Towards the Use of XCS in Interactive Evolutionary Design

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Abstract

Learning classifier systems represent a technique by which various characteristics of a given problem space may be deduced and presented to the user in a readable format. W present results from the use of XCS on simple tasks with the general multi-variable features typically found in problems addressed by an Interactive Evolutionary Design process. That is, we examine the behaviour of XCS with versions of a well-known single-step task and consider the speed of learning, noise, and the ability to respond to changes. We introduce a simple form of supervised learning for XCS with the aim of improving its performance with respect to these two measures. Results show that improvements can be made under the new learning scheme.

1 sXCSR

Interactive Evolutionary Design (IED) (Parmee and Bonham, 1999) moves away from the use of evolutionary computing techniques within a rigid optimization environment and instead utilizes them as generators and gatherers of optimal design information. The approach involves the capture of designer experiential knowledge and intuition within adaptive search processes through an iterative designer/machine-based refinement of the design space. This last aspect of the process is of interest to us here: we consider a way in which to enhance the presentation of results from a given iteration of the search process through the use of learning classifier systems.

XCS (Wilson, 1995) has been shown to perform well on a number of benchmark data mining tasks with the added benefit of producing readable production system rules. XCS uses the incremental Widrow-Hoff procedure to update expected payoff values. Here, we introduce a simplified update procedure whereby newly created rules, i.e. those which have never participated in an action set since their creation (via cover or the GA), have their expected payoff value set to that of the first training instance they experience. This value remains constant. All other parameters are initialized and updated as in traditional XCS. With a real-numbered representation scheme this system is here termed sXCSR. The system was applied to a single-step function defined for binary strings of length $l = k + 2^k$, that is, a real-numbered multiplexor problem. Figure 1 shows that improvements can be made under the new learning scheme.

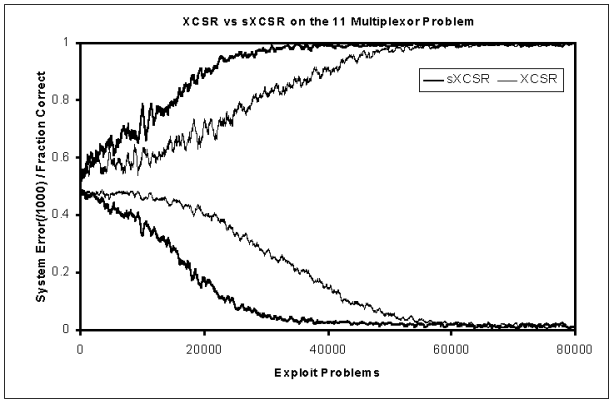

Figure 1: XCSR and sXCSR on the 11-variable multiplexer task.

In terms of the introduction of a learning technique to the Interactive Evolutionary Design concept, this work can only be considered a preliminary investigation. However, the results strongly indicate a significant potential in the utilisation of learning classifier systems to support designers as part of the IED process. Utility could extend beyond this initial task to generating rules relating to a wide spectrum of relevant design information.

References

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