Syllabus for BIEN 237: Medical Diagnostics

Prof. William Grover (wgrover@engr.ucr.edu)

Spring 2017

Class Schedule

TBA

Course description

Provides an overview of medical diagnostics. Topics include methods of biochemical detection, genotyping, DNA sequencing, medical imaging, hematology, microfluidics, epidemiology, diagnostics for point-of-care and resource-limited settings, and case studies of commercially successful diagnostic products. 4 units total: 3 units lecture, 1 unit discussion.

Textbook

None required, but course material will be provided on iLearn, including journal articles, patents, product literature, and example code.

Course outline

Introduction to medical diagnostics. “What kills people?” (survey of leading causes of death globally, by region, and socioeconomic group)


Smartphones in medical diagnostics: motion sensors. Case study: creating a fall detection app using a sensor logging app.


Smartphones in medical diagnostics: light sensors. Case study: creating a photoplethysmography app for measuring heart rate.

Project 1: Smartphone-based medical tools. Students propose, prototype, and present a smartphone-based medical tool.

Introduction to microfluidics. The ASSURED criteria for diagnostics in resource-limited settings. Advantages (and disadvantages) of assay miniaturization.


Simulation of microfluidic systems. Finite element analysis software COMSOL Multiphysics.

Project 2: Microfluidic diagnostics. Students simulate an existing microfluidic diagnostic system, propose an improvement to the system, simulate the improved system, and share results with the class.

Case study: Theranos. An analysis of the rise and fall of a microfluidic medical diagnostic company. Intellectual property.


Diffusion + convection in medical diagnostics. Adding convection to model biosensor. Peclet numbers. Case study of microfluidic HIV viral load measurement.


Grading

- 20% Homework
- 20% Presentation 1
- 20% Presentation 2
- 20% Midterm exam
- 20% Final exam
A+ \geq 97.00
97.00 \text{ > } A \geq 92.00
92.00 \text{ > } A^- \geq 90.00
90.00 \text{ > } B+ \geq 87.00
87.00 \text{ > } B \geq 82.00
82.00 \text{ > } B^- \geq 80.00
80.00 \text{ > } C+ \geq 77.00
77.00 \text{ > } C \geq 72.00
72.00 \text{ > } C^- \geq 70.00
70.00 \text{ > } D+ \geq 67.00
67.00 \text{ > } D \geq 62.00
62.00 \text{ > } D^- \geq 60.00
60.00 \text{ > } F

Homework

- Assigned via iLearn, due one week later by 5pm.
- Solutions posted on iLearn after grading is finished.

Project 1: Smartphone-based medical tools

Students propose, prototype, and present a smartphone-based medical tool. You won’t need to program your own apps. I’ll show you how to use tools like sensor logger apps, sound recorder apps, and camera apps to acquire medically-meaningful data and import that data into a computer for analysis using tools like MATLAB, Python, ImageJ, Audacity, and others. Around Week 6 you will present your app proposal and preliminary results to the class.

Project 2: Microfluidic diagnostics

Students simulate an existing microfluidic diagnostic system, propose an improvement to the system, simulate the improved system, and share results with the class. I’ll give you a crash course in simulating microfluidic chips in COMSOL Multiphysics. Around Week 10 you will present your simulations and proposed improvements to the class.
Presentation rules

• Brief abstracts on proposed topics are due two weeks before presentations.

• Teams of 1, 2, or 3 persons.

• I’ll announce the amount of time allotted for each group’s presentation.

• Visuals in PowerPoint, Keynote, PDF, Google Docs, or on the chalkboard. No Prezi or similar tools please.