Dark Matter, Public Health, and Scientific Computing

Greg Wilson

software carpentry

“Dark Matter Developers”

Scott Hanselman (March 2012)

[We] hypothesize that there is another kind of developer than the ones we meet all the time. We call them Dark Matter Developers. They don't read a lot of blogs, they never write blogs, they don't go to user groups, they don't tweet or facebook, and you don't often see them at large conferences... [They] aren't chasing the latest beta or pushing...limits, they are just producing.

http://www.hanselman.com/blog/DarkMatterDevelopersTheUnseen99.aspx

I'm Not That Optimistic

- 90% of scientists have their heads down
  - Doing science instead of talking about using GPU clouds to personalize collaborative management of reproducible peta-scale workflows
- Not because they don't *want* to do all that Star Trek stuff
- But because e-science is out of reach

Shiny Toys

Grimy Reality

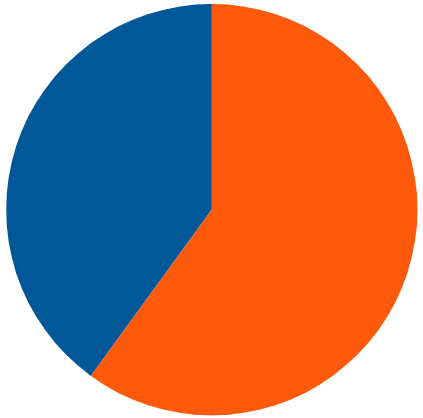
So Here We Are

You

Them

Surely You're Exaggerating

1. How many graduate students write shell scripts to analyze each new data set instead of running those analyses by hand?



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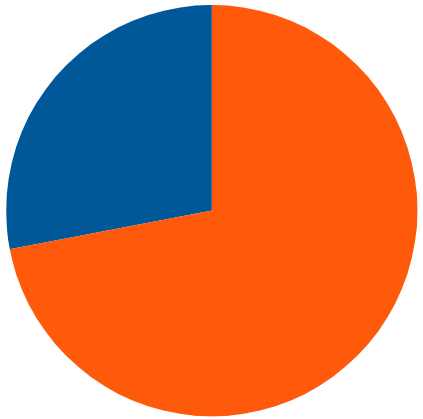
2. How many of them use version control to keep track of their work and collaborate with colleagues?



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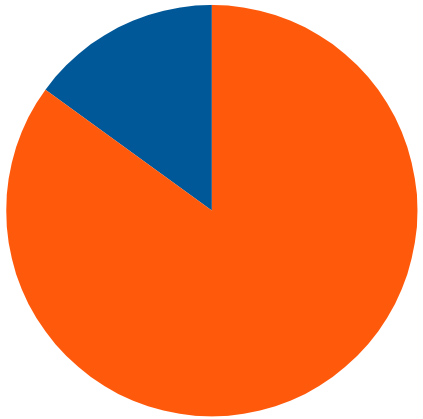
3. How many routinely break large problems into pieces small enough to be
   - comprehensible,
   - testable, and
   - reusable?



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3. How many routinely break large problems into pieces small enough to be
   - comprehensible,
   - testable, and
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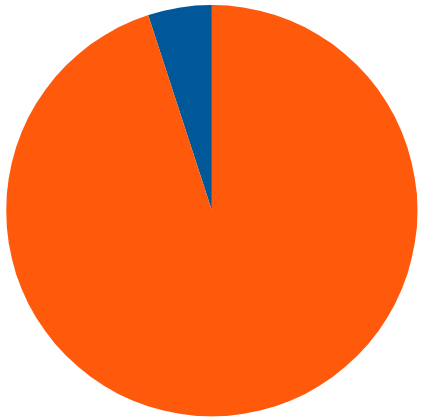
   And how many know those are the same things?



“Not My Problem”

Actually your *biggest* problem

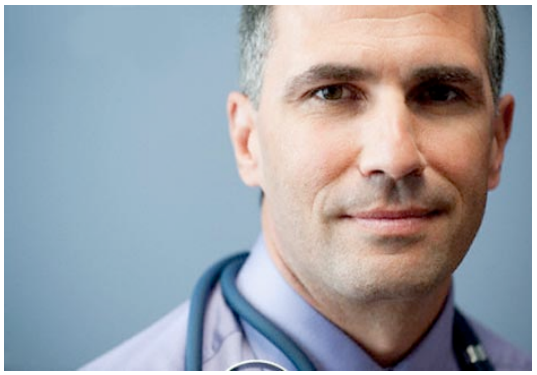
If someone is chronically malnourished as a child, giving them a CT scanner when they're 20 has no effect on their wellbeing.

Their Biggest Problem Too

Them

“I don't know much about this, but I'd like some clean water.”

Us



“Let's talk about brain scans. They're cool.”

We've Left the Majority Behind

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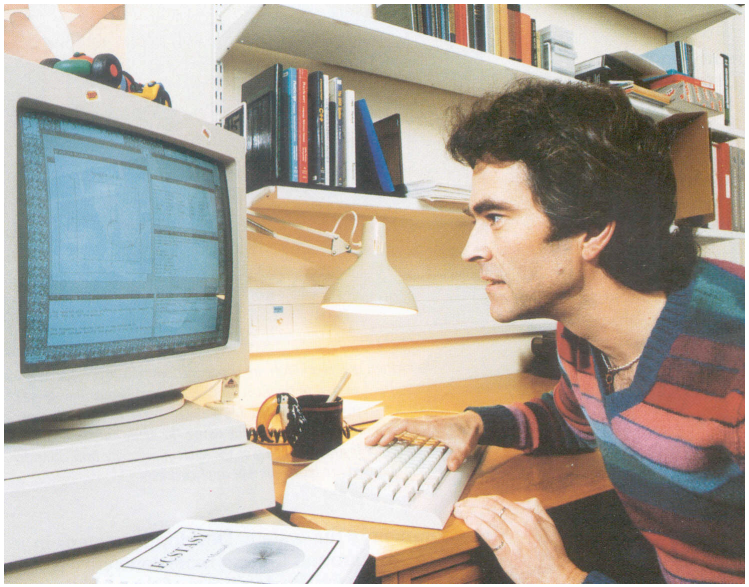

Other than

Googling for things,

the majority of scientists

do not use computers

more effectively today

than they did 28 years ago.

Where Are Your Goalposts?

A scientist is *computationally competent* if she can build, use, validate, and share software to:

- Manage and process data
- Tell if it's been processed correctly
- Find and fix problems when it hasn't been
- Keep track of what they've done
- Share work with others
- Do all of these things efficiently

A Driver's License Exam

- Developed with the Software Sustainability Institute for the DiRAC Consortium
- Formative assessment
  - Do you know what you need to know in order to get the most out of this gear?
- Pencils ready?

Note: actual exam allows for several different programming languages, version control systems, etc.

A Driver's License Exam

1. Check out a working copy of the exam
2. materials from Subversion.
3.
4.
5.
6.
7.

Could do it easily	1.0
Could struggle through	0.5
Wouldn't know where to start	0.0
Don't understand the question	-1.0

A Driver's License Exam

1. Use find and grep in a pipe to create a
2. list of all .dat files in the working copy,
3. redirect the output to a file, and add that
4. file to the repository.
5.
6.
7.

Could do it easily	1.0
Could struggle through	0.5
Wouldn't know where to start	0.0
Don't understand the question	-1.0

A Driver's License Exam

1. Write a shell script that runs a legacy
2. program for each parameter in a set.
3.
4.
5.
6.
7.

Could do it easily	1.0
Could struggle through	0.5
Wouldn't know where to start	0.0
Don't understand the question	-1.0

A Driver's License Exam

1. Edit the Makefile provided so that if any
2. .dat file changes, analyze.py is re-run to
3. create the corresponding .out file.
4.
5.
6.
7.

Could do it easily	1.0
Could struggle through	0.5
Wouldn't know where to start	0.0
Don't understand the question	-1.0

A Driver's License Exam

1. Write four unit tests to exercise a function
2. that calculates running sums. Explain why
3. your four tests are most likely to uncover
4. bugs in the function.
5.
6.
7.

Could do it easily	1.0
Could struggle through	0.5
Wouldn't know where to start	0.0
Don't understand the question	-1.0

A Driver's License Exam

1. Explain when and how a function could
2. pass your tests, but still fail on real data.
3.
4.
5.
6.
7.

Could do it easily	1.0
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A Driver's License Exam

1. Do a code review of the legacy program
2. from Q3 (about 50 lines long) and list
3. the four most important improvements
4. you would make.
5.
6.
7.

Could do it easily	1.0
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How Are We Doing?

a) How well did you do?

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How Are We Doing?

a) How well did you do?

b) How well do you think most scientists would do?

c) Do you think a scientist could use your peta-scale GPU provenance cloud *without* having these skills?

And the knowledge they depend on?

So Why Is This *Your* Problem?

If you're only helping the (small) minority lucky enough to have acquired the base skills that use of your shiny toy depends on...

then your potential user base is many times smaller than it could be.

It Is Therefore Obvious That...

- Put more computing courses in the curriculum!
  - Except the curriculum is already full

It Is Therefore Obvious That...

- Put a little computing in every course!
  - Still adds up: 5 minutes/lecture = 4 courses/degree
  - First thing cut when running late
  - The blind leading the blind

What Has Worked

- Target graduate students
- Intensive short courses (2 days to 2 weeks)
- Focus on practical skills

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http://software-carpentry.org


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Met Office

What We Teach

- Unix shell
- Python
- Version control
- Testing
- Matrix programming, image processing, SQL, ...

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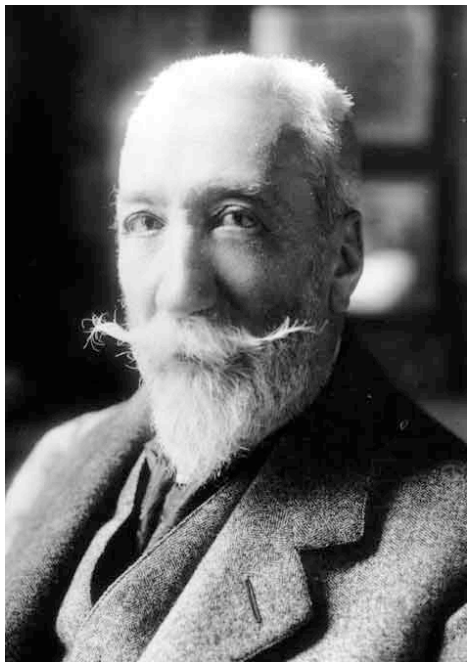
- None of this is publishable any longer
  - Which means it's ineffective career-wise for academic computer scientists
- But *it works*
  - Two independent assessments have validated the impact of what we do

Majestic Equality

Anatole France (1844-1924)

“The law, in its majestic equality, forbids the rich and poor alike to sleep under bridges, to beg in the streets, and to steal bread.”



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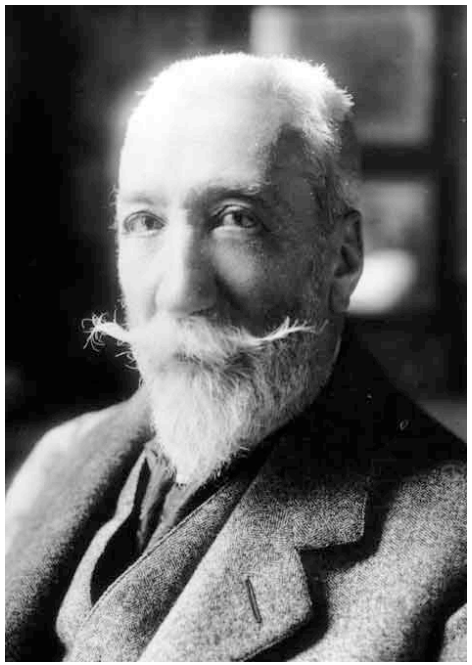

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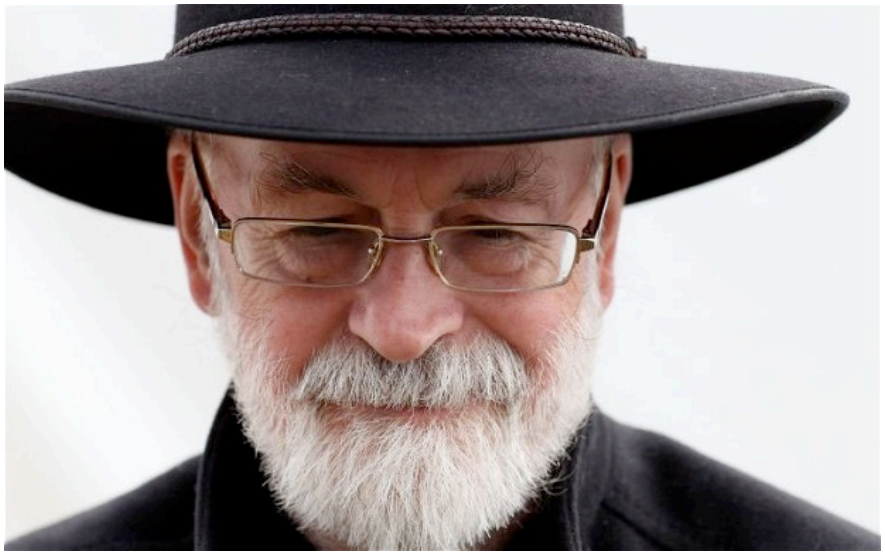
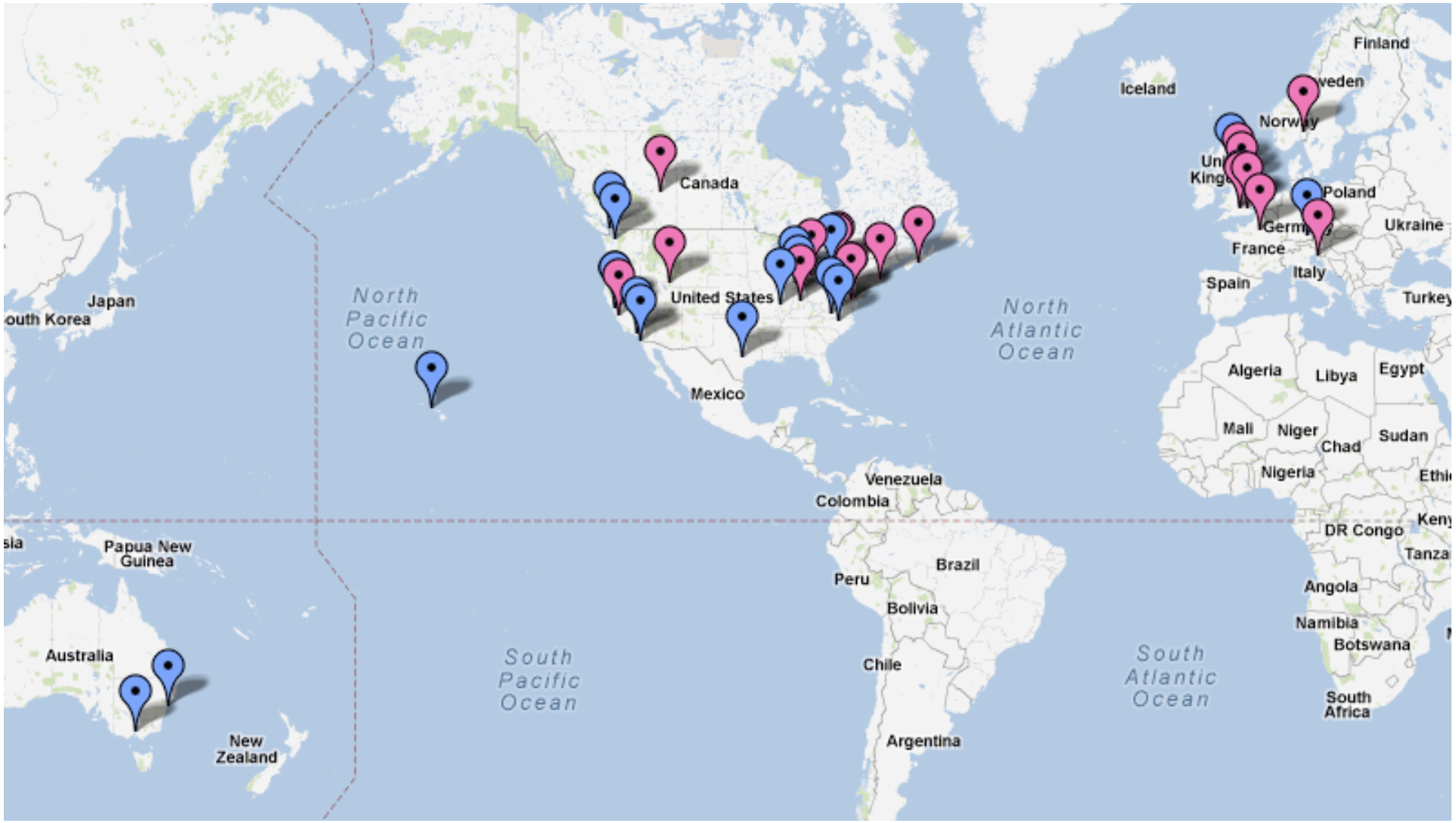
Thanks to modern computers, every scientist can now devote her working life to installation, configuration, and debugging.



If you build a man a fire,
you'll keep him warm for a night.
If you set a man on fire,
you'll keep him warm for the rest of his life.

— Terry Pratchett

Host a Workshop



Teach a Workshop

- All our materials are CC-BY licensed
- We will help train you








Shine Some Light

- Include a few lines about your software stack and working practices in your scientific papers
- Ask about them when reviewing
  - Where's the repository containing the code?
  - What's the coverage of your unit tests?
  - How did you track provenance?

And *Then* We Take Over the World

- We can continue to talk amongst ourselves
  - While our good ideas are left untouched by most of the people we'd like to help

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- We can continue to talk amongst ourselves
  - While our good ideas are left untouched by most of the people we'd like to help
- Or we can help the 90% do more today
  - And even greater things tomorrow

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Thank You