

CSC317 Computer Graphics Tutorial 1

September 11, 2024

Assignment 1: Raster Images

- Due Date: September 17 @ 11:59 pm
- Assignment description can be accessed through [course github page](#), under “Lecture Schedule”

Week	Topic / Event
1	Introduction DL, KS, tutorial Assignment 1 (Raster Images) Math Practice waitlisted ? zip assignment and email to TAs due 17/09
2	Lecture 2, Assignment 2 Ray Casting due 24/09
3	Lecture 3, Assignment 3 Ray Tracing due 01/10

Assignment 1: Raster Images

- Every student is given ten (10) late days **for the entire semester** which are automatically applied, starting at midnight on the due date. Weekends count as late days.
- If you plan on not submitting an assignment (to take advantage of the best 8-of-9 policy) please let us know so late days aren't applied.

Assignment 1: Raster Images

- If you need help:
 - “Issues” page on github for A1
 - E-mail TA: csc317tas@cs.toronto.edu

Assignment 1: Raster Images

- Task1: rgba to rgb
 - Alpha channel: transparency of each pixel location
 - $\text{width} * \text{height} * 4 \Rightarrow \text{width} * \text{height} * 3$
- Input: `const std::vector<unsigned char> & rgba`
 - Getting size of vector: `rgba.size()`
 - Accessing i^{th} element: `rgba.at(i)` or `rgba[i]`
 - Debug: convert to *int* and output to console

Assignment 1: Raster Images

- Task2: write ppm
 - Output result to a .ppm file
 - Support both rgb and grayscale images
- PPM
 - Uncompressed format
 - Header magic number (text-based): P2/P3
 - Output can be directly opened with a text editor

Assignment 1: Raster Images

- Task3: image reflection



Assignment 1: Raster Images

- Task4: image rotation (90 degrees CCW)



- Note: width/height swap

Assignment 1: Raster Images

- Task5: rgb to gray



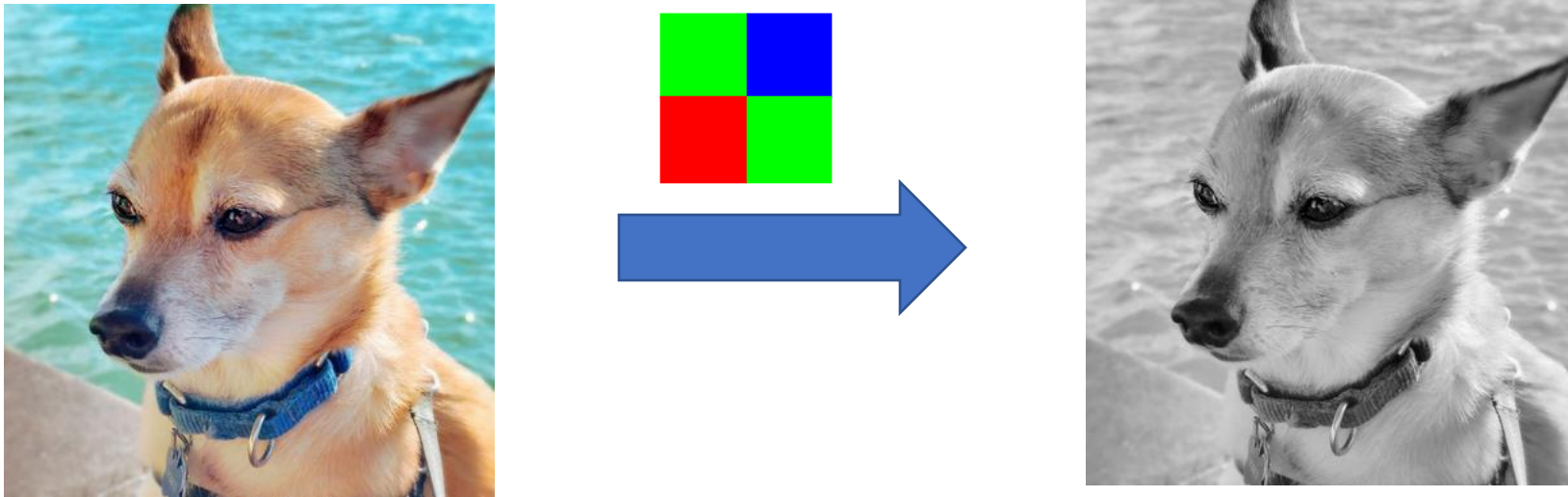
$$i = 0.2126r + 0.7152g + 0.0722b$$



- 3 channels (width*height*3) to 1 channel (width*height)

Assignment 1: Raster Images

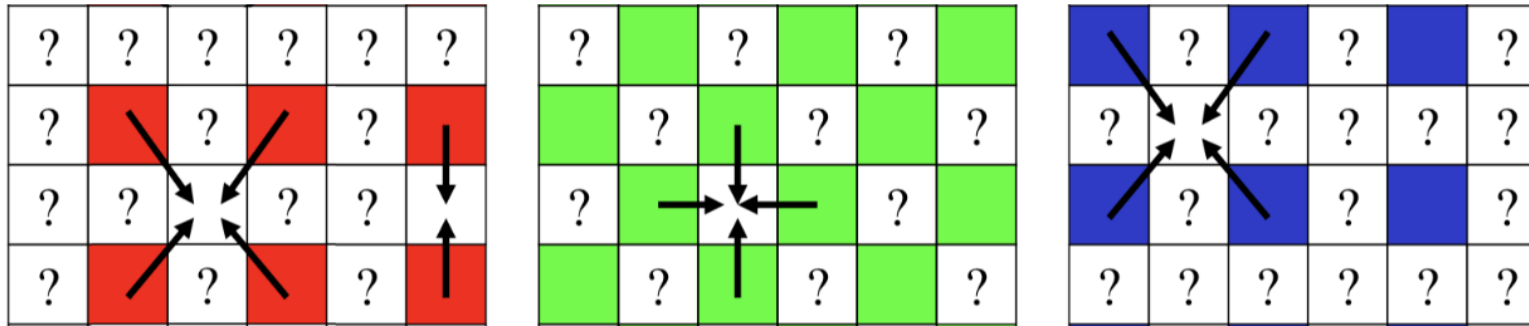
- Task6: simulate bayer mosaic



- 3 channels ($\text{width} \times \text{height} \times 3$) to 1 channel ($\text{width} \times \text{height}$)

Assignment 1: Raster Images

- Task7: Demosaic
- Inverse of the previous task => roughly get the original rgb image
- For each pixel
 - Take exact value if you have it (e.g. take R value if you are on a red pixel)
 - Approximate from the neighbours if you don't have exact value



- 1 channel (width*height) to 3 channels (width*height*3)

Assignment 1: Raster Images

- Task8: helper functions for HSV color space
- RGB to HSV
 - Check with standard values online for correctness
- HSV to RGB
- Be careful with data types (i.e. inputs are of type **double**)
- Be careful with input/output ranges (e.g. 0 to 1 vs. 0 to 255)

Assignment 1: Raster Images

- Task9: hue shift
- Use the HSV helper functions implemented previously



Assignment 1: Raster Images

- Task10: desaturate
- Use the HSV helper functions implemented previously



Assignment 1: Raster Images

- Task11: composite



Assignment 1: Raster Images

- Submission

- Where? [Markus](#)

- What? All .cpp files in the *src* directory (also listed on Markus)

Assignments

ASSIGNMENT	DUE DATE
A1: Raster Images	Tuesday, September 17, 2024, 11:59:00 PM EDT

demosaic.cpp

desaturate.cpp

hsv_to_rgb.cpp

hue_shift.cpp

over.cpp

reflect.cpp

rgb_to_gray.cpp

rgb_to_hsv.cpp

rgba_to_rgb.cpp

rotate.cpp

simulate_bayer_mosaic.cpp

write_ppm.cpp

Assignment 1: Raster Images

- Read assignment handout carefully:
<https://github.com/dilevin/computer-graphics-raster-images/tree/master>
- Program entry: main.cpp
 - Input images
 - Overall flow
- Check PPM outputs online
- Experiment with different test cases

Assignment 1: Raster Images

- Before implementing a function, check its corresponding header file for description

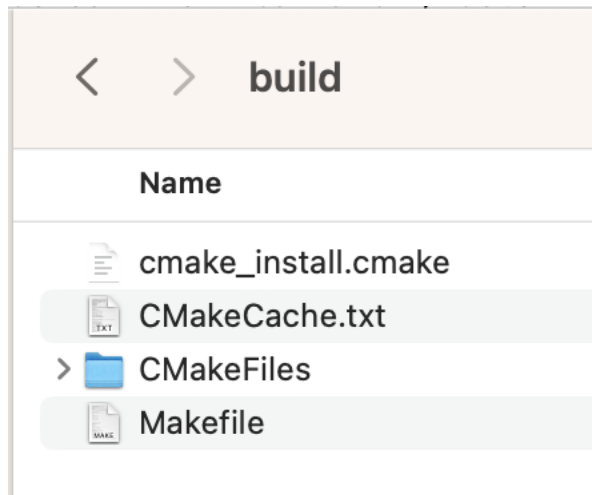
```
1  #ifndef RGBA_TO_RGB_H
2  #define RGBA_TO_RGB_H
3
4  #include <vector>
5
6  // Extract the 3-channel rgb data from a 4-channel rgba image
7  //
8  // Inputs:
9  //   rgba width*height*4 array of 4-channel rgba instensities (i.e., rgb +
10 //     alpha channel for transparency)
11 //   width image width (i.e., number of columns)
12 //   height image height (i.e., number of rows)
13 // Outputs:
14 //   rgb width*height*3 array containing rgb image color intensities
15 //
16 void rgba_to_rgb(
17     const std::vector<unsigned char> & rgba,
18     const int & width,
19     const int & height,
20     std::vector<unsigned char> & rgb);
21
22 #endif
23
```

```
#include "rgba_to_rgb.h"

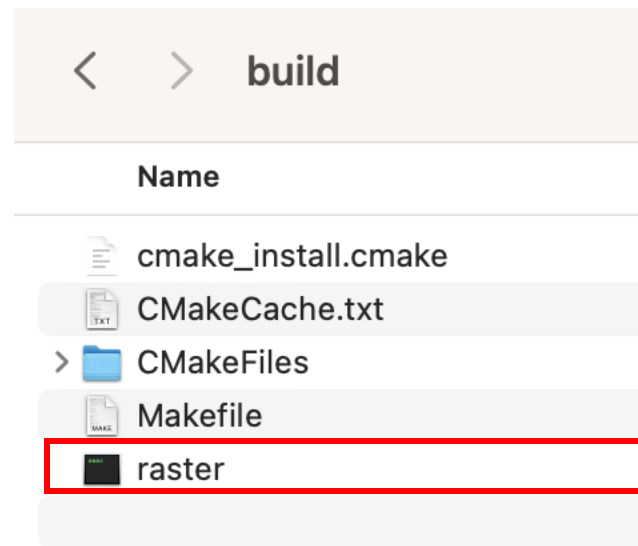
void rgba_to_rgb(
    const std::vector<unsigned char> & rgba,
    const int & width,
    const int & height,
    std::vector<unsigned char> & rgb)
{
    rgb.resize(height*width*3);
    //////////////////////////////////////
    // Add your code here
    //////////////////////////////////////
}
```

Assignment 1: Raster Images

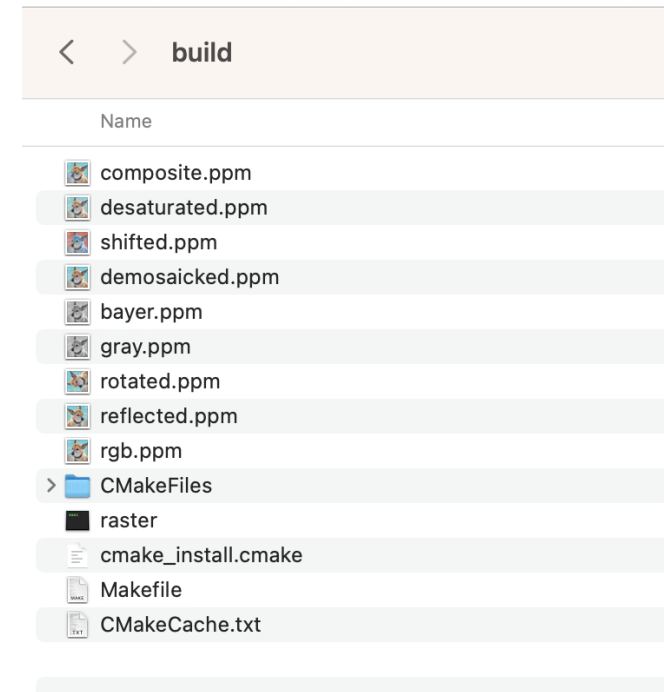
- Compilation and Running (Mac/Linux)



After “cmake ..”



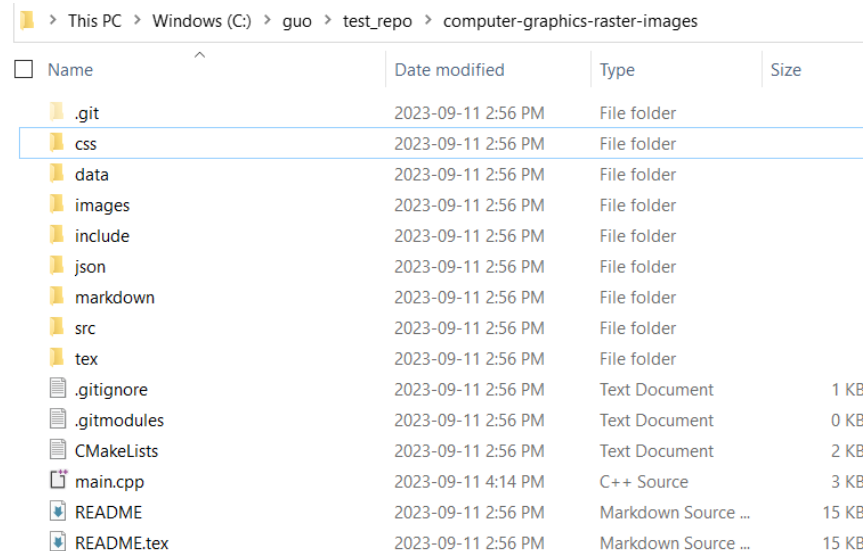
After “make”



After “./raster”

Assignment 1: Raster Images

- Compilation and Running (Windows):

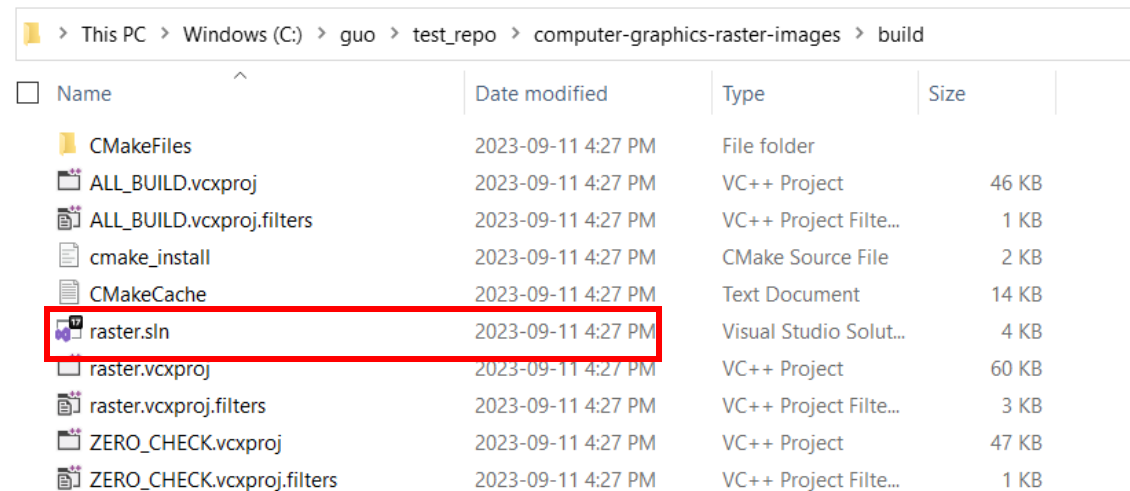


> This PC > Windows (C:) > guo > test_repo > computer-graphics-raster-images			
<input type="checkbox"/> Name	Date modified	Type	Size
.git	2023-09-11 2:56 PM	File folder	
css	2023-09-11 2:56 PM	File folder	
data	2023-09-11 2:56 PM	File folder	
images	2023-09-11 2:56 PM	File folder	
include	2023-09-11 2:56 PM	File folder	
json	2023-09-11 2:56 PM	File folder	
markdown	2023-09-11 2:56 PM	File folder	
src	2023-09-11 2:56 PM	File folder	
tex	2023-09-11 2:56 PM	File folder	
.gitignore	2023-09-11 2:56 PM	Text Document	1 KB
.gitmodules	2023-09-11 2:56 PM	Text Document	0 KB
CMakeLists	2023-09-11 2:56 PM	Text Document	2 KB
main.cpp	2023-09-11 4:14 PM	C++ Source	3 KB
README	2023-09-11 2:56 PM	Markdown Source ...	15 KB
README.tex	2023-09-11 2:56 PM	Markdown Source ...	15 KB

Fresh clone

Assignment 1: Raster Images

- Compilation and Running (Windows):



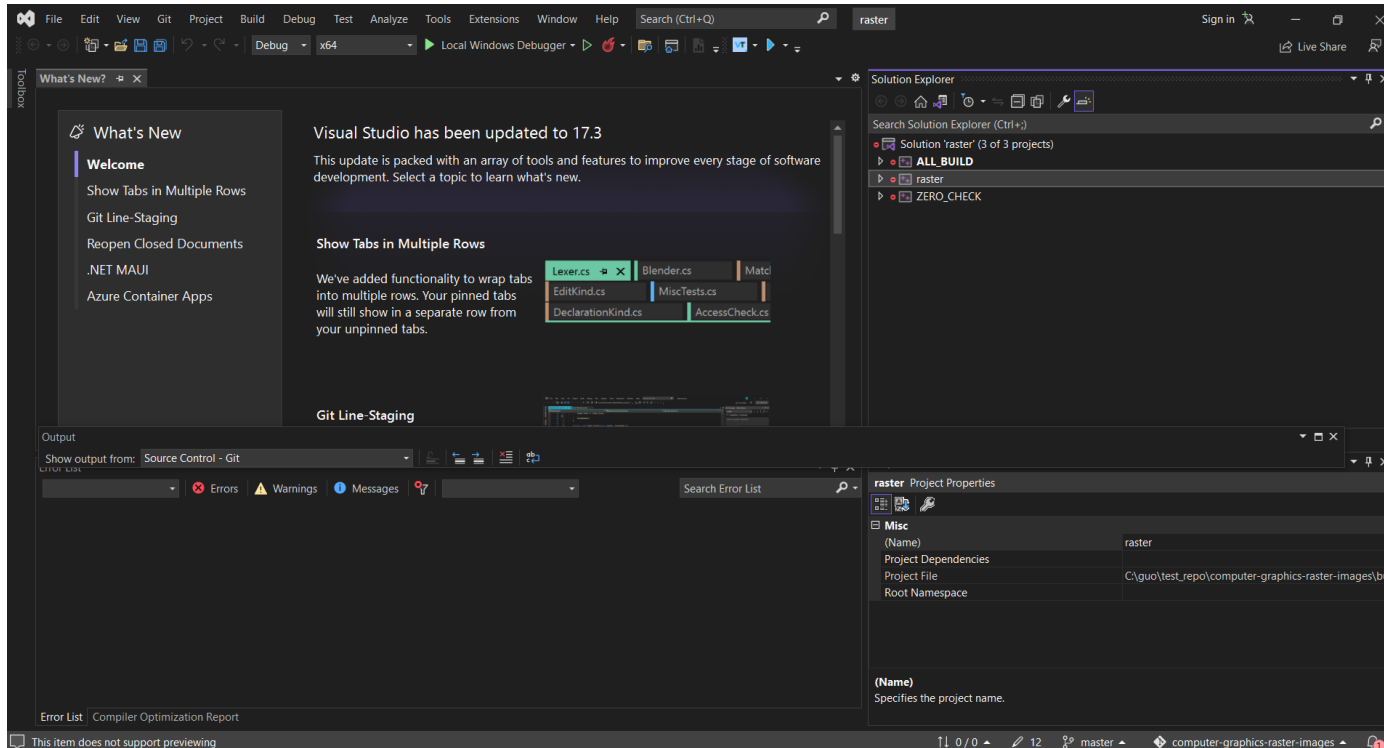
The screenshot shows a Windows File Explorer window with the address bar displaying the path: > This PC > Windows (C:) > guo > test_repo > computer-graphics-raster-images > build. The main area shows a list of files and folders with columns for Name, Date modified, Type, and Size. The file 'raster.sln' is highlighted with a red rectangle.

Name	Date modified	Type	Size
CMakeFiles	2023-09-11 4:27 PM	File folder	
ALL_BUILD.vcxproj	2023-09-11 4:27 PM	VC++ Project	46 KB
ALL_BUILD.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...	1 KB
cmake_install	2023-09-11 4:27 PM	CMake Source File	2 KB
CMakeCache	2023-09-11 4:27 PM	Text Document	14 KB
raster.sln	2023-09-11 4:27 PM	Visual Studio Solut...	4 KB
raster.vcxproj	2023-09-11 4:27 PM	VC++ Project	60 KB
raster.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...	3 KB
ZERO_CHECK.vcxproj	2023-09-11 4:27 PM	VC++ Project	47 KB
ZERO_CHECK.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...	1 KB

After “cmake ..”

Assignment 1: Raster Images

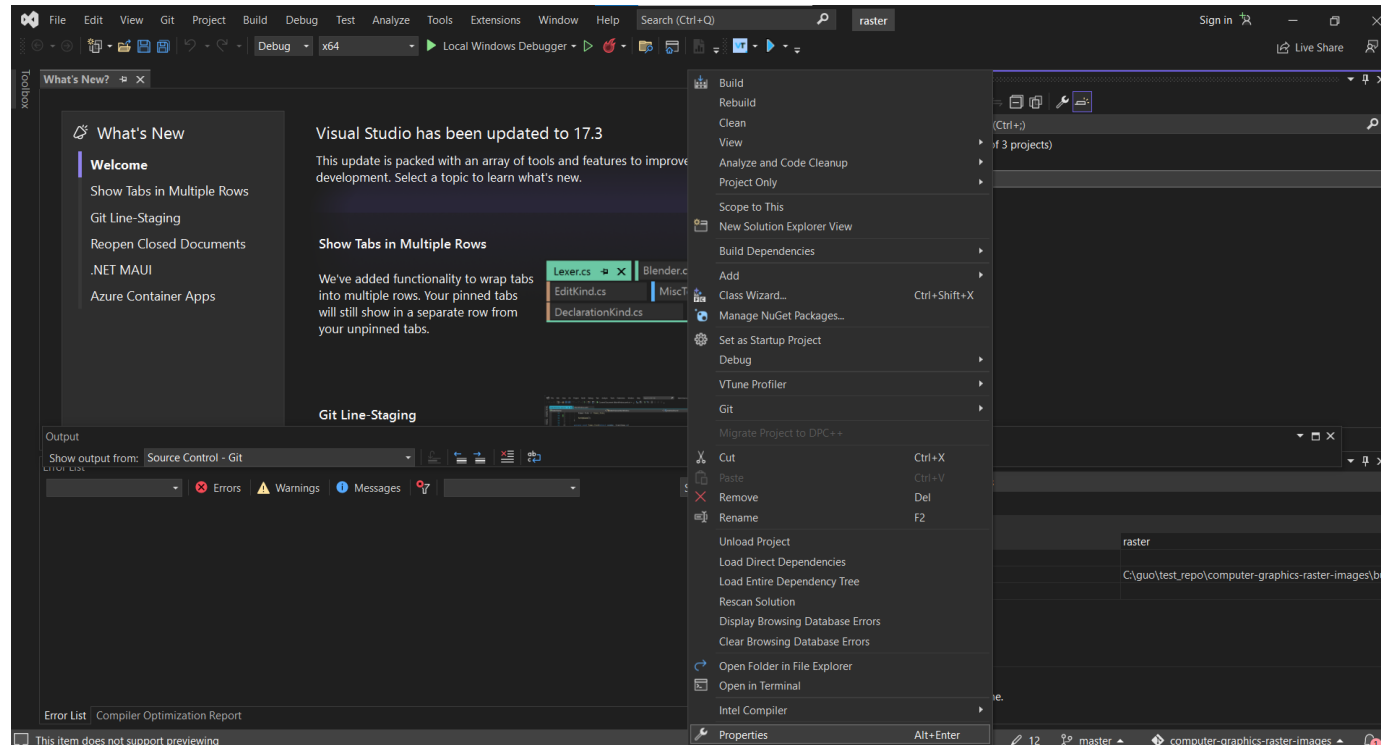
- Compilation and Running (Windows):



Visual Studio solution file

Assignment 1: Raster Images

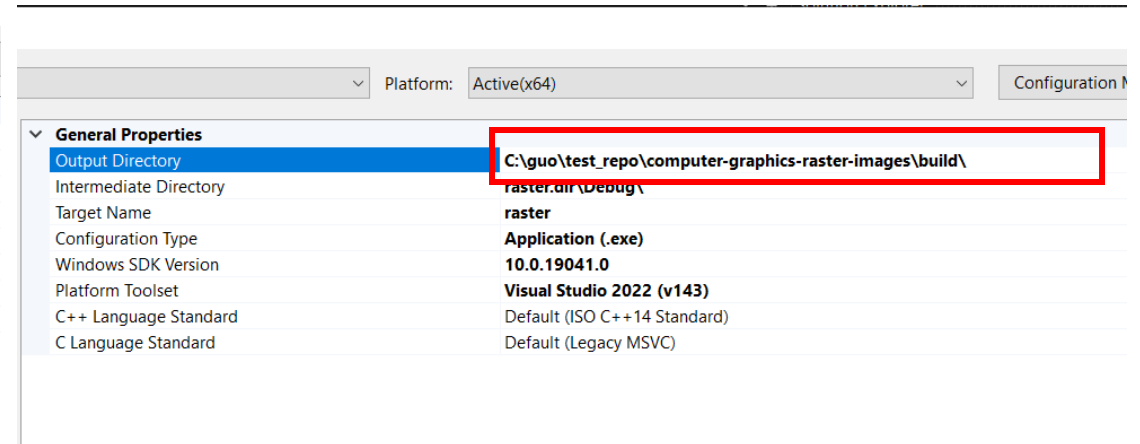
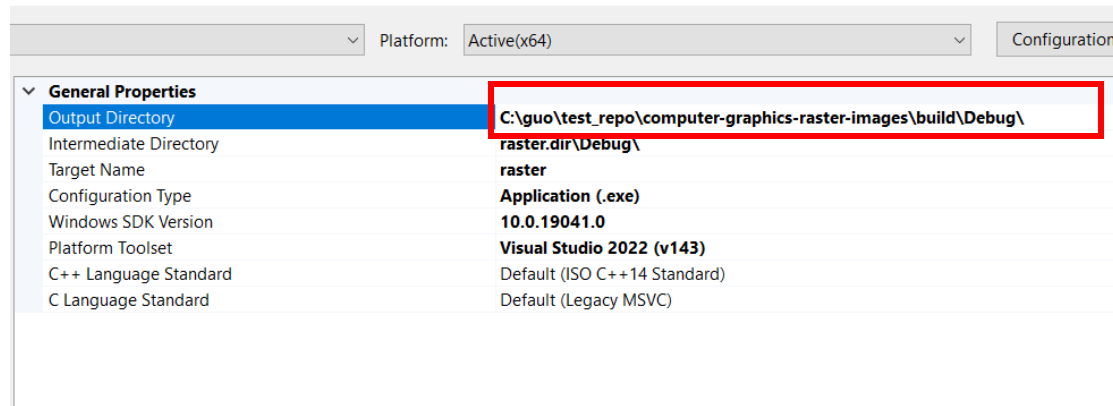
- Compilation and Running (Windows):



Change output path

Assignment 1: Raster Images

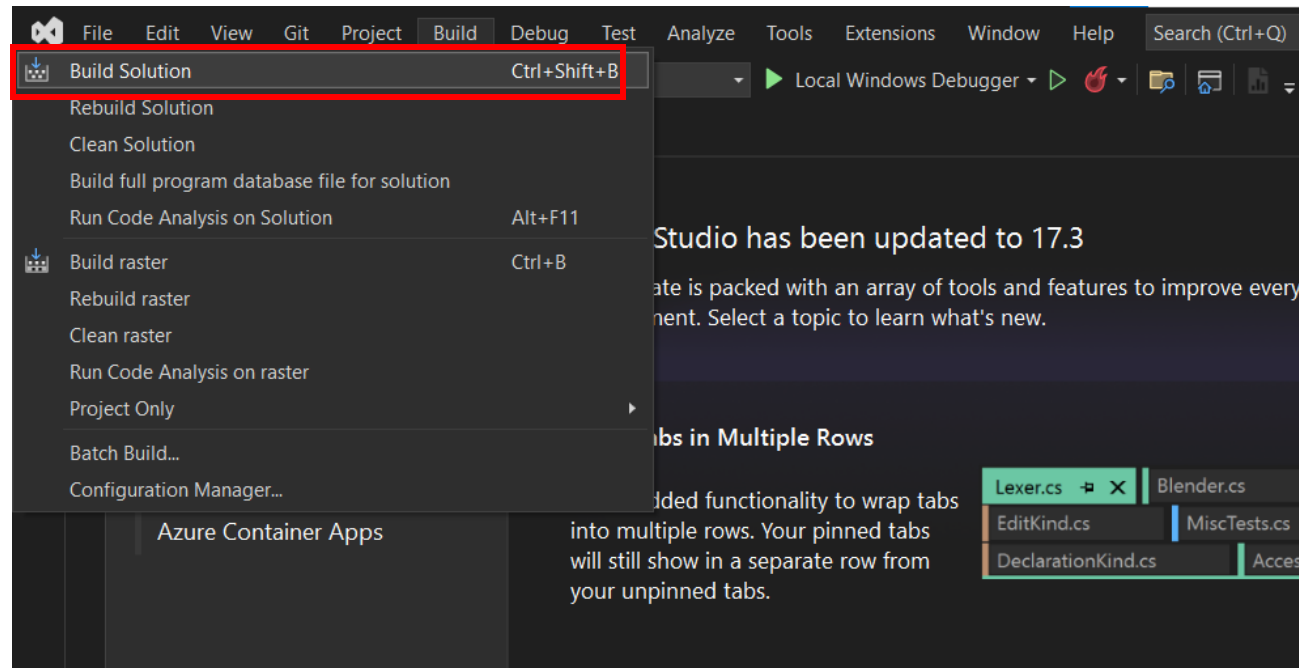
- Compilation and Running (Windows):



Change output path

Assignment 1: Raster Images

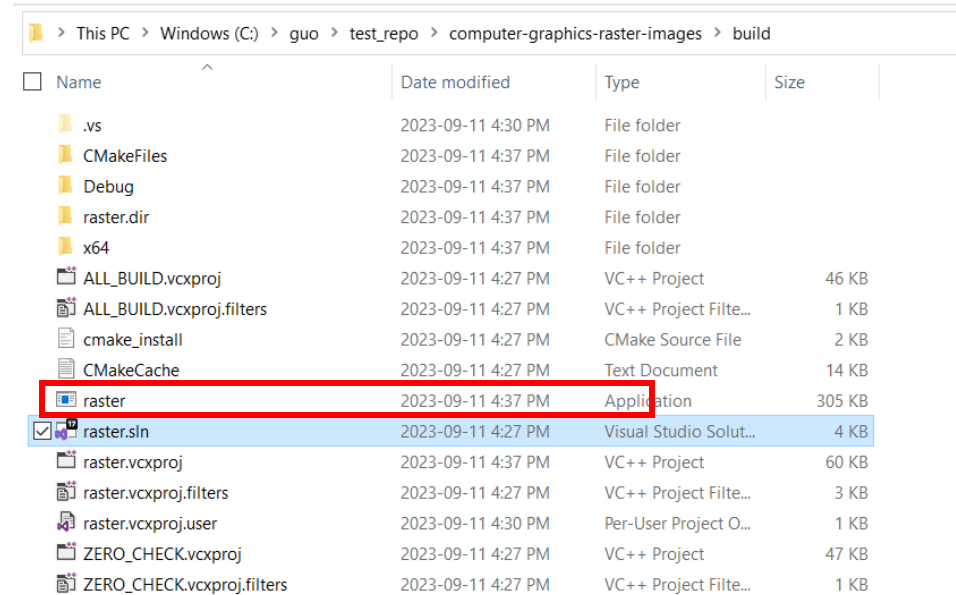
- Compilation and Running (Windows):



Build

Assignment 1: Raster Images

- Compilation and Running (Windows):



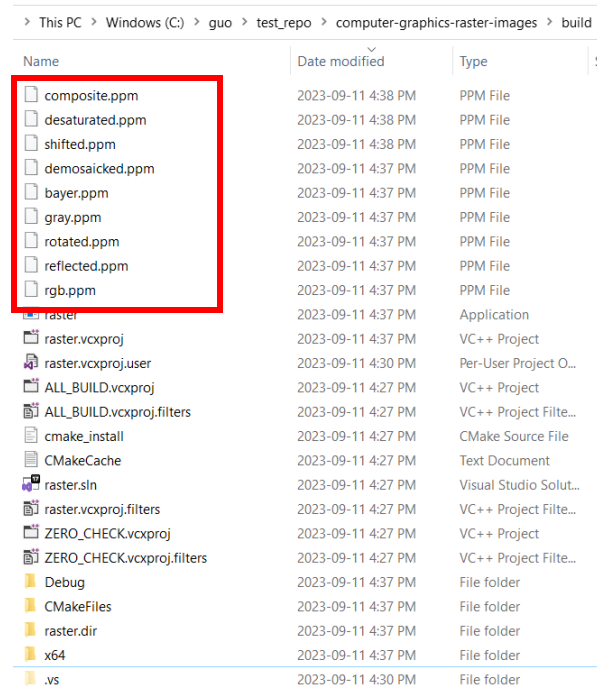
The screenshot shows a Windows File Explorer window with the address bar indicating the path: This PC > Windows (C:) > guo > test_repo > computer-graphics-raster-images > build. The main area displays a list of files and folders. The file 'raster' is highlighted with a red rectangle. Below it, 'raster.sln' is selected with a blue highlight. Other files include project files, CMake files, and folders like '.vs', 'CMakeFiles', 'Debug', 'raster.dir', and 'x64'.

<input type="checkbox"/>	Name	Date modified	Type	Size
	.vs	2023-09-11 4:30 PM	File folder	
	CMakeFiles	2023-09-11 4:37 PM	File folder	
	Debug	2023-09-11 4:37 PM	File folder	
	raster.dir	2023-09-11 4:37 PM	File folder	
	x64	2023-09-11 4:37 PM	File folder	
	ALL_BUILD.vcxproj	2023-09-11 4:27 PM	VC++ Project	46 KB
	ALL_BUILD.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...	1 KB
	cmake_install	2023-09-11 4:27 PM	CMake Source File	2 KB
	CMakeCache	2023-09-11 4:27 PM	Text Document	14 KB
	raster	2023-09-11 4:37 PM	Application	305 KB
<input checked="" type="checkbox"/>	raster.sln	2023-09-11 4:27 PM	Visual Studio Solut...	4 KB
	raster.vcxproj	2023-09-11 4:37 PM	VC++ Project	60 KB
	raster.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...	3 KB
	raster.vcxproj.user	2023-09-11 4:30 PM	Per-User Project O...	1 KB
	ZERO_CHECK.vcxproj	2023-09-11 4:27 PM	VC++ Project	47 KB
	ZERO_CHECK.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...	1 KB

Run executable

Assignment 1: Raster Images

- Compilation and Running (Windows):



This screenshot shows a Windows File Explorer window with the address bar indicating the path: > This PC > Windows (C:) > guo > test_repo > computer-graphics-raster-images > build. The window displays a list of files and folders. A red rectangle highlights a group of nine PPM files: composite.ppm, desaturated.ppm, shifted.ppm, demosaicked.ppm, bayer.ppm, gray.ppm, rotated.ppm, reflected.ppm, and rgb.ppm. Below these files are various project files including raster.vcxproj, raster.vcxproj.user, ALL_BUILD.vcxproj, ALL_BUILD.vcxproj.filters, cmake_install, CMakeCache, raster.sln, raster.vcxproj.filters, ZERO_CHECK.vcxproj, ZERO_CHECK.vcxproj.filters, and several folders: Debug, CMakeFiles, raster.dir, x64, and .vs.

Name	Date modified	Type
composite.ppm	2023-09-11 4:38 PM	PPM File
desaturated.ppm	2023-09-11 4:38 PM	PPM File
shifted.ppm	2023-09-11 4:38 PM	PPM File
demosaicked.ppm	2023-09-11 4:37 PM	PPM File
bayer.ppm	2023-09-11 4:37 PM	PPM File
gray.ppm	2023-09-11 4:37 PM	PPM File
rotated.ppm	2023-09-11 4:37 PM	PPM File
reflected.ppm	2023-09-11 4:37 PM	PPM File
rgb.ppm	2023-09-11 4:37 PM	PPM File
raster	2023-09-11 4:37 PM	Application
raster.vcxproj	2023-09-11 4:37 PM	VC++ Project
raster.vcxproj.user	2023-09-11 4:30 PM	Per-User Project O...
ALL_BUILD.vcxproj	2023-09-11 4:27 PM	VC++ Project
ALL_BUILD.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...
cmake_install	2023-09-11 4:27 PM	CMake Source File
CMakeCache	2023-09-11 4:27 PM	Text Document
raster.sln	2023-09-11 4:27 PM	Visual Studio Solut...
raster.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...
ZERO_CHECK.vcxproj	2023-09-11 4:27 PM	VC++ Project
ZERO_CHECK.vcxproj.filters	2023-09-11 4:27 PM	VC++ Project Filte...
Debug	2023-09-11 4:37 PM	File folder
CMakeFiles	2023-09-11 4:37 PM	File folder
raster.dir	2023-09-11 4:37 PM	File folder
x64	2023-09-11 4:37 PM	File folder
.vs	2023-09-11 4:30 PM	File folder

Check outputs