

# TOOLING INTUITION

BACK 2 BASICS

# IN·TU·I·TION

/,INTOŌ'ISH(ə)N, INTə'WISH(ə)N/

*NOUN*

THE ABILITY TO UNDERSTAND SOMETHING IMMEDIATELY, WITHOUT THE NEED FOR CONSCIOUS REASONING.

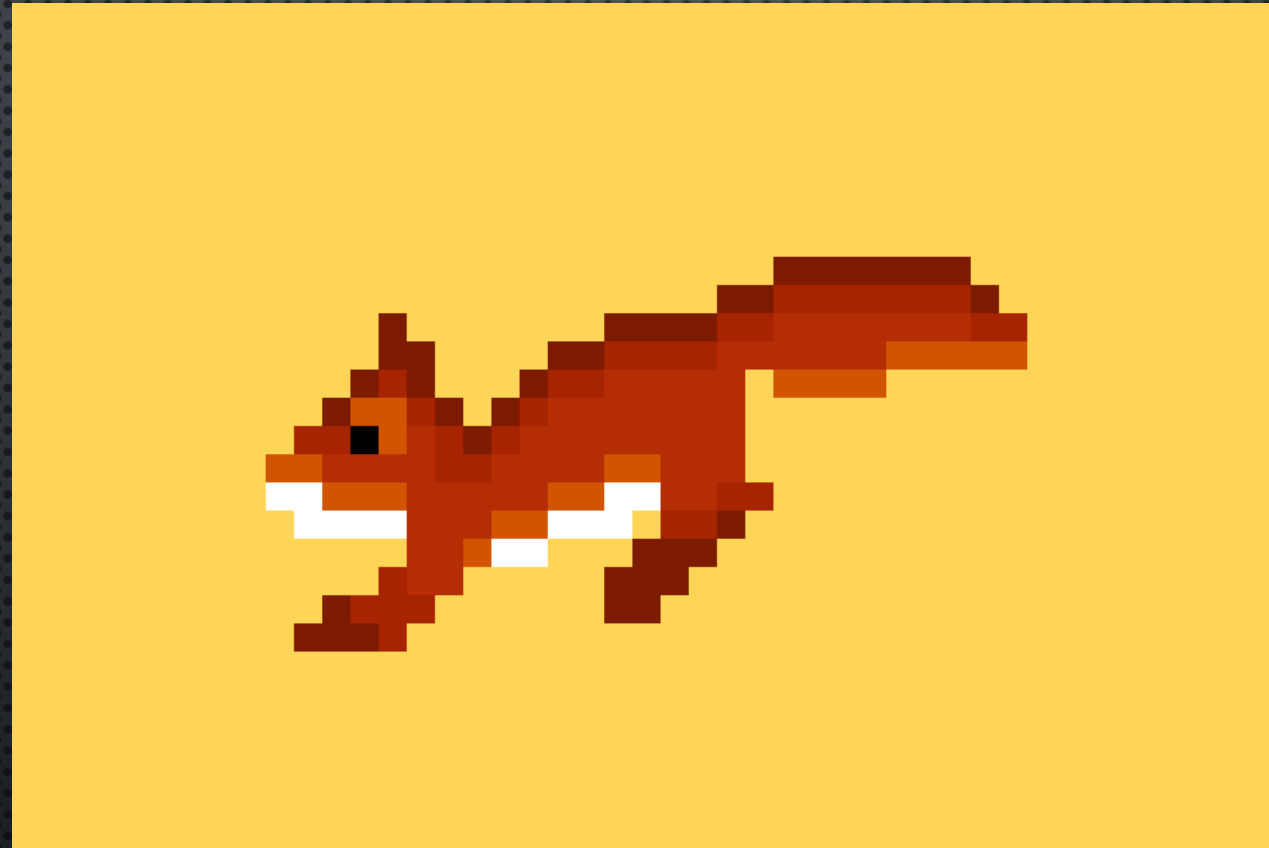
"WE SHALL ALLOW OUR INTUITION TO GUIDE US"

A THING THAT ONE KNOWS OR CONSIDERS LIKELY FROM INSTINCTIVE FEELING RATHER THAN CONSCIOUS REASONING.

**SIMILAR:** INSTINCT INTUITIVENESS SIXTH SENSE DIVINATION CLAIRVOYANCE



SQUIRREL!!!



# IN·TU·I·TION

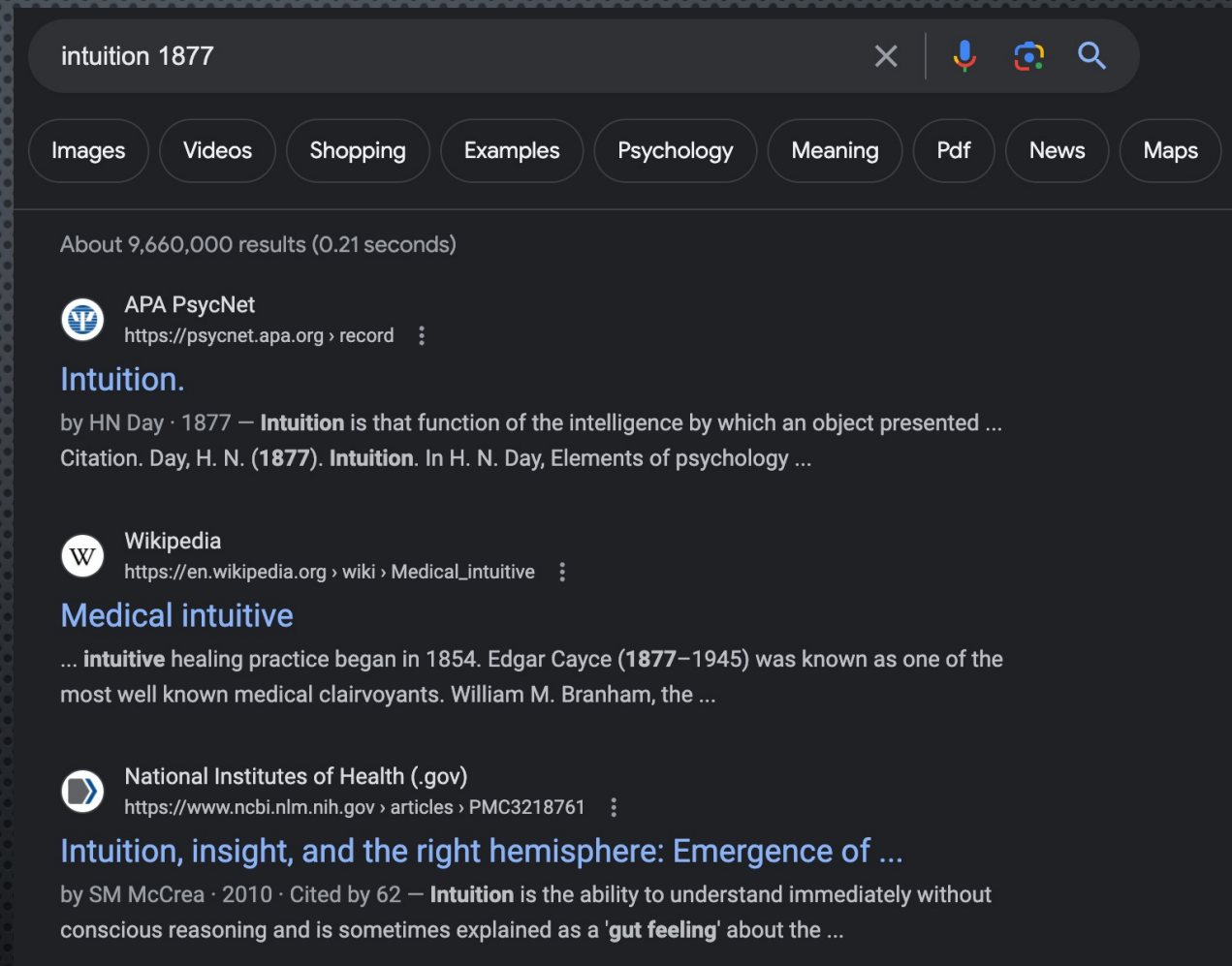
/,INTOO'ISH(ə)N, INTə'WISH(ə)N/



# GOOGLE "INTUITION 1877"

Intuition is that function of the intelligence by which an object presented by the mind itself is apprehended.


Henry N. Day




intuition 1877

Images Videos Shopping Examples Psychology Meaning Pdf News Maps


About 9,660,000 results (0.21 seconds)

 APA PsycNet  
<https://psycnet.apa.org/record>

**Intuition.**  
by HN Day · 1877 — **Intuition** is that function of the intelligence by which an object presented ...  
Citation. Day, H. N. (1877). **Intuition**. In H. N. Day, Elements of psychology ...

 Wikipedia  
[https://en.wikipedia.org/wiki/Medical\\_intuitive](https://en.wikipedia.org/wiki/Medical_intuitive)

**Medical intuitive**  
... **intuitive** healing practice began in 1854. Edgar Cayce (1877–1945) was known as one of the most well known medical clairvoyants. William M. Branham, the ...

 National Institutes of Health (.gov)  
<https://www.ncbi.nlm.nih.gov/articles/PMC3218761>

**Intuition, insight, and the right hemisphere: Emergence of ...**  
by SM McCrea · 2010 · Cited by 62 — **Intuition** is the ability to understand immediately without conscious reasoning and is sometimes explained as a '**gut feeling**' about the ...

# WILLIAM DAVID ROSS (1877 – 1971)



FATHER OF INTUITIONISM.

INTUITIONISM IS THE EPISTEMOLOGICAL VIEW THAT SOME MORAL TRUTHS CAN BE KNOWN WITHOUT LOGICAL INFERENCE OR SYSTEMATIC THOUGHT; SUCH TRUTHS, IT IS ARGUED, CAN BE KNOWN *DIRECTLY* EITHER THROUGH A “MORAL SENSE” (THE EMPIRICIST VIEW) OR BY MEANS OF NON-EMPIRICAL A PRIORI KNOWLEDGE (THE RATIONALIST VIEW).

**SCIENCE** • 5 May 1967 • Vol 156, Issue 3775 • pp. 605-610

# IMMANUEL KANT (1724 – 1804)

THE MERE FORM OF INTUITION, WITHOUT SUBSTANCE, IS IN ITSELF NO OBJECT, BUT THE MERELY FORMAL CONDITION OF AN OBJECT (AS PHENOMENON), AS PURE SPACE AND PURE TIME.

THOUGHTS WITHOUT CONTENT ARE VOID; INTUITIONS WITHOUT CONCEPTIONS, BLIND.

RULES FOR HAPPINESS: SOMETHING TO DO, SOMEONE TO LOVE, SOMETHING TO HOPE FOR.



**THE CRITIQUE OF PURE REASON** • 1787 • Second Edition

# IN·TU·I·TION

/,INTOO'ISH(ə)N, INTə'WISH(ə)N/

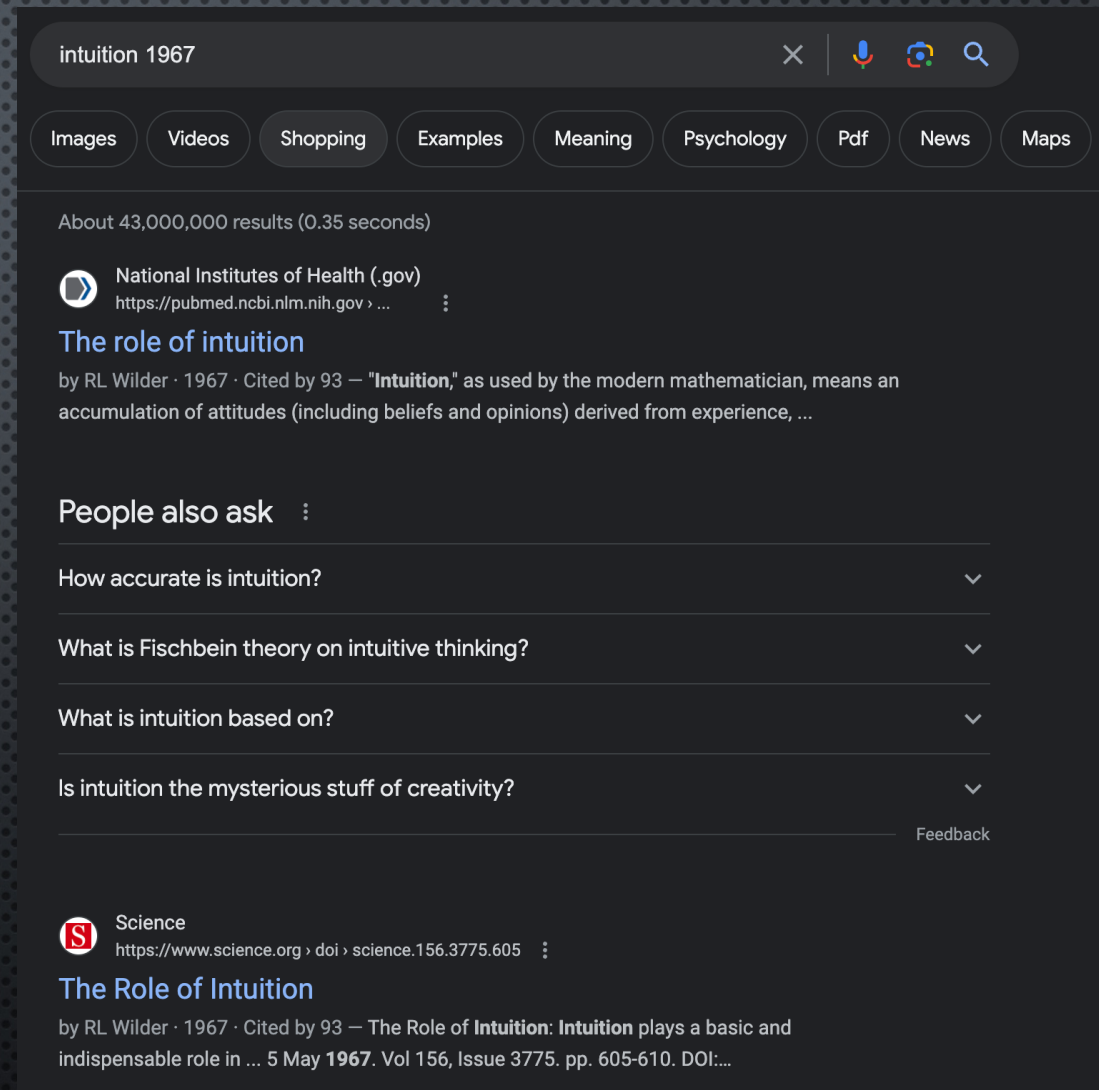




# GOOGLE "INTUITION 1967"

The major role of intuition is to provide a conceptual foundation that suggests the directions which new research should take.


Raymond L. Wilder



intuition 1967

Images Videos Shopping Examples Meaning Psychology Pdf News Maps

About 43,000,000 results (0.35 seconds)


 National Institutes of Health (.gov)  
<https://pubmed.ncbi.nlm.nih.gov> > ...

**The role of intuition**  
by RL Wilder · 1967 · Cited by 93 — "Intuition," as used by the modern mathematician, means an accumulation of attitudes (including beliefs and opinions) derived from experience, ...

People also ask :

- How accurate is intuition? ▾
- What is Fischbein theory on intuitive thinking? ▾
- What is intuition based on? ▾
- Is intuition the mysterious stuff of creativity? ▾

Feedback

 Science  
<https://www.science.org> > doi > science.156.3775.605 > ...

**The Role of Intuition**  
by RL Wilder · 1967 · Cited by 93 — The Role of **Intuition**: **Intuition** plays a basic and indispensable role in ... 5 May **1967**. Vol 156, Issue 3775. pp. 605-610. DOI:...

# RAYMOND LUIS WILDER (1896 – 1982)

THE ROLE OF INTUITION IN RESEARCH IS TO PROVIDE THE "EDUCATED GUESS," WHICH MAY PROVE TO BE TRUE OR FALSE; BUT IN EITHER CASE, PROGRESS CANNOT BE MADE WITHOUT IT AND EVEN A FALSE GUESS MAY LEAD TO PROGRESS.

"INTUITION," AS USED BY THE MODERN MATHEMATICIAN, MEANS AN ACCUMULATION OF ATTITUDES (INCLUDING BELIEFS AND OPINIONS) DERIVED FROM EXPERIENCE, BOTH INDIVIDUAL AND CULTURAL.

**SCIENCE** • 5 May 1967 • Vol 156, Issue 3775 • pp. 605-610



## THE PARAMETERS... MATHEMATICALLY

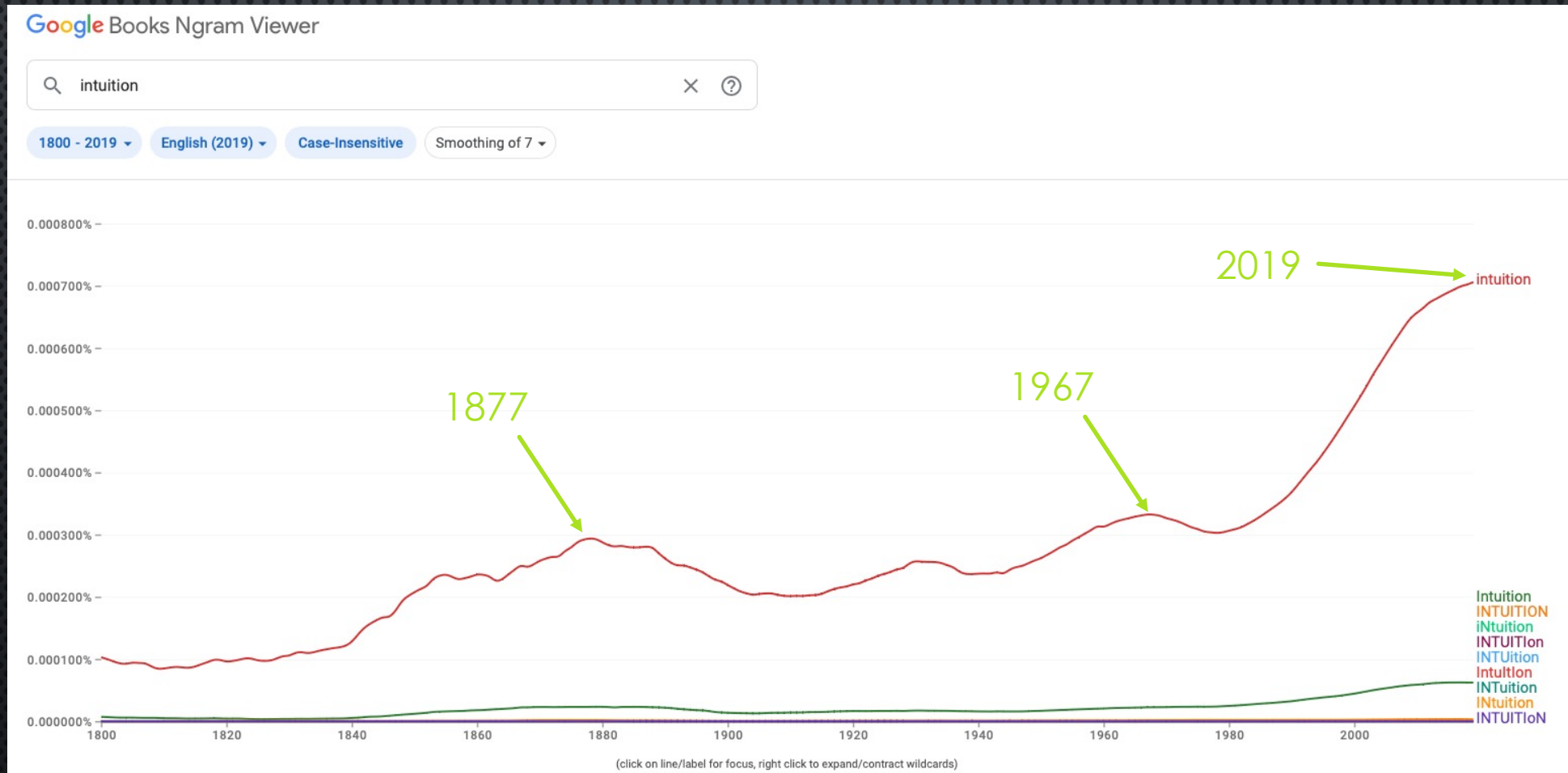
```
USING BYTE = UNSIGNED CHAR;  
INT CONTRIVED( BYTE A, BYTE B) {  
...  
}
```

$$A = 256 \quad \times \quad B = 256$$

65,536 Possibilities

# IN·TU·I·TION

/,INTOO'ISH(ə)N, INTə'WISH(ə)N/



# GOOGLE "INTUITION 2019"



Source: [www.vinology.com](http://www.vinology.com)

Google intuition 2019

Images Videos Shopping Full movie Summary Trailer Netflix News Books

About 70,900,000 results (0.43 seconds)

Showing results for **intuition 2019**  
Search instead for intuition 2019

**Western Reserve Wines**  
<https://www.westernreservewines.com> › Intuition-cotes...  
**Intuition Cotes du Rhone Rouge 2019 Rhone, France ...**  
90 Points - "A crush of basalt and violet candy perfume this rich, plummy blend of Grenache, Syrah, Carignan, Mourvèdre and Cinsault.  
\$11.99 · In stock

**Wine School of Philadelphia**  
<https://www.vinology.com> › wine-review-celler-des-t...  
**Wine Review: Cellier Des Terres Blanches 2019 Intuition ...**  
This is one of those hard-to-find wines that have an insanely great quality to price ratio. For our Pennsylvania readers, the search will be pretty easy: the.

**Wine Enthusiast**  
<https://www.wineenthusiast.com> › buying-guide › celli...  
**Cellier des Terres Blanches 2019 Intuition Red (Côtes du ...**  
A crush of basalt and violet candy perfume this rich, plummy blend of Grenache, Syrah, Carignan, Mourvèdre and Cinsault. Lusciously concentrated and.  
★★★★★ Rating: 90% · Review by Anna Lee C. Iijima

**Wine Chateau**  
<https://winechateau.com> › products › intuition-cotes-d...  
**INTUITION COTES DU RHONE 2019**  
This lovely Rhone red has aromas of black fruit jam, hints of cherry, licquorice and spices. On palate it is balanced, rounded, with notes of candied black ...  
\$21.97 · 3–6 day delivery · In stock

**IMDb**  
<https://www.imdb.com> › title  
**Intuitions (2019)**

# INTUITION – KEY POINTS

- INTUITION IS THAT FUNCTION OF THE INTELLIGENCE
- INTUITIONISM IS THE EPISTEMOLOGICAL VIEW THAT SOME MORAL TRUTHS CAN BE KNOWN WITHOUT LOGICAL INFERENCE
- THE ROLE OF INTUITION IN RESEARCH IS TO PROVIDE THE "EDUCATED GUESS," WHICH MAY PROVE TO BE TRUE OR FALSE
- RULES FOR HAPPINESS: SOMETHING TO DO, SOMEONE TO LOVE, SOMETHING TO HOPE FOR.

VS Code editor interface showing a C++ project. The Explorer sidebar on the left lists files like `main.cpp`, `type_traits.hpp`, `jitinterface.cpp`, and `jitinterface.h`. The main editor displays `jitinterface.cpp` with C++ code for `getILIntrinsicImplementationForRuntimeHelpers`. The interface includes a menu bar, a toolbar, and a terminal window at the bottom.



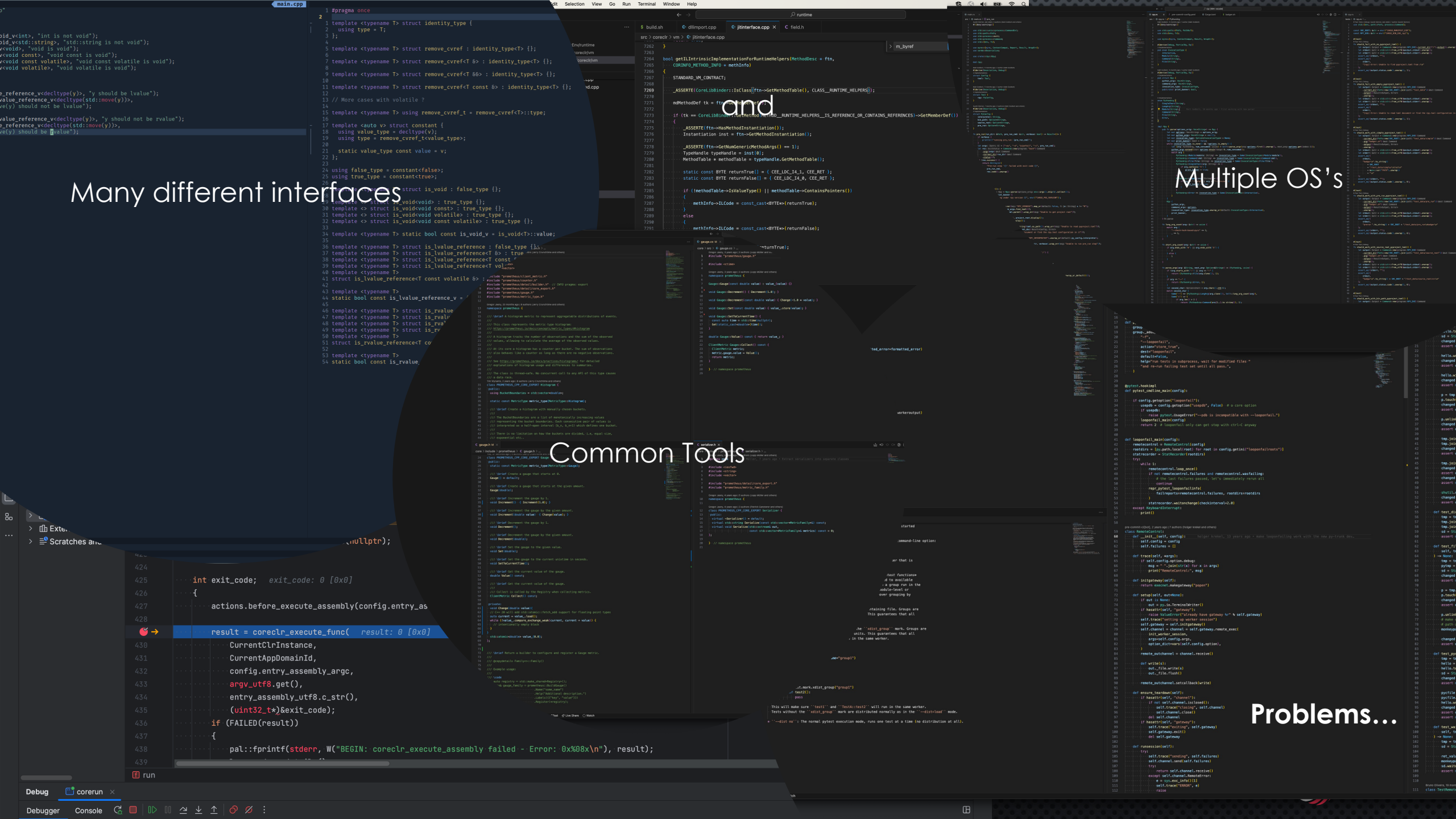
# Many different interfaces

and

# Multiple OS's

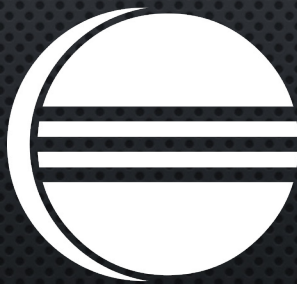
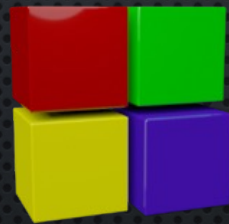
# Common Tools

# Problems...





# INTERFACES



# COMPILERS



https://analysis-tools.dev/

# STATIC ANALYZERS



analysis-tools.dev

Compare 600+ Linters, Static Analysis Tools And Code Formatters

AnalysisTools [Tools](#) [Blog](#) [Sponsors](#) [Contributing](#) [FAQ](#)

Find analysis tools, formatters, linters..

**Static Analysis Tools** [Clear All Filters](#) Sort by: [Votes Desc](#)

**Popular Languages**

- C (103)
- JavaScript (40)
- Kotlin (14)
- Python (38)
- Ruby (21)
- Rust (12)
- TypeScript (22)

**All Languages**

- C++ (106)
- .NET (3)
- ABAP (6)
- ActionScript (2)
- Active Server Pages (6)
- Ada (2)
- Apex (7)
- ASP.NET (3)
- Assembly (3)
- C (103)
- C# (39)

**Mega-Linter** 120

Mega-Linter can handle any type of project thanks to its 70+ embedded Linters, its advanced reporting, runnable on any CI system or locally, with assisted installation and configuration, able to apply formatting and fixes

dotnet apex c csharp  
cpp clojure coffeescript dart

Show more

Maintained Multi-Language cli linter  
68% upvoted

**Teamscale** 78

Static and dynamic analysis tool supporting more than 25 languages and direct IDE integration. Free hosting for Open Source projects available on request. Free academic licenses available.

abap c csharp cpp java  
cli

Maintained Multi-Language  
service ide-plugin linter 79% upvoted



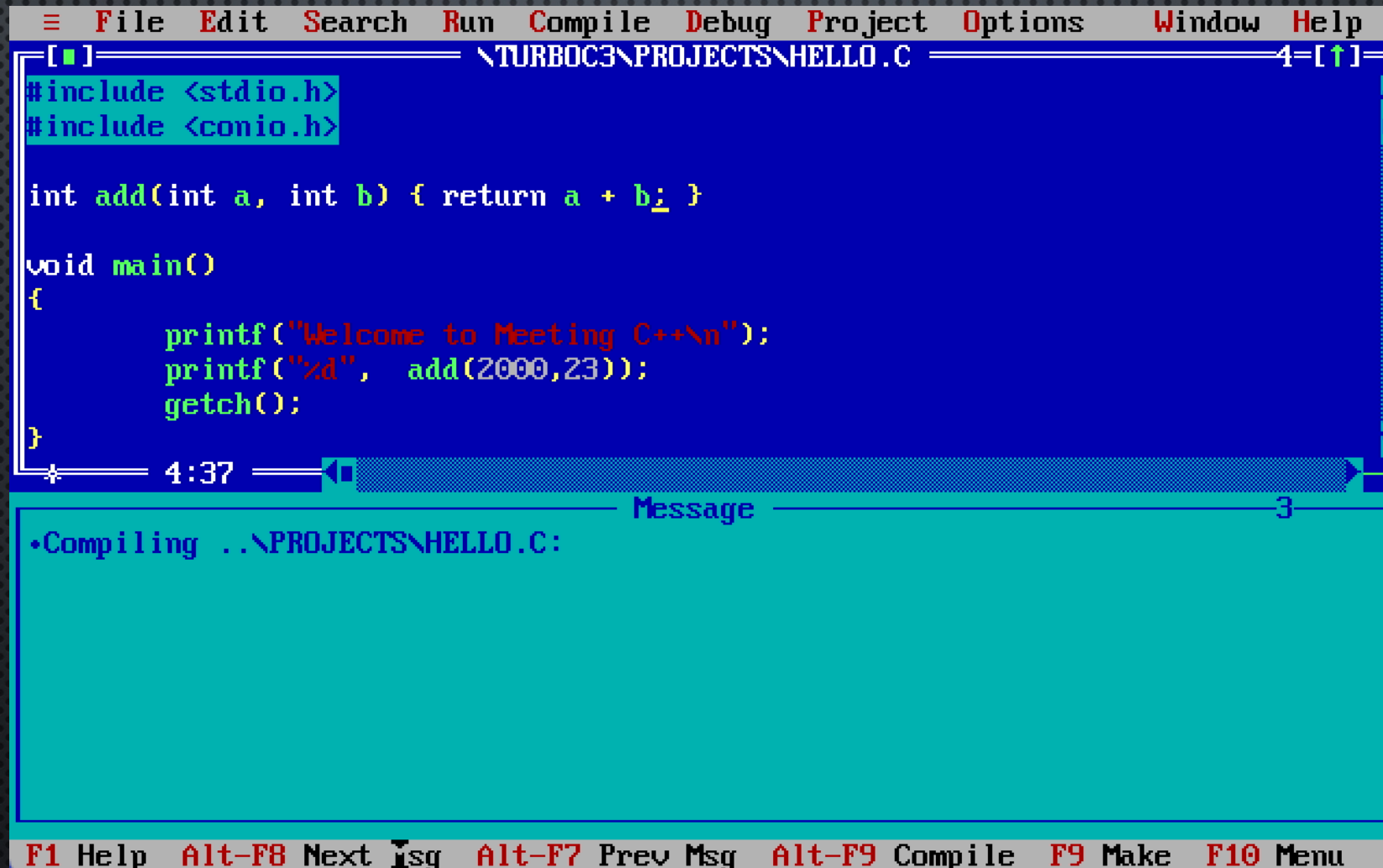
HOW WELL DO YOU USE THEM?

ARE THEY DOING ALL THEY CAN FOR YOU?

# 3 TYPES OF PROBLEMS (AT LEAST...)

- COMPILE TIME
  - SYNTAX ERRORS (VIOLATE STANDARD, OR THAT WHICH IS IMPLEMENTED IN THE COMPILER)
  - TEMPLATES 😊
- LINK TIME
  - MISSING LIBRARIES
  - VERSIONING ISSUES
- RUN TIME
  - LOGICAL ERRORS
  - SEMANTIC ERRORS (UNINITIALIZED VALUES – CORRECT STATEMENTS THAT DON'T MAKE SENSE)

# COMPILERS OF YORE...



The image shows a screenshot of the Turbo C++ IDE. The main window displays a C program named HELLO.C. The code includes standard headers, a function to add two integers, and a main function that prints a message and the result of the addition. A message window at the bottom shows the compilation process.

```
File Edit Search Run Compile Debug Project Options Window Help
\TURBOC3\PROJECTS\HELLO.C
#include <stdio.h>
#include <conio.h>

int add(int a, int b) { return a + b; }

void main()
{
    printf("Welcome to Meeting C++\n");
    printf("%d", add(2000,23));
    getch();
}
```

4:37

Message

•Compiling ..\PROJECTS\HELLO.C:

F1 Help Alt-F8 Next Msg Alt-F7 Prev Msg Alt-F9 Compile F9 Make F10 Menu

# COMPILE TIME ERRORS OF OLD...

```
File Edit Search Run Compile Debug Project Options Window Help
\TURBOC3\PROJECTS\HELLO.C 4
#include <stdio.h>
#include <conio.h>

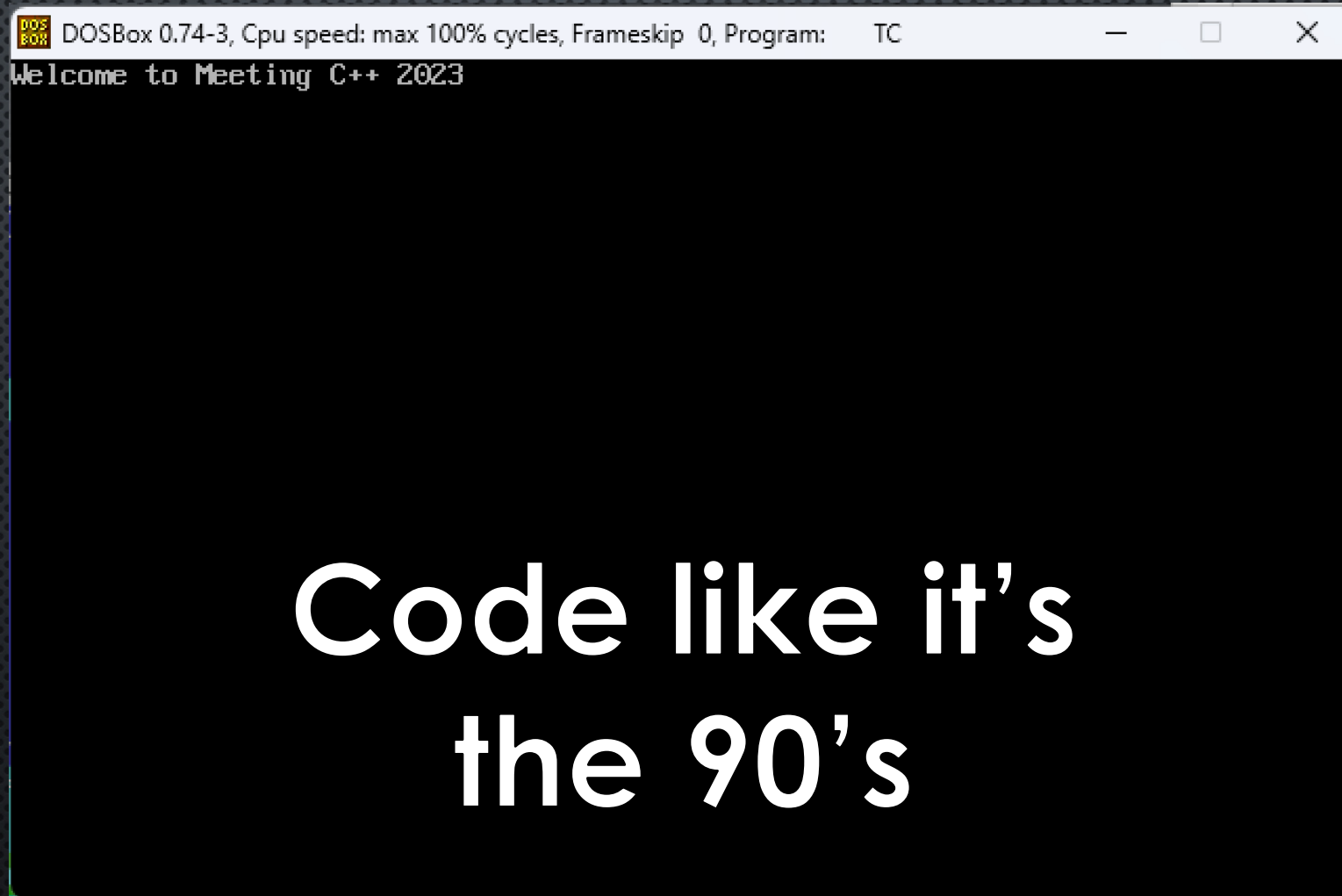
int add(int a, int b) { return a + b }

void main()
{
    printf("Welcome to Meeting C++\n");
    printf("%d", add(2000,23));
    getch();
}
* 4:35

[ ] Message 3=[↑]
Compiling ..\PROJECTS\HELLO.C:
•Error ..\PROJECTS\HELLO.C 4: Return statement missing ;
Error ..\PROJECTS\HELLO.C 6: Declaration is not allowed here
Error ..\PROJECTS\HELLO.C 7: Declaration syntax error
Error ..\PROJECTS\HELLO.C 12: Declaration missing ;
Error ..\PROJECTS\HELLO.C 12: Compound statement missing }
Warning ..\PROJECTS\HELLO.C 12: Parameter 'a' is never used
Warning ..\PROJECTS\HELLO.C 12: Parameter 'b' is never used

F1 Help Space View source Edit source F10 Menu
```

# COMPILE TIME ERRORS OF OLD...





# COMPILE TIME ERRORS

```
#INCLUDE <Iostream>

INT MAIN() {
    STD::COUT << "WELCOME TO MEETING C++ 2023\n"
    RETURN 0;
}
```

X86-64 gcc 4.6.4

Compiler options...



<SOURCE>: IN FUNCTION 'INT MAIN()':

<SOURCE>:5:5: ERROR: EXPECTED ';' BEFORE 'RETURN'

# COMPILE TIME ERRORS

```
#INCLUDE <Iostream>

INT MAIN() {
    STD::COUT << "WELCOME TO MEETING C++ 2023\n"
    ;RETURN 0;
}
```

X86-64 gcc 4.6.4

Compiler options...



WELCOME TO MEETING C++ 2023

# COMPILE TIME ERRORS

```
#INCLUDE <Iostream>

INT MAIN() {
    STD::COUT << "WELCOME TO MEETING C++\n"
    RETURN 0;
}
```

X86-64 clang 3.3

Compiler options...



```
<SOURCE>:4:44: ERROR: EXPECTED ';' AFTER EXPRESSION
```

```
STD::COUT << "WELCOME TO MEETING C++\n"
```

```
          ^
```

```
          ;
```

```
1 ERROR GENERATED.
```

# COMPILE TIME ERRORS

```
#INCLUDE <Iostream>

INT MAIN() {
    STD::COUT << "WELCOME TO MEETING C++\N"
    RETURN 0;
}
```

X86-64 clang 17.0.1

Compiler options...



<SOURCE>:4:44: ERROR: EXPECTED ';' AFTER EXPRESSION

```
4 |     STD::COUT << "WELCOME TO MEETING C++\N"
  |                                                     ^
  |                                                     ;
```

1 ERROR GENERATED.

# COMPILE TIME ERRORS

```
#INCLUDE <Iostream>

INT MAIN() {
    STD::COUT << "WELCOME TO MEETING C++\N"
    RETURN 0;
}
```

X86-64 gcc (trunk)

Compiler options...



<SOURCE>: IN FUNCTION 'INT MAIN()':

<SOURCE>:4:44: ERROR: EXPECTED ';' BEFORE 'RETURN'

```
4 |     STD::COUT << "WELCOME TO MEETING C++\N"
  |                                                     ^
  |                                                     ;
5 |     RETURN 0;
  |     ~~~~~
```

# COMPILE TIME ERRORS - STANDARDS

```
#INCLUDE <IOSTREAM>

#include <FUNCTIONAL>

INT MAIN() {
[OUT = STD::REF(STD::COUT << "WELCOME TO ")](){ OUT.GET() << "MEETING C++ 2023\n"; }();
RETURN 0;
}
```

X86-64 clang 3.7

Compiler options...



<SOURCE>:5:2: ERROR: EXPECTED EXPRESSION

```
[OUT = STD::REF(STD::COUT << "WELCOME TO ")](){ OUT.GET() << "MEETING C++ 2023\n"; }();
^
```

1 ERROR GENERATED.

# COMPILE TIME ERRORS - STANDARDS

```
#INCLUDE <IOSTREAM>

#include <functional>

int main() {
    [out = std::ref(std::cout << "WELCOME TO ")]() { out.get() << "MEETING C++ 2023\n"; }();
    return 0;
}
```

X86-64 clang 3.7

-std=c++14



WELCOME TO MEETING C++ 2023

# 3 TYPES OF PROBLEMS (AT LEAST...)

- COMPILE TIME
  - ~~SYNTAX ERRORS (VIOLATE STANDARD, OR THAT WHICH IS IMPLEMENTED IN THE COMPILER)~~
  - TEMPLATES
- LINK TIME
  - MISSING LIBRARIES
  - VERSIONING ISSUES
- RUN TIME
  - LOGICAL ERRORS
  - SEMANTIC ERRORS (UNINITIALIZED VALUES – CORRECT STATEMENTS THAT DON'T MAKE SENSE)



## TEMPLATE ERRORS

DO YOU LOVE TEMPLATES?

# TEMPLATE ERRORS

```
#INCLUDE <VECTOR>
#include <ALGORITHM>

int main()
{
    int a;
    std::vector< std::vector<int> > v;
    std::find( v.begin(), v.end(), a );
}
```

X86-64 gcc 4.9.4

-std=c++14



/OPT/COMPILER-EXPLORER/GCC-4.9.4/INCLUDE/C++/4.9.4/BITS/STL\_ALGOBASE.H:71:0,

FROM /OPT/COMPILER-EXPLORER/GCC-4.9.4/INCLUDE/C++/4.9.4/VECTOR:60,

FROM <SOURCE>:1:

/OPT/COMPILER-EXPLORER/GCC-4.9.4/INCLUDE/C++/4.9.4/BITS/PREDEFINED\_OPS.H: IN INSTANTIATION OF 'bool  
\_\_gnu\_cxx::\_\_ops::\_Iter\_equals\_val<\_value>::operator()(\_iterator) [with \_iterator =  
\_\_gnu\_cxx::\_\_normal\_iterator<std::vector<int>\*, std::vector<std::vector<int> > >; \_value = const int]':

/OPT/COMPILER-EXPLORER/GCC-4.9.4/INCLUDE/C++/4.9.4/BITS/STL\_ALGO.H:120:22: required from '\_random\_access\_iterator  
std::\_\_find\_if(\_random\_access\_iterator, \_random\_access\_iterator, \_predicate, std::random\_access\_iterator\_tag) [with  
\_random\_access\_iterator = \_\_gnu\_cxx::\_\_normal\_iterator<std::vector<int>\*, std::vector<std::vector<int> > >; \_predicate =  
\_\_gnu\_cxx::\_\_ops::\_Iter\_equals\_val<const int>]'

/OPT/COMPILER-EXPLORER/GCC-4.9.4/INCLUDE/C++/4.9.4/BITS/STL\_ALGO.H:162:43: required from '\_iterator  
std::\_\_find\_if(\_iterator, \_iterator, \_predicate) [with \_iterator = \_\_gnu\_cxx::\_\_normal\_iterator<std::vector<int>\*,  
std::vector<std::vector<int> > >; \_predicate = \_\_gnu\_cxx::\_\_ops::\_Iter\_equals\_val<const int>]'

/OPT/COMPILER-EXPLORER/GCC-4.9.4/INCLUDE/C++/4.9.4/BITS/STL\_ALGO.H:3780:50: required from '\_iiter std::find(\_iiter,  
\_iiter, const \_Tp&) [with \_iiter = \_\_gnu\_cxx::\_\_normal\_iterator<std::vector<int>\*, std::vector<std::vector<int> > >; \_Tp =

# TEMPLATE ERRORS

```
#INCLUDE <VECTOR>
#include <ALGORITHM>

int main()
{
    int a;
    std::vector< std::vector<int> > v;
    std::find( v.begin(), v.end(), a );
}
```

X86-64 clang (trunk)

-std=c++14



IN FILE INCLUDED FROM <SOURCE>:1:

IN FILE INCLUDED FROM /OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../../../../../INCLUDE/C++/14.0.0/VECTOR:62:

IN FILE INCLUDED FROM /OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../../../../../INCLUDE/C++/14.0.0/BITS/STL\_ALGOBASE.H:71:

/OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../../../../../INCLUDE/C++/14.0.0/BITS/PREDEFINED\_OPS.H:270:17: ERROR: INVALID OPERANDS TO BINARY EXPRESSION ('std::vector<int>' AND 'const int')

```
270 |         { return *__it == _M_value; }
    |                   ~~~~~ ^ ~~~~~
```

# TEMPLATE ERRORS

DO YOU -WALL?

# TEMPLATE ERRORS

```
#INCLUDE <VECTOR>
#include <ALGORITHM>

int main()
{
    int a;
    std::vector< std::vector<int> > v;
    std::find( v.begin(), v.end(), a );
}
```

X86-64 clang (trunk)

-std=c++14



IN FILE INCLUDED FROM <SOURCE>:1:

IN FILE INCLUDED FROM /OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../INCLUDE/C++/14.0.0/VECTOR:62:

IN FILE INCLUDED FROM /OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../INCLUDE/C++/14.0.0/BITS/STL\_ALGOBASE.H:71:

/OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../INCLUDE/C++/14.0.0/BITS/PREDEFINED\_OPS.H:270:17: ERROR: INVALID OPERANDS TO BINARY EXPRESSION ('std::vector<int>' AND 'const int')

```
270 |         { return *__it == _M_value; }
    |                   ~~~~~ ^ ~~~~~
```

# TEMPLATE ERRORS

```
#INCLUDE <VECTOR>
#include <ALGORITHM>

int main()
{
    int a;
    std::vector< std::vector<int> > v;
    std::find( v.begin(), v.end(), a );
}
```

X86-64 clang (trunk)

-std=c++14 -Wall



<SOURCE>:7:36: WARNING: VARIABLE 'A' IS UNINITIALIZED WHEN PASSED AS A CONST REFERENCE ARGUMENT HERE [-Wuninitialized-const-reference]

```
7 | std::find( v.begin(), v.end(), a );
```

```
| ^
```

IN FILE INCLUDED FROM <SOURCE>:1:

IN FILE INCLUDED FROM /OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../INCLUDE/C++/14.0.0/VECTOR:62:

IN FILE INCLUDED FROM /OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../INCLUDE/C++/14.0.0/BITS/STL\_ALGOBASE.H:71:

/OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86\_64-LINUX-GNU/14.0.0/../../../../INCLUDE/C++/14.0.0/BITS/PREDEFINED\_OPS.H:270:17:  
ERROR: INVALID OPERANDS TO BINARY EXPRESSION ('std::vector<int>' AND 'const int')

```
270 | { return *_it == _M_value; }
```

```
| ~~~~~ ^ ~~~~~
```

# TEMPLATE ERRORS FIX

```
#INCLUDE <VECTOR>
#include <ALGORITHM>

int main()
{
    std::vector<int> A;
    std::vector< std::vector<int> > V;
    std::find( V.begin(), V.end(), A );
}
```

X86-64 clang (trunk)

-std=c++14



PROGRAM RETURNED: 0

# COMPILER WARNINGS AND OPTIONS

EVERYONE SHOULD...

**-Wall -Wextra -pedantic**

[HTTPS://GCC.GNU.ORG/ONLINEDOCS/GCC/WARNING-OPTIONS.HTML](https://gcc.gnu.org/onlinedocs/gcc/Warning-Options.html)



# COMPILER WARNINGS AND OPTIONS

IN FACT, EVERYONE SHOULD...

[HTTPS://GITHUB.COM/ CPP - BEST - PRACTICES/](https://github.com/cpp-best-practices/)

# AI TOOLING



[HTTPS://YOUTU.BE/19SR8XHN0BM](https://youtu.be/19Sr8XHN0BM)

[HTTPS://GITHUB.COM/PLASMA-UMASS/CWHY](https://github.com/plasma-umass/cwhy)

# 3 TYPES OF PROBLEMS (AT LEAST...)

- COMPILE TIME
  - ~~SYNTAX ERRORS (VIOLATE STANDARD, OR THAT WHICH IS IMPLEMENTED IN THE COMPILER)~~
  - ~~TEMPLATES~~
- LINK TIME
  - MISSING LIBRARIES
  - VERSIONING ISSUES
  - CANNOT FIND SYMBOLS
- RUN TIME
  - LOGICAL ERRORS
  - SEMANTIC ERRORS (UNINITIALIZED VALUES – CORRECT STATEMENTS THAT DON'T MAKE SENSE)

# LINKER ERRORS

- MISSING LIBRARIES
- VERSIONING ISSUES
- CANNOT FIND SYMBOLS

# LINKER ERRORS?

```
STRUCT A {  
    VIRTUAL ~A() = 0;  
};  
STRUCT B: A {  
    VIRTUAL ~B(){}  
};  
EXTERN INT X;  
VOID FOO();  
INT MAIN() {  
    X = 0;  
    FOO();  
    B B;  
}
```

X86-64 gcc 4.9.4

-Wall -Wextra



COMPILER RETURNED: 0

# LINKER ERRORS?

```
STRUCT A { VIRTUAL ~A() = 0; };  
STRUCT B: A { VIRTUAL ~B(){} };  
EXTERN INT X;  
VOID FOO();  
INT MAIN() {  
    X = 0;  
    FOO();  
    B B;  
}
```

X86-64 gcc (trunk)

-Wall -Wextra



```
/OPT/COMPILER-EXPLORER/GCC-TRUNK-20231113/BIN/ ../LIB/GCC/X86_64-LINUX-GNU/14.0.0/ ../.. / ../.. /X86_64-LINUX-GNU/BIN/LD:  
/TMP/CCMT70UG.0: IN FUNCTION `MAIN':
```

```
<SOURCE>:6: UNDEFINED REFERENCE TO `X'
```

```
/OPT/COMPILER-EXPLORER/GCC-TRUNK-20231113/BIN/ ../LIB/GCC/X86_64-LINUX-GNU/14.0.0/ ../.. / ../.. /X86_64-LINUX-GNU/BIN/LD:  
<SOURCE>:7: UNDEFINED REFERENCE TO `FOO()'
```

```
/OPT/COMPILER-EXPLORER/GCC-TRUNK-20231113/BIN/ ../LIB/GCC/X86_64-LINUX-GNU/14.0.0/ ../.. / ../.. /X86_64-LINUX-GNU/BIN/LD:  
/TMP/CCMT70UG.0: IN FUNCTION `B::~~B()':
```

```
<SOURCE>:2: UNDEFINED REFERENCE TO `A::~~A()'
```

```
COLLECT2: ERROR: LD RETURNED 1 EXIT STATUS
```

```
COMPILER RETURNED: 1
```

# LINKER ERRORS?

```
STRUCT A { VIRTUAL ~A() = 0; };  
STRUCT B: A { VIRTUAL ~B(){} };  
EXTERN INT X;  
VOID FOO();  
INT MAIN() {  
    X = 0;  
    FOO();  
    B B;  
}
```

X86-64 clang (trunk)

-Wall -Wextra



```
/OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86_64-LINUX-GNU/14.0.0/..../X86_64-LINUX-GNU/BIN/LD: /TMP/EXAMPLE-  
AFD2BD.0: IN FUNCTION `MAIN':
```

```
<SOURCE>:6: UNDEFINED REFERENCE TO `X'
```

```
/OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86_64-LINUX-GNU/14.0.0/..../X86_64-LINUX-GNU/BIN/LD: <SOURCE>:7:  
UNDEFINED REFERENCE TO `FOO()'
```

```
/OPT/COMPILER-EXPLORER/GCC-SNAPSHOT/LIB/GCC/X86_64-LINUX-GNU/14.0.0/..../X86_64-LINUX-GNU/BIN/LD: /TMP/EXAMPLE-  
AFD2BD.0: IN FUNCTION `B::~~B()':
```

```
<SOURCE>:2: UNDEFINED REFERENCE TO `A::~~A()'
```

```
CLANG++: ERROR: LINKER COMMAND FAILED WITH EXIT CODE 1 (USE -V TO SEE INVOCATION)
```

```
COMPILER RETURNED: 1
```

# 3 TYPES OF PROBLEMS (AT LEAST...)

- COMPILE TIME
  - ~~SYNTAX ERRORS (VIOLATE STANDARD, OR THAT WHICH IS IMPLEMENTED IN THE COMPILER)~~
  - ~~TEMPLATES~~
- LINK TIME
  - ~~MISSING LIBRARIES~~
  - ~~VERSIONING ISSUES~~
  - ~~CANNOT FIND SYMBOLS~~
- RUN TIME
  - LOGICAL ERRORS
  - SEMANTIC ERRORS (UNINITIALIZED VALUES – CORRECT STATEMENTS THAT DON'T MAKE SENSE)



# RUN TIME ERRORS

- WHAT THE COMPILER DOESN'T CATCH...
  - LOGICAL ERRORS
  - SEMANTIC ERRORS (UNINITIALIZED VALUES – CORRECT STATEMENTS THAT DON'T MAKE SENSE)

# SEMANTIC ERRORS

```
#INCLUDE <IOSTREAM>
#include <VECTOR>

INT PRODUCT(STD::VECTOR<INT>& NUMBERS) {
    INT PRODUCT;
    FOR (INT N : NUMBERS) { PRODUCT *= N; }
    RETURN PRODUCT;
}

INT MAIN() {
    STD::VECTOR<INT> NUMBERS = {1, 2, 3, 4, 5};
    STD::COUT << "PRODUCT: " << PRODUCT(NUMBERS) << STD::ENDL;
    RETURN 0;
}
```

X86-64 gcc (trunk)

-Wall -Wextra -Werror



PROGRAM RETURNED: 0

PRODUCT: 0

# SEMANTIC ERRORS

```
#INCLUDE <Iostream>
#include <vector>

int product(std::vector<int>& numbers) {
    int product;
    for (int n : numbers) { product *= n; }
    return product;
}

int main() {
    std::vector<int> numbers = {1, 2, 3, 4, 5};
    std::cout << "product: " << product(numbers) << std::endl;
    return 0;
}
```

X86-64 clang (trunk)

-Wall -Wextra -Werror



```
<SOURCE>:6:29: error: variable 'product' is uninitialized when used here [-Werror,-Wuninitialized]
```

```
6 |     for (int n : numbers) { product *= n; }
  |                                 ^~~~~~
```

```
<SOURCE>:5:16: note: initialize the variable 'product' to silence this warning
```

```
5 |     int product;
  |           ^
  |           = 0
```

```
1 error generated.
```

```
compiler returned: 1
```

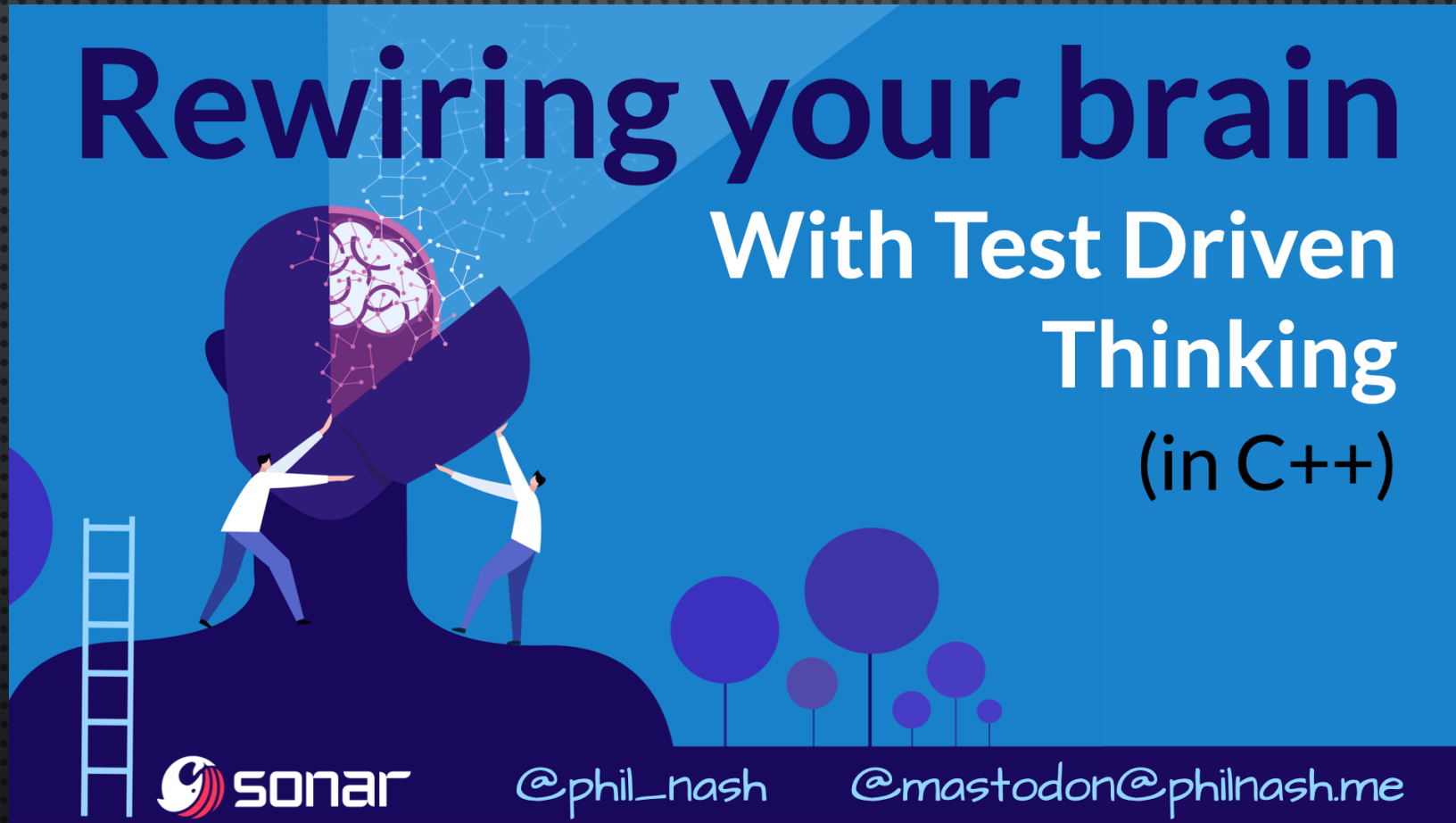
# 3 TYPES OF PROBLEMS (AT LEAST...)

- COMPILE TIME
  - ~~SYNTAX ERRORS (VIOLATE STANDARD, OR THAT WHICH IS IMPLEMENTED IN THE COMPILER)~~
  - ~~TEMPLATES~~
- LINK TIME
  - ~~MISSING LIBRARIES~~
  - ~~VERSIONING ISSUES~~
  - ~~CANNOT FIND SYMBOLS~~
- RUN TIME
  - LOGICAL ERRORS
  - ~~SEMANTIC ERRORS~~

# FINDING OTHER RUNTIME ERRORS

```
56 //-----  
57 TEST_CASE( "BCD - decimal_to_bcd 99", "[visa][unit][bcd]" ) {  
58     const int input = 99;  
59     std::bitset< byte_sz > correct{ str: "10011001" };  
60     std::bitset< byte_sz > incorrect{ str: "01111001" };  
61     auto sut: std::vector<std::uint8_t> = epx::decimal_to_bcd( n: input );  
62  
63     REQUIRE( correct ≠ incorrect );  
64     REQUIRE( std::bitset< byte_sz >{ sut[ 0 ] } ≠ incorrect );  
65     REQUIRE( std::bitset< byte_sz >{ sut[ 0 ] } = correct );  
66 }  
67  
68 //-----  
69 TEST_CASE( "BCD - decimal_to_bcd 45", "[visa][unit][bcd]" ) {  
70     const int input = 45;  
71     std::bitset< byte_sz > correct{ str: "01000101" };  
72     std::bitset< byte_sz > incorrect{ str: "01111001" };  
73     auto sut: std::vector<std::uint8_t> = epx::decimal_to_bcd( n: input );  
74  
75     REQUIRE( correct ≠ incorrect );  
76     REQUIRE( std::bitset< byte_sz >{ sut[ 0 ] } ≠ incorrect );  
77     REQUIRE( std::bitset< byte_sz >{ sut[ 0 ] } = correct );  
78 }
```


# TESTING AND TDD

An illustration on a blue background. A large, dark purple silhouette of a human head is shown in profile. Inside the head, a brain is depicted with a network of white nodes and lines, representing neural connections. Two small figures in white shirts and blue pants are standing on the neck of the head silhouette, reaching up to interact with the brain. A white ladder is positioned on the left side of the head. In the background, there are several stylized purple trees of varying sizes. The text 'Rewiring your brain' is written in a large, bold, dark blue font. Below it, 'With Test Driven Thinking' is written in a smaller, white font, and '(in C++)' is written in a smaller, white font below that. At the bottom left, there is a logo for 'sonar' with a stylized bird icon. To the right of the logo, the text '@phil\_nash' and '@mastodon@philnash.me' is written in a white, sans-serif font.

# Rewiring your brain

## With Test Driven Thinking

(in C++)

 @phil\_nash @mastodon@philnash.me

# 3 TYPES OF PROBLEMS (AT LEAST...)

- COMPILE TIME
  - ~~SYNTAX ERRORS (VIOLATE STANDARD, OR THAT WHICH IS IMPLEMENTED IN THE COMPILER)~~
  - ~~TEMPLATES~~
- LINK TIME
  - ~~MISSING LIBRARIES~~
  - ~~VERSIONING ISSUES~~
  - ~~CANNOT FIND SYMBOLS~~
- RUN TIME
  - ~~LOGICAL ERRORS~~
  - ~~SEMANTIC ERRORS~~

# SONAR LINT & CLANGD

- ⚠ Remove the commented out code. sonarlint(cpp:S125) [Ln 74, Col 3]
- ⚠ function 'handleSIGINT' could be declared with attribute 'noreturn' sonarlint(cpp:S5271) [Ln 78, Col 11]
- ⚠ Do not implicitly decay an array into a pointer; consider using g... clang-tidy([cppcoreguidelines-pro-bounds-array-to-pointer-decay](#)) [Ln 80, Col 11]
- ⚠ Use "function\_name" member function of "std::source\_location" instead of "\_\_func\_\_" predefined value. sonarlint(cpp:S6190) [Ln 80, Col 11]
- ⚠ Method 'dumpError' can be made static clang-tidy([readability-convert-member-functions-to-static](#)) [Ln 85, Col 11]
- ⚠ This function should be declared "const". sonarlint(cpp:S5817) [Ln 85, Col 11]
- ⚠ Pass expensive to copy object "error" by reference to const. sonarlint(cpp:S1238) [Ln 85, Col 21]
- ⚠ The parameter 'error' is copied for each invocation but only used as a const r... clang-tidy([performance-unnecessary-value-param](#)) [Ln 85, Col 28]
- ⚠ Use a trailing return type for this function (fix available) clang-tidy([modernize-use-trailing-return-type](#)) [Ln 91, Col 11]
- ⚠ This function should be declared "const". sonarlint(cpp:S5817) [Ln 91, Col 11]
- ⚠ Define and throw a dedicated exception instead of using a generic one. sonarlint(cpp:S112) [Ln 96, Col 13]
- ⚠ Define and throw a dedicated exception instead of using a generic one. sonarlint(cpp:S112) [Ln 101, Col 13]
- ⚠ Throw the exception by value. sonarlint(cpp:S1035) [Ln 110, Col 11]
- ⚠ Variable 'dumpReset' of type 'bool' can be declared 'const' (fix available) clang-tidy([misc-const-correctness](#)) [Ln 118, Col 3]
- ⚠ Do not implicitly decay an array into a pointer; consider using ... clang-tidy([cppcoreguidelines-pro-bounds-array-to-pointer-decay](#)) [Ln 124, Col 31]
- ⚠ Use "function\_name" member function of "std::source\_location" instead of "\_\_func\_\_" predefined value. sonarlint(cpp:S6190) [Ln 124, Col 31]
- ⚠ Variable 'tempConfiguration' of type 'json' (aka 'basic\_json<>') can be declared 'const' (fix av... clang-tidy([misc-const-correctness](#)) [Ln 130, Col 3]
- ⚠ function 'configThread' could be declared with attribute 'noreturn' sonarlint(cpp:S5271) [Ln 135, Col 11]



# OUR COMPILERS MATTER

- CLANG HAS (GENERALLY) ALWAYS DONE AN EXCELLENT JOB AT REPORTING.
- USE THE NEWEST COMPILER YOU CAN.
- EVEN ON AN OLDER COMPILER SET STANDARD LEVELS IF NECESSARY.
- ADD YOUR COMPILER OPTIONS

# MICROSOFT VISUAL STUDIO (WINDOWS)

/permissive- - Enforces standards conformance.

/W4 /w14640 - use these and consider the following (see descriptions below)

- /W4 All reasonable warnings
- /w14640 Enable warning on thread unsafe static member initialization

Not recommended


- /Wall - Also warns on files included from the standard library, so it's not very useful and creates too many extra warnings.
- Since VS2022, /external:anglebrackets /external:W0 can be used to turn off warnings from all headers included with angle brackets, e.g. #include <utility>.

WHEN THE PROBLEM PERSIST...

*“IT’S NOT THAT I’M SO SMART, IT’S JUST THAT I STAY  
WITH PROBLEMS LONGER”*

*ALBERT EINSTEIN*

CPP WEEKLY



Reviewing My  
25 yo C++ Code...

**IT'S BAD**

[HTTPS://WWW.YOUTUBE.COM/@CPPWEEKLY/SEARCH](https://www.youtube.com/@CPPWEEKLY/SEARCH)

BUILD YOUR INTUITION

USE EVERY RESOURCE YOU CAN

# SUBMIT A TALK!

- SPEAKER LIAISON
  - CPPCON
- VOLUNTEER LIAISON
  - ACCU
  - C++ Now
  - CPPONSEA



[HTTPS://WWW.LINKEDIN.COM/IN/KEVINBCARPENTER/](https://www.linkedin.com/in/kevinbcarpenter/)

EMAIL: [KEVIN.CARPENTER@LIVE.COM](mailto:KEVIN.CARPENTER@LIVE.COM)