2811 / User Interfaces
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Updates:
- v2: moved zip file on onedrive
- v3: typos and new video
- v4: removed suggestion to run in lab
- v5: removed requirement to create copy fns for Location
- v6: clarified submission instructions

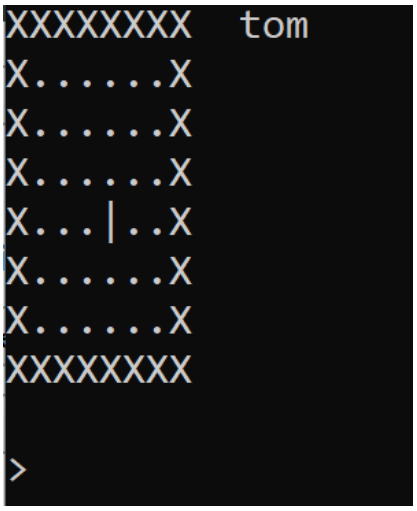
Coursework 1: Cave Plus Plus
Date set: 18.10.21
Date due: 31.10.21, 12 noon (UK time)
Submission: .patch file via Minerva
Weighting: 15%

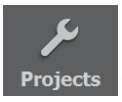
Goals of this CW:

- Test your understanding of basic C++,
- object-oriented programming in C++,
- arrays, pointers, and references.
- Introduce a basic terminal user interface to a block-world

Getting started:

- Download this zipped project and open with Qt Creator. (introductory video):
    - extract the project to a location on your computer
    - go "File" → "Open File or Project" and select the *.pro* file in the zip
    - select the Qt Kit you wish to use (the default is usually correct) and click "Configure Project".
    - click the run button  to start the program. You may need to set the project to "run in terminal" as detailed in lab 1.
    - you should see something like this:



- Try out the program:
  - the program will show you a world which is an array of characters
  - you will be presented with a prompt. Type "move west" followed by enter. observe the result.
  - try these commands:
    - "move north"
    - "move east" - notice this fails!
    - "place coin" - shown as an underscore _, or `L` if Tom is also at the location
    - "place mushroom"
    - "exit"
- Run the test script:
  - If you run the main function with a single command line argument "test", it will run the test function. This is an example of the kind of function I will use to grade your code (but I will change the details).
    - You can set the command line arguments in Creator by clicking 

"Projects" → 

"Run" and then edit "Command line arguments" on the right.
  - The test function will also write out a *.patch* file that you must submit via Minerva before the deadline above.
- Read the code to understand how the program works.
  - Use the debugger and breakpoints to help you do this.
  - You will have to look up library functions online.

Your tasks:
Make the following changes to the program. Do not edit the files marked "Do not change this file" in the comments at the top; you may have to click + to show all comments. You may use the `std` library (but no others) to assist you if necessary. If you get stuck on one part, continue to the others:

1. Fix the code so that the move command will accept "move east" and "move south" and move tom appropriately.

(2 marks)

2. Currently the system only creates a small (8x8) `Cave`. Edit the constructor to cave so that multiple sizes can be constructed. If you set the Command line arguments in your IDE to a string such as "12 16" it will create a cave of a different size.
   - remove the code which throws a `logic_error` if the size is not 8x8 in the `Cave` constructor
   - edit the constructor to create an array of locations based on the sizes given
   - remember to add `Rock`s around the edge of the cave

(2 marks)

3. The `Cave` destructor is currently broken - it does not return all the memory allocated by `new` statements in the `Cave` constructor. Fix this.

(2 marks)

4. The `Cave` class does not have a *copy constructor* or a *copy assignment operator* defined. Implement them, creating a deep copy of the cave each time.
    - A deep copy shares no variables or memory with the original
    - All dynamically allocated variables will have to be deep copied
    - If those variables contain dynamically allocated variables, they will also need to be copied.
    - To copy `Cave` you might write and use a copy constructor in `Location`.
    - To deep copy a `vector` of pointers, you will have to deep copy each element of the vector.

(2 marks)

5. Create the "throw <object>" command:
    - Add a new command, "throw", which works like "place", but takes another argument which specifies the direction (north, south, east, or west). The object is placed 1 location away from tom in the given direction. If the location where the object is thrown is blocking (`Location::isBlocking()`), the object shouldn't be placed. For example, to throw a "coin" one step "north" you would type:

"throw coin north"

(2 marks)

6. Add the placeable object "bomb" and a command "explode" which takes no arguments, and causes a chain reaction through contiguous bombs.
    - Allow us to place a new type of `Thing` called "bomb". This type of thing does not block tom, and can be placed. For example, "place bomb" positions a bomb at tom's current location.
    - "explode" causes all bombs at locations under or adjacent to tom to explode (north, south, east, west of `Tom`, as well as the location of `Tom`).
    - An exploding bomb destroys all objects (including `Rock`s, but not including `Tom`) in the same `Location`.
    - All adjacent bombs (to the north, south, east, and west) also explode in the chain reaction - this continues until no more bombs are adjacent.
    - You may wish to use `std::set` to keep track of the exploding `Location`s.

(5 marks)

(total 15 marks)

To Submit:

- Ensure your program writes no debugging information to `cout` or `cerr`
- As above, run the test script to generate a single patch file of all your work
- This will create a `username.patch` file in your project directory
- Check the contents of the patch file to ensure all your source code is there, and contains the outputs of the tests.
- Submit `username.patch` using Minerva
- Your program will be graded automatically using a script which is similar, but not identical, to *test.cpp*…
- …so test your code carefully. Each part (1..6) of the assignment will be tested in a different execution of your code. If your code crashes at the start of one part, you will receive no marks for that part.