Development of an automated test harness for SNOMED CT-AU

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Introduction

All organisations involved in authoring SNOMED CT®[1] extensions are obligated to ensure the validity of the content produced. The NCTIS is the national release centre responsible for providing SNOMED CT and required extensions to the Australian community of use. Additionally, the NCTIS has had a significant role in the development of the RF2 and as early adopters of the specification - whilst still a draft standard for trial use (DFTU). This involved the creation and subsequent validation of RF2 release files against the specification as well as confirmation of the quality of any data transformations from the original release format. Over a number of releases, the NCTIS has developed an automated process for assessing quality assurance of SNOMED CT-AU release files and early detection of defects.

Background

The NCTIS uses a variant of the IHTSDO® Work Bench (formerly ACE) for content authoring. This involves the creation of reference sets, including the *Australian dialect reference set*, supporting RF2 metadata and new core components. SNOMED CT-AU encompasses the international release along with Australian extensions. With the introduction of DFTU RF2 specifications, NCTIS began publishing the SNOMED CT-AU in both the original RF1 and new RF2 release formats.

The in-house development team who maintain the IHTSDO Workbench and produce release bundles were responsible for the creation of processes to transform the existing national and international terminology data into the new format using draft metadata (collaboratively developed by IHTSDO officers, members and community, and authored by NEHTA) to ultimately produce an RF2 distribution bundle. Whilst effectively implementing the new specifications as a proof of concept, it also drove refinement of the specifications by identifying issues with the specifications. Various quality assurance criteria were developed by the NCTIS testing team based on both the existing technical reference guide and the new RF2 specifications. Points for investigation included:

Technical Integrity of:
- Foreign keys (RF1 and RF2)
- All component ID's (including check digits, namespaces and partition ID's)
- Value constraints for each field (RF1 and RF2)
- History mechanism

Transformation acceptability:
- SNOMED CT to SNOMED CT-AU (RF1)
- RF1 to RF2

A relational database was determined to be an effective tool for measuring the level of compliance of the release files to all the specifications, with the added benefit of independence from the IHTSDO Workbench – the tool used to create the release. Early releases from the NCTIS relied on using SQL scripts to manually import the release files into a SQL Server database and a collection of SQL queries to consistently probe the data to identify any points of failure. Both the execution and reporting for this testing process was labour intensive. Successive manual test cycles were slow and bore a high test re-execution cost which increased overall test duration. An automated process for testing the release files was proposed and developed.

Methods

The automated process leverages the knowledge and process originally developed to manually test the release files. The Importing, Testing and Reporting processes have been largely automated through the introduction of a MySQL database and Java development and testing tools.
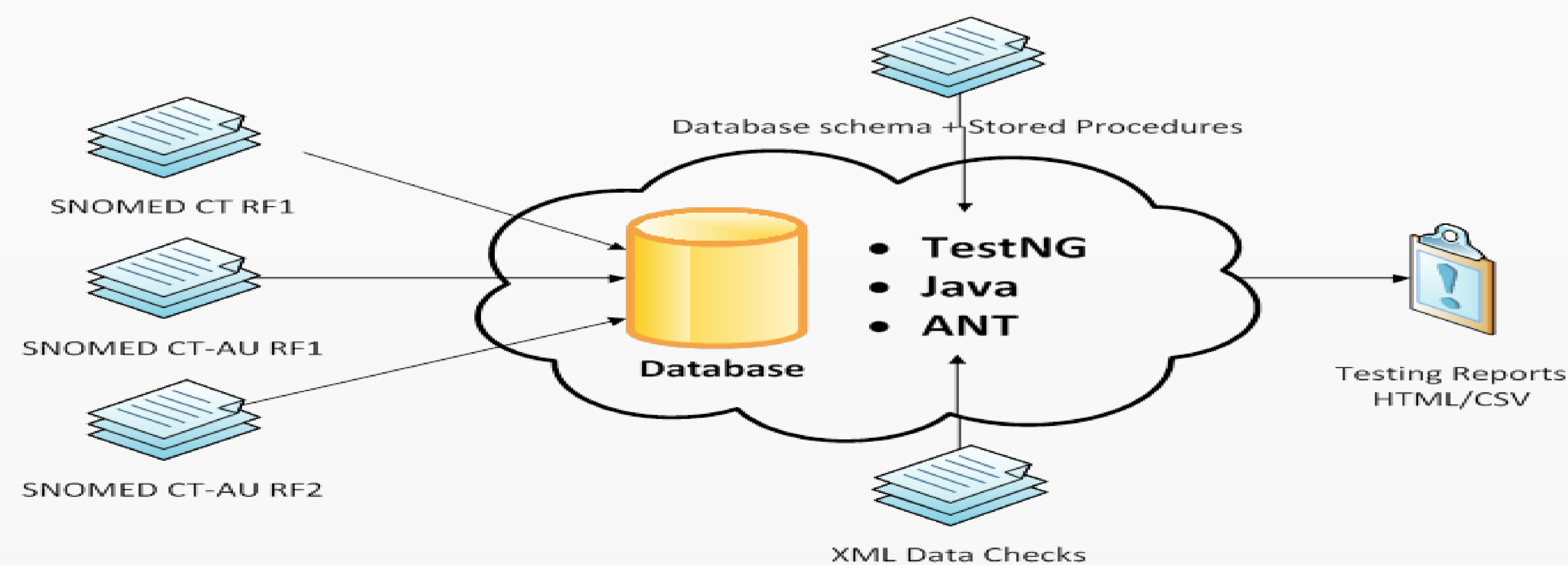
Process Inputs

Release files : Both the current SNOMED CT-AU release in development and the last published releases (RF1 and RF2) along with the last two releases of the international edition of SNOMED CT (RF1) are imported into the database. The Australian release files are produced from the IHTSDO Workbench using a separate build process.

Database Schema and Stored Procedures : SQL scripts detailing the complete database schema, including indexes, and the import procedures for each of the release files. Additional scripts are included for stored procedures (such as generating a transitive closure table) used by the testing process.

XML Data checks : Test cases are represented as series of SQL queries documented in an TestNG XML format. Related tests are grouped as "suites"; e.g. concept table tests or RF2 transformations. Data checks consist of a query and an expected result. The example (right) shows a single data check confirming that concept Identifiers in the SNOMED CT-AU RF1 Concepts table are unique: the query is expected to return a null result set (i.e. No results).

```xml
<test name="Check for unique IDs - RF1_CONCEPTS">
    <parameter name="query" value="select conceptid, count(conceptid) as idcount
                from rf1_concepts
                group by  conceptid
                having idcount>1"/>
    <parameter name="resultCount" value="null"/>
    <classes><class name="au.gov.nehta.test.ResultCountTest"/></classes>
</test>
```

Technology	License	Description
MySQL database	GNU General Public License	• Standard MySQL server deployment with MyISAM database engine used for the best possible performance. • Database scheme is simply a reflection of the release files. • Reference sets are organised according to reference set patterns.
TestNG	Apache 2.0 licence	• Popular testing framework used by Java developers. • Used to execute java validation classes that take SQL and expected results as parameters which are provided in the XML data check files. Example above uses "ResultCountTest" to check the row count from the provided query against the specified expected result. • Formats test results into an HTML report for easy consumption along with a downloadable CSV file. • A test summary report detailing the number of passing failing and skipped tests is also produced (shown below).
Java	Oracle Binary Code License	• Underlying technology used by ANT to script the entire process and TestNG to execute the test cases. • Provides the JDBC connection to the MySQL database. • Current framework works with Java 6.
Apache Ant	Apache 2.0 licence	• Build tool used to develop XML build scripts. • Scripts are used to orchestrate loading the schema, importing the release files, indexing the tables, running any additional stored procedures. • The testing framework uses the TestNG Ant task to run and test.

Process output

- Results of the data checks are provided as a collection of HTML and CSV reports: other report formats can be configured.
- A summary of the results of the data checks are provided per test suite (*right*).
- Each suite can be drilled into further to see the actual and expected results of individual data checks.

Results

The automated test process is executed after the nightly release builds and currently takes just under one hour. It take approximately 30 minutes for the schema to be created and the release files to be imported. The subsequent data checks (over 270 at present) take the remainder of the time (less than 30mins). The full IHTSDO Workbench export process currently takes several hours.
Initial versions of the test suite focussed on compliance to the technical specifications. However validation of the content has been progressively incorporated into the process.

Discussion

Unit Testing: Most data checks have been created when new potential risks are identified, even though there is no evidence of infringement. However, some tests are created in response to a specific issue. The response may involve creation of both generic data checks, to ensure the risk is tested, and also a specific data check for the particular trigger issue. This ensures that the issue is resolved, as well as ongoing monitoring for new incidences.

Test Driven Content Development (TDD): The NCTIS has been investigating incorporating a TDD approach into the content development cycle. This would involve creation of new automated data checks in response to new content requirements before any actual authoring activity. The tests would be expected to fail until the required content authoring is incorporated into the release.

AMT and International adoption/exchange: The technical requirements for any SNOMED CT release are common regardless of the release centre. Therefore a core suite of data checks are applicable to any organisation producing SNOMED CT for distribution. Adoption by the international SNOMED CT community of the process described would affirm a common level of consistent quality between all those involved. A collaborative data check repository or exchange can potentially expedite development of a thoroughly robust quality process for all release centres, and eliminate wasted time and effort developing parallel testing processes.
This automated testing process has successfully been deployed for the Australian Medicines Terminology (AMT) demonstrating transferability of the system.

Conclusion

The development of a robust testing process is perhaps never complete with content development an ongoing process and new risks identified as knowledge of potential issues improves. The introduction of this automated process has greatly improved the efficiency of the testing process with validation now occurring nightly. The greatest benefit of the whole process is that issues and defects are able to be identified at least daily with corresponding resolution turnaround. Early identification testing allows for much cheaper resolution of defects and a more predictable build and release process.

The data checks are continuously being extended as new or potential bugs are identified. Along with test driven content development, including unit testing of raised defects, the entire automated process provides regular assurance of the quality of a terminology release. The system is flexible enough to be reconfigured at least daily and the duration of single testing cycle is such that any changes – including SNOMED CT content authoring – can be incrementally developed and validated.

[1]SNOMED CT® and IHTSDO® are registered trademarks of the International Health Terminology Standards Development Organisation.