

**NICK MONDORA**

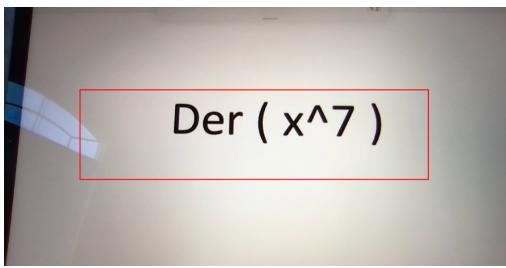
ENGR 133 LC-1 Individual Project

# IMAGE CALCULATOR

**TEAM 12**

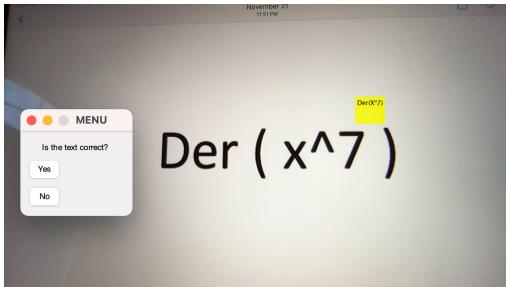
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# RUNNING IMAGECALCULATOR.M



## TAKING THE PHOTO

Select your webcam from the popup menu and then line up your text within the red box. Ensure that your text begins with 'int' (for integer) or 'der' (for derivative). You will have 10 seconds to do this. At right is text we will use for this example.



# **INTERPRETING THE TEXT**

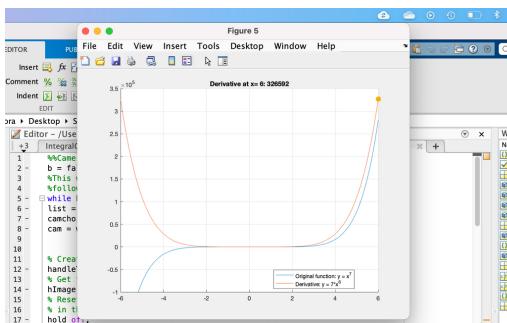
When prompted, confirm or deny that the interpreted text displayed over the image is correct. Note that characters such as ^ may appear as ". The text displayed over our image reads 'Der(X"7). We will click 'yes.'

The screenshot shows the MATLAB IDE with several tabs open: 'mondora/Desktop/School/ENGR 133/MATLab/Project/ImageCalculator or.m', 'DerivativeCalculator.m', 'formatStrings.m', and 'ImageCalculator'. The 'DerivativeCalculator.m' tab is active, displaying the following code:

```
%Initializes b f
loop extend thro Enter x-value to evaluate derivative
processes as long st: repeat the
    else is not correct.
    a
    mlist; %Gets a OK Cancel ! to computer
    menu('Chose webc : to select a webcam
    (camchoice); %Connects to the selected webcam

s control.
= axes();
ndle to the image in the axes.
```

A tooltip is visible over the word 'st:' in the first line of the code, containing the text: 'repeat the is not correct.' and 'st:'. A cursor is positioned at the end of the line 'processes as long st:'. A context menu is open near the 'OK' button, with options 'Copy', 'Cut', 'Paste', 'Delete', 'Find', 'Replace', and 'Format'.



## **SELECTING THE PLACE**

When prompted, enter the limits of integration (if an integral) or some value x (if a derivative). This is where we will calculate the integral or derivative. Since we are calculating a derivative, we will enter '6.'

## WATCHING THE GRAPH

Finally, analyze the graph that appears. Use the tools in the upper right corner to zoom, move, and save.

## Introduction

This program relies on the theme of optical character recognition (OCR) and image processing. I chose this topic because I am interested in learning more about how computers are able to translate things from the real world into machine-encoded text. This program allows the user to point their camera at a math expression that contains either an integral or derivative, and then solves it for them. It returns all necessary information such as: equation of the indefinite integral or derivative, a graph of the original function and the integral or derivative, the derivative evaluated at a certain point, or the integral over a certain range.

## Program Overview

This program starts by asking the user to select one of the webcams attached to their computer. Once selected, a camera preview appears and gives the user 10 seconds to line up their text within the red box displayed on the screen. It then saves this photo as 'Image4Processing.png.' From here, the program calls several different UDFs to perform optical character recognition, format the string so that it can be used in later functions, and finally calculate and display the derivative or integral. Prior to calling functions to calculate the derivative and integral, the user will be asked to verify that the interpreted string is correct.

This main program, ImageCalculator, will only ask the user for input twice. First, it will ask the user to select their preferred webcam. Then later, it will ask the user to verify that the interpreted string is correct, as stated above.

Other than possible error messages if the user's string is incorrect, this program only outputs one thing. It will save the photo that was taken using the webcam as 'Image4Processing.png.' All figures, displays, and outputs are conducted by the appropriate UDF.

## User Defined Functions

### performOCR

This function is used to recognize text using optical character recognition.

It only has one input, 'roi'. 'roi' is the region of interest. Specify 'roi' as a four-element vector of the form [x y w h] in data units. The x and y elements determine the location and the w and h elements determine the size.

performOCR returns one variable, 'ocrResults'. This is an ocrText type variable. It contains: text, character bounding boxes, character confidences, words, word bounding boxes, and word confidences.

This function starts by reading in the image 'Image4Processing.png.' It then uses the function 'ocr()' to look for a line of text within the region of interest ('roi') in the image. Once found, it will display the image with word confidences overlayed. This shows the user how confident the program is with each word it found. A high confidence means that it is very sure it has

recognized the word correctly. Finally, it displays the image with the interpreted string overlayed.

## formatStrings

This function is used to format a string for later use with IntegralCalculator or DerivativeCalculator.

It only has one input, 'strings'. 'strings' is a string type variable that contains a function expression.

Returns a string variable, 'strings', that contains the formatted string. Also returns variable 'substring' which contains either 'der' or 'int'. This indicates whether the string called for integral or derivative.

First, converts string to lowercase. Then determines if the strings contains 'int' or 'der', and removes either. Also removes characters (, ), and ' and any extra spaces. It adds \* before variable 'x' whenever appropriate. Lastly, it replaces " or " with ^ and ,—with -.

## IntegralCalculator

This function is used to calculate and return the indefinite integral and definite integral between 2 points (a and b), as specified by the user.

It has one input, 'strings'. 'strings' is a string type variable that contains a function expression. It is recommended to use formatStrings(strings) prior to IntegralCalculator(strings).

This program has 4 outputs: 'indef', 'def', 'fun', 'answer.' It returns the indefinite integral as variable 'indef', the definite integral between two points (a and b) as variable 'def', the points a and b as variable 'answer', and the original function as variable 'fun'.

The function starts by prompting the user for values of a and b (the bounds of integration). It then converts variable 'strings' to a symbolic variable. Using this, it calculates the indefinite and definite integrals and saves them to the appropriate variable. Lastly, it graphs the original function and the indefinite integral, coloring in the area from a to b. The title of the graph contains the value of the integral from a to b.

## DerivativeCalculator

This function is used to calculate and return the indefinite derivative and definite derivative at one point specified by the user.

It has one input, 'strings'. 'strings' is a string type variable that contains a function expression. It is recommended to use formatStrings(strings) prior to IntegralCalculator(strings).

This program has 4 outputs: 'indef', 'def', 'fun', 'answer.' It returns the indefinite derivative as variable 'indef', definite derivative at one point (a) as variable 'def', the point a 'answer', and the original function as variable 'fun'.

The function starts by prompting the user for a value of x (point at which we will evaluate the derivative). It then converts variable 'strings' to a symbolic variable. Using this, it calculates the indefinite and definite derivatives and saves them to the appropriate variable. Lastly, it graphs the original function and the indefinite derivative, plotting a point at x (where we evaluated the derivative). The title of the graph contains the derivative value at point x.