Computational Creativity: Three Generations of Research and Beyond

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Introduction

One of the meanings of the word “create” is “to produce by imaginative skill” and that of the word “creativity” is “the ability to create,’ according to the Webster Dictionary. However, the intriguing act of human creativity has meant different things to different communities of scholars in different fields. Also, its relationship with “innovation” and otherwise general “intelligent activities” is not very crisp.

Philosophers try to understand creativity from the historical perspectives – how different acts of creativity (primarily in science) might have happened. Psychologists generally avoided the issue of human creativity, except for some researchers who tried to understand the condition of mind that engages in creative activities. In this article we will use a working definition from a computational angle, where computer scientists tried to develop computational tools that engage in creative activities, as perceived by the community at that point in history. We will divide these types of researches in three genres. The classification is not necessarily chronological but has some temporal insinuation and so, we call them as generations. The list of the works that we will discuss is not exhaustive. The purpose of this article is not to provide a survey of the area. Rather, we will choose some sample works as examples for each generation. Lastly, we will discuss the works outside the scope of computational creativity and some recent developments that may have strong bearings to the discipline.

First Generation

Samples of first generation tools that dazzled the community with their “creative” capabilities are the early artificial intelligence (AI) tools, like the game programs, the theorem-provers, and the expert systems. We will discuss the lessons learnt from these works although they cease to be considered as “creative enough” by the subsequent generations of AI researchers.

Second Generation

Samples of the second generation tools are that for mimicking the scientific discovery systems: Kulkarni and Simon’s work on molecular structures, Langley’s work on data-driven discovery of empirical laws, Cheeseman et al.’s *Auto-class* for discovering patterns in Astronomy-related data fall into this group. This generation of works is primarily responsible for bootstrapping the field of Machine learning and Datamining.

Third Generation

The third generation tools are providing the capability to produce patentable quality intellectual products or helping to aid human creativity. John Koza’s work at Stanford has produced patentable circuit designs by using Genetic programming. John Gero at George Mason University also deploys similar evolutionary technique for intelligent design activities. While these systems represent a high end of automated creativity, the works of researchers like Janet Kolodner (Georgia Tech) attempts to help creative activities amongst children. On a similar vein, Bruce Porter’s group’s (University of Texas at Austin) AURA knowledge representation system that is being adapted by SRI and Vulcan, Inc., in their HALO project shows a strong promise in aiding creative activities in science.

And Beyond

In this section we will describe TRIZ – a generic scheme (but not necessarily an automated scheme) that provides structured approach to develop innovative designs. We will investigate some advances in Game Physics, where creativity is essential and is embedded in a very simple way. The recent initiative at NSF (the *CreativeIT* program, which follows a series of related workshops) is possibly a transition point in our history in understanding the mysterious phenomena of human creativity and in generating the next generation of creativity tools. Our discussion will try to discern the possible directions that this new initiative may lead to.