

Bridging Academia and Industry Using Open-Source Software

Stephen R. Aylward, Ph.D.

Senior Director of Operations and Medical Research



The professor...



...and his students



Bob (the “perfect” student)





Bob
graduates



I cannot find
Bob's code.





Bob's code
won't
compile





I cannot
replicate
Bob's
results





I emailed Bob
a question,
but he hasn't
responded

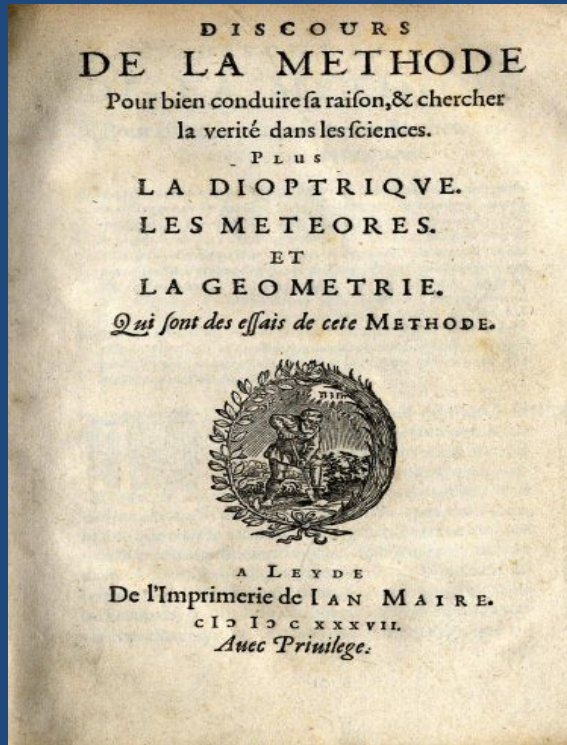


The open-source “attitude” is the answer

*Focus on writing code
that other people can use
and will want to use.*

Open Science

Science must be reproducible



**Discourse
on the (Scientific) Method**

--

Descartes 1637

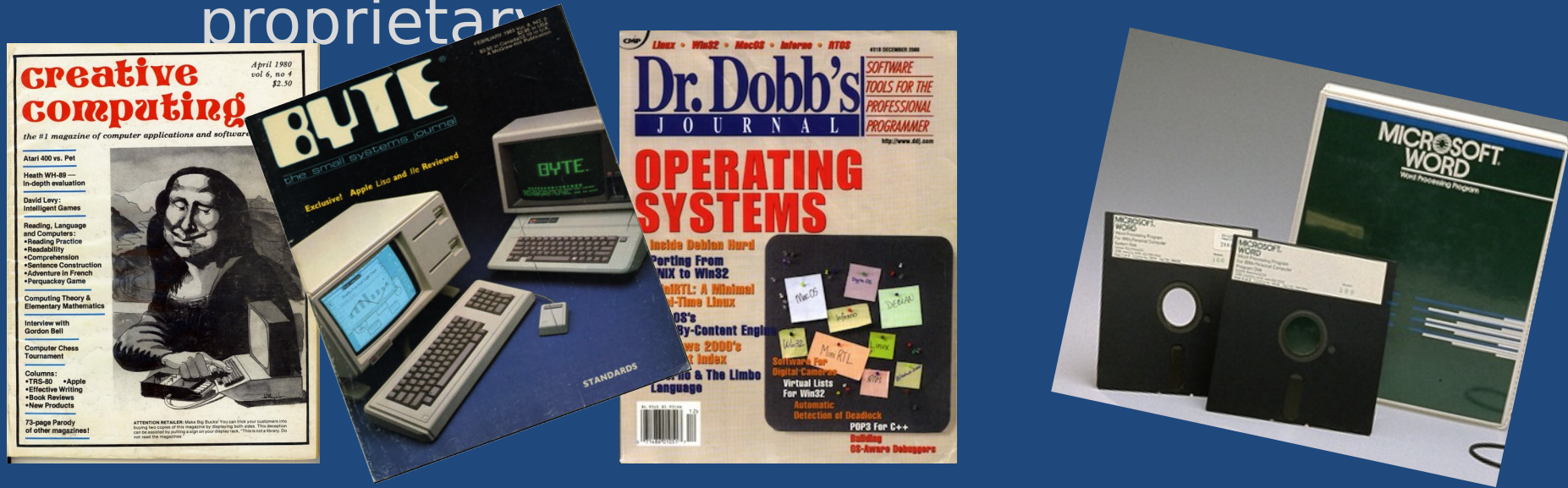
**“DOUBT EVERYTHING and
only believe in those
things that are evidently
true (reproducible)”**

Outline

- History
- Methods
- Bridges and research

History of open source

- 1970's Open source was the norm
- 1980's Almost all software was proprietary



History of open source

- 1983 GNU forced cooperative software development



“Copyleft”

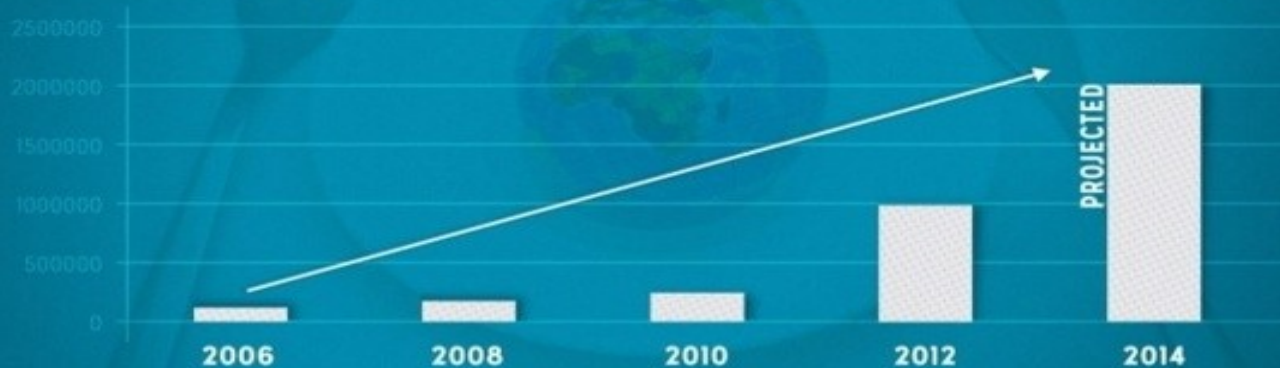
History of open source

- Now Open source permeates academia and industry
 - BSD-style license
 - Platforms: Android, Linux
 - Tools: MySQL, CMake
 - Technologies: ITK, VTK, Slicer



History of open source

OPEN SOURCE IS EATING THE SOFTWARE WORLD



OVER 1 MILLION UNIQUE OPEN SOURCE PROJECTS TODAY

Over 80% of commercial software contains open source.

History of open source

VTK, ITK,
CMake, Slicer,
ParaView

= 130,000++
downloads
per month



World of Warcraft



Excuses

“I’d rather spend my time on things that will help me...

publish

finish my
dissertation

write a
proposal

start my
company

sell my
company

Make
\$1,000,000





The open-source “attitude” is the answer

“Who ever has the most ideas
stolen, wins.”

-- Dr. Fred

Brooks

Impact

- An Object-Oriented Approach To 3D Graphics (Schroeder)
 - 3,065 Citations
- The ITK Software Guide (Yoo)
 - 1,039 Citations
- Object-oriented modeling and design (Lorensen)
 - 10,089

3D Slicer: 179,000 downloads



Failure of Reproducibility

Nature (March 2012)

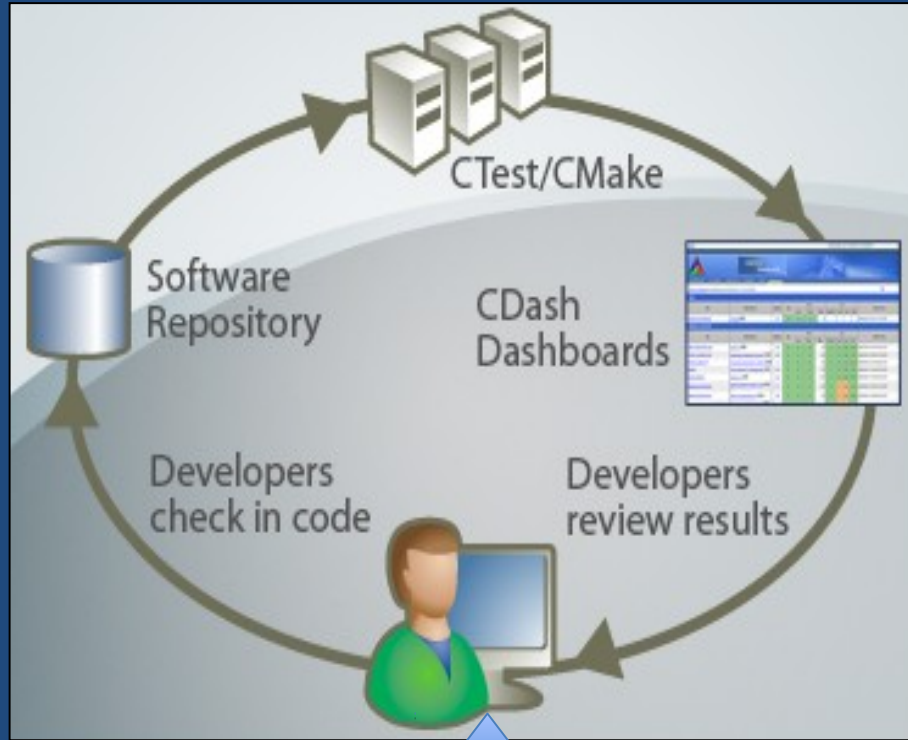
Glenn Begley, head of cancer research at pharma giant Amgen

Lee M. Ellis, cancer researcher at the University of Texas

“During a decade as head of global cancer research at Amgen, Glenn Begley identified 53 'landmark' publications — papers in top journals, from reputable labs — for his team to reproduce. Begley sought to double-check the findings before trying to build on them for drug development. Result: 47 of the 53 could not be replicated.”

Methods of Open Source

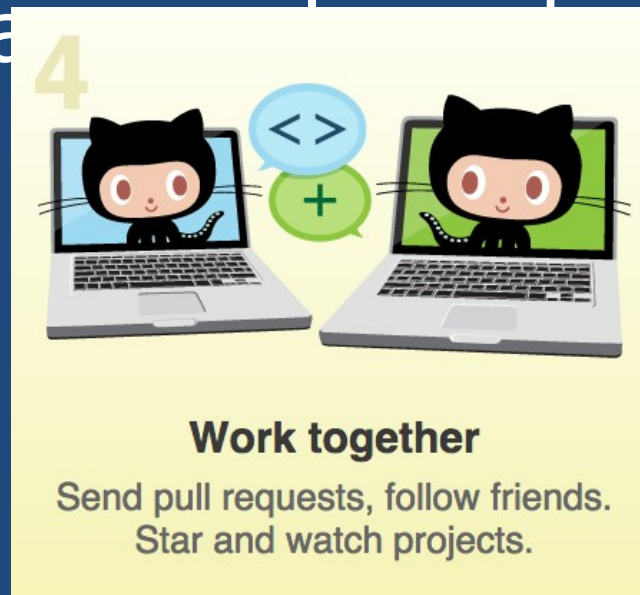
High-quality software processes...



Tools for the Open-Source Attitude

GITHUB as a software
repository...

“Release often.”



Tools for the Open-Source Attitude

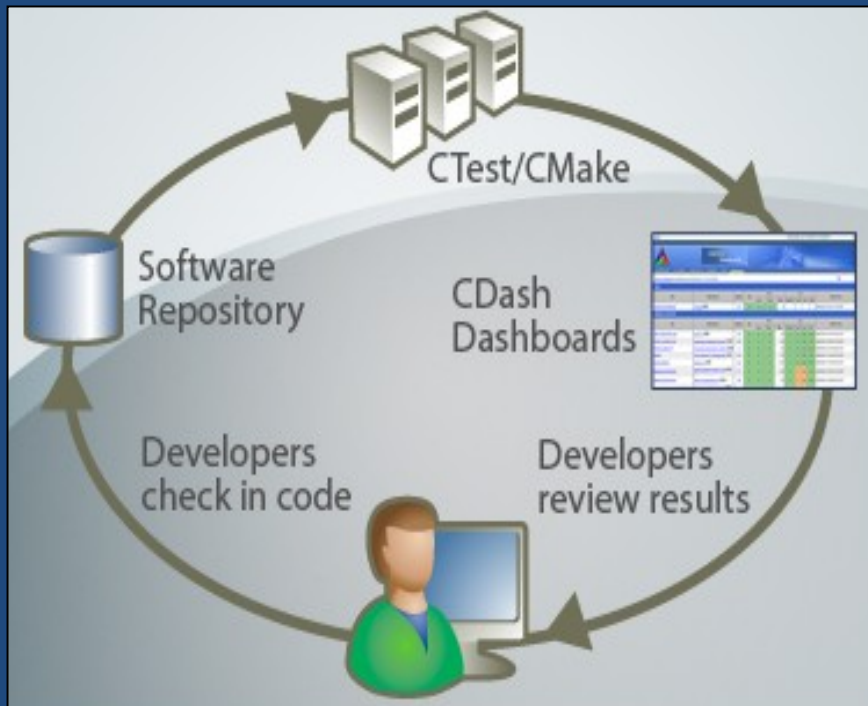
“Test driven development.”

“Continuous reporting of results.”

**CMake &
CDash**

	Build Name	Update	Configure		Build		Test		
		Files	Error	Warn	Error	Warn	Not Run	Fail	Pass
	🍏 MacOSX10.8.2-gcc4.2.1 🗨️📁	11	0	0	0	0	0	15	199
	🐧 Ubuntu12.04-gcc4.6.3 🗨️📁	12	0	0	0	1596 ⁺¹ _{.5}	0	80 ⁺⁷	141
	🍏 MacOSX10.8.2-gcc4.2.1 🗨️📁	1	0	0	0	0	0	15	199
	🐧 Ubuntu12.04-gcc4.6.3 🗨️📁	1	0	0	0	0 _{.123}	0	80 _{.1}	141
	🍏 MacOSX10.8.2-gcc4.2.1 🗨️📁	1	0	0	0	0	0	15	199
	🐧 Ubuntu12.04-gcc4.6.3 🗨️📁	1	0	0	0	0	0	10 _{.7}	211
	🍏 MacOSX10.8.2-gcc4.2.1 🗨️📁	1	0	0	0	0	0	15	199





Industry and academia are converging...

- Open source is a conduit from academia to industry: ideas and people
- Reduces development time, expertise, risks, and costs
- No recurring licenses
- Lifecycle from prototype to production

Proprietary applications and methods

Open source

Proprietary hardware: MRI, Phone

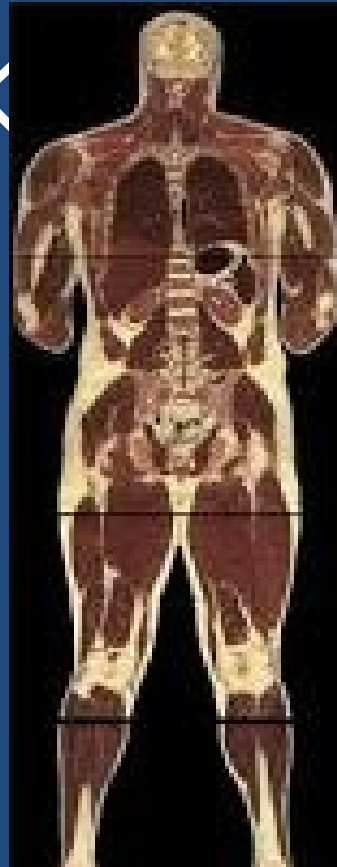




The Insight Toolkit (ITK)

1999: NLM organized \$13.5M
for ITK

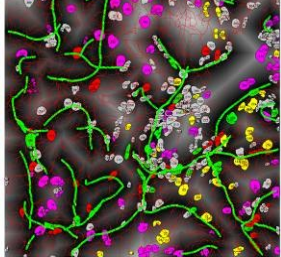
- GE Research / Harvard
- Kitware, Inc.
- Insightful / UPenn
- UNC / UPitt
- UPenn / Columbia
- University of Utah
- Mayo Clinic
- Harvard / Brigham and Women's Hospital
- Cognita, Inc.
- Imperial and King's College London
- University of Iowa
- Georgetown University
- Carnegie Mellon University





2014: ITK is the dominant toolkit for medical image segmentation and registration

- 1.5M lines of code
- Estimated at 452 years of effort



Thank you...

*Focus on writing code
that other people can use
and will want to use.*

