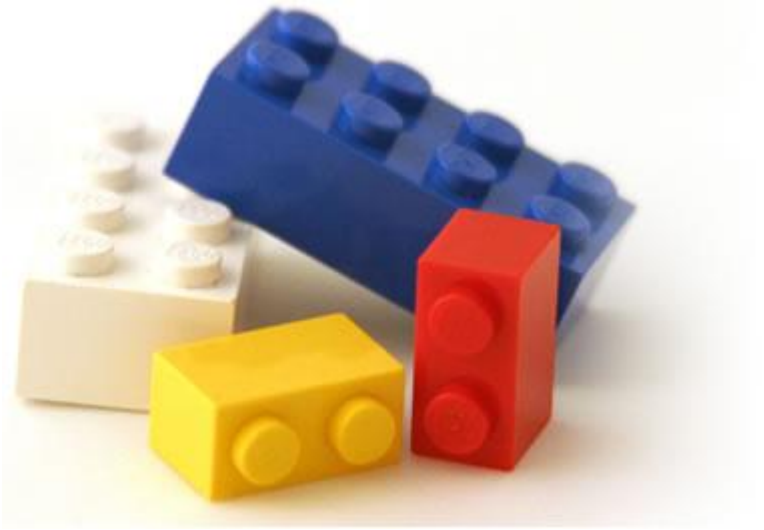
Shake Before Building

Replacing Make with Haskell

Neil Mitchell



community.haskell.org/~ndm/shake

General Purpose Build Systems

h
h
c#
C++
λ
PDF
Adobe

+ Rules

☒ Visual Studio

☒ ghc –make

☒ Cabal

☑ make

☑ Cmake

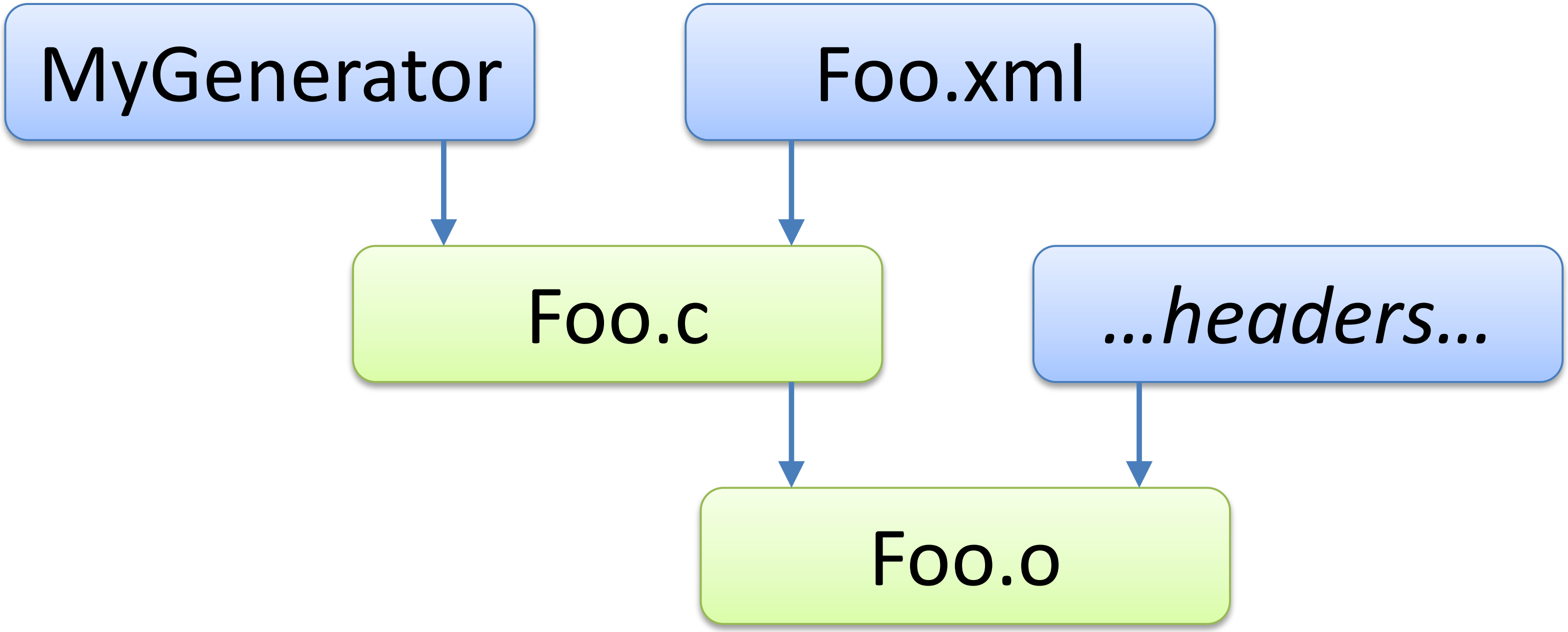
☑ Scons

☑ Waf

☑ Ant

☑Shake

Generated files



- What headers does Foo.c import?

  (Many bad answers, exactly one good answer)

Dependencies in Shake

```
"Foo.o" *> \_ -> do
  need ["Foo.c"]
  (stdout,_) <-
    systemOutput "gcc" ["-MM","Foo.c"]
  need $ drop 2 $ words stdout
  system' "gcc" ["-c","Foo.c"]
```

- Fairly direct
  – What about in make?

Make requires *phases*

```
Foo.o : Foo.c
    gcc –c Foo.o
```

```
Foo.o : $(shell sed … Foo.xml)
```

```
Foo.mk : Foo.c
    gcc –MM Foo.c > Foo.mk
#include Foo.mk
```

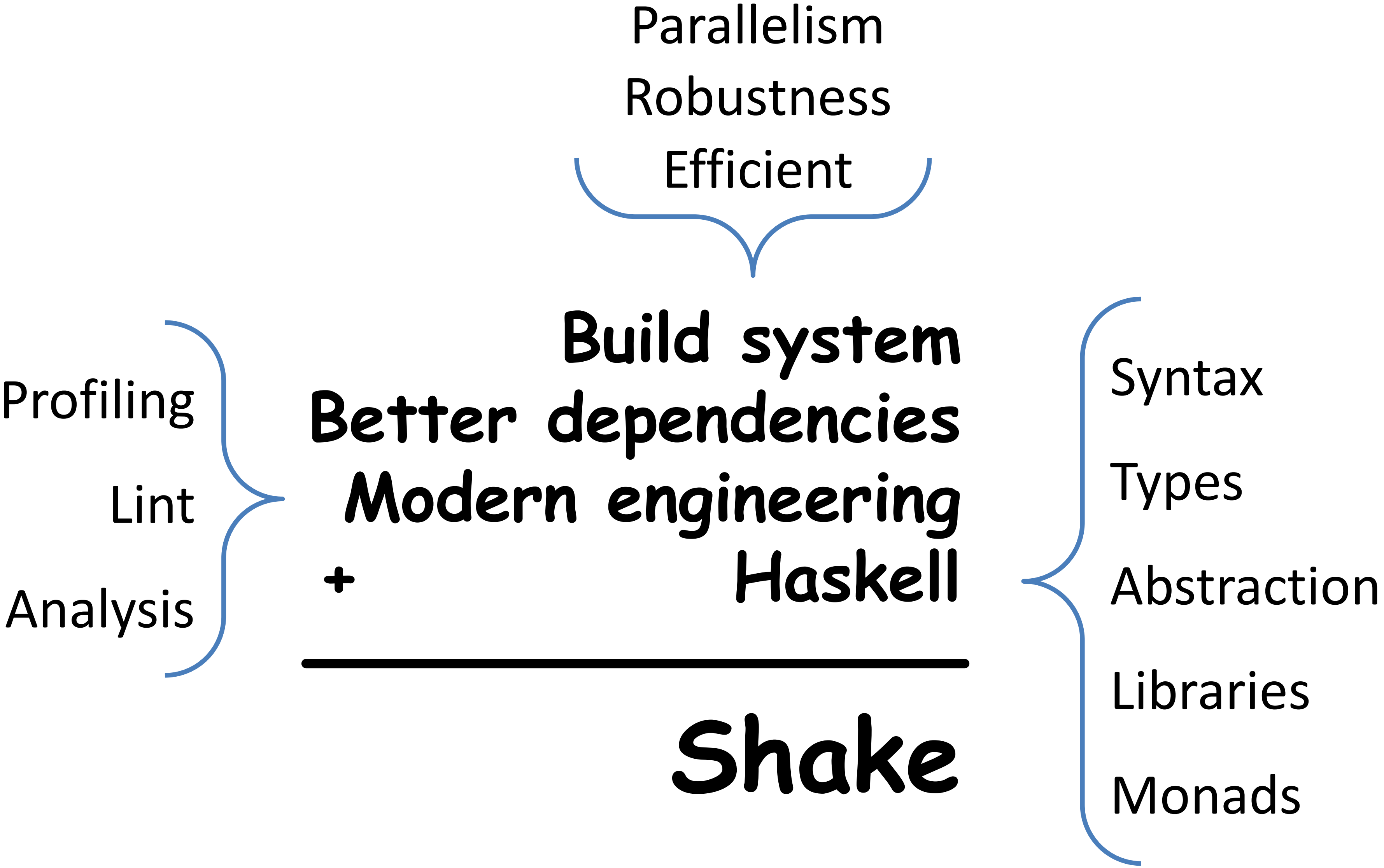
Disclaimer: make has hundreds of extensions, none of which form a consistent whole, but some can paper over a few cracks listed here

Dependency differences

- Make
  - Specify all dependencies *in advance*
  - Generate static dependency graph
- Shake
  - Specify additional dependencies *after* using the results of previous dependencies

$$\boxed{\mathbf{D}_{\text{shake}} > \mathbf{D}_{\text{make}}}$$

A build system with a static dependency graph is insufficient



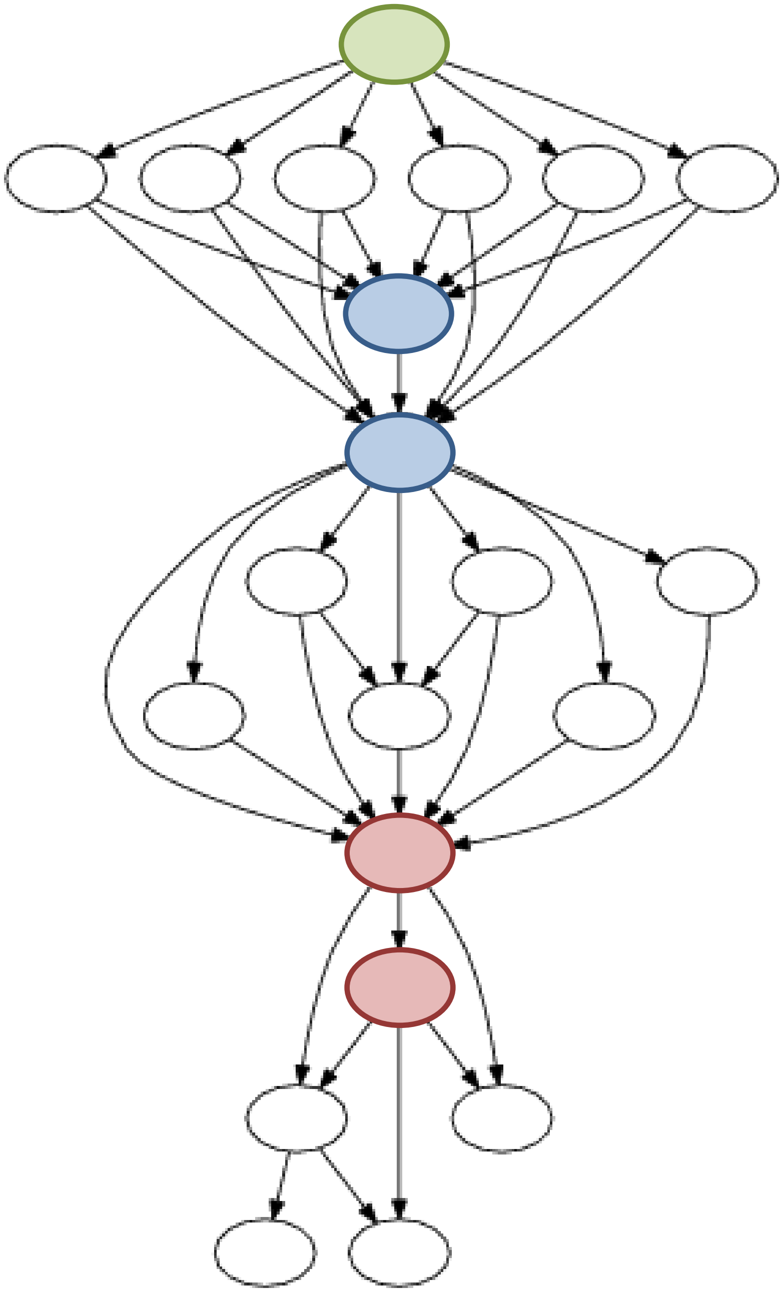
Parallelism
Robustness
Efficient

Profiling
Lint
Analysis

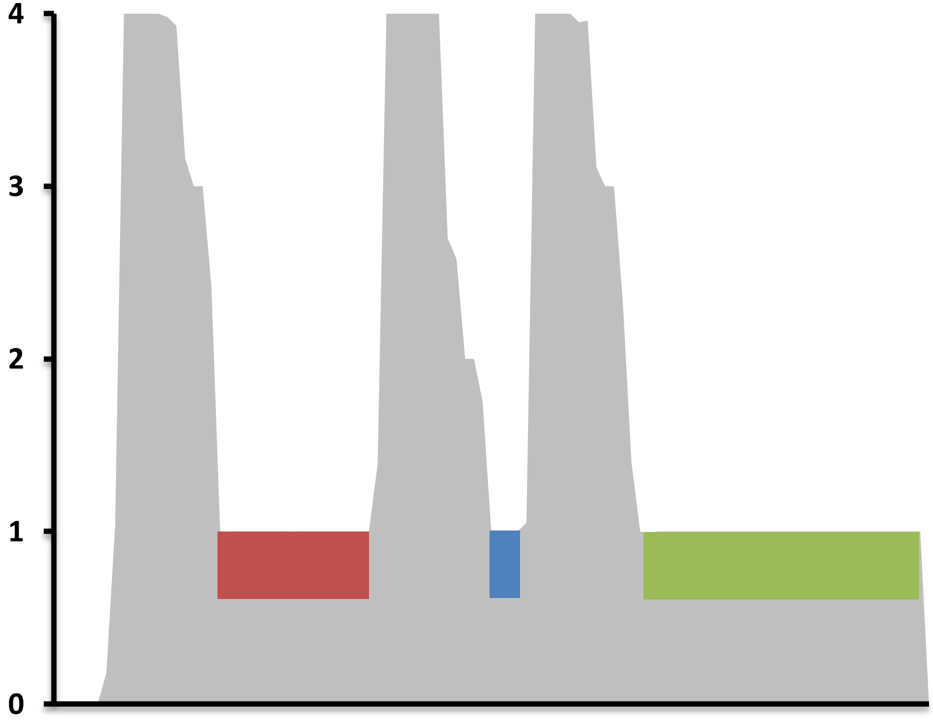
Build system
Better dependencies
Modern engineering
+ Haskell

Shake

Syntax
Types
Abstraction
Libraries
Monads



Profiling



Identical performance to make

Shake at Standard Chartered

- In use for 3 years
  - 1M+ build runs, 30K+ build objects, 1M+ lines source, 1M+ lines generated
- Replaced 10,000 lines of Makefile with 1,000 lines of Shake scripts
  - Twice as fast to compile from scratch
  - Massively more robust

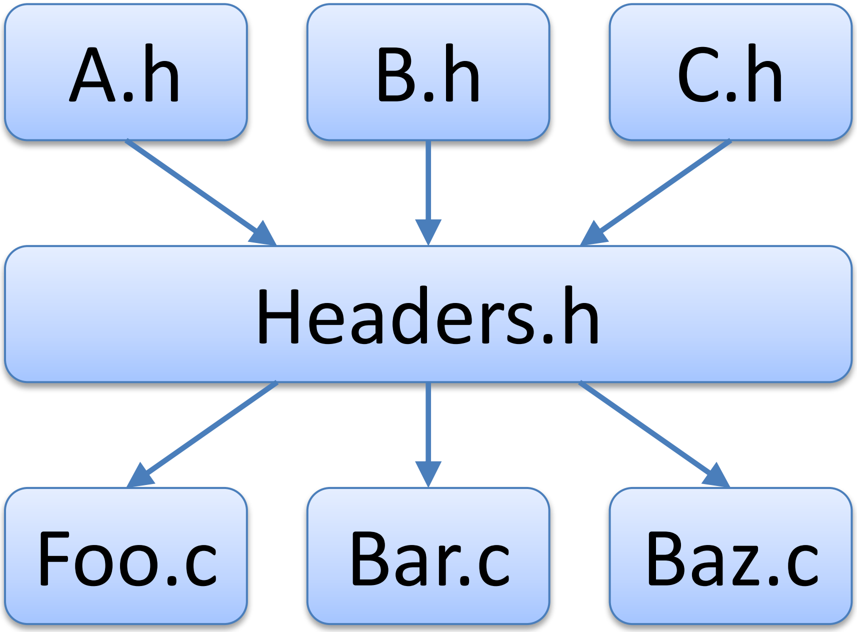
Disclaimer: I am employed by Standard Chartered Bank. This paper has been created in a personal capacity and Standard Chartered Bank does not accept liability for its content. Views expressed in this paper do not necessarily represent the views of Standard Chartered Bank.

Shake vs make:
10x shorter, 2x faster*

*for one real example

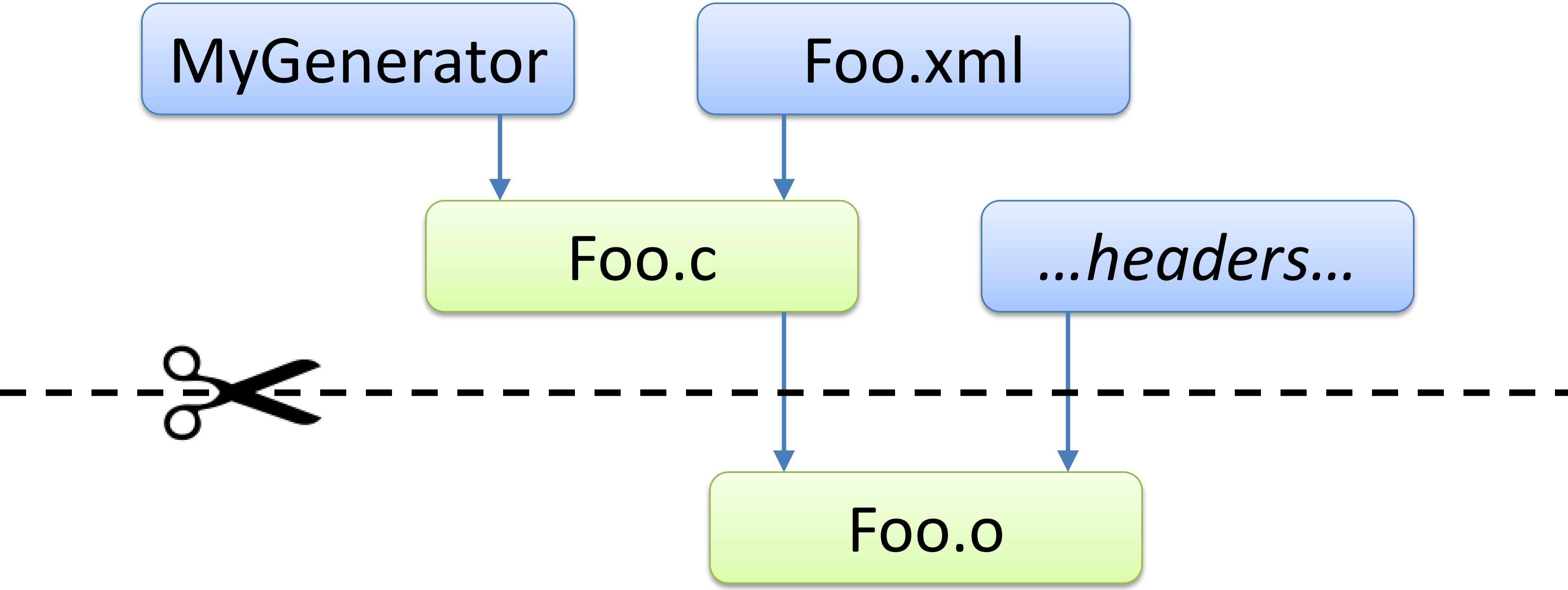
Faster 1 of 4: Less work

- gcc -MM finding headers has bad complexity
  - At large enough scale, it really matters



Scan each header once, instead of once per inclusion

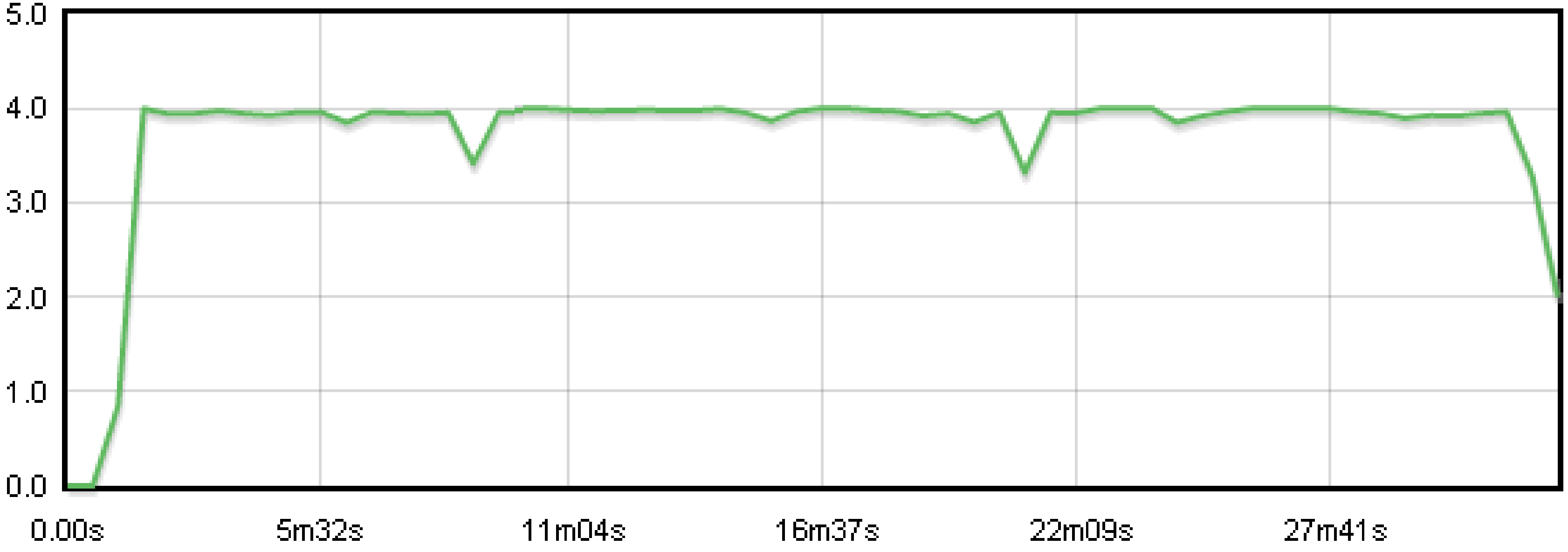
Faster 2 of 4: Less rebuilds



```
commit decea285a863ff147f53d3748aac8b13
Author:  Neil Mitchell <neil@bigproject.com>
Comment: MyGenerator, whitespace only
```

Faster 3 of 4: More parallelism

- Big project ≈ perfect parallelism
  - – No unnecessary dependencies
  - – Depend on only part of a file
  - – No phases (overly coarse dependencies)



Faster 4 of 4: Better parallelism

- Random thread pool = 20% faster
  - – Avoid all compiles then all links

Compiling

Linking

Shake outside a bank

- At least 10 Haskell build libraries
  - 3 are Shake inspired implementations
- 2 Shake addon libraries

> There's a bit of scaffolding to get going, but the flexibility is really worth it to be able to handle auto-generated files easily.

Blueprint Cake Hake Nemesis Zoom

Abba Coadjute Cake Hmk OpenShake

More information

ICFP paper

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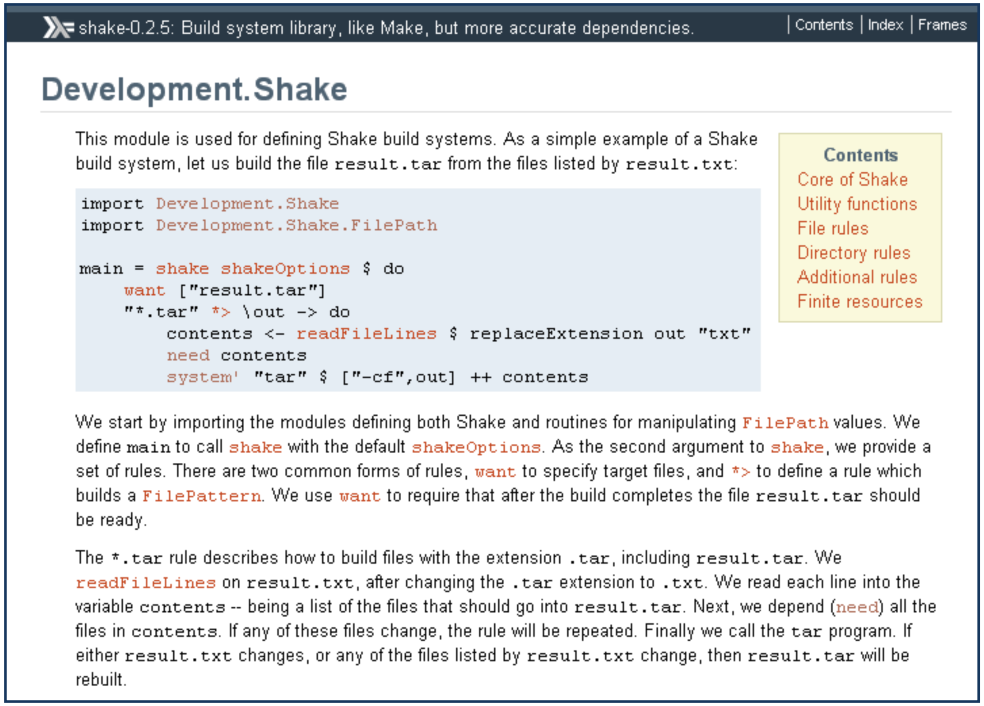
Hackage (shake)



shake-0.2.5: Build system library, like Make, but more accurate dependencies.

Development.Shake

This module is used for defining Shake build systems. As a simple example of a Shake build system, let us build the file `result.tar` from the files listed by `result.txt`:

```
import Development.Shake
import Development.Shake.FilePath

main = shake shakeOptions $ do
    want ["result.tar"]
    "*.tar" *> \out -> do
        contents <- readFileLines $ replaceExtension out "txt"
        need contents
        system' "tar" $ ["-cf",out] ++ contents
```

We start by importing the modules defining both Shake and routines for manipulating `FilePath` values. We define `main` to call `shake` with the default `shakeOptions`. As the second argument to `shake`, we provide a set of rules. There are two common forms of rules, `want` to specify target files, and `*>` to define a rule which builds a `FilePattern`. We use `want` to require that after the build completes the file `result.tar` should be ready.

The `*.tar` rule describes how to build files with the extension `.tar`, including `result.tar`. We `readFileLines` on `result.txt`, after changing the `.tar` extension to `.txt`. We read each line into the variable `contents` -- being a list of the files that should go into `result.tar`. Next, we depend (`need`) all the files in `contents`. If any of these files change, the rule will be repeated. Finally we call the `tar` program. If either `result.txt` changes, or any of the files listed by `result.txt` change, then `result.tar` will be rebuilt.