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## Yoichi Hirai

### Professional Experience

- 2020- Senior Software Engineer at BedRock Systems, Inc..
- 2018-2019 Engineer at brainbot technologies AG, involving Ethereum application development.
- 2016-2018 Formal verification engineer at Ethereum DEV UG, involving specification of Ethereum Virtual Machine in Isabelle/HOL and Isabelle/HOL proofs about a distributed algorithm.
- 2014-2016 Formal verification engineer at FireEye, Inc., involving formal verification in Coq and model-based testing of a microkernel.
- 2013-2014 Researcher at Highly Reliable Software Group in AIST (a Japanese national institute), involving requirement-analysis and SysML modelling of transportation systems and Coq proofs about data encoding.
- 2010-2011 Research assistant at IIJ Innovation Institute, involving a Coq proof about Haskell's Data.Map library.
- 2006-2009 Part-time programmer for Kokolink, Co., involving analysis and modification of PostgreSQL.

### Natural Languages

Japanese (native), English (fluent), German (advanced).

### Publication

#### Refereed Papers (Selected)

- [1] Yoichi Hirai: Defining the Ethereum Virtual Machine for Interactive Theorem Provers. In *Financial Cryptography Workshops 2017*, LNCS 10323, pp. 520–535. 2017.
- [2] Hanno Becker, Juan Manuel Crespo, Jacek Galowicz, Ulrich Hensel, Yoichi Hirai, César Kunz, Keiko Nakata, Jorge Luis Sacchini, Hendrik Tews, Thomas Tuerk: Combining Mechanized Proofs and Model-Based Testing in the Formal Analysis of a Hypervisor In *FM 2016*, LNCS 9995, pp. 69–84. 2016.

- [3] Yoichi Hirai and Kazuhiko Yamamoto: Balancing Weight-Balanced Trees. *Journal of Functional Programming*, **21**(03), pp. 287–307. 2011.
- [4] Yoichi Hirai: An Intuitionistic Epistemic Logic for Sequential Consistency on Shared Memory. In *LPAR-16*, LNAI 6355, pp. 272–289. Springer. 2010.
- [5] Yoichi Hirai: A Lambda Calculus for Gödel–Dummett Logic Capturing Waitfreedom, In *FLOPS 2012*, LNCS 7294, pp. 151–165. 2012.
- [6] Alessandro Facchini, Yoichi Hirai, Maarten Marx, Evgeny Sherkhonov: Containment for Conditional Tree Patterns. In *Logical Methods in Computer Science* **11**(2). 2015.

#### Theses

- [7] Yoichi Hirai: Hyper-Lambda Calculi, Doctoral Thesis, 2013.
- [8] Yoichi Hirai: An Intuitionistic Epistemic Logic for Asynchronous Communication, Master’s Thesis, 2010. Work supervised by Prof. Masami Hagiya.

#### Programming Languages

- proficient* Coq (ssreflect), C, Ethereum Virtual Machine.
- used* Scheme, OCaml, Isabelle/HOL, SysML, Haskell, Ruby, Python, C++, Solidity, Alloy.

#### Open Source Contribution under Username @pirapira

- eth-isabelle* A formalization of Ethereum Virtual Machine, which can be translated into Coq, Isabelle/HOL and OCaml.
- Proof-of-Stake formal methods*  
An Alloy analysis and Isabelle/HOL proofs about a distributed algorithm.
- Yellow Paper*  
The specification of Ethereum.
- raiden-contracts*  
Onchain component of Raiden payment network.
- bamboo* A compiler from a state-machine based language into Ethereum Virtual Machine.

*Solidity* A compiler from a contract-oriented language Solidity into Ethereum Virtual Machine.

*ethereum/tests*  
The test suite for Ethereum Virtual Machine.

### **Education**

*2010–2013* PhD course in computer science, the University of Tokyo.

*2011–2012* Visiting student at ILPS, the University of Amsterdam.

*2008–2010* MSc in computer science, the University of Tokyo.

*2004–2008* BSc in information science, the University of Tokyo.

### **Awards/Distinctions/Research Funding**

*2011–2013* JSPS Research Fellowships for Young Scientists.

*2010* Dean's Award.

*2002* Classified among the 20 best candidates in Japanese Mathematical Olympiad.

### **Visa Status**

A Japanese citizen with a settlement permit (Niederlassungserlaubnis) in Germany.