PLTW COMPUTER SCIENCE

Activity 1.1.1

Getting Started with Block-based Programming: Digital Doodle

goals

- Preview Computer Science Essentials
- Learn block-based programming
- Get started with MIT App Inventor
- Develop an app independently for creative expression

description of App

Create an app that allows the user to take a picture and then draw on the picture in the user interface.

Essential Questions

1. Why is it important to become a creator and not just a user?
2. How does block-based programming make life easier when coding?
3. Why are independent and cooperative strategies so important in computer science?

essential Concepts

- Programming Language Abstraction
- User-centered Design
- Iterative Design and Debugging

- Event-driven Programming

Resources

[App Inventor Debugging Guide]

[1.1.1 Challenge: Additional App Features]

[Digital Doodle app icon]

Getting Started with MIT App Inventor

Design Overview: Digital Doodle

App Overview
You are going to create an app that allows a user to take a picture and then draw on that picture. For replay value, the device screen will clear whenever a user shakes the device. Each of these items is called an app feature, because it describes a specific thing that the app may do. An abbreviated tutorial for this app and many others can be found at the MIT App Inventor website.

User Story

Each feature in an app can be described as a user story. User stories define and prioritize the work you do. The user stories for the Digital Doodle app include three user interactions:

- An app event that allows a user to take a picture when they touch a button.
- Another event that allows a user to touch the screen (swipe gesture as input) to draw on the picture.
- A final app event that allows the shaking of the device to clear all the outputs (the drawing the user made on the picture).

Initial Backlog Breakdown
The user needs to be able to:

- □ Push a button to take a picture
- □ Draw on the picture
- □ Clear the picture
-

If time permits, the user would also like extra features to:

- □ Change the color they draw with
- □ Change the line width

PLTW DEVELOPER'S JOURNAL As you progress, take note of the vocabulary words using a TEMP Chart (Term, Example, Meaning, Picture). As you come across additional key terms, add them to your TEMP chart. Review an example TEMP chart on the PLTW Developer's Journal page.

Design Terminology

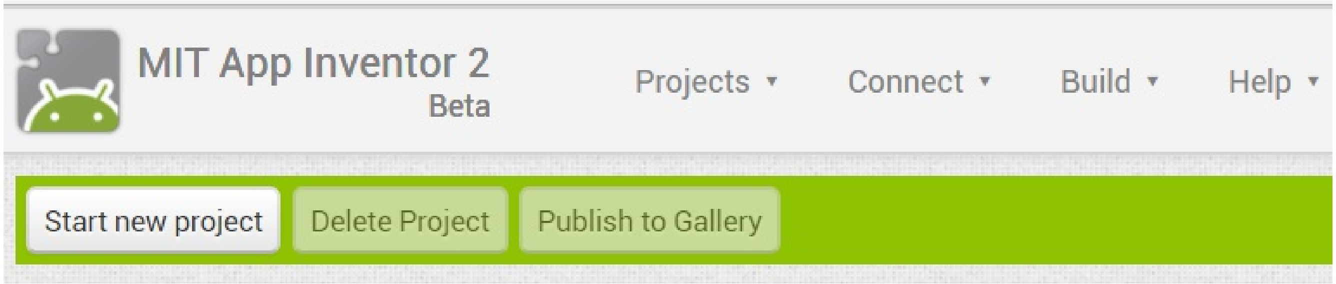
User Story	**Each of the app features is a user story. User stories are the individual items that make up the whole solution or app. Developers make a plan for development that prioritizes and individually addresses each user story's need. With each feature you add, it is important to test and get feedback from other users on how your idea or solution is working. Sometimes new user stories will emerge as people think of new things they want the app to do. All these features need to be visible to the user in the user interface.**
User Centered	When you are developing an app, or any software solution, it is important to think about the people who will be using that software. If the design and development of a software solution is not user centered, then the app may not be used by the intended audience.
User Interface	A user interface is what the user interacts with on the device. It can include the touch screen, buttons, and even an accelerometer that senses and sends the orientation of the device. The user interface sends messages to the operating system to indicate what to do next based on what it senses from the user. As you design apps, you will create many types of user interfaces to meet different user story needs.

Setting Up the Account and Project

1. Access MIT App Inventor in a web browser on your computer.
   - Navigate to http://google.com and log in to your Google account.
   - Navigate to MIT App Inventor at http://appinventor.mit.edu/explore/
   - Click the button that says **Create apps!** and allow login with your Google username and password.
   - Bookmark the MIT App Inventor website on your computer as directed by your teacher. Because you will access this site every class for the next few weeks, this will save you some time at the start of class.

- On your Android device, navigate to the Google Play Store at http://appinv.us/companion and download the AI2 Companion App.
- On your computer, navigate to the App Inventor emulator and open the program. If the program is not already on your desktop, create a shortcut for it and pin it to your start menu or task bar to access it quickly in the future.

2. After App Inventor is open in the web browser, select **Start new project**. Name the project as directed by your teacher.



Designer View and Blocks View

There are two types of views in App Inventor:

- *Designer* view, where you can create the user interface and add common features you want in the app. This is where you let the program know what components you will later want to code.

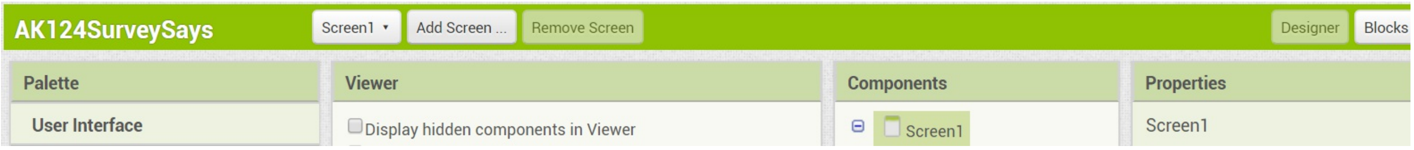
- *Blocks* view, where you can program the features you added in the *Designer* view. To open the *Blocks* view, click **Blocks** in the upper-right corner of the window.

While you develop apps, you will switch between the views. To know which interface to work in, think to yourself:

Refer to your downloadable resources for this material. Interactive content may not be available in the PDF edition of this course.	Refer to your downloadable resources for this material. Interactive content may not be available in the PDF edition of this course.

Components in Designer View

Within the *Designer Palette*, you will find *drawers* with many different *components* in them.



Navigate the Designer View

A component is a tidy package of functionality for an input or output. *Components* are in the *Palette* on the left side of the *Designer* view. The Designer *Palette* has different *drawers* that you can open to see *components* in each category, such as the *User Interface* drawer or *Sensors* drawer.

Toward the right side of the window is a *Components list* of all the components you have added to your app from the *Designer Palette*. In the *Components* list, you can select, rename, or delete the components you want. When you select a component from the list, *Properties* on the far right changes to provide options for the component you selected.

Remember from the user story that this app will need the following components:

- Button (to activate the camera)
- Canvas (to draw on)
- Camera (to take the picture)

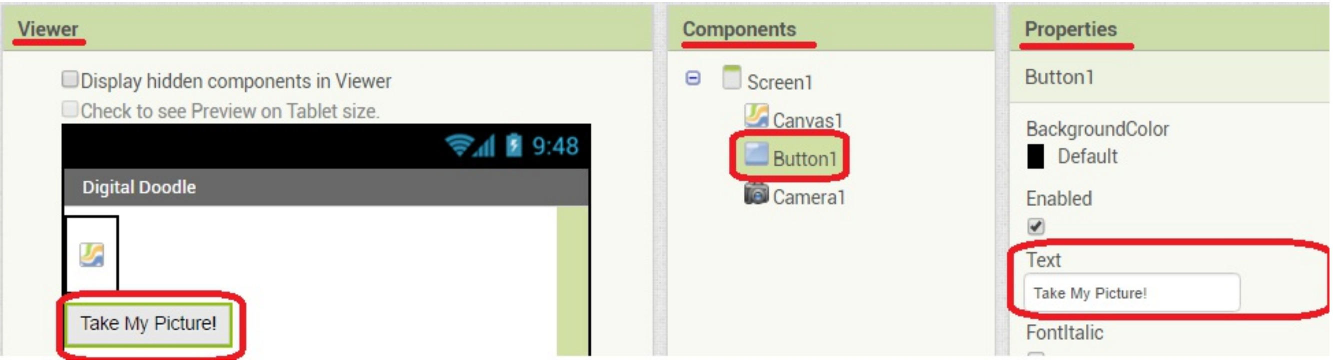
First, you need to have these three design components in the *Designer* view, so that you can switch to the *Blocks* view to program the components. Without the design components in place, you will not see the blocks to make the program.

3. Drag the three components onto the user interface of your app from the following drawers:
   - *User Interface* drawer: Drag out the *Button*, which responds with programmed actions when a user clicks it.
   - *Drawing and Animation* drawer: Drag out the *Canvas*, which provides a touch-sensitive surface where a user can draw and interact.
   - *Media* drawer: Drag out the *Camera*, which accesses the device's camera. The camera is a non-visible component, which means it will appear at the bottom of the window when you drag it to the *Designer* view.

   The default *Text* setting for the *Button* component is "Text for Button", which does not help the user know what the button does.

4. In the *Designer* view, select the **Button** in the *Viewer* or *Components* list.

5. Change the *Button Text* property to **Take a Picture**! Now the user will see text on the *Button* that lets them know how to use the interface.



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Event Handlers

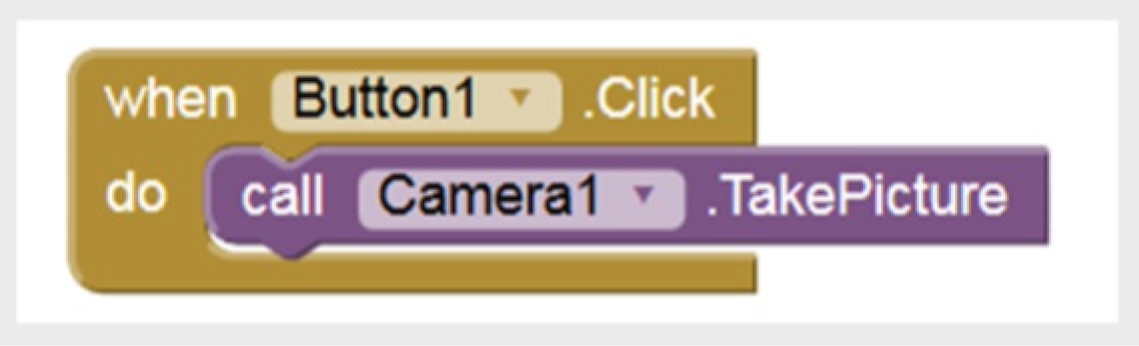
In almost all programs you create, you will have inputs or events that cause the program to take action. These actions usually produce outputs that the user can experience. Events include actions such as clicking a button, touching a screen, or tilting a device that has an accelerometer in it. The program might produce an output for the user, such as sound, graphics, or motor movement. Sometimes the program does not give a noticeable output to the user, but changes something in the program.

Event handlers look for inputs or events to know when to perform a specific action and provide specific outputs. Some event handlers are control blocks that are specific to a component in App Inventor.

Event handlers abstract the details of the structures that enable or disable the control over the components you drag and drop inside them. Each block in App Inventor is doing a lot of work for you behind the scenes. Abstraction keeps you from seeing, and dealing with, the details you do not care about (for right now).

In this example, the control block, or *event handler*, is waiting for an event (*Button* click) and a procedure that produces an output (takes a picture).

Event Handler
when: *Button1* is clicked (input)
do: call *Camera1* and *TakePicture* (output)



```
when Button1 ▾ .Click
do   call Camera1 ▾ .TakePicture
```

Event Handler

Snippet of code showing the event handler for the first feature in the Digital Doodle app. It will use the input of pressing a button to take a picture.

As a developer, you would waste time writing the same code to take a picture every time you use that feature in an app. That code is bundled in a procedure block for repeated use, without having to recode it each time.

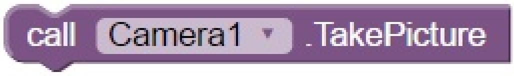
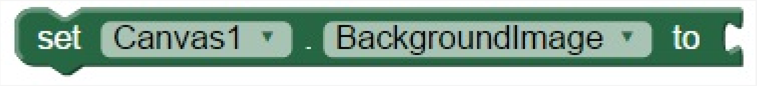
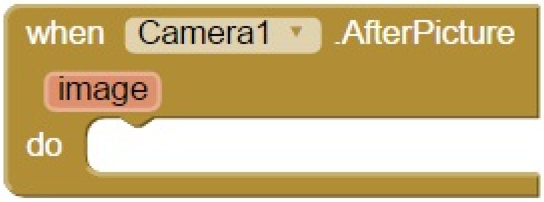
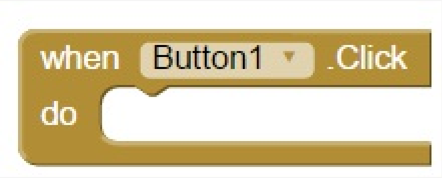
App Inventor abstracts away those details, so you can focus on the app as a whole and have a camera feature, instead of all the steps needed to make the app take a picture.

Abstraction hides the complexity of a task by concealing the details, making it easier for computer scientists to focus on the relevant steps of creatively developing code.

Blocks View

While developing in the *Blocks* view, pay close attention to the event that you want to develop. To find an event handler, look at the event inside the event handler, then find that event component in *Blocks* on the left side of the *Blocks* view.

6. To switch to the *Blocks* view, click **Blocks** in the upper-right corner.
7. In the *Blocks* panel on the left, find the blocks below and drag them out into the *Viewer* part of your screen:

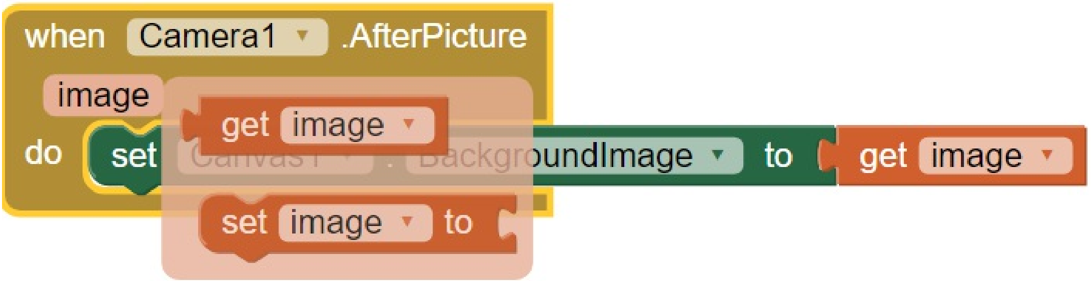
Camera Drawer	 call Camera1 .TakePicture **A block that calls a procedure that lets the user take a picture.**
Canvas Drawer	 set Canvas1 . BackgroundImage to A block that sets the background image of the canvas whenever the event handler the block is placed in is activated.
Camera Drawer	 when Camera1 .AfterPicture image do A block that handles the events after the picture is taken by the user.
Button Drawer	 when Button1 .Click do

	An event handler that executes the blocks within it whenever *Button1* is clicked.

8. If you cannot find a block described in the procedures:

    - Verify that the component is in the *Designer Components* panel*.*
    - If the component is not in the *Designer* view, add it in the *Designer* view then return to the *Blocks* view.
    - Find the same component in the *Blocks* view to be able to grab blocks associated with that specific component.

9. Drag out the *image* block from the *Camera1.AfterPicture*.
    - Move your mouse pointer over the text “image” without clicking.
    - Click the *get image* block that pops up and drag it out. The *image* block may only be used inside the event handler you pulled it from.


when Camera1 .AfterPicture
image
get image
do set Canvas1 . BackgroundImage to get image
set image to

Setting Up Event Handlers

An event handler is a chunk of code that executes (is put into action) when a particular event occurs. To create an interface with an event handler in MIT App Inventor, drag one or more blocks into the event handlers.

10. Look at the “*When..., do...*” *Button.click* event handler block.

    Each time the event occurs (selecting the button on the screen), the code inside the *do* part of the event handler will be performed.

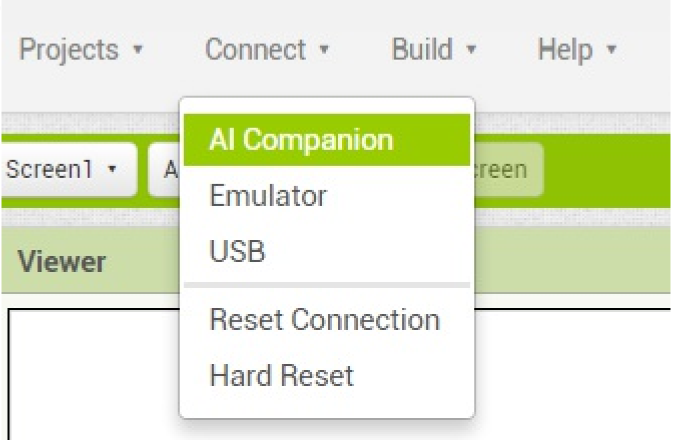
    You are about to fill in the *do* part of the event handler. The blocks work like a puzzle. Either the blocks fit together, or you need to revisit how you are using the blocks to code.

11. Construct two event handlers from the blocks you pulled onto the screen by thinking through two of the features you want:
    - What event (button) triggers an event handler (button click) to make what action happen (call the camera to take a picture)?
    - The camera, after the picture event, should set the *Canvas* to show the background as that image from the camera.

Debugging

12. To test your program, connect to the device with the following steps:
    - In the MIT App Inventor browser window, select **Connect** > **AI Companion**.
    - On the Android™ device, launch the **AI2 Companion** app.
      The browser displays a six-character code.
    - In the Android device's AI Companion app, enter the six-character code and select **Connect with code**.

      Alternatively, you can scan the QR code in the Android device's AI Companion app.



Your program is working properly, if you can:

- □ Touch the button as input
- □ Receive the output of an image on the screen after you take the picture

13. If your program is not working properly, start debugging, which means looking at your code piece by piece to determine why the program is doing something different from what you intended it to do. Refer to the App Inventor Debugging Guide for reminders and steps to debug.

    App Inventor Debugging Guide

Be patient with yourself, and seek help from those around you if your app is not performing as expected.

Iteration and Version Control

After testing and debugging, you have a functioning app!

You probably want to keep it that way as you explore adding more features. Saving your project as a new version (with a new name) will help minimize how much you have to debug or fix moving forward. Naming is important, because it will help you review previous versions of your code as you develop toward the final app.

14. To save your program with a new name, click to open the **Projects** menu and select **Save project as**…

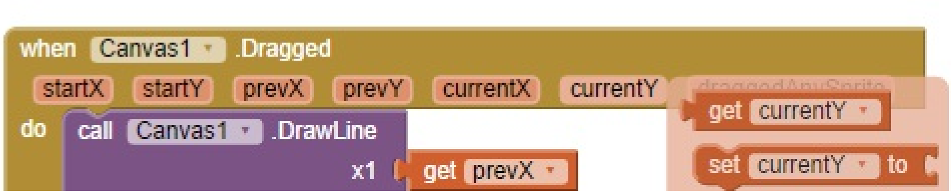
    - As you create these new versions—also known as program iterations, it is important to name them in a way that will make it easy to find specific features or code.
    - Discuss naming schemes with your teacher.

Procedures and Arguments

Set up a *call Canvas.Drawline* procedure under the *Canvas.Dragged* event handler. You can find both of these blocks in the *Canvas* drawer, as they are both connected to the *Canvas* component.

15. Select the blocks and drag them into the viewer.

    The *whenCanvas1.Dragged* event handler block is designed to automatically get (X,Y) location information for you to use in your program (both the previous location and current location when a user drags their finger across the screen). Hover over the orange arguments in the event handler (as pictured below) to access the *get variable* blocks that contain the (X,Y) values. The program can pass the information about the (X,Y) locations to other parts of the program as arguments/variables by plugging a get block into the *callCanvas1.Drawline* procedure.



    For the app to draw a line, the procedure needs to get the coordinates of the screen. The app needs to know where the user first touched and where they touch next.

    Refer to your downloadable resources for this material. Interactive content may not be available in the PDF edition of this course.

    These types of blocks will be discussed more later.

16. Set up the procedure while considering the above outline. For help with the setup, you can read the comments in the picture above, hover your pointer over the event handler in your program to see an explanation, or read more below.

    Refer to your downloadable resources for this material. Interactive content may not be available in the PDF edition of this course.

17. Test and debug your app.

    - If you change your app and it no longer works, you may always go back to the previously saved version.
    - Do an iteration save of your project, if the app allows you to:
        - □ Take a picture

    - □ Draw on the picture

Clear Screen

As you test the app by drawing on it, you may want to clear the screen. It is possible to clear the canvas when you shake the device using the accelerometer. The accelerometer is a built-in feature in some devices that allows the device to sense if and how much the device is tilted in any direction.

18. To use the accelerometer in the app:
    - In the *Designer* view, go to the *Palette Sensors* drawer and drag in the *AccelerometerSensor* component. The *AccelerometerSensor* is a non-visible component, so it will show under the app screen in the Viewer, but the user cannot see it.
    - In the *Blocks* view, select the **AccelerometerSensor** drawer and drag out the *AccelerometerSensor.Shaking* event handler.
    - In the *Blocks* view, select the **Canvas1** drawer. Find and drag out the call *Canvas1.Clear* procedure block and place it inside the AccelerometerSensor.*Shaking* event handler.
    - Test, debug, and save when the app lets you:
        - □ Take a picture
        - □ Draw on the screen
        - □ Shake the device to clear all the drawings

Add Color

The app needs a little color. You can add buttons that will change the pen color. Now is your chance to add the colors you think a user may want to draw with.

19. To add color buttons:
    - In the *Designer* view, add another button.
    - Select the new button in the *Components* list. In the *Designer Properties* of the button, change the *TextColor* to the color you want it to be, for example *red*.
    - In the *Blocks* view, click the button that you want to be red. Find the *When Button.click* event handler and drag it out into the screen.
    - Click the **Canvas** drawer to find the *set canvas.PaintColor* block and add it to the event handler.
    - Click the **Colors** drawer and pull out the color and plug it into the end of the set block.
    - Test your app:
        - □ Take a picture
        - □ Draw on the screen
        - □ Select different colors to draw on the screen
        - □ Draw on the screen
        - □ Shake the device to clear all the drawings

App Completion

20. Review the iterations you have completed with your code.

    > Refer to your downloadable resources for this material. Interactive content may not be available in the PDF edition of this course.

21. When your app is working properly, complete the following as instructed by your teacher.
    - Share your work.
        - Show your MIT App Inventor screen.
        - Demonstrate the app on a device using AI Companion.
    - Back up your work.
        - To download the MIT App Inventor program you created, select **Projects** > **Export selected project** (.**AIA**) **to my computer**.
        - To download the Android™ app, select **Build** > **App** (**save** .**APK to my computer**).
    - Share a quick reference image.
        - In the Blocks view, right-click on the blank area of the screen.
        - In the popup list, select **Download Blocks as Images**.
        - Share the image with your teacher.

Challenge

Challenge yourself by choosing some **additional app features**.

Conclusion

1. Why is it important to design incrementally? Consider: During what iteration did you have a working app? What did you stand to lose and gain with each iteration?
2. Why do you think computer science professionals included things like communication, collaborations, and fostering an inclusive computing environment in the **computer science practices**?
3. How did you interpret and respond to the **essential questions**? Capture your thoughts for future conversations.

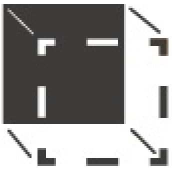
App Inventor Debugging Guide

Resources

- Verbally explain to an elbow partner where you are in the activity guide, what you were trying to do, and what you have already done. Sometimes talking through these steps helps you discover the problem.
- Read any errors that pop up on the screen. These will lend insight into why the software cannot complete the program.
- Remove or right-click to disable some blocks to get a basic working code, and then add blocks back in one at a time to see what is causing the issue.
- Check the names of components in the Designer view to make sure the blocks you think you are programming are the ones you are actually programming.

Steps for Debugging Code

1.



Check for hardware or emulator connection issues. You might need to close the emulator or the MIT AI Companion, reset the connection, and reconnect.

2.

Check for compilation errors (warnings and error messages in the *Blocks* view) and fix them.

3.

To make sure you understand the intended outcomes of each event handler, review your comments and algorithms.

4.

Make sure your code is easy to read. Collapse code that is not related to the bug.

5.

Use debugging strategies to isolate the bug.

- Do It command
- Disable command
- Code trace or variable trace

6.

Test the app.

7.

Fix the bug.

8.

Test the app again.