“Begin the Movement”

Composers: Pop*
Metamusicians: Paul Bodily, and Dan Ventura
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Description of the Work

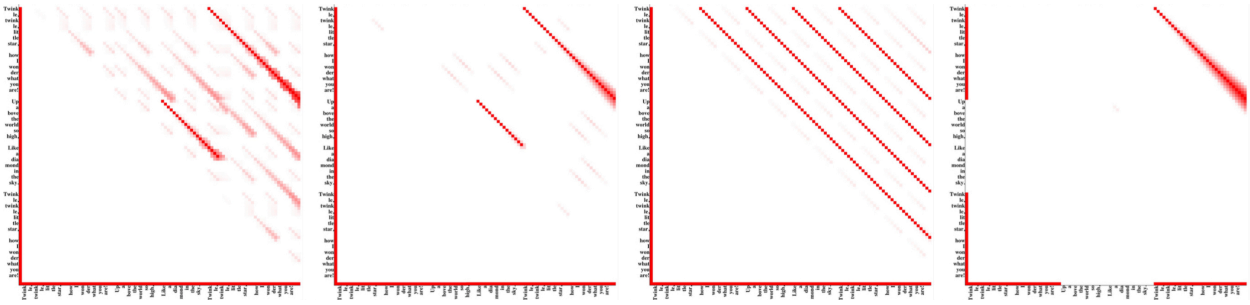
Pop* (pronounced Pop-Star), which was featured in the 2017 MuMe concert, is an automated pop lead sheet composer. It uses a modular framework to generate verse-chorus structure, rhyme-scheme, lyrics, harmony, and melody. Pop* creates novel full-length pop songs in lead sheet format with no external input beyond an inspiring set of pop lead sheets. To concretely render compositions, we generate both printed sheet music and MP3 audio recordings. MP3 audio files feature computer-sung lyrics accompanied by synthesized piano and bass comping chords.

Technical Description

Pop* uses a hierarchical Bayesian program learning model, meaning that the concept of a pop composition is factored into subconcept models such as structure, lyrics, harmony, melodic pitch, and melodic rhythm. These subconcepts are further factored until subconcepts represent simple enough ideas to be approximated using data-driven (conditional) probability distributions. Generation of novel compositions is achieved by combining subconcept values as they are probabilistically sampled from subconcept distributions.

Currently in its second iteration, the system uses probabilistic constrained Markov models to generate sequences for each musical viewpoint. In their traditional form, constrained Markov models allow structure to be imposed on sequential data using unary constraints at any of several sequence positions. We have expanded these models to allow for binary relational constraints which enables the system to impose meaningful patterns of repetition—including motifs, verse-chorus structures, and rhyme schemes—while still sampling composition-length sequences as a single Markov process. This is done by first creating a finite state machine that only recognizes sequences that match relational constraints and then combining this state machine with a Markov model to create a state-aware probabilistic constrained Markov model.

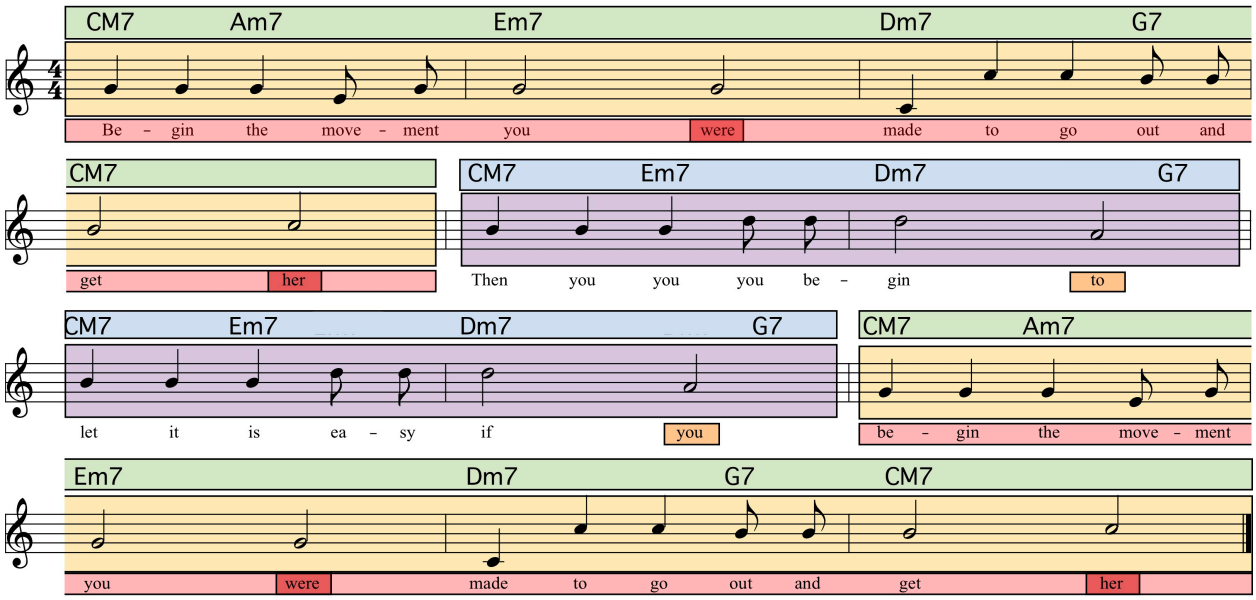
The relational constraints for these models are also automatically learned from data. This is done by inferring viewpoint-specific structural repeats from existing lead sheets using a self-alignment technique and then converting this structure into a set of relational constraints. To learn a match scoring function for self-alignment, we use a genetic algorithm to find weight parameters for raw musical features. These weights generalize to allow structure inference in unlabeled data. Shown here are examples of structure found in *Twinkle, Twinkle, Little Star* for (from left to right) harmony, pitch, rhythm, and lyrics:



The system incorporates added elements of autonomy, inspiration, self-awareness, and framing using semantic analysis to intelligently choose an inspiring set based on the current feeling or mood of the system. This feeling or mood, much like for human composers, is derived from factors in the systems "environment," which includes interactions with friends (via social media), news, and successes and failures of organizations in which the system is either emotionally or financially invested in. In addition to contributing to the inspiration of the system's compositions, the semantic analytic capabilities of the system enable it to assess its own output, determining the extent to which it accomplished its own objectives.

Performance Requirements/Link to Online Recordings

We will perform a set of pop songs precomposed by Pop* and arranged for voice and either piano or guitar (depending on available resources). Additional instruments will be added as available to form a combo. For audio and lead sheet examples visit **https://paulbodily.blogspot.com/2018/04/begin-movement.html.** Below is an example of the system's output with harmonic, melodic, and lyrical structure highlighted in green, yellow, and red respectively. *Begin the Movement* is the first song to be composed by the improved version of Pop*.



Biography

Paul Bodily is a PhD candidate in the CS department at Brigham Young University (BYU). Under the advisement of Dr. Dan Ventura, his research focuses on machine learning in pop music with the intent of building data-driven generative systems.

Dr. Dan Ventura is a CS professor at BYU whose focus is on computational creativity systems generally. Students under his advisement have published systems in domains such as artistic image generation (DARCI), recipe generation (PIERRE), jazz lead sheet composition (CARL), and neology (Nehovah).