For many years, researchers in computer science have focused on rational thinking but discarded the contribution of emotions in machine learning, artificial intelligence and decision making. Similarly in cognitive science, emotions have been considered as exclusive processes for the survival instincts of animals. After the evolution of mankind from hominoids, the limbic system, which sustained all the emotional processing has been thought to be downplayed by a superior system centered in the prefrontal cortex, which sustained all the high-level executive functions involving monitoring, attention, conflict resolution, working memory. However in the last decade, through astonishing progress in cognitive neuroscience, our understanding of the sub-processes in emotion and cognition have progressed. Nowadays, emotion and cognition are viewed as complementary counterparts, interacting through complex top-down and bottom-up systems.

In the light of recent findings from neuroscience research, the emotional experience of the end-users in human-computer interaction may be thought over. Particularly, creating, triggering, sustaining and detecting emotions at the site of the end-user as well as the capability to imitate emotions will prevail as active research areas of our times. Designing interfaces considering affective tools as well as aesthetics; handling game designs in such a way that the user engagement is managed via emotional experiences; greeting/rehabilitating users with affective agents; creating agents with beliefs, desires and intentions are the most promising examples of this new trendy approach.

In the current literature, affective interactions most often refer to the involvement of affect in the interaction between a user and a system. In this type of interaction, usually psychophysiological measures such as skin conductance, eye-blink, heart rate, or electrophysiological measures such as eeg, or behavioral measures such as facial expressions, speech prosody, gestures are input to an automated system. This system then tries to classify the psychological state of the user through machine learning or pattern recognition techniques. After inferring the psychological state of the human, the machine can adapt or manipulate its 'behavior' or more technically its outputs for communicating more efficiently with its user. Although this is an exciting and still unraveled endeavor, there exists a bigger challenge. Rather than inferring a psychological state from the user inputs by choosing from a set of predefined classes, an affective computing system can instead model the actual affective internal world or an affective internal representation as it exists in a human. This allows for a time-varying continuum of emotions, similar to that of the human. If we want the human-computer interaction to occur in a domain similar to the phenomenal world, this new approach seems to be indispensable. Unfortunately, there are two major obstacles that hinder us from implementing such systems in the near-term: 1. The neuroanatomical underpinnings of the affective processes in the human brain are extremely complex and far from being well-understood, hence the field is not quite ready for developing affective models 2. A dynamical platform to model such a system is hard to implement and validate because affective inputs/outputs should be produced and tested in several different temporal scales, while the affective representations across these temporal scales also overlap.

In this book, we humbly aimed at serving two purposes: First, capturing the current state of art in affective computing within the context of affective interactions. And second, providing fundamental knowledge to facilitate development of future affective systems which dynamically interact using affective internal representations. Sections 1 and 2 serve the second purpose, while sections 3, 4, and 5 serve the first purpose.

In section 1, the foundations of affect are reviewed according to the cognitive science, psychology and neuroscience perspectives. Chapter 1 describes the neuroanatomy and neurophysiology of the limbic and prefrontal systems which participate in the sensation, expression, and subjective feeling of emotions in detail. Chapter 2 presents a dual processing approach within the emotional network of the human brain. According to this approach, dual processing occurs based on implicit and explicit motivations; the implicit part is rooted on the low-level limbic areas whereas the explicit system, which is also normative is centered within the pre-frontal areas. Chapter 3 summarizes the widely accepted emotional axes, valence and arousal, and their emergence from cognitive evaluations, as well as psychophysiological measures.

Section 2 contains remarkable examples of theoretical emotional frameworks or models, mostly built by using subsets of knowledge provided in section 1. In chapter 4, design of affective agents is discussed. Based on evolutionary demands, how to change the behavior of these agents is also highlighted. In chapter 5, neural networks are utilized to model six basic emotions and a subset of social emotions, using current, standard, expected, and predicted values of a situational signal. Chapter 6 models complex social emotions using logic, by replacing expectation and predictions with Belief and Goals.

Sections 3 and 4 focus on the expression of emotion in affective interactions. In section 3, up to date reviews of the current work in the technology of nonverbal communication are provided. More specifically, chapter 7 focuses on vocalizations, gestures, postures, while chapter 8 focuses on automatically decoding facial expressions and chapter 9 focuses on facial expression synthesis with computers. Currently, these are the most popular research areas in affective computing. In section 4, a collection of chapters addressing affect in verbal communication is presented. Unfortunately, applications of affective computing in verbal interactions are scarce. This is why we included chapter 10 on the role of affect in human language development. Understanding the primary roles affect plays in language development might aid in the development of affective language learning systems. Chapter 11 highlights the behavioral problems that emerge in text-based computer mediated communication such as email and chat environments. The viewpoint of chapter 11 is centered more towards western populations. In chapter 12, a case study on mobile phone messages is provided in a Japanese population. From here, we learn that affective messages are modulated differently in a non-western population when text-based environments are used.

Finally section 5 brings together fascinating discussions on affective computing in human-computer interaction as well as current trends and promising technologies for designing interactive environments based on affective interactions. In chapter 13, manipulation of affect in interactive environments such as films and games is discussed in detail. This chapter also presents development of adaptive games based on the user's psychophysiological measures. In chapter 14, a general overview of affective aspects in human-computer-interaction is provided, especially for designing efficient affective interfaces and feedback messages. In chapter 15, a wonderful case study is summarized for utilizing adaptive artificial agents such as avatars, for the rehabilitation of autistic patients who are known to have affective deficits. The behavior of the machine (a robot arm, or an avatar), can be manipulated during the training of the patient by using the patient's psychophysiological signals in a feedback loop. Finally in chapter 16, an innovative approach to the presence of emotions in game technologies is provided: 'How can games elicit emotions in the user ?', and 'How does this compare to the emotions elicited in films ?' are the main questions tackled.

The selected chapters end with an Epilog, which contains a brief philosophical discussion on the possibility and plausibility of creating affective machines.

We would like to conclude by saying that in this collection, we tried to assemble several aspects of affective interactions in an interdisciplinary and pleasant reading format so that the literature in neuroscience, psychology and computing fields can be merged lucidly. We hope that this book will reach out to communities associated with computer science, cognitive science or cognitive neuroscience and help in uncovering and representing the elusive interplay between emotion and cognition in affective interactions.

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