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...

Focus on Generation, Ignore Analysis

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) (λb. Term () b -> Term () b)

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

(a, w) -| f = (a, w, f) :-> (a %:)
a |->  b = a :-> const b
a |--> b = (a, 1, always) |-> b
($:)  = Aux False
(|$:) = Aux True
```

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

```haskell
harmony :: Grammar Modulation Degree
harmony = I |:
  [ -- Turn-arounds
    (I,  8, (> wn)) :-> \t ->
      Let (I%:t/2) (\x -> x :-: x)
  , (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)
    -- Modulations
  , (V,  5, (> hn)) :-> \t -> Modulation P5 $: I%:t
  , (V,  3) -| always
  , (II, 2, (> hn)) :-> \t -> Modulation M2 |$: I%:t
  , (II, 8) -| always
  ]

instance Expand Degree Modulation SemiChord where
    ...

voiceLead :: Music SemiChord -> IO (Music Chord)
```

Grammars: Jazz Improvisation

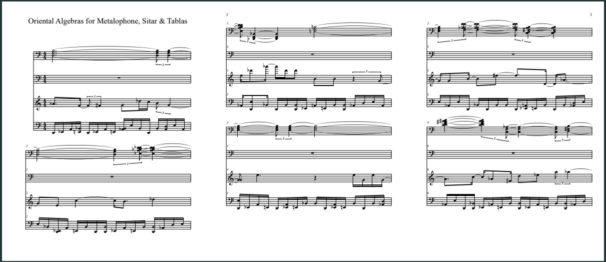
```haskell
melody :: Grammar () NT
melody = MQ |:
  [ -- Abstract Rhythm { MQ ~> Q }
    (MQ,  1, (== qn)) |-> Q%:qn
  , (MQ, 25, (> (hn^.))) :-> \t -> Q%:hn :-: MQ%:(t - hn)
    ...
    -- Concrete Rhythm { Q ~> MN }
  , (Q, 47, (== wn)) |-> MN%:qn :-: Q%:hn :-: MN%:qn
  , (Q,  6, (== hn)) |->
    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

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

Demo: Code

```
orientalAlgebras = do
  let ?config = MusicConfig
    { basePc    = A
    , baseOct = Oct3
    , baseScale = arabian
    , chords    = equally allChords
    , scales    = equally allScales
    , octaves = [(20, Oct4), (15, Oct5), (5, Oct6)]
    , colorWeight = 0, ...
    , tempo = 6%5
    , instruments = [Piano, Sitar, Tabla]
    , 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))
```

Music score


Oriental Algebras for Metalophone, Sitar & Tablas