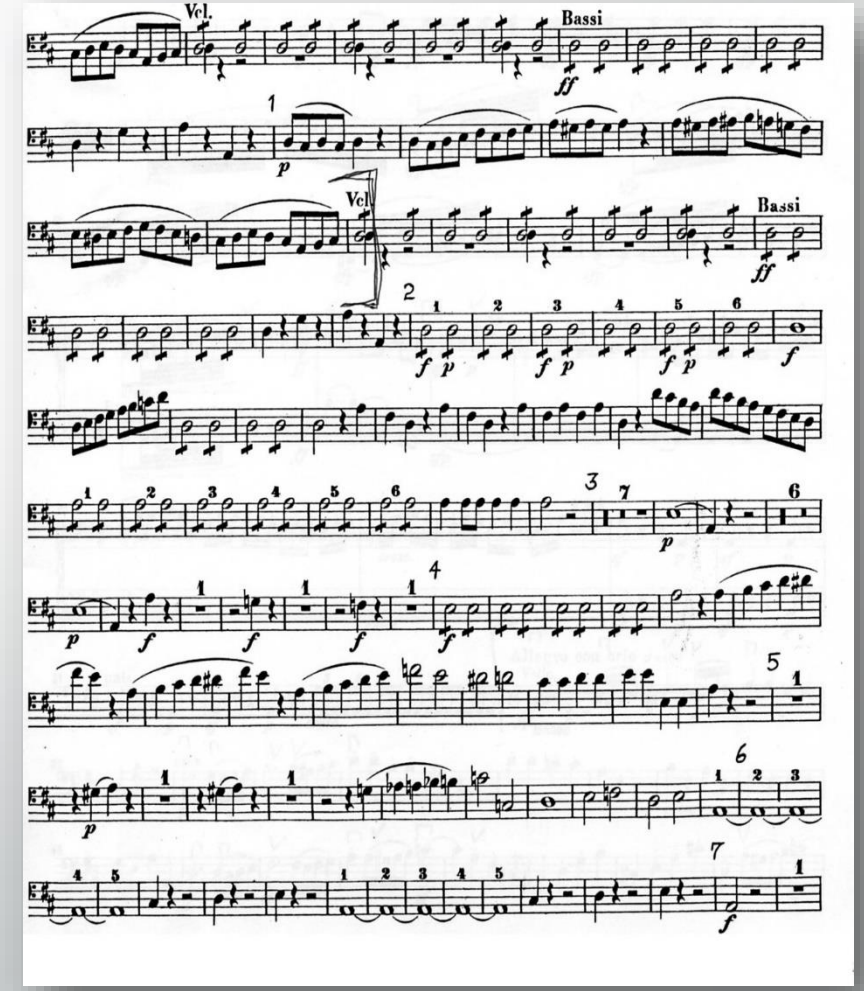
Algorithmic Composition with Pure Data

Somil Govani

Is Music a Science?

- Many patterns
  - Musical scales
  - Harmonics
- Music theory has specific rules
- Could a computer do it?



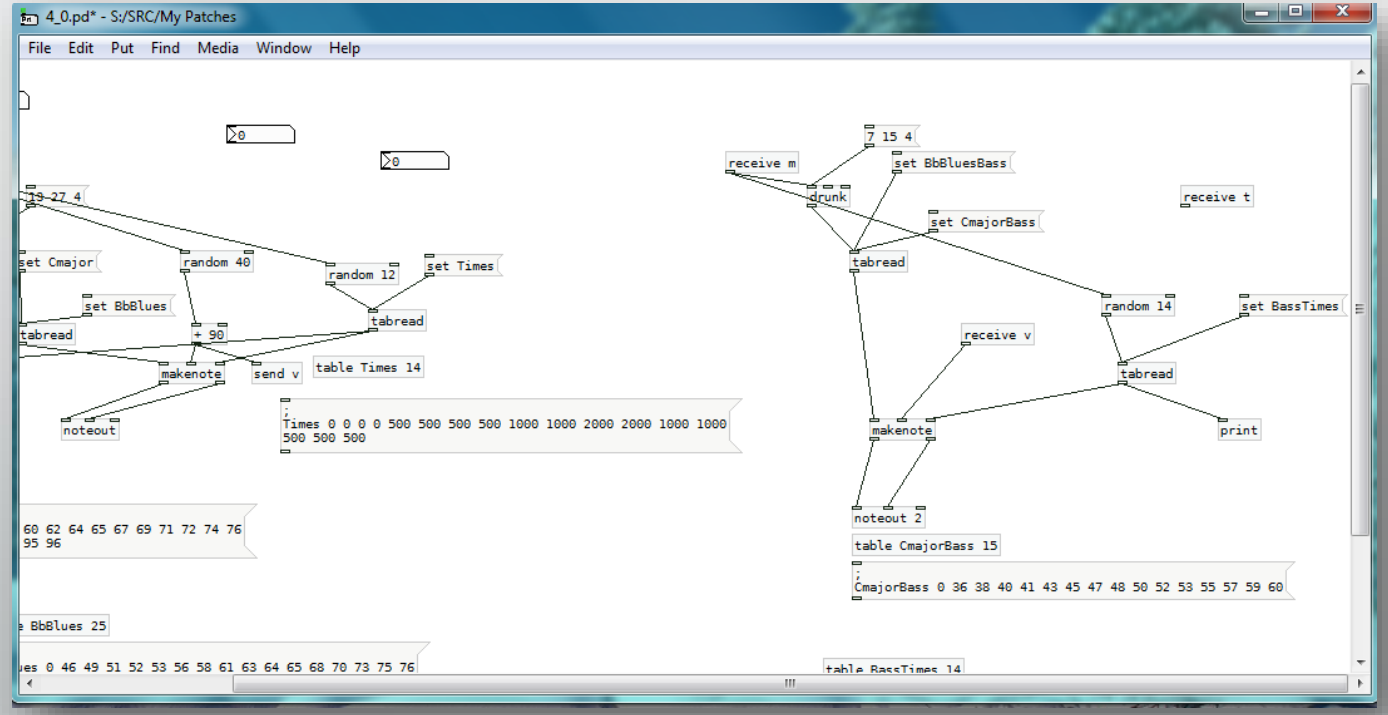
http://sordylhouseofmusic.com/images/sheet-music.jpg

What is Algorithmic Composition?

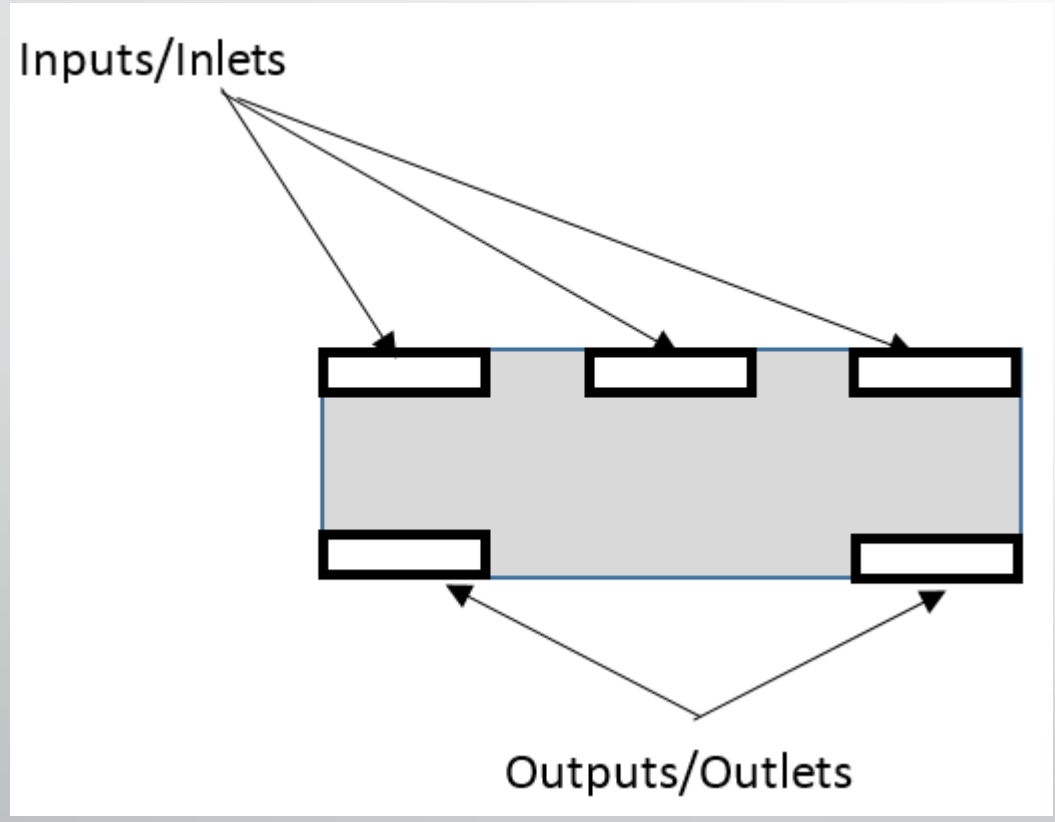
- Use of algorithms and formulas to create music
- Combines math and music
- Spontaneous generation

What is Pure Data?

- Visual Programming Language
- Generates sounds based on program parameters



Syntax

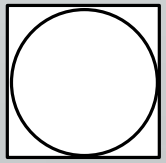


Object

Message

Number

Bang



Goal

use Pure Data to create a self-sufficient computer program, which self-generates music (by definition), through implementation of various concepts of algorithmic composition

Scientific Qualities in Music

Note Variation	Musical Randomization & Improvisation	Frequency Parameters
Limited Step Size (Walks)	Musical Scales	Dynamics
Duration	Polyphony & Harmony	Silence

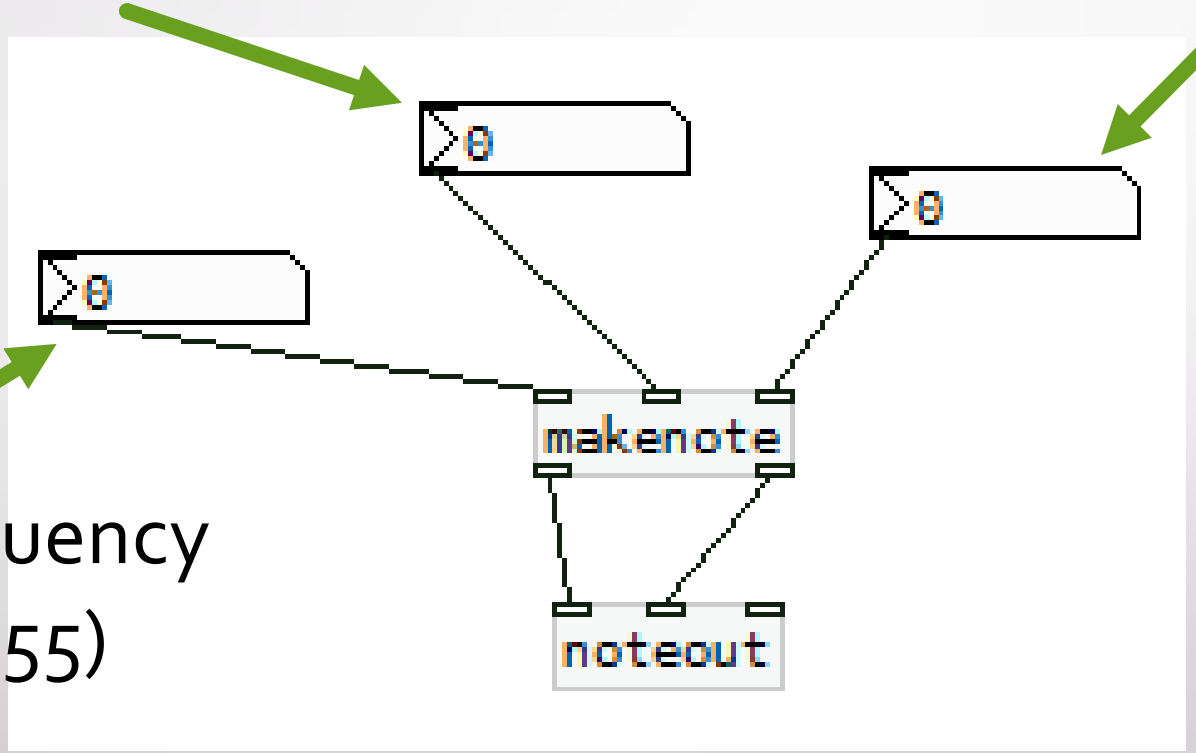
Note Variation

utilization of an assortment of notes, sounds, and frequencies (varied in pitch, velocity (attack), and duration

Note Variation

Velocity (0 to 127)

Duration (milliseconds)



Pitch (Frequency from 0 to 255)

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Musical Randomization & Improvisation

generate music without premeditation or pre-composition (randomize pitch, velocity, duration)

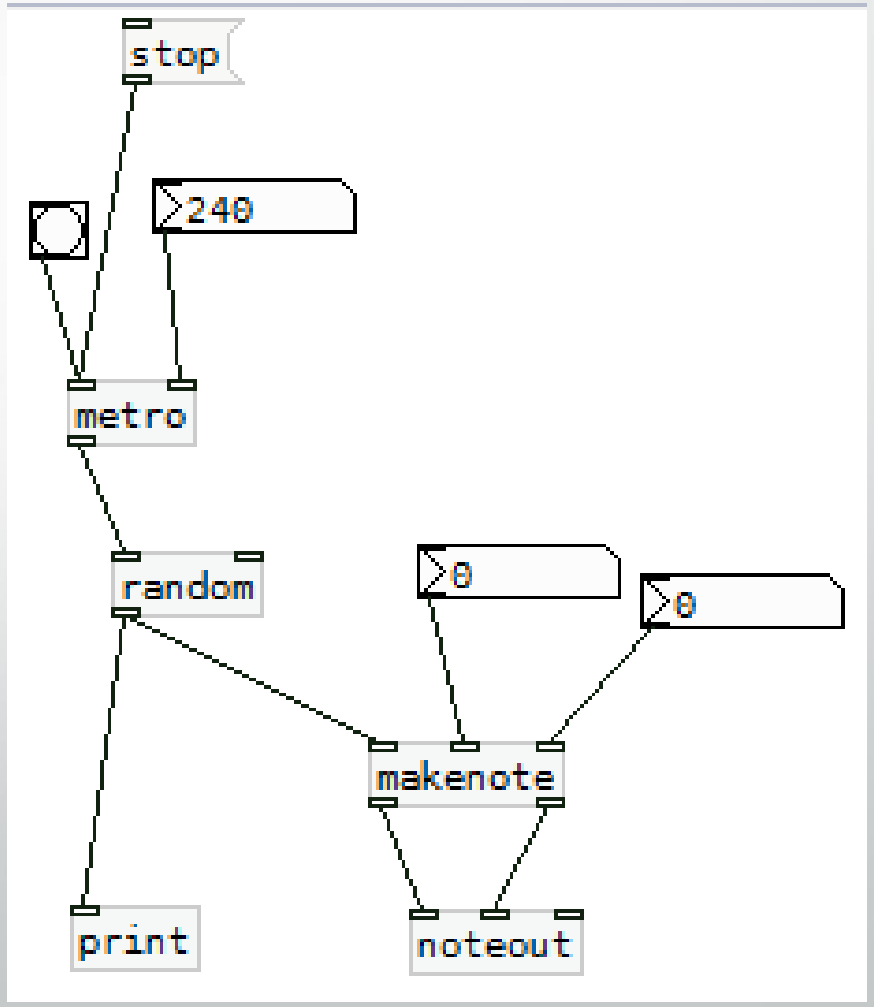
Randomization of Pitch

Message that stops program from running

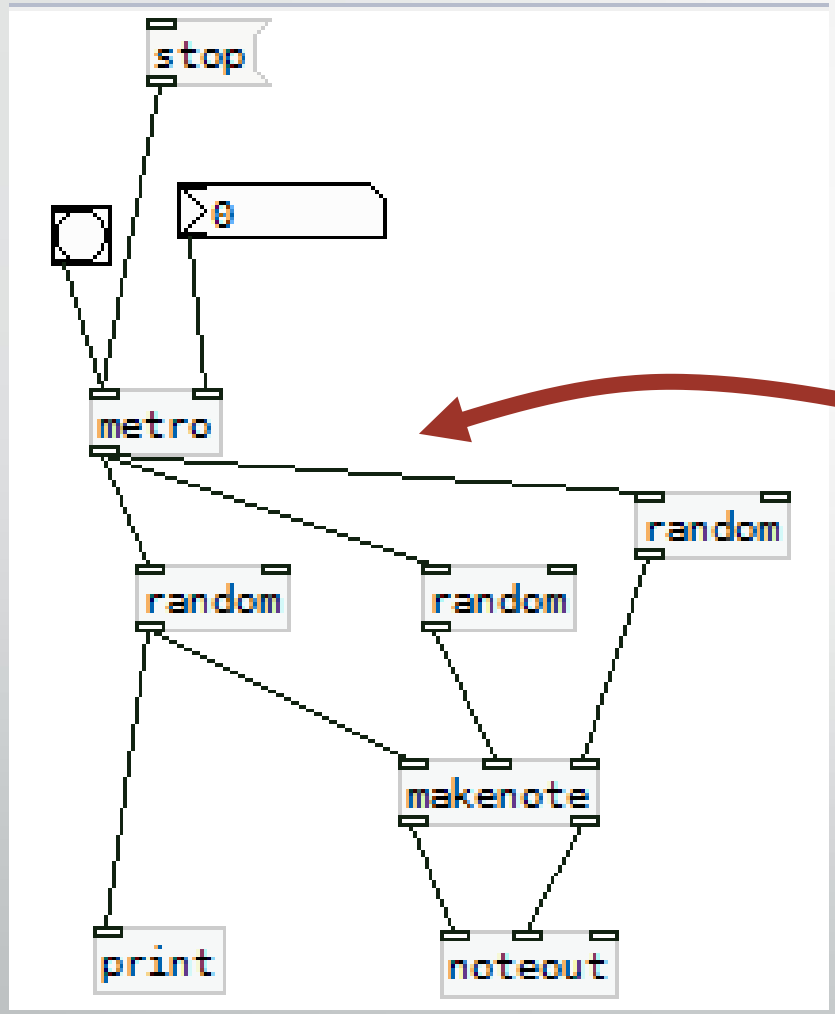
Bang that starts the program flow

Metronome with input that controls tempo (240*)

Randomizes values flowing into makenote *pitch*



Random Velocity & Duration



Similarly randomized velocity (attack) & duration

Linked to same metronome for time correspondence with pitch

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Frequency Parameters

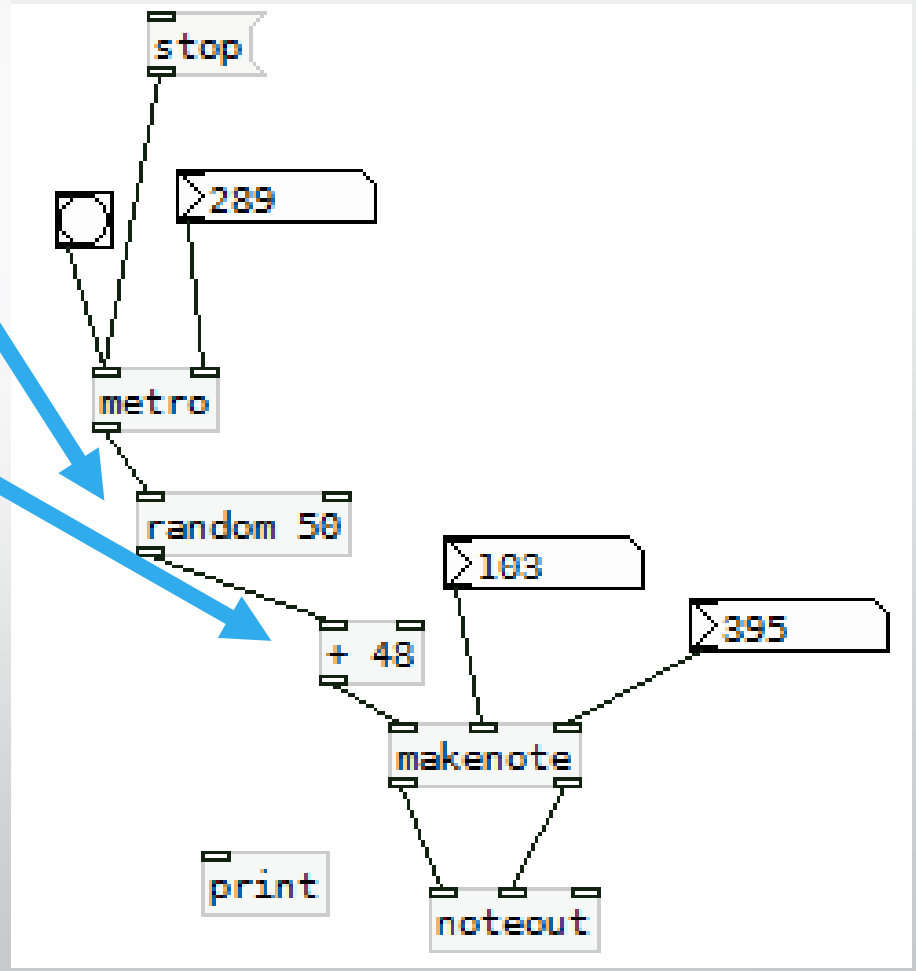
control over the parameters of the upper and lower extremes of pitch variation

Frequency Parameters

Set max value of random to 50

Add 48 to that value

This makes parameter of pitches' range from 48-98



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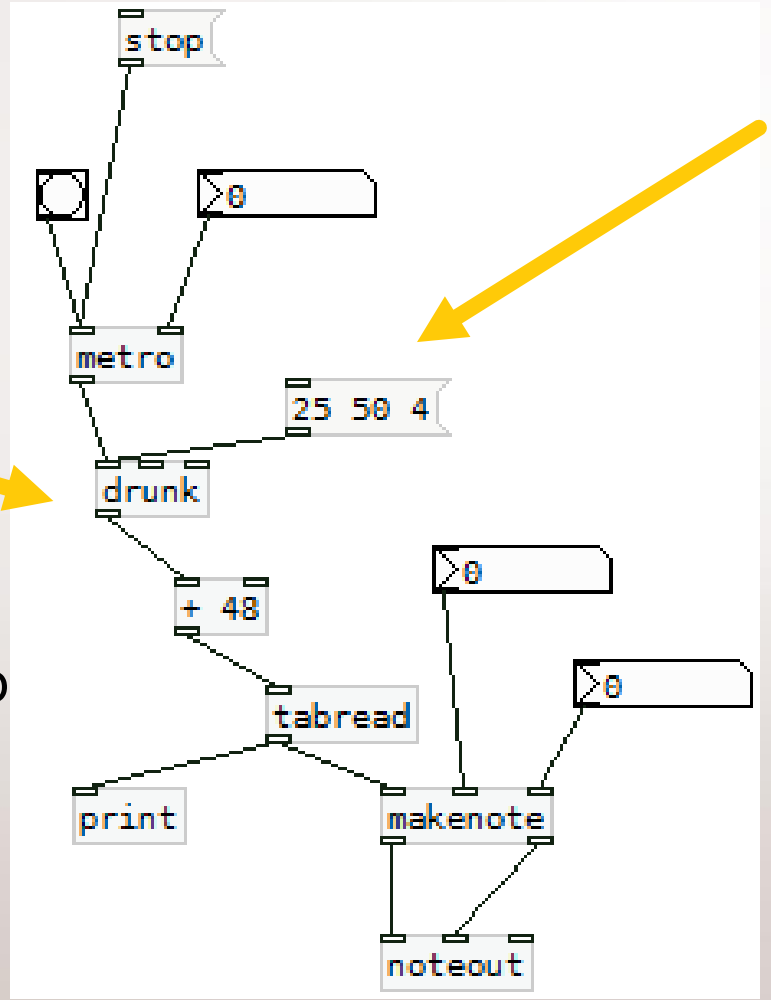
Limit Frequency Step Size (Walks)

regulation of musical randomization & improvisation through limitations on jump ranges

Limit Step Size

Replace *random* with *drunk*

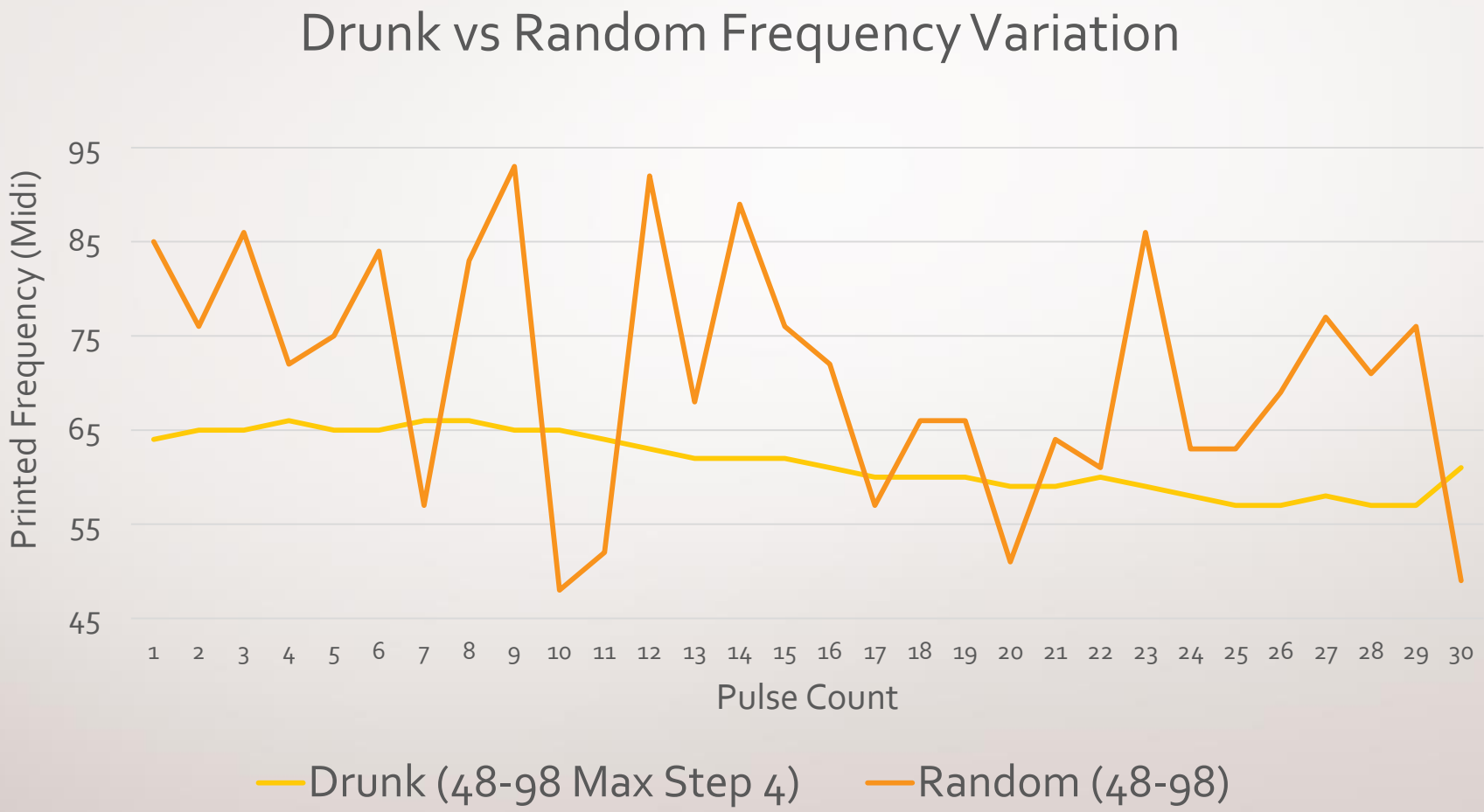
Similar to *random* parameters, + *48* to set range as 48-58



Input with three numbers

1. First number is index value / starting point (25)
2. Second number is maximum
3. Third is maximum movement from previous value

Graphical Juxtaposition



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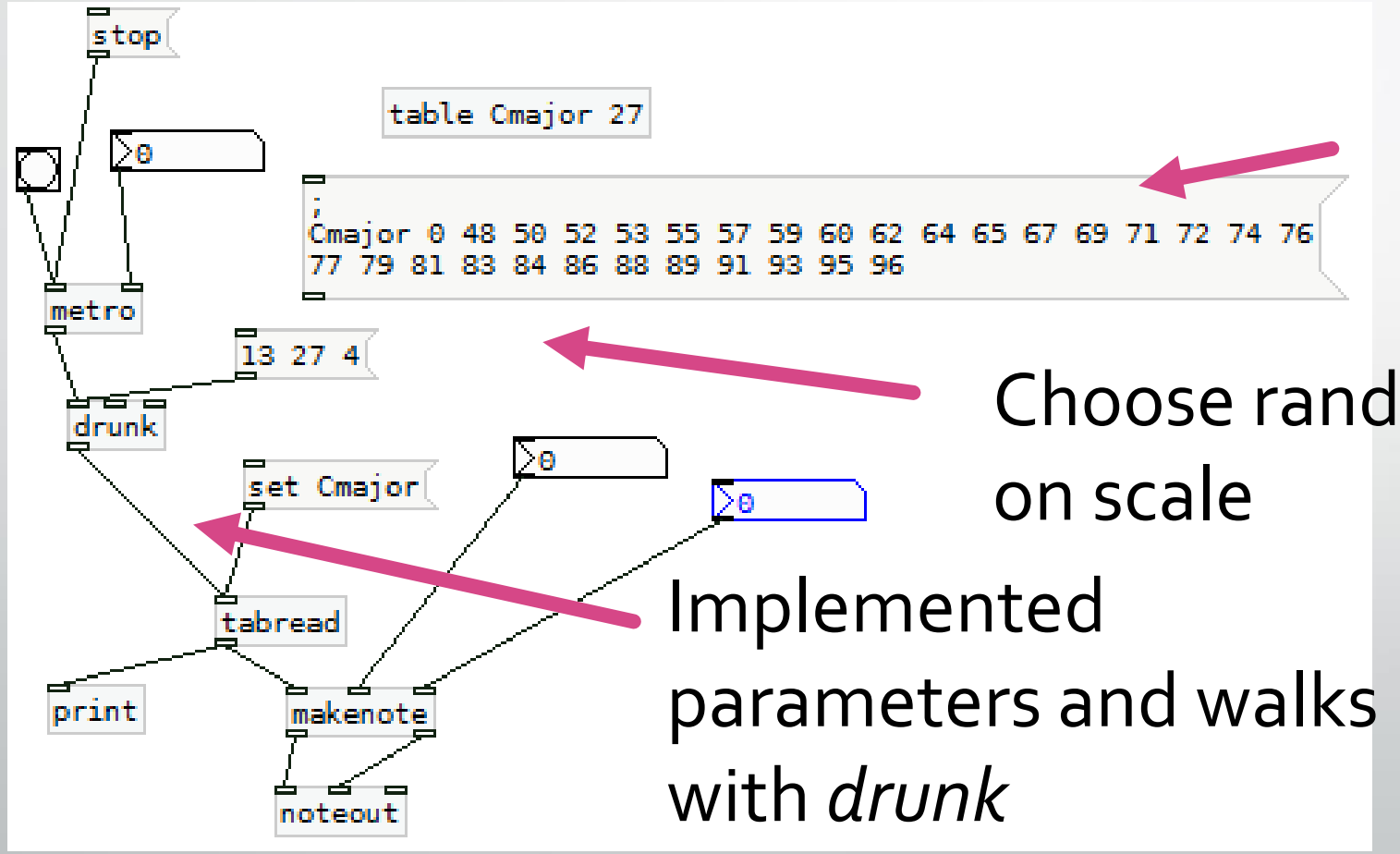
Implementation of Musical Scales

limiting utilization to groups of notes that hold significance in music theory and frequency harmonics

Musical Scales



Converted C-major Scale to frequency values

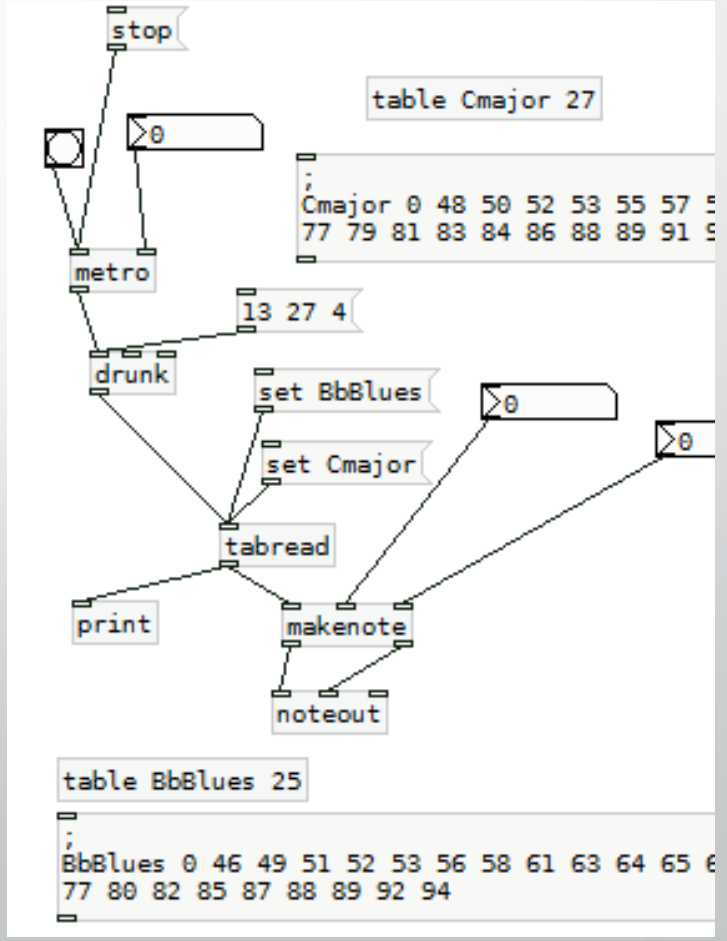
Choose random value on scale

Implemented parameters and walks with *drunk*

Experimentation with other Scales

Cmajor Scale +12k	
C	0
D	2
E	4
F	5
G	7
A	9
B	11

BbBlues Scale +12k	
Bb	10
Db	13
Eb	15
E	16
F	17
Ab	20
Bb	22



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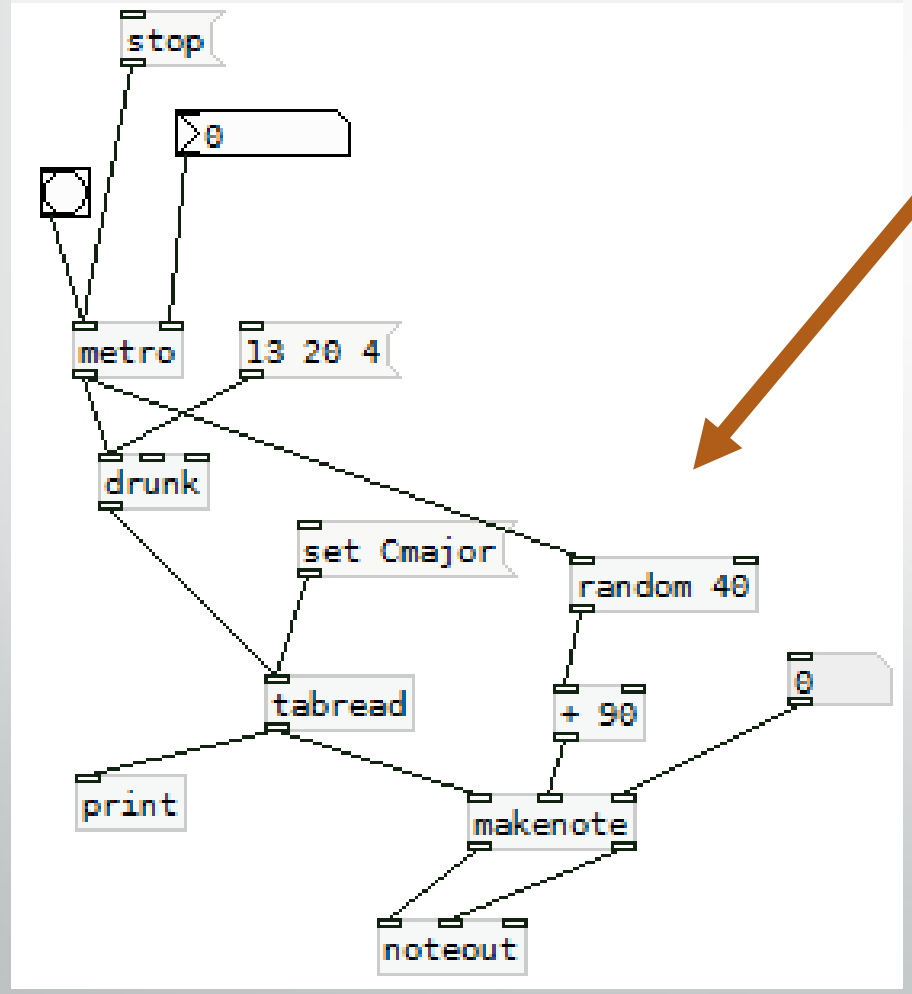
Dynamics

change in the velocity, attack, and volume of notes

Dynamics



Randomize the velocity (attack) similar to pitch

- + *90* sets parameters to 90-130
- Consider using *drunk* for **crescendos** and **decrescendos**

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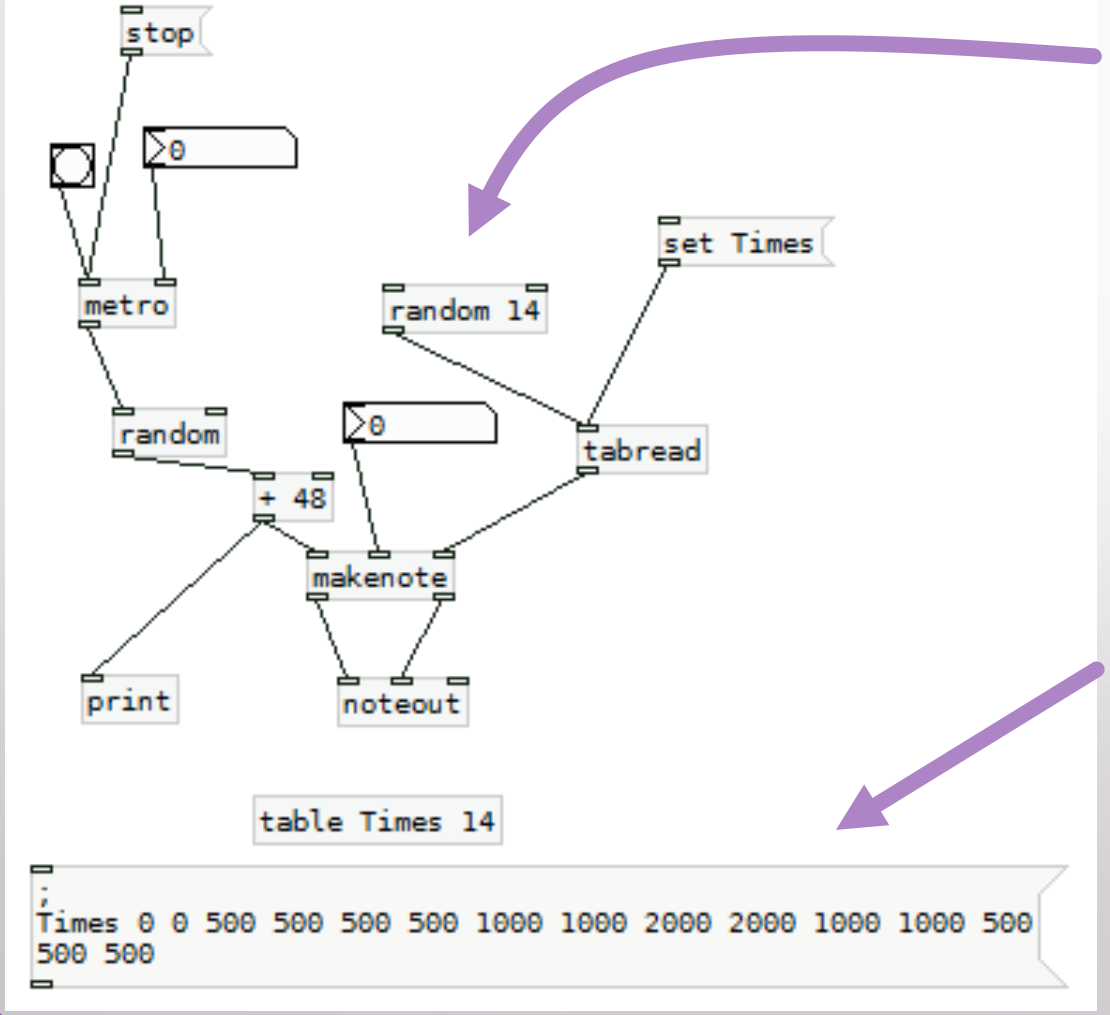
Duration and Rhythm

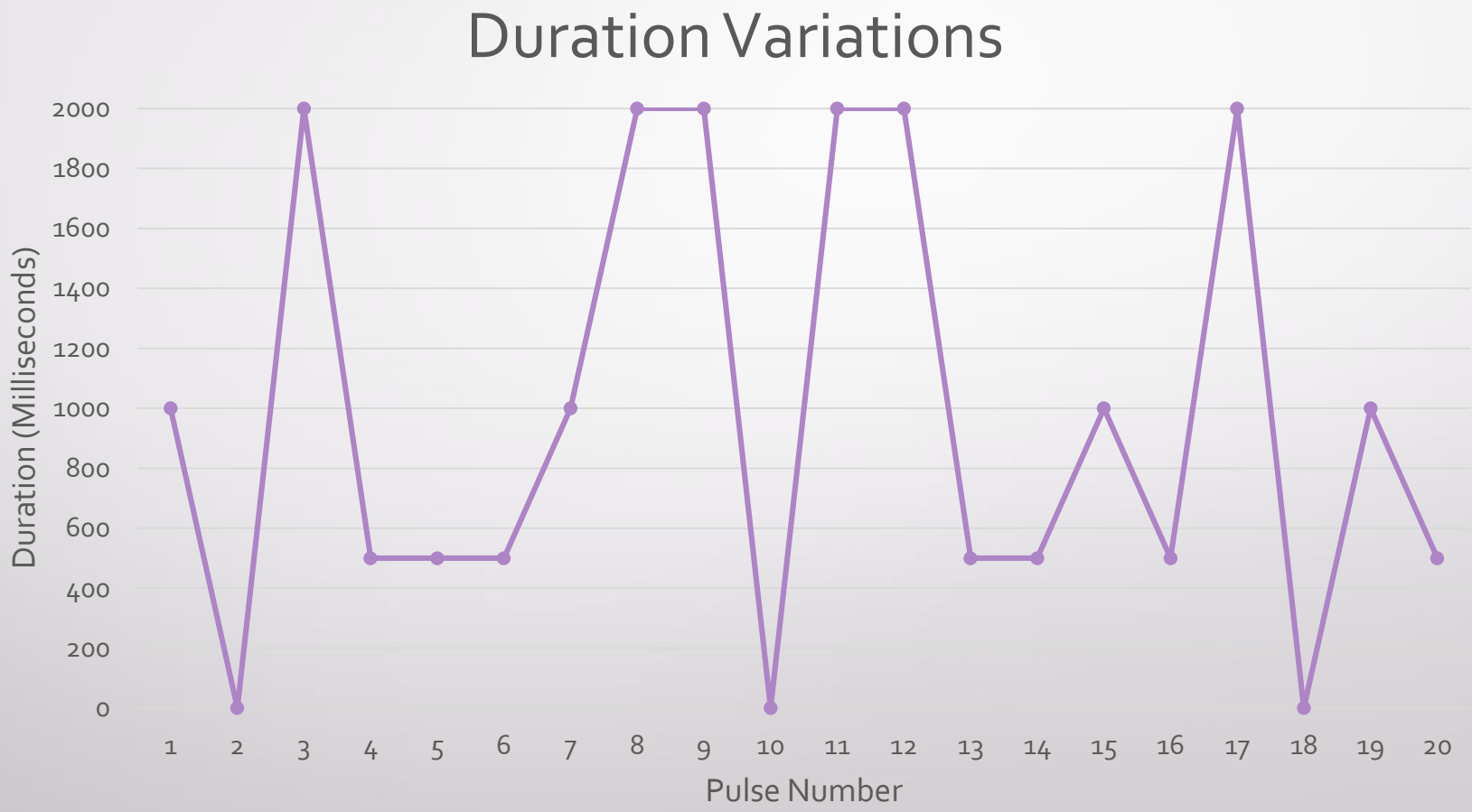
change note lengths to add rhythmic diversity to music

Note Lengths



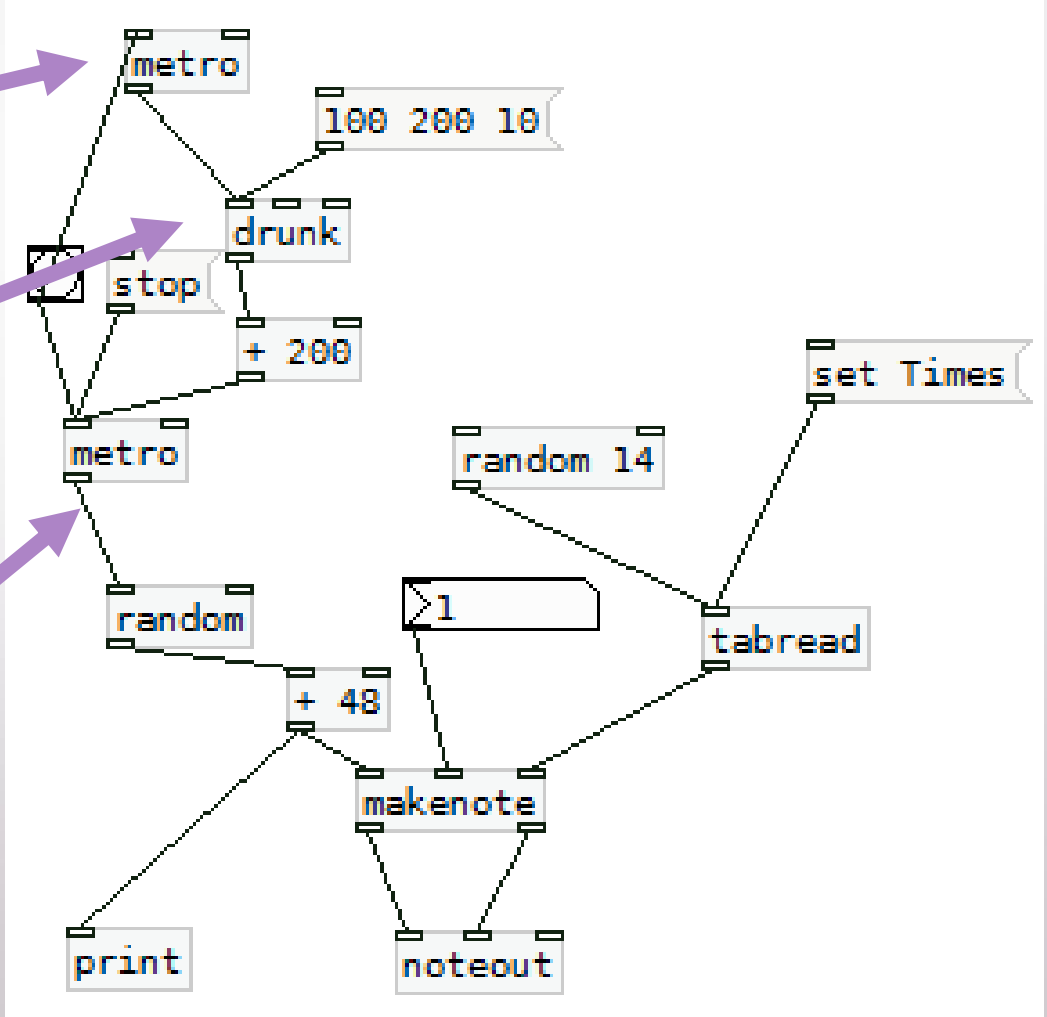
- Use *random* to pick value from 0-14
- Link table of times (milliseconds)
- Unevenly distribute times so some occur more for musical aesthetics

Graphical Representation



Rhythms & Tempos

- Connect second *metro* for independent bang scheme
- Attach *drunk* with parameters of 200-400 (index at 300)
- Run it into original metro (tempo graduates from 200-400)



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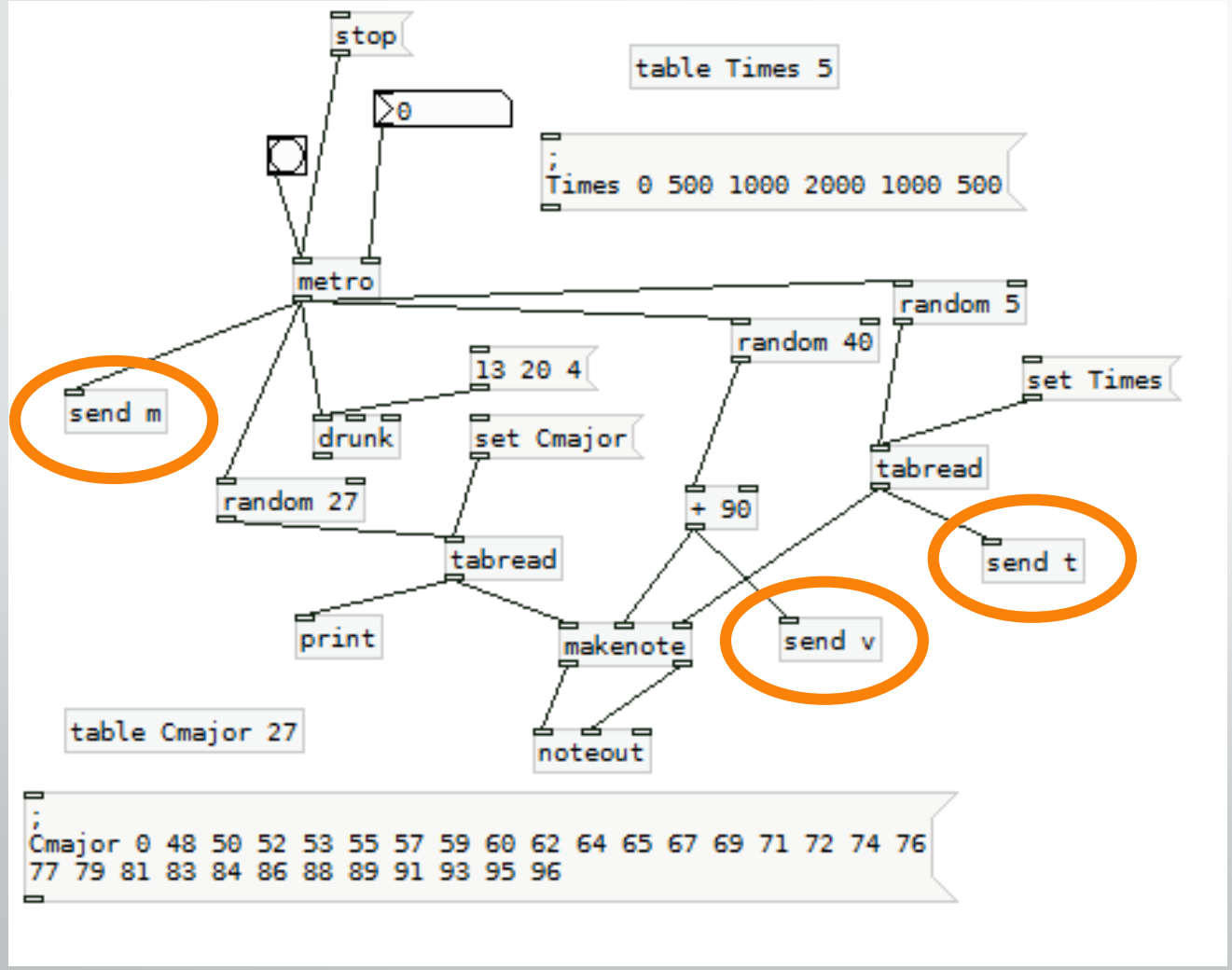
Polyphony & Harmony

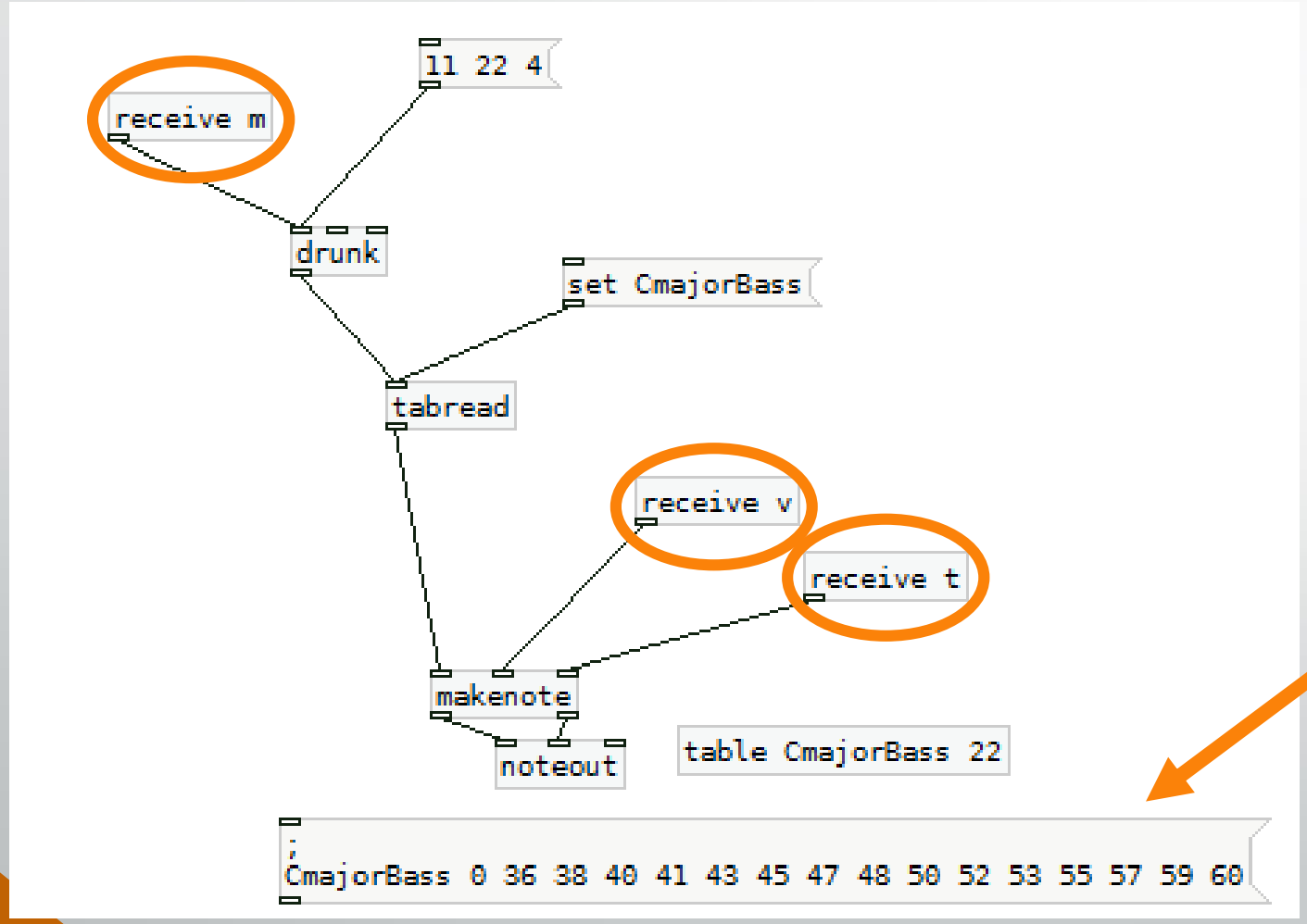
utilization of simultaneous and independent musical tendencies in complement to one another

Bass Accompaniment



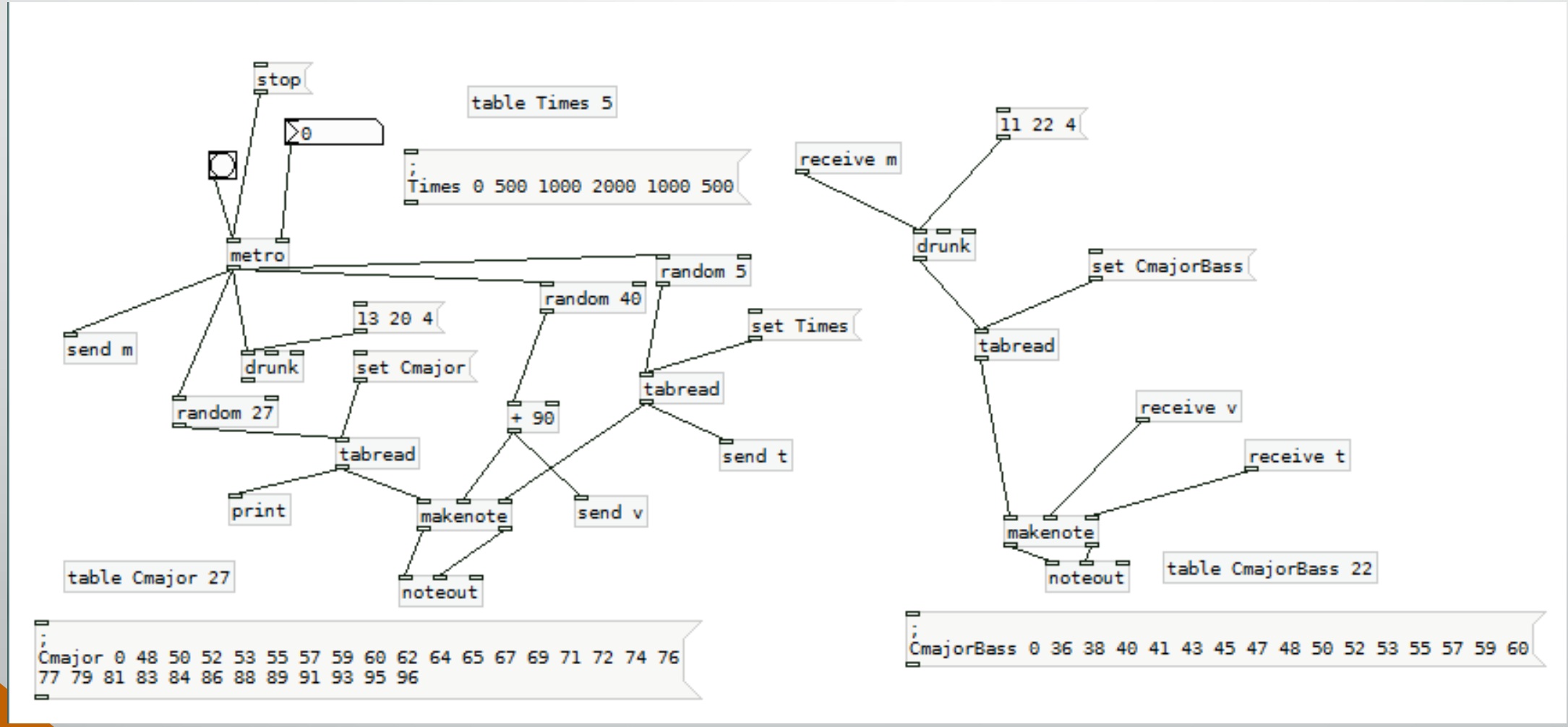
- Send velocity (v)
- Send duration/time (t)
- Send *metro* (m)
- Keeps these values constant in accompaniment

Bass Accompaniment



- Form parallel structure for accompaniment
- Receive m, v, t values in appropriate place
- Add lower octaves
- Add other algorithms

Bass Accompaniment



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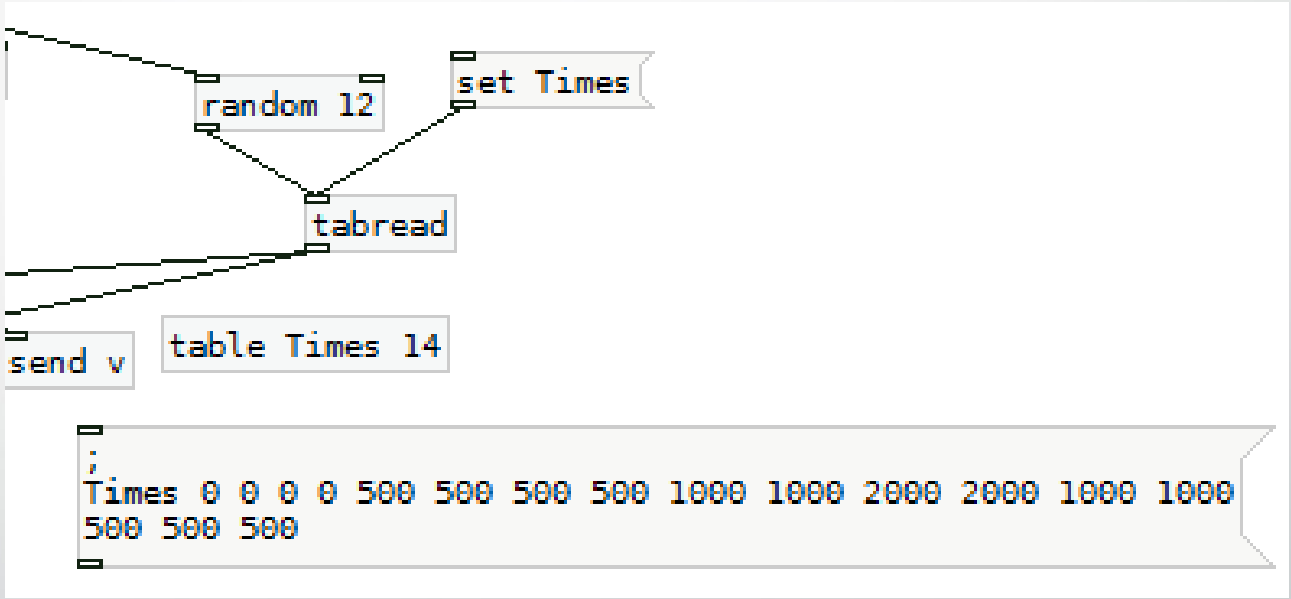
Silence

periodic breaks and rests in musical progression

Silence and Rests

- Add zeroes into duration table
- Will pose as a rest
- Enter multiple times for balance



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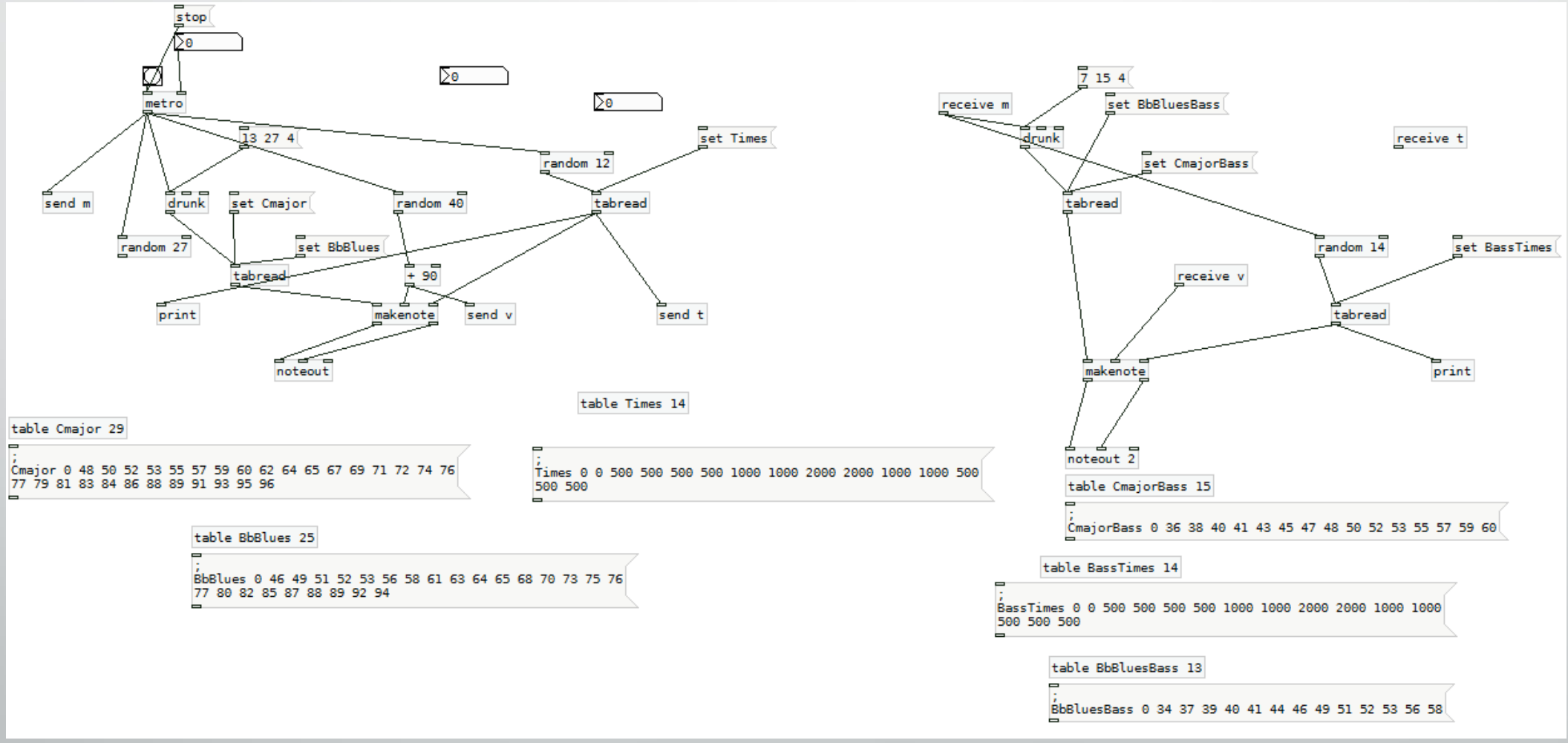
Final Product



Conclusion

Successes

- Possible to combine mathematics, computer science, and music theory to spontaneously generate music
- Implemented multiple aspects of algorithmic composition

Developing Areas

- Computerized – less genuine product
- Continuous flow – needs musical structure
- Additional layers


Determinacy and Repetition
Timbre
Consonance & Dissonance
Imperfection
Musical Structure
Progression
Additional Implements

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Thank You