

COMPUTATIONAL SEMIOTICS: SIGNS, SYMBOLS, AND NEW MEDIA

A Term Paper

by

ADAM BLAINE MIKEAL

Submitted to Dr. Frank Shipman, Department of Computer Science  
Texas A&M University  
in partial fulfillment of the requirements for

Computer Science 689 – Computers and New Media

May 2006

Major Subject: Computer Science 689 – Computers and New Media

## ABSTRACT

Computational Semiotics: Signs, Symbols, and New Media. (May 2006)

Adam Blaine Mikeal, B.A., Texas A&M University

Professor: Dr. Frank Shipman

The field of semiotics emerged in the 19th century as a systematic way to study signs, both individually and as they appear grouped into symbol systems. Included in this concept is the study of how meaning is created, understood, and conveyed to others. As such, semiotics is a broad, cross-disciplinary endeavor that spans the fields of philosophy, linguistics, sociology, and anthropology, to name a few. Computer Science can be understood as the systematic study of automated symbol processors, and the theories that govern them. Obviously, there is a direct connection between a study of symbol systems and a study of symbol-processing machines, although the perspective of the semiotician is frequently more socially focused than that of the computer scientist. This document intends to provide a brief overview of semiotics and semiology as originally formulated by Saussure and Peirce, and then a review of some of the current literature in the field today.

## TABLE OF CONTENTS

CHAPTER		Page
I	INTRODUCTION TO SEMIOTICS . . . . .	1
	A. Early history of semiotics . . . . .	2
	B. Ferdinand de Saussure . . . . .	3
	C. Charles Sanders Peirce . . . . .	3
	D. Umberto Eco . . . . .	4
II	COMPUTATIONAL SEMIOTICS . . . . .	5
	A. Definitions . . . . .	6
	B. Intelligent Systems and Knowledge Representation . . . . .	6
	C. New Media, Culture, and Meaning . . . . .	8
III	CONCLUSION . . . . .	10
	REFERENCES . . . . .	11

## CHAPTER I

## INTRODUCTION TO SEMIOTICS

The field of semiotics emerged in the 19th century as a systematic way to study signs, both individually and as they appear grouped into symbol systems. Included in this concept is the study of how meaning is created, understood, and conveyed to others. As such, semiotics is a broad, cross-disciplinary endeavor that spans fields such as philosophy, linguistics, sociology, and anthropology, to name a few. The name itself comes from the Greek word for “mark” or “sign”, *semeion*, and was originally used by John Locke in his 1690 essay *Concerning Human Understanding* (although with a different spelling) [1].

It is perhaps useful to denote the unique characteristics that distinguish semiotics from other similar, related field; perhaps in this respect semiotics is easier to define by what it is *not*, rather than what it *is*. Semiotics is not communication studies: while communication studies are interested in information theory, and how to most effectively transmit data from one point to another, utilizing the most efficient delivery method possible. Thus, communication theorists construct algorithms and models to explain the biology, psychology, and mechanics involved in this process. Obviously, once the data is received by the recipient, it must be decoded, and here is the tangential connection to semiotics; however, although there are shared concepts between the two fields, the emphasis between the two approaches is different [2].

Linguistics is a bit harder to distinguish, especially because of semiotic’s origins as a sub-discipline of linguistics. Although both start from the same point, semiotics links linguistic and non-linguistic information to offer plausible conclusions that place the interpretation of language in a social context (sometimes termed the *semiosphere*). Pure linguistics takes on a more systematic approach, and deals with the lower-level

components of languages, syntax and grammar.

Possibly most challenging is the distinction between semiotics and the philosophy of language. It has been argued that the difference is one of traditions more than subjects, as different authors have called themselves "philosopher of language" or "semiotician" almost interchangeably. Philosophy of language pays more attention to natural languages or to languages in general, while semiotics focuses on non-linguistic signification.

#### A. Early history of semiotics

Semiotics can trace its roots to some of the earliest Greek philosophers from the 5<sup>th</sup> century BC. Particularly, the writings of Plato and Aristotle begin to deal with the same issues tackled by Saussure 2,000 years later. Platonic Idealism, creating its universals that exist outside and above any particular instantiation of a thing, is seeking to answer the questions of meaning and knowledge transfer.

The concept of *signs* in particular was discussed by the Greeks; the Stoics and the Epicureans debated the differences between *natural* and *conventional* signs. For the Stoics, the prototypical sign was the medical symptom [1].

In the Middle Ages, most of the thought about signs was dictated by St. Augustine's theory of *signa data* – conventional signs. Unlike the classical thinkers, Augustine proposed that these signs were themselves objects that could – and should – be studied. Augustine also moved the discussion about signs toward a binary formulation of *mental* and *non-mental* words.

This limiting of focus had a significant impact on later thinkers, such as William of Ockham, who furthered its influence, and then John Locke in the 17<sup>th</sup> century. Of these early thinkers, Cobley and Jansz [1] note:

Although these figures in European philosophy are in some senses proto-semioticians, it is not until the 20<sup>th</sup> century that a full-blown semiotic awareness appears, under the auspices of two founding fathers.

## B. Ferdinand de Saussure

Ferdinand de Saussure (1857–1913) is often considered the “father” of modern linguistics, and posited a dyadic construction for the sign, of the **signifier**, the purely physical or material aspect of the sign, and **signified**, the mental concept, or Platonic essence of the concept that the signifier is pointing to. This understanding of the sign as a **dyad** is essential to an understanding of European thought on sign systems.

Some of the subsequent thinkers in the field that are heavily indebted to Saussure and his binary formulation of the sign are Baudrillard, Foucault, Derrida, Levi-Strouss, and Roland Barthes [1].

## C. Charles Sanders Peirce

Charles Sanders Peirce (1839–1914) was an American philosopher who proposed a **triadic** (three-part) formulation of the sign [2]:

1. The **representamen**: or *sign*, is the form which the sign takes (not necessarily material)
2. The **interpretant**: the interpretant is *not* the “Interpreter”, but rather the sense made out of the sign. Peirce called it the “proper significate effect”
3. The **object**: the object is that to which the sign/representamen refers

In addition to delineating multiple types of objects (immediate and dynamic), and multiple types of interpretants (immediate, dynamic, and final), Peirce also for-

mulated his triadic sign so that it allowed built-in, automatic recursion, where the interpretant of one sign fulfills the role of the representamen in another triad, and that resulting interpretant becomes the sign/representamen for another, and so on *ad infinitum*.

The recursion is especially significant for our discussion of computational semiotics, since based on the equivalence of a Universal Turing Machine with lambda calculus, any computable problem can be represented in the lambda calculus, which is inherently recursive. The recursive nature of signs and meaning and the inherently recursive nature of computers opens interesting questions regarding the value of semiotics in computational knowledge representation tasks.

#### D. Umberto Eco

Umberto Eco (born 1932) has been an influential modern thinker in the field of semiotics, partially for his integration of semiological thought and concepts into his popular novels, such as *The Name of the Rose*. In addition to his fiction (which is often referred to being in the tradition of Jorge Loius Borges), Eco has produced a prolific volume of scholarly work, starting with his seminal *A Theory of Semiology* in 1976, where he begins to synthesize the “American” and “European” (from Pierce and Saussure, respectively) perspectives on semiotics. He introduces the *referential fallacy* – the fact that simply because a sign exists, it doesn’t necessarily follow that the object really exists. Also significant is his emphasis on the role of the interpreter, which he sees as a kind of hermeneutic – making hypotheses based on a rule, and as a consequence, inferring the result. Thus, an interpreter is not just decoding a message, she is making a hypotheses.

## CHAPTER II

### COMPUTATIONAL SEMIOTICS

Computer Science can be understood as the systematic study of automated symbol processors, and the theories that govern them. Obviously, there is a direct connection between a study of symbol systems and a study of symbol-processing machines, although the perspective of the semiotician is frequently more socially focused than that of the computer scientist. It might follow, therefore, that *Computational Semiotics* is fairly straightforward term, referring to the intersection of these two ideas.

In fact, however, computational semiotics is a somewhat loaded term, partly because of the layers of meaning attached to the “semiotics” component of the expression, but more so because once the qualifier “computational” is added to the beginning, an ambiguity is introduced, and the term is used by different groups in different ways.

An additional problem that can be found with the moniker is the misleading parallel or equivalence that it seems to imply with computational linguistics, when in reality there is none. Obviously, semiotics and linguistics are closely related fields (in fact, Saussure would have situated semiology as a proper subset of linguistics [2]), and particularly so during the formative years of these disciplines, they have certainly diverged recently. Semiotics is still a more fluid area, while linguistics has become more and more a systematic, hard science. Likewise, you won't find the type of certainty in computational semiology that would be generated by research in computational linguistics.

This chapter will look at a few approaches to the term “computational semiotics”, and then provide a brief survey of the current literature in that school of thought.

## A. Definitions

For our purposes, we will be concentrating on two ways in which the term Computational Semiotics is used. The first definition we encounter places this field squarely within the realm of computer science. It takes the ideas and concepts of *semiotics* – signs, symbols, and meaning systems – and applies them to the problems of knowledge representation and intelligent systems. The lessons taught by semiotics find application in the study and development of ontologies and metadata, artificial intelligence, and knowledge processing [3].

The second approach we examine has as its emphasis not so much applying the concepts of semiotics toward computer science, but taking the concepts of computer science and new media and asking how these new technologies impact our culture, and the way we create meaning within our society. Specifically, how do the incunabular forms of New Media afforded by modern computational machines affect us individually and corporately [4]?

Both approaches rely heavily on the formulations of semiotics developed by Saussure and Peirce in the 19<sup>th</sup> and early 20<sup>th</sup> centuries, and thus a common framework of thinking is provided, which allows a greater degree of communication between traditionally insular subject domains.

## B. Intelligent Systems and Knowledge Representation

One of the more prolific writers within this approach to computational semiotics is Ricardo Gudwin from the University of Campinas, in Brazil. Starting with his doctoral dissertation, he has continued to research various methods and techniques to utilize semiotics to aid knowledge processing, and the development of intelligent systems [5] [3]. In *An Approach to Computational Semiotics* he develops a theoretical

foundation for intelligent systems development, using a taxonomy of elementary types of knowledge derived from the classification of sign types from Peirce. This foundation allows him to express objects and their relationships mathematically; then he develops a mathematical mechanism to describe inferences across these objects [3].

In *A Computational Semiotics Approach for Soft Computing*, Gudwin takes this same research foundation and extends it to allow for “soft” computing techniques, such as fuzzy logic systems, neural networks, and evolutive systems [5]. Alexander Maedche describes an approach to using semiotics to derive “emergent ontologies”, which would form from the usage of the system and the interaction between the users and the agents within the system. [6]. utilizing a bottom-up rather than a top-down methodology allows for the ontology to be automatically derived, and respond to changes and subtle shifts within the system.

Works such as John Sowa’s *Ontology, Metadata, and Semiotics* applies the concepts of signs and signifiers to the internet as a whole. According to Sowa, the internet is a giant semiotic system: a massive collection of Peirce’s three kinds of signs: *icons*, which show the form of something; *indices*, which point to something; and *symbols*, which represent something according to some convention. Sowa uses the concepts of semiotics to provide organizing guidelines for this massive symbol system, and to create methods for translating patterns of signs intended for one purpose to other patterns intended for different but related purposes [7].

The final goal in these efforts is to obtain the capability of extracting logic from language on the web (either formal or natural), and with that, the ability to understand meaning and intentionality.

### C. New Media, Culture, and Meaning

Many of the works cited in this section are from the same conference (but from various years): The Conference for Computational Semiotics. This conference has as its published goal to promote “a way of thinking about computers, about what we (and others) make with them, and about how we use them” [4]. This group is more interested in how computing technology changes and affects humans, than using semiotics to develop new approaches in computing. As new media forms become more integrated into our society and our daily lives, how does this affect our culture? How does this change the way we process the signs and symbols that represent these computers (as objects), while the computers are simultaneously creating signifiers of their own?

The conference specifically eliminated a distinction between papers presented by artists and papers presented by researchers, in order to enhance the crossover between digital art and traditional computing research. As a consequence, the range of papers accepted by the conference is significant: everything from an analysis of “Cyburban Semiotics” [8] (a semiotic approach to the use of urban space and digital communications) to the role of context and semiotics in film meaning [9].

A number of the papers accepted in 2004 dealt with textual/graphical experiments of some kind: Rebecca White’s *Dictionary: A Semiotic Experiment* describes a work of digital art that explores the connections between the (seemingly arbitrary) choices of signs to things, and the mechanisms behind the manufacture of new language, and its ability to portray concepts, thoughts and ideas [10]. In *IDtension: The Simulation of Narrative*, Nicolas Szilas has created a project that uses structuralist concepts to allow the user to create original narrative, using a graphical representation of the various characters and their goals and tasks [11].

Some of the literature deals with more traditional computer science research topics. Lucia Leao creates an extended analogy between the labyrinth and the structure of a hypertext, and argues that the labyrinth is always present in hypermedia in two ways: the more evident is the lexia organization at the time of development or creation. The second, less evident – but no less profound, she says – is the labyrinth created by the user when traversing the hypertext and making choices in the forks [12]. Similarly, Edward Hartley deals with a typical computer science problem – the grouping and association of multiple objects into a single, multimedia composite – by approaching it from a semiotics perspective, overlaying the concepts of signs and signifiers onto the UML diagrams normally used to represent these structures.

## CHAPTER III

### CONCLUSION

It has been noted that the body of scientific knowledge is increasing more rapidly than our ability to manage or understand it [13]. There is a widespread feeling that investigating the technologies of the Sematic Web, including techniques for knowledge representation and artificial intelligence, is the best shot at solving these difficulties [6]. Computational semiotics, as it refers to the application of semiotics concepts to knowledge management and intelligent systems, holds the promise of greatly increasing our ability to understand work with these types of systems on a solid, systematic basis [5].

As humans, we are constantly trying to understand our place in society and in the universe. With the advent of computers and the technological advances that they bring, that role has been changing at an ever faster rate, causing us to move to a state of nearly constant re-evaluation. Computational semiotics as a way of thinking about New Media – how we use it, its place in our society, and its impact on our culture – is an important tool in this effort.

Computational semiotics encompasses a broad range of disciplines and research areas, not only because of the various definitions available for the term, but also because of the scope of the problems it seeks to address. Both semiotics and computer science are relatively young fields within the academy, and it will be interesting to see this cross-disciplinary research area continue to develop as technology continues to advance, and our societies continue to further integrate new forms of media into our daily lives.

## REFERENCES

- [1] Paul Cobley and Litza Jansz, *Introducing Semiotics*, Totem Books, Cambridge, 1997.
- [2] Daniel Chandler, *Semiotics: The Basics*, Routledge, London, 2006.
- [3] Ricardo Gudwin and Fernando Gomide, “An approach to computational semiotics,” in *ISAS '97: The proceedings of the 1997 conference for Intelligent Systems and Semiotics: A Learning Perspective*, September 1997.
- [4] “Cosign conference,” Project website, 2006, <http://www.cosignconference.org/>; accessed 5 May 2006.
- [5] R. Gudwin and F. Gomide, “A computational semiotics approach for soft computing,” 1997, vol. 4, pp. 3981–3986 vol.4.
- [6] S. Staab, S. Santini, F. Nack, L. Steels, and A. Maedche, “Emergent semantics,” *Intelligent Systems, IEEE* [see also *IEEE Intelligent Systems and Their Applications*], vol. 17, pp. 78–86, 2002.
- [7] John F. Sowa, “Ontology, metadata, and semiotics,” in *ICCS '00: Proceedings of the Linguistic on Conceptual Structures*, London, UK, 2000, pp. 55–81, Springer-Verlag.
- [8] Timothy J. Jachna, “Cyburban semiotics,” in *COSIGN 2004: Proceedings of the 3rd Conference on Computational Semiotics for Games and New Media*, September 2004.

- [9] Douglas Grant and Jim Bizzocchi, “Context, convention and complexity in film meaning,” in *COSIGN 2004: Proceedings of the 3rd Conference on Computational Semiotics for Games and New Media*, September 2004.
- [10] Rebecca W. White, “A semiotic experiment,” in *COSIGN 2004: Proceedings of the 3rd Conference on Computational Semiotics for Games and New Media*, September 2004.
- [11] Nicolas Szilas, “Idtension: The simulation of narrative,” in *COSIGN 2004: Proceedings of the 3rd Conference on Computational Semiotics for Games and New Media*, 2003, pp. 106–107.
- [12] Lucia Leao, “The labyrinth as a model of complexity: The semiotics of hypermedia,” in *COSIGN-2002: Proceedings of the 2nd Conference on Computational Semiotics for Games and New Media*, 2002, pp. 54–59.
- [13] Vanevar Bush, “As we may think,” *Atlantic Monthly*, vol. 176, no. 1, pp. 101–108, 1945.
- [14] Martin Howse and Jonathan Kemp, “ap - fm01,” in *COSIGN 2004: Proceedings of the 3rd Conference on Computational Semiotics for Games and New Media*, September 2004.
- [15] Edward Hartley, “Bound together: Signs and features in multimedia content representation,” in *COSIGN 2004: Proceedings of the 3rd Conference on Computational Semiotics for Games and New Media*, September 2004.
- [16] A. Mehler, “Toward computational aspects of text semiotics,” 1998, pp. 807–813.

- [17] R. Goncalves, R. Gudwin, and F. Gomide, “Emotions: a computational semi-otics perspective,” 1999, pp. 52–57.