The Embedded Capture the Flag (eCTF)

New College/University Faculty Info Sheet

MITRE's eCTF is an embedded security competition that puts university-affiliated teams (3-20 students each) through the experience of creating a secure system and learning from their mistakes. This competition helps develop practical skills that can be applied to securing critical embedded systems, such as UAVs, smart grids, and IoT devices.

eCTF Competition Format

Over each Spring semester, hundreds of students compete in MITRE's Collegiate Embedded Capture-the-Flag (eCTF) competition.

MITRE's eCTF is unique from other CTF competitions. First, the focus of the eCTF is on **embedded systems**, which present a new set of challenges and security implications. Second, the eCTF **balances offense and defense** by testing and awarding both sets of skills.

The competition is split into two six-week phases: "design" and "attack". In the design phase, students develop a secure embedded system that meets a provided set of requirements. In the attack phase, students compete to break the security of other teams' designs.

"I had no security experience prior to this competition. The learning curve was HUGE and I LOVED that! I was forced to learn so much. I loved doing the research, designing and implementing the secure system, and reviewing and attacking other teams' designs. It was a blast!"

eCTF Competitor

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100%

Learned more about embedded system security

85%

Said eCTF met or exceeded expectations

What Students Get Out of the eCTF

Throughout the competition, students have the opportunity to learn hard and soft skills not often taught in the classroom.

During the design phase, students grapple with designing and building a realistic, large-scale system and meeting complex security requirements without sacrificing functionality. This open-ended task promotes problem-solving and offers what are many students' first experiences in project management, cybersecurity, and embedded systems. Students also gain an in-depth understanding of cryptography through the design and implementation of their secure protocols.

During the attack phase, students learn hands-on, real-world attacks in an unparalleled experience. Since the designs being attacked are created by other teams, students search for and encounter real, unintended vulnerabilities, rather than pre-canned challenges that are often used in other CTFs.

The eCTF as a Course

Many schools offer the eCTF as a **for-credit course**, often as a special topics course or an independent study. We strongly recommend this route as it helps students to commit time for the competition and recognizes and awards students for their efforts.

An example syllabus is available upon request.

The eCTF challenge defines several artifacts and deliverables that universities can use as course assignments. These include design documents, offensive and defensive writeups, and the system implementation/code itself.

Of course, faculty may also choose to augment the competition with additional lectures or readings.

Next Steps

If you are interested in the eCTF, please reach out to ectf@mitre.org to join our email list for updates about the competition. You may also want to begin the process of creating a for-credit course for your team next semester.

During the fall semester, you should begin reaching out to potential student competitors. Good avenues for finding interested students include reaching out to relevant student clubs or groups, announcing the competition in related classes, and posting flyers in public areas (an example flyer is available upon request).

When team registration opens in September, you will be able to register your intent to form a team, even if you don't yet know the exact students that will participate.

Beginning in December, individual competitor registration will open up, which each student on your team will need to complete before the competition begins in mid-January.

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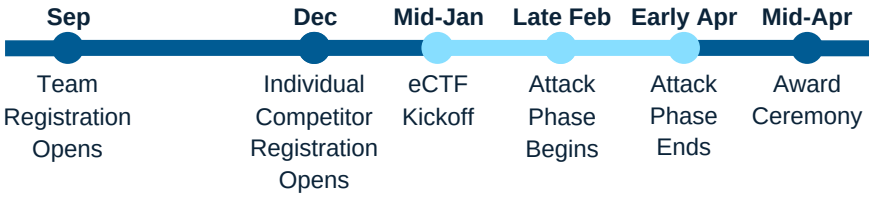
Timeline



Frequently Asked Questions

Does the eCTF cost anything?

Participation in the eCTF is entirely free. MITRE will provide the resources to complete the competition, however teams may choose to purchase additional resources to aid with development or attacking.

Who can participate?

Anyone! Students at all academic levels are welcome to participate. Team sizes are unlimited (although a minimum of 4 students is recommended). Sponsorship of a faculty member to act as a team advisor is strongly preferred.

What is provided by MITRE to help?

MITRE provides teams with a reference implementation, embedded hardware (and/or hardware emulator), and technical guidance.

Are there awards?

Winning teams receive a cash prize, publicity from MITRE, and typically earn accolades from their university as well. Students have used their participation in eCTF to build resumes, present at conferences, and open the door to valuable internship and career opportunities, including engineering positions at MITRE and Riverside Research.

What is this year's challenge?

Teams will design a bootloader to securely perform firmware updates on an avionic device. The system must protect intellectual property and aircraft mission secrets in an untrusted environment, and ensure firmware protection and integrity in the face of supply-chain threats such as hardware trojans.

For more information about MITRE's eCTF, contact ectf@mitre.org or visit us at: http://mitrecyberacademy.org/competitions/embedded/

"This CTF, although really hard, was extremely fun… [It] motivated me to dive in deeper and work that much harder to get better as an engineer. The MITRE staff was AMAZING! Thank you for this opportunity.""

eCTF Competitor

"This competition exposed an entirely new side of cybersecurity to me as a Computer Science major… [It] was a great learning experience and got me interested in lower-level security."

eCTF Competitor

MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our public-private partnerships and federally funded R&D centers, we work across government and in partnership with industry to tackle challenges to the safety, stability, and well-being of our nation.

MITRE | SOLVING PROBLEMS FOR A SAFER WORLD