

```
ouzo2:code$ ghc -O Fib.hs
[1 of 1] Compiling Main          ( Fib.hs, Fib.o )
Linking Fib ...
ouzo2:code$ time ./Fib
701408733
```

```
real    0m3.248s
user    0m3.226s
sys     0m0.006s
```

```
ouzo2:code$ ghc -O -threaded Fib.hs
[1 of 1] Compiling Main          ( Fib.hs, Fib.o )
Linking Fib ...
ouzo2:code$ time ./Fib
701408733
```

```
real    0m16.419s
user    0m16.300s
sys     0m0.111s
```

```
ouzo2:code$ ghc -O -threaded Fib.hs
[1 of 1] Compiling Main          ( Fib.hs, Fib.o )
Linking Fib ...
ouzo2:code$ time ./Fib
701408733
```

```
real    0m3.855s
user    0m3.817s
sys     0m0.028s
```

```
ouzo2:code$ time ./Fib +RTS -N2
701408733
```

```
real    0m1.977s
user    0m3.896s
sys     0m0.023s
```

```
ouzo2:code$ time ./Fib +RTS -N4
701408733
```

```
real    0m1.065s
user    0m4.105s
sys     0m0.023s
```

```
ouzo2:code$ time ./Fib +RTS -N8
701408733
```

```
real    0m0.968s
user    0m7.296s
sys     0m0.059s
```

```
ouzo2:code$ time ./Fib +RTS -N8 -s
701408733
```

```
11,224,504,024 bytes allocated in the heap
 3,660,536 bytes copied during GC
 268,392 bytes maximum residency (2 sample(s))
 128,920 bytes maximum slop
   9 MB total memory in use (0 MB lost due to fragmentation)
```

```
Tot time (elapsed)  Avg pause  Max pause
```

```
Gen 0      1421 colls, 1421 par   5.495s  0.020s   0.0000s  0.0002s
Gen 1         2 colls,    1 par   0.000s  0.000s   0.0001s  0.0001s
```

Parallel GC work balance: 488.31% (serial 0%, perfect 100%)

TASKS: 18 (1 bound, 17 peak workers (17 total), using -N8)

SPARKS: 290 (74 converted, 0 overflowed, 0 dud, 4 GC'd, 212 fizzled)

```
INIT    time    0.001s ( 0.004s elapsed)
MUT     time    1.787s ( 0.923s elapsed)
GC      time    5.496s ( 0.020s elapsed)
EXIT    time    0.001s ( 0.005s elapsed)
Total   time    7.285s ( 0.952s elapsed)
```

Alloc rate 6,280,131,429 bytes per MUT second

Productivity 24.5% of total user, 97.5% of total elapsed

```
gc_alloc_block_sync: 29482
whitehole_spin: 0
gen[0].sync: 211
gen[1].sync: 0
```

```
real    0m0.962s
user    0m7.287s
sys     0m0.059s
```

```
ouzo2:code$ ghci Laziness.hs
GHCi, version 8.2.2: http://www.haskell.org/ghc/  :? for help
Loaded GHCi configuration from /Users/hallgren/.ghci
[1 of 1] Compiling Laziness          ( Laziness.hs, interpreted )
```

```
Laziness.hs:27:7: error:
  Ambiguous occurrence 'choose'
  It could refer to either 'Test.QuickCheck.choose',
                          imported from 'Test.QuickCheck' at Laziness.hs:16:1
-22
                          (and originally defined in 'Test.QuickCheck.Gen')
                          or 'Laziness.choose', defined at Laziness.hs:25:1
```

```
27 | g n = choose (n==0) 1000 (10 `div` n)
    |         ^^^^^^^
```

Failed, no modules loaded.

```
Prelude> :r
[1 of 1] Compiling Laziness          ( Laziness.hs, interpreted )
```

Ok, one module loaded.

```
*Laziness> f 0
```

1000

```
*Laziness> g 0
```

1000

```
*Laziness> [n*n|n<-[0..10]]
```

[0,1,4,9,16,25,36,49,64,81,100]

```
*Laziness> sq
```

sqroot sqrt squares

```

*Laziness> :print sq
sqrt    sqrt    squares
*Laziness> :print squares
squares = (_t1::[Int])
*Laziness> :sprint squares
squares = _
*Laziness> null sq
sqrt    sqrt    squares
*Laziness> null squares
False
*Laziness> :sprint sq
sqrt    sqrt    squares
*Laziness> :sprint squares
squares = _ : _
*Laziness> head sq
sqrt    sqrt    squares
*Laziness> head squares
0
*Laziness> :sprint squares
squares = 0 : _
*Laziness> squares !! 5
25
*Laziness> :sprint squares
squares = 0 : _ : _ : _ : _ : 25 : _
*Laziness> length sq
sqrt    sqrt    squares
*Laziness> length squares
11
*Laziness> :sprint squares
squares = [0,_,_,_,_,_,25,_,_,_,_,_]
*Laziness> last sq
sqrt    sqrt    squares
*Laziness> last squares
100
*Laziness> :sprint squares
squares = [0,_,_,_,_,_,25,_,_,_,_,_,100]
*Laziness> sum sq
sqrt    sqrt    squares
*Laziness> sum sq
sqrt    sqrt    squares
*Laziness> sum squares
385
*Laziness> :sprint squares
squares = [0,1,4,9,16,25,36,49,64,81,100]
*Laziness> :r
[1 of 1] Compiling Laziness          ( Laziness.hs, interpreted )
Ok, one module loaded.
*Laziness> take 20 ones
[1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1]
*Laziness> :r
[1 of 1] Compiling Laziness          ( Laziness.hs, interpreted )
Ok, one module loaded.
*Laziness> :sprint nu
null          numShrinkTries  numTests

```

```

numShrinkFinal numShrinks      numbers
*Laziness> :sprint numbers
numbers = _
*Laziness> take 20 num
numShrinkFinal numShrinkTries numShrinks      numTests      numbers
*Laziness> take 20 numbers
[0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19]
*Laziness> :sprint numbers
numbers = 0 : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 :
          13 : 14 : 15 : 16 : 17 : 18 : 19 : _
*Laziness> :r
[1 of 1] Compiling Laziness      ( Laziness.hs, interpreted )
Ok, one module loaded.
*Laziness> take 10 (countUp 50)
[50,51,52,53,54,55,56,57,58,59]
*Laziness> :r
[1 of 1] Compiling Laziness      ( Laziness.hs, interpreted )
Ok, one module loaded.
*Laziness> fromTo 1 10
[1,2,3,4,5,6,7,8,9,10]
*Laziness> fromTo 1 0
[]
*Laziness> :r
[1 of 1] Compiling Laziness      ( Laziness.hs, interpreted )
Ok, one module loaded.
*Laziness> take 43 fibs
[1,1,2,3,5,8,13,21,34,55,89,144,233,377,610,987,1597,2584,4181,6765,10946,17711,
28657,46368,75025,121393,196418,317811,514229,832040,1346269,2178309,3524578,570
2887,9227465,14930352,24157817,39088169,63245986,102334155,165580141,267914296,4
33494437]
*Laziness> :r
[1 of 1] Compiling Laziness      ( Laziness.hs, interpreted )
Ok, one module loaded.
*Laziness> take 43 fibs
[1,1,2,3,5,8,13,21,34,55,89,144,233,377,610,987,1597,2584,4181,6765,10946,17711,
28657,46368,75025,121393,196418,317811,514229,832040,1346269,2178309,3524578,570
2887,9227465,14930352,24157817,39088169,63245986,102334155,165580141,267914296,4
33494437]
*Laziness> :r
Ok, one module loaded.
*Laziness> :set +s
*Laziness> take 2000 pri
primes      primes_v1      print      printTestCase
*Laziness> take 2000 primes_v1
[2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71,73,79,83,89,97,101,103,
107,109,113,127,131,137,139,149,151,157,163,167,173,179,181,191,193,197,199,211,
223,227,229,233,239,241,251,257,263,269,271,277,281,283,293,307,311,313,317,331,
337,347,349,353,359,367,373,379,383,389,397,401,409,419,421,431,433,439,443,449,
457,461,463,467,479,487,491,499,503,509,521,523,541,547,557,563,569,571,577,587,
593,599,601,607,613,617,619,631,641,643,647,653,659,661,673,677,683,691,701,709,
719,727,733,739,743,751,757,761,769,773,787,797,809,811,821,823,827,829,839,853,
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```

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(9.16 secs, 4,475,870,624 bytes)

**\*Laziness>** :r

[1 of 1] Compiling Laziness (Laziness.hs, interpreted)

Ok, one module loaded.

**\*Laziness>** take 2000 primes

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(1.23 secs, 699,811,648 bytes)

**\*Laziness>** :r

[1 of 1] Compiling Laziness (Laziness.hs, interpreted)

Ok, one module loaded.

**\*Laziness>** ex1

[2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71]

(0.01 secs, 190,144 bytes)

**\*Laziness>** ex2

[2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71,73,79,83,89,97]



