Intelligent Agents: It's nice to get stuff done for you

By Ernest Perez

"Intelligent agents"—chances are you've heard plenty of tall tales about these super-cyber entities that are fast appearing on the Web scene. You'll hear them talked about using a variety of different nouns and phrases. People describe them using such terms as smart agents, search agents, Web robots, bots, avatars, intelligent assistants, smart applications, customer service robots, shopbots, intelligent tools, and other names.

Bots are not new ideas; they are instead predictable developments based on the Artificial Intelligence technology that flourished in the 1980s and 1990s. One of the first articles to recognize the importance of this technology to information professionals was written by Marina Roesler and Donald T. Hawkins in 1994 ("Intelligent Agents: Software Servants for an Electronic Information World (and More!): Intelligent Agents Help Their Users with Routine Computer Tasks, While Still Accommodating Individual Habits," ONLINE, July 1994, pp. 18-32).

What are these tools, and what can and can't they do? Is this just mere hype, hogwash, and sales pitch overdrive? Admittedly, it does sound like science fiction, but on the other hand, these tools really can be the 21st century magic solution to information retrieval problems. Or, is all this in the same fantasy vein as the supposed new ability to cut down on library and research staffing and funding, "since it's all out there on the Web for free"?

Jargon in, Confusion Out

Part of the reason for the confusion is the baffling use of jargon to describe these software tools. Yet these are all variations of the same "smart software" technology vision of the Web. The point of Web smart agents is to turn the network into a more interactive place, with easy location and transferal of information between native Web applications and free-ranging software agents. This information is then ready to be further interpreted and transformed by local processing. The end result is that the Web will also be a friendlier and more inviting environment.

Such intelligence leads us toward what some visionaries are calling the Semantic Web. This is a network future where software agents roam from page to page—mining data, text, and ideas and performing sophisticated tasks at the bidding of their...
tracking agent information

BotSpot [www.botspot.com/]: An Internet.com site, founded but no longer maintained by Marcus Zillman, "BotSpot classifies Bots and Intelligent Agents by subject. Most of the bots you'll find discussed at BotSpot can be downloaded and used on your computer; some require a fee for permanent registration. Others are completely free." BotSpot includes classified agent lists, a newsletter, user forum, bot FAQs, and the "Secret Agent Man" columnist. It's an informative topical site.

BotTechnology [www.bottechnology.com]: Zillman's new site focuses on the technology and provides articles about new developments.

BotKnowledge [www.botknowledge.com/]: "BotKnowledge is a Web site dedicated to providing its users with the latest information related to Bots, and Artificial Intelligence. Our newsletter, bot reviews, bot lists, bot descriptions, and bot uses will keep you informed." Plus, the consultancy will be happy to help you develop your own bots.

Agentland [www.agentland.com/]: "Learn all about Intelligent Agents—set off on a journey to a new world, the world of agents. Discover what agents are, how they work, and how they can be useful to you. Explore the towns in Agentland and learn to distinguish their different families. Finally, read the files and articles from our experts who have ventured deep into this new world." An informative site, appropriately hosted by "Cybelle," an avatar, or humanlike intelligent agent character.

1st SPOT: Agents, Robots, & Spiders [www.1st-spot.com/topic_agents.html]: A comprehensive professional journal site covering individual agent software, commercial vendors, software, articles, columns, books, and pointers to related items elsewhere on its Web site. 1st SPOT asks, "What do you want to know today?"

The Simon Laven Page [www.simonlaven.com/]: Maintained by a software professional, devoted to the Chatterbot topic. This genre may be an entertainment, but the programs can also provide useful interfaces to agent technology. "A Chatterbot is a program that attempts to simulate typed conversation, with the aim of at least temporarily fooling a human into thinking they were talking to another person. ... on this site you will find dozens of Chatterbots in the nine categories, they can be accessed over the Web, downloaded to your PC, or accessed via Java. In addition, there are two Java chatrooms [one with and one without Chatterbots], Message boards, Chatterbot Papers and the latest Chatterbot news."

Virtual Intelligent Agent Search Engines [www.virtualfreesites.com/search.agents.html]: "Over 1,000 fully specialized search engines within 50 categories are waiting to assist you, no matter what you're looking for." Searchable classified listings of specialized Web search agents.

human masters. This vision includes ideas such as automatic "semi-intelligent" exchange of information between agent programs, intelligent agent software traveling across the network to actually operate on different machines, and use of speech communication and interaction between the user and the network. This isn't hype; you can already read about and use prototypes and demos of such tools. In the Semantic Web, agents will connect and harness the latent power of distributed network intelligence.

**CONTROLLING EXTERNAL DEVICES**

At this point, the next step is for agents to fully develop interconnections between the smart network and the external or physical control world. Then agents/programs can expand to advanced control abilities over external devices, such as electronic device microprocessors, operating controls, motors, or thermostats. Remember, we've already started playing with simple external control applications, such as remote Web operation of TV cameras, monitoring inventories of dormitory soft drink machines, using the X10 interface for control of "smart home" controls. This blurs boundaries between network smart agents and external world robots, in the Isaac Asimov sense of the term.

You may remember the Apple Computer film of the late 1980s, depicting a human operator using a smart agent desktop/wall display to communicate and interact with the external world. That was a slick Star Trek vision of a sentient assistant to help in navigating the conceptual and physical universe and to perform complex tasks. Seems like this kind of Web may not be that far away.

The basic smart agent premise is practical and valuable. The goal is to harness the power and potential of the desktop computer and then to leverage or magnify it even more, by combining it with the enormous Internet distributed information file. Such agents automatically perform operations that would otherwise cost humans in personal time, repetitive tasks, error-generation, complexity, difficulty, exactitude, fatigue, and just plain tedium. (That last item is spelled as in brain-petrifying B-O-R-I-N-G!)
FASTER, BETTER, CHEAPER

The value to be gained from using agents is easy to understand. Agents deliver immediate payoff by relieving you, the human, from loads of work. Not to mention the advantages of doing it faster, cheaper, and better. The benefits and leverage of agent use also include the instant payoff from fast searching of multiple Web search engines to locate and retrieve desired information.

Agents can also deliver or give you leverage in entirely new ways. They can provide the ability to cumulate and process data from multiple network searches and sources. They synthesize information into entirely new forms and relationships, as well as enable complex processing, evaluating, and comparing of results. Agents additionally possess the power of goal-seeking behavior. Examples include decision- or business-logic comparisons occurring during the actual data-gathering task, which can dynamically affect the course or scope or logic of the process. This kind of software technology gives you an enormous advantage, since the agent makes it possible to automatically and literally transform the retrieved bits of data into completely digested information collections. This helps in the speed and quality of your information use, intellectual understanding, global information view, decision-making, and course of action.

One might view the integration of complex computing into information retrieval tools as a return to old-fashioned, centralized “data-processing approaches” to the mainframe mentality. But there is a big difference here. We’re now talking network data processing, not old, localized “we have it all here” control orientation. This networked difference means that now you don’t need to originally invest in, possess, or own the raw data. Instead, you can go out and get it, from wherever it exists, when you actually need it. This is just in time applied to handling your “information inventory.” Agent technology gives you the power to dynamically and automatically collect networked data, and adds the ability for further complex processing. Smart agents add synergy from connecting and automating both processes. Either task would be unmanageable or difficult handled as a solely manual operation.

FUZZY DEFINITIONS

Agents have been a bit of a fuzzy concept. Different people have defined them in many different ways. But, getting it down to basics, PC AI Magazine ([www.pcai.com]) puts it concisely: “Intelligent Agents execute tasks on behalf of a business process, computer application, or an individual.” I myself like the more descriptive functional wording of agent characteristics, expressed by Michael J. Grimley and Brian D. Monroe, writing in the Summer 1999 issue of ACM Crossroads. They described an agent application as one which accomplishes the following:

- Takes proactive rather than reactive action to achieve a goal
- Uses autonomous, flexible, goal-defined behavior based on a designed action and rule set
- Is social, in that it can interact and communicate with humans, and perhaps with other agents.

Agent processing can also use simultaneous computing operations to synthesize or create the information obtained from different networked information resources. For example, such an agent might first locate and retrieve desired remote information bits. Then, it could parse and transform the retrieved data into segments, fields, or facts. Examples might include the automatic identification of such items as ISBN, Parts Names and Numbers, Auction Bids, Inventory Amounts, ZIP Codes, or Census Tracts. Such analysis might even include content evaluation and the assignment of conceptual topics or categories of text content “meaning.” Finally, the agent can export the new information values into temporary working files or stored database...
Vivisimo Web metacrawler screen displays results of search for “afghanistan bombing civilian casualties.” Lower-right frame shows full ranked set of 135 results captured from Web spider search engines. The “Source” information below each URL displays original search engine source and ranking in that result set. Lower-left frame displays dynamically generated word or phrase subcategories of documents within the set. Plus (+) sign indicates lower-level folder or document contents, with “Civilian Deaths” category clicked to show contents.

records for further use, as does the NetStepper agent creation tool.

MAGIC AT WORK

Agents can similarly capture, store, and use data from related but separate data sources to include in overall processing. This is another creative opportunity, the possibility of intelligent operation with the benefit of synthesized new facts and information. The stage is set, so that, as Einstein purportedly explained a particularly enigmatic part of one of his equations, “Magic happens here.” Creating new information in the course of work might thus extend the agent’s powers enormously. As in using smoke and mirrors....

Thus, agents may be able to provide completely new information to aid human evaluation and action. They can even use their processing ability to provide automated decision-making or command and control. This is not science fiction. Agents are already routinely used to manage workflow; manage networks for air-traffic control, in information retrieval management, network management, electronic commerce, education, medical patient monitoring and treatment, operation of digital libraries, automated manufacturing, smart databases, and a host of other complex services.

MAJOR TYPES OF AGENTS

Let’s look at some of the existing types of agents, particularly those that will be familiar to librarian and information professional readers, or at least be easily accessible via the Web.

Search Agents

These are the most familiar to information professionals. They include the well-known genre of Web spider search engines, such as AltaVista, Google, and AlltheWeb. These three show the variety of search engine software technology. They range from the pioneering but obsolete simple term-ranking algorithms of AltaVista; to the “Web links pointing to” weighted ranking logic of Google; and to the subclassification analysis approach of AlltheWeb. All these examples satisfy the agent characteristics of Grimley and Monroe—plus the last one adds the “synthesis” operation of analyzing results and presenting the retrieved set with an optional grouping of dynamically generated descriptive subcategories. There are numerous subcategories within this hosted search engine class, such as specialized versions for news, children’s, financial, health, regional, language-specific, and others. You might even consider the Napster-style music search tools to be an example of a specialized smart agent!

Web metacrawler search engines are a major variation from the basic Web spiders. The user may find it hard to differentiate them from the basic spiders in appearance and results. However, these agents do not themselves do the grunt work of directly spidering the Web. Instead, they operate by searching a defined group of the basic Web spiders and then analyzing, ranking, and reformatting the results. These agents then present a standardized results display, using their own presentation format. These applications might be even considered “agents-squared,” since they are actually “agents querying agents.” Examples of these tools include DogPile, MetaCrawler, and Vivisimo. You might also check out qbSearch, which accomplishes a simple and useful results summary by simply pasting together multiple search engine result pages into a single Web page. There’s no real added value processing here, except that the serendipity of the connected single display carries its own advantages.

Desktop metacrawler search engines are also powerful agent tools for end-users. These tools search multiple Web search engines in the same way as the Web metacrawlers. The packages include Copernicus Pro, Bullseye Pro, and Bingoo. They generally offer users a choice of predefined special area searches and offer valuable information synthesis abilities. These tools standardize the search engine results and usually have several alternate methods for exporting or handling result set information. The user can generally e-mail result sets; export information into text, word processor, or common database formats; configure the metasearch tool for automatic update of a search query, including automatic e-mail reporting. This agent genre can therefore add a good deal of
"smart horsepower" for working with the basic query results.

Agents for Specialized Tasks

Remember that simple definition of "Intelligent Agents execute tasks on behalf of a business process, computer application, or an individual" mentioned above? It seems to me that such a description essentially covers the operation of programs. The main distinction seems to be that traditional programs were closed systems, working only with information provided via user input or from existing data storage. Smart agents are open systems—programs with the ability to dynamically access and use networked information resources.

Essentially, then, any networked Web client or host program, any Web CGI, or for that matter, any macro or script editor that accomplishes something to make life easier for us humans is an agent.

So, to get into this "specialized task agent" category description, I'll simply list and describe examples of these tools. (I've not cluttered the listing with a great number of URLs. Most of the following product names are distinctive, so you should be able to locate them easily using Web search engines and a few related terms.)

My general groupings of the specialized task agents are as follows:

- **Monitors:** These include news monitors (agents that get you news from various news sources on the Internet or an intranet); stock monitors (help you monitor your investment portfolio by bringing in the latest quotes); news filters (agents that summarize or filter important news items); page update monitors (agents monitoring your selection of pages for changes, such as added text or new links); search engine update reporting (metacrawlers monitoring major search engines, and delivering periodic topical search updates).

- **specialized search bots:** searching and tracking within specialized areas, such as jobs/employment (Job Sleuth); scholarships (College Bot); entertainment figures (Entertainment Sleuth); corporate information tracking (Company Sleuth); television events (TV Eyes); sports teams or players (Sports Sleuth); and trademarks (TrademarkBot).

Knowledge Management: These agents handle a variety of knowledge compilation, searching, and tracking tasks. They include desktop metasearch applications (Copernic, Bullseye); bibliographic formatting/notes applications (EndNote); "general research engines" for gathering comprehensive topical information (Watson, KarnaK, eLibrary, KnowAll); text summarizers, for producing concise summaries or "abstractions" of informative texts (Copernic Summarizer, Text Analyst).

ChatterBots: Personal, talkative (some via voice synthesis) "virtual personal assistants," ready to help you with the tasks of navigating the Internet (BonzziBuddy, myVian); organizing you (Nooa); just generally getting your life together (ProdyParrot); telephoning you with reminders (iPing, InternetSpeech, MyAlert). (Some of these are great, if you simply have too much spare time!)


"Roll Your Own": You can construct your own agents from scratch. Agent-generator "construction kits" are beginning to appear. Most of these are
still in the computer programmer/hacker mode, but they are getting to be a bit more accessible. Approaches include basic computer languages and program tools designed for efficient writing of agents (Java, REBOL, PHP, Zope); agent construction kits (AgentBuilder, Brain Construction Kit, Intelligent Agent Factory, NetReaper, NetStepper Flangent, RoboNavigation development kit, and the Walk the Talk agent generator).

LIVING WITH BOTS

How close have we come to actually living in an agent/bot environment? Remember, besides the commercial, industrial, and government applications mentioned above, agent technology has already revolutionized the way we personally find out things, perform tasks, buy things, and support people. Maybe we're not totally at Apple's wall display virtual desktop point yet, but just think for a moment:

Are you using Half.com (or a similar Web service) to compare book prices across numerous Web bookstores and to enter and pay for the order? Oh, and when was the last time you used a hardcopy BIP to get information for a personal book purchase?

What do you use to get basic (or detailed) factual information about something, quickly? When was the last time you checked a print encyclopedia?

Where/what do you check when you want to fly across the country or the world, get vacation information, or check out hotels? Have you tried Orbitz or Expedia to search across all member airlines to find the best price for a trip, making a reservation, and paying via credit card?

Have you tried out and used the "auction assistants" that track bids on items of interest on the eBay, Amazon.com, or Yahoo! auction sites? These monitors bid and fire off last-second winning bids (within your set limits) in the last moments of an auction.

Are you using Google or another search engine, to quickly check out someone's publications, professional activities, and affiliations? Have you heard about the singles who routinely do instant Web background checks on their prospective dates?

Have you used a "Find more like this one" search engine function in your Web searching?

Agent technology isn't spectacularly new. However, applications for bot technology are growing rapidly. They affect information professionals both professionally and personally, whether for client research, travel, shopping, or hobbies. The encroachment of bots into the online research world has been steady and is not likely to diminish.

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