



Explain the C++ keywords `public` and `private`. How are they used? What do they mean? How are they different.

Add the **subtract** member function to the **Rational** class given below. You may assume that only the functions listed here have been implemented. Write the prototype in the class in the space provided and implement the **subtract** function below. The function should work in the same way as the **add** function we wrote in class.

```
class Rational {
2 public:
    Rational(int numer=0, int denom=1);
4    ~Rational();
    void display(ostream& os) const;
6    bool read(istream& is);

8

10
private:
12

14

16    reduce();
    setDenom(int denom);
18    int num;
    int den;
20 };
```

Write a definition of the `time` class used in the following program. You only need to define the members of the class used in the program below. You do not need to implement any of the member functions.

```
#include <iostream>
2
int main()
4 {
    unsigned int hr;
6    unsigned int mn;
    unsigned int sec;
8    char colon;

10    std::cout << "Please enter the time of day (HH:MM:SS): " << std::endl;
    std::cin >> hr >> colon >> mn >> colon >> sec;

12
    time current(hr, mn, sec);
14    time later(current);
    ++later;
16    time evenLater;
    evenLater = later + 5;
18    std::cout << current << ' ' << evenLater;

20    return 0;
}
```

Implement the constructor for the following `String` class that takes a character array as an argument.

```
class String {
2 public:
    String ();
4    String(const String& org);
    String(const char str []);
6    ~String ();
    String operator=(const String rhs);
8    unsigned int size() const;
    String& operator+=(const String rhs);
10   char operator[](unsigned int index) const;
    char& operator[](unsigned int index);
12   void display(ostream& os) const;
private:
14   char* characters;
    unsigned int length;
16 };
```

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Explain the difference between `public`, `protected`, and `private` member functions.

Implement the `resize` member function from the following templated class. You may **not** make use of any of the other member functions.

```
template <class T>
2 class Vector {
public:
4   Vector(const Vector<T>& rhs);
   ~Vector();
6   Vector<T>& operator=(const Vector<T>& rhs);
   unsigned int size() const;
8   bool empty() const;
   void push_back(T val);
10  void pop_back();
   T operator[](unsigned int i) const;
12  T& operator[](unsigned int i);

14  // Changes the size of the vector to be sz elements big.
   // If the vector has sz elements, nothing is done.
16  // If the vector has more than sz elements, the first sz elements are
   // retained and the rest of the elements are lost.
18  // If the vector has fewer than sz elements, the additional elements
   // (added at the end) will have the value, val.
20  void resize(unsigned int sz, T val=T());

22 private:
   unsigned int length;
24  T* elements;
};
```

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Describe polymorphism. What does it allow us to do that we couldn't do without it?

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Describe polymorphism. What does it allow us to do that we couldn't do without it?