Humdrum melodic tools

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Project Proposal

- Due next Tuesday

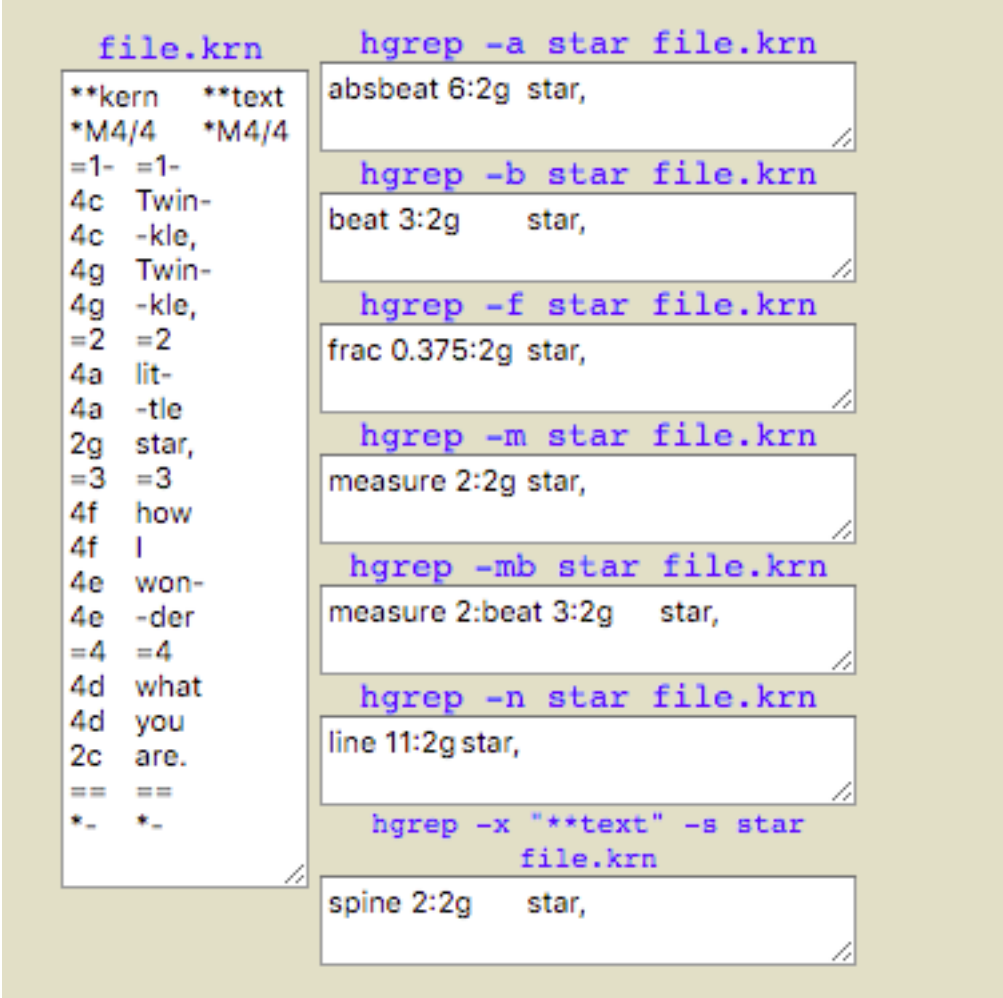
- ~ 2 pages:
  - What you want to do.
  - Literature search: similar projects in the past.
  - Background information.
  - How you are planning on proceeding.
  - What technology you are planning on using.

hgrep HE

"Humdrum GREP": grep program which knows about Humdrum file structure

Documentation: http://extras.humdrum.org/man/hgrep

-m: list measure number which match occurs in
-b: list beat number in measure which match occurs on
-a: list absolute quarter note
-f: list fractional position of match (-a option divided by duration of score)
-n: list line number of match



hgrep

- Identify which chorale has +P15 melodic leap:

```
humcat –s h://chorales | mint -s [_[]  | hgrep -Hm P15
chor024.krn:measure 2:+15   +P8   +m3   +M3
```

Or with pre-downloaded data:

```
mkdir chorales && cd chorales
humsplit h://chorales
humcat –s *.krn | mint -s [_[]  | hgrep -Hm P15
chor024.krn:measure 2:+15   +P8   +m3   +M3
```

Another variation, storing all chorales in one file:

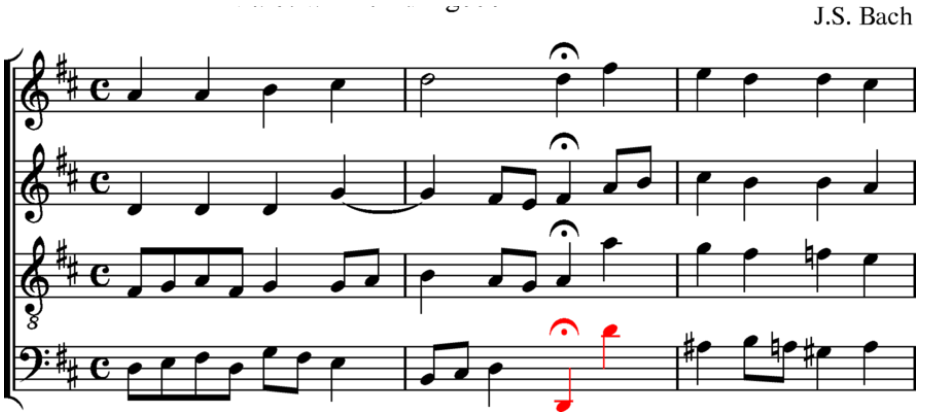
```
humcat -s h://chorales > chorales.krns
cat chorales.krns| mint -s [_[]  | hgrep -Hm P15
chor024.krn:measure 2:+15   +P8   +m3   +M3
```

myank HE

- pull out music around two-octave leap in bass part:

myank -m 1-3 h://chorales/chor024.krn

```
**kern    **kern    **kern    **kern
8DL       8F#L      4d        4a
8E        8G        .         .
8F#       8A        4d        4a
8DJ       8F#J      .         .
8GL       4G        4d        4b
8F#J      .         .         .
4E        8GL       [4g       4cc#
.         8AJ       .         .
=2        =2        =2        =2
8BBL      4B        4g]       2dd
8C#J      .         .         .
4D        8AL       8f#L      .
.         8GJ       8eJ       .
4DD;      4A;       4f#;      4dd;
4d        4a        8aL       4ff#
.         .         8bJ       .
=3        =3        =3        =3
4A#       4g        4cc#      4ee
8BL       4f#       4b        4dd
8AJ       .         .         .
4G#       4f        4b        4dd
4A        4e        4a        4cc#
=         =         =         =
*-        *-        *-        *-
```

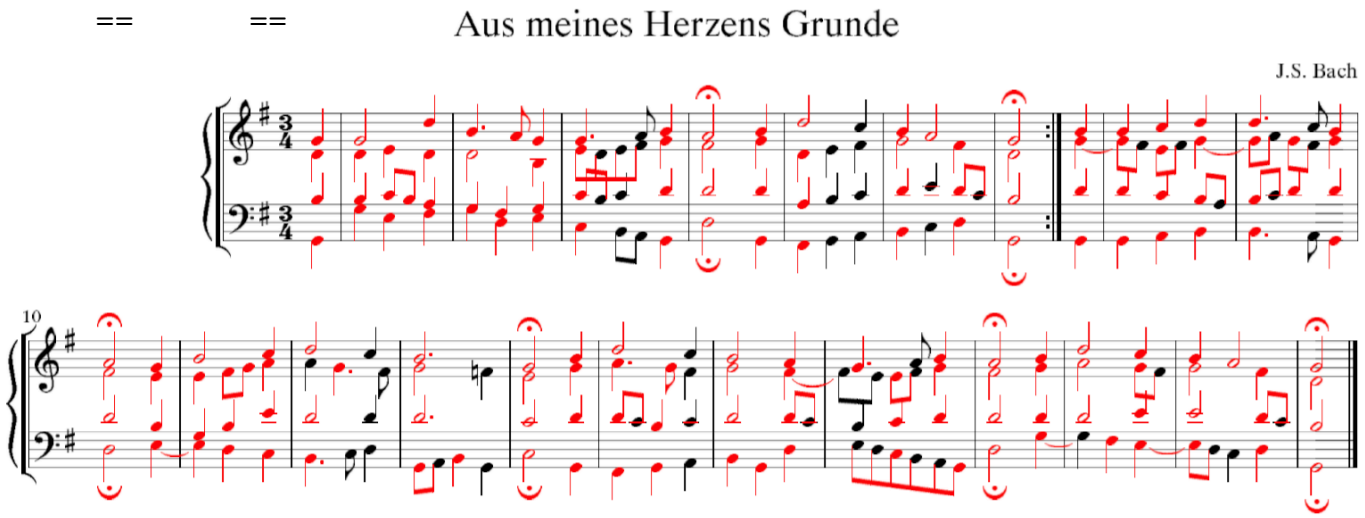


hgrep + tntype

Find and mark all triadic sonorities:

humcat -s h://chorales/chor001.krn | tntype -a | hgrep --mark 3-11

```
=20     =20     =20     =20     =20
8EL]@   2e@     2g@     4b@     3-11A
8DJ     .       .       .       4-26
4C      .       .       2a@     4-26
4D@     8dL@    4f#@    .       3-11B
.       8cJ     .       .       4-27B
=21     =21     =21     =21     =21
2GG;@   2B;@    2d;@    2g;@    3-11B
==      ==      ==      ==      ==
```



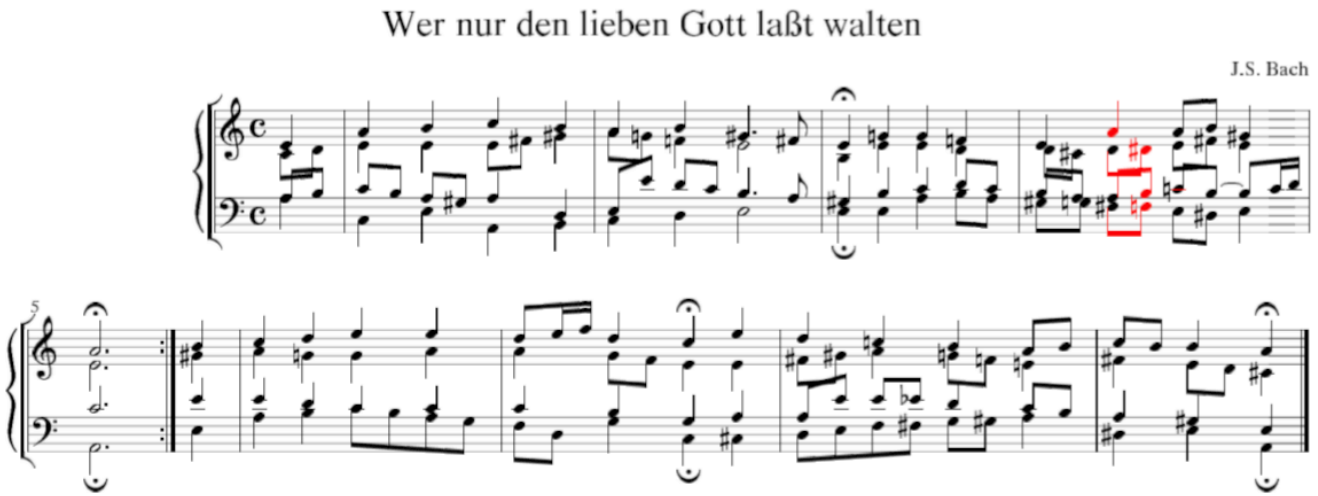
humcat -s h://chorales/chor001.krn | satb2gs | autostem | tntype -a | hgrep --mark 3-11 \
| hum2muse | muse2ps =z14j | ps2pdf -sPAPERSIZE=letter - - > output.pdf

hgrep + sonority

Find all French 6th sonorities in Bach chorales:

```
for i in *.krn
do
   sonority –a $i > $i.sonority
done
hgrep –Hm french *.sonority
```

chor146.krn.sonority:measure 4:8FnJ 8BJ 8d#J . french6:0:F




```
satb2gs chor146.krn | autostem | sonority -a  | hgrep --mark french | hum2muse \
   | muse2ps =z14j | ps2pdf -sPAPERSIZE=letter - - > output.pdf
```

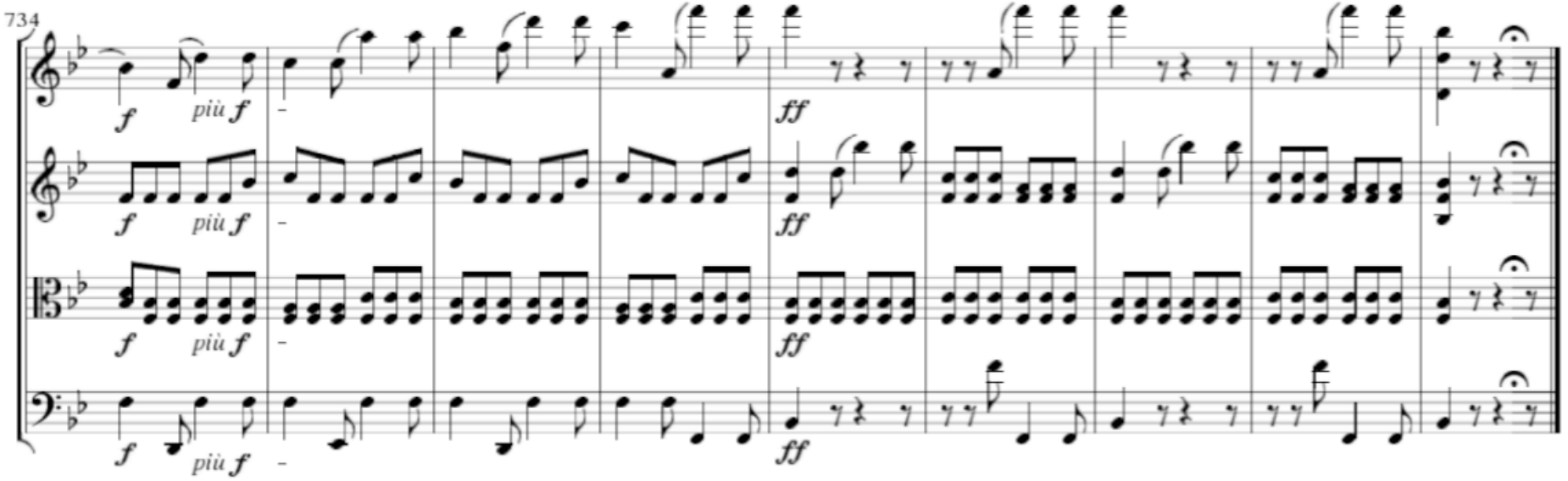
muse2ps

https://github.com/musedata/muse2ps

Documentation: http://muse2ps.ccarh.org

https://github.com/musedata/beethoven-quartets

http://wiki.ccarh.org/wiki/Beethoven_String_Quartets



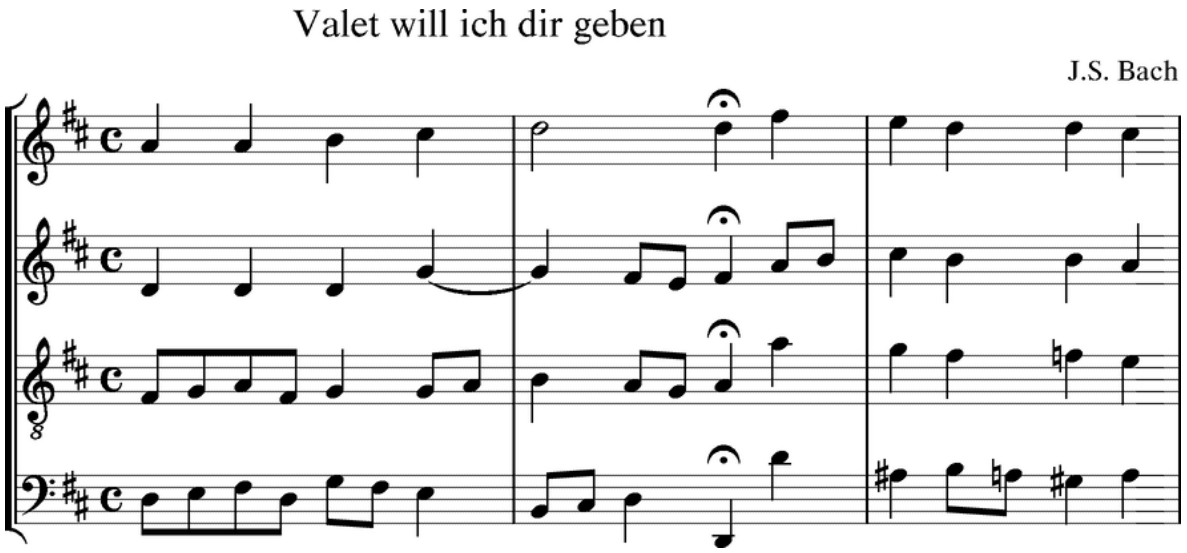
hum2muse[HE] / muse2ps

Make a PDF file:

```
myank  -m 1-3  h://chorales/chor024.krn | autostem | hum2muse | muse2ps =z18j \
    | ps2pdf –sPAPERSIZE=letter - - > output.pdf
```

Make a PNG image:

```
myank  -m 1-3  h://chorales/chor024.krn | autostem | hum2muse | muse2ps =z18j \
    | pstopnm –dpi=300 | convert - -trim –resize 50% output.png
```

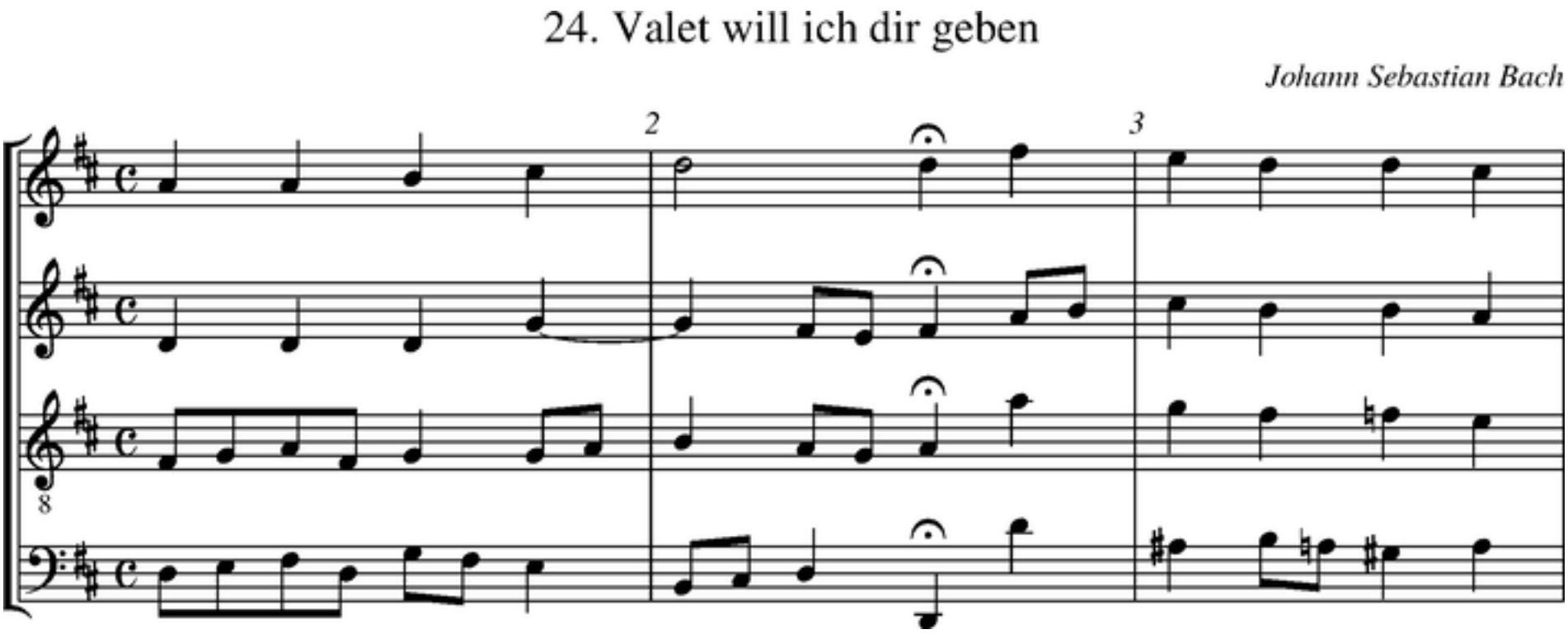


hum2abc / abcm2ps

http://extras.humdrum.org/man/hum2abc
http://moinejf.free.fr

```
myank  -m 1-3  h://chorales/chor024.krn | hum2abc –n1 | abcm2ps - -O -  \
    | ps2pdf –sPAPERSIZE=letter - - > output.pdf
```

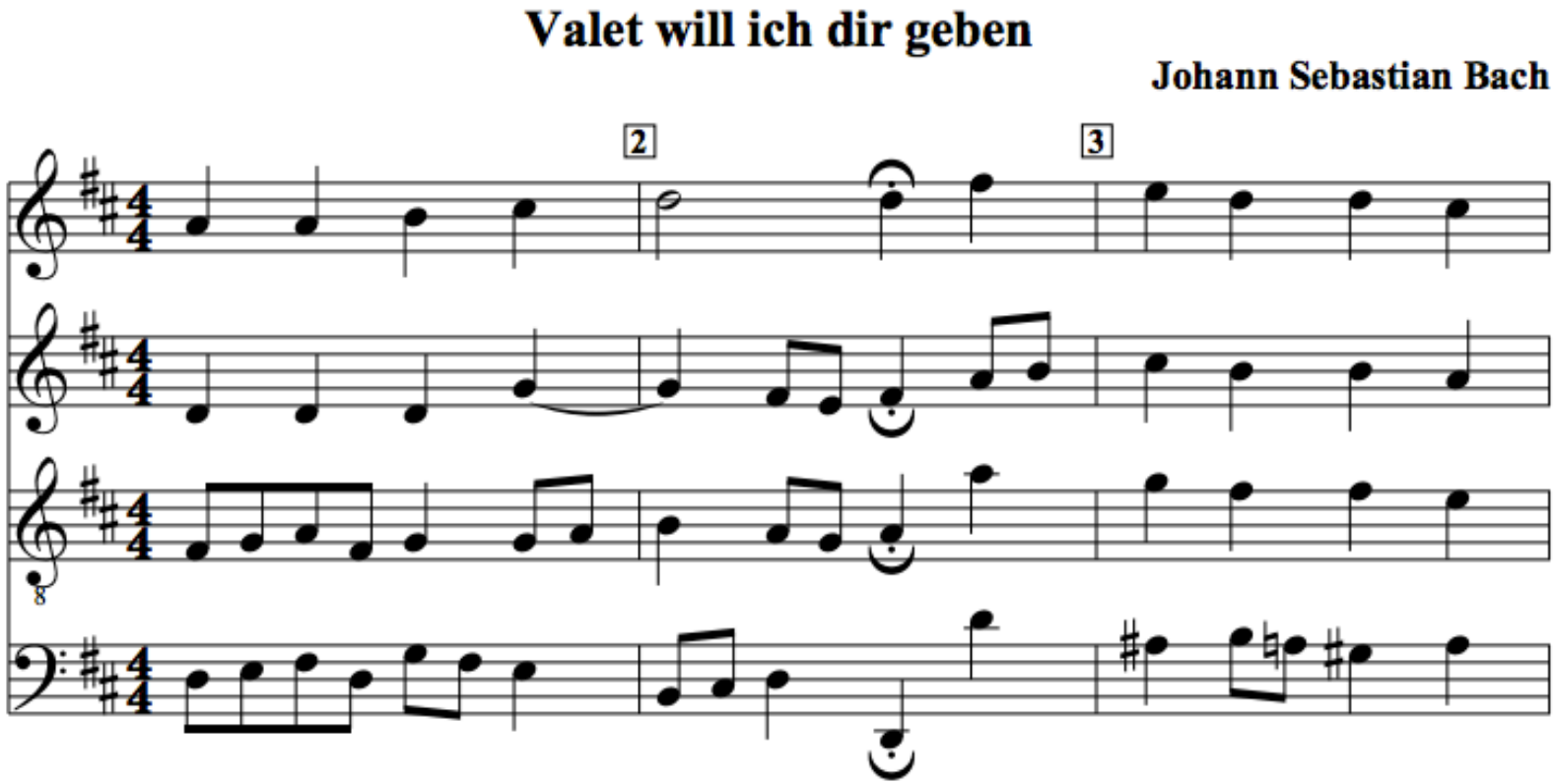
```
myank  -m 1-3  h://chorales/chor024.krn | hum2abc –n1 | abcm2ps - -O - \
    | pstopnm –dpi=300 | convert - -trim –resize 33% output.png
```



ms / mup

http://www.humdrum.org/Humdrum/commands/ms.html
http://www.arkkra.com

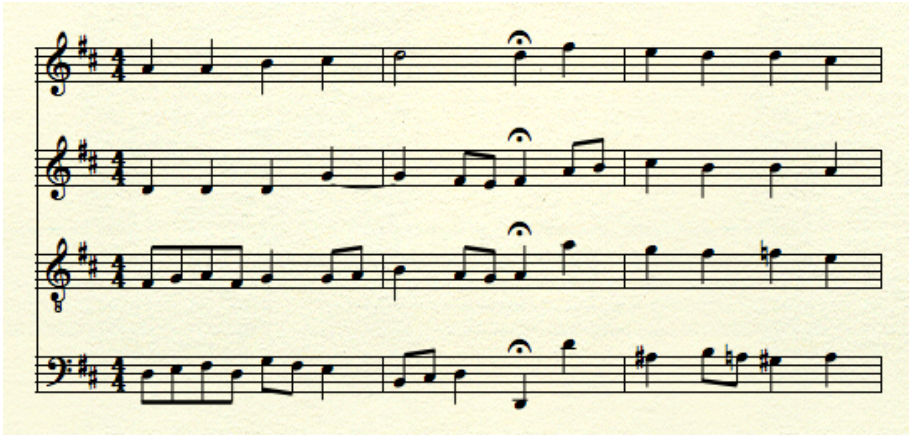
```
myank  -m 1-3  h://chorales/chor024.krn | ms | ps2pdf –sPAPERSIZE=letter - - > output.pdf

myank  -m 1-3  h://chorales/chor024.krn | ms -z | mup  \
    |  ps2pdf –sPAPERSIZE=letter - - > output.pdf
```



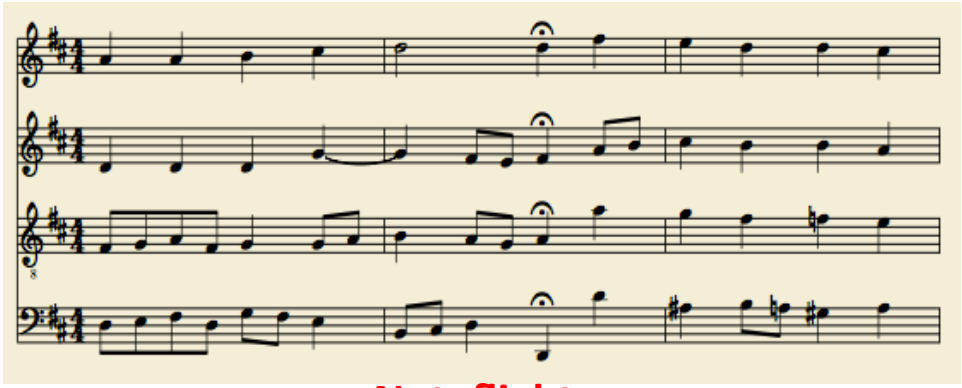
hum2xml / MuseScore | Finale | Sibelius | Noteflight

myank –m 1-3 h://chorales/chor024.krn | autostem | hum2xml > output.xml

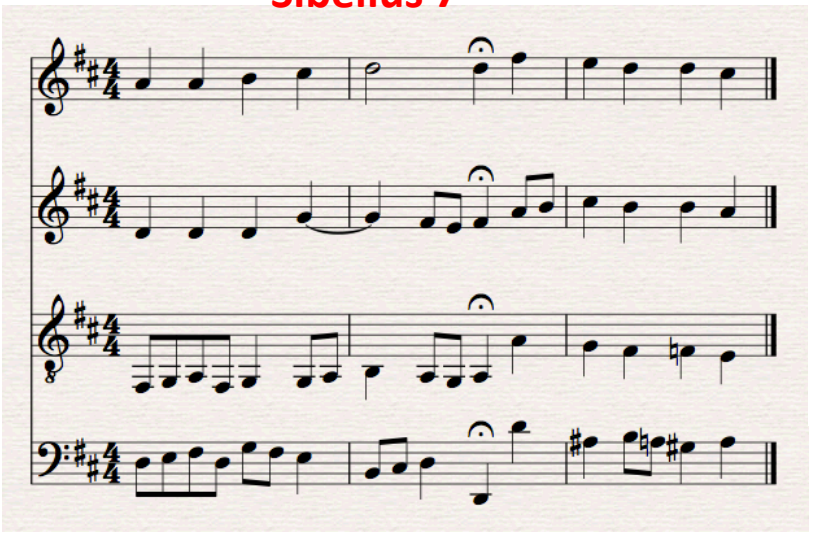
Finale 2012



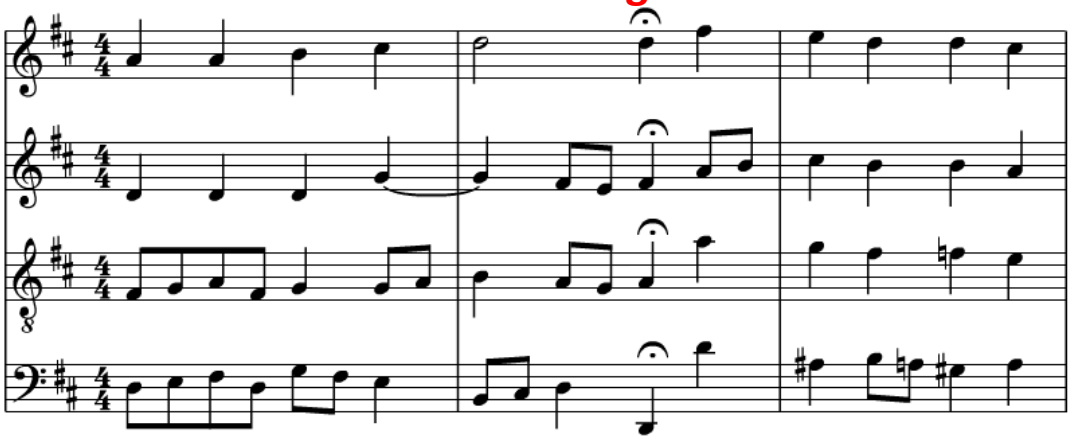
MuseScore 1.2



Sibelius 7



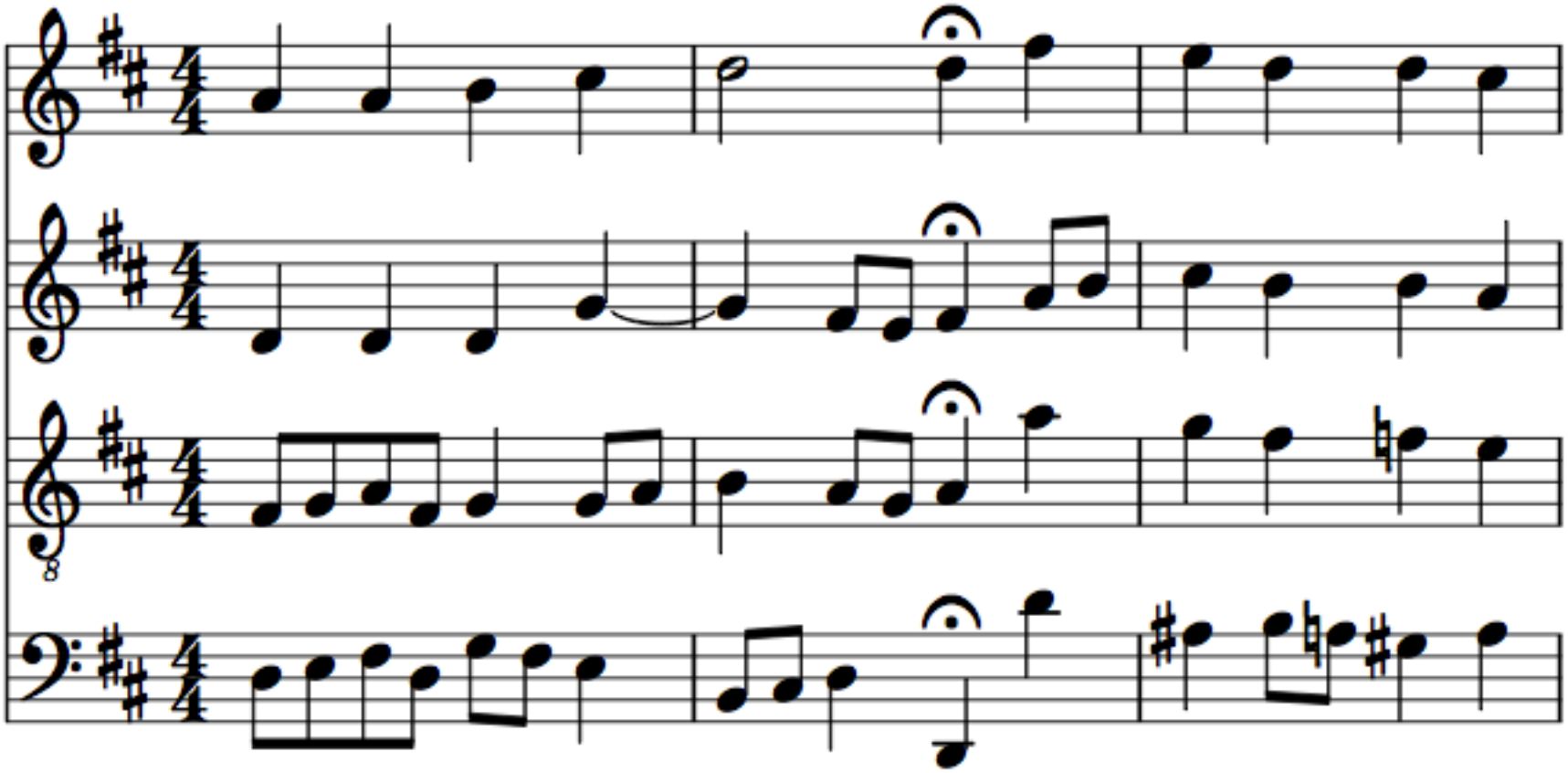
Noteflight



hum2xml / musicxml2ly / lilypond

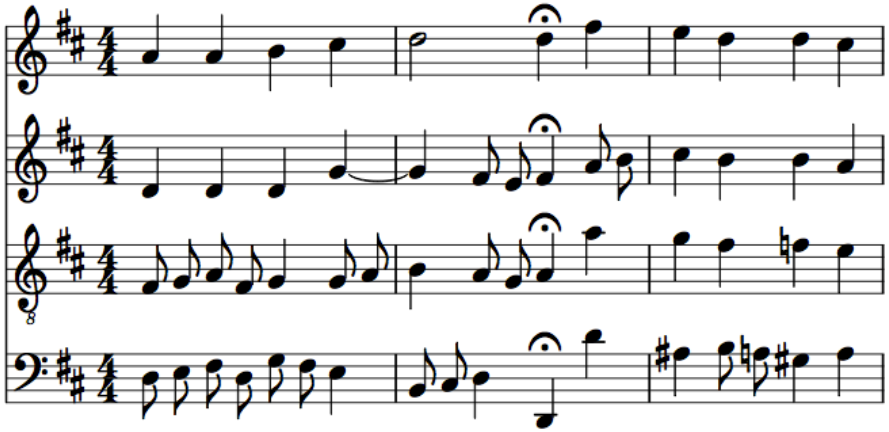
```
myank –m 1-3 h://371chorales/chor024.krn | hum2xml | musicxml2ly - -o- \
    | lilypond  -f pdf –o output
```

- *autostem* feature built into lilypond, so does not need to be used before converting

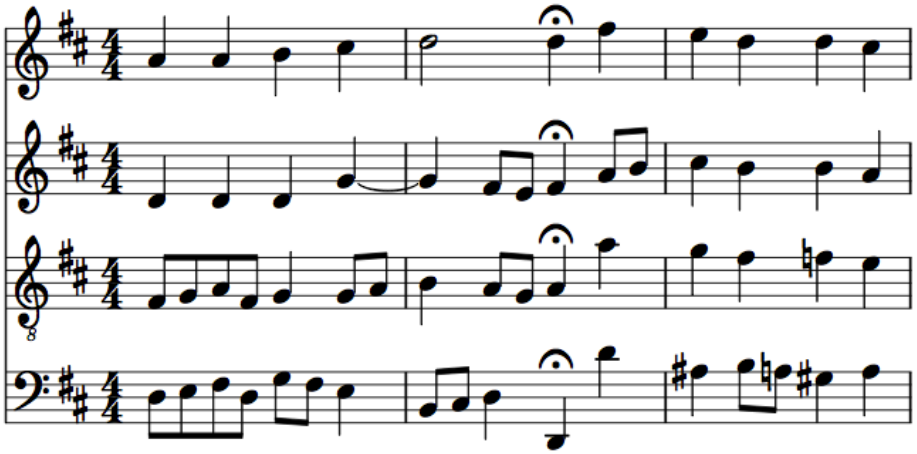


auto-beaming

myank –m 1-3 h://371chorales/chor024.krn | hum2xml | grep -v beam \
| musicxml2ly -o- - | lilypond -o output -



myank –m 1-3 h://371chorales/chor024.krn | hum2xml | grep -v beam \
| musicxml2ly --no-beaming -o- - | lilypond -o output -



Essen Folksongs

http://kern.ccarh.org/browse?l=/essen

scaletype

http://extras.humdrum.org/man/scaletype

Simple categorization of of scales by pitch classes used in a file:

- 8+ pitch classes: “chromatic”
- 7 pitch classes: “heptatonic”
- 6 pitch classes: “hexatonic”
- 5 pitch classes: “pentatonic”
- <5 pitch classes: “too few”

```
humcat –s h://folk/china > china.krns
humcat –s h://folk/germany > germany.krns

scaletype –F china.krns | sort | uniq -c | sort –nr
scaletype –F germany.krns | sort | uniq –c | sort -nr
```

Chinese songs

```
1096 pentatonic
 706 hexatonic
 282 heptatonic
 117 toofew
  40 chromatic
```

Germany songs

```
2558 heptatonic
1415 hexatonic
 842 chromatic
 434 pentatonic
 104 toofew
```

sortcount script

- PERL script to elaborate the pipeline:

  | sort | uniq –c | sort -nr

```
#!/usr/bin/perl
use strict;
use Getopt::Long;

my $alphabeticQ = 0;  # -a: sort output lines alphabetically
my $percentQ    = 0;  # -p: show counts as percentages
my $fractionQ   = 0;  # -f: show counts as fractions
my $totalQ      = 0;  # -t: show total count of input lines
my $smallQ      = 0;  # -s: sort by smallest numbers first
my $humdrumQ    = 0;  # -h: output data in Humdrum file format

Getopt::Long::Configure("bundling");
GetOptions (
    'a|alphabetic'       => \$alphabeticQ,
    'p|percent'          => \$percentQ,
    'f|fraction'         => \$fractionQ,
    't|totalQ'           => \$totalQ,
    's|smallQ'           => \$smallQ,
    'h|humdrum'          => \$humdrumQ,
);

my @contents = <>;

my (%unique, $line, @output, $sum, $key, @output2, $value, @keys);
```

sortcount (2)

```
foreach $line (@contents) {
   $unique{$line}++;
}
@keys = keys %unique;
@keys = sort @keys if $alphabeticQ;
foreach $key (@keys) {
   $sum += $unique{$key};
   $output[@output] = $key;
}
if    ($humdrumQ && $percentQ)  { print "**pcent\t**data\n"; }
elsif ($humdrumQ && $fractionQ) { print "**frac\t**data\n";    }
elsif ($humdrumQ)               { print "**count\t**data\n";   }

foreach $key (@keys) {
   if    ($percentQ)  { $value = int(10000.0*$unique{$key}/$sum + 0.5)/100.0; }
   elsif ($fractionQ) { $value = int(1000.0*$unique{$key}/$sum + 0.5)/1000.0; }
   else               { $value = $unique{$key}; }
   $output2[@output2] =  "$value\t$key";
}
if ($smallQ && !$alphabeticQ) {
   @output2 = sort { $a <=> $b } @output2;
} elsif (!$alphabeticQ) {
   @output2 = sort { $b <=> $a } @output2;
}
print join("", @output2);


print "*-\t*-\n" if $humdrumQ;
if ($totalQ) {
   print "!!" if $humdrumQ;
   print "TOTAL:\t$sum\n";
}
```

sortcount (3)

scaletype china.krns -F | sortcount -hpt

```
**pcent    **data
48.9       pentatonic
31.5       hexatonic
12.6       heptatonic
5.2        toofew
1.8        chromatic
*-         *-
!!TOTAL:   2241
```

scaletype germany.krns -F | sortcount -hpt

```
**pcent    **data
47.8       heptatonic
26.4       hexatonic
15.7       chromatic
8.1        pentatonic
1.9        toofew
*-         *-
!!TOTAL:   5353
```

scaletype –F h://pentatonic | sortcount –hpt

```
**pcent    **data
89.6       pentatonic
10.4       toofew
*-         *-
!!TOTAL:   67
```

Melodic searching

- search engine behind http://themefinder.com and http://jrp.ccarh.org

- **tindex**: generate thema search index — http://extras.humdrum.org/man/tindex
- **themax**: perform search on index — http://extras.humdrum.org/man/themax
- **theloc**: mark matches in original data — http://extras.humdrum.org/man/theloc

```
humcat –s h://folk/china > china.krns
humcat –s h://folk/germany > germany.krns

tindex china.krns > china.tindex
tindex germany.krns > germany.tindex
```

Searching by diatonic pitch name

themax -p "cdfga" china.tindex --total

humdrum://folk/china/han0028.krn::118 38
humdrum://folk/china/han0050.krn::140 67
humdrum://folk/china/han0124.krn::19 32
humdrum://folk/china/han0143.krn::125
humdrum://folk/china/han0200.krn::154
humdrum://folk/china/han0207.krn::176
humdrum://folk/china/han0245.krn::150
humdrum://folk/china/han0246.krn::192
humdrum://folk/china/han0323.krn::137
humdrum://folk/china/han0365.krn::143
humdrum://folk/china/han0386.krn::12
humdrum://folk/china/han0407.krn::124
15

themax -p "cdfga" germany.tindex --total

humdrum://folk/germany/deut0974.krn::1 49
humdrum://folk/germany/deut3227.krn::1 27
2

Location of matches

themax –p “cdefg” china.tindex –total –loc | head –n1 | theloc
humdrum://folk/china/han0028.krn::1 18=5B1-22=6B1.5 38=11B1-42=12B1.5

match from note 18 to 22, measure 5, beat 1 to measure 6 beat 1.5
and 38 to 42, measure 11 beat 1 to measure 12 beat 1.5

themax –p “cdefg” china.tindex –total –loc | head –n1 | theloc –m

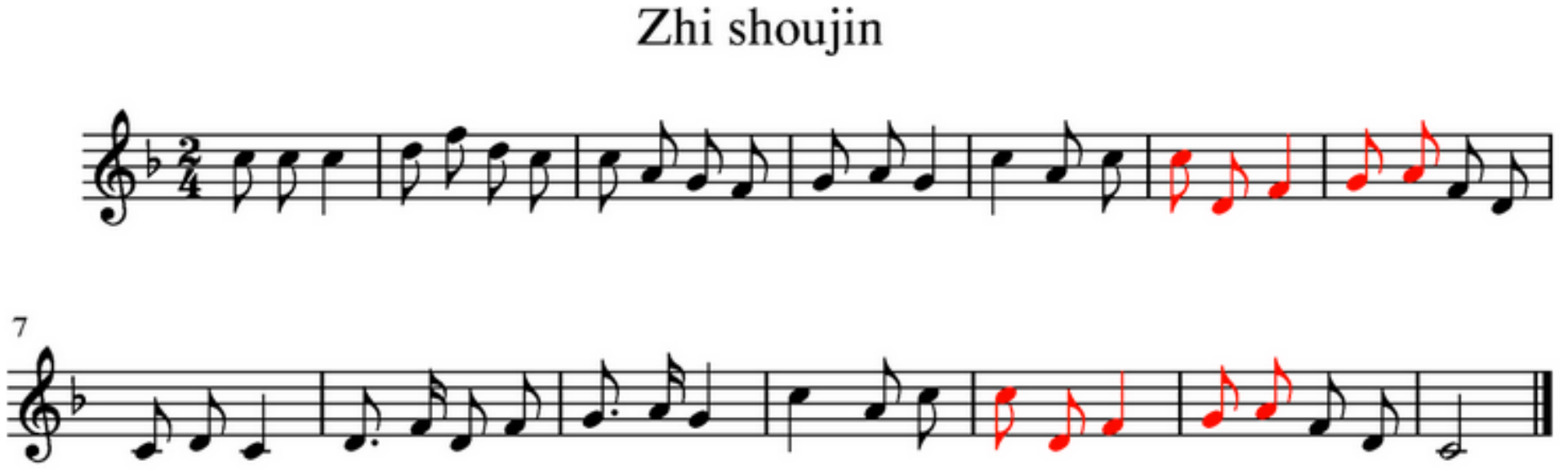
=5
8cc@
8d@
4f@
=6
8g@
8a@
8f
8d
=7

=11
8cc@
8d@
4f@
=12
8g@
8a@
8f
8d
=13

!!!RDF**kern: @= matched note

Display matched notes

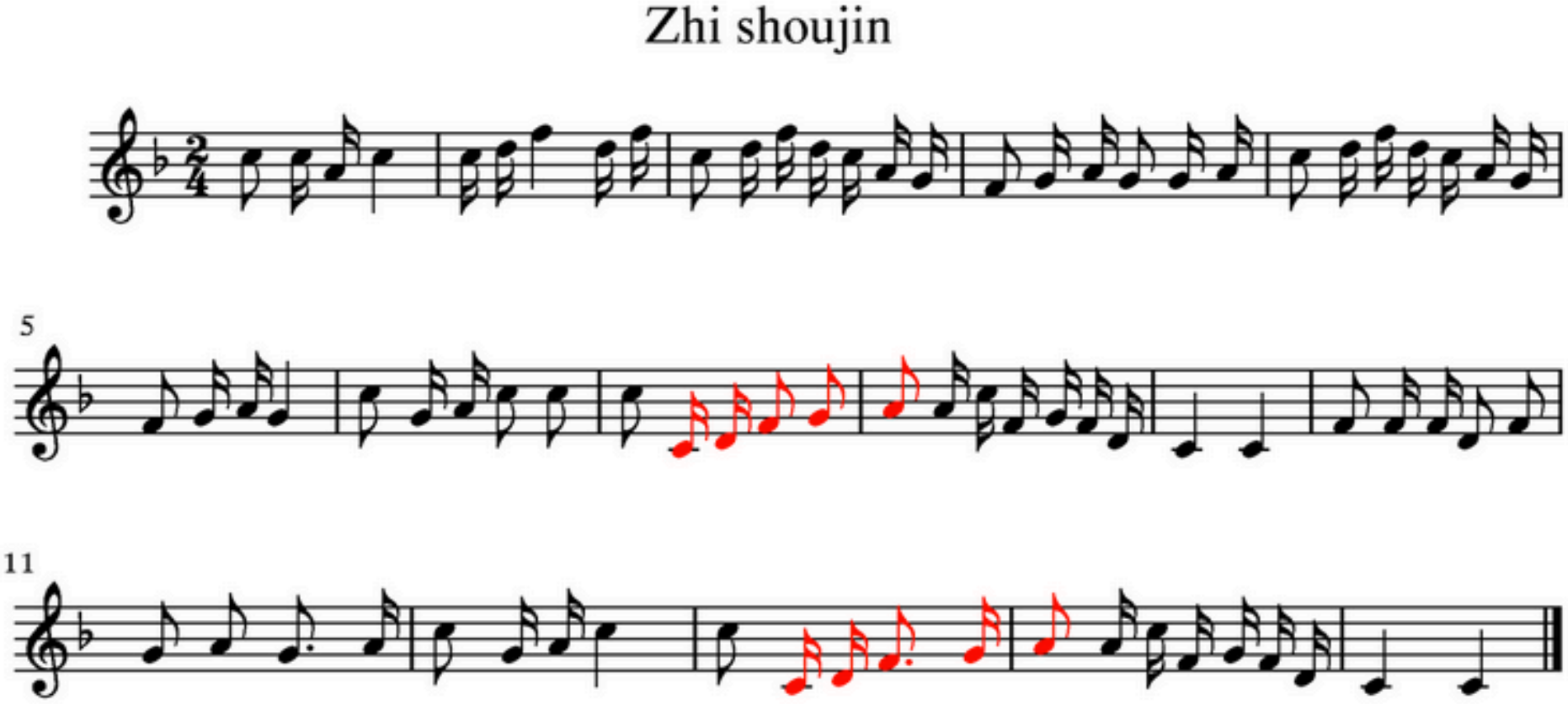
```
themax –p “cdefg” china.tindex --total --loc | head –n1 | theloc –m \
    | autostem | hum2muse  =z21j | muse2ps | pstopnm –dpi=300 \
    | convert - -trim –resize 50%  output.png
```



Parallel feature searching

- search for the pitch-class sequence “cdefg” where sequence always rises

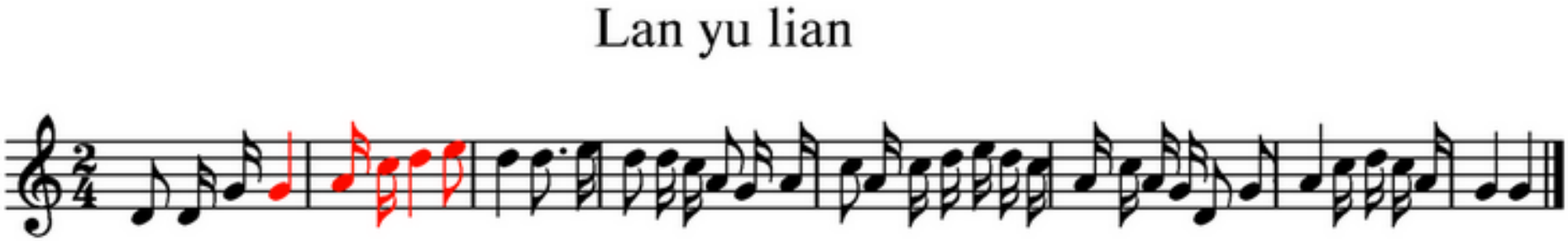
```
themax –p “cdefg” –C “uuuuu” china.tindex –total –loc | head –n1 | theloc –m \
    | autostem | hum2muse  =z21j | muse2ps | pstopnm –dpi=300 \
    | convert - -trim –resize 50%  output.png
```



Parallel feature searching (2)

- search for the semi-tone interval sequence +2 +3 +2 +2 starting on a “G”

```
themax –p “g” -I “+2 +3 +2 +2” china.tindex –total –loc | head –n1 | theloc –m \
    | autostem | hum2muse  =z21jc60 | muse2ps | pstopnm –dpi=300 \
    | convert - -trim –resize 50%  output.png
```



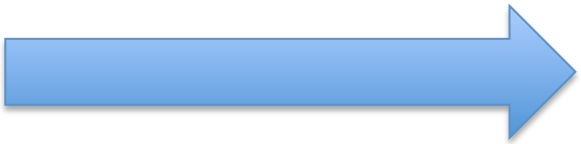
context

http://www.humdrum.org/Humdrum/commands/context.html

- Create lists of successive elements (n-grams)
- Raw data for generating transition probabilities (Markov chains)

```
**data
A
B
C
D
E
F
G
H
I
J
*-
```

context –n 3



```
**data
A B C
B C D
C D E
D E F
E F G
F G H
G H I
H I J
.
.
*-
```

Most common interval patterns

```
kern -x china.krns  | grep -v ^= | mint -s [_[] | grep -v [[] | context  -n 5  |  ridx -H \
    | grep -v r | sortcount -hpt | less
```

china.krns

```
0.32    -M2 -m3 -M2 +M2 +m3
0.23    +M2 -M2 -m3 -M2 +M2
0.22    -M2 +M2 +m3 -m3 -M2
0.22    +M2 -M2 -M2 -m3 -M2
0.22    -M2 +M2 -M2 -m3 -M2
0.22    +M2 +m3 -m3 -M2 -M2
0.22    -M2 +M2 -M2 -M2 -m3
0.21    +M2 +M2 -M2 -M2 -m3
0.21    +m3 +M2 -M2 -m3 -M2
0.2     -M2 +M2 -M2 +M2 -M2
0.19    -m3 -M2 +M2 -M2 -M2
0.19    -M2 -M2 -m3 +m3 +M2
0.19    -m3 -M2 +M2 +m3 -m3
0.19    +M2 -M2 -M2 -m3 +m3
0.18    -M2 -m3 +m3 -m3 -M2
0.17    +M2 +m3 -m3 -M2 -m3
0.17    +m3 -m3 -M2 -M2 +M2
0.17    +M2 -M2 +M2 -M2 +M2
0.16    -m3 -M2 -M2 +M2 +M2
0.16    -M2 -M2 +M2 +M2 -M2
```

germany.krns

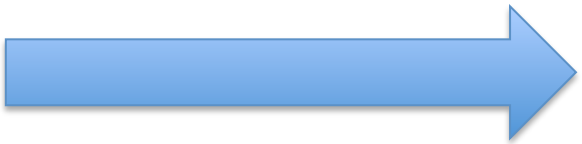
```
0.44     P1   P1   P1   P1   P1
0.33    -M2  -M2  -m2  -M2  -M2
0.30    +M2  -M2  -M2  -m2  -M2
0.22    +M2  +m2  -m2  -M2  -M2
0.22    +m3  -M2  -m2  -M2  -M2
0.20    +M2  +M2  -M2  -M2  -m2
0.20    +m2  +M2  +M2  -M2  -M2
0.19     P1  +M2  -M2  -M2  -m2
0.19    +M2  +M2  +m2  -m2  -M2
0.18    -M2  -m2  -M2  -M2  +M2
0.18    +m2  +M2  -M2  -m2  -M2
0.17     P1  -M2  -m2  -M2  -M2
0.16    +M2  -M2  -m2  -M2  -M2
0.16    -M2  -M2  -m2  +m2  +M2
0.16    -M2  -m2  -M2  -M2   P1
0.16    -M2  -M2  -m2  -M2  +M2
0.16    -m2  -M2  -M2  +M2  -M2
0.16    +M2  +m2  +M2  -M2  -m2
0.15     P1   P1  +M2  +M2  +m2
0.15    +M2  +m2  +M2  +M2  —M2
```

extract

http://www.humdrum.org/Humdrum/commands/extract.html

- extract one or more spines from a Humdrum file
- useful for pulling one or more parts out of a full score

```
**a     **b     **c
a1      b1      c1
a2      b2      c2
a3      b3      c3
a4      b4      c4
a5      b5      c5
a6      b6      c6
*-      *-      *-
```




```
**b
b1
b2
b3
b4
b5
b6
*-
```

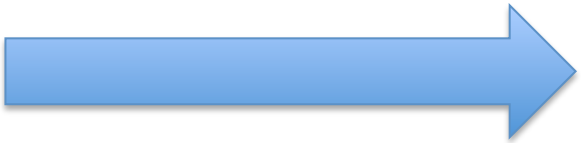
extract (2)

- -f # ➔ extract by field (column)
- -p # ➔ extract by spine (variable field count per line)
- -i **b ➔ extract all **b spines.

```
**a     **b     **c
a1      b1      c1
a2      b2      c2
*       *^      *
a3      b3      B1      c3
a4      b4      B2      c4
a5      b5      B3      c5
*       *v      *v      *
a6      b6      c6
*-      *-      *-
```

extract –p 2

extract –i **b



```
**b
b1
b2
*^
b3  B1
b4  B2
b5  B3
*v  *v
b6
*-
```

Bach chorale melodic patterns

rest/fermata boundaries excluded:

```
extractx -g bass chorales.krns | sed 's/;/ r/g' | serialize -c | mint -s [_[] | egrep -v [=[]  \
    | context -n 5 | grep -v r | ridx -H | sortcount –pht
```

most common bass melodic patterns

```
0.89%    -M2 -M2 -m2 -M2 -M2
0.70     -M2 -M2 -m2 -M2 +M2
0.62     -M2 -m2 -M2 -M2 -m2
0.61     -m2 -M2 -M2 -M2 -m2
0.57     -m2 -M2 -M2 -m2 -M2
0.53     +M2 +m2 -m2 -M2 -M2
0.48     -M2 -m2 -M2 +M2 +m2
0.46     -m2 -M2 -M2 +M2 +M2
0.43     -m2 -M2 +M2 +m2 +M2
0.42     -M2 -m2 -M2 -m2 +m2
0.41     +M2 +M2 +m2 +M2 +M2
0.40     -m2 -M2 -M2 -m2 +m2
0.40     +M2 +M2 +m2 -m2 -M2
0.37     -M2 -M2 +M2 +M2 +m2
0.37     +M2 +m2 +M2 +M2 +m2
0.37     +M2 +m2 -P5 +M2 -P5
0.34     -M2 -m2 +m2 -m2 -M2
TOTAL: 13337
```

tenor

```
0.55%    +M2 +M2 -M2 -M2 -m2
0.39     -M2 -m2 -M2 +M2 +m2
0.36     -M2 -M2 -m2 -M2 +M2
0.36     -m2 -M2 +M2 +m2 +M2
0.35     +M2 +m2 -m2 -M2 -M2
0.30      P1 +M2 -M2 -M2 -m2
0.30     +M2 +M2 +m2 -m2 -M2
0.30     +m2 +M2 +M2 -M2 -M2
0.28     -M2 -M2 +M2 +M2 +m2
0.28     -M2 +M2 +M2 -M2 -M2
0.28     +m2 +M2 +M2 +m2 -m2
0.26     +M2 -M2 -M2 -m2 -M2
0.24     -M2 +M2 +m2 -m2 -M2
0.24     -M2 +M2 +m2 +M2 +M2
0.24     +M2 +M2 +m2 +M2 +M2
0.24     +m2 +M2 -M2 -m2 -M2
0.24      P1 -M2 -M2 +M2 +M2
TOTAL: 12662
```

Josquin bass melodic patterns

humcat –s h://jrp/Jos > josquin.krns

extractx -g Bassus josquin.krns | serialize -S | kern -x | mint -s [_[] | grep -v = \
| context -n 5 | ridx -H | grep -v r | sortcount –pht

most common Bassus melodic patterns

```
0.52%    -m2 -M2 -M2 -m2 -M2
0.47     -M2 -M2 -m2 -M2 -M2
0.39     +M2 +m2 -m2 -M2 -M2
0.37     -m2 -M2 -M2 +M2 -M2
0.35     +M2 +M2 +m2 +M2 +M2
0.33     +M2 +M2 +m2 -m2 -M2
0.33     +m2 -m2 -M2 -M2 +M2
0.32     +M2 -M2 -M2 -m2 -M2
0.31     -M2 -m2 -M2 -M2 +M2
0.31     -m2 -M2 -M2 -M2 -m2
0.28      P1  P1  P1  P1  P1
0.28     -M2 -m2 -M2 +M2 -M2
0.26     +m2 +M2 -M2 -m2 -M2
0.25     +M2 -M2 -m2 -M2 -M2
0.25     +M2 +M2 -M2 -M2 -m2
0.25     -m2 -M2 -M2 +M2 +M2
0.23     +M2 +m2 +M2 +M2 -P5
0.22     -M2 +M2 +M2 +m2 +M2
0.22     -M2 -M2 -m2 -M2 +M2
0.21     +M2 +M2 +m2 +M2 -M2
…
TOTAL: 67535
```

Bach chorale bass part

```
0.89%    -M2 -M2 -m2 -M2 -M2
0.70     -M2 -M2 -m2 -M2 +M2
0.62     -M2 -m2 -M2 -M2 -m2
0.61     -m2 -M2 -M2 -M2 -m2
0.57     -m2 -M2 -M2 -m2 -M2
0.53     +M2 +m2 -m2 -M2 -M2
0.48     -M2 -m2 -M2 +M2 +m2
0.46     -m2 -M2 -M2 +M2 +M2
0.43     -m2 -M2 +M2 +m2 +M2
0.42     -M2 -m2 -M2 -m2 +m2
0.41     +M2 +M2 +m2 +M2 +M2
0.40     -m2 -M2 -M2 -m2 +m2
0.40     +M2 +M2 +m2 -m2 -M2
0.37     -M2 -M2 +M2 +M2 +m2
0.37     +M2 +m2 +M2 +M2 +m2
0.37     +M2 +m2 -P5 +M2 -P5
0.34     -M2 -m2 +m2 -m2 -M2
TOTAL: 13337
```

Melodic intervals across fermata

```
extractx -g bass chorales.krns | sed 's/;/ r/'  \
   | kern -x | grep -v ^[0-9.]*r | serialize –c \
   | grep -v = | context -n 3 | ridx –H |  grep r \
   | egrep -v '^r|r$' | sed 's/ r /\t/' > fermata.krn
```

- Edit fermata.krn to add “**kern **kern” at top of file and “*- *-” at bottom of file (or write a script to do that).

```
hint –v fermata.krn| ridx -H | sortcount -pht
```

```
18.43%   P1
15.75   +P8
12.39   +P4
6.82    +P5
6.77    -m3
4.46    +M2
3.62    -P4
3.04    -m2
3.04    +M3
2.73    +A1
2.62    +M6
2.57    -M3
2.47    -M2
2.41    -P5
1.78    +m2
1.52    +m3
1.47    -P8
1.21    +m6
0.94    +m7
0.79    -d4
0.73    +M7
0.68    -d5
0.58    -m6
0.47    +A4
0.42    +M9
0.37    +A5
0.31    +M10
0.26    -m7
0.26    +A8
0.21    +P11
0.21    +P12
0.16    -M7
0.10    -M6
0.10    +m10
0.05    -M10
0.05    -M9
0.05    -m10
0.05    +P15
0.05    -d8

TOTAL:  1912
```

prange

prange h://371chorales

**keyno	**kern	**count
36	CC	28
37	CC#	2
38	DD	120
39	EE-	32
40	EE	140
41	FF	263
42	FF#	127
43	GG	976
44	GG#	163
45	AA	1459
46	BB-	796
47	BB	1268
48	C	1878
49	C#	833
50	D	3165
51	E-	905
52	E	2931
53	F	1966
54	F#	2089
55	G	3747
56	G#	1244
57	A	5112
58	B-	2188
59	B	3546
60	c	4014
61	c#	1790
62	d	6601
63	e-	1466
64	e	5656
65	f	3323
66	f#	3404
67	g	5332
68	g#	1268
69	a	4905
70	b-	1488
71	b	2890
72	cc	2230
73	cc#	1106
74	dd	2299
75	ee-	376
76	ee	948
77	ff	289
78	ff#	187
79	gg	109
80	gg#	1
81	aa	6
*-	*-	*-

!!tessitura: 45 semitones
!!mean: 60.8378 (c#)
!!median: 62 (d)

prange (2)

extractx –g bass h://371chorales | prange

**keyno	**ker n	**count
36	CC	28
37	CC#	2
38	DD	120
39	EE-	32
40	EE	140
41	FF	263
42	FF#	127
43	GG	976
44	GG#	163
45	AA	1459
46	BB-	796
47	BB	1268
48	C	1873
49	C#	831
50	D	3068
51	E-	870
52	E	2597
53	F	1506
54	F#	1468
55	G	1922
56	G#	573
57	A	1349
58	B-	410
59	B	482
60	c	250
61	c#	90
62	d	107
63	e-	5
64	e	3
*-	*-	*-

!!tessitura: 28 semitones
!!mean: 50.7806 (E-)
!!median: 51 (E-)

tenor

C	5
C#	2
D	97
E-	35
E	333
F	458
F#	618
G	1760
G#	663
A	3437
B-	1627
B	2589
c	2852
c#	1034
d	3230
e-	520
e	1685
f	535
f#	385
g	187
g#	17
a	18

!!tessitura: 21 semitones
!!mean: 59.2681 (B)
!!median: 59 (B)

alto

E	1
F	2
F#	3
G	65
G#	8
A	325
B-	150
B	475
c	870
c#	654
d	2900
e-	850
e	3341
f	2137
f#	2384
g	3184
g#	878
a	1934
b-	453
b	500
cc	124
cc#	71
dd	20

!!tessitura: 22 semitones
!!mean: 64.9064 (f)
!!median: 65 (f)

soprano

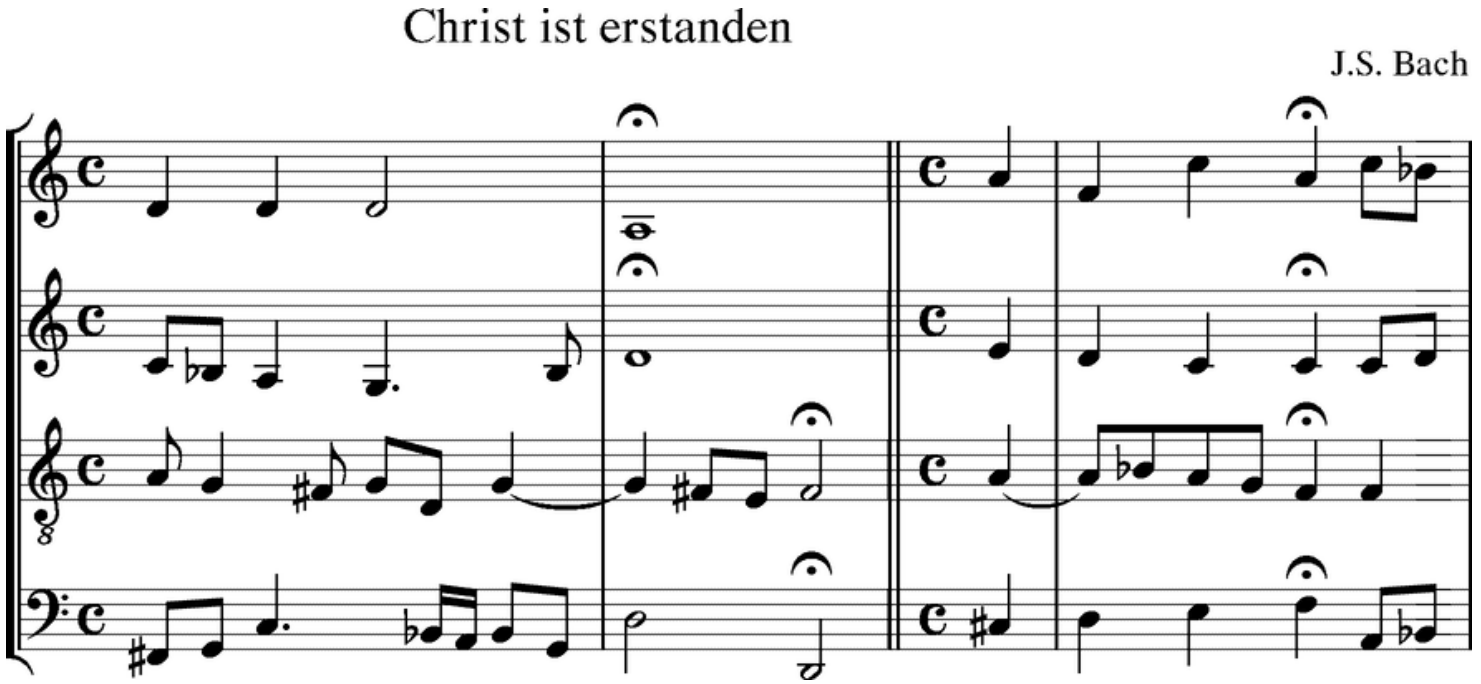
A	1
B-	1
c	42
c#	12
d	364
e-	91
e	627
f	651
f#	635
g	1961
g#	373
a	2953
b-	1035
b	2390
cc	2106
cc#	1035
dd	2279
ee-	376
ee	948
ff	289
ff#	187
gg	109
gg#	1
aa	6

!!tessitura: 24 semitones
!!mean: 70.4183 (b-)
!!median: 71 (b)

Which chorale has the lowest soprano note?

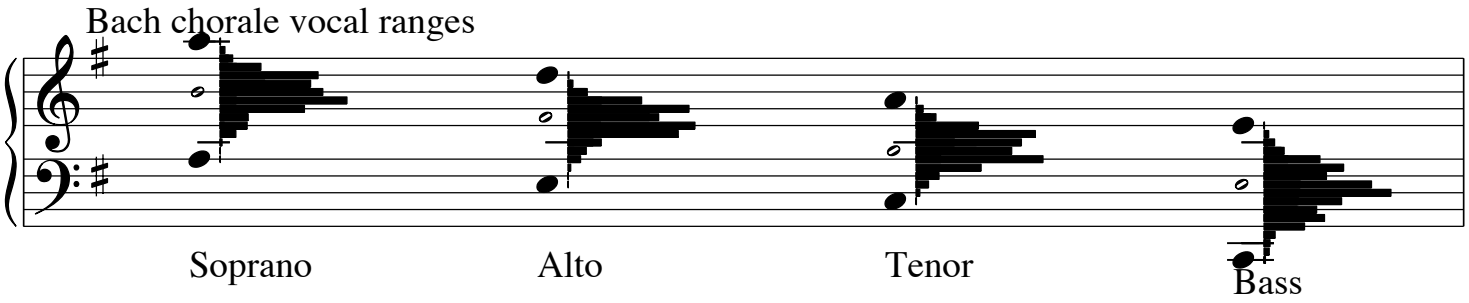
```
extractx -g soprn /tmp/chorales.krns | hgrep -dmH A
chor194.krn:measure 8:1.A#;
chor197.krn:measure 20:1A;
```

```
myank  -m 1-3  h://chorales/chor197.krn | autostem | hum2muse | muse2ps =z18j \
    | convert –density 300 - -trim –resize 50% output.png
```



Bach chorale vocal ranges

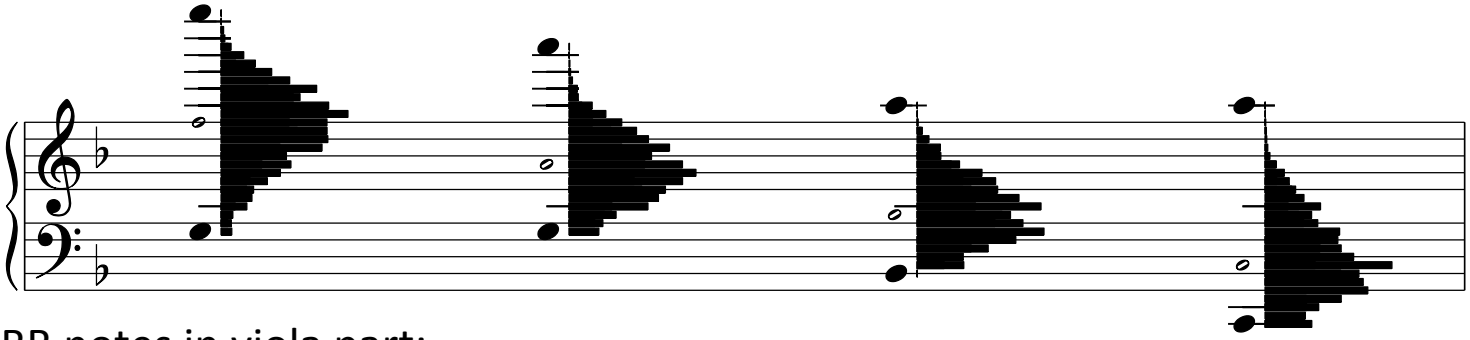
prange --score h://371chorales | geteps > output.eps
prange --score h://371chorales | getsvg > output.svg




```
#!/usr/bin/perl
use HTTP::Request::Common;
use LWP::UserAgent;
while ($line = <>) { $data .= "$line”; }
$ua = LWP::UserAgent->new;
my $response = $ua->request(
      POST 'http://score.sapp.org/cgi-bin/score',
      [  outputformat => 'eps',
         embedpmx     => 'yes',
         inputdata    => [$data],]);
if ($response->is_success) {
   print $response->decoded_content;
} else { die $response->status_line; }
```

Beethoven string quartet ranges

prange --score h://beethoven/quartets | geteps > output.eps



Locate BB notes in viola part:

extractx -i **kern h://beethoven/quartets | extractx -p 2 | hgrep -Hdm BB

```
myank -m 243-249 h://beethoven/quartets/quartet14-7.krn | hum2muse --ns | \
    muse2ps "=z16l2250w3150v90,120,90,100C^^T^Beethoven Op. 131, mvmt. 7,  mm.243-249^" | convert -density 300 - -quality 100 -trim -resize 50%  output.png
```