Preface

In recent years, two quests have been emerging to focus artificial intelligence research for games. The first, and newest, is concerned with developing our understanding of game players. The second is concerned with building more believable and exciting virtual worlds in which to play games. In this book we use information gathered by game data mining researchers about players to inform the design of novel self-motivated game-playing agents to control non-player characters. We demonstrate how self-motivated agents can increase the diversity of non-player characters by permitting agents to exhibit unique decision-making characteristics, which lead to interesting, emergent patterns when they interact.

More and more studies are emerging of the factors that motivate people to play online games and the cultures that emerge among humans in virtual worlds. However, the diversity we see in humans is not yet present in the computer-controlled characters that support online virtual worlds. Techniques for embedding human-like motives in game-playing agents have not yet been widely explored. As the complexity and functionality of multiuser virtual worlds increases, computer-controlled characters are becoming an increasingly challenging application for artificial intelligence techniques. Players are demanding more believable and intelligent non-player characters to enhance their gaming experience.

This book presents a new artificial intelligence technique—computational motivation—and shows how it can be used to increase the diversity of non-player characters by adapting some traditional architectures for computer-controlled game characters. Theoretical issues are addressed for representing and embedding computational models of motivation in rule-based agents, crowds, learning agents and evolutionary algorithms. Practical issues are addressed for defining games, mini-games or in-game scenarios for virtual worlds in which computer-controlled, motivated agents can participate alongside human players.

Large-scale virtual worlds may have hundreds or thousands of virtual characters, and the question arises as to how these characters can be embedded with diverse, individual personalities. Computational motivation provides a novel answer to this question. Our starting point is the ‘influential trio’: achievement, affiliation and

power motivation. Incentive-based theories of achievement, affiliation and power motivation are the basis of competence-seeking behaviour, relationship-building, leadership and resource-controlling behaviour in humans. We show how these motives can be modelled and embedded in artificial agents.

The aim of this book is to provide game programmers, and those with an interest in artificial intelligence, with the knowledge required to develop diverse, believable game-playing agents for virtual worlds. Computational motivation is an exciting, emerging research topic in the field of artificial intelligence. The development of motivated agents is at the cutting edge of artificial intelligence and cognitive modelling research. This opens the way both for new types of artificial agents, new types of computer games and in-world mini-games or scenarios. This book provides an in-depth look at new computational models of motivation and offers insights into the strengths, limitations and future development of motivated agents for gaming applications.

Part I—Game Playing in Virtual Worlds by Humans and Agents

The first part of this book studies the relationship between game play and motivation in humans and proposes ways in which this can be represented and embedded in artificial agents. Chapter 1 studies the motivational characteristics we see in humans playing games, which we might expect to see in a diverse society of computer-controlled game-playing agents. After examining player types that have been identified through subjective and objective studies of human game players, Chap. 1 turns to complementary literature from motivation psychology and reviews the theories that may contribute to these characteristics in humans. It specifically focuses on three incentive-based theories of motivation for achievement, affiliation and power motivation.

Chapter 2 introduces computational models of motivation to embed these human-inspired motives in artificial agents at different levels of fidelity. A flexible mathematical model is introduced that permits achievement, affiliation and power motives to be expressed in terms of approach and avoidance components, which can be adjusted to create different motivation variants. Alternatives are provided to model individual motives, or profiles of several motives.

Chapter 3 describes how motivation can be embedded in four architectures for game-playing agents that can be used to control non-player characters: rule-based agents, crowds, learning agents and evolutionary algorithms. Motivated rule-based agents are suitable for decision making by individual agents, while motivated

learning agents are suitable for competitive or strategic decision making when two or more agents interact. The motivated crowd and evolutionary algorithms are suitable for controlling groups of agents. These architectures are the topics of study in Part II, Part III and Part IV of the book.

Part II—Comparing Human and Artificial Motives

Chapter 4—*Achievement Motivation*
Chapter 5—*Profiles of Achievement, Affiliation and Power Motivation*

Part II of this book describes how the models introduced in Part I can be used to create a number of specific motivation subtypes that have previously been observed in humans. These are then demonstrated by reproducing three canonical human experiments with artificial agents. In Chap. 4, four subtypes of achievement motivation are described. These are embedded in agents playing the ring-toss game. We demonstrate the similarities that can be observed between motivated game-playing agents and humans playing the same game.

In Chap. 5 three profiles of achievement, affiliation and power motivation are introduced for agents playing two different games: roulette and the prisoners' dilemma game. We again demonstrate the similarities that can be observed between motivated game-playing agents and humans playing the same games. We show that we can create a diverse group of agents that compete or cooperate in different ways when playing games.

Part III—Game Scenarios for Motivated Agents

Chapter 6—*Enemies*
Chapter 7—*Pets and Partner Characters*
Chapter 8—*Support Characters*

In Part III in-game scenarios are described that are appropriate for different kinds of motivated agents, including motivated rule-based agents, crowds and learning agents. These scenarios are presented in three chapters, corresponding to scenarios for three common non-player character types: enemies, partner characters and support characters.

Chapter 6 presents an application of motivated rule-based agents as enemies and two scenarios in which motivated learning agents are used as enemies. Chapter 7 considers two further scenarios for motivated learning agents as pets and partner characters. Chapter 8 explores the use of motivated crowds and motivated learning agents in support characters. We show that agents with different motives exhibit different strategies for playing games. This results in behavioural diversity among

characters. In addition, when agents with different motives interact, different outcomes emerge.

Included in this part are theoretical analyses, empirical investigations and sample game applications. We show how theoretical and empirical results can be used to predict the behaviour of agents in practice. We use these motivated agents in two ways: first as non-player characters and secondly to model the different types of responses possible to non-player characters, either by individuals or groups of human players. The applications in this part of the book demonstrate how each abstract agent architecture from the previous part can be connected to the concrete actions available to a game character.

Part IV—Evolution and the Future of Motivated Agents

Chapter 9—*Evolution of Motivated Agents*
Chapter 10—*Conclusion and Future*

Part IV looks to the future of motivated game-playing agents, first with a specific focus on the conditions under which agents with different motives might evolve in a virtual world and then more broadly. Chapter 9 considers the evolution of motivation in a society of game-playing agents. Agents are studied in multiplayer social dilemma games and in a custom implementation of a classic single-player shooter game. This chapter demonstrates how the composition of a society of motivated agents can change over time in response to subjective or objective definitions of the fitness of an agent.

Chapter 10 summarises the algorithms, components and combinations of components that have been studied in the book, and discusses how these components might fit into other motivated agent architectures. The strengths and limitations of motivated agents are considered and used as a basis for discussion of the future directions for motivated agents and multiuser computer games. Advances in computational models of motivation, motivated agent models and their application to different types of games are considered.

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