ECEN 5823 Spring 2025
Internet of Things Embedded Firmware
Assignment #1 - Simplicity Studio Exercise

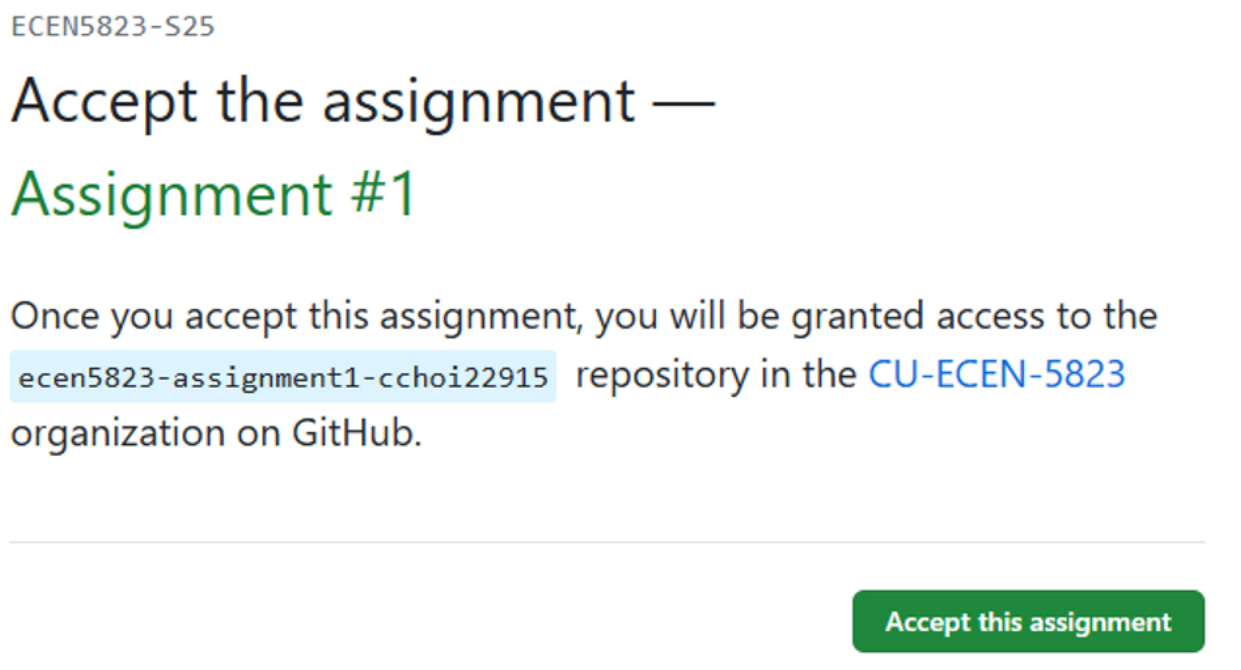
Objective: Install and become familiarized with the Silicon Labs' Simplicity Studio development environment, learn about GPIOs and the Simplicity Studio Energy Profiler. Become familiar with the setup of Github Classroom used for submission of programming assignments.

Instructions:

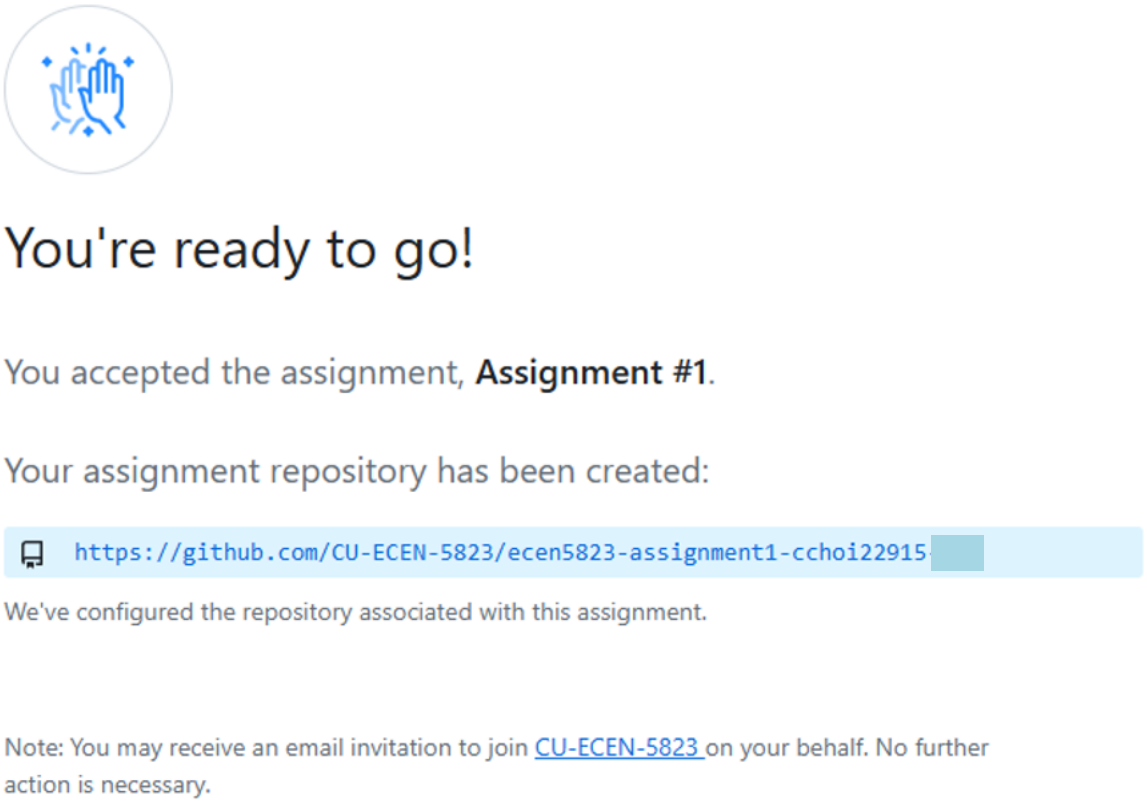
1. Scroll down to the section "**Installation of Simplicity Studio Version 5**" (SSv5) and follow the instructions there.

2. We will use Github Classroom to create a unique repository for each student based on a common starter code repository. If you don't have a GitHub account, please create one (the free account type) prior to clicking the link below. You will then clone your newly created repository from the Cloud to your own machine, do your homework by modifying this repository, commit your changes, and push your changes to Github.
    a. Access the assignment using Github Classroom assignment at https://classroom.github.com/a/swBbyApb

You should see a page like this:



click **Accept this assignment**. It will take a few seconds to generate your repository. You should see:



Click the link to go to your newly created repository. You should see in your web browser a new, empty repository setup for you.

3. Clone this repository into your Simplicity Studio workspace directory (~/SimplicityStudio/v5_workspace/ where ~ is your home directory or C:\Users\<username> on windows).
    a. Use the simplicity studio workspace directory since when located outside this directory some features **such as project rename** are not supported in the IDE.
    b. See https://help.github.com/articles/cloning-a-repository/ for clone instructions from github.

Linux example:

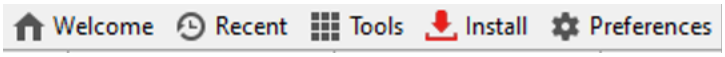
```
% cd ~/SimplicityStudio/v5_workspace
% git clone https://github.com/CU-ECEN-5823/ecen5823-assignment1-cchoi22915
```

cchoi22915 is my GitHub username. A **new directory** will be created in ~/SimplicityStudio/v5_workspace/ called ecen5823-assignment1-cchoi22915/

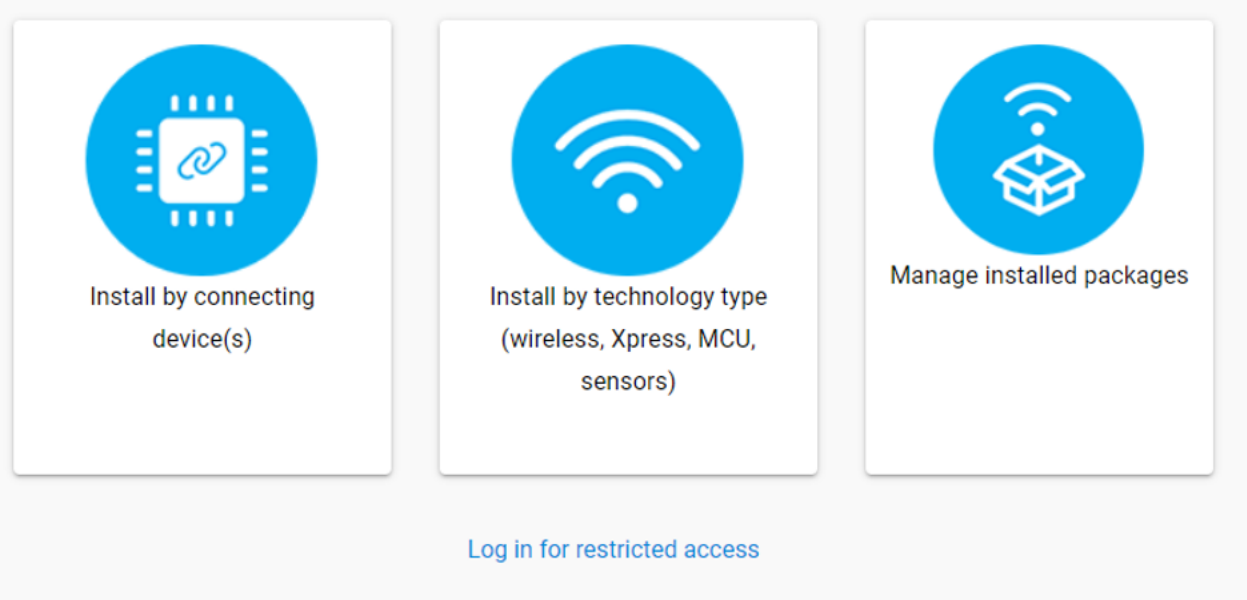
Populate the local repo with code from the starter code repository:

```
% cd ecen5823-assignment1-cchoi22915
% git remote add assignments-base https://github.com/CU-ECEN-5823/ecen5823-s25-assignments.git
% git fetch assignments-base
% git merge assignments-base/master [1]
% git push origin master
```

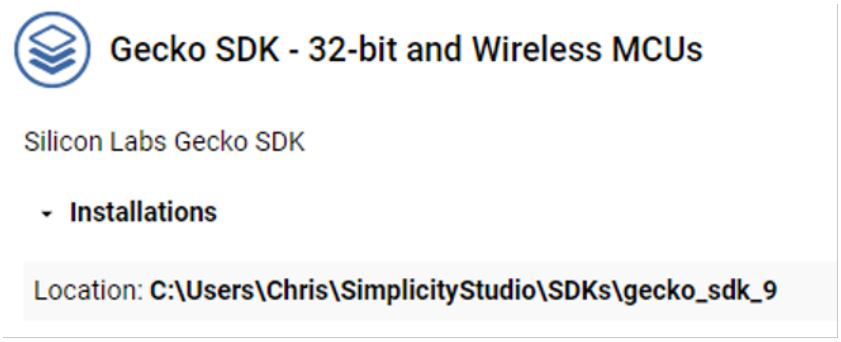
4. **BEFORE YOU IMPORT YOUR PROJECT INTO SIMPLICITY STUDIO, YOU MUST HAVE THE PROPER GECKO SDK VERSIONS AND GNU TOOLCHAIN INSTALLED.**
   a. At the top of the application, find the “Install” button with the download icon.



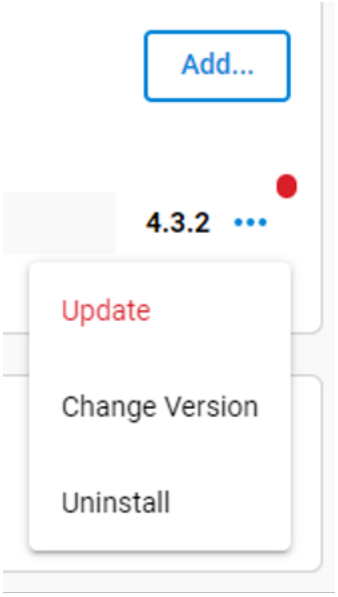
   b. This will open up a menu -> select “Manage installed packages”



   c. At the top of the Installation Manager, you will see a tab for “SDKs”. Click this tab and locate the "Gecko SDK 32-bit and Wireless MCUs” section.

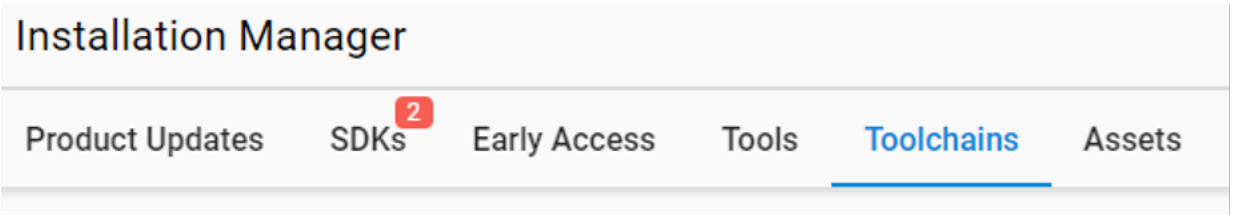


d. To the right of this bar, you will find your current version and three dots. If your version states 4.3.2, you do not have to do the next steps. If your version is ANYTHING ELSE, click on the three dots. This will open a drop down menu. Click on “Change Version” and scroll down to 4.3.2. This will install the correct version. After install, verify the new version by opening the Installation Manager again.



e. To install the correct GNU toolchain, follow steps 4a, 4b again.

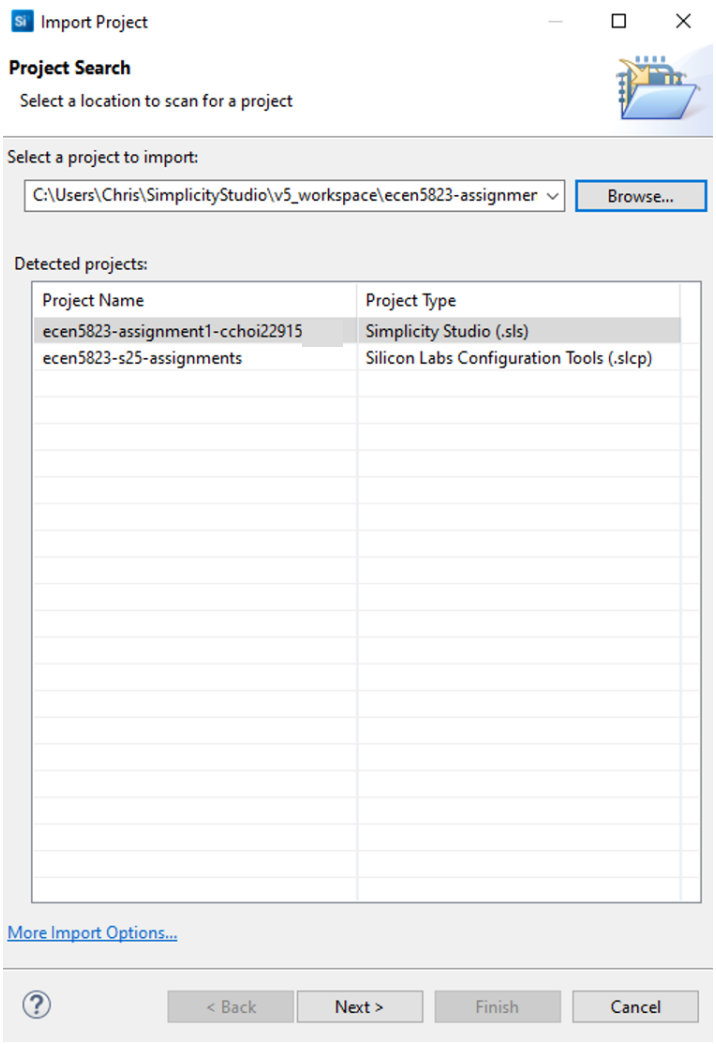
f. At the top of the Installation Manager, you will see a tab for “Toolchains”. Click this tab and locate the “GNU ARM Toolchain(v10.3.2021.10)-10.3.2021” section.



g. To the right of this bar, click on the “Install” button. Wait for installation and verify it has installed. The button should now show “Uninstall”. Do not click “Uninstall”.

You are now ready to import the project into your workspace.

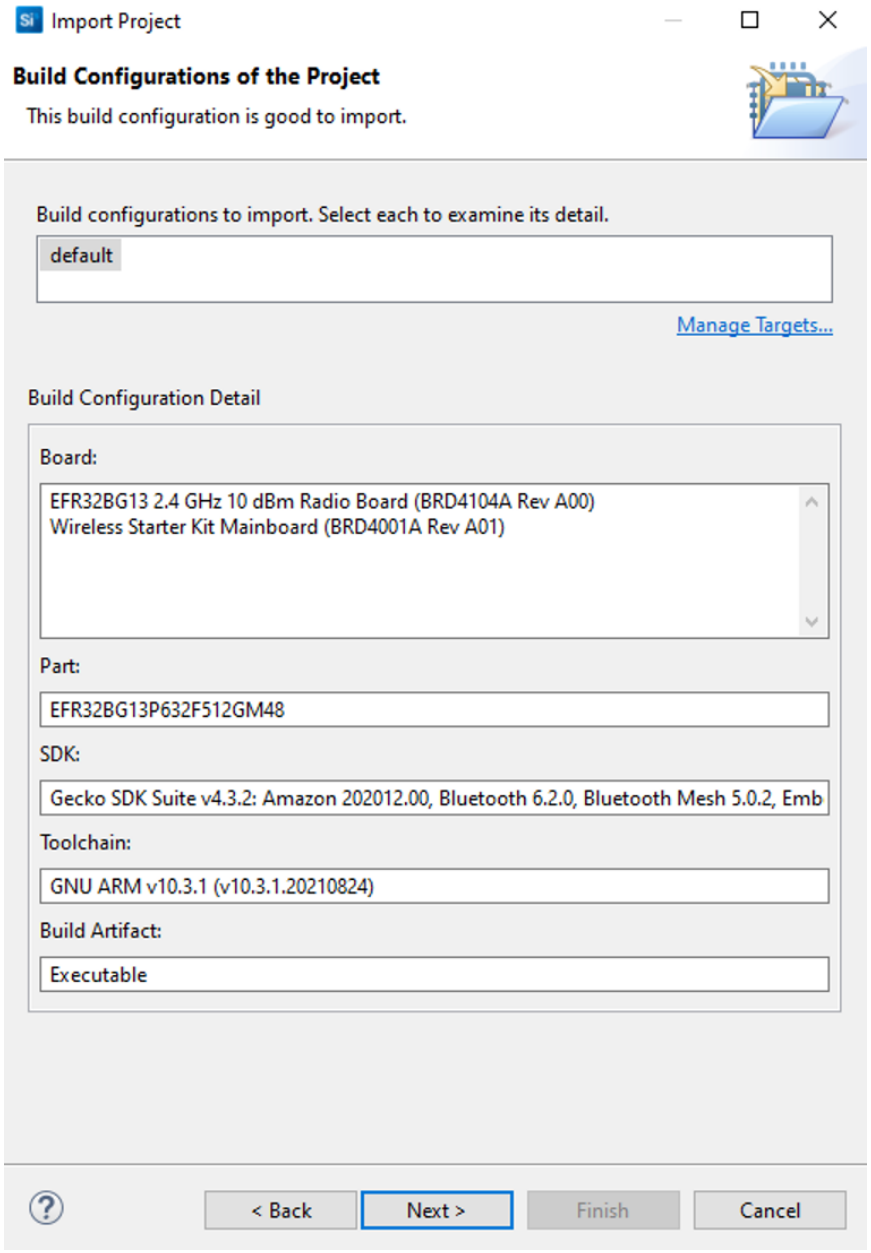
5. In Simplicity Studio, select File->Import and browse to the ecen5823-assignment1-<username> directory that was created in the previous step. You should see a screen similar to this:



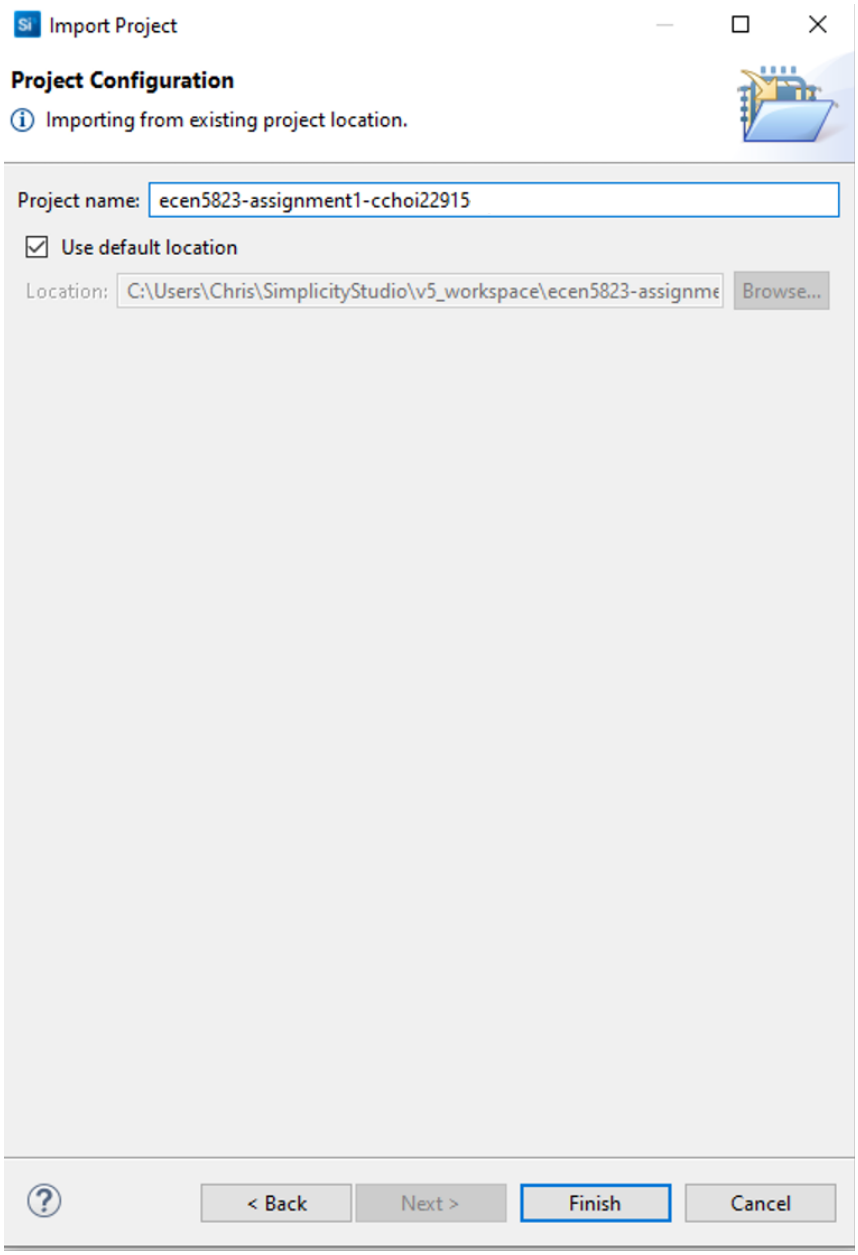
[1] Some Windows users get a “Filename too long” error on the merge command. If this happens try these to commands prior to the merge:

```
% git config --system core.longpaths true
% git fsck --name-object
```

Once you click next, you should see this screen. (YOU MUST HAVE Gecko Suite 4.3.2



Select the “Simplicity Studio.sls” project type and click “Next” through the next two screens, ensuring that the project name is “ecen5823-assignment1-<username>”. **Here you see it added an “_2”, remove the “_2” before continuing, if that should happen for you**. _2 removed (ignore the -1 in the screenshot):



6. Ensure the project name is ecen5823-assignment1-<username> and click “**Finish**” to complete. Now, the starter code project should be loaded into your Simplicity Studio workspace. To reduce the number and types of issues you may see, it is a good practice to perform a **Clean…** operation on your project immediately after importing and prior to

attempting to build (compile) the design. Right-click on the project in the Project Explorer and select "**Clean Project"**. Take a moment to verify the location of your imported project files on your local disk. I see many student issues caused by a project being imported multiple times, resulting in multiple locations (duplicate directories) in the student's local file system. A student will edit 1 set of files and get that code working and end up submitting the files from a duplicate directory that the student was unaware of.

7. Right click on the project in the Project Explorer pane and select "**Build Project**". You should not see any errors or warnings and the .axf file should be created.

See the files app.c, src/gpio.h and src/gpio.c, look for the text string "Student edit:"

8. Expand the project and then open up the /src folder. Open up the gpio.h and gpio.c files and complete the following #define statements by tracing the PCB connections from the LEDs on the main board to the EFR32BG13 MCU. See the link to the documentation in the gpio.c file comments for more information.

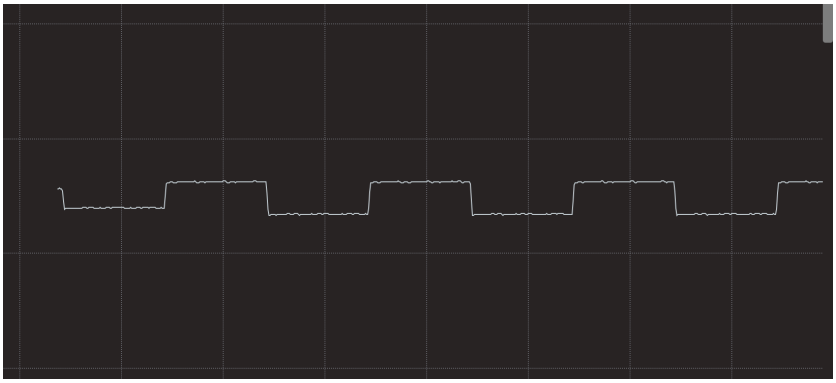
    a. #define LED0_port 0 // change to correct ports and pins
    b. #define LED0_pin 0
    c. #define LED1_port 0
    d. #define LED1_pin 0

and make an edit required in app.c

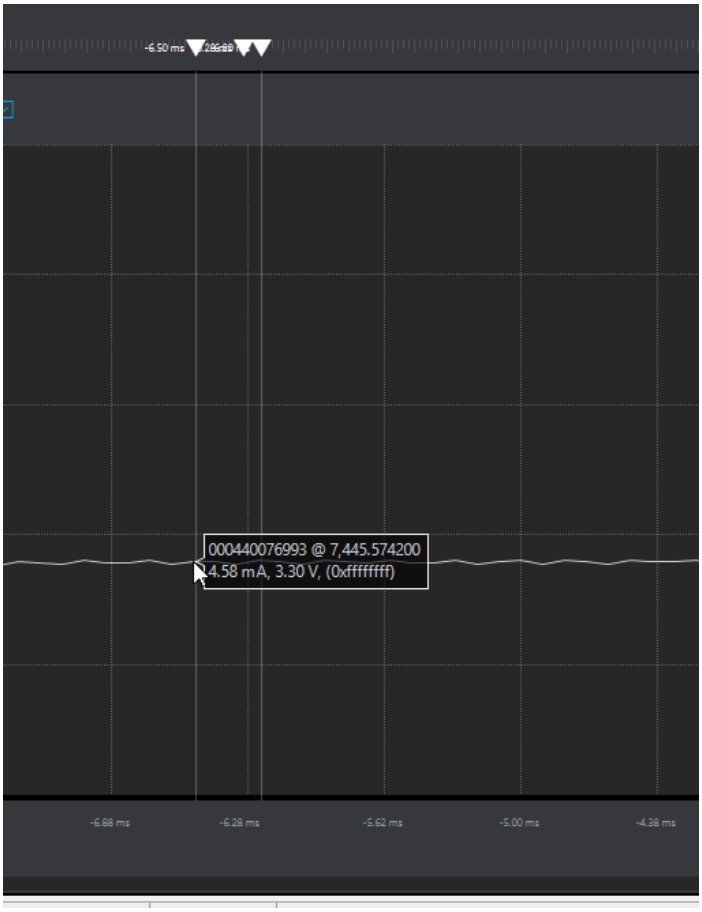
9. Now, build the project again to make sure there are no compilation issues, then under the Run pull down menu, select "Profile As / Simplicity Energy Profiler Target"

    a. Simplicity IDE should begin to compile the project, and then download the code onto Blue Gecko board
    b. After downloading the code to the board, the code should begin to run, and LED0 on the Blue Gecko should begin to flash on and off
    c. Simplicity Studio should now open in the Energy Profiler

10. In the Energy Profiler, click the "Running" or "Paused" button in the center to switch between running/paused modes. You may have to use the Zoom control at the left to increase the vertical display height of the waveform. You should see something like this:



11. Click a point with the mouse to display instantaneous (peak) current measurements



12. Pausing the Energy Profiler, use the instantaneous current measurement to determine how much current a single LED (LED0) draws with the “StrongStrong” setting. Repeat this measurement for the “WeakWeak” setting for a single LED (LED0). This will give you the data to answer questions 1 to 3.

With the drive strengths set to “WeakWeak” for both GPIOs:

13. Run the Energy Profiler, pause it, then measure the average current for 1 LED (LED0, question 4).

14. Edit the code and run the Energy Profiler, pause it, then measure the average current for 2 LEDs (LED0 and LED1, question 5).

Questions:
Answer the questions in the folder questions/Assignment1-SimplicityExerciseQuestions.md within your repository and commit with your final code. There is possible extra points for Question 3 depending on the level of sophistication/detail of your answer.

Deliverables:

1. Answers to the assignment questions in the questions/Assignment1-SimplicityExerciseQuestions.md file within your repository
2. Modified program files with all modifications made (including correct GPIO assignments).

How to submit your assignment:

All files should be submitted using the Github repository link created above when you accepted this assignment in GitHub Classroom.

- Verify your ecen5823-assignment1-<username> repository contains your latest/ intended code and answers to the questions. It is your responsibility to push the correct version of your project/code. Use a web browser to verify the correct version of your project/code has been uploaded to GitHub.
- In **Canvas**, submit the URL to your github repository and in **GitHub** create a tag of your GitHub submission prior to the due date with the text of A1-final. The date and time of the tag creation is what we use to determine whether your submission was on time or late. These 2 steps will complete your assignment submission.

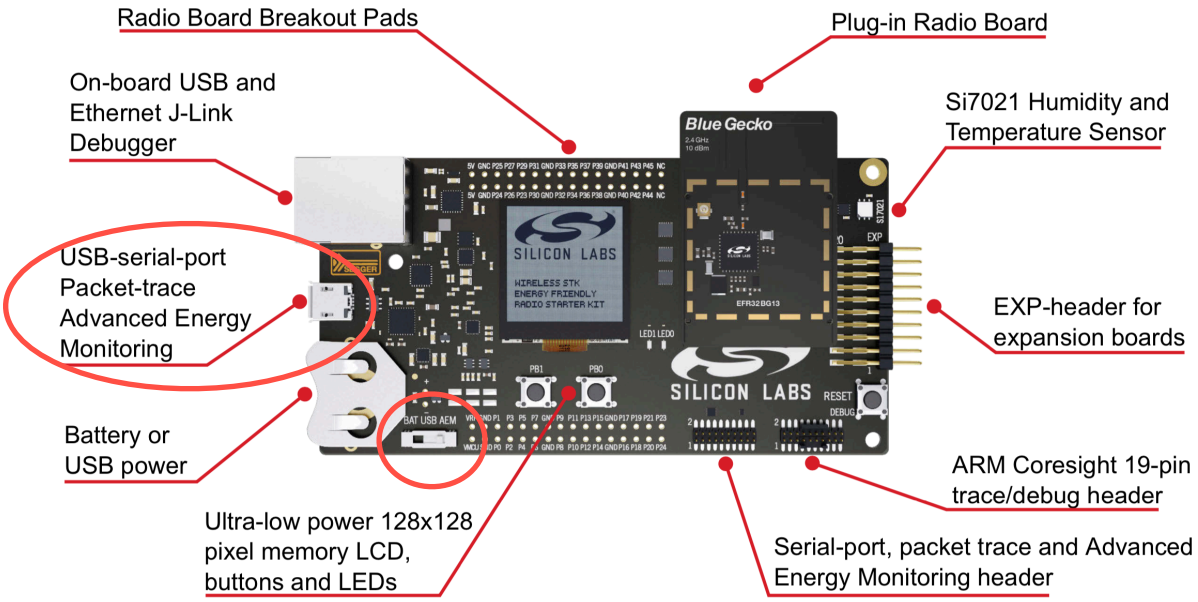
Be sure to push your changes back to your repo before the deadline! Remember: Any code pushed to your GitHub repository is subject to inspection for honor code violations. This is true for the entire semester.

Attention: Make sure to adhere to the ECEN5823 C Coding Style Guidelines.pdf. There are graded items described therein. These guidelines apply to all the code you submit this semester.

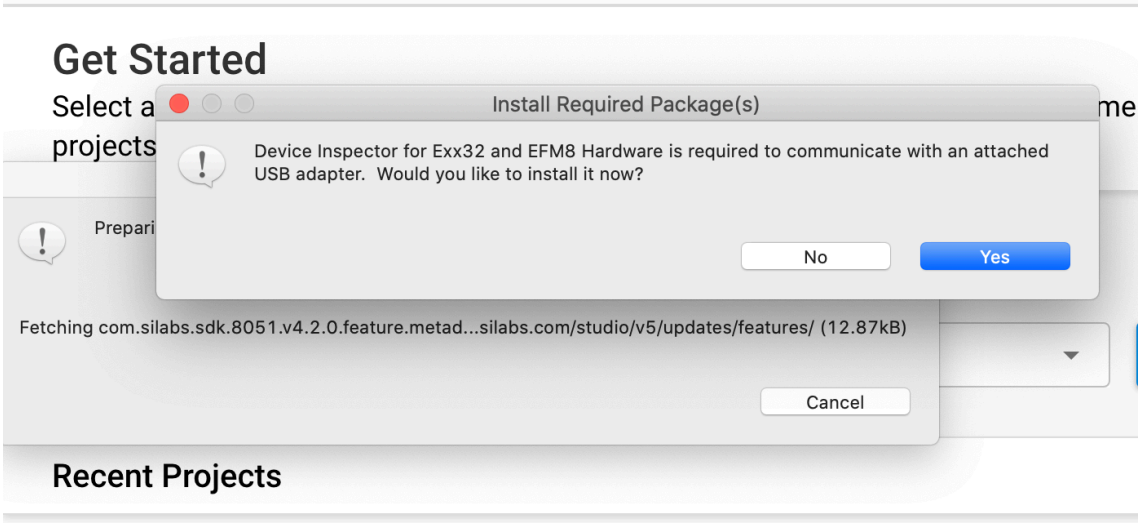
This is the end of the assignment. Installation steps for Simplicity Studio V5 starts on next page.

Installation of Simplicity Studio version 5:

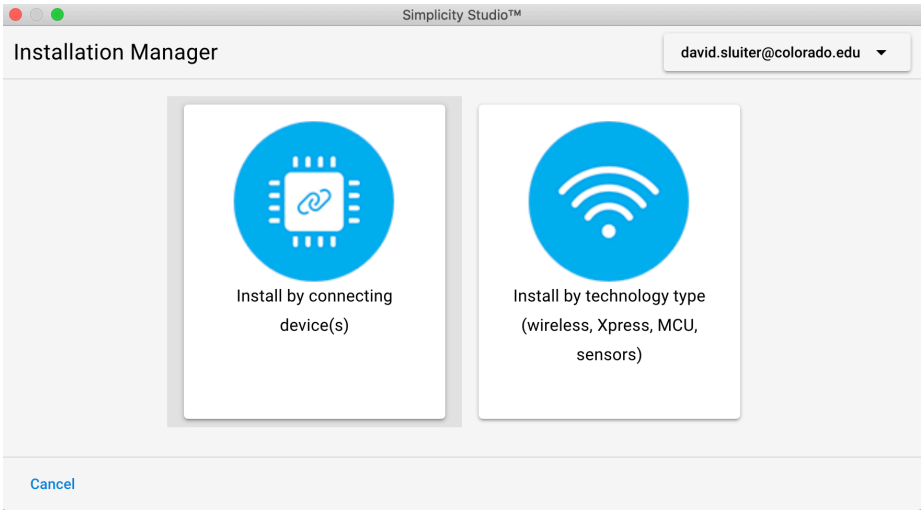
15. Connect your Silicon Labs' Blue Gecko SLWSTK6020B starter kit to your computer via the supplied USB cable, with the BRD4104A radio board module connected to it. Nothing else should be connected to the base board. **Ensure that the Power Source Select is to the AEM position**.

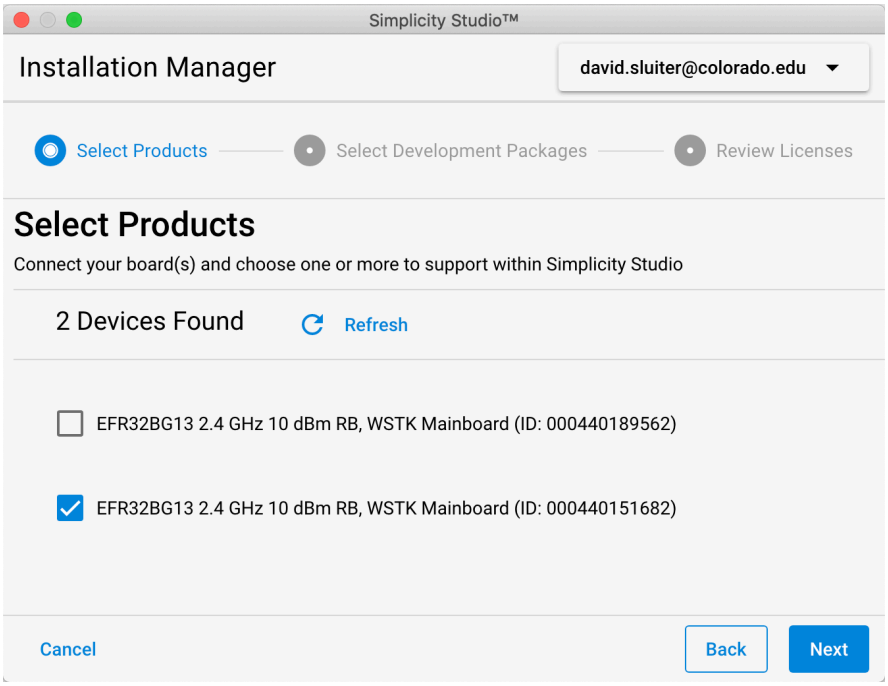


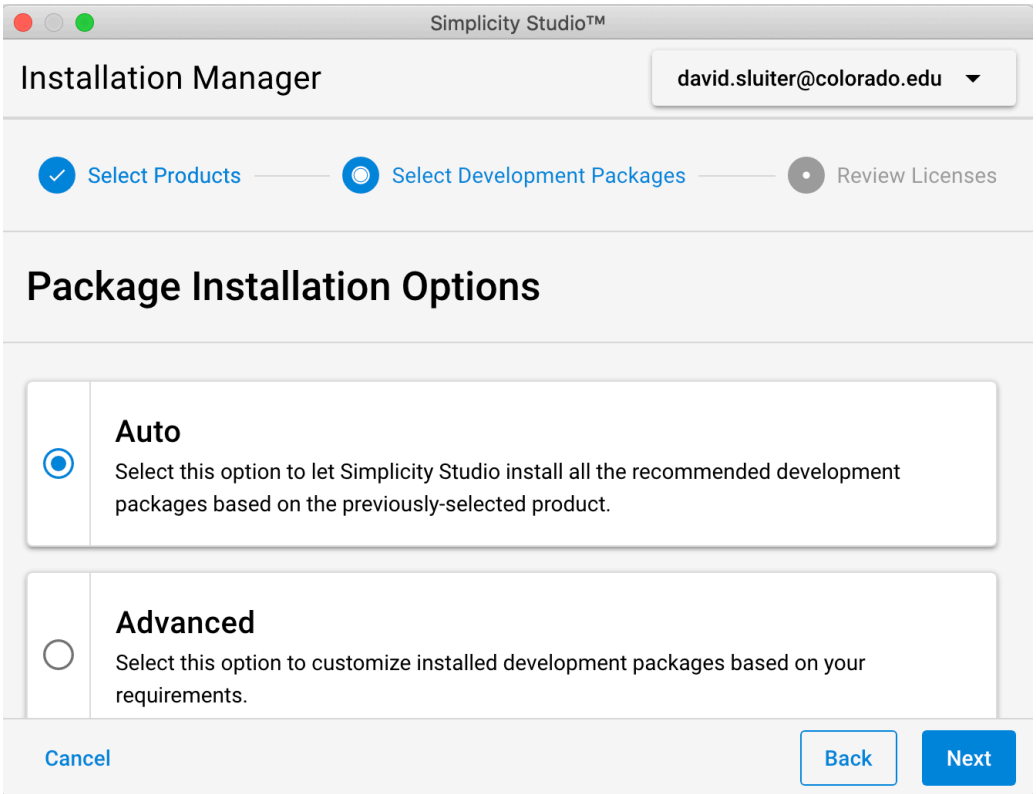
16. Install Silicon Labs' Simplicity Studio Version 5. You can download the software from the following site:
    a. https://www.silabs.com/products/development-tools/software/simplicity-studio
    b. Sign in to Silicon labs, creating an account if necessary.
    c. **Ensure the Gecko board is connected to the computer when installing Simplicity Studio, this should automatically pull in device support. You should see and sequence through the following screens:**

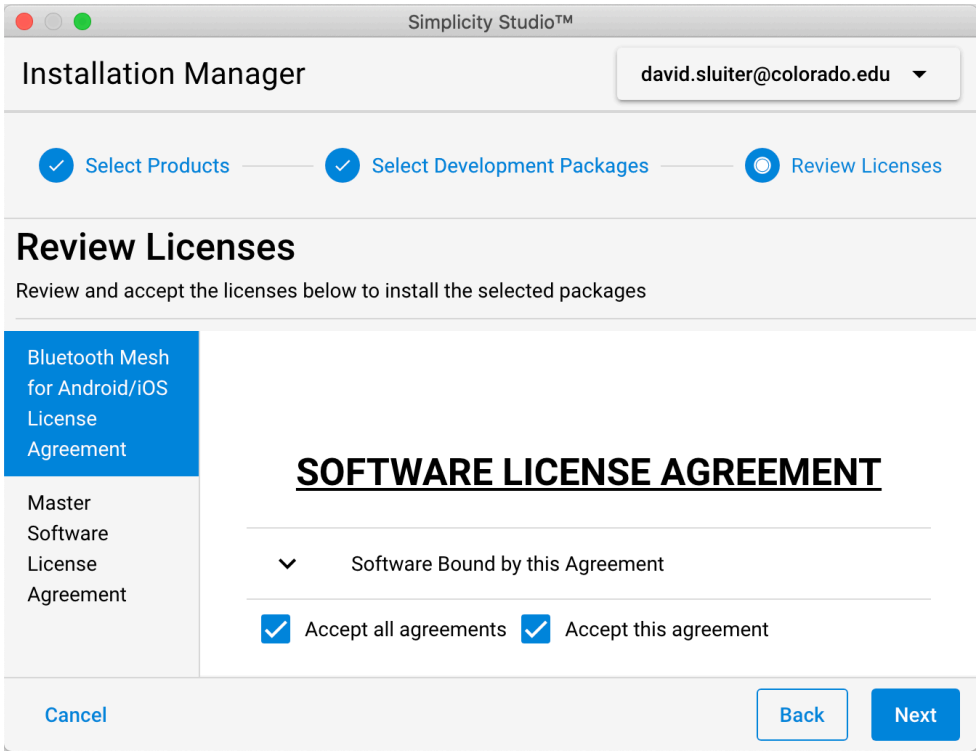


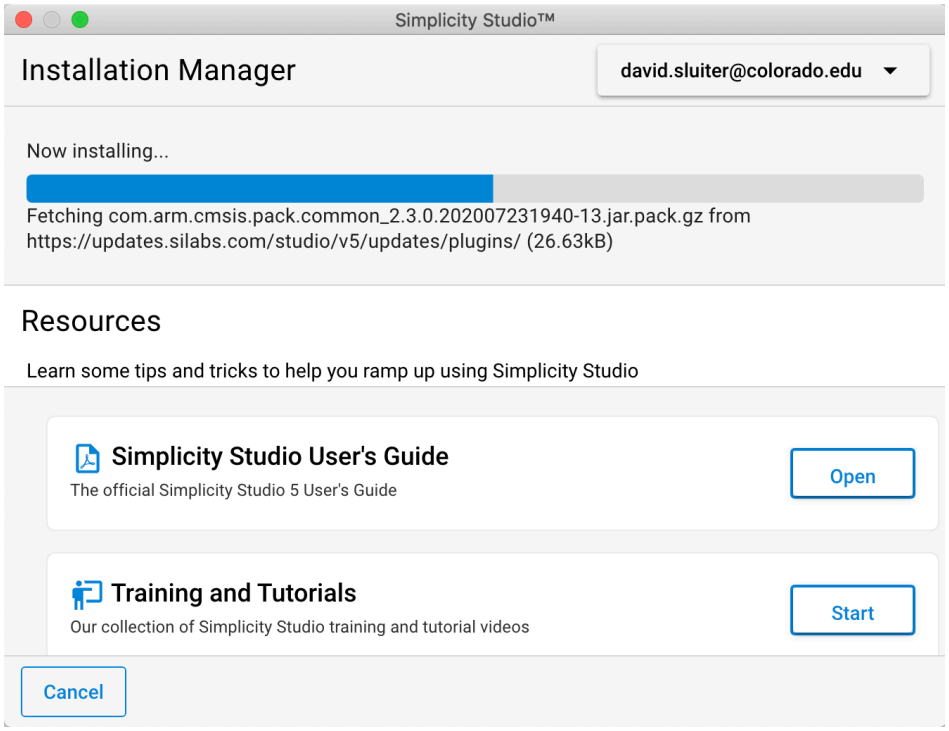
Select “Install by connecting devices”.

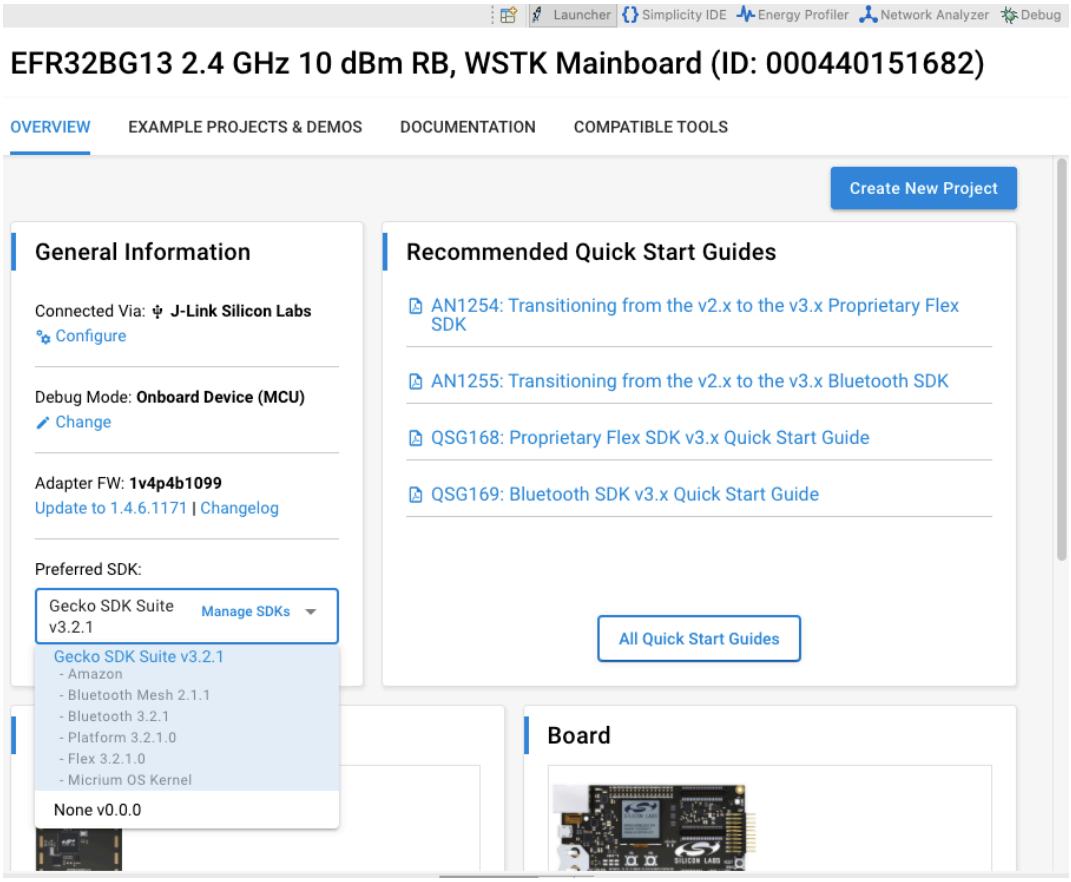



Simplicity Studio™
Installation Manager
david.sluiter@colorado.edu
Select Products
Select Development Packages
Review Licenses
Select Products
Connect your board(s) and choose one or more to support within Simplicity Studio
2 Devices Found
Refresh
EFR32BG13 2.4 GHz 10 dBm RB, WSTK Mainboard (ID: 000440189562)
EFR32BG13 2.4 GHz 10 dBm RB, WSTK Mainboard (ID: 000440151682)
Cancel
Back
Next


Simplicity Studio™
Installation Manager
david.sluiter@colorado.edu
Select Products
Select Development Packages
Review Licenses
Package Installation Options
Auto
Select this option to let Simplicity Studio install all the recommended development packages based on the previously-selected product.
Advanced
Select this option to customize installed development packages based on your requirements.
Cancel
Back
Next

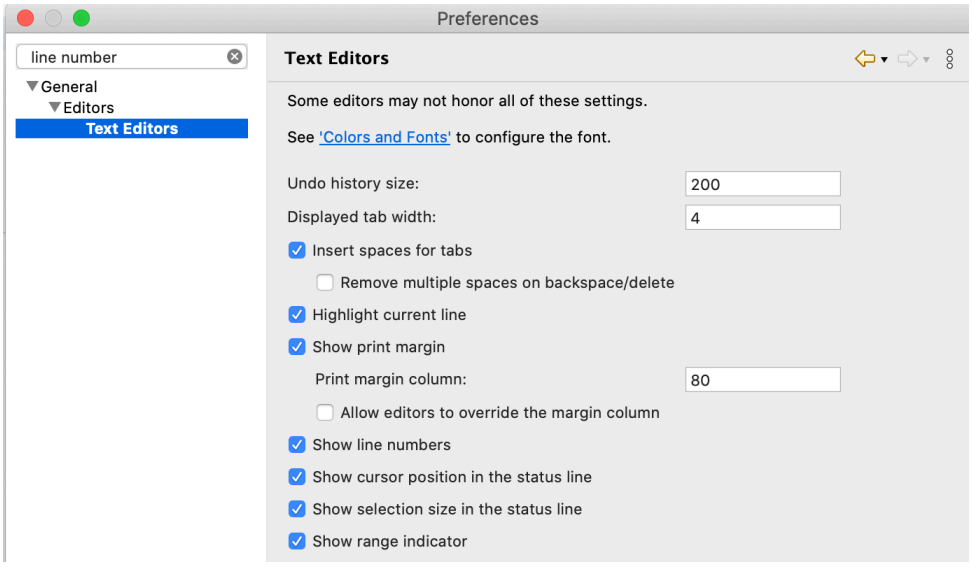

Simplicity Studio™
Installation Manager
david.sluiter@colorado.edu
Select Products
Select Development Packages
Review Licenses
Review Licenses
Review and accept the licenses below to install the selected packages
Bluetooth Mesh for Android/iOS License Agreement
Master Software License Agreement
SOFTWARE LICENSE AGREEMENT
Software Bound by this Agreement
Accept all agreements
Accept this agreement
Cancel
Back
Next


Simplicity Studio™
Installation Manager
david.sluiter@colorado.edu
Now installing...
Fetching com.arm.cmsis.pack.common_2.3.0.202007231940-13.jar.pack.gz from https://updates.silabs.com/studio/v5/updates/plugins/ (26.63kB)
Resources
Learn some tips and tricks to help you ramp up using Simplicity Studio
Simplicity Studio User's Guide
The official Simplicity Studio 5 User's Guide
Open
Training and Tutorials
Our collection of Simplicity Studio training and tutorial videos
Start
Cancel

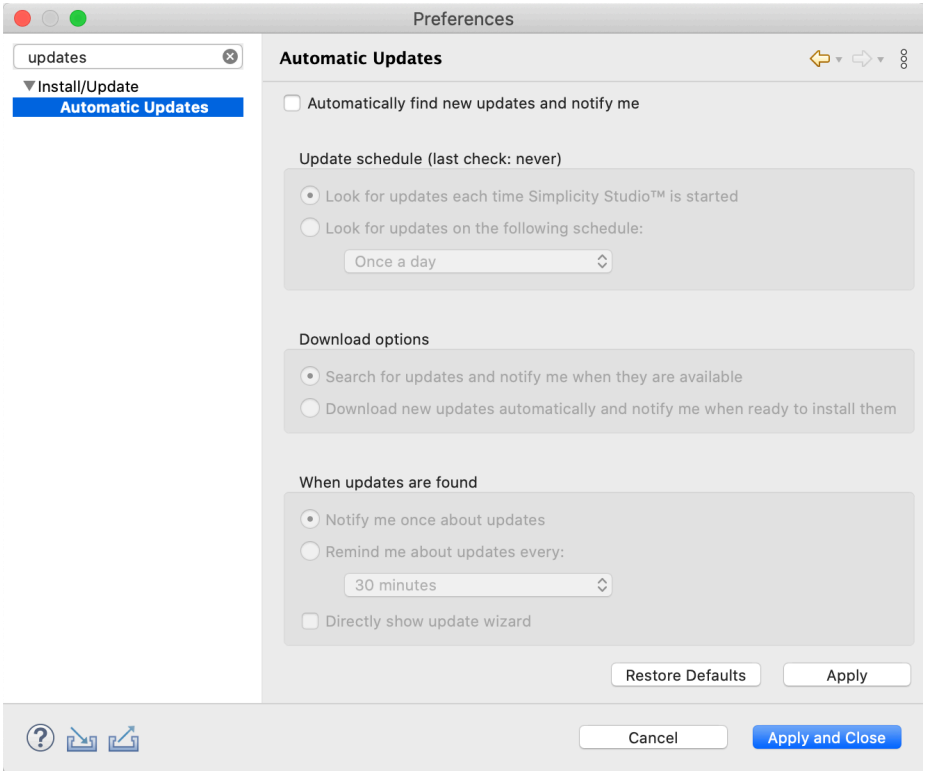


Set some Simplicity Studio Preferences:

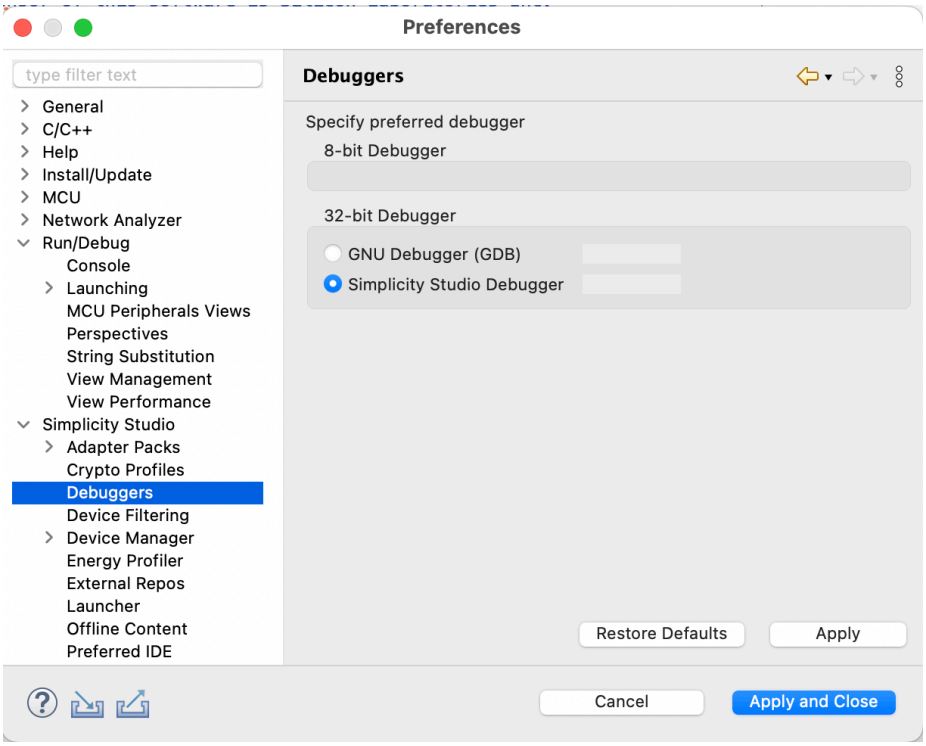
If not set, set Insert spaces for tabs AND Show line numbers



Turn off Automatic updates:



Select the Simplicity Studio Debugger:



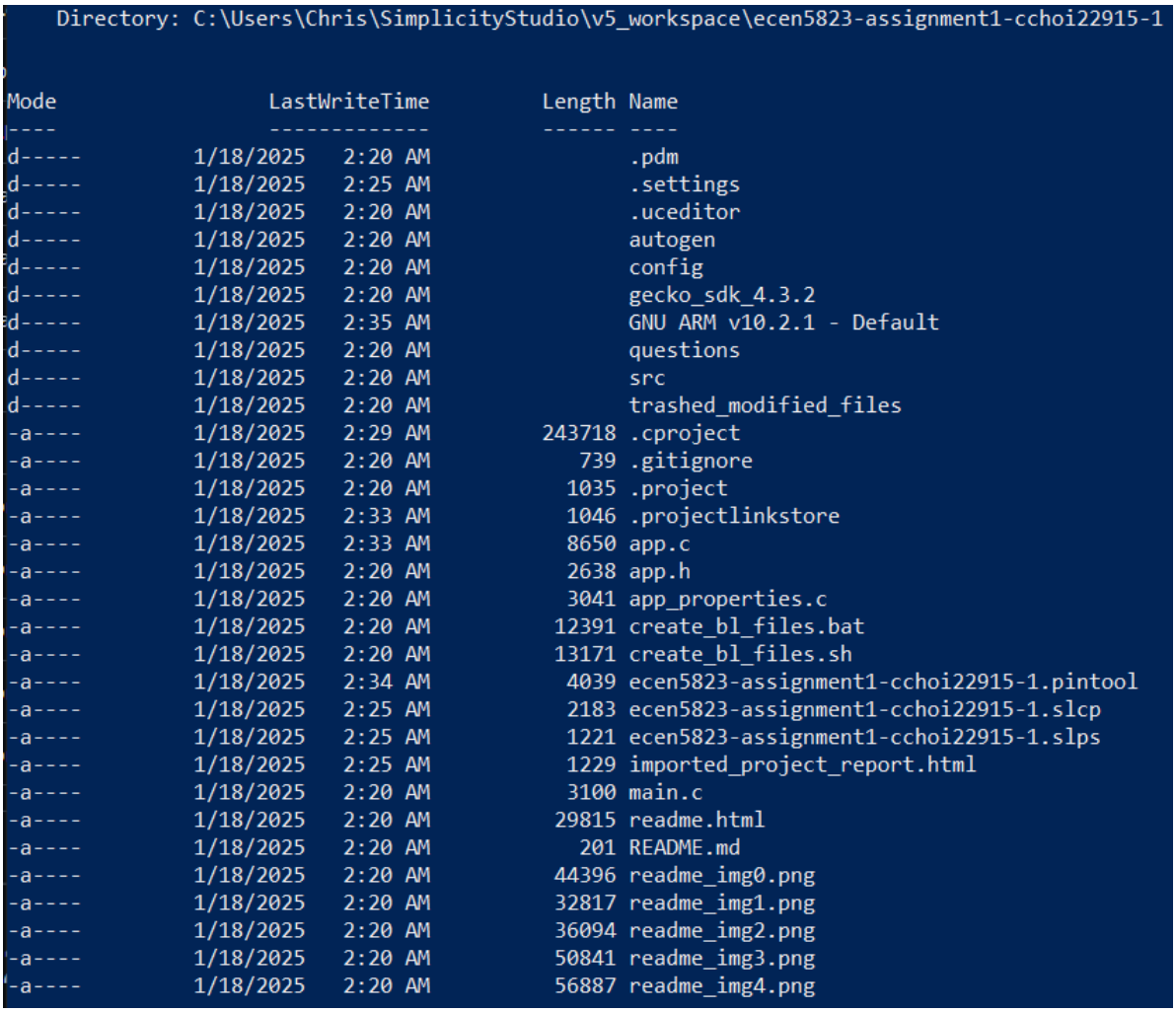
When we’re done with the installation we want:

- Simplicity Studio 5.7.x.x
- Gecko SDK 4.3.2
- GNU ARM Toolchain 10.2.x OR 10.3.x

(More info on next page)

Getting Familiar with the Files in a Simplicity Studio 5 Project

As we work our way through the semester, we copy Assignment #1 (A1) into a new directory A2, and then copy to A3, and then copy A4 etc until A9. Sometimes students end up accidentally modifying or deleting some critical files in the project folder. Let's have a look at the files for A1



```
    Directory: C:\Users\Chris\SimplicityStudio\v5_workspace\ecen5823-assignment1-cchoi22915-1


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         1/18/2025   2:20 AM                .pdm
d-----         1/18/2025   2:25 AM                .settings
d-----         1/18/2025   2:20 AM                .uceditor
d-----         1/18/2025   2:20 AM                autogen
d-----         1/18/2025   2:20 AM                config
d-----         1/18/2025   2:20 AM                gecko_sdk_4.3.2
d-----         1/18/2025   2:35 AM                GNU ARM v10.2.1 - Default
d-----         1/18/2025   2:20 AM                questions
d-----         1/18/2025   2:20 AM                src
d-----         1/18/2025   2:20 AM                trashed_modified_files
-a----         1/18/2025   2:29 AM         243718 .cproject
-a----         1/18/2025   2:20 AM            739 .gitignore
-a----         1/18/2025   2:20 AM           1035 .project
-a----         1/18/2025   2:33 AM           1046 .projectlinkstore
-a----         1/18/2025   2:33 AM           8650 app.c
-a----         1/18/2025   2:20 AM           2638 app.h
-a----         1/18/2025   2:20 AM           3041 app_properties.c
-a----         1/18/2025   2:20 AM          12391 create_bl_files.bat
-a----         1/18/2025   2:20 AM          13171 create_bl_files.sh
-a----         1/18/2025   2:34 AM           4039 ecen5823-assignment1-cchoi22915-1.pintool
-a----         1/18/2025   2:25 AM           2183 ecen5823-assignment1-cchoi22915-1.slcp
-a----         1/18/2025   2:25 AM           1221 ecen5823-assignment1-cchoi22915-1.slps
-a----         1/18/2025   2:25 AM           1229 imported_project_report.html
-a----         1/18/2025   2:20 AM           3100 main.c
-a----         1/18/2025   2:20 AM          29815 readme.html
-a----         1/18/2025   2:20 AM            201 README.md
-a----         1/18/2025   2:20 AM          44396 readme_img0.png
-a----         1/18/2025   2:20 AM          32817 readme_img1.png
-a----         1/18/2025   2:20 AM          36094 readme_img2.png
-a----         1/18/2025   2:20 AM          50841 readme_img3.png
-a----         1/18/2025   2:20 AM          56887 readme_img4.png
```

.cproject - holds project settings
.pdm/ - holds project settings
.project - holds project settings
.settings/ - yup, holds more settings
.uceditor/ - sometimes this directory gets created based on certain actions we take in SSv5
autogen/ - holds the output of the "generator", eventually we'll look at gatt_db.h
config/ - holds device and Bluetooth configuration files
*.slcp - This is the main file for the project that we can open within SSv5.

.git/ and .gitignore - this directory and file are created by and used by GitHub

If your project starts to behave strangely and/or throw error messages during import and compilation, check that the .cproject, .project, .uceditor/ and .pdm/ files and folders are present. Students often have issues when they inadvertently damage their projects.

Safety Precautions

Lastly, these Gecko development boards are fragile. Be sure to discharge any static electric build up on your hands by first touching something metal, then handle the Gecko. The LCD displays on the base board are easy to damage. Here is a picture of a Gecko I damaged by inadvertently pressing a finger on the LCD: