

Michael Serge Lia Cochez

(Male)

Postdoctoral researcher at Fraunhofer - FIT

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I am a postdoctoral researcher at the Fraunhofer Institute for Applied Information Technology FIT and based at the RWTH University in Aachen (Germany). I have done research in several information technology related areas during the past years, currently I am mostly working on areas related to data analysis and knowledge representation like Knowledge Graph Embedding, Scalable Hierarchical Clustering, Prototype-based Ontologies, and Data Mining.

Date and place of birth, nationality, current residence

Born: 22 January 1988, Mortsels, Belgium

Nationality: Belgian

Current Residence: Aachen, Germany

Education and degrees awarded

- **Ph.D. in Mathematical Information Technology** Jyväskylä, Finland
University of Jyväskylä (JYU) 05/2012–05/2016
 - Faculty of Information Technology, Mattilanniemi 2 (P.O.Box 35), 40014 Jyväskylä (Finland)
 - Research related to Knowledge Evolution, Ontology Learning and Matching, Scalable Clustering, Evolutionary Computing, and Optimization
 - Dissertation Grade: excellent (highest), course work grade: excellent (highest)
 - Supervisors: Prof. Vagan Terziyan (JYU) and Prof. Ferrante Neri (Centre for Computational Intelligence, School of Computer Science and Informatics, De Montfort University, United Kingdom)
- **Master of science in Mathematical Information Technology** Jyväskylä, Finland
University of Jyväskylä (JYU) 09/2009–03/2012
 - Faculty of Information Technology, Mattilanniemi 2 (P.O.Box 35), 40014 Jyväskylä (Finland)
 - Mobile systems study line. Minor in Physics
 - Thesis Grade: very good (one to highest), course work grade: excellent (highest), physics minor: very good (one to highest)
 - Advisor: Prof. Vagan Terziyan (JYU)
- **Bachelor in Information Technology – Great Distinction** Antwerp, Belgium
University of Antwerp (UA) 09/2006–06/2009
 - Faculty of Science, Middelheimlaan 1, 2020 Antwerp (Belgium)
 - Information technology : Programming, theoretical information technology, databases, basics in computer graphics, mathematics, etc.
- **General Secondary Education Science–Mathematics** Antwerp, Belgium
H. Pius-X instituut 09/2001–06/2006
 - VIIde-Olympiadelaan 25, 2020 Antwerp (Belgium)
 - Natural sciences (physics, chemistry, biology, geography), mathematics and an emphasis on languages.

Other education and training, qualifications and skills

- **Data protection basics** Germany
Fraunhofer internal certification 11/2018
 - Basics of data protection and privacy (GDPR, BDSG)
- **International ScaDS Summer School on Big Data** Leipzig, Germany
Competence Center For Scalable Data Services and Solutions 07/2016
 - The topics of the summer school included big data storage, distributed data processing (HPC, map reduce, streaming, Apache Spark, Apache Flink), graph analytics and management, and big data integration.
- **CSC Summer School – High Performance Computing** Espoo, Finland
Finnish IT Center for Science (CSC) 06/2014–07/2014
 - The summer school introduced the participants to the use of high performance computing infrastructure. Topics included were C programming, Message Passing Interface (MPI), OpenMP, Parallel I/O, etc.
- **Teaching Academic Content through English (TACE)** Jyväskylä, Finland
University of Jyväskylä 03/2012–03/2013
 - This program is aimed at the development of the participants' university pedagogical and intercultural communication competences for using English in the multicultural teaching, counseling, and assessment of multilingual and multicultural student groups.
- **International Summer School – Modern Computational Science** Oldenburg, Germany
University of Oldenburg 08/2012
 - The summer school contained a variety of lectures on topics related to computational science. Among others there were lectures on random numbers, complexity theory, optimization, interval methods, evolutionary algorithms, etc.
- **Erasmus Exchange to University of Jyväskylä, Finland (JYU)** Jyväskylä, Finland
University of Jyväskylä 09/2008–06/2009
 - I went on an exchange to JYU during my bachelor studies, before starting as a master and doctoral student. The following courses were part of the program: Multi core programming, application protocols, mobile programming, real-time systems, agent based systems, requirements management, etc.
- **Erasmus Intensive Language Course (EILC): Finnish** Jyväskylä, Finland
University of Jyväskylä/CIMO 08/2008
 - Before my exchange I attended an intensive Finnish language and culture course of one month.
- **First year secondary school** Antwerp, Belgium
Provinciaal Instituut voor Voeding Antwerpen (PIVA) 09/2000–06/2001
 - Desguinlei 244, 2018 Antwerp (Belgium)
 - Normal secondary school with specialization in food production (bakery, butchery, cooking and waiter techniques)

Linguistic skills

My mother tongue is Dutch. I studied French, English, and German during my secondary school years. I use English and Finnish as everyday communication languages. English is the main language used in my scientific work. I have some experience supervising using the Finnish language as well.

Mother tongue: **Dutch**

Other languages (self-assessment Nov 2018):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Finnish	C1	B2	B2	B2	B2
French	B1	B1	A2	A2	A2
German	B1	B2	A2	A1	A1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2: Proficient user
Common European Framework of Reference for Languages¹

Current positions

- **Postdoctoral researcher** (*wissenschaftlicher Mitarbeiter*) Aachen Germany
Fraunhofer Institute – FIT, Knowledge Pipelines *07/2016–06/2019*
 - Part of the Knowledge Pipelines group
 - Research related to linked data and semantic web, prototype based ontologies, data pipelines, and data mining.
 - Project funding acquisition and customer management.
- **Postdoctoral researcher, on partial leave** Jyväskylä, Finland
University of Jyväskylä(JYU) *06/2016–05/2020*
 - Master thesis supervision and teaching of several courses.
- **Scientific Advisor, part-time** Jyväskylä, Finland
MyOpt consulting *Since 01/2016*
 - Advisor in artificial intelligence and optimizations related domains.

Previous work experience

- **Research Visit to the Vienna University of Economics and Business** Vienna, Austria
host: Prof. Axel Polleres *08/2018*
 - During this visit I worked on new directions for question-answer systems on graphs.
- **Postgraduate student, full-time** Jyväskylä, Finland
University of Jyväskylä(JYU) *05/2012–05/2016*

¹see also <http://europass.cedefop.europa.eu/en/documents/european-skills-passport/language-passport>

- Research mainly related to my doctoral studies, but also other areas of Multi-Agent Systems and Version control in IT education. Grant and project application writing. Teaching of several courses and master thesis supervision. (see other sections below for details)

- **Research Visit to the Insight Centre for Data Analytics** Galway, Ireland
host: Prof. Stefan Decker 05/2015–08/2015
 - During this visit I worked on several new ideas related to prototype based ontologies.
- **Parental leaves**
I took about 60 working days of parental leave during the period 11/2013–01/2015
- **Research assistant in Cloud Software Program** Jyväskylä, Finland
University of Jyväskylä(JYU) (part- and full-time) 09/2010–04/2012
 - Implementation of semantic cloud software based on the UBIWARE platform in cooperation with Nokia Finland Oy.
 - Research on and implementation of data mining algorithms for staff member data. In cooperation with Tieto Finland Oy.
 - Research on cloud communication channels in cooperation with IPSS Oy (now Steeri Oy).
- **Junior researcher in UBIWARE Project (part-time)** Jyväskylä, Finland
University of Jyväskylä – Agora Center (JYU) 11/2009–12/2010
 - Development and research concerning the UBIWARE semantic agent platform. Focus on package policies.
- **Student worker at IT service department (school holidays)** Antwerp, Belgium
Plantijn Hogeschool Antwerp (now Artesis Plantijn Hogeschool Antwerp) 07/2006–07/2008
 - Installing hardware and software, basic helpdesk services, writing manuals, and website design and implementation.
- **Bakery production and sales (when not at school)** Antwerp, Belgium
Cochez-Stevens (parents' bakery) 09/2000–08/2008

Research funding as well as leadership and supervision

- Research, Education and Conference travel funding (figures are rounded)
 - 4 year funded PhD position** University of Jyväskylä 05/2012–05-2016
 - Funding for several cases in the Cloud Software SHOK project** TEKES (Finland) 01/2010–12/2013
 - Funding for several cases in the Need4Speed SHOK project** TEKES (Finland) 01/2014–12/2015
 - Grant for ICTERI conference travel** €700
ICTERI conference organizers 06/2012
 - Summer school in Oldenburg, Germany** €1,300
Erasmus (European Commission) 08/2012
 - Doctoral study grant** €5,000
Nokia Foundation 01/2013
 - Computing resources grant for courses TIES456 and TIES532** \$5200
Amazon.com, Inc. 09/2013

Computation time for research <i>Finnish IT Center for Science (CSC)</i>	10,000 units 03/2014
Computing resources grant for courses TIES456 and TIES532 <i>Amazon.com, Inc.</i>	\$5,600 09/2014
Computation time for teaching <i>Finnish IT Center for Science (CSC)</i>	10,000 units 10/2014
Computing resources grant for courses TIES457 <i>Amazon.com, Inc.</i>	\$2,000 11/2014
Mobility Grant for Research Visit to DERI/Insight Centre, Galway <i>JYU research council</i>	€4500 05/2015
SIGMOD 2015 conference travel and fee <i>Association for Computing Machinery (ACM)</i>	\$1,385 05/2015
Computing resources grant for courses TIES456 and TIES532 <i>Amazon.com, Inc.</i>	\$3000 10/2015
IEEE SSCI 2015 conference travel <i>Institute of Electrical and Electronics Engineers (IEEE)</i>	\$800 12/2015
Computation time for research <i>Finnish IT Center for Science (CSC)</i>	100,000 units 01/2017
GPU Titan Xp for research <i>NVIDIA Corporation</i>	1 GPU 06/2017
Grant for research visit to Vienna University of Economics and Business <i>WU vienna</i>	€1500 08/2018
Computational Resources Grant RWTH 20K P100 GPU hours <i>RWTH Aachen</i>	20K GPU hours 12/2018
Grant for research visit to TU Dresden <i>TU Dresden</i>	€650 02/2019
Grant for talk at KIT <i>Karlsruhe Institute of Technology</i>	€300 03/2019
H2020 (European Commission), DEMETER <i>Digitising and transforming European industry and services</i>	Total 15 M€, own share 250 K€ 03/2019

- Finished Master Thesis Supervision (some titles shortened for brevity)

Smart Semantic Multi-channel Communication <i>Chen, Jiawen</i>	2/2015
Technology Selection for Off-line Web Applications² <i>Satokangas, Lauri & Heimonen, Olli</i>	11/2015
Using Distributional Semantics For Automatic Taxonomy Induction <i>Bushra Zafar</i>	11/2016
The Pragmatics and Logic of KR with Prototypes <i>Gesche Gierse</i>	10/2017
Semantic Annotation for Big Data <i>Mwakyusa, Phesto</i>	11/2017

²Original Finnish title: Teknologian valinta yhteydettömässä tilassa toimivan web-sovelluksen kehittämiseen

Parking Availability Prediction using Smart Sensors and ML	
<i>Andrei Ionita</i>	12/2017
Exponential Decaying Reservoir Sampling of Evolving Data Streams	
<i>Georg Groß</i>	12/2017
Semantic Data Profiling in Data Lake	
<i>Jasim Waheed Ansari</i>	02/2018
Secure Evaluation of Knowledge Graph Merging Gain	
<i>Leandro Eichenberger</i>	11/2018
Modeling autonomous sensory agents in ROS	
<i>Touhidur Rahman</i>	11/2018
Random hyperplane hashing using not-so-random hyperplanes	
<i>Iraklis Dimitriadis</i>	02/2019
• Finished Bachelor Thesis Supervision (some titles shortened for brevity)	
Prototypes on IPFS: Globally Distributed Reusable Knowledge	
<i>Dominik Hüser</i>	10/2017
Including Attributes in a Graph Embedding	
<i>Jérôme Lenßen</i>	10/2018
Accelerating Graph Embedding using GPUs and Distributed Computing	
<i>Abdulrahman Altaba</i>	02/2019
Concept embeddings for Wikipedia across language editions	
<i>Felix Ingenerf</i>	01/2019
• Bachelor and Master Thesis Examiner (some titles shortened for brevity)	
I was appointed as the examiner for the following master thesis works:	
Semantic Annotation for Big Data	
<i>Mwakyusa, Phesto</i>	11/2017
GUI Personalization Framework using Semantic User Profile	
<i>Suopellonmäki, Pekka</i>	12/2017
Designing a cloud architecture for an application with many users	
<i>Marcel Schuchmann</i>	05/2018
• Ongoing supervision and proposal phase. Dates estimated.	
Classification of medical images using image segmentation techniques	
<i>Jiao Jiao</i>	06/2019
Modeling for Street Level Crime Prediction	
<i>Zhang Jinyang [IDEA grant recipient, with ETH Zürich]</i>	06/2019
Word Sense Disambiguation for Finnish (language learning)	
<i>Frankie Robertson</i>	06/2019
Evaluation of Hierarchical Clustering Algorithms	
<i>Philipp Lützenkirchen [FH Aachen]</i>	09/2019
Graph-Structured Query Construction for Natural Language Questions	
<i>Ruijie Wang</i>	08/2019
Privacy Attack on Social Networks Using Network Embeddings	
<i>Michael Ellers</i>	08/2019

Feature Clustering and Visualization using Clique Cover Theory

Abhijeet Das

08/2019

Machine Learning for Anonymization of Unstructured Text

Sophie Hallstedt

08/2019

Merits in teaching and pedagogical competence

Courses:

I taught these courses independently at master level at the university of Jyväskylä. Each course was worth five ECTS credits (135 hours of study):

Introduction to service oriented architectures (SOA) and cloud computing 2013, 2014, 2015 –

During this course the student got an introduction to technologies used in SOA and cloud computing settings.

Service oriented architectures and cloud computing for developers 2013, 2014, 2015, 2016 –

This course was a follow-up course of the TIES456 course. Students worked individually on more advanced tasks related to the topics from the basic course.

Service oriented architectures and cloud computing 2012 – old form of the two courses above (10 ECTS credits).

Big data engineering in 2014 and 2015 as a normal course, in 2017 as a two week intensive course –

Multiple topics related to Big Data were be studied. Students will get acquainted to large data sets and streaming. Some storage and processing algorithms were studied and hardware related issues discussed. The gathered knowledge was then applied on real world data sets.

Agent technologies for developers 2014, 2016 – The course is about practical use of distributed AI methods. More concretely of multi-agent technologies, for the development of complex cooperating software systems.

Design of agent-based systems, Part II 2013 – old form of the course above.

Other teaching:

Seminars i5 RWTH Aachen In these courses students work on a specific topic towards a presentation and report at the end of the course. The goal is to prepare the students for writing their master thesis. I was the main contact person and responsible for review of reports, etc. Summer semester 2017, Winter Semester 2017/2018, and Winter Semester 2018-2019 at RWTH Aachen University.

Praktikum i5 RWTH Aachen I organized a, so called, Praktikum on Knowledge Graphs in Spring 2018. This is a course in which bachelor students perform practical tasks.

Talks and Tutorials:

Deep neural networks for analysing cancer genomics data I had a minor contribution to this tutorial at the SWAT4HCLS 2018 conference. At the same conference we also hosted a tutorial on the same topic in which we looked into problems like Cancer type detection, Predicting cancer subtypes and Predicting survival rate.

Talk - Knowledge Graph Embedding I gave a talk in which I presented an overview of Knowledge Graph Embedding Techniques at the Vienna University of Business and Economics (August 2018).

Talk - Knowledge Graph Embedding As part of the International Semantic Web Research Summer School 2018, I gave a talk in which I presented an short introduction on Knowledge Graph Embedding Techniques.

Talk - Knowledge Graph Embedding and Graph Convolutional Networks I gave a talk in which I presented an short introduction on Knowledge Graph Embedding Techniques as part of my visit to the TU Dresden (February 2019)

Talk - Knowledge Graph Embedding and Graph Convolutional Networks I gave an invited talk in which I presented an short introduction on Knowledge Graph Embedding Techniques at the seminar of the AIFB group at Karlsruhe Institute of Technology (February 2019)

Courses in which I had a limited role:

Linked Data seminar i5 RWTH Aachen Winter semester 16/17 – description above.

Semantic Web i5 RWTH Aachen 2016 – I taught one of the lectures in this course and was involved in grading of the mid-term test.

Other merits:

Further skills are acquired in the TACE program (see section *Other education and training, qualifications and skills* above)

Besides the classroom teaching activity, I was the main supervisor of more than 10 master thesis workers. (see section *Research funding as well as leadership and supervision* above).

I have also taken part in curriculum planning and student selection:

- I was a tutor at the Semantic Web Research Summer School in Bertinoro in 2018
- Member of the planning group of the Web Intelligence and Service Engineering (WISE) master program – 2012-2016.
- Member of WISE selection committee – 2013, 2014, 2015, 2016.
- Member of the working groups for curriculum development (2014–2017) in the areas of computation (applied mathematics, data analysis, etc.) and technology (software engineering, mobile systems, sensor networks, games, and gamification) – 2013.

Other academic merits

I am/was a programming committee member for the following scientific forums:

- IJCAI 2019
- ISWC 2017, 2018
- WWW (the Web Conference) (2017 as sub reviewer), 2018 (tracks: Semantics and Knowledge, Web Mining and Content Analysis), 2019 (Semantics and Knowledge, Web Mining and Content Analysis)

- Semantic Web Journal (SWJ) 2017, 2018, 2019
- Web Science 2019
- Progress in Artificial Intelligence (Springer) - Special issue Applied Cognitive Computing 2018
- Science of Computer Programming Journal (Elsevier), reviewer for Special issue on Systems development by means of semantic technologies
- WIMS 2014, 2015, 2016, 2017, 2018
- Semantic Deep Learning workshop (SemDeep-4) 2018
- ICTERI 2013, 2014, 2015, 2016, 2017
- DEIS workshop 2012

Conference and Workshop organization:

- I am a co-chair for reproducibility at ISWC 2019
- I was a co-organizer of the Workshop on Deep Learning for Knowledge Graphs at ESWC 2019.
- I assisted in the organization of a Dagstuhl seminar on Knowledge Graphs: The future of the Semantic Web
- I was a co-organizer of the BigNet workshop at the Web Conference 2018.
- I was a co-organizer of the Workshop on Deep Learning for Knowledge Graphs and Semantic Technologies at ESWC 2018.
- I was an ESWC track co-chair (Machine Learning) 2017.
- I chaired a session on Social Network Analysis and Graph Algorithms for the Web at The Web conference 2018, the Applications session at WIMS 2017, and the Symposium on Differential Evolution at IEEE Symposium Series on Computational Intelligence (SSCI) 2015.

I was invited to a Dagstuhl Seminar on *Knowledge Graphs: The future of the Semantic Web*.

Scientific and societal impact of research

- Peer reviewed book chapters, conference papers and journal papers: 29
- Technical reports, documentation and articles (non-reviewed): 10
- Posters: 4
- Master thesis and Doctoral dissertation

Ten selected publications³:

1. **Michael Cochez** and Hao Mou. Twister tries: Approximate hierarchical agglomerative clustering for average distance in linear time. In *Proceedings of the 2015 ACM SIGMOD international conference on Management of data*, SIGMOD '15, New York, NY, USA, 2015. ACM. doi: 10.1145/2723372.2751521. URL http://users.jyu.fi/~miselico/papers/twister_tries.pdf

³complete list from <http://users.jyu.fi/~miselico/research/publications/>

2. **Michael Cochez**, Petar Ristoski, Simone Paolo Ponzetto, and Heiko Paulheim. Global RDF vector space embeddings. In Claudia d'Amato, Miriam Fernandez, and others, editors, *The Semantic Web – ISWC 2017: 16th International Semantic Web Conference, Vienna, Austria, October 21–25, 2017, Proceedings, Part I*, pages 190–207. Springer International Publishing, Cham, 2017b. ISBN 978-3-319-68288-4. doi: 10.1007/978-3-319-68288-4_12. URL <http://users.jyu.fi/~miselico/papers/GlobalRDFEmbedding.pdf>
3. **Michael Cochez**, Stefan Decker, and Eric Prud'hommeaux. Knowledge representation on the web revisited: The case for prototypes. In *The Semantic Web – ISWC 2016: 15th International Semantic Web Conference, Kobe, Japan, October 17–21, 2016, Proceedings, Part I*, pages 151–166. Springer International Publishing, Cham, 2016. ISBN 978-3-319-46523-4. doi: 10.1007/978-3-319-46523-4_10. URL <http://users.jyu.fi/~miselico/papers/knowledge-representation-prototypes.pdf>
4. **Michael Cochez**, Dominik Hüser, and Stefan Decker. The future of the semantic web: Prototypes on a global distributed filesystem. In *2017 IEEE 37th International Conference on Distributed Computing Systems (ICDCS)*, pages 1997–2006, June 2017a. doi: 10.1109/ICDCS.2017.270
5. Svitlana Vakulenko, Maarten de Rijke, **Michael Cochez**, Vadim Savenkov, and Axel Polleres. Measuring semantic coherence of a conversation. *arXiv preprint arXiv:1806.06411*, 2018. URL http://users.jyu.fi/~miselico/papers/semantic_coherence.pdf. Accepted for presentation and inclusion in the proceedings at ISWC 2018
6. **Michael Cochez**, Vagan Terziyan, and Vadim Ermolayev. Large scale knowledge matching with balanced efficiency-effectiveness using LSH forest. In Ngoc Thanh Nguyen, Ryszard Kowalczyk, Alexandre Miguel Pinto, and Jorge Cardoso, editors, *Transactions on Computational Collective Intelligence XXVI*, pages 46–66. Springer International Publishing, Cham, 2017c. ISBN 978-3-319-59268-8. doi: 10.1007/978-3-319-59268-8_3. URL <http://users.jyu.fi/~miselico/papers/KnowledgeMatchingLSHForest.pdf>
7. Vadim Ermolayev, Rajendra Akerkar, Vagan Terziyan, and **Michael Cochez**. Towards evolving knowledge ecosystems for big data understanding. In Rajendra Akerkar, editor, *Big Data Computing*, pages 3–55. Taylor & Francis group - Chapman and Hall/CRC, 2014. ISBN 978-1-46-657837-1. Preprint part of my doctoral dissertation
8. **Michael Cochez** and Ferrante Neri. Scalable hierarchical clustering: Twister tries with a posteriori trie elimination. In *Computational Intelligence, 2015 IEEE Symposium Series on*, pages 756–763. IEEE, Dec 2015. doi: 10.1109/SSCI.2015.12. URL http://users.jyu.fi/~miselico/papers/TT_aposteriori_elimination.pdf
9. Ville Isomöttönen, Ville Tirronen, and **Michael Cochez**. Issues with a course that emphasizes self-direction. In *Proceedings of the 18th ACM Conference on Innovation and Technology in Computer Science Education, ITiCSE '13*, pages 111–116, New York, NY, USA, 2013. ACM. ISBN 978-1-4503-2078-8. doi: 10.1145/2462476.2462495. URL <http://doi.acm.org/10.1145/2462476.2462495>
10. Sergey Chernov, **Michael Cochez**, and Tapani Ristaniemi. Anomaly detection algorithms for the sleeping cell detection in LTE networks. In *Vehicular Technology Conference (VTC Spring), 2015 IEEE 81st*, pages 1–5. IEEE, 2015. URL http://users.jyu.fi/~miselico/papers/anomaly_sleeping_cell.pdf

I was elected to council of the Faculty of Information Technology, University of Jyväskylä
1.1.2014–31.12.2017

I co-organized three coding events for young children (4–9 y.o.) in April, May, and November 2014. We mainly focused on getting children to find their way through the hour of code: <https://studio.code.org/hoc/>.

Starting January 2018 I audit (toiminnan tarkastaja) the working of the Aachenin Suomi-koulu (Aachen Finnish school, keeping educational Finnish language events for expats' children).

I am a member of the bi-weekly chair meeting at the i5 – Information Systems & Databases at RWTH Aachen since April 2018.

I was mentor of Maria Angela Pellegrino during her Erasmus placement at Fraunhofer FIT from March 2018 till August 2018

Other merits

I took part in the following research projects:

UBIWARE project 2007-2010 The project's goal was the creation of an innovative middleware supporting complex self-managed industrial systems. The nature of the components managed by the system varies from smart sensors and actuators to web services and humans. A Multi-Agent System was used as a foundation where the beliefs, desires, intentions, and even the communication is performed using S-APL (the Semantic Agent Programming Language).

Cloud software program SHOK 2010-2013 A program directed towards the creation of new business models, lean software principles, and an open infrastructure for a cloud computing environment.

Need4Speed SHOK 2014-2015 An environment for experimenting with real-time business models based on customer insight.

FITScope 2016-2019

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