

Affective Computing CSCI534

Spring 2021

Objective:

Affective Computing is computing that relates to, arises from, or deliberately influences emotions. This course overviews the theory of human emotion (how it arises from and influences cognition, the body and the social environment), techniques for recognizing and synthesizing emotional behavior, and illustrates how these can be applied to application design. Students will gain a strong background in the theory and practice in human-centered computing as it relates to health, entertainment and pedagogical applications.

Instructor: [Jonathan Gratch](#)

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Date/Time: Mon, Wed 200-3:50, Online

Grades: Grades determined by class participation 10%, mid-term project presentation 15%, homework 40%, final project presentation 15%, final project writeup 20%

Class participation is expected and part of the grade. As this is a zoom-based course, students are expected to attend live, with video, and participate in in-class exercises and discussion.

The course is largely project based. Students are expected to work in teams (of approximately 4 students) to develop, execute and present a research project. Students are encouraged to build on existing tools. A complete list of pre-existing software tools available to students, and summaries of some prior student projects build with these tools can be found [HERE](#). Project guidelines can be found [HERE](#). This is more a theory-based course than

Source book: [Oxford Handbook of Affective Computing](#) (OHAC): useful but not required

Software: Students will gain knowledge and/or hands-on experience with the following software tools related to affective computing including:

- Emotion Recognition Techniques
- Emotion Synthesis Techniques
- Cognitive and Emotional Modeling
- Algorithms and tools that support the above methods
- Human-subjects experimental design and analysis
- Ethical issues in AI

Note to Instructors: Other instructors are welcome to use these course materials. Please acknowledge the original source in footer of slides. Note some slides have been borrowed from other instructors as noted in the footers of presentation material.

Course Outline

(**WARNING: Below will evolve somewhat throughout the semester**). Most current version will be [HERE](#). Don't get more than 1 week ahead on readings. The same topics will be presented but some changes to reading lists may occur. Homework will be added)

Lecture 1 (Wed, Jan 20) Course Overview. Introduction to Affective Computing

- Review structure of course
- What is affective computing?
- Broadly overview functions of affect and why of interest to computer science
- Overview applications that take advantage of these perspective
- **Homework 1: Emotion prediction (posted on blackboard):** Estimated time, 20-30 min, Due Friday Jan 17th, midnight
- Readings:
 - Gratch 2021: [The field of Affective Computing: An interdisciplinary Perspective](#)
- Optional background readings:
 - [OHAC, Chapter 1](#) (skim). Summarizes major topics in affective computing
- Lecture slides

Lecture 2 (Mon, Jan 25) Emotion Theory

- Define affective phenomena (emotion, mood, attitude/sentiment, personality)
- What is theory and why does it matter?
- Review alternative theoretical perspectives on emotion
- Suggested Reading:
 - [OHAC, Chap 3](#). Short history of psychological perspectives on emotion
- Optional background readings
 - [The science of 'Inside Out': Short piece by Dacher Keltner and Paul Ekman about the Pixar movie](#)
- Lecture slides

Lecture 3 (Wed, Jan 27) Emotion Theory (continued)

- Dual-process theories of emotion
- Constructivist theories
- Appraisal theories (continued)
- **In class exercise:** Download in advance of class and prepare to listen: [Stim1](#); [Stim2](#)
- **Homework 2 (part 1):** Appraisal modeling (short online survey)
- Optional Readings
 - [Ellsworth and Scherer 2003](#): review of appraisal theories
 - [Smith and Lazarus 1990](#): description of their appraisal and coping theory
- Lecture slides

Lecture 4 (Mon, Feb 1) Giving Computers Emotion (part 1)

- Discuss ways to make machines "have" emotions
- Introduce Computational Appraisal Theory
- **Homework 2 (part 2): Appraisal modeling** (Due Feb 5, midnight)
- Reading-
 - [Marsella and Gratch \(2009\)](#), sections 1.1, 1.2, 2 and 3: describes model of "the Bird"
- Optional reading:

- [Emotional Calculator](#): a short description of how the Emotion Calculator (HW1) was created
 - [Emotion Analyst](#): a published paper describing how the emotion analyst works.
- Lecture slides

Lecture 5 (Wed, Feb 3) Giving Computers Emotion (part 2)

- Discussion of reinforcement learning based approaches to appraisal modeling
- Discuss framework for evaluating computational appraisal models
- **Homework 3 (part 1): Short decision-making survey** (Due Feb 7, midnight)
chance to earn some extra credit
- Reading
 - [Marsella, Gratch and Petta \(2010\)](#): reviews modeling research. Focus on pp. 31-40.
- Optional reading:
 - [Moerland et al. \(2018\)](#): Survey of Emotion in Reinforcement Learning
- Lecture slides

Lecture 6 (Monday, Feb 8) Emotion and Decision-making

- Review rational choice theory (decision theory)
- Contrast between rational models and human decision making
- **Homework 3 (part2): Decision modeling** (Due Feb 16, midnight)
- **Homework 4 (Part 1): Complete short survey in advance of Lecture 4** (Due Feb 9, midnight)
- Reading:
 - [Lowenstein and Lerner 2003](#), p620-633. You should understand figure 31.1
- Strongly encouraged:
 - Watch NOVA's "[Mind over Money](#)"
- Optional Reading:
 - [Lerner video interview](#): Outlines alternative theories of emotion
 - [Mellers et al 1999](#): Emotion-based choice
- Lecture slides

Lecture 7 (Wed, Feb 10) Experimental Design, Methodology and Analysis

- Guest Lectures by [Gale Lucas](#), USC ICT
- **Homework 4 (part 2): Experimental design and analysis** (Due Feb 17, before class)
- Reading:
 - sparknotes reading on [Research Methods in Psychology](#), a good summary of research methods. You have to click through each section separately to read.
- Lecture slides

February 15: President's Day (no class)

Lecture 8 (Wed, Feb 17) Emotion and the Brain

- Overview of physiological and brain Computing
- Focus on some affective computing approaches to brain measurement
- **Homework 5: Classifying physiological signals** (Due Feb 28, midnight)
- Reading (Sep24):
 - [Fairclough 2009](#) – Fundamentals of physiological computing
- Optional Reading:
 - [OHAC, Chap 15](#): Discusses affective brain-computer interfaces
 - [Davidson et al. 2003](#): Reviews some neuroanatomy of emotion

- [Arani et al., 2015](#): Example of using fNIRS for affective computing.
- Outside resource: [Brain-Computer Interface Tutorial](#)
- Lecture slides

Lecture 9 (Mon, Feb 22) Group project discussion

- Discussion of group projects. Explore topics and tentative teams
 - Expect students to sit in tentative groups. Use class time to develop your ideas. I will circulate through class, expect short “pitches” and give feedback
- Lecture slides

Lecture 10 (Wed, Feb 24) Emotion and the Body

- Overview psychophysiological impacts of emotion
 - Review biopsychosocial model of challenge / threat
 - Review physiological manifestation of coping responses
 - Discuss cardiovascular measures of emotion and coping
- Reading:
 - [Blascovich & Mendes 2010](#): Reviews psychophysiological findings. Only required to read following sections:
 - Neurophysiological systems, advantages & Indices (p199-203)
 - Uses [affect, attitudes, emotion] (p 210-215)
- Optional Reading:
 - [OHAC, Chap 14](#): Reviews physiological sensing of emotion
- Lecture slides

Lecture 11 (Mon, Mar 1) Bodily Expression of Emotion

- Physical manifestation of peripheral psychophysiology
- Embodied theories of emotion
- Reading: [Niedenthal 2007](#): Discusses embodied approaches to emotion
- Optional Reading:
 - [Zacharatos et al. 2014](#). A survey of automatic emotion recognition based on body movement analysis
- Lecture slides

Lecture 12 (Wed, Mar 3) Group Project Proposal Presentations

- Students will give 5min presentations of their project
- **Homework 6 (part 1): Behavioral game theory** (Assigned Feb27; Due Mar 1, midnight)

Lecture 13 (Mon, Mar 8) Synthesis of Emotional Behavior

- Encoding-Decoding: realistic vs. communicative approaches
- Expression synthesis techniques
- Demonstration of virtual human toolkit (**Guest lecture**, Adam Reilly)
- **Homework 6 (part 2): Behavioral game theory** (Due Mar 9, 11:59pm)
- Reading: [OHAC, Chapter 18](#), Section 2 only; Digital expression synthesis
- Reading: [OHAC, Chapter 21](#), Section 3 only; Robotic expression synthesis
- Optional Reading:
 - [Parkinson2008](#): Emotions in social interactions
 - [OHAC, Chapter 20](#); Emotional speech synthesis
 - [OHAC, Chapter 19](#); Gesture & postures synthesis

- Lecture slides , Tutorial Slides

Lecture 14 (Wed, Mar 10) Emotion and Social Interaction I

- completing before class on Oct 10
- Review rational choice theory (game theory)
- Review of behavioral game theory
 - Other-regarding preferences
- Psychological Distance and Mind perception theory
- Reading: [Game Theory Introduction](#), p1-11
- Optional Reading:
 - Fund game about learning game theory: (<https://ncase.me/trust/>)
 - [Behavioral Game Theory](#) (from handbook on judgment and decision-making)
 - [Fehr and Schmidt](#) on other-regarding preferences
- Lecture slides

Lecture 15 (Mon, Mar 15) Emotion and Social Interaction II

- Theories of the social impact of emotion expressions
 - Emotion as contagion
 - Emotion as social information (Reverse Appraisal Theory)
- Computational Models: Affect Control Theory
- **Homework 7: Affect Control Theory** (Assigned Mar10; Due Mar 25, 11:59pm)
- Reading: [de Melo et al 2014](#), introduction, exp1, and general discussion: describes “reverse appraisal”
- Optional Reading: [Affect Control Theory](#)
- Optional Reading: [Keltner and Haidt 1999](#): discusses social functions of emotions
- Lecture slides

Lecture 16 (Wed, Mar 17) Emotion and Social Interaction III

- Fridlund vs. Ekman: Are expressions basic emotions or social motives?
- Emotional Labor
- Role of affective computing in emotional labor
- Optional Reading: [Scarantino, in press](#): Gives nice review of theories of facial expressions and proposed model of emotion displays as “speech acts”
- Lecture slides

Lecture 17 (Mon, Mar 22) Emotion and Social Interaction IV: Deception and Manipulation

- Negotiation as a challenge problem for affective computing
- Manipulative emotions
- Optional Reading:
 - [Okekalns2015](#): How emotions shape negotiation
 - [Gratch et al 2015](#): the misrepresentation game
- Lecture slides

Lecture 18 (Wed, Mar 24) Personality and Culture

- **Homework 8: Facial expression analysis** (Due April 4, midnight)
- Personality computing
 - Review Lens model
 - Discuss automatic personality recognition, perception, synthesis
- Personality (and motivation) in computer games

- Limitations of personality computing approach
- Sacred values and Moral decision making
- Optional Reading:
 - [Haidt and Graham 2007](#): review of moral foundation theory
 - [Vinciarelli and Mohammadi 2014](#): survey of personality computing
 - [Yee et al 2011](#): expression of personality in World of Warcraft
 - [Connelly and Ones 2010](#): Discusses limits of personality approach
- Lecture slides

Lecture 19 (Mon, Mar 29) Rapport and entrainment

- **Short Homework 9: Text analysis (Due, April 1)**
- Emotional feedback and attunement
- Rapport agent. Review learning approaches.
- Optional Reading: [Parkinson 2014](#): reviews theories of social emotions
- Optional Reading: [Tutorials on nonlinear methods](#)
- Lecture slides

Lecture 20 (Wed, Mar 31) Emotion Recognition I: Emotion in Text

- Reading: [OHAC, Chapter 13](#); Recognizing affect from text
- Lecture slides

Lecture 21 (Mon, Apr 5) Emotion Recognition II: Emotions in the face

- Impact of context in emotion recognition
- Reading: [OHAC, Chapter 10](#); Face expressions
- Optional Reading: Bin Lu, [Web Data Mining Chap11](#)
- Optional Reading: [Barrett et al 2011](#); Contextual influences on emotion perception
- Lecture slides

April 7: Wellness Day (no class)

Lecture 22 (Mon, Apr 12) Emotion Recognition IV: Emotion in speech

- Emotion in speech
- Reading: [OHAC, Chapter 12](#); recognizing affect from speech
- Lecture slides, webinar

Lecture 23 (Wed, Apr 14) Emotion Recognition III: Learning representations and multimodal

- Guest Lecture: Mohammad Soleymani
- Multimodal techniques and machine learning
- Recommended Reading: [Baltrušaitis et al 2018](#): Survey of Multimodal ML approaches
- Optional Reading: [D'Melo et al 2015](#): Another survey of MM ML approaches
- Lecture slides, webinar

Lecture 24 (Mon, Apr 19) Bias and Ethics of Affective Computing

- **Homework 10 (Due April 21, 11:59pm)**
- Discuss theories of how social machines might help or hinder human social interactions
- Potential for Bias
- Discuss ethical frameworks
- Reading: [OHAC, Chapter 14](#)

- Optional Reading: [Robot sex](#): discusses ethics of building robots that have relations with people
- Optional Reading: [Turkle 2010](#): Discussion of robot companions
- Lecture slides, webinar

Lecture 25 (Wed, Apr 21) Aesthetic Emotions

- Discuss techniques to classify the “emotion” of music. Recommender systems
- Optional Reading: [Juslin 2013](#): Unified theory of musical emotions
- Optional Reading: [Yang and Chen 2012](#): Review of emotion recognition in music
- Optional Reading: [Renfrow et al 2011](#): Five-factor labeling scheme for music
- Lecture slides webinar

Lecture 26 (Mon, Apr 26) Final Project Presentations

- Lecture slides

Lecture 27 (Wed, Apr 28) Final Project Presentations

May 7: Final project writeup due