

# Alex (Oleksandr) Polozov

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## EDUCATION

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**Ph.D. in Computer Science** 2012-2017

*University of Washington, Seattle, USA*

Advisors: Dr. Sumit Gulwani & Prof. Zoran Popović

Ph.D. Thesis: "A Framework for Mass-Market Inductive Program Synthesis"

**B.Math. in System Analysis** 2008-2012

*National Technical University of Ukraine "Kyiv Polytechnic Institute"*

Advisor: Prof. Yuriy Tymoshenko

Thesis: "Structure and Term Prediction for Mathematical Text"

## PUBLICATIONS

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### Books, book chapters, journal articles, monographs

- [1] S. Gulwani, O. Polozov, and R. Singh, "Program Synthesis", in *Foundations and Trends® in Programming Languages*: Vol. 4: No. 1-2, pp 1-119, 2017.
- [2] O. Polozov. "A Framework for Mass-Market Inductive Program Synthesis." PhD dissertation, 2017.

### Peer-reviewed conference publications, talks

- [3] A. Kalyan, A. Mohta, O. Polozov, D. Batra, P. Jain, and S. Gulwani, "Neural-Guided Deductive Search for Real-Time Program Synthesis from Examples", in *6<sup>th</sup> International Conference on Learning Representations (ICLR)*, 2018.
- [4] R. Rolim, G. Soares, L. D'Antoni, O. Polozov, S. Gulwani, R. Gheyi, R. Suzuki, and B. Hartmann, "Learning syntactic program transformations from examples", in *39<sup>th</sup> International Conference on Software Engineering (ICSE)*, 2017.
- [5] O. Polozov and S. Gulwani, "Program synthesis in the industrial world: inductive, incremental, interactive", in *5<sup>th</sup> Workshop on Program Synthesis (SYNT)*, 2016.
- [6] M. Mayer, G. Soares, M. Grechkin, V. Le, M. Marron, O. Polozov, R. Singh, B. Zorn, and S. Gulwani, "User interaction models for disambiguation in programming by example", in *ACM Symposium on User Interface Software and Technology (UIST)*, 2015.
- [7] O. Polozov and S. Gulwani, "FlashMeta: a framework for inductive program synthesis", in *ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA)*, 2015.
- [8] O. Polozov, E. O'Rourke, A. M. Smith, L. Zettlemoyer, S. Gulwani, and Z. Popović, "Personalized mathematical word problem generation", in *International Joint Conference on Artificial Intelligence (IJCAI)*, 2015.
- [9] O. Polozov and S. Gulwani, "LaSEWeb: automating search strategies over semi-structured web data", in *ACM Conference on Knowledge Discovery and Data Mining (KDD)*, 2014.

### Preprints, technical reports, papers under review

- [10] D. Perelman, O. Polozov, A. Radhakrishna, A. Tiwari, and S. Gulwani, "Significant Inputs for Synthesizing Data Transformation Programs". Under review at *Computer-Aided Verification (CAV)*, 2018.
- [11] S. Padhi, P. Jain, D. Perelman, O. Polozov, S. Gulwani, and T. Millstein, "FlashProfile: Interactive Synthesis of Syntactic Profiles". *arXiv preprint arXiv:1709.05725*, 2017.
- [12] V. Le, D. Perelman, O. Polozov, M. Raza, A. Udupa, and S. Gulwani, "Interactive Program Synthesis". *arXiv preprint arXiv:1703.03539*, 2017.
- [13] O. Polozov, S. Gulwani, and S. Rajamani, "Structure and term prediction for mathematical text". Tech. Rep. MSR-TR-2012-7, 2012.

## EMPLOYMENT

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### Researcher

August 2017 – present

*Microsoft Research AI, Redmond, USA*

Working on the combination of symbolic and neural techniques for automatic program synthesis, as well as on various applications of it in developer assistance, tutoring systems, artificial intelligence, and data wrangling.

### Software Development & Research Contractor

October 2014 – April 2017

*Populus Group at Microsoft, Redmond, USA*

A founding member of the [Program Synthesis using Examples \(PROSE\)](#) R&D team at the Microsoft Data Group.

Developed the PROSE framework for automatic synthesis of data wrangling scripts from incomplete specifications (input-output examples, constraints, demonstrations). It unified and generalized 12+ prior publications (5 years of prior work) in the field of programming by examples, allowing one to develop a by-example technology in 10 weeks instead of 10 months. Its applications are deployed in multiple Microsoft products:

- FlashFill: string transformations by example in Excel,
- ConvertFrom-String and Convert-String cmdlets in PowerShell,
- Text extraction in Azure Operational Management Suite,
- Web & email processing in Exchange and Cortana.

I have been working with a team of 10+ researchers and engineers at Microsoft concurrently with completing my Ph.D.

### Research Intern

March 2014 – September 2014

*Microsoft Research, Redmond, USA*

Designed and developed a modular algorithmic framework for automatic synthesis of programs in domain-specific languages from inductive specifications. Generalizes 5 years of prior work in programming by examples done by the Sumit Gulwani's group and collaborators. This work became a foundation for the Microsoft PROSE team (see above).

### Research Intern

June 2013 – September 2013

*Microsoft Research, Redmond, USA*

Designed a declarative language and an efficient interpreter for designing search strategies for microsegment queries based on linguistic predicates and semi-structured data on the Web.

### Research Intern

June 2012 – September 2012

*Microsoft Research, Redmond, USA*

Developed a language and an algorithm for 2D data visualization by example and data extraction from semi-structured images.

### Software Development & Research Practice Intern

November 2011 – May 2012

*Yandex, Kyiv, Ukraine*

Built a dictionary-based morphological engine with inflection prediction for Russian, Ukrainian, and English.

### Software Development Intern

June 2011 – September 2011

*Microsoft, Redmond, USA*

Team: Office Labs

Built a home/work location prediction with further exploration of user scenarios for a mobile digital assistant.

## SKILLS

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### Programming

C#, C/C++, Python, Wolfram Language, Java, Scala, F#, AnsProlog, TypeScript/JavaScript

### Technologies

CNTK, TensorFlow, Potassco ASP toolkit, Z3 constraint solver, Rosette, Web development

### Theory

- Program synthesis, programming languages, software engineering
- Deep learning, recurrent, convolutional & graph neural networks, neuro-symbolic methods
- Answer set programming, SAT/SMT solving, formal logic
- Natural language processing: morphology, reference resolution, language generation

### Languages

English (fluent), Russian (native), Ukrainian (native)

## INVITED TALKS

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- **Program Synthesis via Neural-Guided Deductive Search**  
Invited talk at the *Machine Learning + Programming Languages Workshop 2018*.
- **Bringing Program Synthesis to the Mass Markets**  
*Approaches and Applications of Inductive Programming, Dagstuhl Seminar 2017*.
- **Data Processing Using Input-Output Examples with Microsoft PROSE SDK**  
**Creating Programming-By-Example Features in Arbitrary Domains with Microsoft PROSE SDK**  
A series of tutorials hosted as part of the *Machine Learning & Data Science Conference (MLADS) 2017*.
- **PROSE: Inductive Program Synthesis for the Mass Markets**  
Invited talk & Hackathon for graduate students at *UC Berkeley, January 2017*.
- **Automated Program Synthesis**  
Invited talk at the *Human-Like Computing Machine Intelligence Workshop (MI20-HLC), October 2016*.
- **PROSE: Growing Program Synthesis to Industrial Applications**  
*UW PLSE Research Retreat Workshop, September 2016*.
- **PROSE: Programming using Examples**  
Co-lectured with Sumit Gulwani. Invited tutorial at the *ACM SIGPLAN Conference on Programming Languages Design & Implementation (PLDI) 2016*.
- **Programming by Examples**  
Co-lectured with Sumit Gulwani at *Marktoberdorf Summer School 2015*.
- **Personalized Mathematical Word Problem Generation**  
*Approaches and Applications of Inductive Programming, Dagstuhl Seminar 2013*.

## SERVICE

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- **PC member:** IJCAI-ECAI 2018, GPCE 2018, ML4PL 2018
- **Ad-hoc reviewer:** Theoretical Computer Science Journal (2015), CAV 2018

## PATENTS

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- [1] Gulwani, S., Zorn, B.G., Singh, R., Marron, M., Polozov, O., Le, V.M., Mayer, M., Soares, G.A. and Grechkin, M., Microsoft Technology Licensing LLC, 2017. *User interaction models for disambiguation in programming-by-example*. U.S. Patent Application 14/853,925.
- [2] Gulwani, S., Polozov, O. and Tiwary, S.K., Microsoft Technology Licensing LLC, 2015. *Control of automated tasks executed over search engine results*. U.S. Patent Application 14/619,702.
- [3] Gulwani, S. and Polozov, O., Microsoft Technology Licensing LLC, 2015. *Parsing and rendering structured images*. U.S. Patent 9,031,894.

## TEACHING EXPERIENCE

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### CSEP 590C: Domain-Specific Languages

Spring 2016, Spring 2017

*Teaching Assistant & Lecturer*

Together with Prof. Rastislav Bodik and Pavel Panchekha, we co-designed and taught a graduate course on DSLs. Audience: professional software engineers with multiple years of industry experience. Course content includes foundations of compiler/interpreter development, a collection of well-known DSLs (D3.js, Mustache, Hadoop, React.js, Rx), program synthesis in PROSE, and lessons on DSL design.

### Functional Programming

2011 – 2012

*Lecturer*

Self-designed and taught an optional 2-semester course for undergraduate Applied Math students. Covered basic FP concepts, parallel programming with monoids and MapReduce, purely functional data structures, monads and type classes, lambda calculus.

Taught advanced algorithms and data structures for undergraduate ACM ICPC teams, with focus on performance and programming competitions.

## REFERENCES

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- Rastislav Bodik, professor:  
[bodik@cs.washington.edu](mailto:bodik@cs.washington.edu)
- Sumit Gulwani, partner research manager:  
[sumitg@microsoft.com](mailto:sumitg@microsoft.com)
- Pushmeet Kohli, senior scientist:  
[pushmeet@google.com](mailto:pushmeet@google.com)
- Danny Simmons, principal software engineer:  
[dsimmons@microsoft.com](mailto:dsimmons@microsoft.com)
- Rishabh Singh, research scientist:  
[rising@google.com](mailto:rising@google.com)
- Ben Zorn, principal researcher & research manager:  
[zorn@microsoft.com](mailto:zorn@microsoft.com)