Concept Quiz 1

ENGR 132 – Summer 2021

Instructions – Read Thoroughly and Carefully

Academic Integrity

You must follow the course and Purdue's academic integrity expectations. You are allowed to use the following resources:

- MATLAB and MathWorks documentation
- Class material (homework, class slides, online videos, etc.)
- Internet searches

Do not share your instructions, answers, solutions, code, internet search links, or any other quiz material with any peer or electronic sharing site.

Saving Image Files

You will need to save figure windows as image files to submit to Gradescope. To save a MATLAB figure as an image file, click File > Save As from the figure window. **Always save the file as a PNG file**. Name the file using the format provided in the problem. The file name must always contain your Purdue career account login.

> **Hint**: Trouble viewing a full equation inside an instruction figure? Resize the figure window to see the full equation before you save the image. Three options to try: Drag the corner of the figure, use the quick edit tools in the figure, or use View > Property Editor. Video example: Resize a figure in MATLAB (Note: the process is the same for MATLAB Online or Desktop.)

Submission Requirements

Submit your solutions to **Concept Quiz 1 – ON TIME** on Gradescope. Your instructor will tell you the submission deadline for this quiz.

This assignment is timed. You have up to 1440 minutes (24 hours) to complete the quiz by the due date. Monitor the number of questions saved and the time remaining at the top of the quiz. **Save your answers after each problem**, or as many times as you want. Click **Submit & View Submission** at the bottom of the quiz to see what has been saved into Gradescope. Click **Resubmit** to add work or change your answers. You can re-submit your quiz as many times as you want until the due date. Your final submission will be graded. Click here and here for more help on the Gradescope submission interface.

As in your homework skills problems, you will submit a p-code function call with your PUID, your instruction text/information, and your solutions to the appropriate boxes or file submission areas. All instruction text will contain a *run receipt* with the format `su21_quiz1(PUID,problem_number) ran at DD-MM-YYYY HH:MM:SS`. Include this information with your instruction text.

Quiz Components

You will need the following items for this quiz. If you do not have access to these things, contact your instructor immediately.

- Your PUID number, MATLAB, access to Gradescope, internet access
- This instructions document
    - This problems document contains information you need for each problem on the quiz, but the problems are incomplete. To get the remaining information, you will use the file `su21_quiz1.p` in the same way you have been using the A0n_skills.p files in your homework.
- The problem generator code file `su21_quiz1.p`, which will display important information for each problem. Remember, you will not "open" the file. You will **run** it following these instructions.
    - Open MATLAB. Copy `su21_quiz1.p` into your current file path in MATLAB. To run the file, type the following command into the MATLAB Command Window prompt:

      `>> su21_quiz1(PUID, problem_number)`

      Where you replace PUID with your 8-digit Purdue University ID number (leave off the leading 00), and replace *`problem_number`* with the problem number indicated in the problems document. Using an incorrect PUID is considered Academic Dishonesty.
    - The problem generator code will display instruction text and/or figures with information that will allow you to complete the question. Any variables included in the instruction text should be assigned to variables in MATLAB as you develop your solutions, unless otherwise specified.
- Two template m-files: one for Problem 4 (Quiz1_Prob4_template.m) and one for Problem 5 (Quiz1_Prob5_template.m).

Tip for Success!

As soon as possible, run su21_quiz1.p with your PUID for all 5 problems in this quiz. You want to make sure you get all your individualized instructions in place before you start working on the solutions to any problems.

The problem generator will give you information for each problem.

- All problems have instruction text and run receipts.
- Problems 1, 3, 4, and 5 have instructional figures.
    - Save each figure window as a PNG. The filename format is Quiz1_Prob*X*_Instructions_*login*.png, where *X* is the problem number. See the problems below.
- In problem 4, make note of the CSV file that appears in your Current Folder.
- In problem 5, make note of the variable that is added into your workspace. You need to have that variable in your workspace for your solution to work. However, you *do not* submit the variable to Gradescope.

For each problem: Copy and submit all your instruction components to Gradescope in the appropriate problem areas.

What if something goes wrong and you get a syntax error when you run su21_quiz1.p for one of the problems? Take a screen shot of the function call and the error displayed in MATLAB. Send that to your instructor and GTA as soon as possible. You need to allow enough time for them to respond to you with a solution for the syntax issue. Continue working on other problems while you wait for a response.

Late submission

Late submissions will be allowed on this quiz. The late submission window gives you an additional 24 hours to complete any work you did not submit on time. **Each problem** submitted late will receive a 25% penalty. Immediately after the due date, **Concept Quiz 1 – LATE** will open in Gradescope with a new 24-hour window. Submit late work there. **Important!** You will not have access to your answers from the on-time submission. DO NOT DUPLICATE WORK IN THE LATE ASSIGNMENT ***unless*** you intend to replace the on-time work with the late submission. Any work submitted to the late assignment will overwrite your on-time submission and will be graded as late. See the figure below for a summary of the Gradescope submission windows.

In Gradescope	
Concept Quiz 1 – ON TIME	Open until the due date. Problems submitted here that are not duplicated in a late submission will be graded for full credit.
Concept Quiz 1 – LATE	Open after the due date, for 24 extra hours. Problems submitted here will be graded with a 25% penalty. Any problem submitted to both assignments will be graded here, with the penalty.

Quiz Problems

Problem 1 (10 points)

You will perform two different calculations using given equations and values. Run `su21_quiz1(PUID,1)` to get the equations you must calculate and the values that you will use within the calculation. The equations will be displayed in a figure window. (See Page 1 if you need to resize the figure to see the complete equations.)

Part A

The equation is displayed at the top of the figure. Use the values displayed in the Command Window to perform the calculation. Assign the variables in MATLAB and then use them to perform the calculation. Enter your command(s) and your answer to Gradescope.

You do not need to format your answer. Run your final calculation command unsuppressed, **without** using a semicolon at the end. The displayed result is the answer you should enter into Gradescope.

Part B

The equation is displayed at the bottom of the figure. Use the arrays displayed in the Command Window to perform the calculation. Assign the array variables in MATLAB and then use them to perform the calculation. Enter your command and your answer to Gradescope.

You do not need to format your answer. Run your final calculation command unsuppressed, **without** using semicolon at the end. The displayed result is the answer you should enter into Gradescope.

Save an image of your equations

Save an image of your equations figure for submission as a PNG. Make sure the full equations are visible (see Page 1 for help). Resize the image if necessary before saving. Name the image file using the format:
Quiz1_Prob1_Instructions_*login*.png.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz1(PUID,1)` using your PUID in the appropriate box.
- Submit the image file with your equations (Quiz1_Prob1_Instructions_*login*.png).
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Part A: Enter the code for your calculation. Do not suppress the results (i.e., do not include the semicolon at the end).
- Part A: Enter the result of your calculation. Copy and paste it from the Command Window.
- Part B: Enter the code for your calculation. Do not suppress the results (i.e., do not include the semicolon at the end).
- Part B: Enter the result of your calculation. Copy and paste it from the Command Window.

Problem 2 (20 points)

You must perform a set of commands using a provided matrix. Run `su21_quiz1(PUID,2)` to get the instruction text and the matrix for this problem. There will be 5 parts, each using the matrix provided.

Do not use loops or selection structures to answer any part of this problem. You may find writing a script to be helpful, but you will only submit the commands.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz1(PUID,2)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Part A: Enter your command(s) in the appropriate box.
- Part B: Enter your command in the appropriate box.
- Part C: Enter your command(s) in the appropriate box.
- Part D: Enter your command(s) in the appropriate box.
- Part E: Enter your command(s) in the appropriate box.

Problem 3 (5 points)

You will get a set of flowcharts and will need to match the correct flowchart to a given piece of code. Run `su21_quiz1(PUID,3)` to get the code snippet and a set of flowcharts to select from.

The flowchart choices will be displayed in a figure window. Save an image of your complete flowchart figure as a PNG with all 4 flowcharts visible. Name the image file using the format: Quiz1_Prob3_Instructions_*login*.png.

You will need internet access to run this problem. The flowchart image is stored on a purdue.engineering.edu server. If this is a problem for you, contact your GTA and instructor for help.

Select the flowchart that best fits the code snippet you were given in the instruction text. Enter your answer into Gradescope.

HINT: Expand the figure window as needed to better read the flowcharts.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz1(PUID,3)` using your PUID in the appropriate box.
- Submit the image file with the flowcharts (Quiz1_Prob3_Instructions_*login*.png).
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Enter your answer.

Problem 4 (20 points)

You are a data analyst trying to understand the relationship between two variables in a complex structure. Your team performed 5 tests on the structure by applying a force (Newtons) and measuring the resulting deflection (millimeters). They then produced two possible functions to model the relationship between force and deflection. You will evaluate the two models, one linear and one quadratic, with data from one of the tests to determine which model is a better fit for the data.

One way to determine the goodness of fit is to compare the original data to the model. You can find how closely the model fits the data using the equation for normalized sum of squared error ($\overline{SSE}$).

$$\overline{SSE} = \frac{\sqrt{\sum_{i=1}^{n}\left(y_i - f(x_i)\right)^2}}{n}$$

Where y_i is the measured deflection for each force, $f(x_i)$ is the calculated deflection for each force using the model, and n is the number of data points in the test. You will use MATLAB to calculate $\overline{SSE}$ for each model to determine which model is a better fit. The smaller the error, the better the fit.

The $\overline{SSE}$ is $\frac{1}{n}$ multiplied by the square root of SSE. SSE is a term you learned about in ENGR 131. If you feel you would like a refresher on SSE in order to understand the equation above, you can re-watch the video module from last semester, focusing on times 4:11-6:06.

Run `su21_quiz1(PUID,4)`. You will get several pieces of information:

- The two potential model equations appear in a figure window. Save an image of this figure window as a PNG with the filename Quiz1_Prob4_Instructions_*login*.png.
- The data from the testing will appear in your MATLAB current folder and will be named **Quiz1_Prob4_data_*PUID*.csv**, where *PUID* is the PUID number you entered into the p-code call.
- An instruction in the Command Window that tells you which test in the data file you will analyze.

Using the provided template **Quiz1_Prob4_template.m**, write a script that will accomplish these tasks:

- Import the full data file into MATLAB using an appropriate built-in function.
- From the data, create one variable for applied force and one variable for the deflection test given in your instructions. **You do not need to analyze the other tests.**
- Use the linear and quadratic models to calculate the modeled deflections.
- Create one figure window that displays two stacked subplots.
    - The top subplot displays the original data for the assigned test and the linear model on the same axes.
    - The bottom subplot displays the original data for the assigned test and the quadratic model on the same axes.
    - Format the figure for technical presentation.
    - Use a figure command in an appropriate location in your script to avoid MATLAB attempting to add your plots to the equation figure window.
- Calculate the $\overline{SSE}$ for each model for your assigned test.
- Use the $\overline{SSE}$ values to determine which model is the better fit and to create an appropriate display to the Command Window:

    - Print the following statements to the Command Window, where ### is the SSE value with 3 decimal values:
        - "`Normalized SSE for the linear model:  ###`"
        - "`Normalized SSE for the quadratic model: ###`"
    - Print one (1) of the following statements, depending on which model is the better fit.
        - Either "The linear fit is better." or "The quadratic fit is better."
        - The script must determine which statement to display. Do not hardcode this information.
- Follow good programming standards.

Run your script. You need to submit your results in the Command Window text display to Gradescope. You also need to submit an image the plot your script produces. Save an image of your figure with the subplots as a PNG. Name the image file using the format: Quiz1_Prob4_figure_*login*.png

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz1(`*PUID*`,4)` using your PUID in the appropriate box.
- Submit the image file with the model equations (Quiz1_Prob4_Instructions_*login*.png).
- Submit your data file (Quiz1_Prob4_data_*PUID*.csv).
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Copy your script's text results in the Command Window to the appropriate box in Gradescope.
- Submit the image file with your final formatted figure (Quiz1_Prob4_figure_*login*.png).
- Submit the m-file for your script (Quiz1_Prob4_*login*.m).

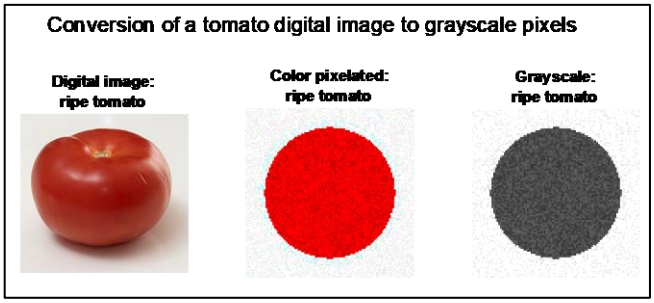
Problem 5 (20 points)

You work for an agricultural company that uses machine vision equipment to inspect fresh produce. The equipment takes digital images of the produce, and then uses software to process the image to determine its color. The actual color, called the 'hue', indicates the ripeness, while color variations may indicate damaged or rotten produce. In this problem, your task is to write MATLAB code that allows you to process digital images of ripe tomatoes to determine their quality. Each image should be placed into one of three categories:

- Whole fruit: The tomato's color variations are very small (indicating no blemishes) and the tomato can be sold raw and whole.
- Fit for processing: The tomato's color variations indicate the presence of blemishes that make the tomato unsuitable for sale as a raw product, but it is suitable for processing into foods such as juice, paste, etc.
- Rejected: The tomato's color variations are excessive, indicating that the tomato may be rotten and is not food safe.

The key parameter is the homogeneity of the hue, which can be determined by calculating the standard deviation of the grayscale values for pixels corresponding to the tomato. Tomatoes with low standard deviation (less than 0.054, a very uniform color) can be sold as raw whole fruit, those with a larger variation (between 0.054 and 0.059, inclusive of both) can be processed into food products, and those with a very large variation (greater than 0.059) should be rejected for food purposes.

This figure shows an image of a tomato being converted to color pixels and then to gray scale:



Clear your workspace and then run `su21_quiz1(`*PUID*`,5)`. You will get three things:

1. A new variable named tomato_gray assigned to your current MATLAB workspace.
   This variable tomato_gray is a matrix of hues (one per pixel in the image) that have been translated to grayscale so their values span the range [0,1]. A value of 0 corresponds to 'black', and a value of 1 corresponds to 'white'. The image of the

tomato has been taken against a white background. Assume the background can be defined by values from 0.8 to 1, inclusive. The tomato red and any blemishes appear on the image as darker colors (i.e., lower numbers than the background).

2. A figure window that shows a color pixel image of a tomato and its grayscale version.
   The grayscale version displays your assigned tomato_gray variable. Save an image of the figure as a PNG and name the file using the format: Quiz1_Prob5_Instructions_*login*.png
3. A short instruction text with a run receipt and a note telling you to look for tomato_gray in your workspace.

You have been given a script template named **Quiz1_Prob5_template.m**. Use the template to write a script to solve the problem. You are not allowed to use any loop structure for this problem. The output of your code should be one of the following statements printed to the Command Window that indicates how the tomato should be used, where ### is replaced with your calculated standard deviation to 3 decimal places:

- "Color standard deviation is ###. Sell as whole fruit."
- "Color standard deviation is ###. Sell for food processing."
- "Color standard deviation is ###. This tomato cannot be used for human consumption."

Your script should work for any grayscale tomato image matrix with the variable name tomato_gray. Once your script is working, run it and then copy your results as they are displayed to the Command Window and paste them into Gradescope.

Notes:

- Follow good programming standards.
- Do not initialize tomato_gray in your script. You can use the variable in the script since it is already present in your workspace.
- **Do not use any loops**.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz1(`*`PUID`*`,5)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit your file with the color and grayscale tomato images (Quiz1_Prob5_Instructions_*login*.png).
- Enter your results in the appropriate box.
- Submit your script m-file with an appropriate name (Quiz1_Prob5_*login*.m).