CMPSCI 590AC: Introduction to Affective Computing

Course Information

**Course Dates:** July 7, 2014 – August 15, 2014

**Instructor:** Eva Hudlicka, Ph.D.
Principal Scientist, Psychometrix Associates & Visiting Lecturer, School of Computer Science, U.Mass.-Amherst

**COURSE DESCRIPTION:**
Affective computing represents a broad, interdisciplinary research and practice area focusing on a range of topics, including: affect-adaptive human-computer interaction, affective user modeling, computational models of emotion, cognitive-affective agent architectures; emotion sensing and recognition; and emotion expression. The course will also explore applications of affective computing in a variety of contexts, including intelligent tutoring, affect-adaptive user interfaces, affective gaming, and intelligent social robots and virtual agents.

Introduction to affective computing will be provided through a combination of lectures, student presentations of selected literature, projects and class discussion. The course content and format will be appropriate for graduate and advanced undergraduate students in computer science, cognitive science, psychology, human factors, and industrial engineering, as well as students in the arts, digital media, gaming, and those interested in the use of technology in education and healthcare.

**Learning Objectives:**
This course will enable the participants to make informed decisions about the appropriateness of incorporating emotion in specific applications involving human-computer interaction, including affect-adaptive user interaction in intelligent tutoring, gaming, and interaction with robots and virtual characters. The course will provide the necessary background for selecting the relevant emotion theories, empirical data, and techniques and methods for sensing, recognition, modeling and expression of emotions, across a variety of contexts.

**Prerequisites:**
Graduate or Senior level in Computer Science or Engineering, or permission of instructor. Computer Science students should be familiar with a high-level programming language. Familiarity with AI, and HCl is desirable, including familiarity with knowledge representation formalisms and symbolic reasoning. Three credits.


COURSE ORGANIZATION:

The course will taught via a combination of lectures (primarily), class discussion, presentations of selected readings by students, and final project presentations.

Student Presentations:
Reading material summaries and student projects will be presented using PPT or similar. Each presentation should include a summary, outlining the salient points, discussion of related work, and a critical evaluation of the benefits and shortcomings of the content.

ASSESSMENT:

Student knowledge of the course material will be assessed as follows: formal exam (midterm), paper presentations, class participation, and a final project. When taught in an on-line format, established protocol will be followed to ensure that the students comply with the honor code.

Projects:

There will be one project, due at the end of the semester. This may be one of the following:

(a) Research paper on a specific theoretical or applied topic
(b) Critical literature review of a particular topic
(c) Development of a computational model of some aspect of affective processing, an affective user model, or an affective agent architecture. Students may use existing systems / agents and augment these with the affective modules (e.g., augment an existing robot or a game NPC with a model of emotion generation).
(d) Development of an emotion sensing and recognition system, or an affective expression capability (e.g., augment an existing virtual character with the ability to display some of the basic emotions)

Grading:

Exam: 35%
Paper presentations: 20%
Class participation: 10%
Final project: 35%
WEEK-BY-WEEK OUTLINE:

**Week 1:**
Overview of course structure; Overview of affective computing; Background on emotion research from psychology and neuroscience & its relevance to affective computing

**Week 2:**
Emotion sensing and recognition; applications in affect-adaptive HCI; affective user modeling

**Week 3:**
Emotion expression; applications in social robotics and virtual agents; applications in gaming

**Week 4:**
Emotion modeling; models of emotion generation; models of emotion effects on cognition and behavior; research vs. applied models

**Week 5:**
Cognitive-affective agent architectures; architectures for social robots & affective virtual agents

**Week 6:**
Affective gaming; affective HCI; future trends & challenges; ethical considerations
### SUMMARY OF CLASS SCHEDULE & LECTURE FILES & HOMEWORKS

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<td><a href="590AC_WK1_Lec_1_Overview_Affective_Computing.ppt">Homework #1:</a></td>
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<td><a href="590AC_WK1_Lec_1_Overview_Affective_Computing.ppt">Overview and history of Affective Computing</a></td>
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<td><a href="590AC_WK1_Lec_2&amp;3_Emotion_Research.ppt">Emotion research in psychology &amp; affective neuroscience &amp; its relevance for Affective Computing</a></td>
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<td><a href="590AC_WK1_Lec_2&amp;3_Emotion_Research.ppt">Emotion research in psychology &amp; affective neuroscience &amp; its relevance for Affective Computing</a></td>
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<td><a href="590AC_WK1_Lec_2&amp;3_Emotion_Research.ppt">Optional Neuroscience</a></td>
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<td><a href="590AC_WK2_Lec_3_Affective_User_Modeling.ppt">Affective User Modeling</a></td>
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<td><a href="590AC_WK3_Lec_2_Expression_Part2.ppt">Homework #4:</a></td>
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<td><a href="590AC_WK3_Lec_2_Expression_Part2.ppt">Emotion expression (2) &amp; Emotion ML</a></td>
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<td><a href="590AC_WK3_Lec_3_Applications_of_Expression.ppt">Applications in Social Robotics &amp; Virtual Agents; Applications in affective gaming</a></td>
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<td><strong>Week 4</strong></td>
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<td><a href="590AC_WK4_Lec_2_Modeling_Emotion_Generation.ppt">Models of emotion generation via cognitive appraisal</a></td>
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<td>August 4 - Exam – ‘take home’ – emailed out</td>
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<td>Affective computing and Affective Virtual Agents</td>
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<td>Challenges and ethical considerations</td>
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<td>Final Project Due</td>
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DETAILED CLASS SCHEDULE & READINGS

WEEK 1: JULY 7 - 13

July 7: Course overview & administrivia (Lecture 1-0)

July 7: Overview and history of Affective Computing (Lecture 1-1)

Hudlicka, forthcoming. Chapter 1 (posted on Blackboard)
(Skip sections 1.2 and 1.3; you can also skip 1.8 and 1.9, as this will be covered in the next lectures in more detail)

Intro to affective computing
Picard. 1997. Introduction, Chapter 1, Chapter 3

Affective computing: Challenges and skeptical views (posted on Blackboard – 2 files)

Hollnagel. 2003. IJHCS + Hudlicka (response) + McNeese (response))
Picard. 2003. IJHCS

July 9 & 11: Emotion research in psychology & affective neuroscience (Lecture 1-2&3, Lecture 1-Optional)

Hudlicka, forthcoming. Chapter 3 (posted on Blackboard)
(This is a long chapter. I encourage you to read the entire chapter by the end of the course, but for now, feel free to skim it to elaborate on the material covered in the lecture, or to cover topics that you are particularly interested in.)

Fellous, 2004. From human emotions to robot emotions. AAAI Spring Symposium – Architectures for Modeling Emotions

Optional Supplemental Readings & References:


Distinctions among affective factors: emotions, moods, temperament (traits)
Ekman & Davidson. 1994. Question #2 (pp. 51 – 96)


WEEK 2: JULY 14 – 20

July 14: Emotion sensing and recognition  (Part 1)

Overview of affective signals and systems

Techniques for emotion sensing & recognition, synthesis and expression

Framework for organizing techniques for machine emotion sensing, recognition and expression


Optional Supplemental Readings:


July 16: Emotion sensing and recognition  (Part 2)

Continue reading the materials listed above.

July 18: Affective User Modeling

Hudlicka, forthcoming. Chapter 1 (posted on Blackboard under “Week 1 – Readings”) (Re-read section 1.4.3 – Affective User Modeling)

Optional Supplemental Readings:


WEEK 3: JULY 21 - 27

**July 21 & 23: Emotion expression & Emotion Markup Languages**

Refer back to the two readings from last week for an overview & organizing framework:

*Techniques for emotion sensing & recognition, synthesis and expression*

Picard. 1997. Chapters 6

Framework for organizing techniques for machine emotion sensing, recognition and expression


Optional Supplemental Readings:


July 25: Applications in Social Robotics & Virtual Agents; Affective Gaming


**WEEK 4: JULY 28 – AUGUST 3**

**July 28: Emotion Modeling; Research vs. Applied Models**

(On B’board)

**Optional Supplemental Readings:**

Cooper & Fox, 2002; Modeling Cognition (On B’board)

Canamero, 2002: Designing Emotions for Activity Selection in Autonomous Agents (On B’board)

**July 30: Models of emotion generation**

Sections: 11.0 – 11.4, 11.6, 11.8 (On B’board)

**August 1: Models of emotion effects on cognition and behavior**

Hudlicka, 2008; Two Sides of Appraisal, AAAI (On B’board)

(On B’board)

**Optional Supplemental Readings:**

Hudlicka, 2008; Modeling the Mechanisms of Emotion Effects on Cognition (On B’board)

**August 1: Guidelines for developing emotion models**

(On B’board)

**WEEK 5: AUGUST 4 – 10**

**August 4: Cognitive-Affective Agent Architectures**


Optional Supplemental Readings:


**August 6: Social Robotics**


**August 8: Affective Virtual Agents**


*Overview of synthetic avatar development*


Note: Additional optional readings will be posted once course begins

**WEEK 5: AUGUST 11 – 17**

**August 11: Affect-Adaptive HCI**

*Overview of Emotions and Affective HCI*

Hudlicka. 2003. To Feel or Not to Feel: The role of affect in human-computer interaction. IJHCS. (on B'board)


Optional Supplemental Readings:


**August 13: Affective Gaming**

Hudlicka, 2008; Affective Computing for Game Design

Hudlicka, 2009; Affective Game Engines: Motivation and Requirements

**Optional Supplemental Readings:**


**August 15: Future trends in Affective Computing**

TBD

**August 16: Challenges and Ethical Considerations**

TBD
REQUIRED TEXTS:


• A reader consisting of papers from the current literature

RECOMMENDED TEXTS:


Supplemental Texts / References:

