Concrete observation occurs in different time and space.	e
Model being applied with different parameters.	df
Relation governing different abstractions of observations.	

w The central topic of this thesis about the computational modeling of repetitions in music in a cognitively plausible way. Since music is fundamentally a mental phenomenon, we approach repetition in music as a specific case of a general cognitive process related to pattern discovery. How the human mind perceive repeat is a rather complex problem to model. Such an intuitive concept is surprisingly nontrivial to formally specify.

Let start with a simple characterization of repeat: **a specific observation occurring in different time and space**. For example, an on-going fire siren correponds to a repeat of a specific sound across time. The decorative motifs found in mozaic tilings are repeats of a visual symbol across space. The periodic motion of a pendulum contains repeats of a specific movement. This characterization is very easily to model computationally, just find the common part of a structure (common patterns in strings, trees,...).

However, consider a postman, when frustrated by his mundane work, complains that he is "doing the same thing" over and over again. Clearly, by "doing the same thing", our imaginary postman does not mean it on a literal sense of repeating a list of concrete physical actions (e.g. turning right on the crossroad at 7:23, and stopping his car at the exact same spot). If the postal company announce a robot who just follows a list of concrete actions without and situational awareness (e.g. whether there is a car or people blocking its path), would you keep using the same postal service?

In order to make the postman's expression work, our model of perceived repeat should allow some degrees of flexibility. One way to model such flexibility is to see these concrete instances of repeats as **outputs of the same program (model/function) but given different parameters**. For example when we look at a cityscape of New York, we find repetition of building. Each appearance of the buildings can be thought of as the result of a function that create the visual of the building while initiated with different configurations such as the building's height, style, year, and the angle facing the viewer, etc. This characterization is fairly simple to model computationally in the generative direction (e.g. as in procedurally generated visual scene), but is much harder the implement in the direction of perception. Still, the goal is clear: given observations y_1, y_2, infer a possible function f and configurations x_1, x_2 such that $y_1 = f(x_1), y_2 = f(x_2)$.

Attempt 1: The same concrete observation occurs in different time and space. Required computational mechanisms : - production: duplication - understanding: equality testing Failed reason: too little flexibility, does not take abstractions into account.

Attempt 2: The same pattern being instantiated in different time and space. Required Computational mechanisms (given the space of generative

function) (on top of attempt 1): - production: sampling function parameters, function application - understanding:

Attempt 3: The same groups of relation governing abstractions of observations.