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April 25, 2002
Honors Geometry 213
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Is Biology the answer?
Using Evolutionary Biology to deduce Logic

What truth is, how we define it and how we find it in the world around us, are difficult questions to answer. Discovery of the truth is a task that we all have to address and that all disciples of learning must undertake. All individuals have their own approach to this search and the same is true for the various disciplines of learning. To a mathematician the truth can be found through deduction, construction or a compilation of symbols. Biologists find truth in the physical nature of the external environment and the processes which drive it. In particular, an evolutionary biologist finds truth in Darwinians theory of evolution and natural selection.

An evolutionary biologist uses this theory to validate and explain the face of the environment at any given instant. Justifying what combination of organisms are present and how this came to be. For those who believe the theory, it provides an explanation to the origins of the populated world in which we find ourselves. It is a powerful theory and some believe that its applications extend beyond our physical nature. Evolutionary theorist William Cooper believes that evolutionary theory is a source of greater truth, arguing that even human logic can be reduced to this one theory. Though Cooper's conclusion may be valid, it is not necessarily justified with Darwin's evolutionary theory. Darwin's theory can be fit into an axiomatic format, which allows for the creation of models, biological and non-biological. In the format deductions, such Cooper's can be evaluated.

Defining Evolutionary Biology

Charles Darwin was one of the first to accurately describe the dynamic process by which species interacted with their environment and proceeded through time. Darwin named the mechanism "Natural Selection" and indicated it as the driving force that shapes the mixture of species present at any given time. In short, the process involves physical variation among species that is heritable to the next generation. Species survival is partially dependent on the physical differences of each individual. Therefore, when some species survive their particular traits survive and are passed to the next generation. Over time, the consistent selections for and against these traits result in the accumulation of some traits and the eradication of others. Given enough time and consistent selection for certain traits, speciation can occur; the resulting species is considered to be a different from the original [3].

Evolutionary theory, like other theories, can be explained in an axiomatic format. An axiomatic system consists of commonly accepted statements or *axioms*, used to deduce more complex ideas. These more complex ideas are validated, regardless of their conceivability, since they are derived from the accepted axioms. Evolutionary theory is built on a few basic fundamentals that can construct the rest of the process. As a result of this structure, an axiomatic system is capable of encapsulating and simplifying the theory. With this system, it is easy to designate validity to the less intuitive claims of the theory, if the axioms are accepted as valid then so are all claims derived from them.

The Axioms of Evolutionary Biology

I found creation of an axiomatic system explaining evolutionary theory to be more difficult then I had originally speculated. The axiomatic system I developed was built out

of Darwin's model of how species proceed through time. I therefore worked backwards, from the model to the axioms. I had difficulty choosing what term would be undefined, so that the axioms would still be logical and yet not be confined to only explaining the Darwin Species Model.

Undefined terms

Genome (genotype)

Species (organisms are a subunit)

Time (generations a subunit)

Axiom 1: Mutations occur randomly in distinct genomes

Definition: variations are the differences that exist between genomes, phenotypes and species

Proposition 1. Infinite variation of the genome exists (A1, defn' of variation)

Definition: phenotypes are the reflection of a given genome in a given species

Lemma 1: (transitivity) a given genome corresponds to a given phenotype which corresponds to a given species and the reverse is true as well (defn' of phenotype)

Proposition 2. Infinite variations of a given species exist (Prop. 1, Lemma 1)

Axiom 2: Species survival is partially based on phenotype and given environment

Definition: survival is a species or genome continuing through time, the opposite being extinction

Definition: the environment is dynamic, yet works equally on all phenotypes present at a given time

Theorem 1. (differential survival) In any given time some species survive while others become extinct

Pf. Species have varied phenotypes (Prop. 2)

Survival is based off of phenotype (A2)

Therefore some survive while others do not

Corollary. In any given environment some genotypes survive while others become extinct

Pf. Species survival is differential (Thm. 1)

Therefore certain phenotypes and their genomes survive (Lma. 1)

Axiom 3: Genomes are heritable

Definition: habitability is the preservation of a genome; passing it from one organism of a species to the next generation of organisms of the same species

Theorem 3. Over time, surviving genomes accumulate

Pf. Genomes are passed on through time (A3)

Some of them survive and therefore accumulate over time (Thm 2)

Theorem 4. Survival of species over time is directional, meaning that the accumulation continues in certain directions over time and not in others

Theorem 5. Over time, speciation (creation of new distinct species) occurs

(The proofs of Thms 4 and 5 are complex and not completely justified by the other theorems yet they are known to be valid statements of evolutionary theory)

Models of the Theory

Darwin's Species Model

Since this is the model that the axiomatic system was designed from, it falls out easily when the undefined terms are assigned their historical biological definitions. Species are interbreeding groups of organisms, they vary, some variations survive and are inherited, and these variations survive and accumulate. Eventually, as a result of time and accumulation the species has changed enough so that it is no longer considered the same species.

The Tree Model (Figure 1)

The dots of the tree are *species* and the lines are variations of the dots surviving through *time*. Some of the lines continue to new dots while others do not. These new

dots also split into multiple lines through time and again some continue up while others terminate. Darwin created this model as a means to illustrate his theory.

Unfortunately, the tree model does not completely hold in the axiomatic system as I have created it. However, the tree model can still be applied to Darwin's Species Model, providing a visual representation of how the theory can explain the face of the environment at any given time. When the tree is taken to represent the entirety of species that have ever existed during a designated time period, it shows the progression of all species and from where the current populations originated. To find the population composition at any time, simply draw a horizontal line through the tree, the various lines crossed represent all the species that were present at that time. This is a visual representation of how evolutionary biologists use evolutionary theory to define the composition of the physical environment around them. All species present at a given time are the result of variations in their ancestors being selected for and against by the surrounding environment.

Application of the Theory

Placing evolutionary theory in the framework of an axiomatic system allows for the extended claims of the theory to be evaluated. From Darwin's original theory, multiple claims and further deduction have been assumed. An example of is the origins of our species. The origins of the species is not included in the axioms, but if Darwin's species model is accepted as valid, it can be deduced and justified that the organisms present on the plant today at a much earlier time branched from other organisms. Common ancestry becomes deducible from these theories. Tracing back along the branches of species that are present at any given time a convergence of these branches

into fewer and fewer branches, down potentially to one is deducible. Evolution is another claim that is justified with these axioms, specifically with theorem 5. Starting with one organism, over a long enough period of time, transformations occur that result in a new organism.

Other branches of biology have concepts deducible by evolutionary theory. Developmental biology is intimately connected with evolutionary biology. The theory can be looked at as the progression of genomes and the various developmental processes they encode (Lemma 1 explains who species translate into genomes). All of these processes then too follow the theory and fit into the tree model. Therefore development processes can be studied in this context, and what occurs during development is the product of adaptations to processes that existed in ancestors. In particular, embryology is a reflection of the culmination of generation, which can be traced back through evolution. The same idea works with other biological disciplines as well, such as genetics and molecular biology.

In addition to evolutionary biology being applicable the other divisions of biology, some believe that it also extends into the other sciences and even into non-science disciplines. Theories of evolution have been applied to economics and politics, by assigning species to represent entities such as markets, political groups or countries. If a valid model can be constructed and justified, the theory can then explain the origins and progression of entities. Spencer's theory of Social Darwinism applied evolutionary theory to a social human model, dealing with social selection and survival based on nature [5]. The theory is highly encompassing and some evolutionists take it to the extreme, believing they is no system that can not be fit as a model of the theory. They

believe that the idea of evolution is so fundamental that it is *the* truth, and can explain all other disciples. "Science can in principle offer rational accounts of all manner of seemingly unscientific things, extending even to artistic creativity [4]."

Reduction of Logic to Evolutionary Biology

Beyond providing answers for the progression of various entities (species) through time is the idea that even fundamental disciplines can be reduced down to evolutionary biology. An elaborate example of which is the argument made by William Cooper, of the reduction of logic to evolution. Here reduction means the replacement or explanation of one idea with another. The result of the reduction of logic to evolution is that the laws of logic are not pre-existing or independent, but instead that they are based on evolutionary laws. Logic is not transcendental and extrabiological, it something that the evolutionary process created [2]. "The evolutionary considerations are asserted to give rise to the logical rules themselves, not merely to a tendency form organisms to obey externally imposed logical rules of mysterious origin [2]." It is the argument between logic being created or discovered, Cooper claims that he can deduce from evolution, that it is created. In summary the argument stems from the idea that nature is engineering blindly and that all human and animal capabilities, including mental, are biologically evolved [2]. If rational organisms evolved, then rationality must have been created by the engineering process of evolution [2]. Cooper builds a ladder of implications starting with evolutionary theory applied to a human species model (Darwin's species model solely focusing on the human branch). Cooper uses this model to deduce a life-history strategy. Life-history strategy is constructed from the idea that behavioral traits and mental capacities are products of evolution, and behavioral characteristics result in logical

cognition [2]. Life-history strategy is a means to determine which characters and strategies will be favored by natural selection [2]. From life-history strategy and evolutionary cognition, Cooper deduces Decision Theory. This is a theory concerned with how an agent might rationally chose among available courses of action [2]. Cooper's justification for this deduction is that organisms with evolutionary stable choice strategies conform to rational decision making. Also, in a similar manner, Cooper takes Decision Theory to imply inductive logic; inductive logic coming from ones ability to make rational decisions. Inductive logic implies deductive logic, which can derive the rest of mathematics [2]. Simplified Cooper is arguing that behaviors and decision making abilities are products of an evolutionary process, which that rational thought and therefore logic can be reduced down to the same evolutionary process.

Problems with Cooper and Other Applications of Evolutionary Theory

The construction of Cooper's theory is rational and each step is justified. However, there are some discrepancies with his application of the evolutionary theory. Cooper's argument is largely dependent on the idea that because organisms, focusing on humans, have the ability for rational decision making, that this is an evolved process. One of the common traps of evolution is the assumption that because it is, it evolved to be that way, but this is not a valid application of the theory. Evolution theory does not necessarily hold true in the opposite direction, it is not and if and only if theory, it cannot be justified top down [4].

> "Nothing in Darwinian theory allows you to say that because some pattern of behavior would increase the amount of some type of genetic material in future generations, therefore it will exists. It does not as it were allow you to say that whatever is right, is. Nor does it allow you to say that because some trait exists, therefore is it an adoption, so that whatever is, is right [1]."

Even though, a valid model for social progress and economics can be constructed from evolutionary theory, the further deductions and assumptions based off of this are not necessarily justified. There is a common misconception that evolution implies that because it is, it is right or that because it is right it has or will evolve. These ideas are not deducible given the axioms. Evolutionary theory is based off random mutations (A1), its direction cannot be predicted. Evolutionary theory is a blind process with no goals of improvement or betterment of a species, but the insensible progression towards traits that survive over other traits.

In the search for truth Darwin's evolutionary theory can answer many questions about the history and composition of the environment around us. Simplified into an axiomatic format, this theory can be used to construct numerous models, providing more insight that can extend beyond biology. Models constructed form evolutionary theory, while offering the benefits of a new perspective, often claim further deductions and assertions that are not necessarily hold in evolutionary theory.

[1] Blackburn, Simon. I Rather Think I am a Darwinian. *Philosophy* 71 (1996): 605-612.

[2] Cooper, William. The Evolution of Reason: Logic as a Branch of Biology. Berkley: Cambridge University Press, 2001.

[3] Darwin, Charles. The Origins of the Species. New York: PF Collier and Son, 1859.

[4] Lindley, David. Questions of Direction. *Nature* 410 (2001): 305-307.

[5] Spencer, Herbert. Social Statics. Revised and Abridged from 1st Ed. [1850]. New York: D Appleton, 1892.

Figure 1. The Tree Model of Evolutionary Biology

Undefined terms:

Genome: not needed in model
Species: dots on tree
Time: lines going up ward