Introduction to Affective Computing and Affective Modeling

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Introduction

In 1980 Norman identified emotion as one of the key issues in cognitive science. Since then, emotion researchers in psychology and neuroscience have made great strides in identifying the pervasive role of emotion in adaptive behavior and social interaction, developing theories of the mechanisms mediating cognitive-affective interactions, and elucidating the neural circuitry underlying affective processes (e.g., Davidson et al., 2003).

Cognitive science researchers have recently begun to recognize the importance of affective influences on cognition and behavior, and have begun to explore approaches for modeling these phenomena in cognitive systems (e.g., Gray, 2006).

Affective computing is an emerging area of research and practice broadly defined as "computing that relates to, arises from, or deliberately influences emotion" (Picard, 1997, p. 3). This includes computational models of emotion generation and cognitive-affective interactions, affective user models and cognitive-affective architectures, methods for emotion sensing and recognition, affect-adaptive user interfaces, and virtual affective agents. Of particular interest to cognitive scientists is the area of affective modeling, focusing on the development of computational models of affective processes and cognitive-affective interactions.

Theoretically oriented affective computing research aims to elucidate the mechanisms of cognitive appraisal and emotion-cognition interactions, define architectural requirements for emotion, and identify the roles of emotion in adaptive behavior. *Applied research* aims to enhance human-computer interaction across a range of applications via affect-adaptive interfaces, affective user models, and virtual affective agents.

This tutorial will provide an introduction to the broad area of affective computing, emphasizing computational models of emotion, and focusing on the topics outlined below.

Background from Psychology and Neuroscience

The background material will focus on definitions and terminology in emotion research, highlighting the multi-modal nature of emotion in biological agents; on theories of cognitive appraisal; and on existing empirical data regarding the effects of emotions on cognition, and cognitive-affective interactions in general.

Affective Modeling

Computational models of emotion and cognitive-affective interactions represent the core focus of the tutorial. Rationales for modeling emotion will be discussed, and a framework will be presented for analyzing and comparing emotion models and cognitive-affective architectures (Hudlicka, 2006). Alternative architecture designs will be outlined, along with their representational and inferencing requirements, and available alternatives for representational and inferencing formalisms. Examples of existing models and architectures modeling cognitive appraisal and emotion effects on cognition will be presented.

The affective modeling section will conclude with a discussion of approaches to model validation, criteria for selection of psychological theories as basis for model development, and the available empirical data. Utility of computational models in identifying the mechanisms mediating cognitive-affective interactions, and progress towards architecture-based definitions of emotions, will also be discussed.

Selected Special Topics

Additional topics will include an overview of the following: techniques for emotion sensing, recognition and expression; role of emotion and affective models in HCI; and development and application of virtual affective agents.

Conclusions

The frequent love-hate relationship that characterized academic emotion research until the 1980's was echoed in the early cognitive science work. Attitudes toward emotion were frequently of the all-or-nothing variety. Emotion was either summarily rejected as infeasible, irrelevant or both, or uncritically embraced as essential for adaptive, intelligent behavior. As affective modeling research matures, these attitudes are giving way to more balanced views.

A key objective of this tutorial is to provide the participants with the information necessary to support rational choices about *when* and *how* to integrate emotions in cognitive and agent architectures.

References

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