MUTLIMEDIA DEVELOPMENT

WITH

APP INVENTOR

MULTIMEDIA APP

FEATURES OF THE APP

This tutorial demonstrates how to build a simple multimedia Digital Xylophone .Similar to the Digital Xylophone (originally created by Liz Looney of the App Inventor team), you can:

- Play eight different notes by touching coloured buttons on the screen.
- Press a Play button to replay the notes played earlier.
- Press a Reset button to make the app forget what notes played earlier and can start of with a new song.

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CONCEPTS INTRODUCED

Following concepts can be achieved from this exercise:

- Sound component to play audio files
- Clock component to measure & enforce delays btw actions
- Creating a procedure
- Advanced use of lists

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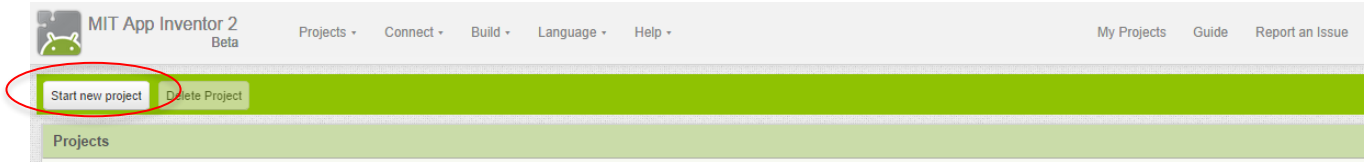
INITIAL STEPS

1. Go to “http://ai2.appinventor.mit.edu/”

2. Sign-in with your Gmail account. If you do not have a Gmail account, you can create a free account at “https://www.google.com.sg/” .

3. Click ‘Start new project’



4. Enter Application Name for project : MultimediaApp

5. You’ll be presented with the Component Designer

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COMPONENT DESIGNER

- This app has **13 different components** (8 of which compose the keyboard), listed in Table .
- Since there are so many, it would get pretty boring to create all of them before starting to write our program, so we'll break down the app into its functional parts and build them sequentially by going back and forth between the Designer and the Blocks Editor

Component type	Palette group	What you'll name it	Purpose
Button	Basic	Button1	Play Low C key.
Button	Basic	Button2	Play D key.
Button	Basic	Button3	Play E key.
Button	Basic	Button4	Play F key.
Button	Basic	Button5	Play G key.
Button	Basic	Button6	Play A key.
Button	Basic	Button7	Play B key.
Button	Basic	Button8	Play High C key.
Sound	Media	Sound1	Play the notes.
Button	Basic	PlayButton	Play back the song.
Button	Basic	ResetButton	Reset the song memory.
Horizontal Arrangement	Screen Arrangement	Horizontal Arrangement1	Place the Play and Reset buttons next to each other.
Clock	Basic	Clock1	Keep track of delays between notes.

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COMPONENT DESIGNER – CREATING THE KEYBOARD

Step1: Component designer

Our user interface will include an eight-note keyboard for a pentatonic (seven-note) major scale ranging from Low C to High C. We will create this musical keyboard in this section.

Creating the First Note Buttons

Start by creating the first two xylophone keys, which we will implement as buttons. From the Basic category, drag a Button onto the screen. Leave its name as **Button1**. We want it to be a long magenta bar, like a key on a xylophone, so set its properties as follows:

- Changing its **BackgroundColor** property to Magenta.
- Changing its **Text** property to "C".
- Setting its **Width** property to "Fill parent" so it goes all the way across the screen.
- Setting its **Height** property to 40 pixels.

Repeat for a second **Button**, named **Button2**, placing it below **Button1**. Use **Width** and **Height** property values, but set its **BackgroundColor** property to Red and its **Text** property to "D".

(Later, we will repeat step 2 for six more note buttons.)

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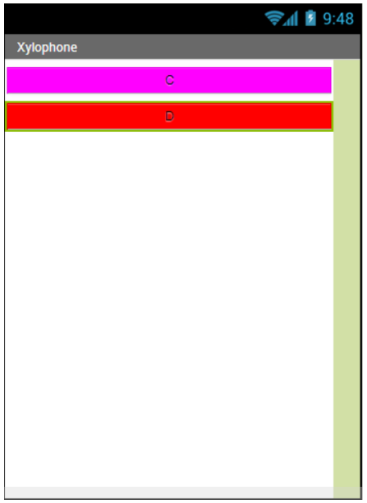
COMPONENT DESIGNER – CREATING THE KEYBOARD

Repeat for a second **Button**, named **Button2**, placing it below **Button1**.

Use **Width** and **Height** property values, but set its **BackgroundColor** property to Red and its **Text** property to "D".

(Later, we will repeat step 2 for six more note buttons.)

The view in the Component Designer should look something as shown in the Figure below:



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COMPONENT DESIGNER – ADDING THE SOUND COMPONENT

We can't have a xylophone without sounds, so create a Sound component, leaving its name as Sound1.

- Change the MinimumInterval property from its default value of 500 milliseconds to 0. This allows us to play the sound as often as we want, instead of having to wait half a second (500 milliseconds) between plays.
- Don’t set its Source property, which we will set in the Blocks Editor.
- Upload the sound files 1.wav and 2.wav by clicking the sound link.
- It is important to use these exact names for reasons that will soon become clear. You can upload the remaining six sound files when directed to later

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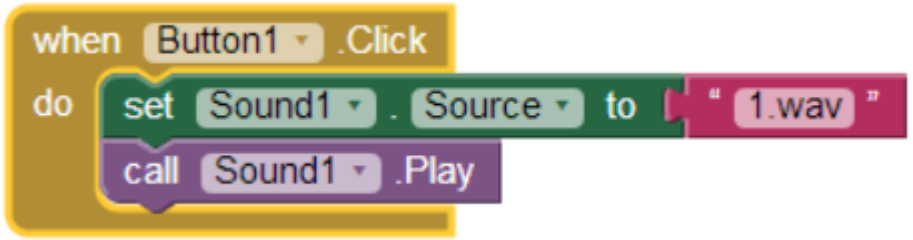
BLOCK EDITOR – CONNECTING THE SOUNDS TO THE BUTTONS

The behaviour we need to program is for a sound file to play when the corresponding button is clicked. Specifically, if Button1 is clicked, we'd like to play 1.wav; if Button2 is clicked, we'd like to play 2.wav; and so on.

We can set this up in the Blocks Editor as shown in Figure below by doing the following:

1. From the My Blocks tab and Button1 drawer, drag out the Button1.Click block.
2. From the Sound1 drawer, drag out the set Sound1.Source block, placing it in the Button1.Click block.
3. Type "text" to create a text block. (This is quicker than going to the Built-In tab and then the Text drawer, although that would work too.) Set its text value to "1.wav" and place it in the Sound1.Source block.
4. Add a Sound1.Play block



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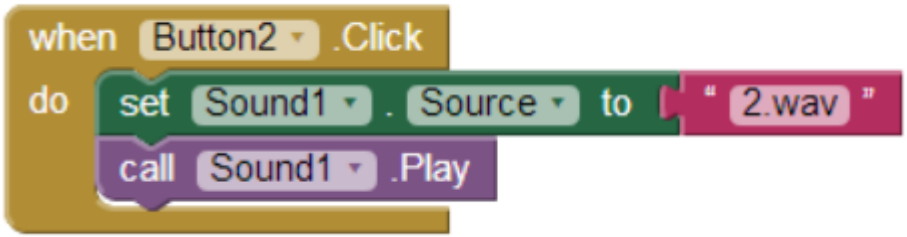
BLOCK EDITOR – CONNECTING THE SOUNDS TO THE BUTTONS

We could do the same for Button2, as shown in Figure (just changing the text value), but the code would be awfully repetitive.



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BLOCK EDITOR – CONNECTING THE SOUNDS TO THE BUTTONS

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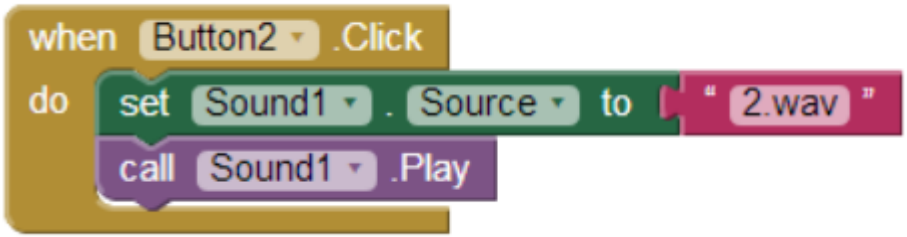

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BLOCK EDITOR - PROCEDURE TO PLAY A NOTE

Component Behavior - This introduces some new App Inventor ideas. The first is the idea of a procedure .

A procedure is a sequence of statements that you can refer to all at once as single command.

If you have a sequence that you need to use more than once in a program, you can define that as a procedure, and then you don't have to repeat the sequence each time you use it.

Procedures in App Inventor can take arguments and return values.

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BLOCK EDITOR - PROCEDURE TO PLAY A NOTE

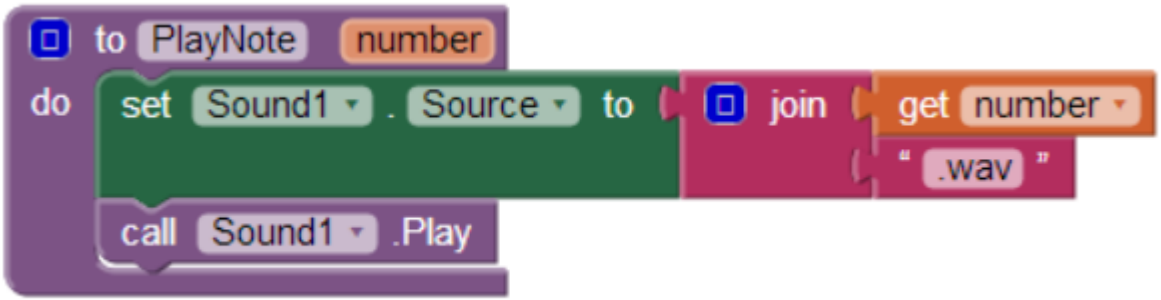
Repeated code is a good sign that you should create a procedure.

We'll create a procedure that

- takes a *number as an argument*,
- sets Sound1's Source to the appropriate file, and plays the sound.

This is another example of refactoring-improving a program's implementation without changing its behavior.

We can use the Text drawer's join block to combine the number (e.g., 1) and the text ".wav" to create the proper filename (e.g., "1.wav").



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BLOCK EDITOR - PROCEDURE TO PLAY A NOTE

Here are the steps for creating the procedure we need:

1. Under the Built-In tab, go to the Definition drawer and drag out the to procedure block.
2. Go back to the Definition drawer and drag a name block into the "arg" socket of to procedure.
3. Click the rightmost "name" and set the name to "number".
4. Click procedure and set the name to "PlayNote".
5. Drag the Sound1.Source block from Button1.Click into PlayNote to the right of the word "do". The Sound1.Play block will move with it.
6. Drag the 1.wav block into the trash can.
7. From the Text drawer, drag the join block into Sound1.Source's socket.
8. Type "number" and move it to the left socket of the join block (if it is not already there).
9. From the Text drawer, drag the text block into the right socket of the join block.
10. Change the text value to ".wav". (Remember not to type the quotation marks.)
11. Under the My Blocks tab, go to the My Definitions drawer and drag a call PlayNote block into the empty body of Button1.Click.
12. Type "1" and put it in the "number" socket.

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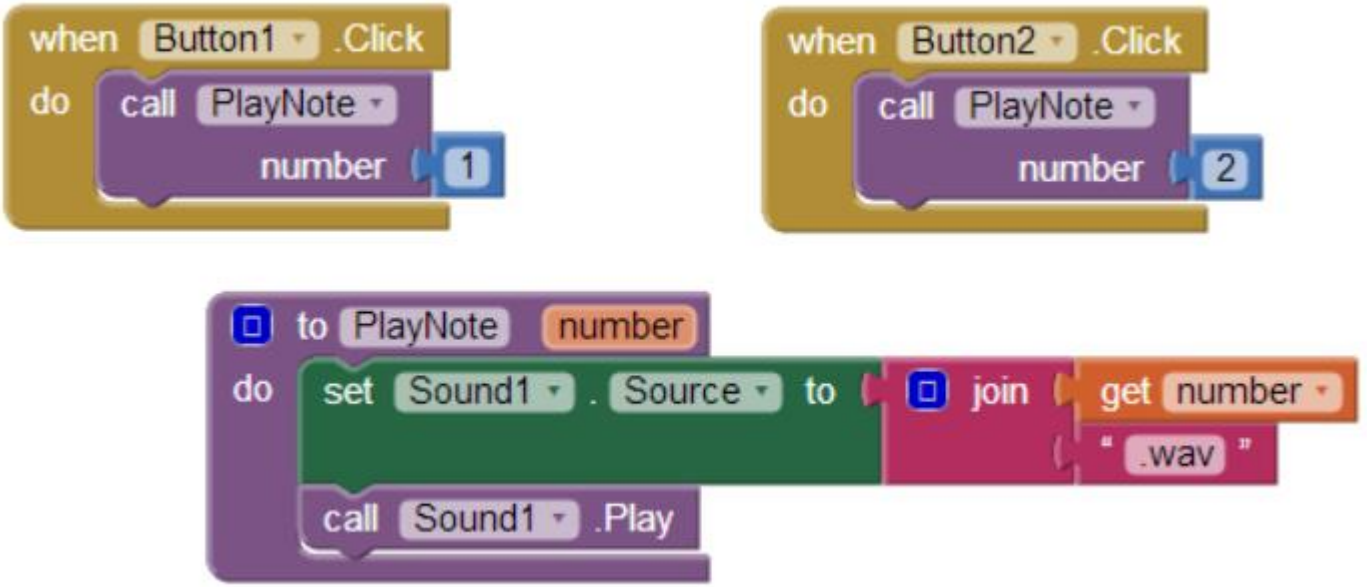
BLOCK EDITOR – PROCEDURE TO PLAY A NOTE

Now, when Button1 is clicked, the procedure PlayNote will be called, with its number argument having the value 1. It should set Sound1.Source to "1.wav" and play the sound.

Create a similar Button2.Click block with a call to PlayNote with an argument of 2.(You can copy the existing PlayNote block and move it into the body of Button2.Click, making sure to change the argument.) Your program should look like Figure.



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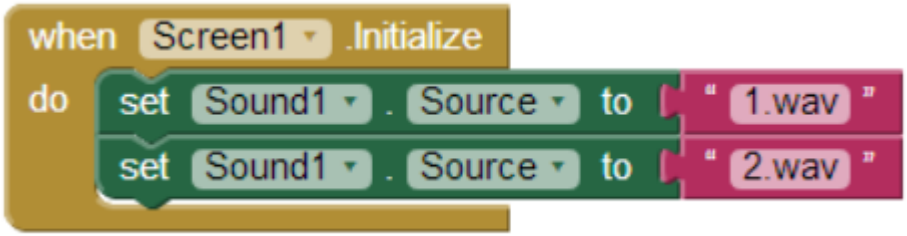
BLOCK EDITOR – LOADING THE SOUNDS

If you tried out the preceding calls to PlayNote, you may have been disappointed by not hearing the sound you expected or by experiencing an unexpected delay. That's because Android needs to load sounds at runtime, which takes time, before they can be played. This issue didn't come up before, because filenames placed in a Sound component's Source property in the Designer are automatically loaded when the program starts.

Since we don't set Sound1.Source until after the program has started, that initialization process does not take place. We have to explicitly load the sounds when the program starts up, as shown in Figure



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BLOCK EDITOR – TEST YOUR APP

Now if you restart the app by clicking on "Connect to Device..." in the Blocks Editor, the notes should play without delay. (If you don't hear anything, make sure that the media volume on your phone is not set to mute

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IMPLEMENTING THE REMAINING NOTES

Now that we have the first two buttons and notes implemented and working, add the remaining six notes by going back to the Designer and uploading the sound files 3.wav, 4.wav, 5.wav, 6.wav, 7.wav, and 8.wav. Then create six new buttons, following the same steps as you did before but setting their Text and **BackgroundColor** properties as follows:

- Button3 ("E", Pink)
- Button4 ("F", Orange)
- Button5 ("G", Yellow)
- Button6 ("A", Green)
- Button7 ("B", Cyan)
- Button8 ("C", Blue)

You may also want to change **Button8's TextColor** property to White, as shown in Figure, so it is more legible.

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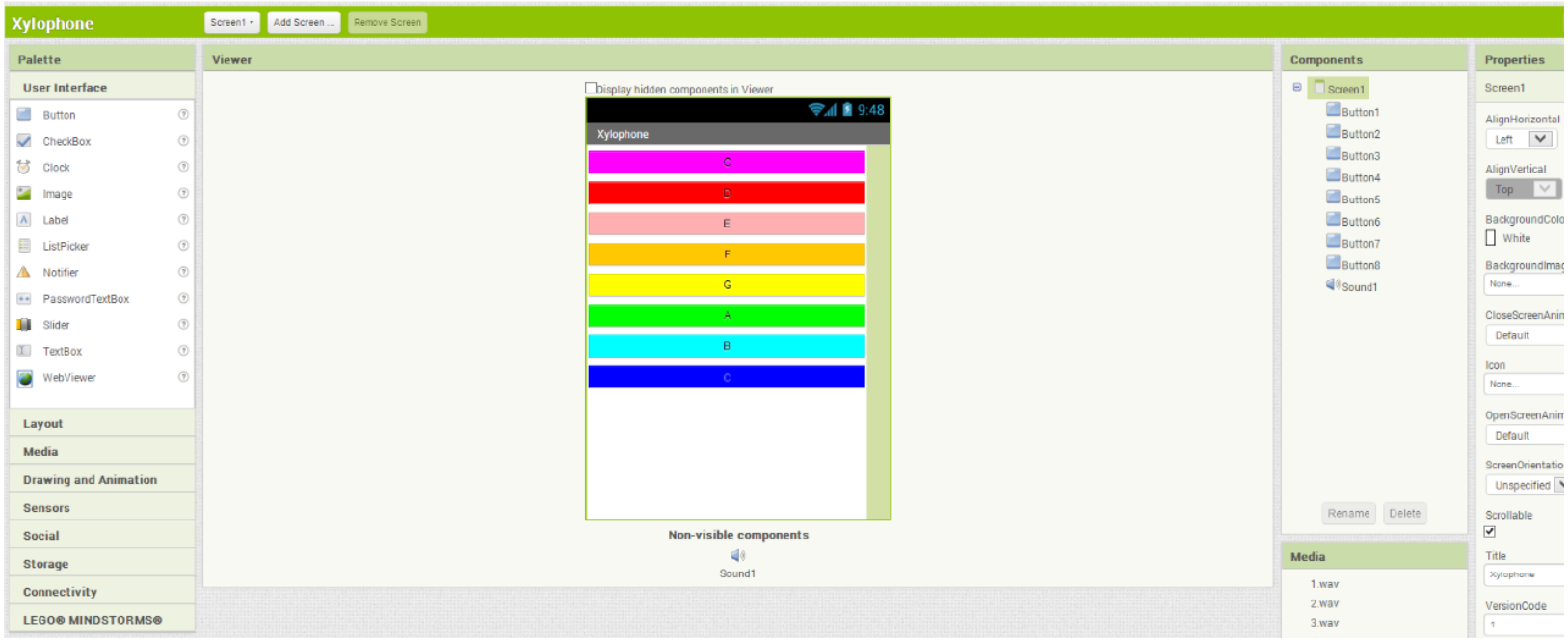
IMPLEMENTING THE REMAINING NOTES



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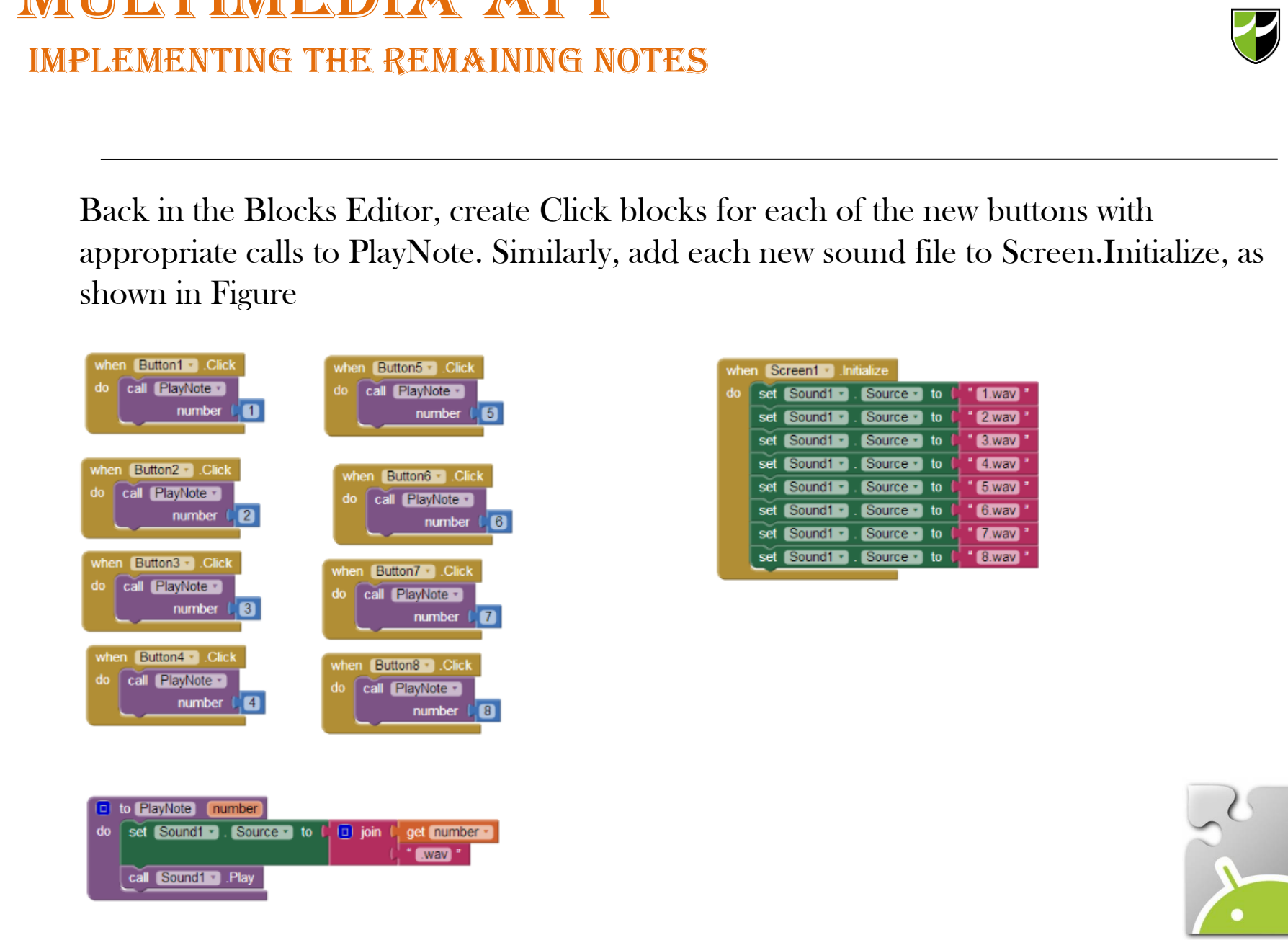
IMPLEMENTING THE REMAINING NOTES



Back in the Blocks Editor, create Click blocks for each of the new buttons with appropriate calls to PlayNote. Similarly, add each new sound file to Screen.Initialize, as shown in Figure

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RECORDING AND PLAYING BACK NOTES

Playing notes by pressing buttons is fun, but being able to record and play back songs is even better. To implement playback, we will need to **maintain a record of played notes.**

In addition to remembering the pitches (sound files) that were played, **we must also record the amount of time between notes**, or we won't be able to distinguish between two notes played in quick succession and two played with a 10-second silence between them.

Our app will maintain two lists, each of which will have one entry for each note that has been played:

- **notes**, which will contain the names of the sound files in the order in which they were played
- **times**, which will record the points in time at which the notes were played

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RECORDING AND PLAYING BACK NOTES

We can get the timing information from a **Clock** component, which we will also use to properly time the notes for playback.

Adding the Components

In the Designer, you will need to add a *Clock component* and *Play* and *Reset* buttons, which we will put in a Horizontal Arrangement:

1. Drag in a Clock component. It will appear in the "Non-visible components" section. *Uncheck its TimerEnabled* property because we don't want its timer to go off until we tell it to during playback.
2. Go to the Screen Arrangement category and drag a *Horizontal Arrangement* component beneath the existing button. Set its Width property to "Fill parent."
3. From the Basic category, drag in a Button. Rename it PlayButton and set its Text property to "Play".
4. Drag in another Button, placing it to the right of PlayButton. Rename the new Button to ResetButton and set its Text property to "Reset".

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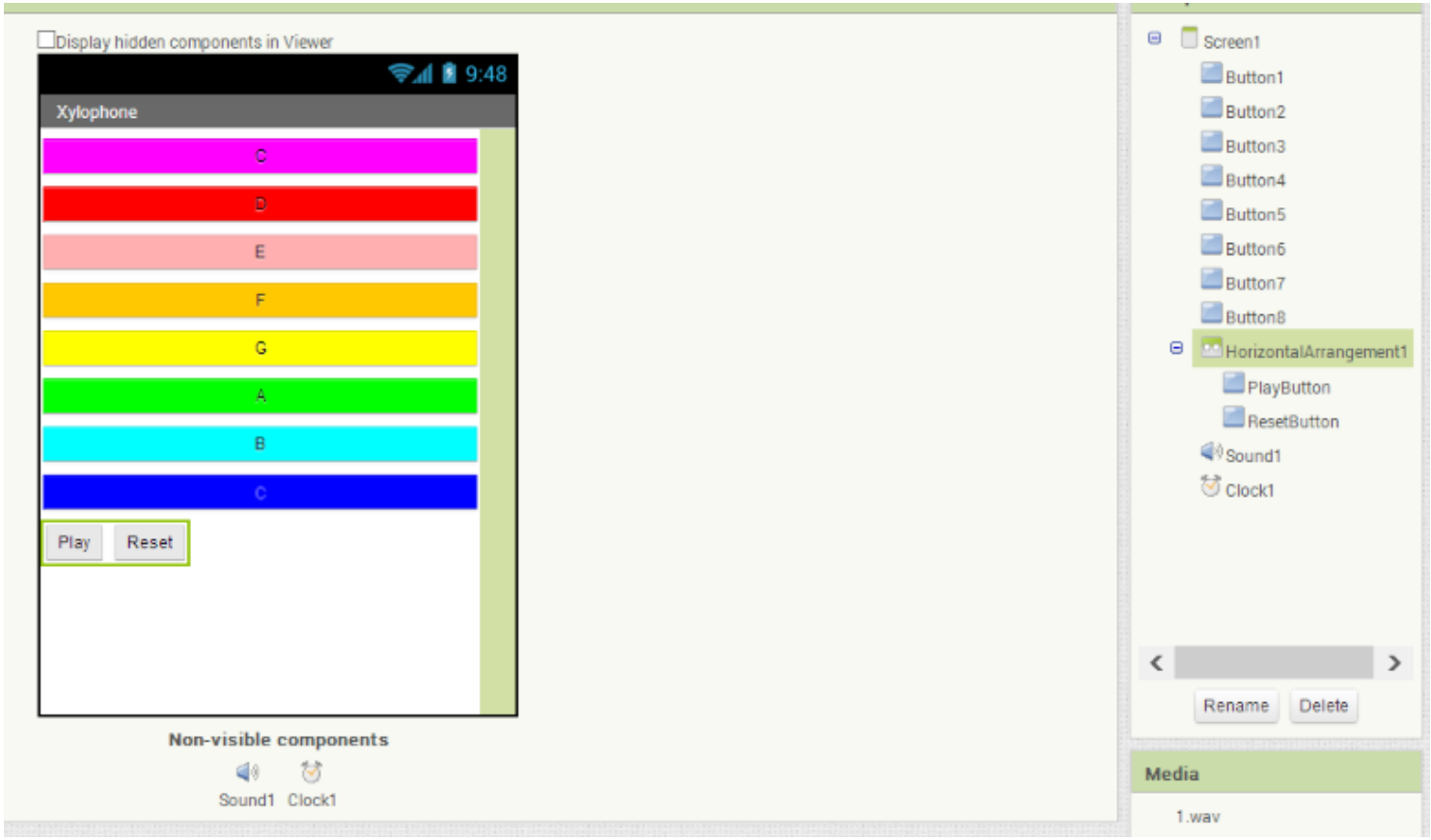
RECORDING AND PLAYING BACK NOTES

The Designer view should look like the Figure.



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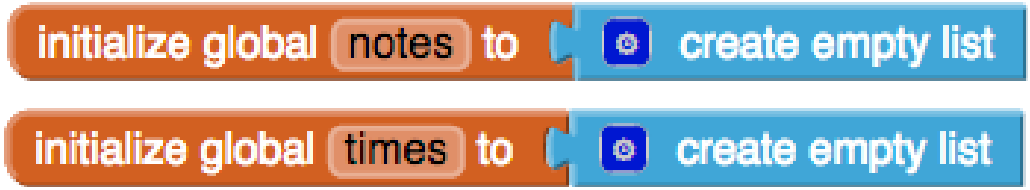
RECORDING AND PLAYING BACK NOTES

We now need to add the correct behaviour in the Blocks Editor. We will need to maintain lists of notes and times and add to the lists whenever the user presses a button.

1. Create a new variable by going to the Variables drawer and dragging out an initialize global to block from the Definition drawer.
2. Change the name of the variable to “notes”.
3. Open the Lists drawer and drag a create empty list block out, placing it in the socket of the initialize global to block.

This defines a new variable named "notes" to be an empty list. Repeat the steps for another variable, which you should name "times". These new blocks should look like Figure shown below.



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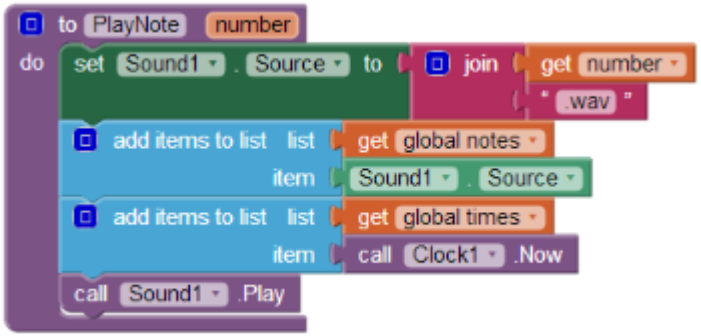
RECORDING AND PLAYING BACK NOTES

Whenever a note is played, we need to save both the **name of the sound file** (to the list notes) and the **instant in time at which it was played** (to the list times). To record the instant in time, we will use the Clock1.

Now block, which returns the current instant in time (e.g., March 12, 2011, 8:33:14 AM), to the nearest millisecond. These values, obtained through the Sound1.Source and Clock1.Now blocks, should be added to the lists notes and times, respectively, as shown in Figure.



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RECORDING AND PLAYING BACK NOTES

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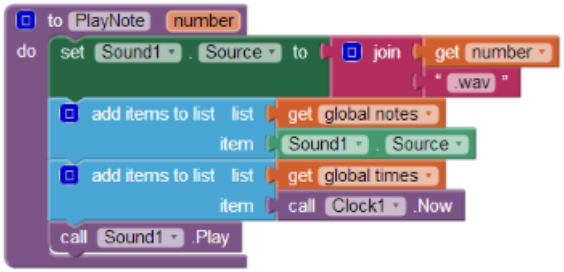
Now block, which returns the current instant in time (e.g., March 12, 2011, 8:33:14 AM), to the nearest millisecond. These values, obtained through the Sound1.Source and Clock1.Now blocks, should be added to the lists notes and times, respectively, as shown in Figure.
For example, if you play "Row, Row, Row Your Boat" [C C C D E], your lists would end up having five entries, which might be:

- notes: 1.wav, 1.wav, 1.wav, 2.wav, 3.wav
- times [dates omitted]: 12:00:01, 12:00:02, 12:00:03, 12:00:03.5, 12:00:04



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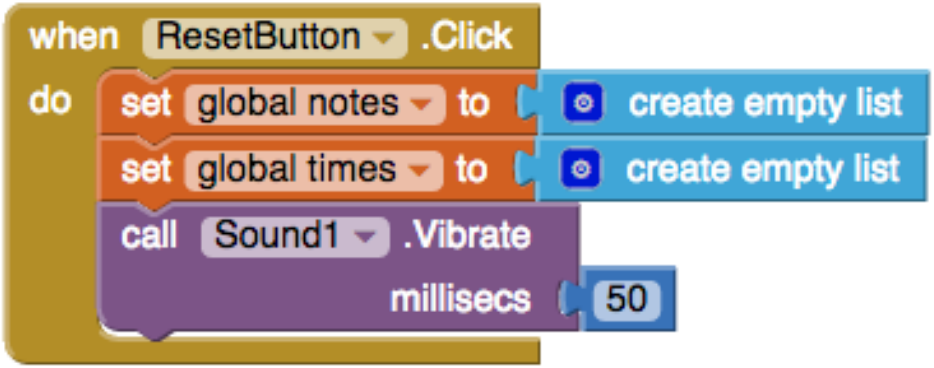
RECORDING AND PLAYING BACK NOTES

When the user presses the **Reset button**, we want the two lists to go back to their original, empty states. Since the user won't see any change, it's nice to add a small Sound1.Vibrate block so he knows that the key click was registered.

Figure below shows the blocks for this behaviour



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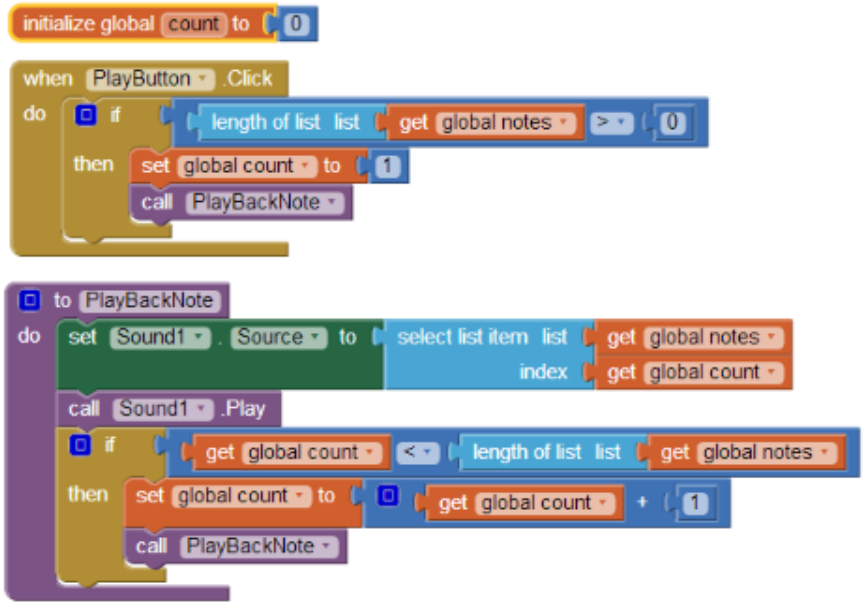
RECORDING AND PLAYING BACK NOTES

Let's look at how to implement note playback without worrying about timing. We could do this by creating these blocks as shown in Figure :

- A variable count to keep track of which note we're on.
- A new procedure, PlayBackNote, which plays that note and moves on to the next one.
- Code to run when PlayButton is pressed that sets the count to 1 and calls PlayBackNote unless there are no saved notes.



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RECORDING AND PLAYING BACK NOTES

This may be the first time you've seen a procedure make a call to itself. While at first glance this might seem bogus, it is in fact an important and powerful computer science concept called recursion.

To get a better idea of how recursion works, let's step through what happens if a user plays three notes (1.wav, 3.wav, and 6.wav) and then presses the Play button.

First, **PlayButton.Click** starts running. Since the length of the list notes is 3, which is greater than 0, count gets set to 1, and PlayBackNote is called:

The first time PlayBackNote is called, count = 1:

- Sound1.Source is set to the first item in notes, which is 1.wav.
- Sound1.Play is called, playing this note.
- Since count (1) less than the length of notes (3),count gets incremented to 2, and PlayBackNote gets called again.

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RECORDING AND PLAYING BACK NOTES

The second time PlayBackNote is called, count = 2:

- Sound1.Source is set to the second item in notes, which is 3.wav.
- Sound1.Play is called, playing this note.
- Since count (2) less than the length of notes (3), count gets incremented to 3, and PlayBackNote gets called again.

The third time PlayBackNote is called, count = 3:

- Sound1.Source is set to the third item in notes, which is 6.wav.
- Sound1.Play is called, playing this note.
- Since count (3) is not less than the length of notes (3), nothing else happens, and playback is complete.

Note. Although recursion is powerful, it can also be dangerous. As a thought experiment, ask yourself what would have happened if the programmer forgot to insert the blocks in PlayBackNote that incremented count.

While the recursion is correct, there is a different problem with the preceding

example: almost no time passes between one call to Sound1.Play and the next,
so each note gets interrupted by the next note, except for the last one.
No note (except for the last) is allowed to complete before Sound1's source is changed and Sound1.Play is called again. To get the correct behavior, we need to implement a delay between calls to PlayBackNote.

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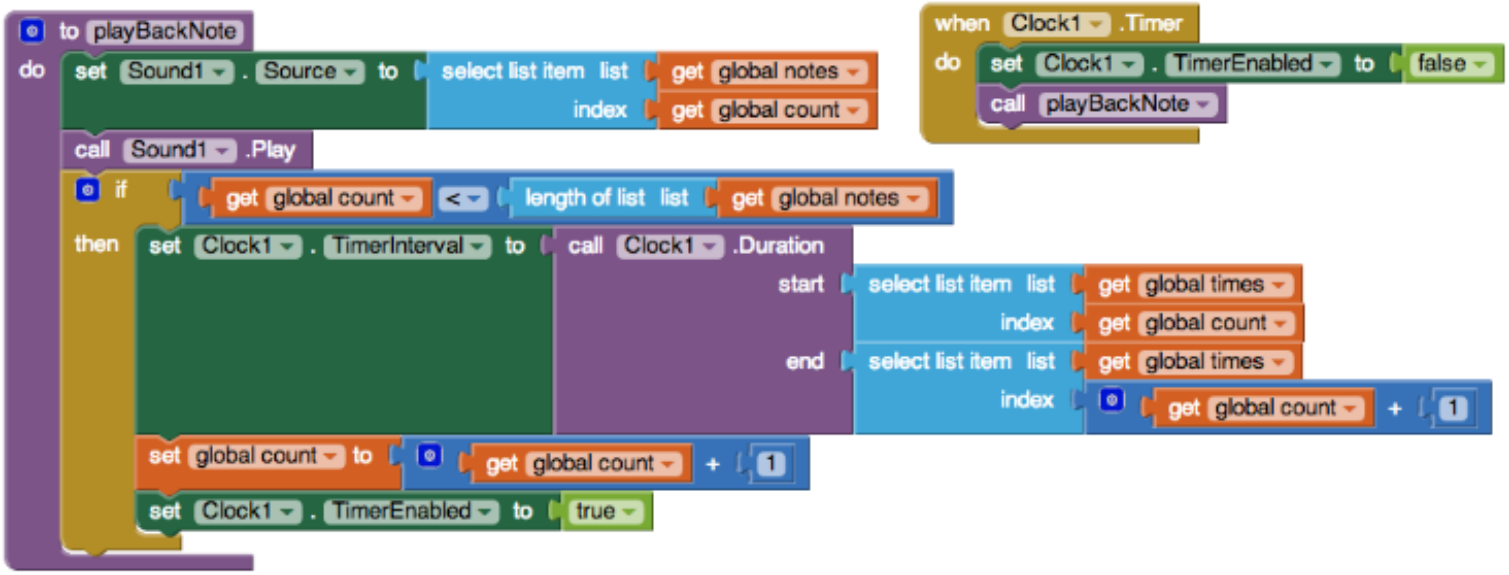
PLAYING BACK NOTES WITH PROPER DELAYS

We will implement the delay by setting the timer on the clock to the amount of time between the current note and the next note. For example, if the next note is played 3,000 milliseconds (3 seconds) after the current note, we will set Clock1.TimerInterval to 3,000, after which PlayBackNote should be called again.

Make the changes shown in Figure to the body of the if block in PlayBackNote, and create and fill in the Clock1.Timer event handler, which says what should happen when the timer goes off. .



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PLAYING BACK NOTES WITH PROPER DELAYS

Let's assume the following contents for the two lists:

- notes: 1.wav, 3.wav, 6.wav
- times: 12:00:00, 12:00:01, 12:00:04

As Figure shows, PlayButton.Click sets count to 1 and calls PlayBackNote. 1.The first time PlayBackNote is called, count = 1:

- ◦Sound1.Source is set to the first item in notes, which is "1.wav".
- ◦Sound1.Play is called, playing this note.
- ◦Since count (1) less than the length of notes (3), Clock1.TimerInterval is set to the amount of time between the first (12:00:00) and second items in times (12:00:01): 1 second. count gets incremented to 2. Clock1.Timer is enabled and starts counting down.

Nothing else happens for 1 second, at which time Clock1.Timer runs, temporarily disabling the timer and calling PlayBackNote.

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PLAYING BACK NOTES WITH PROPER DELAYS

2. The second time PlayBackNote is called, count = 2: ◦Sound1.Source is set to the second item in notes, which is "3.wav".
    - ◦Sound1.Play is called, playing this note.
    - ◦Since count (2) less than the length of notes (3), Clock1.TimerInterval is set to the amount of time between the second (12:00:01) and third items in times (12:00:04): 3 seconds. count gets incremented to 3. Clock1.Timer is enabled and starts counting down.

Nothing else happens for 3 seconds, at which time Clock1.Timer runs, temporarily disabling the timer and calling PlayBackNote.

3.The third time PlayBackNote is called, count = 3:
    - ◦Sound1.Source is set to the third item in notes, which is "6.wav".
    - ◦Sound1.Play is called, playing this note.
    - ◦Since count (3) is not less than the length of notes (3), nothing else happens. Playback is complete.

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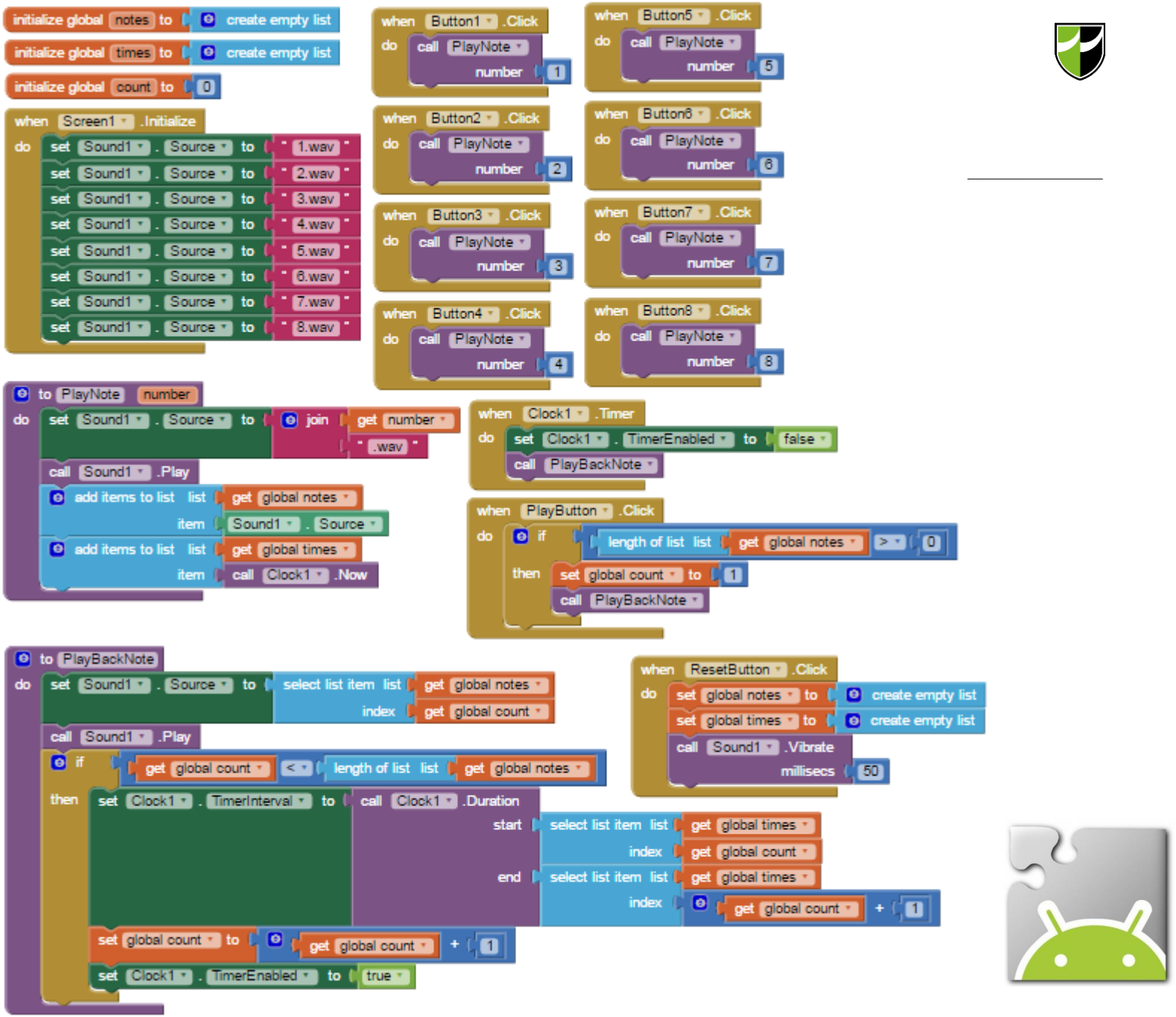
THE COMPL



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Variations

Once you get the game working, you might want to explore some variations.

For example:

- Currently, there's nothing to stop a user from clicking ResetButton during playback, which will cause the program to crash. (Can you figure out why?) Modify PlayButton.Click so it disables ResetButton. To reenable it when the song is complete, change the if block in PlayButton.Click into an ifelse block, and reenable ResetButton in the “else” portion.

- Similarly, the user can currently click PlayButton while a song is already playing. (Can you figure out what will happen if she does so?) Make it so PlayButton.Click disables PlayButton and changes its text to "Playing..."" You can reenable it and reset the text in an ifelse block, as described in the previous bullet.

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SUMMARY

http://www.appinventor.org/Xylophone2

- Here are some of the ideas covered in this project:

- You can play different audio files from a single Sound component by changing its Source property. This enabled us to have one Sound component instead of eight. Just be sure to load the sounds at initialization to prevent delays.

- Lists can provide a program with memory, with a record of user actions stored in the list and later retrieved and reprocessed. We used this functionality to record and play back a song.

- The Clock component can be used to determine the current time. Subtracting two time values gives us the amount of time between two events.

- The Clock's TimerInterval property can be set within the program, such as how we set it to the duration of time between the starts of two notes.

- It is not only possible but sometimes desirable for a procedure to make a call to itself. This is a powerful technique called recursion. When writing a recursive procedure, make sure that there is a base case in which the procedure ends, rather than calling itself, or the program will loop infinitely.

THANK YOU

SEE YOU AGAIN