"Rakud'oh!"

Making our compiler smarter

Jonathan Worthington

Rakudo *

Rakudo *

What we were working towards last time I was here at the Dutch Perl Workshop

Rakudo *

Released last summer

Rakudo *

Plenty to be happy about...

Gave people a feel for the power and beauty of Perl 6

Chained Comparisons Junctions
Classes Signatures Grammars
Perl 6 Regexes Multi-dispatch
Lazy Lists Series Operator
Roles Introspection Traits
Meta-Operators Feeds MAIN
Smart-matching Modules
Native Library Calls Book

Covered A Wide Range of Perl 6 Features

Led to some weird areas of the spec getting worked out

Release attracted more people to the Perl 6 community

Rakudo *

...but plenty of weaknesses

Most things run slowly.
Some run glacially slowly.

High memory usage - both base amount and when running

Various unhelpful errors and failure modes

Weak in areas of language extensibility

Make it work

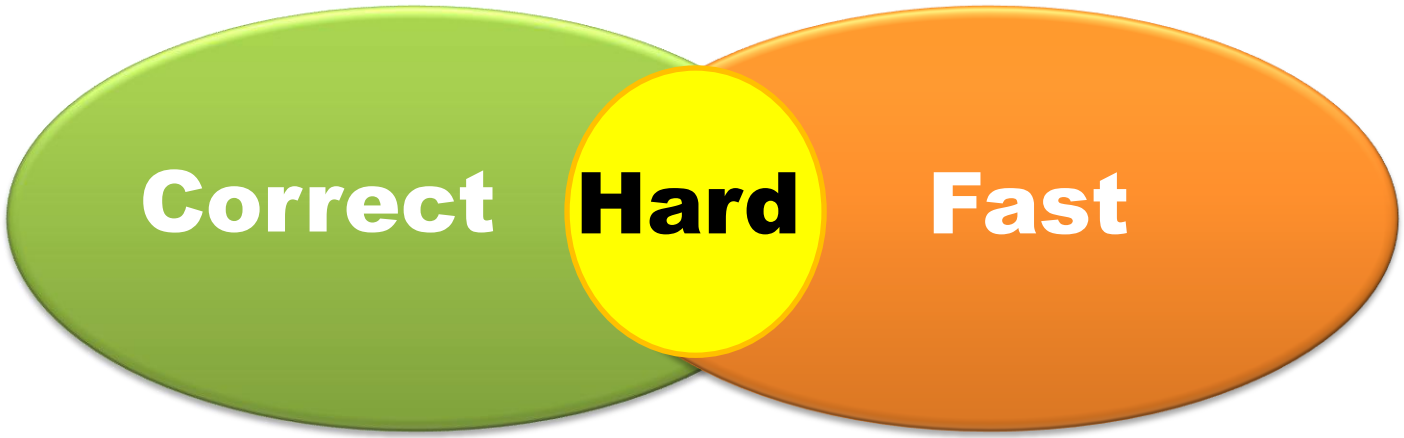
THEN

Make it fast

Many things needed a few tries to get them correct.

(A few things needed many tries to get them correct. ☺)

The quick way to implement a feature with the correct semantics is very rarely the optimal one.



Didn't want to waste time making the wrong thing fast.

Now the development focus is changing.

Many implemented features now relatively stable.

Missing features aren't our main adoption blocker, but speed and memory usage are.

Some things in Rakudo today just make you say "D'oh!"

Need to make Rakudo smarter

More analysis on the code that is being compiled

More awareness of the context of the compilation

The traditional view

Compile Time | **Run Time**

The Perlish view

Compile Time ⋮ **Run Time**

Some of the

we're working on fixing now

Boxed constants created every usage

```
$x = 42;
```

Should construct them once at compile time and stash them away in a constants table

Speed win: less time making objects, less GC churn

Overweight Types

How many GC-able objects should a boxed integer be?

Overweight Types

How many GC-able objects should a boxed integer be?

Today, three...

Overweight Types

How many GC-able objects should a boxed integer be?

Today, three...

Should, of course, be one.
It will be. Less memory, less to allocate, less GC churn.

Slow Type Checks

Today, doing a type check tends to involve a method call and/or a bunch of named lookups

High cost for a relatively common operation

In new OO implementation, usually just a few pointer comparisons

Attribute Access

Anyone spot the typo?

```
class Golf {
    has $!player;
    has $!tee;
    method play() {
        $!player.goto($!pee);
    }
}
```

Attribute Access

Anyone spot the typo?

```
class Golf {
    has $!player;
    has $!tee;
    method play() {
        $!player.goto($!pee);
    }
}
```

Should detect and report at compile time, not runtime.

(Even for custom meta-objects.)

Attribute Access

Often, we can map attributes to slot indexes at compile time.

```
…
    has $!player;    0
    has $!tee;       1

…                    …
```

Then attribute access will be mostly pointer follows, rather than needing to do hash lookups

Too Many Allocations

Various common operations currently end up allocating an object as they do their work

Multi-dispatch cache lookups
Method lookups

They will stop doing so. Making them faster, and less GC churn.

Type info not used

Will this code ever work?

```
my Int $x = 4.2;
```

Type info not used

Will this code ever work?

```
my Int $x = 4.2;
```

No, so complain about it at compile time!

Today that's harder to implement than it should be. Soon we'll have the infrastructure to do so.

Type info not used

Which multi-dispatch candidate will be called here?

```
multi foo(Int $x) { 1 }
multi foo(Num $x) { 2 }
my Int $x = something();
foo($x);
```

Can decide at compile time! Important since all built-in operators are multi-dispatch

(So it's a pre-requisite for inlining.)

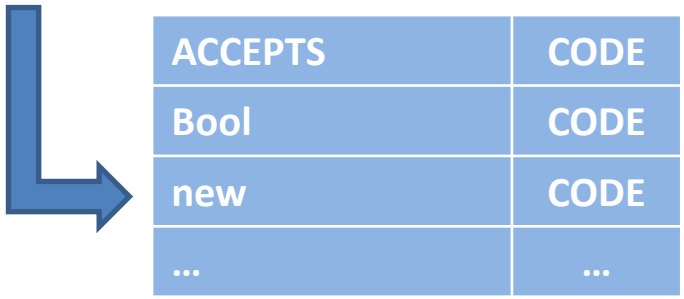
Type info not used

The `new` method is defined in the top type; all objects have one

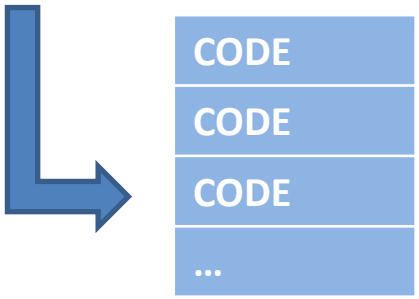
```
my $snack = Stroopwafel.new();
```

Construct a v-table and dispatch such method calls by index

```
callmeth "new"
```




```
callmeth 2
```



Type info not used

The more type information we have in a program, the more calls we will be able to optimize

Which is how gradual typing is supposed to work ☺

(BTW, the same approach can be used to implement a pragma that warns about calling unknown methods.)

Dumb lexical access

We statically know where to find a lexical variable - but today we walk scopes looking for names

```
my $kitten-mass = 0;
for @cats -> $cat {
    if $cat.is_kitten {
        $kitten-mass += $cat.mass;
    }
}
```

"2 scopes down, in slot 0"

Leaky Extensions

Currently, language tweaks always end up global

```
{
    sub postfix:<!>($n) { [*] 1..$n }
    say 10!;
}
say 5!;
```

Should actually be lexically scoped (so the 5! fails to parse)

Leaky Extensions

While this was a contrived example, knowing exactly which language we're parsing is an important part of keeping Perl 6 sanely extensible.

The same set of changes should open the door to implementing macros too.

And the list goes on…

Lots we can do to make common things faster.

Optimize the building blocks that all programs are made from.

Later, still plenty of clever optimizations to explore. ☺

Dank je wel!

Questions?