# SEI CPS-ULS Autonomy Tutorial Series

Overview

Summary

Members of the Cyber-Physical Systems and Ultra Large-scale Systems (CPS-ULS) group in the Software Engineering Institute (SEI) at Carnegie Mellon University (CMU) have spent the last decade pushing the state-of-the-art in the design of cyber-physical systems and in the creation, verification, and validation of complex, distributed autonomous systems for industry and government applications.

In this two-day tutorial series, the CPS-ULS team will showcase open-sourced middleware and tools for the creation, verification, and validation of distributed autonomous systems with a focus on applications for unmanned autonomous vehicles.

The series will focus on usage of the Multi-Agent Distributed Adaptive Resource Allocation (MADARA) project, the Group Autonomy for Mobile Systems (GAMS) project, the Distributed Adaptive Real-Time (DART) project, and the Distributed Execution of Multiple Experiments and Transfer of Empirical Results (DEMETER) project.

## What should tutorial participants bring?

### The tutorial series will showcase hands-on training in the usage of open-sourced, BSD-licensed tools created by the CPS-ULS group at the SEI. Though participants are free simply to watch the tutorial series, participants are encouraged to bring their own laptops to better experience the process. The preferred operating system for both days is Ubuntu Linux, and the user should have administrative privileges on the laptop to install software via apt-get/sudo. However, Day 1 (Creating Distributed Autonomy Capabilities) can also support Mac and Windows.

### We will bring some installation media for SEI CPS-ULS tools for Ubuntu Linux, but an internet connection will be necessary for participants who may need apt-get or other utilities to install prerequisites. Installation from the internet will also help participants understand how to keep open-sourced projects up-to-date from internet software repositories.

## What will tutorial participants learn?

The tutorial series will teach participants how to create, build, maintain, and verify one or more autonomous systems, including teams of autonomous systems. Participants will learn how to:

1. Install the MADARA, GAMS, VREP (Coppelia Robotics simulator), and DART open source projects for autonomy and simulations
2. Update from open-source projects
3. Create portable C++ projects for distributed autonomous systems
4. Network distributed systems in indoor or outdoor environments
5. Share knowledge across a distributed system
6. Create quality-of-service-enabled threads for autonomy applications
7. Create distributed algorithms for the GAMS middleware, simulations and tools
8. Create GAMS platforms for new hardware in simulation or real-world systems
9. Verify distributed autonomous systems using software model checking with DART
10. Verify legacy or blackbox/proprietary software using statistical model checking with DEMETER

## What does the tutorial require?

1. A conference room with good internet connection (allowing VPN access to SEI) for installation media and DEMETER access
2. Any participants who want to follow along during both days should have Ubuntu Linux with sudo/apt-get permissions for installing software on their system. The laptop will need to be able to access the internet to download and install software.

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| Contact Us  Software Engineering Institute 4500 Fifth Avenue, Pittsburgh, PA 15213-2612  **Phone**: 412/268.5800 | 888.201.4479 **Web**: [www.sei.cmu.edu](http://www.sei.cmu.edu) | [www.cert.org](http://www.cert.org) **Email**: info@sei.cmu.edu |