

C Programming II

2022 Spring

Midterm

Instructor: Po-Wen Chi

Date: 2020.04.09 PM 14:00-18:00

Policies:

- Offline test unless you complete the exam and want to submit your code.
- Do not forget to include your Makefile. TA will only use the command `make` to build your program. If `make` fails, you will get zero points and no room for bargaining. So if you do not know how to solve a problem, please, do not include it in your Makefile.
- I do not care your source code file names, but the executive binary names should be **mid01**, **mid02**, **mid03**, **mid04**.
- You can ask TA if you do not understand the problems.

1 My String Library v3 (10 pts)

Again, please implement some existing string functions in your own way.

```
1 char *mystrtok_r(char *str, const char *delim, char **saveptr);
```

The usage of these functions should be the same with the standard version, including their return values. All requirements are in the manual. You need to prepare **mystring.h**, which can be the same file with the last problem, and TA will prepare **mid01.c**. Of course, Makefile is your own business. **Do not forget to make **mid01.c** in your Makefile.**

You cannot call the corresponding standard functions directly in your implementation.

2 World Development Indicators: Population (40 pts)

It is time for you to use C to do data analysis. **Population** is one of the most important indicators to evaluate a country's development status. I will give you a data about world population. Please implement the following functions:

```

1 $ ./mid02
2 Please enter the data name: API_SP.POP.TOTL_DS2_en_csv_v2_3731322.csv
3 Please enter the analysis start time: 1960
4 Please enter the analysis end time : 2020
5 --- Menu ---
6 1) Which country has the largest population growth?
7 2) Which country has the largest population growth rate?
8 3) Which country has the smallest population growth, including negative growth
   ?
9 4) Which country has the smallest population growth rate, including negative
   growth?
10 5) Which country has the largest population standard deviation?
11 6) Which country has the smallest population standard deviation?
12 7) Given a country name (case-insensitive), please use linear least squares
   method to predict the country's population in 2021.
13 8) Exit
14 Your choice:

```

Your program should output the answer country name for choice 1-6. For choice 7, you need to make the user input a country name and output the prediction result. After answering questions, your program should be back to **Menu**. Choice 8 is for leaving the program.

BTW, the data source is from <https://data.worldbank.org/indicator/SP.POP.TOTL>. However, our TAs may modify data their own so do not try to get the answers offline and print the answers directly.

3 Image Rotation (20 pts)

Given a BMP picture and a rotation angle, please generate a picture after counterclockwise rotation. Figure 1 is an example. The output file name should be **output.bmp**. You should fill the redundant part with white color.

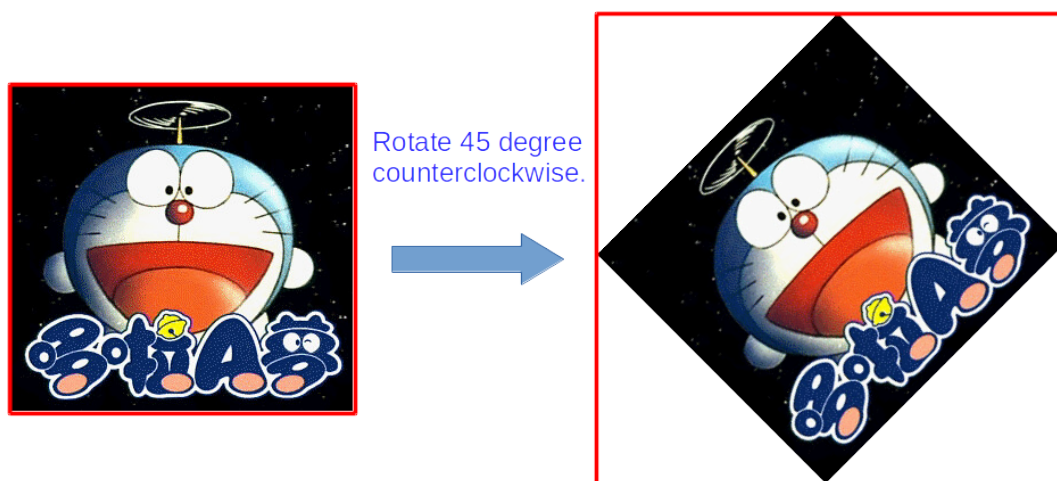


Figure 1: Picture counterclockwise rotation. The red boundary line is for your reference only. You do not need to draw the boundary.

```

1 $ ./mid02
2 Please enter the file name: doraemon.bmp
3 Rotation angle (int, 0-360): 45

```

Note that the rotation precision is not a concern in this problem. Do not forget to handle the error cases.

4 Trigonometric Function Plotter (30 pts)

You all know what trigonometric functions are, right? This time, I want you to develop a program that can plot a trigonometric functions. First, you will be given a text file that contains some equations. Each line has only one equation and the equation format is as follows:

$$y = a \sin(bx) + c \cos(dx)$$

a, b, c, d are all doubles. You need to output a BMP file that graph equations and **each equation has its own color**. The BMP size is determined by the user. You need to add a horizontal line at the center of the output figure, which represents x -axis, and a vertical line at the left, which represent y -axis. The line width is also determined by the user. For your convenience, we make the edge of a point as the line width, as shown in figure 2. The user should also determine the boundary of x -axis. The boundary of y -axis is determined by you and should be **reasonable**.



Figure 2: Different point sizes. From left to right are 1-pixel, 2-pixels, 3-pixels.

The usage of this program is

```

1 $ ./mid04
2 Please enter the output image name: output.bmp
3 Please enter the size (x,y): (1280,800)
4 Please enter the line width (1,2,3): 2
5 Please enter the equation file name: input.txt
6 Please enter the x boundary (unit:pi): 2

```

Figure 3 is the example output for the following input file.

```

1 y=sin(x)
2 y=cos(x)

```

If there is any invalid input, print a warning message and terminate the program. For your convenience, the intersection point's color is set to the color of the last line.

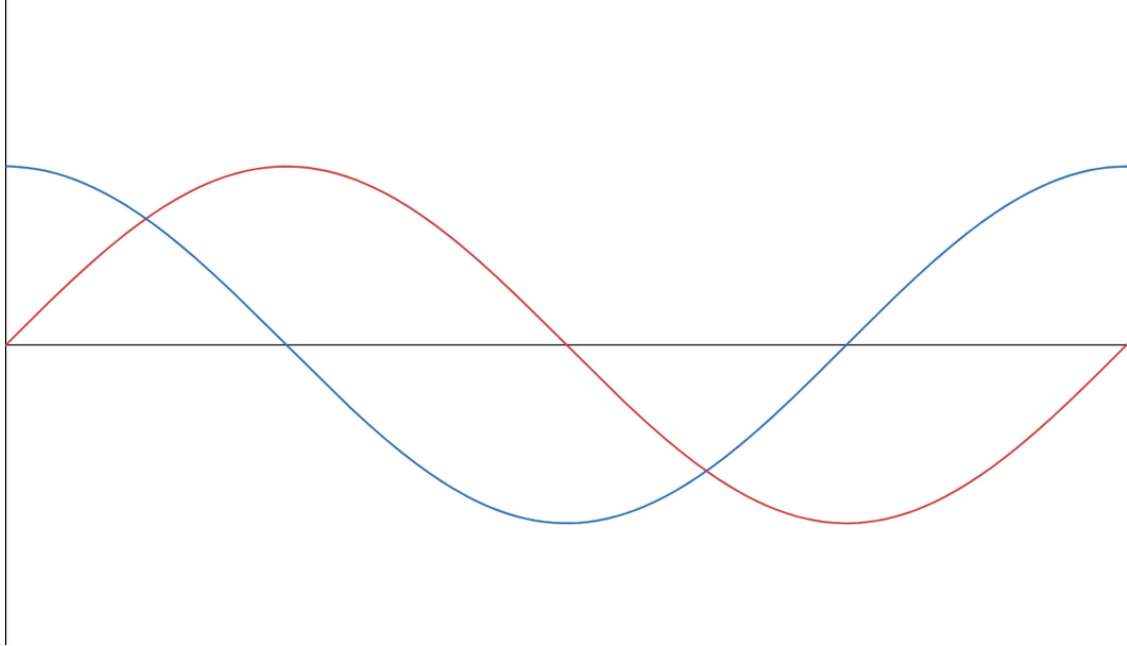


Figure 3: Example.

5 Bonus: Your Comments (5 pts)

Again, any comments are welcomed. However, you will get nothing if you leave this question blank.