Computer Search Logic

How does searching on a computer differ from others searches like paging through books or asking by word of mouth? The computer doesn't merely place another tool at our fingertips. It fashions a whole new mental environment, an information environment where the mind breathes a different atmosphere. The computing atmosphere belongs to an information-rich world where electronic libraries store everything from personal correspondence, papers, and notes to the Gettysburg Address, the Constitution, and the King James Bible. The desktop computer connects to networks that offer satellite images from the Hubbell Space Telescope or the entire corpus of ancient Greek literature.

The sheer quantity of information today requires a computer to assist most research. A computer-assisted search finds references, phrases, or concepts in an instant. A search engine takes a key phrase and in a flash snaps a piece of information into view. Most search engines provide users with the opportunity to do a Boolean search. The user can then scan thousands of periodicals in minutes, without ever having to know anything about silicon microchips, high-level code, or sorting algorithms.

> *Tip:* Internet search engines like Yahoo, Alta Vista, Excite, and HotBot offer Boolean search operations. Some tools provide meta-searches that compile results from several search engines. One such meta-tool is Internet Sleuth at http://www.isleuth.com.

Humans have always posed questions in a variety of ways, and each way reveals a distinct approach to life. Socrates asked face-to-face personal questions that aimed at definitions. Descartes and Galileo taught scientists to pose questions with mathematical precision and empirical hypotheses. Heidegger questioned the scholarly history of reality, and Wittgenstein worried over odd locutions. The type of questions we pose, philosophers agree, shape the possible answers we receive. The way we search limits what we find in our searching. And the style in which we pose our questions usually reflects the

culture that supports our inquiries. Today questions are often posed in front of a computer, and many of our questions begin with Boolean search terms.

These tools for manipulating symbols install the distinctive tempos and biases of our information society. We should then perhaps look more closely at these search tools in order to deepen self-understanding and avoid any cognitive imbalances that our tools might introduce. How do today’s cognitive practices shape our questions? What habits do computer searches nurture in our mental life? What subconscious attitudes do we cultivate as we use these cognitive tools? As we interrogate the world through the computer interface, where many of our questions begin with Boolean terms, how do computers structure our mental environment? What subconscious agencies will affect the questions we ask?

Boolean logic is, of course, a child of modern logic. Modern logic, which makes the computer possible, got its footing in the work of Leibniz (1646-1716) whose discoveries produced a proto-computer as well as the binary logic that laid the foundations of information systems. George Boole (1815-1864) later discovered the branch of mathematics known as *symbolic logic*. Boole's "algebra of logic" used formulas to symbolize logical relations. The formulas in algebraic symbols could describe the general relationships among groups of things that have certain properties. Given a question about how one group relates to another, Boole could manipulate the equations and quickly produce an answer. First his algebra classifies things, and then the algebraic symbols express any relationship between the things that have been classified -- as if we were shuffling things in the internested drawers of a Chinese puzzle box. The broader significance of Boolean logic is often buried in the logic texts that use Boolean algebra to explain the circles of the Venn diagrams.

Historically, Boole's logic was the first system for calculating class membership, for rapidly determining whether or not something falls into one or another category or class of things. Before Boole, logic was a study of statements about things referred to directly and intuitively at hand. After Boole, logic became a system of pure symbols. Pre-Boolean logic focused on the way direct statements or assertions connect and hold together. A set of statements that hangs together can be a valid deductive pattern. Validity is the way

conclusions connect with their supporting reasons or premises. The traditional study of logic harked back to Aristotle, who first noticed patterns in the way we assemble statements into arguments. Aristotle called the assemblage of statements "syllogisms," from the Greek for a pattern of reasoning. Aristotle himself used symbols sparingly in his logic, and when he did use symbols, they served merely to point out language patterns. Aristotle's symbols organized what was already given in direct statements. With Boolean logic, on the contrary, direct statements have value only as instances of the relationships between abstract symbols. Direct language becomes only one possible instance of algebraic mathematics, one possible application of mathematical logic. Through this innovation, Boole inverted the traditional relationship between direct and symbolic languages. He conceived language as a system of symbols, and believed his symbols could absorb all logically correct language. By inverting statement and symbol, Boole's mathematical logic could swallow traditional logic and capture direct statements in a system of symbolic patterns. Logical argument became a branch of calculation.

Note here one important clue: the priority of system. Where system precedes relevance, the way becomes clear for the primacy of information. For it to become manipulable and transmissible as information, knowledge must first be reduced to homogenized units. With the influx of homogenized bits of information, the sense of overall significance dwindles.

This subtle emptying of meaning appears in the Venn diagrams which graphically display Boolean logic. The visual display John Venn created begins with empty circles. Venn noted how Boolean logic treats terms, like "brown" and "cows," strictly as algebraic variables and not as universal terms referring to actually existing things. Venn noted that in Boole's logic terms function like compartments or drawers. Each term functions as a compartment, which may or may not contain any actual members. Boole's logic can use terms that are empty, the class of unicorns, for example. A term with no actually existing members is a null set, an empty compartment. As modern logicians say, the terms of logic do not of themselves carry existential import. The terms reveal relationships among themselves but they remain unconnected to existence or to the direct references of first-hand experience. (Mathematics also shares this existential vacuum: the formula 2+2=4 remains arithmetically true whether or

not four things actually exist.) Boolean logic uses terms only to show relationships -- of inclusion or exclusion -- among the terms. It shows whether one drawer fits into another or not and ignores the question of whether there is anything in the drawers.

The Boolean vocabulary uses abstract counters, tokens devoid of all but systemic meaning. On Venn diagrams, then, we begin with empty circles to map statements that contain universal terms. We can map the statement "All the cows are brown" by drawing two overlapping circles, one representing cows and the other brown things. Shade in (exclude) the area that represents cows and that does not overlap the area representing "brown things" and you have a graphic map of the statement "All the cows are brown." The map remains accurate regardless of whether or not any cows actually exist; you could equally well have drawn a map of the unicorns that are white. Add a third circle to represent spotted things and you can map "No brown cows are spotted" or "All brown cows are spotted," and so on. What does this procedure really map? According to Boolean logic, no cows or brown things or spotted things need actually exist. All we have mapped is the relationship between sets or classes. The sets could refer to custards or quarks or square circles.

In its intrinsic remoteness from direct human experience, Boolean search logic shows another aspect of the priority of system: a gain in power at the price of our direct involvement with things. The Boolean search affects our relationship to language and thought by placing us at a new remove from subject matter, by directing us away from the texture of what we are exploring. To add particular statements to our map, like "Some spotted cows are brown," we need to introduce further symbols. We can map statements about particular things on the diagrams by stipulating another conventional symbol, often a star, an asterisk, or some other mark. Statements which imply that a particular member of a class actually exists must be specifically marked as such, otherwise the general term labels a potentially empty compartment.

From the outset, then, Boolean logic assumes that, as a rule, we stand at a remove from direct statements about particular things in which we existing beings are actually, personally involved. Now this shift in the meaning of logical terms has drastic consequences for logic itself -- and for logic as a

formal study. Traditional Aristotelian logic presupposed an actual subject, ideal or real, to which logical terms or words refer. Traditional logic presupposed that logical thinking is -- like spontaneous thought and speech -- intimately involved with a real subject matter. Mathematical logic gained the upper hand by severing its significance from the conditions under which we make direct statements. Today, logicians like Willard Van Orman Quine can argue that a concrete and unique individual thing (which we refer to as such) has no more reality than "to be the value of a variable" -- at least when we consider things "from a logical point of view." The modern logical point of view begins with the system, not with concrete content. It operates in a domain of pure formality and abstract detachment. The modern logical point of view proceeds from an intricate net of abstract relations having no inherent connection to the things we directly perceive and experience. We can contrast this aloof abstraction with the traditional logic that still swam in the element of direct experience.

Traditional logic began with direct statements insofar as its logical language presupposed as necessary the existential interpretation of statements. When we state something in everyday language, we attribute something to something; we attribute the color mauve to the wall, the quality of mercy to a creditor. We speak of what is before us and we speak in the context of other people who may also have access to what we are talking about. We commonly assume the existence or at least the existential relevance what we are talking about. Modern symbolic logic, on the contrary, mimics modern mathematics, which has no interest in the actually existing world -- not even in the world of direct statements. In this sense, modern logic operates at a remove from our everyday involvement with things.

But why pick on modern Boolean logic? Don't all logics bring abstraction and alienation? Even the words we use to pose any question testify to a gap between us and the wordless things we think about. Any logic can distance us. We sometimes run across a person arguing, with impeccable logic, for a conclusion contrary to our own gut feelings, and we often feel overwhelmed, and forcibly so, by the sheer power of the argument itself. Logic can move like a juggernaut adrift from any personal engagement with its subject matter. Someone with a great deal less experience, for example, can make us feel

compelled to accept a conclusion we know intuitively to be wrong. We feel the logical coercion even though we may have much more familiarity with the matter under discussion. Arguing with someone like Socrates, or William F. Buckley, can be disconcerting. We sense a line of thought pushing inexorably through the topic -- perhaps even in spite of the topic.

Logic, like mathematics, operates outside the intuitive wisdom of experience and common sense. Hence the mathematical idiot savant. Like math, logic can hover smoothly above particular facts and circumstances, linking chains of statements trailing from some phantom first premise. You can be perfectly logical yet float completely adrift from reality. By its very nature, logic operates with abstractions. But modern logic operates with a greater degree of abstraction than Aristotelian logic, placing us at a further remove from experience and from felt insight. When college students study those Venn diagrams "from sophomore geometry," they feel the pain of that disengaged logic. When they first learn to symbolize statements and arguments in symbolic logic, they must pass through a lengthy and painful process of converting their English language into abstract symbols. So far removed does this logic stand from the direct everyday use of language that the textbook refers to the process of converting arguments into symbols as "translation." Before analyzing their thoughts logically, students must first translate them to fit the system of modern logic. Statements in direct English must first undergo a sea change. The painful translation into symbols signals the primacy of system.

But when logic works on the computer, the pain turns into convenience. When the computer converts input into algebraic bytes automatically and invisibly, the user is shielded from the translation into modern logic. Instead of the human mind puzzling how language fits the system, the computer does the fitting; it swallows our alphabet into manipulable bits and digests it for digital regurgitation. As a medium, the computer relieves us of the exertion needed to pour our thoughts into the algebraic mold. The shift from intuitive content to bit-sized information proceeds invisibly and smoothly. On the machine level, the computer's microswitches in the central processing unit organize everything through a circuit based on symbolic logic, Boolean searches simply apply that same logic to text processing. Hardly noticing this spider-like, non-direct logic, we stand at a new remove from concretely embedded language.

The computer absorbs our language so we can squirt symbols at lightning speeds -- or scan the whole range of human thought with Boolean searches. Because the computer, not the student, does the translating, the shift takes place subtly. The computer system slides us from a direct awareness of things to the detached world of logical distance. By encoding language as data, the computer already modifies the language we use into mathematized ASCII (American Standard Code for Information Interchange). We can them operate with the certitude of Boolean formulas. The logical distance we gain offers all the allure of control and power without the pain of having to translate back and forth from our everyday approach to the things we experience.

But so what if computer power removes us from direct intuitive language? So what if Boolean logic injects greater existential distance from practical contexts than any previous logic? Don't our other text tools also operate at a remove from direct context-embedded language? Isn't all media, by definition, a mediation? If the Boolean search operates at a great remove from direct oral discourse, don't also pen and paper, not to mention rubber erasers and linotype printing presses?

Non-linguistic tools like erasers do indeed insert a distance between ourselves and our context-embedded mother tongue. And, yes, using a rubber eraser does affect us -- in subtle, psychological ways. Teachers understand that getting a student to use an eraser marks a significant step on the road to good writing. A self-critical attitude distinguishes good from bad writing, and picking up an eraser means we are beginning to evaluate our own words and thoughts.

> *Tip:* An excellent piece of software for Boolean searches across the hard drive of your personal computer is available as freeware from www.inforapid.com.

But using Boolean search logic on a computer marks a giant step in the human species' relationship to thought and language. Just as the invention of the wax tablet made a giant stride in writing habits, forever marginalizing chiseled stones, so too Boolean search logic marks the new psychic framework of electronic text woven around us by computers.

With electronic text we speed along a superhighway in the world of information, and Boolean search logic shifts our mental life into a high gear. The Boolean search shows the characteristic way we put questions to the world of information. When we pose a question to the Boolean world, we use keywords, buzzwords, thought bits to scan the vast store of knowledge. Keeping an abstract, cybernetic distance from the sources of knowledge, we set up tiny funnels to capture the onrush of data. The funnels sift out the "hits" triggered by our keywords. Through minute logical apertures, we observe the world much like a robot rapidly surveying the surface of things. We cover an enormous amount of material in an incredibly short time, but what we see comes through narrow thought channels.

Because they operate with potentially empty circles, the Boolean search terms propel us at breakneck pace through the knowledge tunnel. The computer supports our rapid survey of knowledge in the mode of scanning, and through the computer's tools we adapt to this mode of knowing. The scanning mode infiltrates all our other modes of knowing. The byte, the breezy bit, the verbal/visual hit, take the place of heavier substance.

While this conclusion about Boolean search logic appears melancholy and dyspeptic, my thoughts do not end here. This article was condensed from the first section of Chapter Two “Logic and Intuition” from my book *The Metaphysics of Virtual Reality* (NY: Oxford U. Press, 1993). The original essay –too long for this newsletter -- suggests ways in which intuition can offset Boolean mental habits. The background philosophy of language and the theory of mental habits first appeared in *Electric Language: A Philosophical Study of Word Processing* (New Haven: Yale U. Press, 1987, 2nd ed. 1999). The initial inspiration for these reflections came from translating Heidegger's *The Metaphysical Foundations of Logic* (Bloomington: Indiana U. Press, 1984). To see a more balanced approach to digital text, the interested reader should look more deeply into these books of which some chapters are available online from links at http://www.mheim.com.

Michael Heim
Redondo Beach, California
January, 1999
Email: mike@mheim.com

Michael Heim teaches Virtual Worlds Theory and Virtual Worlds Design at Art Center College of Design in Pasadena, California where he is on the Graduate Faculty for New Media and Communications.