

Chapter 8. Meeting 8, Approaches: Permutations, Generators, and Chaos

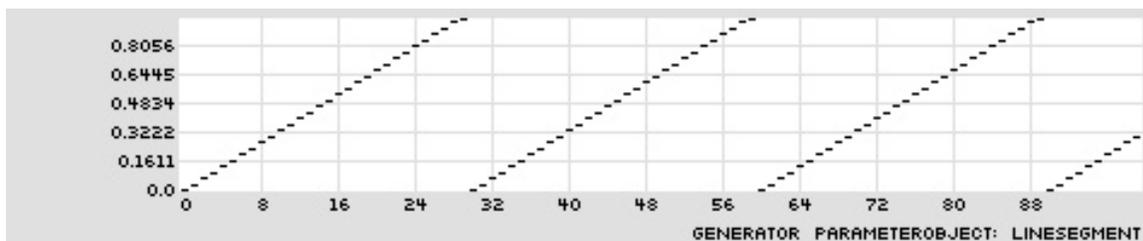
8.1. Announcements

- KIOKU concert this Friday, 6:30, in the MIT Lewis Music Library
- Musical Design Report 2 due 11 March: details to follow
- Sonic System Project Draft due 27 April: start thinking

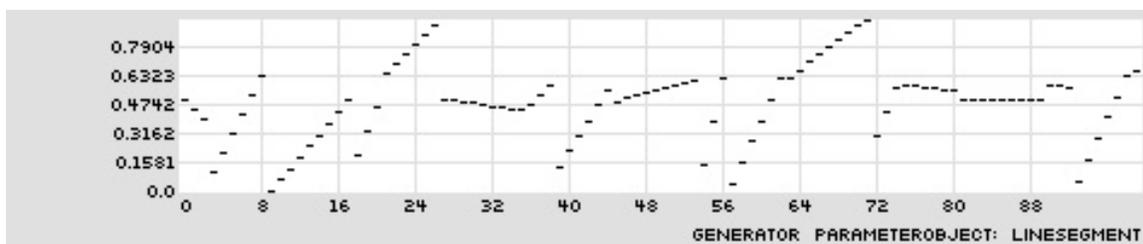
8.2. A Line Segment Generator

- Often we need to vary a parameter linearly over time or events
- Break point functions require defining individual points
- LineSegment: A dynamic line generator between minimum and maximum values over a duration

```
:: tpmmap 100 ls,e,30,0,1  
lineSegment, (constant, 30), (constant, 0), (constant, 1)  
TPmap display complete.
```



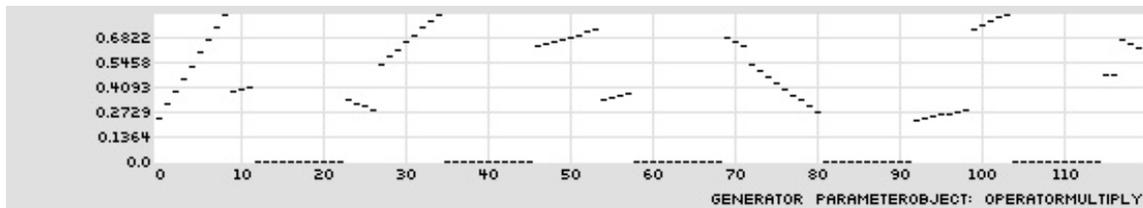
```
:: tpmmap 100 ls,e,(bg,oc,(3,6,9)),(ru,0,.7),(ru,.3,1)  
lineSegment, (basketGen, orderedCyclic, (3,6,9)), (randomUniform, (constant, 0),  
(constant, 0.7)), (randomUniform, (constant, 0.3), (constant, 1))  
TPmap display complete.
```



8.3. Large Scale Amplitude Behavior with Operators

- By multiplying or summing multiple behaviors, dynamic large-scale shapes are possible
- Multiplying amplitudes by zero can create periods of inactivity
- Techniques derived from modular synthesis
- OperatorMultiply used to scale LineSegment and WavePulse

```
:: tpmmap 120 om,(ls,e,9,(ru,.2,1),(ru,.2,1)),(wp,e,23,0,0,1)
operatorMultiply,(lineSegment,(constant,9),(randomUniform,(constant,0.2),
(constant,1)),(randomUniform,(constant,0.2),(constant,1))),(wavePulse,
event,(constant,23),0,(constant,0),(constant,1))
TPmap display complete.
```



- Command sequence:
 - emo mp
 - tin a 64
 - tie r pt,(bg,rp,(16,16,8)),(bg,rp,(2,2,1,4)),(c,1)
 - tie a om,(ls,e,9,(ru,.2,1),(ru,.2,1)),(wp,e,23,0,0,1)
 - eln; elh
- Related ParameterObjects: OperatorAdd, OperatorMultiply, OperatorDivide, OperatorPower, OperatorSubtract, OperatorCongruence

8.4. Reading: Ames. A Catalog of Sequence Generators: Accounting for Proximity, Pattern, Exclusion, Balance and/or Randomness

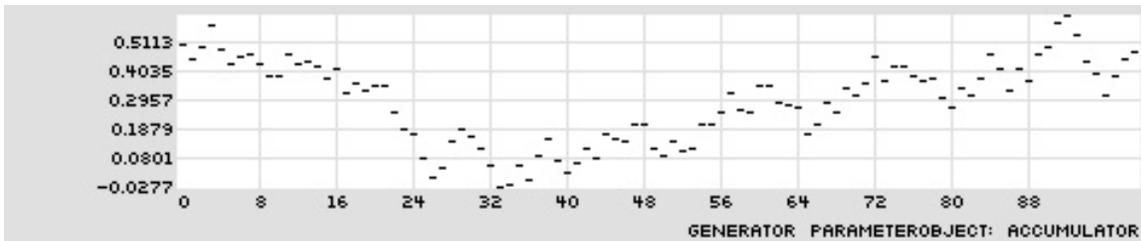
- Ames, C. 1992. "A Catalog of Sequence Generators: Accounting for Proximity, Pattern, Exclusion, Balance and/or Randomness." *Leonardo Music Journal* 2(1): 55-72.
- What does ames mean by dependence, exclusion, and balance

- Why does Ames have so many varieties of random uniform generators, such as LEHMER, SPREAD, FILL, and others?
- How is Brownian motion related to random walks?
- How does Ames characterize the artistic opportunities of using 1/f noise?
- What are the characteristics of output provided by chaotic generators such as LOGISTIC and BAKER
- What is the idea of a chaos knob?

8.5. Continuous Random Walks

- We can use BasketGen for discrete random walks
- We can use Accumulator for continuous random walks
- Accumulator

```
:: tpmmap 100 a,.5,(ru,-.1,.1)
accumulator, 0.5, (randomUniform, (constant, -0.1), (constant, 0.1))
TPmap display complete.
```



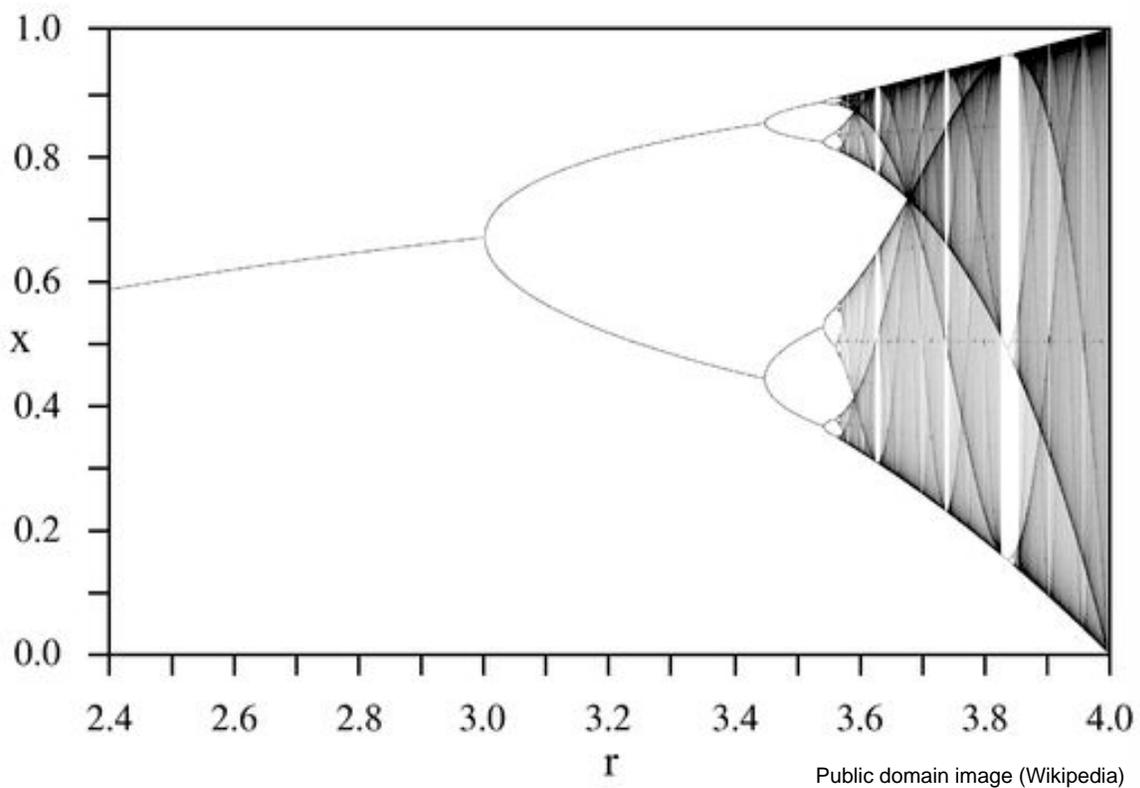
8.6. Chaos and the Logistic Map

- Complex dynamical systems
- Deterministic systems that exhibit complex behavior
- Most employ iterative processing and result in sensitivity to initial conditions (butterfly effect)
- The logistic map was developed as a model of population growth by Pierre Verhulst

$$x_{n+1} = rx_n(1 - x_n)$$

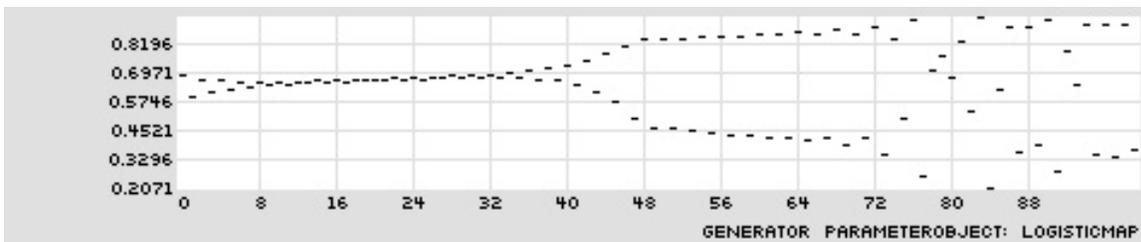
r is a positive number between 0 and 4 that represents a combined rate for reproduction and starvation

- States produces constant outputs, oscillating behavior, and complex behavior



- LogisticMap: most interesting output available from p (or r , λ , or chaos knob) between 2.75 and 4

```
:: tpmmap 100 lm,.5,(ls,e,100,2.75,4),0,1
logisticMap, 0.5, (lineSegment, (constant, 100), (constant, 2.75), (constant,
4)), (constant, 0), (constant, 1)
TPmap display complete.
```



- Related ParameterObjects: henonBasket, lorenzBasket

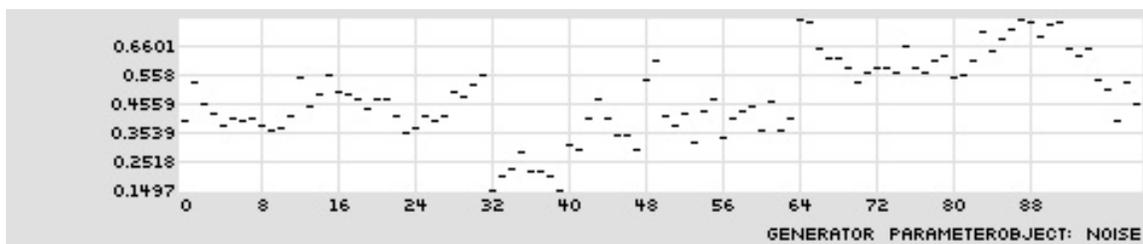
8.7. Reading: Voss and Clarke. 1/f Noise in Music: Music from 1/f Noise

- Voss, R. F. and J. Clarke. 1978. "1/f Noise in Music: Music from 1/f Noise." *Journal of the Acoustical Society of America* 63(1): 258-263.
- What is a 1/f noise, and what is the variations of noise from 1/f₀, 1/f₁, 1/f₂, 1/f₃?
- The sound and shape of correlated noise: [noiseColors.pd]
- What technique did Voss and Clarke use to analyze music?
- What sort of data did Voss and Clarke collect?
- Extracting an amplitude envelope from an audio signal: [vossClarke.pd]
- What conclusions do Voss and Clarke make about 1/f spectral densities?
- Is music (or the averaged spectral analysis of amplitude envelopes) intelligent behavior
- What technique did Voss and Clarke use to generate melodies? Is this technique parallel to the analysis technique?
- What conclusions did they draw from human evaluation of their generated melodies? Were these conclusions based on the 1/f noise source?

8.8. 1/f Noise

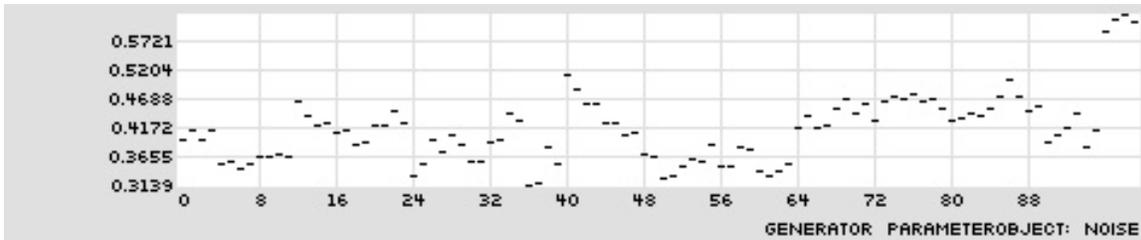
- Rather than just one type of 1/f noise, use many
- Gamma can move between 0 (white), 1 (pink), 2 (brown), 3 (black)
- 1/f noise: gamma == 1

```
:: tpmapp 100 n,100,1,0,1  
noise, 100, (constant, 1), (constant, 0), (constant, 1)  
TPmap display complete.
```



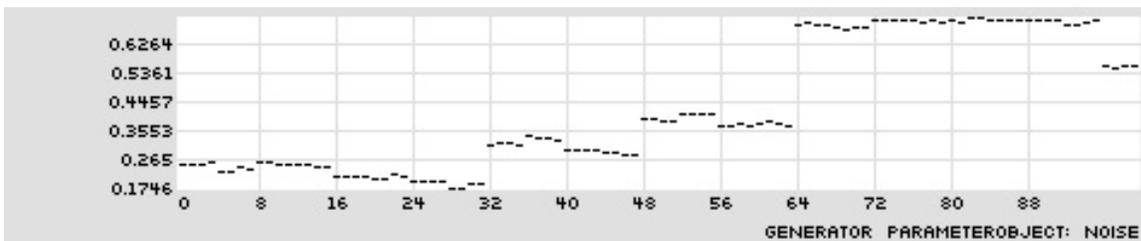
- 1/f noise: gamma == 2

```
:: tpmmap 100 n,100,2,0,1
noise, 100, (constant, 2), (constant, 0), (constant, 1)
TPmap display complete.
```



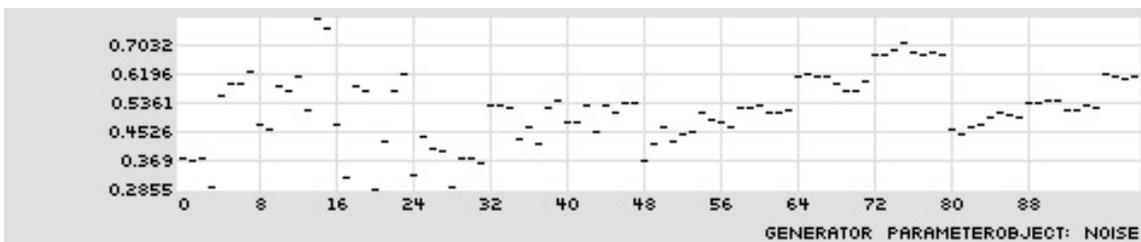
- 1/f noise: gamma == 3

```
:: tpmmap 100 n,100,3,0,1
noise, 100, (constant, 3), (constant, 0), (constant, 1)
TPmap display complete.
```



- Noise: dynamically varying the gamma

```
:: tpmmap 100 n,100,(ls,e,100,0,3),0,1
noise, 100, (lineSegment, (constant, 100), (constant, 0), (constant, 3)),
(constant, 0), (constant, 1)
TPmap display complete.
```

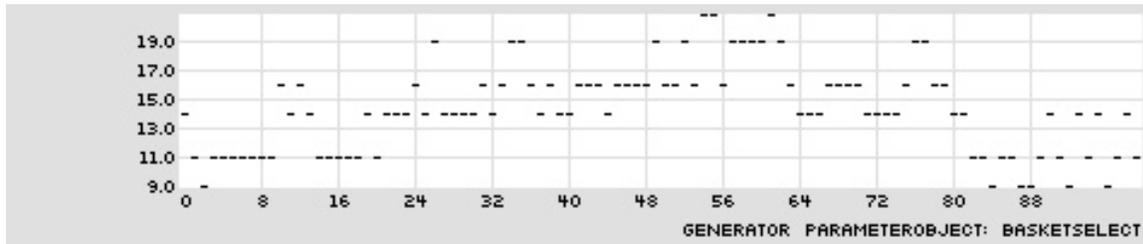


8.9. 1/f Noise in Melodic Generation: LineGroove

- Using BasketSelect to select discrete values from a continuous generator

```
:: tpmmap 100 bs,(2,4,7,9,11,14,16,19,21,23),(n,100,1,0,1)
basketSelect, (2,4,7,9,11,14,16,19,21,23), (noise, 100, (constant, 1)),
```

(constant, 0), (constant, 1)),
 TPmap display complete.



- Command sequence using TM LineGroove:
 - emo m
 - tmo lg
 - tin a 108
 - tie r cs,(ls,e,10,(ru,.01,.2),(ru,.01,.2))
 - tie f bs,(2,4,7,9,11,14,16,19,21,23),(n,100,1,0,1)
 - eln; elh

8.10. 1/f Noise in Melodic Generation: HarmonicAssembly

- Command sequence using TM Harmonic Assembly:
 - emo m
 - pin a d3,e3,g3,a3,b3,d4,e4,g4,a4,b4,d5,e5,g5,a5,b5
 - tmo ha
 - tin a 27
 - tie r pt,(c,16),(ig,(bg,rc,(1,2,3,5,7)),(bg,rc,(3,6,9,12))), (c,1)
 - tie a om,(ls,e,9,(ru,.2,1),(ru,.2,1)),(wp,e,23,0,0,1)
 - tie d0 c,0
 - tie d1 n,100,2,0,14
 - tie d2 c,1
 - tie d3 c,1

- eln; elh
- Continued command sequence: with chord size generation between 1 through 4
 - tie d3 ru,1,4
 - eln; elh

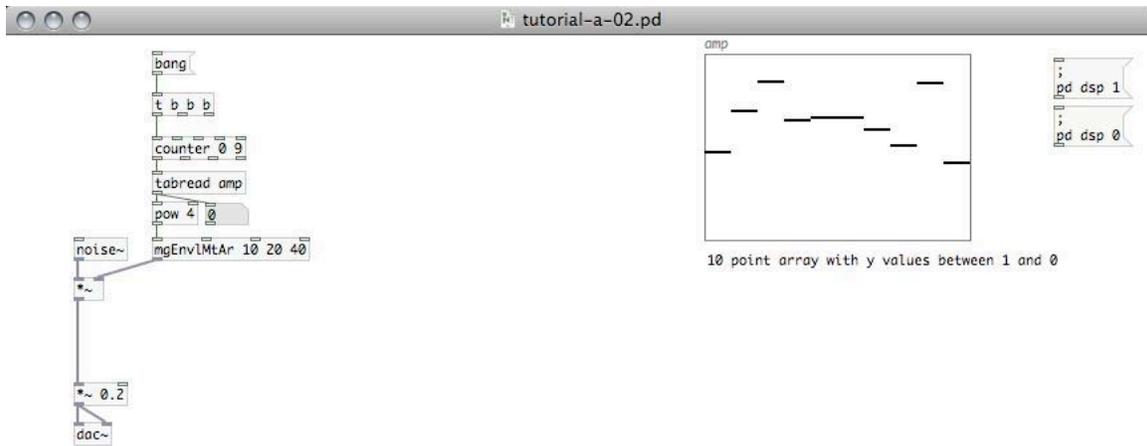
8.11. Tutorial: PD Arrays as Parameters: Filtered Noise

- [mgEnvlMtAr] creates a mono-triggered, attack-release envelope
- [mgEnvlMtAr] arguments: attack time, release time, duration
- [mgEnvlMtAr] trigger: a floating point value that sets the peak amp



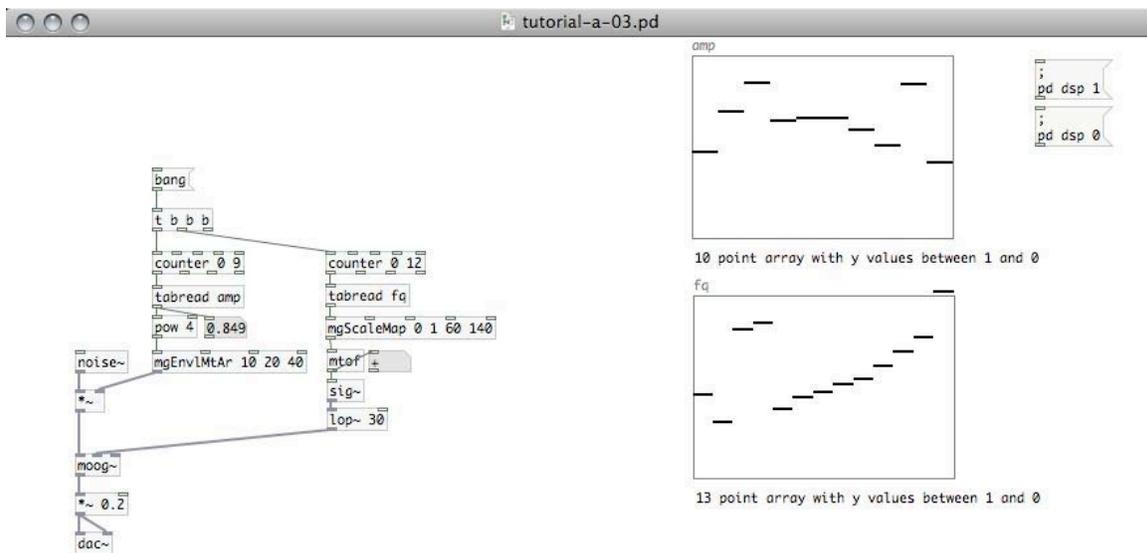
8.12. Tutorial: PD Arrays as Parameters: Cyclical Amplitude Values

- Looping through an array with amplitude values with [counter]
- [pow 4] provides non-linear to linear amplitude scaling



8.13. Tutorial: PD Arrays as Parameters: Cyclical Cutoff Frequency Values

- Looping through an array if values scaled to MIDI pitch values (60-140) with [mgScaleMap]
- MIDI pitch values are scaled to frequency values with [mtof]
- Data values are converted to signals with [mtof] and [lop~ 30]
- [moog~] provides a signal controlled low pass filter with variable resonance



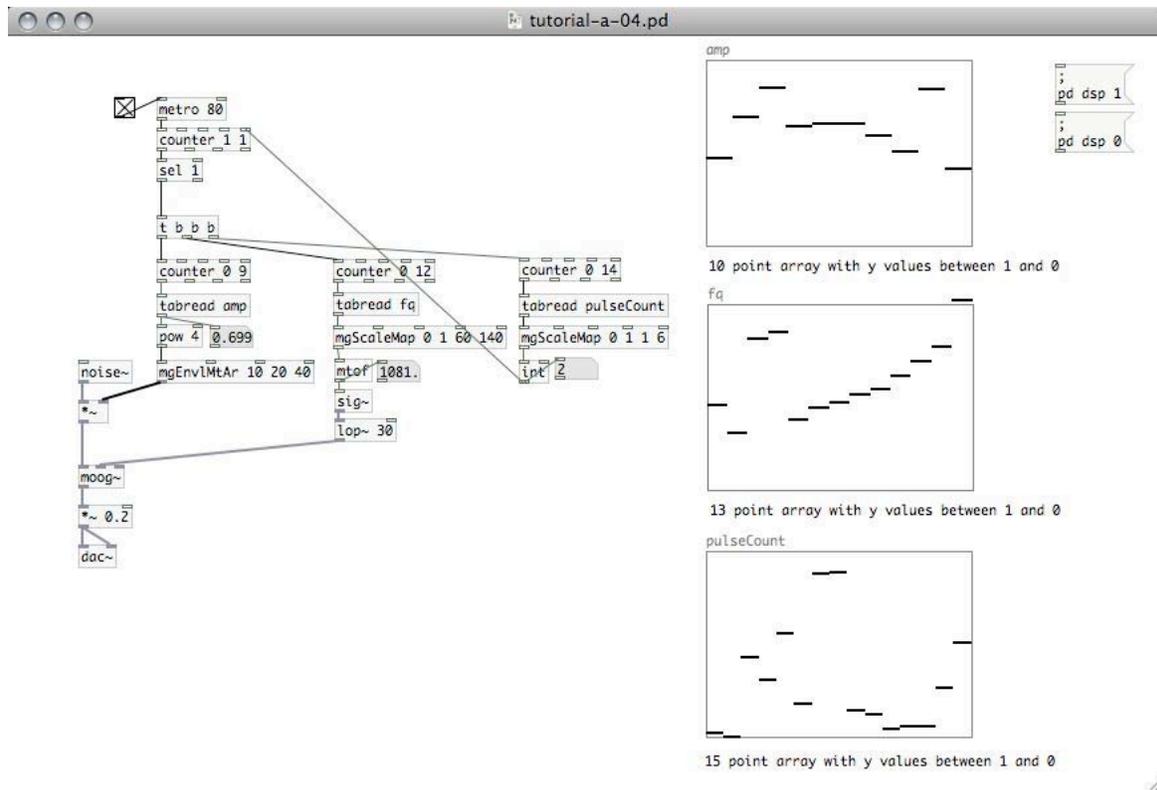
8.14. Tutorial: PD Arrays as Parameters: Cyclical Pulse Multipliers

- [metro] provides regularly spaced triggers

[counter] and [sel 1] are used to select the first of each cycle

An array of values is scaled to pulse multipliers with [mgScaleMap]

The [counter] max value is dynamically set after reading and mapping a value from the array



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