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BeC++

Minimal Logging in C++ 20

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Existing approaches
01 Qt

- Streaming operators
  - Automatic newlines
- Severities
  - qInfo()
  - qDebug()
  - qWarning()
- Categories
- Output configured at runtime
  - Filtering (category + severity)
  - Output format

Existing approaches
02 iostream

- Anything you want
  - i.e., use std::cout

- Could use macros to avoid repetition
  - __FILE__
  - __FUNCTION__
  - __LINE__

```
#define LOG(message) \
std::cout << __FILE__ << "(" << __LINE__ << ") `" << __FUNCTION__ << "`: " message "\n";
```

  - I do not like macros …

Existing approaches
03 SourceLocation

- C++ 20 std::source_location
  - #include <source_location>

```
void log(const std::string_view message,
        const std::source_location location = std::source_location::current())
{
   std::cout << location.file_name() << "(" << location.line()
          << ") `" << location.function_name() << "`: " << message << '\n';
}
```

- Prevent macros using default argument
  - Requires compiler support

Existing approaches

- Why code names?
- Also: why log plain text*
  - Hard to process in automated systems
- How about the debugger?

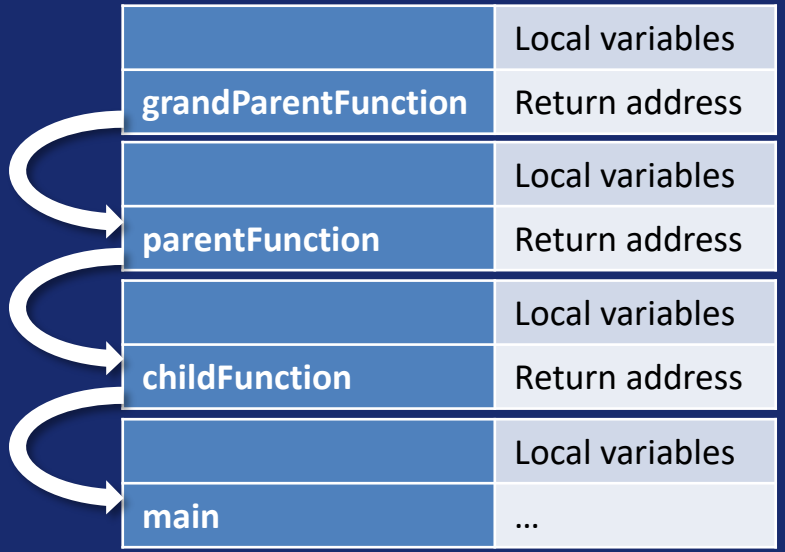
*: There is no such thing as plain text Plain Text - Dylan Beattie - NDC Oslo 2021

VANDEWIELE | Intermezzo 1 : Debugger

Debugger | GDB for "00-NoLogging" | Threads:

Level	Function	File	Line	Address
1	grandParentFunction	00-NoLoggingMain.cpp	3	0x7ff7ce961534
2	parentFunction	00-NoLoggingMain.cpp	7	0x7ff7ce961548
3	childFunction	00-NoLoggingMain.cpp	11	0x7ff7ce96155e
4	main	00-NoLoggingMain.cpp	16	0x7ff7ce961579

- Knows this already …
- Stack frames
  - Function call = new stack frame
  - Contains return address
- “Stack walking”
  - Reverse walk from current
- Look up addresses in debugging info



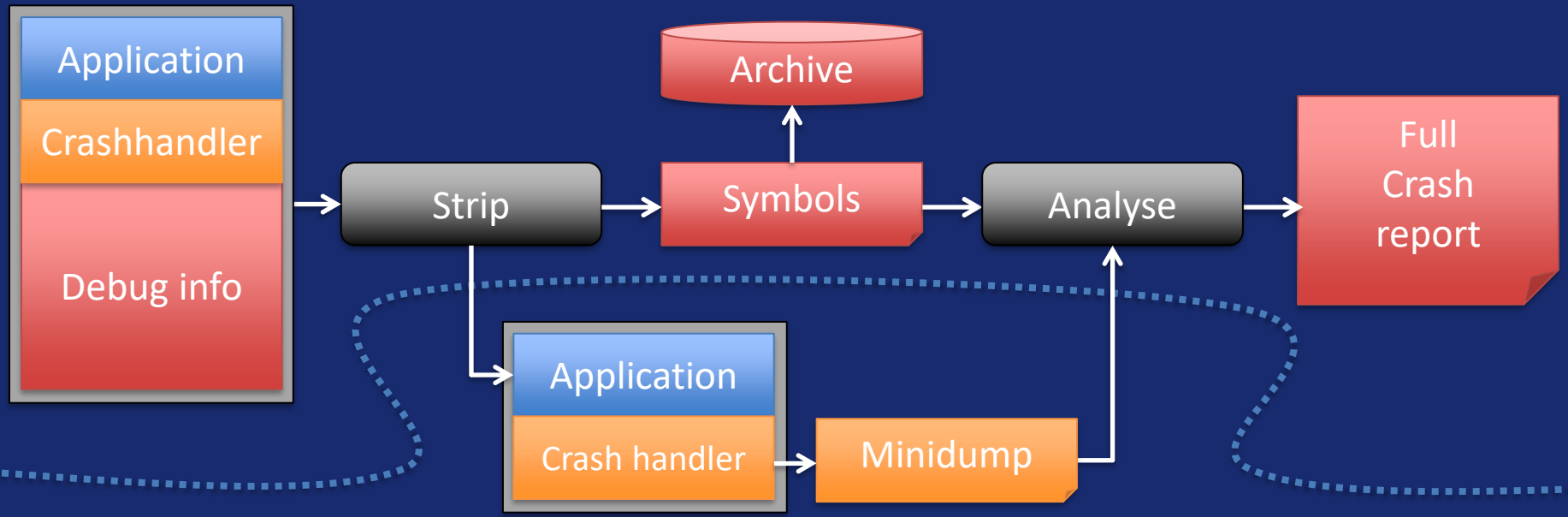
Existing approaches

- Include debugging symbols?
- No!
  - Increases binary size significantly
  - Intellectual property
    - void **writePropietaryFileFormat**(…)
  - Security risk
    - SuperSecretSoftwareProtection.cpp
    - bool **checkLicenseKey**(…)

	Without	With
No logging	37 KB	69 KB
Qt	42 KB	419 KB
iostream	40 KB	94 KB
SourceLocation	40 KB	105 KB

Intermezzo 2: Crash dumps

- Crash dump contains stack
  - Use “Stack walking” to determine location



Based on https://github.com/google/breakpad/blob/main/docs/getting_started_with_breakpad.md

Symbols for logging?

- Using symbols
  - Translate back to
    - Function
    - File/line
    - …
- What else is required?
  - The instruction pointer
    - Special register, cheap to obtain

Minimal Logging
Unit tests

- Live coding is a risk
  - Unit tests as safety net
- Run tests for non-compiling code?
  - C++20 Concepts to the rescue!

```
if constexpr (requires(Logger l) {
        l.rocketscience();
    })
{
    Logger logger;
    logger.rocketscience();
    …
}
else
{
    QSKIP(“Does not compile");
}
```

Minimal Logging Phase 1/3

- Trace the instruction pointer
  - Retrieve it using inline assembly
  - Write it into a buffer

- Test translation back into
  - Function
  - File & line
    - This does not work ~ compiler support std::source_location::current
    - Could be done using macros

Minimal Logging
Phase 1/3: remarks

- (Reserved field for next phases)
- uintptr_t
  - Representation of an address
- No string literals in the binary
  - Actually using the symbols file
- C++11 __attribute__((always_inline))
  - Impact inlining (still requires optimized build)

Minimal Logging Phase 2/3

- Add time information
  - std::chrono

Minimal Logging
Phase 2/3: remarks

- Choose a clock
  - Clock dependent types to not loose data
- Type safe handling of time
  - Was it sleep(seconds) or sleep(milliseconds)?
  - See also Boost::Units

Minimal Logging
Phase 3/3

- Argument
- Arguments

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Minimal Logging
Phase 3/3: remarks

- Use std::tuple like structure to represent arguments
  - Use custom packed type to avoid padding
- How to decode?
  - Trace the trace method
- C++17 std::any to represent data
  - Type safe union
- __attribute__((used)) to avoid function collapsing
  - LLVM specific?

Minimal Logging
Open points

- Resolving file:line
  - Any ideas?
- Symbol versioning
  - Link with source code revision
- Shared libraries
  - All log to the same buffer
  - Special handling for symbols
- Thread safety
  - Lock free buffer
- Handling of fixed literals
  - Why log constant information?
- Include in crash dumps
  - Already the case (stack allocated)

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Minimal Logging Framework in C++ 20

Questions?

1. How about strings?
2. How does this compare to spdlog (gabime/spdlog: Fast C++ logging library. (github.com))

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Minimal Logging Framework in C++ 20

inspired by Expertise

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