Self–Normalizing Distance Learning Tools

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INTRODUCTION

Communication system designers minimize noise with self-correcting codes that add redundant information to the signal, increasing the probability of error detection, and recovery of the uncorrupted data. Evolutionary biologists claim that knowledge transmitted between generations of biological organisms have mechanisms that create probability traps for errors. Designers of online systems are starting to mimic these systems.

BACKGROUND

Devices like cell-phones and modems express information as sequences of codes such that noise generated errors can be detected and corrected. For instance, Modems detect errors by checksum, which is the sum of the digits in a given message modulo some number. If the received message produces a checksum different from the produced by the transmitted one, the system recognizes that it is dealing with erroneous data. A simple method of performing a checksum is to add a parity bit to a 7 bit code, such that the total number of 1s is even; if the receiver gets a message with a byte that does not meet this requirement, an error is present. There are more sophisticated methods of performing the checksum, but the example given here is adequate enough to show that e*rror detection and correction is not only possible, but widely used.*

In a learning environment, error detection is quite common in the teacher-student relationship. Ancient Greeks invented a clever method of error detection called dialectics. Plato's dialogs (Plato, 1925) show how it works. One of the most common dialectic tricks is the *reduction ad absurdum*, where the student tries to derive an absurd outcome from what he has learned. In case of success, the knowledge is flagged as corrupted. Another common error detecting method among the Ancient Greeks was to check knowledge against known facts.

Once fully developed, Logics also provided a method to scrutinize information for errors; Aristotle and other philosophers classified and analyzed fallacies, in order to filter out wrong arguments. An introductory text on fallacies is (Tindale, 2007). A fallacy is an argument that is demonstrably flawed in its form, which renders it invalid as a whole. Modern logicians classify fallacies as material, verbal, and logical. In his Sophistic Refutations (Aristotle, 1987) Aristotle lists the following types of material fallacies, among others:

- Generalization that disregards exceptions. E. g. *Telling lies is a mean act; the mother that tells her child that is suffering from leukemia that he/she will get better is telling a lie; therefore she is mean.*
- Argumentum ad hominem: Instead of examining the contents of the information, one worries about the ideology, or moral standing of the author. E.g. *Herrnstein and Murray argue that the cognitive elite is becoming separated from those with average intelligence. But it must be false, since these political scientists are the authors of The Bell Curve (Herrnstein & Murray, 1996), a racist book.* Some times, the argumentum ad hominem refers to the moral standing of people that have little or nothing to do with the authors of the refuted argument. I have seen arguments against vegetarianism based on the fact that Hitler was a vegetarian.

- Petitio Principii or circular argument: Demonstrates a conclusion by means of premises that assume that conclusion.
- Non Sequitur: Incorrectly assumes one thing is the cause of another.
- Post hoc ergo propter hoc: Believing that temporal succession implies a causal relationship.

There are two important facts about fallacies. The first one is that most people who commit fallacies are unaware that their argument is faulty (Cohen, 1982), but since the patterns of many common fallacies are easily perceived, the student can use them to detect flaws on distance education lessons. The second fact about fallacies is that they often hinder knowledge transmission; the student may not understand a correct fact because the lesson has a fallacious pattern; a fallacious pattern which one often finds in tutorials is the circular argument (Circulus in Probando).

Verbal fallacies are the most common mistakes in lessons and tutorials, and they are easily detected by a trained student. Below the reader will find a listing of some verbal fallacies.

- Argumentum verbosium: Proof by verbosity. The author of the tutorial thinks that s/he must present his/her ideas with such a volume of material that the topic appears to be well-researched, and supported by facts. The consequence is that the student may allow the important information to slide by unlearned.
- Equivocation consists of employing the same word in more than one sense. To avoid this kind of fallacy, the teacher must be careful and make sure that all important terms have been defined.

A logical fallacy is a flaw in the structure of a deductive argument which renders it invalid. We will not discuss this kind of fallacy here, because it has a limited role in detecting errors in online tutorials.

ERROR DETECTION

Classification of Errors

Whether teachers and students were aware of it or not, learning systems have always been based on er-

ror detection. In a learning environment, errors can be classified as:

- Plain errors. The instruction conveys a piece of information that is outright wrong.
- Communication errors. The student cannot understand the message. There are many causes for the message failing to reach the student; one of them has to do with shortcomings in the student's aptitudes or prior knowledge.
- Deviations in the learning process. The learning process leans towards unwanted states. For instance, when learning to swim, the student may substitute a wrong stroke for the correct one during a drill; in the end, the wrong stroke becomes automatic.

The main shortcomings of distance learning is that error detection methods designed for human beings in close contact and acting synchronously do not function well when people are working in distant places, and with different time tables. In this paper, the authors propose a few error detecting methods that can be used during the process of online learning.

Classification of Error Recovery

1. Nature provided key. Whenever the subject matter deals with natural phenomena, then observations and well designed kits for laboratory work allow the student:
   o to fill in gaps existing in online tutorials;
   o to detect errors in pieces of information;
   o to establish checking points on the state graph that he/she must go through.

Performing manual labor to learn a handicraft falls into the category of Nature provided key. One does not learn how to cook, if she or he does not try and recreate the recipes learned from television programs, or online videos. Dawkins (1998) believes that Nature feedback provides checking points on the road to knowledge acquisition, making it digital, i.e., true or false; to make a long story short, Dawkins' check points are pieces of knowledge that obey three related laws:

- Bivalence: Any proposition is either true or false.

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