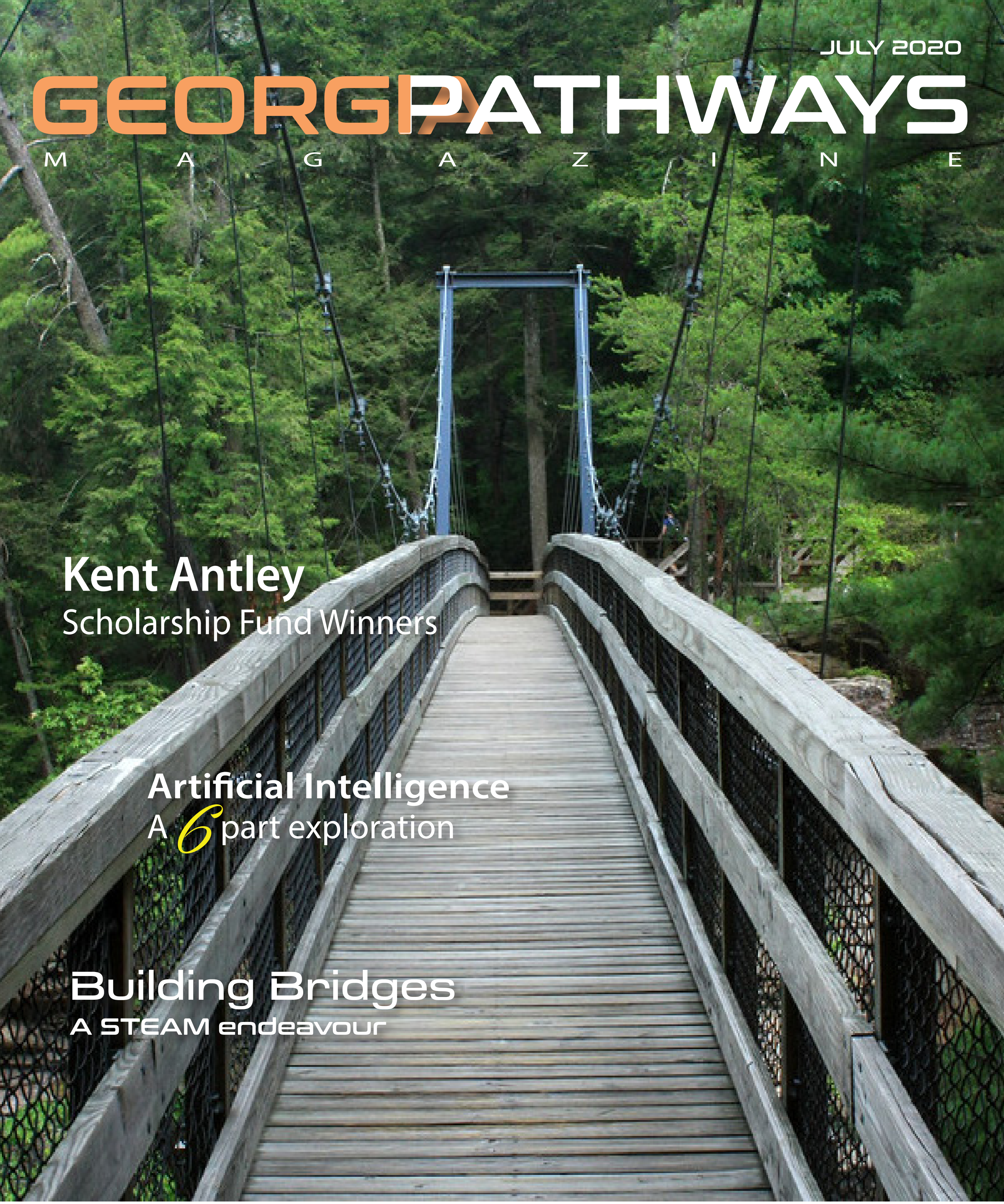
JULY 2020

GEORGIA PATHWAYS

MAGAZINE



Kent Antley
Scholarship Fund Winners

Artificial Intelligence
A 6 part exploration

Building Bridges
A STEAM endeavour

TAG Technology Association of Georgia

TAG TAG-Ed Education Collaborative

Use Georgia Pathways Magazine in class and at home. Share the link state-wide in Georgia as a valuable education resource.

Each issue is appropriate for all grades and all teachers in all subjects.

Curiosity and learning are ageless.

Remember to include the parents, especially now during the summer and into the fall as many families will be learning remotely. Content is always welcome and link distribution is Georgia wide.

TAG
Technology Association of Georgia

Technology and innovation are catalysts for positive progress and with Covid-19, social justice, and other historic movements, now, more than ever tech-ed is paramount to a positive future.

We are working hard at TAG-Ed with an eye to the future. Providing opportunities through scholarships and other means to Georgia's future talent today continues to be our focus and an important cause. People who engage in technology and innovation can indeed change the world and we need all of our smart, talented people working hard to address our many challenges. Whether working with private enterprise to deliver new products and services, working to improve global health or provide residents better access to the public sector services, individuals can make this a better world.

Georgia is a great place to launch this journey.

I would like to congratulate the recipients of our Kent Antley scholarship award winners. Jennifer Deng, Snigdha Nellutla and Anika Vennel. I applaud them for their passion for STEM and furthering their education in computer science, aerospace engineering and biomedical engineering. Their interests are in high demand for not just great careers but also for the betterment of our community.

Kent Antley (1947 to 2017) was a life-long learner with a passion for people who challenged and explored possibilities, and this drove him to establish the scholarship that now bears his name. Kent studied at the University of London as a Fulbright scholar, after which he attained his JD from Duke University. Kent was a great leader and one of the original founders of the Technology Association of Georgia (TAG), and later helped establish the TAG Foundation. He believed technology and innovation drive our economy and that Georgia is a great global hub for the talent needed to keep us at the forefront of the innovation economy.

Considering the most recent scholarship winners, I have full faith and confidence in the future of Georgia and beyond. Jennifer, Snigdha and Anika, we are counting on you and congratulations!

Larry K. Williams
President
TAG-Ed

Larry K. Williams serves as the President and CEO of the Technology Association of Georgia (TAG) and President of the TAG Education Collaborative (TAG-Ed). TAG-Ed's mission is to strengthen Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting Technology Association of Georgia (TAG) resources with leading STEM education initiatives.

The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEM learning opportunities and connecting them to Technology Association of Georgia (TAG) resources. Formerly the TAG Foundation, TAG-Ed is a 501(C)(3) non-profit organization formed by TAG in 2002. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEM education in Georgia.

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To understand STEM...

...you must DEFINE STEM, but you cannot define an acronym using the words it stands for; *you must define the words the acronym stands for.*

Universities and organizations around the world continue to debate what a STEM career is. There is no doubt that "every career" uses STEM skills and this observation remains the focus of STEM Magazine.

SCIENCE: "The systematic accumulation of knowledge" (all subjects and careers fields)

TECHNOLOGY: "The practical application of science" (all subjects and careers)

ENGINEERING: "The engineering method: a step by step process of solving problems and making decisions" (every subject and career)

MATHEMATICS: "The science of numbers and their operations, interrelations, combinations, generalizations, and abstractions" (every career will use some form[s])

For a moment, set aside any preconceived notions of what you think a STEM career is and use the above dictionary definitions to determine the skills used in any career field you choose.

These definitions are the "real" meaning of STEM and STEM careers.

TAG | TAG-Ed
Education Collaborative

TAG Education Collaborative Announces
2020 Recipients of the Kent Antley Scholarship Fund

Kenneth Furman Antley
1947 - 2017

Kent was a member of the Board of Directors of the Georgia Justice Project, President of the Business and Technology Alliance, which eventually became the Technology Association of Georgia (TAG), and was a founding sponsor of the Atlanta Chapter of the MIT Enterprise Forum, which later awarded him the first Lifetime Membership Award.

Each year, the TAG Education Collaborative disperses the Kent Antley Scholarship Fund. The Kent Antley Scholarship is awarded to those that exemplify the man in which the scholarship is named after: visionary, steadfast, dedicated and focused on pursuing STEM education.

Kent was one of the first individuals to begin working on what would become the Technology Association of Georgia. We are undoubtedly thankful for his efforts and are pleased to be able to offer these scholarships to the next generation pursing technology.

TAG-Ed strengthens Georgia's future workforce by providing students with access, exposure and awareness to STEM opportunities through innovative and relevant hands-on learning experiences. By providing exposure today through internships, professional development, immersion experiences and connections to industry professionals we help shape the future workforce possibilities and talent of tomorrow.

As part of their outstanding performance, we are pleased to announce the following students as recipients of the 2020 Kent Antley Scholarships:

Jennifer Deng

Computer Science / Georgia Institute of Technology

"I would also like to thank TAG-Ed for providing me the opportunity of interning to grow as a STEM student and thinker."

Snigdha Nellutla

Aerospace Engineering
Georgia Institute of Technology

"I want to give a huge thank you to TAG Ed for providing me with so many resources over the past two years. I've gotten to attend numerous career readiness sessions, be a summer intern at WarnerMedia, win the Revolutionary Award, participate in the Digital Student Immersion Experience, earn a small scholarship for college, and most importantly, prepare myself for my future and build lifelong connections. Thank you TAG Ed!"

Anika Vennel

Biomedical Engineering / University of Alabama

"I will be studying Biomedical Engineering in the Honors program at the University of Alabama at Birmingham. I aim to pursue a career in medicine and work in prosthetics and orthotics. I hope that through my career I will be able to leave a positive impact on others' lives through healthcare. I am very thankful to TAG-Ed for this scholarship to help me in furthering my education and allowing me to pursue my career goals. Thank you!"

The Potential of Artificial Intelligence

A six-part series about lifting humanity with AI

By Song-Chun Zhu, PhD
Professor of Statistics and Computer Science, UCLA
Founder and Chairman, DM Group

The Current State of AI

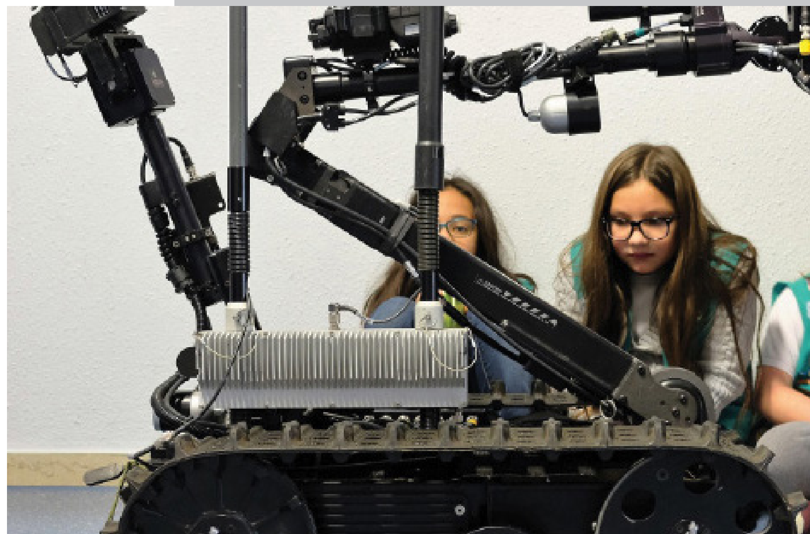
I define “artificial intelligence” as any technology that augments, through harmonious cooperation between humans and machines, human ability in performing tasks that change the physical and social world.

Intelligent computing machines can be virtual or physical robots. They differ from the tools and machines we have built over thousands of years: they can perceive, recognize, reason, make decisions, learn; they can perform tasks, collaborate, and communicate within social settings; they can adapt to human preferences, emotions, and even our ethical principles.

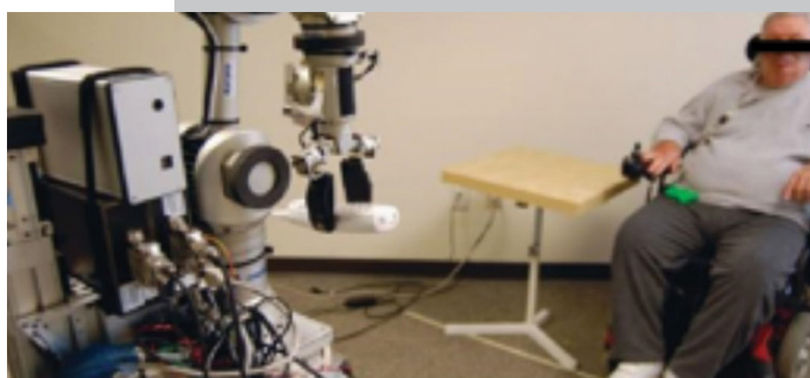
Science fiction and fantasies aside, let’s acknowledge recent breakthrough applications of A.I. Autonomous vehicles are already within reach. Robots can now be used in disaster relief, providing assistance in dangerous environments. iRobot PackBots, for example, are deployed in war zones to clear explosive devices and to detect biological, chemical, and radioactive threats. Intelligent prosthetic devices connect the human brain and body, restoring some control to people who have lost physical capabilities. Assistance robots are appearing in elder- and patient-care settings. The vision for intelligent systems has often outpaced reality itself.

Many public exhibitions of AI have been exposed as “hard-coded” robots that can only work in a specific setting, or only when operated directly by humans – controlled by “the man behind the curtain.”

The Fukushima Daiichi nuclear disaster of March 2011 illustrated some of the limits inherent in robotic technologies. Robots designed for deployment into disaster relief areas encountered unexpected challenges. In one particularly memorable case, a robot entering the disaster area dragged a cable along with it, subsequently becoming entangled within the cable.



Upon observation, a robotics expert joked that with our current technology, a robot would need two miniature nuclear power plants, one for the computer and motors and the other for the cooling system, to escape this predicament.



This claim may seem like an exaggeration to some given the astonishing robotic performances we see on the internet. In video demonstrations from Boston Dynamics, pictured at right, robots rarely tip over when kicked, and they can even upright themselves after a fall. Some of these robots have been designed to move fast like animals; some models look like robotic donkeys or giant dogs, and they are built to carry heavy loads.

Boston Dynamics was initially tasked and supported by the US Department of Defense to develop a fully-featured robot. After its acquisition by Google, the company discontinued their defense projects;

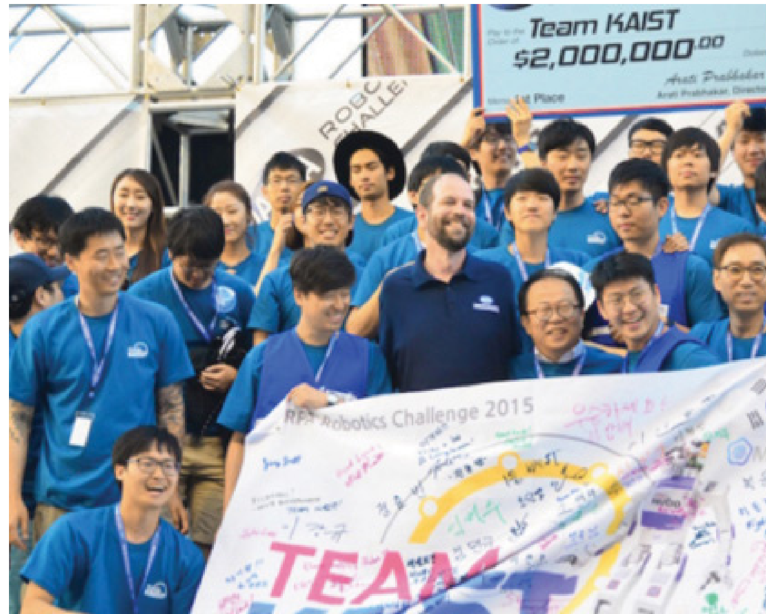
soon, however, Google sold the division to SoftBank.

A Telling Observation

In 2015, to test the status quo of robotics technology, the US Department of Defense Advanced Research Project Agency (DARPA) sponsored the final DARPA Robotics Challenge (DRC). The first prize was $2 million. Many teams competed to develop the best robotic system for assisting humans in response to a simulated natural disaster.

The challenge took place across three arenas, each one replicating, with Hollywood ingenuity, a disaster relief scene. Within these scenes, each robot attempted the following tasks:

1. Drive a car to the disaster site.
2. Step out of the car.
3. Open a door and enter a building.
4. Acquire tools.
5. Locate and close the offending valve.
6. Use a tool to break a hole in a concrete wall.
7. Pass through a barrier made of bricks.
8. Walk up an industrial ladder.



The winning team (pictured above) was from the Korea Advanced Institute of Science and Technology. On the right is their robot providing "disaster relief" by opening a door.

As I sat in the audience watching, the robots appeared to be effective. I was shocked and impressed. But later I learned that all the robots' actions were teleoperated. Every step and scene had an interface and was being controlled by a few students. Perception, autonomous action, and decision-making were all performed by humans. The robots themselves had little perception, cognitive reasoning, or planning ability.

When one robot tried to grasp the door handle, an error as small as one centimeter would prevent success. A small misstep on the stairs would cause the robot to lose balance. Because the off-stage human handlers had no "balance" signal, they could not react quickly enough to keep their robots upright.

Think about it: we avoid falling if tripped because we respond as an integrated body, but the students watching from a distance were too far removed from the robots' experience to respond in time...

...and the robots staggered on.

A Brief History of AI

The First Boom | 1956-1974

The first AI boom was from 1956-1974. The technologies of the time included propositional logic, predicate logic, and other forms of knowledge expression, such as heuristic search algorithms. Studies of computer chess began during this time.

Then the first so-called "AI Winter" began, marked by the ALPAC (Automatic Language Processing Advisory Committee) report of 1966. This report concluded that machine translation had failed, after a $20 million effort, due to the "common sense" problem. Meanwhile, other pessimistic reports were published, concluding that nothing practical would emerge from AI research in any reasonable time frame.

The Next Boom | 1980-1987 |

The second boom began with a group of outspoken professors and researchers in the early 1980s. At the time, people in the field were particularly excited about expert systems, knowledge engineering, and medical diagnosis. Following the US, China sought to develop expert systems for traditional Chinese medicine. Although progress was made, the solutions sometimes lacked sound theoretical foundations.

In 1986, I went to the University of Science and Technology in China to pursue my undergraduate degree in computer science. I was not very interested in the computer itself, since it was such a well-prescribed tool with a well-defined set of accompanying skills required to operate it. But AI was a deep, dark territory ripe for long-term exploration, so I took a graduate-level course in AI.

I was disappointed that, contrary to my expectations, the class covered little more than symbolic reasoning, which seemed out of touch from the reality of intelligence. At that time, the AI community was quite pessimistic, and morale was low. So, I focused instead on the relevant areas of human intelligence: neurophysiology, psychology, cognitive science, and others. This path led me to become aware of the emerging discipline of computer vision.

A brief wave of interest in neural networks arrived in the late 1980s. At the time, my undergraduate program was in its fifth and final year, and my thesis was related to this exciting AI method. Once the wave subsided, AI fell into relative obscurity for nearly thirty years.

The Third Boom | 2012-Now

The third explosion of interest in AI arrived with the rise of deep learning and continues to expand. At first, most researchers were cautious, pointing towards specific application areas, avoiding undue speculation about general-purpose artificial intelligence. Although Hollywood and some high-profile entrepreneurs and scientists discussed the concept of general AI (AGI, for Artificial General Intelligence), the attitude among researchers still remains cautious. I believe this trend may soon end.

As deep learning enabled breakthroughs in image recognition, speech transcription, and language translation, the term "AI" made a comeback in broader society. The corporate world seized this golden opportunity to generate positive PR; the term "AI" is used liberally, even by companies who do not fully understand it, to spark excitement and convey a sense of being on innovation's cutting edge. Surely, the thinking goes, AI will unlock vast transformations, and no one wants to be seen as missing the train.

Some believe that this boom will not bust – that this time around, winter will not come. But whether winter comes or not depends on how and what we do today.

For nearly thirty years from when I started university, the term "AI" disappeared from the public conversation. But AI did not disappear; it ramified into five distinct disciplines:

- **Computer vision**
- **Cognitive science**
- **Natural language understanding**
- **Robotics**
- **Machine learning**

Each discipline formed its own academic community, with its own international conferences and its own journals to match. Each discipline developed independently; a small community working on game playing and common sense reasoning were all that was left of what was once considered the field of "artificial intelligence."

I call these thirty years the "divide-and-conquer period," a time in which the five disciplines of what is now AI grew and developed independently.

About the author:
Song-Chun Zhu is a Chinese-American computer scientist and applied mathematician known for his work in computer vision, cognitive artificial intelligence, and robotics. Zhu founded DMAI as an AI startup to lift humanity by developing cognitive AI assistants and platforms that make personal connections to individuals. He is widely recognized as a global thought leader and innovator within the field of artificial general intelligence.

Engage Students

With Real-World STEM Connections

Nepris partners professionals with learners to explain their professions.

by Wayne D'Orio

Karla Clark knows the power of helping children find out what their passions may be. As a project manager with the Southern Oregon Education Service District, she's using the Covid-19 shutdown to help highlight various careers in her area through videos with industry professionals.

When a recent session featured a hair salon owner, her own 14-year-old daughter was interested. After learning the specifics, from cutting hair to balancing finances and more, her daughter's mind was made up. "I don't want to do that," she said.

Clark had a much happier outcome when she ran a recent video session on Valley Immediate Care, an urgent care center with offices throughout Oregon. A high school student, watching with her mother, finished the session by declaring: "I want to intern there."

Clark is using Nepris, a company that facilitates virtual connections between students and industry professionals to help inform children in her corner of Oregon about the vast number of jobs, many including STEM, in their area.

Nepris offered free access through May to its live virtual industry chats and video library, allowing students and their parents to peruse the nearly 2,000 videos involving STEM careers alone on the platform.

This summer, Nepris is hosting a Virtual Summer Camp for students in elementary, middle and high school that costs just $20 per week. Students get to meet career professionals from L'Oreal USA, NASA, World Wildlife Fund, Google, YouTube, Verizon, LinkedIn, just to name a few. From touring a farm to understand where food comes from to learning about space from rocket scientists, campers have real-world experiences to make the subjects they learn in school more relevant to their lives and that hopefully help them map out a career path.

STEM Needs Surge

Fifteen years ago, the country's STEM crisis was laid bare, as a key report showed that students were falling behind in vital topics at precisely the time the country needed more of these workers.

The report, Rising Above the Gathering Storm by the U.S. National Academies of Science, Engineering, and Medicine, kicked off a flurry of activity from federal legislation to new science standards to provisions in the Every Student Succeeds Act. The public was on board, as 86 percent agreed that increasing the number of STEM workers would help the country maintain its position in the global economy.

All this momentum has resulted in a good news/bad news scenario. The good? More American students are choosing STEM majors in college. From 2010 to 2016,

there was a 43 percent increase in undergraduate students studying science, technology, engineering, and math. Indeed, three of every four graduates in 2018 majored in STEM-related fields.

The bad? Even with that surge, the country may be in even worse shape regarding STEM readiness than it was in 2005. How is this possible? A big part of the answer is simple supply and demand. In the last decade alone, there were two million new STEM jobs created. Because eight of the 10 fastest growing jobs are in STEM fields, there were still 2.4 million positions unfilled in 2018.

Awareness and Information

Clark aims to help lessen the STEM need by making sure to provide southern Oregon students first awareness about certain professions, and then as they get older, the information they need to direct their studies toward STEM industries.

Through Nepris, these real-world connections to a wide variety of professionals in a variety of STEM fields can range from what it's like to work a telescope at the National Solar Observatory to life as a NASA engineer.

Educators can use Nepris in a variety of ways. Teachers can request a live session, spelling out their students' ages, what they are studying, and what they hope to learn during the video. They can view a prerecorded chat, quickly picking between the thousands of existing videos. The chats are arranged both by topic and grade level, making it easy to zero in on a STEM talent fitting their students. For instance, among the nearly 2,000 STEM videos, elementary students can learn about the various uses for drones while advanced high school students can learn how to perform independent research to produce usable quantities of PETase to dissolve polyethylene terephthalate microplastics.

In Oregon, Clark goes to various companies and sets up industry chats, where officials explain what they do and the education they obtained to qualify for their jobs. Students can watch these sessions live, or dip into the library and watch on demand.

"As a rural district it's not often possible to connect our students with diverse industry professionals. Nepris has made it effortless," says Kim Alexander, the CEO of Roscoe Collegiate Independent School District. Roscoe is located more than 200 miles west of Dallas.

"My students were engaged and really asking some deep, higher-ordered questions. This was such a fabulous, authentic learning experience that my children will talk about it for years to come," says Courtney Parks, a fifth-grade teacher from New Jersey's Drum Point Elementary School.

As much as educators like the site, so do the professionals who are able to volunteer easily. "If I can convince one student to become an engineer, then I consider this session a success," says Neeraj Shah, an automotive engineer with General Motors.

"Now is a time to promote STEM learning and growth," says Ashley Szofer, senior director of STEMconnector, a professional services firm. "STEMconnector is collaborating with members across our network to ensure access to virtual resources."

Representing Minorities

The wide field of professionals also allows teachers to specify languages for their students. For instance, Clark ran one session with a sign language interpreter and live captions after an instructor mentioned she had hard-of-hearing students.

And down in Kansas City, Missouri, English Language Learner teacher Stacey Hinkle set up a session with NASA engineer Benito Prats entirely in Spanish. For her Hispanic and Latinx students, "it really helps to see people in careers that look like them," Hinkle says. Prats discussed his educational background and showed the students models of NASA's Mars rover. Although not all of her students at Crossroads Preparatory Academy are taking engineering, the engaging session captured their attention, she adds.

Hinkle says she has coordinated about seven Nepris sessions, including another one in Spanish and one that took students on a virtual tour of a Kansas City fire station.

With the format of school in the fall uncertain, Clark knows that she'll use Nepris as part of her students' future. She's already lining up subjects for upcoming sessions, including a fish biologist from the Bureau of Land Management, professionals from a timber company, and the owner of a chain of Supercuts.

"It's hard to plan if we don't know what school will look like this fall," Clark says. "But we have to plan something. We need a plan B and a plan C."

Wayne D'Orio is a freelance journalist who writes frequently about education, equity, and rural issues. He is a regular contributor to The Hechinger Report. His byline has appeared in The Atlantic, Wired, Education Next, and Christian Science Monitor. Follow him @waynedorio.

Professional Etiquette Is *Still* Important

JJ DiGeronimo
President of Tech Savvy Women, author of "Accelerate Your Impact" and "The Working Woman's GPS" to retain, develop and advance diverse talent in STEM- based organizations.

by JJ DiGeronimo

In this tech-driven world, we often find ourselves using shorthand speak in an effort to speed up projects, objectives and business experiences. However, there are some old school traditions that simply can't be forgotten; professional etiquette should be at the top of the list and both school, home and work.

Professional Etiquette – A Sign of Respect
Whether you are meeting for the first time or not, utilizing a little etiquette is a great way of showing respect:

- Arrive on time
- Offer your hand for a firm handshake
- Make eye contact
- Use your full name
- Introduce those that might be with you
- Be polite

Etiquette can be demonstrated in person, over the phone or within your email messages.

Phone Etiquette

There are several ways that you can show respect to the other person on the phone. It may sound silly, but putting a smile on your face when you speak on the phone really does make a difference in the tone of your voice.

Always be aware of the other person's time and schedule. Make sure you ask if this is a good time to talk and if not, offer up options for a follow-up call.

Speak clearly. If you are a fast talker, be aware that it may be difficult to follow your conversation so take time to slow your cadence. Using mobile phones can offer up additional challenges, be aware of your cell reception, background sounds, and other distractions.

Email Etiquette

Email offers its own unique challenges when it comes to Professional Etiquette. We've all been part of the never-ending email chain that includes way more people than are really necessary and the dreaded "reply all."

There are actually times when reply all is necessary but first, make sure that the right people are included in the message. Use a clear subject line and keep the body of your email to one topic. Many people file and sort their messages by project, department or person and if you include multiple topics in one email, this becomes a challenge.

Also, if the opportunity to speak in person is an option, consider walking down the hall or picking up the phone so that you can engage in a conversation. How many times have you received an email from the person in the next office when they could have easily just knocked on your door?

Professional Etiquette When Seeking a Mentor/Sponsor

There is a special level of importance to your professional etiquette when seeking a mentor or a sponsor to help you advance in your career.

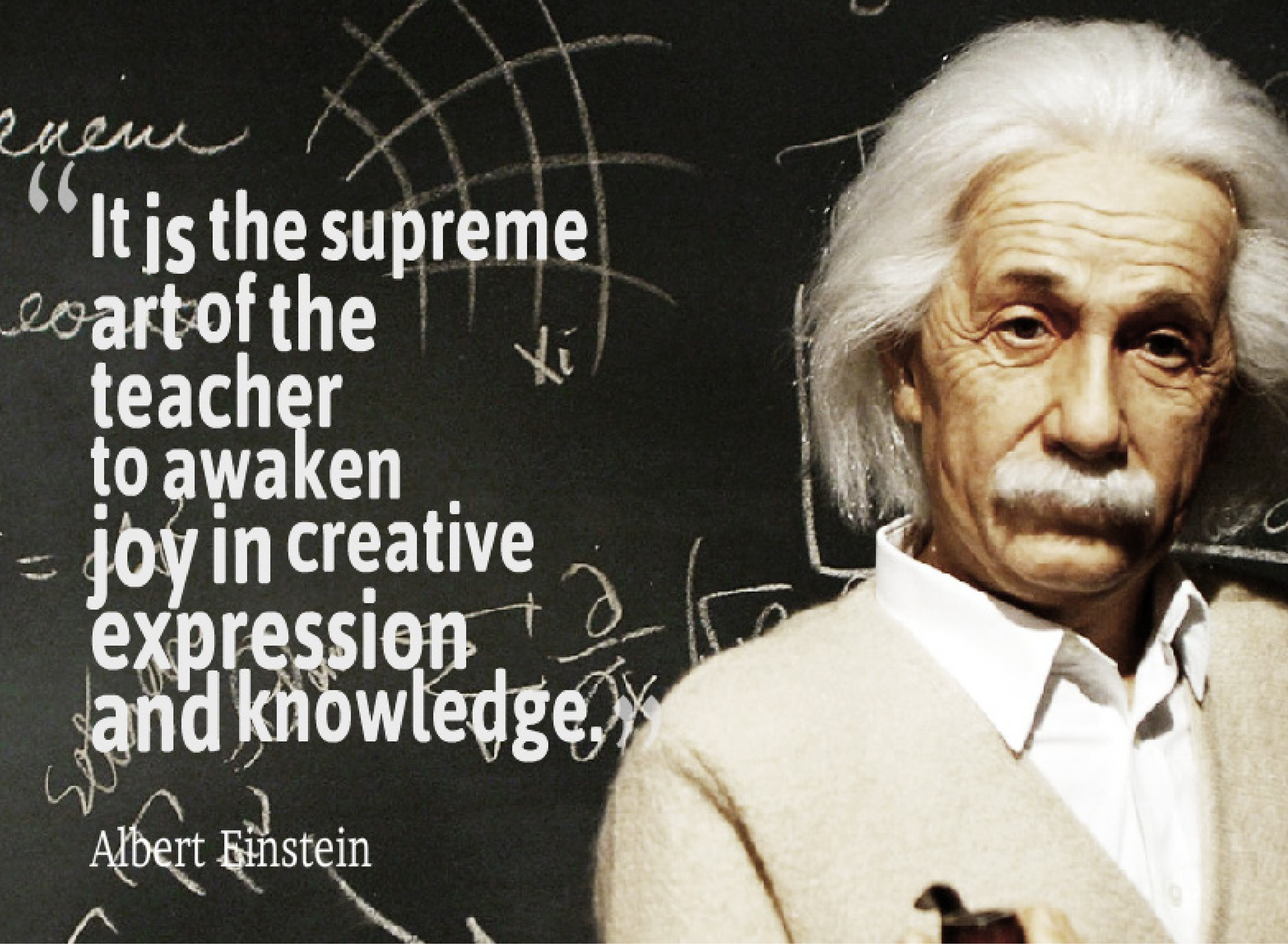
Like most strategic activities, aligning with sponsors takes a plan, awareness, and courtesy. These exchanges and high-value alignments can help catapult your career or business to new levels of impact. With this, professional etiquette still applies. I recommend the same professional politeness you would have for executives with a focus on consideration for their time, awareness of competing activities, and acknowledgment that it takes personal preparation. Even though there are many professionals with social capital, not everyone wants or can be your sponsor, so be ready for some rejections too. Accept rejections with grace.

It is nice to know that in this face-paced, ever-changing world, basics like chivalry, ethics, respect, and etiquette are still important in our lives.

Please enjoy and share this issue with your teachers, parents, and students, so they may enjoy it and learn too.

Now more than ever, the home is where resources are needed to explore how to learn best, and how to teach effectively. Georgia Pathways has always focused first on the educator, as they are usually the primary influencer in the lives of our students. As parents come onboard the “teaching team” during this crisis, educational information has never been more necessary or valued.

Let Georgia Pathways be one of your value-added assets.



Combining Science with the Art of Teaching

Dr. Judy Willis

The implications of neuroimaging for education and learning research are still largely suggestive. Researchers have not yet established a solid link between how the brain learns and how it metabolizes oxygen or glucose.

It is premature to claim that any instructional strategies are firmly validated by a solid combination of cognitive studies, neuroimaging, and classroom research. For now, educators must be guided by a combination of the art of teaching and the science of how the brain responds metabolically and electrically to stimuli. Here are some promising areas of research and practice.

The Amygdala—Where Heart Meets Mind

The education literature has included theories about the effects of emotion on language acquisition for decades. Dulay and Burt (1977) and Krashen (1982) proposed that strong positive emotion reinforces learning, whereas excessive levels of stress and anxiety interfere with learning. Educators know from subsequent cognitive psychology studies and firsthand classroom experience that high stress, boredom, confusion, low motivation, and anxiety can hinder students' learning (Christianson, 1992).

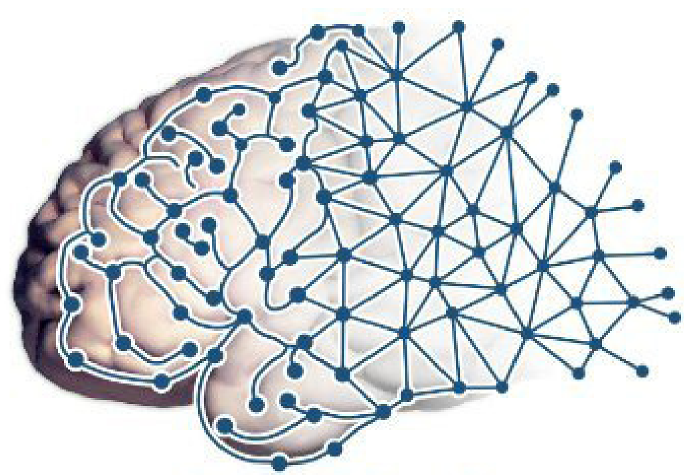
Research using neuroimaging and neuroelectrical brain wave monitoring supports the connection between emotion and learning, enabling us to see what happens in the brain during stress (Introini-Collison, Miyazaki, & McGaugh, 1991).

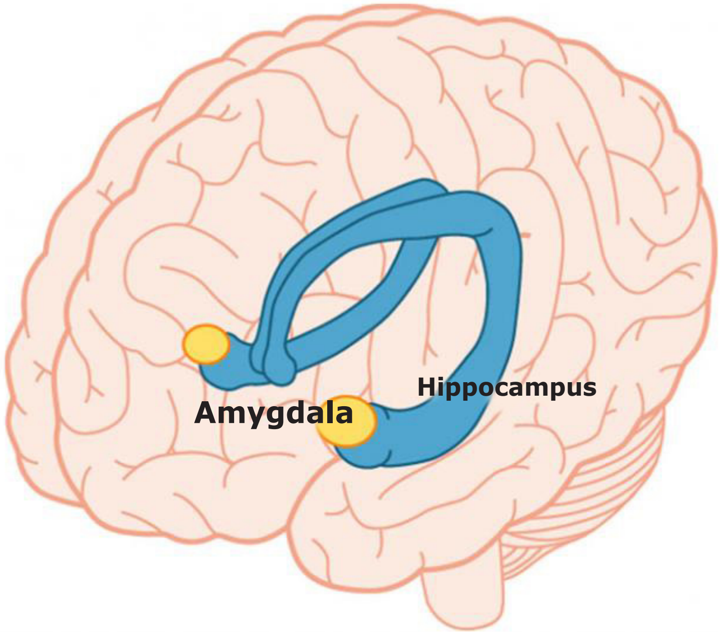
The amygdala, part of the limbic system in the temporal lobe, senses threat and becomes overactive, delaying or blocking electrical activity conduction through the higher cognitive centers of the brain. When the amygdala is in the overactive metabolic state associated with stress, the rest of the brain's cortex does not show the usual fMRI or PET scan activation that represents the processing of data (Chugani, 1998; Pawlak, Magarinos, Melchor, McEwen, & Strickland, 2003).

New information coming through the sensory intake areas of the brain cannot pass as efficiently through the amygdala's affective filter to gain access to the brain's cognitive processing and memory storage areas, such as the left prefrontal cortex.

Additional evidence of the amygdala's role as an affective filter comes from real-time neuroelectric studies, which demonstrate that the somato-sensory cortex areas are the most active areas of the brain during the moments when new information is received. These are regions found in each brain lobe that receive input from each individual sense—hearing, touch, taste, vision, and smell (Andreasen et al. 1999).

Mapping studies show that bursts of brain activity from the somatosensory cortex are followed milliseconds later by bursts of electrical activity in the hippocampus, the amygdala, and then the other parts of the limbic system (Sowell, Peterson, & Thompson, 2003). This is one of the most exciting areas of brain-based learning research because it shows which strategies stimulate and impede communication among the parts of the brain when an individual processes and stores information (Shadmehr & Holcomb, 1997).





"This is one of the most exciting areas of brain-based learning research because it shows which strategies stimulate and impede communication among the parts of the brain when an individual processes and stores information"

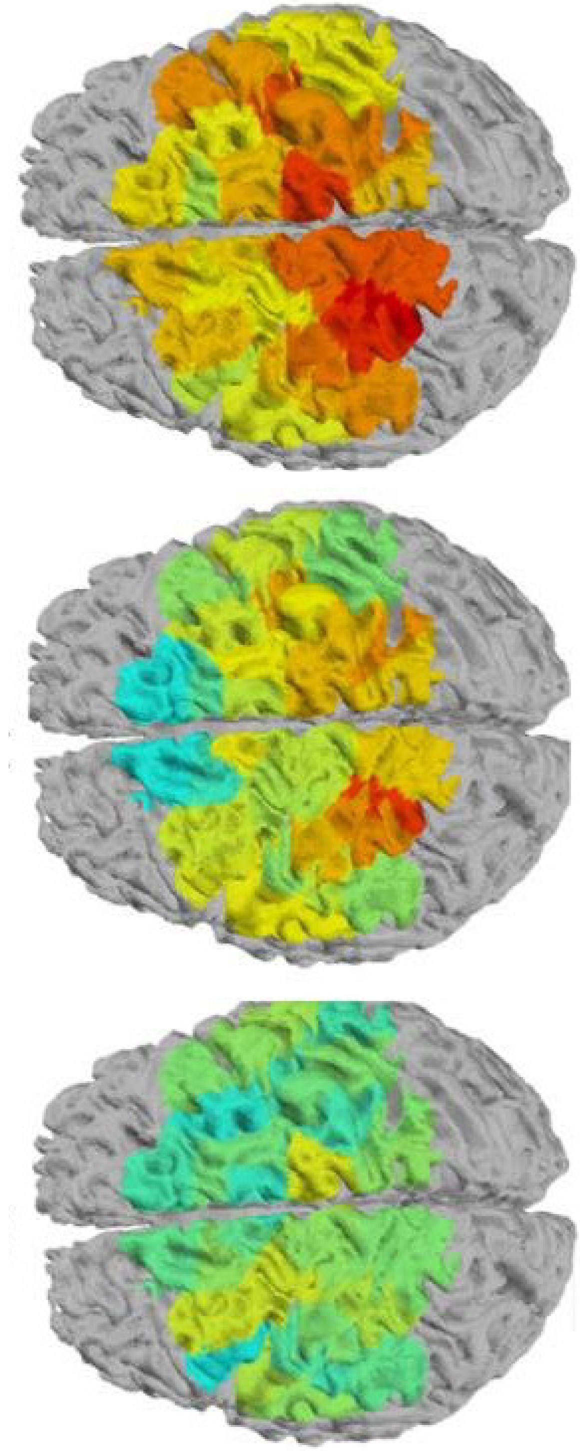
This brain research supports educators' firsthand experience, which tells us that superior learning takes place when learning activities are enjoyable and relevant to students' lives, interests, and experiences (Puca & Schmalt, 1999). Teachers recognize the state of anxiety that occurs when students feel alienated from their reading experiences or anxious about their lack of understanding. I witnessed this response when, as a student teacher, I worked in a school district that had implemented time-and-page synchronization of its phonics-heavy reading program (Open Court). All teachers were required to cover material at a mandated pace, so that students at each grade level were on the same page of the program each day.

Second graders were brought to tears or outbursts of frustration when they were confused; their requests for help went unheeded as teachers struggled to keep to the timetable. Students were told, "Don't worry. If you don't understand or finish now, you'll be taught this same material in a lesson some time in the future."

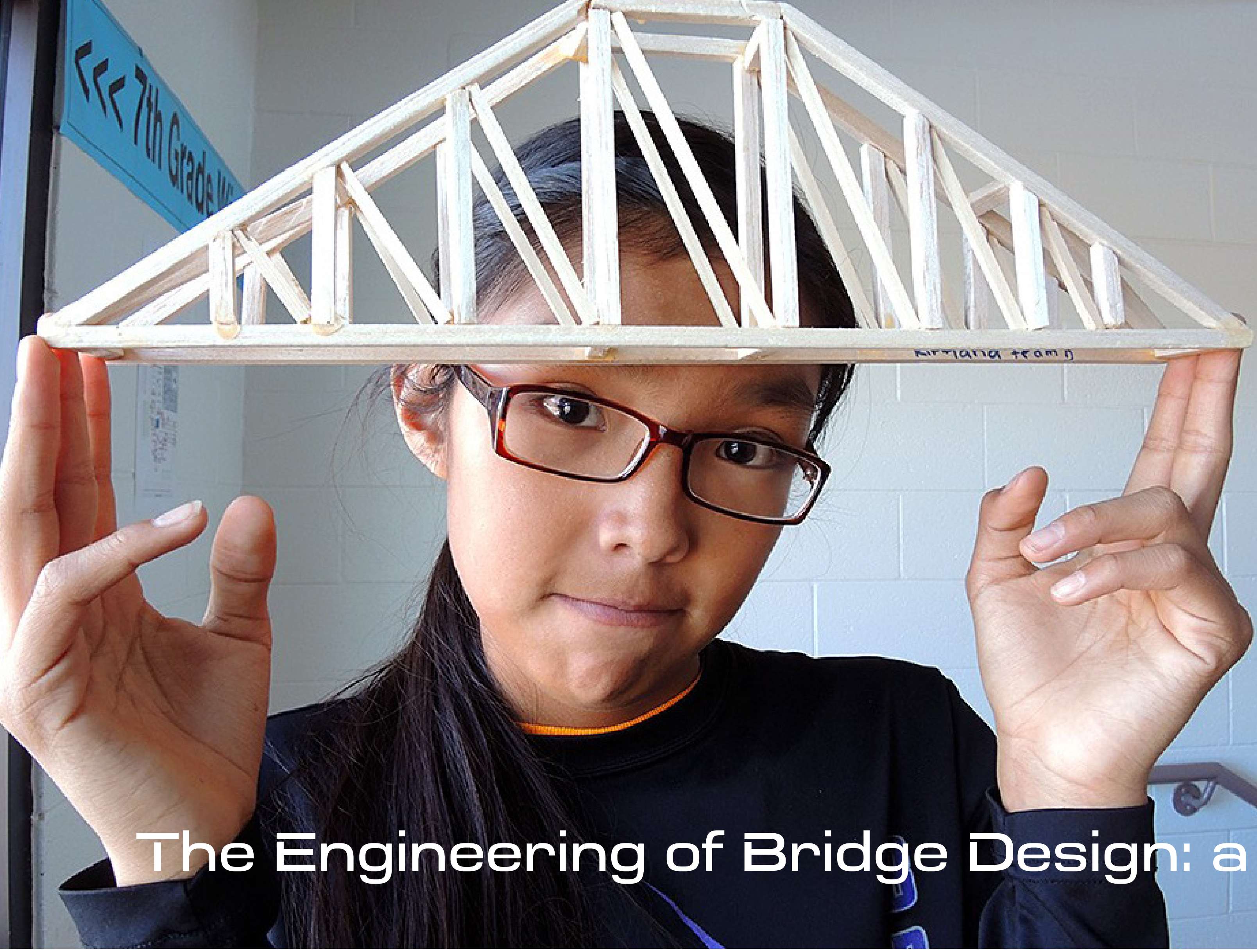
"Second graders were brought to tears or outbursts of frustration when they were confused; their requests for help went unheeded as teachers struggled to keep to the timetable."

Neurochemical, neuroimaging, and neuroelectric research support a learning model in which reading experiences are enjoyable and relevant. The brain research evidence reinforces the need for classrooms to become places where students' imaginations and spirits are embraced when reading time begins.

Now, with parents being even more promonantly in the forefront of their children's education, they as well as every teacher and administrator in your school needs to know this. This is not a science issue or math issue.....it's a learning issue. Please share it with them and encourage them to read STEM Magazine.



Dr. Judy Willis is an authority on brain research regarding learning and the brain. With the unique background as both a neurologist and classroom teacher, she writes extensively for professional educational journals and has written six books about applying the mind, brain, and education research to classroom teaching strategies, including an ASCD top seller, Research-Based Strategies to Ignite Student Learning.



The Engineering of Bridge Design: a

by Wayne Carley

"Do you want to design and build something wonderful at home?

This is a great home activity with tons of educational value for every age group. You can use almost anything around the house to build a bridge, and if that doesn't work, go outside and use dirt and rocks!"

Modern designers have written about elegance or aesthetics since the early 19th century, beginning with the Scottish engineer Thomas Telford. Bridges ultimately belong to the general public, which is the final arbiter of this issue, but in general there are three positions taken by professionals.

The first principle says that the structure of a bridge is the "imagination" of the engineer and that beauty is fully achieved only by the addition of architecture.

The second idea, arguing from the standpoint of pure engineering, insists that bridges making the most efficient possible use of materials are by definition beautiful. The third case holds that architecture is not needed but that engineers must think about how to make the structure beautiful. This last principle recognizes the fact that engineers have many possible choices of roughly equal efficiency and economy and can therefore express their own aesthetic ideas without adding significantly to materials or cost.

All major bridges are built with the publics money. Therefore, bridge design that best serves the public interest has a threefold goal: to be as efficient, as economical, and as elegant as is safely possible.

STEAM endeavour

Efficiency is a scientific principle that puts a value on reducing materials while increasing performance.

Economy is a social principle that puts value on reducing the costs of construction and maintenance while retaining efficiency. Finally, elegance is a symbolic or visual principle that puts value on the personal expression of the designer without compromising performance or economy. There is little disagreement over what constitutes efficiency and economy, but the definition of elegance has always been controversial.

Bridge structure is that which spans horizontally between supports, whose function is to carry vertical loads. The prototypical bridge is quite simple—two supports holding up a beam—yet the engineering problems that must be overcome even in this simple form are inherent in every bridge: the supports must be strong enough to hold the structure up, and the span between supports must be strong enough to carry the loads. Spans are generally made as short as possible; long spans are justified where good foundations are limited—for example, over estuaries with deep water.

Generally speaking, bridges can be divided into two categories: standard overpass bridges or unique-design bridges over rivers, chasms, or estuaries.

THE ELEMENTS OF BRIDGE DESIGN BASIC FORMS

There are six basic bridge forms: the beam, the truss, the arch, the suspension, the cantilever, and the cable-stay.

BEAM

The beam bridge is the most common bridge form. A beam carries vertical loads by bending. As the beam bridge bends, it undergoes horizontal compression on the top. At the same time, the bottom of the beam is subjected to horizontal tension. The supports carry the loads from the beam by compression vertically to the foundations.

When a bridge is made up of beams spanning between only two supports, it is called a simply supported beam bridge.

If two or more beams are joined rigidly together over supports, the bridge becomes continuous.

TRUSS

A single-span truss bridge is like a simply supported beam because it carries vertical loads by bending. Bending leads to compression in the top chords (or horizontal members), tension in the bottom chords, and either tension or compression in the vertical and diagonal members, depending on their orientation. Trusses are popular because they use a relatively small amount of material to carry relatively large loads.

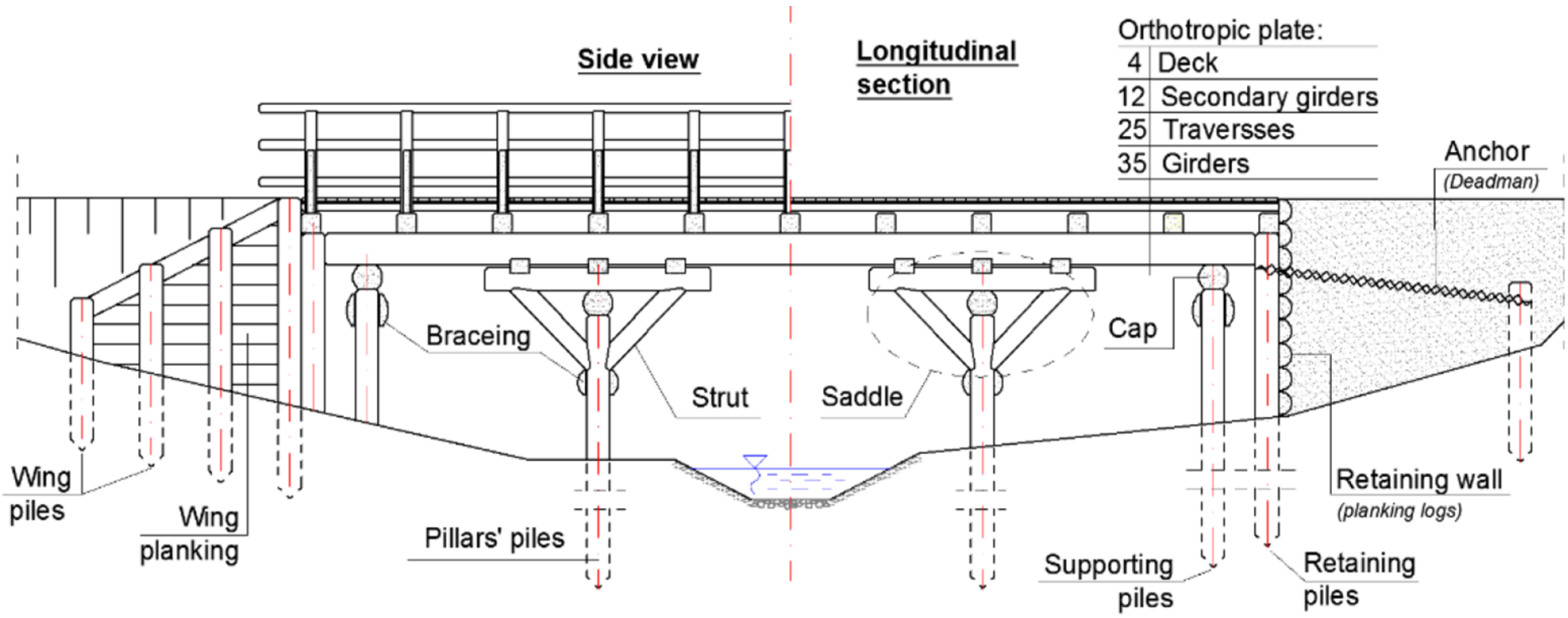
ARCH

The arch bridge carries loads primarily by compression, which exerts on the foundation both vertical and horizontal forces. Arch foundations must therefore prevent both vertical settling and horizontal sliding.

In spite of the more complicated foundation design, the structure itself normally requires less material than a beam bridge of the same span.

SUSPENSION

A suspension bridge carries vertical loads through curved cables in tension. These loads are transferred both to the towers, which carry them by vertical compression to the ground, and to the anchorages, which must resist the inward and some-



times vertical pull of the cables. The suspension bridge can be viewed as an upside-down arch in tension with only the towers in compression. Because the deck is hung in the air, care must be taken to ensure that it does not move excessively under loading. The deck therefore must be either heavy or stiff or both.

CANTILEVER

A beam is said to be cantilevered when it projects outward, supported only at one end. A cantilever bridge is generally made with three spans, of which the outer spans are both anchored down at the shore and cantilever out over the channel to be crossed.

The central span rests on the cantilevered arms extending from the outer spans; it carries vertical loads like a simply supported beam or a truss—that is, by tension forces in the lower chords and compression in the upper chords. The cantilevers carry their loads by tension in the upper chords and compression in the lower ones. Inner towers carry those forces by compression to the foundation, and outer towers carry the forces by tension to the far foundations.

CABLE-STAY

Cable-stayed bridges carry the vertical main-span loads by nearly straight diagonal cables in tension. The towers transfer the cable forces to the foundations through vertical compression. The tensile forces in the cables also put the deck into horizontal compression.

MATERIALS

The four primary materials used for bridges have been wood, stone, iron, and concrete. Of these, iron has had the greatest effect on modern bridges. From iron, steel is made, and steel is used to make reinforced and pre-stressed concrete. Modern bridges are almost exclusively built with steel, reinforced concrete, and pre-stressed concrete.

WOOD AND STONE

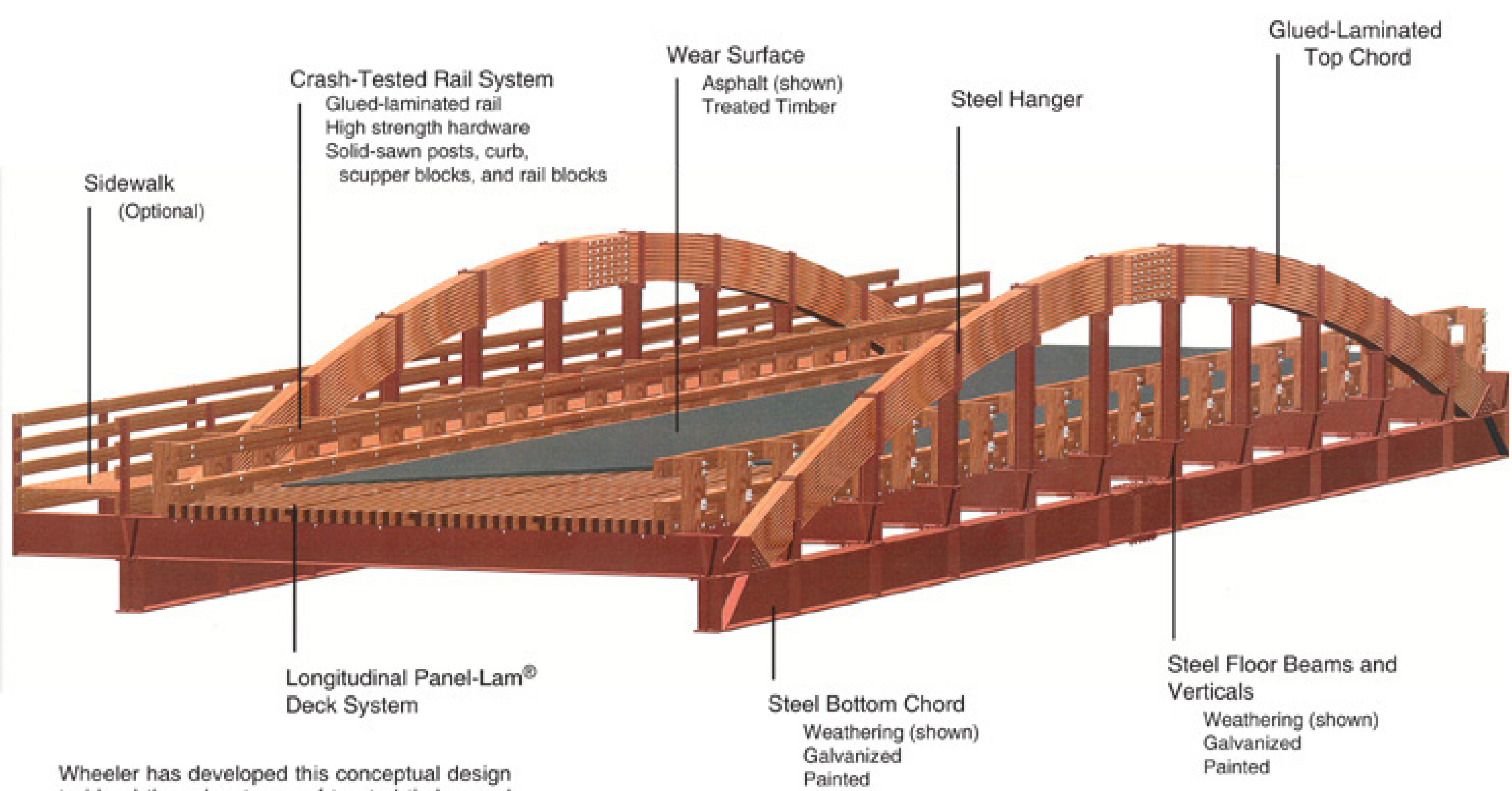
Wood is relatively weak in both compression and tension, but it has almost always been widely available and inexpensive. Wood has been used effectively for small bridges that carry light loads, such as footbridges. Engineers now incorporate laminated wooden beams and arches into some modern bridges. Stone is strong in compression but weak in tension. Its primary application has been in arches, piers, and abutments.

IRON AND STEEL

The first iron used during the Industrial Revolution was cast iron, which is strong in compression but weak in tension. Wrought iron, on the other hand, is as strong in compression as cast iron, but it also has much greater tensile strength. Steel is an even further refinement of iron and is yet stronger, superior to any iron in both tension and compression. Steel can be made to varying strengths, some alloys being five times stronger than others. The engineer refers to these as high-strength steels.

CONCRETE

Concrete is an artificial stone made from a mixture of water, sand, gravel, and a binder such as cement. Like stone, it is strong in compression and weak in tension. Concrete with steel bars embedded in it is called reinforced concrete. Reinforcement allows for less concrete to be used because the steel carries all the tension; also, the concrete protects the steel from corrosion and fire.



Wheeler has developed this conceptual design to blend the advantages of treated timber and steel. This long span design is based on a two lane roadway and HS-20 loading.

Pre-stressed concrete is an important variation of reinforced concrete. A typical process, called post-tensioned pre-stressing, involves casting concrete beams with longitudinal holes for steel tendons—cables or bars—like reinforced concrete, but the holes for the tendons are curved upward from end to end, and the tendons, once fitted inside, are stretched and then anchored at the ends.

The tendons, now under high tension, pull the two anchored ends together, putting the beam into compression. In addition, the curved tendons exert an upward force, and the designer can make this upward force counteract much of the downward load expected to be carried by the beam. Pre-stressed concrete reduces the amount of steel and concrete needed in a structure, leading to lighter designs that are often less expensive designs.

The Science:

The definition of science we prefer is "the systematic accumulation of knowledge".

Past experience of bridge building is vital information when planning your design... what has failed?, what has worked? Are there any past construction project that are like mine? The more time you spend gathering information about past designs, materials, locations, weather patterns, soil chemistry and new materials technology, the better your chances of success.

The Technology:

Year after year, new devices for measuring material strength, durability, affordability and maintenance are developed. This will be another important part of your successful design.

The Engineering:

Engineering is a "problem solving" process, not just building things. A vast number of problems must be overcome to design your bridge. Here are a few concerns.

Location;
- over water
- through mountains
- across swamps

- long distances
- high locations
- bad weather conditions
- limited budget / money
- man made obstacles already there

One thing is certain, new problems you did not expect will occur and you will have to find a solution. That is engineering method.

The ART:

The creative aspects of design and use of past, current and potential materials and construction methods have always driven bridge construction. Otherwise, all bridges would look alike. This may be the most exciting part for the bridge architect as they explore the "possible" and find their own personal satisfaction in this career choice.

The Math:

Although you will have employees to also check the math, you and the architects will have your hands full. The math calculations will make or break your project. Here are a few.

- The geometry of the bridge; a branch of mathematics that deals with the measurement, properties, and relationships of points, lines, angles, surfaces, and solids....or easier said, the shape of the bridge.

Will it stay up? Will it support the weight of traffic? Will the wind blow it over?

- The use of algebra; a branch of mathematics in which symbols (as letters and numbers) are combined according to the rules of arithmetic. There will be many applications of basic math and the use of letters and numbers that apply to materials, angles and calculations.

The Physics; a science that deals with matter and energy and the way they act on each other in heat, light, electricity, and sound. Physics is both scientific and mathematical but may be one of the most important subject you will need to know.

It is important to remember that if you really want to accomplish a task of any kind, even if you may not really enjoy the school subjects required, you WILL learn that subject because of your determination to succeed. The medicine may taste bad, but you know it will make you healthy again.

Take it one day at a time, learn one new thing at a time, never quit, and soon you'll know ALL the things you need to pursue that dream career.

Major aircraft manufacturers are predicting a need for thousands of aircraft mechanic s each year over the next several years as more and more airplanes are produced. So the career as an aircraft mechanic is still up-and-coming. There is the answer of how to become an aircraft mechanic.

Previously a person who was responsible for aircraft technical support was called aircraft mechanic. Now the term used in the U.S. is usually aircraft maintenance technicians (AMT).

A Great STEAM Career, across the U.S.

AMT

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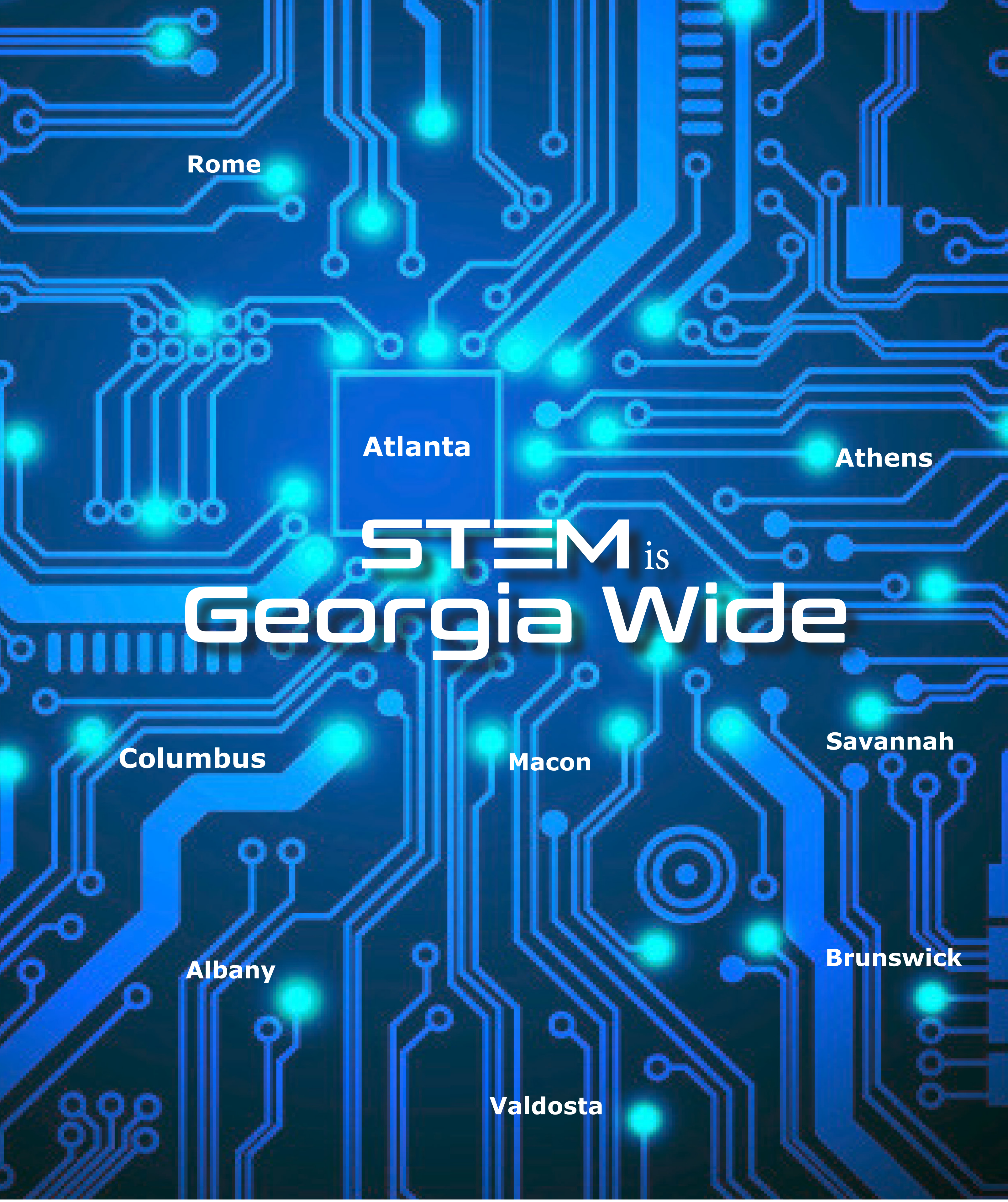

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