ALGORHYTHM

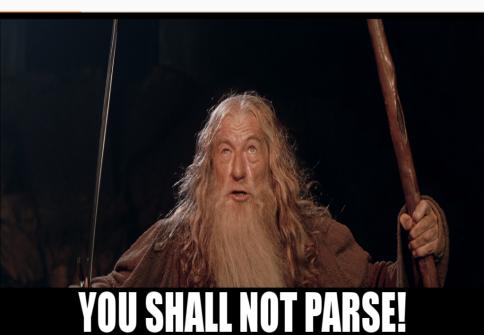
A LIBRARY FOR ALGORITHMIC MUSIC COMPOSITION

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Music DSL

music representation (Music, MusicCore, Scale, Chord, etc... music manipulation (transpose, retrograde, time-scale, etc..



GENERATION

genState, selectors, diatonic improv, etc..

DYNAMIC PERFORMANCE

k-means, etc...

GRAMMARS: PROPERTIES

(Generative) context-free grammars, with a few extra features:

- · Temporal: Rules are parametric to duration
- · Probabilistic: Rules can be assigned weights
- Graph: Allow node sharing (using *let*-expressions)

GRAMMARS: DEFINITION

```
data Grammar meta a =
   a |: [Rule meta a]
data Rule meta a =
    (a, Weight, Dur -> Bool) :-> (Dur -> Term meta a)
data Term meta a =
    a:%: Dur
    Term meta a :-: Term meta a
    | Aux Bool meta (Term meta a)
     Let (Term meta a) (Term meta a -> Term meta a)
(a, w) - | f = (a, w, f) :-> (a %:)
a |-> b = a :-> const b
a \mid --> b = (a, 1, always) \mid -> b
($:) = Aux False
(|\$:) = Aux True
```

GRAMMARS: GENERATION

```
gen :: (Eq a, Eq meta, Expand input meta a b)
     => Grammar meta a -> input -> Dur -> Music b
gen gr i t = rewrite gr t >>> unlet >>> expand i >>> toMusic
```

1. Given an initial duration, rewrite until fixpoint

```
rewrite :: (Eq a, Eq meta)
=> Grammar meta a -> Dur -> Term meta a
```

2. Unfold *let*-expressions

```
unlet (Let x f) = f x
unlet x = x
```

3. Expand auxiliary wrappers

```
class Expand input meta a b | input meta a -> b where
  expand :: input -> Term meta a -> Term () b
```

4. Convert to music

```
(:%:) ~> (<|)
(:-:) ~> (:+:)
```

GRAMMARS: TABLA RHYTHM

```
tabla :: Grammar () Syllable
tabla = S |:
  S |--> TE1 :-: XI
  . XI |--> TA7 :-: XD
  . XD |--> TA8
  . XG |--> TB2 :-: XA
  , TE4 |--> Ti :-: Rest :-: Dha :-: Ti
  . TC2 |--> Tira :-: Kita
  . TB3 |--> Dha :-: Tira :-: Kita
  . TD1 |--> Rest
instance ToMusicCore Syllable where
```

GRAMMARS: TONAL HARMONY

```
harmony :: Grammar Modulation Degree
harmony = I |:
    (I, 8, (> wn)) :-> \t ->
      Let (I\%:t/2) (\x -> x :-: x)
  \overline{(I, 6, (> hn) / (<= wn))} :-> \t ->
      II:%:t/4 :-: V:%:t/4 :-: I:%:t/2
  (I, 2, (> hn) / (<= wn)) :-> t ->
  V:%:t/2 :-: I:%:t/2
, (I, 2) -| (<= wn)
  , (V, 5, (> hn)) :-> \t -> Modulation P5 $: I:%:t
  , (V, 3) - always
  , (II, 2, (> hn)) :-> \t -> Modulation M2 | \frac{\pi}{2}: I:%:t
  , (II, 8) - | always
instance Expand Config Degree Modulation SemiChord where
voiceLead :: Music SemiChord -> IO (Music Chord)
```

GRAMMARS: JAZZ IMPROVISATION

```
melody :: Grammar () NT
melody = MQ |:
  [ -- Abstract Rhythm { MQ ~> Q }
    (MQ, 1, (== qn)) \rightarrow Q:\%:qn
  (MQ, 25, (> (hn^{\circ}.))) :-> \t -> Q:%:hn :-: MQ:%:(t - hn)
  , (Q, 47, (== wn)) |-> MN:%:qn :-: Q:%:hn :-: MN:%:qn
  , (Q, 6, (== hn)) |->
      MN:\%:(qn^{\wedge \wedge}) :-: MN:\%:(qn^{\wedge \wedge}) :-: MN:\%:(qn^{\wedge \wedge})
  , (MN, 1, (== wn)) |-> N:%:qn :-: N:%:qn :-: MN:%:hn
  , (MN, 1, (== qn)) |->
      N:%:(en^^^) :-: N:%:(en^^^) :-: N:%:(en^^^)
  , (N, 50, (== qn)) |-> ChordTone:%:qn
  , (N, 45, (== qn)) |-> Rest:%:qn
  (N, 1, (== en)) |-> ApproachTone:%:en
```

mkSolo :: Music SemiChord -> Music NT -> IO Melody

```
orientalAlgebras = do
 let ?config = MusicConfig
     basePc = A
   , baseOct = Oct3
   , tempo = 6<mark>%</mark>5
   , instruments = [Piano, Sita<u>r, Tabla]</u>
     beat = sn
 let t = 12 * wn
 har <- voiceLead <$> runGrammar harmony t
 mel <- mkSolo har <$> runGrammar melody t
 rhy <- runGrammar tabla t
 writeToMidiFile "out.mid" (dyn (har :=: mel :=: rhy))
```

DEMO: MUSIC SCORE

