

tlmn-bench

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1 bench.sh

```
#!/bin/bash
cabal install -O2 --constraint=type-level-natural-number==1.1 --program-suffix ↵
  ↵ =-1.1
cabal install -O2 --constraint=type-level-natural-number==1.1.1 --program-suffix ↵
  ↵ =-1.1.1
~/.cabal/bin/type-level-natural-number-bench-1.1 -gu 1.1.csv
5 ~/.cabal/bin/type-level-natural-number-bench-1.1.1 -gu 1.1.1.csv
cat 1.1.csv | cut -d, -f 2 | tail -n+3 > 1.1.dat
cat 1.1.1.csv | cut -d, -f 2 | tail -n+3 > 1.1.1.dat
cat <<-"PLOT" | gnuplot
    set xlabel "number :: N"
10    set ylabel "time (nanoseconds)"
    set title "type-level-natural-number"
    set log
    set term png
    set output "bench.png"
15    plot "./1.1.dat" using (10**$0):(1e9*$1) title "1.1" with lines, ↵
      ↵ "./1.1.1.dat" using (10**$0):(1e9*$1) title "1.1.1" with lines
PLOT
display bench.png
```

2 .gitignore

```
dist
*.csv
```

*.dat
*.png

3 LICENSE

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THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT
(INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE
30 OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

4 Main.hs

```
{-# LANGUAGE Rank2Types, ScopedTypeVariables #-}
module Main where

import Wrapper
import TypeLevel.NaturalNumber
import Criterion.Main

at :: forall r . Int -> (forall n . NaturalNumber n => n -> r) -> r
at i f = go (undefined :: Zero) i
10   where
       go :: NaturalNumber m => m -> Int -> r
       go z 0 = f (undefined 'asTypeOf' z)
       go z i = go (successorTo z) (pred i)

15   nat :: Int -> IO Int
       nat i = at i naturalNumberAsIntIO

main :: IO ()
main = defaultMain
```

```

20   [ bgroup "naturalNumberAsInt"
      [ bench "0" $ nat 0
        , bench "1" $ nat 1
        , bench "10" $ nat 10
        , bench "100" $ nat 100
25     , bench "1000" $ nat 1000
      ]
    ]

```

5 patches/0001-performance-enhancements-to-naturalNumberAsInt.patch

From 851572ef426623b549db970c5cdef45f90dbb3af Mon Sep 17 00:00:00 2001

From: Claude Heiland-Allen <claude@mathr.co.uk>

Date: Thu, 11 Oct 2012 18:24:59 +0100

Subject: [PATCH 1/6] performance enhancements to naturalNumberAsInt

5

```

TypeLevel/NaturalNumber.hs | 11 ++++++++
1 file changed, 10 insertions(+), 1 deletion(-)

```

```

10 diff --git a/TypeLevel/NaturalNumber.hs b/TypeLevel/NaturalNumber.hs
index 0996059..7a1ee5d 100644
--- a/TypeLevel/NaturalNumber.hs
+++ b/TypeLevel/NaturalNumber.hs
@@ -71,7 +71,16 @@ class NaturalNumber n where
15   instance NaturalNumber Zero where
       naturalNumberAsInt _ = 0
       instance NaturalNumber n => NaturalNumber (SuccessorTo n) where
-         naturalNumberAsInt x = 1 + naturalNumberAsInt (predecessorOf x)
+         -- performance enhancing hoop jumping:
+         --   this convinces GHC that the function is constant
+         --   and so doesn't need to be recomputed every time
+         --   which gives a huge performance boost if used a lot
+         naturalNumberAsInt = self
+         where
25         +         self = const k
+         +         k = (1 +) $! naturalNumberAsInt (predecessorOf (undefined 'asTypeIn'
+         ↪ self))
+         +         asTypeIn :: a -> (a -> b) -> a
+         +         asTypeIn = const
30   instance Show Zero where
       show _ = "0"
--
1.7.10.4

```

6 patches/0002-simplified-show-implementation.patch

From 03a3df26bd178a4e343871068b8edcf7eb650643 Mon Sep 17 00:00:00 2001

From: Claude Heiland-Allen <claude@mathr.co.uk>

Date: Thu, 11 Oct 2012 18:25:27 +0100

Subject: [PATCH 2/6] simplified show implementation

5

```

TypeLevel/NaturalNumber.hs | 2 +-
1 file changed, 1 insertion(+), 1 deletion(-)

```

```

10 diff --git a/TypeLevel/NaturalNumber.hs b/TypeLevel/NaturalNumber.hs
index 7a1ee5d..0cf1f7e 100644
--- a/TypeLevel/NaturalNumber.hs
+++ b/TypeLevel/NaturalNumber.hs
@@ -85,7 +85,7 @@ instance NaturalNumber n => NaturalNumber (SuccessorTo n) where
    where
15 instance Show Zero where
    show _ = "0"
    instance NaturalNumber n => Show (SuccessorTo n) where
-    show = show . (+1) . naturalNumberAsInt . predecessorOf
+    show = show . naturalNumberAsInt
20
    instance Eq Zero where
        (==) _ _ = True
--
1.7.10.4

```

7 patches/0003-update-documentation-with-changes.patch

From f430eb31c336b522e68781c44a516008719dceb7 Mon Sep 17 00:00:00 2001

From: Claude Heiland-Allen <claude@mathr.co.uk>

Date: Thu, 11 Oct 2012 18:29:24 +0100

Subject: [PATCH 3/6] update documentation with changes

```

5 ---
NEWS | 6 ++++++
type-level-natural-number.cabal | 4 +++
2 files changed, 8 insertions(+), 2 deletions(-)
10
diff --git a/NEWS b/NEWS
index 6b7a401..8faae83 100644
--- a/NEWS
+++ b/NEWS
15 @@ -1,3 +1,9 @@
+Version 1.1.1
+=====
+
+
+*) Performance enhancements for naturalNumberAsInt.
20 +*) Simplified Show implementation.
+
+Version 1.1
+=====
25
diff --git a/type-level-natural-number.cabal b/type-level-natural-number.cabal
index d4d0880..ff805c5 100644
--- a/type-level-natural-number.cabal
+++ b/type-level-natural-number.cabal
@@ -26,8 +26,8 @@ Description: This is a simple, Haskell 2010 compatible
    implementation
30
    with the intent of making this functionality more
    widely available.

-
- Difference from 1.0: Added instances for Typeable, and
- word synonyms for N0...N15.
35 +
+ Difference from 1.1: Performance enhancements for
+ naturalNumberAsInt. Simplified Show implementation.

```

```

Cabal-version:    >=1.2.3
Build-type:      Simple
Category:        Type System, Data

```

```

40  --
    1.7.10.4

```

8 patches/0004-add-build-system-Setup.hs-fixes-cabal-check-error.patch

```

From db046db8c4d4527c82bf4f8e9dd571ca715a177b Mon Sep 17 00:00:00 2001
From: Claude Heiland-Allen <claude@mathr.co.uk>
Date: Thu, 11 Oct 2012 18:35:20 +0100
Subject: [PATCH 4/6] add build-system Setup.hs (fixes cabal check error)

```

```

5  ---
    Setup.hs |      2 ++
    1 file changed, 2 insertions(+)
    create mode 100644 Setup.hs
10
    diff --git a/Setup.hs b/Setup.hs
    new file mode 100644
    index 00000000..9a994af
    --- /dev/null
15  +++ b/Setup.hs
    @@ -0,0 +1,2 @@
    +import Distribution.Simple
    +main = defaultMain
    --
20  1.7.10.4

```

9 patches/0005-add-source-repository-sections-fixes-cabal-check-war.patch

```

From 07f166d01df138ee56392dc82a9608b282ad42f4 Mon Sep 17 00:00:00 2001
From: Claude Heiland-Allen <claude@mathr.co.uk>
Date: Thu, 11 Oct 2012 18:40:58 +0100
Subject: [PATCH 5/6] add 'source-repository:' sections (fixes cabal check
5  warning; required a 'Cabal-version:' bump)

```

```

10  ---
    type-level-natural-number.cabal |    11 ++++++++
    1 file changed, 10 insertions(+), 1 deletion(-)
10
    diff --git a/type-level-natural-number.cabal b/type-level-natural-number.cabal
    index ff805c5..8abb1f5 100644
    --- a/type-level-natural-number.cabal
    +++ b/type-level-natural-number.cabal
15  @@ -28,7 +28,7 @@ Description:      This is a simple, Haskell 2010 compatible ↵
        ↵ implementation
        .
        Difference from 1.1: Performance enhancements for
        naturalNumberAsInt. Simplified Show implementation.
    -Cabal-version:    >=1.2.3
20  +Cabal-version:    >=1.6
    Build-type:      Simple
    Category:        Type System, Data

```

```

25 @@ -36,3 +36,12 @@ Library
    Build-depends:    base >= 3 && < 5
    Exposed-modules:  TypeLevel.NaturalNumber
    Extensions:       EmptyDataDecls
+
+source-repository head
30 + type:              git
+ location:            git://github.com/gcross/type-level-natural-number.git
+
+source-repository this
+ type:                git
35 + location:           git://github.com/gcross/type-level-natural-number.git
+ tag:                 1.1.1
--
1.7.10.4

```

10 patches/0006-type-level-natural-number-version-1.1.1.patch

From ccf51cb79fa7d44cedaadb78ff8ebfd519374f Mon Sep 17 00:00:00 2001

From: Claude Heiland-Allen <claude@mathr.co.uk>

Date: Thu, 11 Oct 2012 18:43:47 +0100

Subject: [PATCH 6/6] type-level-natural-number version 1.1.1

```

5 ---
   type-level-natural-number.cabal |    2 +-
   1 file changed, 1 insertion(+), 1 deletion(-)

10 diff --git a/type-level-natural-number.cabal b/type-level-natural-number.cabal
index 8abb1f5..5c9b149 100644
--- a/type-level-natural-number.cabal
+++ b/type-level-natural-number.cabal
@@ -1,5 +1,5 @@
15   Name:                type-level-natural-number
   -Version:              1.1
   +Version:              1.1.1
   License:               BSD3
   License-file:          LICENSE
20   Author:               Gregory Crosswhite
--
1.7.10.4

```

11 README

test procedure

./bench.sh

test results

with ghc-7.6.1 on my laptop, 1.1 is linear time and 1.1.1 is constant time

12 Setup.hs

```
import Distribution.Simple
```

```
main = defaultMain
```

13 type-level-natural-number-bench.cabal

```

name:                type-level-natural-number-bench
version:             0.2.0.0
synopsis:             benchmarks for type-level-natural-number
license:             BSD3
5  license-file:      LICENSE
author:              Claude Heiland-Allen
maintainer:          claude@mathr.co.uk
category:            Benchmarking
build-type:          Simple
10 cabal-version:     >=1.8

executable type-level-natural-number-bench
  main-is:           Main.hs
  other-modules:      Wrapper
15  build-depends:
    base < 5,
    type-level-natural-number ==1.1.*,
    criterion ==0.6.*

```

14 Wrapper.hs

```

module Wrapper(naturalNumberAsIntIO) where
import TypeLevel.NaturalNumber(NaturalNumber(..))

naturalNumberAsIntIO :: NaturalNumber n => n -> IO Int
5 {-# NOINLINE naturalNumberAsIntIO #-}
naturalNumberAsIntIO n = return $! naturalNumberAsInt n

```