Developers are Researchers

Improve the work you love with Research Driven Development
Phil Winder

Visit http://WinderResearch.com

@DrPhilWinder
phil@WinderResearch.com

MACHINE LEARNING
Winder Research
CLOUD
1. Developers are Researchers
2. Great Researchers
3. Research Patterns
What is research?

An attempt to improve or advance

“[r]esearch is a process of steps used to collect and analyze information to increase our understanding of a topic or issue” - Creswell, J. W. (2008). Educational Research

“The systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions.” - Oxford English Dictionary

“R&D comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications.” - University College London

“a detailed study of a subject, especially in order to discover (new) information or reach a (new) understanding” - Cambridge English Dictionary
Why should companies perform research?

Research attracts a 10–30% return on investment

Stats note: highly stochastic, long tails.

Why should companies perform research?

Innovation breeds enthusiasm.
Developers are Researchers
What is a researcher?

- Someone who works in a university?
- A scientist?
Common Misconceptions

- “I don’t have a Ph.D.”
- “I’m not smart enough”
- ...
- “Only academics have time to do real research”
Early career, group researcher

Small research group - 2 PHD students

"Fear of failing is a massive driver, I've come this far, been successful, now I just need to get tenure and I can relax a bit."

https://unlockingresearch.blog.lib.cam.ac.uk/?p=515
Senior research fellow

8:00 - 9:00 AM: Learning Chinese

9:00 - 10:00 AM: Dealing with a few emails

10:00 - 11:00 AM: Writing an article on the History of Ethics

11:00 - 12:00 PM: Supervision with 3rd year undergraduate student

12:00 - 1:00 PM: Lunch

1:00 - 2:00 PM: Interview with researcher

2:00 - 3:00 PM: Preparation for supervision

3:00 - 4:00 PM: Responding to an email about issues with a new course he is teaching

4:00 - 5:00 PM: Dealing with personal matters in advance of trip to China

5:00 - 6:00 PM: Writing article

6:00 - 7:00 PM: Dinner at College

7:00 - 8:00 PM: Writing article

8:00 - 9:00 PM: Writing article

9:00 - 10:00 PM: Writing article

10:00 - 11:00 PM: Writing article

11:00 PM to 8:00 AM: Sleep

Solo researcher

"Writing is by far the hardest thing I do, but it’s also the most enjoyable."

The approval process is just “rubber stamping” what we [the committee] say.

You’d think it would be easy, but actually it has been very problematic!

https://unlockingresearch.blog.lib.cam.ac.uk/?p=515
The Role of an Academic Researcher

The post requires a physical scientist with excellent communication skills who is comfortable conducting interdisciplinary and policy-relevant climate change mitigation research. The focus of the research must be on one of the following areas: climate science and mitigation of greenhouse gas emissions; mitigation of aviation and/or shipping CO2 emissions; energy system decarbonisation scenarios. It is expected that you will have a strong publishing track record, lecturing and supervisory experience, demonstrable experience in attracting research funding, as well as experience in conducting knowledge exchange activity.

- Lecturer in Energy & Climate Change, University of Manchester
Academic summary

- Specialist knowledge
- Teaching
- Administration
- Meetings
- Sales
- Delivery
What is research?

- Pursuit of knowledge
- Develop new understanding
- Deliver or enact
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If we accept that we are disguised researchers, can we do it better?
Great Researchers
Francis Crick (1916-2004)
British biophysicist.
Received the 1962 Nobel Prize for Physiology or Medicine for their determination of the molecular structure of deoxyribonucleic acid (DNA).
With James Watson and Maurice Wilkins.

Image: https://www.britannica.com/biography/Francis-Crick
‘I do recall going home and telling [my wife] that we seemed to have made a big discovery. Years later she told me she hadn’t believed a word of it. “You were always coming home and saying things like that”’
‘... so that Jim [Watson] soon began to tire of my repetitious enthusiasm. In fact at times he had cold feet, thinking that perhaps it was **all a pipe dream**...’
‘...we were able to take a long cool look at the structure, sorting out its accidental features (which were somewhat inaccurate) from its really fundamental properties...’
‘...I enjoyed every moment of it, the downs as well as the ups. It certainly helped me in my subsequent propaganda for the genetic code.’
‘The important thing is to be there when the picture is painted’
- John Milton
‘...is partly a matter of luck, partly good judgement, inspiration and persistent application.’

What Mad Pursuit, Francis Crick, 2008
The best researchers are...

- Confident yet humble
- Critical yet collaborative
- Ambitious yet realistic
- Thorough yet know when to stop
‘Francis Crick’s genius thrived on collaboration and conversation’
Software Engineer/Research qualities

**Personal**
- Passion
- Perseverance
- Integrity
- Self-confidence
- Self-reflection
- Responsibility

**Working with others**
- Team working
- Leadership
- Respect
- People management
- Mentoring
- Supervision

**Knowledge base**
- Subject knowledge
- Information seeking
- Information literacy
- Languages

**Cognitive ability**
- Analysis
- Synthesis
- Critical thinking
- Evaluation
- Problem solving

**Creativity**
- Inquisitive
- Insightful
- Innovative
- Argument construction

**Communication**
- Speaking
- Publishing
- Writing
- Collaboration
- Public image
- PR

**Self-management**
- Prioritisation
- Commitment
- Time management
- Work-life balance
- Disciplined
- Pragmatic

**Research management**
- Strategy
- Planning and delivery
- Risk management

**Professional conduct**
- Ethics, principals
- Legal requirements
- IPR and copyright
- Respect
- Confidentiality
- Client work

**Technical ability**
- Basic CS skills
- Languages
- Practices
- Technology

**Business acumen**
- Strategic
- Financial
- Sales
- Valuing
- Marketing
- Business development

**Personal development**
- Career management
- Learning
- Opportunistic
- Reputable
- Networking
3 Research Patterns
Hypotheses

A proposed explanation, usually based on prior experience, background knowledge, preliminary observations, and logic.

- Results of the research support or do not support the hypothesis
Scientific Method

systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses

The Scientific Method as an Ongoing Process

- **Make Observations**
  - What do I see in nature? This can be from one's own experiences, thoughts, or reading.

- **Think of Interesting Questions**
  - Why does that pattern occur?

- **Refine, Alter, Expand, or Reject Hypotheses**

- **Formulate Hypotheses**
  - What are the general causes of the phenomenon I am wondering about?

- **Gather Data to Test Predictions**
  - Relevant data can come from the literature, new observations, or formal experiments. Thorough testing requires replication to verify results.

- **Develop Testable Predictions**
  - If my hypothesis is correct, then I expect a, b, c,...

- **Develop General Theories**
  - General theories must be consistent with most or all available data and with other current theories.
Hi I'm @Slide38 and I'm an engineer.

You can tell, because I have an @ in front of my name and I have hair in the wrong places.

And I have a bug.
bool flag = false;

// Sometimes carry out the work 
if (flag)
    SomeWork();
bool flag = false;

// Sometimes carry out the work 
if (flag)
    SomeWork();

... some work
bool flag = false;

// Sometimes carry out the work 
if (flag)
  SomeWork();

... some work
bool flag = false;

// Sometimes carry out the work
if (flag)
    SomeWork();

... some work
bool flag = false;

// Sometimes carry out the work 
cout << "Hello World!";
if (flag)
    SomeWork();
bool flag = false;

// Sometimes carry out the work 
cout << "Hello World!";
if (flag)
    SomeWork();
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// Sometimes carry out the work
cout << "Hello World!";
if (flag)
    SomeWork();

Hello World!

General theory!
(I’m an idiot)
Experimental Research

Performing controlled experiments to verify a hypothesis.

- Comparisons between competing designs
- Requires a robust metric
- Depending on repeatability, may require lots of data

The Five ‘Ws’

- What is the research?
- Why do I want to do the research?
- Who are the participants?
- Where can I perform the research?
- When am I going to do the research?
The ‘Why’ is important
"Why is [state] so..."
Generally, any problem should...

- Make money
- Reduce costs
- Save time
**Action Research**

A problem involving people, tasks or procedures where a change can cause a more desirable outcome.

- Purpose
- Focus
- Relations
- Method
- Validation

Working on a problem

Most problems are iterative in nature. They follow a distinctive pattern flowing from ignorance to knowledge.

Also see: OODA loop.
Find

- Improve front-end developer productivity
- Reduce lead time on new features

Key questions: Why? How long? How much?
Understand

- Improve front-end developer productivity
- Reduce lead time on new features

- Definition of “productive”?
- Which frameworks/languages?
- How to measure productivity and lead times?
- Baselines?
- Does this just related to front-end developers?
Solve

- Planning
- Teams
- Tasks
- Research
- ...

...
Review

- Report findings
- Present finding
- Implement actions
- Repeat
Fail fast
Fail fast
Stop smart
A "rate"
- Revenue / yr
- Features / wk

PRODUCT PERFECTION

PEAK PERFECTION

QUIT TOO EARLY
QUIT TOO LATE

TIME
THE GOAL

PRODUCT
PERFECTION

TIME
PRODUCT
PERFECTION

BOREDOM

TIME
SUNK COST FALLACY

TIME

PRODUCT PERFECTION
Persist until you have that **sinking feeling**.
Thanks!

Visit [http://WinderResearch.com](http://WinderResearch.com)

@DrPhilWinder

phil@WinderResearch.com