

The `ddphonism` package*

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Abstract

This is a music-related package focused on notation from the Twelve-Tone System, also called Dodecaphonism. It provides \LaTeX algorithms that produce typical dodecaphonic diagrams based off a musical series, or row sequence, of variable length.

Keywords

twelve tone system, dodecaphonism, music, mathematics, matrix, row, series, diagram, clock diagram, notation, algorithm, schoenberg, contemporary music, 20th century

Contents

1	Introduction	1
2	Using the <code>ddphonism</code> package	2
3	The package code	6

1 Introduction

There are hundreds of music tools and software online which are able to produce different music notations. However, I have never seen a \LaTeX tool that can do the same. This package is not only about notation, but it also calculates mathematically how this notation should work.

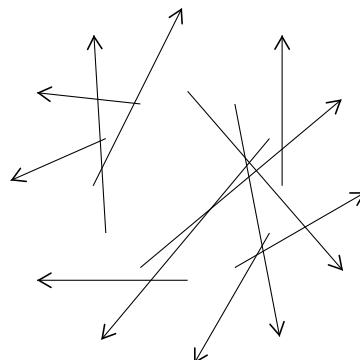
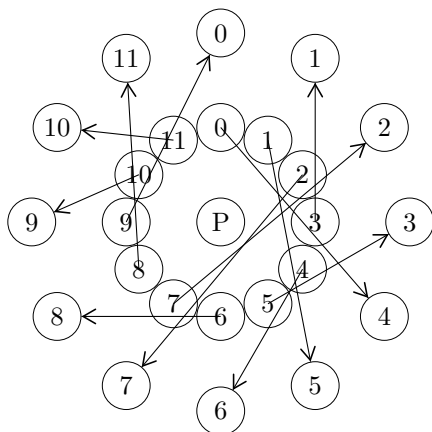
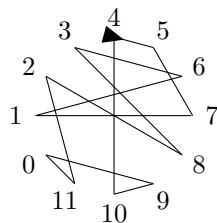
It is said that a twelve-tone matrix is the only thing a twelve-tone composer should need, because it provides the whole serial spectrum with which they may work. I wanted \LaTeX users to be able to generate them automatically.

But I also think that a twelve-tone matrix is not enough, that there exist several other notations with which they may understand their series and its potential. These are the diagrams that can be obtained with this package.

*This document corresponds to `ddphonism` v0.2, dated 2019/08/10.

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0	1	2	3	4
4	0	1	2	3
3	4	0	1	2
2	3	4	0	1
1	2	3	4	0



$$\begin{pmatrix} 0 & 1 & 2 & 3 & 4 \\ 4 & 3 & 2 & 1 & 0 \end{pmatrix}$$

2 Using the **ddphonism** package

These are the commands provided by **ddphonism**. The main parameter in every command is the row sequence.

`\dmatrix` produces a twelve-tone matrix of arbitrary length, as shown in this website. For example, `\dmatrix{0,2,1,4,3,6,5}` produces the matrix

0	2	1	4	3	6	5
5	0	6	2	1	4	3
6	1	0	3	2	5	4
3	5	4	0	6	2	1
4	6	5	1	0	3	2
1	3	2	5	4	0	6
2	4	3	6	5	1	0

`sep` scales the matrix.

`vsep` scales the matrix vertically.

`hsep` scales the matrix horizontally.

`lines` draws lines between rows and columns.

`outside lines` only draws the outside lines.

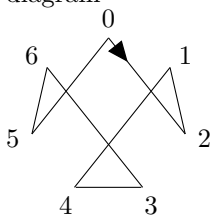
inside lines only draws the inside lines.
vlines lines only draws the vertical lines.
hlines lines only draws the horizontal lines.

`\dmatrix[lines,sep=0.75]{0,2,1,4,3,6,5}` produces the matrix

0	2	1	4	3	6	5
5	0	6	2	1	4	3
6	1	0	3	2	5	4
3	5	4	0	6	2	1
4	6	5	1	0	3	2
1	3	2	5	4	0	6
2	4	3	6	5	1	0

`no tikz` deletes the tikz environment and lets the user write it instead.

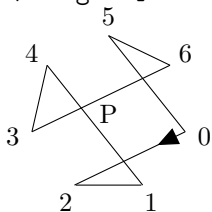
`\ddiagram` produces a twelve tone clock diagram of arbitrary length, as shown in this website. For example, `\ddiagram{0,2,1,4,3,6,5}` produces the diagram



`name` lets the user write a name at the center of the diagram.

`up` lets the user choose which number is up north. The default value is the first number in the row.

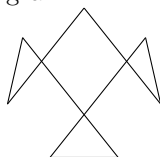
`\ddiagram[name=P, up=5]{0,2,1,4,3,6,5}` produces the diagram



`no numbers` deletes the numbers around the diagram.

`no arrow` deletes the arrow inside the diagram.

`\ddiagram[no numbers, no arrow]{0,2,1,4,3,6,5}` produces the diagram



`xshift` lets the user shift the figure horizontally.
`yshift` lets the user shift the figure vertically.
`no tikz` deletes the `tikz` environment and lets the user write it instead.
The option `up` does not work anymore and the `up` position becomes 0. It is recommended that the user passes the option `ddiagram` to the environment:

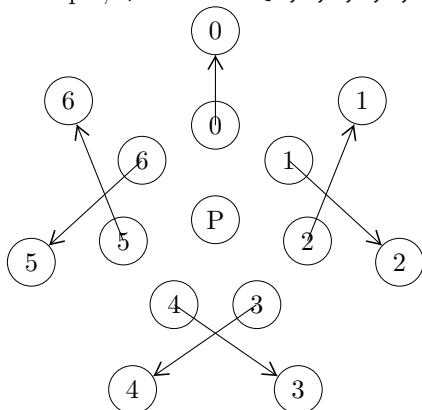
```

\begin{tikzpicture}[ddiagram]
\ddiagram[no tikz]{0,2,1,4,3,6,5}
\end{tikzpicture}

```

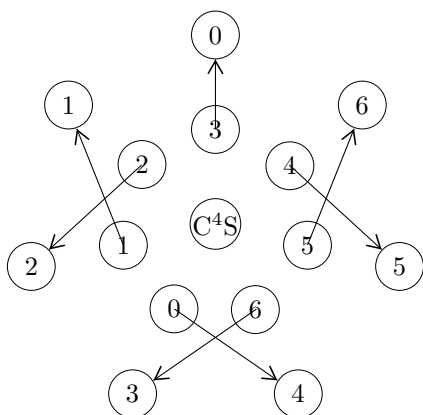
produces the same diagram as `\ddiagram{0,2,1,4,3,6,5}`.

`\ddihedral` produces a dihedral representation of a series of arbitrary length. For example, `\ddihedral{0,2,1,4,3,6,5}` produces the diagram



`t` lets the user apply the transformation *transposition* to the diagram.
`s` lets the user apply the transformation *inversion* to the diagram.
`c` lets the user apply the transformation *cyclic shift* to the diagram.
`v` lets the user apply the transformation *retrograde* to the diagram.
The transformations are applied in that exact order.

`\ddihedral[s=1, c=4]{0,2,1,4,3,6,5}` produces the diagram

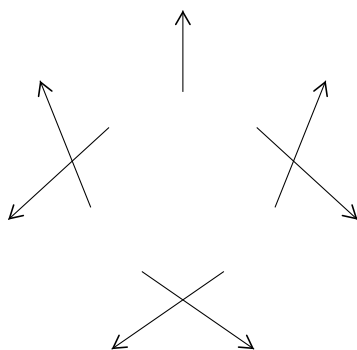


`no tikz` deletes the `tikz` environment and lets the user write it instead. It is recommended that the user passes the option `ddihedral` to the environment:

```
\begin{tikzpicture}[ddihedral]
\ddihedral[no tikz]{0,2,1,4,3,6,5}
\end{tikzpicture}
```

produces the same diagram as `\ddihedral{0,2,1,4,3,6,5}`.

`\darrows` produces the arrows from the `\ddihedral` diagram. For example, `\darrows{0,2,1,4,3,6,5}` produces the arrows



`no tikz` deletes the `tikz` environment and lets the user write it instead.

`\drow` produces a twelve-tone row sequence as a permutation in its matrix form. For example, `\drow{0,2,1,4,3,6,5}` produces the row

$$\begin{pmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ 0 & 2 & 1 & 4 & 3 & 6 & 5 \end{pmatrix}$$

`sep` lets the user choose the column separation.

`\drow[sep=10pt]{0,2,1,4,3,6,5}` produces the row

$$\begin{pmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ 0 & 2 & 1 & 4 & 3 & 6 & 5 \end{pmatrix}$$

3 The package code

```

1  % ddphonism
   %
3  % (c) Celia Rubio Madrigal
   %
5  %% This program can be redistributed and/or modified under the terms
   %% of the LaTeX Project Public License Distributed from CTAN archives
7  %% in directory macros/latex/base/lppl.txt.

9  \NeedsTeXFormat{LaTeX2e}
   \ProvidesPackage{ddphonism}
11 [2019/08/10 v0.2 Dodecaphonic diagrams: twelve—tone matrices, clock diagrams, etc.]

13 \RequirePackage{etoolbox}
   \RequirePackage{xparse}
15 \RequirePackage{tikz}
   \RequirePackage{xstring}
17 \RequirePackage{pgfkeys}

19
   %%%%%%%%%%%
21 % Matrices

23 \usetikzlibrary {matrix}

25 \ExplSyntaxOn
   \DeclareExpandableDocumentCommand{\Evaluation}{m}{\int_eval:n {#1}}
27 \ExplSyntaxOff

29 \newcounter{Dsize}
   \newcommand{\DsizeMake}[1]{%
31   \setcounter{Dsize}{0}%
   \foreach \n in {#1}{%
33     \stepcounter{Dsize}%
   }%
35 }

37 % Only with numbers.
   \newcounter{Dfirst}
39 \newcommand{\DheadMake}[1]{%
   \setcounter{Dfirst}{-1}%
41   \foreach \n in {#1}{%
   \ifnum\theDfirst=-1%
43     \setcounter{Dfirst}{\n}%
   \fi %
45   }%
   }

47 % Only when DsizeMake is already done.
49 \newcounter{Dmod}

```

```

\newcommand{\Modulo}[1]{%
51   \setcounter{Dmod}{#1}%
    \loop%
53     \ifnum\theDmod>\Evaluation{\theDsize-1}%
        \setcounter{Dmod}{\Evaluation{\theDmod-\theDsize}}%
55     \repeat%
    \ifnum\theDmod<0%
57     \setcounter{Dmod}{\Evaluation{\theDmod+\theDsize}}%
        \repeat%
59   \theDmod%
}

61
\newif\ifdmatrixLines
63 \newif\ifdmatrixOutside
\newif\ifdmatrixInside
65 \newif\ifdmatrixV
\newif\ifdmatrixH
67 \newif\ifdmatrixTikz
\pgfkeys{
69   /dmatrix/.is family
    , /dmatrix
71   , default/.style =
      { lines = false
73       , outside lines = false
        , inside lines = false
75       , sep = 1
        , vsep = 1
77       , hsep = 1
        , no tikz = false
79       }
    , no tikz/.is if=dmatrixTikz
81   , lines/.is if=dmatrixLines
    , outside lines/.is if=dmatrixOutside
83   , inside lines/.is if=dmatrixInside
    , vl原因es/.is if=dmatrixV
85   , hlines/.is if=dmatrixH
    , sep/.estore in=\dmatrixSep
87   , vsep/.estore in=\dmatrixVsep
    , hsep/.estore in=\dmatrixHsep
89 }

91 \newcommand{\DLOH}{%
    \draw (0.05*\dmatrixSep*\dmatrixHsep,0) --%
93   (\theDsize*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,0);%
    \draw (0.05*\dmatrixSep*\dmatrixHsep,-\theDsize*0.5*\dmatrixSep*\dmatrixVsep) -- %
95   (\theDsize*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,-\theDsize*0.5*\dmatrixSep*\dmatrixVsep);%
}

97
\newcommand{\DLOV}{%
99   \draw (0.05*\dmatrixSep*\dmatrixHsep,0) -- %
    (0.05*\dmatrixSep*\dmatrixHsep,-\theDsize*0.5*\dmatrixSep*\dmatrixVsep);%
101   \draw (\theDsize*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,0) -- %
    (\theDsize*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,-\theDsize*0.5*\dmatrixSep*\dmatrixVsep);
103 }

105 \newcommand{\DLIH}{%
    \draw (0.05*\dmatrixSep*\dmatrixHsep,-\xD*0.5*\dmatrixSep*\dmatrixVsep) -- %

```

```

107      (\theDsize*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,-\xD*0.5*\dmatrixSep*\dmatrixVsep);%
109    }
110    \newcommand{\DLIV}{%
111      \draw (\xD*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,0) -- %
112      (\xD*\dmatrixSep*\dmatrixHsep+0.05*\dmatrixSep*\dmatrixHsep,-\theDsize*0.5*\dmatrixSep*\dmatrixVsep);%
113    }
114
115    \newcommand{\dmatrix}[2][]{%
116      \DsizeMake{#2}%
117      \DheadMake{#2}%
118      %
119      \pgfkeys{/dmatrix, default, #1}%
120      %
121      \ifdmatrixTikz \else %
122        \begin{tikzpicture} %
123          \fi %
124          \foreach [count=\nj] \j in {#2} {%
125            \foreach [count=\ni] \i in {#2} {%
126              \draw node at
127                ( \ni*\dmatrixSep*\dmatrixHsep-0.5*\dmatrixSep*\dmatrixHsep
128                  , -\nj*\dmatrixSep*\dmatrixVsep/2+0.25*\dmatrixSep*\dmatrixVsep) {%
129                  \Modulo{\Evaluation{\i-\j+\theDfirst}}}%
130                };%
131            }%
132          }%
133          \foreach \xD in {1,...,\Evaluation{\theDsize-1}} {%
134            \ifdmatrixLines
135              \DLOH\DLOV\DLIH\DLIV
136            \fi
137            \ifdmatrixOutside
138              \DLOH\DLOV
139            \fi
140            \ifdmatrixInside
141              \DLIH\DLIV
142            \fi
143            \ifdmatrixH
144              \DLOH\DLIH
145            \fi
146            \ifdmatrixV
147              \DLOV\DLIV
148            \fi
149          }%
150          %
151          \ifdmatrixTikz \else %
152            \end{tikzpicture} %
153          \fi %
154        }
155      }
156
157      %%%%%%%%%%%
158      % Diagrams
159
160      \usetikzlibrary {shapes,arrows,decorations.markings,shapes.misc}
161
162      \tikzstyle ddiagramArrow=[decoration=
163        {markings,mark=at position 0.25 with

```



```

165         {\arrow[scale=1.25,>=triangle 45]{>}}},
        postaction={decorate}}

167 \tikzstyle {ddiagram}=[minimum height=0pt,inner sep=0pt,outer sep=0pt,scale=0.65]

169 \newif\ifddiagramTikz
170 \newif\ifddiagramNum
171 \newif\ifddiagramArr
172 \pgfkeys{
173     /ddiagram/.is family
174     , /ddiagram
175     , default/.style =
176     { name =\empty%
177     , up =\empty%
178     , no tikz = false
179     , no numbers = false
180     , no arrow = false
181     , xshift = 0
182     , yshift = 0
183     }
184     , no tikz/.is if=ddiagramTikz
185     , no numbers/.is if=ddiagramNum
186     , no arrow/.is if=ddiagramArr
187     , name/.estore in=\ddiagramName
188     , up/.estore in=\ddiagramUp
189     , xshift/.estore in=\ddiagramX
190     , yshift/.estore in=\ddiagramY
191 }

193 \newcounter{Dprev}
194 \newcommand{\Dvar}{}
195 \newcommand{\ddiagram}[2][]{%
196     \DsizeMake{#2}%
197     \DheadMake{#2}%
198     %
199     \pgfkeys{/ddiagram, default, #1}%
200     %
201     \ifdefequal {\ddiagramUp}{\empty}%
202     {\renewcommand{\Dvar}{\theDfirst}}% if empty
203     {\renewcommand{\Dvar}{\ddiagramUp}}% if not empty
204     %
205     \ifddiagramTikz\else%
206     \begin{tikzpicture}[ddiagram,rotate=360*\Dvar/\theDsize]%
207     \fi%
208     \foreach \x in {0,...,\ Evaluation{\theDsize-1}} {%
209         \ifddiagramNum\else
210         \node [xshift=\ddiagramX,yshift=\ddiagramY] at (90-360*\x/\theDsize:2) {\x};%
211         \fi
212         \node [xshift=\ddiagramX,yshift=\ddiagramY] (\x) at (90-360*\x/\theDsize:1.6) {};%
213     };%
214     %
215     \setcounter{Dprev}{-1}%
216     \foreach \x in {#2}{%
217         \ifnum \theDprev=\theDfirst%
218         \ifddiagramArr
219         \draw [xshift=\ddiagramX,yshift=\ddiagramY] (\theDprev) -- (\x);%
220         \else

```

```

221         \draw [ style =ddiagramArrow,xshift=\ddiagramX,yshift=\ddiagramY] (\theDprev) -- (\x);%
222         \fi
223         \else \ifnum \theDprev=-1 \else%
224         \draw [ xshift=\ddiagramX,yshift=\ddiagramY] (\theDprev) -- (\x);%
225         \fi \fi %
226         \setcounter{Dprev}{\x}%
227     };%
228     \draw [ xshift=\ddiagramX,yshift=\ddiagramY] (\theDprev) -- (\theDfirst);%
229     %
230     \ifdefequal {\ddiagramName}{\empty}%
231     {}% if empty
232     {\node [ xshift=\ddiagramX,yshift=\ddiagramY] at (0,0) [ circle , fill =white] {\ddiagramName};}% if not empty
233     \ifddiagramTikz\else%
234     \end{tikzpicture}%
235     \fi %
236 }
237
238 %%%%%%%%%%%%%%
239 % Dihedral diagrams
240
241 \tikzstyle ddihedralArrow=[decoration=
242 {markings,mark=at position 1 with {\arrow[ scale=1.5,>=angle 60]{>}}},
243 postaction={decorate}}
244
245 \tikzstyle {ddihedral}=[inner sep=0,minimum height=18pt]
246
247 \newif\ifddihedralTikz
248 \pgfkeys{
249 /ddihedral/.is family, /ddihedral,
250 default/.style = {t = 0, c = 0, s = 0, v = 0, no tikz=false},
251 no tikz/.is if=ddihedralTikz,
252 t/.estore in = \ddihedralT,
253 c/.estore in = \ddihedralC,
254 s/.estore in = \ddihedralS,
255 v/.estore in = \ddihedralV,
256 }
257
258 \newif\ifdarrowsTikz
259 \pgfkeys{
260 /darrows/.is family, /darrows,
261 default/.style = {no tikz=false},
262 no tikz/.is if=darrowsTikz,
263 }
264 \newcommand{\darrows}[2][{}]{%
265 \DsizeMake{#2}%
266 %
267 \pgfkeys{/darrows, default, #1}%
268 %
269 \ifdarrowsTikz\else%
270 \begin{tikzpicture}%
271 \fi %
272 \draw foreach \x in {0,...,\Evaluation{\theDsize-1}} {%
273 (90-360*\x/\theDsize:2.5) node[circle] (\x) {}%
274 };%
275 \foreach \x [count=\y] in {#2} {%
276 \draw [ style =ddihedralArrow] (90-360*\Evaluation{\y-1}/\theDsize:1.25) -- (\x);%

```

```

};%
279 \ifdarrowsTikz\else%
\end{tikzpicture}%
281 \fi%
}
283 \newcommand\ddihedral[2][]{%
285 \DsizeMake{#2}%
%
287 \pgfkeys{/ddihedral, default, #1}%
%
289 \ifddihedralTikz\else%
\begin{tikzpicture}[ddihedral]%
291 \fi%
\draw foreach \x in {0,...,\Evaluation{\theDsize-1}} {%
293 (\Evaluation{(90+\ddihedralT*360/\theDsize)+(2*\ddihedralS-1)*\x*360/\theDsize}:2.5)%
node[very thin, circle, draw] (\x) {\x}%
295 };%
%
297 \draw foreach \x in {0,...,\Evaluation{\theDsize-1}} {%
(\Evaluation{(90-\ddihedralC*360/\theDsize)+(2*\ddihedralV-1)*\x*360/\theDsize}:1.25)%
299 node[very thin, circle, draw] {\x}%
};%
%
301 \darrows[no tikz]{#2}%
303 %
\node at (0,0) [very thin, draw, circle, fill=white] {%
305 \ifnum\ddihedralV=0%
\ifnum\ddihedralC=0%
307 \ifnum\ddihedralS=0%
\ifnum\ddihedralT=0%
309 P%
\fi\fi\fi%
311 \else V\fi%
\ifnum\ddihedralC=0%
313 \else C^{\ddihedralC}$\fi%
\ifnum\ddihedralS=0%
315 \else S\fi%
\ifnum\ddihedralT=0%
317 \else T^{\ddihedralT}$\fi%
};%
319 \ifddihedralTikz\else%
\end{tikzpicture}%
321 \fi%
}
323
325 %%%%%%%%%%%%%%%
% Rows
327 \pgfkeys{
329 /drow/.is family, /drow,
default/.style={sep=arraycolsep},
331 sep/.estore in=\drowSep,
}
333 \long\def\addto#1#2{\expandafter\def\expandafter#1\expandafter{#1#2}}

```

```

335 \newcounter{myDDcntr}
    \newlength{\Dvarr}
337
    \newcommand{\drow}[2][{}]{%
339     \DsizeMake{#2}%
        %
341     \pgfkeys{/drow, default, #1}%
        \setlength{\Dvarr}{\arraycolsep}
343     \setlength{\arraycolsep}{\drowSep}
        %
345     \ifnum\theDsize=0%
        \ensuremath{\left(\right)}%
347     \else\ifnum\theDsize=1%
        \ensuremath{%
349         \left(\begin{array}{*{\theDsize}c}%
            0\,%
351             #2\,%
            \end{array}\right)%
353         }%
        \else%
355         \def\TableDDdata{}%
            \setcounter{myDDcntr}{0}%
357         \loop%
            \addto\TableDDdata{\themyDDcntr\stepcounter{myDDcntr} \&}%
359         \stepcounter{myDDcntr}%
            \ifnum\themyDDcntr<\Evaluation{\theDsize-1}%
361             \repeat%
            \addto\TableDDdata{\themyDDcntr \\\}%
363             \setcounter{myDDcntr}{0}%
            %
365             \ensuremath{%
                \left(\begin{array}{*{\theDsize}c}%
367                     \TableDDdata%
                    \StrSubstitute{#2}{,}{\&}\,%
369                     \end{array}\right)%
                }%
371             \fi\fi%
            \setlength{\arraycolsep}{\Dvarr}
373 }

375 \endinput

377
%% End of file 'ddphonism.sty'.

```