I present a new approach to evolutionary search called novelty search, wherein only behavioral novelty is rewarded, thereby abstracting evolution as a search for novel forms. This new approach contrasts with the traditional approach of rewarding progress towards the objective through an objective function. Although they are designed to light a path to the objective, objective functions can instead deceive search into converging to dead ends called local optima. As a significant problem in evolutionary computation, deception has inspired many techniques designed to mitigate it. However, nearly all such methods are still ultimately susceptible to deceptive local optima because they still measure progress with respect to the objective, which this dissertation will show is often a broken compass. Furthermore, although novelty search completely abandons the objective, it counterintuitively often outperforms methods that search directly for the objective in deceptive tasks and can induce evolutionary dynamics closer in spirit to natural evolution. The main contributions are to (1) introduce novelty search, an example of an effective search method that is not guided by actively measuring or encouraging objective progress; (2) validate novelty search by applying it to biped locomotion; (3) demonstrate novelty search's benefits for evolvability (i.e. the ability of an organism to further evolve) in a variety of domains; (4) introduce an extension of novelty search called minimal criteria novelty search that brings a new abstraction of natural evolution to evolutionary computation (i.e. evolution as a search for many ways of meeting the minimal criteria of life);(5) present a second extension of novelty search called novelty search with local competition that abstracts evolution instead as a process driven towards diversity with competition playing a subservient role; and (6) evolve a diversity of functional virtual creatures in a single run as a culminating application of novelty search with local competition. Overall these contributions establish novelty search as an important new research direction for the field of evolutionary computation.

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The public is welcome to attend.