

FEATURE

CATALOGING COOL COURSES

By Kim Catley



Justin A. Blanco, associate professor in the Electrical and Computer Engineering Department, discusses how data from brain-machine systems can be mined for a variety of practical uses, including monitoring the cognitive performance of fighter pilots' brains. This information can be used to determine how fast and efficiently pilots can make decisions under stress.

Skim through the latest Naval Academy course catalog, and a few courses are bound to leap off the pages. Midshipmen are being introduced to cutting-edge technology and preparing for literal sea changes in how we navigate the globe. New majors and courses are evolving in response to military priorities, and to teach midshipmen how to contend with new arenas of warfare.

Future Navy and Marine Corps officers have long come to the Academy to hone their expertise in science, technology, engineering and math. In more recent years, critical languages such as Arabic and leadership-specific courses have gained prominence. But amidst the usual offerings lie a few unexpected surprises. Whether it's a new spin on 400-year-old texts or the next generation of cyber sciences, these classes will make you want to hit the books again, no matter how long ago you graduated. Keep reading to see how Naval Academy professors are getting midshipmen out of their seats and into the field, challenging them to shake up their perspectives and preparing them for the future technical needs of the Navy and Marine Corps.

SEA CHANGES

Course: Polar Oceanography

Taught by: CDR Shawn Gallaher, USN

As climate change shifts the landscape of the Arctic Region and the sea ice covering the Arctic Ocean rapidly melts away, the Navy is watching as new maritime pathways develop for transporting goods between Asia, Europe and North America.

“[Students] enjoy the remoteness of being out there doing [fieldwork], alone and unafraid.”

—CDR Shawn Gallaher, USN

“There’s a lot more traffic starting to flow through the Northern Sea Route, and eventually the Trans Polar Sea Route,” said Commander Shawn Gallaher, USN, associate chair of the oceanography department. “The Navy knows they’re going to have to be present as freedom of navigation issues start to pop up there.”

The Navy’s Arctic Roadmap outlines the complex environment of the region, national defense concerns and the opportunities that exist for infrastructure development, commercial investment and even fishing and tourism. The future needs of the plan informed the Naval Academy’s specialization in polar oceanography within the oceanography major.

The upper-level “Polar Oceanography” course gives a 30,000-foot overview of the polar science in the Arctic and Antarctic regions, followed by an in-depth investigation of momentum, heat and mass budgets.

“I look at it from a very local level, from a spot in the western Arctic Ocean where I’ve got tons of data from graduate school,” he said. “I get them up to speed on that interaction between the atmosphere driving the ice, the ice driving the ocean, and then where the heat comes from.”

Gallaher’s “Polar Oceanography” course is part of the Polar Science and Technology Program, a multi-disciplinary, project-based program that affords midshipmen the opportunity to conduct

fieldwork and research in polar environments. The course is typically complemented by a summer of high-latitude fieldwork and a research project. This past summer, Gallaher and Associate Professor Joe Smith brought several student researchers to Alaska to work on the North Slope material flux study. He’s also sent students to intern

and conduct research at the Polar Science Center in Seattle, WA, where they worked on seasonal ice zone reconnaissance surveys, and the University of Anchorage’s Arctic Domain Awareness Center, where they tested equipment on sea ice.

“Students love to get out and actually experience the Arctic environment,” he said. “They enjoy the remoteness of being out there doing [fieldwork], alone and unafraid.”

HACKING THE SYSTEM

Course: Human Factors in Cyber Operations

Taught by: LCDR Joseph Hatfield, USN

Have you ever received an email promising millions of dollars, if you just share your bank information with the sender? Or a message prompting you to log in to your Facebook or Google account ... but something looks slightly off?

In Joseph Hatfield’s “Human Factors in Cyber Operations” course, students learn to identify phishing scams like these and study what makes people susceptible to believing them.

“Human beings tend to be the weakest link in any computer network.”

—LCDR Joseph Hatfield, USN

“Human beings tend to be the weakest link in any computer network,” said Hatfield, an assistant professor in the Department of Cyber Science. “They make human decisions for human reasons, and they can be manipulated. This class focuses on how to exploit that fact in order to achieve the effects we want, or to mitigate our own risks.”

Working in test environments, students learn how to build cloned webpages and phishing emails designed to trick Hatfield, who often plays the victim, into sharing login credentials and personal data. The semester culminates in a project where students develop a hypothetical plan for implementing passive cyber reconnaissance on a real target. Students who are also enrolled in a parallel web and database course then carry out the attack in a secure environment against a fake target.

“One of the best ways to learn how to defend yourself is to learn how the offensive side works,” Hatfield said. “They know how to potentially defend themselves because they understand the inner workings.”

“Traditionally, people have thought of cyberspace as a purely technical issue,” Hatfield said. “We believe that cyberspace operations require people to understand electrical engineering, computer engineering, computer architecture and hardware vulnerabilities—but also ethics, policy and the human factors.”

“Human Factors in Cyber Operations” is one of an array of courses offered in the Naval Academy’s cyber operations program, accredited by ABET in 2018. The program teaches defensive and offensive cybersecurity practices, with a heavy emphasis on ethics and the law. The major was developed in response to the emergence of cyberspace as a new domain of warfare.

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The cyber operations major was established in 2013, and all midshipmen are required to take two cyber courses during their time at the Academy.

The program's growth has been significant: in 2016, 27 midshipmen majored in cyber operations. The class of 2021 has 110 majors.

FOLLOW THE LEADER

Course: Psychology of Leadership **Taught by: CDR David Wallace '96, USN**

What does leadership look like? It might not be what you think.

Take the surprisingly open-ended capstone project in the "Psychology of Leadership" course taught by Commander David Wallace '96, USN. Each team—which he assembles with an intentional mix of majors, companies, genders and expertise—spends the semester making something together.

What they choose is completely up to the group. Two teams cooked a meal together, collaborating on location, food choice and how to measure success. Another group developed a training video to be used by the Naval Academy's Sexual Assault Prevention and Response Office.

"They can't work independently towards a final project that gets put together at the last minute," said Wallace, the Admiral Jay L. Johnson Professor of Leadership and Ethics and a Permanent Military Professor in Industrial-Organizational Psychology. "What's important is the interactions among the team members."

The projects unfold as team efforts often do, with conflict and resolution, and hopefully plenty of idea generation. They might follow the typical stages of storming and norming to ultimately reach the pinnacle of performing. Every step along the way offers an opportunity

for Wallace to connect their experiences to best practices in team leadership.

Step one, he said, is establishing group norms, like when and where to meet, expectations for member contributions and preferred communication channels.

"Sitting down and creating a team charter where they determine how the team is going to interact and get its work done is just as important as the work itself," Wallace said. "That usually surprises students. They think if they get a group of good people together, they'll do good work, but the processes of teamwork take some deliberate planning."

Wallace's other key takeaway might seem a little surprising in a class dedicated to leadership principles. He wants students to understand that team leadership doesn't just come from the leader, nor should the position be limited to one person.

"While it's useful to have somebody who's conscientious and driving the problem, when we approach leadership from the perspective of the single leader, it narrows our perspective," Wallace said. "When we incorporate the followers as an active part of the leadership collective, it brings diversity of ideas, diversity of thought. The first half of a team's existence should be focused on divergent ideas, opinions and plans. Then, the job of a leader is to help the team converge around a single idea and execute it."

MACHINE LEARNING

Course: Brain-Machine Interfaces **Taught by: Justin Blanco**

Limb prostheses. Cochlear implants. Seizure detection implants. All of these devices can interact with the human nervous system, recording activity in the brain and responding with a therapeutic or rehabilitative action. And all of these are studied in "Brain-Machine Interfaces,"

taught by Justin Blanco, associate professor in the Department of Electrical and Computer Engineering.

The class combines two fundamental topics—neuroscience and machine learning—with hands-on experience manipulating datasets. In one assignment, for example, Blanco provides a dataset from monkeys operating a joystick and asks his students to interpret the activity coming from the motor area of the monkey's brain to predict the position of the monkey's arm.

"There are topics that every electrical engineering and computer science student will encounter at some point—like multivariable calculus, optimization, probability and statistics, and signal processing—and they don't always take away the application," Blanco said. "This is a class where they get to see how that fundamental material coalesces to do something real, practical, useful and important."

While the benefits of creating and refining these therapeutic or assistive devices are obvious for the people who need them, knowledge of brain-machine systems extends much further. As computing power has advanced and data storage expanded, data is collected on seemingly everything, and technology helps process and catalog it efficiently. There's more information than ever, allowing people to evaluate performance in everything from medicine and aviation to Wall Street and military readiness.

"Whether a midshipman is thinking about weapons control, communication systems, or they want to get into predicting stocks, machine learning applies," Blanco said. "The knowledge gained in this course is transferable to a lot of different domains."

LIFE LESSONS FROM THE BARD

Course: Shakespeare

Taught by: Anne Marie Drew

English professor Anne Marie Drew begins every semester of her Shakespeare class with the same question: "What Shakespeare have you read?"

"...the job of a leader is to help the team converge around a single idea and execute it."

—CDR David Wallace '96, USN

The answers, she says, are predictable. “It’s almost always ‘Romeo and Juliet,’ ‘Hamlet,’ ‘Macbeth’ and ‘Julius Caesar,’” she said. “It’s all tragedies. They think Shakespeare is all dead bodies—and nothing could be further from the truth.”

You’re probably wondering what a class about Shakespeare is doing on a list of interesting and innovative courses.

“Shakespeare, done right, expands your view of what it means to be human.”

—Anne Marie Drew

It’s a standard-issue subject at nearly every university. It’s required reading for English majors, and it draws plenty of students searching for a familiar subject to fill their general humanities credit.

Drew isn’t even the only Naval Academy professor to teach the class.

But she does strive to bring novelty to 400-year-old content. She challenges her students to look at Shakespeare’s plays as language texts and performances. Starting with “Romeo and Juliet,” she pushes them to think about how the performance would look and sound on

stage, or notice how a long soliloquy might actually be masking an elaborate costume change.

Then, Drew pushes the class to expand their horizons by reading

Shakespeare’s tragicomedies (“The Winter’s Tale” is one of her favorites).

“I love the late romances,” she said. “He doesn’t play Mary Poppins. Sometimes life is really dreadful. Sometimes we really screw up, or life gives us a bad hand. But if you hold on, and with enough grace and forgiveness, things will be redeemed.”

By the end of the semester, Drew says most students—whether they’re English majors or future engineers—walk out with a new appreciation for the Bard.

“Shakespeare, done right, expands your view of what it means to be human,” she said. “What it means to love human beings. What it means to be your best self. What it’s like to look at people with a generous eye and a forgiving heart. And what it means to walk headlong into tragedy and survive it.”

“Those are all life lessons that we need.” ⚓

Good Things Come in Threes!

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