Using Clang for fun and profit

Examples from the Chromium project

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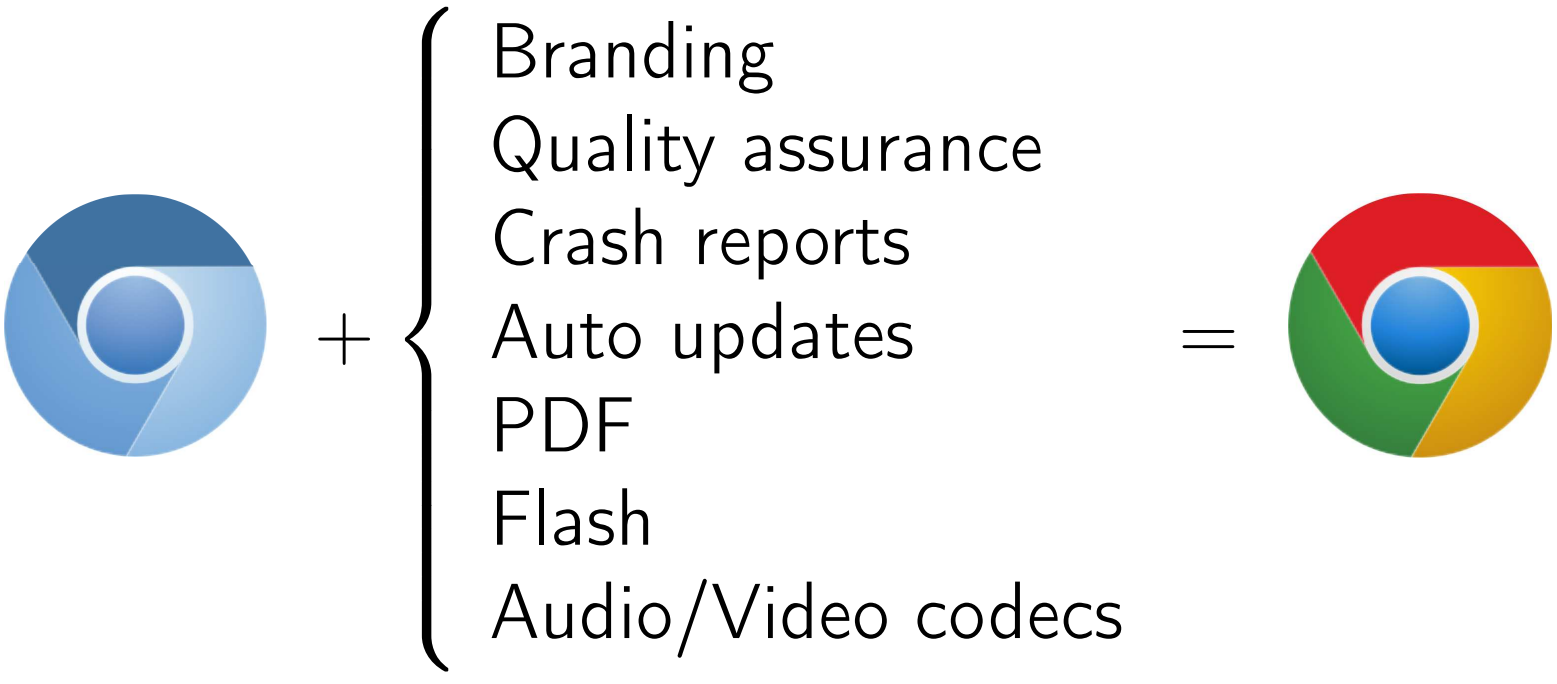
Outline

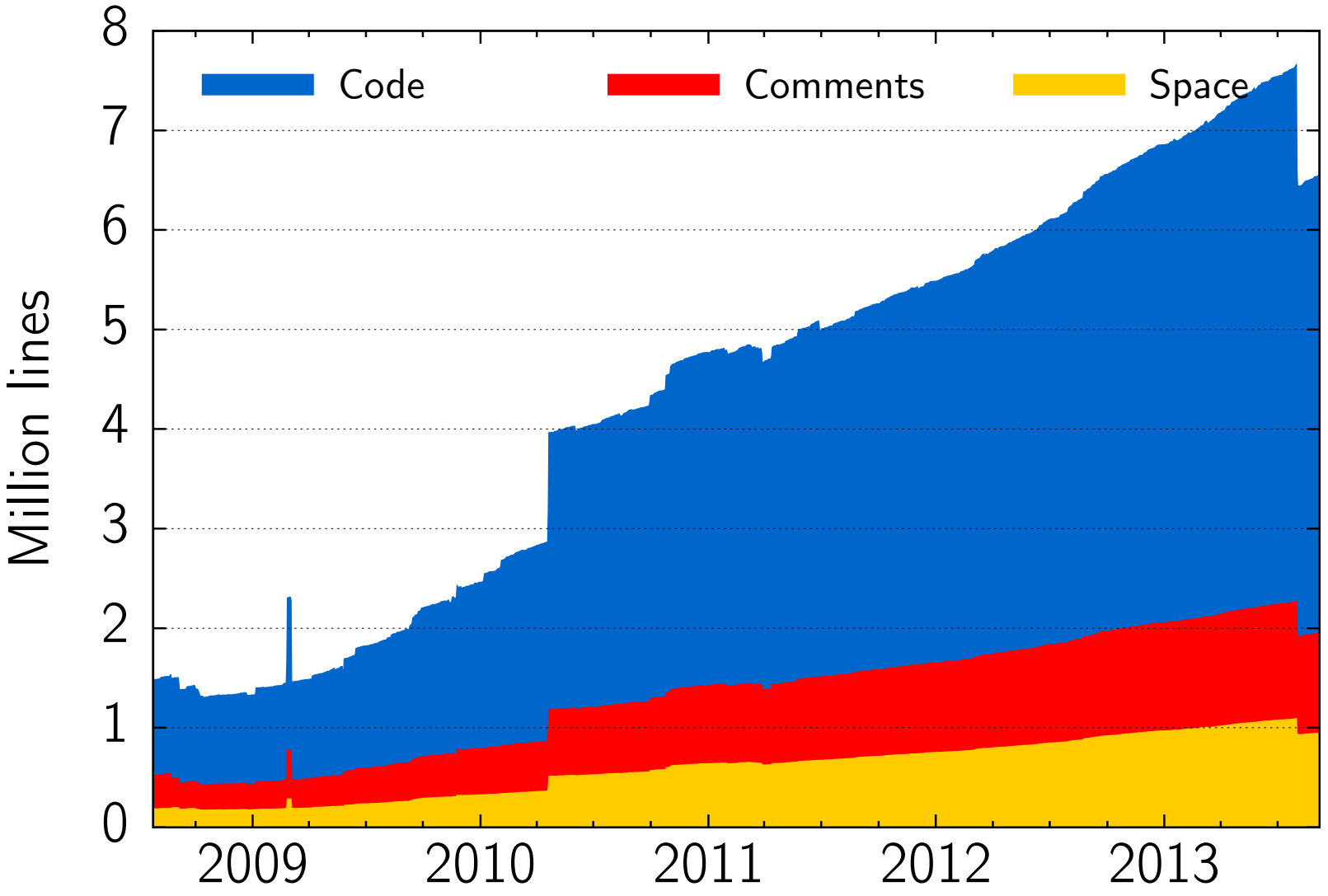
Introducing Chrome

- A web browser from Google
- First released 2008
- Pushing the web forward
- 750 M active users (May 2013)
- Windows, Mac, Linux, ChromeOS, Android, iOS
- Mostly open source.

Chromium vs. Chrome



The Code

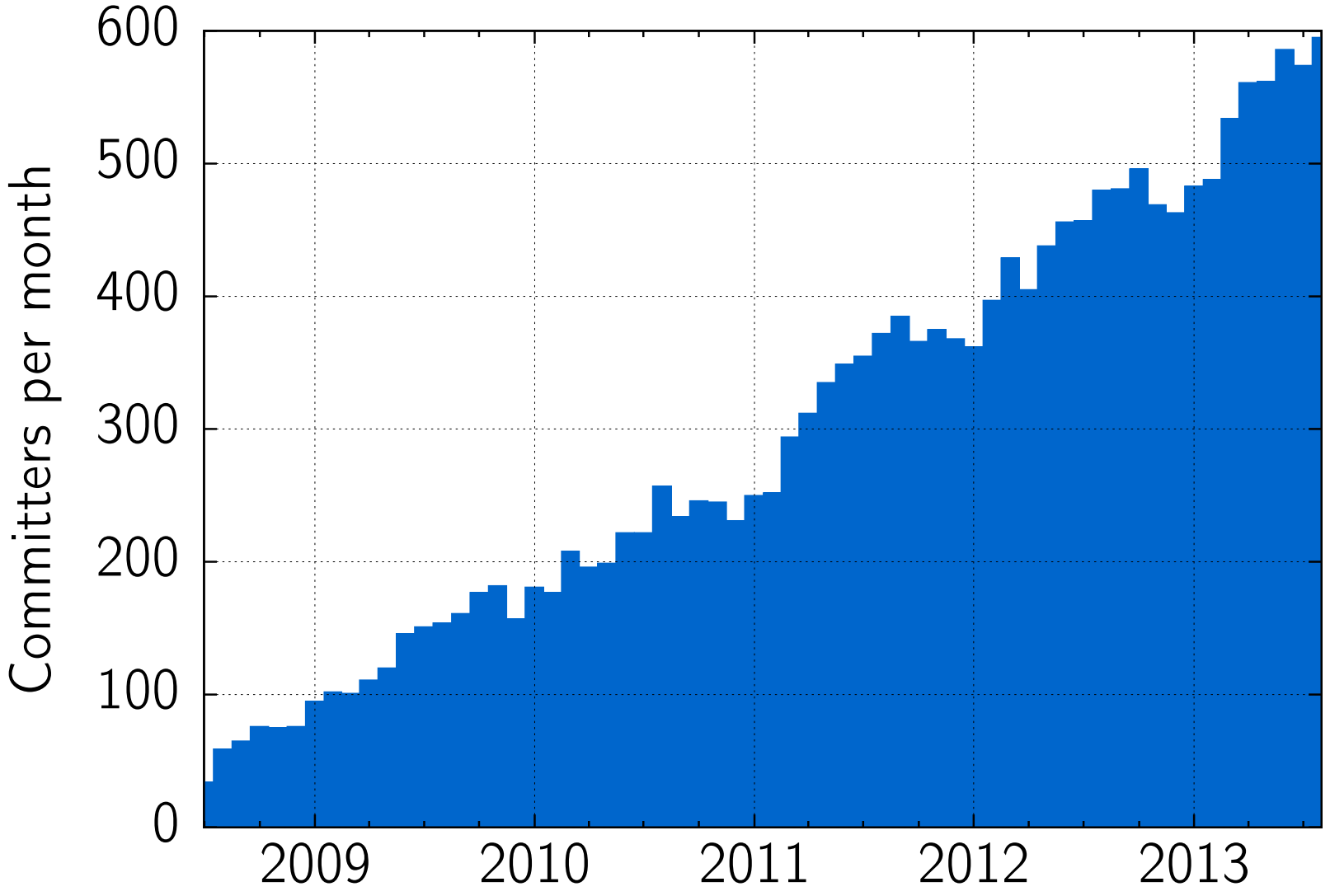

Code
Comments
Space
Million lines
0
1
2
3
4
5
6
7
8
2009
2010
2011
2012
2013

The Code (continued)

5 M lines more in third-party libraries:

- Blink
- V8
- angle
- breakpad
- ffmpeg
- flac
- gmock
- googleurl
- gtest
- hunspell
- icu
- jsoncpp
- leveldb
- libjingle
- libsrtp
- libvpx
- lss
- NaCl
- nss
- sfntly
- skia
- webrtc
- ...

The People


Committers per month
600
500
400
300
200
100
0
2009
2010
2011
2012
2013

Clang

- Up-and-coming C++, C, Objective-C compiler
- Part of the LLVM project
- Announced 2007 by Apple
- Production quality compiler since ca 2010
- Open-source, BSD-style license
- Designed to be GCC compatible.

Clang in Chromium

- Used since 2010
- Work on 20% time by three Googlers
- Used for Mac binaries, and more.

What makes Clang interesting?

- Fast
- Good output
- Clear error messages
- High quality warnings
- Hackable and extendable.

The missing semicolon (GCC 4.6)

```
int f(int x) {
        int s = 0
        for (int i = 0; i < x; ++i)
                s += i;
        return s;
}
```

```
a.cc: In function 'int f(int)':
a.cc:3:9: error: expected ',' or ';' before 'for'
a.cc:3:25: error: 'i' was not declared in this scope
a.cc:3:35: error: expected ';' before ')' token
```

The missing semicolon (Clang)

```
int f(int x) {
        int s = 0
        for (int i = 0; i < x; ++i)
                s += i;
        return s;
}
```

```
a.cc:2:18: error: expected ';' at end of declaration
        int s = 0
                 ^
                 ;
1 error generated.
```

The missing semicolon (GCC 4.9 trunk)

```
a.cc: In function 'int f(int)':
a.cc:3:9: error: expected ',' or ';' before 'for'
         for (int i = 0; i < x; ++i)
         ^
a.cc:3:25: error: 'i' was not declared in this scope
         for (int i = 0; i < x; ++i)
                         ^
```

Typo correction

```
a.cc:5:9: error: use of undeclared identifier 'dout';
      did you mean 'cout'?
        dout << "Hello, world!" << endl;
        ^~~~
        cout
```

The Conditional Operator

```
int f(bool b, int x, int y) {
  return 7 + b ? x : y;
}
```

The Conditional Operator

```
a.cc:2:16: warning: operator '?:' has lower precedence
      than '+'; '+' will be evaluated first
  return 7 + b ? x : y;
         ~~~~~ ^
a.cc:2:16: note: place parentheses around the '?:'
      expression to evaluate it first
  return 7 + b ? x : y;
               ^
             (       )
1 warning generated.
```

The Boolean Accident

```
void f(bool *delete_user_data) {
        if (!migrate_data_to_new_location()) {
                delete_user_data = false;
                return;
        }

        ...
}
```

The Boolean Accident

```
a.cc:5:36: warning: initialization of pointer of type
    'bool *' to null from a constant boolean expression
                delete_user_data = false;
                                   ^~~~~
```

Hackability

- Clang is extendable
- It is a set of libraries
- We can use it to build tools.

Chromium Style Checker

- Mark functions `virtual` explicitly
- Use `override` for overriding functions
- ...

Chromium Style Checker

```
a.cc:8:5: warning: [chromium-style] Overriding
      method must have "virtual" keyword.
    void f();
    ^
    virtual
1 warnings generated.
```

clang-format

- Formatting is important
- Formatting is boring
- Automatic formatting of C++ is hard.

AddressSanitizer (ASan)

- Fast memory error detector for C, C++, etc.
- Compile-time instrumentation
- Typically ca 2x slow-down
- Catches many kinds of errors.

ThreadSanitizer (TSan)

- Data race detector for C, C++, etc.
- Uses Clang/LLVM to insert compile-time instrumentation
- Overhead is large but not crazy
- Points out racy situations.

Undefined Behavior Sanitizer (UBSan)

- C and C++ have a thing called undefined behaviour
- Division by zero, array overflow, NULL ptr deref, etc.
- Helps efficient language implementation
- Also source of subtle bugs
- UBSan tries to catch those bugs for you.

Fun and Profit.

References

- www.chromium.org
- clang.llvm.org
- blog.llvm.org/2013/09/clang-warnings.html
- code.google.com/p/chromium/wiki/WritingClangPlugins
- clang.llvm.org/docs/ClangFormat.html
- code.google.com/p/address-sanitizer/