Lesson #4: Markov analysis of A Little Tune

What's It All About?

This lesson involves a Markov analysis of a very simple Melody, that of a three note piece called "Little Tune" composed long ago by Dmitri Kabalevsky.

The Setup

The following sequence of symbols is a representation of "A Little Tune" in JFugue notation:

```
EQ DQ EQ CQ DQ CQ DH EQ DQ EQ CQ DH DH EQ DQ EQ CQ DQ CQ DH EQ DQ EQ DQ CH CH
```

Each symbol represents a note. The first letter of the symbol represents a pitch, and the second letter of the symbol represents a duration. Three pitches are represented and two durations are represented. The melody consists of 26 notes of just 5 types.

Task 1: State transition count matrix

The "state transition count matrix" simply indicates the number of transitions from one state to another state for a given sequence of states. **Important: As you work with "A Little Tune", imagine that it is a "wrap around" melody in that it begins again on the first note after it ends on the last note.**

from\to	CQ	DH	EQ	DQ	CH
CQ					
DH					
EQ					
DQ					
CH					

Task 2: State transition probability matrix

The "state transition probability matrix" indicates the probability of transiting from one state to another state. Plese derive this matrix from the state transition count matrix, by working row by row, where each cell entry is computed as the count for the cell divided by the number of entries in the entire row.

from\to	CQ	DH	EQ	DQ	CH
CQ					
DH					
EQ					
DQ					
CH					

Question ...

Do you think that this state transition probability matrix in some sense captures the spirit of Little Tune? Please say more than merely "yes" or "no".

Task 3: State transition probability distribution matrix

The "state transition distribution matrix" represents a set of cumulative distribution functions for transiting from one state to all other states. Please derive this matrix from the state transition probability matrix by cumulatively adding columns from left to right.

from\to	CQ	DH	EQ	DQ	CH
CQ					
DH					
EQ					
DQ					
CH					

Task 4: Simulation based on STPDM pseudocode simulation

Simulate a sequence of state transitions based by executing the previously given STPDM pseudocode in the context of the state transition distribution function that you just derived. More specifically, perform a short simulation given the following sequence of random numbers, and using as many of them as you need from left to right:

```
0.579 0.637 0.358 0.904 0.912 0.130 0.331 0.539 0.925 0.819 0.400 0.648 0.952 0.264 0.742 0.83
0.224 0.274 0.837 0.307 0.901 0.787 0.925 0.925 0.430
```

Task 5: Play your algorithmically composed melody

Play the melody that you generated! Preferablly, play it yourself on whatever instrument you like! That said, please feel free to use a software tool of your choice to play the melody.