AdaCore 2022 Tech Update

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GNAT Pro robust and flexible Ada, C and C++ development environment

Ada 2022 Support in GNAT:

- Jorvik (evolution of Ravenscar tasking)
- Improvements to the 'Image attribute
- Atomic Operations
- Support for infinite precision numbers
- User-Defined Literals
- And more…
  - Declare expressions
  - Delta aggregates
  - Static expression functions
  - Assignment target name @
  - Renames with type inference
  - Container aggregates
  - Etc.

Try it now:
learn.adacore.com/courses/whats-new-in-ada-2022/

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Experimental Ada Language Extensions

- Pattern Matching (generalized case statement)
- Generalized Object.Method Notation for Untagged Types
- Simpler, Compile-Time Accessibility Rules
- Additional “when” Constructs: “return”, “goto”, “raise”
- Fixed Array Lower Bounds

More details at blog.adacore.com/going-beyond-ada-2022

GNAT Pro robust and flexible Ada, C and C++ development environment

- Security Hardening
  - Register Scrubbing: generate code to **zero-out hardware registers** before returning from a subprogram
  - Stack Scrubbing: generate code to **zero-out stack frames** used by subprograms
  - Hardened Conditionals: harden conditionals to **protect against control-flow attacks**
  - Hardened Booleans: with a high hamming distance
  - Control Flow Redundancy: **guard against unexpected execution flows**, such as branching into the middle of subprograms, as in Return Oriented Programming exploits

SPARK formally analyzable subset of Ada

- Extensions of the pointer support with ownership
- Extensions of the support of proof of termination
- More complex proof of data initialization now possible
- Updates to core provers: Alt-Ergo 2.4.0, cvc5 1.0, Z3 4.8.17 and a new prover COLIBRI
- Automatic checking before displaying counterexamples when proof fails
- Initial support in Visual Studio Code

GNAT Studio & VS Code

- Ada Language Server: New engine for completion, navigation, code refactoring
  - Add Parameter
  - Remove Parameter
  - Move Parameter
  - Change Parameter Mode
  - Change Parameter Type
  - Change Parameter Default Value
  - Extract Subprogram
  - Pull Up Declaration
  - Suppress Separate
  - Etc.
- VS Code support
- GTK 3.24+ and Python3 transition

https://github.com/AdaCore/ada_language_server/blob/master/doc/refactoring_tools.md

Libadalang powerful and modern syntactic analysis of Ada/SPARK

- LKQL: run queries on Ada codebase
- New logic solver
- Improved Ada2022 support
- Improved generics support
- Support of pre-processing
- Support of rational numbers
- Improved memory footprint

Used extensively by AdaCore and our customers:

- GNAT coverage
- GNAT check
- GNAT test
- GNAT pp
- GNAT doc
- IDEs (Ada Language Server)
- GNAT fuzz
- CodePeer
- Know Problems Detection

GNAT check coding standard verification

- Complete rewrite using Libadalang and LKQL
- Write your own rules with LKQL
- Use GNATcheck as a Known Problem Detector
- Off-the-shelf qualification material for DO-178B/C and EN 50128

GNAT Dynamic Analysis Suite formerly known as GNATcoverage

- Source coverage analysis via source instrumentation.
  - All GNAT Pro platforms, included embedded ones, and all GNAT Pro versions are now supported
- GNATtest has been transitioned to Libadalang
  - faster, more flexible, and more reliable processing
- GNATtest and GNATcoverage are now better integrated
- On the roadmap, the version 23 will include a beta release of GNATfuzz (fuzzing technology)

RecordFlux verifiable binary parsers and message generators

- Formally describe, test, and implement binary communication protocols
- Domain Specific Language
  - Definition of complex data formats
  - Definition of complex protocol behavior
- Provable message parsers, serializers and state machines in SPARK
  - Absence of runtime errors proven statically
  - Functional correctness proven statically

```
package TLS_Heartbeat is

   type Message_Type is
      (Heartbeat_Request  => 1,
       Heartbeat_Response => 2)
   with Size => 8;

   type Payload_Length is range 0 .. 2**14 - 20
   with Size => 16;

   type Heartbeat_Message is
      message
         Message_Type   : Message_Type;
         Payload_Length : Payload_Length;
         Payload        : Opaque;
         Padding        : Opaque;
      end message;

end TLS_Heartbeat;
```

CodePeer static analysis toolsuite for Ada

- Integration of checks based on Facebook's infer
- Move from a database centric to a file centric approach to management of messages and analysis
- Improving performance on big codebases

End of GNAT Community Edition

- A cleaner and more familiar ecosystem with two variants:
  - GNAT Pro: provided and supported by AdaCore for commercial/industrial projects
  - GNAT FSF: provided by the community for open source projects
- No more GNAT release with pure-GPL run-times
- We encourage all GNAT Community users to transition to **Alire** going forward

See the announcement: blog.adacore.com/a-new-era-for-ada-spark-open-source-community

Alire source-based package manager for Ada and SPARK

- Easily build upon open-source projects shared by the community
  - 250+ projects available
- Easily share projects for others to build upon
- A game changer for the Ada/SPARK open-source ecosystem
- AdaCore is sponsoring and contributing to Alire

Get started here: alire.ada.dev

Thank You

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