Architecture of EiffelStudio

Emmanuel Stapf
Eiffel Software
April 17th 2007

Overview of EiffelStudio

- EiffelStudio by numbers
- General overview
- Compiler
  - Validation
  - Code generation
- User interface – EiffelStudio
- Repository
- Runtime
- Projects
- Q&A

Overview 1 - EiffelStudio's architecture

- EiffelStudio contains:
  - Compiler
  - Debugger
  - Editor
  - Browsing tools
  - Reporting tools (warnings, errors, C compilation output)
- The graphical IDE contains the command line compiler.
- Command-line compiler can be compiled stand-alone.

Numbers from April 2006

- Command-line compiler only:
  - ~2100 classes (~460 for libraries)
  - ~440 000 lines of code (~120 000 for libraries)
- Full graphical IDE:
  - ~4200 classes (~1100 for libraries)
  - ~980 000 lines of code (~280 000 for libraries)
- C code:
  - ~100 000 lines of code

Overview 1 - EiffelStudio’s architecture (2)

- At the source level, EiffelStudio uses:
  - Libraries
  - Frameworks
  - Its own code

- Framework is a library that is a reusable component but specialized for EiffelStudio. Some frameworks are good candidates for becoming libraries.

A few numbers

- Command-line compiler only:
  - 2548 classes (1083 for libraries)
  - ~1 250 000 lines of code (~935 000 for libraries)
- Full graphical IDE:
  - 5395 classes (2860 for libraries)
  - ~1 880 000 lines of code (~1 200 000 for libraries)
- C code:
  - ~100 000 lines of code
Overview 1 - EiffelStudio's architecture (3)

- Libraries
  - EiffelBase
  - EiffelParser
  - Editor
  - Compiler Core
  - .NET generation

- Framework
  - Configuration
  - EiffelParser
  - AST generation
  - .NET debugger
  - General extensions

- Application
  - Errors
  - Display
  - Browsing
  - Metrics
  - Wizards
  - Tools
  - Search
  - Dialogs

Patterns in EiffelStudio - Visitor

- Visitor pattern for traversing tree structures:
  - Compiler ASTs
  - Byte node ASTs (for code generation)
  - Types

- Initially visitor pattern was not used and some traversals are still done the old way (i.e. defining the same feature in all the descendant of a class).

Overview 2 - Compilation process

- Degree 6: finding classes
- Degree 5: parsing classes
- Degree 4: inheritance analysis
- Degree 3: type checking

Patterns in EiffelStudio - Extensibility

- To abstract some platforms differences we use the extensibility pattern in:
  - Debugger (classic vs. dotnet)
  - Dotnet code generation (None/Microsoft .NET, and in the future Mono).

Overview 2 - Compilation process (2)

- Degree 2/1: melting
- Degree -1: freezing
- Degree -2-3: finalization
  - Degree -2: process polymorphism
  - DCR: Dead Code Removal
  - Degree -3: code generation

Patterns in EiffelStudio - Factory

- Factories are either used for abstracting:
  - Platform specific implementation (same purpose as extensibility)
  - Different needs in functionality:
    - See AST_FACTORY descendants
    - See CONF_FACTORY descendants
Patterns in EiffelStudio - Others

- Other patterns in use in EiffelStudio:
  - Observer
  - Singleton
  - Lazy initialization
  - Flyweight

Compiler – AST

- All classes representing AST nodes are descendants of AST_EIFFEL and have the _AS suffix.
- Parser written using gelex/geyacc.
- Parser has many faces:
  - Syntax checker: no AST, useful for syntax validation.
  - Light parser: keeps only nodes needed for validation.
  - Full parser (aka roundtrip parser): preserves all information about Eiffel text (code, blanks and comments).

Compiler – Types

- All types appearing in an AST are transformed into instances of TYPE_A.
- TYPE_A descendants:
  - CL_TYPE_A
  - GEN_TYPE_A
  - TUPLE_TYPE_A
  - LIKE_FEATURE
  - FORMAL_A
  - ...

Compiler – Features

- The features of a class are stored in CLASS_C into an instance of FEATURE_TABLE.
- A FEATURE_TABLE is a container of FEATURE_I, indexed by feature names and, for fast lookup, by “routine IDs”.
- Descendants of FEATURE_I:
  - PROCEDURE_I
  - DYN_FUN_I
  - ATTRIBUTE_I
  - EXTERNAL_I
  - ...

Compiler – Classes

- Every class has an associated CLASS_I instance.
- CLASS_I stores information about the file holding the class text: modification date, class name, associated cluster.
- Classes that are part of the system also have an associated CLASS_C instance.
- CLASS_C stores relations between classes as well as its features.

Compiler – IDs

- Class ID: identifier given to each class.
- Routine ID: identifier given to each feature globally for polymorphism
- Feature ID: identifier given to each feature within a class
- Body ID (aka Body Index): identifier given to a feature text
Compiler – IDs

A
  class_id = 1
  routine_id_set = {1}
  feature_id = 1
  body_id = 1

B
  class_id = 2
  routine_id_set = {2}
  feature_id = 4
  body_id = 2

C
  class_id = 3
  routine_id_set = {1, 2}
  feature_id = 8
  body_id = 3

Compiler – Code Generation

- At degree 3 each feature is transformed into a BYTE_CODE instance, a tree of BYTE_NODES.
- Different types of code generation:
  * Melting
  * Freezing
  * Finalization
  * .NET freezing
  * .NET finalizing
  * Java freezing
  * Java finalizing

Dynamic dispatch

- Based on routine IDs
- Each routine ID is associated with a virtual table indexed by the dynamic type of an object at runtime.
- Generated code looks like:
  \[ a.f \text{ (args)} \Rightarrow \text{routine [dynamic_type (a)] (args)} \]

EiffelStudio – Editor

- Designed as a library.
- Configured by EiffelStudio to add:
  * Code completion
  * Pick and drop/Context Menu
  * Syntax highlighting
- Used for displaying code, but also results of formatters (views: flat, contract, interface...)
- TEXT_PANEL is the ancestor to all editors

EiffelStudio – Tools

- Controlled by EB_TOOL
- Information outputs:
  * Compilation global process, system information
  * Errors
  * Warnings
  * C compiler output
- Executing commands from EiffelStudio: svn status, svn update, svn commit...

EiffelStudio – Diagram tool

- Uses graph library as data structure for internal representation:
  * Inherits from EG_NODE
  * Supports “physics” (force directed layout)
- Drawing done using model cluster of EiffelVision2 (EV_MODEL_WORLD)
- Two models are supported:
  * BON (BON_CLASS_DIAGRAM)
  * UML (UML subset, UML_CLASS_DIAGRAM)
EiffelStudio - Queries

- Unification of classes/features/metrics facilities through a query language
- Grammar not fully specified yet
- What we have in mind: something like
  ```
  select classes
  from cluster=base
  where count(features) > 10
  ```
- Work still in progress

EiffelStudio – Navigation (3)

- STONE descendants:
  - CLASSI_STONE: non-compiled class
  - CLASSC_STONE: compiled class
  - CLUSTER_STONE: cluster/group/library/assembly
  - FEATURE_STONE: feature in context of a class
  - ERROR_STONE: compilation error
  - OBJECT_STONE: object in debugger
  - ...

EiffelStudio – Navigation

- Search facility (**EB_MULTI_SEARCH_TOOL**):
  - Multiple scope: class, cluster, multiple clusters, system
  - Regular expression support
  - Search bar add-on to all editors
- Clusters and classes: **EB_CLUSTER_TOOL** and **EB_CLASSES_TREE**
- Features tree: **EB_FEATURES_TOOL** and **EB_FEATURES_TREE**

EiffelStudio – Navigation (4)

- Locate a class or feature through an instance of **EB_ADDRESS_MANAGER**
- Used under two forms:
  - As toolbar
  - As modal dialog from context tool
- But same semantics

EiffelStudio – Navigation (2)

- Pebbles used for Pick and Drop are descendants of **STONE: CLASSI_STONE, CLASSC_STONE, ...**
- Communication between all graphical elements is done through a stone (instance of **STONE**)

EiffelStudio – Main window

- **EB DEVELOPMENT_WINDOW**
  - Top level window in EiffelStudio
  - Handles all tools (clusters, features, context tool, editor, search,...) and their layout
  - Handles tool synchronization through stones
  - Handles creation of menus and commands
  - Two state: developing or debugging
Adding New Tool in EiffelStudio

- A good tutorial can be found at: [http://eiffelsoftware.origo.ethz.ch/index.php/How_to_add_a_tool_to_Eiffel_Studio](http://eiffelsoftware.origo.ethz.ch/index.php/How_to_add_a_tool_to_Eiffel_Studio)
- Summary:
  - Add class which inherits from `EB_TOOL` and implements the deferred features
  - Add tool to `EB_DEVELOPMENT_WINDOWTOOLS`
  - Add tool creation to `EB_DEVELOPMENT_WINDOW_MAIN_BUILDER`

How to start digging into EiffelStudio

- Get familiar with EiffelStudio
- Start with either `EB_TOOL` and `EB_DEVELOPMENT_WINDOW`
- Usually names are meaningful therefore doing a regular expression search on class names should yield a positive results
- Web resources:
  - Wiki: [http://eiffelsoftware.origo.ethz.ch](http://eiffelsoftware.origo.ethz.ch)
  - Mailing list: [mailto:es-devel@origo.ethz.ch](mailto:es-devel@origo.ethz.ch)
  - Your ETH assistant

Repository

- Under trunk you have:
  - Delivery: Files and scripts to build a complete installation of EiffelStudio
  - Documentation: XML representation converted in HTML to produce the EiffelStudio documentation at [http://docs.eiffel.com](http://docs.eiffel.com)
  - Src: Source code for libraries, frameworks, samples and tools
  - eweasel: regression test tool used for the Eiffel compiler

Repository (2)

- Under Src:
  - Build: EiffelBuild source code
  - C: runtime code
  - C_library: libpng, zlib
  - dotnet: .NET specific tools for importing .NET assemblies
  - Eiffel: EiffelStudio source code and runtime
  - examples: examples included in EiffelStudio delivery
  - framework: libraries currently used by EiffelStudio. They are potential candidates for libraries
  - help: source code of wizards for project creation
  - Library:
    - tools: various tool useful for developing

Documentation

- Source code for building doc_builder is at trunk/Src/tools/doc_builder
- Documentation is written in XML and then converted to HTML using doc_builder

Runtime

- Handles:
  - Memory management and garbage collection
  - Equality and copy
  - Generic conformance
  - Object traversal
  - Debugging facilities for EiffelStudio
  - Threading
Runtime binaries

- Runtime: C/run-time/lib[mt][ebench|wkbench|finalized].[a|so]
- Ecdbgd: C/ipc/deamon/ecdbgd
- Helper for incremental objects storing in compiler: C/compiler/lib[mt][w]compiler.a
- Helper for debugging: C/ipc/ewb/lib[mt][w]ewb.a
- Helper for launching C compilation: C/platform/libplatform.a

Contributions

- Best contributions will be integrated to EiffelStudio
- What are “best” contributions?
  - Useful for all/most Eiffel programmers
  - Working
  - Clean
  - Documented
  - Elegant design
  - Contracted

Potential good projects

- Code completion:
  - Add stub routines for inherited deferred routines
  - Add preconditions to a routine by analyzing preconditions of routines used
  - Add predefined code snippet
  - Add new type of refactoring
  - New wizards to create classes (e.g. if it is a Vision2 window, then add vision2 library automatically to project configuration)

More potential good projects!

- Tooltip in editor for both showing routines contract and attribute/local/argument value when debugging
- Redo error and warning reporting
- Detect syntax and semantics errors while typing
- Auto-correction facilities
- Integrate EiffelBuild into EiffelStudio

Already in 6.0

- Tabbed editor
- Fully customizable layout
- Contextual menus instead of pick and drop

More!

- See Wiki: http://eiffelsoftware.origo.ethz.ch/index.php/Category:Projects
Useful links

- http://www.eiffel.com
- http://docs.eiffel.com
- http://eiffelsoftware.origo.ethz.ch
- https://eiffelsoftware.origo.ethz.ch/svn/es

Q&A

Any questions?

Thanks and happy Eiffeling!