Preface

This special issue "Intelligence Computation and Evolutionary Computation" is a collection of essays, selected and peer reviewed papers from the 2010 international conference on intelligence computation and evolutionary computation. Each essay revolves around important, interesting and unresolved questions in the field of intelligence computation (IC) and evolutionary computation (EC).

In this special issue much has been written about how great solutions often have a certain aesthetic appeal (symmetry, simplicity, originality, unity and so on). In sharp contrast, characteristics of great problems remain something of a mystery. It is useful to think of a problem as existing in at least one of four states: undiscovered, unsolved, solved and hibernating. However, truly interesting problems-- great problems-- manage a simultaneous, contrary existence in all four quadrants. Even fields with a progressive tradition, like Physics and Mathematics, have problems that refuse to stay solved. The problem of explaining the directionality of the thermodynamic arrow of time, and the debate over whether mathematical objects are invented or discovered are but two examples that comes to mind. Great problems act as co-ordinate systems for the geography of our imaginations and explain why we do what we do.

So it is gratifying (rather than alarming) that IC & EC are also evolving its own collection of really hard problems. For example, is an evolutionary process an algorithmic process (in the sense of Church-Turing)? Are building blocks theoretical rather than empirical constructs? Which results in EC are dependent on problem representation and which ones independent of it? What precise role does crossover play? Is there a way to unify the different formalisms used to model evolutionary processes? What are the characteristics of problems solvable by EC? Some of these problems are discussed at length in this volume.

This special grew out of a proposed session for the international conference on intelligence computation and evolutionary computation in Chengdu, China. I had thought that a collection of authoritative essays, each devoted to the description of a substantially unsolved problem in IC&EC, could help bring coherence to the field, clarify its important issues, and provoke imaginations. Unfortunately, time constraints prevented the session from going forward. But the highly positive response from the invitees, as well as from others who had heard about the idea, suggested that a special issue could be an alternate and appropriate forum for implementing the idea.

The authors in this collection are wonderfully varied in their backgrounds, writing styles and interests. But their essays are related by several common goals: extensions to IC&EC theories, discussion of various formalisms, summaries of the state of the art, and careful speculation on what could be done to resolve various issues. The essays also leave no doubt that the ferment caused by active trading is producing a watershed event in the marketplace of ideas.

IC&EC are young discipline, and consequently, it is still a field that has the rare chance to be defined in terms of its unsolved problems, rather than its solved ones. No doubt, the many encounters offered in this book, the journeys it will inspire, and the inevitable predilection of problems to get solved, will change this situation in the next few decades. But till then, this special is meant to serve as a beckoning toward the roads still not taken.