Cookies: HTTP State Management

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This library provides utilities for handling cookies as specified in RFC 6265 [RFC6265] and its 2023 update [RFC6265bis].

```
(require net/cookies)
```
package: net-cookies-lib

Provides all names exported from net/cookies/common, net/cookies/server, and net/cookies/user-agent.

The net/cookies/server and net/cookies/user-agent modules are designed to stand on their own, however, so for any program that is exclusively client- or server-side, it will suffice to import one of those two modules.

1 Cookies: Common Functionality

```
(require net/cookies/common)
```
package: net-cookies-lib

The net/cookies/common library contains cookie-related code common to servers and user agents.

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

Returns #t if v is a valid cookie name (represented as a string or a byte string), #f otherwise.

Cookie names must consist of ASCII characters. They may not contain control characters (ASCII codes 0-31 or 127) or the following "separators":

- double quotes
- whitespace characters
- #\@ or #\?
- parentheses, brackets, or curly braces
- commas, colons, or semicolons
- equals, greater-than, or less-than signs
- slashes or backslashes

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

Returns #t if v is a valid cookie value (represented as a string or byte string), #f otherwise.

Cookie values must consist of ASCII characters. They may not contain:

- control characters
- whitespace characters
- double-quotes, except at the beginning and end if the entire value is double-quoted
- commas
- semicolons

- backslashes

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

Returns #t iff v is a string that can be used as the value of a "Path=" attribute, or as an additional attribute (or attribute/value pair) whose meaning is not specified by RFC6265.

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

Returns #t iff v is a string that contains a (sub)domain name, as defined by RFCs 1034 (Section 3.5) [RFC1034] and 1123 (Section 2.1) [RFC1123].

```
(samesite-value?  v
                  [#:ignore-case? ignore-case?]) → boolean?
  v : any/c
  ignore-case? : boolean? = #t
```

Returns #t iff v is a string that contains a value for [RFC6265bis] §4.1.1's "SameSite" attribute in a "Set-Cookie" response header.

There are only three such values: "Strict", "Lax", and "None". However, since user agents match case-insensitively, this procedure defaults to case-insensitive matching (e.g., (samesite-value? "LaX") is #t). It can be made case-sensitive with the optional keyword parameter.

2 Cookies and HTTP Servers

```
(require net/cookies/server)
```
package: net-cookies-lib

The net/cookies/server library is for handling cookies on the server side; it includes:

- a serializable cookie structure definition
- functions to convert a cookie structure to a string, or a value for the HTTP "Set-Cookie" response header
- functions that allow reading an HTTP "Cookie" header generated by a user agent

```
(struct cookie/same-site cookie (same-site))
  same-site : (or/c 'strict 'lax 'none #f)
```

A structure type for cookies the server will send to the user agent. For client-side cookies, see net/cookies/user-agent. Programs using this library should construct their cookie/same-site structs via make-cookie, below.

Added in version 1.3 of package net-cookies-lib.

```
(struct cookie (name
                value
                expires
                max-age
                domain
                path
                secure?
                http-only?
                same-site
                extension))
  name : (and/c string? cookie-name?)
  value : (and/c string? cookie-value?)
  expires : (or/c date? #f)
  max-age : (or/c (and/c integer? positive?) #f)
  domain : (or/c domain-value? #f)
  path : (or/c path/extension-value? #f)
  secure? : boolean?
  http-only? : boolean?
  same-site : (or/c 'strict 'lax 'none #f)
  extension : (or/c path/extension-value? #f)
```

Old version of struct type for cookies the server will send.

NOTE: This structure type is deprecated; use `cookie/same-site`, instead. The library no longer directly creates instances of this struct type. Avoid referencing this struct type in `match` patterns and contracts.

```
(make-cookie  name
              value
             [#:expires exp-date
              #:max-age max-age
              #:domain domain
              #:path path
              #:secure? secure?
              #:http-only? http-only?]
              #:same-site same-site
             [#:extension extension])  → cookie?
  name : cookie-name?
  value : cookie-value?
  exp-date : (or/c date? #f) = #f
  max-age : (or/c (and/c integer? positive?) #f) = #f
  domain : (or/c domain-value? #f) = #f
  path : (or/c path/extension-value? #f) = #f
  secure? : boolean? = #f
  http-only? : boolean? = #f
  same-site : (or/c 'strict 'lax 'none #f)
  extension : (or/c path/extension-value? #f) = #f
```

Constructs a cookie for sending to a user agent. If *name* or *value* is a byte string, this procedure will convert it to a string using `bytes->string/utf-8`; programs requiring a different encoding should convert their byte strings before calling `make-cookie`.

Both *exp-date* and *max-age* are for specifying a time at which the user agent should remove the cookie from its cookie store. *exp-date* is for specifying this expiration time as a date; *max-age* is for specifying it as a number of seconds in the future. If both *exp-date* and *max-age* are given, an RFC6265-compliant user agent will disregard the *exp-date* and use the *max-age*.

domain indicates that the recipient should send the cookie back to the server only if the hostname in the request URI is either *domain* itself, or a host within *domain*.

path indicates that the recipient should send the cookie back to the server only if *path* is a prefix of the request URI's path.

`secure`, when `#t`, sets a flag telling the recipient that the cookie may only be sent if the request URI's scheme specifies a "secure" protocol (presumably HTTPS).

http-only?, when `#t`, sets a flag telling the recipient that the cookie may be communicated only to a server and only via HTTP or HTTPS. **This flag is important for security rea-**

sons: Browsers provide JavaScript access to cookies (for example, via `document.cookie`), and consequently, when cookies contain sensitive data such as user session info, malicious JavaScript can compromise that data. The `HttpOnly` cookie flag, set by this keyword argument, instructs the browser not to make this cookie available to JavaScript code. **If a cookie is intended to be confidential, both *http-only?* and *secure?* should be `#t`, and all connections should use HTTPS.** (Some older browsers do not support this flag; see the OWASP page on HttpOnly for more info.)

same-site, specified in [RFC6265bis], tells the client when to enforce the rule that cookies must only be sent with same-site requests. It exists to defend against CSRF attacks by specifying if and when this cookie may be sent with cross-site requests.

- `'strict` restricts this cookie to requests originating from the same site that sets it
- `'lax` differs from `'strict` by sending the cookie with a cross-site request iff the request is for a top-level navigation via a safe HTTP method
- `'none` allows this cookie to be sent with cross-site requests

Warning: Setting *same-site* to `'none` requires also setting *secure?* to `#t`. As of this writing, major browsers silently reject cookies having **SameSite=None** without **Secure**. If you call `make-cookie` with `#:same-site 'none` and `#:secure? #f`, this library will permit constructing the cookie, but emit a warning with `log-warning`.

See MDN's documentation on cookies for further discussion of the `"SameSite"` attribute.

Changed in version 1.3 of package `net-cookies-lib`: Added *same-site* parameter.

```
(cookie->set-cookie-header c) → bytes?
  c : cookie?
```

Produces a byte string containing the value portion of a "Set-Cookie:" HTTP response header suitable for sending `c` to a user agent.

Example:

```
> (cookie->set-cookie-header
    (make-cookie "rememberUser" "bob" #:path "/main"))
#"rememberUser=bob; Path=/main"
```

This procedure uses `string->bytes/utf-8` to convert the cookie to bytes; for an application that needs a different encoding function, use `cookie->string` and perform the bytes conversion with that function.

```
(clear-cookie-header name
                     [#:domain domain
                      #:path path])    → bytes?
  name : cookie-name?
  domain : (or/c domain-value? #f) = #f
  path : (or/c path/extension-value? #f) = #f
```

Produces a byte string containing a "Set-Cookie:" header suitable for telling a user agent to clear the cookie with the given *name*. (This is done, as per RFC6265, by sending a cookie with an expiration date in the past.)

Example:

```
> (clear-cookie-header "rememberUser" #:path "/main")
#"rememberUser=; Expires=Thu, 01 Jan 2015 00:00:00 GMT;
Path=/main"
```

```
(cookie-header->alist header) → (listof (cons/c bytes? bytes?))
  header : bytes?
(cookie-header->alist header decode) → (listof (cons/c X X))
  header : bytes?
  decode : (-> bytes? X)
```

Given the value part of a "Cookie:" header, produces an alist of all cookie name/value mappings in the header. If a *decode* function is given, applies *decode* to each key and each value before inserting the new key-value pair into the alist. Invalid cookies will not be present in the alist.

If a key in the header has no value, then #"", or (*decode* #"") if *decode* is present, is used as the value.

Examples:

```
> (cookie-header->alist #"SID=31d4d96e407aad42; lang=en-US")
'((#"SID" . #"31d4d96e407aad42") (#"lang" . #"en-US"))
> (cookie-header->alist #"SID=31d4d96e407aad42; lang=en-US"
                        bytes->string/utf-8)
'(("SID" . "31d4d96e407aad42") ("lang" . "en-US"))
> (cookie-header->alist #"seenIntro=; logins=3"
                        (compose (lambda (s) (or (string-
>number s) s))
                                 bytes->string/utf-8))
'(("seenIntro" . "") ("logins" . 3))
```

```
(cookie->string c) → string?
  c : cookie?
```

Produces a string containing the given cookie as text.

Examples:

```
> (cookie->string
   (make-cookie "usesRacket" "true"))
"usesRacket=true"
> (cookie->string
   (make-cookie "favColor" "teal"
                #:max-age 86400
                #:domain "example.com"
                #:secure? #t))
"favColor=teal; Max-Age=86400; Domain=example.com; Secure"
> (cookie->string
   (make-cookie "user" "racketeer"
                #:max-age 3600
                #:domain "example.net"
                #:secure? #t
                #:same-site 'strict))
"user=racketeer; Max-Age=3600; Domain=example.net; Secure; Same-
Site=Strict"
> (cookie->string
   (make-cookie "foo" "bar"
                #:max-age 3600
                #:domain "example.net"
                #:secure? #t
                #:same-site 'lax))
"foo=bar; Max-Age=3600; Domain=example.net; Secure; SameSite=Lax"
```

3 Cookies and HTTP User Agents

```
(require net/cookies/user-agent)
```
package: net-cookies-lib

The net/cookies/user-agent library provides facilities specific to user agents' handling of cookies.

Many user agents will need only two of this library's procedures:

- extract-and-save-cookies!, for storing cookies
- cookie-header, for retrieving them and generating a "Cookie:" header

```
(struct ua-cookie (name
                   value
                   domain
                   path
                   expiration-time
                   creation-time
                   access-time
                   persistent?
                   host-only?
                   secure-only?
                   http-only?))
  name : cookie-name?
  value : cookie-value?
  domain : domain-value?
  path : path/extension-value?
  expiration-time : (and/c integer? positive?)
  creation-time : (and/c integer? positive?)
  access-time : (and/c integer? positive?)
  persistent? : boolean?
  host-only? : boolean?
  secure-only? : boolean?
  http-only? : boolean?
```

A structure representing a cookie from a user agent's point of view.

All times are represented as the number of seconds since midnight UTC, January 1, 1970, like the values produced by current-seconds.

It's unlikely a client will need to construct a ua-cookie instance directly (except perhaps for testing); extract-cookies produces struct instances for all the cookies received in a server's response.

```
(cookie-expired? cookie [current-time]) → boolean?
  cookie : ua-cookie?
  current-time : integer? = (current-seconds)
```

True iff the given cookie's expiration time precedes *current-time*.

3.1 Cookie jars: Client storage

```
(extract-and-save-cookies! headers
                           url
                          [decode]) → void?
  headers : (or/c (listof (cons/c bytes? bytes?)) (listof bytes?))
  url : url?
  decode : (-> bytes? string?) = bytes->string/utf-8
```

Reads all cookies from any "Set-Cookie" headers present in *headers* received in an HTTP response from *url*, converts them to strings using *decode*, and stores them in the current-cookie-jar.

The given *headers* may be provided either as an alist mapping header names to header values, or as a raw list of bytes such as the second return value produced by http-conn-recv! in net/http-client. Here is an example of each:

Examples:

```
> (require net/url)
> (define site-url
    (string->url "http://test.example.com/apps/main"))
> (extract-and-save-cookies!
   '((#"X-Test-Header" . #"isThisACookie=no")
     (#"Set-Cookie" . #"a=b; Max-Age=2000; Path=/")
     (#"Set-Cookie" . #"user=bob; Max-Age=86400; Path=/apps"))
   site-url)
> (cookie-header site-url)
#"user=bob; a=b"
> (extract-and-save-cookies!
   '(#"X-Ignore-This: thisIsStillNotACookie=yes"
     #"Set-Cookie: p=q; Max-Age=2000; Path=/"
     #"Set-Cookie: usersMom=alice; Max-Age=86400; Path=/apps")
   site-url)
> (cookie-header site-url)
#"usersMom=alice; user=bob; p=q; a=b"
```

```
(save-cookie! c [via-http?]) → void?
  c : ua-cookie?
  via-http? : boolean? = #t
```

Attempts to save a single cookie `c`, received via an HTTP API iff `via-http?`, to the `current-cookie-jar`. Per Section 5.3 of RFC 6265, the cookie will be ignored if its `http-only?` flag (or that of the cookie it would replace) is set and it wasn't received via an HTTP API.

```
(cookie-header url [encode #:filter-with ok?]) → (or/c bytes? #f)
  url : url?
  encode : (-> string? bytes?) = string->bytes/utf-8
  ok? : (-> ua-cookie? boolean?) = (lambda (x) #t)
```

Finds any unexpired cookies matching `url` in the `current-cookie-jar`, removes any for which `ok?` produces `#f`, and produces the value portion of a "Cookie:" HTTP request header. Produces `#f` if no cookies match.

Cookies with the "Secure" flag will be included in this header iff `(url-scheme url)` is `"https"`, unless you remove them manually using the `ok?` parameter.

Example:

```
> (cookie-header
    (string->url "http://test.example.com/home"))
#"p=q; a=b"
```

```
cookie-jar<%> : interface?
```

An interface for storing cookies received from servers. Implemented by `list-cookie-jar%`. Provides for saving cookies (imperatively) and extracting all cookies that match a given URL.

Most clients will not need to deal with this interface, and none should need to call its methods directly. (Use `cookie-header` and `extract-and-save-cookies!`, instead.) It is provided for situations in which the default `list-cookie-jar%` class will not suffice. For example, if the user agent will be storing thousands of cookies, the linear insertion time of `list-cookie-jar%` could mean that writing a `cookie-jar<%>` implementation based on hash tables, trees, or a DBMS might be a better alternative.

Programs requiring such a class should install an instance of it using the `current-cookie-jar` parameter.

```
(send a-cookie-jar save-cookie! c
                                [via-http?]) → void?
  c : ua-cookie?
  via-http? : boolean? = #t
```

Saves *c* to the jar, and removes any expired cookies from the jar as well.

via-http? should be #t if the cookie was received via an HTTP API; it is for properly ignoring the cookie if the cookie's http-only? flag is set, or if the cookie is attempting to replace an "HTTP only" cookie already present in the jar.

```
(send a-cookie-jar save-cookies! cs
                                 [via-http?]) → void?
  cs : (listof ua-cookie?)
  via-http? : boolean? = #t
```

Saves each cookie in *cs* to the jar, and removes any expired cookies from the jar. See the note immediately above, for explanation of the *via-http?* flag.

```
(send a-cookie-jar cookies-matching url
                                    [secure?])
 → (listof ua-cookie?)
  url : url?
  secure? : boolean? = (equal? (url-scheme url) "https")
```

Produces all cookies in the jar that should be sent in the "Cookie" header for a request made to *url*. *secure?* specifies whether the cookies will be sent via a secure protocol. (If not, cookies with the "Secure" flag set should not be returned by this method.)

This method should produce its cookies in the order expected according to RFC6265:

- Cookies with longer paths are listed before cookies with shorter paths.
- Among cookies that have equal-length path fields, cookies with earlier creation-times are listed before cookies with later creation-times.

If there are multiple cookies in the jar with the same name and different domains or paths, the RFC does not specify which to send. The default list-cookie-jar% class's implementation of this method produces **all** cookies that match the domain and path of the given URL, in the order specified above.

```
list-cookie-jar% : class?
  superclass: object%
  extends: cookie-jar<%>
```

Stores cookies in a list, internally maintaining a sorted order that mirrors the sort order specified by the RFC for the "Cookie" header.

```
(current-cookie-jar) → (is-a?/c cookie-jar<%>)
(current-cookie-jar jar) → void?
  jar : (is-a?/c cookie-jar<%>)
 = (new list-cookie-jar%)
```

A parameter that specifies the cookie jar to use for storing and retrieving cookies.

3.2 Reading the Set-Cookie header

```
(extract-cookies headers url [decode]) → (listof ua-cookie?)
  headers : (or/c (listof (cons/c bytes? bytes?))
                  (listof bytes?))
  url : url?
  decode : (-> bytes? string?) = bytes->string/utf-8
```

Given a list of all the headers received in the response to a request from the given *url*, produces a list of cookies corresponding to all the "Set-Cookie" headers present. The *decode* function is used to convert the cookie's fields to strings.

The given *headers* may be provided either as an alist mapping header names to header values, or as a raw list of bytes such as the second return value produced by `http-conn-recv!` in `net/http-client`.

This function is suitable for use with the `headers/raw` field of a `request` structure (from `web-server/http/request-structs`), or with the output of `(extract-all-fields h)`, where `h` is a byte string.

```
(parse-cookie set-cookie-bytes url [decode]) → (or/c ua-cookie? #f)
  set-cookie-bytes : bytes?
  url : url?
  decode : (-> bytes? string?) = bytes->string/utf-8
```

Given a single "Set-Cookie" header's value *set-cookie-bytes* received in response to a request from the given *url*, produces a `ua-cookie` representing the cookie received, or `#f` if *set-cookie-bytes* can't be parsed as a cookie.

The *decode* function is used to convert the cookie's textual fields (`name`, `value`, `domain`, and `path`) to strings.

```
(default-path url) → string?
  url : url?
```

Given a URL, produces the path that should be used for a cookie that has no “Path” attribute, as specified in Section 5.1.4 of the RFC.

```
max-cookie-seconds : (and/c integer? positive?)
min-cookie-seconds : (and/c integer? negative?)
```

The largest and smallest integers that this user agent library will use, or be guaranteed to accept, as time measurements in seconds since midnight UTC on January 1, 1970.

```
(parse-date s) → (or/c string? #f)
  s : string?
```

Parses the given string for a date, producing `#f` if it is not possible to extract a date from the string using the algorithm specified in Section 5.1.1 of the RFC.

4 Acknowledgements

The server-side library is based on the original net/cookie library by Francisco Solsona <solsona@acm.org>. Many of the cookie-construction tests for this library are adapted from the net/cookie tests.

Roman Klochkov <kalimehtar@mail.ru> wrote the first client-side cookie library on which this user-agent library is based. In particular, this library relies on his code for parsing dates and other cookie components.

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