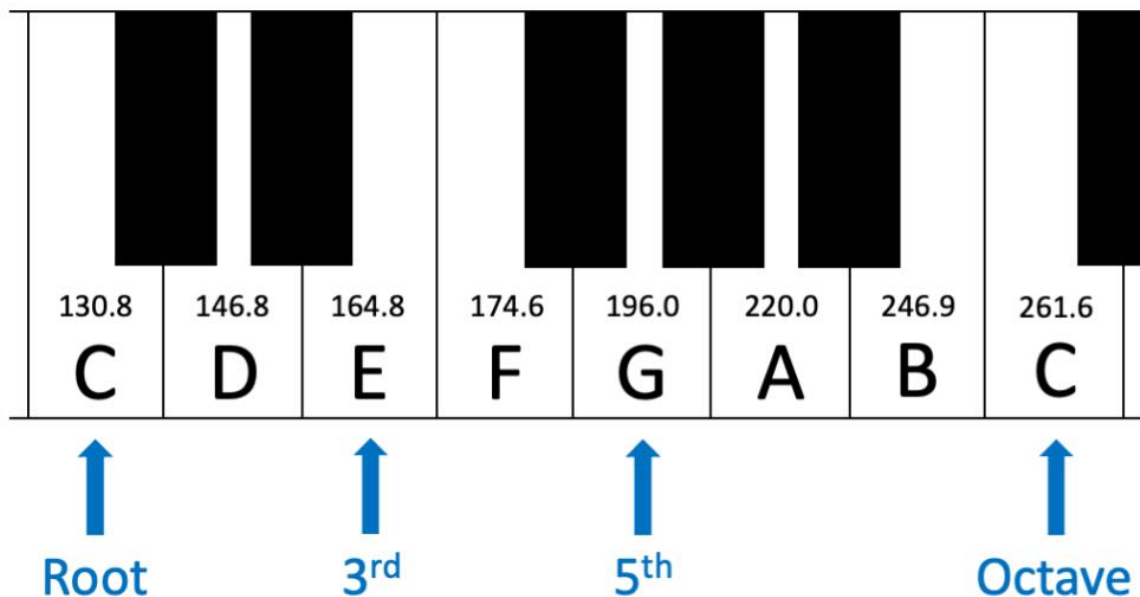


It is required to create a synthesizer capable of producing eight musical notes within an octave in Simulink environment by utilizing DSP System Toolbox. The 3 Simulink Models and block settings must be set up according to the following specifications:

Model_1:

- Begin by selecting a Sine Wave block from the Sources library in the DSP System Toolbox. Adjust the **sample time** of the Sine Wave block to 1/8000 and specify a high C frequency of 261.6 Hz. Configure the **Samples per frame** to be 1000.
- The Sine Wave blocks need to be copied seven times and relabelled to the names of the notes. Each block's frequency should be changed to produce the eight musical notes of an octave. Check the figure to determine the frequency of each note.



- Use a **Multiport Switch** block from the Signal Routing library to select the notes to play. The first port of the Multiport Switch block is the control signal. The Multiport Switch block should use **zero-based indexing**, and the parameter **Number of data ports** should be set to 8.
- Import a **Constant** block from the Sources section of the DSP System Toolbox library and connect it to **Round** block and connect the output signal to the control signal of **Multiport Switch block**.
- Import a **Slider** block and open the parameters page of the block and set the Minimum and Maximum value to 0 and 8 respectively and select Constant block to Connect it to the Slider.
- Simulate the model for **inf** seconds. Listen to the output with an **Audio Device Writer** block. Attach a **Signal Viewer** to the Output signal.

Model_2: utilize your previously designed Model_1 and proceed by following steps:

- a. Modify the **frequency** parameter of the first Sine Wave block in your model and set the value to a **1-by-8** vector of values, representing the musical notes in an octave. Set the sampling time for the Sine Wave block to 1/8000. Delete the remaining seven Sine Wave blocks.
- b. Replace the **Multiport Switch** block with a **Variable Selector** block from the Signal Management/Indexing library in the DSP System Toolbox. The first port of the Variable Selector is the Sine Wave (input) and the second port is the control signal (index).
- c. Double-click on the Variable Selector block to modify its Index mode to Zero-based, and the Select field to Columns instead of Rows.
- d. Duplicate the **Sine Wave Block**, **Variable Selector**, **Constant**, **Slider** and **Round** Block.
- e. Import **Sum** Block and sum the output of two variable Selector blocks.
- f. Connect the output of Sum Block to **Audio Device Writer** and **Spectrum Analyzer**
- g. Specify following configurations for Spectrum analyzer:
 - At Analyzer Tab set Sample time to inherited.
 - At estimation tab set the **input domain** to time and **frequency span** to full.
 - At Measurements tab activate the **peak finder** and set **num peaks** to 2.
 - At spectrum tab uncheck the **Two-sided spectrum**.
- h. Share your model and explain the result and the procedure in detail.

Model_3: utilize your previously designed Model_1 and proceed by following steps:

- a. Modify the **frequency** parameter of the first Sine Wave block in your model and set the value to a **1-by-9** vector of values, representing the musical notes in an octave and add 1 Hz to the last element of the vector. Set the sampling time for the Sine Wave block to 1/8000. Delete the remaining seven Sine Wave blocks and slider and round blocks.
- b. Replace the **Multiport Switch** block with a **Variable Selector** block from the Signal Management/Indexing library in the DSP System Toolbox. The first port of the Variable Selector is the Sine Wave (input) and the second port is the control signal (index).
- c. Double-click on the Variable Selector block to modify its Index mode to Zero-based, and the Select field to Columns instead of Rows.
- d. Replace the constant block with a Signal from Workspace block from the DSP System Toolbox. Set the Sample time for the block to -1. Set the Signal parameter to S.
- e. In MATLAB workspace, define a vector named "S" with values from 0 to 9 for playing notes in Simulink.
- f. Configure the simulation time and the count of numbers at vector S to play each note for 1 second.

Instructions for Submissions

- Prepare a report that explains your work in detail and the function of each model. Include screenshots of your models and model outputs (if any) in this report. The report should be in pdf format. Name of this report should be “{StudentID}_HW2.pdf”
- Create a folder that contains your report and all 3 model files. Model files should be named as “{StudentID}_model_{ModelNo}”.
- Compress the folder as .zip, .rar or .7z file.
- Upload the compressed file to the link below.

Upload link: <https://forms.gle/V6QscYqENNRpxUcH9>

Deadline: 08/01/2024