

# The `fretplot` package

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# 1 Introduction

The *fretplot* Lua $\text{\TeX}$  package provides batch generation of scale and chord diagrams for plucked string instruments, such as the guitar.

It is designed for high flexibility, automation, and customization via simple yet powerful custom file formats for describing fretboard diagrams, which allow for easy batch generation of diagrams. To complement the high customizability, the package also comes with sensible yet attractive default settings for the diagrams.

The package also provides some easy-to-use  $\text{\LaTeX}$  macros that understand the underlying music theory, allowing one to render, for example, a guitar scale diagram by specifying the musical scale or scale type via built-in macros, or even more directly via degree, pitch class, or interval formulae.

## 2 L<sup>A</sup>T<sub>E</sub>X macros

This package defines the following user-facing macros:

- `\fptotikz`
- `\fptemplate`
- `\fpstemplate`
- `\fpscale`

### 2.1 `\fptotikz`

Syntax: `\fptotikz[OUTPUT_TIKZ_FILE]{INPUT_FP_FILE}`

Description: compile an input fretplot file to TikZ.

Arguments:

- `INPUT_FP_FILE`: path to input fretplot file.
- `OUTPUT_TIKZ_FILE` (optional): path to output file to which generated TikZ will be written. If `OUTPUT_TIKZ_FILE` is not specified, then the output TikZ code will be included inline at the location of the `\fptotikz` invocation.

### 2.2 `\fptemplate`

Syntax: `\fptemplate{OUTPUT_FP_FILE}`

Description: generate a template fretplot file.

Arguments: `OUTPUT_FP_FILE`: path to output fretplot file.

### 2.3 `\fpstemplate`

Syntax: `\fpstemplate{OUTPUT_FPS_FILE}`

Description: generate a template fretplot scale style file.

Arguments: `OUTPUT_FPS_FILE`: path to output fretplot scale style file.

### 2.4 `\fpscale`

Syntax: `\fpscale{ARGS}`

Description: render diagram of (mode of) scale based on input scale formula (degree, pitch class, or interval) or generate corresponding fretplot file or TikZ code.

Arguments: `ARGS`: | and/or |\n-delimited list (possibly empty) of named argument assignments of the form `key=value` (with no surrounding spaces) in any order. Some of the subsequent pages of this section contain 2 tables:

- A complete table of keys for **ARGS** and their respective default and possible values. If a key does not have a default value, then the corresponding entry in the table is empty.
  - \* In the table, a *pitch class* refers to any element of the set  
 $\{C, C\#, D, Eb, E, F, F\#, G, Ab, A, Bb, B\}$ .
  - \* In the table, a *degree* is any element of the set  
 $\{1, b2, 2, b3, 3, 4, b5, 5, b6, 6, b7, 7\}$ .
  - \* In the table, an *interval* is a positive integer representing the number of semitones in a musical interval.
- A table containing a list of macros that expand to interval formulas for popular scale types.

## 2.5 Examples

Create directories `include` and `tikz` in the same directory as your main document.

```

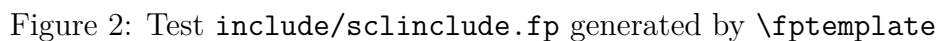
1 \documentclass[12pt,letterpaper]{article}
2 \usepackage{fretplot}
3 \usepackage{float} % for [H] placement specifier in figures
4
5 \begin{document}
6
7 \begin{figure}[H]
8 \fpscale{parentroot=C#|formulatype=d|formula=1 2 b3 4 5 b6 7}
9 \caption{C$\sharp$ harmonic minor scale}
10 \end{figure}
11
12 % Create a fretplot file include/sclinclude.fp
13 % and a fretplot scale style file include/styles.fps.
14 % Comment these 2 lines out after the first run if
15 % you do not want to overwrite them in subsequent runs.
16 \fptemplate{include/sclinclude.fp}
17 \fpstyletemplate{include/styles.fps}
18
19 % Use fptotikz to test include/sclinclude.fp
20 % generated by \fpstyletemplate.
21 \begin{figure}[H]
22 \fptotikz{include/sclinclude.fp}
23 \caption{Test \texttt{include/sclinclude.fp} generated by \texttt{\textbackslash fptemplate}}
24 \end{figure}
25
26 % Also test the TikZ file generation capability of
27 % \fptotikz, although the rest of the code does not
28 % depend on this. Note that this will merely create
29 % the file tikz/sclinclude.tex containing the
30 % TikZ code, but not include it in the document.
31 \fptotikz[tikz/sclinclude.tex]{include/sclinclude.fp}
32
33 \begin{figure}[H]
34 \fpscale{parentroot=A|formulatype=i|formula=\fpmaj|mode=2|
35 tuning=E B G D A E|numfrets=12|styletype=d|
36 labeltype=p|scalestylefile=include/styles.fps|
37 includefpfile=include/sclinclude.fp}
38 \caption{2\textsuperscript{nd} mode of A major scale (B Dorian)}
39 \end{figure}
40
41 \end{document}

```

Compile the above code with

```
lualatex --shell-escape my_document.tex
```

to get the following output:



5

## 2.6 Tables

KEY	DEFAULT VALUE	VALUE
parentroot	C	Root of parent scale. This can be any pitch class. This is ignored if <code>formulatype=p</code> or if <code>moderoot</code> is specified. Please see the description of <code>mode</code> for more details.
formulatype	d	Type of the formula specified in the key named <code>formula</code> . Possible values are {d, p, i}. Here d stands for <i>degree</i> , p stands for <i>pitch class</i> , and i stands for <i>interval</i> .
formula	1 2 3 4 5 6 7	Formula of parent scale. This should be a list of degrees or pitch classes or intervals delimited by single ordinary space characters (ASCII 32). The type of this formula is indicated by specifying <code>formulatype</code> .
mode	1	Mode index of scale. This is specified as a positive integer. This mode will be rendered by <code>\fpscale</code> . Examples: if <code>formulatype=p</code> , <code>formula=C D E F G A B</code> , and <code>mode=3</code> , then the 3rd mode of the C major scale (E Phrygian) will be rendered. If <code>formulatype=d</code> , <code>formula=1 2 3 4 5 6 7</code> , <code>mode=2</code> , <code>parentroot=A</code> , and <code>moderoot</code> is not specified, then the 2nd mode of the A major scale (which is B Dorian) will be rendered. In the above scenario, if <code>moderoot=A</code> , then A Dorian will be rendered instead.
moderoot		Optional root of mode of scale. This can be any pitch class. This is ignored if <code>formulatype=p</code> . Please see the description of <code>mode</code> for more details.
tuning	E B G D A E	Tuning of strings of the instrument. This is specified as a list of pitch classes delimited by single ordinary space characters (ASCII 32).
numfrets	12	Number of frets on the fingerboard. If the instrument does not have frets, then one can style them to be transparent in the render.
styletype	d	Specify if the styling of notes should be degree-indexed or pitch class-indexed. Possible values are {d, p}. Here d stands for <i>degree</i> and p stands for <i>pitch class</i> . The user can customize the actual styles by specifying the key <code>scalestylefile</code> .
labeltype	d	Specify if the labelling of notes should be degree-indexed or pitch class-indexed. Possible values are {d, p}. Here d stands for <i>degree</i> and p stands for <i>pitch class</i> . The user can customize the actual labels by specifying the key <code>scalestylefile</code> .
outffile		Optional path to output fretplot file describing (mode of) scale. If this is specified, then no TikZ code will be generated by <code>\fpscale</code> (neither inline nor to <code>outtikzfile</code> ). One can then make modifications to the output fretplot file and then generate TikZ code (inline or external file) from the fretplot file using <code>\fptotikz</code> . The keys <code>includeffile</code> and <code>scalestylefile</code> are used to further customize the rendering. In particular, <code>includeffile</code> is included at the end of <code>outffile</code> . Even if <code>outffile</code> is not specified, <code>\fpscale</code> still internally creates a temporary fretplot file which is then converted to TikZ. This temporary fretplot file also includes <code>includeffile</code> at its end, which allows one to customize their render via <code>includeffile</code> without specifying <code>outffile</code> . The same fretplot file can serve as the <code>includeffile</code> for multiple <code>\fpscale</code> invocations, which allows for batch manipulation of scale plots. Temporary fretplot files created by <code>\fpscale</code> internally are deleted later automatically.
outtikzfile		Optional path to output file containing TikZ code describing (mode of) scale. This will be ignored if <code>outffile</code> is specified. If <code>outffile</code> is not specified and <code>outtikzfile</code> is specified, then <code>\fpscale</code> will not generate inline TikZ code. One can then make modifications to the output TikZ code and use <code>\input</code> to use it in their document.
includeffile		Optional path to input fretplot file to be included at the end of <code>outffile</code> or an equivalent temporary fretplot file created by <code>\fpscale</code> for internal use. If there does not exist a file at the path specified by <code>includeffile</code> , then a new empty file will be created at that path; one can then edit this new file for use in subsequent compilations. For more details, please see <code>outffile</code> .
scalestylefile		Optional path to input fretplot scale style file. This can be used to customize degree and/or pitch class-based styling and labelling for scale notes. Please see <code>styletype</code> and <code>labeltype</code> for additional details.

Table 1: Key-value pairs for `\fpscale`

MACRO	INTERVAL FORMULA IN SEMITONES	DESCRIPTION
<code>\fmpent</code> <code>\fpblues</code>	3 2 2 3 2 3 2 1 1 3 2	Minor pentatonic scale Blues scale
<code>\fpmaj</code> <code>\fpjmin</code> <code>\fphmin</code>	2 2 1 2 2 2 1 2 1 2 2 2 2 1 2 1 2 2 1 3 1	Major scale Jazz minor scale (ascending melodic minor scale) Harmonic minor scale
<code>\fphmaj</code> <code>\fpdhmaj</code> <code>\fpmaj</code> <code>\fpmmin</code> <code>\fphunmaj</code>	2 2 1 2 1 3 1 1 3 1 2 1 3 1 1 2 2 2 2 2 1 1 2 2 2 1 3 1 3 1 2 1 2 1 2	Harmonic major scale Double harmonic major scale Neapolitan major scale Neapolitan minor scale Hungarian major scale
<code>\fpbmaj</code> <code>\fpbmin</code> <code>\fpbdom</code> <code>\fpldb</code> <code>\fpdbeb</code>	2 2 1 2 1 1 2 1 2 1 2 2 2 1 1 1 2 2 1 2 2 1 1 1 2 2 2 1 2 1 1 1 1 3 1 2 1 2 1 1	Bebop major scale Bebop minor scale Bebop dominant scale Lydian dominant bebop scale Phrygian dominant bebop scale
<code>\fpchr</code> <code>\fpwt</code> <code>\fptwot</code> <code>\fpthree</code> <code>\fpmon</code>	1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 4 4 4 6 6 12	Chromatic scale Whole tone scale Two whole tones scale Three whole tones scale Monotonic scale
<code>\fpaug</code> <code>\fptrit</code> <code>\fpwhdim</code>	3 1 3 1 3 1 1 3 2 1 3 2 2 1 2 1 2 1 2 1	Augmented scale Tritone scale Whole half diminished scale
<code>\fpmajsevenarp</code> <code>\fpdomsevenarp</code> <code>\fpminsevenarp</code> <code>\fpdimsevenarp</code> <code>\fpdimsevenarp</code> <code>\fpminmajsevenarp</code>	4 3 4 1 4 3 3 2 3 4 3 2 3 3 4 2 3 3 3 3 3 4 4 1	Major seventh arpeggio Dominant seventh arpeggio Minor seventh arpeggio Half diminished seventh arpeggio Diminished seventh arpeggio Minor major seventh arpeggio

Table 2: Macros for interval formulae of popular scale types

## 3 The fretplot file format

A *fretplot file*, *fp file*, or *.fp* file describes the layout and appearance of a fretboard diagram.

### 3.1 Syntax

- Comment lines start with **#**. Comment lines and empty lines are ignored.
- Every other line of a fretplot file will have lines of form **firstword lots of data**, where **firstword** and **lots of data** must be separated by a single ordinary space character (ASCII 32), **lots of data** cannot be empty, and the first character of **lots of data** cannot be a whitespace character (space, tab, newline, or anything that matches **%s** in Lua).
  - Note notation: **<STRINGINDEX,FRETINDEX>**  
Example: **<6,5>**
  - Barre notation: **<STARTSTRINGINDEX-ENDSTRINGINDEX,FRETINDEX>**  
Example: **<1-6,5>**
- Barres never have labels. Frets, strings, and notes by default have no labels, but can be specified as follows:
  - Frets: **f1FRETINDEX LABEL**  
Example: **f13 3**
  - Strings: **s1STRINGINDEX LABEL**  
Example: **s11 {\Large e}**
  - Notes: **n1<STRINGINDEX,FRETINDEX> LABEL**  
Example: **n1<6,5> {\Large A}**
- To include another fretplot file at the current location of a fretplot file, use **include FILEPATH**.

### 3.2 Parameters

All available parameters that can be used in a fretplot file are listed in the table on the next page. Operations are case-sensitive and must be written exactly as shown.



TYPE	POSSIBLE VALUES	OPERATIONS	OP DESCRIPTION	PARAMETERS	PARAM DESC	DEFAULT PARAM VALUE
Boolean	True, False	flip <b>PARAMETER</b>	negate parameter named <b>PARAMETER</b>	onf0	draw notes directly on top of fret 0 (nut of guitar) if True and not if False	False
				sovf	draw strings over frets if True and frets over strings if False	True
Numerical	Any numerical value	+ <b>PARAMETER VALUE</b>	add literal numerical value <b>VALUE</b> to numerical parameter named <b>PARAMETER</b>	zoom	Factor by which the diagram will be scaled	1.0
		- <b>PARAMETER VALUE</b>	subtract literal numerical value <b>VALUE</b> from numerical parameter named <b>PARAMETER</b>			
		* <b>PARAMETER VALUE</b>	multiply numerical parameter named <b>PARAMETER</b> by literal numerical value <b>VALUE</b>	rotn	Angle (in degrees) by which the diagram will be rotated	0
		/ <b>PARAMETER VALUE</b>	divide numerical parameter named <b>PARAMETER</b> by literal numerical value <b>VALUE</b>	numfrt	Number of frets	12
		% <b>PARAMETER VALUE</b>	mod numerical parameter named <b>PARAMETER</b> by literal numerical value <b>VALUE</b>	numstr	Number of strings	6
		^ <b>PARAMETER VALUE</b>	raise numerical parameter named <b>PARAMETER</b> to the power of literal numerical value <b>VALUE</b>			
List	List of items delimited by single ordinary space characters (ASCII 32), or the <i>empty list</i>	void <b>PARAMETER</b>	empty the list parameter named <b>PARAMETER</b>	frets	List of fret indices	0 1 2 3 4 5 6 7 8 9 10 11 12
		> <b>PARAMETER VALUE</b>	extend list parameter named <b>PARAMETER</b> by literal list value <b>VALUE</b>	strings	List of string indices	1 2 3 4 5 6
		< <b>PARAMETER VALUE</b>	remove values in literal list value <b>VALUE</b> from list parameter named <b>PARAMETER</b>	notes	List of notes	empty list
				barres	List of barres	empty list
Style	List of PGF/TikZ styles delimited by single , (comma) characters	& <b>PARAMETER VALUE</b>	extend style parameter named <b>PARAMETER</b> by literal comma-delimited collection of styles <b>VALUE</b>	fx	Fret style	solid,line width=0.6,color=black
				sx	String style	solid,line width=0.6,color=black
				bx	Barre style	fill=black,draw=black
				nx	Note style	shape=rectangle,draw=black,text=white,fill=black

Table 3: Parameters for fretplot files

### 3.3 Batch processing using operations on parameters

The operations are particularly useful for batch manipulation of diagrams.

For example, say, you are writing a book containing 100 chord diagrams. Each of those diagrams is described using its own fretplot file. Now you want to scale/enlarge each of them to 1.5 times of their respective original sizes, and additionally you want to rotate all of them by 30 degrees.

To do this, in each of those 100 fretplot files you can include another common fretplot file, say, `common.fp` by writing `include common.fp` at the end of all of those 100 fretplot files, and then in `common.fp` you can write the following two lines:

```
1 +rotn 30
2 *zoom 1.5
```

This will rotate all those 100 diagrams by 30 degrees and zoom in by a factor of 1.5, without you having to edit each of those 100 files individually.

Please note that lines in a fretplot file are interpreted sequentially, so the location where you write `include common.fp` in a fretplot file matters due to non-commutativity of certain operations. For instance, if the parameter `rotn` was 10 and you wanted to multiply it by 2 and subtract 5 from it, the order in which you performed those operations would matter.

The following is an example fretplot file that demonstrates the use of some parameters and some operations on them:

```
1 # Set a Boolean parameters
2 onf0 False
3 # Negate a Boolean parameter
4 flip onf0
5
6 # Perform some arithmetic operations on numerical parameters
7 +rotn 90
8 /rotn 2
9 -rotn 45
10 %numstr 4
11
12 # Setting styles of some frets
13 fx0 solid,line width=1.2,color=black
14 fx1 solid,line width=0.6,color=brown
15 # Setting labels of some frets
16 fl3 3
17 fl5 5
18
19 # Setting styles of some strings
20 sx1 solid,line width=0.5,color=black
21 # Setting labels of some strings
22 sl1 {\scriptsize e}
23
24 # List of notes to be drawn
25 notes <6,5> <3,6> <4,7> <5,7> <2,5> <1,5>
26 # Style a note
27 nx<6,5> shape=circle,draw=red,text=white,fill=red,inner sep=1.5
28 # Label a note
29 nl<6,5> {\scriptsize A}
30 # Change style of the note
31 nx<6,5> shape=rectangle,draw=red,text=blue,fill=white,fill opacity=0.5,inner sep=1.0
32 # Relabel the note
33 nl<6,5> 1
```

```

34 # Add some notes
35 >notes <1,0> <1,1>
36 # Remove some notes
37 <notes <5,5> <1,5> <2,2>
38 # Add more to existing style of a note
39 &nx<2,5> draw=red,shape=circle

```

### 3.4 Example: barre chord diagram

Save source below as `include/amaj/src.fp`:

```

1 zoom 1.2
2 rotn -90
3
4 # A major triad barre chord
5
6 barres <1-6,5>
7 bx<1-6,5> fill=black, draw=black
8
9 notes <6,5> <3,6> <4,7> <5,7> <2,5> <1,5>
10
11 nx<6,5> shape=circle,draw=red,text=white,fill=red,inner sep=1.5
12 nl<6,5> {\scriptsize A}
13
14 nx<5,7> shape=circle,draw=red,text=blue,fill=white,inner sep=1.7
15 nl<5,7> {\scriptsize E}
16
17 nx<4,7> shape=circle,draw=red,text=white,fill=red,inner sep=1.5
18 nl<4,7> {\scriptsize A}
19
20 nx<3,6> shape=circle,draw=red,text=blue,fill=white,inner sep=0.3
21 nl<3,6> {\scriptsize C\sharp}
22
23 nx<2,5> shape=circle,draw=red,text=blue,fill=white,inner sep=1.7
24 nl<2,5> {\scriptsize E}
25
26 nx<1,5> shape=circle,draw=red,text=white,fill=red,inner sep=1.5
27 nl<1,5> {\scriptsize A}

```

Run `lualatex --shell-escape amaj.tex` after saving source below as `amaj.tex` to get output on the right:

```

1 \documentclass[12pt,letterpaper]{article}
2 \usepackage{fretplot}
3 \usepackage{float} % for [H] placement specifier in figures
4
5 \begin{document}
6
7 \begin{figure}[H]
8 \centering
9 \fptotikz{include/amaj/src.fp}
10 \caption{A major triad barre chord}
11 \end{figure}
12
13 \end{document}

```

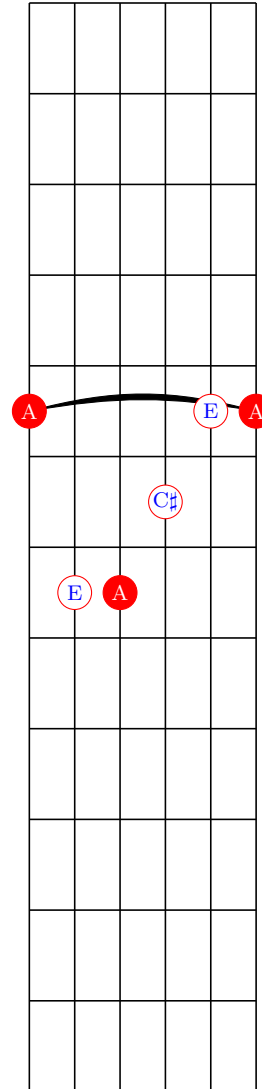


Figure 4: A major triad barre chord

### 3.5 Example: fretless guitar diagram

Save source below as `include/fretless/src.fp`:

```
1 zoom 0.8
2 rotn -90
3
4 # Fretless guitar
5 frets 0 12
6
7 # Uncomment the following line to remove the nut and the bridge
8 # void frets
9
10 # Add some notes
11 notes <6,5> <3,6>
12
13 nx<6,5> shape=circle,draw=red,text=white,fill=red,inner sep=1.5
14 nl<6,5> {\scriptsize A}
15
16 nx<3,6> shape=circle,draw=red,text=blue,fill=white,inner sep=0.3
17 nl<3,6> {\scriptsize C$\sharp$}
```

Run `lualatex --shell-escape fretless.tex` after saving source below as `fretless.tex` to get output on the right:

```
1 \documentclass[12pt,letterpaper]{article}
2 \usepackage{fretplot}
3 \usepackage{float} % for [H] placement specifier in figures
4
5 \begin{document}
6
7 \begin{figure}[H]
8 \centering
9 \fptotikz{include/fretless/src.fp}
10 \caption{Some notes indicated on a fretless guitar}
11 \end{figure}
12
13 \end{document}
```

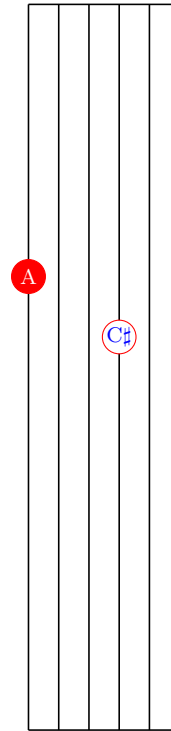


Figure 5: Some notes indicated on a fretless guitar

## 3.6 Example: custom instrument diagram

Save source below as `include/custom.instrument/src.fp`:

```

1 zoom 0.8
2 rotn -95
3
4 # Set fret and string counts
5 numfret 5
6 numstr 8
7
8 # Set frets
9 # Fret 0 is the nut
10 frets 0 1 3 4 5
11
12 # Set strings
13 strings 1 2 3 4 5 6 7 8
14 # Remove a string
15 <strings 3
16
17 # Label frets
18 fl1 1
19 fl4 4
20 fl5 5
21
22 # Style the frets
23 fx1 dashed,line width=0.6,color=black
24 fx3 solid,line width=0.6,color=red
25
26 # Label strings
27 sl1 1
28 sl2 2
29 sl4 4
30 sl5 5
31 sl6 6
32 sl7 7
33 sl8 8
34
35 # Draw the frets over the strings
36 sovf False
37
38 # Add a note
39 notes <6,0>
40 nx<6,0> shape=circle,draw=red,text=white,fill=red,inner sep=1.5
41 nl<6,0> {\scriptsize A}
42 # I want this note to be drawn on fret 0 (nut)
43 onf0 True

```

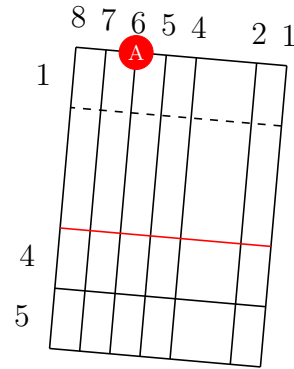


Figure 6: Instrument with 8 strings and 5 frets with a fret and a string missing

Run `lualatex --shell-escape custom.instrument.tex` after saving source

below as `custom.instrument.tex` to get output on the right:

```

1 \documentclass[12pt,letterpaper]{article}
2 \usepackage{fretplot}
3 \usepackage{float} % for [H] placement specifier in figures
4
5 \begin{document}
6
7 \begin{figure}[H]
8 \centering
9 \fptotikz{include/custom.instrument/src.fp}
10 \caption{Instrument with 8 strings and 5 frets with a fret and a string missing}
11 \end{figure}
12
13 \end{document}

```

## 4 The fretplot scale style file format

A *fretplot scale style file*, *fps file*, or `.fps` file customizes the appearance and labels of notes in a scale, based on pitch class or degree.

### 4.1 Syntax

- A *pitch class* is any element of the set

`{C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B}.`

- A *degree* is any element of the set

`{1, b2, 2, b3, 3, 4, b5, 5, b6, 6, b7, 7}.`

- Each line assigns a style or label to a pitch class or degree:
  - Label based on pitch class: `1PITCHCLASS LABEL.`
  - Label based on degree: `1DEGREE LABEL.`
  - PGF/TikZ style based on pitch class: `xPITCHCLASS STYLE.`
  - PGF/TikZ style based on degree: `xDEGREE STYLE.`

### 4.2 An example

```
1 1C {\scriptsize C}
2 1C# {\tiny C$\sharp$}
3 1D {\scriptsize D}
4 1Eb {\tiny E$\flat$}
5
6 xC shape=circle,draw=red,text=blue,fill=white,inner sep=1.0
7 xC# shape=circle,draw=red,text=blue,fill=white,inner sep=1.0
8
9 11 {\scriptsize 1}
10 1b2 {\tiny $\flat$2}
11
12 x1 shape=circle,draw=red,text=white,fill=red,inner sep=1.0
13 xb2 shape=circle,draw=red,text=blue,fill=white,inner sep=1.0
```