

HOW SOFTWARE ENGINEERING BECAME MY CAREER

Dr. Katie Stolee
Assistant Professor
North Carolina State University



Where I've been

- 2004 – 2013 : B.S. (JDE -> Raikes), M.S., Ph.D. University of Nebraska-Lincoln



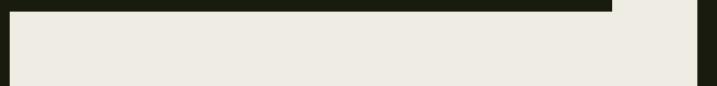
- 2013 – 2015 : Harpole-Pentair Assistant Professor at Iowa State University



- 2016 – present : Assistant Professor at North Carolina State University



WHY SOFTWARE ENGINEERING?



Semeste
r 1

- Java

Semeste
r 2

- C++

Semeste
r 3

- Algorithms
- Computer Organization

Semeste
r 4

- Software Engineering

SOFTWARE
ENGINEERING IS NOT
ABOUT
PROGRAMMING. IT'S
ABOUT PEOPLE.

SOFTWARE
ENGINEERING
RESEARCH IS ABOUT
PEOPLE, TOO.

PhD

NSF
Funded

How do developers use code search to support their development activities?

How can we automatically patch programs in a way that's natural to developers?

MS

How do developers use the Kodu language, and what is their development process?

NSF
Funded

What pain points do developers experience while working with regular expressions?

What is the impact of code smells on developer comprehension?

How can we increase the persistence of underrepresented groups in STEM fields?

Developers and code search - At Google



chromium
An open-source browser to help move the web forward.

Project Home Downloads Wiki Issues **Code Search**

Search code

Class: class:HashMap
Function: function:toString
Symbol: symbol:std::vector
Case Sensitive: No
Exact: exact:yes

Search with support

chromium
An open-source browser to help move the web forward.

Project Home Downloads Wiki Issues **Code Search**

regular expressions

Results 1 - 10 of 596 (0.597 seconds)

[chromium] src/v8/src/ast.h

v8::internal

```
794: void AstVisitor::VisitExpressions(2c
795:     for (int i = 0; i < expressions->length(); i++)
796:         // The variable statement visiting code has NULL expressions
797:         // to this code. Maybe this should be a warning?
```

806: // -----
807: // Regular expressions

```
934: // Convert regular expression trees to a more standard grammar
935: // This representation should be different from the regular grammar
```

[chromium] src/out/Debug/gen/devtools/inspec

```
1565: ... .Widget.__assert(!child._widget)
1567: ... .Widget.__assert(!child._widget)
<global>
3980: ... CSS.StyleSheetOrigin",{Injected:"injected",UserAgent:"user-agent",Inspector:"ins
```

4603: {return this.origin === "injected"},get isViaInspector()
4604: {return this.origin === "inspector"},get isRegular()
4605: {return this.origin === "regular";}}

Smart report per result
A code preview
Cross-reference
d

Developers and code search

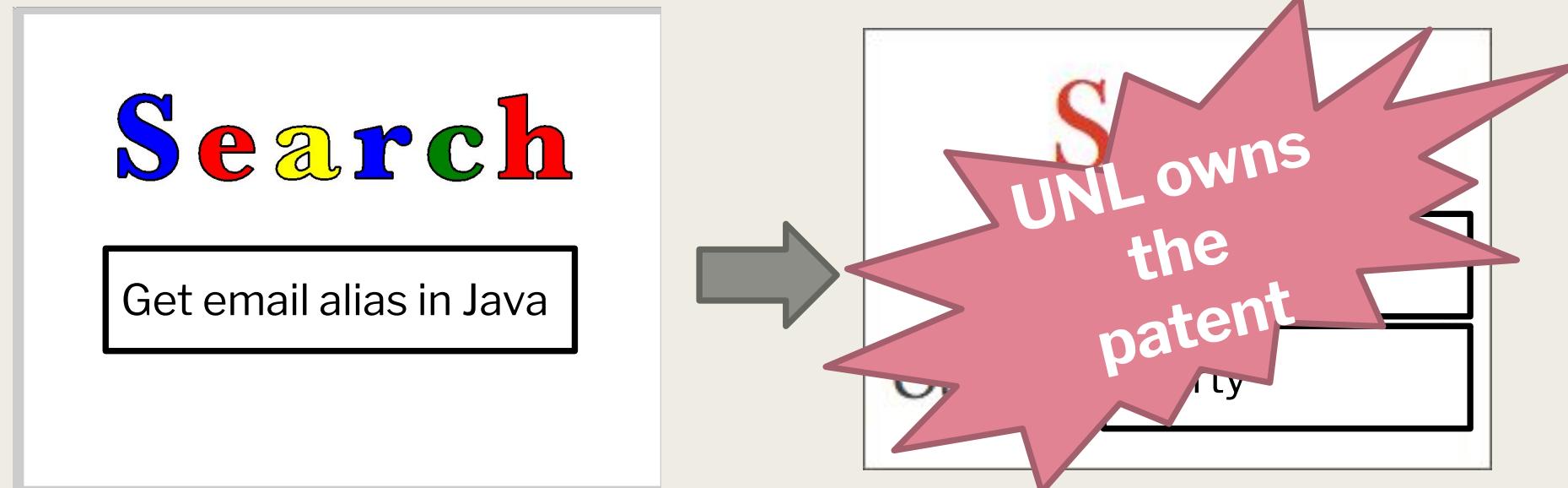
- In the wild



- Code search queries are *linguistically* different
- Code search queries *take more effort* for task completion

Code search is different than information search.

Developers and Code Search



Satsy often returns more relevant search results than Google!

How do developers use code search to support their development activities?

How do developers use the Kodu language, and what is their development process?

What is the impact of code smells on developer comprehension?

How can we automatically patch programs in a way that's natural to developers?

What pain points do developers experience while working with regular expressions?

How can we increase the persistence of underrepresented groups in STEM fields?

How do developers use code search to support their development activities?

How do developers use the Kodu language, and what is their development process?

What is the impact of code smells on developer comprehension?

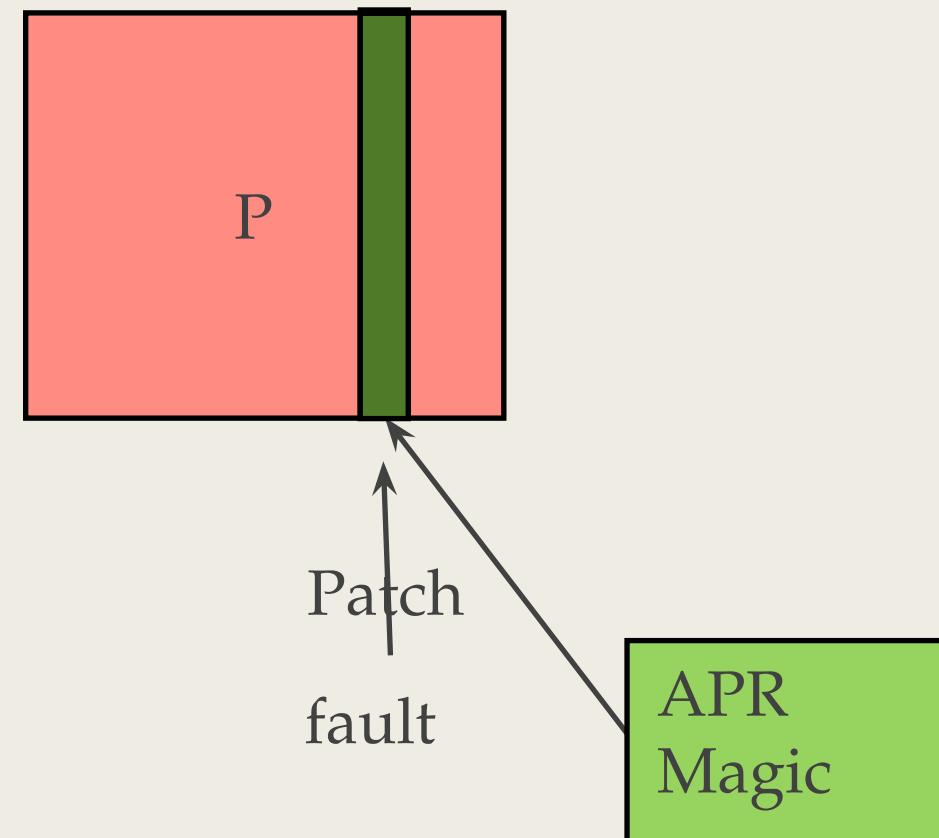
How can we automatically patch programs in a way that's natural to developers?

What pain points do developers experience while working with regular expressions?

How can we increase the persistence of underrepresented groups in STEM fields?

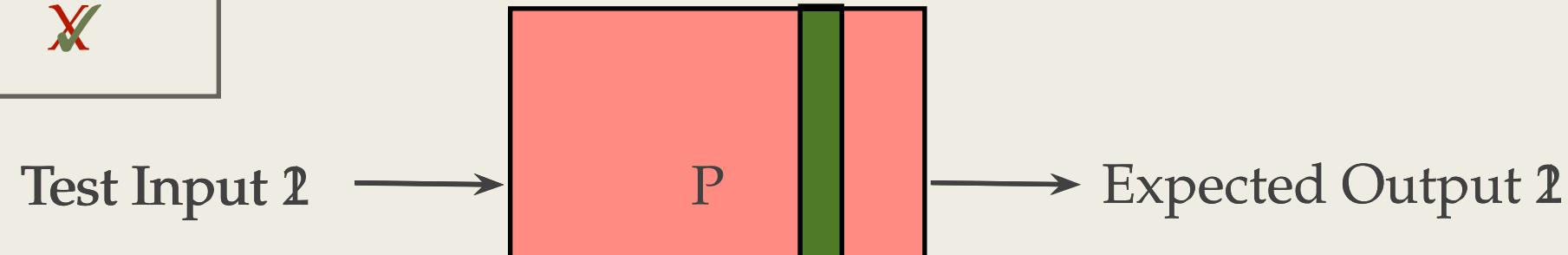
Automated Program Repair

Test Suite
Test Case 1 ✓
Test Case 2 ✗

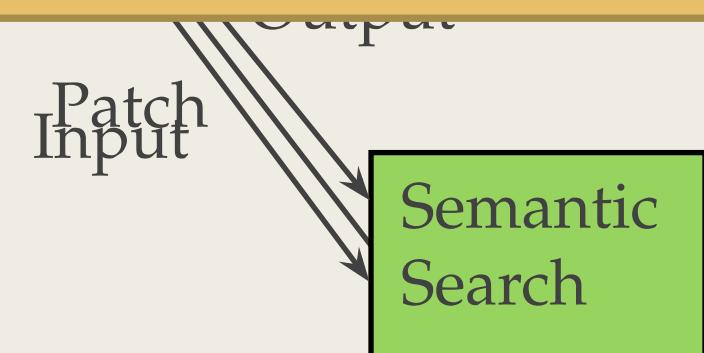


My Automated Program Repair

Test Suite
Test Case 1 ✓
Test Case 2 ✗



Produces patches of *measurably* higher quality than prior approaches



My Automated Program Repa



Patch
(inserted code)
for Python bug
#69223

```
if (n < 0) {  
    PyErr_SetString(PyExc_ValueError,  
        "read length must be positive");  
    return NULL;  
}
```

How do developers use code search to support their development activities?

How do developers use the Kodu language, and what is their development process?

What is the impact of code smells on developer comprehension?

How can we automatically patch programs in a way that's natural to developers?

What pain points do developers experience while working with regular expressions?

How can we increase the persistence of underrepresented groups in STEM fields?

Developers and Regular Expressions



- **Survey:** Pain Points
 - *Difficult to read and maintain*
 - *Tricky to write correctly*

- **Experiment:** Comprehension
 - *Use This: [1-9][0-9]?[0-9]?*
 - *Not That: [1-9][0-9]{0,2}*

[Chapman and Stolee. "Exploring Regular Expression Usage and Context in Python." ISSSTA 2016.]

[Chapman, Wang, and Stolee. "Understandability Smells in Regular Expressions." ASE 2017.]

OTHER RESEARCH IS
ABOUT PEOPLE,
TOO.

How do developers use code search to support their development activities?

How do developers use the Kodu language, and what is their development process?

What is the impact of code smells on developer comprehension?

How can we automatically patch programs in a way that's natural to developers?

What pain points do developers experience while working with regular expressions?

How can we increase the persistence of underrepresented groups in STEM fields?

Persistence in Computer Science

To: Student
From: Instructor
Subject: Test 1 Grade

- Simple intervention:

“You got a 92% on Test 1! Congratulations! Since average grades in STEM courses tend to be lower than in other university classes, I wanted to make sure that you know that you are a top performer in the class! **You scored in the top 10%, and earned the 8th highest score in the class!** Keep working hard! I know that you have what it takes to be successful in Computer Science!”

- Promising results among high performers:

- *Increases in all students' self-assessments of CS ability*
- *Increased female CS persistence intentions*



UNL IS ABOUT PEOPLE

....grit and glory, too

2004-2008: Raikes School



Raikes Community, beyond UNL

Vancouver,
Canada.
2009



Minneapolis,
MN.
2013



Seattle,
WA.
2010



Oxnard,
CA.
2012

E² Lab 2008 - 2013



PhD Advisor



Banff, Canada.
2011



Zurich, Switzerland,
2012



Lincoln, NE, USA.
2013



Gothenburg, Sweden.
2018



Buenos Aires, Argentina.
2017

Collaborators



Honolulu, Hawaii.
2011



Zurich, Switzerland.
2012

UNL and CSE have been there for it all



My daughter's birth day,
2011



3rd Birthday, a "Go Big Red" party

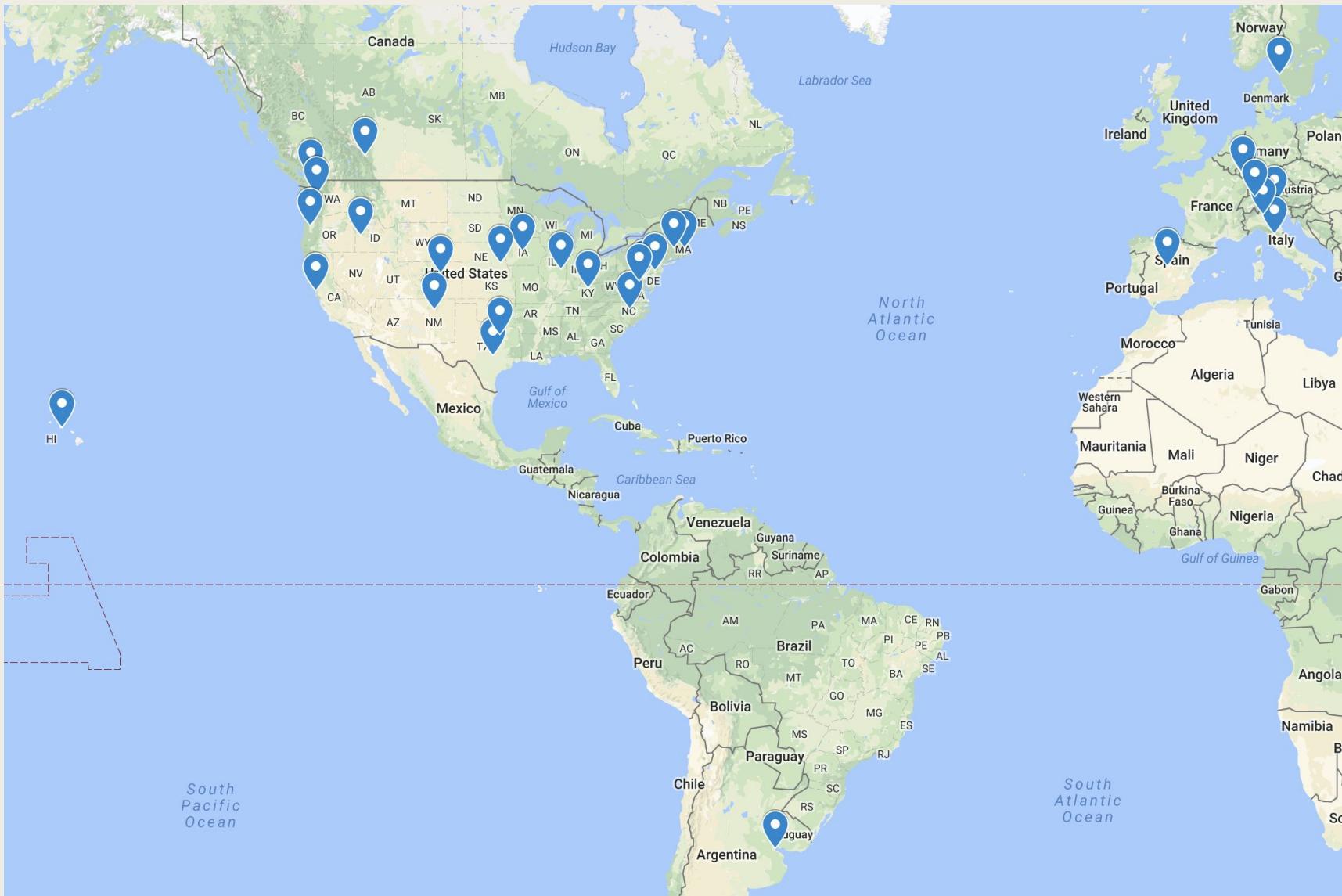
UNL HAS PAVED
THE WAY



I've had some success

- \$1.7 million in grants and contracts
- NSF CAREER award
- 25+ conference and journal publications
- 1 best paper award

I've seen the world



I've learned a few things

- **Undergrads:** Get to know your professors, and let them get to know you.
- **Grad students:** You are not in competition with those around you. Support your peers. These are long-lasting relationships.
- **Faculty:** Invest in your students and celebrate their successes as your own.
- **Alums:** Keep in touch with your professors. We also think about you!

THANKS!

- **Funding:**

- [2018-2023] NSF CAREER #1749936: *On the Foundations of Semantic Code Search*
- [2016-2020] NSF SHF Medium #1645136: *Collaborative Research: Semi and Fully Automated Program Repair and Synthesis via Semantic Code Search*
- [2014-2016] NSF SHF EAGER #1446932: *Collaborative Research: Demonstrating the Feasibility of Automatic Program Repair Guided by Semantic Code Search.*

- **All the people in the photos**