MAY 2022

GEORGIA PATHWAYS

MAGAZINE

Cows and Robots?

A New Georgia STEM Career Path

Machine Learning

Aerodynamics of Racing

TAG Technology Association of Georgia

TAG TAG-Ed Education Collaborative

The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEAM 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 2000. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEAM education in Georgia.

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Welcome to the May 2022 issue of Georgia Pathways Magazine.

TAG and our non-profit arm TAG-Ed are deeply committed to developing the next generation of tech talent in Georgia and beyond.

As such, TAG-Ed recently launched a new initiative to connect young professionals with industry experts and executives. The Pathways to Leadership program enables those who are starting their careers to receive tailored advice from seasoned professionals.

This year's cohort will focus on collaboration as they create, build, and invent new solutions to solve challenges relevant to our region. Some of the topics that will be broached include creative problem-solving, strategic agility, conflict management, and navigating change. Our cohorts are consistently diverse and representative of different backgrounds in Georgia, including various industries, cultures, ages, and experiences.

Members for the twelve-month program are chosen based on their nomination by an executive within their organization or community. Interested individuals may also self-nominate. Cohort classes are supplemented with small group conversations and projects to encourage relationship building, experiences, and outcomes. The deadline to apply is May 31st, 2022.

In addition, TAG-Ed recommends a variety of regional summer camps to help Georgia's youth hone new skills in a playful, age-appropriate setting. From computer science and coding to engineering, robotics, rocketry, and mathematics challenges, participants will continue to expand their knowledge as they take time off from school.

TAG
Technology Association of Georgia

By attending a supplementary STEM program, children will learn new abilities from positive role models and make life-long connections with like-minded children. Continue to check our website (www.tagedonline.org) to find the perfect program as camp information becomes available.

TAG and TAG-Ed look forward to witnessing the emergence of a new era of tech leaders in Georgia and beyond. Our dedication to the advancement of our students and young professionals remains strong as we continue to offer career development opportunities throughout the year.

If you enjoy this month's issue of Georgia Pathways Magazine, please share it to assist in our mission of developing the workforce of tomorrow. We hope to inspire the next generation of tech talent to continue to develop as leaders and learn about the many career possibilities available to them.

Larry K. Williams
President
TAG / 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.

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CYBERWARRIOR FOUNDATION
CyberWarrior.org/diversity

WORKFORCE DIVERSITY PROGRAM

The CyberWarrior Foundation, in partnership with the Security & Infrastructure Security Agency (CISA), is creating high-wage career opportunities for historically underrepresented communities, including the underserved, women, veterans, and underemployed individuals.

Our mission is to bridge the technology skills and diversity gaps by providing cybersecurity training, employment opportunities, and transitional support necessary for people to gain the knowledge, skills, and abilities for career opportunities and growth. We understand that strength lies in differences, not in similarities, so diversity is our core value, and we actively promote it through the cybersecurity industry.

Our Cybersecurity Workforce Development and Training Program for Underserved Communities, in coordination with the Department of Homeland Security and CISA, serves people from the Northeast (CISA Region #1) and the Southeast (CISA Region #4).

If you are from a state on one of the following maps, visit cyberwarrior.org/diversity for more information.

BOOTCAMP PROGRAM OVERVIEW

CyberWarrior has developed a training that brings together vocational lab-driven exercises delivered by ethical hackers and industry experts, combined with the hands-on knowledge, tools, and certifications necessary to launch a career in cybersecurity. Further, the content was built using the National Institute of Standards and Technology (NIST) framework and mapped to the National Initiative for Cybersecurity Education (NICE).

CLASSROOM AND LAB TRAINING

4	800	28	7
national recognized certifications	Hours	weeks	proprietary technical courses

INDUSTRY-RECOGNIZED CERTIFICATIONS + PROPRIETARY TECHNICAL COURSES

- CompTIA Network+
- CompTIA Security+
- EC-Council Certified Ethical Hacker (CEH)
- EC-Council Certified Network Defender (CND)
- Malware Analysis
- Incident Response
- Security Automation
- Firewalls and IDPS
- Vulnerability Management
- Package Analysis
- Security Monitoring

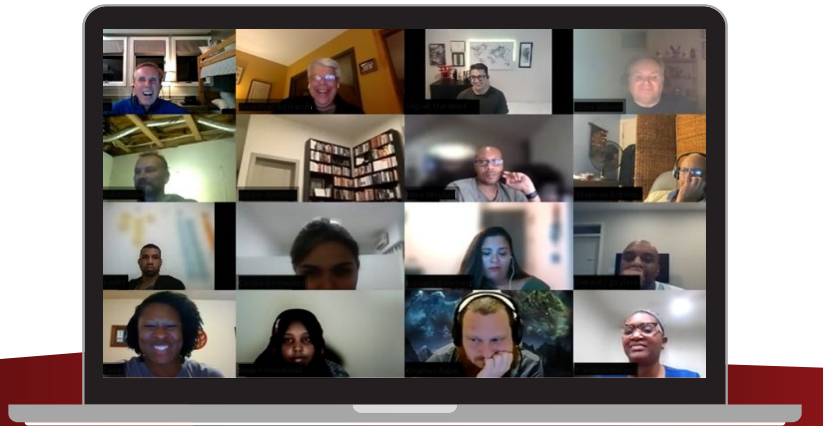
Our students have the opportunity to receive 27 college credits, making CyberWarrior Cybersecurity Bootcamp the most comprehensive cybersecurity program today.

Our innovative Career Hacks course delivers the soft skills to engage in the “business” of cybersecurity. Moreover, CyberWarrior exclusively connects the students with industry practitioners (recognized CISOs, security directors, and more) to share real-world experiences, “a day in the life” of a Cybersecurity professional, what the student should expect upon graduation, and receive personal mentorship each week.

DELIVERY METHODOLOGY

CyberWarrior’s curriculum is refined for online learning and is purposely dynamic to meet the evolving needs of our employer partners. Our model includes 4-hour online classes with live instructors, quizzes, and hands-on labs, in individual and group settings. Instructors are experts who can give real examples of our content’s relevance during an attack.

Launch your cybersecurity career in just six months. To learn more, visit us at CyberWarrior.org/diversity.



Parents reading this magazine often notice the shortcomings of STEM education in Elementary and Middle School education. While public and private schools are making strides in growing their STEM programs, supplementary STEM education is also an option. This recovery or advancement can come through summer camps, after-school enrichment programs, and in-school field trips. There are more providers every year, but choosing the right one for your child can be challenging.

When evaluating supplemental STEM education programs for a child, consider the reputation of the company and the social fit for your child. Children interested in STEM often look for like-minded friends that they are not meeting in their regular school activities.

Attending a supplementary STEM program can allow the child to learn new skills from positive role models and make life-long connections with like-minded friends.

At Club SciKidz, we know that you want to be the parent who chooses the best camp for your kid. In order to do that, you need a fun and safe camp where your child will learn new skills from positive role models. The problem is that planning your kid's summer activities can be overwhelming. We believe you can plan a great summer experience for your kid. We understand, we have kids, and our children's well-being is our top priority, which is why we're proud that 70% of our campers each year come from referrals and repeat business.

https://atlanta.clubscikidz.com/

ROBOTICS and **Dairy Cows**

New Georgia career pathways

Georgia's first robotic milking dairy, Hillcrest Farms, has been family owned since 1941 on the perimeter of Dearing Georgia, not too far from Athens. It has continued to be owned and operated by the Rodgers Family and is now on its 4th generation, three of which still work on the farm today. Now, this Georgia dairy institution can boast their integrated and evolving technology in robotics.

A primary goal of Hillcrest Farms is to create the most comfortable environment possible for their cows through the use of cutting edge technology, careful observation, and environmental friendly practices.

Hill Crest is providing their cows with soft comfortable sand beds, temperature activated sprinkles and fans for those warm Georgia days, several cow brushes to scratch that itch that can't be reached, and reusable rubber flooring to make a soft walking surface. These Hillcrest happy girls live a life of luxury.

This farm made the move to Robotic Milking Systems in 2019 allowing each cow to go to be milked when she chooses. With this transition it has allowed the family and employees to focus on the other aspects of the cow including cow comfort, herd health and management, while maintaining our relationship with the land and environment.

The robotic "stars" of this innovative integration are the 5 DeLaval Robots they installed which replaced the traditional milking parlor. Instead of walking each cow to the milking parlor three times a day, now each cow can go as often as they choose.

With this transition, we can look at our cell phones, day or night, and be able to see how each individual cow is doing. This allows for faster detection of cows who may not feel well, or behaving unusually, allowing for instant intervention for healthier and happier cows.

The VMS™ V300 features the best milking process we have ever created, focused on maximizing the economic benefit of every visit your cows make to it. It allows each cow to be milked according to her individual needs and capacity. This means that each cow is able to reach their full potential.

This system allows each cow to be milked according to her individual needs

- Up to 7000lbs milk per day *
- Up to 10% higher capacity *
- Up to 50% faster attachment time *
- Up to 99.8% attachment rate *
- Teatspray up to 99% hit rate *

The robotic DeLaval InControl™ system and app doesn't just make it easy to control and monitor your herd, it will provide you with simple visual reports, analysis and information to help you to make better decisions. DeLaval InControl™ means you can call up the performance of a cow, see throughput statistics or change the settings of your system.

Best of all, it delivers all this functionality to you, wherever you want it. Using either the touchscreen or a mobile device, you are always able to view your VMS™, to control its operation, track daily routines, update individual cow data or share information with staff.

- Cow queue to VMS™
- Individual cow status and performance data
- Find my cow in the barn or pasture
- Recently milked cow info
- Activity monitoring information
- Somatic cell count information
- Fine-tune individual cow settings

Other advantages:

- Better hygiene
- Stimulation
- Adjustable settings
- Transparent cup
- Soaps can be added

It becomes clear that knowledge in;

- basic and advanced computer technology (the tech of STEAM education),

- the tracking of herd data (science; systemmatic accumulation of knowledge / data),

- the engineering of the dairy industry (problem solving and decision making) and

- the necessary mathematical skills and understand to interact with the robotics, app and associated hardware, are necessary in this unique dairy field opportunity.

The melding of animal husbandry in the dairy industry and the interaction, maintenance and use of robotics offers a fascinating combination of farm life and technology, not to mention the out of doors life style.

an·i·mal hus·band·ry
noun: animal husbandry

- the science of breeding and caring for farm animals.

ro·bot·ics
noun: robotics

- the branch of technology that deals with the design, construction, operation, and application of robots.

Do you enjoy the outdoors?

Are you interested in managing animals?

Do robots fascinate you?

This synergy of farming and tech might be worth investigating.... and yes, drones are also a widely used remote tech for herd and crop management.

Learn more about Hillcrest Dairy Farm and consider a tour of their facilities.

https://www.hillcrestdairy.com

90 Minute Tour

During your 90 minute tour at Georgia's First Robotic Dairy Farm, you will have the opportunity to have an exclusive Trolley Ride through ALL parts of our farm! During your tour make sure to visit our Robotic Observation Room and watch the girls in action!

Student: K-12th Grade

Students from Kindergarten to 12th grade can have the same great 90 minute exclusive tour at a discounted rate! For booking your class trip please call to schedule your visit.

3 Years and Under

Bring your children along for the tour and our family friendly Robotic Observation Room for FREE!


Williams Street
South
75 85
Macon
Montgomery
Williams St
Downtown
Georgia Dome
North Ave
Georgia Tech

OAK RIDGE National Laboratory

Traffic-based analyses of buildings advance smart city capabilities

By Elizabeth Rosenthal / ORNL

Every day, hundreds of thousands of commuters across the country travel from houses, apartments and other residential spaces to commercial buildings — from offices and schools to gyms and grocery stores. These destinations, combined with transportation between them, account for more than half of the total energy consumed in the United States each year.

To determine how these daily mobility patterns affect energy usage, researchers at the U.S. Department of Energy's Oak Ridge National Laboratory partnered with the Smart City Division within the City of Chattanooga's Department of Information Technology. Benefits from this work could ultimately include more efficient heating and cooling of buildings based on their populations and faster, better informed responses in emergency scenarios.

The team studied traffic data captured by 45 sensors stationed at major intersections in the busy downtown area of Chattanooga, a technologically advanced "smart city" in Tennessee that boasts a total of 100 traffic sensors and is home to multiple ORNL-led projects.

Although the sensors are designed to monitor traffic flow and reduce congestion by optimizing the timing of signal changes, the dense network was suitable, too, for the researchers to study the energy consumption of nearby buildings. They used Voronoi diagrams, which are computational geometry maps that assign buildings to one or more intersections within walking distance, to create occupancy schedules that estimate vehicle arrival and departure times. The schedules also approximate the number of people present in specific structures over the course of a year.

Led by ORNL researcher Andy Berres, the team focused on two adjacent sections, or "cells," containing a finite number of intersections and buildings to obtain useful data while maintaining the privacy of individuals. The results are published in Building Simulation.

"There are a lot of aspects for which the number of people in a building makes a difference, and with these improved occupancy schedules, you can get a much more accurate picture of what's actually happening energy wise," Berres said.

Increases in building occupancy can lead to more demand for heating, ventilation and air conditioning; electricity; and other utilities, whereas decreases in occupancy may result in energy wasted on amenities in unoccupied areas.

Although stock occupancy schedules can provide some insights into this balancing act, the team's custom counterparts include more detailed data for individual buildings. The researchers anticipate that tracking monthly and seasonal trends in these schedules will reveal opportunities for enhanced efficiency.

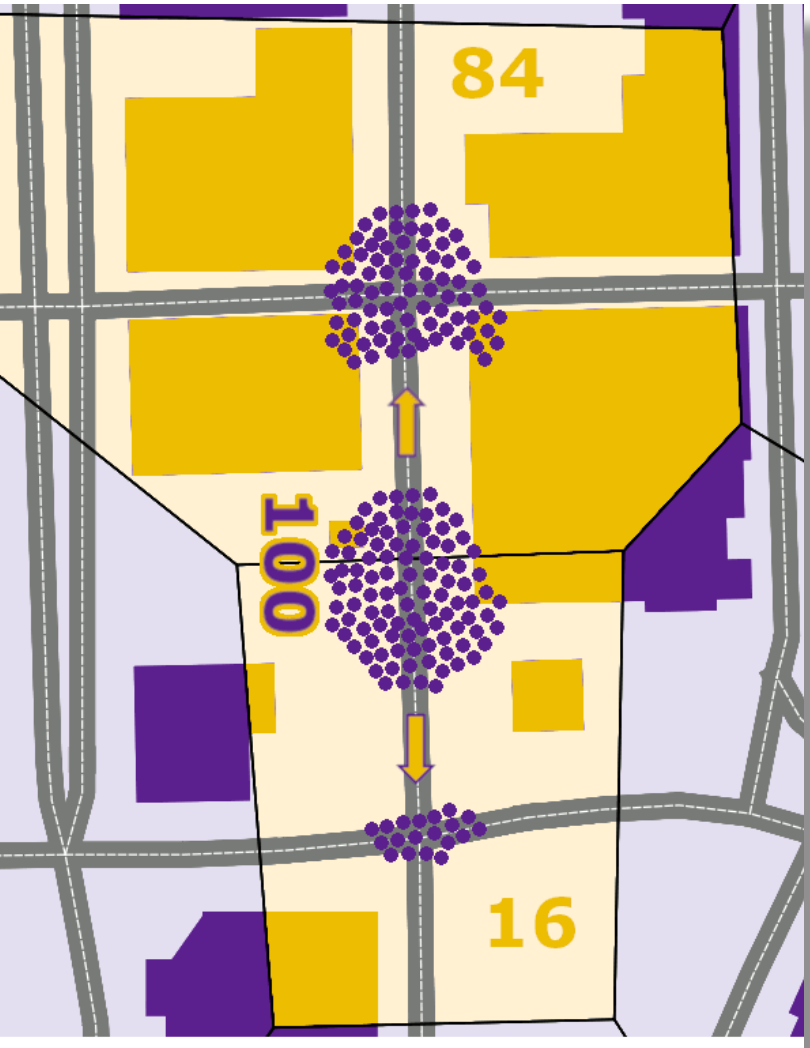
"Basically, we're trying to get a better idea of how many people are where at what times of day," Berres said. "We are currently compiling hourly schedules, but those could be broken up into shorter segments of 5 or 10 or 15 minutes to be more precise."

Because traffic and building occupancy decreased during the COVID-19 pandemic — especially in March and April of 2020 when many businesses were closed — Berres compared measured energy use from 2019 provided by EPB of Chattanooga with simulated energy use for both default and custom occupancy levels in 2020. Outside of those two months, weekdays in both years saw similar levels of activity.

This work builds on a previous project focusing on Chicago, Illinois, by many of the same team members. Berres, ORNL's

Jibo Sanyal, Computational Urban Sciences group leader, and their collaborators ran simulations based on data from the Illinois Department of Transportation, the National Household Travel Survey and LandScan using the Titan supercomputer. (Titan was decommissioned by ORNL's Oak Ridge Leadership Computing Facility, a DOE Office of Science user facility, in 2019.)

Instead of Voronoi diagrams, which are centered around the area of interest and typically ensure that adjacent vehicles are assigned to the same cell or neighboring cells, the researchers simulated building occupancy schedules using quadtrees.



These computer graphics data structures, which resemble genealogy charts, sometimes place vehicles from the same geographic vicinity in separate branches of the tree, which presents them as distant relatives rather than immediate family members. The team's work was published in the proceedings of the IEEE International Conference on Big Data.

"We went from enabling simulation capabilities in Chicago to actually capturing real-world data and applying these techniques in Chattanooga," said Sanyal, who leads the Regional Mobility project through which the team obtained access to traffic sensor data. "Voronoi segmentation is one method for overcoming some of the challenges of studying how a transportation network affects energy applications."

Better building occupancy schedules could also help first responders determine how many people from each building may need help evacuating during emergency scenarios, such as natural disasters.

Between this effort and related projects focused on developing digital twins of both buildings and roadways, Berres envisions a future in which daily operations could be adjusted in real time to maximize energy savings in response to traffic incidents.

"If there's construction on the interstate, people might come into work later because they didn't account for that amount

of traffic," they said. "So, it might be beneficial to start the air conditioning in an office building a little later to save some energy because most people are not there yet."

Updated traffic sensors with the ability to count pedestrians, bicyclists and public transportation users in addition to cars could further improve the accuracy of building occupancy schedules in Chattanooga and other smart cities, both nationally and internationally.

"Buildings account for about 40% of energy consumption in the United States, and HVAC systems play a major role," Berres said. "Gaining a better understanding of the time people spend in buildings and adjusting HVAC schedules accordingly could really improve energy efficiency."

The Chicago study was funded by the DOE Office of Science and the Exascale Computing Project, and the Chattanooga project received funding from DOE's Vehicle Technologies Office, Building Technologies Office, and Office of Electricity.

Donate to Georgia public schools and reduce your state taxes

Georgia Foundation for Public Education encourages support of state schools

Davis Knox is a resident of Athens-Clarke County and founder and CEO of Fire & Flavor. He serves as chair of the Georgia Foundation for Public Education. In this guest column, he explains the foundation's purpose and encourages Georgians to donate to public schools through the foundation.

By Davis Knox
Our schools have been through a lot in the last two years, and students and teachers need our support. If you love the state of Georgia and want to see our public schools strengthened, consider supporting public schools through a donation to the Georgia Foundation for Public Education. In exchange for your donation, you can receive a dollar-for-dollar state tax credit, which we call the Qualified Education Donation (QED) tax credit.

Donated funds are directed toward innovation in Georgia public schools, with a specific focus on the lowest-performing 5% of schools. Schools and school districts have the opportunity to apply for grant funds for projects they propose, meaning the ideas and projects we fund are developed and steered from the ground up, by those who know students best.

In May 2021, Gov. Brian Kemp signed legislation merging the Innovation Fund Foundation — formerly housed within the Governor's Office of Student Achievement — with the Georgia Foundation for Public Education, the philanthropic arm of the Georgia Department of Education. The two organizations now operate under the GFPE name, expanding our capacity to fund innovation and meet financial needs in Georgia's K-12 public schools. Specifically, the merger expands fundraising capacity for the Qualified Education Donation — we are working to increase donations made through the tax credit program and ultimately provide more funding to support innovation and expand opportunities for students.

The Qualified Education Donation has previously funded support for COVID-19 relief efforts in Georgia schools, Innovative Education Fund grants for teachers, the Governor's Honors Program, and more.

Specific examples include:

- Early County High School used an Innovative Education Fund grant to implement a program emphasizing real-world science experiences, with a focus on agriculture — helping students learn skills they could apply to future careers. The program trained students to use unmanned drone devices to survey farmland and collect data for local farmers.

- The Richmond County School System used an Innovative Education Fund grant to provide 24/7 on-demand and live instruction for K-12 students, allowing students the opportunity to receive tutoring services aligned with their needs and family schedules.

- Ivy Preparatory Academy used an Innovative Education Fund grant to implement Raspberry Pi, a program designed to teach students the fundamentals of computer science.

- Houston County's Northside Middle School used an Innovative Education Fund grant to establish a STEAM Farm to enhance hands-on and project-based learning. Specifically, the grant allowed the school to expand its recycling program and raised vegetable beds, and add hydroponic towers, a quail hatchery, an arboretum, and seating for an outdoor classroom.

All Georgians — from parents, families, and students to educators to business owners — benefit from a strong public education system. Donating through the Qualified Education Donation is one of the simplest and most impactful ways you can show tangible support for public schools in our state.

I encourage you to become a donor and invest in public education today.

To learn more, including tax credit limits based on filing status, go to gfpe.org/tax_credit/donor_information.

* This article includes the career fields of computer science, chemistry, engineering, research, development, aerospace careers, data analysis and more.

Rensselaer

Machine Learning

Tests Abilities of Rare-Earth Phosphates Given Atmospheric Extremes

By Jeanne Hedden Gallagher

Materials and mechanical scientists are using machine learning to rapidly vet combinations of elements that could be used in next-generation environmental barrier coatings needed to protect vehicles traveling in the extreme conditions of aerospace and space environments. The project, led by researchers at Rensselaer Polytechnic Institute, is supported by the National Science Foundation.

Environmental barrier coatings, or EBCs, are used to seal parts in the engines and structural components of rockets, hypersonic jets, and other space-bound vehicles. The coatings protect parts from harsh operating conditions such as high temperatures, supersonic speeds, intense stress, and severe oxidation and corrosion. Rare earth silicates are the current choice for EBCs used to coat the silicon carbide-based ceramic matrix materials in state-of-the-art jet engines, but these materials are problematic, and subject to performance degradation.

As an alternative, the Rensselaer team proposes EBCs made from multi-component rare earth phosphates instead of silicates.

"New concepts and innovations are required in order to design next-generation EBCs with transformative performance," said Jie Lian, a professor in the Department of Mechanical, Aerospace, and Nuclear Engineering and the principal investigator of the grant. "The proposed multicomponent rare-earth phosphates offer unlimited possibilities in designing future EBCs and extending their performance."

This $1.8 million NSF grant aims to revolutionize material design and support the methodology development by synergizing high-throughput computation – experimentation and machine learning for

data-driven materials design and discovery.

The researchers will use advanced computer algorithms to create combinations of elements in multiple configurations, determining the most favorable framework for the high-performance EBCs needed for aerospace and space transportation systems of the future.

"The empirical trial-error approach is too expensive and soon becomes impractical for material discovery over a large design space," said Liping Huang, a co-principal investigator and professor in the Department of Materials Science and Engineering. "We aim at a novel approach that couples physics-based modeling with machine learning to predict the optimal composition and microstructure of the next generation EBCs."

Lian, an expert in experimentation and material behavior under extreme environments, and Huang, an expert in high-throughput atomic simulation, are joined in this four-year research project by Suvranu De, an expert in finite element analysis and director of the Center for Modeling, Simulation, and Imaging in Medicine (CeMSIM) at Rensselaer, and Lucy Zhang, an expert in machine learning and a professor in the Department of Mechanical, Aerospace, and Nuclear Engineering.

"Machine learning models trained on data generated from high-throughput multiscale simulations can speed up the

design and optimization of the structure and performance of multicomponent rare earth phosphates as EBCs," Zhang said.

The Rensselaer team will collaborate with researchers at the General Electric Global Research, a leading industry of EBCs.

About Rensselaer Polytechnic Institute
Founded in 1824, Rensselaer Polytechnic Institute is America's first technological research university. Rensselaer encompasses five schools, 32 research centers, more than 145 academic programs, and a dynamic community made up of more than 7,600 students and over 100,000 living alumni.

Rensselaer faculty and alumni include more than 145 National Academy members, six members of the National Inventors Hall of Fame, six National Medal of Technology winners, five National Medal of Science winners, and a Nobel Prize winner in Physics. With nearly 200 years of experience advancing scientific and technological knowledge, Rensselaer remains focused on addressing global challenges with a spirit of ingenuity and collaboration.

TAG-Ed's annual wine tasting and auction benefiting STEM education and workforce development.

Thursday, November 3rd, 6pm

Park Tavern Garden Tent and Meadow

500 10th St. NE, Atlanta, GA, 30309

Become a sponsor or purchase tickets today

For questions or more information: heather@tagonline.org

TAG | TAG-Ed Education Collaborative

The Aerodynamics of NASCAR

By Wayne Carley

aerodynamics

noun, plural in form but singular or plural in construction

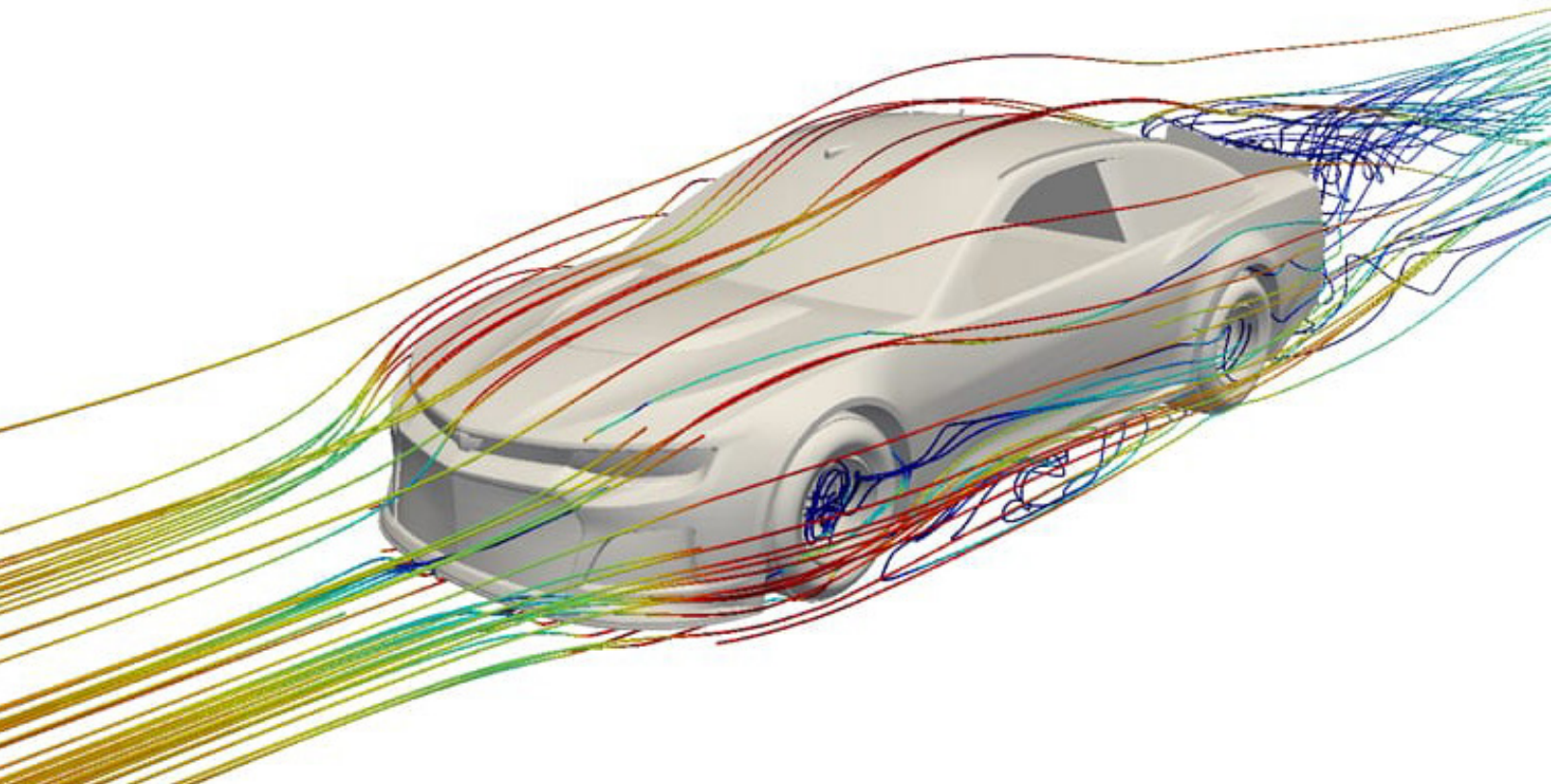
aero·dy·nam·ics | \ ˌer-ō-dī-ˈna-miks

1 : a branch of dynamics that deals with the motion of air and other gaseous fluids and with the forces acting on bodies in motion relative to such fluids

2 : the qualities of an object that affect how easily it is able to move through the air

It's not just about going fast. As we discussed last month, with few alterations, NASCAR engines are designed to run fairly equally leaving the competitive edge to the driver. As drivers are in physical control of their cars, their understanding, strategy and exploitation of physics is a critical element throughout the race.

The physics (science, engineering, math) we are referring to in this article is aerodynamics - driving the race car through the air more efficiently than the other competitors. This will be a layman's explanation of aerodynamics to offer a basic understanding that can be applied to motor sports.



Though the prefix "aero" is usually associated with aircraft, aerodynamics and its cousin, fluid-dynamics, apply to anything that moves through the air. Air molecules move very much like a liquid such as water, so the study and understanding of both is useful and does overlap significantly.

AIR

Air is not a "thing", but rather a collection of molecules that include primarily nitrogen and oxygen as well as water, carbon dioxide, ozone, and many other compounds in trace amounts, some created naturally, and others the result of human activity. In addition to gases, the atmosphere contains extras such as smoke, dust, acid droplets, and pollen. The air is full of stuff floating around, and yes, you're breathing it in every moment of every day.

There is often a great amount of "space" between these molecules allowing for them to ***move out of the way*** as we pass through, causing them of compress in front of us a bit, depending on the force exerted. The greater the force, the greater the compression - the faster we move forward, the faster they must move out of the way.

Here is the catch; there are limits as to how fast the air molecules can move out of the way. They have to "fight each other" to keep their place in space and quickly cause resistance, making it harder to go faster. They just pile up in your way.

If you'd like to feel this resistance, just open your hand (like you're shaking hands) and move your arm side to side as fast and wide as you can. Better yet, carefully stick your arm out the window of your car (you're not driving and with adult supervision) on the freeway and you'll get a big taste of air resistance as it tries to get about your arm and out of the way (I'm sure you've already done this).

"Whether you're walking, running, biking, driving or flying, you are moving through the air, experiencing a variety of levels of air resistance and interacting with aerodynamics."

If you've ever wondered, "Why can't I run or bike faster?", the answer may not be that you're weak or out of shape as much as you're having trouble pushing the air molecules out of the way. You have to "keep pushing" during the entire exercise and at some point, you just run out of energy.

Four Aerodynamic Forces

- Thrust

The power used to move forward; the racing engine or your legs.

- Drag

The shape and size of the race car that the air molecules are resisting and fighting against to get out of the way. This also includes "friction", both against the air and the tire contact with the track. Drag is anything that's trying to slow you down.

friction
noun / fric·tion | \ ˈfrik-shən

a : the rubbing of one surface against another / the friction of sandpaper on wood / race car body against the air

b : the force that resists relative motion between two bodies in contact oil in a car engine reduces friction

- Lift

Though we don't want our race car to "fly", we cannot allow too much air under the chassis or we just might take flight, briefly. There is almost nothing desirable about lift when it comes to auto racing. Special effort goes into finding "***down force***" to keep the car on track, improving traction and control. For more information about aerodynamic lift as it applies to airplanes, refer to Bernoulli's principle and airfoil shape on the web. Pressure waves caused by the compaction of air in front of a fast moving object will be covered in another article.

- Gravity

Gravity is the force that attracts a body toward the center of the earth, or toward any other physical body having mass.

Gravity is constantly pulling everything down (*with few gaseous exceptions such as Helium*), including the race car, causing drag against the pavement of the track. This is good for driver control and traction, but does slow us down.

So, with these definitions, how do we take best advantage of these forces to safely go faster with the best thrust, the least amount of drag and friction while limiting lift and finding a balance with gravity?

The Car Body Shape

There are new visual changes to the Next Gen cars. NASCAR is allowing teams to shape the bodies to more closely resemble the production cars they are named after. The teams submit their designs and pre-race, NASCAR verifies electronically and visually that they meet their stringent aerodynamic requirements. The car bodies will also be symmetrical (*correspondence in size, shape, and relative position of parts*).

The shell of the Next Gen car will be assembled with carbon-fiber-reinforced plastic panels. The carbon-fiber bodies are more flexible and durable, so an unpleasant interaction (rubbing) with another driver or hitting the wall will have fewer consequences. This is also more affordable for teams to repair and usually faster to replace.

The body is 6" shorter, 1.6" wider with a new roofline of 50.4". It's also 1.5 inches lower while the wheel base remains the same. Aerodynamically, the front splitter and rear wing will always be dictated by NASCAR to limit how much downforce a car can generate, while at the same time limiting speed.

We talked about minimizing lift, and limiting how much air (and turbulence) was getting underneath the car body. With the Next Gen, previously exposed elements on the underside have been eliminated and replaced with carbon-fiber undertrays to create a flat surface, removing the need to develop exposed parts, and to smooth out the air (without flying).

NASCAR has what are called "Aero Packages", which are required for specific race tracks throughout the season. These body design rules affect how the car cuts through the air (aerodynamically) and usually correspond to how fast the race track is, the geographic location and other track related considerations. Going slower reduces many of the aerodynamic concerns experienced at super speedway speeds, which are in excess of most airplane take-off speeds.

Three basic "aero packages" are as follows:

The ***NA18D package*** will be used at nine tracks: Atlanta, Charlotte (speedway course), Homestead, Kansas, Las Vegas, Michigan, Pocono, Texas (regular season race plus All-Star Race).

The ***ST/RC short track/road course package*** will be used at 13 tracks: Bristol, Charlotte road course, Circuit of the Americas, Darlington, Daytona road course, Dover, Indianapolis road course, New Hampshire, Martinsville, Nashville, Phoenix, Richmond, Road America, Sonoma and Watkins Glen.

The standard ***super-speedway aero package*** will be run at the four combined races at Talladega and Daytona.

As we discussed, the faster you race, the greater the aerodynamic resistance and the need for physics considerations.

The Best Way To Beat Air Resistance

The engines and parts are about equal. The new Next Gen bodies are better balanced competitively. So what's left?

"Have someone else move your air out of the way!"

Drafting

Moving through the air is hard work for a race car. It's hard on the engine, the fuel consumption, the driver physically and of course the tires. The best way to overcome the air resistance is to have a "friend" move it out of your way. This is called drafting.

In the image below, note that this car is doing all the "air moving" and it takes a minute for the air to "fill in" the space left behind the car, seen as a disorganized turbulence in back. This turbulence is actually much easier to get through as the air molecules are not as tightly packed and offer less resistance. But about one car length back, the air "gets organized" again and become very thick and resistant for the next car. Here is the fun part...

If the driver can "slip" into that sweet spot right behind the lead car where the air is thinner, (*molecules spaced further apart*), the second car;

- moves forward with much less effort, reducing the impact (drag) of the air on the car,

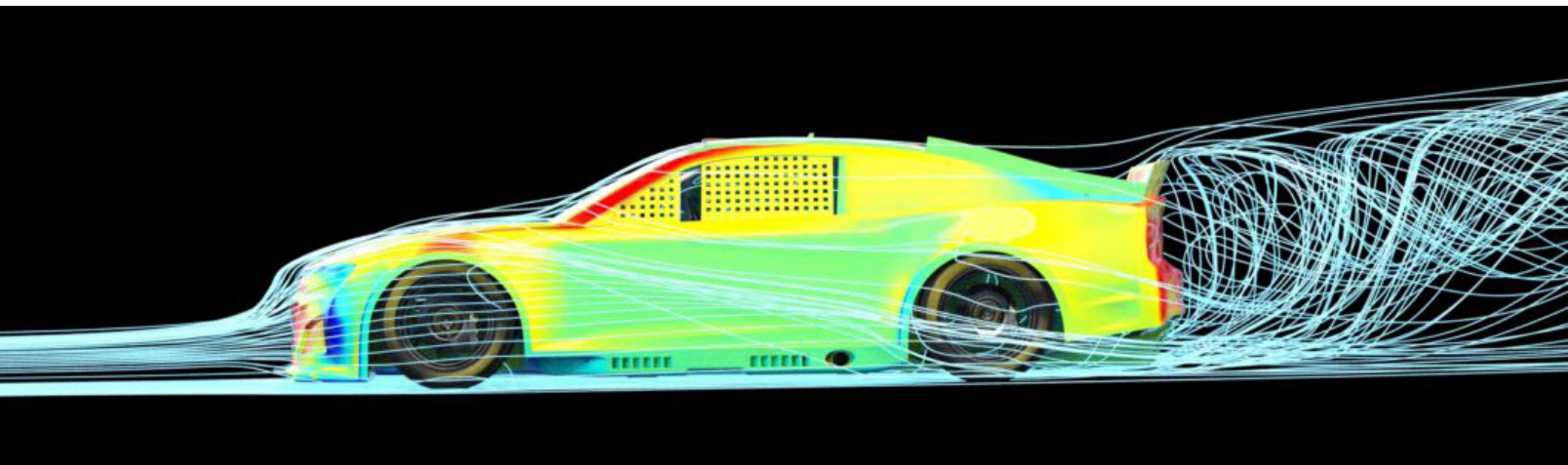
- reducing the power needed from the engine to go fast (thrust). Drivers actually have to let up on the gas,

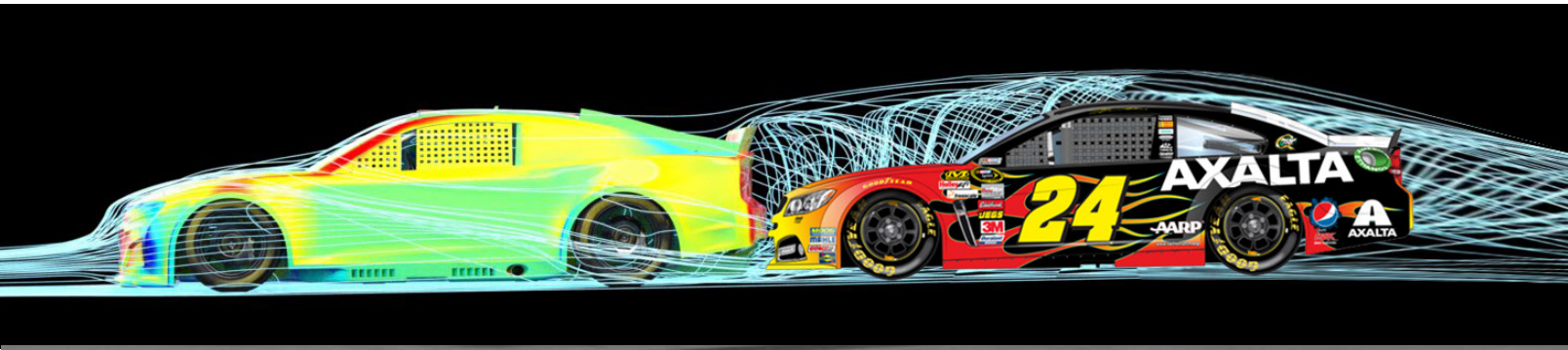
- improving fuel consumption

- and reducing heat caused by aero-friction to many part of the car.

For the lead car, being drafted does eliminate much of the drag caused by the turbulence behind them, giving them a "little push" from the drafting car. Drafting provides a solution to many of the obstacles aerodynamics presents - primarily moving the air out of the way.

Having a thorough understanding of aerodynamics as it applies to motor sports, is an essential part of the engineering strategy and driver performance needed for the best race outcome.





To recap, air molecules have density, or different levels of compaction depending on the air temperature, amount of liquid (which is humidity), other airborne particles such as pollution or dust and the distance from the ground.

Gravity also affects air density. The higher the altitude, the thinner the air, thus less air to move out of our way allowing for greater speed. Field goal kickers in Denver can kick further than in Miami on a humid day, golfers hit it longer in the mountains and racers go faster at altitude. Is it any surprise that the fastest NASCAR track in the country is the Pikes Peak International Raceway in Colorado Springs, Colorado?

Every activity involving propulsion through our atmosphere, regardless of the direction, involves the physics of aerodynamics and every type of racing sport benefits from drafting.

SOFT SKILLS

- personal attributes that enable someone to interact effectively and harmoniously with other people.

By Brian Michilan

Communication skills

This doesn't mean you have to be a brilliant orator or writer. It does mean you have to express yourself well, whether it's writing a coherent memo, persuading others with a presentation or just being able to calmly explain to a team member what you need.

"It's time to get your face out of your mobile device and start communicating with people face to face."

Yes, every career opportunity ahead of you require skills in science, technology, engineering (problem solving) and some math. Major corporations and small business are all sharing the same complaint about their new, young employees:

"They are lacking soft skills"

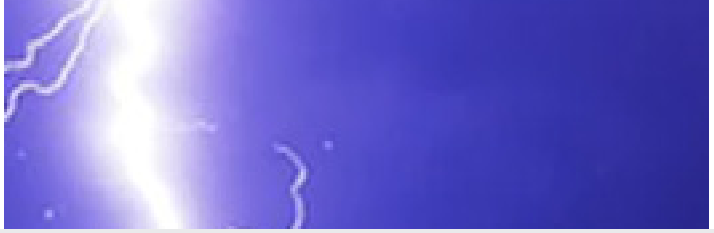
Teamwork & collaboration

Employers want employees who play well with others—who can effectively work as part of a team. "That means sometimes being a leader, sometimes being a good follower, monitoring the progress, meeting deadlines and working with others across the organization to achieve a common goal," says Lynne Sarikas, the MBA Career Center Director at Northeastern University.

Adaptability

This is especially important for more seasoned professionals to demonstrate, to counter the (often erroneous) opinion that older workers are too set in their ways.

"To succeed in most organizations, you need to have a passion for learning and the ability to continue to grow and stretch your skills to adapt to the ***changing needs of the organization,***" Sarikas says.



"On your resume, on your cover letter and in your interview, explain the ways you've continued to learn and grow throughout your career."

Conflict resolution

The ability to:

- persuade

- negotiate

- resolve conflicts, which is crucial if you plan to move up. "You need to have the skill to develop mutually beneficial relationships in the organization so you can influence and persuade people," Sarikas says. "You need to be able to negotiate win-win solutions to serve the best interests of the company and the individuals involved."

Conflict resolution is huge because you will have conflict....I promise. Just like in class right now, there WILL be people at work that you just cannot stand to be around, and now you have to work "with" them. What subject at school teaches this skill? How will you learn it?

Self-motivation

Employers (and teachers) love this one. In its simplest form, it is the force that drives you to do things. Once you understand your work responsibilities, self-motivation as a soft skill relieves your boss from having to constantly look over your shoulder telling you everything to do. This skill does not come easily to everyone and for some, will always be a "goal", but you should definitely put it near the top of your soft skill list.

There are basically two types of motivation:

Intrinsic = love, because we want to.

Extrinsic = money, because we have to.

Which one drives you?

Learn soft skills

The good news is that, like any skill, soft skills can be learned. The better news? Boosting your soft skills not only gives you a leg up on a new job or a promotion, but these skills also have obvious applications in all areas of a person's life, both professional and personal.

Practice the soft skills you need, like 'communications'

Aim to be understood-

Your goal, whether speaking or writing, should be to communicate clearly. Fancy or highfalutin language can oftentimes make the point you're trying to make confusing or unclear. Some ideas to improve your clarity in communication include:

Staying on topic-

Focus on the point of your communication. This could be something as simple as determining whether your coworker is free for lunch.

Be specific when communicating-

You may have difficulty getting to the point. To improve your clarity, use specific terms instead of general pronouns or indefinite periods of time.

Make eye contact-

Acknowledge that you are paying attention to someone by meeting their gaze eye to eye. Eye contact will make your conversation partner feel like you're more engaged. If you have difficulty doing this, turn your body to face the person you're speaking with. By turning your body to face your conversation partner directly, you'll naturally be more likely to look them in the eye.

"Speak clearly, if you choose to speak at all and carve every word carefully before you let it fall"

Oliver Wendell Holmes

If you're uncomfortable looking someone directly in the eyes, choose a point just above or below the eyes, like the bridge of the nose, and look there instead. Even if there are other distractions in the room, keep your eyes focused on your conversation partner. Allowing your gaze to wander can come across as rude.

Monitor your body language-
Show interest by sitting up and leaning forward slightly. Resist the urge to tap your fingers or foot, as this can indicate impatience. You can also connect with conversation partners by mimicking their posture.

Although it might seem odd at first, by mimicking the posture of your conversation partner, you're subconsciously sending the message that you both are the same, which will put them at ease.

Try to curb unconscious motions that could be taken the wrong way, like playing with your hair or bouncing your leg up and down.

Practice speaking-
This includes both public speaking and casual conversation. Even if you're uncomfortable speaking in front of others, practice will make speaking come more easily and improve your ability. Be conscious of your pace and volume while practicing.

If you are uneasy in personal relationships, try practicing with a close friend or family member you are comfortable with. If you are nervous about speaking in public, volunteer to give presentations within a smaller group and work your way up to a larger one.

Develop your writing skills-
Much like speaking, the more you write, the easier it will become. You can also take courses to improve your writing. You can do writing exercises on your own. You can also frequently find affordable writing workshops offered at community centers or community colleges.

When you finish writing something, be sure to glance it over for grammar and spelling errors.

OR

This only takes a minute or two, and can drastically improve the quality of your written work. Be direct and to the point instead of elaborate. Although you may feel uncomfortable with this at first, being direct can greatly improve the clarity of your writing.

Note that I said "writing", not typing.

"Handwriting is a complex task which requires various skills – feeling the pen and paper, moving the writing implement, and directing movement by thought," says Edouard Gentaz, professor of developmental psychology at the University of Geneva.

Operating a keyboard is not the same at all - all you have to do is press the right key. It is easy enough for children to learn very fast, but above all the movement is exactly the same whatever the letter. "It's a big change," says Roland Jouvent, head of adult psychiatry at Pitié-Salpêtrière hospital in Paris.

"Handwriting is the result of a singular movement of the body - typing is not."

Practice active listening skills-

Listening requires focus and self-discipline. We listen for many different reasons: to understand instructions, to empathize with another individual, or to judge whether a plan is good or not. You can show your conversation partner you're paying attention by:

Paraphrasing and asking questions about what was said. This demonstrates interest and focus. It also helps you understand the situation.

Taking notes when appropriate. This shows that the subject matter is important to you. Practice taking notes in team meetings or staff training sessions.

Refraining from interrupting others. Show you respect your speaking partner by letting them finish saying what they are saying.

"Most people listen with the intent of responding... rather than *listening*"

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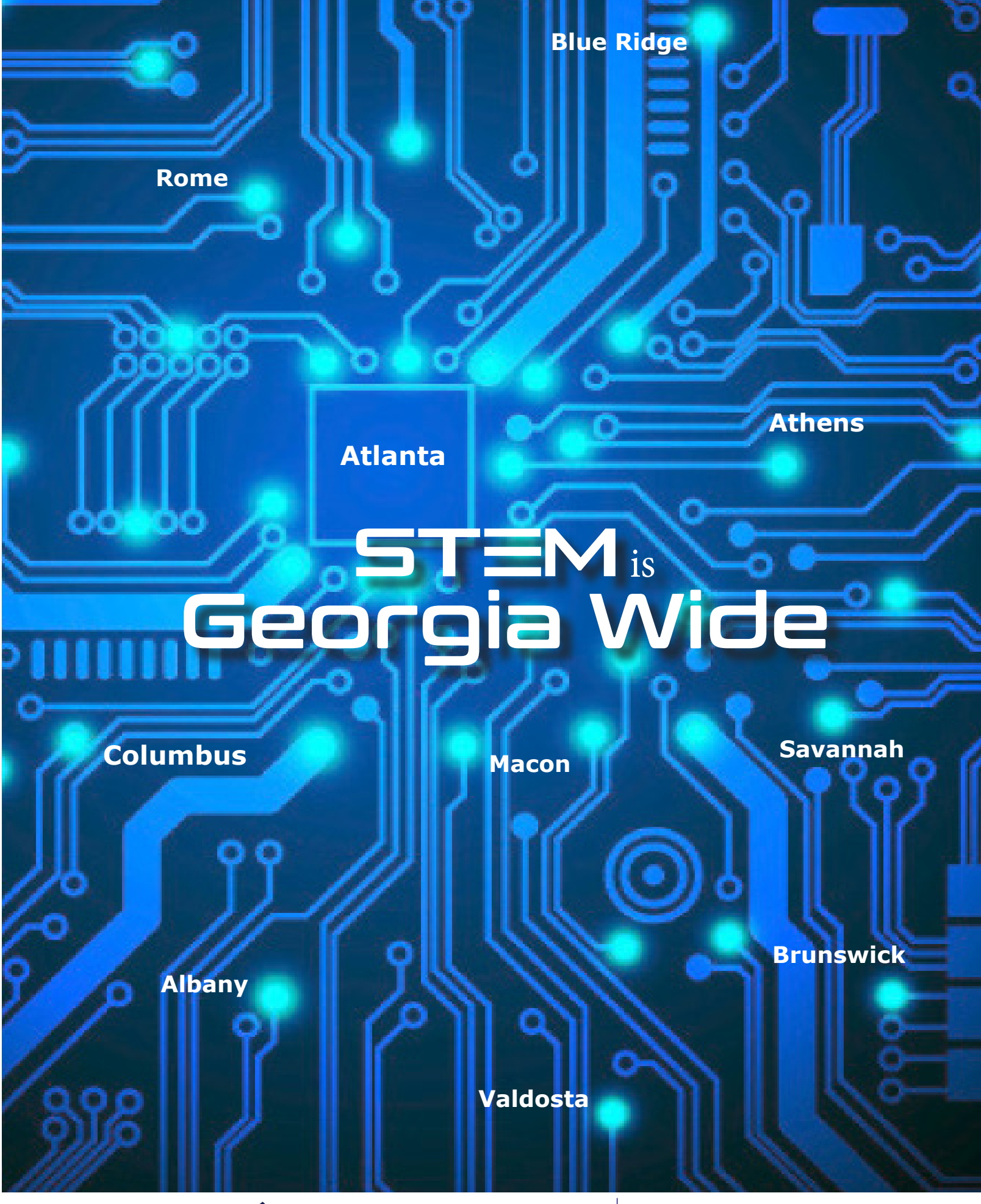

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