear on your transcript as a withdrawal.

CRTC Academic Policy Guidelines:
Guidelines regarding CRTC course registration and enrollment, grades, tuition obligation, and academic leave are consolidated in the CRTC Academic Policy Guidelines. Please take a moment to review this document.

CRTC Guidelines for Academic and Non-Academic Transgressions:
By registering for this course, you have agreed to the terms of the CRTC Guidelines for Academic and Non-Academic Transgressions. If you have not already reviewed this policy, please be sure to before beginning any CRTC related coursework.

Academic Integrity/Plagiarism:
- Academic dishonesty is a serious offense that may lead to probation, suspension, or dismissal from the University. One form of academic dishonesty is plagiarism – the use of an author’s ideas, statements, or approaches without crediting the source. Academic dishonesty also includes such acts as cheating by copying information from another student. Plagiarism and cheating are not acceptable.
- Academic dishonesty will be reported to the Office of the Registrar for possible action. The course-master will make an academic judgment about the student’s grade on that work and in that course. The CRTC process regarding academic dishonesty is described in the CRTC Guidelines for Academic and Non-Academic Transgressions.

Writing Assistance:
For additional help on your writing, consult the expert staff of The Writing Center in Olin Library (first floor). It can be enormously helpful to ask someone outside a course to read your essays and to provide feedback on strength of argument, clarity, organization, etc.
Mental Health Resources:
Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: http://shs.wustl.edu/MentalHealth.

Reporting Policies:
Please also review the CRTC website for policies regarding sexual assault reporting and reporting concerns about bias, prejudice or discrimination or review the text below:

Accommodations based upon sexual assault:
The University is committed to offering reasonable academic accommodations to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support services and accommodations. If you need to request such accommodations, please direct your request to one of following resources: Dr. Karen Winters, MD, Director of Student Health Service; Dr. Gladys Smith, PhD, Sexual Violence Prevention Therapist and Licensed Psychologist, or Kim Webb, Director of the Relationship and Sexual Violence Prevention Center at the Danforth Campus. These are confidential resources; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

If a student comes to me to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if I otherwise observe or become aware of such an allegation, I will keep the information as private as I can, but as a faculty member of Washington University School of Medicine, I am required to immediately report it to an Office of Education Dean or directly to Ms. Jessica Kennedy, the University’s Title IX Director. If you would like to speak directly with Ms. Kennedy, she can be reached at (314) 935-3118, or by visiting the Title IX office in Umrah Hall on Danforth Campus. Additionally, you can report incidents or complaints to the Office of Student Affairs or by contacting WUSM Protective Services 314-362-4357 or your local law enforcement agency.

You can also speak confidentially and learn more about available resources by contacting Dr. Gladys Smith, PhD, Sexual Violence Prevention Therapist and Licensed Psychologist at the Medical Campus, (314) 362-2404, or contacting the Relationship and Sexual Violence Prevention Center located on the 4th floor of Seigle Hall on Danforth Campus, (314) 935-3445.

For further Resources, see: wusmhealth.wustl.edu/students/victims-sexual-assault-abuse/resources-2/

Bias Reporting:
The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. See: diversityinclusion.wustl.edu/brss/. To report mistreatment or offensive behavior in the MD program, please report via the following pathways:

- **CANVAS** (the Learning Management System) utilizing the direct link from the Student Commons < Mistreatment, Offensive Behavior, and Bias Reporting
- Directly contacting any of the following individuals:
  - Senior Associate Dean for Education
- Associate Dean for Student Affairs
- Associate Dean for Medical Student Education
- Student Ombudsperson (as another confidential resource)

**Office of the Associate Vice Chancellor for Diversity, Equity and Inclusion (DEI)**

The **DEI Training Team** designs, facilitates and leads diversity education programming for faculty, staff and students on a wide range of topics including: creating a climate of respect, the value of diversity and the role of biases in our day-to-day lives.

[diversity.med.wustl.edu/training/](diversity.med.wustl.edu/training/)

The **Office of Diversity Programs** promotes diversity among and prepares medical students to lead in a global society. A priority for the Office of Diversity Programs is to cultivate and foster a supportive campus climate for students of all backgrounds, cultures and identities.

[mddiversity.wustl.edu/](mddiversity.wustl.edu/)

The **Diversity and Inclusion Student Council** promotes an inclusive campus environment for all School of Medicine students.

[sites.wustl.edu/disc/](sites.wustl.edu/disc/)

The **Office for International Students and Scholars** embraces the university’s mission of welcoming promising students from around the world.

[wumma.wustl.edu/](wumma.wustl.edu/)