Delphi Summit
June 2024 | Amsterdam

The *Global* **Delphi** Summit

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Evidence Based Delphi Engineering:

How to ignore "best practices" and so called "experts."

Jim McKeeth
jim@gdksoftware.com
gdksoftware.com

How you ***Know*** *you are*
Writing the RIGHT code

About Jim McKeeth

- Director of GDK Software, USA & Delphi MVP
- Previously Embarcadero Chief Dev Advocate
- Over 30 years experience in software development
- Worked professionally in many languages and platforms, including Delphi, C#, C/C++, Java, JavaScript, and Python
- Multiple technology patents & book contributions
- Spoken on software development all around the world
- Professional improv comedy performer for 10 years

BEGIN

INTERFACE

- Premise
- What is software engineering?
- Finding the Evidence
- Understanding Runtime: Big O
- Premature Optimization
- Use the source
- In the IDE
- External Tools
- More Resources

This is a work in progress and will continue to evolve over time.

github.com/jimmckeeth/
Evidence-Based-Software-Engineering

Why do **you** write the **CODE** you write?

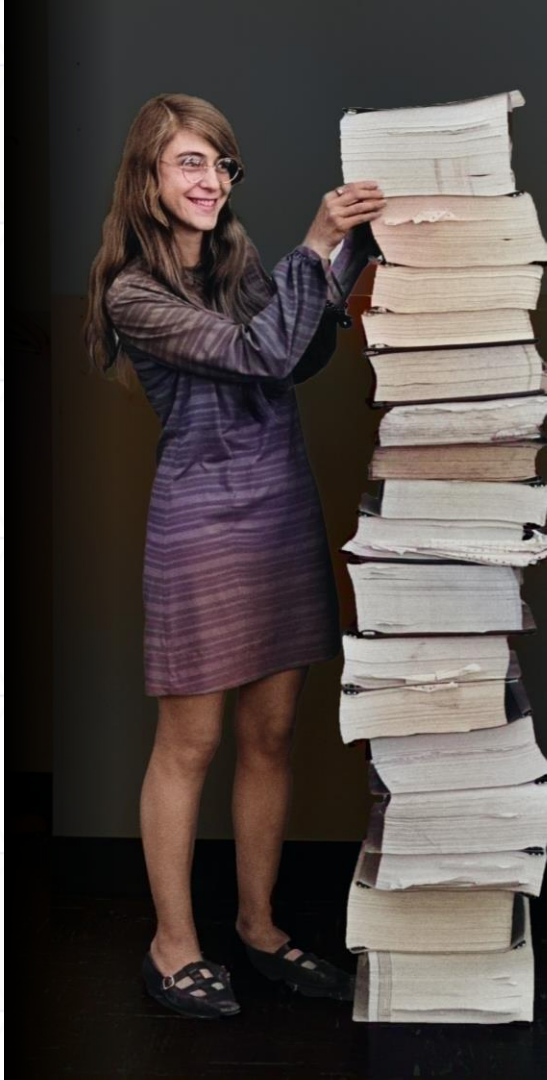
Grace Hopper, RDML

- Wrote first computer manual
- Machine-independent programming languages
  - FLOW-MATIC & COBOL
- Carried around light nanoseconds
  - 29.97 cm of wire
- The most dangerous phrase, *"We've always done it this way."*

https://en.wikipedia.org/wiki/Grace_Hopper

Margaret Hamilton

- Director of the Software Engineering Division of the MIT Instrumentation Laboratory
- Developed flight software for the Apollo program
- 2016 – Presidential Medal of Freedom from Obama
- Published over 130 papers
- Invented the term “software engineering”
  - *“…to distinguish it from hardware and other kinds of engineering, yet … as part of the overall* ***systems engineering process****.”*



https://en.wikipedia.org/wiki/Margaret_Hamilton_(software_engineer)

Women of NASA

LEGO Set # 21312

IMPLEMENTATION

Don't believe ***anything*** I tell you!

TRAVEL BACK IN TIME…

Circa 2007

Consider this Code

```
sl := TStringList.Create;
try
    // use TStringList
except
  raise;
end;
sl.free;
```

Justification…

The **try/except** guarantees the code after the **end** is executed…

Raise allows the exception handler further up the stack to handle it…

Unfortunately…

Raise in the **except** prevents the code after the **end** from running when an exception occurs….

The exception code path was never tested, so this pattern was wide spread in production and multiple projects.

The developer read this in a book and accepted it as **truth**, never questioning the *way* he used it…

Superstitions

- “We've always done it that way.”
- Right way
- Best practices

The question
I'm always asked

What is the ***best*** …

What is the *best* …

- Component set
- Database access framework
- Grid component or library for …
- Way to handle exceptions
- LiveBindings vs Data Aware vs manual
- Memory manager
- OOP vs Procedural vs Functional
- Database (NoSQL vs RDMBS)
- Development methodology (SCRUM, Agile, etc.)
- Programming language

Now you try

You need to loop through some **`TDataSet`** records. For each record you need to examine multiple fields:

- What is *best* solution and why?
- Fastest?
- Uses least memory?
- Easiest to maintain?
- Simplest to explain?

How confident are you with your answer?

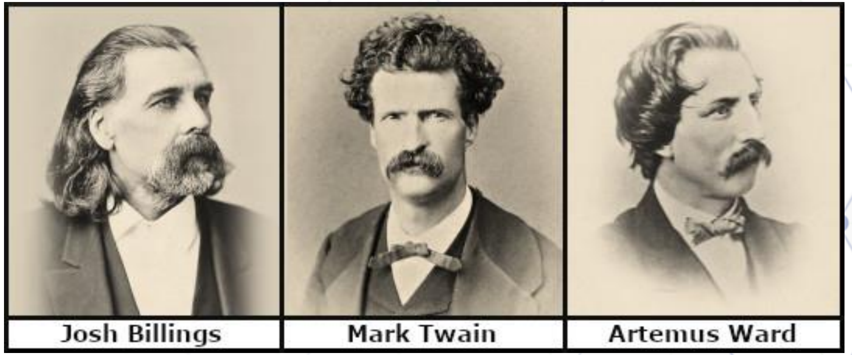
Possible Solutions:

1. FieldByName
2. FieldByNumber
3. Hard coded field names
4. Local references to each field
5. Custom SQL for each
6. Don't use TDataSet descendent
7. Switch to NoSQL from RDBMS
8. Something else….

The answer is always

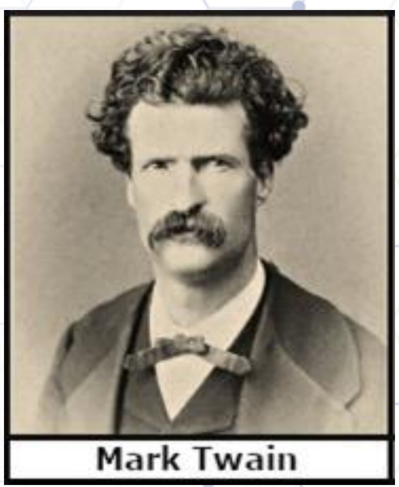
It depends …

> ”It ain’t what you don’t know
> that gets you into trouble.
>
> It’s what you know for sure
> that just ain’t so.



Josh Billings Mark Twain Artemus Ward

“The trouble with old men is they remember so many things that ain’t so.”



Unfounded confidence gets us in trouble

Programming Changes

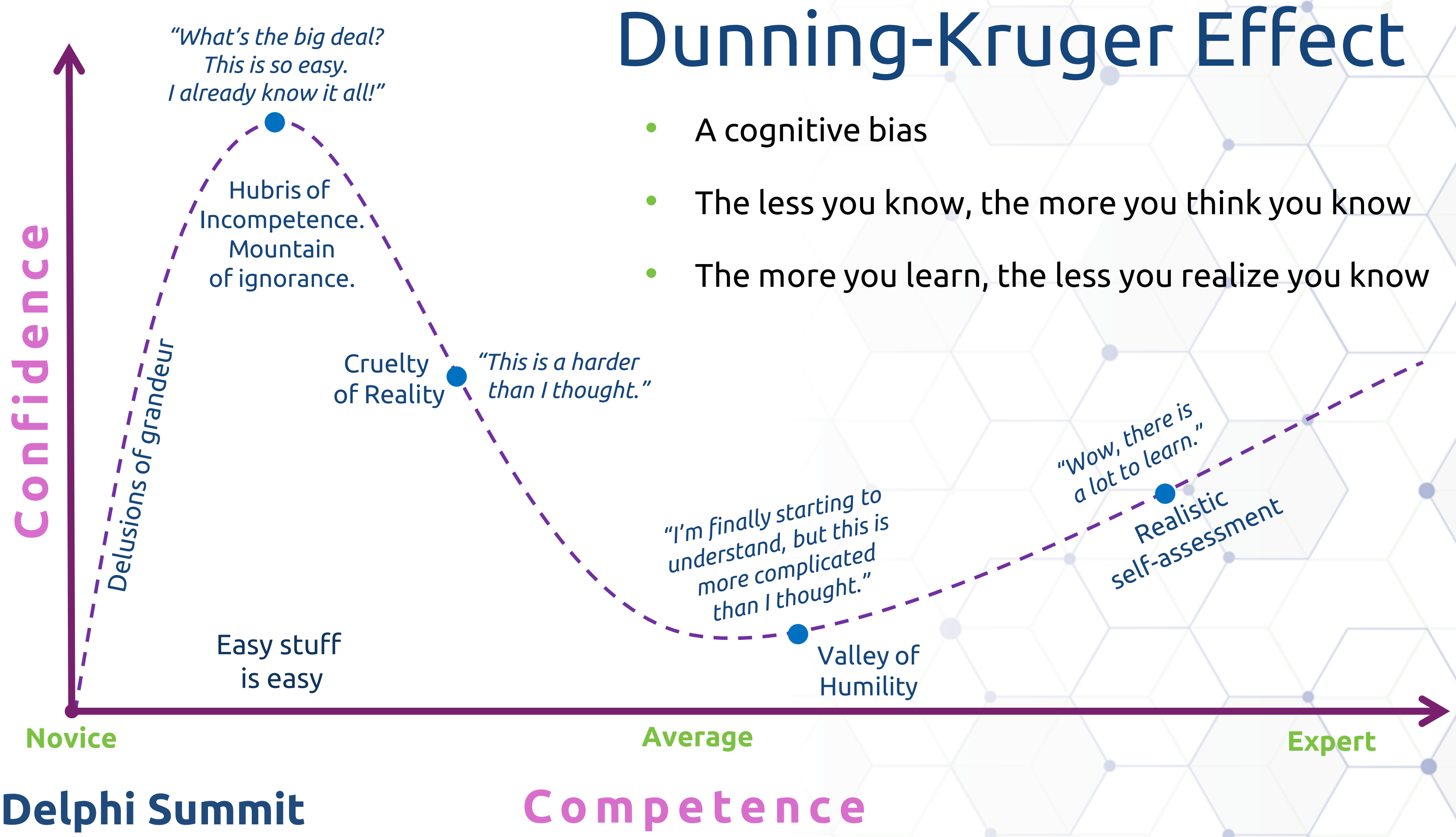
- New versions of the Delphi compiler
- Changes to the RTL
- Different database access frameworks
- Database backend changes
- API changes
- New versions of Windows
- Different operating systems
  (Android, MacOS, Linux, etc.)
- Multicore CPUs
- New CPU instructions
- *We learn more*

"Programming is an ART that fights back."

-Chad "Kudzu" Howard

Dunning-Kruger Effect

- A cognitive bias
- The less you know, the more you think you know
- The more you learn, the less you realize you know



*"What's the big deal?
This is so easy.
I already know it all!"*

Hubris of
Incompetence.
Mountain
of ignorance.

Delusions of grandeur

Cruelty
of Reality

*"This is a harder
than I thought."*

*"I'm finally starting to
understand, but this is
more complicated
than I thought."*

Valley of
Humility

*"Wow, there is
a lot to learn."*

Realistic
self-assessment

Easy stuff
is easy

Confidence

Novice

Average

Expert

Competence

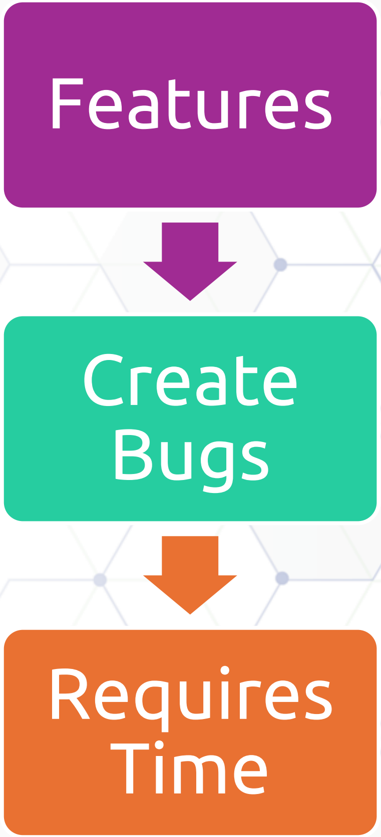
en.wikipedia.org/wiki/Dunning%E2%80%93Kruger_effect

Software Developer Levels

- Junior Developer
  - *Learning best practices*
- Intermediate Developer
  - *Follows best practices*
- Senior Developer
  - *Knows when to not follow best practices*

The Math of Bugs and Fixes

- The source of bugs is writing code
- Adding features produces bugs
- Measure feature work as **churn**
- Collect data on your team
- How many bugs per unit of churn?
- Keep testing and fixing until expected number of bugs found

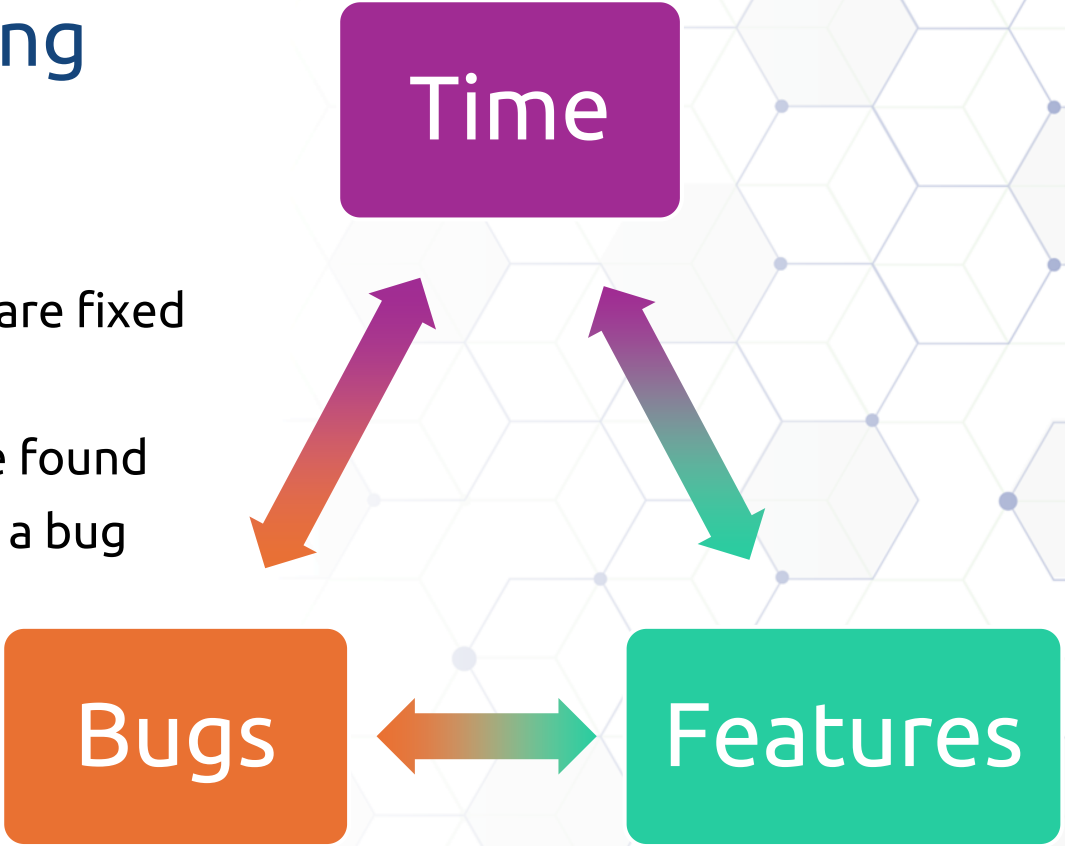

Features

Create Bugs

Requires Time

Software Engineering

- It is a trade off between
  - Time, Features & Bugs
- Given enough time all bugs are fixed
- Shipping is also a feature
- Reality is not all bugs will be found
- What is the cost of shipping a bug



Time

Bugs

Features

Think Outside The Box

- Writing code isn't always the answer
- Removed code doesn’t need to be maintained

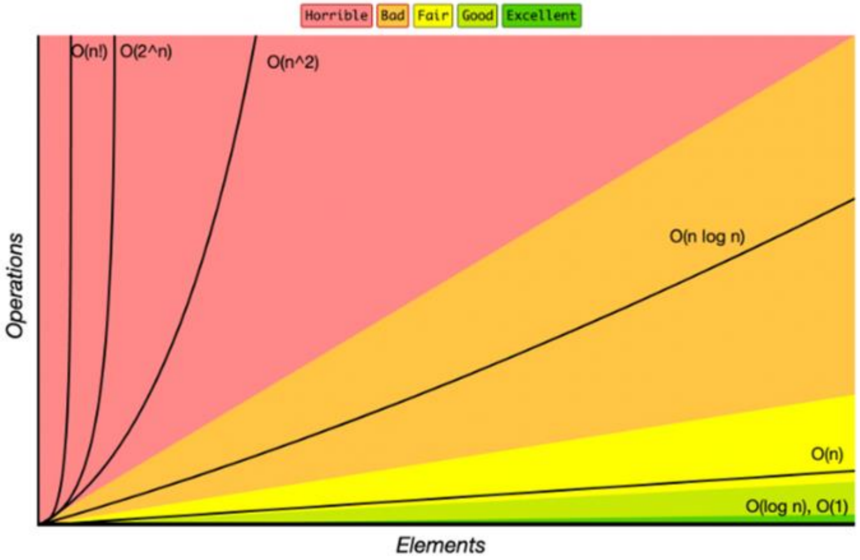
Other options

- Change system requirements
- Update the environment
- Use an external library
- Change the back-end
- Add hardware
- What about a RAM drive?

Deleting >1000 lines of code after finding a framework that does it better

Big O Notation

- Measures worst-case time and space complexity based on input size
- Useful to consider performance of different algorithms



Six types/levels of complexity

1. Constant: O(1)
    - Same time for any data size
2. Linear time: O(n)
    - Single loop
3. Logarithmic time: O(n log n)
    - Recursion
4. Quadratic time: O(n^2)
    - Nested loops
5. Exponential time: O(2^n)
    - Doubles with each item
6. Factorial time: O(n!)
    - GAH!

freecodecamp.org/news/big-o-cheat-sheet-time-complexity-chart/
en.wikipedia.org/wiki/Big_O_notation
khanacademy.org/computing/computer-science/algorithms/asymptotic-notation/a/big-o-notation

Putting Theory into Practice

Extremism
vs.
Pragmatism

Different Types of Code

Application Code

- The majority of development
- Applications that solve problems for end users
- Very focused on productivity
- Performance is less important
- *Underengineered*

Library Code

- Used in applications
- Focused on correctness, robustness, and reusability
- Testing is more important than shipping
- Performance is very important
- *Overengineered*

Both still require good, clean code

The FizzBuzz Example

For numbers 1 through 100,

- if the number is divisible by 3 print Fizz;
- if the number is divisible by 5 print Buzz;
- if the number is divisible by 3 and 5 (15) print FizzBuzz;
- else, print the number.

```
1
2
Fizz
4
Buzz
Fizz
7
8
Fizz
Buzz
11
Fizz
13
14
FizzBuzz
...
```

FizzBuzz : Application Solution

```
procedure RunFizzBuzz;
begin
  for var i := 1 to 100 do
  begin
    if (i mod 3 = 0) and (i mod 5 = 0) then
      WriteLn('FizzBuzz')
    else if i mod 3 = 0 then
      WriteLn('Fizz')
    else if i mod 5 = 0 then
      WriteLn('Buzz')
    else
      WriteLn(i);
  end;
end;
```

```
1
2
Fizz
4
Buzz
Fizz
7
8
Fizz
Buzz
11
Fizz
13
14
FizzBuzz
...
```

The “Enterprise” Solution

- Heavy use of Factory pattern, Dependency Injection, and the Strategy pattern
- Everything has an object, every object has an interface
- A processor to handle the rules
- Modularity to add or remove rules as needed
- 200+ line example in Delphi: github.com/jimmckeeth/FizzBuzzEnterpriseEdition-Delphi
- *This is a joke to illustrate a point.*
- See also:
  - github.com/jongeorge1/FizzBuzzEnterpriseEdition-CSharp 48 C# files, over 6 projects
  - github.com/EnterpriseQualityCoding/FizzBuzzEnterpriseEdition 89 Java files

```
1
2
Fizz
4
Buzz
Fizz
7
8
Fizz
Buzz
11
Fizz
13
14
FizzBuzz
...
```

So What?

- Most of the time we are writing application code
- ***Don’t over engineer it***
- ***Avoid premature optimization***
- Use safeguards
- Still write clean code
- Still use tests and best practices
- *Get it done and ship the application*

```
1
2
Fizz
4
Buzz
Fizz
7
8
Fizz
Buzz
11
Fizz
13
14
FizzBuzz
...
```

Premature Optimization

- Avoid it
- Without data any optimization:
  - May be counter productive
  - Produce little impact
  - Not worth the effort
- Don’t waste your time, *profile first*

Tools

- Profilers
- Unit Testing
- Code Coverage
- Static Code Analysis
- Logging
- What other tools give you *evidence*?

Profilers

- delphitools.info/samplingprofiler
- prodelphi.de
- smartbear.com/product/aqtime-pro
- yavfast.github.io/dbg-spider
- github.com/ase379/gpprofile2017

CPU Specific

- Intel Vtune
- AMD µProf

- Apple Instruments
- List of Performance Analysis Tools

See what code is spending the most time, both per execution, and total number of executions

Find out where to optimize

Focus on slowest code with most executions and impacting most users

The xz Utils backdoor was discovered via micro-benchmarking

Unit Testing

- Dunit

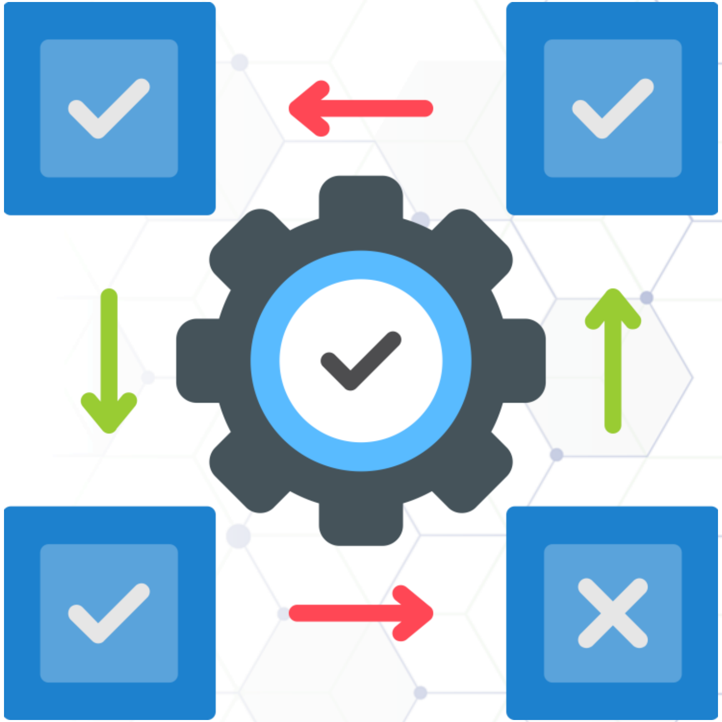
  docwiki/RADStudio/en/DUnit_Overview

- DunitX 👈

  github.com/VSoftTechnologies/DUnitX

- TestInsight 👈

  bitbucket.org/sglienke/testinsight/wiki



Logging

Logging

- raize.com/codesite *with Method Tracer!*
- code-partners.com/offerings/smartinspect
- github.com/grijjy/GrijjyCloudLogger
- madexcept.com
- eurekalog.com

Code Coverage

- github.com/DelphiCodeCoverage/DelphiCodeCoverage
- github.com/MHumm/delphi-code-coverage-wizard-plus
- sourceforge.net/projects/discoverd/
- AQTime
- SmartInspect
- CodeInsite

Static Code Analysis

- www.tmssoftware.com/site/fixinsight.asp
- github.com/Embarcadero/SonarDelphi
- peganza.com Pascal Analyzer & Pascal Expert
- derscanner.com

DIY

- github.com/RomanYankovsky/DelphiAST

Outdated

- github.com/SourceMonitor/SM-Info
- socksoftware.com/codehealer.php
- github.com/MikhailIzvekov/DelphiSCA

FINALIZATION

- Don’t believe what you “know”
- Test
- Collect data
- Use the source & tools
- github.com/jimmckeeth/Evidence-Based-Software-Engineering
- jim@gdksoftware.com

END.

github.com/jimmckeeth/Evidence-Based-Software-Engineering

jim@gdksoftware.com