

# Chord Progression

A discussion on an algorithmic  
approach to Musical Chord  
Progressions



# Agenda

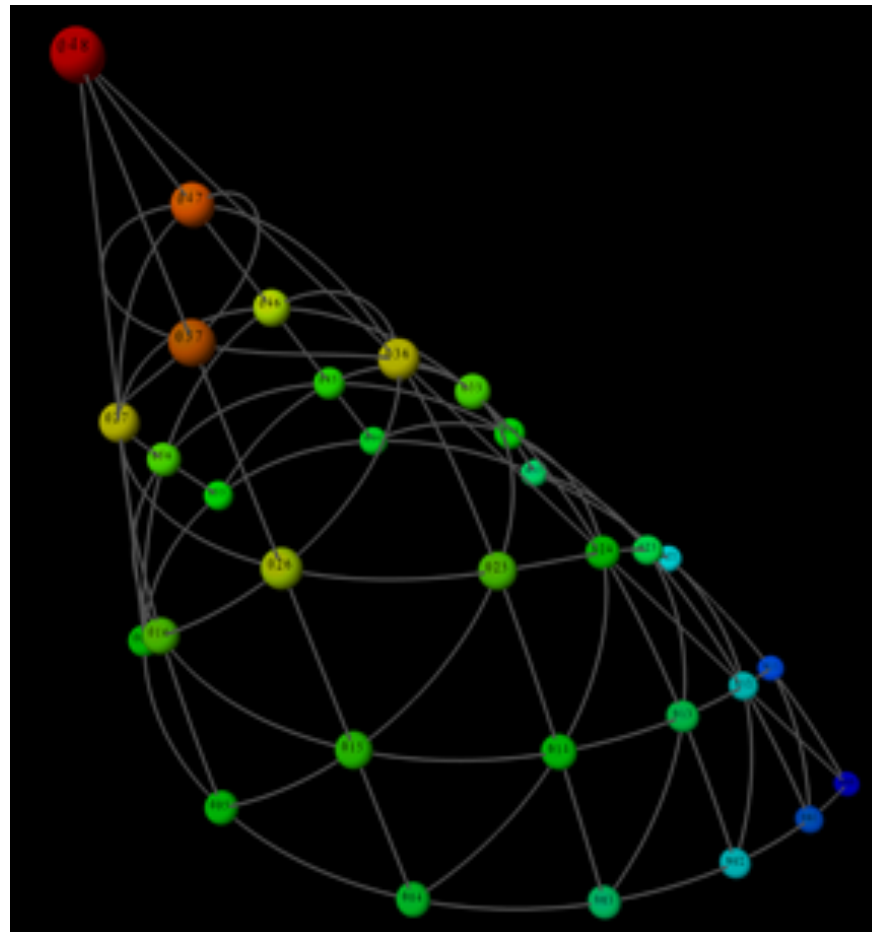
- Background
- Building the Model
- Markov Decision Processes
- Adding Temporality (and other things I need to consider)
- Conclusion
- Questions, Comments, & Recommendations



# Background

- The 5 components of tonality:
  - Conjunct melodic motion
  - Acoustic Consonance
  - Harmonic Consistency
  - Limited Macro-harmony
  - Centricity
- This algorithm Focuses on:
  - Acoustic Consonance
  - Harmonic Consistency
  - Limited Macro-harmony
  - Centricity

# Geometric Music Theory



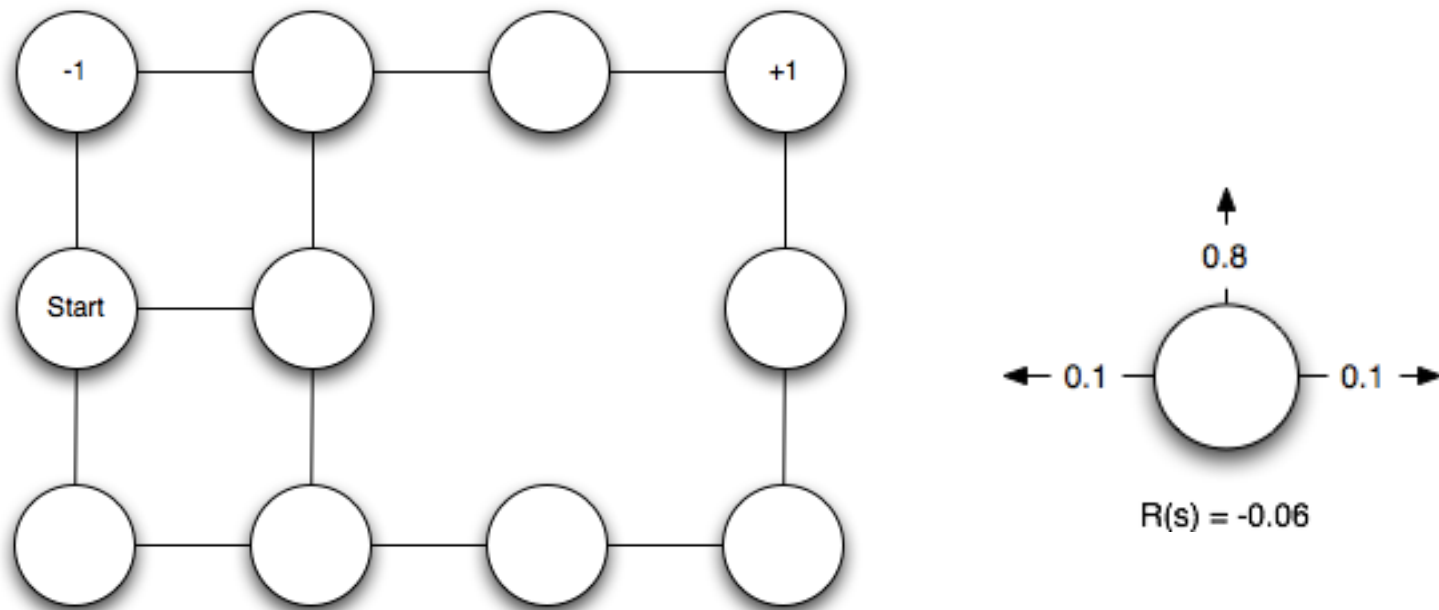


# Association with Computation

- Graph Theory to the rescue!
- Geometric Theory - graph of N-dimensions
- Probabilistic weighting of the edges
- Model is a Markov Decision Process (MDP)
- Chord Progressions – a planning problem

# Markov Decision Processes

“A sequential decision process for an agent in a fully observable environment with a Markovian transition model and additive rewards” (Russell 1995)



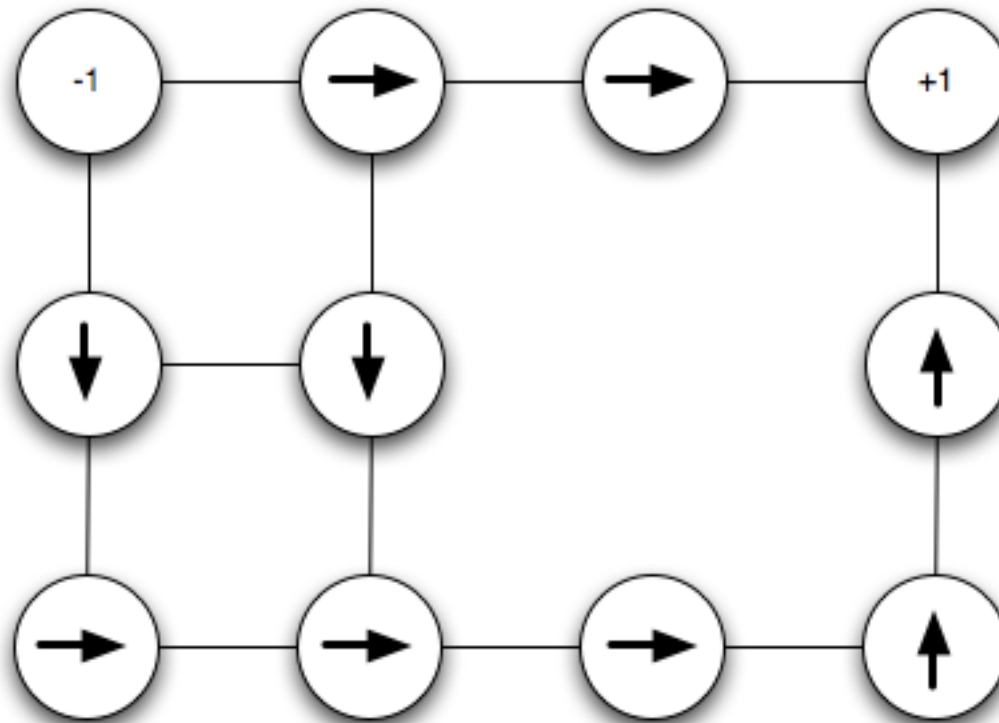
# Markov decision Processes

- Transition model:  $T(s,a,s')$
- Reward function:  $R(s)$
- An Optimal Policy is a sequence that maximizes utility
  - The utility of a state is the reward for that state plus the utility of the next optimal state.

$$U(s) = R(s) + \max \sum T(s,a,s')U(s')$$

- Work backwards like any Bellman search algorithm
- A proper policy is one that is guaranteed to reach a terminal state.

# Markov Decision Processes



Remember this is NOT a shortest path algorithm!



# MDPs in Chord Progressions

- Certain nodes (Chords) lead to Cadences
  - Keeps a central chord through rewards
- Explorations (Key Modulations)
  - Changes in Centricity
  - Probabilistic Movements
    - Can push chords to consonance
    - Explores dissonant chords (to a limited degree)
    - Can limit the notes used


# Adding Temporality

(and other things I need to consider)

- Chords rarely ever reach the goal in one move
  - Multiple rewards pulling progression?
  - Should rewards grow with time?
- Key modulations change reward locations
  - When do I declare a modulation?
  - How do I handle chromatic chords that **MUST** move to a defined chord?
- Voice Leading!
  - How should I handle proper voice leading in the chord progressions? (Tymoczko 2008)
    - Creative Dynamic Programming!

# Conclusion

- Geometric Music theory – a mathematical framework for chord progressions
- Markov Decision Processes – provides planning for movements in the graph.
- MDPs not a singular solution to the problem.
  - Proper Voice Leading
  - Conjunct melodic motion



Questions,  
Comments,  
Recommendations