

biber

A backend bibliography processor for biblatex

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1 Introduction

1.1 About

biber is conceptually a bibtex replacement for biblatex. It is written in Perl with the aim of providing a customised and sophisticated data preparation backend for biblatex. Functionally, it offers a superset of bibtex's capabilities but is tightly coupled with biblatex and cannot be used as a stand-alone tool with standard .bst styles. biber's role is to support biblatex by performing the following tasks:

- Parsing data from data sources
- Processing cross-references, entry sets, related entries
- Generating data for name, name list and name/year disambiguation
- Structural validation according to biblatex data model
- Sorting reference lists
- Outputting data to a .bbl for biblatex to consume

1.2 Requirements

`biber` is distributed in two ways. There is a Perl source version which requires you to have a working Perl installation (preferably version 5.12 but no less than 5.10) and the ability to install the pre-requisite modules. Also provided are binaries for major OSes built with the Perl `PAR::Packer` module and utilities.

Currently there are binaries available for:

- OSX Intel 64-bit
- Windows
- Linux 32-bit
- Linux 64-bit

These should work on any fairly recent OS version. Both binaries and Perl source are available on SourceForge¹.

1.3 License

`biber` is released under the free software Artistic License 2.0²

1.4 History

`bibtex` has been the default (only ...) integrated choice for bibliography processing in TeX for a long time. It has well known limitations which stem from its data format, data model and lack of Unicode support³. The `.bst` language for writing bibliography styles is painful to learn and use. It is not a general programming language and this makes it really very hard to do sophisticated automated processing of bibliographies.

`biblatex` was a major advance for LaTeX users as it moved much of the bibliography processing into LaTeX macros. However, `biblatex` still used `bibtex` as a sorting engine for the bibliography and also to generate various labels for entries. `bibtex`'s capabilities even for this reduced set of tasks was still quite restricted due to the lack of Unicode support and the more and more complex programming issues involved in label preparation and file encoding.

`biber` was designed specifically for `biblatex` in order to provide a powerful backend engine which could deal with any required tasks to do with `.bbl` preparation. Its main features are:

- Deals with the full range of UTF-8

¹<http://sourceforge.net/projects/biblatex-biber/>

²<http://www.opensource.org/licenses/artistic-license-2.0.php>

³In fact, there is now a Unicode version

- Sorts in a completely customisable manner, using when available, CLDR collation tailorings
- Allows for per-entrytype options
- Automatically encodes the `.bbl` into any supported encoding format⁴
- Processes all bibliography sections in one pass of the tool
- Handles UTF-8 citekeys and filenames (given a suitable fully UTF-8 compliant TeX engine)
- Creates entry sets dynamically and allow easily defined static entry sets, all processed in one pass
- Flexible user-customisable crossreference field inheritance model
- Support for related entries, to enable generic treatment of things like ‘translated as’, ‘reprinted as’, ‘reprint of’ etc.⁵
- Handles very complex auto-expansion and contraction of names and namelists⁶
- Extensible modular data sources architecture for ease of adding more data source types.
- Support for remote data sources

1.5 Performance

`biber` can’t really be compared with `bibtex` in any meaningful way performance-wise. `biber` is written in perl and does a great deal more than `bibtex` which is written in C. One of `biber`’s test cases is a 2150 entry, 15,000 line `.bib` file which references a 630 entry macros file with a resulting 160 or so page (A4) formatted bibliography. This takes `biber` about 100 seconds on average to process on a reasonable computer. This is perfectly acceptable, especially for a batch program ...

1.6 Acknowledgements

François Charette originally wrote `biber`. Philip Kime joined in the development in 2009.

2 Use

Firstly, running `biber --help` will display all options and a brief description of each. This is the most useful brief source of usage information. `biber` returns an exit code of 0 on success or 1 if there was an error.

Most `biber` options can be specified in long or short format. When mentioning options below, they are referred to as ‘long form|short form’ when an option

⁴‘Supported’ here means encodings supported by the Perl Encode module

⁵In BibLaTeX 1.2

⁶In BibLaTeX 1.3

has both a long and short form. As usual with such options, when the option requires an argument, the long form is followed by an equals sign '=' and then the argument, the short form is followed by a space and then the argument. For example, the `--configfile|-g` option can be given in two ways:

```
biber --configfile=somefile.conf
biber -g somefile.conf
```

With the `backend=biber` option, `biblatex` switches its backend interface and passes all options and information relevant to `biber`'s operation in a control file with extension `.bcf`⁷. This is conceptually equivalent to the `.aux` file which `LaTeX` uses to pass information to `bibtex`. The `.bcf` file is XML and contains many options and settings which configure how `biber` is to process the bibliography and generate the `.bbl` file.

The usual way to call `biber` is simply with the `.bcf` file as the only argument. The '`.bcf`' extension of the control file is not optional. `biblatex` always outputs a control file with the `.bcf` extension. Specifying the '`.bcf`' extension to `biber` is optional. Assuming a control file called `test.bcf`, the following two commands are equivalent:

```
biber test.bcf
biber test
```

2.1 Options and config file

`biber` sets its options using the following resource chain which is given in decreasing precedence order:

```
command line options →
  .bcf file →
    biber.conf file →
      biber hard-coded defaults
```

Users do not need to care directly about the contents or format of the `.bcf` file as this is generated from the options which they specify for `biblatex`. To override the `.bcf` options, users may use either a configuration file or the command line to set options.

The configuration file is by default called `biber.conf` but this can be changed using the `--configfile|-g` option. Unless `--configfile|-g` is used, the config file

⁷BibLaTeX Control File

is looked for in the following places, in decreasing order of preference:

`biber.conf` in the current directory →

`$HOME/.biber.conf` →

`$XDG_CONFIG_HOME/biber/biber.conf` →

`$HOME/Library/biber/biber.conf` (Mac OSX only)

`$APPDATA/biber.conf` (Windows only) →

the output of `kpsewhich biber.conf` (if available on the system)

The config file format is a very flexible one which allows users to specify options in most common formats, even mixed in the same file. It's easier to see an example. Here is a config file which displays the `biber` hard-coded defaults:

```
bblencoding          UTF-8
bibencoding           UTF-8
collate               1
<collate_options>
  level               3
</collate_options>
debug                 0
fastsort              0
mincrossrefs          2
nolog                 0
nostdmacros           0
<nosort>
  # ignore prefixes like 'al-' when sorting name fields
  type_names          \A\p{L}{2}\p{Pd}
  # ignore diacritics when sorting author
  type_names          [\x{2bf}\x{2018}]
</nosort>
onlylog               0
quiet                 0
sortcase              true
sortlocale            en_US.utf8
sortupper             true
trace                 0
validate_control      0
validate_structure    0
wraplines             0
```

You can see here that options with multiple key/value pairs of their own like `--collate_options|-c` can be specified in Apache config format. Please see the documentation for the `Config::General` Perl module⁸ if you really need details. In practise, if you use a config file at all for `biber`, it will contain very little as you will usually set all options by setting options in `biblatex` which will pass them to `biber` via the `.bcf` file.

The `--collate_options|-c` option takes a number of key/value pairs as value. See section 2.4 for details.

2.1.1 The ‘nosort’ option

The value of the `nosort` option can only be set in the config file and not on the command line. This is because the values are Perl regular expressions and would need special quoting to set on the command line. This can get a bit tricky on some OSes (like Windows) so it’s safer to set them in the config file. In any case, it’s unlikely you would want to set them for particular `biber` runs; they would more likely be set as your personal default and thus they would naturally be set in the config file anyway. `nosort` allows you to ignore parts of a field for sorting. This is done using `perl` regular expressions which specify what to ignore in a field. You can specify as many patterns as you like for a specific field. Also available are some field type aliases so you can, for example, specify patterns for all name fields or all title fields. These field types all begin with the string ‘`type_`’, see Table 1.

For example, this option can be used to ignore diacritic marks and prefixes in names which should not be considered when sorting. Given (the default):

```
<nosort>
  type_names      \A\p{L}{2}\p{Pd}
  type_names      [\x{2bf}\x{2018}]
</nosort>
```

and the `.bib` data source entry:

```
author      = {{al-Hasan}, °Alī},
```

the prefix ‘`al-`’ and the diacritic ‘`°`’ will not be considered when sorting. See the `perl` regular expression manual page for details of the regular expression syntax⁹.

If a `nosort` option is found for a specific field, it will override any option for a type which also covers that field.

Here is another example. Suppose you wanted to ignore ‘`The`’ at the beginning of a `TITLE` field when sorting, you could add this to your `biber.conf`:

⁸<http://search.cpan.org/search?query=Config::General&mode=all>

⁹<http://perldoc.perl.org/perlre.html>

Alias	Fields
type_name	author afterword annotator bookauthor commentator editor editora editorb editorc foreword holder introduction namea nameb namec shortauthor shorteditor translator
type_title	booktitle eventtitle issuetitle journaltitle maintitle origtitle title

Table 1: nosort option field type aliases

```
<nosort>
  title      \AThe\s+
</nosort>
```

If you wanted to do this for all title fields listed in Table 1, then you would do this:

```
<nosort>
  type_title      \AThe\s+
</nosort>
```

Note: `nosort` can be specified for most fields but not for things like dates and special fields as that wouldn't make much sense.

2.2 Input/Output File Locations

2.2.1 Control file

The control file is normally passed as the only argument to `biber`. It is searched for in the following locations, in decreasing order of priority:

Absolute filename →

In the `--output_directory`, if specified →

Relative to current directory →

Using `kpsewhich`, if available

2.2.2 Data sources

Local data sources of type 'file' are searched for in the following locations, in decreasing order of priority:

Absolute filename →

In the `--output_directory`, if specified →

Relative to current directory →

In the same directory as the control file →

Using `kpsewhich` for supported formats, if available

Remote file data sources (beginning with `http://` or `ftp://`) are retrieved to a temp file and processed as normal. Users do not specify explicitly the bibliography database files; they are passed in the `.bcf` control file, which is constructed from the `biblatex \addbibresource{}` macros.

2.3 Logfile

By default, the logfile for biber will be named `\jobname.blg`, so, if you run

```
biber <options> test.bcf
```

then the logfile will be called `'test.blg'`. Like the `.bbl` output file, it will be created in the `--output_directory|-c`, if this option is defined. You can override the logfile name by using the `--logfile` option:

```
biber --logfile=lfname test.bcf
```

results in a logfile called `'lfname.blg'`.

Warning: be careful if you are expecting `biber` to write to directories which you don't have appropriate permissions to. This is more commonly an issue on non-Windows OSes. For example, if you rely on `kpsewhich` to find your database files which are in system TeX directories, you may well not have write permission there so `biber` will not be able to write the `.bbl`. Use the `--outfile|-O` option to specify the location to write the `.bbl` to in such cases.

2.4 Collation and Localisation

`biber` takes care of collating the bibliography for `biblatex`. It writes entries to the `.bbl` file sorted by a completely customisable set of rules which are passed in the `.bcf` file by `biblatex`. `biber` has two ways of performing collation:

`-collate|-C`

The default. This option makes `biber` use the `Unicode::Collate` module for collation which implements the full UCA (Unicode Collation Algorithm). It also has CLDR (Common Locale Data Repository) tailoring to deal with cases which are not covered by the UCA. It is a little slower than `--fastsort|-f` but the advantages are such that it's rarely worth using `--fastsort|-f`

`-fastsort|-f`

`Biber` will sort using the OS locale collation tables. The drawback for this method is that special collation tailoring for various languages are not implemented in the collation tables for many OSes. For example, few OSes correctly sort `'å'` before `'ä'` in the Swedish (`sv_SE`) locale. If you are using a common latin alphabet, then this is probably not a problem for you.

The locale used for collation is determined by the following resource chain which is given in decreasing precedence order:

```
--collate_options|-c (e.g. -c 'locale => "de_DE"') →  
--sortlocale|-l →  
  LC_COLLATE environment variable →  
  LANG environment variable →  
  LC_ALL environment variable
```

With the default `--collate|-C` option, the locale will be used to look for a collation tailoring for that locale. It will generate an informational warning if it finds none. This is not a problem as the vast majority of collation cases are covered by the standard UCA and many locales neither have nor need any special collation tailoring.

With the `--fastsort|-f` option, the locale will be used to locate an OS locale definition to use for the collation. This may or may not be correctly tailored, depending on the locale and the OS.

Collation is by default case sensitive. You can turn this off using the `biber` option `--sortcase=false` or from `biblatex` using its option `sortcase=false`.

`--collate|-C` by default collates uppercase before lower. You can reverse this using the `biber` option `--sortupper=false` or from `biblatex` by using its option `sortupper=false`. Be aware though that some locales rightly enforce a particular setting for this (for example, Danish). You will be able to override it but `biber` will warn you if you do. `sortupper` has no effect when using `--fastsort|-f`—you are at the mercy of what your OS locale does.

There are in fact many options to `Unicode::Collate` which can tailor the collation in various ways in addition to the locale tailoring which is automatically performed. Users should see the the documentation to the module for the various options, most of which the vast majority of users will never need¹⁰. Options are passed using the `--collate_options|-c` option as a single quoted string, each option separated by comma, each key and value separated by `'=>'`. See examples.

¹⁰For details on the various options, see <http://search.cpan.org/search?query=Unicode%3A%3ACollate&mode=all>

2.4.1 Examples

`biber`

Call `biber` using all settings from the `.bcf` generated from the LaTeX run. Case sensitive UCA sorting is performed taking the locale for tailoring from the environment if no `sortlocale` is defined in the `.bcf`

`biber -sortlocale=de_DE`

Override any locale setting in the `.bcf` or the environment.

`biber -fastsort`

Use slightly quicker internal sorting routine. This uses the OS locale files which may or may not be accurate.

`biber -sortcase=false`

Case insensitive sorting.

`biber -sortupper=false -collate_options="backwards => 2"`

Collate lowercase before upper and collate French accents in reverse order at UCA level 2.

2.5 Encoding of files

`biber` takes care of reencoding the data source data as necessary. In normal use, `biblatex` passes its `bibencoding` option value to `biber` via the `.bcf` file. It also passes the value of its `texencoding` option (which maps to `biber's` `sbbencoding|-E` option) the default value of which depends on which TeX engine and encoding packages you are using (see `biblatex` manual for details).

`biber` performs the following tasks:

1. Decodes the data source into UTF-8 if it is not UTF-8 already
2. Decodes LaTeX character macros into UTF-8 if `--bblencoding|-E` is UTF-8
3. Encodes the output so that the `.bbl` is in the encoding that `--bblencoding|-E` specifies
4. Warns if it is asked to output to the `.bbl` any UTF-8 decoded LaTeX character macros which are not in the `--bblencoding|-E` encoding. Replaces with a suitable LaTeX macro

Normally, you do not need to set the encoding options on the `biber` command line as they are passed in the `.bcf` via the information in your `biblatex` environment. However, you can override the `.bcf` settings with the command line or config file. The resource chain for encoding settings is, in decreasing order of preference:

```
--bibencoding|-e and --bblencoding|-E →  
  biber config file →  
    .bcf control file
```

2.5.1 LaTeX macro decoding

As mentioned above, `biber` sometimes converts LaTeX character macros into UTF-8. In fact there are two situations in which this occurs.

1. When `--bblencoding|-E` is UTF-8
2. Always for internal sorting purposes

This decoding is very useful but take note of the following two scenarios, which relate to each of the two situations in which LaTeX macro decoding occurs:

Decoding when output is UTF-8

If you are using PDFLaTeX and `\usepackage[utf8]{inputenc}`, it is possible that the UTF-8 characters resulting from `biber`'s internal LaTeX character macro decoding break `inputenc`. This is because `inputenc` does not implement all of UTF-8, only a commonly used subset.

An example—if you had `\DJ` in your `.bib` data source, `biber` decodes this correctly to ‘Đ’ and this breaks `inputenc` because it doesn’t understand that UTF-8 character. The real solution here is to switch to a TeX engine with full UTF-8 support like XeTeX or LuaTeX as these don’t use or need `inputenc`. However, you can also try the `--bblsafechars` option which will try to convert any UTF-8 chars into LaTeX macros on output. The `biblatex` option ‘`texencoding=ascii`’ (which corresponds to the `biber` option ‘`--bblencoding|-E`’) will automatically set `--bblsafechars`.

See also the `biber --help` output for the `--bblsafecharsset` option which can customise the set of conversion characters to use.

Decoding for internal sorting

If your `bblencoding` is not UTF-8, and you are using some UTF-8 equivalent LaTeX character macros in your `.bib` data source, then some `.bbl` fields (currently only `\sortinit{}`) might end up with invalid characters in them, according to the `.bbl` encoding. This is because some fields must be generated from the final sorting data which is only available after the LaTeX character macro decoding step.

For example, suppose you are using PDFLaTeX with `\usepackage[latin1]{inputenc}` and the following `bibtex` data source entry:

```
@BOOK{citekey1,
  AUTHOR = {{\v S}imple, Simon},
}
```

With normal LaTeX character macro decoding, the `{\v S}` is decoded into ‘Š’ and so with name-first sorting, `\sortinit{}` would be ‘Š’. This is an invalid character in `latin1` encoding and so the `.bbl` would be broken. In such cases when `\sortinit{}` is a char not valid in the `bblencoding`, `biber` tries to replace the

character with a suitable LaTeX macro. The solution is really to use UTF-8 .bbl encoding whenever possible. In extreme cases where even with UTF-8 encoding, the char is not recognised by LaTeX due to an incomplete UTF-8 implementation (as with `inputenc`), this might also mean switching TeX engines to one that supports full UTF-8.

2.5.2 Examples

```
biber
    Set bibencoding and bblencoding from the config file or .bcf.
biber -bblencoding=latin2
    Encode the .bbl as latin2, overriding the .bcf.
biber -bblsafechars
    Set bibencoding and bblencoding from the config file or .bcf. Force encoding
    of UTF-8 chars to LaTeX macros using default conversion set.
biber -bblencoding=ascii
    Encode the .bbl as ascii, overriding the .bcf. Automatically sets --bblsafechars
    to force UTF-8 to LaTeX macro conversion.
biber -bblencoding=ascii -bblsafecharsset=full
    Encode the .bbl as ascii, overriding the .bcf. Automatically sets --bblsafechars
    to force UTF-8 to LaTeX macro conversion using the full set of conversions
biber -decodecharsset=full
    Set bibencoding and bblencoding from the config file or .bcf. Use the full
    LaTeX macro to UTF-8 conversion set because you have some more obscure charac-
    ter macros in your .bib data source which you want to sort correctly
biber -u
    Shortcut alias for biber --bibencoding=UTF-8
biber -U
    Shortcut alias for biber --bblencoding=UTF-8
```

2.6 Limitations

Currently, users are restricted to a one-one mapping from datasource entry types/fields to the `biblatex` supported entry type/fields. This is mitigated a little by the type/field aliases which `biblatex` supports. In the future, users will be able to customise the data source driver config in order to define their own entry type/field aliases so that there is more flexibility in mapping data source entry type/fields to internal `biblatex` types/fields.

Currently it is not possible to automatically expand name lists to their minimally unique truncation which is required by some styles (APA for example). This is quite a hard problem, a solution to which is implemented in an experimental

biber branch but which also needs biblatex support, envisaged for version 2.x. It requires an enhanced .bbl format, amongst other things.

2.7 Editor Integration

Here is some information on how to integrate biber into some of the more common editors

2.7.1 Emacs

Emacs has the very powerful AUCTeX mode for editing TeX and running compilations. BibTeX is already integrated into AUCTeX and it is quite simple to add support for biber. Use the Emacs Customise interface to modify the TeX-command-list variable and add a Biber command.

```
M-x customise-variable
TeX-command-list
```

and then Ins somewhere a new command that looks like Figure 1.

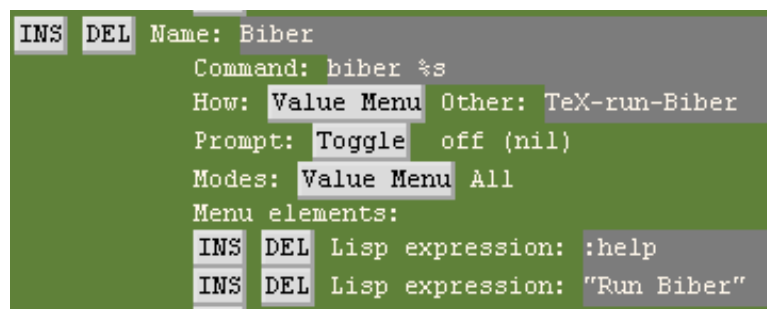


Figure 1: Screenshot of AUCTeX command setup for Biber

Alternatively, you can add it directly in lisp to your .emacs like this:

```
(add-to-list 'TeX-command-list
  (quote
    ("Biber" "biber %s" TeX-run-Biber nil t :help "Run Biber")))
```

However you add the command to TeX-command-list, customise the actual Biber command parameters as you want them, using '%s' as the LaTeX file name place holder. Then define the following two functions in your .emacs.

```
(eval-after-load "tex"
  (quote (defun TeX-run-Biber (name command file)
```

```

"Create a process for NAME using COMMAND to format FILE with Biber."
(let ((process (TeX-run-command name command file)))
  (setq TeX-sentinel-function 'TeX-Biber-sentinel)
  (if TeX-process-asynchronous
      process
      (TeX-synchronous-sentinel name file process))))
)

(eval-after-load "tex"
  (quote (defun TeX-Biber-sentinel (process name)
    "Cleanup TeX output buffer after running Biber."
    (goto-char (point-max))
    (cond
     ;; Check whether Biber reports any warnings or errors.
     ((re-search-backward (concat
                           "^ (There \\(?:was\\|were\\) \\([0-9]+\\) "
                           "\\(warnings?\\|error messages?\\))") nil t)
      ;; Tell the user their number so that she sees whether the
      ;; situation is getting better or worse.
      (message (concat "Biber finished with %s %s. "
                       "Type '%s' to display output.")
               (match-string 1) (match-string 2)
               (substitute-command-keys
                "\\<TeX-mode-map>\\[TeX-recenter-output-buffer]")))
      (t
       (message (concat "Biber finished successfully. "
                        "Run LaTeX again to get citations right."))))
    (setq TeX-command-next TeX-command-default))
  )
)

```

You'll then see a Biber option in your AUCTeX command menu or you can just C-c C-c and type Biber.

2.7.2 TeXworks

It's very easy to add biber support to TeXworks. In the Preferences, select the Typesetting tab and then add a new Processing Tool as in Figure 2.

2.8 BibTeX macros and the MONTH field

BibTeX defines automatically macros for month abbreviations like 'jan', 'feb' etc. biber also does this, defining them as numbers since that is what biblatex wants. In case you are also defining these yourself (although if you are only using biblatex, there isn't much point), you will get macro redefinition warnings from

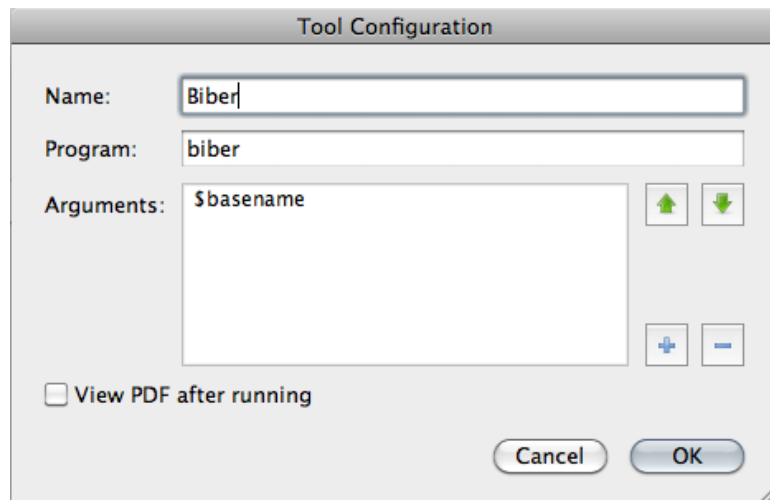


Figure 2: Screenshot of TeXworks processing tool setup for Biber

the `btparse` library. You can turn off `biber`’s macro definitions to avoid this by using the option `--nostdmacros`.

`biber` will look at any `MONTH` field in a `bibtex` data source and if it’s not a number as `biblatex` expects (because it wasn’t one of the macros as mentioned above or these macros were disabled by `--nostdmacros`), it will try to turn it into the right number in the `.bbl`. If you only use `biblatex` with your `bibtex` data source files, you should probably make any `MONTH` fields be the numbers which `biblatex` expects.

2.9 Biber datasource drivers

`biber` uses a modular data source driver model to provide access to supported data sources. The drivers are responsible for mapping driver entry types and fields to the `biblatex` model. This is aided by a driver configuration file (`.dcf`). The information in this file for each driver can be found in the driver documentation folder on SourceForge¹¹. This file shows you which handlers the driver uses for different fields and what certain entry types and fields are aliased to in the `biblatex` data model. This is not fantastically useful to know without know what the named driver handlers do specifically but there is a ‘description’ section which mentions any special handling and general comments on the driver. You should read the documentation for the drivers you use to get an idea of how `biber` handles your data. Data model mapping is an imprecise art and the drivers are where the neces-

¹¹<https://sourceforge.net/projects/biblatex-biber/files/biblatex-biber/current/documentation/drivers>

sarily messy parts of `biber` live. Most data source models are not designed with typesetting in mind and are usually not fine-grained enough to provide the sorts of information that `biblatex` needs. `biber` does its best to suck as much meaningful information from a data source as possible.

3 Binaries

The binary distributions of `biber` are made using the Perl `PAR::Packer` module. They can be used as a normal binary but have some behaviour which is worth noting:

- Don't be worried by the size of the binaries. `PAR::Packer` essentially constructs a self-extracting archive which unpacks the needed files first and so the binaries look larger than what actually runs in memory.
- On the first run of a new version (that is, with a specific hash), they actually unpack themselves to a temporary location which varies by operating system. This unpacking can take a little while and only happens on the first run of a new version. **Please don't kill the process if it seems to take some time to do anything on the first run of a new binary.** If you do, it will not unpack everything and it will almost certainly break `biber`. You will then have to delete your binary cache (see section 3.1 below) and re-run the `biber` executable again for the first time to allow it to unpack properly.

3.1 Binary Caches

`PAR::Packer` works by unpacking the required files to a cache location. It only does this on the first run of a binary by computing a hash of the binary and comparing it with the cache directory name which contains the hash. So, if you run several versions of a binary, you will end up with several cached trees which are never used. This is particularly true if you are regularly testing new versions of the `biber` binary. It is a good idea to delete the caches for older binaries as they are not needed and can take up a fair bit of space. The caches are located in a temporary location which varies from OS to OS. The cache name is:

```
par-<username>/cache-<hash> (Linux/Unix/OSX)
par-<username>\cache-<hash> (Windows)
```

The temp location is not always obvious but these are sensible places to look (where * can vary depending on username):

- `/var/folders/*/*/-Tmp-/` (OSX, local GUI login shell)

- `/var/tmp/` (OSX, remote ssh login shell)
- `/tmp/` (Linux)
- `C:\Documents and Settings\<username>\Local Settings\Temp` (Windows)
- `C:\Windows\Temp` (Windows)

To clean up, you can just remove the whole `par-<username>` directory/folder and then run the current binary again.

3.2 Binary Architectures

Binaries are available for the following architectures:

- `linux_x86_32` — Linux x86 32-bit (built on Ubuntu 9.04)
- `linux_x86_64` — Linux x86 64-bit (built on Ubuntu 9.04)
- `MSWin` — Windows. Should work on 32 or 64 bit (built on XP)
- `darwin_x86_64` — OSX Intel 64-bit (built on OSX 10.6)

3.3 Installing

These instructions only apply to manually downloaded binaries. If `biber` came with your TeX distribution just use it as normal.

Download the binary appropriate to you OS/arch¹². Below I assume it's on your desktop.

You have to move the binary to somewhere in you command-line or TeX utility path so that it can be found. If you know how to do this, just ignore the rest of this section which contains some instructions for users who are not sure about this.

3.3.1 OSX

If you are using the TexLive MacTeX distribution:

```
sudo mv ~/Desktop/biber /usr/texbin/
sudo chmod +x /usr/texbin/biber
```

If you are using the macports TexLive distribution:

```
sudo mv ~/Desktop/biber /opt/local/bin/
sudo chmod +x /opt/local/bin/biber
```

The 'sudo' commands will prompt you for your password.

¹²<https://sourceforge.net/projects/biblatex-biber>

3.3.2 Windows

The easiest way is to just move the executable into your `C:\Windows` directory since that is always in your path. A more elegant is to put it somewhere in your TeX distribution that is already in your path. For example if you are using MiKTeX:

```
C:\Program Files\MiKTeX 2.8\miktex\bin\
```

3.3.3 Unix/Linux

```
sudo mv ~/Desktop/biber /usr/local/bin/biber
sudo chmod +x /usr/local/bin/biber
```

Make sure `/usr/local/bin` is in your PATH. Search Google for ‘set PATH linux’ if unsure about this. There are many pages about this, for example: <http://www.cyberciti.biz/faq/unix-linux-adding-path/>

3.4 Building

Instructions for those who want/need to build an executable from the Perl version. For this, you will need to have a recent Perl, preferably 5.12 at least with the following modules:

- PAR
- PAR::Packer
- All `biber` pre-requisites

You should have the latest CPAN versions of all required modules as `biber` is very specific in some cases about module versions and depends on recent fixes in many cases. You can see if you have the `biber` Perl dependencies by the usual

```
perl ./Build.PL
```

invocation in the `biber` Perl distribution tree directory. Normally, the build procedure for the binaries is as follows¹³:

- Get the `biber` source tree from SF and put it on the architecture you are building for
- `cd` to the root of the source tree
- `perl Build.PL` (this will check your module dependencies)
- `Build test`
- `Build install` (may need to run this as `sudo` on UNIXesque systems)

¹³On UNIXesque systems, you may need to specify a full path to the scripts e.g. `./Build`

- `cd dist/<arch>`
- `build.sh` (`build.bat` on Windows)

This leaves a binary called `'biber-<arch>'` (also with a `'.exe'` extension on Windows) in your current directory. The tricky part is constructing the information for the build script. There are two things that need to be configured, both of which are required by the `PAR::Packer` module:

1. A list of modules/libraries to include in the binary which are not automatically detected by the `PAR::Packer` dependency scanner
2. A list of extra files to include in the binary which are not automatically detected by the `PAR::Packer` dependency scanner

To build `biber` for a new architecture you need to define these two things as part of constructing new build scripts:

- Make a new subfolder in the `dist` directory named after the architecture you are building for. This name is arbitrary but should be fairly obvious like `'solaris-sparc-64'`, for example.
- Copy the `biber.files` file from an existing build architecture into this directory.
- For all of the files with absolute pathnames in there (that is, ones we are not pulling from the `biber` tree itself), locate these files in your Perl installation tree and put the correct path in the file.
- Copy the build script from a vaguely similar architecture (i.e. Windows/non-Windows ...) to your new architecture directory.
- Change the `--link` options to point to where the required libraries reside on your system.
- Change the `--output` option to name the resulting binary for your architecture.
- Run the build script

The `--link` options can be a little tricky sometimes. It is usually best to build without them once and then run `ldd` (or Windows equivalent) on the binary to see which version/location of a library you should link to. You can also try just running the binary and it should complain about missing libraries and where it expected to find them. Put this path into the `--link` option. The `--module` options are the same for all architectures and do not need to be modified. On architectures which have or can have case-insensitive file systems, you should use the build script from either Windows or OSX as a reference as these include a step to copy the main `biber` script to a new name before packing the binary. This is required as otherwise a spurious error is reported to the user on first run of the binary due to a name collision when it unpacks itself.