
SEMINAR »VERIFICATION AND TESTING OF COMPLEX SYSTEMS«

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Topic Overview

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1 – Testing and Test Control Notation 3 (TTCN-3)	
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Topic 1: Testing and Test Control Notation 3 (TTCN-3)

- Subject
 - Standardized testing language
 - European Telecommunication Standards Institute (ETSI)
 - Supports automated and distributed testing
- Objectives
 - Present the key concepts of the test language
 - Develop sample test suite in TTCN-3
 - Use case: Bank withdrawal, account balance request
 - Analyze tool support (Eclipse Titan)
- References
 - <http://www.ttcn-3.org>
 - <https://projects.eclipse.org/projects/tools.titan>

Topic 2: Jnario – Executable Specifications for Java

■ Subject

- Testing, specification, and documentation framework
- Executable unit, integration, and acceptance specifications
- Orchestration of specifications
- Developed at BMW Car IT

■ Objectives

- Present the key concepts of Jnario
- Explain how Domain Specific Languages (DSLs) can be defined with Xbase/Xtext
- Live demonstration based on self-defined use case

■ References

- <http://jnario.org/>
- <https://github.com/sebastianbenz/Jnario/issues/168>
- https://github.com/borisbrodski/Jnario/tree/no_xtend_xttext2.9

Topic 3: SAT-Based Formal Verification

- Subject
 - SAT-based formal verification (propositional logic)
 - How to use SAT solvers for model checking
 - Formulating a verification problem as a SAT problem
- Prerequisite:
 - Knowledge of math. logic & complexity theory
- Objectives
 - Understand, present & explain new results
- References
 - M. Prasad, A. Biere, and A. Gupta. A survey of recent advances in SAT-based formal verification. Int J Softw Tools Technol Transfer (2005) 7: 156-173.

Topic 4: Continuous Integration & Automated Testing

■ Subject

- Continuous integration - integrate code early and often into code mainline
- Automated regression testing

■ Objectives

- Explain how testing can be coupled with continuous integration

■ References

- M. Goedicke, T. Menzies, S. Motoshi. Communicating continuous integration servers for increasing effectiveness of automated testing. In: Proceedings of the 27th IEEE/ACM International Conference on Automated Software Engineering (ASE 2012), ACM New York, USA, 2012, pages 374-377.
- S. Stolberg. Enabling Agile Testing through Continuous Integration. In: Proceedings of Agile Conference, 2009 (AGILE '09). Pages 369-374.
- R. A. Razak, F. R. Fahrurazi: Agile testing with Selenium. In: Proceedings of the 2011 Malaysian Conference in Software Engineering, IEEE, 2011, pages 217-219.

Topic 5: Testing Grid and Cloud Infrastructures

- Subject
 - Testing of grid and cloud infrastructures
- Objectives
 - Present the specific requirements for testing cloud/grid computing environments
 - Present work on standardized test framework
- References
 - T. Rings, J. Grabowski, S. Schulz. On the Standardization of a Testing Framework for Application Deployment on Grid and Cloud Infrastructures. Proceedings of the 2nd International Conference on Advances in System Testing and Validation Lifecycle (VALID), 2010.
 - K. Inçki, I. Ari, H. Sözer: A Survey of Software Testing in the Cloud. IEEE Sixth International Conference on Software Security and Reliability Companion (SERE-C), 2012.
 - St. Herbold, A. De Francesco, J. Grabowski, et al.: The MIDAS Cloud Platform for Testing SOA Applications. IEEE 8th International Conference on Software Testing, Verification and Validation (ICST), 2015.

Topic 6: Test Generation Based on Finite State Machines

■ Subject

- Finite State Machines to model specifications
- Various methods to derive test cases
 - addressing fault models
 - minimizing the size of test cases

■ Objectives

- Describe the underlying assumptions and constraints
- Present different approaches to generate tests based on FSMs
- Provide examples

■ References

- H. Ural: Formal methods for test sequence generation. Computer Communications. Volume 15, Issue 5, June 1992, Pages 311 – 325, <http://people.cs.aau.dk/~kgl/TOV04/ural.pdf>
- M. C. Yalcin, H. Yenigun: Using Distinguishing and UIO Sequences Together in a Checking Sequence. Proceedings of Testing of Communicating Systems. Lecture Notes in Computer Science Volume 3964, 2006, pp 259-273

Topic 7: Model-Based Testing With Spec Explorer

■ Subject

- Testing environment developed by Microsoft Research
- Reactive Systems = Non-deterministic

■ Objectives

- Understand & present key ideas

■ References

- M. Veanes, C. Campbell, W. Grieskamp, W. Schulte, N. Tillmann, and L. Nachmanson. Model-Based Testing of Object-Oriented Reactive Systems with Spec Explorer. Lecture Notes in Computer Science, 2008, volume 4949, 39-76.

Topic 8: Lazy Systematic Unit Testing

- Subject
 - Semi-automatic unit test generation
 - “Tests for full conformance to a lazy specification, which is inferred on-the-fly from the code, by static and dynamic analysis, and from hints supplied by the programmer”
- Objectives
 - Understand & present approach
 - Showcase »JWalk«
- References
 - Journal and conference publications at <http://staffwww.dcs.shef.ac.uk/people/A.Simons/jwalk/>
- Note:
 - Request academic license from author in time!

Topic 9: Mobile Testing as a Service (MTaaS)

■ Subject

- Validation of mobile Apps and SaaS applications on mobile web
- High complexity due to diversity of mobile devices and computational resources

■ Objectives

- Provide a survey of the challenges, technologies, approaches, and infrastructures

■ References

- A. Malini; N. Venkatesh; K. Sundarakantham; S. Mercyshalinie: Mobile application testing on smart devices using MTAAS framework in cloud. International Conference on Computer and Communications Technologies (ICCCT), 2014
- J. Gao, W.-T. Tsai, R. Paul, X. Bai, T. Uehara: Mobile Testing-as-a-Service (MTaaS) -- Infrastructures, Issues, Solutions and Needs. IEEE 15th International Symposium on High-Assurance Systems Engineering, 2014.
- I. K. Villanes, E. A. Bezerra Costa, A. C. Dias-Neto: Automated Mobile Testing as a Service (AM-TaaS). IEEE World Congress on Services. 2015

Topic 10: Regression Test Selection

- Subject
 - Regression testing as an expensive maintenance activity
 - Test selection based on control flow graphs for a (modified) program
- Objectives
 - Present the concepts and provide examples
- References:
 - G. Rothermel, M. J. Harrold: A Safe, Efficient Regression Test Selection Technique, ACM Transactions on Software Engineering and Methodology, Vol. 6, No. 2, 1997.

Topic 11: Practical Application of Model Checking

■ Subject

- Use model checking to find serious errors in file systems
- Find corner-case errors by exploring the system's state space
- File systems as a use case:
 - Errors are most serious
 - Hard to test whether a systems recovers after any crash

■ Objectives

- Introduce basic concepts of model checking
- Describe the techniques and tools applied
- Summarize the findings of the use case

■ References

- J. Yang, P. Twohey and D. Engler, M. Musuvathi: Using Model Checking to Find Serious File System Errors. ACM Transactions on Computer Systems, November 2006, vol. 24, no. 4. (<https://web.stanford.edu/~engler/osdi04-fisc.pdf>)