Computing in the Speech Sciences
Fall, 2020

Instructor: Charles Redmon   Meeting Times: TBD
Office: TBD   Office Hours: TBD

This course will introduce you to basic programming techniques for use in speech science research, and will use these techniques to introduce core computing concepts in phonetics and phonology. In particular, we will cover Python programming and Praat scripting, with the former focused on general programming concepts—variables, input/output, data types, functions, control statements—and the latter specific to processing audio data. In the second part of the course, we will apply these techniques to the concrete understanding of theoretical concepts in the speech sciences rooted in computing, including concepts from Information theory and Complexity theory.

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1 Course Requirements

1.1 Problem Sets (60%)

Six problem sets will be assigned over the course of the semester, consisting of programming problems and short answer questions. For programming problems all code must be submitted electronically before class the day it is due, while the write-up should be printed out and submitted in class. Each problem set will be due two weeks after it is assigned and will count for 10% of the final grade. You may work in groups, but your answers must be your own (please include the names of your group partners on your submission).

1.2 Final Exam (25%)

There will be a final take-home exam that will be assigned during Week 14, and will be due on the date of our final exam during Exam Week. Unlike the problem sets, you may not work in groups on the exam, though you may see me in office hours if you have any questions. The final exam will consist of both practical programming problems and general short-answer questions about theoretical concepts discussed in the latter part of the course.

1.3 Reading Summaries and Discussion Questions (10%)

In the latter part of the course, readings from the speech science literature will be critical to understanding the core ideas and theory, and if you haven't done the readings ahead of class the material will be difficult to follow and class discussion will be hampered. For this reason, you will each be expected to submit to me before the first class of the week—starting in Week 9—a brief summary (approximately 100 words) of each reading and a question you had on that reading (this could be a question on the theoretical background, argumentation, or methodology, or an open-ended question the reading raises but does not directly answer). These assignments are merely to prepare you for class and provide material for discussion, and so they will be graded simply for completion.

1.4 Participation (5%)

An important part of this course is classroom discussion, as many of concepts require multiple perspectives and angles on a problem to fully understand. You are each encouraged to answer and ask questions, offer your opinions, and give feedback on topics throughout the course. If you are at all at risk of losing points for participation, I will contact you and meet with you about how you can get more involved in class (if you do not hear from me, you are doing a great job already and can expect full points).

2 Schedule

Week 1 (08/31–09/04) Introduction to Computer Programming and Python

- Readings: Knuth (1997). "Basic Concepts: Algorithms." In Knuth, *The Art of Computer Programming,* Vol. 1 (pp. 1-10). ◇ Downey (2012). *Think Python*, Chapter 1: The Way to Program.

Week 2 (09/08–09/11) Python Language Fundamentals

- Readings: *Think Python*, Chapter 2: Variables, Expressions, and Statements. ◇ *Think Python*, Chapter 3: Functions.

Week 3 (09/14–09/18) Control Statements

- Readings: *Think Python*, Chapter 5: Conditionals and Recursion. ◇ *Think Python*, Chapter 7: Iteration.

Week 4 (09/21–09/25) Data Structures

- Readings: *Think Python*, Chapter 10: Lists. ◇ *Think Python*, Chapter 14: Files.

Week 5 (09/28–10/02) Text Processing and Regular Expressions

- Readings: *Think Python*, Chapter 8: Strings. ◇ Lopez & Romero (2014). "Introducing Regular Expressions." In Lopez & Romero, *Mastering Python Regular Expressions*.

Week 6 (10/05–10/09) Introduction to Praat

- Readings: Boersma & Van Heuven (2001). "Speak and unSpeak with Praat" ◇ van Lieshout (2017). "Praat Short Tutorial: An Introduction"

Week 7 (10/12–10/16) Basic Praat Scripting

- Readings: Praat Scripting Tutorial [within Praat, under "Help > Scripting Tutorial"]

Week 8 (10/19–10/23) NO CLASS – FALL BREAK

Week 9 (10/26–10/30) Introduction to Information Theory

- Readings: Pierce (1980). *An Introduction to Information Theory: Symbols, Signals, and Noise*, Ch. 1-5.

Week 10 (11/02–11/06) Functional Load

- Readings: Martinet (1952). "Function, Structure, and Sound Change." ◇ Hockett (1967). "The Quantification of Functional Load" ◇ Oh, Coupé, Marsico, & Pellegrino (2015). "Bridging Phonological System and Lexicon: Insights from a Corpus Study of Functional Load."

Week 11 (11/09–11/13) Transmitted Information in Perception Experiments

- Readings: Miller (1953). "What is information measurement?." ◇ Miller & Nicely (1955). "An Analysis of Perceptual Confusions among some English Consonants." ◇ Stanislaw & Todorov (1999). "Calculation of Signal Detection Theory Measures."

Week 12 (11/16–11/20) Introduction to Complexity Theory

- Readings: Mitchell (2009). *Complexity: A Guided Tour*, Chapter 1: What is Complexity? ◇ Newman (2011). "Complex systems: A Survey" ◇ Goldreich (2008). *Computational Complexity: A Conceptual Perspective*, Chapter 1: Introduction and Preliminaries ◇ Rashevsky (1955). "Life, Information Theory, and Topology"

Week 13 (11/23–11/25) Neighborhood Density and Phonological Networks

- Readings: Vitevitch & Luce (2016). "Phonological Neighborhood Effects in Spoken Word Perception and Production." ⋄ Vitevitch (2008). "What can Graph Theory Tell us about Word Learning and Lexical Retrieval? ⋄ Dautriche, Mahowald, Gibson, Christophe, & Piantadosi (2017). "Words Cluster Phonetically Beyond Phonotactic Regularities."

Week 14 (11/30–12/04) Self-Organization in Speech Systems

- Readings: de Boer & Vogt (1999). "Emergence of Speech Sounds in Changing Populations." ⋄ De Jong (1998). The Development of a Lexicon Based on Behavior." ⋄ Wedel (2011). "Self-Organization in Phonology."

Week 15 (12/07–12/09) Exam Help

- We will use this week to have open class time for you to work on your take-home exams and ask questions.