Tower of Hanoi

Prof. Wade Fagen-Ulmschneider

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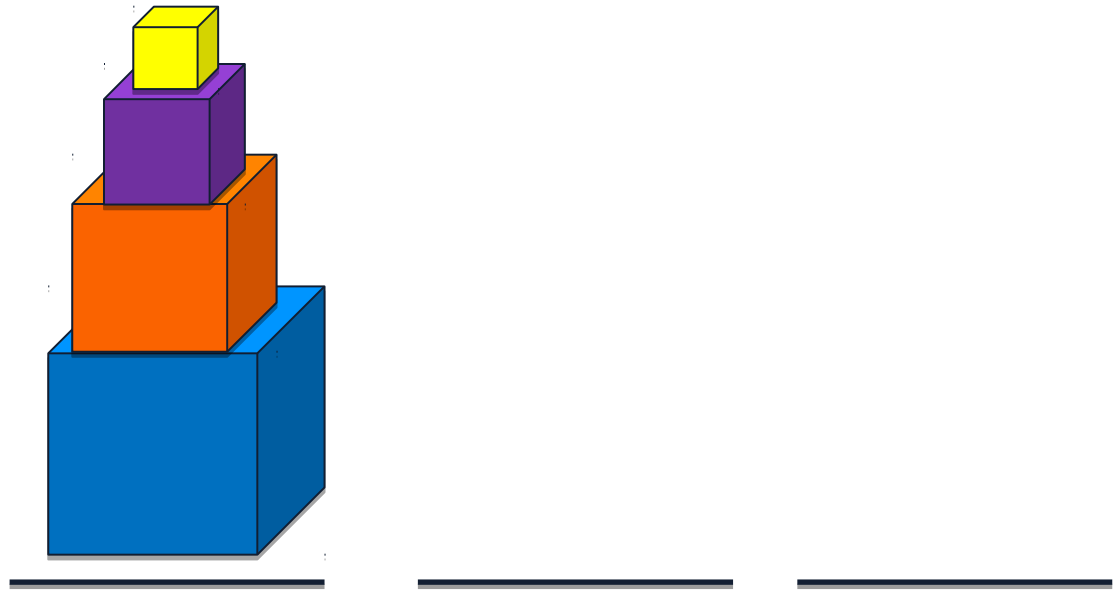

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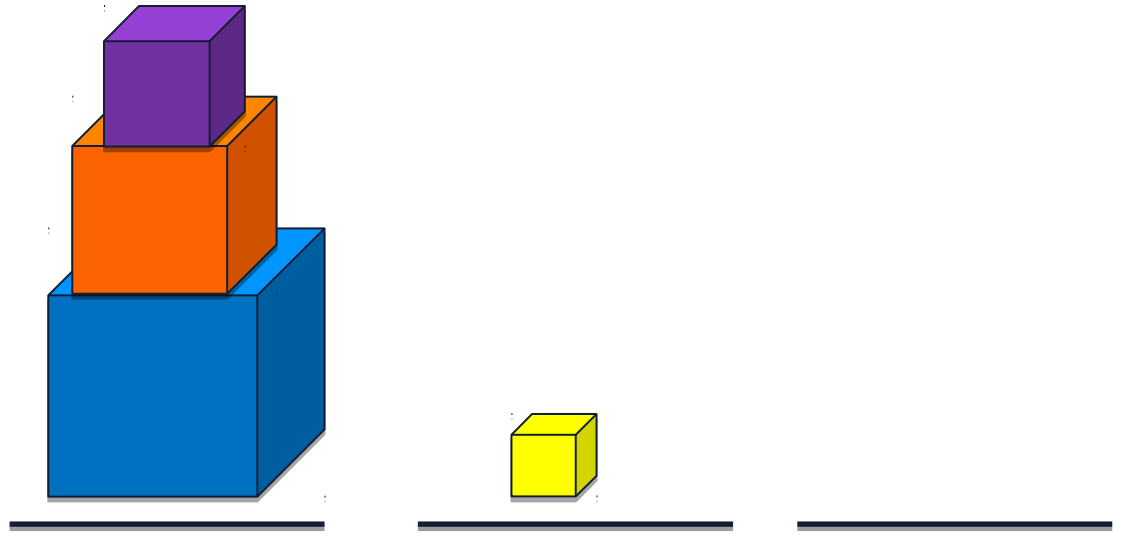

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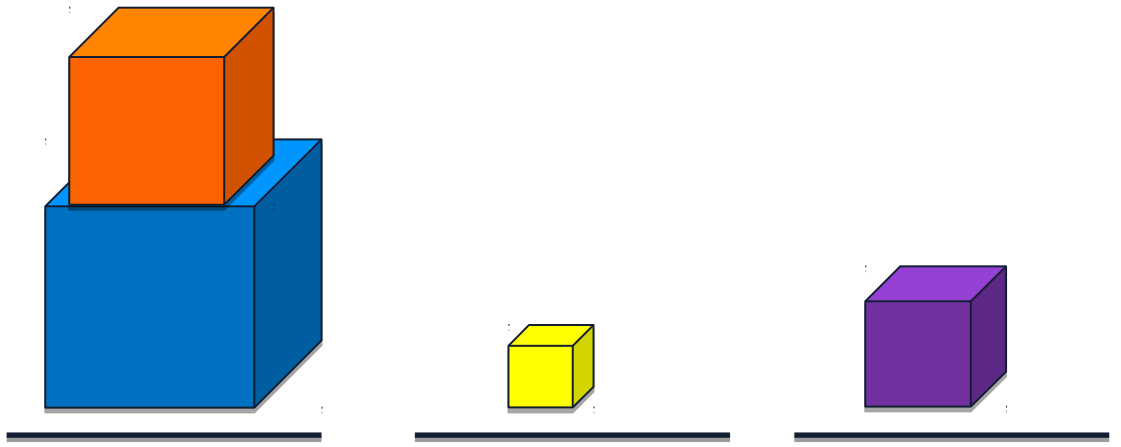

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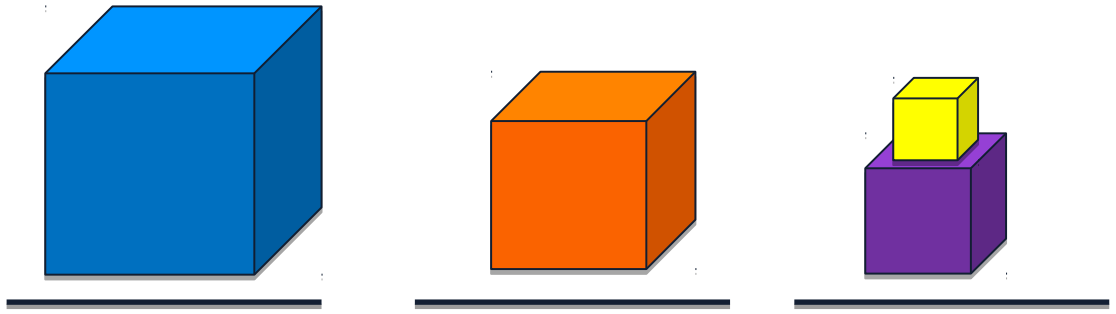

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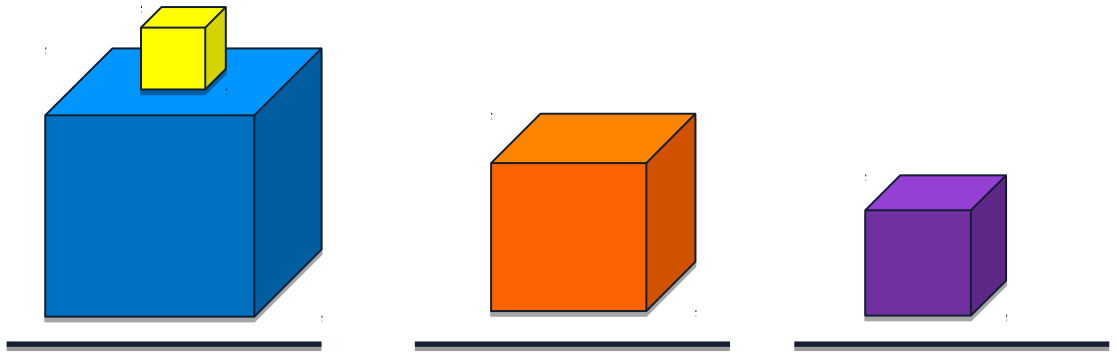

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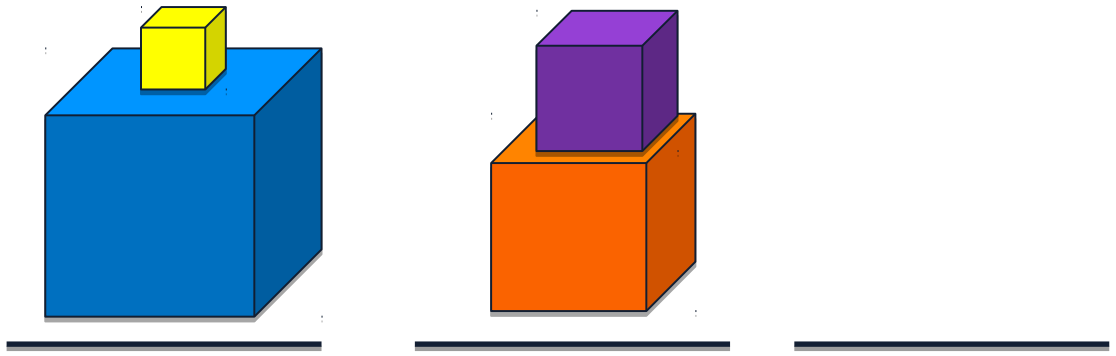

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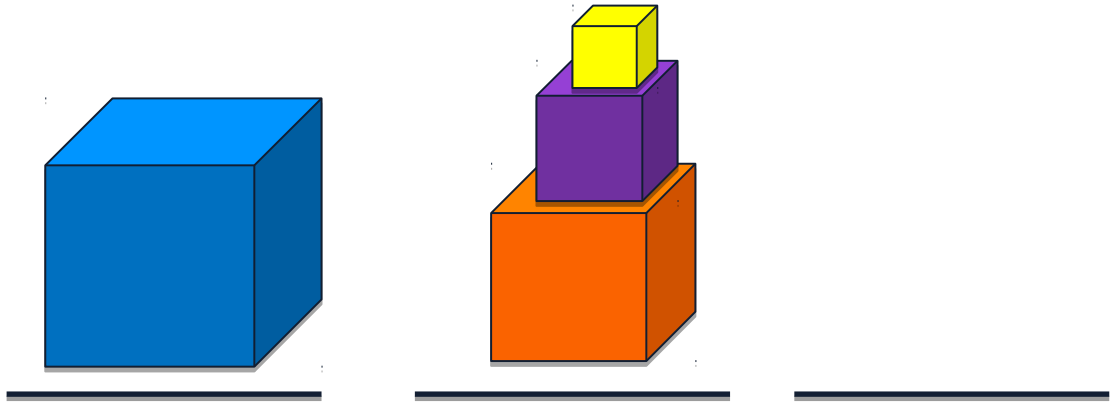

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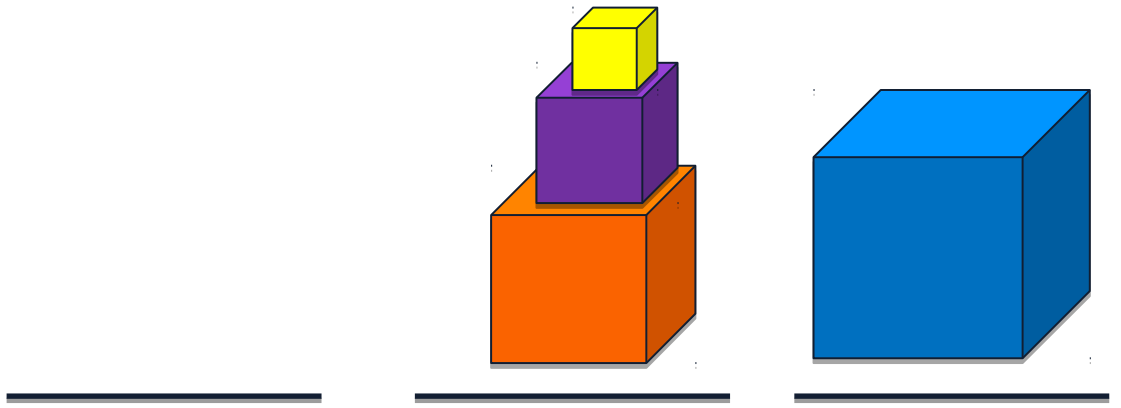
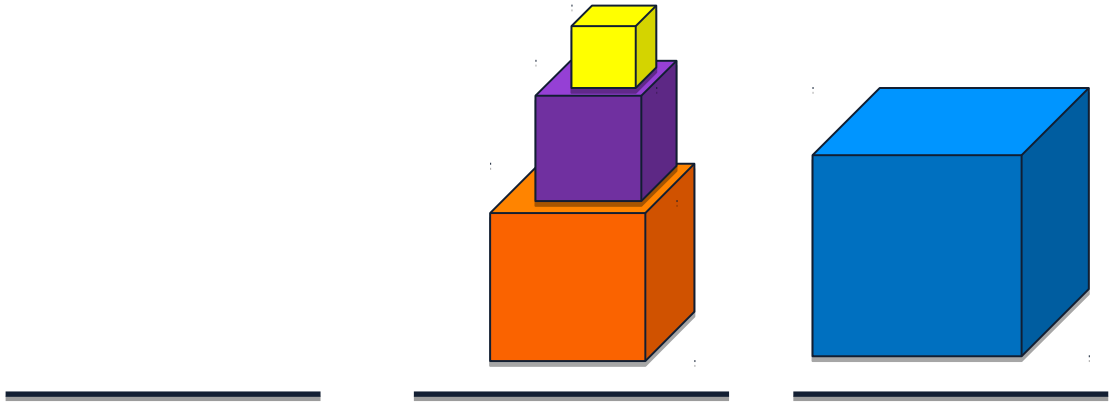


Programmatic Structure

The Tower of Hanoi problem involves three district entitles that must be represented in code:



Extending the Cube

The cube class needs a color:

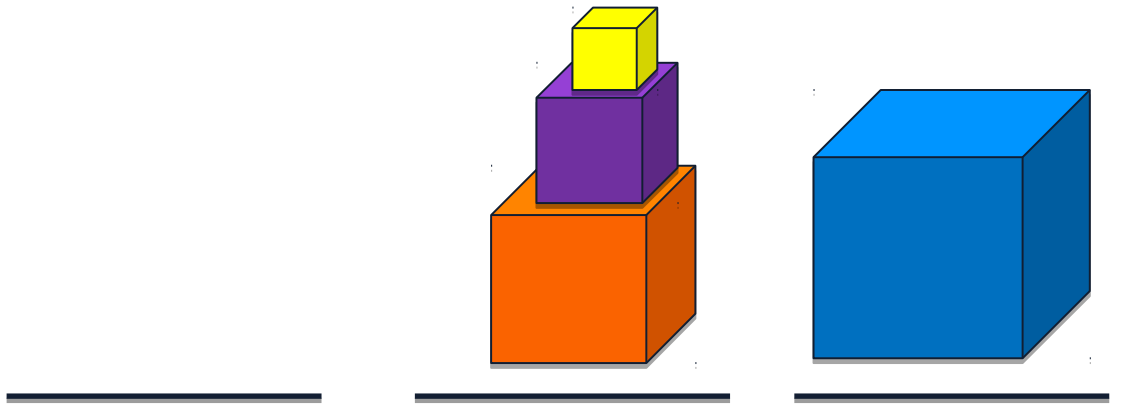
- In last week's assignment, we built `uiuc::HSLAPixel`.

cpp-tower/uiuc/Cube.h

```
12 namespace uiuc {
13   class Cube {
14     public:
15       Cube(double length, HSLAPixel color);
16
17       double getLength() const;
18       void setLength(double length);
19
20       double getVolume() const;
21       double getSurfaceArea() const;
22
23     private:
24       double length_;
25       HSLAPixel color_;
26   };
27 }
```

Building the Tower of Hanoi Game

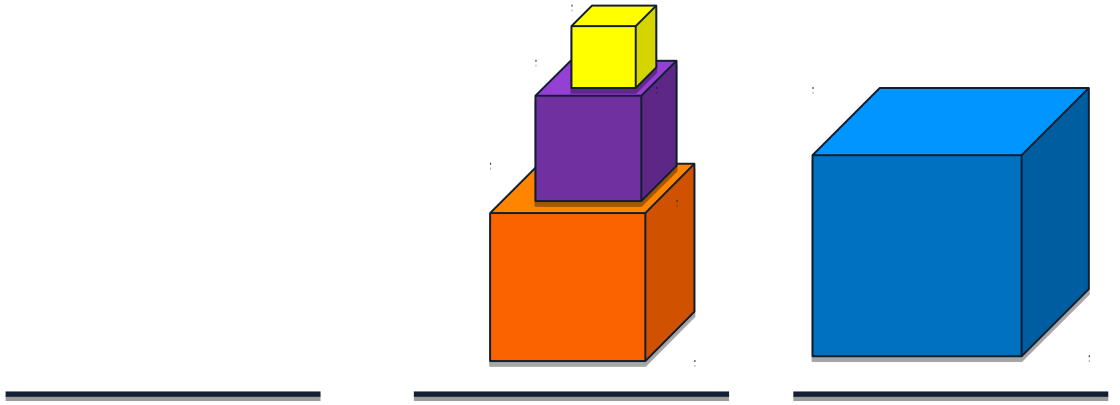
A new class must be created to represent each of the stacks in the Tower of Hanoi game:



Building the Stack Class

A single stack must contain:

- An vector of cubes
- Operations to interact with the top of the stack



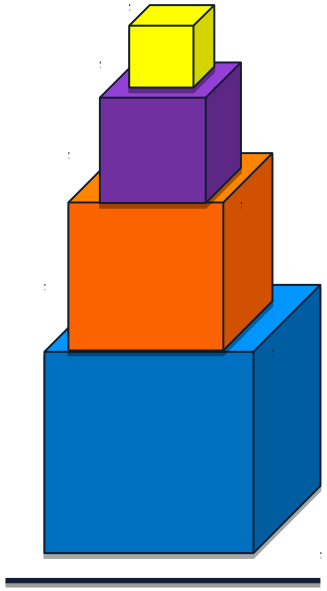
cpp-tower/Stack.h

```
14 class Stack {
15   public:
16     void push_back(const Cube & cube);
17     Cube   removeTop();
18     Cube & peekTop();
19     unsigned size() const;
20
21     // An overloaded operator<<, allowing us to print the stack
       // via `cout<<`:
22     friend std::ostream& operator<<(std::ostream & os,
                                       const Stack & stack);
23
24   private:
25     std::vector<Cube> cubes_;
26 };
```

Building the Tower of Hanoi Game

Finally, the game is built from the components we have already built:

- An array of three stacks
- The initial state has four cubes in the first stack

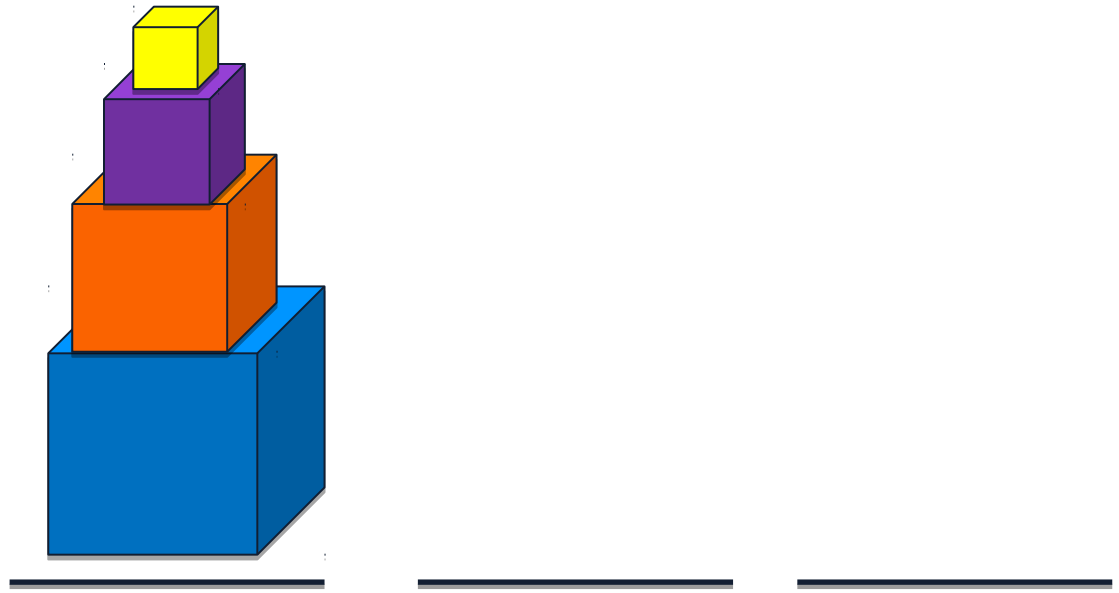


cpp-tower/Game.h

```
8  #pragma once
9
10 #include "Stack.h"
11 #include <vector>
12
13 class Game {
14   public:
15     Game();
16     void solve();
17
19     friend std::ostream& operator<<(std::ostream & os,
                                       const Game & game);
20
21   private:
22     std::vector<Stack> stacks_;
23 };
```

cpp-tower/Game.cpp

```
27 Game::Game() {
28   // Create the three empty stacks:
29   for (int i = 0; i < 3; i++) {
30     Stack stackOfCubes;
31     stacks_.push_back( stackOfCubes );
32   }
33
34   // Create the four cubes, placing each on the [0]th stack:
35   Cube blue(4, uiuc::HSLAPixel::BLUE);
36   stacks_[0].push_back(blue);
37
38   Cube orange(3, uiuc::HSLAPixel::ORANGE);
39   stacks_[0].push_back(orange);
40
41   Cube purple(2, uiuc::HSLAPixel::PURPLE);
42   stacks_[0].push_back(purple);
43
44   Cube yellow(1, uiuc::HSLAPixel::YELLOW);
45   stacks_[0].push_back(yellow);
46 }
```



cpp-tower/main.cpp

```cpp
#include "Game.h"
#include <iostream>

int main() {
  Game g;

  std::cout << "Initial game state: " << std::endl;
  std::cout << g << std::endl;

  g.solve();

  std::cout << "Final game state: " << std::endl;
  std::cout << g << std::endl;

  return 0;
}
```