Bio-inspired computing (BIC), short for biologically inspired computing, is a field of study that loosely knits together subfields related to the topics of connectionism, social behaviour and emergence. The field of bio-inspired computing brings together researchers from many disciplines, including biology, computer science, mathematics, physics and genetics. Biological systems have many advantages over computer systems, as they use far less energy, can survive faults, and are even able to heal. Briefly put, it is the use of computers to model the living phenomena and the study of life to improve the usage of computers.

Bio-inspired algorithms can exhibit strength through flexibility, or strength in numbers. They often work well even when the desired task is poorly defined, adapt to unforeseen changes in the task environment, or achieve global behaviour through interaction among many simply programmed agents. These methods adhere to the bottom-up philosophy in that there is no central designer; rather, a collection of solutions compete against one another to solve the given problem. Through the process of natural selection, good solutions tend to become dominant and most of the time are given as the optimum solution.

In this Special Issue, four research papers and one review are selected to cover a number of key domains in BIC. This Special Issue collected submissions by two routes: (i) Invited Papers from the selected conference (BIC-TA 2018) papers after expanding substantially, and (ii) Open Call-for-papers from the Bio-inspired computing research fields. The topics include the study on the covering rough sets by topological methods; multi-objective NSGA-III for optimising biomedical ontology alignment; expanded models of the project portfolio selection problem with learning effect; the teaching–learning-based optimisation with variable weights applied to shop scheduling problems; and a reviewing paper on QoS-aware web service selection and composition with nature-inspired computing.

In the first paper, ‘Study on covering rough sets with topological methods’ by Wang et al., the research on the rough set theory through topological methods is presented. Rough set theory is an effective theory to deal with complexity by establishing appropriate models and making effective calculations to remove the false and retain the true, remove the coarse and extract the essence. If the approximate space replacing complex systems is a topological space, the used operators are internal or closure operators and the models can clearly grasp the properties of elements and their relationships in the system. Axioms of Separation are important topological methods to classify topological spaces and handle element relationships. In this paper, several common rough approximate spaces are defined as covering rough topological (CRT) space under some conditions, Axioms of Separation are introduced in these spaces. So, the operators, elements and their relationships are dealt with and discussed in detail using topological methods and a series of important and sufficient conditions for some important questions in these spaces are obtained. The results presented in this paper will not only play a very important role to deal with the classification, reduction and computation in complex systems, but also open the way to study complex system by combining topology theory with rough set theory.

The second paper in this Special Issue, ‘Using NSGA-III for optimising biomedical ontology alignment’ by Xue et al., covers biomedical ontology matching using a multi-objective evolutionary optimisation approach and a non-dominated sorting genetic algorithm (NSGA)-III. The biomedical concepts are fuzzy and ambiguous. Characteristics of large-scale biomedical ontology also raises the difficulty of the ontology alignment. In this paper, an ontology partitioning technique is proposed to transform the large-scale ontology matching problem into several segment-matching problems. On this basis, the many-objective optimal model is defined by combining various similarity measures. The NSGA-III algorithm is designed to optimise the biomedical ontology alignment. The experimental results show that the proposed approach can determine the high-quality biomedical ontology alignments efficiently.

The third paper in this Special Issue, ‘Expanded models of the project portfolio selection problem with learning effect’ by Li et al., discusses the impact of the learning effect on the project portfolio selection problem (PPSP) and project investment cost. In real life, many projects have production cost reduction over time due to learning from the repetition of their activity associated with cumulative production. So, introducing a learning effect into PPSP is meaningful. A new research perspective is provided to calculate the project investment cost. Investment costs are related to the actual execution time of projects, while the learning effect affects the project’s investment cost by affecting the completion time of the project. Considering project’s interruption is more adaptive to the reality. Meanwhile, for the interruption, two common situations are proposed. In the first situation, the interruption is short and will not affect learning experience. In the second situation, the interruption is too long to re-accumulate the learning experience. During the model solving process, in order to make the model easy to solve and the solution speed faster, some formulas in the paper are equivalently replaced and proof are given. Finally, the paper uses solver-GAMS to analyse the data and get experimental results, which demonstrates that the introduction of the learning effect has certain influences on the benefit.

The fourth paper in this Special Issue, ‘TLBO with variable weights applied to shop scheduling problems’ by Rodrigues et al., studies the teaching-learning-based optimisation (TLBO), and aims to improve the balance between the diversification and the intensification capabilities of the algorithm. In recent years, TLBO has been widely used in the solution of different optimisation problems, with good performance. Different variants of the original algorithm have been proposed. However, there are still opportunities for improvements. In this paper, new approaches to select students during the student phase of the algorithm are investigated in order to improve its performance on the solution of complex optimisation problems. In contrast to the original TLBO, in which students are selected with equal probabilities, this paper investigates three different strategies to select students. In the proposed strategies, higher weights are assigned to students with better solutions for the problem under consideration. Experimental results using benchmark instances of the flow shop and the job shop scheduling problems show that the
proposed approaches give better convergence speeds in comparison with the original TLBO and two variant versions already proposed in the literature, with a similar performance in terms of solution quality.

The last paper in this Special Issue, ‘Advances on QoS-aware web service selection and composition with nature-inspired computing’ by Zhao et al., the authors present the advances on quality of service (QoS)-aware web service selection and composition with various nature-inspired computing methods. Service-oriented architecture (SOA) has been recognised as the next generation framework for building agile distributed applications over the internet. Applications are provided as web services, which can be discovered and composed into more coarse-grained services, i.e., composite services. The aim is to search for the optimal set of services that are composed to create a new service and result in the best QoS under the constraints of users or service designers. Therefore, how to leverage, aggregate and make use of individual component’s QoS information to derive the optimal QoS of the composite service, which meets the needs of users, is still an ongoing hot research problem. This paper aims at reviewing the present advance of the state-of-the-art in technologies and inspiring possible new ideas for web service selection and composition, especially involving nature-inspired computing approaches. The background knowledge of web services is firstly presented. Various nature-inspired web selection and composition approaches are then systematically reviewed and analysed for QoS-aware web services. Finally, challenges, remarks and discussions about QoS-aware web service composition are presented.