

Net: Networking Libraries

Version 5.1.3

August 15, 2011

Contents

| | | |
|----------|--|-----------|
| 1 | URLs and HTTP | 6 |
| 1.1 | URL Structure | 6 |
| 1.2 | URL Functions | 7 |
| 1.3 | URL Unit | 12 |
| 1.4 | URL Signature | 13 |
| 2 | URI Codec: Encoding and Decoding URIs | 14 |
| 2.1 | Functions | 14 |
| 3 | WebSocket | 18 |
| 3.1 | Client API | 18 |
| 3.2 | Server API | 18 |
| 3.3 | Connections | 19 |
| 3.4 | Example | 21 |
| 4 | FTP: Client Downloading | 22 |
| 4.1 | Functions | 22 |
| 4.2 | FTP Unit | 23 |
| 4.3 | FTP Signature | 24 |
| 5 | Send URL: Opening a Web Browser | 25 |
| 6 | SMTP: Sending E-Mail | 28 |
| 6.1 | SMTP Functions | 28 |
| 6.2 | SMTP Unit | 30 |
| 6.3 | SMTP Signature | 30 |

| | | |
|-----------|---|-----------|
| 7 | sendmail: Sending E-Mail | 31 |
| 7.1 | Sendmail Functions | 31 |
| 7.2 | Sendmail Unit | 32 |
| 7.3 | Sendmail Signature | 32 |
| 8 | Headers: Parsing and Constructing | 34 |
| 8.1 | Functions | 34 |
| 8.2 | Header Unit | 38 |
| 8.3 | Header Signature | 38 |
| 9 | IMAP: Reading Mail | 39 |
| 9.1 | Connecting and Selecting Mailboxes | 39 |
| 9.2 | Selected Mailbox State | 41 |
| 9.3 | Manipulating Messages | 44 |
| 9.4 | Querying and Changing (Other) Mailboxes | 46 |
| 9.5 | IMAP Unit | 48 |
| 9.6 | IMAP Signature | 48 |
| 10 | POP3: Reading Mail | 49 |
| 10.1 | Exceptions | 51 |
| 10.2 | Example Session | 53 |
| 10.3 | POP3 Unit | 53 |
| 10.4 | POP3 Signature | 53 |
| 11 | MIME: Decoding Internet Data | 55 |
| 11.1 | Message Decoding | 55 |
| 11.2 | Exceptions | 58 |

| | | |
|-----------|--|-----------|
| 11.3 | MIME Unit | 59 |
| 11.4 | MIME Signature | 60 |
| 12 | Base 64: Encoding and Decoding | 61 |
| 12.1 | Functions | 61 |
| 12.2 | Base64 Unit | 62 |
| 12.3 | Base64 Signature | 62 |
| 13 | Quoted-Printable: Encoding and Decoding | 63 |
| 13.1 | Functions | 63 |
| 13.2 | Exceptions | 64 |
| 13.3 | Quoted-Printable Unit | 64 |
| 13.4 | -Printable Signature | 64 |
| 14 | DNS: Domain Name Service Queries | 65 |
| 14.1 | Functions | 65 |
| 14.2 | DNS Unit | 66 |
| 14.3 | DNS Signature | 66 |
| 15 | NNTP: Newsgroup Protocol | 67 |
| 15.1 | Connection and Operations | 67 |
| 15.2 | Exceptions | 69 |
| 15.3 | NNTP Unit | 70 |
| 15.4 | NNTP Signature | 71 |
| 16 | TCP: Unit and Signature | 72 |
| 16.1 | TCP Signature | 72 |
| 16.2 | TCP Unit | 74 |

| | |
|---|-----------|
| 17 TCP Redirect: tcp^ via Channels | 75 |
| 18 SSL Unit: tcp^ via SSL | 76 |
| 19 CGI Scripts | 77 |
| 19.1 CGI Functions | 77 |
| 19.2 CGI Unit | 79 |
| 19.3 CGI Signature | 80 |
| 20 Cookie: HTTP Client Storage | 81 |
| 20.1 Functions | 81 |
| 20.2 Examples | 83 |
| 20.2.1 Creating a cookie | 83 |
| 20.2.2 Parsing a cookie | 84 |
| 20.3 Cookie Unit | 84 |
| 20.4 Cookie Signature | 84 |
| Index | 87 |

1 URLs and HTTP

```
(require net/url)
```

The `net/url` library provides utilities to parse and manipulate URIs, as specified in RFC 2396 [RFC2396], and to use the HTTP protocol.

To access the text of a document from the web, first obtain its URL as a string. Convert the address into a `url` structure using `string->url`. Then, open the document using `get-pure-port` or `get-impure-port`, depending on whether or not you wish to examine its MIME headers. At this point, you have a regular input port with which to process the document, as with any other file.

Currently the only supported protocols are `"http"`, `"https"`, and sometimes `"file"`.

1.1 URL Structure

```
(require net/url-structs)
```

The URL structure types are provided by the `net/url-structs` library, and re-exported by `net/url`.

```
(struct url (scheme
            user
            host
            port
            path-absolute?
            path
            query
            fragment)
          #:extra-constructor-name make-url)
scheme : (or/c false/c string?)
user : (or/c false/c string?)
host : (or/c false/c string?)
port : (or/c false/c exact-nonnegative-integer?)
path-absolute? : boolean?
path : (listof path/param?)
query : (listof (cons/c symbol? (or/c false/c string?)))
fragment : (or/c false/c string?)
```

The basic structure for all URLs, which is explained in RFC 3986 [RFC3986]. The following diagram illustrates the parts:

```
http://sky@www:801/cgi-bin/finger;xyz?name=shriram;host=nw#top
```

```
{-1} {2} {3} {4}{---5-----} {6} {---7-----} {8}
```

1 = scheme, 2 = user, 3 = host, 4 = port,
5 = path (two elements), 6 = param (of second path element),
7 = query, 8 = fragment

The strings inside the `user`, `path`, `query`, and `fragment` fields are represented directly as Racket strings, without URL-syntax-specific quoting. The procedures `string->url` and `url->string` translate encodings such as `%20` into spaces and back again.

By default, query associations are parsed with either `;` or `&` as a separator, and they are generated with `&` as a separator. The `current-alist-separator-mode` parameter adjusts the behavior.

An empty string at the end of the `path` list corresponds to a URL that ends in a slash. For example, the result of `(string->url "http://racket-lang.org/a/")` has a `path` field with strings `"a"` and `" "`, while the result of `(string->url "http://racket-lang.org/a")` has a `path` field with only the string `"a"`.

When a "file" URL is represented by a `url` structure, the `path` field is mostly a list of path elements. For Unix paths, the root directory is not included in `path`; its presence or absence is implicit in the `path-absolute?` flag. For Windows paths, the first element typically represents a drive, but a UNC path is represented by a first element that is `" "` and then successive elements complete the drive components that are separated by `\\` or `\\.`

```
(struct path/param (path param)
  #:extra-constructor-name make-path/param)
  path : (or/c string? (one-of/c 'up 'same))
  param : (listof string?)
```

A pair that joins a path segment with its params in a URL.

1.2 URL Functions

An HTTP connection is created as a *pure port* or a *impure port*. A pure port is one from which the MIME headers have been removed, so that what remains is purely the first content fragment. An impure port is one that still has its MIME headers.

```
(string->url str) → url?
  str : string?
```

Parses the URL specified by `str` into a `url` struct. The `string->url` procedure uses `form-urlencoded->alist` when parsing the query, so it is sensitive to the `current-alist-separator-mode` parameter for determining the association separator.

If `str` starts with `"file:"`, then the path is always parsed as an absolute path, and the parsing details depend on `file-url-path-convention-type`:

- `'unix`: If `"file:"` is followed by `///` and a non-`/`, then the first element after the `///` is parsed as a host (and maybe port); otherwise, the first element starts the path, and the host is `"`.
- `'windows`: If `"file:"` is followed by `///`, then the `///` is stripped; the remainder parsed as a Windows path. The host is always `"` and the port is always `#f`.

```
(combine-url/relative base relative) → url?  
  base : url?  
  relative : string?
```

Given a base URL and a relative path, combines the two and returns a new URL as per the URL combination specification. They are combined according to the rules in RFC 3986 [RFC3986].

This function does not raise any exceptions.

```
(netscape/string->url str) → url?  
  str : string?
```

Turns a string into a URL, applying (what appear to be) Netscape's conventions on automatically specifying the scheme: a string starting with a slash gets the scheme `"file"`, while all others get the scheme `"http"`.

```
(url->string URL) → string?  
  URL : url?
```

Generates a string corresponding to the contents of a `url` struct. For a `"file:"` URL, the URL must not be relative, the result always starts `file://`, and the interpretation of the path depends on the value of `file-url-path-convention-type`:

- `'unix`: Elements in `URL` are treated as path elements. Empty strings in the path list are treated like `'same`.
- `'windows`: If the first element is `"` then the next two elements define the UNC root, and the rest of the elements are treated as path elements. Empty strings in the path list are treated like `'same`.

The `url->string` procedure uses `alist->form-urlencoded` when formatting the query, so it is sensitive to the `current-alist-separator-mode` parameter for determining the association separator. The default is to separate associations with a `&`.

```
(path->url path) → url?
  path : (or/c path-string? path-for-some-system?)
```

Converts a path to a [url](#).

```
(url->path URL [kind]) → path-for-some-system?
  URL : url?
  kind : (one-of/c 'unix 'windows)
         = (system-path-convention-type)
```

Converts *URL*, which is assumed to be a "file" URL, to a path.

```
(file-url-path-convention-type) → (one-of/c 'unix 'windows)
(file-url-path-convention-type kind) → void?
  kind : (one-of/c 'unix 'windows)
```

Determines the default conversion to and from strings for "file" URLs. See [string->url](#) and [url->string](#).

```
(get-pure-port URL [header]) → input-port?
  URL : url?
  header : (listof string?) = null
(head-pure-port URL [header]) → input-port?
  URL : url?
  header : (listof string?) = null
(delete-pure-port URL [header]) → input-port?
  URL : url?
  header : (listof string?) = null
```

Initiates a GET/HEAD/DELETE request for *URL* and returns a pure port corresponding to the body of the response. The optional list of strings can be used to send header lines to the server.

The GET method is used to retrieve whatever information is identified by *URL*.

The HEAD method is identical to GET, except the server must not return a message body. The meta-information returned in a response to a HEAD request should be identical to the information in a response to a GET request.

The DELETE method is used to delete the entity identified by *URL*.

Beware: By default, "https" scheme handling does not verify a server's certificate (i.e., it's equivalent of clicking through a browser's warnings), so communication is safe, but the

identity of the server is not verified. To validate the server's certificate, set `current-https-protocol` to a context created with `ssl-make-client-context`, and enable certificate validation in the context with `ssl-set-verify!`.

The "file" scheme for URLs is handled only by `get-pure-port`, which uses `open-input-file`, does not handle exceptions, and ignores the optional strings.

```
(get-impure-port URL [header]) → input-port?
  URL : url?
  header : (listof string?) = null
(head-impure-port URL [header]) → input-port?
  URL : url?
  header : (listof string?) = null
(delete-impure-port URL [header]) → input-port?
  URL : url?
  header : (listof string?) = null
```

Like `get-pure-port`, etc., but the resulting impure port contains both the returned headers and the body. The "file" URL scheme is not handled by these functions.

```
(post-pure-port URL post [header]) → input-port?
  URL : url?
  post : bytes?
  header : (listof string?) = null
(put-pure-port URL post [header]) → input-port?
  URL : url?
  post : bytes?
  header : (listof string?) = null
```

Initiates a POST/PUT request for `URL` and sends the `post` byte string. The result is a pure port, which contains the body of the response is returned. The optional list of strings can be used to send header lines to the server.

Beware: See `get-pure-port` for warnings about "https" certificate validation.

```
(post-impure-port URL post [header]) → input-port?
  URL : url?
  post : bytes?
  header : (listof string?) = null
(put-impure-port URL post [header]) → input-port?
  URL : url?
  post : bytes?
  header : (listof string?) = null
```

Like `post-pure-port` and `put-pure-port`, but the resulting impure port contains both the returned headers and body.

```
(display-pure-port in) → void?  
  in : input-port?
```

Writes the output of a pure port, which is useful for debugging purposes.

```
(purify-port in) → string?  
  in : input-port?
```

Purifies a port, returning the MIME headers, plus a leading line for the form `HTTP/<vers> <code> <message>`, where `<vers>` is something like `1.0` or `1.1`, `<code>` is an exact integer for the response code, and `<message>` is arbitrary text without a return or new-line.

The `net/head` library provides procedures, such as `extract-field` for manipulating the header.

Since web servers sometimes return mis-formatted replies, `purify-port` is liberal in what it accepts as a header. as a result, the result string may be ill formed, but it will either be the empty string, or it will be a string matching the following regexp:

```
#rx"~HTTP/.*(\r\n\r\n|\n\n|\r\r)"
```

```
(call/input-url URL connect handle) → any  
  URL : url?  
  connect : (url? . -> . input-port?)  
  handle : (input-port? . -> . any)  
(call/input-url URL connect handle header) → any  
  URL : url?  
  connect : (url? (listof string?) . -> . input-port?)  
  handle : (input-port? . -> . any)  
  header : (listof string?)
```

Given a URL and a `connect` procedure like `get-pure-port` to convert the URL to an input port (either a pure port or impure port), calls the `handle` procedure on the port and closes the port on return. The result of the `handle` procedure is the result of `call/input-url`.

When a `header` argument is supplied, it is passed along to the `connect` procedure.

The connection is made in such a way that the port is closed before `call/input-url` returns, no matter how it returns. In particular, it is closed if `handle` raises an exception, or if the connection process is interrupted by an asynchronous break exception.

```
(current-proxy-servers)
→ (listof (list/c string? string? (integer-in 0 65535)))
(current-proxy-servers mapping) → void?
  mapping : (listof (list/c string? string? (integer-in 0 65535)))
```

A parameter that determines a mapping of proxy servers used for connections. Each mapping is a list of three elements:

- the URL scheme, such as "http";
- the proxy server address; and
- the proxy server port number.

Currently, the only proxiable scheme is "http". The default mapping is the empty list (i.e., no proxies).

```
(current-https-protocol) → (or/c ssl-client-context? symbol?)
(current-https-protocol protocol) → void?
  protocol : (or/c ssl-client-context? symbol?)
```

A parameter that determines the connection mode for "https" connections; the parameter value is passed as the third argument to `ssl-connect` when creating an "https" connection. Set this parameter to validate a server's certificates, for example, as described with `get-pure-port`.

1.3 URL Unit

```
(require net/url-unit)
```

```
url@ : unit?
```

Imports `tcp^`, exports `url+scheme^`.

The `url+scheme^` signature contains `current-connect-scheme`, which `url@` binds to a parameter. The parameter is set to the scheme of a URL when `tcp-connect` is called to create a connection. A `tcp-connect` variant linked to `url@` can check this parameter to choose the connection mode; in particular, `net/url` supplies a `tcp-connect` that actually uses `ssl-connect` when `(current-connect-scheme)` produces "https".

Note that `net/url` does not provide the `current-connect-scheme` parameter.

1.4 URL Signature

```
(require net/url-sig)
```

`url^` : signature

Includes everything exported by the `net/url` module except `current-https-protocol`. Note that the exports of `net/url` and the `url^` signature do not include `current-connect-scheme`.

`url+scheme^` : signature

Adds `current-connect-scheme` to `url^`.

2 URI Codec: Encoding and Decoding URIs

(require net/uri-codec)

The `net/uri-codec` module provides utilities for encoding and decoding strings using the URI encoding rules given in RFC 2396 [RFC2396], and to encode and decode name/value pairs using the `application/x-www-form-urlencoded` mimetype given in the HTML 4.0 specification. There are minor differences between the two encodings.

The URI encoding uses allows a few characters to be represented as-is: `a` through `z`, `A` through `Z`, `0-9`, `=`, `_`, `-`, `!`, `~`, `*`, `!`, `(` and `)`. The remaining characters are encoded as `%<xx>`, where `<xx>` is the two-character hex representation of the integer value of the character (where the mapping character–integer is determined by US-ASCII if the integer is less than 128).

The encoding, in line with RFC 2396’s recommendation, represents a character as-is, if possible. The decoding allows any characters to be represented by their hex values, and allows characters to be incorrectly represented as-is.

The rules for the `application/x-www-form-urlencoded` mimetype given in the HTML 4.0 spec are:

- Control names and values are escaped. Space characters are replaced by `+`, and then reserved characters are escaped as described in RFC 1738, section 2.2: Non-alphanumeric characters are replaced by `%<xx>` representing the ASCII code of the character. Line breaks are represented as CRLF pairs: `%0D%0A`. Note that RFC 2396 supersedes RFC 1738 [RFC1738].
- The control names/values are listed in the order they appear in the document. The name is separated from the value by `=` and name/value pairs are separated from each other by either `;` or `&`. When encoding, `;` is used as the separator by default. When decoding, both `;` and `&` are parsed as separators by default.

These rules differs slightly from the straight encoding in RFC 2396 in that `+` is allowed, and it represents a space. The `net/uri-codec` library follows this convention, encoding a space as `+` and decoding `+` as a space. In addition, since there appear to be some brain-dead decoders on the web, the library also encodes `!`, `~`, `!`, `(`, and `)` using their hex representation, which is the same choice as made by the Java’s `URLEncoder`.

2.1 Functions

`(uri-encode str) → string?`
`str : string?`

Encode a string using the URI encoding rules.

```
(uri-decode str) → string?  
  str : string?
```

Decode a string using the URI decoding rules.

```
(uri-path-segment-encode str) → string?  
  str : string?
```

Encodes a string according to the rules in [RFC3986] for path segments.

```
(uri-path-segment-decode str) → string?  
  str : string?
```

Decodes a string according to the rules in [RFC3986] for path segments.

```
(uri-userinfo-encode str) → string?  
  str : string?
```

Encodes a string according to the rules in [RFC3986] for the userinfo field.

```
(uri-userinfo-decode str) → string?  
  str : string?
```

Decodes a string according to the rules in [RFC3986] for the userinfo field.

```
(form-urlencoded-encode str) → string?  
  str : string?
```

Encode a string using the application/x-www-form-urlencoded encoding rules. The result string contains no non-ASCII characters.

```
(form-urlencoded-decode str) → string?  
  str : string?
```

Decode a string encoded using the application/x-www-form-urlencoded encoding rules.

```
(alist->form-urlencoded alist) → string?  
  alist : (listof (cons/c symbol? string?))
```

Encode an association list using the application/x-www-form-urlencoded encoding rules.

The `current-alist-separator-mode` parameter determines the separator used in the result.

```
(form-urlencoded->alist str)
→ (listof (cons/c symbol? string?))
  str : string
```

Decode a string encoded using the application/x-www-form-urlencoded encoding rules into an association list. All keys are case-folded for conversion to symbols.

The `current-alist-separator-mode` parameter determines the way that separators are parsed in the input.

```
(current-alist-separator-mode)
→ (one-of/c 'amp 'semi 'amp-or-semi 'semi-or-amp)
(current-alist-separator-mode mode) → void?
  mode : (one-of/c 'amp 'semi 'amp-or-semi 'semi-or-amp)
```

A parameter that determines the separator used/recognized between associations in `form-urlencoded->alist`, `alist->form-urlencoded`, `url->string`, and `string->url`.

The default value is `'amp-or-semi`, which means that both `&` and `;` are treated as separators when parsing, and `&` is used as a separator when encoding. The other modes use/recognize only of the separators.

Examples:

```
> (define ex '((x . "foo") (y . "bar") (z . "baz")))
> (current-alist-separator-mode 'amp) ; try 'amp...
> (form-urlencoded->alist "x=foo&y=bar&z=baz")
'((x . "foo") (y . "bar") (z . "baz"))
> (form-urlencoded->alist "x=foo;y=bar;z=baz")
'((x . "foo;y=bar;z=baz"))
> (alist->form-urlencoded ex)
"x=foo&y=bar&z=baz"
> (current-alist-separator-mode 'semi) ; try 'semi...
> (form-urlencoded->alist "x=foo;y=bar;z=baz")
'((x . "foo") (y . "bar") (z . "baz"))
> (form-urlencoded->alist "x=foo&y=bar&z=baz")
'((x . "foo&y=bar&z=baz"))
> (alist->form-urlencoded ex)
"x=foo;y=bar;z=baz"
> (current-alist-separator-mode 'amp-or-semi) ; try 'amp-or-semi...
```



```
> (form-urlencoded->alist "x=foo&y=bar&z=baz")
'((x . "foo") (y . "bar") (z . "baz"))
> (form-urlencoded->alist "x=foo;y=bar;z=baz")
'((x . "foo") (y . "bar") (z . "baz"))
> (alist->form-urlencoded ex)
"x=foo&y=bar&z=baz"
> (current-alist-separator-mode 'semi-or-amp) ; try 'semi-or-amp...
> (form-urlencoded->alist "x=foo&y=bar&z=baz")
'((x . "foo") (y . "bar") (z . "baz"))
> (form-urlencoded->alist "x=foo;y=bar;z=baz")
'((x . "foo") (y . "bar") (z . "baz"))
> (alist->form-urlencoded ex)
"x=foo;y=bar;z=baz"
```

3 WebSocket

```
(require net/websocket)
```

The `net/websocket` library provides utilities to run and communicate with WebSocket servers, as specified in the WebSocket protocol IETF draft as of August 16th, 2010.

This module provides the exports from `net/websocket/client` and `net/websocket/server`.

3.1 Client API

```
(require net/websocket/client)
```

```
(ws-url? x) → boolean?  
  x : any/c
```

Returns true if `x` is a `url?` and has a `url-scheme` equal to `ws` or `wss`.

```
(wss-url? x) → boolean?  
  x : any/c
```

Returns true if `x` is a `url?` and has a `url-scheme` equal to `wss`.

```
(ws-connect u [#:headers headers]) → open-ws-conn?  
  u : ws-url?  
  headers : (listof header?) = empty
```

Connects to the WebSocket server specified by `u`, providing `headers` as additional headers. Returns the connection handle.

This module also provides the exports from `net/websocket/conn`.

3.2 Server API

```
(require net/websocket/server)
```

```

(ws-serve conn-handle
  [#:conn-headers conn-headers
   #:tcp@ tcp@
   #:port port
   #:listen-ip listen-ip
   #:max-waiting max-waiting
   #:timeout timeout
   #:confirmation-channel confirm-ch]) → (-> void)
conn-handle : (open-ws-conn? any/c . -> . void)
conn-headers : (bytes? (listof header?) . -> . (values (listof header?) any/c))
              = (λ (b hs) (values empty (void)))
tcp@ : (unit/c (import) (export tcp^)) = raw:tcp@
port : tcp-listen-port? = 80
listen-ip : (or/c string? false/c) = #f
max-waiting : integer? = 4
timeout : integer? = (* 60 60)
confirm-ch : (or/c false/c async-channel?) = #f

```

Starts a WebSocket server where each new connection uses *conn-headers* to compute what headers the client receives based on the client’s request line and headers. *conn-headers* also returns a piece of state that will be passed to *conn-handle* as its second argument. After the connection handshake is finished, *conn-handle* receives the connection and is in sole control until the WebSocket connection completes.

All other arguments are used as in a §1 “Dispatching Server”.

The `#:tcp@` keyword is provided for building an SSL server.

This module also provides the exports from `net/websocket/conn`.

3.3 Connections

```
(require net/websocket/conn)
```

```

(framing-mode) → (symbols 'old 'new)
(framing-mode mode) → void?
mode : (symbols 'old 'new)

```

Controls whether framing is as before August 16th, 2010 or after. (Most Web browsers currently support only `'old` and they are incompatible, so you must choose the correct one.) Defaults to `'old`.

```
(ws-conn? x) → boolean?
```

`x : any/c`

Returns true if `x` is a WebSocket connection.

`(open-ws-conn? x) → boolean?`
`x : any/c`

Returns true if `x` is an open WebSocket connection.

`(ws-conn-line ws) → bytes?`
`ws : ws-conn?`

Returns the request/response line of the WebSocket connection.

`(ws-conn-closed? ws) → boolean?`
`ws : ws-conn?`

Returns true if the WebSocket connection has been closed.

`(ws-conn-headers ws) → (listof header?)`
`ws : ws-conn?`

Returns the headers of the WebSocket connection.

WebSocket connection support only blocking calls:

`(ws-send! ws s) → void`
`ws : open-ws-conn?`
`s : string?`

Sends `s` over `ws`.

`(ws-recv ws) → (or/c string? eof-object?)`
`ws : open-ws-conn?`

Receives a string from `ws`. Returns `eof` if the other end closes the connection.

`(ws-close! ws) → void`
`ws : open-ws-conn?`

Closes `ws`.

3.4 Example

This is a WebSocket echo server compatible with the browser origin security model:

```
(ws-serve
 #:port 8080
 (λ (wsc _)
  (let loop ()
    (define m (ws-recv wsc))
    (printf "~a\n" m)
    (unless (eof-object? m)
      (ws-send! wsc m)
      (loop))))
 #:conn-headers
 (λ (_ hs)
  (define origin
    (header-value (headers-assq* #"Origin" hs)))
  (values
   (list
    (make-header #"Sec-WebSocket-Origin" origin)
    (make-header #"Sec-WebSocket-Location"
                  #"ws://localhost:8080/"))
   #f)))
```

4 FTP: Client Downloading

```
(require net/ftp)
```

The `net/ftp` library provides utilities for FTP client operations.

The library was written by Micah Flatt.

4.1 Functions

```
(ftp-connection? v) → boolean?  
  v : any/c
```

Returns `#t` if `v` represents an FTP connection as returned by `ftp-establish-connection`, `#f` otherwise.

```
(ftp-establish-connection server  
                          port-no  
                          user  
                          passwd) → ftp-connection?  
  
  server : string?  
  port-no : (integer-in 0 65535)  
  user : string?  
  passwd : string?
```

Establishes an FTP connection with the given server using the supplied username and password.

The username and password strings are encoded to bytes using the current locale's encoding.

```
(ftp-close-connection ftp-conn) → void?  
  ftp-conn : ftp-connection?
```

Closes an FTP connection.

```
(ftp-cd ftp-conn new-dir) → void?  
  ftp-conn : ftp-connection?  
  new-dir : string?
```

Changes the current directory on the FTP server to `new-dir`. The `new-dir` argument is not interpreted at all, but simply passed on to the server (encoded using the current locale's encoding); it must not contain a newline.

```
(ftp-directory-list ftp-conn)
→ (listof (list/c (one-of/c "-" "d" "l")
                 string?
                 string?))
   ftp-conn : ftp-connection?
```

Returns a list of files and directories in the current directory of the server, assuming that the server provides directory information in the quasi-standard Unix format.

Each file or directory is represented by a list of three strings. The first string is either "-", "d", or "l", depending on whether the item is a file, directory, or link, respectively. The second item is the file's date; to convert this value to seconds consistent with `file-seconds`, pass the date string to `ftp-make-file-seconds`, below. The third string is the name of the file or directory.

All strings are decoded from bytes using the current locale's encoding.

```
(ftp-make-file-seconds ftp-date) → exact-integer?
   ftp-date : string?
```

Takes a date string produced by `ftp-directory-list` and converts it to seconds (which can be used with `seconds->date`).

```
(ftp-download-file ftp-conn local-dir file) → void?
   ftp-conn : ftp-connection?
   local-dir : path-string?
   file : string?
```

Downloads `file` from the server's current directory and puts it in `local-dir` using the same name. If the file already exists in the local directory, it is replaced, but only after the transfer succeeds (i.e., the file is first downloaded to a temporary file, then moved into place on success).

4.2 FTP Unit

```
(require net/ftp-unit)
```

```
ftp@ : unit?
```

Imports nothing, exports `ftp^`.

4.3 FTP Signature

```
(require net/ftp-sig)
```

`ftp^` : signature

Includes everything exported by the `net/ftp` module.

5 Send URL: Opening a Web Browser

(require net/sendurl)

Provides `send-url` for opening a URL in the user's chosen web browser.

See also `browser/external`, which requires `racket/gui`, but can prompt the user for a browser if no browser preference is set.

```
(send-url str
  [separate-window?
   #:escape escape?]) → void?
str : string?
separate-window? : any/c = #t
escape? : any/c = #t
```

Opens `str`, which represents a URL, in a platform-specific manner. For some platforms and configurations, the `separate-window?` parameter determines if the browser creates a new window to display the URL or not.

On Windows, `send-url` normally uses `shell-execute` to launch a browser. (If the URL appears to contain a fragment, it may use an intermediate redirecting file due to a bug in IE7.)

On Mac OS X, `send-url` runs `osascript` to start the user's chosen browser.

On Unix, `send-url` uses a user-preference, or when none is set, it will look for a known browser. See the description of `external-browser` for details.

The `url` string is usually escaped to avoid dangerous shell characters (quotations, dollar signs, backslashes, and non-ASCII). Note that it is a good idea to encode URLs before passing them to this function.

On all platforms, `external-browser` parameter can be set to a procedure to override the above behavior — the procedure will be called with the `url` string.

```
(send-url/file path
  [separate-window?
   #:fragment fragment
   #:query query]) → void?
path : path-string?
separate-window? : any/c = #t
fragment : (or/c string? false/c) = #f
query : (or/c string? false/c) = #f
```

Similar to `send-url`, but accepts a path to a file to be displayed by the browser. Use this function when you want to display a local file: it takes care of the peculiarities of constructing the correct `file://` URL, and uses `send-url` to display the file. If you need to use an anchor fragment or a query string, use the corresponding keyword arguments.

```
(send-url/contents contents
  [separate-window?
   #:fragment fragment
   #:query query
   #:delete-at seconds]) → void?

contents : string?
separate-window? : any/c = #t
fragment : (or/c string? false/c) = #f
query : (or/c string? false/c) = #f
seconds : (or/c number? false/c) = #f
```

Similar to `send-url/file`, but it consumes the contents of a page to show, and displays it from a temporary file.

If `delete-at` is a number, the temporary file is removed after this many seconds. The deletion happens in a thread, so if racket exits before that it will not happen — when this function is called it scans old generated files (this happens randomly, not on every call) and removes them to avoid cluttering the temporary directory. If `delete-at` is `#f`, no delayed deletion happens, but old temporary files are still deleted as described above.

```
(external-browser) → browser-preference?
(external-browser cmd) → void?
  cmd : browser-preference?
```

A parameter that can hold a procedure to override how a browser is started, or `#f` to use the default platform-dependent command.

On Unix, the command that is used depends on the `'external-browser` preference. If the preference is unset, `send-url` uses the first of the browsers from `unix-browser-list` for which the executable is found. Otherwise, the preference should hold a symbol indicating a known browser (from the `unix-browser-list`), or it a pair of a prefix and a suffix string that are concatenated around the `url` string to make up a shell command to run. In addition, the `external-browser` parameter can be set to one of these values, and `send-url` will use it instead of the preference value.

Note that the URL is encoded to make it work inside shell double-quotes: URLs can still hold characters like `#`, `?`, and `&`, so if the `external-browser` is set to a pair of prefix/suffix strings, they should use double quotes around the url.

If the preferred or default browser can't be launched, `send-url` fails. See `get-preference`

and [put-preferences](#) for details on setting preferences.

```
(browser-preference? a) → boolean?  
a : any/c
```

Returns `#t` if `v` is a valid browser preference, `#f` otherwise. See [external-browser](#) for more information.

```
unix-browser-list : (listof symbol?)
```

A list of symbols representing Unix executable names that may be tried in order by [send-url](#). The [send-url](#) function internally includes information on how to launch each executable with a URL.

6 SMTP: Sending E-Mail

```
(require net/smtp)
```

The `net/smtp` module provides tools for sending electronic mail messages using SMTP. The client must provide the address of an SMTP server; in contrast, the `net/sendmail` module uses a pre-configured `sendmail` on the local system.

The `net/head` library defines the format of a header string, which is used by `send-smtp-message`. The `net/head` module also provides utilities to verify the formatting of a mail address. The procedures of the `net/smtp` module assume that the given string arguments are well-formed.

6.1 SMTP Functions

```
(smtp-send-message server-address
                  from
                  to
                  header
                  message
                  [#:port-no port-no/k
                  #:auth-user user
                  #:auth-passwd pw
                  #:tcp-connect connect
                  #:tls-encode encode
                  port-no]) → void?

server-address : string?
from : string?
to : (listof string?)
header : string?
message : (listof (or/c string? bytes?))
port-no/k : (integer-in 0 65535) = 25
user : (or/c string? false/c) = #f
pw : (or/c string? false/c) = #f
connect : ((string? (integer-in 0 65535)) = tcp-connect
           . ->* . (input-port? output-port?))
encode : (or/c false/c = #f
         ((input-port? output-port?
           #:mode (one-of/c 'connect)
           #:encrypt (one-of/c 'tls)
           #:close-original? (one-of/c #t))
         . ->* . (input-port? output-port?)))
port-no : (integer-in 0 65535) = port-no/k
```

Connects to the server at *server-address* and *port-no* to send a message. The *from* argument specifies the mail address of the sender, and *to* is a list of recipient addresses (including “To:”, “CC”, and “BCC” recipients).

The *header* argument is the complete message header, which should already include “From:”, “To:”, and “CC:” fields consistent with the given sender and recipients. See also the *net/head* library for header-creating utilities.

The *message* argument is the body of the message, where each string or byte string in the list corresponds to a single line of message text. No string in *message* should contain a carriage return or linefeed character.

The optional *port-no* argument—which can be specified either with the `#:port-no` keyword or, for backward compatibility, as an extra argument after keywords—specifies the IP port to use in contacting the SMTP server.

The optional `#:auth-user` and `#:auth-passwd` keyword arguments supply a username and password for authenticated SMTP (using the AUTH PLAIN protocol).

The optional `#:tcp-connect` keyword argument supplies a connection procedure to be used in place of `tcp-connect`. For example, use `ssl-connect` to connect to the server via SSL.

If the optional `#:tls-encode` keyword argument supplies a procedure instead of `#f`, then the ESMTP STARTTLS protocol is used to initiate SSL communication with the server. The procedure given as the `#:tls-encode` argument should be like `ports->ssl-ports`; it will be called as

```
(encode r w #:mode 'connect #:encrypt 'tls #:close-original? #t)
```

and it should return two values: an input port and an export port. All further SMTP communication uses the returned ports.

For encrypted communication, normally either `ssl-connect` should be supplied for `#:tcp-connect`, or `ports->ssl-ports` should be supplied for `#:tls-encode`—one or the other (depending on what the server expects), rather than both.

```
(smtp-sending-end-of-message) → (-> any)  
(smtp-sending-end-of-message proc) → void?  
proc : (-> any)
```

A parameter that determines a send-done procedure to be called after `smtp-send-message` has completely sent the message. Before the send-done procedure is called, breaking the thread that is executing `smtp-send-message` cancels the send. After the send-done procedure is called, breaking may or may not cancel the send (and probably will not).

6.2 SMTP Unit

```
(require net/smtp-unit)
```

```
smtp@ : unit?
```

Imports nothing, exports smtp^.

6.3 SMTP Signature

```
(require net/smtp-sig)
```

```
smtp^ : signature
```

Includes everything exported by the `net/smtp` module.

7 sendmail: Sending E-Mail

```
(require net/sendmail)
```

The `net/sendmail` module provides tools for sending electronic mail messages using a `sendmail` program on the local system. See also the `net/smtp` package, which sends mail via SMTP.

All strings used in mail messages are assumed to conform to their corresponding SMTP specifications, except as noted otherwise.

7.1 Sendmail Functions

```
(send-mail-message/port from
                        subject
                        to
                        cc
                        bcc
                        extra-header ...) → output-port?

from : string?
subject : string?
to : (listof string?)
cc : (listof string?)
bcc : (listof string?)
extra-header : string?
```

The first argument is the header for the sender, the second is the subject line, the third a list of “To:” recipients, the fourth a list of “CC:” recipients, and the fifth a list of “BCC:” recipients. Additional arguments supply other mail headers, which must be provided as lines (not terminated by a linefeed or carriage return) to include verbatim in the header.

The return value is an output port into which the client must write the message. Clients are urged to use `close-output-port` on the return value as soon as the necessary text has been written, so that the `sendmail` process can complete.

The `from` argument can be any value; of course, spoofing should be used with care.

```
(send-mail-message from
                   subject
                   to
                   cc
                   bcc
                   body
                   extra-header ...) → void?

from : string?
subject : string?
to : (listof string?)
cc : (listof string?)
bcc : (listof string?)
body : (listof string?)
extra-header : string?
```

Like `send-mail-message/port`, but with `body` as a list of strings, each providing a line of the message body.

Lines that contain a single period do not need to be quoted.

```
(struct no-mail-recipients exn ()
       #:extra-constructor-name make-no-mail-recipients)
```

Raised when no mail recipients were specified for `send-mail-message/port`.

7.2 Sendmail Unit

```
(require net/sendmail-unit)
```

```
sendmail@ : unit?
```

Imports nothing, exports `sendmail^`.

7.3 Sendmail Signature

```
(require net/sendmail-sig)
```

```
sendmail^ : signature
```


Includes everything exported by the `net/sendmail` module.

8 Headers: Parsing and Constructing

(require net/head)

The `net/head` module provides utilities for parsing and constructing RFC 822 headers [RFC822], which are used in protocols such as HTTP, SMTP, and NNTP.

A *header* is represented as a string or byte string containing CRLF-delimited lines. Each field within the header spans one or more lines. In addition, the header ends with two CRLFs (because the first one terminates the last field, and the second terminates the header).

8.1 Functions

`empty-header` : string?

The string `"\r\n\r\n"`, which corresponds to the empty header. This value is useful for building up headers with `insert-field` and `append-headers`.

(`validate-header candidate`) → void?
`candidate` : (or string? bytes?)

Checks that `candidate` matches RFC 822. If it does not, an exception is raised.

(`extract-field field header`) → (or/c string? bytes? false/c)
`field` : (or/c string? bytes?)
`header` : (or/c string? bytes?)

Returns the header content for the specified field, or `#f` if the field is not in the header. The `field` string should not end with `":"`, and it is used case-insensitively. The returned string will not contain the field name, color separator, or CRLF terminator for the field; however, if the field spans multiple lines, the CRLFs separating the lines will be intact.

The `field` and `header` arguments must be both strings or both byte strings, and the result (if not `#f`) is of the same type.

Example:

```
> (extract-field "TO" (insert-field "to" "me@localhost"
                             empty-header))
"me@localhost"
```

(`extract-all-fields header`)

```
→ (listof (cons/c (or/c string? bytes?)
                 (or/c string? bytes?)))
  header : (or/c string? bytes?)
```

Returns an association-list version of the header; the case of the field names is preserved, as well as the order and duplicate uses of a field name.

The result provides strings if *header* is a string, byte strings if *header* is a byte string.

```
(remove-field field header) → (or/c string? bytes?)
  field : (or/c string? bytes?)
  header : (or/c string? bytes?)
```

Creates a new header by removing the specified field from *header* (or the first instance of the field, if it occurs multiple times). If the field is not in *header*, then the return value is *header*.

The *field* and *header* arguments must be both strings or both byte strings, and the result is of the same type.

```
(insert-field field value header) → (or/c string? bytes?)
  field : (or/c string? bytes?)
  value : (or/c string? bytes?)
  header : (or/c string? bytes?)
```

Creates a new header by prefixing the given *header* with the given *field-value* pair. The *value* string should not contain a terminating CRLF, but a multi-line value (perhaps created with `data-lines->data`) may contain separator CRLFs.

The *field*, *value*, and *header* arguments must be all strings or all byte strings, and the result is of the same type.

```
(replaces-field field value header) → (or/c string? bytes?)
  field : (or/c string? bytes?)
  value : (or/c string? bytes? false/c)
  header : (or/c string? bytes?)
```

Composes `remove-field` and (if *value* is not `#f`) `insert-field`.

```
(append-headers header1 header2) → (or/c string? bytes?)
  header1 : (or/c string? bytes?)
  header2 : (or/c string? bytes?)
```

Appends two headers.

The *header1* and *header2* arguments must be both strings or both byte strings, and the result is of the same type.

```
(standard-message-header from
                          to
                          cc
                          bcc
                          subject) → string?

from : string?
to : (listof string?)
cc : (listof string?)
bcc : (listof string?)
subject : string?
```

Creates a standard mail header given the sender, various lists of recipients, a subject. A "Date" field is added to the header automatically, using the current time.

The BCC recipients do not actually appear in the header, but they're accepted anyway to complete the abstraction.

```
(data-lines->data listof) → string?
listof : string?
```

Merges multiple lines for a single field value into one string, adding CRLF-TAB separators.

```
(extract-addresses line kind)
→ (or/c (listof string?)
        (listof (list/c string? string? string?)))

line : string?
kind : (one-of/c 'name 'address
                'full 'all)
```

Parses *string* as a list of comma-delimited mail addresses, raising an exception if the list is ill-formed. This procedure can be used for single-address strings, in which case the returned list contains only one address.

The *kind* argument specifies which portion of an address should be returned:

- *'name* — the free-form name in the address, or the address itself if no name is available.

Examples:

```
> (extract-addresses "John Doe <doe@localhost>" 'name)
'("John Doe")
```

```

> (extract-addresses "doe@localhost (Johnny Doe)" 'name)
'("Johnny Doe")
> (extract-addresses "doe@localhost" 'name)
'("doe@localhost")
> (extract-addresses " \"Doe, John\" <doe@localhost>, jane"
'address)
'(" \"Doe, John\" "jane")

```

- `'address` — just the mailing address, without any free-form names.

Examples:

```

> (extract-addresses "John Doe <doe@localhost>" 'address)
'("doe@localhost")
> (extract-addresses "doe@localhost (Johnny Doe)" 'address)
'("doe@localhost")
> (extract-addresses "doe@localhost" 'address)
'("doe@localhost")
> (extract-addresses " \"Doe, John\" <doe@localhost>, jane"
'address)
'("doe@localhost" "jane")

```

- `'full` — the full address, essentially as it appears in the input, but normalized.

Examples:

```

> (extract-addresses "John Doe < doe@localhost >" 'full)
'("John Doe <doe@localhost>")
> (extract-addresses " doe@localhost (Johnny Doe)" 'full)
'("doe@localhost (Johnny Doe)")
> (extract-addresses "doe@localhost" 'full)
'("doe@localhost")
> (extract-addresses " \"Doe, John\" <doe@localhost>, jane"
'full)
'(" \"Doe, John\" <doe@localhost>" "jane")

```

- `'all` — a list containing each of the three possibilities: free-form name, address, and full address (in that order).

Examples:

```

> (extract-addresses "John Doe <doe@localhost>" 'all)
'(("John Doe" "doe@localhost" "John Doe <doe@localhost>"))
> (extract-addresses "doe@localhost (Johnny Doe)" 'all)
'(("Johnny Doe" "doe@localhost" "doe@localhost (Johnny Doe)"))
> (extract-addresses "doe@localhost" 'all)
'(("doe@localhost" "doe@localhost" "doe@localhost"))
> (define r
  (extract-addresses " \"John\" <doe@localhost>, jane"
'address))

```

```
> (length r)
2
> (car r)
'("\John\" "doe@localhost" "\John\" <doe@localhost>")
> (cadr r)
'("jane" "jane" "jane")
```

```
(assemble-address-field addrs) → string?
addrs : (listof string?)
```

Creates a header field value from a list of addresses. The addresses are comma-separated, and possibly broken into multiple lines.

Example:

```
> (assemble-address-field '("doe@localhost"
                           "Jane <jane@elsewhere>"))
"doe@localhost, Jane <jane@elsewhere>"
```

8.2 Header Unit

```
(require net/head-unit)
```

```
head@ : unit?
```

Imports nothing, exports head@.

8.3 Header Signature

```
(require net/head-sig)
```

```
head^ : signature
```

Includes everything exported by the net/head module.

9 IMAP: Reading Mail

```
(require net/imap)
```

The `net/imap` module provides utilities for the client side of Internet Message Access Protocol version 4rev1 [RFC2060].

9.1 Connecting and Selecting Mailboxes

```
(imap-connection? v) → boolean?  
v : any/c
```

Return `#t` if `v` is a IMAP-connection value (which is opaque), `#f` otherwise.

```
(imap-connect server  
             username  
             password  
             mailbox) → imap-connection?  
                    exact-nonnegative-integer?  
                    exact-nonnegative-integer?  
  
server : string?  
username : (or/c string? bytes?)  
password : (or/c string? bytes?)  
mailbox : (or/c string? bytes?)
```

Establishes an IMAP connection to the given server using the given username and password, and selects the specified mailbox. The first result value represents the connection.

The second and third return values indicate the total number of messages in the mailbox and the number of recent messages (i.e., messages received since the mailbox was last selected), respectively.

See also `imap-port-number`.

A user's primary mailbox is always called "INBOX". (Capitalization doesn't matter for that mailbox name.)

Updated message-count and recent-count values are available through `imap-messages` and `imap-recent`. See also `imap-new?` and `imap-reset-new!`.

```
(imap-port-number) → (integer-in 0 65535)  
(imap-port-number k) → void?
```

`k : (integer-in 0 65535)`

A parameter that determines the server port number. The initial value is 143.

```
(imap-connect* in
               out
               username
               password
               mailbox) → imap-connection?
                        exact-nonnegative-integer?
                        exact-nonnegative-integer?

in : input-port?
out : output-port?
username : (or/c string? bytes?)
password : (or/c string? bytes?)
mailbox : (or/c string? bytes?)
```

Like `imap-connect`, but given input and output ports (e.g., ports for an SSL session) instead of a server address.

```
(imap-disconnect imap) → void?
imap : imap-connection?
```

Closes an IMAP connection. The close may fail due to a communication error.

```
(imap-force-disconnect imap) → void?
imap : imap-connection?
```

Closes an IMAP connection forcefully (i.e., without send a close message to the server). A forced disconnect never fails.

```
(imap-reselect imap mailbox) → exact-nonnegative-integer?
                               exact-nonnegative-integer?

imap : imap-connection?
mailbox : (or/c string? bytes?)
```

De-selects the mailbox currently selected by the connection and selects the specified mailbox, returning the total and recent message counts for the new mailbox. Expunge and message-state information is removed.

Do not use this procedure to poll a mailbox to see whether there are any new messages. Use `imap-noop`, `imap-new?`, and `imap-reset-new!` instead.

```
(imap-examine imap mailbox) → exact-nonnegative-integer?
                                exact-nonnegative-integer?
  imap : imap-connection?
  mailbox : (or/c string? bytes?)
```

Like `imap-reselect`, but the mailbox is selected as read-only.

9.2 Selected Mailbox State

```
(imap-noop imap) → exact-nonnegative-integer?
                  exact-nonnegative-integer?
  imap : imap-connection?
```

Sends a “no-op” message to the server, typically to keep the session alive. As for many commands, the server may report message-state updates or expunges, which are recorded in `imap`.

The return information is the same as for `imap-reselect`.

```
(imap-poll imap) → void?
  imap : imap-connection?
```

Does not send a request to the server, but checks for asynchronous messages from the server that update the message count, to report expunges, etc.

```
(imap-messages imap) → exact-nonnegative-integer?
  imap : imap-connection?
```

Returns the number of messages in the selected mailbox. The server can update this count during most any interaction.

This operation does not communicate with the server. It merely reports the result of previous communication.

```
(imap-recent imap) → exact-nonnegative-integer?
  imap : imap-connection?
```

Returns the number of “recent” messages in the currently selected mailbox, as most recently reported by the server. The server can update this count during most any interaction.

This operation does not communicate with the server. It merely reports the result of previous communication.

```
(imap-unseen imap) → (or/c exact-nonnegative-integer? false/c)
  imap : imap-connection?
```

Returns the number of “unseen” messages in the currently selected mailbox, as most recently reported by the server. The server can update this count during most any interaction. Old IMAP servers might not report this value, in which case the result is #f.

This operation does not communicate with the server. It merely reports the result of previous communication.

```
(imap-uidnext imap) → (or/c exact-nonnegative-integer? false/c)
  imap : imap-connection?
```

Returns the predicted next uid for a message in the currently selected mailbox, as most recently reported by the server. The server can update this count during most any interaction. Old IMAP servers might not report this value, in which case the result is #f.

This operation does not communicate with the server. It merely reports the result of previous communication.

```
(imap-uidvalidity imap)
→ (or/c exact-nonnegative-integer? false/c)
  imap : imap-connection?
```

Returns an id number that changes when all uids become invalid. The server *cannot* update this number during a session. Old IMAP servers might not report this value, in which case the result is #f.

This operation does not communicate with the server. It merely reports the result of previous communication.

```
(imap-new? imap) → boolean?
  imap : imap-connection?
```

Returns #t if the server has reported an increase in the message count for the currently mailbox since the last call to `imap-reset-new!`. Selecting a mailbox implicitly calls `imap-reset-new!`.

This operation does not communicate with the server. It merely reports the result of previous communication.

```
(imap-reset-new! imap) → void?
  imap : imap-connection?
```

Resets the new flag for the session; see [imap-new?](#). This operation does not communicate with the server.

```
(imap-get-expunges imap) → (listof exact-nonnegative-integer?)  
  imap : imap-connection?
```

Returns pending expunge notifications from the server for the selected mailbox in terms of message positions (not uids), and clears the pending notifications. The result list is sorted, ascending.

This operation does not communicate with the server. It merely reports the result of previous communication.

The server can notify the client of newly deleted messages during most other commands, but not asynchronously between commands. Furthermore, the server cannot report new deletions during [imap-get-messages](#) or [imap-store](#) operations.

Before calling any IMAP operation that works in terms of message numbers, pending expunge notifications must be handled by calling [imap-get-expunges](#).

```
(imap-pending-expunges? imap) → boolean?  
  imap : imap-connection?
```

Returns `#f` if [imap-get-expunges](#) would return an empty list, `#t` otherwise.

```
(imap-get-updates imap)  
→ (listof (cons/c exact-nonnegative-integer?  
              (listof pair?)))  
  imap : imap-connection?
```

Returns information much like [imap-get-messages](#), but includes information reported asynchronously by the server (e.g., to notify a client with some other client changes a message attribute). Instead of reporting specific requested information for specific messages, the result is associates message positions to field-value association lists. The result list is sorted by message position, ascending.

This operation does not communicate with the server. It merely reports the result of previous communication. It also clears the update information from the connection after reporting it.

When a server reports information that supersedes old reported information for a message, or if the server reports that a message has been deleted, then old information for the message is dropped. Similarly, if [imap-get-messages](#) is used to explicitly obtain information, any redundant (or out-of-date) information is dropped.

A client need not use [imap-get-updates](#) ever, but accumulated information for the con-

nection consumes space.

```
(imap-pending-updates? imap) → boolean?  
imap : imap-connection?
```

Returns `#f` if `imap-get-updates` would return an list, `#t` otherwise.

9.3 Manipulating Messages

```
(imap-get-messages imap msg-nums fields) → (listof list?)  
imap : imap-connection?  
msg-nums : (listof exact-nonnegative-integer?)  
fields : (listof (one-of/c 'uid  
                        'header  
                        'body  
                        'flags))
```

Downloads information for a set of messages. The `msg-nums` argument specifies a set of messages by their message positions (not their uids). The `fields` argument specifies the type of information to download for each message. The available fields are:

- `'uid` — the value is an integer
- `'header` — the value is a header (a string, but see `net/head`)
- `'body` — the value is a byte string, with CRLF-separated lines
- `'flags` — the value is a list of symbols that correspond to IMAP flags; see `imap-flag->symbol`

The return value is a list of entry items in parallel to `msg-nums`. Each entry is itself a list containing value items in parallel to `fields`.

Pending expunges must be handled before calling this function; see `imap-get-expunges`.

Example:

```
> (imap-get-message imap '(1 3 5) '(uid header))  
'((107 #"From: larry@stooges.com ...") (110 #"From: moe@stooges.com  
...") (112 #"From: curly@stooges.com ..."))
```

```
(imap-flag->symbol flag) → symbol?  
flag : symbol?
```

```
(symbol->imap-flag sym) → symbol?  
sym : symbol?
```

An IMAP flag is a symbol, but it is generally not a convenient one to use within a Racket program, because it usually starts with a backslash. The `imap-flag->symbol` and `symbol->imap-flag` procedures convert IMAP flags to convenient symbols and vice-versa:

| | <i>symbol</i> | <i>IMAP flag</i> |
|----------------|----------------|------------------|
| message flags: | 'seen | ' \Seen |
| | 'answered | ' \Answered |
| | 'flagged | ' \Flagged |
| | 'deleted | ' \Deleted |
| | 'draft | ' \Draft |
| | 'recent | ' \Recent |
| mailbox flags: | 'noinferiors | ' \NoInferiors |
| | 'noselect | ' \Noselect |
| | 'marked | ' \Marked |
| | 'unmarked | ' \Unmarked |
| | 'hasnochildren | ' \HasNoChildren |
| | 'haschildren | ' \HasChildren |

The `imap-flag->symbol` and `symbol->imap-flag` functions act like the identity function when any other symbol is provided.

```
(imap-store imap mode msg-nums imap-flags) → void?  
imap : imap-connection?  
mode : (one-of/c '+ '- '!)  
msg-nums : (listof exact-nonnegative-integer?)  
imap-flags : (listof symbol?)
```

Sets flags for a set of messages. The mode argument specifies how flags are set:

- '+' — add the given flags to each message
- '-' — remove the given flags from each message
- '!' — set each message's flags to the given set

The `msg-nums` argument specifies a set of messages by their message positions (not their uids). The `flags` argument specifies the imap flags to add/remove/install.

Pending expunges must be handled before calling this function; see `imap-get-expunges`. The server will not report back message-state changes (so they will not show up through `imap-get-updates`).

Examples:

```
> (imap-store imap '+ '(1 2 3) (list (symbol->imap-flag 'deleted)))
; marks the first three messages to be deleted
> (imap-expunge imap)
; permanently removes the first three messages (and possibly
; others) from the currently-selected mailbox
```

```
(imap-expunge imap) → void?
imap : imap-connection?
```

Purges every message currently marked with the `'|\Deleted|` flag from the mailbox.

9.4 Querying and Changing (Other) Mailboxes

```
(imap-copy imap msg-nums dest-mailbox) → void?
imap : imap-connection?
msg-nums : (listof exact-nonnegative-integer?)
dest-mailbox : (or/c string? bytes?)
```

Copies the specified messages from the currently selected mailbox to the specified mailbox.

Pending expunges must be handled before calling this function; see [imap-get-expunges](#).

```
(imap-append imap mailbox message) → void?
imap : imap-connection?
mailbox : string?
message : (or/c string? bytes?)
```

Adds a new message (containing *message*) to the given mailbox.

```
(imap-status imap mailbox statuses) → list?
imap : imap-connection?
mailbox : (or/c string? bytes?)
statuses : (listof symbol?)
```

Requests information about a mailbox from the server, typically *not* the currently selected mailbox.

The *statuses* list specifies the request, and the return value includes one value for each symbol in *statuses*. The allowed status symbols are:

- `'messages` — number of messages
- `'recent` — number of recent messages

- `'unseen` — number of unseen messages
- `'uidnext` — uid for next received message
- `'uidvalidity` — id that changes when all uids are changed

Use `imap-messages` to get the message count for the currently selected mailbox, etc. Use `imap-new?` and `imap-reset-new!` to detect when new messages are available in the currently selected mailbox.

```
(imap-mailbox-exists? imap mailbox) → boolean?
  imap : imap-connection?
  mailbox : (or/c string? bytes?)
```

Returns `#t` if `mailbox` exists, `#f` otherwise.

```
(imap-create-mailbox imap mailbox) → void?
  imap : imap-connection?
  mailbox : (or/c string? bytes?)
```

Creates `mailbox`. (It must not exist already.)

```
(imap-list-child-mailboxes imap
                           mailbox
                           [delimiter])
→ (listof (list/c (listof symbol?) bytes?))
  imap : imap-connection?
  mailbox : (or/c string? bytes? false/c)
  delimiter : (or/c string? bytes?)
             = (imap-get-hierarchy-delimiter)
```

Returns information about sub-mailboxes of `mailbox`; if `mailbox` is `#f`, information about all top-level mailboxes is returned. The `delimiter` is used to parse mailbox names from the server to detect hierarchy.

The return value is a list of mailbox-information lists. Each mailbox-information list contains two items:

- a list of imap flags for the mailbox
- the mailbox's name

```
(imap-get-hierarchy-delimiter imap) → bytes?
```

`imap` : `imap-connection?`

Returns the server-specific string that is used as a separator in mailbox path names.

```
(imap-mailbox-flags imap mailbox) → (listof symbol?)  
  imap : imap-connection?  
  mailbox : (or/c string? bytes?)
```

Returns a list of IMAP flags for the given mailbox. See also `imap-flag->symbol`.

9.5 IMAP Unit

```
(require net/imap-unit)
```

`imap@` : `unit?`

Imports nothing, exports `imap^`.

9.6 IMAP Signature

```
(require net/imap-sig)
```

`imap^` : `signature`

Includes everything exported by the `net/imap` module.

10 POP3: Reading Mail

```
(require net/pop3)
```

The `net/pop3` module provides tools for the Post Office Protocol version 3 [RFC977].

```
(struct communicator (sender receiver server port state)
  #:extra-constructor-name make-communicator)
  sender : output-port?
  receiver : input-port?
  server : string?
  port : (integer-in 0 65535)
  state : (one-of/c 'disconnected 'authorization 'transaction)
```

Once a connection to a POP-3 server has been established, its state is stored in a `communicator` instance, and other procedures take `communicator` instances as an argument.

```
(connect-to-server server [port-number]) → communicator?
  server : string?
  port-number : (integer-in 0 65535) = 110
```

Connects to `server` at `port-number`.

```
(disconnect-from-server communicator) → void?
  communicator : communicator?
```

Disconnects `communicator` from the server, and sets `communicator`'s state to `'disconnected`.

```
(authenticate/plain-text user
  passwd
  communicator) → void?
  user : string?
  passwd : string?
  communicator : communicator?
```

Authenticates using `user` and `passwd`. If authentication is successful, `communicator`'s state is set to `'transaction`.

```
(get-mailbox-status communicator) → exact-nonnegative-integer?
  exact-nonnegative-integer?
  communicator : communicator?
```

Returns the number of messages and the number of octets in the mailbox.

```
(get-message/complete communicator
                      message-number)
→ (listof string?) (listof string?)
   communicator : communicator?
   message-number : exact-integer?
```

Given a message number, returns a list of message-header lines and list of message-body lines.

```
(get-message/headers communicator
                    message-number)
→ (listof string?) (listof string?)
   communicator : communicator?
   message-number : exact-integer?
```

Given a message number, returns a list of message-header lines.

```
(get-message/body communicator
                 message-number)
→ (listof string?) (listof string?)
   communicator : communicator?
   message-number : exact-integer?
```

Given a message number, returns a list of message-body lines.

```
(delete-message communicator
               message-number) → void?
   communicator : communicator?
   message-number : exact-integer?
```

Deletes the specified message.

```
(get-unique-id/single communicator
                    message-number) → string?
   communicator : communicator?
   message-number : exact-integer?
```

Gets the server's unique id for a particular message.

```
(get-unique-id/all communicator)
```

```
→ (listof (cons/c exact-integer? string?))
communicator : communicator?
```

Gets a list of unique id's from the server for all the messages in the mailbox. The `car` of each item in the result list is the message number, and the `cdr` of each item is the message's id.

```
(make-desired-header tag-string) → regexp?
tag-string : string?
```

Takes a header field's tag and returns a regexp to match the field

```
(extract-desired-headers header desireds) → (listof string?)
header : (listof string?)
desireds : (listof regexp?)
```

Given a list of header lines and of desired regexps, returns the header lines that match any of the *desireds*.

10.1 Exceptions

```
(struct pop3 exn ()
 #:extra-constructor-name make-pop3)
```

The supertype of all POP3 exceptions.

```
(struct cannot-connect pop3 ()
 #:extra-constructor-name make-cannot-connect)
```

Raised when a connection to a server cannot be established.

```
(struct username-rejected pop3 ()
 #:extra-constructor-name make-username-rejected)
```

Raised if the username is rejected.

```
(struct password-rejected pop3 ()
 #:extra-constructor-name make-password-rejected)
```

Raised if the password is rejected.

```
(struct not-ready-for-transaction pop3 (communicator)
  #:extra-constructor-name make-not-ready-for-transaction)
  communicator : communicator?
```

Raised when the communicator is not in transaction mode.

```
(struct not-given-headers pop3 (communicator message)
  #:extra-constructor-name make-not-given-headers)
  communicator : communicator?
  message : exact-integer?
```

Raised when the server does not respond with headers for a message as requested.

```
(struct illegal-message-number pop3 (communicator message)
  #:extra-constructor-name make-illegal-message-number)
  communicator : communicator?
  message : exact-integer?
```

Raised when the client specifies an illegal message number.

```
(struct cannot-delete-message exn (communicator message)
  #:extra-constructor-name make-cannot-delete-message)
  communicator : communicator?
  message : exact-integer?
```

Raised when the server is unable to delete a message.

```
(struct disconnect-not-quiet pop3 (communicator)
  #:extra-constructor-name make-disconnect-not-quiet)
  communicator : communicator?
```

Raised when the server does not gracefully disconnect.

```
(struct malformed-server-response pop3 (communicator)
  #:extra-constructor-name make-malformed-server-response)
  communicator : communicator?
```

Raised when the server produces a malformed response.

10.2 Example Session

```
> (require net/pop3)
> (define c (connect-to-server "foo.bar.com"))
> (authenticate/plain-text "bob" "*****" c)
> (get-mailbox-status c)
196
816400
> (get-message/headers c 100)
("Date: Thu, 6 Nov 1997 12:34:18 -0600 (CST)"
 "Message-Id: <199711061834.MAA11961@foo.bar.com>"
 "From: Alice <alice@foo.bar.com>"
 . . . .
 "Status: R0")
> (get-message/complete c 100)
("Date: Thu, 6 Nov 1997 12:34:18 -0600 (CST)"
 "Message-Id: <199711061834.MAA11961@foo.bar.com>"
 "From: Alice <alice@foo.bar.com>"
 . . . .
 "Status: R0")
("some body" "text" "goes" "." "here" "." "")
> (get-unique-id/single c 205)
no message numbered 205 available for unique id
> (list-tail (get-unique-id/all c) 194)
((195 . "e24d13c7ef050000") (196 . "3ad2767070050000"))
> (get-unique-id/single c 196)
"3ad2767070050000"
> (disconnect-from-server c)
```

10.3 POP3 Unit

```
(require net/pop3-unit)
```

```
pop3@ : unit?
```

```
Imports nothing, exports pop3^.
```

10.4 POP3 Signature

```
(require net/pop3-sig)
```

pop3~ : signature

Includes everything exported by the [net/pop3](#) module.

11 MIME: Decoding Internet Data

```
(require net/mime)
```

The `net/mime` library provides utilities for parsing and creating MIME encodings as described in RFC 2045 through RFC 2049.

The library was written by Francisco Solsona.

11.1 Message Decoding

```
(mime-analyze message-in part?) → message?  
message-in : (or/c bytes? input-port)  
part? : any/c
```

Parses `message-in` and returns the parsed result as a `message` instance.

```
(struct message (version entity fields)  
  #:extra-constructor-name make-message)  
version : real?  
entity : entity  
fields : (listof string?)
```

A decoded MIME message. The version is `1.0` by default. The `entity` field represents the message data. The `fields` field contains one string for each field in the message header.

```
(struct entity (type  
  subtype  
  charset  
  encoding  
  disposition  
  params  
  id  
  description  
  other  
  fields  
  parts  
  body)  
  #:extra-constructor-name make-entity)  
type : symbol?  
subtype : symbol?  
charset : symbol?
```

```

encoding : symbol?
disposition : disposition?
params : (listof (cons/c symbol? string?))
id : string?
description : string?
other : (listof string?)
fields : (listof string?)
parts : (listof message?)
body : (output-port? . -> . void?)

```

Represents the content of a message or a sub-part.

Standard values for the `type` field include `'text`, `'image`, `'audio`, `'video`, `'application`, `'message`, and `'multipart`.

Standard values for the `subtype` field depend on the `type` field, and include the following:

| | | |
|--------------------|-----------------------|----------------------------------|
| 'text | 'plain | [RFC1521, NSB] |
| | 'richtext | [RFC1521, NSB] |
| | 'tab-separated-values | [Lindner] |
| 'multipart | 'mixed | [RFC1521, NSB] |
| | 'alternative | [RFC1521, NSB] |
| | 'digest | [RFC1521, NSB] |
| | 'parallel | [RFC1521, NSB] |
| | 'appledouble | [MacMime, Faltstrom] |
| | 'header-set | [Crocker] |
| 'message | 'rfc822 | [RFC1521, NSB] |
| | 'partial | [RFC1521, NSB] |
| | 'external-body | [RFC1521, NSB] |
| | 'news | [RFC 1036, Spencer] |
| 'application | 'octet-stream | [RFC1521, NSB] |
| | 'postscript | [RFC1521, NSB] |
| | 'oda | [RFC1521, NSB] |
| | 'atomicmail | [atomicmail, NSB] |
| | 'andrew-inset | [andrew-inset, NSB] |
| | 'slate | [slate, Crowley] |
| | 'wita | [Wang Info Transfer, Campbell] |
| | 'dec-dx | [Digital Doc Trans, Campbell] |
| | 'dca-rft | [IBM Doc Content Arch, Campbell] |
| | 'activemessage | [Shapiro] |
| | 'rtf | [Lindner] |
| | 'applefile | [MacMime, Faltstrom] |
| | 'mac-binhex40 | [MacMime, Faltstrom] |
| | 'news-message-id | [RFC1036, Spencer] |
| 'news-transmission | [RFC1036, Spencer] | |
| 'wordperfect5.1 | [Lindner] | |

| | | |
|--------|------------------|----------------|
| | 'pdf | [Lindner] |
| | 'zip | [Lindner] |
| | 'macwriteii | [Lindner] |
| | 'msword | [Lindner] |
| | 'remote-printing | [RFC1486,MTR] |
| 'image | 'jpeg | [RFC1521, NSB] |
| | 'gif | [RFC1521, NSB] |
| | 'ief | [RFC1314] |
| | 'tiff | [MTR] |
| 'audio | 'basic | [RFC1521, NSB] |
| 'video | 'mpeg | [RFC1521, NSB] |
| | 'quicktime | [Lindner] |

Standard values for the `charset` field include `'us-ascii`, which is the default.

Standard values for the `encoding` field are `'7bit`, `'8bit`, `'binary`, `'quoted-printable`, and `'base64`. The default is `'7bit`.

The `params` field contains a list of parameters from other MIME headers.

The `id` field is taken from the `"Content-Id"` header field.

The `description` field is taken from the `"Content-description"` header field.

The `other` field contains additional (non-standard) field headers whose field names start with `"Content-"`.

The `fields` field contains additional field headers whose field names *do not* start with `"Content-"`.

The `parts` contains sub-parts from multipart MIME messages. This list is non-empty only when `type` is `'multipart` or `'message`.

The `body` field represents the body as a function that consumes an output out and writes the decoded message to the port. No bytes are written if `type` is `'multipart` or `'message`. All of the standard values of `encoding` are supported. The procedure only works once (since the encoded body is pulled from a stream).

```
(struct disposition (type
                    filename
                    creation
                    modification
                    read
                    size
                    params)
 #:extra-constructor-name make-disposition)
```

```
type : symbol?
filename : (or/c string? false/c)
creation : (or/c string? false/c)
modification : (or/c string? false/c)
read : (or/c string? false/c)
size : (or/c exact-nonnegative-integer? false/c)
params : (listof (cons/c symbol? string?))
```

Represents a "Content-Disposition" header as defined in RFC 2183.

Standard values for the `type` field include `'inline` and `'attachment`.

The `filename` field is drawn from the "filename" parameter of the "Content-Disposition" header, if included in the message.

The `creation`, `modification`, and `read` fields represent file timestamps as drawn from the "creation-date", "modification-date", and "read-date" attributes of the "Content-Disposition" header, if included in the message.

The `size` field is drawn from the "size" parameter of the "Content-Disposition" header, if included in the message.

The `params` field stores any additional attribute bindings of the "Content-Disposition" header, if included in the message.

11.2 Exceptions

```
(struct mime-error ()
  #:extra-constructor-name make-mime-error)
```

The supertype of all MIME exceptions.

```
(struct unexpected-termination mime-error (msg)
  #:extra-constructor-name make-unexpected-termination)
msg : string?
```

Raised when an end-of-file is reached while parsing the headers of a MIME entity. It usually means that the message does not conform to RFC 2045 and friends.

```
(struct missing-multipart-boundary-parameter mime-error ()
  #:extra-constructor-name make-missing-multipart-boundary-parameter)
```

Raised when a multipart type is specified, but no "Boundary" parameter is given or an

end-of-file is encountered before the boundary.

```
(struct malformed-multipart-entity mime-error (msg)
  #:extra-constructor-name make-malformed-multipart-entity)
  msg : string?
```

Similar to `unexpected-termination`, but used only while scanning parts of a multipart message.

```
(struct empty-mechanism mime-error ()
  #:extra-constructor-name make-empty-mechanism)
```

Raised when no transport encoding mechanism was provided with the `"Content-Transfer-Encoding"` field.

```
(struct empty-type mime-error ()
  #:extra-constructor-name make-empty-type)
```

Raised when no type is specified for `"Content-Type"`, or when the specification is incorrectly formatted.

```
(struct empty-subtype mime-error ()
  #:extra-constructor-name make-empty-subtype)
```

Raised when no sub-type is specified for `"Content-Type"`, or when the specification is incorrectly formatted.

```
(struct empty-disposition-type mime-error ()
  #:extra-constructor-name make-empty-disposition-type)
```

Raised when type specified for the `"Content-Disposition"` field, or when the specification is incorrectly formatted.

11.3 MIME Unit

```
(require net/mime-unit)
```

```
mime@ : unit?
```

Imports nothing, exports `mime^`.

11.4 MIME Signature

```
(require net/mime-sig)
```

mime^ : signature

Includes everything exported by the `net/mime` module.

12 Base 64: Encoding and Decoding

(require net/base64)

The `net/base64` library provides utilities for Base 64 (mime-standard) encoding and decoding.

12.1 Functions

(`base64-encode bstr`) → `bytes?`
`bstr` : `bytes?`

Consumes a byte string and returns its Base 64 encoding as a new byte string. The returned string is broken into 72-byte lines separated by CRLF combinations, and always ends with a CRLF combination unless the input is empty.

(`base64-decode bstr`) → `bytes?`
`bstr` : `bytes?`

Consumes a byte string and returns its Base 64 decoding as a new byte string.

(`base64-encode-stream in out [newline-bstr]`) → `void?`
`in` : `input-port?`
`out` : `output-port?`
`newline-bstr` : `bytes?` = `"\n"`

Reads bytes from `in` and writes the encoded result to `out`, breaking the output into 72-character lines separated by `newline-bstr`, and ending with `newline-bstr` unless the input stream is empty. Note that the default `newline-bstr` is just `"\n"`, not `"\r\n"`. The procedure returns when it encounters an end-of-file from `in`.

(`base64-decode-stream in out`) → `void?`
`in` : `input-port?`
`out` : `output-port?`

Reads a Base 64 encoding from `in` and writes the decoded result to `out`. The procedure returns when it encounters an end-of-file or Base 64 terminator `=` from `in`.

12.2 Base64 Unit

```
(require net/base64-unit)
```

```
base64@ : unit?
```

Imports nothing, exports base64^.

12.3 Base64 Signature

```
(require net/base64-sig)
```

```
base64^ : signature
```

Includes everything exported by the `net/base64` module.

13 Quoted-Printable: Encoding and Decoding

(require net/qp)

The `net/qp` library provides utilities for quoted-printable (mime-standard) encoding and decoding from RFC 2045 section 6.7.

The library was written by Francisco Solsona.

13.1 Functions

```
(qp-encode bstr) → bytes?  
  bstr : bytes?
```

Consumes a byte string and returns its quoted printable representation as a new string. The encoded string uses `#"\r\n"` where necessary to create shorter lines.

```
(qp-decode bstr) → bytes?  
  bstr : bytes?
```

Consumes a byte string and returns its un-quoted printable representation as a new string. Non-soft line breaks are preserved in whatever form they exist (CR, LR, or CRLF) in the input string.

```
(qp-encode-stream in out [newline-bstr]) → void?  
  in : input-port?  
  out : output-port?  
  newline-bstr : bytes? = #"\n"
```

Reads characters from `in` and writes the quoted printable encoded result to `out`.

The `newline-bstr` argument is used for soft line-breaks (after `=`). Note that the default `newline-bstr` is just `#"\n"`, not `#"\r\n"`.

Other line breaks are preserved in whatever form they exist (CR, LR, or CRLF) in the input stream.

```
(qp-decode-stream in out) → void?  
  in : input-port?  
  out : output-port?
```

Reads characters from `in` and writes de-quoted-printable result to `out`. Non-soft line breaks

are preserved in whatever form they exist (CR, LR, or CRLF) in the input stream.

13.2 Exceptions

```
(struct qp-error ()
  #:extra-constructor-name make-qp-error)
(struct qp-wrong-input qp-error ()
  #:extra-constructor-name make-qp-wrong-input)
(struct qp-wrong-line-size qp-error ()
  #:extra-constructor-name make-qp-wrong-line-size)
```

None of these are used anymore, but the bindings are preserved for backward compatibility.

13.3 Quoted-Printable Unit

```
(require net/qp-unit)
```

`qp@` : unit?

Imports nothing, exports `qp^`.

13.4 -Printable Signature

```
(require net/qp-sig)
```

`qp^` : signature

Includes everything exported by the `net/qp` module.

14 DNS: Domain Name Service Queries

(require net/dns)

The `net/dns` library provides utilities for looking up hostnames.

Thanks to Eduardo Cavazos and Jason Crowe for repairs and improvements.

14.1 Functions

```
(dns-get-address nameserver address) → string?  
  nameserver : string?  
  address : string?
```

Consults the specified nameserver (normally a numerical address like "128.42.1.30") to obtain a numerical address for the given Internet address.

The query record sent to the DNS server includes the "recursive" bit, but `dns-get-address` also implements a recursive search itself in case the server does not provide this optional feature.

```
(dns-get-name nameserver address) → string?  
  nameserver : string?  
  address : string?
```

Consults the specified nameserver (normally a numerical address like "128.42.1.30") to obtain a name for the given numerical address.

```
(dns-get-mail-exchanger nameserver address) → string?  
  nameserver : string?  
  address : string?
```

Consults the specified nameserver to obtain the address for a mail exchanger the given mail host address. For example, the mail exchanger for "ollie.cs.rice.edu" might be "cs.rice.edu".

```
(dns-find-nameserver) → (or/c string? false/c)
```

Attempts to find the address of a nameserver on the present system. On Unix and Mac OS X, this procedure parses "/etc/resolv.conf" to extract the first nameserver address. On Windows, it runs `nslookup.exe`.

14.2 DNS Unit

```
(require net/dns-unit)
```

```
dns@ : unit?
```

Imports nothing, exports dns^.

14.3 DNS Signature

```
(require net/dns-sig)
```

```
dns^ : signature
```

Includes everything exported by the `net/dns` module.

15 NNTP: Newsgroup Protocol

```
(require net/nntp)
```

The `net/nntp` module provides tools to access Usenet group via NNTP [RFC977].

15.1 Connection and Operations

```
(struct communicator (sender receiver server port)
  #:extra-constructor-name make-communicator)
  sender : output-port?
  receiver : input-port?
  server : string?
  port : (integer-in 0 65535)
```

Once a connection to a Usenet server has been established, its state is stored in a `communicator`, and other procedures take communicators as an argument.

```
(connect-to-server server [port-number]) → communicator?
  server : string?
  port-number : (integer-in 0 65535) = 119
```

Connects to `server` at `port-number`.

```
(disconnect-from-server communicator) → void?
  communicator : communicator?
```

Disconnects an NNTP communicator.

```
(open-news-group communicator newsgroup)
→ exact-nonnegative-integer?
  exact-nonnegative-integer?
  exact-nonnegative-integer?
  communicator : communicator?
  newsgroup : string?
```

Selects the newsgroup of an NNTP connection. The returned values are the total number of articles in the group, the first available article, and the last available article.

```
(authenticate-user communicator
  username
  password) → void?
communicator : communicator?
username : string?
password : string?
```

Tries to authenticate a user with the original `authinfo` command (uses cleartext). The `password` argument is ignored if the server does not ask for it.

```
(head-of-message communicator
  message-index) → (listof string?)
communicator : communicator?
message-index : exact-nonnegative-integer?
```

Given a message number, returns its header lines.

```
(body-of-message communicator
  message-index) → (listof string?)
communicator : communicator?
message-index : exact-nonnegative-integer?
```

Given a message number, returns the body of the message.

```
(newnews-since communicator message-index) → (listof string?)
communicator : communicator?
message-index : exact-nonnegative-integer?
```

Implements the `NEWNEWS` command (often disabled on servers).

```
((generic-message-command command
  ok-code)
  communicator
  message-index) → (listof string?)
command : string?
ok-code : exact-integer?
communicator : communicator?
message-index : exact-nonnegative-integer?
```

Useful primitive for implementing `head-of-message`, `body-of-message` and other similar commands.

```
(make-desired-header tag-string) → regexp?  
tag-string : string?
```

Takes a header field's tag and returns a regexp to match the field

```
(extract-desired-headers header desireds) → (listof string?)  
header : (listof string?)  
desireds : (listof regexp?)
```

Given a list of header lines and of desired regexps, returns the header lines that match any of the *desireds*.

15.2 Exceptions

```
(struct nntp exn ()  
 #:extra-constructor-name make-nntp)
```

The supertype of all NNTP exceptions.

```
(struct unexpected-response nntp (code text)  
 #:extra-constructor-name make-unexpected-response)  
code : exact-integer?  
text : string?
```

Raised whenever an unexpected response code is received. The `text` field holds the response text sent by the server.

```
(struct bad-status-line nntp (line)  
 #:extra-constructor-name make-bad-status-line)  
line : string?
```

Raised for mal-formed status lines.

```
(struct premature-close nntp (communicator)  
 #:extra-constructor-name make-premature-close)  
communicator : communicator?
```

Raised when a remote server closes its connection unexpectedly.

```
(struct bad-newsgroup-line nntp (line)
  #:extra-constructor-name make-bad-newsgroup-line)
  line : string?
```

Raised when the newsgroup line is improperly formatted.

```
(struct non-existent-group nntp (group)
  #:extra-constructor-name make-non-existent-group)
  group : string?
```

Raised when the server does not recognize the name of the requested group.

```
(struct article-not-in-group nntp (article)
  #:extra-constructor-name make-article-not-in-group)
  article : exact-integer?
```

Raised when an article is outside the server's range for that group.

```
(struct no-group-selected nntp ()
  #:extra-constructor-name make-no-group-selected)
```

Raised when an article operation is used before a group has been selected.

```
(struct article-not-found nntp (article)
  #:extra-constructor-name make-article-not-found)
  article : exact-integer?
```

Raised when the server is unable to locate the article.

```
(struct authentication-rejected nntp ()
  #:extra-constructor-name make-authentication-rejected)
```

Raised when the server reject an authentication attempt.

15.3 NNTP Unit

```
(require net/nntp-unit)
```

```
nntp@ : unit?
```

Imports nothing, exports `nntp^`.

15.4 NNTP Signature

```
(require net/nntp-sig)
```

`nntp^` : signature

Includes everything exported by the `net/nntp` module.

16 TCP: Unit and Signature

The `net/tcp-sig` and `net/tcp-unit` libraries define a `tcp^` signature and `tcp@` implementation, where the implementation uses `racket/tcp`.

Some units in the "net" collection import `tcp^`, so that they can be used with transports other than plain TCP. For example, `url@` imports `tcp^`.

See also `tcp-redirect` and `make-ssl-tcp@`.

16.1 TCP Signature

```
(require net/tcp-sig)
```

`tcp^` : signature

```
(tcp-listen port-no
            [max-allow-wait
             reuse?
             hostname]) → tcp-listener?
port-no : (and/c exact-nonnegative-integer?
                (integer-in 1 65535))
max-allow-wait : exact-nonnegative-integer? = 4
reuse? : any/c = #f
hostname : (or/c string? false/c) = #f
```

Like `tcp-listen` from `racket/tcp`.

```
(tcp-connect hostname
             port-no
             [local-hostname
              local-port-no]) → input-port? output-port?
hostname : string?
port-no : (and/c exact-nonnegative-integer?
                (integer-in 1 65535))
local-hostname : (or/c string? false/c) = #f
local-port-no : (or/c (and/c exact-nonnegative-integer? = #f
                             (integer-in 1 65535))
                  false/c)
```

Like `tcp-connect` from `racket/tcp`.

```
(tcp-connect/enable-break hostname
                           port-no
                           [local-hostname]
                           local-port-no)
```

```
→ input-port? output-port?
hostname : string?
port-no : (and/c exact-nonnegative-integer?
              (integer-in 1 65535))
local-hostname : (or/c string? false/c) = #f
local-port-no : (or/c (and/c exact-nonnegative-integer?
                            (integer-in 1 65535))
                  false/c)
```

Like `tcp-connect/enable-break` from `racket/tcp`.

```
(tcp-accept listener) → input-port? output-port?
listener : tcp-listener?
```

Like `tcp-accept` from `racket/tcp`.

```
(tcp-accept/enable-break listener) → input-port? output-port?
listener : tcp-listener?
```

Like `tcp-accept/enable-break` from `racket/tcp`.

```
(tcp-accept-ready? listener) → boolean?
listener : tcp-listener?
```

Like `tcp-accept-ready?` from `racket/tcp`.

```
(tcp-close listener) → void?
listener : tcp-listener?
```

Like `tcp-close` from `racket/tcp`.

```
(tcp-listener? v) → boolean?
v : any/c
```

Like `tcp-listener?` from `racket/tcp`.

```
(tcp-abandon-port tcp-port) → void?
tcp-port : port?
```

Like `tcp-abandon-port` from `racket/tcp`.

```
(tcp-addresses tcp-port [port-numbers?])
→ (or/c (values string? string?)
         (values string? (integer-in 1 65535)
                    string? (integer-in 1 65535)))
```

```
tcp-port : port?  
port-numbers? : any/c = #f
```

Like `tcp-addresses` from `racket/tcp`.

16.2 TCP Unit

```
(require net/tcp-unit)
```

```
tcp@ : unit?
```

Imports nothing and exports `tcp^`, implemented using `racket/tcp`.

17 TCP Redirect: `tcp^` via Channels

```
(require net/tcp-redirect)
```

The `net/tcp-redirect` library provides a function for directing some TCP port numbers to use buffered channels instead of the TCP support from `racket/tcp`.

```
(tcp-redirect port-numbers) → unit?  
port-numbers : (listof (integer-in 0 65535))
```

Returns a unit that implements `tcp^`. For port numbers not listed in `port-numbers`, the unit's implementations are the `racket/tcp` implementations.

For the port numbers listed in `port-numbers` and for connections to "`127.0.0.1`", the unit's implementation does not use TCP connections, but instead uses internal buffered channels. Such channels behave exactly as TCP listeners and ports.

18 SSL Unit: `tcp^` via SSL

```
(require net/ssl-tcp-unit)
```

The `net/ssl-tcp-unit` library provides a function for creating a `tcp^` implementation with `openssl` functionality.

```
(make-ssl-tcp@ server-cert-file
               server-key-file
               server-root-cert-files
               server-suggest-auth-file
               client-cert-file
               client-key-file
               client-root-cert-files) → unit?
server-cert-file : (or/c path-string? false/c)
server-key-file  : (or/c path-string? false/c)
server-root-cert-files : (or/c (listof path-string?) false/c)
server-suggest-auth-file : path-string?
client-cert-file  : (or/c path-string? false/c)
client-key-file   : (or/c path-string? false/c)
client-root-cert-files : (listof path-string?)
```

Returns a unit that implements `tcp^` using the SSL functions from `openssl`. The arguments to `make-ssl-tcp@` control the certificates and keys uses by server and client connections:

- `server-cert-file` — a PEM file for a server's certificate; `#f` means no certificate (which is unlikely to work with any SSL client)
- `server-key-file` — a private key PEM to go with `server-cert-file`; `#f` means no key (which is likely renders a certificate useless)
- `server-root-cert-files` — a list of PEM files for trusted root certificates; `#f` disables verification of peer client certificates
- `server-suggest-auth-file` — PEM file for root certificates to be suggested to peer clients that must supply certificates
- `client-cert-file` — a PEM file for a client's certificate; `#f` means no certificate (which is usually fine)
- `client-key-file` — a private key PEM to go with `client-cert-file`; `#f` means no key (which is likely renders a certificate useless)
- `client-root-cert-files` — a list of PEM files for trusted root certificates; `#f` disables verification of peer server certificates

19 CGI Scripts

```
(require net/cgi)
```

The `net/cgi` module provides tools for scripts that follow the Common Gateway Interface [CGI].

The `net/cgi` library expects to be run in a certain context as defined by the CGI standard. This means, for instance, that certain environment variables will be bound.

Unfortunately, not all CGI environments provide this. For instance, the FastCGI library, despite its name, does not bind the environment variables required of the standard. Users of FastCGI will need to bind `REQUEST_METHOD` and possibly also `QUERY_STRING` to successfully employ the CGI library. The FastCGI library ought to provide a way to extract the values bound to these variables; the user can then put these into the CGI program's environment using the `putenv` function.

A CGI *binding* is an association of a form item with its value. Some form items, such as checkboxes, may correspond to multiple bindings. A binding is a tag-string pair, where a tag is a symbol or a string.

19.1 CGI Functions

```
(get-bindings)
→ (listof (cons/c (or/c symbol? string?) string?))
(get-bindings/post)
→ (listof (cons/c (or/c symbol? string?) string?))
(get-bindings/get)
→ (listof (cons/c (or/c symbol? string?) string?))
```

Returns the bindings that corresponding to the options specified by the user. The `get-bindings/post` and `get-bindings/get` variants work only when POST and GET forms are used, respectively, while `get-bindings` determines the kind of form that was used and invokes the appropriate function.

These functions respect `current-alist-separator-mode`.

```
(extract-bindings key? bindings) → (listof string?)
  key? : (or/c symbol? string?)
  bindings : (listof (cons/c (or/c symbol? string?) string?))
```

Given a key and a set of bindings, determines which ones correspond to a given key. There may be zero, one, or many associations for a given key.

```
(extract-binding/single key? bindings) → string?
  key? : (or/c symbol? string?)
  bindings : (listof (cons/c (or/c symbol? string?) string?))
```

Like `extract-bindings`, but for a key that has exactly one association.

```
(output-http-headers) → void?
```

Outputs all the HTTP headers needed for a normal response. Only call this function if you are not using `generate-html-output` or `generate-error-output`.

```
(generate-html-output title
  body
  [text-color
   bg-color
   link-color
   vlink-color
   alink-color]) → void?

title : string?
body : (listof string?)
text-color : string? = "#000000"
bg-color : string? = "#ffffff"
link-color : string? = "#cc2200"
vlink-color : string? = "#882200"
alink-color : string? = "#444444"
```

Outputs an response: a title and a list of strings for the body.

The last five arguments are each strings representing a HTML color; in order, they represent the color of the text, the background, un-visited links, visited links, and a link being selected.

```
(string->html str) → string?
  str : string?
```

Converts a string into an HTML string by applying the appropriate HTML quoting conventions.

```
(generate-link-text str html-str) → string?
  str : string?
  html-str : string?
```

Takes a string representing a URL, a HTML string for the anchor text, and generates HTML

corresponding to an anchor.

```
(generate-error-output strs) → any  
  strs : (listof string?)
```

The procedure takes a list of HTML strings representing the body, prints them with the subject line "Internal error", and exits via `exit`.

```
(get-cgi-method) → (one-of/c "GET" "POST")
```

Returns either "GET" or "POST" when invoked inside a CGI script, unpredictable otherwise.

```
(bindings-as-html listof) → (listof string?)  
  listof : (cons/c (or/c symbol? string?) string?)
```

Converts a set of bindings into a list of HTML strings, which is useful for debugging.

```
(struct cgi-error ()  
  #:extra-constructor-name make-cgi-error)
```

A supertype for all exceptions thrown by the `net/cgi` library.

```
(struct incomplete-%-suffix cgi-error (chars)  
  #:extra-constructor-name make-incomplete-%-suffix)  
  chars : (listof char?)
```

Raised when a `%` in a query is followed by an incomplete suffix. The characters of the suffix—excluding the `%`—are provided by the exception.

```
(struct invalid-%-suffix cgi-error (char)  
  #:extra-constructor-name make-invalid-%-suffix)  
  char : char?
```

Raised when the character immediately following a `%` in a query is invalid.

19.2 CGI Unit

```
(require net/cgi-unit)
```

```
cgi@ : unit?
```

Imports nothing, exports `cgi^`.

19.3 CGI Signature

```
(require net/cgi-sig)
```

`cgi^` : signature

Includes everything exported by the `net/cgi` module.

20 Cookie: HTTP Client Storage

```
(require net/cookie)
```

The `net/cookie` library provides utilities for using cookies as specified in RFC 2109 [RFC2109].

20.1 Functions

```
(cookie? v) → boolean?  
v : any/c
```

Returns `#t` if `v` represents a cookie, `#f` otherwise.

```
(valid-domain? v) → boolean?  
v : any/c
```

Returns `#t` if `v` represents a valid domain, `#f` otherwise.

```
(cookie-name? v) → boolean?  
v : any/c
```

Returns `#t` if `v` is a valid cookie name string, `#f` otherwise.

```
(cookie-value? v) → boolean?  
v : any/c
```

Returns `#t` if `v` is a valid cookie value string, `#f` otherwise.

```
(set-cookie name value) → cookie?  
name : cookie-name?  
value : cookie-value?
```

Creates a new cookie, with default values for required fields.

```
(cookie:add-comment cookie comment) → cookie?  
cookie : cookie?  
comment : string?
```

Modifies `cookie` with a comment, and also returns `cookie`.

```
(cookie:add-domain cookie domain) → cookie?  
  cookie : cookie?  
  domain : valid-domain?
```

Modifies *cookie* with a domain, and also returns *cookie*. The *domain* must match a prefix of the request URI.

```
(cookie:add-max-age cookie seconds) → cookie?  
  cookie : cookie?  
  seconds : exact-nonnegative-integer?
```

Modifies *cookie* with a maximum age, and also returns *cookie*. The *seconds* argument is number of seconds that a client should retain the cookie.

```
(cookie:add-path cookie path) → cookie?  
  cookie : cookie?  
  path : valid-path?
```

Modifies *cookie* with a path, and also returns *cookie*.

```
(cookie:secure cookie secure) → cookie?  
  cookie : cookie?  
  secure : boolean?
```

Modifies *cookie* with a security flag, and also returns *cookie*.

```
(cookie:version cookie version) → cookie?  
  cookie : cookie?  
  version : exact-nonnegative-integer?
```

Modifies *cookie* with a version, and also returns *cookie*. The default is the only known incarnation of HTTP cookies: 1.

```
(print-cookie cookie) → string?  
  cookie : cookie?
```

Prints *cookie* to a string. Empty fields do not appear in the output except when there is a required default.

```
(get-cookie name cookies) → (listof cookie-value?)  
  name : cookie-name?
```

```
cookies : string?
```

Returns a list with all the values (strings) associated with *name*.

The method used to obtain the "Cookie" header depends on the web server. It may be an environment variable (CGI), or you may have to read it from the input port (FastCGI), or maybe it comes in an initial-request structure, etc. The `get-cookie` and `get-cookie/single` procedure can be used to extract fields from a "Cookie" field value.

```
(get-cookie/single name cookies) → (or/c cookie-value? false/c)
  name : cookie-name?
  cookies : string?
```

Like `get-cookie`, but returns the just first value string associated to *name*, or #f if no association is found.

```
(struct cookie-error exn:fail ()
  #:extra-constructor-name make-cookie-error)
```

Raised for errors when handling cookies.

20.2 Examples

20.2.1 Creating a cookie

```
(let ((c (cookie:add-max-age
          (cookie:add-path
            (set-cookie "foo" "bar")
              "/servlets")
              3600)))
  (print-cookie c))
```

Produces

```
"foo=bar; Max-Age=3600; Path=/servlets; Version=1"
```

To use this output in a “regular” CGI, instead of the last line use:

```
(display (format "Set-Cookie: ~a" (print-cookie c)))
```

and to use with the PLT Web Server, use:

```
(make-response/full code message (current-seconds) mime
  (list (make-header #"Set-Cookie" (string-
>bytes/utf-8 (print-cookie c))))
  body)
```

20.2.2 Parsing a cookie

Imagine your Cookie header looks like this:

```
> (define cookies
  "test2=2; test3=3; xfcTheme=theme6; xfcTheme=theme2")
```

Then, to get the values of the xfcTheme cookie, use

```
> (get-cookie "xfcTheme" cookies)
'("theme6" "theme2")
> (get-cookie/single "xfcTheme" cookies)
"theme6"
```

If you try to get a cookie that simply is not there:

```
> (get-cookie/single "foo" cookies)
#f
> (get-cookie "foo" cookies)
'()
```

Note that not having a cookie is normally not an error. Most clients won't have a cookie set then first arrive at your site.

20.3 Cookie Unit

```
(require net/cookie-unit)
```

```
cookie@ : unit?
```

Imports nothing, exports cookie[^].

20.4 Cookie Signature

```
(require net/cookie-sig)
```

`cookie^` : signature

Includes everything exported by the `net/cookie` module.

Bibliography

- [CGI] “Common Gateway Interface (CGI/1.1).”
<http://hoohoo.ncsa.uiuc.edu/cgi/>
- [RFC822] David Crocker, “Standard for the Format of ARPA Internet Text Messages,” RFC, 1982. <http://www.ietf.org/rfc/rfc0822.txt>
- [RFC977] Brian Kantor and Phil Lapsley, “Network News Transfer Protocol,” RFC, 1986. <http://www.ietf.org/rfc/rfc0977.txt>
- [RFC1738] T. Berners-Lee, L. Masinter, and M. McCahill, “Uniform Resource Locators (URL),” RFC, 1994. <http://www.ietf.org/rfc/rfc1738.txt>
- [RFC1939] J. Myers and M. Rose, “Post Office Protocol - Version 3,” RFC, 1996. <http://www.ietf.org/rfc/rfc1939.txt>
- [RFC2060] M. Crispin, “Internet Message Access Protocol - Version 4rev1,” RFC, 1996. <http://www.ietf.org/rfc/rfc2060.txt>
- [RFC2109] D. Kristol and L. Montulli, “HTTP State Management Mechanism,” RFC, 1997. <http://www.ietf.org/rfc/rfc2109.txt>
- [RFC2396] T. Berners-Lee, R. Fielding, and L. Masinter, “Uniform Resource Identifiers (URI): Generic Syntax,” RFC, 1998. <http://www.ietf.org/rfc/rfc2396.txt>
- [RFC3986] T. Berners-Lee, R. Fielding, and L. Masinter, “Uniform Resource Identifier (URI): Generic Syntax,” RFC, 2005. <http://www.ietf.org/rfc/rfc3986.txt>

Index

- Printable Signature, 64
- [alist->form-urlencoded](#), 15
- [append-headers](#), 35
- [article-not-found](#), 70
- [article-not-found-article](#), 70
- [article-not-found?](#), 70
- [article-not-in-group](#), 70
- [article-not-in-group-article](#), 70
- [article-not-in-group?](#), 70
- [assemble-address-field](#), 38
- [authenticate-user](#), 68
- [authenticate/plain-text](#), 49
- [authentication-rejected](#), 70
- [authentication-rejected?](#), 70
- [bad-newsgroup-line](#), 70
- [bad-newsgroup-line-line](#), 70
- [bad-newsgroup-line?](#), 70
- [bad-status-line](#), 69
- [bad-status-line-line](#), 69
- [bad-status-line?](#), 69
- Base 64: Encoding and Decoding, 61
- Base64 Signature, 62
- Base64 Unit, 62
- [base64-decode](#), 61
- [base64-decode-stream](#), 61
- [base64-encode](#), 61
- [base64-encode-stream](#), 61
- [base64@](#), 62
- [base64^](#), 62
- binding*, 77
- [bindings-as-html](#), 79
- [body-of-message](#), 68
- [browser-preference?](#), 27
- [call/input-url](#), 11
- [cannot-connect](#), 51
- [cannot-connect?](#), 51
- [cannot-delete-message](#), 52
- [cannot-delete-message-communicator](#), 52
- [cannot-delete-message-message](#), 52
- [cannot-delete-message?](#), 52
- CGI Functions, 77
- CGI Scripts, 77
- CGI Signature, 80
- CGI Unit, 79
- [cgi-error](#), 79
- [cgi-error?](#), 79
- [cgi@](#), 79
- [cgi^](#), 80
- Client API, 18
- [combine-url/relative](#), 8
- [communicator](#), 49
- [communicator](#), 67
- [communicator-port](#), 49
- [communicator-port](#), 67
- [communicator-receiver](#), 49
- [communicator-receiver](#), 67
- [communicator-sender](#), 67
- [communicator-sender](#), 49
- [communicator-server](#), 49
- [communicator-server](#), 67
- [communicator-state](#), 49
- [communicator?](#), 49
- [communicator?](#), 67
- [connect-to-server](#), 67
- [connect-to-server](#), 49
- Connecting and Selecting Mailboxes, 39
- Connection and Operations, 67
- Connections, 19
- Cookie Signature, 84
- Cookie Unit, 84
- [cookie-error](#), 83
- [cookie-error?](#), 83
- [cookie-name?](#), 81
- [cookie-value?](#), 81
- Cookie: HTTP Client Storage, 81
- [cookie:add-comment](#), 81
- [cookie:add-domain](#), 82
- [cookie:add-max-age](#), 82
- [cookie:add-path](#), 82
- [cookie:secure](#), 82
- [cookie:version](#), 82

- cookie?, 81
- cookie@, 84
- cookie^, 85
- Creating a cookie, 83
- current-alist-separator-mode, 16
- current-https-protocol, 12
- current-proxy-servers, 12
- data-lines->data, 36
- delete-impure-port, 10
- delete-message, 50
- delete-pure-port, 9
- disconnect-from-server, 67
- disconnect-from-server, 49
- disconnect-not-quiet, 52
- disconnect-not-quiet-communicator, 52
- disconnect-not-quiet?, 52
- display-pure-port, 11
- disposition, 57
- disposition-creation, 57
- disposition-filename, 57
- disposition-modification, 57
- disposition-params, 57
- disposition-read, 57
- disposition-size, 57
- disposition-type, 57
- disposition?, 57
- DNS Signature, 66
- DNS Unit, 66
- dns-find-nameserver, 65
- dns-get-address, 65
- dns-get-mail-exchanger, 65
- dns-get-name, 65
- DNS: Domain Name Service Queries, 65
- dns@, 66
- dns^, 66
- empty-disposition-type, 59
- empty-disposition-type?, 59
- empty-header, 34
- empty-mechanism, 59
- empty-mechanism?, 59
- empty-subtype, 59
- empty-subtype?, 59
- empty-type, 59
- empty-type?, 59
- entity, 55
- entity-body, 55
- entity-charset, 55
- entity-description, 55
- entity-disposition, 55
- entity-encoding, 55
- entity-fields, 55
- entity-id, 55
- entity-other, 55
- entity-params, 55
- entity-parts, 55
- entity-subtype, 55
- entity-type, 55
- entity?, 55
- Example, 21
- Example Session, 53
- Examples, 83
- Exceptions, 69
- Exceptions, 58
- Exceptions, 51
- Exceptions, 64
- external-browser, 26
- extract-addresses, 36
- extract-all-fields, 34
- extract-binding/single, 78
- extract-bindings, 77
- extract-desired-headers, 51
- extract-desired-headers, 69
- extract-field, 34
- file-url-path-convention-type, 9
- form-urlencoded->alist, 16
- form-urlencoded-decode, 15
- form-urlencoded-encode, 15
- framing-mode, 19
- FTP Signature, 24
- FTP Unit, 23
- ftp-cd, 22
- ftp-close-connection, 22
- ftp-connection?, 22

- [ftp-directory-list](#), 23
- [ftp-download-file](#), 23
- [ftp-establish-connection](#), 22
- [ftp-make-file-seconds](#), 23
- FTP: Client Downloading, 22
- [ftp@](#), 23
- [ftp^](#), 24
- Functions, 34
- Functions, 61
- Functions, 81
- Functions, 65
- Functions, 22
- Functions, 63
- Functions, 14
- [generate-error-output](#), 79
- [generate-html-output](#), 78
- [generate-link-text](#), 78
- [generic-message-command](#), 68
- [get-bindings](#), 77
- [get-bindings/get](#), 77
- [get-bindings/post](#), 77
- [get-cgi-method](#), 79
- [get-cookie](#), 82
- [get-cookie/single](#), 83
- [get-impure-port](#), 10
- [get-mailbox-status](#), 49
- [get-message/body](#), 50
- [get-message/complete](#), 50
- [get-message/headers](#), 50
- [get-pure-port](#), 9
- [get-unique-id/all](#), 50
- [get-unique-id/single](#), 50
- [head-impure-port](#), 10
- [head-of-message](#), 68
- [head-pure-port](#), 9
- [head@](#), 38
- [head^](#), 38
- header*, 34
- Header Signature, 38
- Header Unit, 38
- Headers: Parsing and Constructing, 34
- [illegal-message-number](#), 52
- [illegal-message-number-communicator](#), 52
- [illegal-message-number-message](#), 52
- [illegal-message-number?](#), 52
- IMAP Signature, 48
- IMAP Unit, 48
- [imap-append](#), 46
- [imap-connect](#), 39
- [imap-connect*](#), 40
- [imap-connection?](#), 39
- [imap-copy](#), 46
- [imap-create-mailbox](#), 47
- [imap-disconnect](#), 40
- [imap-examine](#), 41
- [imap-expunge](#), 46
- [imap-flag->symbol](#), 44
- [imap-force-disconnect](#), 40
- [imap-get-expunges](#), 43
- [imap-get-hierarchy-delimiter](#), 47
- [imap-get-messages](#), 44
- [imap-get-updates](#), 43
- [imap-list-child-mailboxes](#), 47
- [imap-mailbox-exists?](#), 47
- [imap-mailbox-flags](#), 48
- [imap-messages](#), 41
- [imap-new?](#), 42
- [imap-noop](#), 41
- [imap-pending-expunges?](#), 43
- [imap-pending-updates?](#), 44
- [imap-poll](#), 41
- [imap-port-number](#), 39
- [imap-recent](#), 41
- [imap-reselect](#), 40
- [imap-reset-new!](#), 42
- [imap-status](#), 46
- [imap-store](#), 45
- [imap-uidnext](#), 42
- [imap-uidvalidity](#), 42
- [imap-unseen](#), 42
- IMAP: Reading Mail, 39
- [imap@](#), 48
- [imap^](#), 48

- impure port*, 7
- incomplete-%-suffix, 79
- incomplete-%-suffix-chars, 79
- incomplete-%-suffix?, 79
- insert-field, 35
- invalid-%-suffix, 79
- invalid-%-suffix-char, 79
- invalid-%-suffix?, 79
- make-article-not-found, 70
- make-article-not-in-group, 70
- make-authentication-rejected, 70
- make-bad-newsgroup-line, 70
- make-bad-status-line, 69
- make-cannot-connect, 51
- make-cannot-delete-message, 52
- make-cgi-error, 79
- make-communicator, 49
- make-communicator, 67
- make-cookie-error, 83
- make-desired-header, 51
- make-desired-header, 69
- make-disconnect-not-quiet, 52
- make-disposition, 57
- make-empty-disposition-type, 59
- make-empty-mechanism, 59
- make-empty-subtype, 59
- make-empty-type, 59
- make-entity, 55
- make-illegal-message-number, 52
- make-incomplete-%-suffix, 79
- make-invalid-%-suffix, 79
- make-malformed-multipart-entity, 59
- make-malformed-server-response, 52
- make-message, 55
- make-mime-error, 58
- make-missing-multipart-boundary-parameter, 58
- make-nntp, 69
- make-no-group-selected, 70
- make-no-mail-recipients, 32
- make-non-existent-group, 70
- make-not-given-headers, 52
- make-not-ready-for-transaction, 52
- make-password-rejected, 51
- make-path/param, 7
- make-pop3, 51
- make-premature-close, 69
- make-qp-error, 64
- make-qp-wrong-input, 64
- make-qp-wrong-line-size, 64
- make-ssl-tcp@, 76
- make-unexpected-response, 69
- make-unexpected-termination, 58
- make-url, 6
- make-username-rejected, 51
- malformed-multipart-entity, 59
- malformed-multipart-entity-msg, 59
- malformed-multipart-entity?, 59
- malformed-server-response, 52
- malformed-server-response-communicator, 52
- malformed-server-response?, 52
- Manipulating Messages, 44
- message, 55
- Message Decoding, 55
- message-entity, 55
- message-fields, 55
- message-version, 55
- message?, 55
- MIME Signature, 60
- MIME Unit, 59
- mime-analyze, 55
- mime-error, 58
- mime-error?, 58
- MIME: Decoding Internet Data, 55
- mime@, 59
- mime^, 60
- missing-multipart-boundary-parameter, 58
- missing-multipart-boundary-parameter?, 58
- net/base64, 61
- net/base64-sig, 62
- net/base64-unit, 62

- net/cgi, 77
- net/cgi-sig, 80
- net/cgi-unit, 79
- net/cookie, 81
- net/cookie-sig, 84
- net/cookie-unit, 84
- net/dns, 65
- net/dns-sig, 66
- net/dns-unit, 66
- net/ftp, 22
- net/ftp-sig, 24
- net/ftp-unit, 23
- net/head, 34
- net/head-sig, 38
- net/head-unit, 38
- net/imap, 39
- net/imap-sig, 48
- net/imap-unit, 48
- net/mime, 55
- net/mime-sig, 60
- net/mime-unit, 59
- net/nntp, 67
- net/nntp-sig, 71
- net/nntp-unit, 70
- net/pop3, 49
- net/pop3-sig, 53
- net/pop3-unit, 53
- net/qp, 63
- net/qp-sig, 64
- net/qp-unit, 64
- net/sendmail, 31
- net/sendmail-sig, 32
- net/sendmail-unit, 32
- net/sendurl, 25
- net/smtp, 28
- net/smtp-sig, 30
- net/smtp-unit, 30
- net/ssl-tcp-unit, 76
- net/tcp-redirect, 75
- net/tcp-sig, 72
- net/tcp-unit, 74
- net/uri-codec, 14
- net/url, 6
- net/url-sig, 13
- net/url-structs, 6
- net/url-unit, 12
- net/websocket, 18
- net/websocket/client, 18
- net/websocket/conn, 19
- net/websocket/server, 18
- Net: Networking Libraries, 1
- netscape/string->url, 8
- newnews-since, 68
- nntp, 69
- NNTP Signature, 71
- NNTP Unit, 70
- NNTP: Newsgroup Protocol, 67
- nntp?, 69
- nntp@, 70
- nntp^, 71
- no-group-selected, 70
- no-group-selected?, 70
- no-mail-recipients, 32
- no-mail-recipients?, 32
- non-existent-group, 70
- non-existent-group-group, 70
- non-existent-group?, 70
- not-given-headers, 52
- not-given-headers-communicator, 52
- not-given-headers-message, 52
- not-given-headers?, 52
- not-ready-for-transaction, 52
- not-ready-for-transaction-communicator, 52
- not-ready-for-transaction?, 52
- open-news-group, 67
- open-ws-conn?, 20
- output-http-headers, 78
- Parsing a cookie, 84
- password-rejected, 51
- password-rejected?, 51
- path->url, 9
- path/param, 7
- path/param-param, 7

- [path/param-path](#), 7
- [path/param?](#), 7
- [pop3](#), 51
- POP3 Signature, 53
- POP3 Unit, 53
- POP3: Reading Mail, 49
- [pop3?](#), 51
- [pop3@](#), 53
- [pop3^](#), 54
- [post-impure-port](#), 10
- [post-pure-port](#), 10
- [premature-close](#), 69
- [premature-close-communicator](#), 69
- [premature-close?](#), 69
- [print-cookie](#), 82
- pure port*, 7
- [purify-port](#), 11
- [put-impure-port](#), 10
- [put-pure-port](#), 10
- [qp-decode](#), 63
- [qp-decode-stream](#), 63
- [qp-encode](#), 63
- [qp-encode-stream](#), 63
- [qp-error](#), 64
- [qp-error?](#), 64
- [qp-wrong-input](#), 64
- [qp-wrong-input?](#), 64
- [qp-wrong-line-size](#), 64
- [qp-wrong-line-size?](#), 64
- [qp@](#), 64
- [qp^](#), 64
- Querying and Changing (Other) Mailboxes, 46
- Quoted-Printable Unit, 64
- Quoted-Printable: Encoding and Decoding, 63
- [remove-field](#), 35
- [replaces-field](#), 35
- Selected Mailbox State, 41
- Send URL: Opening a Web Browser, 25
- [send-mail-message](#), 32
- [send-mail-message/port](#), 31
- [send-url](#), 25
- [send-url/contents](#), 26
- [send-url/file](#), 25
- Sendmail Functions, 31
- Sendmail Signature, 32
- Sendmail Unit, 32
- [sendmail: Sending E-Mail](#), 31
- [sendmail@](#), 32
- [sendmail^](#), 32
- Server API, 18
- [set-cookie](#), 81
- SMTP Functions, 28
- SMTP Signature, 30
- SMTP Unit, 30
- [smtp-send-message](#), 28
- [smtp-sending-end-of-message](#), 29
- SMTP: Sending E-Mail, 28
- [smtp@](#), 30
- [smtp^](#), 30
- SSL Unit: [tcp^ via SSL](#), 76
- [standard-message-header](#), 36
- [string->html](#), 78
- [string->url](#), 7
- [struct:article-not-found](#), 70
- [struct:article-not-in-group](#), 70
- [struct:authentication-rejected](#), 70
- [struct:bad-newsgroup-line](#), 70
- [struct:bad-status-line](#), 69
- [struct:cannot-connect](#), 51
- [struct:cannot-delete-message](#), 52
- [struct:cgi-error](#), 79
- [struct:communicator](#), 67
- [struct:communicator](#), 49
- [struct:cookie-error](#), 83
- [struct:disconnect-not-quiet](#), 52
- [struct:disposition](#), 57
- [struct:empty-disposition-type](#), 59
- [struct:empty-mechanism](#), 59
- [struct:empty-subtype](#), 59
- [struct:empty-type](#), 59
- [struct:entity](#), 55
- [struct:illegal-message-number](#), 52

- struct:incomplete-%-suffix, 79
- struct:invalid-%-suffix, 79
- struct:malformed-multipart-entity, 59
- struct:malformed-server-response, 52
- struct:message, 55
- struct:mime-error, 58
- struct:missing-multipart-boundary-parameter, 58
- struct:mntp, 69
- struct:no-group-selected, 70
- struct:no-mail-recipients, 32
- struct:non-existent-group, 70
- struct:not-given-headers, 52
- struct:not-ready-for-transaction, 52
- struct:password-rejected, 51
- struct:path/param, 7
- struct:pop3, 51
- struct:premature-close, 69
- struct:qp-error, 64
- struct:qp-wrong-input, 64
- struct:qp-wrong-line-size, 64
- struct:unexpected-response, 69
- struct:unexpected-termination, 58
- struct:url, 6
- struct:username-rejected, 51
- symbol->imap-flag, 45
- TCP Redirect: tcp^ via Channels, 75
- TCP Signature, 72
- TCP Unit, 74
- tcp-abandon-port, 73
- tcp-accept, 73
- tcp-accept-ready?, 73
- tcp-accept/enable-break, 73
- tcp-addresses, 73
- tcp-close, 73
- tcp-connect, 72
- tcp-connect/enable-break, 73
- tcp-listen, 72
- tcp-listener?, 73
- tcp-redirect, 75
- TCP: Unit and Signature, 72
- tcp@, 74
- tcp^, 72
- unexpected-response, 69
- unexpected-response-code, 69
- unexpected-response-text, 69
- unexpected-response?, 69
- unexpected-termination, 58
- unexpected-termination-msg, 58
- unexpected-termination?, 58
- unix-browser-list, 27
- URI Codec: Encoding and Decoding URIs, 14
- uri-decode, 15
- uri-encode, 14
- uri-path-segment-decode, 15
- uri-path-segment-encode, 15
- uri-userinfo-decode, 15
- uri-userinfo-encode, 15
- url, 6
- URL Functions, 7
- URL Signature, 13
- URL Structure, 6
- URL Unit, 12
- url+scheme^, 13
- url->path, 9
- url->string, 8
- url-fragment, 6
- url-host, 6
- url-path, 6
- url-path-absolute?, 6
- url-port, 6
- url-query, 6
- url-scheme, 6
- url-user, 6
- url?, 6
- url@, 12
- url^, 13
- URLs and HTTP, 6
- username-rejected, 51
- username-rejected?, 51

[valid-domain?](#), 81
[validate-header](#), 34
WebSocket, 18
[ws-close!](#), 20
[ws-conn-closed?](#), 20
[ws-conn-headers](#), 20
[ws-conn-line](#), 20
[ws-conn?](#), 19
[ws-connect](#), 18
[ws-recv](#), 20
[ws-send!](#), 20
[ws-serve](#), 19
[ws-url?](#), 18
[wss-url?](#), 18