AdaCore
The GNAT Pro Company

GPR Project Files

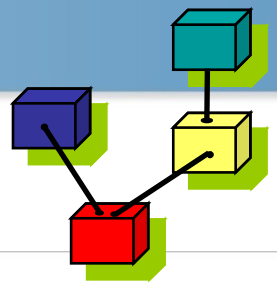
Vincent Celier
Senior software engineer, AdaCore

FOSDEM

8-9 February 2009

The GPR Project Facility

- Overview
- GPR Project Files
- Property Values
- Setting Project Properties
- External and Conditional References
- Importing Projects
- Extending ("Modifying") Projects
- Source File Naming Schemes



The GPR Project Facility

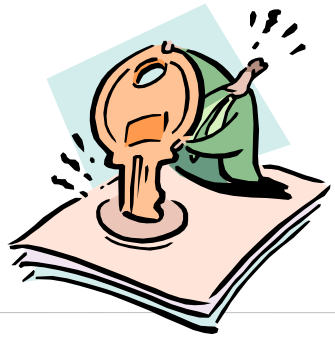
- **Provides configurable properties for source files**
  - Represented by "projects"
- **Supports incremental, modular project definition**
  - Projects can **import** other projects containing needed files
  - *Child* projects can **extend** *parent* projects, inheriting source files and optionally overriding any of them
- **Facilitates the structuring of large development efforts into hierarchical subsystems**
  - With build decisions deferred to the subsystem level

Configurable Properties

- **Source directories and specific files' names**
- **Output directory for object modules and .ali files**
- **Target directory for executable programs**
- **Switch settings for project-enabled tools**
- **Source files for main subprogram(s) to be built**
- **Source programming languages**
  - Ada / C / C++ / Fortran / ...
- **Source file naming conventions**

Sample Uses

- **Common set of sources generating object files in different directories, via different switches**
  - "Debug" version
  - "Release" version
- **Multiple versions of the body for a package spec**
- **Note this is not a configuration management facility**
  - "Projects" should be under CM too!



GPR Project Files

- **Text files with Ada-like syntax**
- **Integrated into command-line tools**
  - Specified via the –Pproject-file-name switch
- **Integrated into GPS**
  - A fundamental part of the IDE
  - Automatically generated
  - There is even a Project Wizard

Property Values Introduction

- **Strings**
- **Lists of strings**

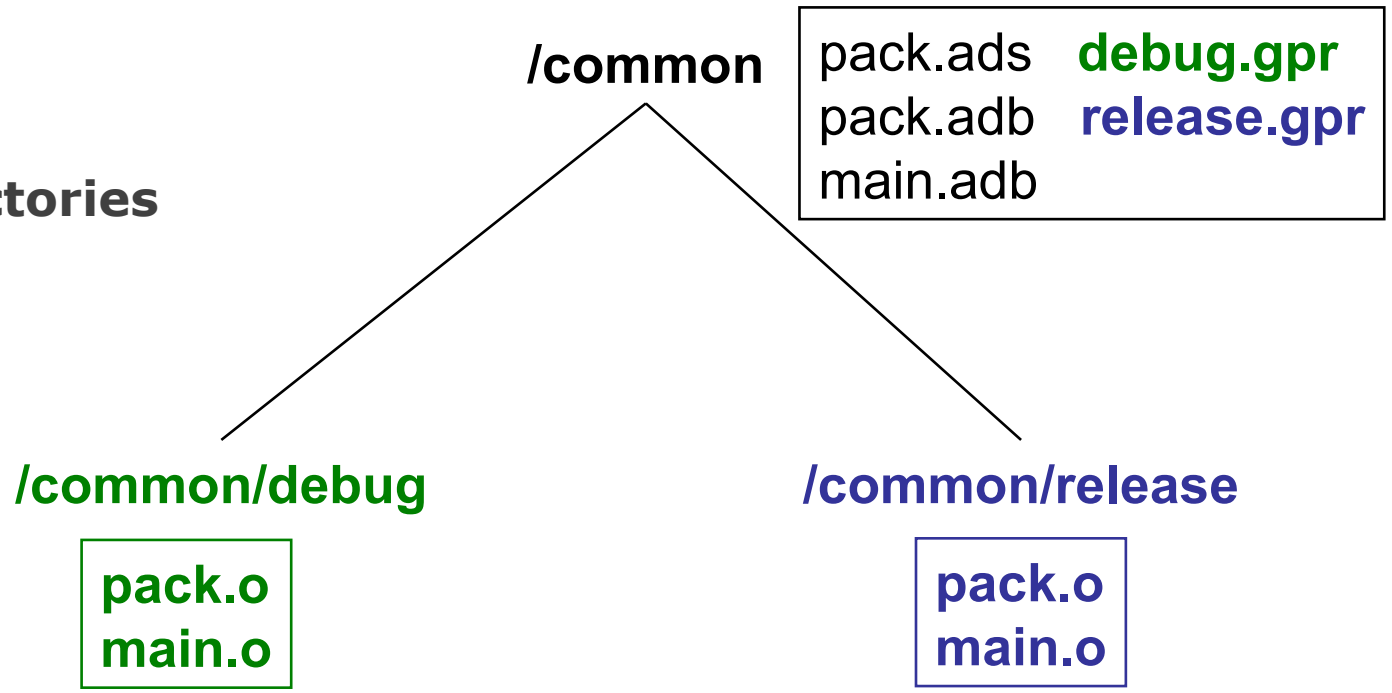
("-v", "-gnatv")

- **Associative arrays**
  - Like functions that map an input string to either a single string or a list of strings

for Switches (*"Ada"*) **use** ("-v", "-gnatv");

Common Files with Different Switches Example

- **Directories**



- **Example usage for debug case**
  - gnatmake –P/common/debug.gpr /common/main.adb

Common Files with Different Switches Projects

```
project Debug is
  for Object_Dir use "debug";
  package Builder is
    for Default_Switches ("Ada") use ("-g");
  end Builder;
  package Compiler is
    for Default_Switches ("Ada")
       use ("-fstack-check", "-gnata", "-gnato");
  end Compiler;
end Debug;
```

```
project Release is
  for Object_Dir use "release";
  package Compiler is
    for Default_Switches ("Ada") use ("-O2");
  end Compiler;
end Release;
```

Conventions for Naming GPR Project Files

- **File name should match project name**
  - Not case sensitive
- **Extension should be ".gpr"**
- **Warnings issued if not followed**

Setting Project Properties

- Packages
- Variables
- Types
- Switches
- Source Directories
- Source Files
- Object Directory
- Executable Directory

Packages In GPR Project Files

- **Package names correspond to tools**
  - Builder
  - Compiler
  - Linker
  - Binder
  - etc.
- **Allowable names and content defined by facility**
  - Not by users

Typed Versus Untyped Variables

- **Typed variables have only listed values possible**
  - Case sensitive, unlike Ada
- **Typed variables are declared *once* per scope**
  - Once at project level
  - Once within any package
  - Essentially read-only constants
    - Especially nice for external inputs
- **Untyped variables may be "declared" many times**
  - No previous declaration required

Switches In GPR Project Files

- **May be specified to apply by default**

```
package Compiler is
  for Default_Switches ("Ada") use ("-gnaty", "-v");
end Compiler;
```

- **May be specified on a *per-unit* basis**
  - Associative array "Switches" indexed by unit name

```
package Builder is
  for Switches ("main1.adb") use ("-O2");
  for Switches ("main2.adb") use ("-g");
end Builder;
```

Source Directories In GPR Project Files

- One or more in any project file
- Default is same directory as project file
- Can specify additional individual directories

```
for Source_Dirs use ("mains", "drivers");
```

- Can specify additional directory trees

```
for Source_Dirs use ("foo/**", "./**");
```

- Can specify that none are present

```
for Source_Dirs use ();
```

Source Files In GPR Project Files

- **Must contain at least one "immediate" source file**
  - In one of the source directories of the project file
  - Unless explicitly specifies none present

```
for Source_Files use ();
```

- **Can specify source files by name**

```
for Source_Files use ("main.adb","pack1.ads","pack2.adb");
```

- **Can specify an external *file* containing source names**

```
for Source_List_File use "files.list";
```

Object Directory In GPR Project Files

- **Specifies the location for compiler's output**
  - Such as “ali” files and object files
  - For the project's *immediate* sources

```
project Release is
  for Object_Dir use "release";
  ...
end Release;
```

- **Only one per project**
  - When extending a parent project the child’s object directory is used for any inherited sources not already compiled in the parent

Executable Directory In GPR Project Files

- **Specifies the location for executable image**

```
project Release is
  for Exec_Dir use “executables";
  ...
end Release;
```

- **Default is same directory as object files**
- **Only one per project**

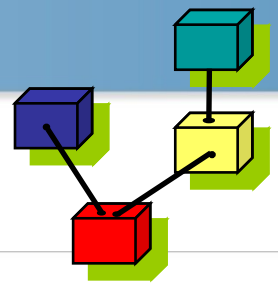
External and Conditional References

- **Allow project file content to depend on value of environment variables & command-line arguments**
- **Reference to external values is by function**
  - external(*name* [, *default*]) returns value of *name* as supplied on the command line or as environment variable
  - If *name* is undefined, return *default* (if supplied) or “”
- **Set via command line switch (for example)**
  - gnatmake –P… -X*name*=*value* …

```
gnatmake –P/common/build.gpr -Xtarget=test  /common/main.adb
```

External/Conditional Reference Example

```
project Build is
   type Targets is ("release", "test");
   Target : Targets := external("target", "test");
   case Target is -- project attributes
      when "release" =>
         for Object_Dir use "release";
         for Exec_Dir use ".";
      when "test" =>
         for Object_Dir use "debug";
   end case;
   package Compiler is
      case Target is
         when "release" =>
            for Default_Switches ("Ada") use ("-O2");
         when "test" =>
            for Default_Switches ("Ada") use
                  ("-g", "-s", "-gnata", "-gnato", "-gnatE");
      end case;
   end Compiler;
end Build;
```



Importing Projects

- **Compilation units in source files of one project may depend on compilation units in source files of others**
  - "Depend" in the Ada sense (contains with-clauses)
- **We want to localize properties of other projects**
  - Switches etc.
  - Defined in one place and not repeated elsewhere
- **Thus dependent projects "import" other projects to place other projects' source files on search path**

Project Import Notation

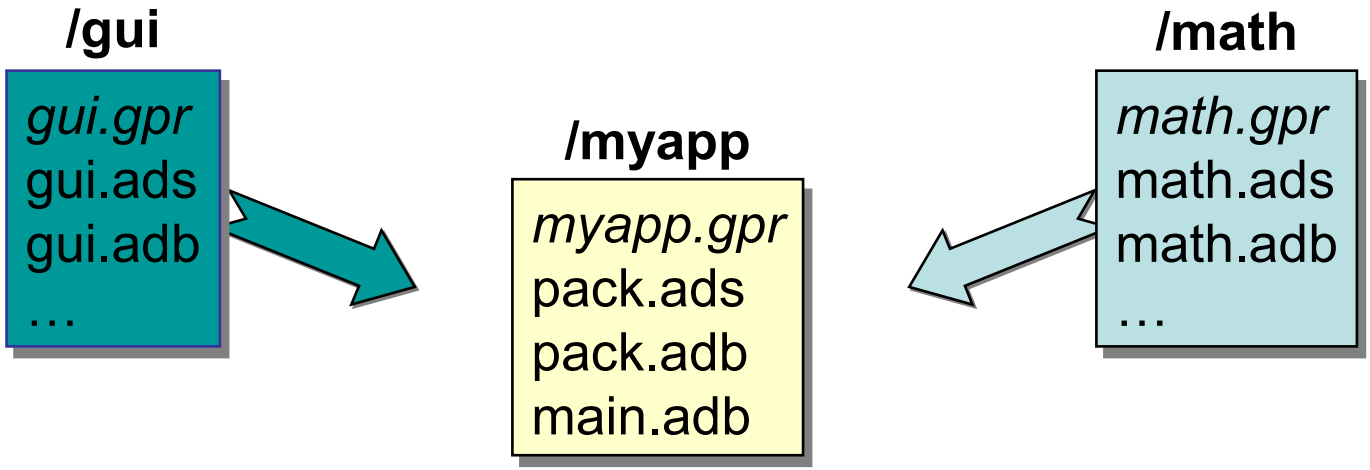
- **Similar to Ada's "with" clauses**
  - But uses strings

with *literal_string* { , *literal_string* } ;

- **String literals are path names of project files**
  - Relative
  - Absolute

Importing Projects Example

with *GUI*, *Math*;
package body Pack **is** ...




```
with “/gui/gui.gpr", “/math/math";
project MyApp is
  ...
end MyApp;
```

Project Path

- **Locates GPR project files referenced by other projects**
- **Combined content of:**
  - Directory containing GPR project file
  - GPR_PROJECT_PATH environment variable (if defined)
- **Note "with" clauses are transitive**
  - Indirectly imported projects are automatically included
  - Unlike Ada "with" clauses
  - A project is responsible for making its own imports work regardless of whether or not it is imported elsewhere

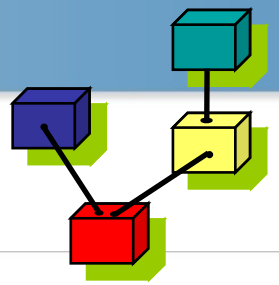
Project Path Examples

- **If** /gui,/math ***are*** **on** GPR_PROJECT_PATH

```
with "gui.gpr", "math";
project MyApp is ...
```

- **If** /gui,/math ***are not*** **on** GPR_PROJECT_PATH

```
with "/gui/gui.gpr", "/math/math";
project MyApp is ...
```

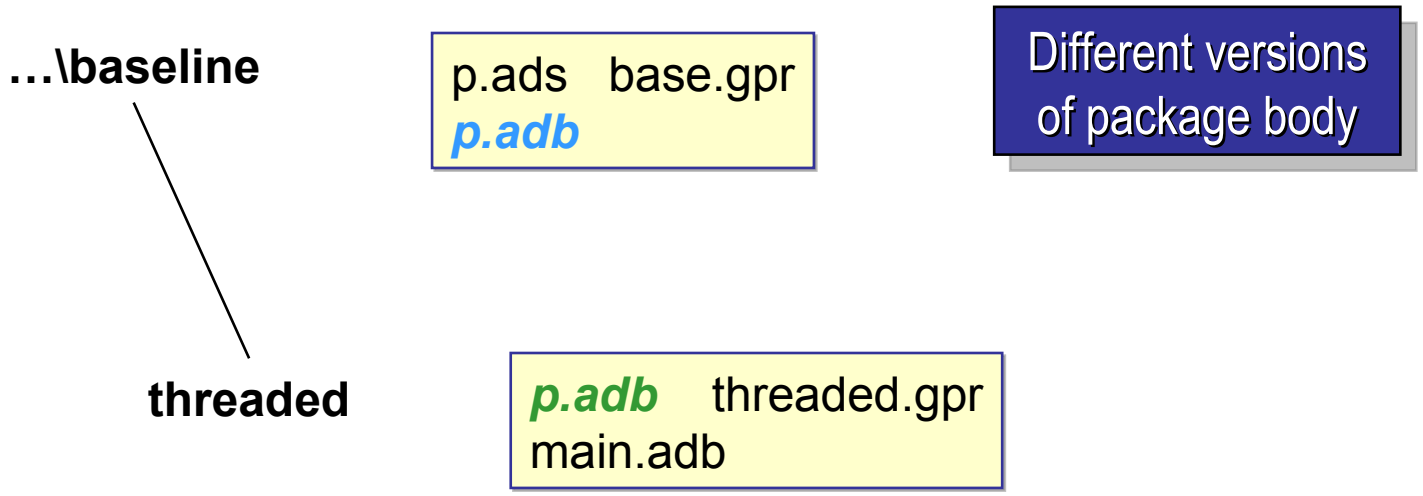


Extending ("Modifying") Projects

- **Allows using modified versions of source files without changing the original sources**
- **Based on "inheritance" of parent project's properties**
  - Source files
  - Switch settings
- **Supports localized build decisions and properties**
  - Inherited properties may be overridden with new versions
- **Hierarchies permitted**

Multiple Versions of Unit Bodies Example

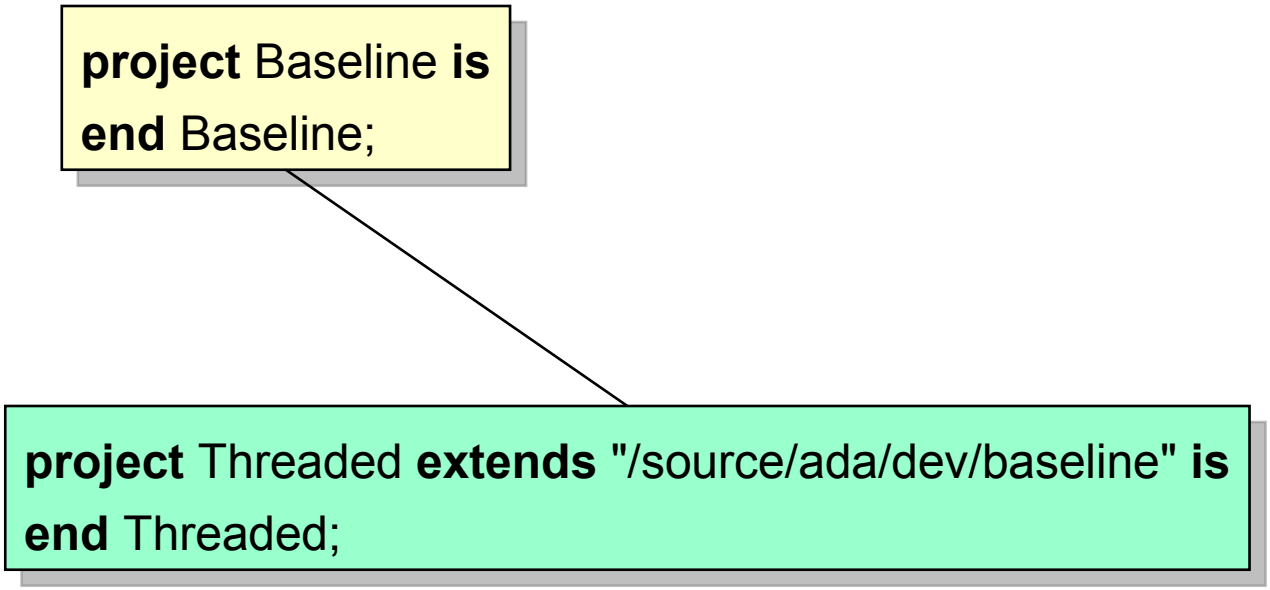
- **Assume this directory structure & files**



- **Usage (assume baseline is current directory)**

gnatmake –Pthreaded/threaded.gpr main

Multiple Versions of Unit Bodies File



Source File Naming Schemes

- **Allow arbitrary naming conventions**
  - Other than default convention
- **May be applied to *all* source files in a project**
  - Specified in a package named "Naming"
- **May be applied to *specific* files in a project**
  - Individual attribute specifications

Foreign Default File Naming Example

```
project APEX is
  for Source_Files use ();
  package Naming is
    for Casing use "lowercase";
    for Dot_Replacement use ".";
    for Specification_Suffix ("Ada")  use ".1.ada";
    for Implementation_Suffix ("Ada") use ".2.ada";
  end Naming;
end APEX;
```

GNAT Default File Naming Example

```
project GNAT is
  for Source_Files use ();
  package Naming is
    for Casing use "lowercase";
    for Dot_Replacement use "-";
    for Specification_Suffix ("Ada")  use ".ads";
    for Implementation_Suffix ("Ada") use ".adb";
  end Naming;
end GNAT;
```

Individual (Arbitrary) File Naming

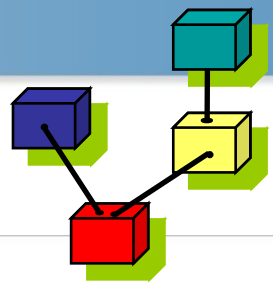
- **Uses associative arrays to specify file names**
  - Index is a string containing the unit name
  - Value is a string
    - Case sensitivity depends on host file system
- **Has distinct attributes for specifications and bodies**

```
for Specification ("MyPack.MyChild")
use "mypack.mychild.spec";

for Implementation ("MyPack.MyChild")
use "mypack.mychild.body";
```

GPS Directly Supports Projects

- The fundamental conceptual basis for GPS
- Graphically displays a project hierarchy
- Provides a wizard to help you create projects
- Displays and navigates project sources
- Compiles sources defined by a project
- Creates executables for project main programs
- Debugs a project's executables
- et cetera



GPR Project Manager Summary

- Supports hierarchical, localized build decisions
- Supports arbitrary file naming conventions
- GPS provides direct support
- See the GNAT User's Guide for further details!