

# Challenges for technology transfer – industry to academia

Judith Bishop

Director of Computer Science

[jbishop@microsoft.com](mailto:jbishop@microsoft.com)





# Prof. Judith Bishop

## Microsoft Research

### Academia

Software Engineering

Programming Languages

*Hon. Prof. Univ. Cape Town*

### Career

South Africa until June 2009

Microsoft Research, Redmond

### Microsoft Research

Software Engineering

Concurrency

F# in Education

Programming on a phone

### Community

ACM (Coalition and CSEdweek)

IFIP WG2.4

Conference chairing and reviewing

Keynotes worldwide



# Technology Transfer



# Some History

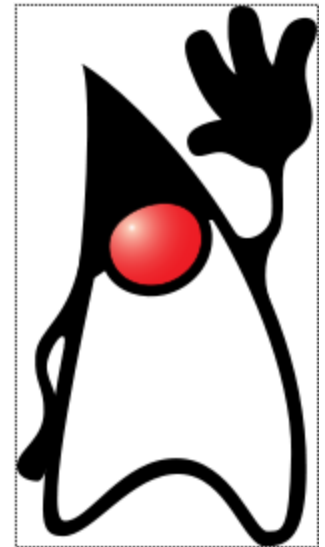
➤ **Eclipse** software development environment with its extensible plug-in system.

- From IBM Canada, 2001
- Now in a Foundation
- Free and open source under its own licence
- Strong community base



➤ Java programming language and its run-time platform

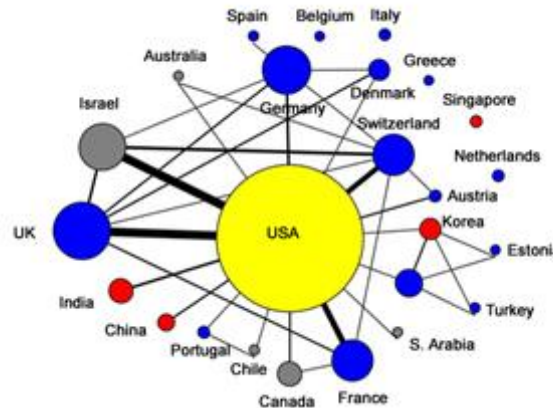
- From Sun Microsystems in 1995
- Now with Oracle
- Free and Open Source under GNU public license
- Strong research, education and developer base
- Part of browser technology



# Why Technology Transfer to Universities

## ➤ Why?

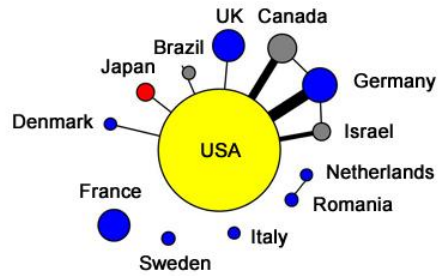
- Expand a lab's research base from 100s to 10,000s
- Verify the work in practice
- Launch new applications



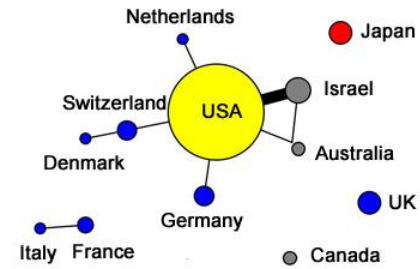
- Influence tomorrow's leaders



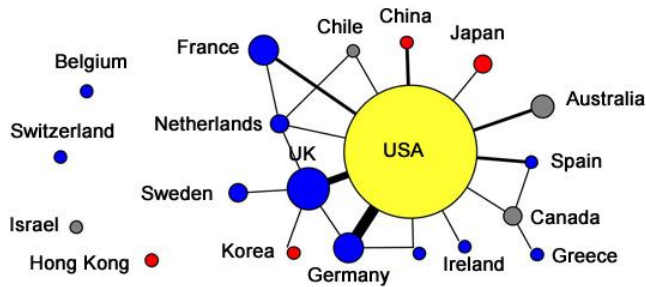
# Mapping Collaboration Networks in 'Programming' Conferences



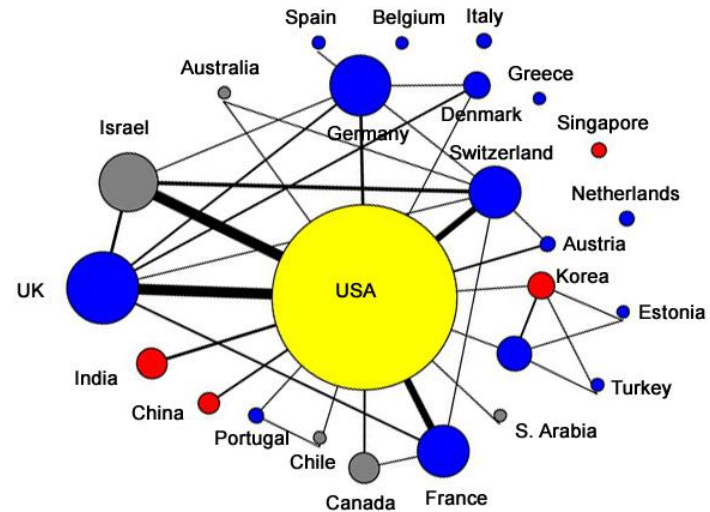
1996



2001



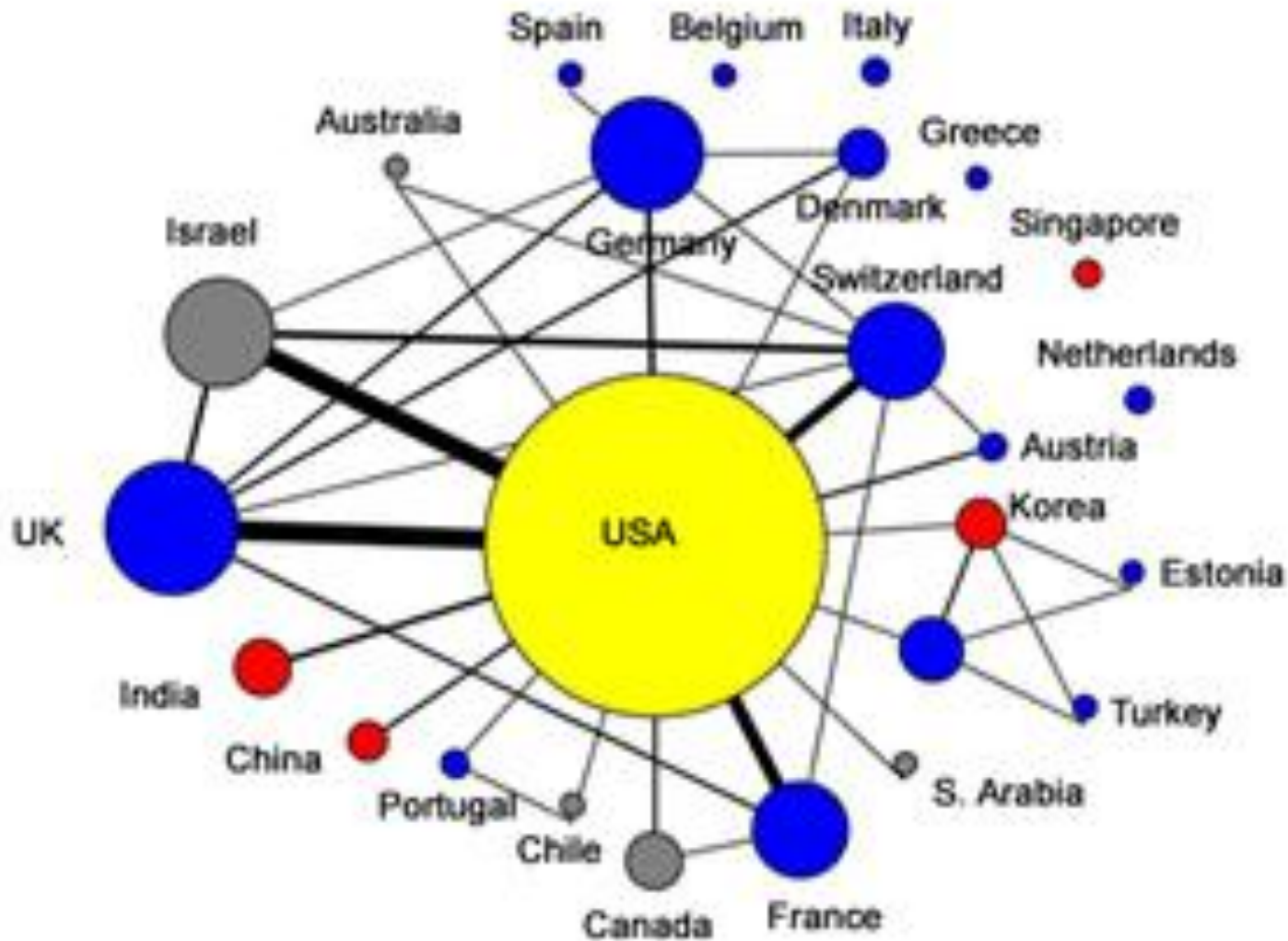
2006



2011

\* Circle size represents number of publications authored by each country. Lines between countries indicate publication co-authorship. Line width indicate the degree of collaboration (wider = more collaborations). Conferences analyzed include PPOPP, POPL, PLDI, and OOPSLA.

# PL Collaboration 2010



# Top 12 CS Research Organizations



Advanced Search

- Author »
- Publication »
- Conference »
- Journal »
- Organization »
- Keyword »

Academic > Top organizations in Computer Science

1 - 100 of 9,599 results

Computer Science Overall for Computer Science All Years All Continents

Organization	Publications	H-Index
Stanford University	35354	327
University of California Berkeley	32888	315
Massachusetts Institute of Technology	36272	312
Microsoft	36967	303
Carnegie Mellon University	38826	272
IBM	47624	261
Princeton University	11242	211
Cornell University	13488	208
University of Illinois Urbana Champaign	26523	204
AT&T Labs Research	9471	203
University of Washington	15524	202
Google Inc.	9459	192



# Top 12 PL organizations last 5 years

Advanced Search

Academic > Top organizations in Programming Languages

1 - 100 of 1,703 results

Computer Science

Programming Languages

Last 5 Years

All Continents

Organization

Publications

H-Index

[Microsoft](#)

574

31

[IBM](#)

434

18

[The french National Institute for Research in Computer science and Control](#)

303

18

[University of California Berkeley](#)

170

18

[Carnegie Mellon University](#)

295

17

[Massachusetts Institute of Technology](#)

188

17

[University of Oxford](#)

178

17

[Stanford University](#)

87

17

[University of Texas Austin](#)

158

16

[Intel Corporation](#)

113

16

[Georgia Institute of Technology](#)

125

15

[University of California San Diego](#)

101

15

# What to Transfer?

## ➤ What?

- Research technology and tools
- NOT basic software

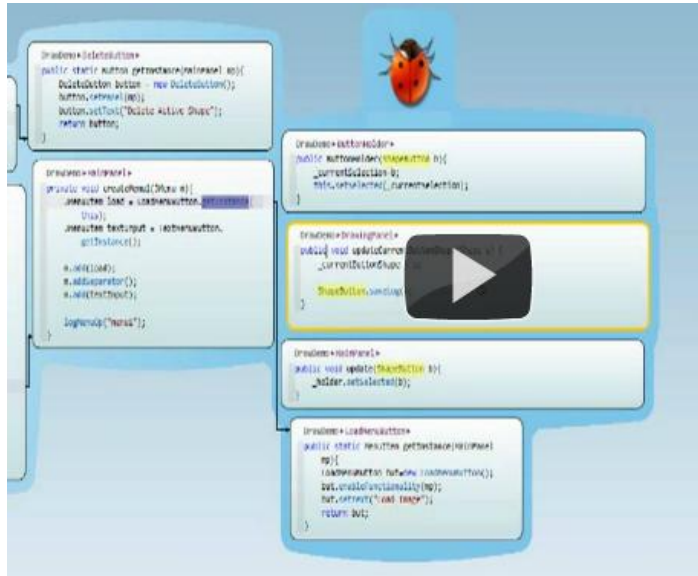
## ➤ Basic challenges

- Platform suitability
- Timeliness
- Training
- Support
- Community building


## ➤ Overcoming these challenges

- Browser based software
- SDKs

# Unique, Best Software Tools



NOT



## Why upgrade to Visual Studio 2010?

Discover all the benefits of upgrading here.



NOT



# Types of software

➤ For language implementations, we see three types:

1. Only a browser, e.g., Explorer, Firefox, Safari

2. A platform and language(s), e.g., a CLI implementation and C# or F#

3. An integrated development environment (IDE), e.g., Visual Studio or Eclipse

# Browser based software

## Sandbox Approach

- Download a Silverlight/ Moonlight control with a complete compiler
- All interaction directed to the control from the browser
- Computation on client
- Con: Effort to create the system
- Pro: No additional hardware needed

## Server Approach

- Maintain a server (or cloud) presence
- All interaction directed to the server from the browser
- Computation on server
- Con: Scalability issue
- Pro: Can gather data on usability



# www.tryfsharp.org



About / Tutorials / Tools & Resources / What Experts Say / Feedback



### Building Rich User Interfaces

```
Canvas.SetTop(label, 20.0)
Canvas.SetLeft(label, 20.0)

let updateLabel() =
    label.Text <- string System.DateTime.Now
updateLabel()

let timer = new DispatcherTimer()
timer.Interval <- new System.TimeSpan
(0,0,0,1)
timer.Tick.Add(fun args -> updateLabel())
timer.Start()

App.Dispatch (fun() ->
    App.Console.ClearCanvas()
    App.Console.CanvasPosition <-
    CanvasPosition.Right
    clock2 ()
)
```

[load & run ▶](#)

#### A fancier clock

Since Try F# is built in Silverlight, the full power of the Silverlight platform is available. As an example, consider the clock sample from the Silverlight SDK after it has been ported to F#.

[load ▶](#) [run ▶](#)

Don't forget to click the Run button after the file has finished loading.

```
// Silverlight Clock sample implemented and running in the browser
// http://code.msdn.microsoft.com/silverlightsdk
//
open System
open System.Windows
open System.Windows.Controls
open System.Windows.Markup
open System.Windows.Media
open System.Windows.Media.Animation
open System.Windows.Shapes
open Microsoft.TryFSharp

let buildClockUI (canvas:Canvas) =
    let xaml = "
```

[run](#)

```
> // Silverlight Clock sample implemented and running in the browser
// http://code.msdn.microsoft.com/silverlightsdk
//
open System
open System.Windows
open System.Windows.Controls
open System.Windows.Markup
open System.Windows.Media
open System.Windows.Media.Animation
[... and 115 more line(s)]

val buildClockUI : System.Windows.Controls.Canvas -> unit
>
```



Don Syme, Dean Guo, Christophe Poulain, Joe Pamer, Laurent le Brun, Nigel Horspool, Judith Bishop, 2010

# Try F# Demo

facebook 3 2 Search

## try F#

Computers · [Edit Info](#)

Wall TryFS

Share: [Status](#) [Photo](#) [Link](#) [Video](#) [Questi](#)

Write something...

**TryFSharp** created an event.

**# in Education Workshop, Nov 5, 2010**  
Wednesday, December 29, 2010 at 9:00am  
Cambridge, Massachusetts

1,430 Impressions · 0.28% Feedback

[31](#) Like · [Comment](#) · [Share](#) · December 29, 2010 at 2:08p

[3](#) people like this.

**About** [Edit](#)

TryFSharp.org will bring F#, a multi-paradigm programming language, to all...

More



# www.Pex4fun.com

- Pex - Visual Studio 2010 Power Tool developed by Microsoft Research to help unit testing of .NET applications.
  - Can be launched from the command line and run as Type 2 or Type 3 software.
- Pex4Fun is a radically simplified version of the fully featured Pex accessed via a browser and all the work happens on one of Microsoft Research servers
  - Creates a game out of unit testing by providing existing or user entered code puzzles in C#, Visual Basic, or F#
  - Users determine from the unit tests what code needs to be added or changed.

[Nikolai Tillmann](#)  
[Peli de Halleux](#)  
[Wolfram Schulte](#)  
[Nikolaj Bjørner](#)



648,740 clicked 'Ask Pex!'

# Pex4Fun Demo

[My Duels](#) | [Settings](#) | [Sign In](#)

Pex



for fun

Random Puzzle

Learn

New

556,385 clicked 'Ask Pex!'

C#

Visual Basic

F#

The code is a puzzle. Do you understand what the code does? Click **Ask Pex!** to find out.

```
using System;
using System.Linq;

public class Program {
    // What numbers reveal the secret? Ask Pex to find out!
    public static void Puzzle(int[] numbers) {
        var filteredNumbers =
            from n in numbers
            where n == 42
            select n;
        if (filteredNumbers.Count() > 0)
            Console.WriteLine("found secret");
    }
}
```

**Ask Pex!**

Done. 5 interesting inputs found. [How does Pex work?](#)

[Permalink](#)

	numbers	Output/Exception	Error Message
✘	null	ArgumentNullException	Value cannot be null. Parameter name: source
✔	{}		
✔	{0}		
✔	{42}	found secret	
✔	{0, 0}		



**Pex and Moles** on Facebook



You like this.



Tweet



# Rise 4Fun

## Research in Software Engineering (RiSE)

**RiSE** coordinates Microsoft's Research in Software Engineering in Redmond, USA. Our mission is to advance the state of the art in Software Engineering and Programming Languages, and to bring those advances to Microsoft's business.



The screenshot shows a web browser window with the URL <http://rise4fun.com>. The main heading is "RiSE4fun" with the text "Gave 348 answers!" below it. A row of tool buttons includes Agl, Bek, Boogie, Code Contracts, Concurrent Revisions, Dafny, Esm, Fine, Pex, Rex, Spec#, Vcc, and Z3. A prompt says "Click on a tool to Load the next sample." Below this is a code editor containing a Dafny program snippet:

```
(declare-funs ((a BitVec[4]) (b BitVec[4])))  
(assert (not (iff (bvumul_noovf1 a b) (= (bv2int[Int] (bvmul a b)) (* (bv2int[Int] a) (bv2int[Int] b))))))
```

At the bottom, there is a "Ask Z3!" button and the text "Is this formula satisfiable? Ask Z3!". Social media sharing options for "Tweet" and "75 people" are also visible.

<http://rise4fun.com>, our tools in **your** browser.



[see all...](#)

Using video clips  
on Channel9



# 3. Software Development Kits

➤ Used for access to

- Proprietary hardware and their drivers
- Large proprietary data

[Research.microsoft.com/cs](http://Research.microsoft.com/cs)

## Project Hawaii

- On WP7
- Executes in the cloud
- OCR, Speech to text etc
- WP7 phones loaned to universities worldwide
- C#

## Kinect SDK

- Drivers and rich APIs for raw sensor streams and human motion tracking
- Kinect unit is \$150
- C++, C#, VB

## Web-NGram

- Content and model types
- N-gram availability to 5
- Training size: *All* documents indexed by Bing in the en-us market
- Updated Periodically

Arjmand Samuel, Stewart Tansley, Evelyne Viegas

# On to Mobile

## TouchDevelop



## Programming is changing

- Instead of keyboards, advanced touchscreens
- Mobile devices equipped with more sensors, location information and acceleration, and connected to the cloud.
- TouchDevelop has built-in primitives which make it easy to access the rich sensor data available on a mobile device

# Example

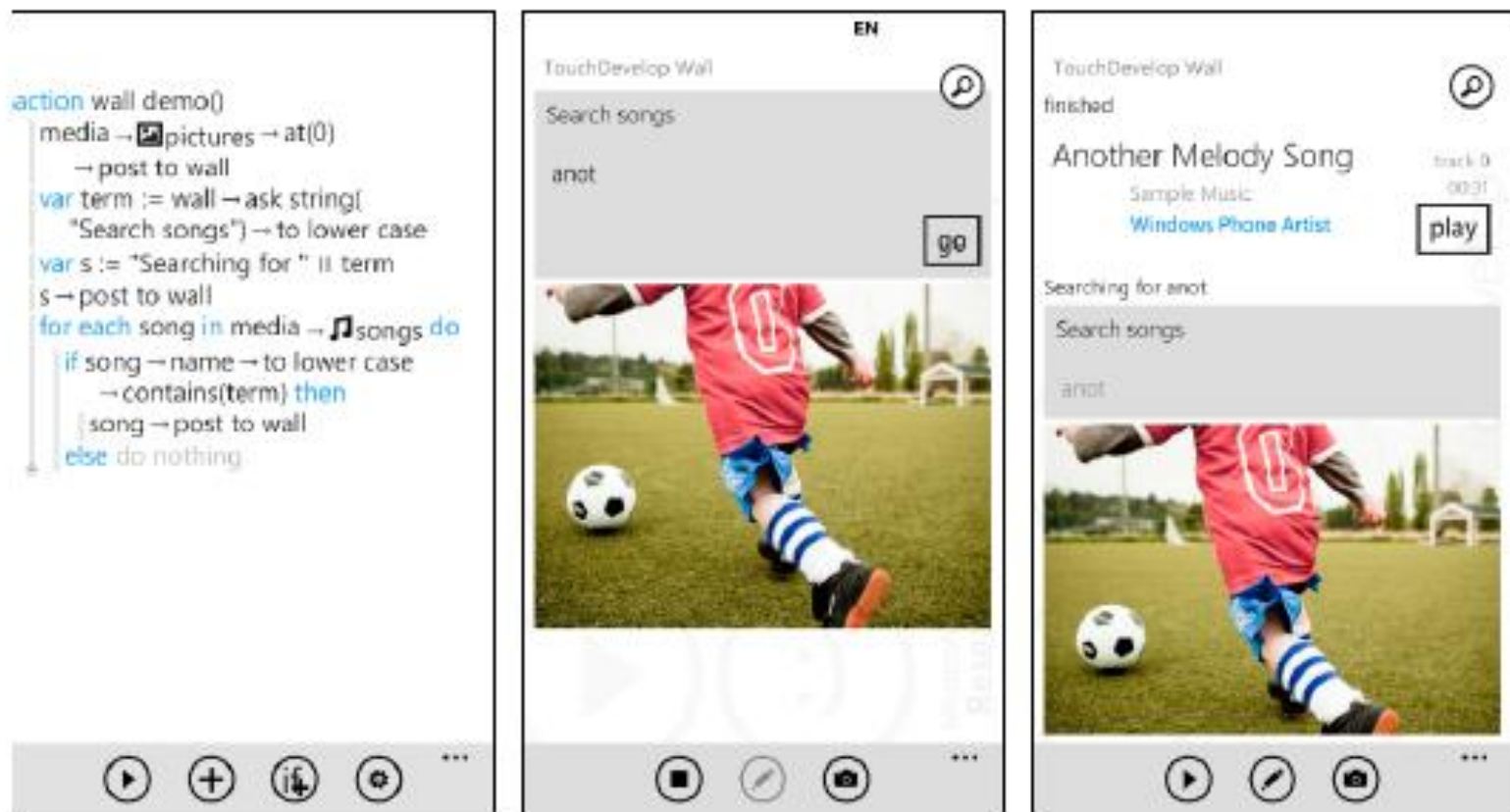


Figure 5: Capabilities of wall. (left) Action that pops up input box and posts a few things to the wall: a string, a song, and a picture. (middle) Input box. (right) The wall after executing the action.

# Security

- Submission of apps to WP Marketplace is gated: they have to be approved
- TouchDevelop scripts are light-weight and are shared in a Bazaar
- A transparent privacy control approach uses automatic static analysis to reveal to the user how private information is used inside an application

The screenshot displays four app listings from the Windows Phone Marketplace. Each listing includes an icon, the app name, the developer's name, the release date, and a star rating.

App Name	Developer	Release Date	Rating
clock	jonholt jd	54 days ago	★★★★★
Photoframe	Alex Karamushko	38 days ago	★★★★☆
avalanche	Grant Bronsdon	66 days ago	★☆☆☆☆
access my songs	Nuttakit Chlongjun	24 days ago	☆☆☆☆☆

# Conclusion - best practices

- Technology transfer to academia by moving to
  - Browsers
  - SDKs
  - Phones
- Encouraging community through social media
  - Scoreboards
  - Facebook
  - Forums
- Writing accompanying teaching material
  - Online tutorials
  - Books
  - Videos