**Goal** In 1787, Wolfgang Amadeus Mozart created a dice game (Mozart’s Musikalisches Würfelspiel), in which you compose a two-part waltz by pasting together 32 of 272 pre-composed musical elements at random. The goal of this project is to implement Mozart’s game by writing a program to generate a two-part waltz and another program to play the waltz.

**The Waltz** The waltz consists of two parts — the minuet and the trio. Each is comprised of 16 measures, which are generated at random according to a fixed set of rules, as described below.

- **Minuet** The minuet consists of 16 measures. There are 176 possible minuet measures, named M1.wav through M176.wav in the data directory. To determine which one to play, roll two fair dice, and use the following table:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td>2</td>
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<td>108</td>
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<td>12</td>
<td>124</td>
<td>44</td>
</tr>
</tbody>
</table>

For example, if you roll a 4 and 6 for measure 8, then play measure 123 (ie, data/M123.wav).

- **Trio** The trio also consists of 16 measures. There are 96 possible trio measures named T1.wav through T96.wav in the data directory. To determine which one to play, roll one fair die, and use the following table:

<table>
<thead>
<tr>
<th>1</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
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<td>24</td>
<td>86</td>
<td>51</td>
<td>60</td>
<td>78</td>
<td>31</td>
</tr>
</tbody>
</table>

For example, if you roll a 4 for measure 29, then play measure 57 (ie, data/T57.wav).

**Data** The data directory contains:

- The 272 minuet and trio measures as .wav files.
- The values of the above minuet and trio tables in mozart.txt.
- A sample waltz, mozart.wav, generated using the process described above.

**Composition** There are $11^{16} \times 6^{16} = 129,629,238,163,050,258,624,287,932,416$ possible compositions, some of which are more likely than others. Since this is a huge number of different possibilities, each time you play the game you are likely to compose a piece of music that has never been heard before! Mozart carefully constructed the measures to obey a rigid harmonic structure, so each waltz reflects Mozart’s distinct style. Unfortunately, due to the rigidity, the process never results in anything truly extraordinary.
Problem 1. (Generating the Waltz) Write a program called `generatewaltz.py` that accepts the minuet and trio tables from standard input, generates a random sequence of 32 measures according to the rules described above, and writes the sequence to standard output.

```
$ ~/workspace/project3
$ python3 generatewaltz.py < data/mozart.txt
69 95
27 103 105 129 21 24 66 155 48 34 43 18 89 78 72 39 59 68 29 7 15 94 76 34 93 77 12 95 47 10
$ python3 generatewaltz.py < data/mozart.txt
32 84 27 153 97 36 100 16 4 150 34 51 115 1 78 18 3 59 74 37 43 52 71 9 20 32 79 57 35 90 10
```

Directions:

- Read the minuet measures from standard input into a 2D list with dimensions $11 \times 16$.
- Read the trio measures from standard input into a 2D list with dimensions $6 \times 16$.
- Write to standard output a random sequence of 16 minuet measures, each of which is a value from the minuet table — the column index $j$ is a value from $[0, 15]$ and the row index $i \in [0, 10]$ is obtained from the sum of two die rolls.
- Write to standard output a random sequence of 16 trio measures, each of which is a value from the trio table — the column index $j$ is a value from $[0, 15]$ and the row index $i \in [0, 5]$ is obtained from a die roll.

Problem 2. (Playing the Waltz) Write a program called `playwaltz.py` that accepts from standard input, a sequence of 32 integers representing the 32 measures of a waltz, and plays the waltz to standard audio. Before playing any audio, your program must check if the inputs are correct, and if they are not, must call `sys.exit(message)` to exit the program with an appropriate error message. The following errors must be handled:

- If the number of measures is not 32, exit with the message “A waltz must contain exactly 32 measures”.
- If a minuet measure is not from $[1, 176]$, exit with the message “A minuet measure must be from $[1, 176]$”.
- If a trio measure is not from $[1, 96]$, exit with the message “A trio measure must be from $[1, 96]$”.

```
$ ~/workspace/project3
$ python3 generatewaltz.py < data/mozart.txt | python3 playwaltz.py
```

Directions:

- Read the waltz measures from standard input into a 1D list.
- Handle the input errors described above.
- Play each of the first 16 minuet measures by calling `stdaudio.playFile(f)`, where $f$ is the filename of the minuet (eg, if the measure is 123, then $f = \'data/M123\'\$).
- Play each of the last 16 trio measures by calling `stdaudio.playFile(f)`, where $f$ is the filename of the trio (eg, if the measure is 57, then $f = \'data/T57\'\$).

Data The `data` directory contains:

- The 272 measures as `.wav` files.
- The values of the minuet and trio tables in `mozart.txt`.
- A sample waltz `mozart.wav` generated using the process described in this writeup.
Acknowledgements This project is an adaptation of the Mozart Waltz Generator assignment developed at Princeton University by David Costanzo and Kevin Wayne.

Files to Submit

1. generatewaltz.py
2. playwaltz.py
3. notes.txt
Before you submit your files, make sure:

- You do not use concepts from sections beyond “Input and Output”.
- Your code is adequately commented, follows good programming principles, and meets any specific requirements such as corner cases and running times.
- You edit the sections (#1 mandatory, #2 if applicable, and #3 optional) in the given notes.txt file as appropriate. Section #1 must provide a clear high-level description of the project in no more than 200 words.