UTSA Computer Science

CS KICKSTART

DID YOU KNOW…?

Only 8% of the world's currency is physical money, the rest exists on computers.

Source Data:
Ed Grabianowski "How Currency Works" 2 September 2003

UTSA COMPUTER SCIENCE ASSISTANT PROFESSOR ABDULLAH MUZAHID RECEIVES $450K NSF CAREER AWARD

BY KIMBERLY WARD

Abdullah Muzahid, assistant professor in the UTSA Department of Computer Science, has been awarded a National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award. The award includes a $450,000 grant to support his research in machine learning over the next five years. He is the seventh faculty member in Computer Science to receive this award.

His project, *CAREER: A Dynamic Program Monitoring Framework Using Neural Network Hardware,* focuses on utilizing a specialized hardware that implements neural network.

Neural network is a machine learning technique that mimics human brain. Therefore, neural network hardware provides some unique capabilities that can be utilized in many different ways.

The usage that this project considers is about "program monitoring." Program execution monitoring is often used to detect software bugs, performance issues, security attacks etc. When neural network hardware is used to monitor program executions, at first it tries to learn the normal behavior of the program. Such behavior is defined in terms of various events or features that the program exhibits.

Once the neural network hardware learns the normal

"Muzahid: NSF CAREER Award"

UTSA COMPUTER SCIENCE RESEARCH: THE LASOR LAB

BY KIMBERLY WARD

A recent addition to UTSA, Dr. Wei Wang joins the department of Computer Science as an assistant professor and leads the **LArge-scale System Optimization Research (LASOR) Lab.**

The goal of Dr. Wang's lab is to make future large-scale data-intensive systems faster and greener.

Dr. Wei Wang, assistant professor of Computer Science at UTSA

Their research falls in the intersections of Cloud Computing, system software, computer architecture and software engineering.

Current investigations include redesigning data centers with novel energy-efficient hardware, improving hardware management and data management in system software, and inventing new

software development techniques to help users write and execute large-scale applications efficiently on Clouds.

Artificial Intelligence and Machine Learning

Artificial Intelligence (AI) and Machine Learning (ML) applications now constitute a significant part of Data Center workloads. The increasing need to processing larger data sets and more user requests forces us to build larger data centers. However, with the growing demand and the computation-power-hungry nature of these applications, soon our data centers will be too expensive to build and operate. It is because of these heavy memory consumers that Wang's lab investigates data center design problems, focusing on the memory system.

Software Performance Testing for Cloud

While the low cost of ownership and the flexibility have attracted businesses and users to migrate their applications, Internet services, and IT infrastructures

"UTSA LASOR LAB"

UTSA LASOR LAB CONTD.

to the Cloud, performance uncertainty puts many potential Cloud users in doubt. This performance uncertainty makes it very difficult to determine if Cloud services can meet a user's performance target. Even in the case where Cloud can meet a performance target, this uncertainty makes it very challenging to project the potential the resource usage and cost of using Cloud services.

Performance testing is traditionally the way to determine if a system satisfies certain performance targets. However, cloud services are provided to the users as black boxes, i.e., users have limited control over the execution environments. This black-boxed approach is also one of the causes of performance uncertainty. If traditional performance testing is employed in Cloud, extremely time-consuming tests have to be conducted to extensively explore the unknown execution environments, which is cost prohibitive in practice.

To reduce the testing cost, Wang's LASOR lab is investigating how to incorporate Cloud system knowledge into performance testing. The knowledge of Cloud systems help users better control and interpret execution environments to reduce the number of tests.

Additionally, to help users determine the Cloud resource configura-

tions that minimize their costs, LASOR also applies machine learning into Cloud testing. Machine learning that may help reduce the search space of potential cost-efficient resource configurations.

Automatic Elasticity Management for Cloud Application

Elasticity is used to describe the characteristic of Cloud Computing where users can dynamically increase or decrease their resource usages based on workload demands. While elasticity is the key to achieve low-cost-of-ownership of Clouds, users are responsible to design elasticity policies. However, properly designing elasticity policies is extremely challenging even to power users.

A good elasticity policy requires two predictions: 1) the prediction of in-come workloads, so that a Cloud application can prepare in advance for future workloads spikes or drops; 2) the prediction of the performance of Cloud resource configurations, so that a Cloud application can correctly choose the configuration with lowest cost while meeting performance goals. However, accurately making these predictions remains open questions.

It is worth noting that, for any deployed applications, there is usually a history of past workloads, performance and resources usages. This history may reveal valuable insights of application behaviors, and thus help improve the accuracy of workload and performance predictions. Because this history is already available to Cloud providers, Wang believes Cloud providers can supply users with accurate predictors to help them design elastic policies. In fact, given the large application pool and the histories of a wide range of applications, Cloud providers may be able to directly supply users with elasticity policies, completely relieving the users from the burden of designing their own policies.

At LASOR, Wang's research team combines the knowledge of Cloud Computing, computer systems and data mining to identify the type of historical data that are required for elasticity policy design, and investigate how to utilize the history to improve elasticity policies.

ALUMNI SPOTLIGHT: A DAY IN THE LIFE OF A CLOUD COMPUTING EXPERT

BY AIMEE CARDENAS
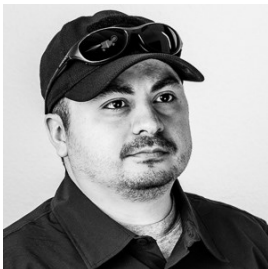
Carlos Cardenas, Cloud Computing Expert at Cumulus Networks

Aimee Cardenas (AC): Hi Carlos! Tell us a little about yourself.

Carlos Cardenas (CC): My name is Carlos Cardenas, and I work for Cumulus Networks. My background is multi-varied in cloud computing, cloud security and high performance computing systems. I have a bachelor's degree with honors in Computer Science from UTSA. I also have a master's degree in Computer Science with a concentration in information security also from UTSA.

AC: Can you briefly explain to us what is cloud computing?

CC: Cloud computing is the idea that we can take what's typically called our ubiquitous computing and treat it just like we treat electricity needs. For example, not everyone has a generator to power their household needs. Instead, they buy it through a broker which is through a series of vendors that generate electricity. That all gets fed into what's called "the grid" for power which is distributed through brokerage companies and eventually ends up at your home. Cloud computing is very similar to that where you have a series of companies that put all their resources into these data centers where the users can go directly to these companies or through brokerage companies and request resources whether it's compute, storage, networking, or just regular software services.

AC: What are clouds used for?

CC: Clouds can be used for a variety of different things. Probably the first known use for clouds was when Amazon was using what they would call a cloud. In the early 2000's, it was called Amazon Web Services where they were having issues with scaling for peak demand times like Thanksgiving, Black Friday, Christmas, and such. They built an infrastructure so they could provision additional

"Alumni Spotlight"

STAFF SPOTLIGHT: CINDY MURPHY

BY KIMBERLY WARD

Cindy Murphy receiving the College of Science Staff Service Award 2016 with College Dean George Perry.

When Cindy Murphy joined UTSA 23 years ago, the Math, Computer Science, and Statistics programs were all housed in one department office. Class enrollments were conducted manually through paper-based add forms and students would form lines wrapping around the third floor of the science building to register for classes.

Fast forward to 2017, the Computer Science department is thriving and located in the North Paseo Building where Murphy serves as an Administrative Services Officer II.

Murphy plays a key role in the department by managing the budget, handling all employment and payroll related issues, faculty grant management, and taking care of student related financial activities (stipends paid, tuition/scholarship payments, and graduate and doctoral student funding).

The College of Sciences Staff Service Award was established in 2015 by Dr. George Perry to recognize one staff member's exceptional accomplishments, leadership, and service to the university each year. Murphy was the second recipient of this award in December of 2016 for her contributions and leadership in the growth of the department and the university college.

FEATURED PHOTO:
ACM UTSA CHAPTER GROUP PHOTO

The Association for Computing Machinery (ACM) chapter meetings are Fridays at 3:00pm in NPB 1.226 at UTSA's main campus. For more information, email acm.utsa@gmail.com

Upcoming CS Events Spring 2017

February 2017

♦ *Fri 2/10 1:00pm—2:00pm*
Graduate Research Seminar Presentations by David Holland and Jin Han

♦ *Fri 2/24 3:00pm—4:30pm*
CS Student Career Development Mock Interviews

March 2017

♦ *Fri 3/3 1:00pm—2:00pm*
Graduate Research Seminar Presentations by Foyzul Hassan and Brita Munsinger

♦ *Wed 3/29 1:00pm—2:00pm*
Graduate Research Seminar Presentations by Joy Rahman and Sharif Mohammad Shahnewaz Ferdous

April 2017

♦ *Fri 4/7 3:00pm—4:30pm*
CS Student Career Development

♦ *Fri 4/14 1:00pm—2:00pm*
Graduate Research Seminar Presentations by Sam Silvestro and Richard Garcia-Lebron

Scan this QR code with your cell phone to see all upcoming department events or go to
http://cs.utsa.edu/events

MUZAHID: NSF CAREER AWARD CONTD.

behavior sufficiently, it looks for any deviation of that behavior. Such deviation can be attributed to software bugs, performance issues or security attacks. By focusing on different behavior, the proposed approach can detect different software bugs, performance issues or security attacks. Since the neural network hardware can learn any new behavior, this approach is adaptive, can be done on-the-fly, and creates a general framework for bugs and security attacks. The project proposes a multi layer approach consisting of hardware, runtime system, and compiler to implement this idea.

Besides this project, Dr. Muzahid is leading few other projects. One project is exploring the idea of approximate computing. There is a domain of applications (such as scientific simulation, modeling, graphics etc.) that does not require 100% accurate results. For such applications, we can introduce some inaccuracy (e.g., by relaxing certain constraints on synchronization, communication etc.) and still be able to produce acceptable results. On the positive side, the relaxation of various constraints can enable simplification of hardware, runtime system or even programming models and help us improve overall performance and energy efficiency. Other projects look into issues ranging from multiprocessor's memory model, data center scheduling, and workload characterization.

Besides the NSF CAREER award, Dr. Muzahid was previously awarded another NSF grant of around $250K. Currently, he is in the process of receiving a seed grant from Intel Corporation.

COMPUTER SCIENCE MAJOR?

SCHOLARSHIPS AVAILABLE FOR CURRENT AND PROSPECTIVE STUDENTS

- **Armed Forces Communications Electronics Association Cyber Security (AFCEA)**
- **Will Winsborough Memorial Endowed Scholarship**
- **NSF Scholarships for Service**
- **Allen N. Martinese Endowed Scholarship**
- **Center for Infrastructure Assurance and Security (CIAS) Annual Scholarship**
- **CNF Cyber Security Scholarship**
- **Edward Engates Memorial Scholarship**
- **Michael Maltrud Memorial Scholarship**
- **Richard Murphy & Mary Bancroft Book Fund**
- **Computer Science Academic Graduate Scholarship**
- **Doctoral student scholarship**

For more information on how to apply, please contact scholarships@cs.utsa.edu

If you are an alumni or a business/organization interested in funding student scholarships, email us at cs@utsa.edu

ALUMNI SPOTLIGHT: A DAY IN THE LIFE OF A CLOUD COMPUTING EXPERT CONTD.

resources whether it was database servers, load balancers or web servers to help with these peak times. They found that they didn't use the majority of their resources for most of the year. Rather than having resources sit idle, Amazon started selling those resources to other companies and individuals. This move was not only from the e-Commerce world, but also from your standard companies. You're seeing a lot more start-ups nowadays where they don't have to invest millions of dollars just to have a data center to host WhatsApp or insert startup communicator de jour. They can just go to a cloud provider or through a cloud brokerage firm and set up the infrastructure they need. We're starting to see this behavior more in enterprises, local and state governments, and even some of the federal institutions. A good example of this is healthcare.gov.

AC: Are all clouds the same?

CC: There are a variety of different clouds with different purposes. We'll talk about three. One, we'll call the public cloud. These clouds are open for everyone. As long as you have an active and valid credit card number, you can provision resources. The second one is called a private cloud. The premise is that we want to have a cloud with the same kind of elastic resources but we want to have it on site. We see a lot of private clouds in financial institutions or some of the other large organizations that have their own set of needs and requirements. The third is kind of a mix between the two and this is what we call hybrid clouds. You start off with a private cloud and you have your core services present, but every now and again as you incur growth or you run into these different lulls and funding cycles, you can always burst to the public cloud to augment your private cloud re-sources such that you can continue doing business as normal.

AC: How do you make a cloud secure yet readily usable?

CC: : That's the golden question everyone wants answered. Security is broken down into three different areas: confidentiality, integrity and availability. Confidentiality is making sure that whatever data I put in the cloud is owned and accessible only by me. Integrity means that whatever actions and functions I'm using in the cloud, they are performed by me and me alone. Cloud providers will go to great lengths to ensure this integrity model because without it, they can't bill effectively. If providers can't bill effective-

ly, then these clouds are no longer in business. The third is availability: I should be able to access my own resources at any time.

AC: What drew you to a career in cloud computing?

CC: Cloud computing is not this new revolutionary way of computing. It's actually an evolutionary process. We can go back to high-performance computing. Think of these as huge monolithic systems of computers that were all operating to perform a common task. Typically, these systems were used in the scientific, research and academic fields. Over a period of time, we saw what's called grid computing come up where it borrowed a lot from high performance computing. The grid was very rigid in terms of what could be used, deployed and provisioned. In the natural evolution of things, they took the core pieces of grid and high performance computing and used that as the basis for cloud computing. Clouds enabled elasticity, fluidity and utilized a common framework which allowed people to use and deploy different models. So, cloud computing is just a fancy name for a whole bunch of technologies over the last twenty some odd years wrapped up with some orchestration. Where that parallels with me working in cloud computing was that I started in high performance computing.

AC: Describe your typical work day as a cloud expert.

CC: In the typical day for a cloud systems-admin, you would see all network traffic, including perhaps some peaks or some spikes. You have to be able to dig down and look at the traffic, not only at the micro-level with packet analysis but also at the macro-level through traffic pattern recognition on a geographical basis. If it's a bug, you need to be able to track down the bug, whether you file the case to your development team or you make patches yourself. Another aspect is that you take the same concept from networking and move it over to compute and storage and determine if these things are benign in nature or malicious. A lot of the work consists of instrumenting, data analysis, and bug fixing.

AC: What skills are most important for someone who wants to become a cloud expert?

CC: You have to be a jack of all trades. You definitely want to know operating systems, how the kernel works, how the operating system works (at least at the macro-level), and be able to drill down and find out more information at the micro-level as needed. Next, you need to know about networking and be able to drill down and find more information on the nitty-gritty, especially when an issue arises. The same thing goes for the different storage technologies. Lastly, what ties everything together is your working knowledge of programming languages. It's best to know multiple because whenever you look at the entire cloud stack, pretty much everything is written in a different language. You have to be very adept at using the correct tools for the job, especially whenever you're trying to isolate and replicate bugs.

AC: Thank you for sharing your experiences with us. Is there anything else you'd like to add?

CC: The only thing I'd like to add is just to tell the students to keep on doing y'all's thing. I for one know, some semesters in CS are going to be difficult. Just take it in stride and know that what you're learning is really invaluable. I think y'all will come out on top and have a really enjoyable career in the future.

Cumulus Networks

http://cumulusnetworks.com/

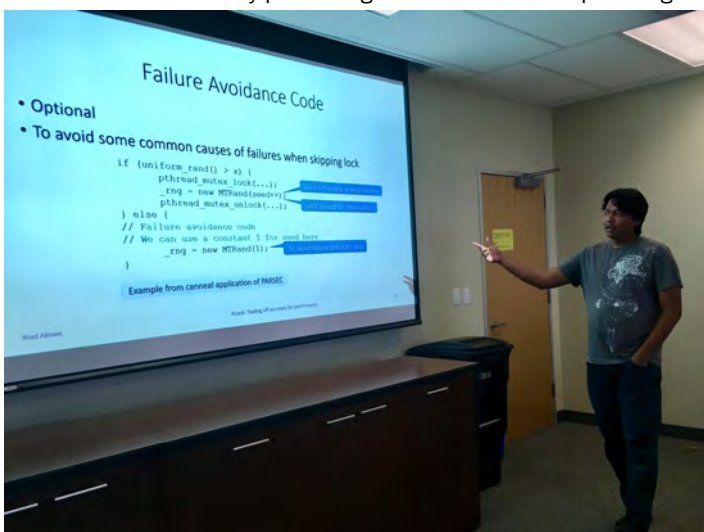# UTSA CS GRADUATE RESEARCH SEMINAR SERIES SPRING 2017

BY KIMBERLY WARD

The Computer Science Graduate Student Association (CSGSA) hosted the first session of the Spring 2017 CS Graduate Research Seminar Series on January 25th. The five scheduled sessions will feature UTSA student research currently being conducted in the department. All computing students and faculty are welcome to attend the sessions to support the student community and provide feedback on their presented research.

Lee Boyd, CSGSA chapter president and CS doctoral student, kicked off the seminar series by presenting his research titled Optimizing Parallelized Deep Learning. Boyd's research is supported by UTSA associate professor Dr. Weining Zhang and the Data Science and Technology Laboratory (DSTL).

Riad Akram, CS doctoral student, presented his research to his fellow CS students and faculty attendees. His research, titled *Approximate Lock: Trading off Accuracy for Performance by Skipping Critical Sections*, presents modifications to provide performance improvement for applications.

Riad Akram, CS doctoral student, presented his research to his fellow CS students and faculty attendees.

## CS GRADUATE RESEARCH SEMINAR SERIES SCHEDULE SPRING 2017

♦ **Friday 2/10 1:00pm—2:00pm** Presentations by David Holland and Jin Han

♦ **Fri 3/3 1:00pm—2:00pm** Presentations by Foyzul Hassan and Brita Munsinger

♦ **Wed 3/29 1:00pm—2:00pm** Presentations by Joy Rahman and Sharif Mohammad Shahnewaz Ferdous

♦ **Fri 4/14 1:00pm—2:00pm** Presentations by Sam Silvestro and Richard Garcia-Lebron

For more information, scan the QR code or email **jianhua.ruan@utsa.edu**

BOOK REVIEW: "TUBES: A JOURNEY TO THE CENTER OF THE INTERNET" BY ANDREW BLUM

BY RICHARD MURPHY
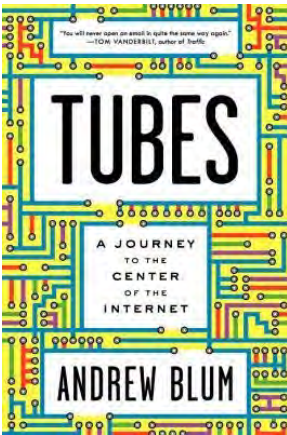
What is the Internet? Most of us rarely think about it in 2017, just like we do not think about the highway system when we get into our car. Those under the age of 30 mostly likely expect the internet to be present everywhere they go.

When William Gibson coined the word "cyberspace" for his novel *Neuromancer* back in 1984, besides being visionary, he provided the meme that has been with us ever since. This word conjures an intangible entity that pervades space, in this case carrying information to control things.

Students enrolled in CS 3873 (Computer Networks) learn to visualize the Internet as a Lego-like construct of interacting protocols, which is still as abstract as cyberspace. Hence we come to Andrew Blum, who was overcome with curiosity one day when his Internet went out due to a squirrel damaging a cable near his house. He wanted to actually see the physical infrastructure that underpins the internet and set out on a journey just to do that.

The book's title, *Tubes: A Journey to the Center of the Internet*, is an allusion to Jules Verne's iconic novel *A Journey to the Center of the Earth* due to the uncanny similarity between Blum's journey and the journey of protagonist Professor Lidenbrock who followed volcanic tubes to the center of the earth. Blum describes visiting a lonely cove in Cornwall, England in order to see where the transatlantic fiber cables come ashore. This particular location has hosted ocean crossing cables since the days of the telegraph.

While his language sometimes veers into the poetic, Blum expounds at length about international fiber optic cables: who builds them, who owns them, and the effect their bandwidth has on the continents and countries that they serve. Readers are provided a true picture of the
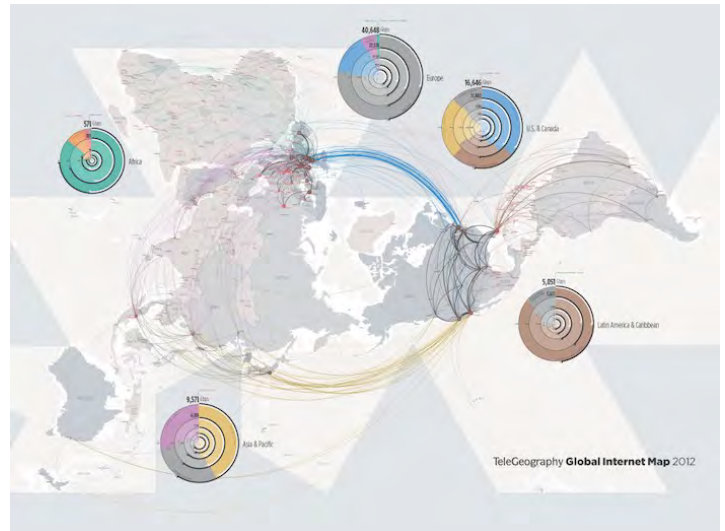
The Internet Map, which is based on data from TeleGeography's Global Internet Geography research, illustrates the key internet connections that link the countries of the world. Photo courtesy of TeleGeography 2012

many entities that together bring the Internet into existence. These include the bandwidth providers (many not household names), the many critical exchange points where these providers meet, and the vast warehouses of computers behind the content providers like Google and Facebook.

Tubes covers many interesting aspects of the Internet vis-à-vis other major inventions that changed communications. Blum points out that, unlike the telephone or telegraph, the Internet and its foundational technologies were not the product of a single person. Many people contributed to create various protocols and technologies that built the early networks of computers; many of their ideas live on today through the magic of "backward compatibility."

Many of his visits to these locations involved invitations inside of security perimeters rarely granted to non-employees. His insights can be startling at times, such as his description of one exchange point that sounds like a creepy warehouse from a Stephen King novel and the data centers of the high desert of eastern Oregon that could easily fit into an X-Files plot.

The book is a fun read as Blum knows how to tell a good story without over simplifying the technology. If you are interested in the Internet as a physical thing, the hidden corporate structure behind the curtain, or are interested in deeper research into network resilience, this a great book to get you started on your journey.

A behind the scenes look at one Google's data warehouse centers. Cables and tubs such as these are just a part of what makes up the information superhighway, as referenced in Andrew Blum's Tubes: *A Journey to the Center of the Internet.* Photo courtesy of Google Data Centers Photo Gallery 2012

We want to hear from you!

Do you have any suggestions for topics you would like to see covered? Do you have any UTSA or CS related photos that we can include? Email us at **cs@utsa.edu**

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http://www.cs.utsa.edu/

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for all archived newsletters >>>

Featured Job Opportunities!

#	Employer	Job Title	Type	Application Deadline	How to Apply
1	Girlstart	Girlstart STEM CREW Intern	Internship	February 10, 2017 at 5:00pm	Apply via UTSA Handshake job board
2	UT Health Science Center at San Antonio	Bioinformatics Assistant	Part time	February 11, 2017 at 11:59pm	Submit a simple CV with a short description of education, research interests and experience tojinv@uthscsa.edu
3	Synaptics, Inc.	Research Scientists	Full time	February 28, 2017 at 3:00pm	Apply via UTSA Handshake job board
4	Intel	Summer Undergraduate-Level Intern – Software/Electrical Engineer	Internship	March 20, 2017 at 4:00am	Apply via UTSA Handshake job board
5	Citrix	Software Development Engineer	Full time	June 01, 2017 at 2:00am	Apply via UTSA Handshake job board
6	The Congressional Budget Office	Information Technology Internship	Paid internship	Open until filled	Submit a cover letter, résumé, unofficial transcripts, and two references online at www.cbo.gov/careers.
7	Kumon Math And Reading Center	Grader	Part time	February 28, 2017 at 9:00am	Apply via UTSA Handshake job board
8	NuStar Energy	Intern-Information Systems	Internship	March 2, 2017 at 11:59pm	Apply via UTSA handshake job board
9	Corporate Travel Planners	Assistant Web Developer	Internship	April 30, 2017	Apply via UTSA handshake job board
10	My Campus Concierge Inc.	Student Tutor	Part time	Open until filled	Apply via UTSA handshake job board

VISIT UTSA'S CAREEREDGE WEBSITE

http://careercenter.utsa.edu/

FOR MORE GREAT OPPORTUNITIES LIKE THESE!!!

UTSA University Career Center
Career Events

FEBRUARY

06 **Veterans' Networking Reception**
6:00 p.m. – 8:00 p.m.
Omni Colonnade Hotel

07 **S.T.E.M. Career Fair**
8:30 a.m. – 11:30 a.m.
HUC Ballroom

07 **All-Majors Career Fair**
1:30 p.m. – 4:30 p.m.
HUC Ballroom

MARCH

01 **Professional Etiquette Dinner**
5:30 p.m. – 8:00 p.m.
Denman Ballroom

22 **March Into Your Major**
10:00 a.m. – 2:00 p.m.
HUC Ballroom

28 **Summer Jobs Fair**
9:00 a.m. – 1:00 p.m.
UC North 1st & 2nd Floors

Have Questions?

Story Ideas?

Photos?

Email the editor at

cs@utsa.edu

Kimberly Ward