Just as software has driven the past 30 years of innovation, it will be the key to enabling another quarter-century of breakthroughs and, in the process, transforming how people live, work, learn, and are entertained.

Bill Gates
At Microsoft Research Asia, we're not only creating technologies for tomorrow, but also for the day after tomorrow. As we work on cutting-edge technology, we constantly push the state of the art in computing.

Dr. Hsiao-Wuen Hon
Managing Director
Microsoft Research Asia

It’s interesting how much of the research directed at the Asian marketplace turns out to be generally applicable. They’ll often attack a problem differently from what would happen in Europe or the U.S., because they come from a different perspective. They often find solutions that are different, and in some cases different turns out to be better.

Dr. Rick Rashid
Senior Vice President
Microsoft Research

Foreword

In November of 2008, Microsoft Research Asia celebrated more than a decade of innovation, collaboration, and talent development. For more than 10 years, our researchers and engineers pushed the boundaries of innovation by reaching into their imaginations and turning their ideas into reality.

Our lab will continue to tackle computing’s greatest challenges with the zeal and passion that have helped to establish Microsoft Research Asia as one of the world’s foremost fundamental research facilities. Today, these research efforts span more than 20 different fields and include disciplines such as natural user interface, multimedia, data-intensive computing, search and online advertising, and fundamental subjects in computer science.

As we enter our second decade, the values and traditions that we have created over the last 10 years will continue to feed our success and future growth. We will continue to foster a research environment and culture that is open to new ideas, that sets high standards for research excellence, that recognizes the value of peer review and sharing our results with the academic community, and that understands that success cannot come without taking risks.

One reflection of this culture is the tradition we have built over the years of openly publishing and sharing our research and knowledge with the international community. To date, researchers at Microsoft Research Asia have published more than 3,000 papers in top international journals and conferences, including SIGGRAPH, SIGIR, CVPR, ACL, and WWW. These efforts have frequently resulted in international recognition. Within this past year, the lab was presented with the “Best Paper” awards at the CVPR 2009, IEEE CSVT 2009, PCM 2008, and NSDI 2009 conferences, and the “Best Demo” awards at NSDI 2009 and the influential MobiSys 2008 conference.

The lab has also made tremendous strides toward building on our strong talent development programs. Many of the young researchers, who joined us in the early years, are now experts in
their respective fields leading teams as research managers or senior researchers. They have mentored thousands of interns, who have passed through our doors and gone on to use the knowledge they have gained at our lab to help build stronger economies throughout Asia. Our efforts have been recognized by governments in the region, including the Chinese Ministry of Education, which has honored Microsoft Research Asia with a “Special Contribution Award” in each of the past five years.

As we have grown, our commitment to fostering talent and to helping build healthy IT ecosystems in the region has expanded. In nine years, we have extended the scope of our university relations programs by establishing joint labs with universities in Asia, conducting joint research programs, and hosting top-notch visiting professors at our lab. These relationships have allowed us to create new opportunities for both Microsoft and academia in the Asia Pacific region.

As the head of Microsoft Research Asia, I am very proud of our researchers and engineers. I am also highly appreciative of our partners for their continued support. Our collective hard work has helped to build the lab into what it is today. As was so famously announced to the world on the cover of the MIT Technology Review, I am confident that “the World’s Hottest Computer Lab” holds even greater promise as we move forward and make history by breaking new barriers and define the future of computing.

**Introduction**

Microsoft Research Asia, Microsoft’s research arm in the Asia Pacific region, conducts fundamental, curiosity-driven research with the goal of realizing Microsoft’s vision of future computing. By harnessing the best talent from across Asia and the world, Microsoft Research Asia has grown from its nascent beginnings in 1998 into a world-class research lab that is constantly pushing the state of the art forward and improving the computing experience for information technology users.

Over more than a decade, Microsoft Research Asia has excelled at creating an “academic environment”, where researchers are free to pursue areas of science that are of interest to them, and that fosters a culture that looks for ways to make an impact on the world of information technology. This culture not only drives researchers to develop groundbreaking technologies and work at the cutting edge, but has also made Microsoft Research Asia a natural partner for universities and governments in the region.

In the coming years, Microsoft Research Asia will continue to enhance its capabilities and strengthen its expertise while broadening its research initiatives.

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**Dr. Hsiao-Wuen Hon**

Managing Director
Microsoft Research Asia
Overview

Over more than ten years, Microsoft Research Asia has grown into an organization that has filed more than 1,000 patents, has welcomed more than 3,000 interns, has awarded over 250 Microsoft fellowships, has published over 3,000 papers for top international journals and conferences, and has achieved many technological innovations.

Technologies from Microsoft Research Asia have had an influence not only within Microsoft but also on the broader community. Over 260 innovations from the lab have been transferred to Microsoft products, including Windows 7, Office 2010, Xbox, Office System 2007, Windows Server, Windows Media Center Edition, AdCenter, MSN, Windows Live, Windows Mobile, SharePoint, Tablet PC, and Bing. The lab has also issued more than 20 IP licenses to businesses around the world over the past 4 years and technologies from the lab have been adopted by international standards bodies such as MPEG4 (error-resilient video transmission), IETF (TCP/IP header compression), and ITU/ISO (video-compression technology).

During the past decade, Microsoft Research Asia has also incubated the Advanced Technology Center (2003) and the Search Technology Center (2005) in Beijing; divisions of Microsoft R&D that are helping to further the company’s position as one of the most innovative in the world.

Many of these successes are the result of an ambitious research agenda that boils down to five areas central to Microsoft’s long-term vision and strategy:

- **Natural User Interface** enables users to interact with a computer using speech, gestures, and expressions.
- **Next-generation Multimedia** allows people to search for and to be immersed in interactive online shopping, education, meetings, and entertainment activities.
- **Data-Intensive Computing** explores new infrastructures, algorithms, tools, and applications to collect, analyze, and mine results for data-intensive business in both the consumer and enterprise sectors.
- **Search and Online Ads** takes Web search and online advertising to the next level by applying data-mining, machine-learning, and knowledge-discovery techniques to information analysis, organization, retrieval, and visualization.
- **Computer Science Fundamentals** includes areas such as theoretical computer science (theory), systems, networking, and machine learning that will have an impact on multiple applications and products.

(From left to right in alphabetic order)

**Dr. Baining Guo**
Assistant Managing Director

**Dr. Wei-Ying Ma**
Assistant Managing Director

**Dr. Feng Zhao**
Assistant Managing Director

(From left to right in alphabetic order)

**Dr. Eric Chang**
Director of Technology Strategy

**Dr. Shipeng Li**
Research Area Manager

**Lolan Song**
Senior Director

**Dr. Zhang Zheng**
Research Area Manager
Areas of Focus:

Image/Video Tagging
This project aims to develop a system that can assign tags to images/videos in a semi-automatic way. Users can input tags for several images or videos through different approaches, including full manual input, clicking recommended candidates, and via games such as ESP. Machine learning algorithms are employed to predict the tags of other samples. These tags will be useful in image/video search, summarization, and advertising.

Multimedia Search and Mining
The explosion of multimedia data brings us new challenges with regards to multimedia content understanding, organization, presentation, and search - especially in terms of scalability. However, both computational costs and performance are still far from satisfactory. This increasing amount of data, along with the massive amount of grassroots users, also provides us with new opportunities to attack these challenges, as well as conventional problems in multimedia analysis and computer vision. This research direction will use all this information, as well as technologies in multimedia content analysis, machine learning, data mining and human-computer interface, to facilitate multimedia search on and across desktops, the Internet, and mobile devices. Research topics include: large-scale video/image annotation/tagging, ranking and re-ranking, new multimedia query interfaces, multimedia search result organization and presentation, as well as accessible multimedia search.

Multimedia Advertising
The internet has become the biggest and most powerful computing and service platform for multimedia content. This content has become the primary source for more effective online advertising. Conventional advertising systems treat multimedia content the same as general text, without considering automatically monetizing the rich content of images and videos. This research direction will leverage content analysis and understanding to enable more effective and efficient advertising on multimedia content.

Mobile Multimedia Computing
Mobile devices are becoming the most frequently used terminal to access information through the Internet and social networks. More and more multimedia content is spreading over the network of mobile devices. This area is concerned with intelligent multimedia techniques to facilitate effort-free multimedia experiences on mobile devices, including media acquisition, editing, sharing, recommendation, and data and user interface.

Internet-scale Multimedia Retrieval and Mining
Recent years have witnessed an explosive growth of online multimedia data. Stimulated by recent progress in scalable machine learning, feature indexing and multi-modal analysis techniques, we are particularly interested in exploring challenges and new opportunities for developing internet-scale approaches for multimedia retrieval and mining. Our topics of interest are: (i) Indexing and retrieval for large multimedia collections; (ii) web-scale social- and content-network analysis; (iii) near-duplicate detection over large data sets; (iv) automatic machine
tagging, semantic annotation and object recognition on massive multimedia collections; (v) scalable and distributed machine learning and data mining methods for multimedia; (vi) construction of standard large-scale multimedia collections; (vi) interfaces for exploring, browsing and visualizing large multimedia collections; and (vii) video event and temporal analysis over diverse sources.

**eHealth**

Our eHealth project aims to build a user-centric & data-driven personalized eHealth software and services platform for improving quality of life and efficiency of treatment. eHealth will research how personal health data can be ubiquitously collected through body sensor networks into heterogeneous devices and into the cloud; how the data can be smartly processed, visualized, analyzed, summarized, personalized, and searched; and how eHealth computing can be optimized between devices and the cloud to provide a seamless user experience and personalized services across different devices.

**Media Cloud Computing**

Media content distribution, searching, editing, sharing, publishing, and delivery across different devices poses a great challenge, due to multimedia’s quality of service (QoS) requirement and the heterogeneity of devices. This project envisions seamless and ubiquitous media services across different devices with good QoS. It will explore how media data and programming will be optimized among clients and the cloud, and how media content will be distributed, searched, and delivered ubiquitously across heterogeneous devices.

**Human Interactive Proofs and Web Security**

We are innovating technologies by exploiting the capability difference between humans and computers to: 1) Prevent bots from pretending to be humans to interact with applications designated for human users; and 2) integrate human intelligence in a computing process to solve AI (Artificial Intelligence) problems. We are also advancing technologies to fortify Web and cloud computing security.

**Program Defect Detection and Performance Improvement**

We are building up novel technologies to: 1) Detect and locate program defects and vulnerabilities to ensure that programs are reliable and trustworthy; and 2) diagnose performance anomalies and improve program performance.

**Areas of Focus:**

- Imaging and Photogrammetry, including high-resolution cameras, radiometric calibration, photometric stereos, 3D imaging and video, and image and video enhancement.
- Pattern Recognition and Statistical Learning, including data clustering and classification, manifold learning, and high-dimensional geometry and statistics.

**Visual Computing Group**

Computer Vision is an exciting new research area that studies how to make computers efficiently perceive, process, and understand visual data such as images and videos. The ultimate goal is for computers to emulate the striking perceptual capability of human eyes and brains, or even to surpass and assist the human in certain ways. The Visual Computing Group at Microsoft Research Asia consists of an elite team of researchers and engineers whose expertise spans the entire spectrum of research topics in computer vision, from mathematical theory to practical applications, from physical systems to software development, and from low-level image processing to high-level image understanding. Research results from our group have made fundamental impacts on many important applications such as New High-Resolution Cameras, Face Recognition, Image Search, Virtual Earth, and Graphics & Games.

Dr. Yi Ma  
Research Manager
Object Detection and Recognition, including face detection, alignment, and tagging, video-based face recognition, and sparsity-based robust face recognition.

Dynamical Vision, including object tracking, video motion analysis and editing, video summarization, video motion and object segmentation, and dynamical photometric stereo.

Interactive and Internet Vision, including interactive image segmentation, completion, and normal reconstruction, and image search and re-ranking, and large scale image and object retrieval, and large volume of images visualization.

**A Digital Giga-Pixel Camera**
This revolutionary camera represents the state of the art commercially affordable (less than $25k) solution to high-quality and high-resolution imaging. The camera produces high-quality images at the resolution of 1.6 giga pixels. It has been used to digitize artworks and antiques with unprecedented detail. For example, combined with photometric stereo, images captured by this camera can recover striking 3D surface details of oil paintings and hence help reveal the artist’s skills and style. This camera has broad applications in cultural heritage, archeology, and art preservation and insurance.

**Robust Processing Analysis of High-Dimensional Data**
The need to detect and correct gross errors and outliers arises in problems throughout computational data analysis. For example, in many computer vision problems erroneous measurements arise due to occlusion, tracker failure, or due to violations of an assumed model (i.e., specularities in face recognition or photometric stereo). Correctly handling such non-ideal observations is essential to building systems that work under real-world conditions. We are working to meet this need with new algorithmic tools based on convex optimization. These algorithms are scalable and efficient, and come with sharp performance guarantees based on concentration of measure in high-dimensional spaces. These new tools have made revolutionary impacts on important problems, such as highly robust face recognition and robust principal component analysis.

**Photo Album Management – Face Tagging**
Today, more and more people take a huge number of photos in their daily lives. The final goal of photo album management work is to help users to easily manage, search, share and enjoy these photos. “Who is in the photo” is important when organizing and sharing photos. However, tagging names is a tedious job for the user. Our Face Tagging work is trying to combine state of the art face recognition and clustering technologies with a friendly user interface to make tagging effortless and fun.

**Video Analysis and Synthesis**
We work on the problems of analysis, browsing, and automated synthesis of videos. Video is an important medium that becomes more and more popular with the increasing availability of video cameras. Many previous approaches take a natural extension from image analysis and synthesis, and the dynamics in the video is often disregarded. We are interested in the dynamics in videos, and use it for further analyses and applications. Past works include video stabilization, video completion, and global motion analysis. We are innovating new technologies capitalizing on the visual dynamics in videos.

**Interactive Image Segmentation and Cut-Out**
The problem of efficient, interactive foreground/background segmentation in still images is of great practical importance in image editing. As research outputs, we have developed a scribble-based tool (Lazy Snapping) and a painting-based tool (Paint Selection). Using these tools, the user can effortlessly select an object/region they are interested in with minimal user assistance, for applications from object cut-and-paste to local color/tone adjustment.
Internet Media Group
The Internet Media group aims to build seamless yet efficient media systems through breakthroughs in fundamental theory and innovations in system technology. We address the problem of media content, format adaptation, and the generic scalability issues of computing systems in terms of bandwidth, processing capability, screen resolution, memory and battery power. The goal is to bring optimized computing and media experiences adaptive to users’ computing resources, no matter when, where, and how they need them.

Dr. Feng Wu
Research Manager

Areas of Focus:

Titanium
Project Titanium aims at bringing new computing experiences through enriched cloud-client computing. While data and programs can be provided as services from the cloud, the screen, referring to the entire collection of data involved in user interface, constitutes the missing third dimension. Titanium will address the problems of adaptive screen composition, representation, and processing, following the roadmap of Titanium Screen, Titanium Remote, Titanium Live, and Titanium Cloud. As “Titanium” suggests, it will provide a light-weight yet efficient solution towards ultimate computing experiences in the cloud plus service era.

Mira
Project Mira aims at enabling multimedia representation and processing towards perceptual quality rather than pixel-wise fidelity through a joint effort of signal processing, computer vision and machine learning. In particular, it seeks to build systems not only incorporating this newly developed vision and learning technologies into compression but also inspiring new vision technologies by looking at the problem from the view of signal processing. By bridging vision and signal processing, this project is expected to offer a fresh frame of mind to multimedia representation and processing.

HyperComm
We envision that, with the development of sensing, networking, and storage technologies, the Internet will rapidly expand and grow into a universal network containing physical and virtual objects. This project will explore theoretical and engineering problems in such a network: at the edge, it considers massive data acquisition in wireless sensor networks and mobile networks; in the center, it addresses the interconnection between networks and data communications in their entire life cycle. This project will leverage and develop technologies in network coding, distributed compressive sensing, network optimization, and network protocols.

LiquidSilver
LiquidSilver is a media framework that works seamlessly across platforms, devices, and even applications. In LiquidSilver, media is represented in a scalable, portable, adaptive, and self-contained way. Unlike the traditional closed-form media systems, LiquidSilver consists of a set of media components and tools that facilitate capturing, editing, coding, delivery and consumption throughout its life cycle. This project advances multimedia technologies in broad Media 2.0 applications, and helps to create and consume media on demand.

Fundamental Theory for Media Representation
Despite much evolution of digital media representation, the underlying theory remains the same, leaving little room for further improvement. This project studies new representations of digital media based on the recent progresses on signal processing. We will investigate the fundamental signal processing theory for media representation leveraging local properties of the content; develop cutting-edge technologies to efficiently represent media for future standards; and build media representation systems to advance the state of the art.
Internet Graphics Group

Research activities at the Internet Graphics Group focus on cutting edge graphics technologies, ranging from graphics algorithms and systems, graphical interactive techniques, and motion picture and video game technologies. Our mission is to conduct world-leading graphics research that can impact both the academia and the industry, by leveraging our extensive research expertise on rendering, modeling, and animation. We also develop techniques that support Microsoft graphics and game platforms such as DirectX and XDK, and work closely with Microsoft Game Studios on next generation game engines.

Dr. Baining Guo
Assistant Managing Director

Areas of Focus:

Appearance Modeling and Rendering - Modeling Anisotropic Surface Reflectance

Visual modeling of spatially varying anisotropic reflectance using data captured from a single view is challenging. We represent reflectance using a microfacet-based BRDF which tabulates the facets’ normal distribution (NDF) as a function of surface location. Data from a single view provides a 2D slice of the 4D BRDF at each surface point from which we fit a partial NDF. The fitted NDF is partial because the single view direction coupled with the set of light directions covers only a portion of the “half-angle” hemisphere. We complete the NDF at each point by applying a novel variant of texture synthesis using similar, overlapping partial NDFs from other points. Our system includes a simple acquisition device that collects images over a 2D set of light directions by scanning a linear array of LEDs over a flat sample. Results demonstrate that our approach preserves spatial and directional BRDF details and generates a visually compelling match to measured materials.

Rendering - RenderAnts: Interactive REYES Rendering on GPUs

RenderAnts is the first system that enables interactive REYES rendering on GPUs. Taking RenderMan scenes and shaders as input, our system first compiles RenderMan shaders to GPU shaders. Then all stages of the basic REYES pipeline, including bounding/splitting, dicing, shading, sampling, compositing and filtering, are executed on GPUs using carefully designed dataparallel algorithms. Advanced effects such as shadows, motion blur and depth-of-field can be also rendered with our system. In order to avoid exhausting GPU memory, we introduce a novel dynamic scheduling algorithm to bound the memory consumption during rendering. We also propose a multi-GPU scheduling technique based on work stealing so that the system can support scalable rendering on multiple GPUs. Compared to Pixar’s PRMan, our system can generate images of comparably high quality, but is over one order of magnitude faster.

Modeling - Example-Based Hair Geometry Synthesis

Creating hairstyles either manually or through image-based acquisition is a costly and time-consuming process. We introduce a hierarchical hair synthesis framework that views a hairstyle both as a 3D vector field and a 2D arrangement of hair strands on the scalp. Since hair forms wisps, a hierarchical hair clustering algorithm has been developed for detecting wisps in example hairstyles. The coarsest level of the output hairstyle is synthesized using traditional 2D texture synthesis techniques.
Synthesizing finer levels of the hierarchy is based on cluster-oriented detail transfer. Finally, we compute a discrete tangent vector field from the synthesized hair at every level of the hierarchy to remove undesired inconsistencies among hair trajectories. Improved hair trajectories can be extracted from the vector field. Based on our automatic hair synthesis method, we have also developed simple user-controlled synthesis and editing techniques including feature-preserving combing as well as detail transfer between different hairstyles.

**Animation and Deformation - Joint-aware Manipulation of Deformable Models**

Complex mesh models of man-made objects often consist of multiple components connected by various types of joints. We propose a joint-aware deformation framework that supports the direct manipulation of an arbitrary mix of rigid and deformable components. First, we apply slippable motion analysis to automatically detect multiple types of joint constraints that are implicit in model geometry. For single-component geometry or models with disconnected components, we support user-defined virtual joints. Then we integrate manipulation handle constraints, multiple components, joint constraints, joint limits, and deformation energies into a single volumetric-cell-based space deformation problem. An iterative, parallelized Gauss-Newton solver is used to solve the resulting nonlinear optimization. Interactive deformable manipulation is demonstrated on a variety of geometric models while automatically respecting their multi-component nature and the natural behavior of their joints.
**Web Search and Data Mining Group**

The goal of the Web Search & Data Mining Group of Microsoft Research Asia is to drive the next generation of Web search by leveraging data mining, machine learning, and knowledge discovery techniques for information analysis, organization, retrieval, and visualization. In addition, we also devote ourselves to developing innovative technologies to help people in areas of location, mobile, rich media and social networking services.

**Dr. Wei-Ying Ma**
Assistant Managing Director

**Areas of Focus:**

**Social Media Search and Understanding**

In recent years, social media has been pervasive on the Web as blogs, forums, wikis and social bookmarks that people use to share opinions, experiences and perspectives with each other. As a result, a tremendous amount of user-created content (UCC) has been accumulated on the Web. To better understand the user-created free text and multimedia materials that are loosely organized in various Web services, we are conducting research to address the challenging problems related to social media search and understanding. Particularly, we focus on the problems of UCC data acquisition and parsing, deep text mining, user interesting modeling, and content recommendation. The results of these research efforts are leading to more advanced services that deliver intelligence and insight to Web users.

**Data Intelligence from the Physical World**

Context aware computing sought to deal with linking changes in the environment with computer systems. In other words, computing systems become more intelligent through analyzing and reacting to the physical world surrounding them. The coming era of cloud computing brings new opportunities to this long studied research area. By accumulating and aggregating physical world contextual information from multiple users and multiple devices over a long period, we can obtain collective social intelligence from them. Based on this, we are working on various technologies with a view to managing physical world information and building intelligence from them. More innovative Internet services can be developed to facilitate people's everyday lives.

**Location-based Social Networks and Data Mining**

The increasing availability of GPS-enabled devices brings us a large number of GPS trajectories representing people’s location histories, which imply, to some extent, users’ interests and intentions and enable us to better understand people and locations. We are working on developing a number of location-based social-networking technologies that enable people to build connections with each other using their location histories. With multiple users’ GPS trajectories, we do not only try to understand an individual and a location, but also explore the similarity between users and the correlation among locations.

Besides GPS data, we also target at developing a travel search service by aggregating and mining user-generated travelogues from blogs and forums. We hope to answer three key issues in planning a trip: when, where, and what. The challenging problems mainly include automatic mining of location names, time, and tips from free-text travelogues to provide valuable recommendation. Meanwhile, map services, as well as high quality web images will also be integrated to present a rich multimedia interface to users.

**Rich Media Analysis and Intelligent Advertising**

As one of the most pervasive media formats on the Web, image has unique advantages in that it is attractive compared to text. However, current image-based
ads are mainly manually designed. How to automatically delivery image ads is still a challenging problem. Inspired by image display processes on the Web, we propose an innovative method for non-intrusively embedding ads into images in a visually pleasant manner, particularly when users are waiting for full resolution images being downloaded due to network bandwidth limitations. To find relevant ads to match with web images, we utilize a data-driven technology we developed for image annotation.

We are also working on an image-centric advertisement platform in which advertisers bid on images instead of keywords. For example, a toy seller could bid on the image of a related movie poster, while a restaurant could bid on the image of a cooking-magazine cover. Users would receive ads based on the content of images they recently browsed or used. Components of this platform include an advertisement editorial tool and image-content-understanding, image-matching, and user-understanding modules.

Web-scale Similarity-based Document Retrieval
Retrieving similar documents from a large-scale corpus according to a given document is a fundamental problem for many applications. However, existing indexing techniques cannot address this problem due to special properties of a document query, e.g. hundreds of query terms. We propose a framework based on a document decomposition idea and develop a highly efficient index structure in a theoretically principled way, which is capable to be scaled up to index billions of documents. The technology is also fundamental to web-scale image retrieval in which the bag-of-visual-word model is used for similarity search.

Web-scale Image Understanding and Automatic Annotation
Although having been studied for decades by computer vision and machine learning communities, image annotation is still far from practical and satisfactory. To leverage the search technology and the huge number of images existing on the Web, we have reformulated the annotation problem as a novel two-step fashion: searching for semantically and visually similar images on the Web, and mining key phrases extracted from the descriptions of the images. The new formulation will re-emphasize the researches on high dimensional indexing, content analysis, and concept modeling from a new perspective.
Search Result Ranking
Given a query, we aim to rank the retrieved documents in terms of relevance and importance of the documents. We are working on search result ranking from several aspects: query understanding, document understanding, and query-document matching. For example, we have developed a method for query refinement using a conditional random fields model, a method for discovering the topic of hypertext documents, and a model for calculating the relevance between a query and document based on metric distance learning.

Data Selection in Search
How to calculate the importance of web pages and select the most important ones when crawling, indexing, and ranking is a critical issue in web search. Importance is usually calculated using web graph data. We have developed an experimental platform for conducting mining and learning experiments on large-scale graph data. It is built on Microsoft’s distributed computing infrastructure and is efficient, flexible, and easy to use. We are also developing new algorithms for page importance calculation on top of the platform. BrowseRank is one of these algorithms, which creates user browsing graph data from behavioral data, defines a continuous time Markov model, and calculates page importance.

Search Log Mining
Search engine log data can be used to analyze search behavior and to develop technologies to improve users’ search experiences. We are developing a search log mining platform to enable researchers and engineers to conduct data mining on search behavior data, including search session data and click-through data. We are also conducting research on search log mining on top of the platform and have proposed a “context aware query suggestion” method.

Next Generation Enterprise Search
We propose a new approach to enterprise information management and search, in which we organize information in advance, using information extraction and machine learning technologies, and then provide this information to the user during a search. Our technologies include document metadata extraction, expert/expertise mining, and definition and FAQ extraction; we have developed a prototype system and deployed it within Microsoft. We have also extended the system to enterprise social computing.

Web Data Management Group
The Web is described as a large-scale, unstructured, heterogeneous, and hidden information source, which poses challenges to the management of Web data. The mission of the Web Data Management Group is to develop systems and algorithms to address these challenges. In principle, we adopt a “data+infrastructure+tools” methodology to make Web data management as effective as a database system, and as flexible as an information retrieval system.

Dr. Ji-Rong Wen
Research Manager

Areas of Focus:
WebStudio-Building Infrastructure for Web Data Management
WebStudio is an infrastructure designed to provide large-scale Web data management and processing capabilities. It provides an integrated development environment (IDE) for use in quickly prototyping and conducting experiments at Web-scale. It is also a Web data management system to allow users to easily store, access, and manipulate Web data. Based on WebStudio, we are also exploring the possibility of building a new search engine with data-centric architecture.
EntityCube: Entity Relationship Search

The need for collecting and understanding Web information about a real-world entity (such as a person or a product) is currently fulfilled manually through search engines. However, the information about a single entity might well appear in thousands of Web pages. Even if a search engine could find all the relevant Web pages about an entity, the user would need to sift through all the pages to get a complete view of the entity. The EntityCube project aims to build entity relationship search engines that efficiently generate summaries of Web entities and mine entity relationship graphs from billions of crawled Web pages. The core technologies of EntityCube have been implemented in several working systems: Libra Academic Search (http://libra.msra.cn), Windows Live Product Search (http://products.live.com), and object relationship search engine Renglifang (http://renlifang.msra.cn). EntityCube is also the name of a general entity search engine we are currently developing. In EntityCube, users will enjoy a much better user experience when they search for information about entities (including people, locations, organizations, products, conferences, and journals) and explore their relationships. The EntityCube project has so far been well received by Internet users. For example, Renlifang (i.e. the Chinese version of EntityCube) has been highlighted by mainstream media in China (including CCTV and Phoenix TV) and has received millions of daily page-views during peak days.

Data Mining and Intelligent Search

We are studying an interesting problem: what kinds of user queries cannot be well addressed by existing search engines? We investigate various user information needs from different perspectives, and meanwhile mine knowledge from large-scale web data for novel searches. Search is not a simple keyword match between a query and a web page. It should be more akin to a knowledgeable person who can organize knowledge efficiently and construct effective links between concepts. An intelligent search can rouse associations to clarify users’ unconscious needs; it can successfully organize search results to provide users with valuable knowledge instead of a list of blue links; and it can learn from history so that search can grow in an organic way.

Human Computer Interaction Group

The Human Computer Interaction Group at Microsoft Research Asia aims to advance the state of the art in Human-Computer Interaction by combining fundamental research with the practical application of usability, user experience, and interaction design skills.

Dr. Wei-Ying Ma
Acting Research Manager

Areas of Focus:

We are a multidisciplinary team that tackles a diverse range of project types, drawing on our backgrounds in computer science, behavioral science, and industrial design to imagine, build, and evaluate new kinds of interactive technology. From the creation of concept sketches to the incubation of new products, our goal is to let technology serve a mediating role in the engagement between people and information, balancing users’ needs for power and simplicity in ways that expand the boundaries of what is possible through interaction.
Natural Clients+Cloud Interaction
The blurring of the boundaries between our virtual and reality-based activities means that we will increasingly need to access and interact with digital information while participating in the real world. By augmenting users in ways that exploit and extend their natural capabilities, the goal of our Natural Clients+Cloud Interaction theme is to support on-demand engagement with cloud-based content in a diverse range of naturalistic situations.

Enterprise Social Computing
The growing popularity of web 2.0 and social media will have profound implications for the ways in which people work. Whether through driving innovation or productivity, or harnessing the knowledge of the wise and the wisdom of the crowds, the goal of the enterprise social computing theme is understanding social norms and social interaction patterns in the workplace to deliver the knowledge from grass roots to real life business scenarios.

Web User Experience
As the Web evolves into a platform for the delivery of rich multimedia content, new ways are needed to visualize, search, mash-up, and explore diverse sources of social, scientific, cultural, linguistic, and geographic data. In our Web User Experience theme, we adopt a deployment-driven approach to the design and evaluation of new interface concepts that can transform users’ online experiences.

Natural Language Computing Group
The information era has brought us vast amounts of digitized text that is generated, propagated, exchanged, stored, and accessed through the Internet each day across the world. The accumulation of this data is making information acquisition increasingly difficult, with language becoming a critical obstacle to growth. To overcome these difficulties, the Natural Language Computing Group is focusing its efforts on a variety of research topics, including multi-language text analysis, machine translation, cross language information retrieval, and question answering.

Dr. Ming Zhou
Research Manager
Microsoft Research Asia

Human Computer Interaction Group

Areas of Focus:
Corpus Collection, Classification, and Annotation
This is a continuous effort to build a large text corpus (from the web) as the infrastructure for statistical learning. Text classification by topic and writing style is useful for the construction of a balanced corpus as well as various domain specific corpora. However, annotation is a challenging task; it includes word segmentation, named entity identification, parts-of-speech tagging, syntactic parsing, word sense
tagging, and anaphora tagging. These tagging tools can be used directly in a number of natural language applications and the annotated corpora can serve as supervised training data for statistical language modeling.

**Asian Language Natural Language Processing**

Text Information Mining and Extraction (TIME) is a platform used to extract key information from a variety of documents such as web pages, word documents, and PowerPoint presentations in different languages. The extracted information can be used to support information retrieval and search engines, machine translation, summarization, and question answering. This innovation covers a variety of technologies such as tokenization, named entity identification, semantic labeling or skeleton information extraction, key term extraction, and summarization.

**Statistical Machine Translation**

The focus of the Statistical Machine Translation project is on helping and guiding non-native English users to read and write English more fluently. To this end, the NLC Group has applied statistical machine translation to provide meaningful translation solutions at the word, phrase or collocation, and sentence levels. Supported by translation technologies, the group is conducting research into new applications for search engines, such as Multilingual Search. This application works at the word level, for inputted queries, and the sentence level, for translation of returned snippets.

**Information Retrieval**

Our goal is to explore using technologies to improve the performance of classical information retrieval (IR) including indexing, query suggestion, spelling, and relevance ranking. We have explored the best indexing terms for Chinese, new approaches for query expansion, mining word association and similarity from a text corpus, the fusing method of the retrieval results from different IR systems, base NP identification, accurate query translation using a statistical approach and example-based approaches. We participated in the cross-lingual track of TREC-9 and NTCIR-III and achieved best results on cross-language information retrieval. We focused on the query translation and optimizing indexing for a Chinese IR system. We also participated in the Web track of TREC-10. Based on the above mentioned technologies, we have built a successful linguistic search engine for English as a Second Language (ESL) writing (www.engkoo.com), collaborated with IEG group.

**Question Answering**

Question answering is a key technology being developed for the next generation search engine. Given a question, a user hopes to get an exact answer rather than face a huge number of query results. The NLC Group is creating question reformulation, paraphrasing, and various answer extraction techniques for factoid questions and non-factoid questions. Based on this work, the group also hopes to build domain specific chatbots with question answering technologies that mine text forums, web blogs, and other web resources.

**Language Gaming**

Can you imagine a computer capable of generating Chinese couplets? The NLC Group has made this a reality for the first time in the world by creating Chinese Couplet Generation software as part of its language gaming project for the Internet and mobile games (http://duilian.msra.cn). The software works by accepting a sentence provided by a user and then extrapolating a couplet sentence. This technology can be used to further Chinese language learning by entertaining and engaging users.
Web Intelligence Group
We aim to deliver a world of actionable knowledge and to bring relevant experts to users’ fingertips through automatic discovery of relevant information from the web and intelligent interaction between humans and machines.

Dr. Chin-Yew Lin
Research Manager

Areas of Focus:
To achieve this goal, we develop scalable automatic content analysis methods and quality metrics to analyze a huge amount of online text, and to harvest explicit and implicit knowledge. To ensure quality, we automatically construct per-topic global and local expert rankings through statistical analysis of the people who created the online content. The results are not only used to rate harvested knowledge but also to form an active expert network. To leverage the collective intelligence of the crowd, we design smart applications that simplify users’ tasks and also learn and improve from their interaction with users.

Social Question Answering & Summarization
The popularity of social question answering (SQA) services, such as Microsoft Answers and MSDN Forums, Yahoo! Answers, Baidu Zhidao, and Naver Knowledge-In, has demonstrated the value of social question answering. However, the existing SQA services are purely human-based, do not provide aggregated answers, and do not aggregate across services. Furthermore, there are related existing questions and their answers that can be found on the web. We would like to create a one-stop social question answering service that aggregates all services and all forms of existing questions and their answers through automatic question detection, question clustering, answer extraction, and answer summarization.

Sentiment Analysis
User generated content (UGC), such as blogs, forums, reviews, Twitter, etc., has become a great resource for observing user sentiment toward events, products, people, policies, and so on. To leverage this valuable content and provide insightful feedback to users, manufacturers, and other interested parties, we are developing automatic methods based on machine learning techniques, as well as semantic and discourse analysis to mine user sentiments from various UGC. Our collaboration with the Machine Learning group at MSRA has been adopted in Microsoft’s Commerce Search.

Expert and Social Search
Information retrieval and web search mostly focuses on finding relevant documents or web sites to satisfy user needs. Less attention has been paid to assist users in
identifying relevant experts or trusted people who can offer solutions in a timely and human manner. Our goal is to automatically create a global expert and friend recommendation social network to not only facilitate web-scale expert and social search but also leverage the results to rate online content.

**User Intent/Activity Recognition and Prediction**

The holy grail of information access is to understand what users want and present to them just that. Researchers have started to make inroads into this area by building automatic classifiers to recognize user intentions. However, most classification schemes are still coarse-grained and at single intent level, for example, “job intent” or “product intent”. To advance the state of the art in user intent recognition, we utilize web scale query logs, question logs and click-through logs to automatically induce an inventory of user intentions and aggregate them into user activities. The ultimate aspiration is to move beyond single intent recognition into multiple user-intent sequence prediction.

**Inarticulate User Assistance**

Users of systems and services can be inarticulate for many reasons. They may be unaware of their information need, or unable to express it in the form of queries; they may have a poor input device; they may be physically challenged or their hands may be occupied. We would like to help such users solve their problems through minimal human-computer interaction, based on physical and digital user contexts.

**Information Access Evaluation**

Information access (IA) includes techniques such as information retrieval, question answering, text categorization, summarization and opinion analysis. To optimize IA systems economically and efficiently for end users, our project aims at the design and construction of reliable test data and evaluation metrics. Our goal is to ensure user satisfaction while minimizing the need for human-in-the-loop evaluations.

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**Web Intelligence Group**

**Hardware Computing Group**

Our primary aim is to push forward the state of the art in hardware computing: to innovate in software services and to realize novel devices. Regarding innovation in software services, we research fundamental computer architecture, identify hardware opportunities in specific services, and build integrated hardware/software solutions. For realization of novel devices, we work with the Microsoft product team where appropriate, extrapolate hardware trends, study new interaction models, and construct working prototypes. The end goal is to deliver rich and responsive user experiences at work, at home, and on the move.

Dr. Feng-Hsiung Hsu  
Research Manager

**Areas of Focus:**

**Hardware Acceleration**

The industry trend toward software as a service creates the need to look beyond the traditional computing paradigms. Hardware acceleration based on FPGA, GPU, and new memory hierarchies is one way to shorten development cycles and improve cost performance. We have previously demonstrated hardware speedup from over ten-fold to over a thousand-fold for machine learning algorithms of practical importance and have had the accelerators deployed in real applications, significantly shortening the development time for product teams. Our newer efforts are more geared toward cost performance improvement. The operation and maintenance of a
large data center can now cost over a billion dollars annually. We believe that hardware acceleration can be used to significantly reduce this cost. We are exploring how new memory hierarchies, including the use of flash and other non-volatile memories, in combination with FPGA and GPU, can accelerate certain specific data center applications of interest to Microsoft. For this exploration, we are building experimental systems that can reach the scale of hundreds of servers in lab environments, with the aim of eventually deploying real systems with much larger scales.

Devices

The popularity of new devices like Netbooks signifies a new consumer trend for low cost mobile devices with new modes of interaction. On the display side, we have seen the rapid drop in the cost of flat panel displays, the launch of low power e-paper displays, and the likely arrival of commercial rollup displays in the near future. Touch and motion-based interfaces have also become popular. On the memory end, we have seen flash becoming the main storage for several new devices. Upcoming technologies, such as Phase Change Memory, promise the dream of a unified memory. Meanwhile, mobile CPUs have continued to add functionality while maintaining or lowering power consumption. All these represent new opportunities, as well as new challenges, for Microsoft. We are conducting research in related fundamental and applied technologies with the aim of helping Microsoft address these new opportunities and tackle new challenges in front of us. Presently, we have identified several new devices that can fundamentally enhance user experiences in real scenarios and have built or are in the process of building prototypes for such devices.

System Group

The system research group engages in the fundamental system research that spans and bridges both theory and practice. The charter of the group is to design and build state of the art and future systems that enrich computing and social experiences, enable new scientific discoveries, and empower people to realize their full potential. Our current focus includes large-scale distributed systems that power internet services and cloud computing, tools for building distributed systems, and new system architectures for emerging hardware trends and applications.

Areas of Focus:

Distributed Systems and Large Scale Data Processing

In this area, our interest mainly focuses on the design and implementation of distributed storage systems, large-scale parallel data processing systems, debugging and verification mechanisms in such systems, as well as Peer-to-Peer systems and social networking systems. We have committed to understanding and solving system problems that arise from both the real world and from the experimental systems, ranging from protocols and algorithms to architectures and services involved in such systems. Besides publishing in leading researching conference and journals, we have also worked closely with product groups to help them build better systems.
WiDS: Distributed System Tools
No work can be done easily without handy tools. This is particularly true for system developers who build large-scale, distributed systems, because these systems exhibit complex behaviors and suffer from subtle, but serious, bugs, which cannot easily be detected and eliminated manually.

WiDS has been our long-time research investment that focuses on developing and debugging tools. Our goal is to build tools that help developers attack bugs more effectively and comprehensively, and that make systems robust, reliable, and more efficient.

We have built a range of tools using various debugging technologies, such as static analysis, model checking, and predicate checking. For example, MoDist is a transparent model checker that can systematically explore execution paths for a distributed system, effectively revealing bugs at corner cases; R2/iTarget is a lightweight recording and replay tool that can replay an execution deterministically and faithfully, enabling “time-travel debugging” for root cause analysis; D3S/CloudMeter enables predicate checking on a large, deployed system, allowing people to easily analyze its behaviors and detect anomalies.

Emerging Hardware and System Architecture
In the System Research Group, we have been closely following the emerging computer architecture trends and are actively pursuing research directions in order to understand and leverage new hardware with an aim to improve the performance and reliability of computer systems. Our current projects encompass research on a wide range of new and exciting technologies. Some of the on-going projects include designing multi-core friendly operating systems; implementing next generation solid state storage systems and investigating their implications on OSes and user applications; leveraging multi-core microprocessors to accelerate program analysis and debugging; using reconfigurable hardware to accelerate database and Boolean Satisfiability (SAT) solving; and using a Graphics Processing Unit (GPU) to accelerate the general-purpose computation.

Areas of Focus:

Wireless Networking Research
We foresee that the increasingly powerful multi-core architecture and parallel data processing will fundamentally change wireless communications. Software-based cognitive wireless systems will become much more powerful, flexible, and efficient compared with existing wireless technologies. We have built a high-performance software radio platform called “Sora” with a general purpose CPU. It will enable a broad range of wireless research in physical layer, medium access control, and cross-layer optimization. The new programming model and various tools will greatly reduce the effort involved in implementing high-speed wide-band wireless systems, and hence facilitate innovative wireless systems research in the real world.
We are also studying new architectures and developing key technologies using software radio for next generation wireless systems. Our current research focus includes high-speed MAC, MIMO, Spatial Division Multi-Access, and white-space cognitive systems.

**Mobile Systems and Sensor Network Research**

Our mobile systems research focuses on investigating new mobile platforms that enable “better-together” mobile application paradigms, smoother mobile user experiences, and novel mobile applications and services. Over the past three years, we have been developing various mechanisms to enable novel applications by bringing together multiple mobile devices. Our latest work focuses on how to bring mobile devices and the Cloud together to further improve a user’s mobile experience, and to enable a spectrum of new mobile applications that harness the power of the Cloud. Example projects include a better work/life organizer, mobile-Cloud architecture, power/bandwidth efficiency, programming framework, and mobile social networks.

Our sensor network research concentrates on platforms and methods to bridge the gaps between the physical and cyber worlds. We take a people-centric approach and emphasize the key role of mobile devices in information collecting and consumption. We also investigate sensor and actuator network applications in environmental and energy conservation.

**Data Center Networking and Cloud Computing**

As the IT industry enters the era of Cloud Computing, companies are building large data centers to host online services for our daily life. In the near future, mega data centers will be built to contain millions of servers. It has become a major research challenge in discovering how to interconnect such large numbers of machines. In our data center networking (DCN) project, we address this challenge with a holistic approach that includes network architecture, infrastructure consolidation, measurement, management, congestion control, traffic engineering, energy saving, and application and OS support.

Regarding Cloud Computing research, we aim at improving user experiences of online services from a networking perspective, by considering users, the Internet, and data centers as a whole. Example projects that we are working on include: how to provide data centers to users as a single computing device; how to reduce user perceived end-to-end latency; how to provide security and privacy for user data, etc.

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**Media Communication Group**

The mission of the Media Communication Group is to develop new tools and services to facilitate computer users’ work and life through leveraging group members’ expertise in media, communication, networking, user interface, and machine learning.

As computers become faster and bandwidth becomes wider, we expect computers to be more intelligent and do more for human beings. We believe that it is the computing requirement from new tools and services that drives the sustainable development of the information industry.

**Areas of Focus:**

**E-assistant**

Employees in modern enterprises usually engage in a wide variety of software-based operations in their day-to-day work. Some operations are performed repetitively and are tedious or time consuming. Currently, computers can only respond to users’ commands, they cannot learn, predict, and automatically do something for the users.

This project aims to develop E-assistant - a virtual personal assistant that can facilitate users’ daily computer operations. It acts on behalf of the user, performs
routine, tedious, and time-consuming tasks, gathers information, generates personalized recommendations, and provides decision support. We try to meet the needs of everyone who has ever dreamed of a personal aide but cannot afford a human one.

**A Performance Analysis Tool for Distributed Systems**
Distributed systems are becoming key engines of IT companies. However, it is very hard to diagnose and improve the performance of a distributed system. This project aims to construct a simple analysis tool that can facilitate administrators’ and developers’ management and analysis work. The system consists of four parts: (1) inspecting agent, which is installed in each machine of a distributed system for inspecting system status and events; (2) trace collector, which is responsible for collecting the traces from agents and saving traces to the database; (3) management server, which is used for managing an inspecting job; and (4) analyzer, which includes our key technologies, such as locating problems through unstructured log analysis.

**Microsoft Research Asia P2P Broadcast System**
Between the 8th and 24th August 2008, using our P2P broadcast system, we broadcasted 11 Beijing Olympic Games channels for the Chinese Central Television Station on the Internet. The system ran stably throughout the entire period and served more than 2,400,000 users. The condition of the Internet during the broadcast was very challenging. First, more than 50% of the users had ADSL connections with speeds only ranging from 512K - 1Mbps; second, about 60% of the users were behind NAT/firewalls. We designed and implemented three features; (1) a distributed NAT traversal algorithm to address the connectivity problem, (2) a contribution-aware overlay construction algorithm and (3) an optimal packet scheduling algorithm to improve scalability and continuity. We also developed a monitoring and management subsystem for the deployment, management, and diagnosis of the P2P broadcast service. Through comparing this with other commercial P2P broadcast systems, we found that our system started playing more quickly and played more smoothly. It is fully compatible with Windows media format and supports DRM protection. The system provides a complete solution for live video broadcast at TV stations, ISPs, and Content Providers.

**Speech Group**
Using speech to communicate continues to be the most natural way to exchange ideas and thoughts. However, the challenge becomes greater when communicating with machines like computers. Our Group is working to make the "speech chain" smooth and robust when there is a machine involved. We develop spoken language technologies that enable human-computer voice interaction and enrich human-to-human communication.

Dr. Frank Soong
Research Manager

**Areas of Focus:**
The group’s current focus includes automatic speech recognition to enable computers to facilitate access to data, create content, and perform tasks; speech synthesis to enable computers to speak with a human-sounding voice, to respond and provide information, and to read; spoken-document retrieval and processing to enrich communication between people like converting voice-mail into text or transcribing conversational speech into text; signal processing to improve the conditioning of signals, change speech signal parameters like pitch, speaking rates, and voice characteristics in a seamless way. Extending statistical learning algorithms we developed to other pattern recognition problems like hand-written math equations, East-Asian character and gesture recognition is also investigated.
Trainable Text-to-Speech Synthesis
We developed two statistically trained, automatic text-to-speech (TTS) systems for server-based or handheld device-based applications. They are: unit selection, waveform concatenation TTS; and HMM, parametric TTS. Multiple new distinctive features are built into the two systems correspondingly: 1) a universal objective criterion for model training and speech generation; 2) different sized databases, from small to large, can be used to train a desirable TTS; 3) a small, hidden Markov model (HMM) or high quality, waveform concatenation systems are available for different voice qualities and available resources; 4) flexible, easy modification of pitch, gain, speaking rate of synthesized speech, and other relevant parameters; 5) adapting a TTS voice to a new speaker; and 6) highly intelligible TTS for pronouncing name entities.

A Voice User Interface with Intelligent Correction
We developed an intelligent voice user interface for text input. It employs continuous speech as its main input mode and handwriting as its correction mechanism. Continuous speech is adopted for its fast text-input speed, and handwriting is for easy pointing and/or correction of speech-recognition errors. This natural interface is also intelligent; statistically, it can correct more errors than indicated by the user’s handwritten input. We verified in multiple language speech databases that we can rewrite a word graph produced in speech recognition to generate a revised sentence with fewer word errors than indicated by the user.

Discriminative Training of HMM Models
We trained highly discriminative HMM models for recognizing speech and free hand input of East Asian characters. A unified framework is established for dealing with various different discriminative criteria, such as maximum mutual information, minimum classification error, minimum phone or radical error.

Enhancing Human-Human Communication: Speech Indexing
Humans exchange most information when they speak to each other. However, when they need to keep records, they resort to notes, memos, meeting minutes, and various documents. Unfortunately, today’s technologies do not allow for the efficient use of recorded audio conversations. Enabling computers to be smart about speech and audio is a primary focus of the Speech Group. A core innovation that has come out of this is a search engine that can index the words spoken in recorded conversations, whether they are from meetings, conference calls, voice mails, presentations, online lectures, or even Internet video. Microsoft OneNote 2007, a part of Microsoft Office, is the first Microsoft product to include our speech-indexing technology to allow users to search for keywords spoken in recorded meetings and phone calls.
Software Analytics Group

A huge wealth of various data exists in the software development process and hidden in the data is information about the quality of software and services and the dynamics of software development. Employing pattern recognition, machine learning, and information visualization technologies, the Software Analytics Group at Microsoft Research Asia strives to research and develop data exploration and analysis tools in order to obtain insightful and actionable information for data-driven software and services.

Dr. Dongmei Zhang
Research Manager

Areas of Focus:

Advanced Software Quality Analysis and Tools

The software development process produces various types of data, including source code, feature specifications, traces/logs, test cases, testing results, bugs, and real-world user feedback after the software is released. Today these data sources are often located in silos and yet to be fully exploited to gain insight and understanding on software quality and development dynamics. We are researching advanced analysis techniques and developing easy-to-use tools to help product teams measure, track and improve the reliability, performance, security, and usage of their software products. The goal is to enable the acquisition of actionable information and driving informed decision making in every aspect of development and throughout the software development cycle.

Information Visualization

It can be overwhelming for users to be surrounded by tons of information from various sources, especially in the era of the Internet. Visualization technologies provide interactive and visual representations of information that not only enable users to obtain and understand the information but also to communicate and collaborate on it. Our research focus is to innovate and utilize visualization techniques to build a new generation of tools for the design, development, deployment, and maintenance of software plus services.

Large-scale Data Processing and Computing

Analysis research on large-scale and various types of data requires infrastructure support on highly scalable and highly efficient data storage and computing. Collaborating with computer system researchers and taking advantage of the state of the art technologies in both computer hardware and software, we are researching and building a data analysis research platform that provides storage and fast access to large volumes of complex data as well as powerful data computing capabilities that greatly increase experimentation efficiency.
Machine Learning Group

The Machine Learning Group at Microsoft Research Asia focuses on research and innovation in algorithms and technologies to discover knowledge from large-scale data. With the continuing increase of information on the Web and user behavior online, it is critical for service providers to learn and make sense of what information users will access and what they do with that information to allow developers to better meet user needs. Our research includes statistical learning, knowledge discovery, pattern recognition, text mining, optimization, game theory, and information retrieval with large-scale and diverse data, such as textual data, graphical data, Web log data, and software usage data. Online advertising and other digital marketing areas serve as a test bed to apply innovative new technologies.

Dr. Zheng Chen
Research Manager

Areas of Focus:
In terms of large scale machine learning, our research work aims to develop intelligent algorithms, build intelligent machine learning platforms, provide solutions for intelligent Web services etc to help Web participants from different perspectives.

User Intelligence
Analyzing the interests, habits, and behavioral patterns of online users is an essential part of user intelligence. We are studying and developing novel technologies to provide optimum methods to classify and cluster large scale Web users and help Web service providers to more clearly understand users and provide targeted services. In addition, through understanding users based on their large scale sparse behavior, we can further help Web service providers to bring personalized services to end users. Besides user behaviors on the Web, users’ opinions are also valuable information, which exist in blogs, online forums, product reviews, and so on. Thus we are developing scalable solutions to search and analyze user opinions. Some ongoing projects along this research direction include:

- Behavioral targeted advertising
- Chain of user intention mining
- Opinion search and mining

Semantic Intelligence
Keywords play a critical role in Web services such as search and advertising. For example, the search query is integral to Web search and keyword matching plays a central role in online advertising. We are researching a series of keyword technologies that include keyword extraction from Web pages, keyword suggestions based on various criteria, keyword classifications with pre-defined taxonomy, keyword organization into semantic clusters, and keyword trend prediction. Based on keyword technologies, we are also getting close to the core of semantic research centered on the relevance of documents to user queries. Some ongoing projects along this direction include:

- Categorized search
- Query classification/clustering
- KEX (Keyword extraction)
- Keyword suggestion and smart match

Business Intelligence
Analyzing Web service providers’ businesses and developing effective strategies on service improvements are fundamental to business success. Based on instrumentation of user activities on service provider systems, we can provide a fundamental platform to analyze user activities for better decision making. For example, a large scale user index and classification toolkit is essential for advertisement delivery engines to make more accurate business decisions. More importantly, a platform that allows others to develop their own algorithms to perform large scale data analysis can help users make faster and higher quality business decisions. Some ongoing projects along this direction include:

- Large scale machine learning platforms
- Large scale machine learning toolkits
Deployment Driven Research
Utilizing our multi-disciplined team in engineering, IEG has a charter to develop and manage infrastructure and platforms in support of deployment driven research, promoting software engineering excellence across the lab. Leveraging the broad research results of the lab, we develop and deploy technology solutions directly to end users. Through this deployment program, we explore new applications and services, which can result in new product offerings. It also provides user feedback directly to researchers, which helps to advance research with a shortened cycle.

The Innovation Engineering Group tackles challenging projects based on advanced research technologies and delivers high-quality software and deployed services. The group applies expertise in program management, software development, testing, and operations.

Engineering Excellence
It takes little time for most people to learn a program language and print out “Hello World!” on the computer screen. However, to produce a world class software product or service, it takes a huge amount of knowledge, processes, and collaborative effort. Over its relatively short history of 50 years, the software industry has demanded that its professionals master a great deal of skills in planning, design, implementation, maintenance, project management and user experience; we call all of these skills, which separate a professional software engineer from a program hobbyist, “Engineering Excellence”. Today, IEG is responsible for promoting software engineering throughout MSRA; we provide training to new hires and interns, seminars to enhance our employees’ skills, and courses to help college students in software engineering. Engineering Excellence is not just about concepts and ideologies; we also develop tools to help our software engineers and teams to become more efficient and productive. Much of our effort has been well received and widely recognized inside the Microsoft community.
Search Technology Center Asia

Microsoft Research Asia and Microsoft Bing (formerly Microsoft Live Search) partnered to form the Search Technology Center Asia (STCA) in Beijing in October 2005; STCA has since expanded to Tokyo. The Center is dedicated to advancing state of the art search technology and enabling a more intelligent online search experience.

Our two-fold mission is to:
- Deliver the favorite way for people in Asia to find and use information.
- Bring the best search ideas from Asia to users around the world.

STCA consists of top engineers working jointly with researchers. By combining Microsoft’s research and development talent, STCA has become a highly versatile, agile, and unique center.

Internet Search in China and Japan

People at STCA understand the local market, the culture, and the language, marrying that knowledge with deep technical understanding to deliver a service tailored for users in China and Japan. The Center has been actively working with the global Bing organization to deliver a more useful Internet search service that covers the general web plus specific areas, such as local information, mobile web pages, video content, maps, and news search. In addition, the Center works closely with Microsoft’s local partners, such as China Telecom.

Thanks to STCA’s unique model of aligning MSRA’s world-class research with Microsoft’s proven development model, innovative technologies have been quickly brought to market, far faster than traditional R&D practices. An example is the joint collaboration on core technologies that have enabled better Chinese language query suggestions and spelling correction.

Next Generation Search

Microsoft is making a large investment in the transition from a plain text search to a structured search experience to provide users with more relevant answers and a richer, interactive user experience using those answers. Core investments in classification, document segmentation, machine learning, and feedback loops enable STCA to create features that infer structure from unstructured web documents and to use that structure in a substantially improved search user experience.

Steve Macbeth
General Manager

Tony Chor
Director of Program Management

Peter Zeng
Director of Test

John Liu
Director of Development
University Relations Group
The University Relations group acts as a bridge between Microsoft Research Asia and the academic community throughout the Asia-Pacific region. Our mission is to build long-term and mutually beneficial relations by fostering innovative research, promoting academic exchange, and cultivating tomorrow’s leading researchers.

Lolan Song
Senior Director

The University Relations Program at Microsoft Research Asia seeks broad engagement with the academic community and governments throughout the Asia-Pacific region to foster innovative research, advance education, develop talent, and promote academic collaboration.

Our team has forged strong relations with universities and institutions, partnering with nearly 100, to organize various programs and events. Since 1998, we have organized more than 600 events in 10 countries and regions that have attracted more than 300,000 participants.

Regional programs are also developed to extend collaboration with universities in Hong Kong, Taiwan, Japan, Korea, Australia, New Zealand, and Singapore. With a greater focus on local research interests and education, Microsoft Research Asia is looking forward to making the University Relations program as extensive and diverse as the academic community.

Research Collaboration
Over the years, more than 600 research projects have been funded in the Asia-Pacific region. A book named Innovation Together, published by Springer, has best demonstrated the results of research collaboration over the years. The on-going programs include regional theme research projects and joint research labs, among other initiatives.

Regional theme research projects are offered at the regional level and support basic research in promising areas. At present, we are working on themes such as Context Aware Cloud Computing and Location Based Social Networks, Windows Core Technologies, Machine Translation for Multiple Language Information Access, and how to apply the latest computing technology to cultural heritage, education, health, environment, and other scientific research areas, e.g. astronomy.

We collaborate with universities and governments to form research organizations ranging from joint labs to innovative partnerships. Currently, we have ten joint labs in Mainland China and Hong Kong. In 2005, the Microsoft Institutes for Japanese Academic Research Collaboration (IJARC) was established in Tokyo; the Microsoft-Queensland University of Technology (Brisbane, Australia) eResearch Centre was opened in February 2007. KAIST, Korea’s premier institution for science and technology research and education, and Microsoft Research (MSR) signed a memorandum of understanding to establish a joint research center in Korea in October 2008.

Talent Fostering
Our programs have given thousands of students and early-career faculty members the opportunity to pursue their academic passions and gain valuable research experience. Over the last 10 years, more than 3,000 students from around 100 universities worldwide have participated in our “Stars of Tomorrow” internship program. On top of this, the lab’s Fellowship Program has successfully engaged over 250 Ph.D. students. We also connect with thousands more students through the
Microsoft Technology Club, which has chapters at about 30 universities in China.

**Curriculum Innovation**

To meet the demands of the academic world and to increase the prominence and quality of software education, Microsoft supports advanced curricula in computer science, computer engineering, electronic engineering and other related fields. The University Relations group works with educators to create opportunities for improved teaching content and to initiate programs to improve learning and teaching experiences using various innovative methods.

**Academic Exchange**

The University Relations group fosters international collaboration and communication among Microsoft researchers and professors in emerging research areas and education. Every year, Microsoft Research Asia hosts a number of worldwide academic exchange events, including the annual “Computing in the 21st Century” conference and the Microsoft Research Asia Faculty Summit. Researchers at Microsoft also engage in teaching and lecturing at universities to support educational development.

Microsoft Research Asia employs top minds in computing and related engineering and social science disciplines. Microsoft Research Asia offers them the opportunity to see their research go into products and services used by millions of people across the globe.

We have created an academic environment where researchers are free to pursue scientific ideas that interest them. The lab fosters a culture that looks for ways to make a substantial impact on information technology. The culture not only drives researchers to develop groundbreaking technologies and work at the cutting edge of innovation, but has also made Microsoft Research Asia a natural partner for universities and governments in the region.

Specifically, we promote a free, open, risk-taking, and people-centric culture.

**Free**

- Freedom to explore research topics of interest
- Freedom to bring innovation to millions of people all over the world

**Open**

- Extensive paper publications and collaboration with academia
- Dynamic communication between teams

**Risk-Taking**

- Unlimited opportunities to explore the unexplored
- Emphasis on innovation outside of your comfort zone

**People-Centric**

- Opportunities for personal and professional growth
- Strong support system
In the Media

The World's Hottest Computer Lab

By Gregory T. Huang, MIT Technology Review, 2004

(Excerpt)

Half a world away from the calm beauty of Seattle and Puget Sound, there's a lab where software dreams come true. At Microsoft Research Asia, the drive to succeed is as intense as the traffic that roars by the front door in unbridled, chaotic fury.

It's all part of the lab's ambition to lead the world in making computers interactive, entertaining, and ultimately more useful. "They're doing really first-class research," says Victor Zue, co-director of MIT's Computer Science and Artificial Intelligence Laboratory and a member of the Beijing lab's technical advisory board. And Raj Reddy, a renowned expert in human-computer interaction at Carnegie Mellon University, calls the lab's leadership and talent pool "outstanding."

Indeed, Microsoft Research Asia has become a powerhouse of infotech R&D. Far faster than even Microsoft's top brass expected, the Beijing research outpost is influencing the company's global business. "It's interesting how much of the research directed at the Asian marketplace turns out to be generally applicable," says Rick Rashid, senior vice president of Microsoft Research, which besides its main facility in Redmond, WA, also runs labs in San Francisco, Mountain View, CA, and Cambridge, England. "They'll often attack a problem differently from what would happen in Europe or the U.S., because they come from a different perspective. They often find solutions that are different, and in some cases different turns out to be better."

So has Bill Gates figured out China? He lights up when talk turns to his Beijing bonanza. "When you start a lab, you're supposed to say, Okay, in five years we want you to contribute," Gates told Technology Review. "These guys-nine months after they got started-had these video compression results." Those kinds of results are already setting the Microsoft lab apart from its competitors, making it a case study in global innovation. "People should pay attention to China," says Gates. "It is a phenomenon in every respect."

The Microsoft lab in Beijing has the feel of an adrenaline-fueled start-up than an academic institute.

Microsoft Research Asia ... is one of the few labs here [in China] spared the pressure of developing products for direct application; its researchers, like those in Microsoft's labs in Redmond, San Francisco and Cambridge in Britain, are given leeway to explore ideas with no immediate commercial payoff.

"Let a Thousand Ideas Flower: China Is a New Hotbed of Research"

New York Times, September 13, 2004

Microsoft Research Asia ... is an essential element in Microsoft’s efforts to counter rivals Google, Nokia and Sony.

Microsoft has positioned China at the hub of its R&D operations in the East Asian region. Specifically, the company recruits people from Japan, Korea and Southeast Asia to work at MSRA, while at the same time appealing for joint research projects with universities in each of the countries.

Science and technology students from Tsinghua University and China’s other top universities put Microsoft firmly in the lead as their choice of potential employer.

"China – The Secret to Successful Student Engagement"

Nikkei Electronics, January 14, 2008

While Microsoft researchers are looking at ways to apply computer science to computational biology, these efforts don't directly relate to the company's core business activities......But these activities still benefit Microsoft, by allowing its researchers to push the boundaries of how computer science and software can be applied.

"Microsoft Takes Computer Science into Fight against HIV"

IDG, November 7, 2008