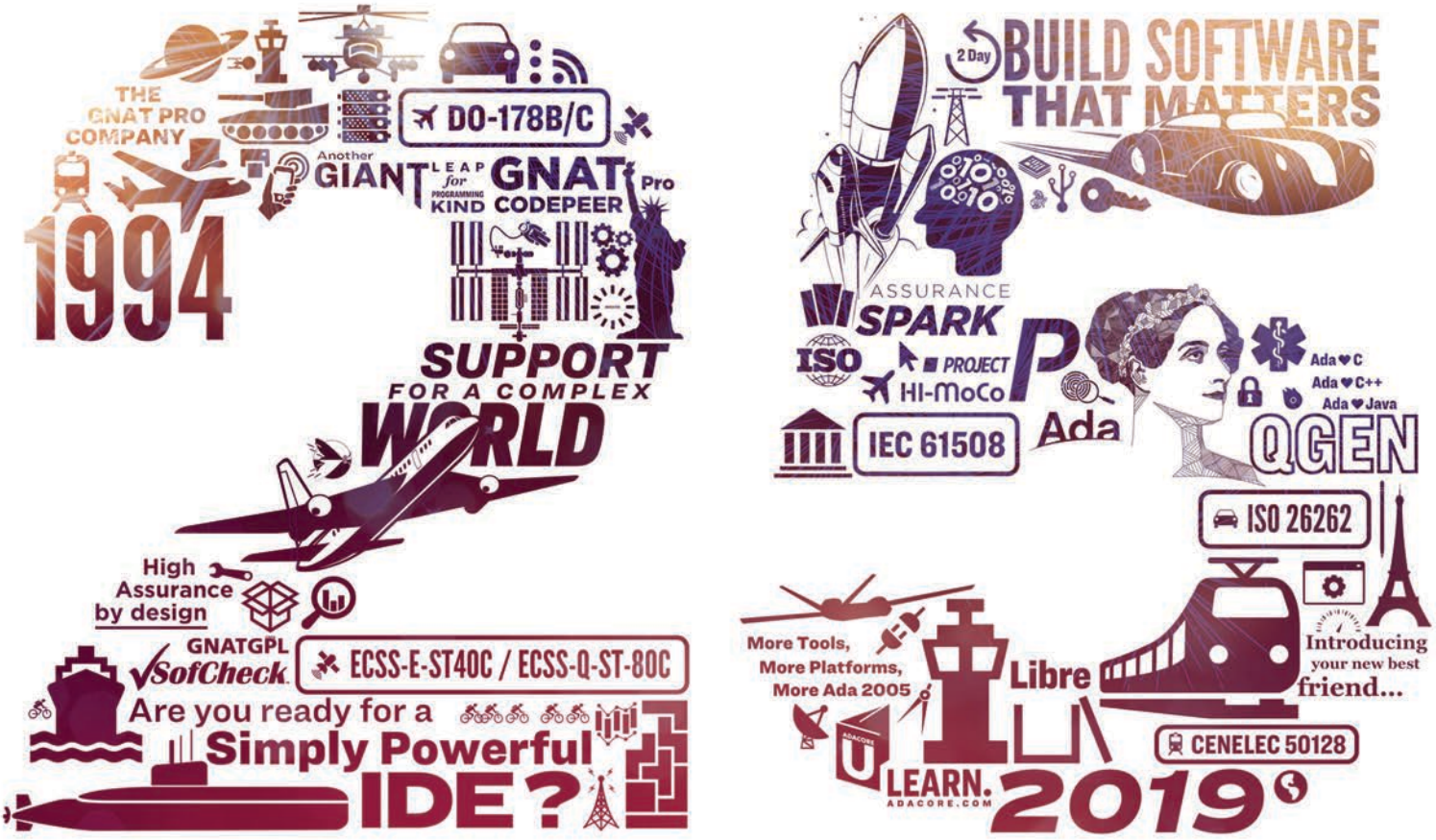
Inside AdaCore



YEARS

July–December 2019

AdaCore Turns 25 | *Make with Ada* Winners Announced | Tech Days EU and US Announced for 2019 | Roadmap Announced for GNAT Pro on Wind River VxWorks 7 SR066xx Platforms | AdaCore Joins RISC-V Foundation | New AdaCore Blogs | GNAT Pro Available for C and C++ | Welcome GNAT Studio! | Spotlighting a GAP Member: Institut Supérieur de l'Aéronautique et de l'Espace (Toulouse, France) | AdaCore Ltd Is Born | Frama-C & SPARK Day Explores Formal Verification Methods | AdaCore Now a Principal Member of the Open Group FACE™ Consortium | Tech Day Held in Huntsville, Alabama

AdaCore Turns 25

July 2019 marks a milestone for AdaCore, as the company celebrates its 25th birthday.

Since AdaCore's founders first decided to commercialize the Ada 95 technology that their team had developed at New York University, the company has grown steadily over the years and now has offices in nine countries and a staff of over one hundred.

AdaCore's product line has expanded to meet the needs of customers around the globe; major players in aerospace, defense, rail, automotive, medical, and other critical domains depend on the company's software development and verification tools to field reliable, safe and secure systems.

ABOVE: GNAT implementation team in New York office, circa 1998.

LEFT: Lady Ada (Karen Mason) and Cyrille Comar at ACM SIGAda (TRI-Ada) Conference in Philadelphia, 1996.

BELOW: Group photo at company summer gathering, Le Grand Mello Châteaux (France), 2018.

A key to AdaCore's success has been the company's adoption of Free Software ("free" as in "freedom") as the basis of its business model. The Free Software approach, sometimes referred to as Freely Licensed Open Source Software (FLOSS), has allowed AdaCore to take advantage of the GNU Compiler Collection (GCC) technology in its GNAT Pro development environments, bringing Ada to a wide range of platforms for both native and embedded applications. The company issues major product upgrades annually, and the product developers themselves furnish expert and timely support to customers. With a subscription renewal rate of more than 90%, AdaCore has a proven track record of customer satisfaction.

AdaCore was founded by the late Robert Dewar and his colleagues Edmond Schonberg, Richard Kenner, Cyrille Comar, and Franco Gasperoni. To see Ed and Richard's retrospective / history on the company's first twenty-five years, and Franco and Cyrille's thoughts on future directions, please visit **www.adacore.com/adacore25/**.

Make with Ada Winners Announced

AdaCore's third annual *Make with Ada* competition ended on February 15, 2019, and yielded a diverse group of winning projects from the several dozen entries. The $5000 1st-place prize was awarded to Guillermo Alberto Perez Guillen (Mexico) for his *PID Light Meter Controller*, the $2000 2nd-place prize (and also the student prize of an Analog Discovery 2 Pro Bundle) went to Samira Peiris (Sri Lanka) for his *Ada Modbus Analyzer*, and the $1000 3rd-place prize was awarded to Angel Gonzalez and Adrian Martinez (Spain) for their *Low-Cost ECG Pathology Detection with Deep Neural Networks*. For details on the projects, please visit **www.hackster.io/contests/adacore/**.

The *Make with Ada* competition illustrates how Ada and SPARK can significantly improve code quality for modern embedded systems without requiring a steep learning curve for developers new to these languages. The next competition runs from September 2, 2019 until January 31, 2020; it will offer additional prizes and also broaden the judging criteria. For more information please visit **www.hackster.io/contests/adacore2/**.

Tech Days EU and US Announced for 2019

AdaCore's annual Tech Days conferences will be held in Paris on Thursday, October 3, and in Boston (Burlington, MA) on Wednesday and Thursday, November 13–14. These customer-focused events will feature product demos and roadmaps, "how-to" guidance on technical topics, an overview of the company's activities in the area of System Software Integration, and most importantly an opportunity for attendees to meet and talk with AdaCore's experts. The Paris event will include customer presentations from GE Aviation and Componolit, and Boston Tech Days will include keynote talks from George Romanski (FAA) and Ray Richards (DARPA), and a customer presentation from NVIDIA.

For more information or to register, please visit **events.adacore.com/techdaysparis2019** or **events.adacore.com/techdaysboston2019**.

Roadmap Announced for GNAT Pro on Wind River VxWorks 7 SR06xx Platforms

Continuing its longstanding support for Wind River's VxWorks real-time operating system (RTOS), AdaCore has released GNAT Pro Ada for the VxWorks 7r2 SR06xx series RTOS, with immediate availability for the ARM 64-bit processor. Additional platforms (32- and 64-bit PowerPC, 32-bit ARM, 32- and 64-bit Intel) are scheduled for release during Q4 2019, incorporating the GNAT Pro v20 technology.

GNAT Pro customers using SR0540 can continue to do so, with an easy upgrade path to SR06xx. AdaCore's GNAT Pro C Development Environment is on the same schedule as GNAT Pro Ada, and GNAT Pro C++ for the SR06xx series is planned for early 2020.

AdaCore Joins RISC-V Foundation

AdaCore has joined the RISC-V Foundation, a non-profit organization chartered to standardize and promote the free and open RISC-V instruction set architecture (ISA) together with its hardware and software ecosystem. As a Foundation member AdaCore is bringing the Ada and SPARK programming languages to the forefront of the technologies available to RISC-V developers, offering a unique environment for safety- and security-critical applications developed on this platform. AdaCore's initial product offerings include GNAT Pro Ada and GNAT Pro C targeted to bare metal RISC-V 32- and 64-bit architectures, as well as the GNAT Community edition for bare metal RISC-V 32-bit configurations. For GNAT Pro customers with software safety certification requirements, run-time library certification and tool qualification materials are available as an add-on for standards in industries such as avionics (DO-178C/ED-12C), railway (EN 50128) and automotive (ISO 26262). For more information please see the press release **www.adacore.com/press/adacore-joins-the-risc-v-foundation/**.

New AdaCore Blogs

AdaCore's blog site offers an informative and personal perspective on Ada and related technologies, from both AdaCore staff and external contributors. Entries this year include "NVIDIA Is Joining the Ada and SPARK Adopter Wave", "AdaFractal Part 1: Ada with a Portable GUI" and "AdaFractal Part 2: Fixed Point and Floating Point Math Performance and Parallelization", "A Readable Introduction to Both MISRA C and SPARK Ada", "Ten Years of Using SPARK to Build CubeSat Nano Satellites With Students", "How Do We Use CodePeer at AdaCore", "Using SPARK to Prove 255-bit Integer Arithmetic from Curve25519", "Winning DTU RoboCup with Ada and SPARK", "Bringing Ada To MultiZone", "Using Pointers in SPARK", "Using Ada for a Spanish Satellite Project", and "Proving a Simple Program Doing I/O . . . with SPARK".

For these and other blogs, please visit **blog.adacore.com/**.

GNAT Pro Available for C and C++

Customers whose projects involve C or C++ can now receive support for these languages by subscribing to GNAT Pro C or GNAT Pro C++. Both GNAT Pro C and GNAT Pro C++ are available on native x86 platforms (Linux and Windows). For embedded development, GNAT Pro C is targeted to the PowerPC, ARM, x86 and RISC-V instruction set architectures, with support for a variety of RTOSes—Embedded Linux, VxWorks 6, VxWorks 7, LynxOS-178—as well as Bare Metal. GNAT Pro C++ for Embedded Linux is available now as part of an early access to the GNAT Pro v20 technology. GNAT Pro C++ for PowerPC VxWorks 6 is also on the v20 roadmap. As mentioned earlier, GNAT Pro C++ for VxWorks 7 SR06xx is planned for early 2020.

The GNAT Pro C and C++ development environments offer up-to-date language support for C11 and C++17 and include the gprbuild multi-language build tool, the gnatstack stack analyzer, and binding generators that produce Ada package specs from C or C++ header files or *vice versa*. The dynamic analysis tool GNATcoverage for C is available on specific platforms as a supplemental product for reporting source or object code coverage.

For additional information about these products, please contact **info@adacore.com**.

in the pipeline

Welcome GNAT Studio!

AdaCore's GNAT Programming Studio (GPS) IDE is being rebranded as GNAT Studio in the v20 release, and along with the new name some major enhancements are coming. Most significant is a completely new engine for source navigation, based on Libadalang, which doesn't rely on the compiler for navigation information, and doesn't need an on-disk database—a major benefit in terms of usability and performance.

This new engine is implemented through support for Microsoft's Language Server Protocol (LSP), and includes a server for this protocol for the Ada and SPARK languages. A language server based on the LSP encapsulates the language-specific knowledge that clients (such as editing tools) can access via standard requests and through inter-process communication. An IDE that supports LSP can handle any language for which a language server is implemented, and in the other direction a language server can be reused in any IDE that supports LSP, such as Visual Studio Code.

The initial version of GNAT Studio's Ada Language Server will support navigation and tooltips, with enhancements planned during 2020 (code completion, live diagnostics, and others). For more information, or to follow developments in the technology, please visit the Ada Language Server github repository **github.com/AdaCore/ada_language_server/**.

academic corner

Spotlighting a GAP Member

Institut Supérieur de l'Aéronautique et de l'Espace (Toulouse, France)

ISAE-SUPAERO is one of the leading French "Grandes Ecoles", training students for careers in the field of space and aeronautics. Its curriculum spans all areas of the industry, and the courses dealing with software place a particular emphasis on embedded and critical systems. ISAE-SUPAERO students are taught a broad range of subjects: aerodynamics, flight dynamics, signal processing, mathematics, fundamental physics, and computer science are all part of the curriculum. Most of these courses are based on continuous rather than discrete mathematics, and the students—who include managers as well as engineers—do not generally have a background in theoretical Computer Science or the semantics of advanced programming languages.

Prof. Christophe Garion and his team in the Critical Systems Architecture group teach rigorous development methods for safety-critical software, with a focus on formal methods and Ada. The challenge: how to educate future aeronautical engineers about formal methods in a few hours when they do not have a strong background in theoretical Computer Science? The approach adopted by Prof. Garion's team comprised two stages. First, they took the content in the C-oriented *ACSL by Example*[1] and adapted it to the SPARK language, producing *SPARK by Example*[2]. Yannick Moy and Claire Dross from AdaCore provided some guidance during this process. Prof. Garion explains: "The results were beyond our expectations: the most complex proofs were completed by two students as part of a summer internship. They had a solid background in mathematics but no previous knowledge of Ada or formal methods. The *SPARK by Example* project clearly showed us that the technology was mature enough to be transitioned to our students."

The second stage used *SPARK by Example* as the basis for teaching the principles of safe and secure programming in a 15-hour class for students in the Critical Software curriculum. "This was quite a challenge," said Prof. Garion, "but it was also the high point of the students' curriculum. Being trained in mathematics, and reasoning at large on complex systems, a student majoring in Computer Science could understand why software matters in aeronautics." The course used a project-driven approach, with students selecting either model-checking, abstract interpretation, or deductive methods (using either Frama-C or SPARK). Students then related their positive and negative experience during a debriefing, and the feedback was diverse. SPARK's conciseness and efficiency were quickly recognized as key impact factors.

"The students also learned some important messages: software is not just about fancy programming languages, and specifications can be formal rather than informal," said Prof. Garion. "Indeed, formal methods can serve to prove the correctness of software, not just play with models. This definitely changes students' perception of software's role and mathematical underpinnings."

An interesting side effect is that first-year students changed their minds about Computer Science, paying it more respect thanks to its stronger connection to mathematical reasoning as shown by SPARK and other tools. Computer Science is more than programming.

[1] **www.cs.umd.edu/class/spring2016/cmsc838G/frama-c/ACSL-by-Example-12.1.0.pdf**
[2] **github.com/tofgarion/spark-by-example**

AdaCore Ltd Is Born

AdaCore has established an office in the UK, increasing its investment in the UK market and strengthening its ties to the country where the SPARK programming language originated and where the aerospace and defense industry is seeing prominent advances. With a physical presence, AdaCore can better serve its UK customers and strategic partners, as well as participate in research and development. The company is also seeking to benefit from the considerable talent pool within the UK; please visit AdaCore's careers page **www.adacore.com/company/careers** for information about current positions.

Frama-C & SPARK Day Explores Formal Verification Methods

This year's Frama-C & SPARK Day was held in Paris on June 3, 2019. Cosponsored by AdaCore, the conference offered a forum for an international group of researchers and engineers to share their experiences and new perspectives on the SPARK verification environment for Ada and the Frama-C platform for C. The program focused on three topics: autonomy, embedded systems, and safety. SPARK-related talks included "Thoughts on SPARK from an automotive perspective" (Zenuity), "Software for a total artificial heart" (Scandinavian Real Heart), and "Proof and test with rich SPARK 2014 contracts" (Altran UK). Attracting more than 100 participants, the conference highlighted the growing interest in, and importance of, formal method technologies in the verification of critical software. To download the slide presentations, please visit **frama-c.com/FCSD19.html**.

AdaCore Now a Principal Member of the Open Group FACE™ Consortium

AdaCore has elevated its membership level in The Open Group's Future Airborne Capability Environment (FACE™) Consortium from Associate to Principal. This transition reinforces the company's commitment to the FACE approach and its objective of cost-effective software component portability, which is fully in sync with Ada and with AdaCore's corporate mission and product offerings.

AdaCore has been an active member of The Open Group FACE Consortium since 2012. The company's contributions include:

- Reviewing the various versions of the FACE Technical Standard and assisting in the definition of the IDL-to-Ada mapping;
- Providing Ada run-time libraries that meet the requirements of the FACE Technical Standard's Ada capability sets;
- Working towards incorporating Ada 2012 capability set support in future versions of the FACE Technical Standard so that FACE component developers can take advantage of contract-based programming and other useful features;
- Serving as a key member of the Conformance and Operating System Subcommittees and thereby helping to formulate effective policies and procedures for FACE Technical Standard conformance, including operating systems and run-time libraries; and
- Sponsoring FACE Consortium meetings and presenting papers / conducting demos at FACE Technical Interchange Meetings.

For more information about AdaCore and the FACE Consortium, please see the press release **www.adacore.com/press/adacore-now-a-principal-member-of-the-open-group-face-consortium/**.

newsflash

AdaCore Enhances Security-Critical Firmware with NVIDIA

AdaCore is working with NVIDIA to implement the Ada and SPARK programming languages for select security-critical firmware used for applications that demand stringent safety and security capabilities, such as automated and autonomous driving. Some NVIDIA system-on-a-chip product lines will migrate to a new architecture using the RISC-V Instruction Set Architecture. Also, NVIDIA plans to upgrade select security-critical firmware software, rewriting it from C to Ada and SPARK. Both moves are intended to increase verification efficiencies to achieve compliance with the functional safety standard ISO 26262. For more information please see the press release **www.adacore.com/press/adacore-enhances-security-critical-firmware-with-nvidia/**.

Case Study Available on Ada and SPARK for Medical Devices

Hillrom, a global leader in medical technology, has decided to migrate from C++ to Ada and SPARK for electrocardiogram (ECG) algorithm development for Welch Allyn devices. This includes both new code as well as translation of legacy C++ applications to Ada and SPARK. The objective of this adoption is threefold: it is aimed at verifying the safety of the code by formally proving some properties, improving its efficiency by removing dynamic checks, all the while keeping development and verification costs down. A case study by Patrick Noffke (Hillrom) and Quentin Ochem (AdaCore), *Ada and SPARK: Beyond Static Analysis for Medical Devices*, is available at **www.adacore.com/hillrom-casestudy** with details on the project.

White Paper Available on Ada as a Modern Language

In a 2018 report on the "Do's and Don'ts for Software", the Defense Innovation Board in the US advises "Use modern languages and operating systems. . . . Treat software development as a continuous activity, adding functionality across its life cycle." AdaCore has prepared a white paper, *Ada: Meeting Tomorrow's Software Challenges Today*, demonstrating how the Ada language's state-of-the-art features (such as its support for contract-based programming) and growing ecosystem embody these "do's" while reducing life cycle costs. The white paper is available at **www.adacore.com/papers/ada-meeting-tomorrows-software-challenges-today/**.

Tech Day Held in Huntsville, Alabama

AdaCore took its Tech Day conference on the road on May 9, with Quentin Ochem, Pat Rogers, Rob Tice, and Michelle Ricardo presenting the latest news and product demos / roadmaps to an enthusiastic audience in Huntsville, Alabama. The presentations covered a range of topics including AdaCore's activities related to the US Department of Defense's Future Airborne Capability Environment (FACE™) approach; product support for C and C++; AdaCore technologies for cyber security; and Ada coding tips. The event also featured demos of the GNAT Pro Ada toolsuite, the GNATtest and GNATcoverage dynamic analysis tools, and the CodePeer advanced static analysis tool for Ada. The conference was very highly rated by attendees, and AdaCore is planning similar events in the US in the future to supplement the annual Boston Tech Days. For copies of the slide presentations, please visit **www.adacore.com/tech-days-alabama/**.

QGen Wins "Best in Show" Award at Aerospace Tech Week

José Ruiz from AdaCore holds "Best in Show" Award. Photo by Ingo Houben

AdaCore's QGen model-based development toolsuite was a 4-star award winner—the top recognition—at the March 2019 *Aerospace Tech Week* conference and exposition in Munich, Germany. The award was presented by the conference sponsor, *Avionics Design*, with winners selected on the basis of the improved performance and innovation that they bring to aerospace applications. The award announcement cited QGen's qualifiable and tunable code generator, its feature set selection from the Simulink® and Stateflow® environments to ensure applicability to critical systems, its preservation of model semantics in the generated code, and its ability to generate code in MISRA C and SPARK.

AdaCore at RISC-V Workshop

AdaCore participated in the RISC-V Workshop in Zurich (June 11–13, 2019) with an exhibit / demo and also a presentation by AdaCore Senior Embedded Software Engineer Fabien Chouteau on *Ada & PolarFire SoC, a Software and Hardware Alloy for Safety & Security*. Coauthored with Pierre Selwan from Microchip, the talk described the architecture and deterministic execution of Microchip's PolarFire SoC and explained how Ada and SPARK, together with AdaCore's Ravenscar real-time kernel, could help developers field safe and secure applications on this RISC-V platform. Slides and video of the talk are available at **riscv.org/2019/06/risc-v-workshop-zurich-proceedings/**.

Booklet Available on SPARK for the MISRA C Developer

AdaCore has published a booklet presenting the SPARK technology through an example-driven comparison with the rules in the MISRA C subset of the C language. Authored by AdaCore expert Yannick Moy, the booklet shows how SPARK can be used to achieve high code quality with guarantees that go beyond what would be feasible in MISRA C. The SPARK static analysis tool takes advantage of Ada's strong typing and other semantic checks, and is sound while minimizing false alarms. To download a copy of the booklet please visit **www.adacore.com/books/spark-ada-for-misra-c-developer**, or, to receive a printed version, please contact **info@adacore.com**. An on-line and interactive version of the booklet is available at **learn.adacore.com/courses/SPARK_for_the_MISRA_C_Developer/**.

New Target Platform Support

A number of new GNAT Pro target platforms are on the roadmap for the 2nd half of 2019 and early 2020.

- GNAT Pro Ada 19.2 for VxWorks 653 3.0.1.1 cert
- GNAT Pro Ada 20.1 for VxWorks 7 SR06x0 (AArch64, ARM, PPC, PPC64, x86, x86_64), and also for ARM PikeOS 4.2

calendar highlights / July–December 2019

For up-to-date information on conferences where AdaCore is participating, please visit **www.adacore.com/events/**.

Getting Started with RISC-V
September 24, 2019 / Paris, France

AdaCore is presenting at this event.
events.linuxfoundation.org/events/risc-vparis2019/

US Air Force FACE™ Technical Interchange Meeting
September 17, 2019 / Dayton OH, USA

AdaCore is presenting "Verifying High-Assurance FACE™ Components with Ada and SPARK" and is exhibiting at this event.
www.opengroup.org/content/future-airborne-capability-environment-face/events

UK Space Conference 2019
September 24–26, 2019 / Newport, South Wales, UK

AdaCore is exhibiting at this event - Booth D16.
www.ukspace.org/event/uk-space-conference-2019/

IEEE Secure Development Conference (SecDev 2019)
September 25–27, 2019 / McLean VA, USA

AdaCore is conducting a tutorial "A Practical Introduction to Formal Development and Verification of High-Assurance Software with SPARK".
secdev.ieee.org/2019/Home/

AdaCore Tech Days
October 3, 2019 / Paris, France
November 13–14, 2019 / Boston (Burlington) MA, US

For information about these annual customer-focused events please see the companion article in this newsletter.
events.adacore.com/techdaysparis2019; events.adacore.com/techdaysboston2019

Public Ada Training
October 21–25, 2019 / Bath, UK

This practical introduction to the Ada language combines live lectures and hands-on workshops using AdaCore's latest GNAT technology.
www.adacore.com/public-ada-training-uk

High Integrity Software Conference (HIS 2019)
November 5, 2019 / Bristol, UK

AdaCore is co-organizing, cosponsoring and exhibiting at this event.
www.his-2019.co.uk/

RISC-V Summit
December 9, 2019 / San Jose CA, USA

AdaCore is exhibiting at this event.
tmt.knect365.com/risc-v-summit/

Flight Software Workshop (FSW 2019)
December 9–12, 2019 / Huntsville AL, USA

AdaCore is a sponsor of this event.
flightsoftware.jhuapl.edu/

contact us!

Please contact us at **info@adacore.com** with questions/comments or to get further information about any of the items in this newsletter.

Inside AdaCore is published twice a year simultaneously in New York and Paris by AdaCore.

150 W. 30th Street, 16th floor
New York, NY 10001, USA
tel +1 212 620 7300
fax +1 212 807 0162

46 rue d'Amsterdam
75009 Paris, France
tel +33 1 49 70 67 16
fax +33 1 49 70 05 52

info@adacore.com
www.adacore.com

AdaCore