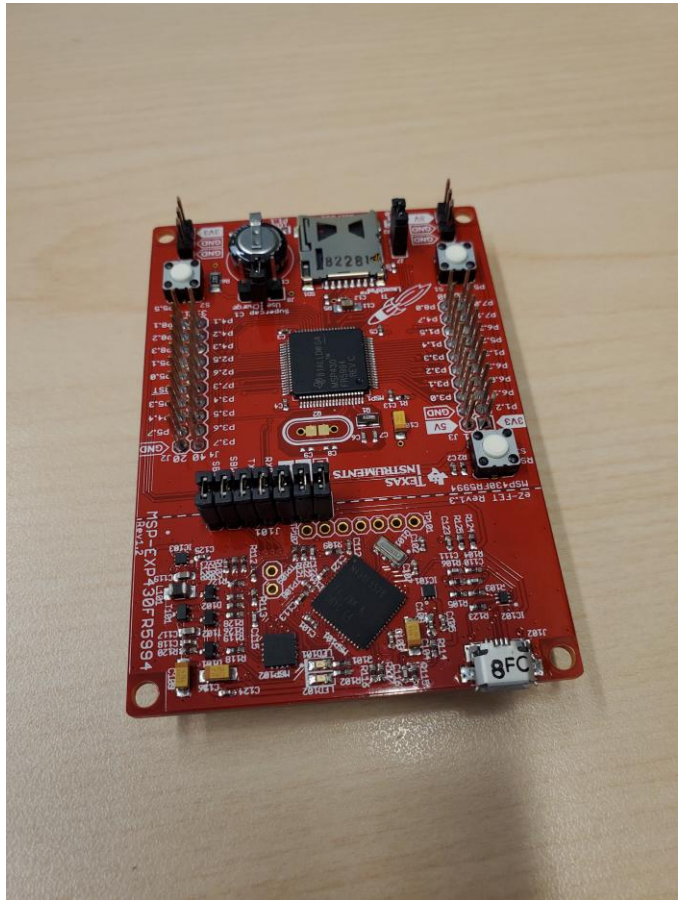
TI Kits

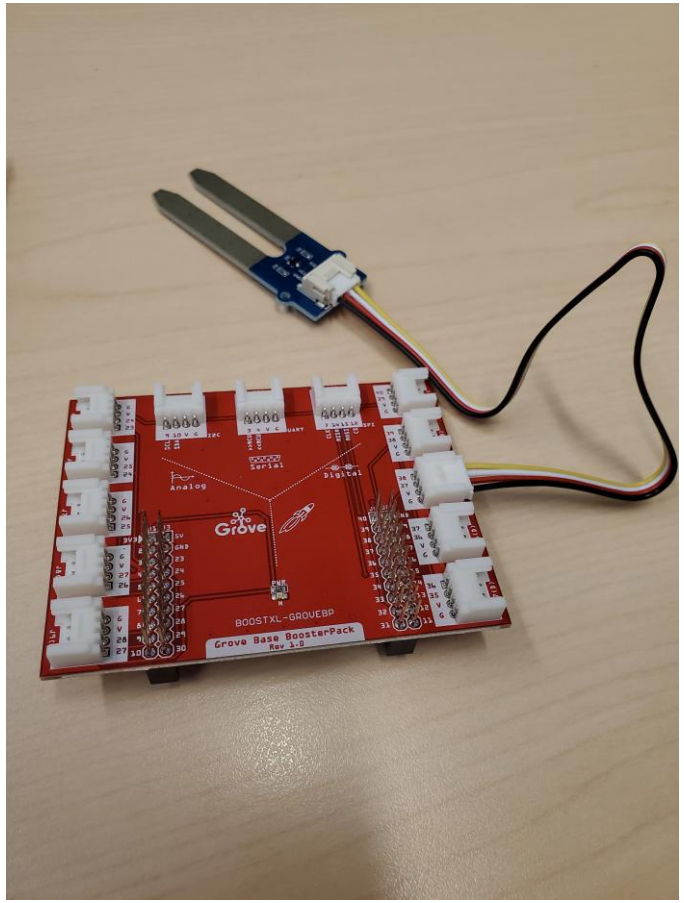
In-Class Activity: TI Kits – Part 1

PURDUE UNIVERSITY | School of Engineering Education

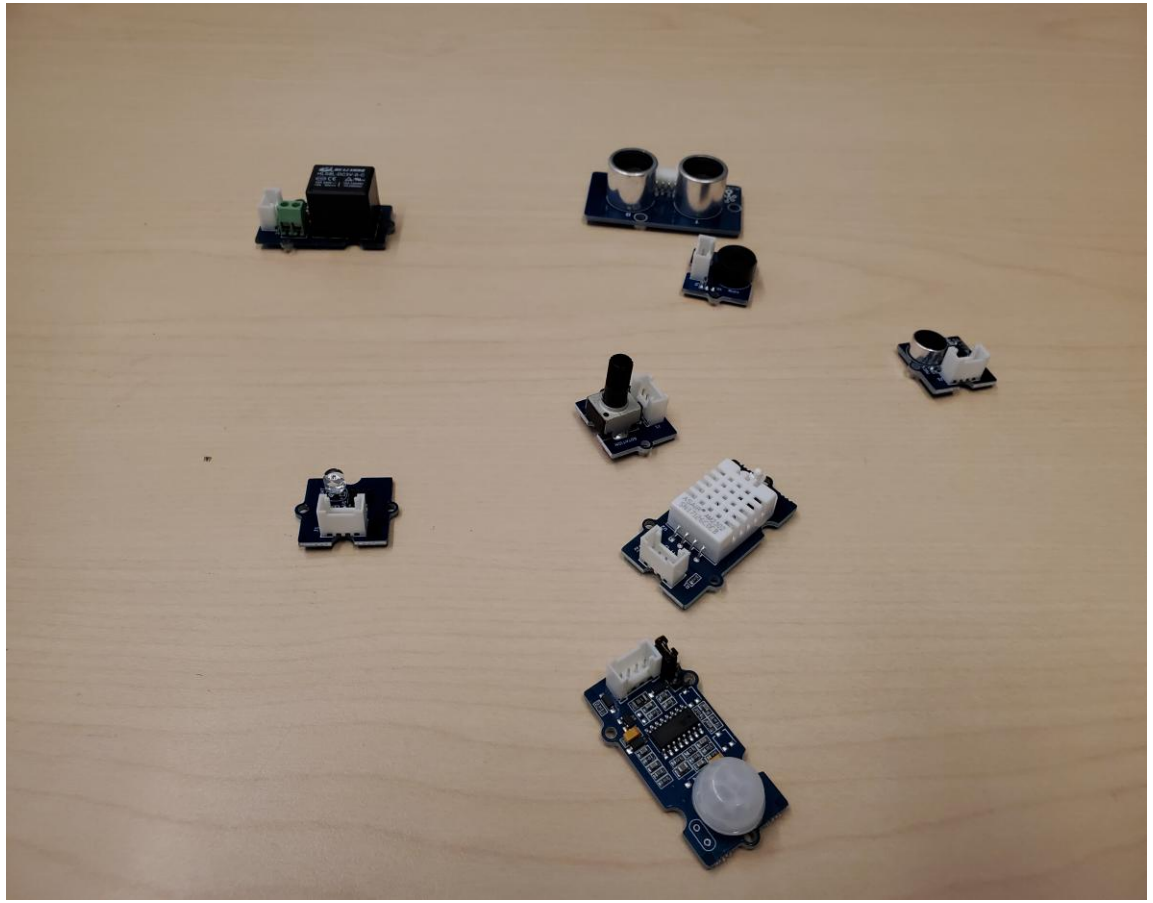
Microcontrollers: TI Kit Basics



MSP 430/432 Microcontroller from Texas Instruments (TI)



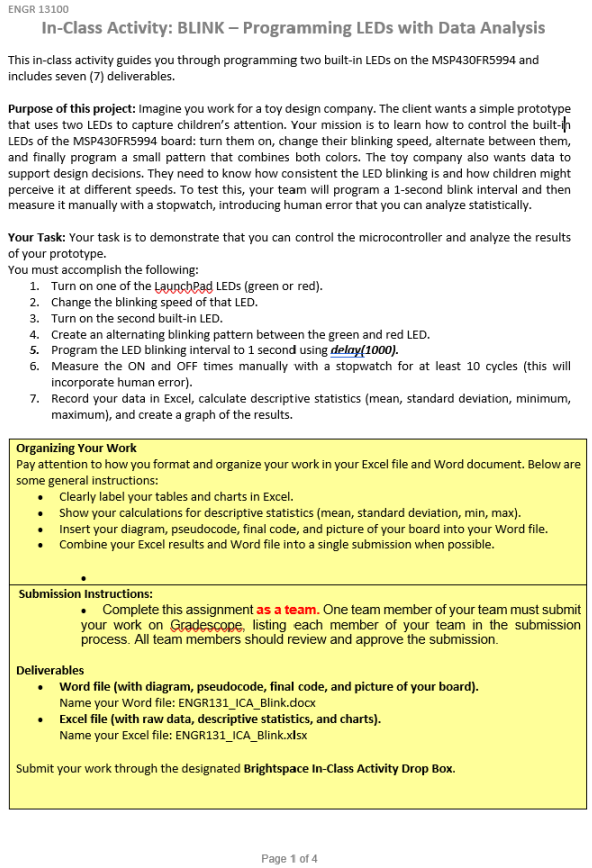
Grove Boosterpack to TI Kit with moisture sensor



Some of the available sensors

In-Class Activity: TI KITs

- **Download ICA from Brightspace**
  ICA Activities → Class 2B →
- ENGR131_ICA_Instructions.pdf
- ENGR131_ICA_Blink.docx (Answer Sheet)
- ENGR131_ICA_Blink.xlsx (Excel Template)



ENGR 13100

In-Class Activity: BLINK – Programming LEDs with Data Analysis

This in-class activity guides you through programming two built-in LEDs on the MSP430FR5994 and includes seven (7) deliverables.

Purpose of this project: Imagine you work for a toy design company. The client wants a simple prototype that uses two LEDs to capture children's attention. Your mission is to learn how to control the built-in LEDs of the MSP430FR5994 board: turn them on, change their blinking speed, alternate between them, and finally program a small pattern that combines both colors. The toy company also wants data to support design decisions. They need to know how consistent the LED blinking is and how children might perceive it at different speeds. To test this, your team will program a 1-second blink interval and then measure it manually with a stopwatch, introducing human error that you can analyze statistically.

Your Task: Your task is to demonstrate that you can control the microcontroller and analyze the results of your prototype.
You must accomplish the following:

1. Turn on one of the LaunchPad LEDs (green or red).
2. Change the blinking speed of that LED.
3. Turn on the second built-in LED.
4. Create an alternating blinking pattern between the green and red LED.
5. Program the LED blinking interval to 1 second using ***delay(1000)***.
6. Measure the ON and OFF times manually with a stopwatch for at least 10 cycles (this will incorporate human error).
7. Record your data in Excel, calculate descriptive statistics (mean, standard deviation, minimum, maximum), and create a graph of the results.

Organizing Your Work
Pay attention to how you format and organize your work in your Excel file and Word document. Below are some general instructions:

- Clearly label your tables and charts in Excel.
- Show your calculations for descriptive statistics (mean, standard deviation, min, max).
- Insert your diagram, pseudocode, final code, and picture of your board into your Word file.
- Combine your Excel results and Word file into a single submission when possible.

Submission Instructions:

- Complete this assignment **as a team**. One team member of your team must submit your work on Gradescope, listing each member of your team in the submission process. All team members should review and approve the submission.

Deliverables

- **Word file (with diagram, pseudocode, final code, and picture of your board).**
  Name your Word file: ENGR131_ICA_Blink.docx
- **Excel file (with raw data, descriptive statistics, and charts).**
  Name your Excel file: ENGR131_ICA_Blink.xlsx

Submit your work through the designated **Brightspace In-Class Activity Drop Box**.

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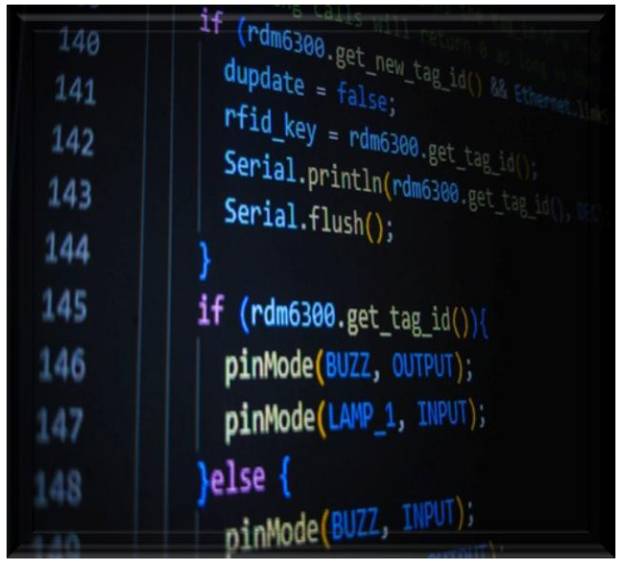
This ICA is due by the end of class 3A. Complete as many tasks as you can. There are 6 tasks.

In-Class Activity: TI Kit Basics

Objective:

- Learn how to use Energia IDE with the TI Kit.
- Understand basic Arduino-style coding for microcontrollers.



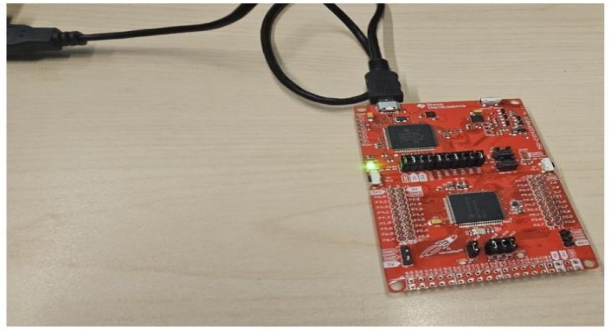
In-Class Activity: Task 1 – Block Diagram

What is a Block Diagram?

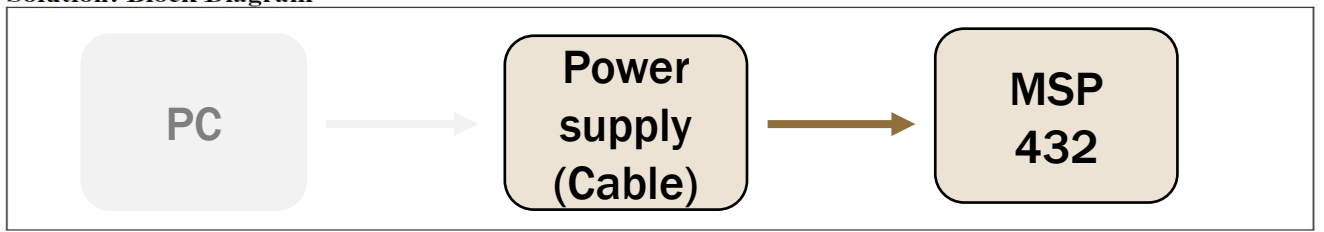
- A **block diagram** is a simple, high-level picture that shows how a system works. Each block represents a **component** (e.g., PC, Energia software, MSP430 board, LED).
- Arrows show the **flow of information or energy** between components.

Task 1: Block Diagram

A) Draw (by hand or using a computer) a block diagram of the microcontroller set-up shown in the picture.



Solution: Block Diagram



In-Class Activity: TI kits

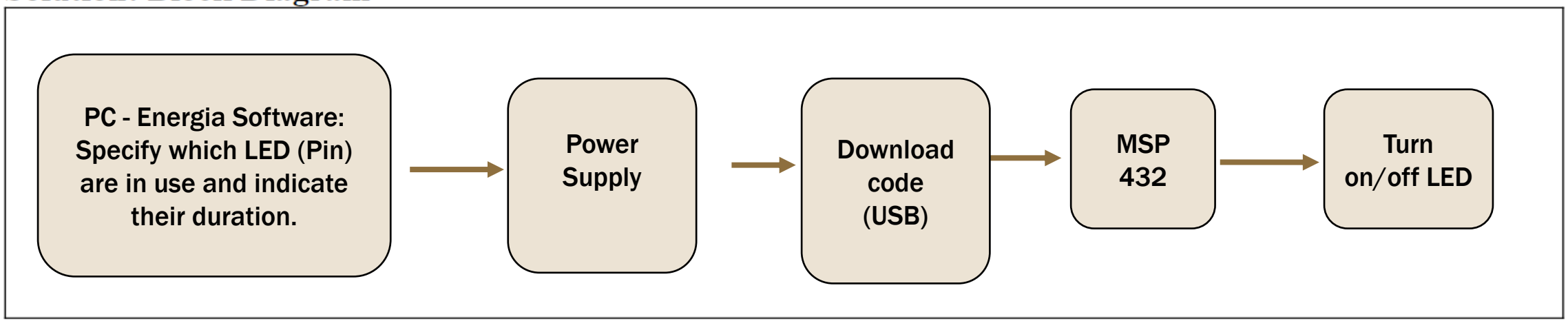
What is Pseudocode?

Pseudocode is writing the steps of a program in plain words (not real code). It helps to plan the logic before using the exact programming language.

Task 2: Pseudo Code / Flowchart

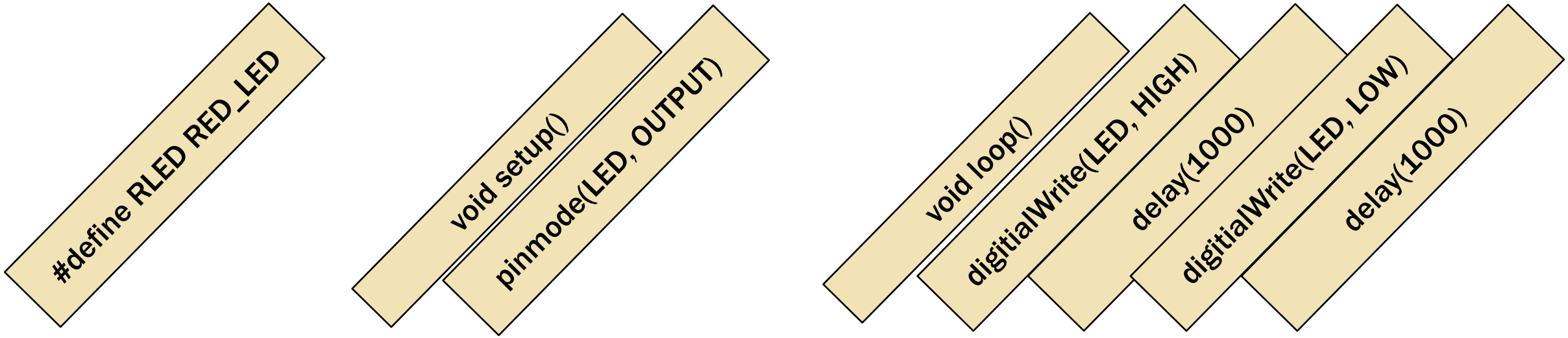
A) Draw (by hand or via a computer) a flowchart of the steps that would be needed to make the red led blink on and off repeatedly.

Solution: Block Diagram

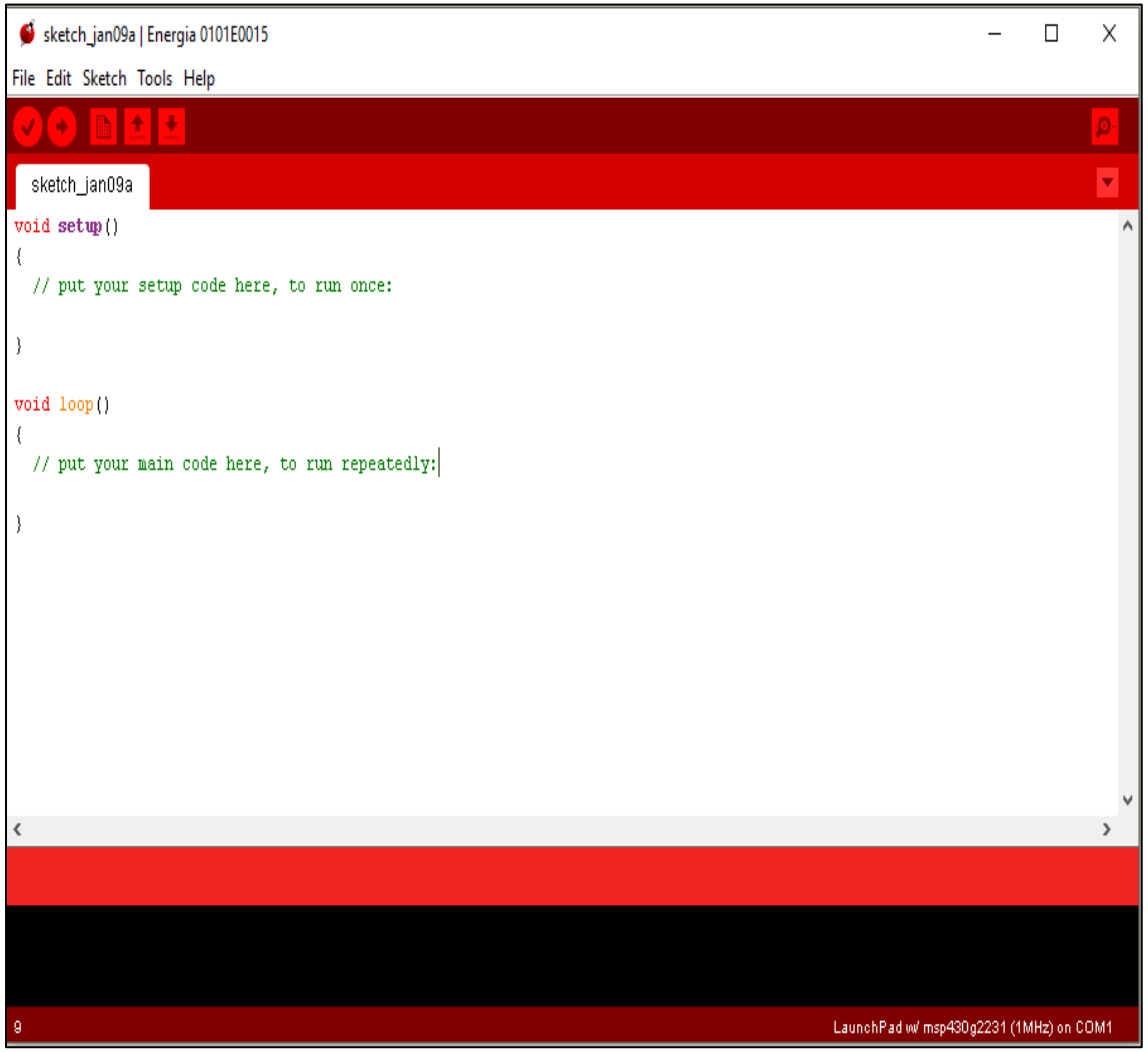


Code

PC - Energia Software: Specify which LED (Pin) are in use and indicate their duration.



In-Class Activity: Debug Energia

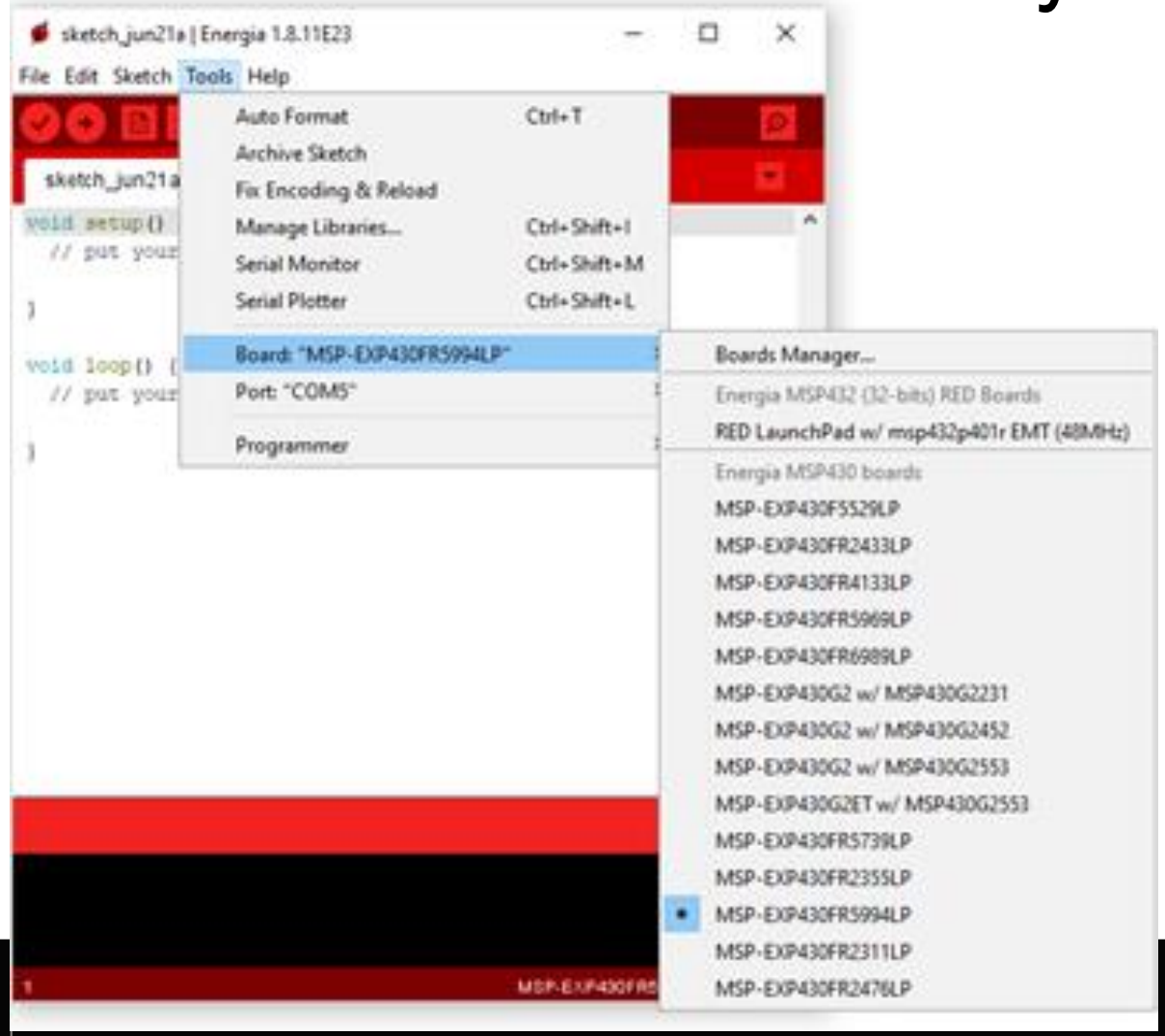


Energia

- Each set of code is called a sketch.
- The term void is used to define a function (or set of steps)
- Two main functions of code are required
  - void setup() – code that runs once.
  - void loop() – code that runs on an infinite loop OR until a new sketch is uploaded.
- Other functions or libraries can be added to a sketch.

In-Class Activity: Debug Energia

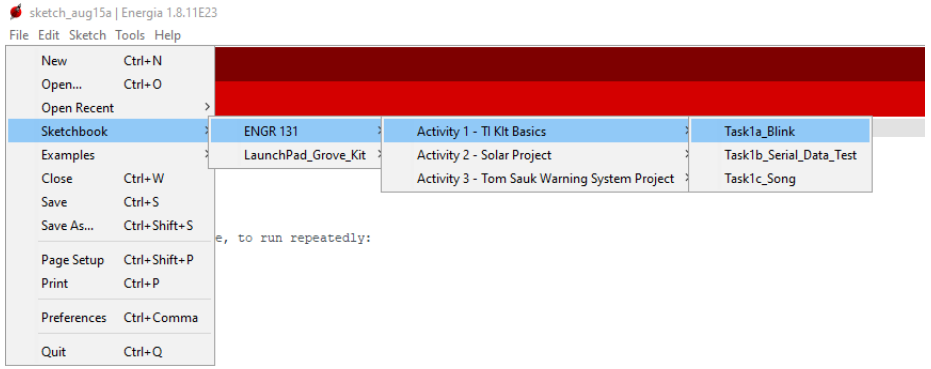
In Energia, go to Tools → Boards and select your board version



In-Class Activity: TI kits

Task 3: Upload your code to the TI Board

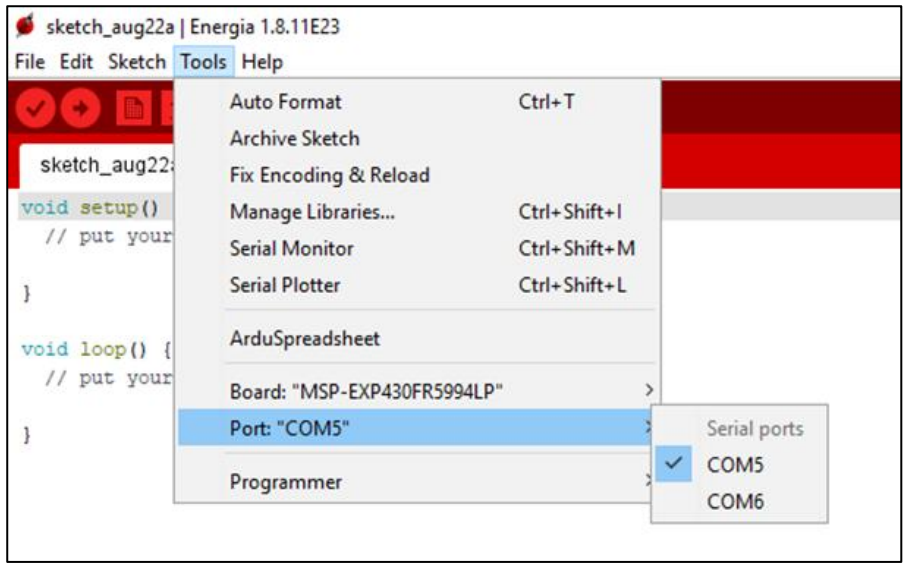
- **Upload your code to the TI Board**
- A) Open the Sketchbook/ENGR 131/Activity 1 – Introduction/Task1a_blink file in Energia. If you don't see the ENGR 131 folder in your sketchbook options, please see the Getting Started page for download and instructions

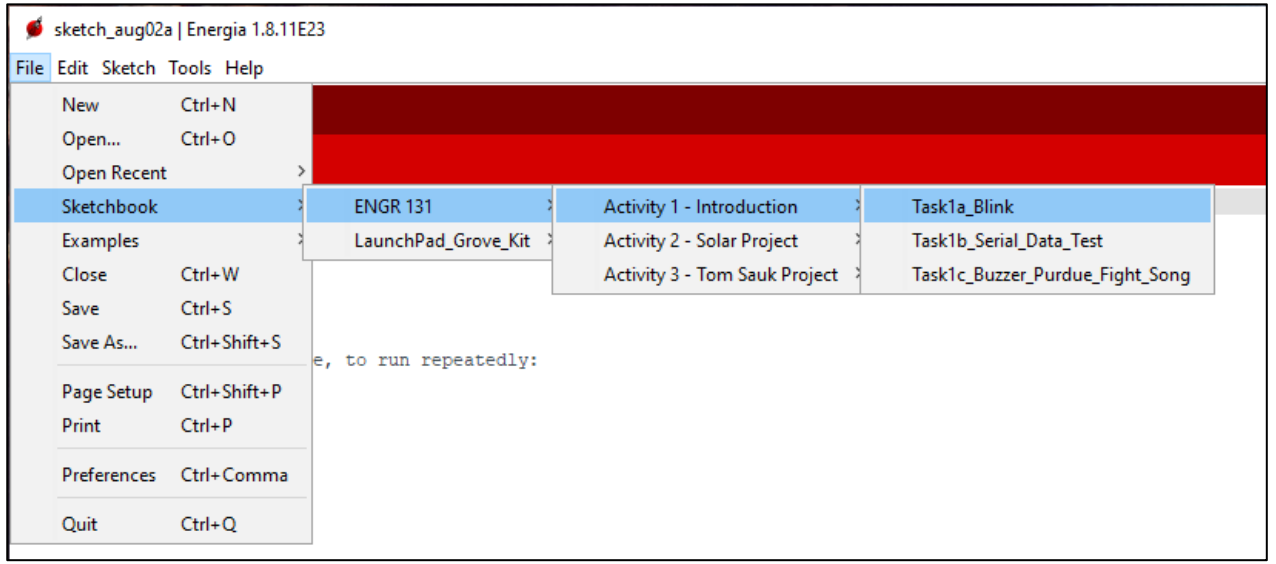


In-Class Activity: Debug Energia

- If your microcontroller doesn't blink, you may need to change the COM port.

The COM Port setup is under Tools > Port, below the Boards Manager.





In-Class Activity: TI kits

Task 4: Upload your code to the TI Board

- A) Change the blinking speed of one LED (make it faster or slower).
- B) Make both the red and green LEDs blink in an alternating pattern.
- C) Program the LEDs to blink with a 1-second interval (delay(2000)).

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In-Class Activity: TI Kits – Part 2 (Next Class)

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In-Class Activity: TI kits

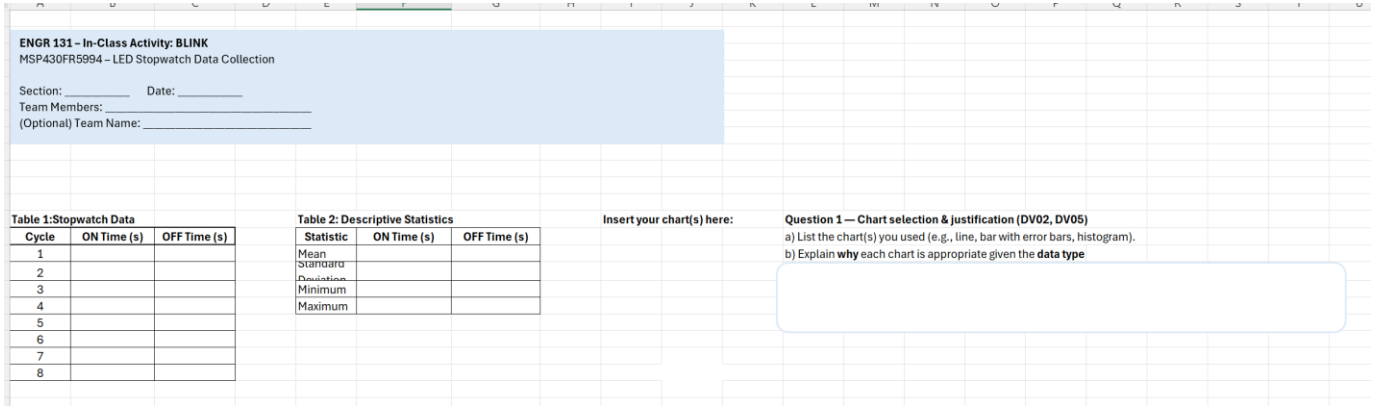
Task 5: Data Collection with Stopwatch

A) Run your code with the programmed interval (delay(2000)).

B) Using a stopwatch, measure the ON and OFF times of the LEDs for **8 cycles**.

C) Record your data in the **Excel template provided.**

Reminder: Use one column for *Cycle*, one for *ON Time (s)*, and one for *OFF Time (s)*.



ENGR 131 – In-Class Activity: BLINK
MSP430FR5994 – LED Stopwatch Data Collection

Section: _____ Date: _____
Team Members: _____
(Optional) Team Name: _____

Table 1:Stopwatch Data

Cycle	ON Time (s)	OFF Time (s)
1		
2		
3		
4		
5		
6		
7		
8		

Table 2: Descriptive Statistics

Statistic	ON Time (s)	OFF Time (s)
Mean		
Standard Deviation		
Minimum		
Maximum		

Insert your chart(s) here:

Question 1 — Chart selection & justification (DV02, DV05)
a) List the chart(s) you used (e.g., line, bar with error bars, histogram).
b) Explain **why** each chart is appropriate given the **data type**

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Task 6: Data Analysis in Excel

A) In your Excel file template, calculate the following descriptive statistics for both ON and OFF times:

- Mean
- Standard Deviation
- Minimum
- Maximum

B) Create at least one chart (line, bar, or histogram) to visualize your measured times compared to the expected **2.0 seconds**.

Reminder: Make sure your table and chart are clearly labeled (title, axis labels, units).

Submission Instructions

- Download the three files from **Brightspace > Content > TI Kits > Class 2B_3A_Blink**:
  - **ENGR131_ICA_Blink_YourName.pdf** *(Background and Instructions – do not submit)*
  - **ENGR131_ICA_Blink_YourName.docx** *(Answer Sheet – to complete & submit)*
  - **ENGR131_ICA_Blink_YourName.xlsx** *(Excel Template – to complete & submit)*
- Complete the **.docx** and **.xlsx** files with your answers.
- Submit **only the .docx and .xlsx files** on **Brightspace > TI Kits > In-Class Activity Drop Box.**