

Affective Computing CSCI534: An interdisciplinary approach

Spring 2023

NOTE: most links below currently broken as my home page seems to have died over the break

Course Objective:

This course provides a comprehensive and interdisciplinary introduction to the topic of Affective Computing: i.e., 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. The course adopts an interdisciplinary perspective and is suitable for non-computer science students with some familiarity in computational methods. Students will gain a strong background in the theory and practice in human-centered computing as it relates to decision-making, health, entertainment and pedagogy.

Instructor: [Jonathan Gratch](#)

TA: Yufeng Yin <yin@ict.usc.edu>

Date/Time: Mon, Wed 2:00-3:50p, KDC 236 (All times Los Angeles Time Zone)

Piazza: <https://piazza.com/usc/spring2023/csci534>

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

See [Late homework policy](#).

Class participation is expected and part of the grade. Lectures often involve demonstrations and exercises that involve group participation. Thus, students are expected to attend class and participate in in-class activities.

The course is largely project based. Students are expected to work in teams (of approximately 4-5 students) to develop, execute and present a research project. Students are encouraged to build on existing tools. A list of some 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](#).

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

Other useful books: ACM [Handbook on Social Agents](#) (AHSIA); Oxford [Handbook on Affective Science](#)

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 has yet to be fully updated for 2023**). Most current version will be [HERE](#). Don't get more than 1 week ahead on readings. The same topics will be presented but changes to reading lists and homework may occur.)

Lecture 1 (Mon, Jan 9) 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 (all homework will be posted on blackboard):** Estimated time, 20 min, Due Wed Jan 11th, 11:59p
- Readings:
 - Gratch 2021: [The field of Affective Computing: An interdisciplinary Perspective](#)
- Optional background readings:
 - [OHAC, Chapter 1](#). Summarizes major topics in affective computing
 - [The rise of affectivism](#). article illustrating the growing importance of affective science
- [Lecture slides](#)

Lecture 2 (Wed, Jan 11) Emotion Theory:

- Define affective phenomena (emotion, mood, attitude/sentiment, personality)
- What is theory and why does it matter?
- Review alternative theoretical perspectives on emotion across social functions
- **Homework 2 (part 1): Short appraisal experiment** (Due Fri, Jan 13th, 11:59pm)
- 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](#)

Martin Luther King's Birthday (Mon, Jan 16th)

PART I: EMOTION ELICITATION

Lecture 3 (Wed, Jan 18) Theories of emotion elicitation

- Appraisal theories
- Dual-process theories of emotion
- Constructivist theories
- **Homework 2 (part 2): Appraisal modeling** (Due Jan 25th, 11:59pm)
- Suggested Reading
 - [OHAC, Chap 5](#). Discussion of appraisal theory and its influence over computational models.
- [Lecture slides](#)

Lecture 4 (Mon, Jan 23) Models of emotion elicitation I

- Discuss ways to make machines "have" emotions
- Introduce Computational Appraisal Theory
- **Homework 3 (part 1): Short decision-making experiment** (Due Jan 26th, 11:59p)
chance to earn some extra credit
- Suggested 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 Profiler](#): a published paper describing how the emotion profiler works (here they call it the “Emotion Analyst” but it is the same thing).
- [Lecture slides](#)

Lecture 5 (Wed, Jan 25) Models of emotion elicitation II

- Discussion of reinforcement learning based approaches to appraisal modeling
- Discuss framework for evaluating computational appraisal models
- Suggested 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](#)

PART II: CONSEQUENCES OF EMOTION

Lecture 6 (Mon, Jan 30) Cognitive consequences of emotion

- Review rational choice theory (decision theory)
- Contrast between rational models and human decision making
- **Homework 3 (part2): Decision modeling** (Due Feb 6th, 11:59p)
- Suggested 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](#): A model of how emotions shape decisions – we will discuss in class
- [Lecture slides](#)

Lecture 7 (Wed, Feb 1) Biological consequences of emotion I (the brain)

- Overview of physiological and brain Computing
- Focus on some affective computing approaches to brain measurement
- Suggested Reading:
 - [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 8 (Mon, Feb 6) 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
- **Homework 4: Physiological analysis** (Due Feb 13th, 11:59p)

Lecture 9 (Wed, Feb 8) Biological consequences of emotion II (physiology)

- Overview psychophysiological impacts of emotion
 - Review biopsychosocial model of challenge / threat
 - Review physiological manifestation of coping responses

- Discuss cardiovascular measures of emotion and coping
- **Project Descriptions Due:** 1 paragraph tentative project description and team list (Due Feb 19, 11:59pm)
- 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 10 (Mon, Feb 13) Biological consequences (Motor system)

- How emotion is manifest in observable signals.
- How these signals can feedback (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 11 (Wed, Feb 15) Emotion Regulation

- Gross' Process model' Computational methods to measure or shape regulation
- Reading: Emotion regulation for HCI: <https://arxiv.org/abs/2204.00118>
- **Homework 5 (part 1): Short survey for in prep for Lecture 12** (Due Feb 21, 11:59p)
- **Homework 5 (part 2): Experimental design** (Due Feb 26, 11:59p)
- [Lecture slides](#)

President's Day (Mon, Feb 20)

Lecture 12 (Wed, Feb 22) Experimental Design, Methodology and Analysis **[Instructor AWAY]**

- Guest Lectures by [Gale Lucas](#), USC ICT
- Reading:
 - SparkNotes reading on [Research Methods in Psychology](#), a good summary of research methods. You have to click through each section separately to read.
- Recommended Reading
 - [AHSIA, Chapter 2](#): Introduction to empirical methods for social agents
 - [Its only a computer](#): This study will be discussed as part of lecture
- [Lecture slides](#)

Lecture 13 (Mon, Feb 27) Group Project Proposal Presentations

- Students will give 5min presentations of their project

PART III: Emotion Perception

Lecture 14 (Wed, Mar 1) Machine expression of emotion

- How (and why) machines can convey that they experiencing emotion
- Segue to social emotions: Distinguish realistic vs. communicative approaches
- Expression synthesis techniques
- Demonstration of virtual human toolkit (**Guest lecture**, Arno Hartholt)
- **Homework 6: Facial expression analysis** (Due Mar 20th, 11:59pm)
- Suggested Reading:

- [OHAC, Chapter 18](#), Section 2 only; Digital expression synthesis
- [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](#)

Lecture 15 (Mon, Mar 6) Emotion Recognition I: Emotion in Text Lecture 14 (Wed, Mar 1)

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

Lecture 16 (Wed, Mar 8) Emotion Recognition II: Emotions in the face and body

- 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](#)

SPRING BREAK (Mar 13-17)

Lecture 17 (Mon, Mar 20) Emotion Recognition III: Emotion in speech

- **Homework 7 (part 1): Game theory experiment** (Due Mar 23, 11:59p)
- Emotion in speech
- Reading: [OHAC, Chapter 12](#); recognizing affect from speech
- Lecture slides

Lecture 18 (Wed, Mar 22) Emotion Recognition IV: 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

PART IV: SOCIAL EMOTIONS

Lecture 19 (Mon, Mar 27) Emotion and Social Interaction I

- How social goals shape emotion elicitation and consequences
- Review behavioral game theory as computational framework
- Consider how AI can shape social goals (AFOSR)
- **Homework 6 (part 2): Behavior game theory and emotional manipulation** (Due Apr 3, 11:59p)
- Reading: [Game Theory Introduction](#), p1-11
- Optional Reading:
 - Fun 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
 - FAST current opinions
- Lecture slides

Lecture 20 (Wed, Mar 29) Emotion and Social Interaction II

- How expressions of emotion shape emotion elicitation and consequences
 - Emotion as contagion
 - Emotion as social information (Reverse Appraisal Theory)
- Computational Models: Affect Control Theory
- **Homework 7 (part 1): Short negotiation experiment** (Due Mar 31st, 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 21 (Mon, Apr 3) Emotion and Social Interaction III

- Social regulation and Social-functional theories of emotion expression
- Emotional Labor
- Role of affective computing in emotional labor
- **Homework 7 (part 2): Emotion and Negotiation** (Due Apr 10th, 11:59pm)
- Optional Reading: [Scarantino, 2017](#): Gives nice review of theories of facial expressions and proposed model of emotion displays as “speech acts”
- Lecture slides

Lecture 22 (Wed, Apr 5) 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

PART V: INTERACTION AND OTHER TOPICS

Lecture 23 (Mon, Apr 10) Rapport and Social Interactivity

- Emotional feedback and attunement
- Rapport agent. Review learning approaches.
- **Homework 8: Bias and Personality**
- Optional Reading: [Parkinson 2014](#): reviews theories of social emotions
- Optional Reading: [Tutorials on nonlinear methods](#)
- Lecture slides

Lecture 24 (Wed, Apr 12) 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

Lecture 25 (Mon Apr 17) Personality and Culture

- 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 26 (Wed, Apr 19) Bias and Ethics of Affective Computing

- 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

Lecture 27 (Mon, Apr 24) Final Project Presentations

Lecture 28 (Wed, Apr 26) Final Project Presentations

May 5: Final project writeup due

Late Homework Policy

Homework is expected to be turned in on time. Many of the assignments elicit data needed by the class for subsequent assignments. I remove 10% if an assignment is late and an additional 10% for every two days it is still not turned in. If you enroll in the class late (after an assignment is due), there is no penalty but coordinate w/ me on new due dates. I will waive penalties if you have a verified emergency or inform me in advance of a complication (e.g., job interview).