



INSTITUTE FOR HUMAN & MACHINE COGNITION

# ihmhc

VOLUME 2 ISSUE 3

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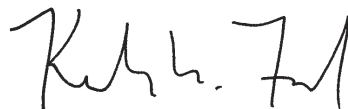
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Hurricane Ivan made landfall on September 16th, leaving us with an unanticipated level of devastation throughout our community. More than two months out, the damage is still evident almost everywhere you look. At IHMC we are still waiting for the first floor offices at our main facility as well as the entire administrative office building to become operational. Several of our staff were also displaced by the storm, with some living in hotels, others with friends and family. Drive down almost any street in the city and you will see blue FEMA roofs on many homes and boarded up windows at many businesses.

Throughout these last months I have been impressed with the hard work and resilience of the IHMC staff and the Pensacola community. From the back breaking labor of pulling out carpets and moving furniture in the first days to the cramped second floor offices where first floor staff have been welcomed without complaint, our staff has shown their dedication to recovering and moving forward. In spite of our physical appearance, IHMC has continued to sponsor our guest lecture series, and these events continue to be well attended by the community.

One sign of the recovery of the city is the return of the Pelicans in Paradise and the display of new ones. Coordinated through the Pensacola News Journal, the pelicans are a community art project to raise funds for local literacy programs. So far 35 pelicans have been placed throughout downtown Pensacola. One of the newest arrivals is RoboPelican, sponsored by IHMC. Through generous gifts from staff and contributions from IHMC, we raised \$5500 to sponsor the pelican, which, after a period of public display, will come to roost permanently in the IHMC courtyard.



Kenneth M. Ford, Director



Come visit our RoboPelican on Adams Street near Seville Square

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A University Affiliated  
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# Semantic Web



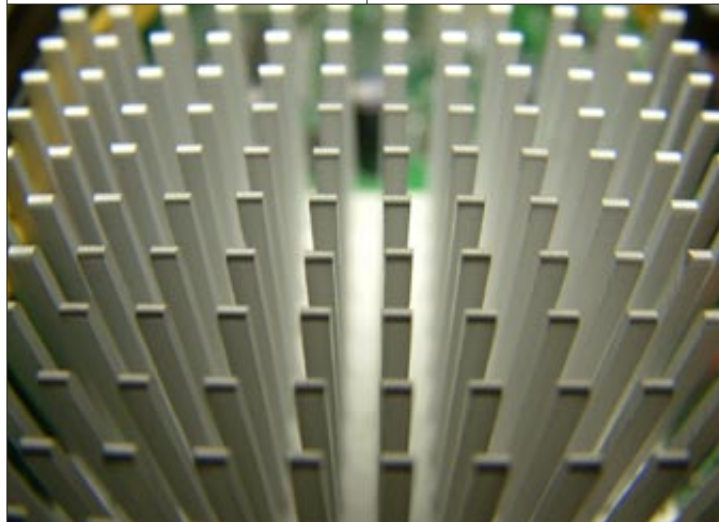
“The universe is wider than our views of it.”

—HENRY DAVID THOREAU

With all of the information available on the Internet, we could make almost any decision with close to full knowledge. A farmer may want to know whether to plant soybeans or tobacco next year. He would obviously want to look at the weather predictions, but also the status of genetically modified crops in Europe or a potential public smoking ban in China would be influential. Maybe his decision would change if he could get in touch with a company with novel uses for the non-leaf parts of the tobacco plants.

Unfortunately, the website for the seed company wasn't coded to link to all of the relevant information. Enter the Semantic Web. Instead

of relying on the web page composers to determine what information is relevant, the user, with the help of software tools, could explore for themselves. Perhaps they'll find a topic on the page that they'd like to know more about, such as legislation on GM crops. Clicking it pops up a small menu of subcategories, like continents, from which you could find which countries



have outlawed GM crops and which are considering it.

How do we get there from here? First, we have to create standards. In order for us to share information, we all must speak a common language, define everything in common ways. As part of a team of researchers worldwide under the umbrella of the World Wide Web Consortium (W3C), IHMC's Pat Hayes is contrib-

uting to the development of common standards for these languages, called ontologies. With meetings by phone every week for a year and a half, he and the other members of the team just completed the initial standards. These standards are designed to work with all of the existing web pages, so nothing will have to be scrapped.

While the W3C has no authority, since the Internet is a self-governing system, there is a strong pressure for conformity. It doesn't do an information provider, whether a merchant or a recruiter, any good to just speak to a limited group. However, if someone comes up with a standard better than those put forward by the W3C, that standard could

## SCIENTIST PROFILES

### Pat Hayes

Hometown: Calne, England

Education: B.A. in mathematics, Cambridge University, England; Ph.D. in artificial intelligence, University of Edinburgh, Scotland

Joined IHMC: 1998

Pat was really good at math in high school but was awed by other math students at Cambridge. He realized that he would never be a first-rate mathematician, so he decided to revert to his back-up plan, what he really wanted to do: since he was 11 years old, he wanted to make smart machines. He built clockwork robots out of erector sets, including one that would sense the edge of tables and steer away to stay on the table. Having discovered computers at Cambridge, he decided to pursue a Diploma in machine intelligence on offer at the University of Edinburgh. When he graduated with his Ph.D. in artificial intelligence, it was the first degree granted there with that title.

Later, Pat was a Luce professor at the University of Rochester, but decided he had had enough snow. He moved to California, working at Schlumberger, Xerox PARC, and SRI. He then returned to academia, at the Beckman Institute in Illinois, but never quite recovered from the industry experience. Academia had too much infighting, and he found that the majority of his communication with his colleagues in the same building was through email since their schedules kept them apart. He quickly realized that he could do his research anywhere with internet access.

A fellow (and ex-President) of the American Association of Artificial Intelligence, Pat was established enough to go wherever he wanted. Having watched the evolution of IHMC from a table in Ken Ford's office to a strong research center, he chose to move to



the Pensacola. He enjoys the variety of people with different backgrounds—not everyone has been an academic all along. He believes it is rare to find such a mixture of talents on a scale where he can know them all. And he enjoys being able to find someone to talk to about any topic of interest.

Pat has also enjoyed the open environment in Pensacola, particularly within the arts. As a kid he had wanted to go to art college, but his father pushed for Cambridge and won. He still enjoys painting landscapes and drawing people. Here, though, he has formed friendships with local artists and has gotten connected with a local gallery. He even is scheduled to jury an upcoming show there. He has never had the hubris to get involved in the art scene in an active way in the larger cities where he has lived.

Beyond art, Pat, along with his wife, enjoys restoring antique clocks using authentic mechanisms and materials. He also is a skilled builder, fixing up damaged homes. He built a new workshop behind his house last year but didn't get the final permit because the inspector pointed out that the shingle edges weren't glued down properly. However, ironically, his workshop didn't lose a single shingle during Hurricane Ivan, but City Hall was severely damaged. He still plans on adding the glue to get the permit, though.

become the standard if the majority of people start using it.

Of course, a computer doesn't speak English or Chinese or any other language. So all of the definitions of words and the relationships between them must be coded into the web page for the information to be available to semantic web software. For example, a cooking website might contain definitions of different ingredients and different cooking methods, such as frying or baking. In addition, it might have information on common substitutions for missing ingredients. A recipe within the site might have information on the order and quantity of ingredients, preparation time, and necessary cooking instruments. A user might then be able to search for a recipe with a legume and poultry or fish that can be prepared in an hour. They might have previously entered a listing on their computer of all their cooking equipment, so the search will rule out recipes that call for a deep fryer.

The page designer doesn't necessarily have to enter all of the connections a user might like to know. According to Hayes, "There is a much bigger collection of implicit links

that could be inferred from information on the web that could be made explicit by software. Then browsing could be a completely different game." For example, another website, one on native crops, may include information on which vegetables are from which continent. As long as each site has the same definition of the vegetables, the semantic web can access that information to help the user decide on the recipe.

In the current standards, all of this information will be binary linkages detailed within a secondary page linked to the main, visible page. Looking at the structure of the information required for the secondary page, Hayes realized that it is just a form of a concept map. Therefore, he and other IHMC researchers including Raul Saavedra and Tom Estridge and their collaborator Thomas Reichherzer, formerly at IHMC, are adapting CmapTools for use in generating and viewing semantic web pages.

If you just naively generate a Cmap from a semantic web page, it is a huge tangled mess. To make the Cmaps sensible, they have extended the CmapTools code to employ a number of techniques. For instance, much of the



■ ■ ■ The standards for the semantic web are, in essence, a real-world application of the traditional artificial intelligence field of knowledge representation. ■ ■ ■

semantic web information is definitions. However, many words have a few different, but related, definitions, so the semantic web Cmaps originally contained many nodes linked by “same as”. The new Big Nodes tool can include multiple definitions of one word inside the node for the word, reducing the number of repetitive linkages. Much like DreamWeaver or FrontPage allow those without knowledge of HTML to make attractive and functional web pages currently, CmapTools will allow the design and viewing of semantic web pages without learning the intricacies of the ontologies.

The standards for the semantic web are, in essence, a real-world application of the traditional artificial intelligence field of knowledge representation. As such, it is presenting many interesting challenges. Knowledge representation typically has been done on a small system, creating a small brain that knows everything about something. However, these systems assume a fixed universe, that all users have a similar reference point. But on the web, everyone will come with their own assumptions, their own universe. For example, a British user of the recipe site might define corn as any small grain cereal, while an American would assume it was what the British call maize. Corn chowder with barley just wouldn't be the same.

An additional problem has been the standard logic of knowledge representation notations. Most knowledge representation systems frequently use the term “For all X” to define attributes

of the group X. If the system being represented is related to the Florida election system, X might be likely voters, assuming they were only Floridians. However, a user from Nebraska might assume they were voters nationwide. Even more troublesome is the concept of the complement, “For everything that is not X.” In this example, a traditional system might assume it is the non-registered voters in Florida. Once this system becomes accessible to outsiders, though, it could be anything in the whole universe, from bacteria to black holes.

Hayes is working with a number of like-minded colleagues around the world to develop a new standard language, called Simplified Common Logic, that solves some of these problems. In this language, all qualifiers, like “For all X,” must be quantified. While in most instances adding more constraints slows down a system, the resulting logic in this case is highly efficient. This new language also includes new ways of dealing with imprecise information and ambiguity, such as where the Australian Outback begins. In most cases, it is not necessary to define that information precisely in order for two people to generally communicate their ideas.

Clarifying the definitions of our individual universes, whether specifically or imprecisely, is central to communicating our ideas to others. First we must agree on how to define things. Then the Semantic Web will allow us all to expand our views of the universe.

# HAPPENINGS

EVENTS, HONORS, AND NEWS AT IHMC

## IHMC hosts first board meeting



From left to right: Hal Hudson, Jim Reeves, Tim Goldfarb, Terry Hickey, Collier Merrill, Ray Russenberger, Chris Hart, Carol Carlan (chair), John Delaney, Ken Ford, Pam Bilibrey, Eric Nickelsen (vice-chair), Larry Lemanski, Eugene Franklin. Missing: John Cavanaugh and Bev Kitaoka.

The first meeting of the board of directors of the not-for-profit IHMC was held June 25th. Of primary importance were the items necessary for the initiation of the organization. Actions included the approval of the articles of incorporation and bylaws and the appointment of Ken Ford as Chief Executive Officer.

In addition to these preliminary actions, the Board chose to move forward on a number of critical issues. IHMC currently leases its main building and the associated land from the UWF Foundation. Because the facility has been customized to the unique needs of IHMC, the Board approved the acquisition of the land, facilities, and improvements at 40 S.

Alcaniz Street. The land included in the acquisition is that on which IHMC has proposed future expansion.

An additional affiliation agreement with the University of Central Florida is in the works.

Finally, the Board of Directors approved an agreement with the Florida Board of Governors, who oversee the higher education system of Florida. This agreement is central to IHMC entering into affiliation agreements with Florida universities. This spring IHMC and UWF signed a formal affiliation, and this fall IHMC affiliated with Florida Atlantic University.

### SYMPOSIUM HONORS KYBURG

Henry Kyburg, Jr., was honored with a symposium on October 9th and 10th celebrating his nearly 50-year career. Former and current students and professional colleagues met to discuss the work of Kyburg, a leading authority on philosophical problems in the study of science and mathematics. In addition to his appointment at IHMC, he is the University of Rochester Burbank Professor of Moral and Intellectual Philosophy and holds appointments at Rochester in both the philosophy and computer science departments. His current research focuses on uncertain or probabilistic inference—the process by which humans reach most conclusions and the process that will be central to artificial intelligence—and data mining—the process by which computers search for information in data and draw conclusions from it. During the symposium, Kyburg and

other national experts in computer science and philosophy participated in a panel discussion on "Probability as a Guide to Life," examining probability theory as it applies to practical matters of evidence, choice, and explanation.

### NOVAK HONORED AT CONCEPT MAPPING CONFERENCE

IHMC's Joe Novak created concept mapping early in his career. The impact of this tool and Novak's contributions to education were applauded at the First International Conference on Concept Mapping banquet on September 16th. Concept maps form the basis of IHMC's CmapTools, to which Novak has contributed, as well as a variety of other educational tools. Novak also gave the inaugural address for the conference, detailing the history and impact of concept mapping.

# HAPPENINGS

## EVENTS, HONORS, AND NEWS AT IHMC

### IHMC AND FAU SIGN AN AFFILIATION AGREEMENT

In October, IHMC finalized an affiliation agreement with the Florida Atlantic University (FAU). The agreement establishes a unique relationship between the two entities, paving the way for joint research, faculty appointments, and a range of other activities beneficial to both. It builds upon extensive exploration of mutual and complementary research interests, ranging from computer and cognitive science to robotics to ocean engineering to transportation security.

"Throughout Florida, there is a wonderful mix of innovation being furthered through strategic partnerships as represented by the IHMC/FAU technology partnership," said Governor Jeb Bush. "On their own, these institutions are involved in world-class research and technology development. But combined, their potential for discovering and unveiling next generation innovations is immediately enhanced, and I

applaud their forward thinking." FAU Provost Dr. John Pritchett signed the affiliation agreement on behalf of FAU and Chief Executive Officer Dr. Kenneth Ford, signed the agreement on behalf of IHMC. Dr. Larry Lemanski, the Vice President for Research and Graduate Studies at FAU and an IHMC Board member, noted, "We are very excited about this new relationship and see it as a key part of FAU's continuation toward research excellence." Dr. Ford expressed his enthusiasm about this new relationship as well, noting that "FAU's strengths compliment those of IHMC very well, and the partnership has enormous potential." "We are indeed fortunate to live in a community where the brilliant scientists and researchers of our own IHMC are appreciated and pursued," said Allan Bense, Speaker-Designate of the Florida House of Representatives. "It's exciting to see how this partnership will combine the talents of some of Florida's brightest entrepreneurial minds." The Florida State Legislature established FAU in 1961 as the fifth



Featured speaker Jim Clifton

university in the state system. Today, FAU offers a comprehensive array of undergraduate and graduate programs, enrolling more than 25,000 students. It occupies seven campuses in of Southeast Florida. Its research expenditures have grown rapidly in recent years, and they now exceed \$60 million on an annual basis.

### GALLUP PRESIDENT ADDRESSES LEADERSHIP

The economic strength of a community is related to the strength of the leadership, Jim Clifton said during his talk at IHMC on October 6th. In studies by the Gallup Organization, of which Clifton is CEO, several qualities of strong cities have emerged. The three metrics he watches to determine the growth trajectory of a city are the GNP, per job pay, and "brain drain." While new slaughterhouses and call centers boost GNP, often they reduce per job pay. The brains that a city doesn't want to leave are the

25 to 35 year old single, college educated workers.

Clifton pointed out that there are four types of people you want to attract and retain in a city: high-tech entrepreneurs, inventors, super-mentors, and role models. Cities need strong universities to spawn entrepreneurs and innovators. The more connections, ideally three or more, these individuals have with community leaders, the more likely they are going to stay and contribute to the community.

Some companies are "traders," like grocery stores and movie theaters. They don't bring in new money. Cities should strive to attract and retain more "guest" companies, companies that could leave easily to bigger and better markets. They tend to be high-tech companies and improve the local economy.

The American dream has changed over the last few decades; now "people define themselves and their relationship with the world through their jobs." A great city, according to Clifton, is built one company at a time. A great company is built one job at a time, keeping with the new American dream.

Clifton's lecture was almost cancelled due to the damage of the hurricane. However, as he pointed out, "this is a time your whole community will be looking to the leadership, a time when you have to jump up" and lead. The lecture was held in the classroom at IHMC which had its carpet and a portion of its drywall removed.



Dr. Jack Hansen, Dr. Ken Ford, Dr. John Pritchett, Dr. Larry Lemanski at October 20, 2004 signing of FAU/IHMC agreement

# GRANTS

IHMC was recently rewarded over \$1 million for research.

## NEW GRANTS

### Detecting Changes and Repairing Imperfections in Evolving Data

PI: Dr. Choh Man Teng  
Amount: \$574,237  
Granting Agency: NASA

Data quality and integrity greatly affect the process of learning and data understanding. In many cases the underlying structure of the data is evolving rather than static, which poses an additional challenge in determining imperfections in the data. IHMC researchers will extend an imperfection repair mechanism called "polishing" to work with evolving data. One of the main tasks is to identify the relevant reference sets to be used for predicting the appropriate values of potentially corrupted data. They will make use of statistical principles that take into account various relationships and the dynamics within the data to assimilate potentially conflicting statistical information. In addition, they will investigate the effects of summarizing operations on the mechanism. This project will result in a suite of imperfection repair techniques that can be used with data arising from an evolving underlying structure.

### Toward Process Integrated Mechanisms

PI: Dr. Ken Ford  
Amount \$250,078  
Granting Agency: NASA

Many NASA exploration scenarios envision large teams of semi-autonomous robots engaged in complex tasks requiring coordinated action to achieve complex and changing goals in an uncertain and possibly hostile environment. We are concerned with the control and coordination of such robot teams. Presently no satisfactory techniques exist for reliably coordinating robot teams in realistically complex environments.

Attempts to address this challenge include agent-based approaches, in which each robot enjoys "agent-hood" and is responsible for its own actions and maintains its unique perspective or world-view, and biologically-inspired approaches which envision "swarms" of simple robots from which emergent behaviors are supposed to emerge. What both these approaches lack is a common viewpoint or perspective on the action of the entire team considered as an integrated system. Such a viewpoint is needed for coherent planning of team activities, particularly when these require dynamic and shifting patterns of cooperation and action between team members. Under this project IHMC researchers will develop a novel architecture, Process Integrated Mechanism (PIM), which enjoys the advantages of having a single coordinating authority while avoiding the structural difficulties that have traditionally led to its rejection in such complex settings. PIMs will improve on previous models with regard to coordination, security, ease of software development, and robustness.

### Secure Agent-Based Platform for Network Defense

PI: Niranjan Suri  
Amount: \$129,636  
Granting Agency: US Army

The National Missile Defense system will rely on networked computers with strong security. IHMC researchers will assist Sentar, Inc., in their project for the U.S. Army titled "Security Configuration Auditing for Network Defense (SCAND)." Particularly they will assess how automated updates of system security configurations affect SCAND objectives. In addition, they will assess the application of mobile agent technologies in such secure systems.

Mobile agents increase system complexity and provide particular security challenges.

### Psychophysiological Computer-Based Testing

PI: Dr. Frank Andrasik  
Amount: \$29,977  
Granting Agency: NAMRL

The ability to handle complex, intense workloads is critical in many fields, such as aviation. Multiple physiological measurements, such as heart rate and pupil dilation, could serve as indicators of workload. Dr. Andrasik will work with researchers at the Naval Aerospace Medical Research Laboratory to develop a variety of tests to assess a candidate's aptitude for an aviation career. He will measure physiological indicators such as EEG and heart rate while administering standard skills tests to provide an initial validation of physiological correlates of workload. In addition, he will work on developing computer-based testing tools which assess an individual's ability to handle both motor and cognitive tasks simultaneously.

### MSS Test Battery Development

PI: Dr. Frank Andrasik  
Amount: \$19,978  
Granting Agency: Naval Operational Medical Institute

A person's ability to engage in multiple tracking and cognitive tasks simultaneously can indicate success in complex situations. The Naval Aerospace Medical Research Laboratory previously developed a battery of such psychomotor tests intended to be predictive of success in aviation related fields. With upgrades in computers and internet capabilities, the existing tests can be improved, adding more complexity and resulting in better assessment. IHMC researchers are revamping



the existing software to create a new Multiple Measures System (MMS). With an expanded battery of working psychomotor tests, an evaluation can be made as to which combination of sub-tests best predicts subsequent flight training performance.

### Correlation of Selection Tests and Physiologic Measures

PI: Dr. Anil Raj  
Amount: \$4330  
Granting Agency: NAMRL

Dr. Raj will collaborate with researchers at the Naval Aerospace Medical Research Laboratory to integrate the computer based aviator selection tests with physiologic measurement devices in order to research whether cognitive state changes can be detected and correlated with specific cognitive tasks within the standard test battery. Specifically, NAMRL's Procomp hardware and IHMC's IScan pupilometry device will be integrated using a software architecture that will acquire in real time the test question number along with two channels of electroencephalogram, respiration, heart rate/interbeat interval and pupil diameter. Dr. Raj will provide technical support for the architecture during the initial experimental protocol, and NAMRL researchers will conduct all human subject testing and data analysis.



# ARRIVALS

■ ■ ■ JUNE 2004 THROUGH DECEMBER 2004



**Ronnie Armstrong:** Ronnie is pleased to be joining IHMC as controller. Previously he served as the executive director of the UWF Foundation, a non-profit organization that receives, invests, and admin-

isters private support for the University of West Florida. A native of Pensacola, he received his degree in Accounting from UWF. He is enjoying the accounting challenges he is facing in his new position as IHMC transitions to its new not-for-profit status. He is happy to have an exciting position in Pensacola, the place he wants to raise his two children, Addison and Kathryn. In addition to spending time with his family, Ronnie finds time for fishing and cooking.

**Mauro Tortonesi:** Mauro is a Ph.D. student at the University of Ferrara, Italy, from which he received his Laurea Degree in Electronics Engineering in 2002. At the IHMC he is working on the NOMADS/Mockets project as a visiting research fellow, developing an extension to the framework in order to support advanced message oriented services.

**Sara Krishack:** Sara joins IHMC as the Executive Assistant to Ken Ford and Julie Sheppard. A graduate of UWF, Sara received her B.A. in Communication Arts. Previously she was the Graphic Designer for Evergreen Marketing. She plans to continue her education with a Master's Degree in Business.

**Patti Caruso:** A former caterer, Patti is now assisting Lisa Karnes in coordinating special events and visits to IHMC.

SEASON'S GREETINGS  
FROM YOUR FRIENDS AT



# LOCAL NEWS

## THE IMPACT OF HURRICANE IVAN



IHMC's front lawn underwater

### Ivan batters Pensacola and IHMC

Hurricane Ivan made the national news for several days, but in Pensacola we will be recovering for quite some time. The efforts of all at IHMC to continue our work under adverse conditions show our strength and dedication. It will be several weeks before our offices are all habitable and likely several months before all of the necessary repairs can be completed.

Though neither of IHMC's buildings is in what is considered a flood zone, the floors all had 1-2 inches of water. Most of the staff and researchers who were back in the days after the flood pitched in to remove the carpets and move furniture since

it was still a few days before power and internet service were restored. All drywall within two feet of the floor was removed throughout the first floor. That was the condition of the building when we hosted the James Clifton lecture.

While waiting for the buildings to be habitable,

folks made do with what was available. Those with generators and still-connected internet opened their doors to coworkers. Many folks simply stayed out of town for a week and a half, staying with friends and relatives. Power, internet, and phones were restored a week after the storm. Now with the first floor still out of commission, every nook and cranny in the second floor is occupied by researchers. Many grants and papers had deadlines of early October, but not a single researcher needed to ask for an extension.

While the IHMC buildings fared well, many of our researchers, like many other Pensacolians, saw major damage to their homes. Most suffered felled trees or leaky



Bayfront home in Mackey Cove



Kitchen remains in northeast Pensacola

help the rest of the community back on its feet. Jeff Bradshaw, who himself lost his home, helped coordinate the activities of volunteers for three weeks. The volunteers, members of the Church of Latter Day Saints from Pensacola and throughout the country, tallied nearly 70,000 hours of service, including repair or tree removal for over a thousand homes and feeding of thousands of others. Since many people were still living in shelters and repair crews have taken over many of the hotels, the volunteers simply camped out at churches. Other IHMC staff, too, helped in big and small ways to assist in recovery efforts.

Considering the tremendous task involved, we at IHMC and throughout the community are recovering at an extremely rapid pace. Most of the speed is due to the hard work of many people, all chipping in to help where they can. Though many services are up and running, it will be several months before a sense of normalcy returns for most people and longer for many others.

roofs. Many still lacked phone or cable service a month after the storm. Unfortunately, ten of our staff lost their homes or have such severe damage their homes are uninhabitable for the time being. Other staff members worked hard to line up some alternative housing.

Even in the midst of taking care of their own situations, IHMC staff worked hard to



Boats washed up in storm surge

# IVAN PHOTOS

## THE IMPACT OF HURRICANE IVAN



Flood waters take their toll at 40 S. Alcaniz Street



IHMC's Jeff Bradshaw's house



IHMC's Anil Raj's house



Bayfront Parkway takes a beating



An all too common scene in Mackey Cove



Volunteers coordinated by IHMC's Bradshaw



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