PA2.1. PA2 Fancy Fills

Due: Mar 7, 22:00

Goals and Overview

In this PA (Programming Assignment) you will:

- learn about Stacks and Queues
- learn about applications of Stacks and Queues called depth-first-search (DFS) and breadth-first-search (BFS)
- explore flood fill algorithms.
- become more skilled at C++ constructs, including the use of basic templates and inheritance

Part 1: The `Stack`, `Queue`, and `PriorityNeighbours` Classes

> **Template Compilation** Note that the `stack.h` and `queue.h` files we've given you include the `stack.cpp` and `queue.cpp` files respectively at the end, so you should NOT use a `#include "stack.h"` (or `#include "queue.h"`) statement at the top of the `stack.cpp` (or `queue.cpp`) file. We have done it this way so that the template types are instantiated appropriately.

The `Stack` Class

You will write a class named `Stack` that works just like the stack you heard about in lecture, with the addition of the `Peek()` function. It is declared in the given file `stack.h`. You will implement it in `stack.cpp`.

Your `Stack` class must implement all of the methods mentioned in the given code. Please read the documentation in the header file to see what limitations we have placed on your `Stack` class and what the running times of each function should be.

The `Queue` Class

You will write a class named `Queue` that works just like the queue you heard about in lecture, with the addition of the `Peek()` function. It is declared in the given file `queue.h`. You will implement it in `queue.cpp`.

Your `Queue` class must implement all of the methods mentioned in the given code. Please read the documentation in the header file to see what limitations we have placed on your `Queue` class and what the running times of each function should be.

The `PriorityNeighbours` Class

You will write a class named `PriorityNeighbours` that is designed specifically to be used in this PA. It is used to store a collection of (x, y) image coordinates along with some color information. Its behaviour when an item is removed, is to select the item from among its contents that best satisfies a priority condition. Please carefully read the documentation in `priority.h` for a detailed explanation of the priority condition.

Testing

We have provided test files `testStackQueue.cpp` and `testPriority` which include a few (albeit trivial) test cases that your code should pass if it is correct. To compile this executable, type:

```
make testStackQueue
```

or

Programming Assignment 2

Assessment overview

Total points: 27/27

Score: 100%

Question

Value: 27

History: 27 27

Awarded points: 27/27

Report an error in this question

Previous question

Next question

Attached files

No attached files

Attachments can't be added or deleted because the assessment is closed.

```
make testPriority
```

These test cases are deliberately insufficient. We encourage you to augment this file with additional test cases, using the provided ones as examples.

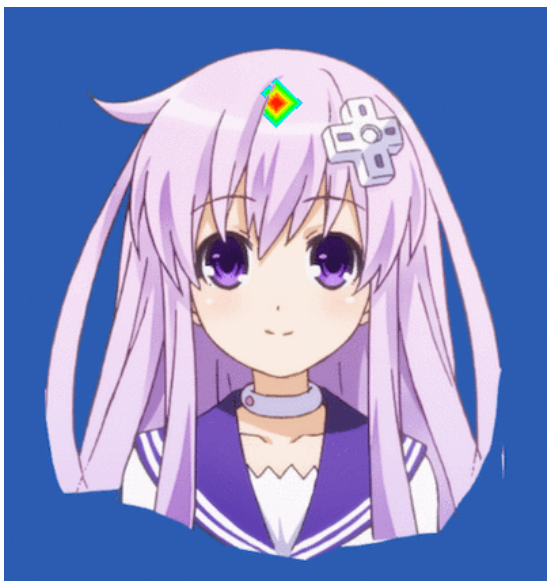
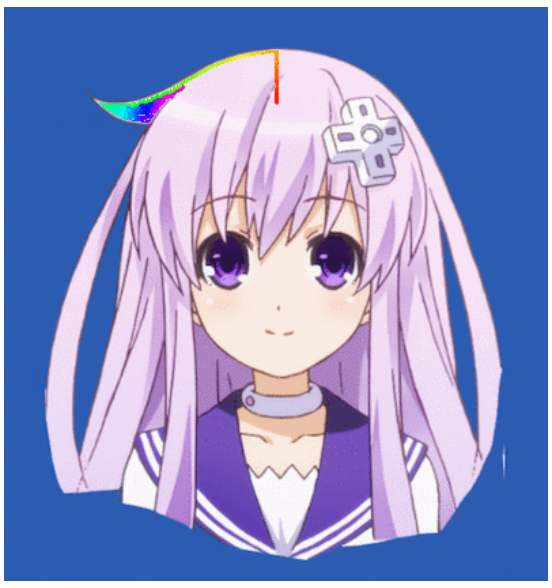
Grading Information for Part 1

The following files are used to grade the stack and queue classes:

- `stack.cpp`
- `queue.cpp`
- `priority.h`
- `priority.cpp`

All other files (including any testing files you create) will not be used for grading.

Part 2: Flood Fill

For this part of the assignment, you will be writing a number of functions that execute a "flood fill" on a `PNG` image. To flood fill a region of an image, you specify a point on the image and a fill color (or pattern) and all points similar in color and adjacent to the chosen point are changed to the fill color (or pattern). We will implement two different fill algorithms and three different fill patterns. The two fill algorithms are animated in the pictures above with a rainbow color fill pattern that *we* implemented.

Functors

Your first task in this part of the project is to implement the mechanism by which colors are selected for the fill pattern. To do this, you will create function objects (also known as "functors") which will be passed into the fill algorithm and applied to pixels in a `PNG`. Specifically you will be making three new functors, each of which will be derived classes of the abstract base class called `colorPicker`, which is provided and described in the given code file `colorPicker.h`. We have also given you an example functor so you can see how things are supposed to work. Our functor is called `rainbowColorPicker` (its behavior is a little non-deterministic--er--buggy, but it's cool to look at!). The `colorPicker` base class has one purely virtual function that you **must** implement in your derived classes, but you may add other functions if you wish. You should expect your derived class constructors to initialize the functor with situation-dependent variables, and it is up to you do decide what those variables should be.

The purpose of any `colorPicker` is to take an image coordinate as its `(x,y)` parameters to `operator()`, and return the color it would suggest the client recolor that location in the source `PNG` to be. So in the examples above, the `colorPicker` is returning rainbow colors, based on the number of iterations in the fill algorithm.

Your task is to implement the `ImageTileColorPicker`, `NegativeColorPicker`, and `CensorColorPicker` function objects. Refer to the given code for implementation details (particularly `solidColorPicker.cpp` and `rainbowColorPicker.cpp` as they are already completed): they **must** overwrite the abstract **operator()**!

The Fill Algorithms

You will be implementing two different basic kinds of flood fills: **depth-first-search** (DFS) and **breadth-first-search** (BFS), each with three different `patterns`. The first pattern will be a simple replacement of pixels from a different image into the destination image (`ImageTileColorPicker`). The second will be filling in the area with negated hue and saturation values of the original color (`NegativeColorPicker`), and the third produces a blocky mosaic censor using averaged colors, covering a circular region of specified size and location (`CensorColorPicker`). The animations above are breadth-first-search and depth-first-search, respectively, both with a rainbow fill. We have written the rainbow fill functions as an example for the others.

You must implement **all** of the functions in the `filler` namespace. Refer to the documentation in the header file for implementation details.

Testing

Note that you must have ImageMagick installed if you're developing on your personal machine. You can test for this requirement by running

```
convert
```

in your terminal. Windows users should visit ImageMagick to download the latest binary. OSX users can use homebrew or MacPorts to install it if missing. Linux users likely already have it installed. If not, then you can install it via your system's package manager.

We have provided a file `testFills.cpp` which includes several test cases that your code should pass if it is correct. To compile this executable, type:

```
make testFills
```

This will create executable `testFills`.

One important thing to note about this PA is that the `.gif` compression may take some time. In general, on the remote machines via `ssh`, the solution code runs in somewhere from 5-20 seconds when all the tests are enabled and completed and the server is under a light load. It is advisable to comment out the tests for things you have already completed, so that you don't have to wait as long (and use the CPU up) for things you already did. That said, the main point is that if your code doesn't finish immediately don't fret. Also note that as more traffic is happening on the server things will slow down. This may be an incentive to not wait until the last minute and have to try to run your code when everyone else is too!

(These slow tests may feel unrealistic. The opposite is true: trading off which expensive tests to run and how often is an absolutely critical workflow choice in substantial projects in industry!)

The `testFills` program will generate images and animated gifs in the `images/` folder, which can be diffed with the solution images in `soln_images/`. For animated gifs, the frames making up the animation are placed in `frames/`, and can be diffed with their corresponding expected frames in `soln_frames/`.

You can diff each frame, which will probably be useful for debugging:

```
diff frames/bfssolid00.png soln_frames/bfssolid00.png
```

These test cases are deliberately insufficient. We encourage you to augment this file with additional test cases, using the provided ones as examples.

Handing in Your Code

Pair work is highly encouraged for this assignment. Each group member will be able to make joint submissions and have access to submissions made by other members.

Grading Information

The following files are used to grade PA 2:

- `stack.cpp`
- `queue.cpp`
- `priority.h`
- `priority.cpp`
- `imageTileColorPicker.h`
- `imageTileColorPicker.cpp`
- `negativeColorPicker.h`
- `negativeColorPicker.cpp`
- `censorColorPicker.h`
- `censorColorPicker.cpp`
- `filler.h`
- `filler.cpp`

All other files will not be used for grading.

Implementation Constraints and Advice

For Part 1, we *strongly* encourage you to sketch out small examples to help you understand how the `Queue` class should work.

For Part 2, you are also welcome to add your own helper functions. You'll be submitting both the `.h` and `.cpp` files for that part of the assignment. (The same is *not* true for the Stack and Queue of Part 1.)

Getting the Given Code

Download the source files here pa2-20220222-2317.zip and follow the procedures you learned in lab to move them to your home directory on the remote linux machines.

Submission

Submit your files for PA2 grading here! These are the only files used for grading.

Files

stack.cpp uploaded	Download	Show preview
queue.cpp uploaded	Download	Show preview
priority.h uploaded	Download	Show preview
priority.cpp uploaded	Download	Show preview
imageTileColorPicker.h uploaded	Download	Show preview

imageTileColorPicker.cpp
uploaded
Download Show preview

negativeColorPicker.h
uploaded
Download Show preview

negativeColorPicker.cpp
uploaded
Download Show preview

censorColorPicker.h
uploaded
Download Show preview

censorColorPicker.cpp
uploaded
Download Show preview

filler.h
uploaded
Download Show preview

filler.cpp
uploaded
Download Show preview

All other files will not be used for grading.

Correct answer

Submitted answer 20 correct: 100%

Submitted at 2022-03-07 01:20:53 (PST)

hide

Files

censorColorPicker.cpp
uploaded
Download Show preview

censorColorPicker.h
uploaded
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filler.cpp
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filler.h
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imageTileColorPicker.cpp
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priority.cpp
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Download Show preview

priority.h
uploaded
Download Show preview

queue.cpp
uploaded
Download Show preview

stack.cpp
uploaded
Download Show preview

Score: 27/27 (100%)

Output

```
Test group priority output:
stdout: clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -
Wextra -pedantic testPriority.cpp -o testPriority.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic priority.cpp -o priority.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic cs221util/lodepng/lodepng.cpp -o lodepng.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic cs221util/HSLAPixel.cpp -o HSLAPixel.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic cs221util/PNG.cpp -o PNG.o
clang++ testPriority.o priority.o lodepng.o HSLAPixel.o
PNG.o -std=c++1y -stdlib=libc++ -lc++abi -lpthread -lm -o
testPriority

stderr:
Test group stack_queue output:
stdout: clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -
Wextra -pedantic testStackQueue.cpp
clang++ testStackQueue.o -std=c++1y -stdlib=libc++ -lc++abi
-lpthread -lm -o testStackQueue

stderr:
Test group fills output:
stdout: clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -
Wextra -pedantic imageTileColorPicker.cpp -o
imageTileColorPicker.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic negativeColorPicker.cpp -o negativeColorPicker.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic censorColorPicker.cpp -o censorColorPicker.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic solidColorPicker.cpp -o solidColorPicker.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic rainbowColorPicker.cpp -o rainbowColorPicker.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic testFills.cpp -o testFills.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic priority.cpp -o priority.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic animation.cpp -o animation.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic cs221util/lodepng/lodepng.cpp -o lodepng.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic cs221util/HSLAPixel.cpp -o HSLAPixel.o
clang++ -std=c++1y -stdlib=libc++ -c -g -O0 -Wall -Wextra -
pedantic cs221util/PNG.cpp -o PNG.o
clang++ imageTileColorPicker.o negativeColorPicker.o
censorColorPicker.o solidColorPicker.o rainbowColorPicker.o
testFills.o priority.o animation.o lodepng.o HSLAPixel.o
PNG.o -std=c++1y -stdlib=libc++ -lc++abi -lpthread -lm -o
testFills

stderr: solidColorPicker.cpp:11:51: warning: unused
parameter 'p' [-Wunused-parameter]
HSLAPixel SolidColorPicker::operator()(PixelPoint p)
                                                  ^
1 warning generated.
```

Test Results

✔ **[1/1] PriorityNeighbours::distinct_colors**

✔ [1/1] PriorityNeighbours::same_colors

✔ [1/1] stack::basic functions

✔ [1/1] stack::peek function

✔ [1/1] stack::empty four times

✔ [1/1] stack::big miscellaneous ops

✔ [1/1] stack::resize

✔ [1/1] queue::basic functions

✔ [1/1] queue::peek function

✔ [1/1] queue::empty four times

✔ [1/1] queue::big miscellaneous ops

✔ [1/1] colorPicker::basic imagetile

✔ [1/1] colorPicker::basic negative

✔ [1/1] colorPicker::censor bw5 rad30

✔ [1/1] colorPicker::censor bw10 rad40

✔ [1/1] fill::basic imagetile dfs

✔ [1/1] fill::edge imagetile dfs

✔ [1/1] fill::basic imagetile bfs

✔ [1/1] fill::edge imagetile bfs

✔ [1/1] fill::basic negative dfs

✔ [1/1] fill::edge negative dfs

✔ [1/1] fill::basic negative bfs

✔ [1/1] fill::edge negative bfs

✔ [1/1] fill::basic censor dfs bw8 rad40

✔ [1/1] fill::edge censor dfs bw8 rad40

✔ [1/1] fill::basic censor bfs 6px rad30

✔ [1/1] fill::edge censor bfs 6px rad30

Submitted answer 19 correct: 100%

Submitted at 2022-03-07 01:14:41 (PST)

show

Submitted answer 18 partially correct: 40%

Submitted at 2022-03-06 23:41:19 (PST)

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