Script generated by TTT

Title: Nipkow: Info2 (12.12.2014)

Date: Fri Dec 12 09:01:53 CET 2014

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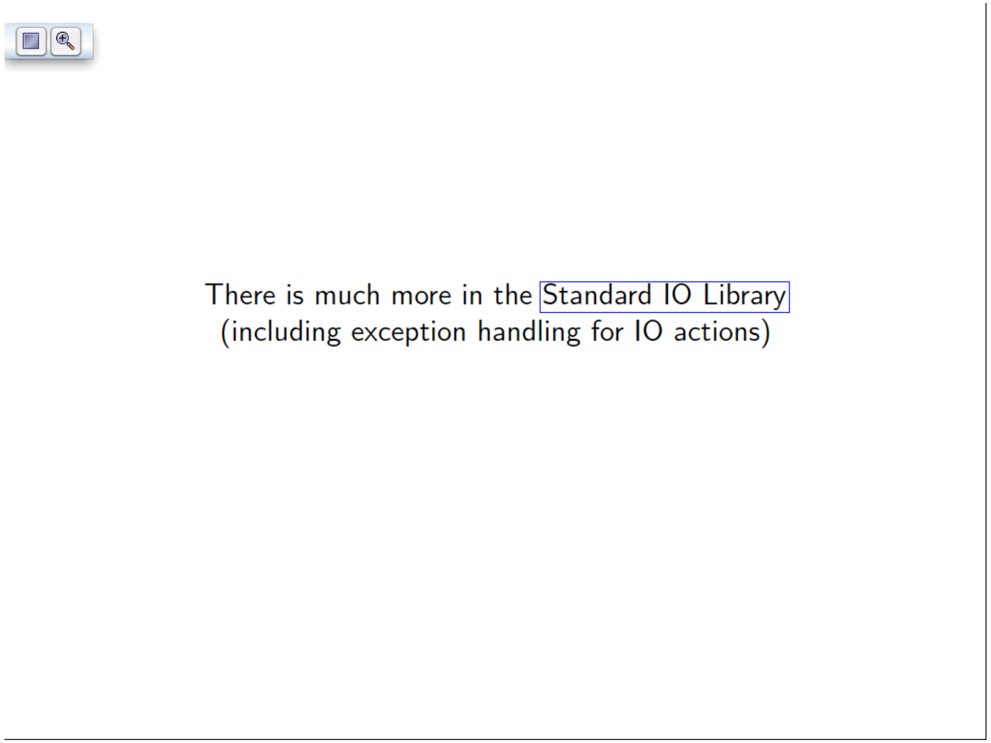
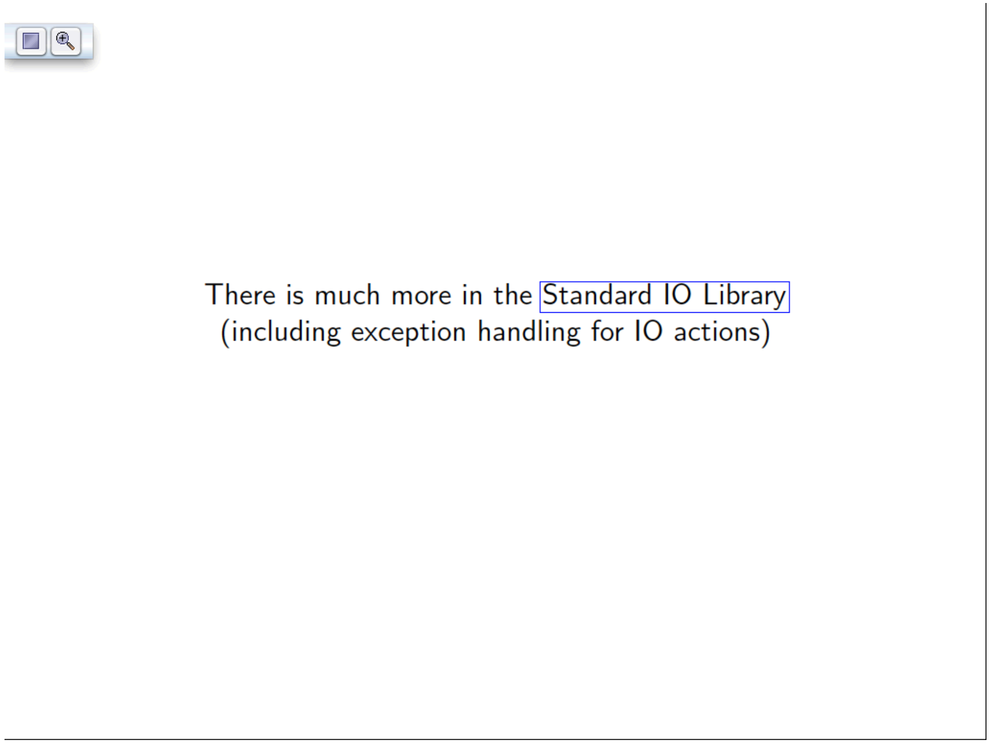
Pages: 104



There is much more in the Standard IO Library
(including exception handling for IO actions)



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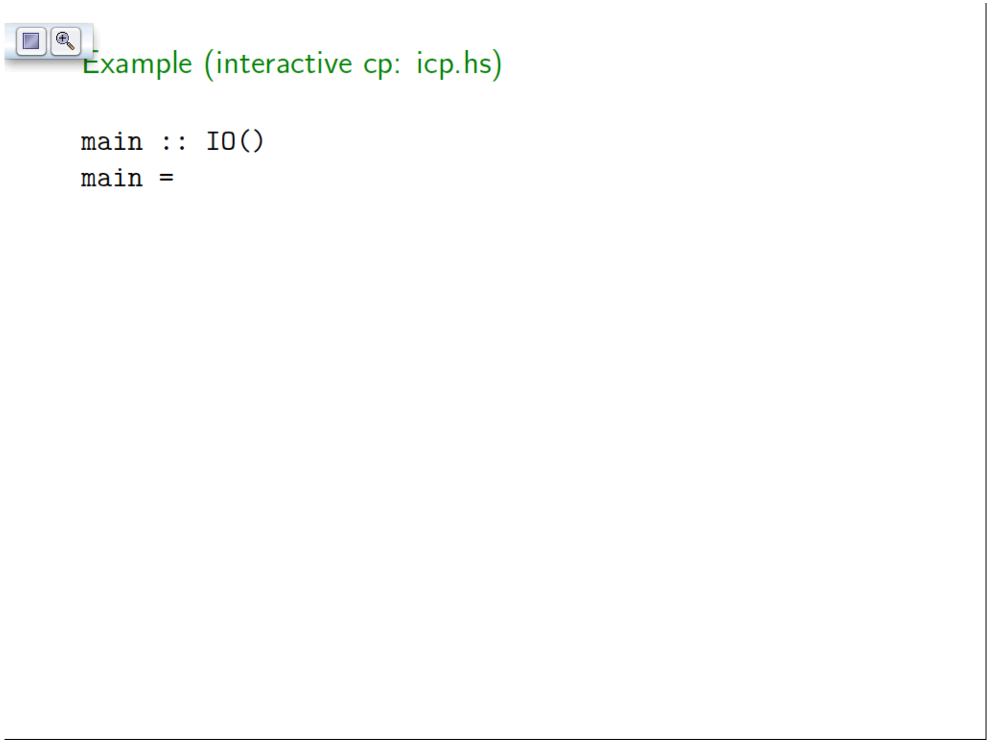

Example (interactive cp: icp.hs)

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main :: IO()
main =
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readOpenFile :: String -> IOMode -> IO Handle
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Executing xyz.hs

If xyz.hs contains a definition of main:

- runhaskell xyz

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readOpenFile :: String -> IOMode -> IO Handle
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     handle <- openFile name mode
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```

There is much more in the Standard IO Library
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Executing `xyz.hs`

If `xyz.hs` contains a definition of `main`:

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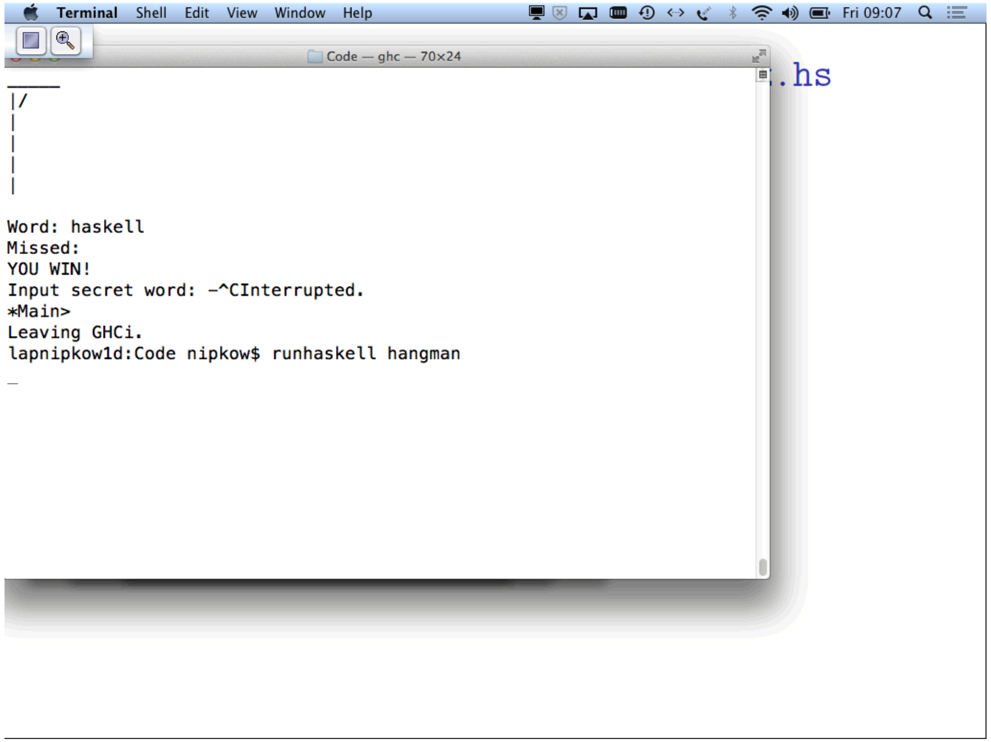
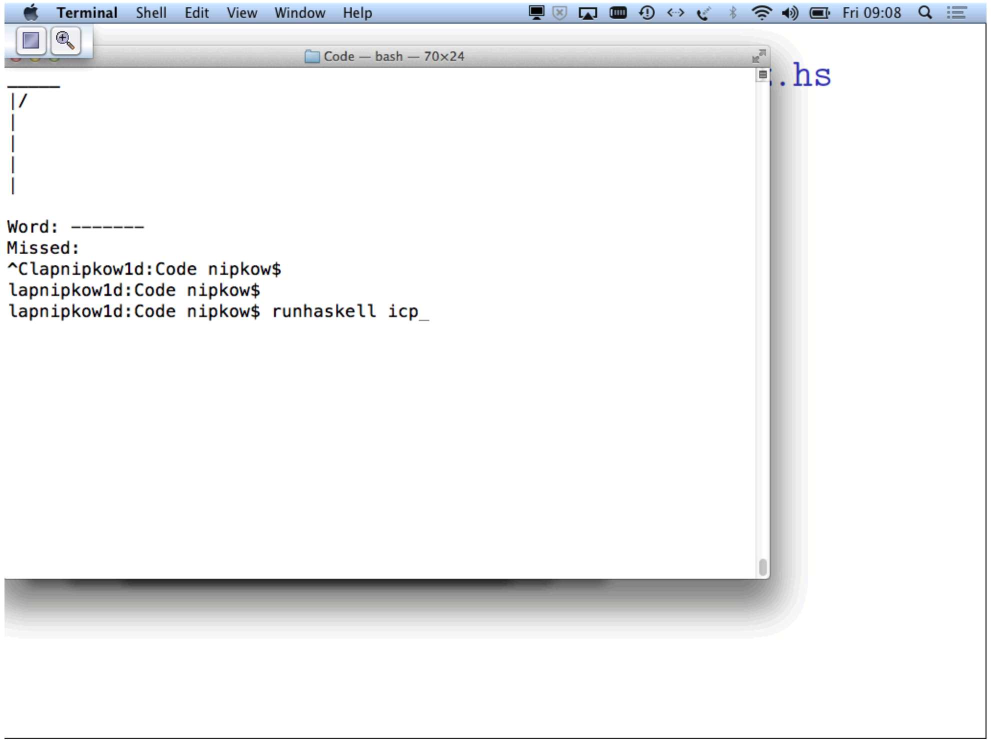


```
_____
|/
|
|
|
|


Word: haskell
Missed:
YOU WIN!
Input secret word: -^CInterrupted.
*Main>
Leaving GHCi.
lapnipkow1d:Code nipkow$ runhaskell hangman

_
```



```
_____
|/
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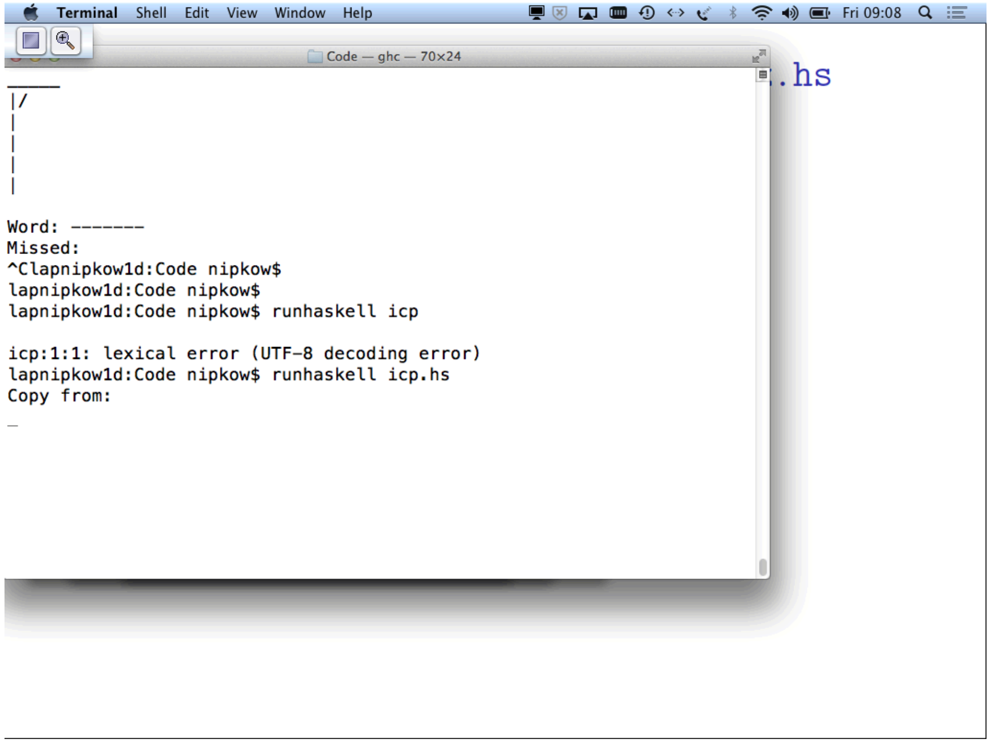
|


Word: -------
Missed:
^Clapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$ runhaskell icp_
```



```
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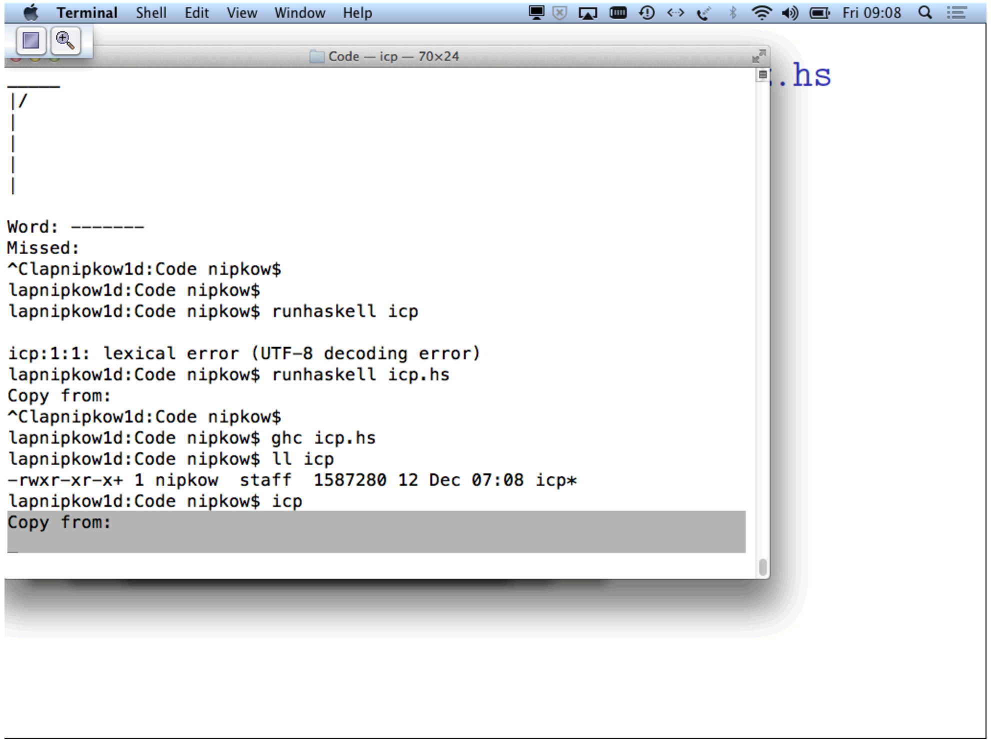
Word: -------
Missed:
^Clapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$ runhaskell icp

icp:1:1: lexical error (UTF-8 decoding error)
lapnipkow1d:Code nipkow$ runhaskell icp.hs
Copy from:

_
```



```
_____
|/
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|
|
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Word: -------
Missed:
^Clapnipkow1d:Code nipkow$
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Copy from:
^Clapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$ ghc icp.hs
lapnipkow1d:Code nipkow$ ll icp
-rwxr-xr-x+ 1 nipkow  staff  1587280 12 Dec 07:08 icp*
lapnipkow1d:Code nipkow$ icp
Copy from:
```

Executing `xyz.hs`

If `xyz.hs` contains a definition of `main`:

- `runhaskell xyz`
  or
- `ghc xyz` ⇝ executable file `xyz`

9.2 Network I/O

Types

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  A socket is one endpoint of a two-way communication link between two programs running on the network.
- `data PortId = PortNumber PortNumber | ...`
- `data PortNumber`
  `instance Num PortNumber`
  ⟹ `PortNumber 9000 :: PortId`

Server functions

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- `listenOn :: PortId -> IO Socket`
  Create server side socket for specific port

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  Create server side socket for specific port
- `accept :: Socket -> IO (Handle, ..., ...)`
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- `sClose :: Socket -> IO ()`
  Close socket

Initialization for Windows

```
withSocketsDo :: IO a -> IO a
```

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```
withSocketsDo :: IO a -> IO a
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Standard use pattern:

```
main  =  withSocketsDo $ do ...
```

Example (pingPong.hs)

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main  =  withSocketsDo $ do
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```

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  hSetBuffering h LineBuffering
  loop h
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loop :: Handle -> IO ()
loop h  =  do
  input <- hGetLine h
  if take 4 input == "quit"
  then do hPutStrLn h "goodbye!"
          hClose h
  else do hPutStrLn h ("got " ++ input)
          loop h
```

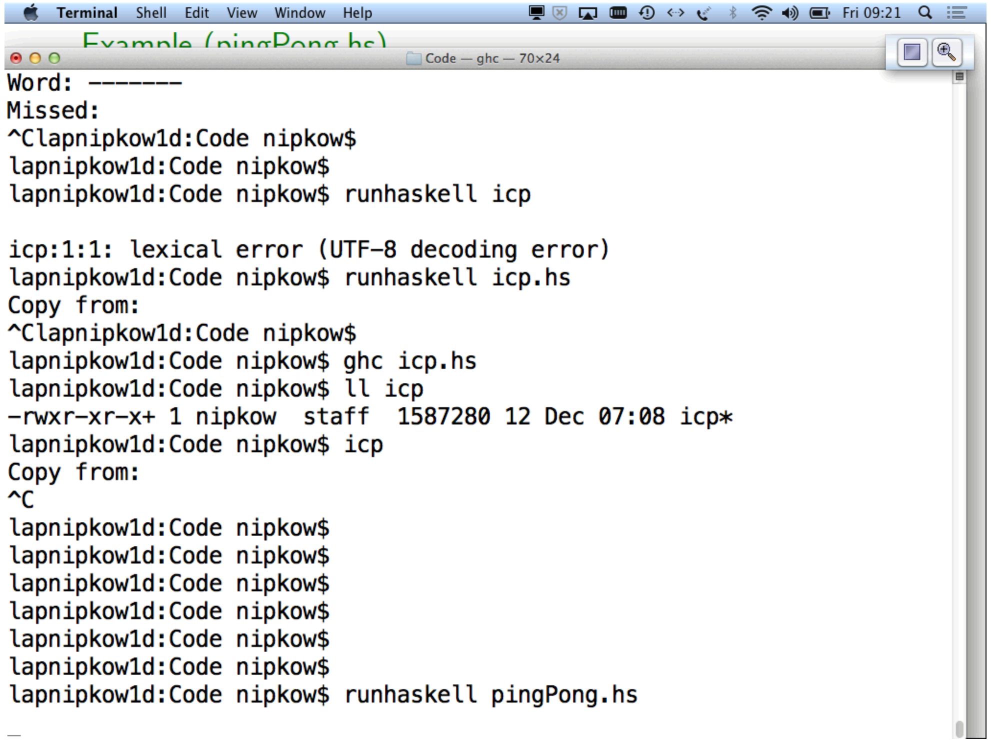

```
Word: --------
Missed:
^Clapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$ runhaskell icp

icp:1:1: lexical error (UTF-8 decoding error)
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Copy from:
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lapnipkow1d:Code nipkow$ ghc icp.hs
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-rwxr-xr-x+ 1 nipkow  staff  1587280 12 Dec 07:08 icp*
lapnipkow1d:Code nipkow$ icp
Copy from:
^C
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$ runhaskell pingPong.hs
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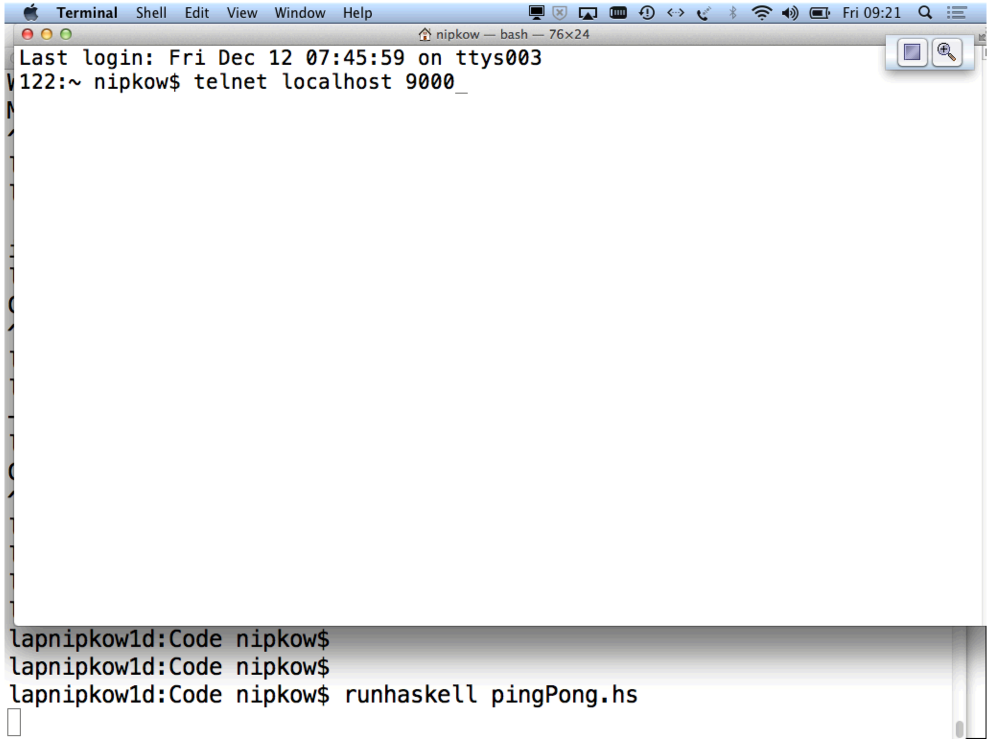

```
Last login: Fri Dec 12 07:45:59 on ttys003
122:~ nipkow$ telnet localhost 9000
```

```
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
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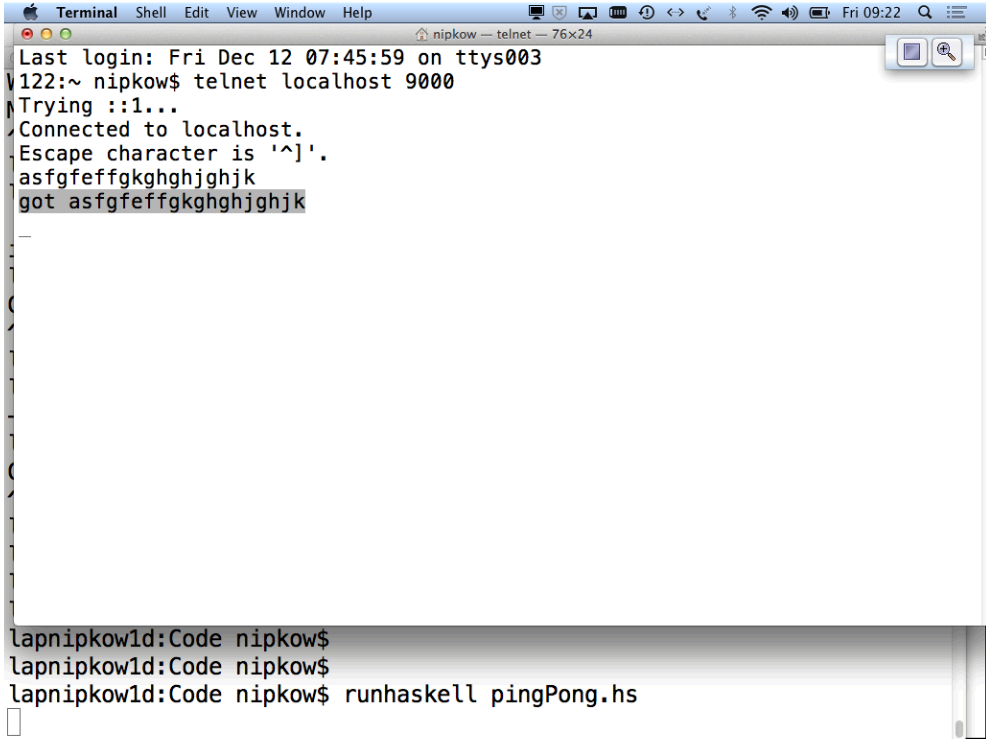

```
Last login: Fri Dec 12 07:45:59 on ttys003
122:~ nipkow$ telnet localhost 9000
Trying ::1...
Connected to localhost.
Escape character is '^]'.
asfgfeffgkghghjghjk
got asfgfeffgkghghjghjk
```

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lapnipkow1d:Code nipkow$
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lapnipkow1d:Code nipkow$ runhaskell pingPong.hs
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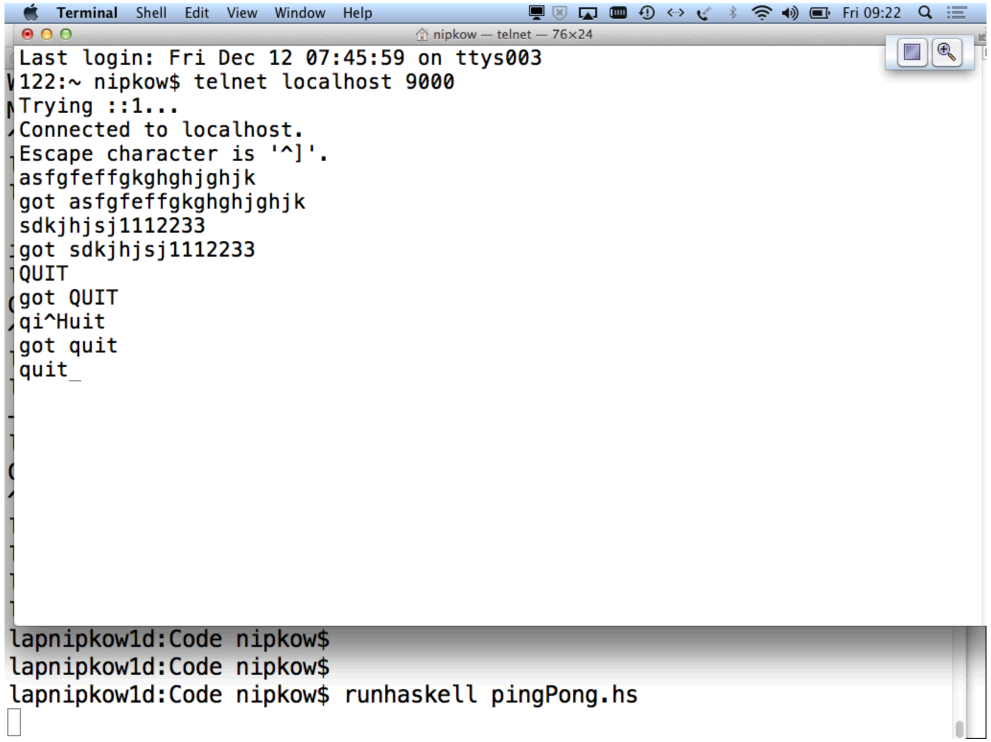

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sdkjhjsj1112233
got sdkjhjsj1112233
QUIT
got QUIT
qi^Huit
got quit
quit
```

```
lapnipkow1d:Code nipkow$
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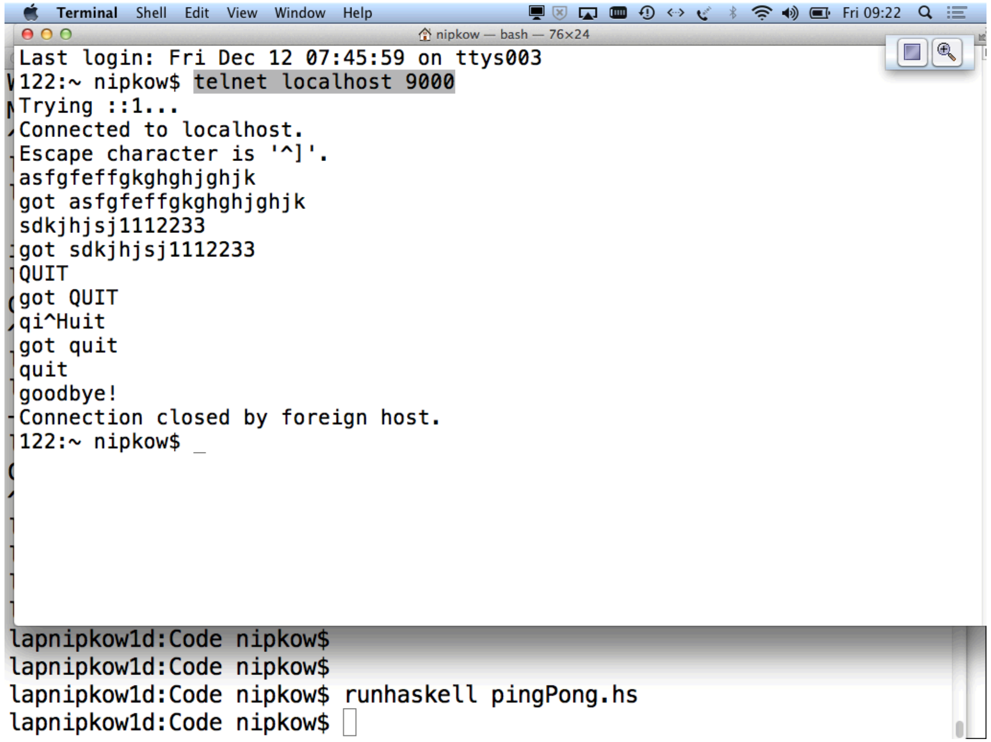

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got QUIT
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got quit
quit
goodbye!
Connection closed by foreign host.
122:~ nipkow$
```

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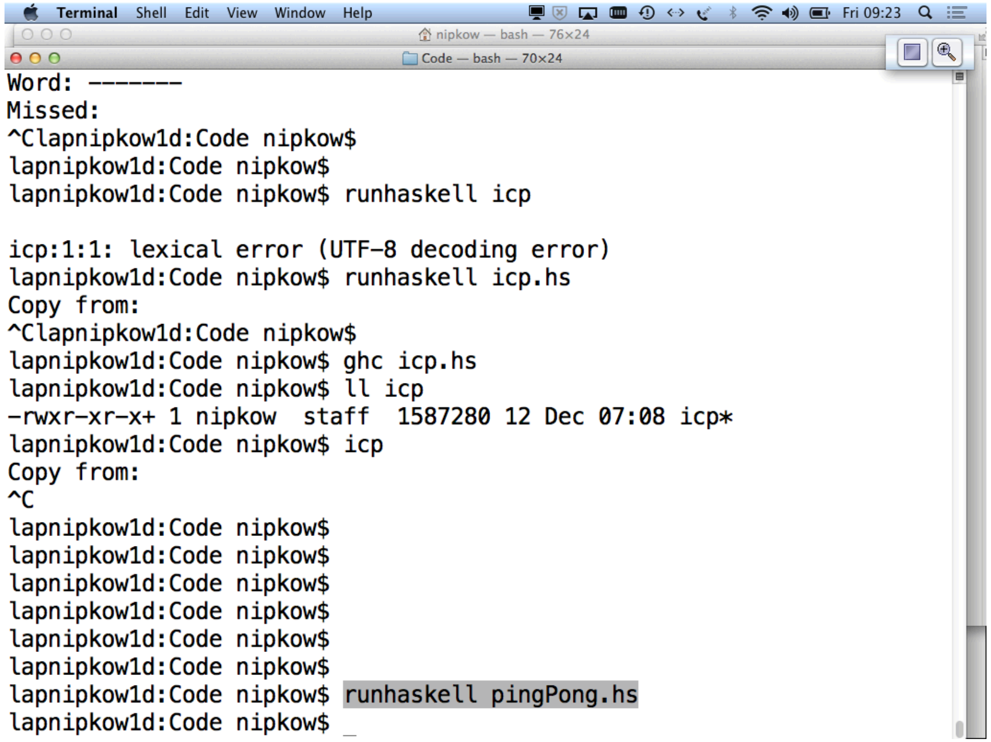

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lapnipkow1d:Code nipkow$
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lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$
lapnipkow1d:Code nipkow$ runhaskell pingPong.hs
lapnipkow1d:Code nipkow$ _
```

Example (pingPong.hs)

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main :: IO ()
main  =  withSocketsDo $ do
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- `type HostName = String`
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- `connectTo :: HostName -> PortId -> IO Handle`
  Connect to specific port of specific host

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main = withSocketsDo $ do
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  putStrLn "Resource?"
  res <- getLine
```

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For more detail see

http://hackage.haskell.org/package/network/docs/Network.html

http://hackage.haskell.org/package/network/docs/Network-Socket.html

Example (wGet.hs)

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  putStrLn s
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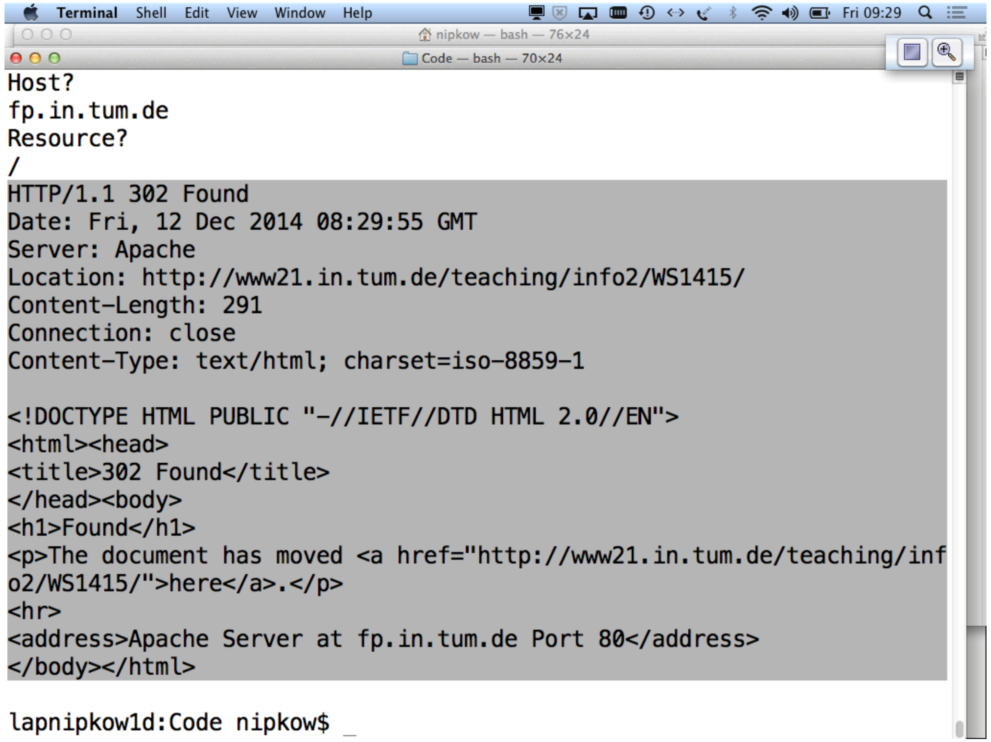
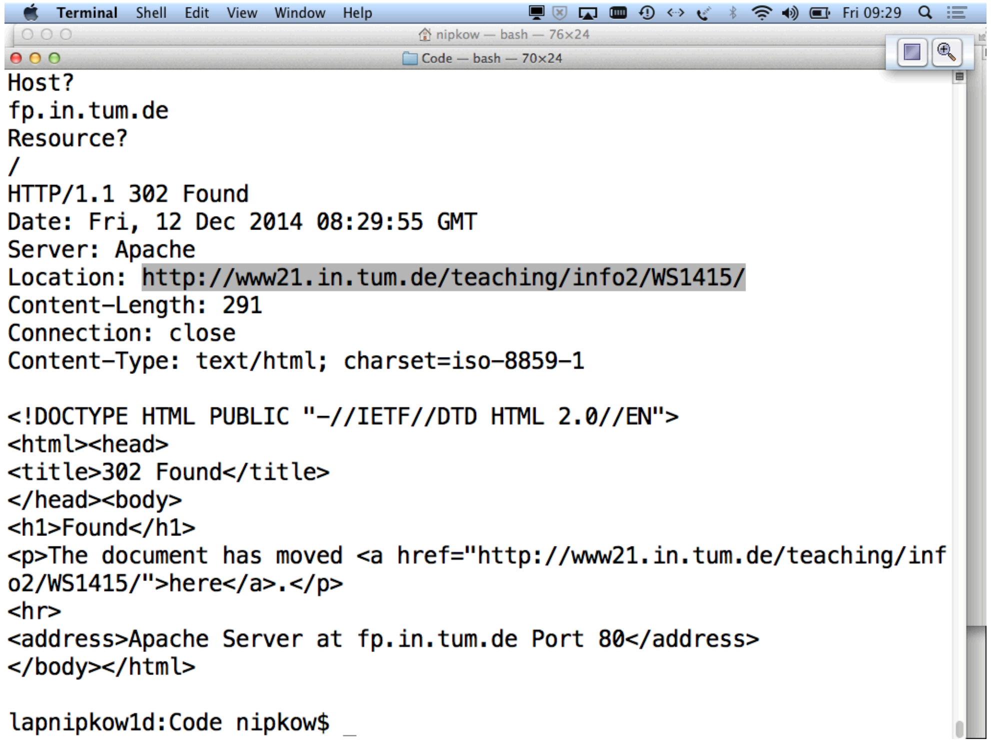


```
Host?
fp.in.tum.de
Resource?
/
HTTP/1.1 302 Found
Date: Fri, 12 Dec 2014 08:29:55 GMT
Server: Apache
Location: http://www21.in.tum.de/teaching/info2/WS1415/
Content-Length: 291
Connection: close
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>302 Found</title>
</head><body>
<h1>Found</h1>
<p>The document has moved <a href="http://www21.in.tum.de/teaching/inf
o2/WS1415/">here</a>.</p>
<hr>
<address>Apache Server at fp.in.tum.de Port 80</address>
</body></html>

lapnipkow1d:Code nipkow$ _
```



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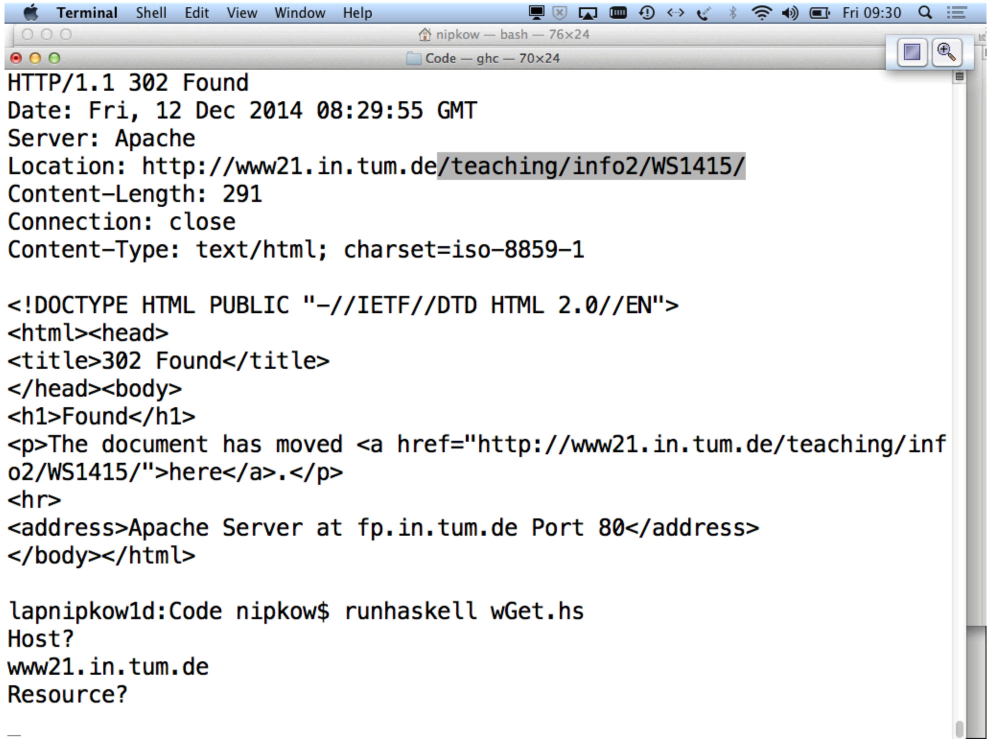

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</body></html>

lapnipkow1d:Code nipkow$ runhaskell wGet.hs
Host?
www21.in.tum.de
Resource?
_
```

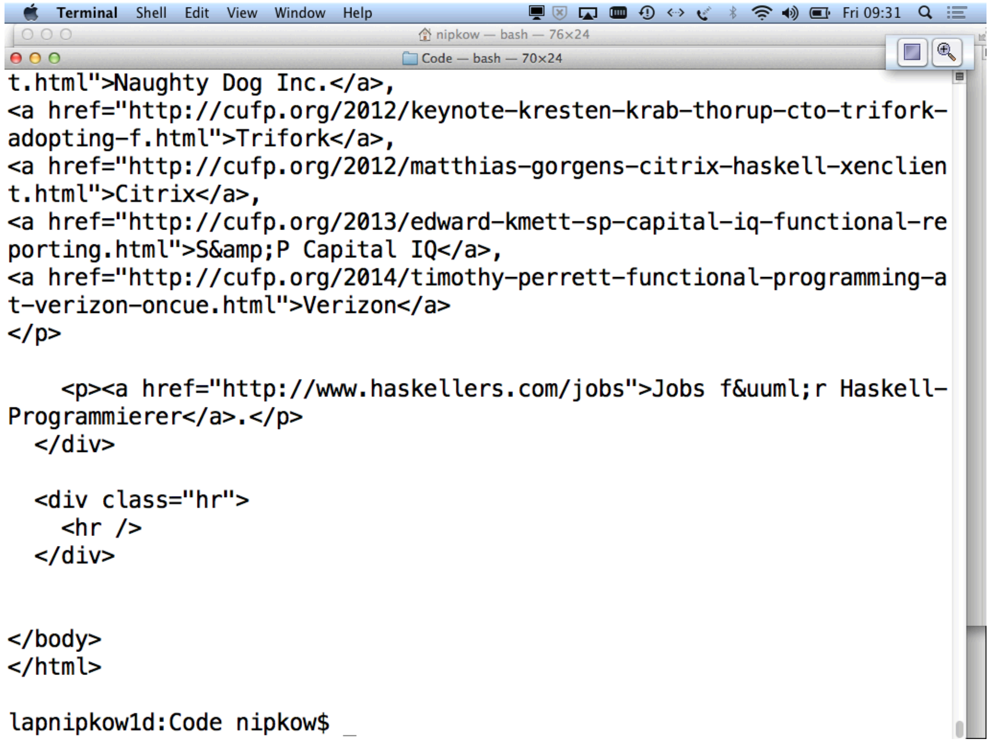

```
t.html">Naughty Dog Inc.</a>,
<a href="http://cufp.org/2012/keynote-kresten-krab-thorup-cto-trifork-
adopting-f.html">Trifork</a>,
<a href="http://cufp.org/2012/matthias-gorgens-citrix-haskell-xenclien
t.html">Citrix</a>,
<a href="http://cufp.org/2013/edward-kmett-sp-capital-iq-functional-re
porting.html">S&amp;P Capital IQ</a>,
<a href="http://cufp.org/2014/timothy-perrett-functional-programming-a
t-verizon-oncue.html">Verizon</a>
</p>

    <p><a href="http://www.haskellers.com/jobs">Jobs f&uuml;r Haskell-
Programmierer</a>.</p>
  </div>

  <div class="hr">
    <hr />
  </div>


</body>
</html>

lapnipkow1d:Code nipkow$ _
```

Example (wGet.hs)

```
main :: IO()
main = withSocketsDo $ do
  putStrLn "Host?"
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  hSetBuffering h LineBuffering
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  s <- hGetContents h
  putStrLn s
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For more detail see

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http://hackage.haskell.org/package/network/docs/Network-Socket.html

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- Interfaces
- Division of labour

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- Interfaces
- Division of labour
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- Information hiding

GHC: one module per file

Recommendation: module `M` in file `M.hs`

Module header

```
module M where
```

Module header

```
module M where    -- M must start with capital letter
```

Module header

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↑
```

All definitions must start in this column

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All definitions must start in this column

- Exports everything defined in `M` (at the top level)

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```
module M where    -- M must start with capital letter
↑
```

All definitions must start in this column

- Exports everything defined in `M` (at the top level)

Selective export:

```
module M (T, f, ...)  where
```

Exporting data types

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```
module M (T) where
data T = ...
```

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```
module M (T) where
data T = ...
```

- Exports only T, but not its constructors

Types

- `data Socket`
  A socket is one endpoint of a two-way communication link between two programs running on the network.

Exporting data types

```
module M (T) where
data T = ...
```

- Exports only T, but not its constructors

```
module M (T(C,D,...)) where
data T = ...
```

- Exports T and its constructors C, D, ...

Exporting data types

```
module M (T) where
data T = ...
```

- Exports only T, but not its constructors

```
module M (T(C,D,...)) where
data T = ...
```

- Exports T and its constructors C, D, ...

```
module M (T(..)) where
data T = ...
```

- Exports T and all of its constructors

Exporting data types

```
module M (T) where
data T = ...
```

- Exports only T, but not its constructors

```
module M (T(C,D,...)) where
data T = ...
```

- Exports T and its constructors C, D, . . .

```
module M (T(..)) where
data T = ...
```

- Exports T and all of its constructors

Not permitted: `module M (T,C,D) where`

Exporting modules

By default, modules do not export names from imported modules

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```
module B where
import A
...
```

Exporting modules

By default, modules do not export names from imported modules

```
module B where                module A where
import A                      f = ...
...                           ...
```

⟹ B does not export f

Unless the names are mentioned in the export list

Exporting modules

By default, modules do not export names from imported modules

```
module B where              module A where
import A                    f = ...
...                         ...
```

⟹ B does not export f

Unless the names are mentioned in the export list

```
module B (f) where
import A
...
```

Exporting modules

By default, modules do not export names from imported modules

```
module B where              module A where
import A                    f = ...
...                         ...
```

⟹ B does not export f

Unless the names are mentioned in the export list

```
module B (f) where
import A
...
```

Or the whole module is exported

Exporting modules

By default, modules do not export names from imported modules

```
module B where              module A where
import A                    f = ...
...                         ...
```

⟹ B does not export f

Unless the names are mentioned in the export list

```
module B (f) where
import A
...
```

Or the whole module is exported

```
module B (module A) where
import A
...
```

import

import

By default, everything that is exported is imported

```
module B where
import A
...
```

import

By default, everything that is exported is imported

```
module B where                module A where
import A                      f = ...
...                           g = ...
```

⟹ B imports `f` and `g`

Unless an import list is specified

import

By default, everything that is exported is imported

```
module B where                module A where
import A                      f = ...
...                           g = ...
```

⟹ B imports `f` and `g`

Unless an import list is specified

```
module B where
import A (f)
...
```

⟹ B imports only `f`

Or specific names are hidden

import

By default, everything that is exported is imported

```
module B where                module A where
import A                      f = ...
...                           g = ...
```

⟹ B imports `f` and `g`

Unless an import list is specified

```
module B where
import A (f)
...
```

⟹ B imports only `f`

Or specific names are hidden

```
module B where
import A hiding (g)
...
```

qualified

qualified

```
import A
import B
import C
... f ...
```

Where does f come from??

qualified

```
import A
import B
import C
... f ...
```

Where does f come from??

Clearer: *qualified names*

```
... A.f ...
```

Renaming modules

Renaming modules

Renaming modules

```
import TotallyAwesomeModule

... TotallyAwesomeModule.f ...
```

Painful

Renaming modules

```
import TotallyAwesomeModule

... TotallyAwesomeModule.f ...
```

Painful

More readable:

```
import qualified TotallyAwesomeModule as TAM
```

Renaming modules

```
import TotallyAwesomeModule

... TotallyAwesomeModule.f ...
```

Painful

More readable:

```
import qualified TotallyAwesomeModule as TAM

... TAM.f ...
```

For the full description of the module system
see the Haskell report

qualified

```
import A
import B
import C
... f ...
```

Where does `f` come from??

Clearer: *qualified names*

```
... A.f ...
```

Can be enforced:

```
import qualified A
```

⟹ must always write `A.f`

Renaming modules

```
import TotallyAwesomeModule

... TotallyAwesomeModule.f ...
```

Painful

More readable:

```
import qualified TotallyAwesomeModule as TAM

... TAM.f ...
```

For the full description of the module system
see the Haskell report

10.2 Abstract Data Types