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Hunters and Gatherers: The Future of Search

Andrea Fallas
Seamntico, Ltd., Andrea.Fallas@semantico.com

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Hunters and Gatherers: The Future of Search

by **Dr. Andrea Fallas** (UX Designer, Semantico Ltd.) <Andrea.Fallas@semantico.com>

As a species, our ability to manipulate the world around us is unparalleled. Since we first developed complex tools some fifty thousand years ago we have been shaping our physical environment — and ourselves — in ever more elaborate ways. Our tool-making prowess has culminated in the exponential technological advances we have witnessed over the last few decades. Since the advent of the Internet we have been creating a parallel, virtual world that requires tools and toolmakers as much as our material reality does.

Our ancestors once depended on their ability to forage for physical resources. In this information age our quarry is digital. Once faced with the daunting task of locating sustenance amid scarcity, the problem now is finding meaningful information amongst a deluge of data.

Collectively, we produce a staggering amount of information. Prior to the year 2000, the total amount of recorded information in the entire world was estimated to be in the range of tens of exabytes (one exabyte is equivalent to a million terabytes, or a billion gigabytes). By 2012, we were producing the same amount of data every few days. This astronomical increase in the amount of available data is accompanied by a dilution of meaning. We have a limited capacity for attention, and for any particular signal of interest there will be a lot more noise.

Search tools aim to guide us towards areas of increased meaning. Given the enormity of the digital universe, it's not surprising that three of the top five sites visited globally are search engines. If we take into consideration the various specialised and proprietary search tools that are available, it seems fair to say that search is the primary means by which we access our digital data.

With the total amount of information ever on the increase, how we process and make sense of it all is a burning question. However, it is not a new one: information overload has been documented throughout history from ancient times until today. For the last few thousand years people have been cataloguing information in an attempt to make it searchable and alleviate the cognitive overload that comes with trying to find a needle in a haystack. Cataloguing and classifying information has taken on a new scale and importance in recent years due to the exponential amounts being created and distributed.

Clearly, we need to keep up with this spiralling glut of data. In order to further refine and develop our search tools, we need to understand the mechanics of search more fully. Search is of course not simply about a particular technology, it is about is the process of locating relevant information. So in order to really hone our tools we need take into consideration both the technological and human aspects.

Foraging for Survival

Our progression from stone tools to modern computers has happened in the blink of an eye in evolutionary terms. Consequently, the same cognitive processes that once allowed us to survive in the wilderness still determine how we we hunt for information today.

Living beings constantly make decisions crucial to their survival: what to eat, where to look for food and how long for, and what strategies to use to find sustenance. Optimal foraging theory is a conceptual framework in ecology that describes how organisms forage in mathematical terms and helps us understand the factors that determine an organism's food preferences and feeding strategies.

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Any particular type of food will provide a certain amount of energy. To locate more of the same type it takes some average amount of time. This *search time* varies depending on how abundant the food is and how easy it is to locate. More time is also spent capturing, eating and digesting, and this *handling time* is dictated by the characteristics of both the food item and the organism.

Of course, not all food sources are equal and some are more profitable than others. Optimal foraging theory states that organisms behave so as to maximize their energy intake while minimising the time they spend searching for and handling food. By framing foraging in terms of costs and benefits, the theory allows ecologists to make quantitative predictions about diet and feeding behaviours.

Abundance is an important factor when considering foraging strategies. When food is scarce, an organism spends most of its time searching and consumes everything that it finds. However, when food is highly abundant, each new food item is found almost immediately. The organism spends almost all of its time engaged in handling its food, and chooses only those items with the highest profitability.

Animals may also have generalist or specialist diets, depending on the relationship between handling time and search time. Generalists tend to have short handling times compared to their search times: they will consume each food item they encounter, since their food is relatively far apart and the handling time is short. Specialists find food quickly but their handling times are long, so they tend to consume only the most profitable items.

Foraging for Information

Drawing on the ideas of optimal foraging theory, information foraging theory describe how humans behave while searching for information. By replacing the energy currency of the ecological theory with information value, information foraging theory states that people maximise their rate of gaining valuable information. The analogy extends to modeling how we follow cues to navigate clusters of information and make decisions to pursue one information source over another as part of our information diet.

A random walk through the information space is a costly strategy. We estimate the likely success of a given action — like clicking on a link — from the information scent. This is our subjective sense of value based on proximal perceptual cues, such as text and images, relating to distal information. By following trails of information scent through the information landscape, we can locate meaningful information.

Successful searching requires some understanding of the information space: how to navigate it, and how the information within it is organised or categorised, for example. We also need to be able to describe what we are searching for, which requires some fluency in the vocabulary of the subject domain. After all, when looking for a needle in a haystack it helps to know whether you're looking for a pine needle or a knitting needle. So, both search expertise and domain expertise play a role in determining how we search and how successful we are.

For the last twenty years, information foraging theory has underpinned our understanding of how we hunt for meaning on the Web. It has been enormously influential in fuelling the design of digital tools to assist us in foraging effectively. Information foraging theory can help us to understand how we search on a general level, yet in terms of its application, the devil is in the detail.

The State of Search

We typically begin by formulating a query in relation to our contextual task. We input this query into a search tool and receive the results of our search. We then assess and analyse the results of our query, exploring further along trails of information scent.

Google is almost certainly the search tool that we are most familiar with. In fact, it's so pervasive that we use it as a verb synonymous with search. We instinctively understand the meaning of the search box, wherever we see it on our screens. Yet the omnipresent search box is not the only way that we enter our search queries.

Google can be activated using voice commands, while Google's image search accepts images as input, for example. Along similar lines, the music identification service Shazam uses snippets of audio recorded using the built-in microphone of a mobile phone. In more specialised areas, we find tools like ChemSpider's structure search for chemical structures, or the Princeton 3D Model Search Engine that finds 3D structures from sketches or submitted models.

Our current search tools even assist us in formulating queries. Spelling and grammatical errors can be identified and corrected by comparing search queries to a dictionary or other text corpus. By adding a thesaurus, our search tools can extend our vocabulary to include related terms we might otherwise not have thought of. Advanced search interfaces often allow us to include more complex logic, but these typically require some degree of expertise to operate.

Despite the diversity of inputs, today's search tools still all too often require us to learn some kind of specific vocabulary in order to interact with them effectively. This need for some level of search expertise puts limits on the success of our information foraging. Developing tools that are intuitive and simple to use goes a long way towards alleviating these constraints.

Succeeding the Screen

The distance between our machines and us is getting smaller. In the last few years, the familiar desktop setup of keyboard, monitor, and mouse has transformed into a portable, touch-sensitive screen that lives in our pockets. Head-mounted displays like Google Glass bring our screens closer still. It's likely that soon even these technologies will be superseded by devices that blend reality and virtual reality in front of our eyes. While screens are integral in today's world, new generations of "wearables" like the FitBit wireless activity trackers are poised to do away with them altogether.

So how will we search when screens are no longer what they are today? From AskJeeves and Wolfram Alpha to Apple's Siri, natural language processing is transforming how we interact with our devices. Instead of having to learn another language with which to query our databases, searching will eventually become a conversation.

That conversation might not even need to be spoken aloud. We are making incredible inroads with brain-computer interfaces. Researchers can understand what other people are perceiving, by reconstructing images and movies from brain imaging data. Last year even saw the first brain-to-brain interface, which allowed one researcher to control his colleague's movements by thought alone.

Perhaps we won't even need to formulate our queries at all. Google's engineering director, **Scott Huffman**, envisages a world where our future technology will bring you the information you want, when you want it. Bridging the gap between us and our devices by mimicking natural structures and processes will lead to more instinctive ways of searching.

Subtle interfaces and natural language queries address variations in search expertise by making searching more intuitive for all of us, but what about the issue of domain expertise?

Experts and novices differ in terms of where, how, and how successfully they search. Our tools should be able to determine our level of domain expertise in real time and adapt to it, bridging any gaps in knowledge. Of course, making light of existing connections and relationships are also only half the picture. It is the gaps and negative spaces that require definition too. For expert users, our tools might help drive creativity by suggesting unusual links and associations.

Perhaps we can also better understand the topology of the domain we are foraging in. Our current implementation of the digital landscape is largely two-dimensional, existing in the plane of our screens. By limiting ourselves to flat representations, we are limiting our sense of space. Allusions to three-dimensional space are already being used as narrative tools — think parallaxing, or other transitions that evoke a sense of depth in mobile and tablet apps. The gaming world is a leader in this regard, with complex three-dimensional landscapes being a staple offering and a major driver of innovation, from motion-tracking technology in products like the Xbox Kinect and Nintendo Wii to virtual reality devices such as the Oculus Rift.

As technologies that would have sounded like science fiction at the birth of the Internet age become mainstream, we need to reconsider the architecture of our online world. We must take a holistic approach to designing our digital spaces and our tools. Lessons from disciplines such as neuroscience and psychology can help us better understand ourselves — and our limitations. It is in this space that innovation will take hold in shaping the future of search.

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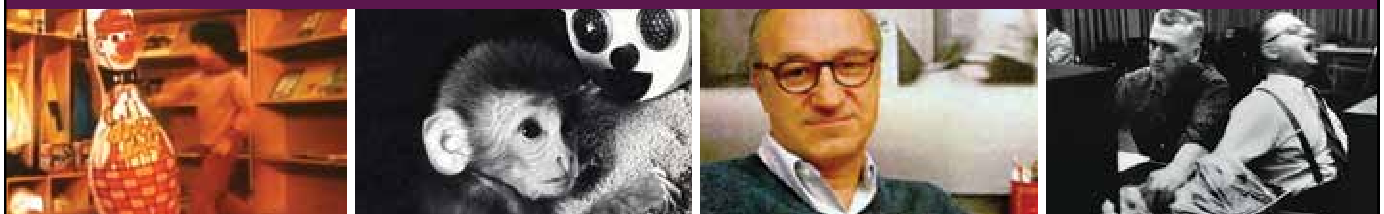

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Beyond the simple mechanics of information foraging, factors such as visual perception or cultural conditioning can also play a deciding role. How information is displayed in terms of colour, shape, and positioning might dramatically affect the handling time of each search result, or perceptions of value. User experience is a field emerging at the intersection of various disciplines from computer science to design, and is uniquely placed to offer insights into precisely these kinds of problems. By observing and recording our online behaviour, we can qualify and quantify the design of our digital tools.

Technology is becoming increasingly modular and contextual as we begin to build an Internet of Things, involving direct connections between smart objects and devices. The advent of ubiquitous computing might mean that instead of having to actively visit a search engine or device to do your searching, we will be able to seamlessly search from whatever context we are in. Of course, this vision hinges on our devices being able to understand information like we do, so there is a huge task ahead to turn our heaps of unstructured data into structured, machine intelligible information.

Finally, as much as we shape our tools, they shape us too. In little over a decade, the Internet has become so pervasive that for many of us it now acts as a form of external memory. When access to information is no longer a limitation, it's less important to recall the information itself and more important to know where and how to access it. This search-and-retrieval process is fundamental to life in the information age and the more we understand it, the better our symbiotic relationship with searching will become.

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teams of its portfolio companies and a focus on building value through the significant resources available through the **Accel-KKR** network. **Accel-KKR** has a particular focus on buyouts and recapitalizations of family-owned or closely-held private companies, going-private transactions and divisional buyouts of larger companies. It invests across a range of structures, functions as minority or majority investors and commits a wide range of capital — from less than $10 million to over $100 million. The firm has offices in Menlo Park, Atlanta, and London. For more information, please visit: *www.accel-kkr.com.*

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Congratulations to **Tyler** (Digital Services Librarian, **Addlestone Library**) who sent this photo of his son **Jack Edwin Mobley**, born on April 17th and weighing in at 6 lbs, 10 oz.

Another huge announcement! **Innovative Interfaces** has acquired **VTLS**, a library automation solutions provider with customers in 44 countries. The combined companies will be led by **Innovative** CEO **Kim Massana**. **VTLS's** offerings include well-known and respected library automation products including Virtua, VITAL, Chamo, and FasTrac. The acquisition by **Innovative** brings together its corporate resources with the special consulting and support expertise that **VTLS** has established internationally. As part of the transition, **VTLS flagship products** will be re-branded, incorporating the company name into the product name including VTLS-Virtua, VTLS-VITAL, and VTLS-Chamo Discovery. Corporate headquarters will continue to be located in Emeryville, CA, with other major offices in Blacksburg, VA; Syracuse, NY; Dublin, Ireland; Barcelona, Spain; Kuala Lumpur (Selangor), Malaysia; Noida, India; Madrid, Spain; and Taipei City, Taiwan. **Innovative** now employs more than 500 staff members, including 150 librarians. See more at: *http://www.iii.com/vtls#sthash.nrFYWmj7.dpuf.*

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