



# Sound of Music

## How It Works

### Session 8A

### Musical Notation



OLLI at Illinois  
Spring 2020

D. H. Tracy

## To Request a link to a Powerpoint Version with Sound and Animations

- Send an email to [OLLI\\_Tracy@outlook.com](mailto:OLLI_Tracy@outlook.com)
  - Say whether you want “Sound of Music 8 – Notation”  
or “Sound of Music 8 – Harmony”  
or both.
- Note that you will need a recent version of Microsoft Powerpoint on your computer to view these pptx files.

# Course Outline



1. Building Blocks: Some basic concepts
2. Resonance: Building Sounds
3. Hearing and the Ear
4. Musical Scales
5. Musical Instruments
6. More Musical Instruments
7. Singing
8. **Musical Notation; Harmony and Dissonance**

# Musical Notation

MIDI

81	880		A 5	
80	830.6		G#/Ab 5	
79	784.0		G 5	
78	740.0		F#/Gb 5	
77	698.5		F 5	
76	659.3		E 5	
75	622.3		D#/Eb 5	
74	587.3		D 5	
73	554.4		C#/Db 5	
72	523.3		C 5	
71	493.9		B 4	
70	466.2		A#/Bb 4	
69	440		A 4	
68	415.3		G#/Ab 4	
67	392.0		G 4	O
66	370.0		F#/Gb 4	
65	349.2		F 4	N
64	329.6		E 4	M
63	311.1		D#/Eb 4	
62	293.7		D 4	L
61	277.2		C#/Db 4	
60	261.6		C 4	K
59	246.9		B 3	I
58	233.1		A#/Bb 3	
57	220		A 3	H
56	207.7		G#/Ab 3	
55	196.0		G 3	G
54	185.0		F#/Gb 3	
53	174.6		F 3	F
52	164.8		E 3	E
51	155.6		D#/Eb 3	
50	146.8		D 3	D
49	138.6		C#/Db 3	
48	130.8		C 3	C
47	123.5		B 2	B
46	116.5		A#/Bb 2	
45	110		A 2	A
44	103.8		G#/Ab 2	
43	98.0		G 2	

ca. 500 AD

# Naming the Notes



≈Tenor Range

Boëthius (Roman Philosopher, 477-524)  
[Sainted 1883]



MIDI

# Naming the Notes

ca. 500 AD



Boëthius

(Roman Philosopher, 477-524)

**B flat** was the first note beyond the Diatonic C Major subscale to be added

Organized by Octaves



Sound of Music  
8A

81	880		A 5		
80	830.6		G#/Ab 5		
79	784.0		G 5	gg	
78	740.0		F#/Gb 5		
77	698.5		F 5	ff	
76	659.3		E 5	ee	
75	622.3		D#/Eb 5		
74	587.3		D 5	dd	
73	554.4		C#/Db 5	cc	
72	523.3		C 5		
71	493.9		B 4	bb	
70	466.2		A#/Bb 4	bb	
69	440		A 4	aa	
68	415.3		G#/Ab 4		
67	392.0		G 4	O	g
66	370.0		F#/Gb 4		
65	349.2		F 4	N	f
64	329.6		E 4	M	e
63	311.1		D#/Eb 4		
62	293.7		D 4	L	d
61	277.2		C#/Db 4		
60	261.6		C 4	K	c
59	246.9		B 3	I	b
58	233.1		A#/Bb 3		
57	220		A 3	H	a
56	207.7		G#/Ab 3		
55	196.0		G 3	G	G
54	185.0		F#/Gb 3		
53	174.6		F 3	F	F
52	164.8		E 3	E	E
51	155.6		D#/Eb 3		
50	146.8		D 3	D	D
49	138.6		C#/Db 3		
48	130.8		C 3	C	C
47	123.5		B 2	B	B
46	116.5		A#/Bb 2		
45	110		A 2	A	A
44	103.8		G#/Ab 2		
43	98.0		G 2		Γ

MIDI

81	880		A 5			
80	830.6		G#/Ab 5			
79	784.0		G 5	gg	g''	
78	740.0		F#/Gb 5			
77	698.5		F 5	ff	f''	
76	659.3		E 5	ee	e''	
75	622.3		D#/Eb 5			
74	587.3		D 5	dd	d''	
73	554.4		C#/Db 5	cc		
72	523.3		C 5		c''	
71	493.9		B 4	bb	b'	
70	466.2		A#/Bb 4	bb		
69	440		A 4	aa	a'	
68	415.3		G#/Ab 4			
67	392.0		G 4	O	g	g'
66	370.0		F#/Gb 4			
65	349.2		F 4	N	f	f'
64	329.6		E 4	M	e	e'
63	311.1		D#/Eb 4			
62	293.7		D 4	L	d	d'
61	277.2		C#/Db 4			
60	261.6		C 4	K	c	c'
59	246.9		B 3	I	b	b
58	233.1		A#/Bb 3		b	
57	220		A 3	H	a	a
56	207.7		G#/Ab 3			
55	196.0		G 3	G	G	g
54	185.0		F#/Gb 3			
53	174.6		F 3	F	F	f
52	164.8		E 3	E	E	e
51	155.6		D#/Eb 3			
50	146.8		D 3	D	D	d
49	138.6		C#/Db 3			
48	130.8		C 3	C	C	c
47	123.5		B 2	B	B	B
46	116.5		A#/Bb 2		B	
45	110		A 2	A	A	A
44	103.8		G#/Ab 2			
43	98.0		G 2		Γ	G

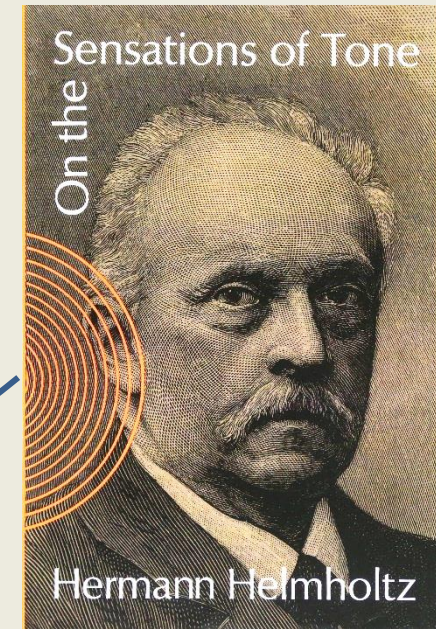
# Naming the Notes

ca. 500 AD



Boëthius

Organized by Octaves, but starting at C instead of A!



Hermann Helmholtz



MIDI

# Naming the Notes

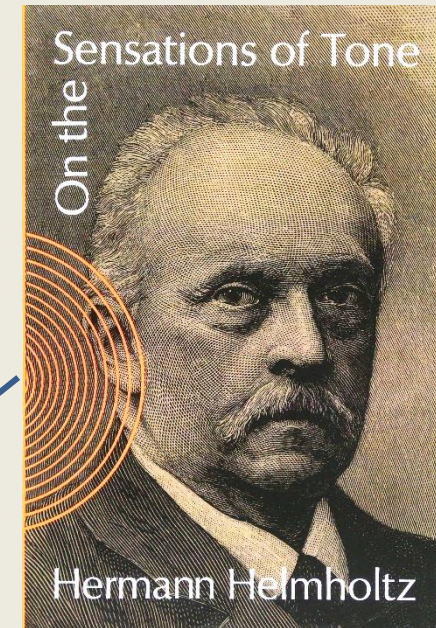
ca. 500 AD



Boëthius

Scientific Notation System (20<sup>th</sup> Century)

Also Organized by Octaves, starting at C



Hermann Helmholtz

Sound of Music 8A

81	880		A 5			A5
80	830.6		G#/A $\flat$ 5			G#5
79	784.0		G 5	gg	g''	G5
78	740.0		F#/G $\flat$ 5			F#5
77	698.5		F 5	ff	f''	F5
76	659.3		E 5	ee	e''	E5
75	622.3		D#/E $\flat$ 5			D#5
74	587.3		D 5	dd	d''	D5
73	554.4		C#/D $\flat$ 5	cc		C#5
72	523.3		C 5		c''	C5
71	493.9		B 4	bb	b'	B4
70	466.2		A#/B $\flat$ 4	bb		A#4
69	440		A 4	aa	a'	A4
68	415.3		G#/A $\flat$ 4			G#4
67	392.0		G 4	O	g	G4
66	370.0		F#/G $\flat$ 4			F#4
65	349.2		F 4	N	f	F4
64	329.6		E 4	M	e	E4
63	311.1		D#/E $\flat$ 4			D#4
62	293.7		D 4	L	d	D4
61	277.2		C#/D $\flat$ 4			C#4
60	261.6		C 4	K	c	C4
59	246.9		B 3	I	b	B3
58	233.1		A#/B $\flat$ 3			A#3
57	220		A 3	H	a	A3
56	207.7		G#/A $\flat$ 3			G#3
55	196.0		G 3	G	g	G3
54	185.0		F#/G $\flat$ 3			F#3
53	174.6		F 3	F	f	F3
52	164.8		E 3	E	e	E3
51	155.6		D#/E $\flat$ 3			D#3
50	146.8		D 3	D	d	D3
49	138.6		C#/D $\flat$ 3			C#3
48	130.8		C 3	C	c	C3
47	123.5		B 2	B	B	B2
46	116.5		A#/B $\flat$ 2			A#2
45	110		A 2	A	A	A2
44	103.8		G#/A $\flat$ 2			G#2
43	98.0		G 2		G	G2



MIDI

# Naming the Notes

81	880		A 5			A5	La
80	830.6		G#/Ab 5			G#5	Si
79	784.0		G 5	gg	g''	G5	Sol
78	740.0		F#/Gb 5			F#5	Fi
77	698.5		F 5	ff	f''	F5	Fa
76	659.3		E 5	ee	e''	E5	Mi
75	622.3		D#/Eb 5			D#5	Ri
74	587.3		D 5	dd	d''	D5	Re
73	554.4		C#/Db 5	cc		C#5	Di
72	523.3		C 5		c''	C5	Do
71	493.9		B 4	bb	b'	B4	Ti
70	466.2		A#/Bb 4	bb		A#4	Li
69	440		A 4	aa	a'	A4	La
68	415.3		G#/Ab 4			G#4	Si
67	392.0		G 4	O	g	G4	Sol
66	370.0		F#/Gb 4			F#4	Fi
65	349.2		F 4	N	f	F4	Fa
64	329.6		E 4	M	e	E4	Mi
63	311.1		D#/Eb 4			D#4	Ri
62	293.7		D 4	L	d	D4	Re
61	277.2		C#/Db 4			C#4	Di
60	261.6		C 4	K	c	C4	Do
59	246.9		B 3	I	b	B3	Ti
58	233.1		A#/Bb 3		b	A#3	Li
57	220		A 3	H	a	A3	La
56	207.7		G#/Ab 3			G#3	Si
55	196.0		G 3	G	g	G3	Sol
54	185.0		F#/Gb 3			F#3	Fi
53	174.6		F 3	F	f	F3	Fa
52	164.8		E 3	E	e	E3	Mi
51	155.6		D#/Eb 3			D#3	Ri
50	146.8		D 3	D	d	D3	Re
49	138.6		C#/Db 3			C#3	Di
48	130.8		C 3	C	c	C3	Do
47	123.5		B 2	B	B	B2	Ti
46	116.5		A#/Bb 2		B	A#2	Li
45	110		A 2	A	A	A2	La
44	103.8		G#/Ab 2			G#2	Si
43	98.0		G 2		G	G2	Sol

ca. 500 AD

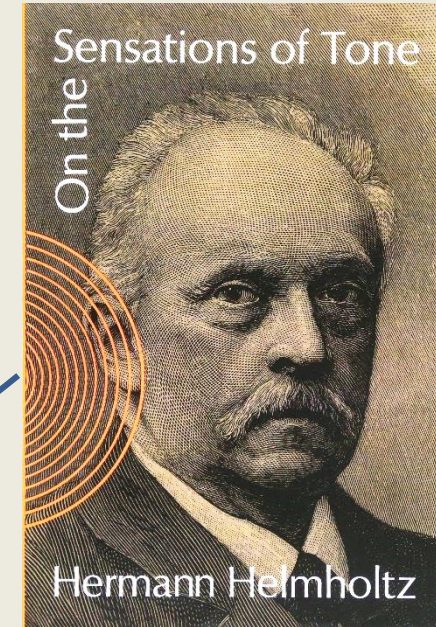
Solfège



Boëthius

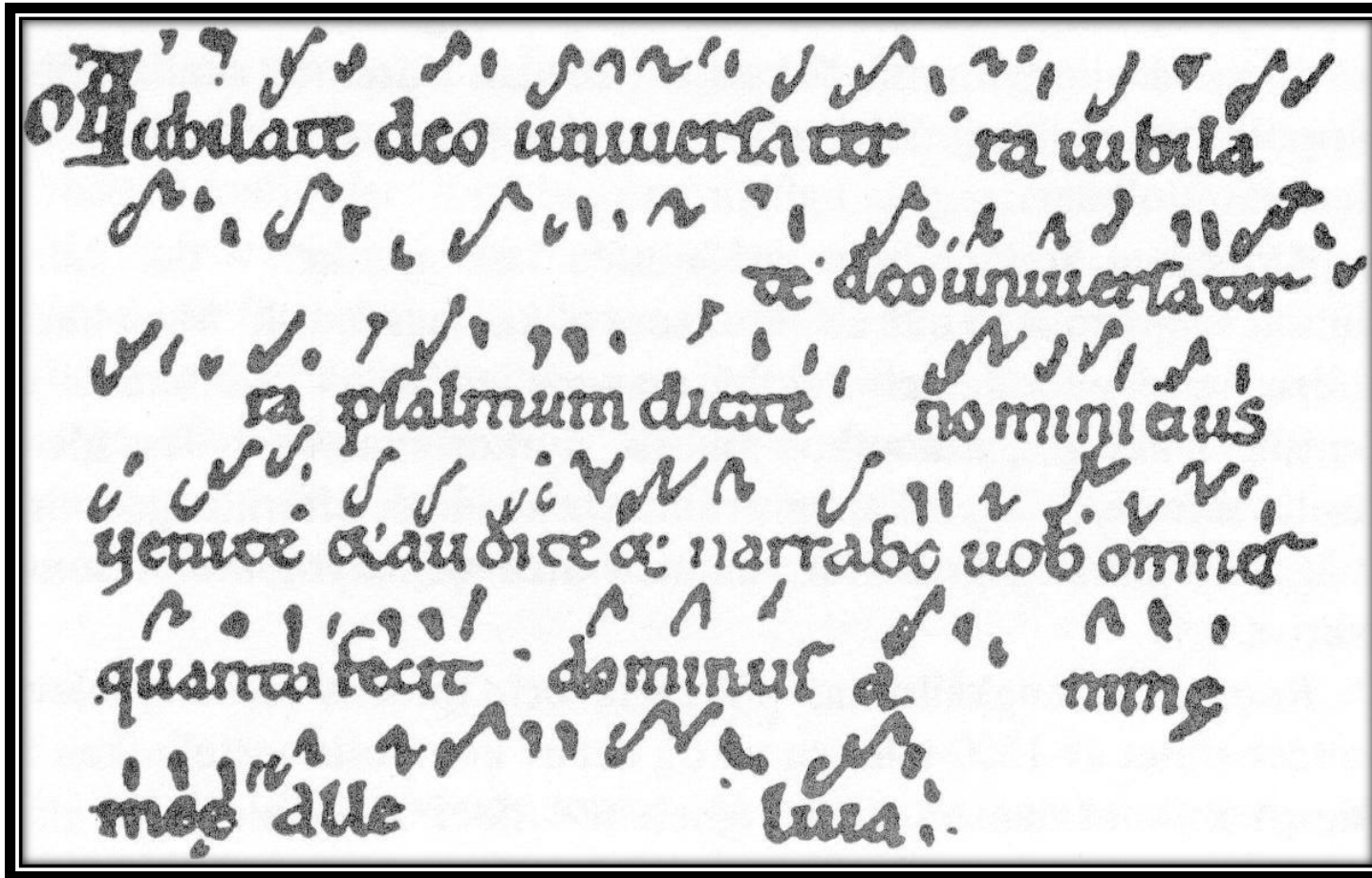
Scientific Notation System (20<sup>th</sup> Century)

Organized by Octaves, starting at C



Hermann Helmholtz

# Neumes: Pre-modern Notation



These kinds of tone 'hints' began to appear in the West as early as 800 AD, starting around Metz

Wikipedia



# Neumes

*U*mbilate deo uniuersiter ra uibila  
te deo uniuersiter  
ra psalmum dicite nomini eius  
yentice & au dite & narrabo uob omnia  
quanta fecit domi  
nues alle

d dfgh s s s sf gff ded ffg  
me sal uum fac seruum tu um de

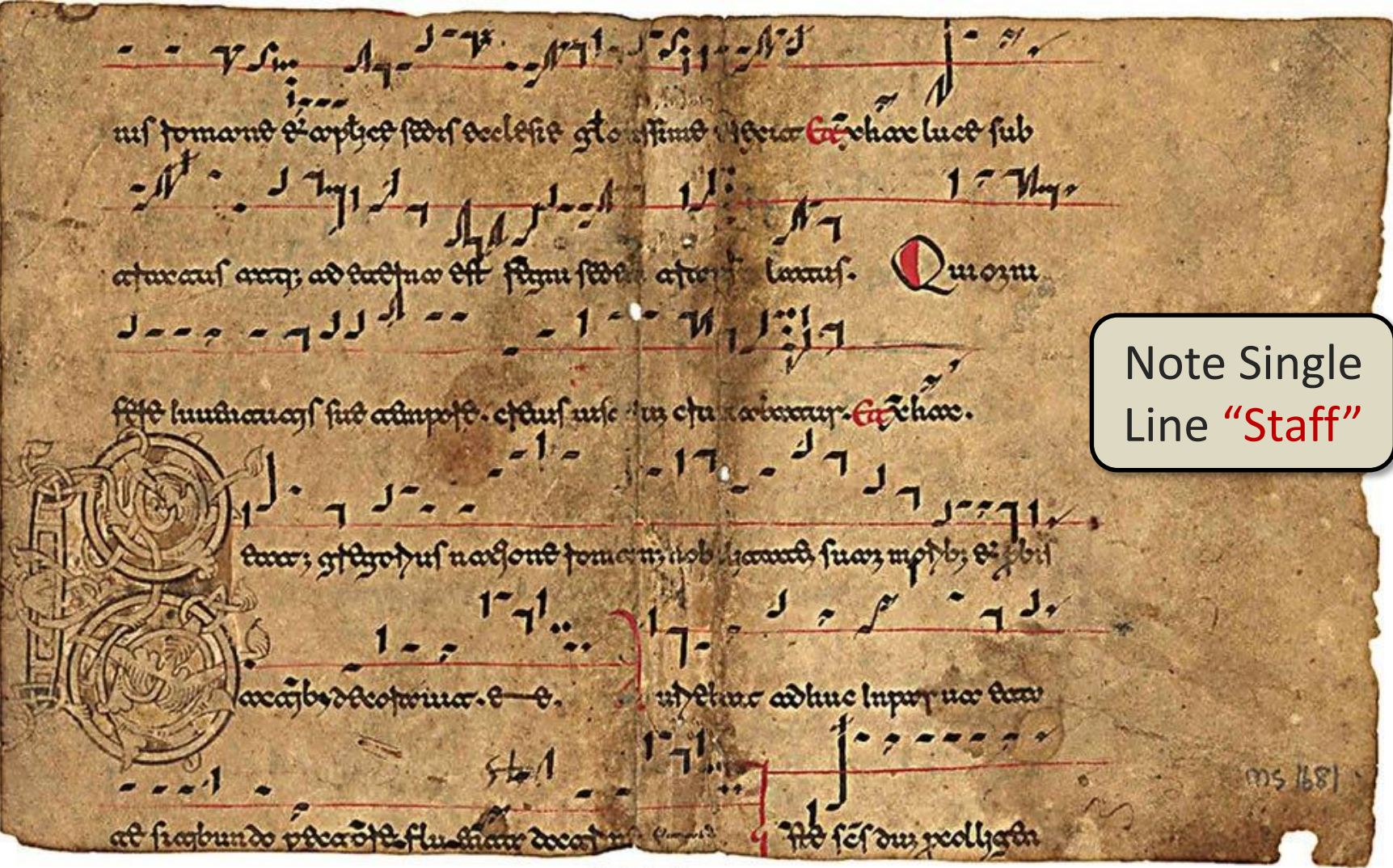
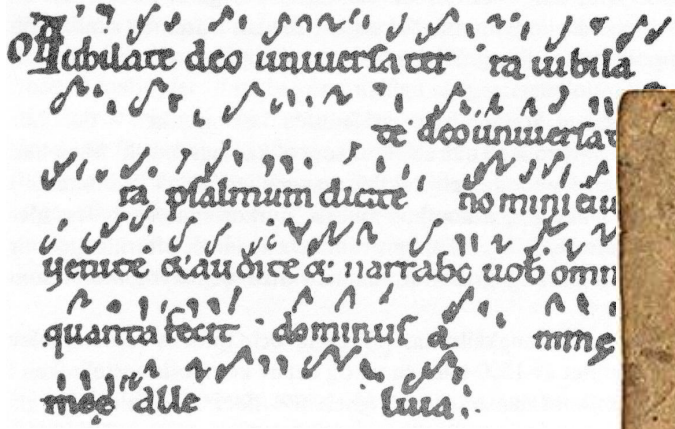
hg hgfg sf f ghg b se s eg f deded  
tem in te mise rere mihi domi

Wikipedia

Digraphic Neume (11<sup>th</sup> Century manuscript from Saint-Bénigne de Dijon)



# Neumes



Note Single Line "Staff"



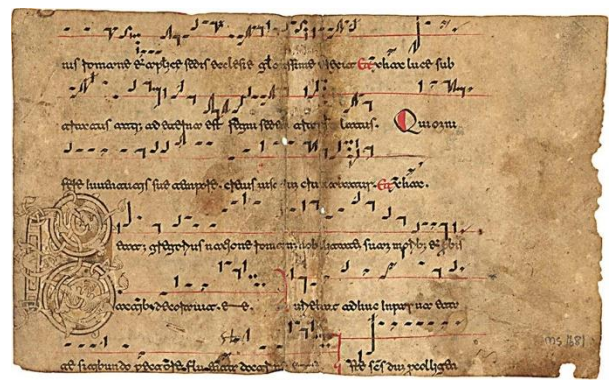
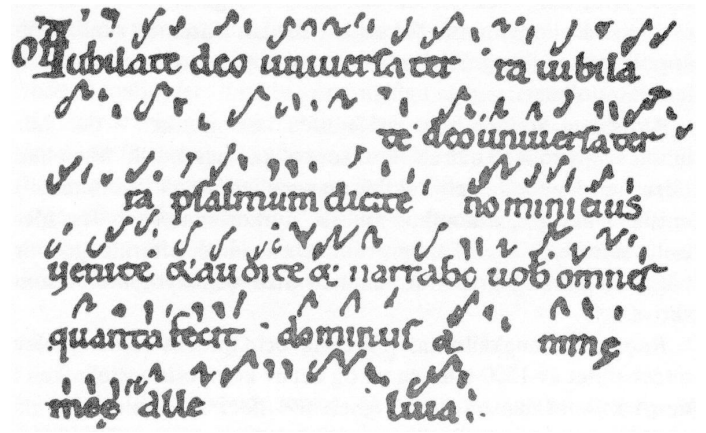
Example of Beneventon Script  
14<sup>th</sup> Century  
Southern Italy





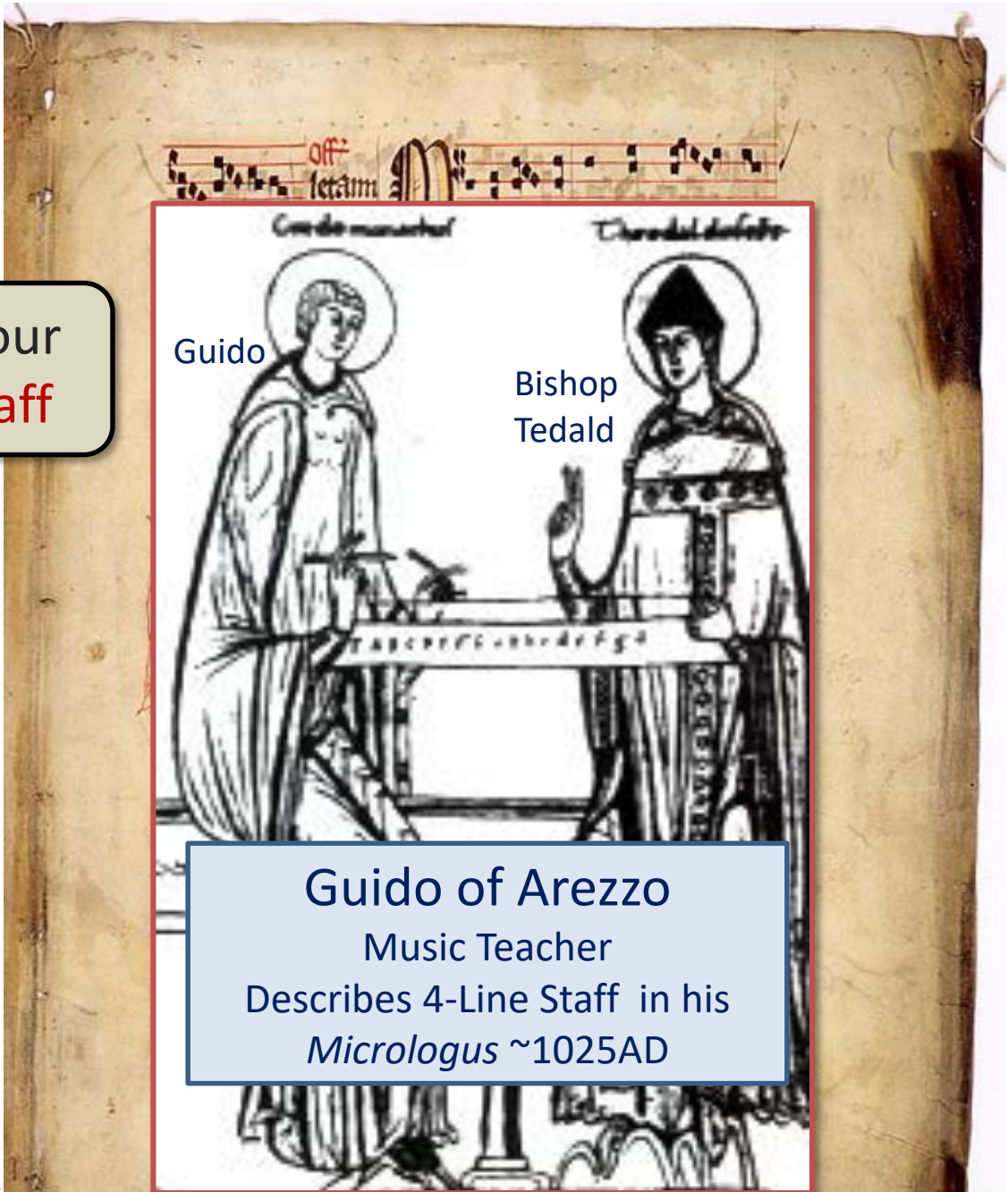


# Neumes



Note Four  
Line Staff

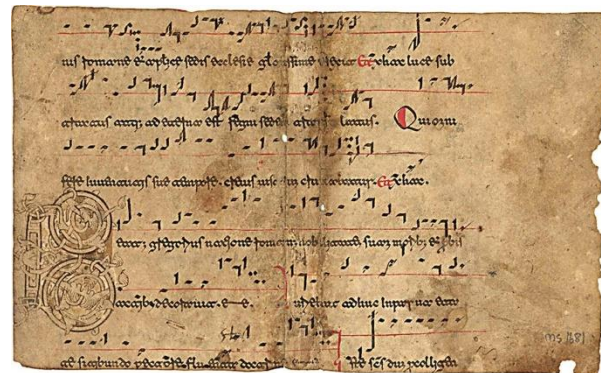
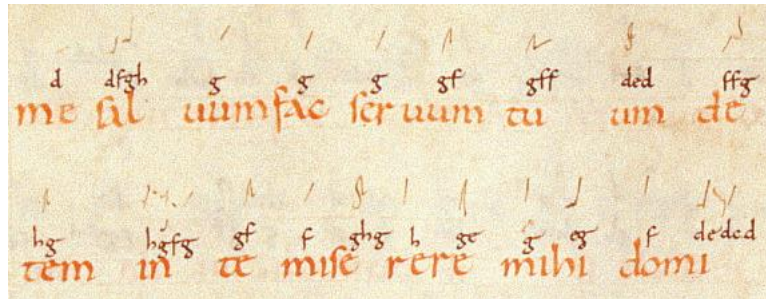
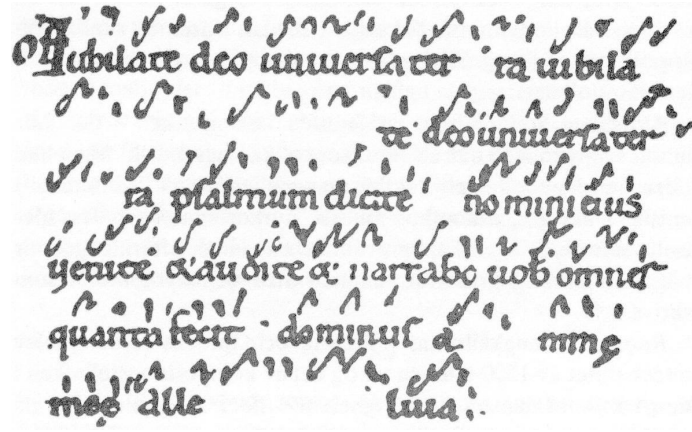
from  
Graduale  
Aboense  
Hymn Book of  
Turku, Finland  
14<sup>th</sup>-15<sup>th</sup> century  
Gregorian Chant



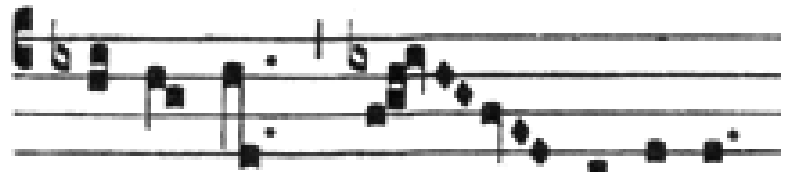
Guido of Arezzo  
Music Teacher  
Describes 4-Line Staff in his  
*Micrologus* ~1025AD



# Neumes



Modern Version on Four Line Staff

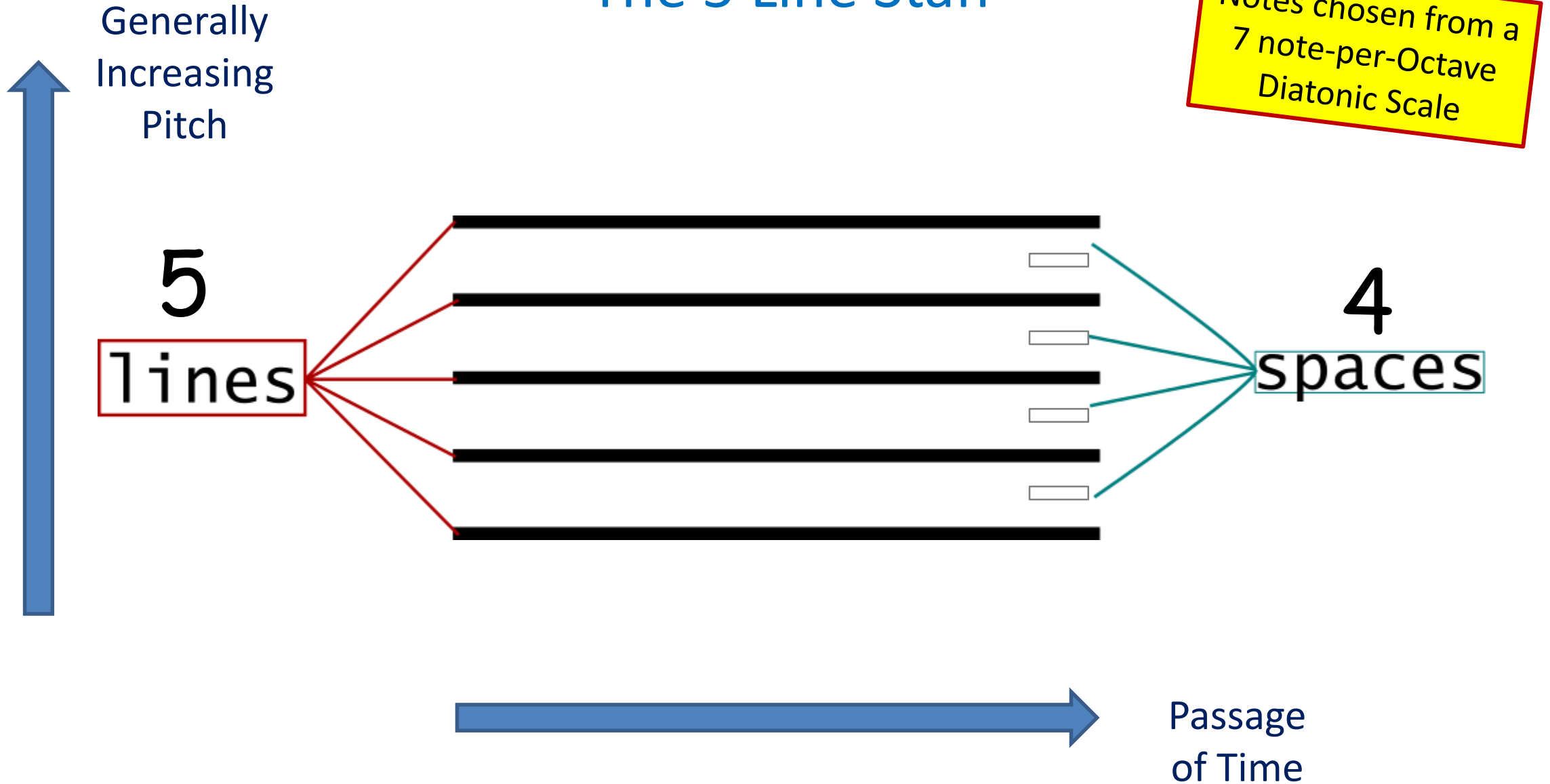
1. 

**K** Y-ri- e \* e- lé- i-son.

Orbis Factor  
(Kyrie XI)  
A Gregorian Chant

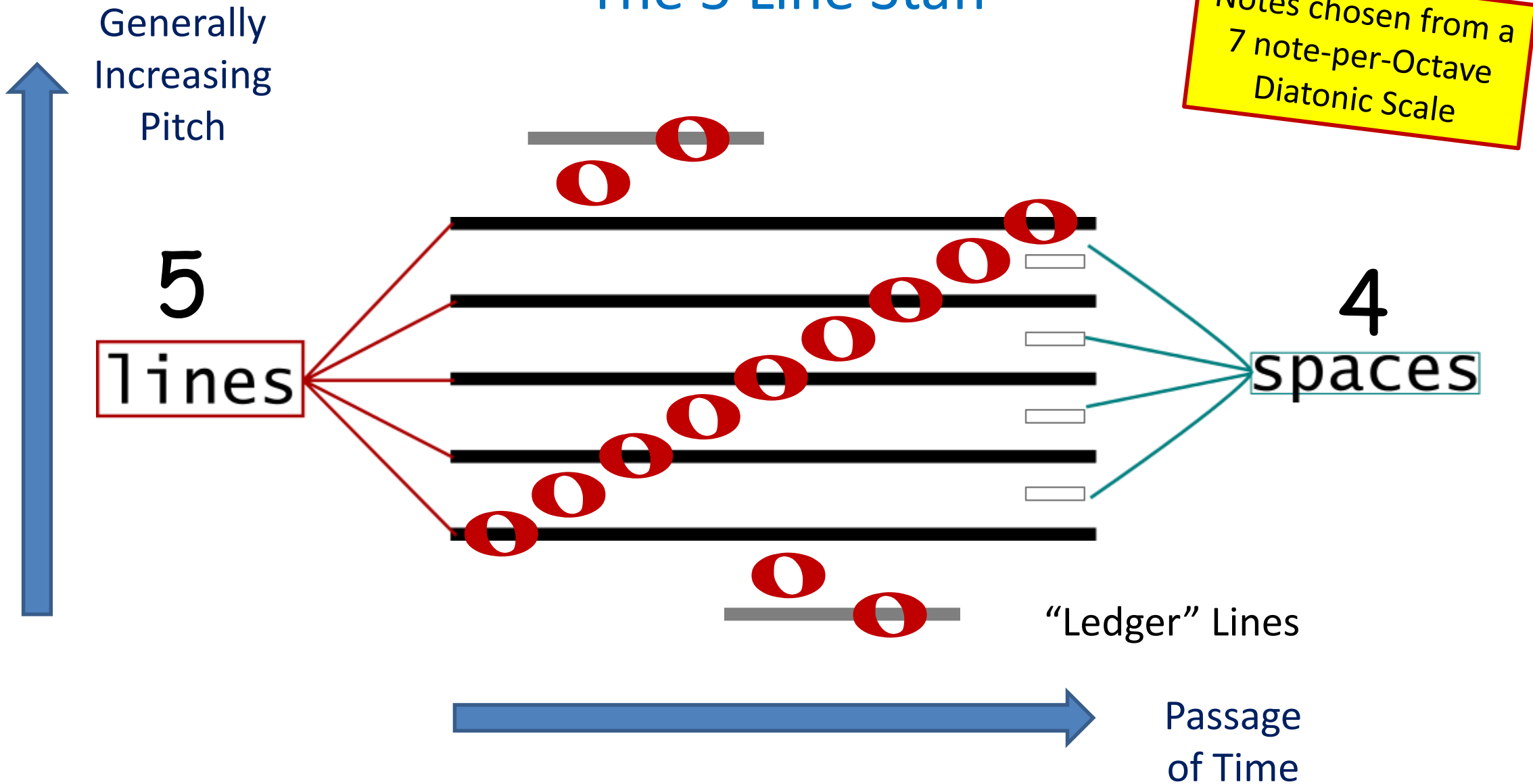


# The 5 Line Staff





# The 5 Line Staff



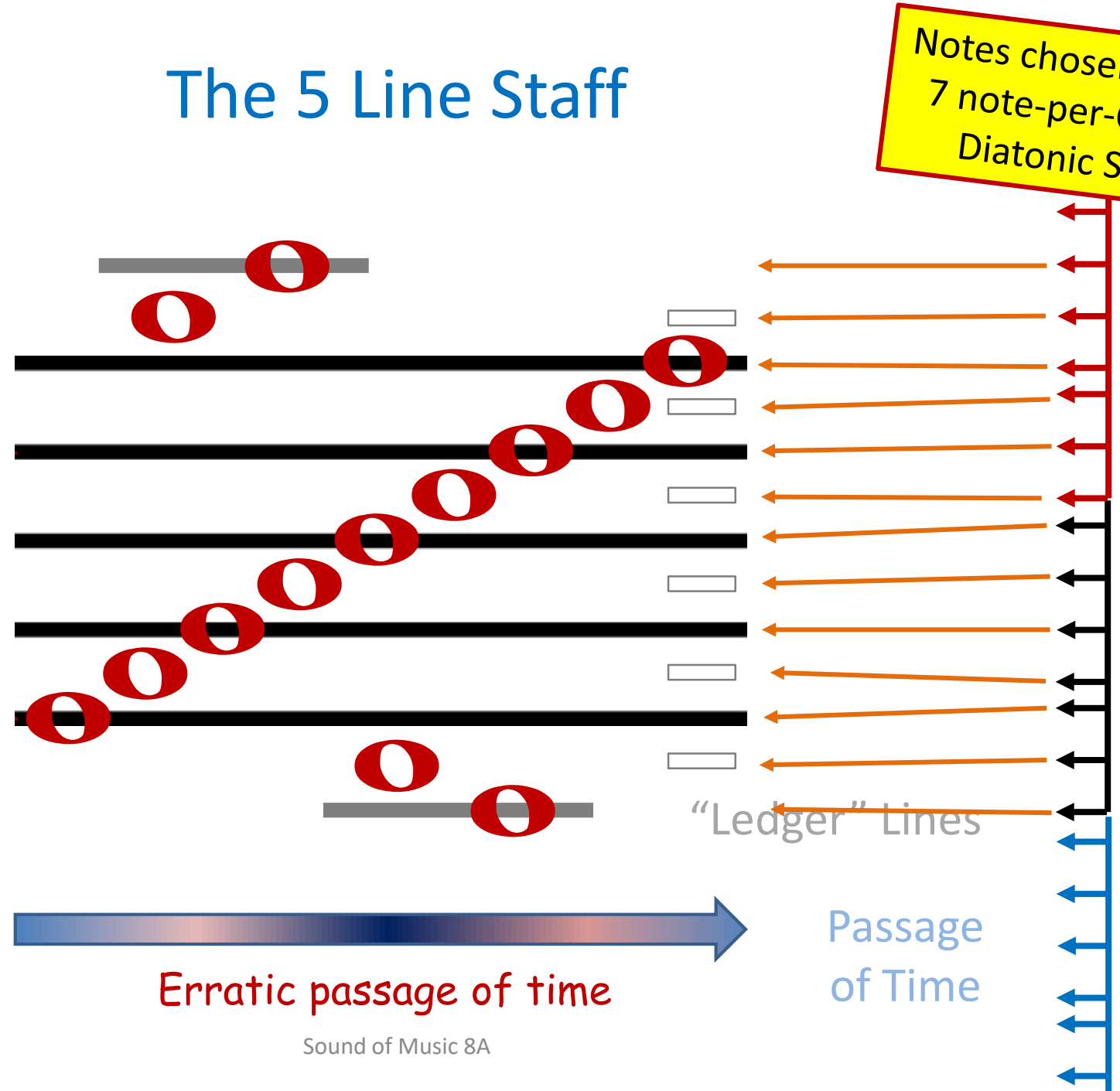
# The 5 Line Staff

Notes chosen from a 7 note-per-Octave Diatonic Scale

Generally Increasing Pitch

Erratic "Sorta-Log" Pitch Scale

True Log Pitch Scale



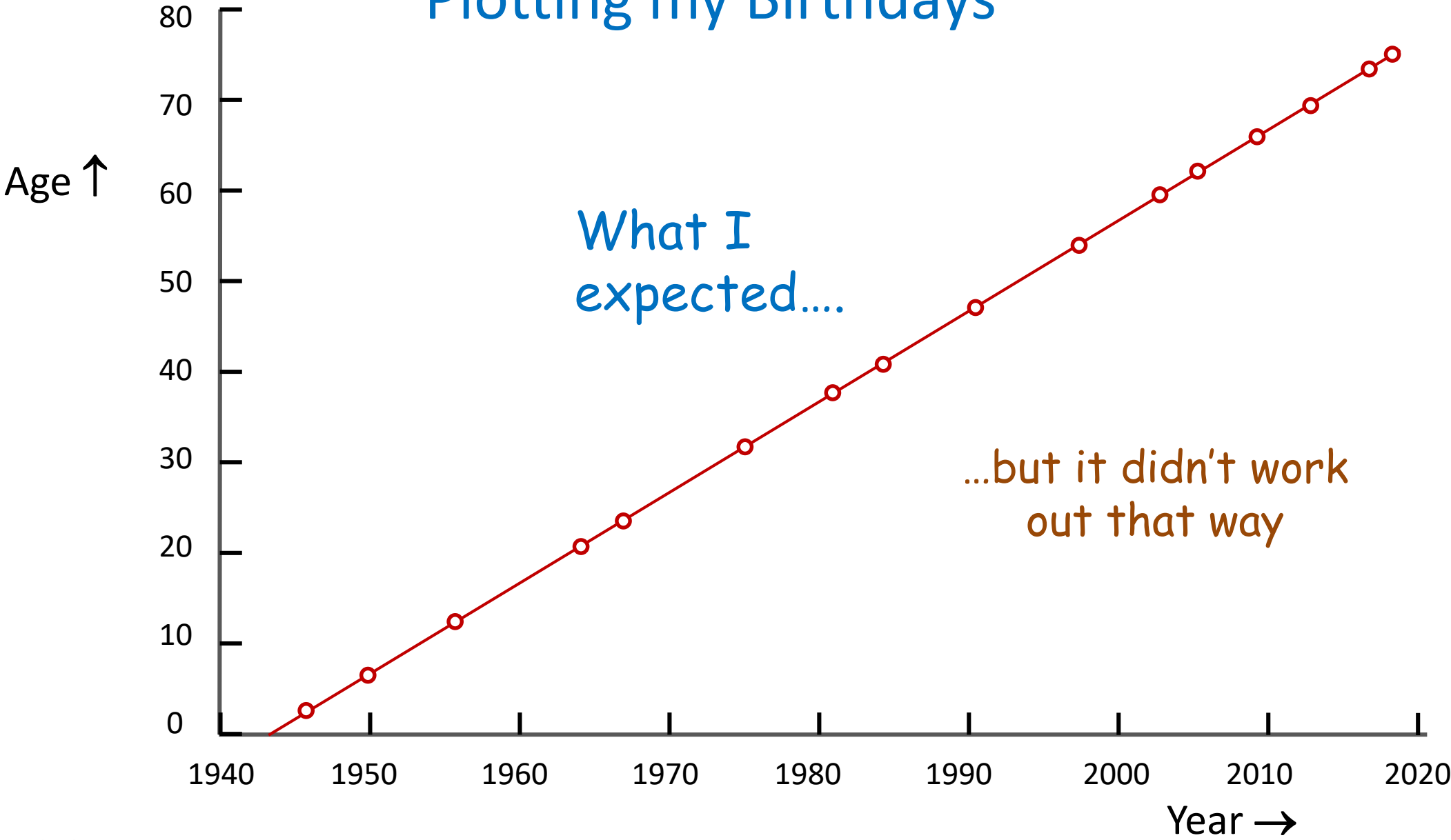
"Ledge" Lines

Erratic passage of time

Passage of Time

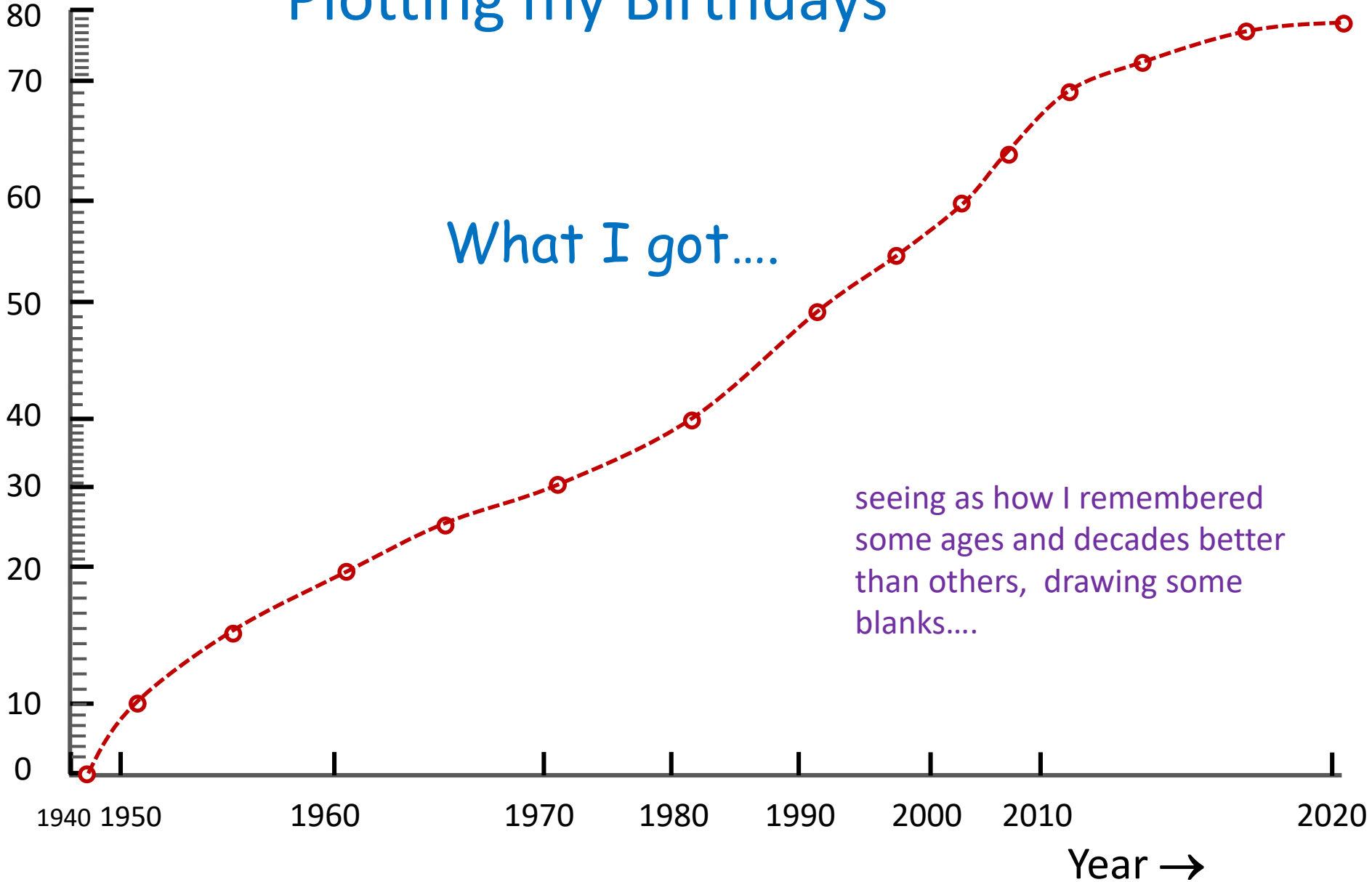


# Plotting my Birthdays



# Plotting my Birthdays

Age ↑





# The 5 Line Staff

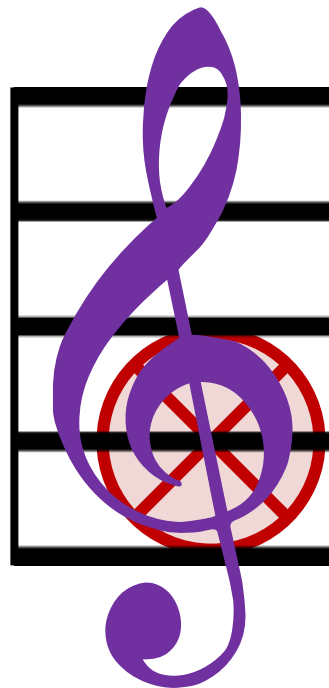
Generally

Q: How do we know which staff *line* corresponds to which note/frequency?

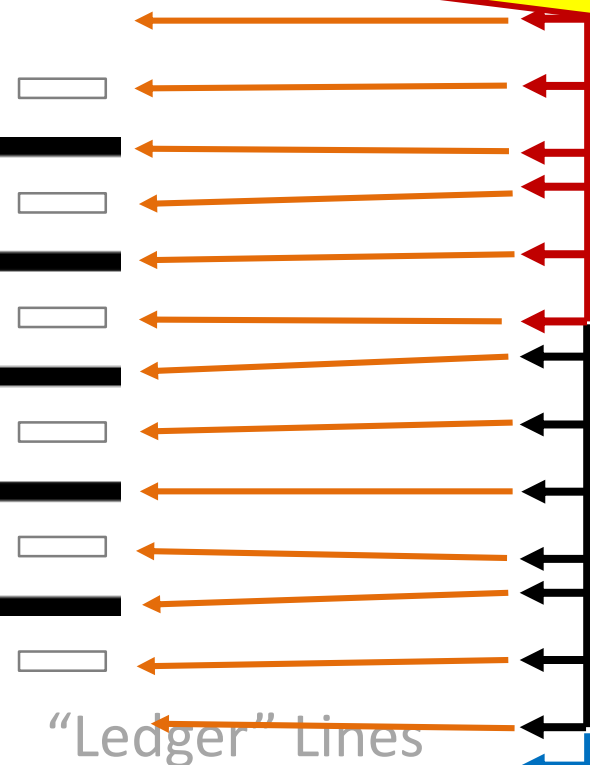
A: With a Clef Symbol

Erratic  
"Sorta-Log"  
Pitch Scale

Example:  
The **G-Clef** or  
Treble Clef:  
Bullseye on G4



Notes chosen from a  
7 note-per-Octave  
Diatonic Scale



G4

True  
Log Pitch  
Scale

C Major  
Scale

Passage  
of Time



# The 5 Line Staff

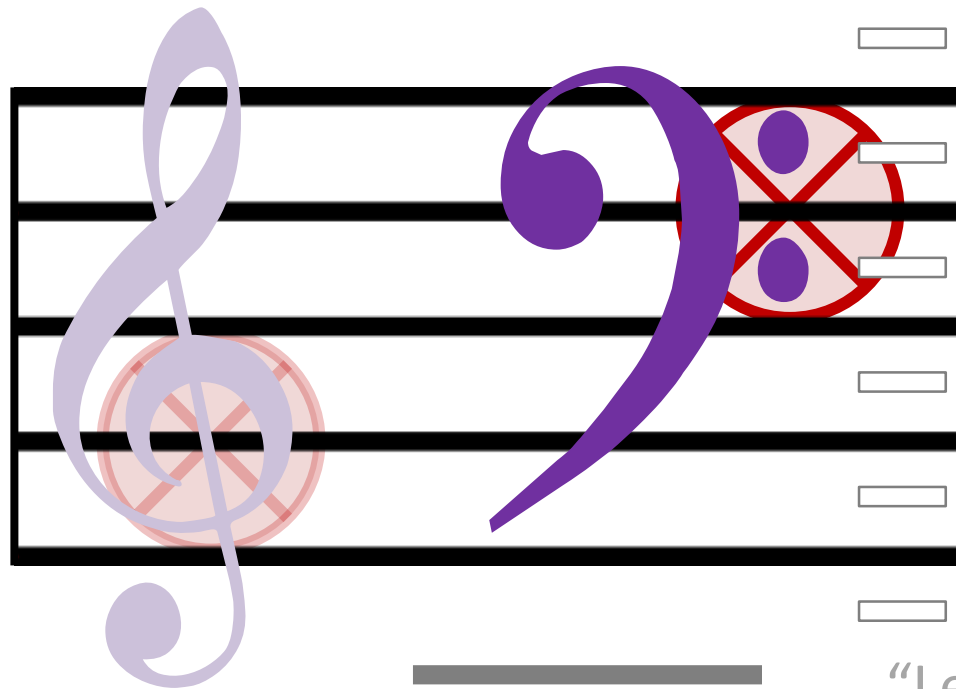
Generally

Q: How do we know which staff *line* corresponds to which note/frequency?

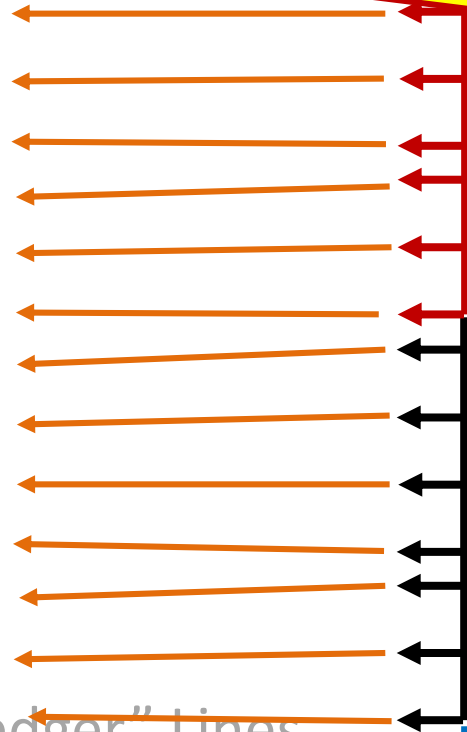
A: With a Clef Symbol

Erratic  
"Sorta-Log"  
Pitch Scale

Another Example:  
The **F-Clef** or  
Bass Clef:  
Bullseye on F3



Notes chosen from a  
7 note-per-Octave  
Diatonic Scale



True  
Log Pitch  
Scale

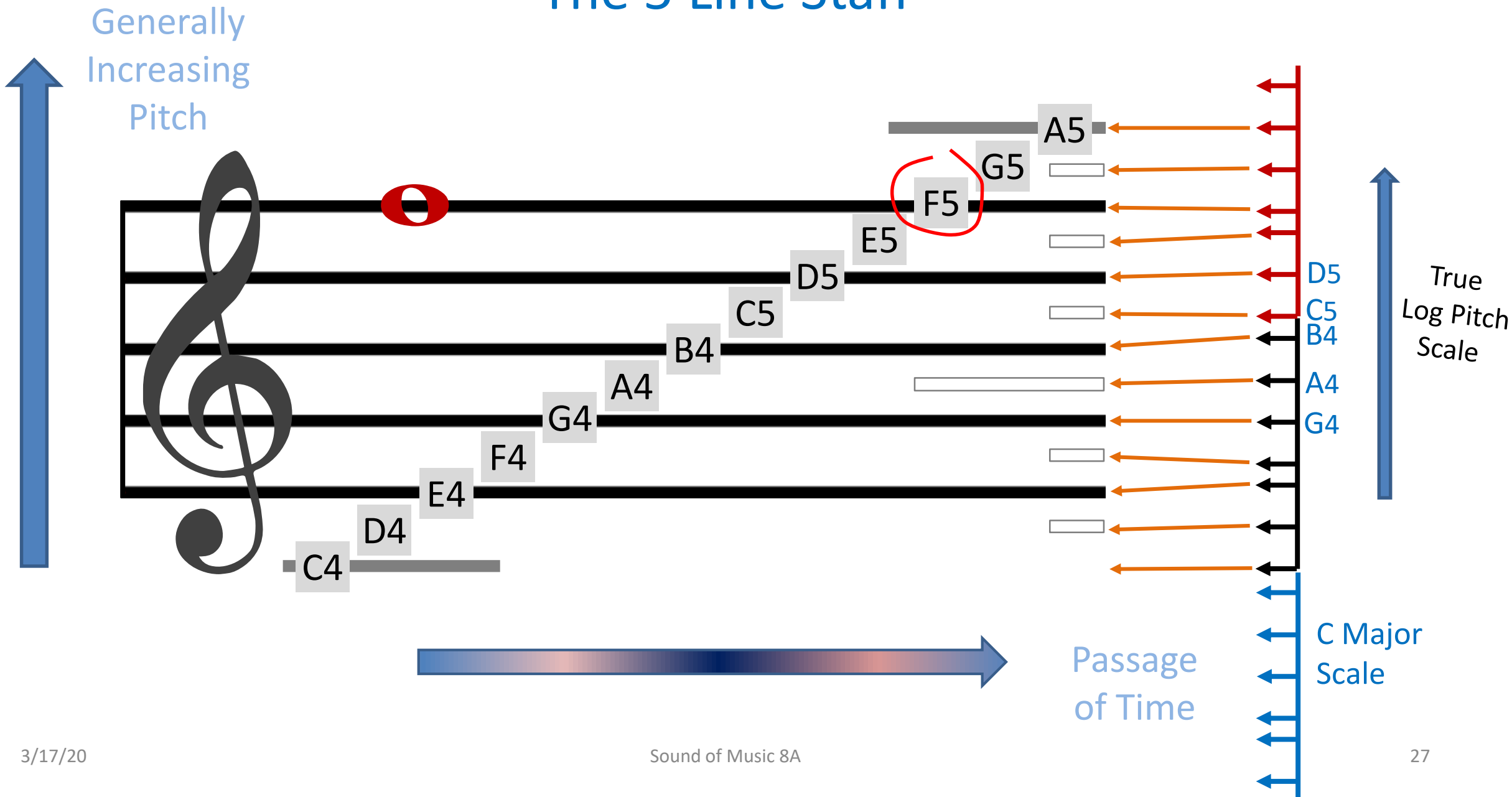
G4

"Ledge" Lines

Passage  
of Time

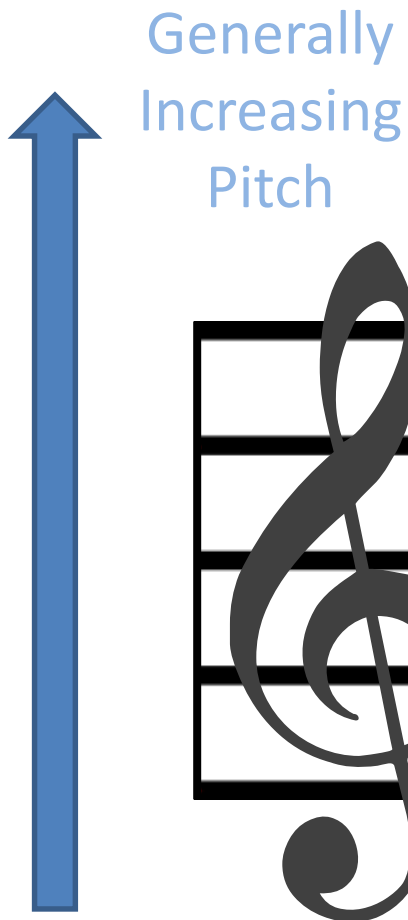
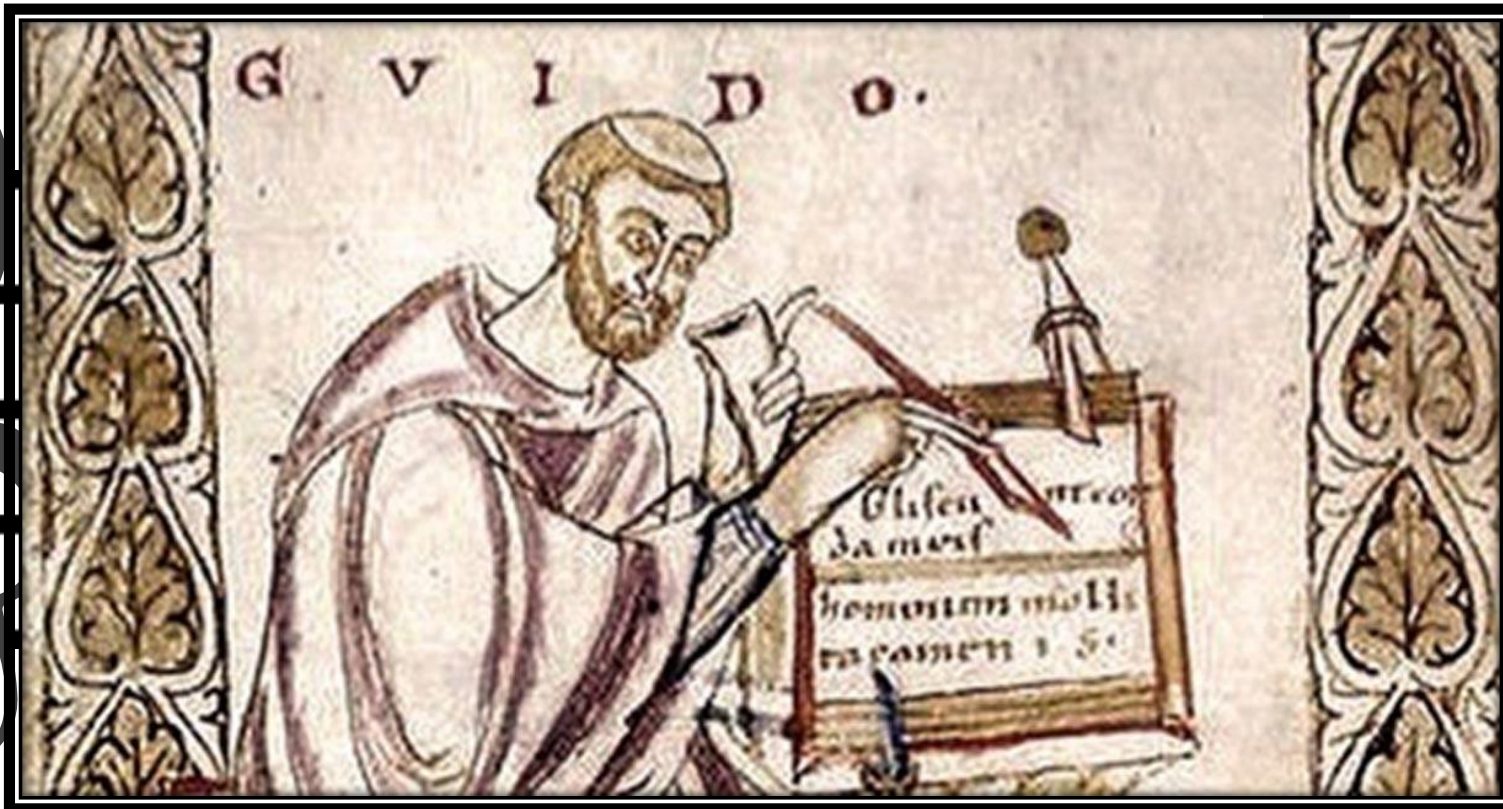
C Major  
Scale

# The 5 Line Staff

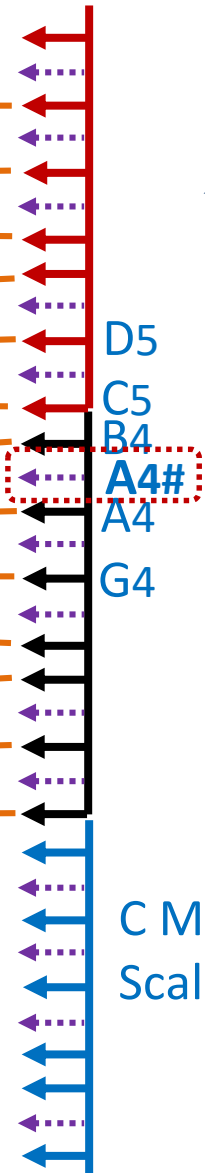


# The 5 Line Staff

4 line version attributed to Guido of Arezzo



Newfangled Chromatic Scale



True Log Pitch Scale

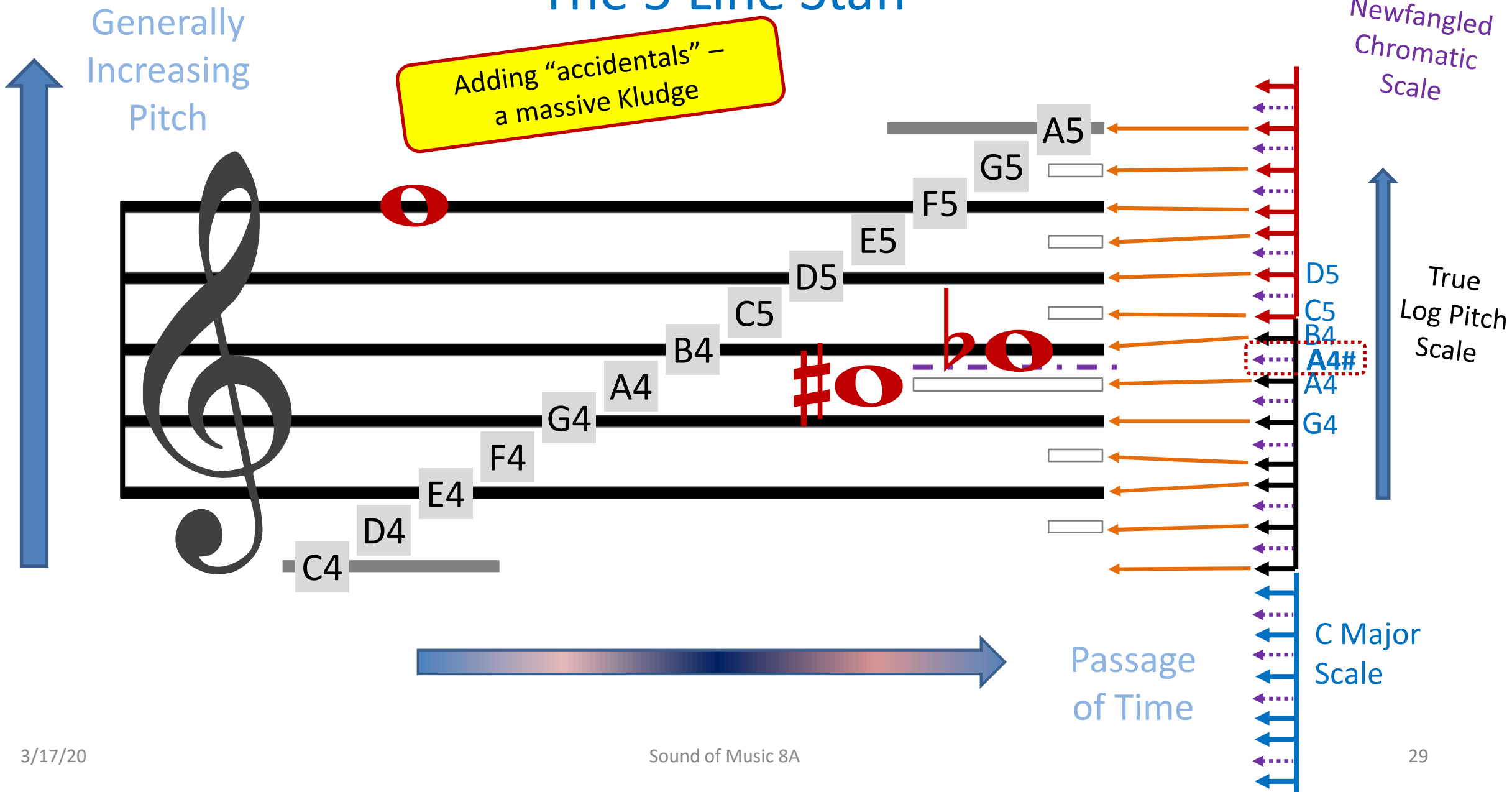
C Major Scale



Passage of Time



# The 5 Line Staff



# Music in Keys Other than C Major or A minor

Lots of Sharp and Flat signs.....

C5

G4



Passage  
of Time

# Music in Keys Other than C Major or A minor

The diagram illustrates musical notation on a five-line staff. A treble clef is on the left. A vertical blue arrow on the far left points upwards. A yellow callout box with a red border says "or marking the whole line or space up front". A purple callout box with a purple arrow says "Natural Symbol cancels the sharp!". A yellow callout box with a red border says "Including by convention other lines or spaces of the same pitch class!". A blue arrow at the bottom points to the right, labeled "Passage of Time".

Labels on the staff include C5 (next to a sharp sign on the second line), G4 (next to the second space), and C4 (next to a red note on a line below the staff). Red ovals represent notes on the staff. A purple natural symbol is on the second line. Small white boxes are on the right side of the staff lines.

# If the Romans Forgot to Give Us Vowels...

[w="a", q="e", j="i", k="o", g="u". Underscore= 'no change']

Jt wws thq bqst kf tjmq<sup>s</sup>, jt wws thq wkrst kf tjmq<sup>s</sup>, jt wws thq  
wgq kf wjsdkm, jt wws thq wgq kf fkkljshnq<sup>ss</sup>, jt wws thq qpkch  
kf bqljqf, jt wws thq qpkch kf jncrqdgljty, jt wws thq sqwskn kf  
Ljght, jt wws thq sqwskn kf Dwrknq<sup>ss</sup>, jt wws thq sprjng kf hkpq,  
jt wws thq wjntqr kf dqspwjr.

We could have gotten by  
with many fewer letters

Chwrlqs Djckqns

*W Twlq kf Twk Cjtjqs (1859)*

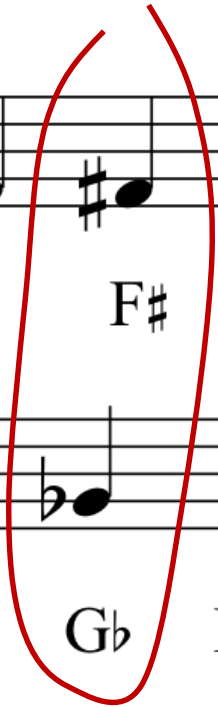
# The Full Chromatic Scale on the 5 Line Staff



Obviously, these are the same thing (although in some Temperaments they aren't!)

C<sub>4</sub> C<sup>#</sup> D D<sup>#</sup> E F F<sup>#</sup> G G<sup>#</sup> A A<sup>#</sup> B<sub>4</sub> C<sub>5</sub>

C<sub>5</sub> B<sub>4</sub> B<sup>b</sup> A A<sup>b</sup> G G<sup>b</sup> F E E<sup>b</sup> D D<sup>b</sup> C<sub>4</sub>





# The Full Chromatic Scale on the 5 Line Staff

C<sub>4</sub> C<sup>#</sup> D D<sup>#</sup> E F F<sup>#</sup> G G<sup>#</sup> A A<sup>#</sup> B<sub>4</sub> C<sub>5</sub>  
 C<sub>5</sub> B<sub>4</sub> B<sup>b</sup> A A<sup>b</sup> G G<sup>b</sup> F E E<sup>b</sup> D D<sup>b</sup> C<sub>4</sub>

Note durations

Whole Note

Half Note

Quarter Note

Eighth Note

16th Note

Simple, huh?



2

1½

1

7/8

¾

½

7/16

3/8

¼

3/16

1/8

3/64

1/16

1/32

1/64

1/128 ...

# Für sechs Streichinstrumente

## 1. Geige

Arnold Schönberg, Op. 4

**Sehr langsam**

2 1. Bratsche

*pp*

*immer leise*

*pp*

*trm*

*immer leise*

*trm*

*pp*

*cresc.*

*espress.*

*3*

*rit.*

**A**

*f*

*accel.*

*f*

*p*

**B**

*rit. steigernd*

*1*

*1*

*2*

2. Geige

# VERKLAERTE NACHT

(Transfigured Night)

Opus 4, for String Sextet (1899)

After a Poem by RICHARD DEHMEL

VIOLIN I

ARNOLD SCHOENBERG

(1875-1951)

Sehr langsam.

*immer leise*

1. Bratsche.

*pp*

*pp*

*trmn*

*immer leise*

*pp*

*cresc.*

*espress.*

*rit.*

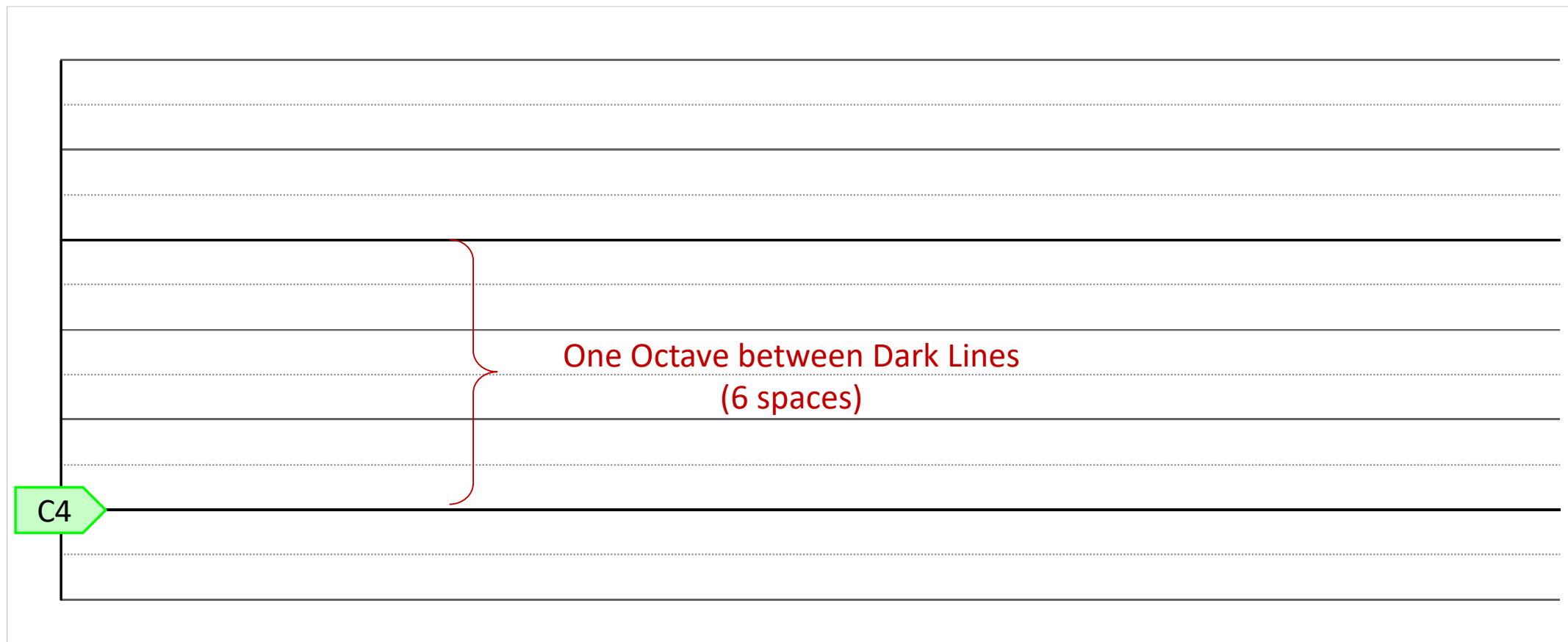
**B**

*rit. steigend*

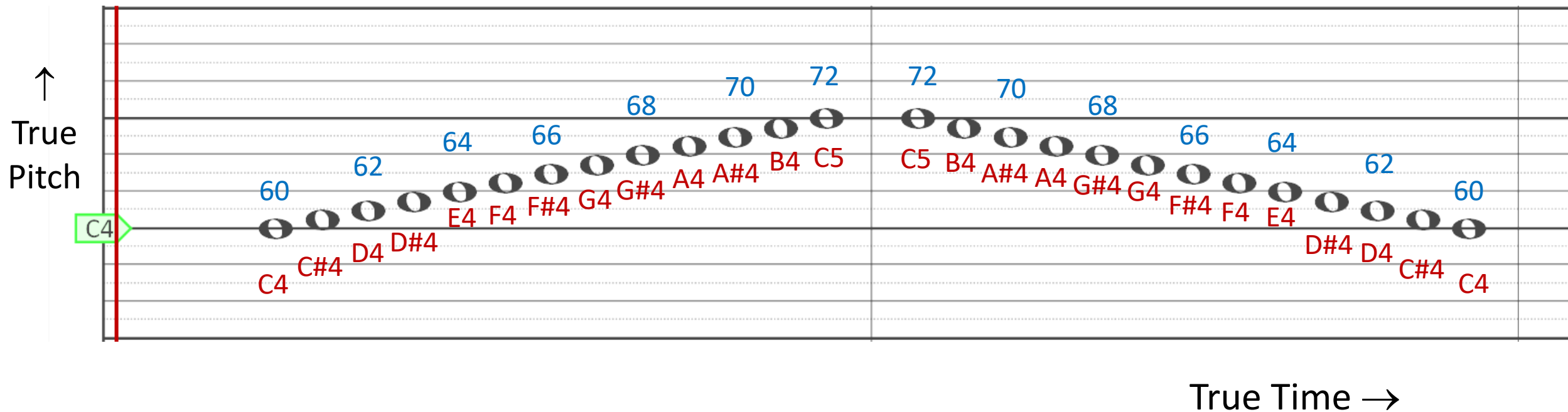
**2**

The image shows the first five staves of the Violin I part of Arnold Schoenberg's 'Verklärte Nacht'. The music is in a key with one flat (B-flat) and a 3/4 time signature. It begins with a tempo marking of 'Sehr langsam.' and a dynamic of 'pp'. The score includes various musical notations such as slurs, trills, and dynamic markings like 'cresc.', 'espress.', and 'rit.'. There are also section markers 'A' and 'B' and a '2' indicating a second ending.

# A Modest Proposal: the *OLLI*•staff



# Chromatic Scale with *OLLI*•staff



But what would poor music students do with all their free time ???





# Scott Joplin: The Entertainer on *OLLI*•staff



The Entertainer  
NewNotation 1.11.xlsm



...but we were far too late

People have recognized the problem and  
have been working on it for centuries....



**SCOOPED**

Example:

# Dodeka System

Note Durations Using Bars with actual Lengths

1/32		
1/16		
1/8		
1/4		
3/8		
1/2		
3/4		
Whole		

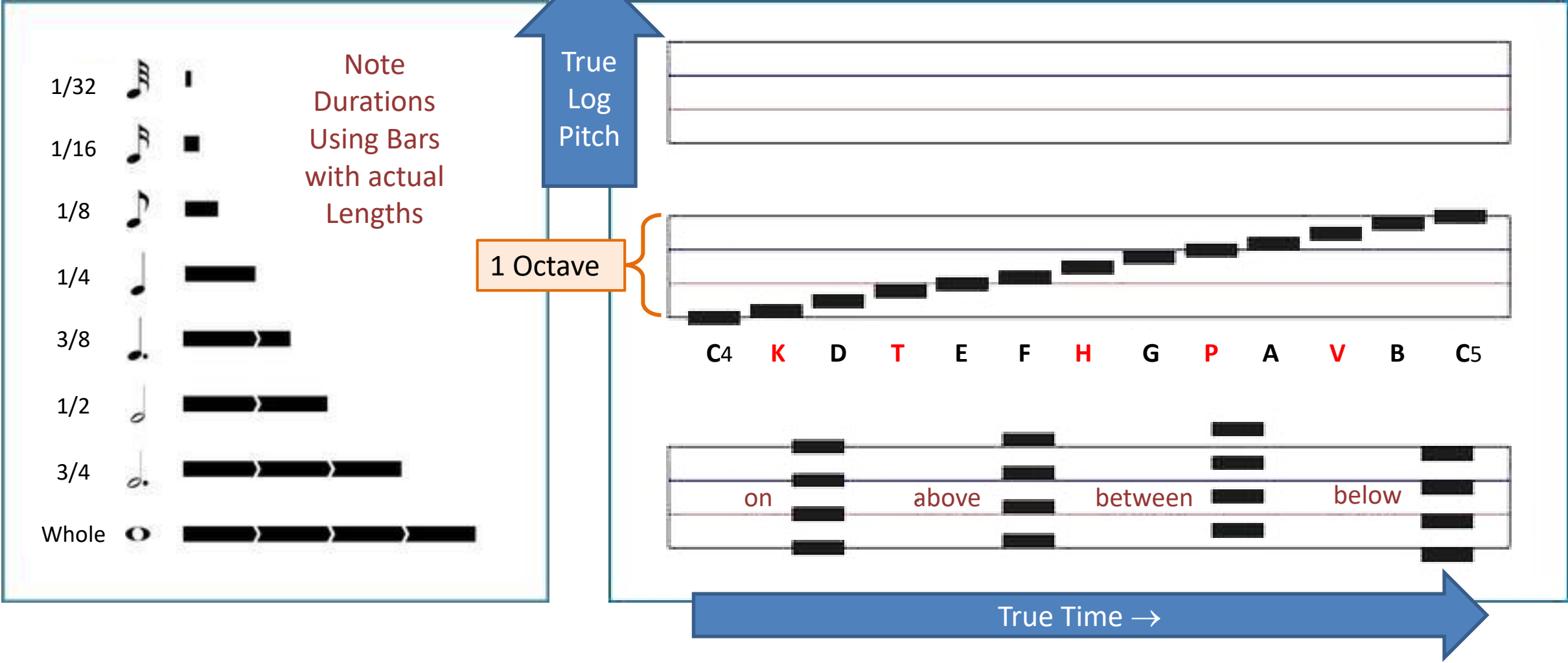
[www.DodekaMusic.com](http://www.DodekaMusic.com)





**SCOOPED**

# Dodeka System



DODEKA PLAY

# LULLABY

JOHANNES BRAHMS



Navigation icons: back, play/pause, waveform, progress bar, tempo 120, eye icon.

A musical score for a 3-measure phrase on a 5-line staff. The first measure is marked with a large '3' and a vertical bar line. The notes are as follows:

Measure	Staff 5	Staff 4	Staff 3	Staff 2
1		Two black notes		Two grey notes
2	Two black notes with a right-pointing arrow	Two black notes	Two blue notes	
3	Two black notes with a right-pointing arrow	Two black notes	Two blue notes	

The final measure of the phrase is highlighted in orange and contains:

Staff 5	Staff 4	Staff 3	Staff 2
Two brown notes	Two brown notes	Two green notes with a right-pointing arrow	



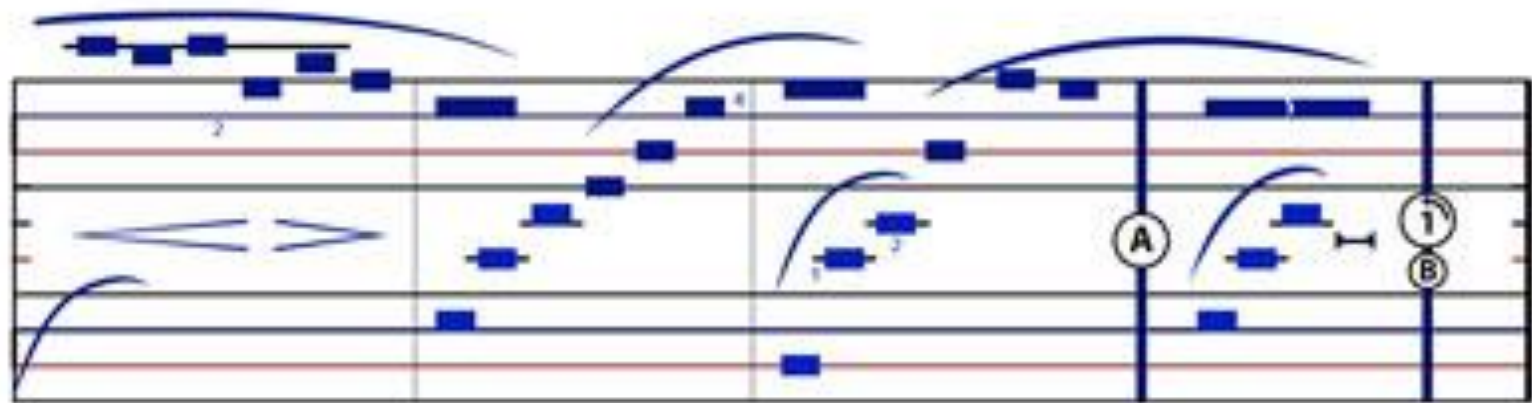
Timeline bar with musical notation and a DODEKA logo in the bottom right corner.



# Dodeka

*Fur Elise* (A minor) excerpt

Ludwig van Beethoven (1810)



Intervals and chords  
always look exactly the  
same, regardless of root  
degree or key.  
Far less to learn.

Transposing Keys is Trivial  
– just shift all notes up or  
down as desired.  
No change in appearance

# Music notation tools...

A few of the hundreds of Dodeka symbols

## Single score


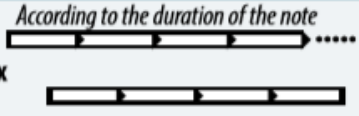

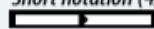





















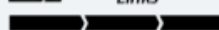

Diagram illustrating a single score with various notation tools. The score is on a four-line staff with a circled '6' at the beginning. Tools shown include: Speed (represented by a black bar with '= 60'), Intensity (represented by '+' and '-' signs), Nuances (represented by a wedge), Pedal (represented by a slider), Tone (represented by a bar), Additional line (represented by a blue bar), Change (represented by a diamond), Repetitions (represented by circles with '2'), Return (represented by arrows), and End (represented by a vertical bar). A zoomed-in section on the right shows a vertical stack of lines with numbers 4, 5, and 6.


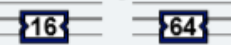




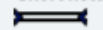



















## Triple scores

Diagram illustrating triple scores with various notation tools. The score is on a seven-line staff with a circled '4' at the beginning. Tools shown include: Octave (represented by a bar), Tempo (represented by a bar), Notes (represented by blue bars), Expression (represented by a bar), Mesure (represented by a bar), Time zoom (represented by a bar), Landmarks (represented by vertical bars), and Zoom sound (represented by a vertical bar). A zoomed-in section on the right shows a vertical stack of lines with numbers 4, 5, 6, and 7. Other tools include Triplet (represented by a bracket), Expression (represented by a wavy line), and Repeat (represented by a diamond).

# Comparison of Traditional and Dodeka Note and Rest Symbols

Estimated learning time advantage: > 3x

Notes	
	N. value: 16-32x <i>According to the duration of the note</i> 
	Note value: 8 x <i>Short notation (4x)</i>  <i>Linear notation</i> 
	Value: 4 x <i>Short notation (4x)</i>  <i>Linear notation</i> 
	Note value: 2 x <i>Short notation (4x)</i>  <i>Linear notation</i> 
	Reference note value: 1 x 
	Note value: 1/2 
	Note value: 1/4 
	Note value: 1/8 
	1/16 1/32 1/64 Zoom 4x  1/2 1/4 1/8
	Beamed notes  Arrow
	Dotted note  Links 
	Ghost note x xx xxx Depending on the duration

Rests	
	Time : 16-32x <i>Duration according to the number</i> 
	R. value: 16x  R. value: 8 x 
	R. value : 4x <i>Short notation (4x)</i>  <i>Linear notation</i> 
	Rest value: 2x <i>Short notation (4x)</i>  <i>Linear notation</i> 
	Reference rest value: 1 x 
	Rest value: 1/2 
	Rest value: 1/4 
	Rest value: 1/8 
	Rest value: 1/16
	1/32 1/64 Zoom 4x  + 1/4 1/8
	Breath mark 
	Caesura 

But alas, we are probably doomed.....