

## Contact Information

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## Research Interests

Formal Modeling and Verification of System's Behavior.  
Formal Modeling and Verification of Machine Learning Software.  
System Security and Reliability.  
Deductive and Runtime Verification.  
Design and Development of Programming and Specification Languages.

## Summary of Work Experience

- Research and Development            (approx. **11 years**)
- Software Industry                      (approx. **6 years**)
- Teaching                                 (approx. **11 years**)

## Education

- 2009 – 2014    Ph.D. in Computer Science (Software Engineering/Formal Methods) ([Distinction](#))  
Johannes Kepler University (JKU), Linz, Austria  
*Thesis Title:* Formal Specification and Verification of Computer Algebra Software
- 2007 – 2008    M.Sc. in Advanced Distributed Systems ([Distinction](#))  
University of Leicester, UK  
*Project Title:* Space Link Extension Service Management (co-jointly with [NASA](#)).
- 1998 – 2000    M.Sc. in Computer Science ([First Class](#))  
The University of Bahawalpur, Pakistan  
*Project Title:* WAP-based trading system.

## Academic/Research Work Experience

- 2016 – Date    Postdoctoral Fellow in Informatics Systems  
Alpen-Adria University  
Klagenfurt, Austria
- 2014 – 2016    Postdoctoral Fellow (jointly with QCRI)  
MIT CSAIL  
Cambridge, USA
- 2009 – 2014    Research assistant in the Symbolic Computation Group  
Research Institute for Symbolic Computation  
Johannes Kepler University, Linz, Austria
- 2003 – 2005    Research assistant in the Computer Networks Group  
Punjab University College of Information Technology  
Lahore, Pakistan

## Teaching Experience

2016 – Date	Teacher Alpen-Adria University, Klagenfurt, Austria
2013 – Date	Associate tutor and thesis supervisor University of Leicester, UK
2008 – 2009	Assistant professor COMSATS University, Abbottabad, Pakistan
2007 – 2008	Teaching assistant University of Leicester, UK
2005 – 2006	Lecturer COMSATS University, Abbottabad, Pakistan
2005	Lecturer Balochistan University of IT and MS, Quetta, Pakistan
2003 – 2005	Lecturer University of the Punjab, Lahore, Pakistan

## Professional Software Development Experience

2002 – 2005	Software Architect (J2EE) Acrologix Pvt. Ltd., Lahore, Pakistan
2000 – 2002	Lead Java Development and Design Team WaxSys. Pvt. Ltd., Lahore, Pakistan

## International Research Collaborations

- [MIT CSAIL, USA](#)
- [CERN, Switzerland](#)
- [INRIA, France](#)

## Fellowships

2009 – 2013	PhD Scholarship, Fully funded by Austrian Science Fund (FWF) in the frame of the “Doctoral Program: Computational Mathematics”, Hagenberg, Austria.
2007	Merit Scholarship, Scholarship by University of Leicester, UK.
2007 – 2008	MS Scholarship, Fully funded by Higher Education Commission of Pakistan for higher studies in UK.

## Awards and Achievements

2014	Addition of special text of excellence on my PhD Result Card Certificate being one of the best candidates of JKU in the frame of special doctoral program Doktoratskolleg in Computational Mathematics
2014	All-Distinction in Doctoral studies at Johannes Kepler University, Austria
2012	Best Student Paper Award at Conferences on Intelligent Computer Mathematics <sup>1</sup> , Germany
2008	Overseas Research Scholarship Award <sup>2</sup> for PhD studies by British Government
2008	Distinction in M.Sc. Adv. Distributed Systems at University of Leicester, UK
2007	Awarded teaching assistantship for an outstanding position in the first semester by the University of Leicester, UK
2000 – 2003	Assisted my project manager Mr. Bilal Siddiqui (an XML Consultant) in writing paid articles for IBM, USA.

<sup>1</sup>CICM is the second highest ranked conference in the area of computer mathematics.

<sup>2</sup>In the last 31 years, I was the first Pakistani to win ORSAS for the University of Leicester, UK.

## Memberships

2013 – Date    European Association of Software Science and Technology (EASST)

## Scientific Visits

Jun. 2015 – Jul. 2015	Scientist	Research teams AIRE and Programming Languages and Verification Group  CSAIL, MIT, USA
Jul. 2014 – Aug. 2014	Scientist	Research teams AIRE and Programming Languages and Verification Group  CSAIL, MIT, USA
Sep. 2011 – Dec. 2011	Scientist	Research teams FoCaLiZe and Why3 (Studying specification abstractions of various computer algebra concepts and also to learn verification tool Why3) INRIA, France

## International Summer Schools

September 4 – 10, 2011	8th LASER Summer School on Tools for Practical Software Verification Elba, Italy
August 3 – 15, 2010 <sup>3</sup>	40th Marktoberdorf Summer School on Software and Systems Safety: Specification and Verification, Marktoberdorf, Germany

## Next: Further Details

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<sup>3</sup>The most premier and prestigious summer school. The limited number of participants around the globe are selected through a formal selection procedure. The term "software engineering" was coined in this school back in 1960s.

## APPENDIX A - Publications

### Articles

- Giovanni Liva, Muhammad Taimoor Khan, Martin Pinzger. *Extracting Timed Automata from Java Methods*. Empirical Software Engineering, Springer, in review, 2018 **IF - 3.95 and CORE RANK - A**.
- Dimitrios Serpanos, Muhammad Taimoor Khan, Howard Shrobe. *Designing Safe and Secure Industrial Control Systems: A Tutorial Review*. IEEE Design & Test, to appear, March 2018. **IF - 1.37**
- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe. *ARMET: Behavior based Secure and Resilient Industrial Control Systems*. Proceedings of the IEEE, 106(1), 129–143, January 2018. **IF - 9.237**
- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe. *Run-time Security Assurance of Cyber Physical System Applications*. IEEE Software, IEEE, in review, 2018. **IF - 2.192**
- Inka Brijacak, Bernhard Dieber, Michael Hofbaur, Muhammad Taimoor Khan, Martin Pinzger, Saeed Yahyanejad. *Perception based Safety Assurance in Human-Robot Interaction*. IEEE Software, IEEE, in review, 2018. **IF -2.192**
- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe. *A Formally Reliable Cognitive Middleware for the Security of Industrial Control Systems*. Electronics, 6(3):58, MDPI, August 2017.
- Dimitrios Serpanos, Howard Shrobe, Muhammad Taimoor Khan, *Behavior Based Security of Cyber Physical Systems*, n: European Research Consortium for Informatics and Mathematics (ERCIM) News. ERCIM, vol. 2016, number 107, 2016.

### Books

- Muhammad Taimoor Khan, *Formal Verification of Space Missions Communication Protocols*, ISBN 978-3-659-25299-0, LAP Lambert Academic Publishing, 2012.

### Refereed Papers

- P. Michalopoulos, V. Ieronymakis, O. Alrawi, M.T. Khan and D. Serpanos. *An Open Source, Extensible Malware Analysis Platform*. In: Proceedings of the International Conference of Engineering Against Failures (ICEAF). 2018.
- G. Liva, M. T. Khan, F. Spegni, L.Spalazzi, A. Bollin, and M. Pinzger. *Modeling Time in Java Programs for Automatic Error Detection*. In: Proceedings of the International Conference on Formal Methods in Software Engineering (FormalISE). IEEE, 2018 (part of IEEE ICSE **CORE RANK - A\***).
- Giovanni Liva, Muhammad Taimoor Khan, Martin Pinzger. *Extracting Timed Automata from Java Methods*. In: Proceedings of the 17<sup>th</sup> IEEE International Working Conference on Source Code Analysis and Manipulation (Research Track). IEEE, September 2017 (part of IEEE ICSME **CORE RANK - A**).
- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe. *A Rigorous and Efficient Run-time Security Monitor for Real-time Critical Embedded System Applications*. In: Proceedings of the MARTCPS'16, IEEE World Forum on Internet of Things. IEEE, pages 100-105, 2016 **Best Paper Award**.
- Muhammad Taimoor Khan, Anastasios Fragopoulos, Dimitrios Serpanos, Howard Shrobe. *Abstract Data Machine: Data Classifier for Reliable Software Systems*. In: Proceedings of the 10th Workshop on Embedded Systems Security. ACM, New York, USA, Article 8, pages 5, October, 2015 (part of ACM Conference on Embedded Software (EMSOFT) **CORE RANK - A**).

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<sup>4</sup>The highest ranked (A\*) and the most premier and prestigious conference in the field of computer mathematics.

- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe. *On the Behavioral Formalization of the Cognitive Middleware AWD RAT*. In: Proceedings of the 26th Nordic Workshop on Programming Theory (NWPT'14), pp. 37–39. October 2014. Halmstad, Sweden.
- Muhammad Taimoor Khan, Wolfgang Schreiner. *A Verification Framework for MiniMaple Programs*. In: ACM Communications in Computer Algebra, 47(3):88–99, ACM, September 2013, 38<sup>th</sup> International Symposium on Symbolic and Algebraic Computation (ISSAC<sup>4</sup>). **CORE Rank - A\***
- Muhammad Taimoor Khan. *On the Formal Semantics of MiniMaple and its Specification Language*. In: Proceedings of the 10<sup>th</sup> International Conference on Frontiers of Information Technology (FIT 2012), IEEE Digital Library, December 2012, pp. 169-174, ISBN 978-0-7695-4927-9/125.
- Muhammad Taimoor Khan, Wolfgang Schreiner. *Towards the Formal Specification and Verification of Maple Programs*. In: Intelligent Computer Mathematics, Johan Jeuring, John A. Campbell, Jacques Carette, Gabriel Dos Reis, Petr Sojka, Makarius Wenzel, Volker Sorge (ed.), Lecture Notes in Artificial Intelligence (LNAI) 7362, pp. 231-247. July 2012. Springer Berlin/Heidelberg, ISBN 978-3-642-31373-8, **Best Student Paper Award**.
- Muhammad Taimoor Khan, Wolfgang Schreiner. *On the Formal Specification of Maple Programs*. In: Intelligent Computer Mathematics, Johan Jeuring, John A. Campbell, Jacques Carette, Gabriel Dos Reis, Petr Sojka, Makarius Wenzel, Volker Sorge (ed.), Lecture Notes in Artificial Intelligence (LNAI) 7362, pp. 442-446. July 2012. Springer Berlin/Heidelberg, ISBN 978-3-642-31373-8.
- Muhammad Taimoor Khan, Wolfgang Schreiner. *Towards a Behavioral Analysis of Computer Algebra Programs*. In: Proceedings of the 23rd Nordic Workshop on Programming Theory (NWPT'11), Paul Pettersson and Cristina Seceleanu (ed.), pp. 42-44. October 2011. Vasteras, Sweden.
- Muhammad Taimoor Khan, Kashif Zia. *Future Context-aware Pervasive Learning Environment: Smart Campus*. Proc. of the Integration of Information Technology in Science, Gazimagusa, Turkish Republic of Northern Cyprus, January 16–18, 2007.
- Muhammad Taimoor Khan, Kashif Zia, Nadeem Daudpota, S.A. Hussain, Najma Taimoor. *Integrating Context-aware Pervasive Environments*. Proc. of the 2<sup>nd</sup> IEEE International Conference on Emerging Technologies, Peshawar, Pakistan, pp. 683-688, IEEE, 2006.
- Babar Nazir, Muhammad Taimoor Khan. *Fault Tolerant Job Scheduling in Computational Grid*. Proc. of the 2<sup>nd</sup> IEEE International Conference on Emerging Technologies, Peshawar, Pakistan, pp. 708-713, IEEE, 2006.
- M.A. Pasha, S.A. Hussain, Muhammad Akhlaq, Muhammad Taimoor Khan. *Using Bayesian Neural Network for Modeling Users in Location Tracking Pervasive Applications*. Proc. of the International Conference on Information Technology and Applications, Quetta, Pakistan, 2005.

## Technical Reports

- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe. *Sound and Complete Runtime Security Monitor for Application Software*. CSAIL MIT Technical Report Series, MIT-CSAIL-2016-017, CSAIL, MIT, USA
- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe, *On the Soundness of an Architectural Differencer*. CSAIL MIT Technical Report Series, MIT-CSAIL-2015-007, CSAIL, MIT, USA.
- Muhammad Taimoor Khan, Dimitrios Serpanos, Howard Shrobe, *On the Formal Semantics of the Cognitive Middleware AWD RAT*. Technical Report 15-xx, MIT Report Series, CSAIL, MIT, USA.
- Muhammad Taimoor Khan, *Formal Specification and Verification of Computer Algebra Software*. Technical Report 14-04, RISC Report Series, Johannes Kepler University, Linz-Austria.

- Muhammad Taimoor Khan, *On the Soundness of the Translation of MiniMaple to Why3ML*. DK Report 2014-03, Johannes Kepler University, Linz-Austria.
- Muhammad Taimoor Khan, *On the Verification of Maple Programs*. DK Report 2013-06, Johannes Kepler University, Linz-Austria.
- Muhammad Taimoor Khan, *Translation of MiniMaple to WhyML*. DK Report 2013-02, Johannes Kepler University, Linz-Austria.
- Muhammad Taimoor Khan, *Formal Semantics of a Specification Language for MiniMaple*. DK Report 2012-06, Johannes Kepler University, Linz-Austria.
- Muhammad Taimoor Khan, *Formal Semantics of MiniMaple*. DK Report 2012-01, Johannes Kepler University, Linz-Austria.
- Muhammad Taimoor Khan, *Towards a Behavioral Analysis of Computer Algebra Programs*. DK Report 2011-13, Johannes Kepler University, Linz-Austria.
- Muhammad Taimoor Khan, *A Type Checker for MiniMaple*. DK Report 2011-05, Johannes Kepler University, Linz-Austria.

## Posters

- Muhammad Taimoor Khan, Wolfgang Schreiner. *A Verification Framework for MiniMaple Programs*. In: 38<sup>th</sup> International Symposium on Symbolic and Algebraic Computation, June 2013.
- Muhammad Taimoor Khan, Kashif Zia, M.A. Pasha, M. Abbas Chaudhary. *A Step towards Personalizing Pervasive e-Business*. Proc. of the 3<sup>rd</sup> International Conference on e-Governance, Lahore, Pakistan, 2005.
- Muhammad Taimoor Khan, Najma Taimoor, Muhammad Aisf Naeem, M. Abbas Chaudhary. *COD-WIM: Context-based Ontological Dynamic Web Information Mining Framework For Smart Spaces*. Proc. of the 3<sup>rd</sup> International Conference on e-Governance, Lahore, Pakistan, 2005.

## National Conferences

- S.A. Hussain, Kashif Zia, Muhammad Taimoor Khan, Sajjad Ahmad, Umar Farooq. *Dynamic Contention Window for Quality of Service in IEEE 802.11 Networks*. Proc. of the National Conference on Emerging Technologies, Karachi, Pakistan, 2004.

## Misc<sup>5</sup>. (journals and book chapters that are accepted but unpublished)

- Muhammad Taimoor Khan et al. *Integrating Context-Aware Pervasive Environments*, CISSE 2006, Accepted for Springer Book Advances in Computer, Information, and Systems Sciences, and Engineering, ISBN 1-4020-5260-X
- Muhammad Taimoor Khan et al. *Quality Sensitive Integration of Web Services based Business supporting Multiple Channel: A Proposed Framework*, CISSE 2006, Accepted for Springer Book Advances in Computer, Information, and Systems Sciences, and Engineering, ISBN 1-4020-5260-X
- Muhammad Taimoor Khan et al. *An Enhancement in 802.11e EDCF Mechanism*, 5<sup>th</sup> DNCOCO 2006, (accepted for WSEAS Transactions on Computers, Issue 9, Vol 6, ISSN 1109 2750)
- Muhammad Taimoor Khan et al. *Middleware for Context-aware Pervasive Environments: A Layered Architecture*, DNCOCO 2006, (accepted for WSEAS Transactions on Computers, Issue 9, Vol 6, ISSN 1109 2750)

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<sup>5</sup>The work could not be published because the publishing was subject to the presentation in the associated conferences. However, the reason for not attending conferences was visa processing time for the conferences hosting countries.

## APPENDIX B - Research Projects

2014 – Date **Behaviorally Adaptable, Secure and Resilient Software Systems**

*Main goal:* To develop systems that are behaviorally secure and resilient based on formal verification methods. Our efforts include developing a tool (middleware ARMET) to automatically detect (resp. correct) known and unknown cybersecurity attacks in general and false data injection and advanced persistent threats/attacks in particular by the application of formal methods.

*Collaborations:* MIT CSAIL, USA and University of Patras, Greece

*My Responsibilities:* To design and develop a tool that automatically monitors, detects (resp. corrects) known and unknown cybersecurity attacks through behavioral inconsistencies (as compromises) and later to diagnose and restore the system into a safe state to continue operation successfully. Here, we have extended our partner's system, AWD RAT from CSAIL, MIT, USA.

In detail, based on AWD RAT, ARMET has a model of normal behavior; when the application deviates from the behavior prescribed by that model, it employs diagnostic reasoning techniques to further isolate and characterize the failure. It has both greater robustness and higher diagnostic resolution. But it achieves this only through the construction of a far more complex model. ARMET has an active model of normal behavior, namely an executable specification (aka System Architectural Model) of the application. This executable specification consists of a decomposition into sub-modules and pre- and post-conditions for each sub-module. In addition, data-flow and control-flow links connect the sub-modules, specifying the expected flow of values and of control. The pre- and post-conditions are arbitrary first-order statements about the set of data values that flow into and out of the sub-modules.

ARMET runs this executable specification in parallel with the actual application code, comparing their results at the granularity and abstraction level of the executable specification. (This is therefore a special case of the standard fault tolerance technique of running multiple versions of the same code and comparing their results.) The executable specification is hierarchical, allowing flexibility in the granularity of the monitoring. When threats are not expected, the executable specification is run at a high level of abstraction, incurring less overhead, but requiring more diagnostic reasoning should the program diverge from the prescribed behavior of the executable specification. In times of heightened threat, the executable specification can be elaborated to a greater degree, incurring more overhead, but providing more containment.

Optionally, the model can also include models for suspected incorrect behaviors of a component, allowing the diagnostic reasoning to characterize the way in which a component might have misbehaved. A diagnosis is then a selection of behavioral modes for each component of the specification such that the specification predicts the observed misbehavior of the system.

We have proved soundness and completeness of the monitor. Currently, we are mechanizing the proof using Coq and FIAT (developed by Adam's group at MIT CSAIL). Furthermore, we are applying ARMET to industrial control systems to ensure security and detect attacks.

2017 – Date **Reliable and Efficient Machine Learning based Data Analysis**

*Main goal:* To develop an adaptive, efficient and reliable machine learning algorithms for streamed data with parallel deep incremental feature learning.

*Collaborations:* [CERN, Switzerland](#), [University of Derby, UK](#), [MIT CSAIL, USA](#)

*My Responsibilities:* To design and develop machine learning algorithms integrated with reasoning framework that enables to

- specify the behavior of machine learning algorithms
- derive behavioral invariant of the algorithms, for instance, the convergence/divergence and learning conditions for such algorithms and
- verify the implementations of the algorithms that are efficient, secure and resource effective.

The automatic management of complex systems in real-time is a problem for a wide range of applications, such as Data Quality Monitoring of particle accelerator systems at the LHC and Engine Health Monitoring of jet engines at Rolls Royce. The learning of multiple consecutive tasks with continual identification of new features, from streamed data is considered as the challenging online machine learning task, known as lifelong learning. Our Adaptive Shallow Architecture for Streaming (ASAS) framework tackles such a problem by combining fast analysis on the data stream from a shallow network, with parallel deep networks trained to adapt to new features in the data incrementally, using transfer learning techniques. The proposed model is intended to address the continuous collection of high-energy physics data for the  $O^2$  framework on the [ALICE experiment at the LHC, CERN](#).

In detail, the project aims to assure that the features identified by the data analysis are consistent with Physics experiment based on the reasoning framework that enables us to

- **certify** the implementation of data analytical method, i.e. a computer proof that shows that the algorithm implementation is correct w.r.t. its specification,
- **explain** the selected feature based on the reasoning,
- **detect and correct** inconsistent and incomplete data through monitoring consistency between the algorithm execution and its specification (i.e. invariant which are those properties of the algorithm, under which the algorithm should always diverge/converge).

**To the best of our knowledge, this is the first effort at industrial scale that assures the development of *reliable* and *efficient* machine learning based data analysis methods.**



- 2009 – 2013 **Formally Specified Computer Algebra Software** (Research Project DK10 in the frame of the “Doctoral Program: Computational Mathematics”)  
*Main goal:* To develop a tool to automatically detect behavioral errors in computer algebra programs written in untyped languages by static analysis.  
*My responsibilities:* To design and develop a tool for static analysis of computer algebra programs; in particular the computer algebra programs written in untyped languages, which usually cause runtime errors. The tool finds the errors in programs annotated with type information, for example type inconsistencies and violation of method preconditions. As a starting point, we have designed a type system for the substantial subset (called *MiniMaple*) of the symbolic computation language *Maple*. A type checker for the language has been implemented to validate our results. The results are applied to the Maple package *DifferenceDifferential* developed at our institute for the computation of bivariate difference-differential dimension polynomials. We have also designed the specification language for *MiniMaple* and implemented the corresponding type checker. Also we have defined the denotational semantics of *MiniMaple* and its specification language as a prerequisite of our verification calculus, as the verification conditions generated by the calculus must be sound w.r.t. semantics. Here, we have proved the soundness of the translation, i.e. equivalence of denotational semantics of *MiniMaple* to operational semantics of Why3ML. For verification, we translate annotated *MiniMaple* program to the intermediate language Why3ML, from which the verification framework Why3 generates verification conditions whose correctness was proved by various back-end supported automatic decision procedures and interactive provers (e.g. Z3 and Coq respectively). We have formally specified high-level procedures (which call low-level procedures) of the package with the help of abstract data types and have also devised a corresponding verification strategy for proving their correctness. The verification framework was applied to the package *DifferenceDifferential* to validate the results.  
My responsibilities also include to report the work at international conferences and workshops, to write scientific papers and technical reports, to attend research seminars and lectures, to collaborate with other research groups.
- 2007 – 2008 **Formal specification and verification of satellite communication protocols of NASA** at the University of Leicester, UK  
*Main goal:* To study the official documents provided by NASA and to formally specify and verify the various satellite communication protocols.  
*My responsibilities:* To study the specification documents provided by NASA, to find the ambiguities in the requirements of communication protocols, to devise a unified protocol, to specify the proposed protocol, to verify the certain properties of proposed protocol, e.g. dead-lock, information inconsistencies etc.
- 2003 – 2005 Research member of computer networks group at University of the Punjab, Lahore, Pakistan (PUCIT)  
*My responsibilities:* To design and implement various wireless network MAC and routing protocols, to work on various issues of pervasive systems, to report the work at international conferences, to write scientific papers and technical reports, to attend graduate lectures, to teach undergraduates lectures.

## APPENDIX C - Selected Invited Talks

### *Certified Systems Security*

- **University of Manchester, UK** (invited seminar) 01/2018

### *Developing Formally Certified Efficient and Reliable Computing Systems*

- **University of Cambridge, UK** (invited seminar) 09/2017
- University of Derby, UK (invited talk) 09/2017

### *A Rigorous and Efficient Runtime Security Monitoring*

- Infineon, Austria (invited talk) 05/2017
- Johanneum Robotic Research, Austria (invited talk) 03/2017
- **MIT, CSAIL, USA** (invited seminar) 06/2016
- Alpen-Adria University, Austria (postdoc interview talk) 03/2015

### *Formal Semantics of Programming Languages*

- University of Swansea, UK (postdoc interview talk) 03/2014

### *Formal Verification of Computer Algebra Programs*

- **ETH, Switzerland** (postdoc interview talk) 10/2013
- **INRIA, Paris, France** (invited seminar) 11/2011

### *Formal Methods based Software Engineering*

- Software Competence Center, Austria (invited seminar) 01/2013
- System Analysis and Verification Lab, NUST, Pakistan (invited seminar) 12/2012

## APPENDIX D - Selected Taught Courses

### *Alpen-Adria University, Klagenfurt, Austria*

- Specification and Verification in WS2017/18
- Certified Software Development in SS2017, SS2018
- System Development Process in SS2017, SS2018

### *University of Leicester, United Kingdom*

- Service Oriented Architecture in SS2008, SS2014, SS2015, SS2016, SS2017, SS2018
- Agile Cloud Automation in WS2015/16, WS2016/17, WS2017/18
- Domain Specific Languages in WS2013/14, WS2014/15
- Advanced Web Technologies in WS2007/08

### *COMSATS University, Pakistan*

- Advanced Distributed Systems in SS2009
- Advanced Computer Networks in SS2009

- Digital System Design in WS2008/09
- Network Switching in WS2008/09
- Computer Programming in WS2006/07
- Computer Graphics in SS2006
- Network Programming in WS2005/06
- Distributed Systems in WS2005/06

*Baluchistan University of IT, Pakistan*

- Advanced Data Mining in SS2005
- Advanced Software Engineering in SS2005

*University of the Punjab, Pakistan*

- Software Engineering in WS2003/04
- Computer Networks in WS2003/04

## APPENDIX E - Selected Reviewing Activities

*Journals*

- Proceedings of the IEEE
- IEEE Transactions on Industrial Informatics
- IEEE Software
- Journal of Software: Evolution and Process

*Conferences and Workshops*

- CMC 2017 - 11<sup>th</sup> Joint Conference on Mathematics and Computer Science
- SACMAT 2016 - 21<sup>st</sup> ACM Symposium on Access Control Models and Technologies
- AsiaCCS 2016 - 11<sup>th</sup> ACM Asia Conference on Computer and Communications Security
- WESS 2015 - 10<sup>th</sup> Workshop on Embedded Systems Security
- AsiaCCS 2015 - 10<sup>th</sup> ACM Asia Conference on Computer and Communications Security
- IWDM 2014 - 2<sup>nd</sup> IEEE International Workshop on Data Management
- ITAAC 2013 - 3<sup>rd</sup> International Workshop on Intelligent Techniques and Architectures for Autonomous Clouds
- CICM 2013 - Conference on Intelligent Computer Mathematics
- FIT 2012 - 10<sup>th</sup> International Conference on Frontiers of Information Technology
- FIT 2011 - 9<sup>th</sup> International Conference on Frontiers of Information Technology
- FIT 2009 - 7<sup>th</sup> International Conference on Frontiers of Information Technology
- FIT 2008 - 6<sup>th</sup> International Conference on Frontiers of Information Technology
- ICITA 2005 - International Conference on Information Technology and Applications

## APPENDIX F - Typical/Selected Computer Skills

### *Typical Programming Languages*

- Java (SE/EE/ME), C/C++/C#.
- Mathematica and Maple.
- LISP, Prolog, Python, ML.
- Macro Assembler.
- Embedded VB/VC, OpenGL.

### *Formal Methods Skills*

- *Specification Languages/Tools*: Ltac, (Open)JML, Spec#, OBJ family, Promela.
- *Model Checkers*: Spin, PVS, UMC.
- *Verification Tools*: Why, Boogie, Dafny.
- *SMT Solvers*: Simplify, CVC3/4, Z3.
- *Proof Assistants*: Coq, ProgramNavigator, ProgramExplorer.

### *Modeling Languages*

- UML, RUP, CommUnity, SRML.

### *Typical Architectures and Frameworks*

- EJB (1.x/2.x/3.x), CORBA/ RMI-IIOP
- JNI, RPC, J2EE (JSF/JSP/Servlets/Design Patterns), WAP, PHP, J2ME, Web Services.

### *Web and Application Servers*

- Web Logic 6.x/7.x, JRun 3.x, Tomcat 4.x-6.x, IIS, IBM Web Sphere 5.x, JBoss 3.x.

### *Standard Programs*

- Latex, MS Office, Xfig.

## APPENDIX G - Foreign Languages

English, fluent

German, intermediate level

French, basic level.

## APPENDIX H - References

- *Howard Shrobe*. Director Cybersecurity Initiative, Computer Science Artificial Intelligence Laboratory, MIT, USA. Email: hes@csail.mit.edu
- *Dimitrios Serpanos*. Director, Industrial Systems Institute, University of Patras, Greece. Email: dserpanos@qi.org.qa
- *Renaud Rioboo*. Computer Science Professor at ENSIIE and CNAM, France. Email: renaud.rioboo@ensiie.fr.
- *Reiko Heckel*. Professor at School of Mathematics and Computer Science, University of Leicester, UK. Email: reiko@mcs.le.ac.uk.