

Testing Times

April 1999

The IPL Software Products Newsletter

No 12

Cantata++ - Version 2

In the last issue of Testing Times we announced that the next major release of Cantata++ would be available in the spring. Right on time IPL is proud to present Cantata++ V2, incorporating over 300 Static Analysis metrics specifically selected for C++ and OO.

Cantata++ provides the user with many static analysis metrics on the use of coding constructs, automating the verification of coding standards. The 'academic' metrics which are provided permit objective measurement of code complexity, and if used wisely, will lead to increased software maintainability.

OO Metrics

In addition to the 'traditional' McCabe and Halstead code complexity metrics, and common sense metrics such as average and maximum nesting levels, Cantata++ also provides a number of metrics which measure aspects of object-oriented implementation. These include:

- Chidamber and Kemerer's MOOSE metric set.
- Fernando Brito e Abreu's MOOD metric set.
- Bansiya and Davis' QMOOD metric set.
- Robert Martin's object-oriented dependency metrics.
- McCabe's object-oriented metrics.

- Bansiya's class entropy metrics.

All metrics are provided at the function, class, translation unit, or system level, as appropriate.

Analysis Made Easy

Using Cantata++ Static Analysis could hardly be easier. Just select the option and every metric is automatically calculated. Cantata++ reads and analyses the C++ source code and produces a comma separated value (CSV) file containing all the raw metrics data. This data can then be analysed by any suitable spreadsheet package. Using this simple two-step process, users can focus on both individual classes and functions, and perform higher (system) level analysis. Whereas the example below shows a simple graph of the complexity of various classes, the power of the chosen spreadsheet package enables users to develop far more complex analyses of the metrics.

Platform Availability

In addition to developing Static Analysis, porting work has continued apace. Platform availability for Cantata++ V2 has been extended to supporting Microsoft Visual C++ V6 and GCC for AIX. We are also currently looking at a number of target ports.

Cantata Audited for DO-178B Level A

During the last six months Cantata has passed two customer audits to qualify its use on DO-178B Level A (Safety Critical) projects. The two customers are the Marconi Avionics Group (Rochester), relating to the Head-Up Display system for use by American Airlines, and Sextant Avionique (Bordeaux) for a Eurocopter Flight Display system.

The RTCA DO-178B standard regulates the use of software in Civil Avionics systems. For Level A systems, all development and verification tools used, are required by the authorities (the FAA/CAA/JAA) to be audited to qualify as suitable for such safety critical developments.

Customer Quotes

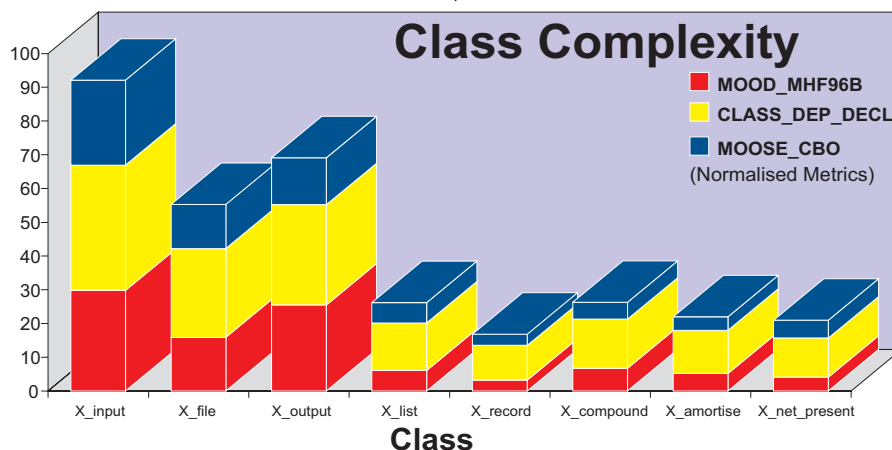
Continuing the tradition of passing on customer thoughts on our tools, here are a few from the last six months:

"If I had to grade IPL (support) responsiveness between 0 - 100, your grade is 110! I must tell you that I have not received such a service from any supplier." Elbit

"I have found AdaTEST and in particular the Test Case Generator on the whole very useful in that it standardises the way and layout of the tests done by personnel....The instrumenter Static and Dynamic metrics are also very good and thorough, allowing me to produce my effort estimations efficiently and monitor easily the extent of testing performed." Marconi Electronic Systems

"Cantata is a nice little tool." Alstom

"Cantata certainly proved itself on the last project." IFR International



Inside: EFA Typhoon Case Study - Pilkington Thorn Optronics

Pilkington Optronics, Typhoon - *AdaTEST for long-term quality*



The Typhoon, formerly EFA, undergoing Flight Trials

For the case study in this issue of Testing Times we look at a company that started unit testing with AdaTEST several years ago and has now gained considerable experience in producing large volumes of high quality Ada software. This experience has been gained in the context of a long-term multinational program, involving an overseas customer and overseas partners.

Pilkington Optronics (PO) is a joint venture company owned by Thomson CSF and Pilkington Glass plc. It specialises in the design and manufacture of electro-optical products for a wide range of military and civil programmes covering the full breadth of land, sea and airborne applications. A major programme under development at the Pilkington Optronics Staines facility is the combined Forward Looking Infra Red (FLIR) and Infra Red Search and Track (IRST) sensors to be fitted to the new Eurofighter Typhoon fighter aircraft.

Pilkington Optronics are working within a consortium called EuroFirst with Italian and Spanish partners (FIAR, part of Finmeccanica, based in Milan and TecnoBit based in Madrid).

"AdaTEST has been instrumental in allowing the project to produce a lot of code with a very low residual bug level."

EuroFirst won the contract in 1992 and will move into flight trials during 1999.

Motivation to find an Ada testing tool

PO's role in EuroFirst was to act as design authority for the project, which meant that they had front line responsibility for the major software decisions in the programme. The project was designated EFA Risk Class 2 and later upgraded to risk class 2*, requiring a high standard of software engineering. This involved the use of certain mandated standards and development practices. Some of the most significant constraints placed on the project by the EFA consortium, were the use of the Ada language and use of the HOOD design methodology. Chief among the software testing requirements was the need to demonstrate 100% code coverage (for statements and decisions).

The PO project engineers were also acutely aware of the need to automate as

much as possible of the software testing process. Their previous work on an earlier system had brought home the benefits of tools in bringing consistency and productivity to the Ada testing process. The dangers of not using tool support, were that testing would be ad-hoc, leading to too many bugs slipping through the V&V net, only to be discovered (expensively) late in the day. In addition, the sheer volume of code expected on the IRST system meant that, without automation, the unit testing phase would be extremely expensive.

Evaluation

The team under project engineer Dick Franks set up an evaluation of some candidate testing tools including AdaTEST. The first requirement was to find a tool which would enable the contractual requirements on test coverage to be met, and added credit would be given to the tool which best enabled the general goal of 'better testing' to be achieved.

In the event, only two tools were evaluated in detail, and of these AdaTEST became the preferred one. The reasons were simply that AdaTEST gave accurate measurement of test

coverage (thus meeting the first requirement) over the entire range of Ada syntax. In addition AdaTEST's test harness facility was found to be robust and simple to use. AdaTEST gave approximately a three-to-one advantage over its rival in terms of the effort required to test a module, and was able to do so without repeated errors. Franks' conclusion in October 1994 was to recommend selection of AdaTEST on the fundamental grounds that, "It could perform the required job, without fuss".

Deployment and use

AdaTEST was eventually procured for project use in mid-1995, and training courses were provided by IPL to support the deployment. By then, AdaTEST was able to offer the Script Generation facilities so, after some initial hesitation, these were adopted and have become the project's standard method of using the tool. Greg Ives and Ian Flack were the project engineers with most responsibility for the tool's day-to-day use. They were instrumental in the establishment of design principles which have greatly contributed to AdaTEST's success, and have also created a number of AdaTEST 'add-ons' which have extended its functionality. Some of their ideas can be described thus:

1. Maximise Host Testing.

For numerous reasons initial code testing on the host is preferred. This has meant close attention to 'design for testability' practices including the ability to swap target-specific addresses for host-accessible ones as much as possible. By employing such practices it has been possible to test around 98% of the code on the host before going near a target system.

2. Automate Detection of Sub-program Calls.

The design methodology used (HOOD), led to the specification of objects and associated operations, which could be coded as Ada packages and sub-programs. An AdaTEST extension was created by Ives which allowed the test team to identify automatically whether any operation of the object under test had NOT been exercised.

3. Stubbable Error Logging Calls to Force Execution of 'Hard-to-Reach' Code.

Some parts of the code especially certain exception handlers would have been very hard to exercise without the use of stubbed Error Logging calls. These permitted the raising of

exceptions which then diverted execution into an appropriate handler, allowing coverage targets to be met. This is an aspect of the general discipline of 'design for testability'.

4. Negative Tests on Package Body Data.

AdaTEST automatically detects accidental corruption of data declared in Ada package specifications. Ives created a new facility which did the equivalent for package body data.

For all the above, AdaTEST's open architecture has made it easy to add the extra facilities.

"[AdaTEST scripts are] easy to write and review, and most importantly to enforce a consistency of style."

Conclusions

Three years on, what can the team point to? There is the production of over 250 HOOD objects, coded in Ada and amounting to over 160,000 lines of source code. The use of AdaTEST Script Generation has made testing of this volume of code economic and maintainable. The scripts are described, by project engineer Ian Flack as "easy to write and review, and most importantly to enforce a consistency of style." A side benefit has been that the scripts have lent themselves very well to incorporation into the project documentation, thus saving a lot of effort in otherwise needlessly translating between a software module test plan and its implementation as a working script.

For the Software Manager, Cliff Edwards, there has been one overriding benefit, which is simply that AdaTEST has been instrumental in allowing the project to produce a lot of code with a very low residual bug level. This is satisfying in its own right, and good for the engineers' professional self-esteem, but also vital in this particular circumstance of having to co-operate with outside partners to deliver a high-integrity product. Edwards is adamant that the satisfaction of being able to deliver virtually bug-free software and have the FIAR and Tecnobit engineers integrate it without problems, makes the whole unit testing effort worthwhile!

IPL wish to thank the Pilkington Optronics team for their co-operation in sharing their experiences in this Case Study. We wish them well with their ongoing work.

Letter from America



A contribution from Scott Thomas of QCS, IPL's US distributor.

In the US software development marketplace, testing is very much a "Tale of Two Cities." On the one hand there is the 'safety-critical' sector, and on the other there is the commercial systems sector. And depending on where you are software testing will be viewed with either respect or disdain!

In the safety-critical market, where lives may hang in the balance, testing is considered a vital and necessary part of the development process. Testing is taken seriously and is performed at the unit, integration and system levels, following formal procedures, and requiring evidence of completeness to be provided. Proper tools like Cantata and AdaTEST, and training in testing methodologies, are made available to the project team. Most importantly though, there is an attitude that testing is key to the success of the project.

By contrast, in the overwhelmingly huge US commercial applications marketplace, time to market and immediate development costs are given priority over quality, so as project schedules slip, the first to feel the impact is the testing phase. The "we'll fix it in the next release and charge for the upgrade" syndrome is unfortunately all too commonplace.

Then there is the view that testing is a menial task to be delegated to the most junior personnel on the project. A common sentiment is that, "Our developers are too valuable to be spending their time doing testing". Most such US companies tend to rely on crisis management to determine when a product is ready to ship. Many times the exploding complexity of the technology used exceeds the abilities of those individuals or organizations tasked with managing it.

In summary, there is much room for improvement in the testing philosophy in the US commercial market. Until software development is treated as an engineering discipline, and not a "black art", any improvement will be slow in coming. The key here is to educate the actual end users that system crashes and defects don't have to be tolerated, and that having a reliable product in your hands is more important than having the latest whizzy widget.

AdaTEST - Upgrade Plans

There are now definite plans to upgrade AdaTEST and AdaTEST 95 during the course of 1999. Interested customers are invited to contact Ian Gilchrist (iang@iplbath.com).

OO-Testing Survey

The German Informatics Society Special Interest Group (SIG) on Software Testing has carried out a survey of various 'OO' testing tools. The results, in which Cantata++ features very positively, can be seen at www.informatik.fernuni-hagen.de/~imort/pi3/GI/CAST/Results.htm.

IEC Framework V Research

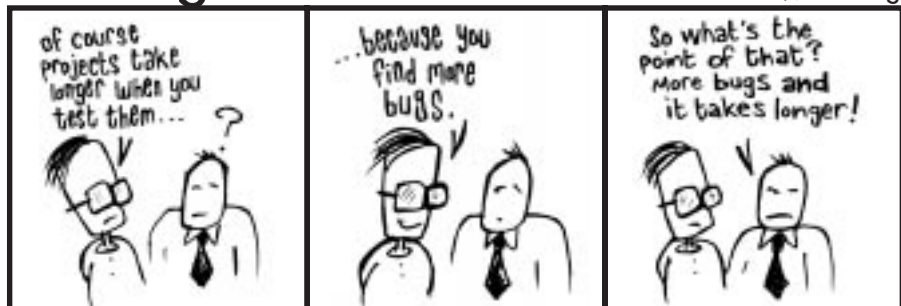
IPL is participating in an initiative led by the University of Bristol Safety Systems Research Centre (SSRC) to investigate improvements to the reliability of distributed systems. Typical application areas include air-traffic control, nuclear power control, and railway signalling systems. There is still time to include newcomers in this work, and non-UK European organisations are especially welcome to take part. If interested please contact Ian Gilchrist (iang@iplbath.com).

New Prices

A new price list will be applied to IPL products from the start of this month. There is no change at all in the pricing for Cantata and AdaTEST/95. In fact the only change which will affect most customers is that Cantata++ prices are being increased by about 20%, to reflect the inclusion of the product's static analysis capabilities. For our European customers we can now offer prices in Euros.

This is the first change in our pricing for nearly two and a half years and reflects IPL's policy of providing a stable pricing environment to help our customers plan their purchases. If you

Testing Ted



wish to see the new price list, please contact your supplier.

Millennium Compliance

We have announced this before but with hysteria continuing, here it is again: Our products have been tested and, to the best of our knowledge, current versions of AdaTEST/95 and Cantata/++ are millennium-compliant! If any customer or prospective customer requires a statement to this effect with full details please contact your supplier. Alternatively, the statement may be obtained from IPL's web page, <http://www.iplbath.com/p22.htm>.

Events

During 1999, IPL will be participating in the following events:

May 26-27. Dev-Test in London, where IPL will be presenting a paper on 'Testing C++ Classes'.

November 8-12. EuroSTAR in Barcelona. See www.eurostar.ie for more information.

Symphony in C++

IPL, in partnership with I-Logix, the company well-known for its Rhapsody, UML-based software design tool, is to provide an integration between it and Cantata++. We believe this will offer 'high integrity' C++ software developers a unique and cost-effective solution to lifecycle support for a wide-range of environments. The results of this co-operation are being presented at an event called 'Symphony in C++' in Bath on April 14. If you have not received an invitation and would like to know more please contact IPL.

Safety Critical Seminars with Aonix

IPL will be holding joint seminars with Aonix on Safety-Critical Software development during the week commencing 10 May. Please contact us for more information.

Training Dates

Product training courses are intended to teach new users enough about Cantata, Cantata++ and AdaTEST to become productive with the tools. The following are the currently scheduled dates for courses in Bath and Munich through to the end of 1999:

Introduction to Testing C++ with Cantata++ *:

Bath: Tuesdays - May 18, July 20, September 21, November 23.

Munich: Wednesdays - April 28, June 23, September 15, November 10.

Using Cantata++:

Bath: Wednesdays - May 19, July 21, September 22, November 24.

Munich: Thursdays - April 29, June 24, September 16, November 11.

Introduction to Cantata:

Bath: Thursdays - May 20, July 22, September 23, November 25.

Munich: Tuesdays - April 27, June 22, September 14, November 9.

Introduction to AdaTEST:

Bath only: Fridays - May 21, July 23, September 24, November 26.

* This course is also available as a multi-media CD-ROM on rental terms.

The above courses are of one day duration and are presented at our offices. If you are interested in any of the above, AdaTEST 95 training or on-site training courses, please contact us for further details. Please also see: <http://www.iplbath.com/p72.htm> for further training course information.

Further Information

An information request sheet is enclosed with this newsletter. Also remember that most of our literature is available for immediate access at the web address given below.

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