Rational

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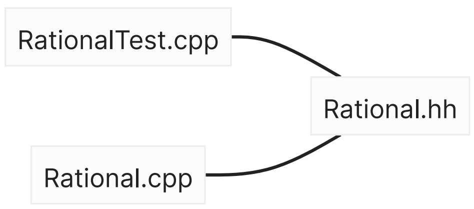

`Rational.hh`

```
// c++11
class Rational {
        public: // using declaration for name lookup
                using Int = long;
        private:
                Int num_;
                Int den_;

                void simplify();
        public:
                bool check_inv() const;

                Rational()
                        : Rational(0,1) {}00
                ~Rational() = default; // destructor
                Rational(const Rational&) = default; // copy
                Rational(Rational&&) = default; // movement
                Rational& operator=(const Rational&) = default; // assign copy
                Rational& operator=(Rational&&) = default; // assign movement

                explicit Rational(Int n)
                        : Rational(n,1) {} // avoids implicit conversion
                Rational(Int n, Int d);

                const Int& num() const;
                const Int& den() const;

                Rational operator+(const Rational& a2) const;
                Rational operator-(const Rational& a2) const;
                Rational operator/(const Rational& a2) const;
                Rational operator*(const Rational& a2) const;

                Rational& operator+=(const Rational& a2);
                Rational& operator-=(const Rational& a2);
                Rational& operator/=(const Rational& a2);
                Rational& operator*=(const Rational& a2);

                Rational& operator ==

                Rational operator-() const;
                Rational operator+() const;
                Rational& operator++();
                Rational operator++(int); // post-increment

                Rational& operator--();
                Rational operator--(int);

                bool operator==(const Rational& a2) const { // class invariance
                        return num_ == a2.num_ && den_ == a2.den_;
                }

                bool operator!=(const Rational& a2) const;
                bool operator<(const Rational& a2) const;
                bool operator<=(const Rational& a2) const;
                bool operator>(const Rational& a2) const;
                bool operator>=(const Rational& a2) const;

                void print(std::ostream& os) const;
}; // class Ration

inline std::ostream& operator<<(std::ostream& os,const Rational& r) {
        r.print(os);
        return os;
}
```

Rational.cpp

```
#include "Rational.hh"
#include <numeric>
#include <cassert>

namespace Numeric {
        bool Rational::check_inv() const {
                if(num_ == 0)
                        return den_ == 1;
                if(den_ <= 0)
                        return false;
                if(std::gcd(num_,den_) != 1)
                        return false;
                // invariant here is satisfied
                return true;
        }

        void Rational::simplify() {
                assert(den_ > 0);
                Int gcd = std::gcd(num_, den_);
                if(gcd != 1) {
                        num_ /= gcd;
                        den_ /= gcd;
                }
        }

        Rational::Rational(const Int& num, const Int& den)
                : num_(num), den_(den) {
                assert(den != 0);

                if(num_ == 0) {
                        den_ = 1;
                        assert(check_inv());
                        return;
                }
                if(den_ < 0) {
                        num_ = -num_;
                        den_ = -den_;
                }
                Int gcd = std::gcd(num_,den_);
                if(gcd != 1) {
                        num_ /= gcd;
                        den_ /= gcd;
                }
                assert(check_inv());
        }
}
```