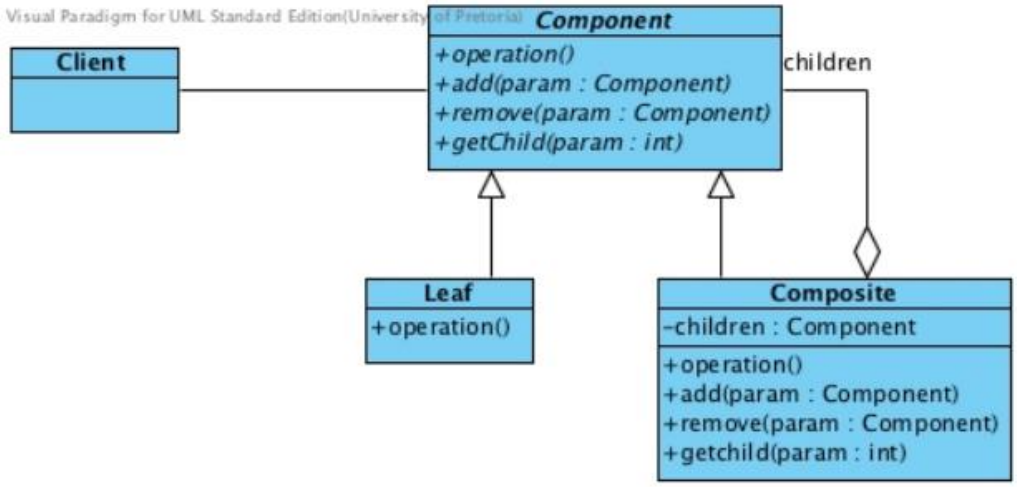
Composite

Name	Classification	Strategy
Composite	Structural	Delegation (Object)
Intent		
Compose objects into tree structures to represent part-whole hierarchies. Composite lets clients treat individual objects and compositions of objects uniformly. ([2]:163)		

11.3.2 Structure



11.3.4 Participants

Component

- provides the interface with which the client interacts.

Leaf

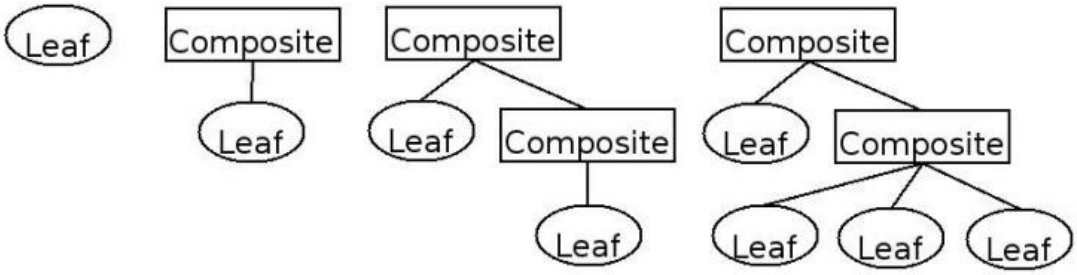
- do not have children, define the primitive objects of the composition.

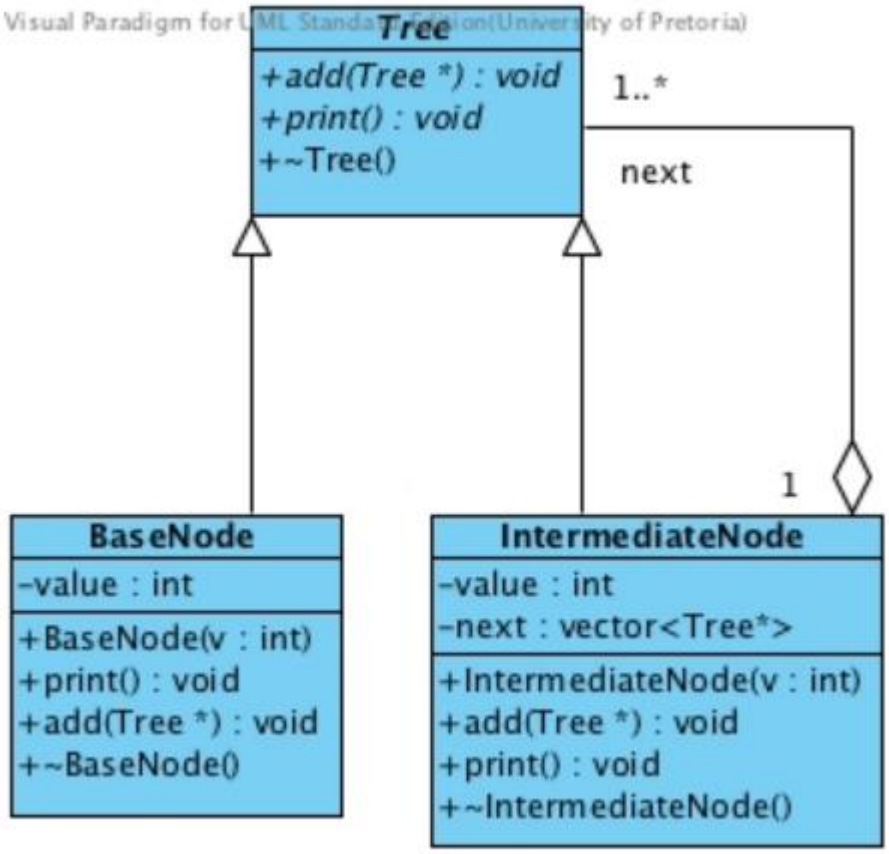
Composite

- contains children that are either composites or leaves.

Client

- manipulates the objects that comprise the composite.

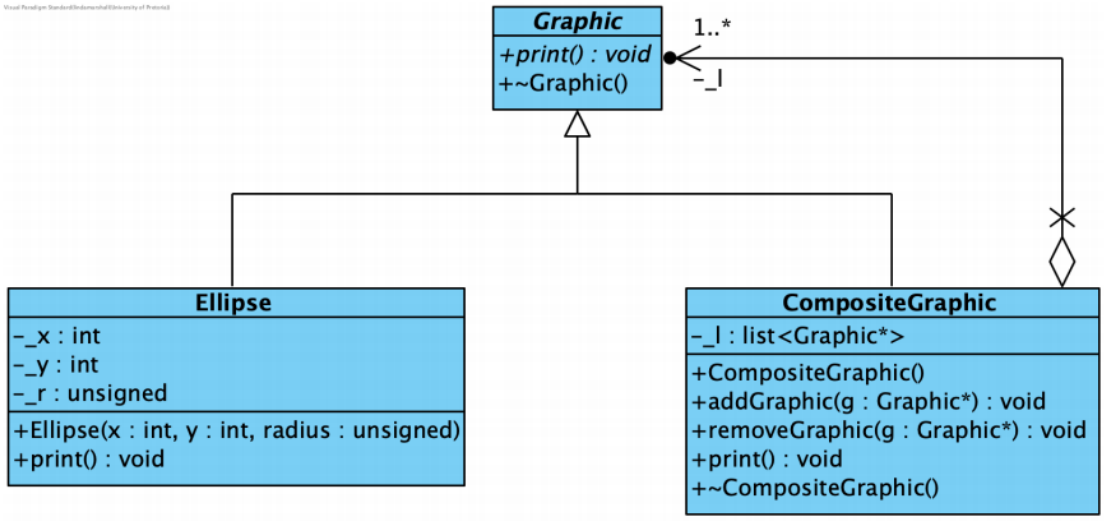

Leaf
Composite
Leaf
Composite
Leaf
Composite
Leaf
Composite
Leaf
Composite
Leaf
Leaf
Leaf


Visual Paradigm for UML Standard Edition(University of Pretoria)
Tree
+add(Tree *) : void
+print() : void
+~Tree()
1..*
next
1
BaseNode
-value : int
+BaseNode(v : int)
+print() : void
+add(Tree *) : void
+~BaseNode()
IntermediateNode
-value : int
-next : vector<Tree*>
+IntermediateNode(v : int)
+add(Tree *) : void
+print() : void
+~IntermediateNode()

Code:

```
#include <iostream>
#include <vector>

using namespace std;

class Tree { //component
public:
    virtual void add(Tree*) = 0;
    virtual void print() = 0;
    virtual ~Tree() {}; // Added
};

class BaseNode : public Tree { //leaf
public:
    BaseNode(int v) : value(v) {};
    virtual void print() {
        cout << " " << value << " ";
    };
    virtual void add(Tree*) {};
    virtual ~BaseNode() {}; // Added
private:
    int value;
};

class IntermediateNode : public Tree { //composite
public:
    IntermediateNode(int v) : value(v) {};
    virtual void add(Tree*);
    virtual void print();
    virtual ~IntermediateNode(); // Added
private:
    int value;
    vector<Tree*> next; //holds leaves and/or other composites
};

void IntermediateNode::add(Tree* t){
    next.push_back(t);
}

void IntermediateNode::print(){
    cout << "-" << value << "[";
    vector<Tree*>:: iterator it;

    for (it = next.begin(); it != next.end(); ++it)//calling print on each of
        (*it)->print();                            the elements in the vector
    cout << "]";
}
```

```
IntermediateNode::~IntermediateNode(){
  vector<Tree*>:: iterator it;

  for (it = next.begin(); it != next.end(); ++it)//self destructs all its
    delete *it;                                  children so it doesn't get done in
}                                                      main



int main(){

    Tree* t = new IntermediateNode(10);
    Tree* b = new BaseNode(5);
    t->add(new BaseNode(5)); // anonymous allocation
    Tree* l1 = new IntermediateNode(20);
    l1->add(new BaseNode(67)); // anonymous allocation
    l1->add(new BaseNode(20)); // anonymous allocation
    t->add(l1);
    t->print();
    cout<<endl;
    // deallcoate memory in reverse order of allocation
//   delete l1;  // Linked into the tree.
   delete b; // Not linked into Tree t and therefore needs to be deleted separ
ately
   delete t;
   // This does not delete the anonymous allocations -
> Deletion needs to be done by composite
   // Implication is that the composite must implement destructors and that th
e base class destructor
   //    MUST be virtual

    return 0;
}
```




```cpp
#include <iostream>
#include <list>


class Graphic { //component
public:
    /// Print out the Graphic
    virtual void print() = 0;

    // Will ensure well-behaved deletion if no anonymous objects.
    virtual ~Graphic(){
        std::cout << "Deleting" << std::endl;
    };
};

class CompositeGraphic: public Graphic { //composite
public:
    CompositeGraphic() : Graphic(), _l() {}

    /// Add a child
    void addGraphic(Graphic* g) {
        _l.push_back(g);
    }

    /// Remove a child
    void removeGraphic(Graphic* g);

    void print(){
        // for each child ...
        for (std::list<Graphic*>::iterator it =
                _l.begin();
                it != _l.end();
```

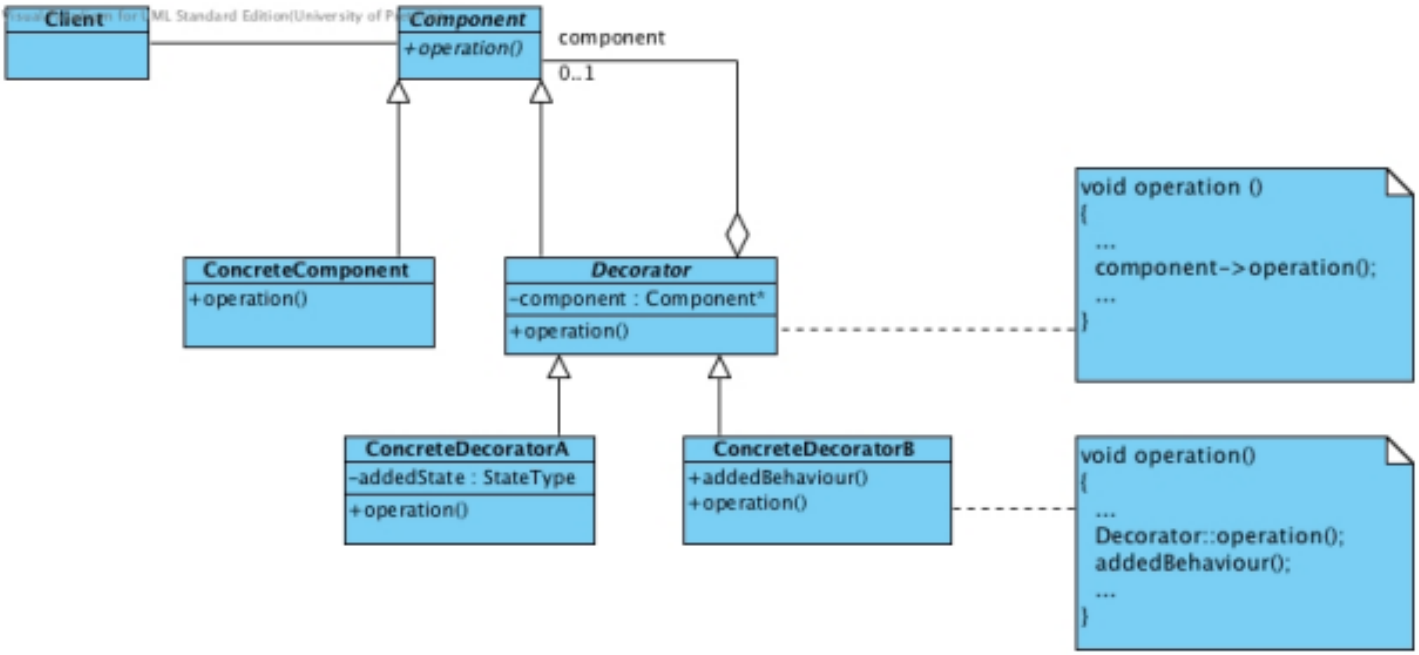
```
                ++it)
            (*it)->print(); // ... print it
    }

    // Added so that delete is called for all children. This will delete anony
mous objects as well.
    ~CompositeGraphic() {
        for (std::list<Graphic*>::iterator it =
             _l.begin();
             it != _l.end();
             ++it)
            delete *it;
    }

private:
    /// children
    std::list<Graphic*> _l;
};

class Ellipse: public Graphic {//leaf
public:
    /// Build an ellipse with the specified
    // coordinates and radius
    Ellipse(int x, int y, unsigned radius)
    : Graphic(), _x(x), _y(y), _r(radius) {}

    virtual void print() {
        std::cout << "Ellipse("
        << _x << ", "
        << _y << ", "
        << _r << ")"
        << std::endl;
    }

private:
    int _x;
    int _y;
    unsigned _r;
};

int main(){
  Ellipse* e1 = new Ellipse(42, 51, 69);
  Ellipse* e2 = new Ellipse(16, 64, 86);
  Ellipse* e3 = new Ellipse(1, 33, 7);
  CompositeGraphic* g1 = new CompositeGraphic();
  CompositeGraphic g2;
  g1->addGraphic(e1);
  g1->addGraphic(e2);
```

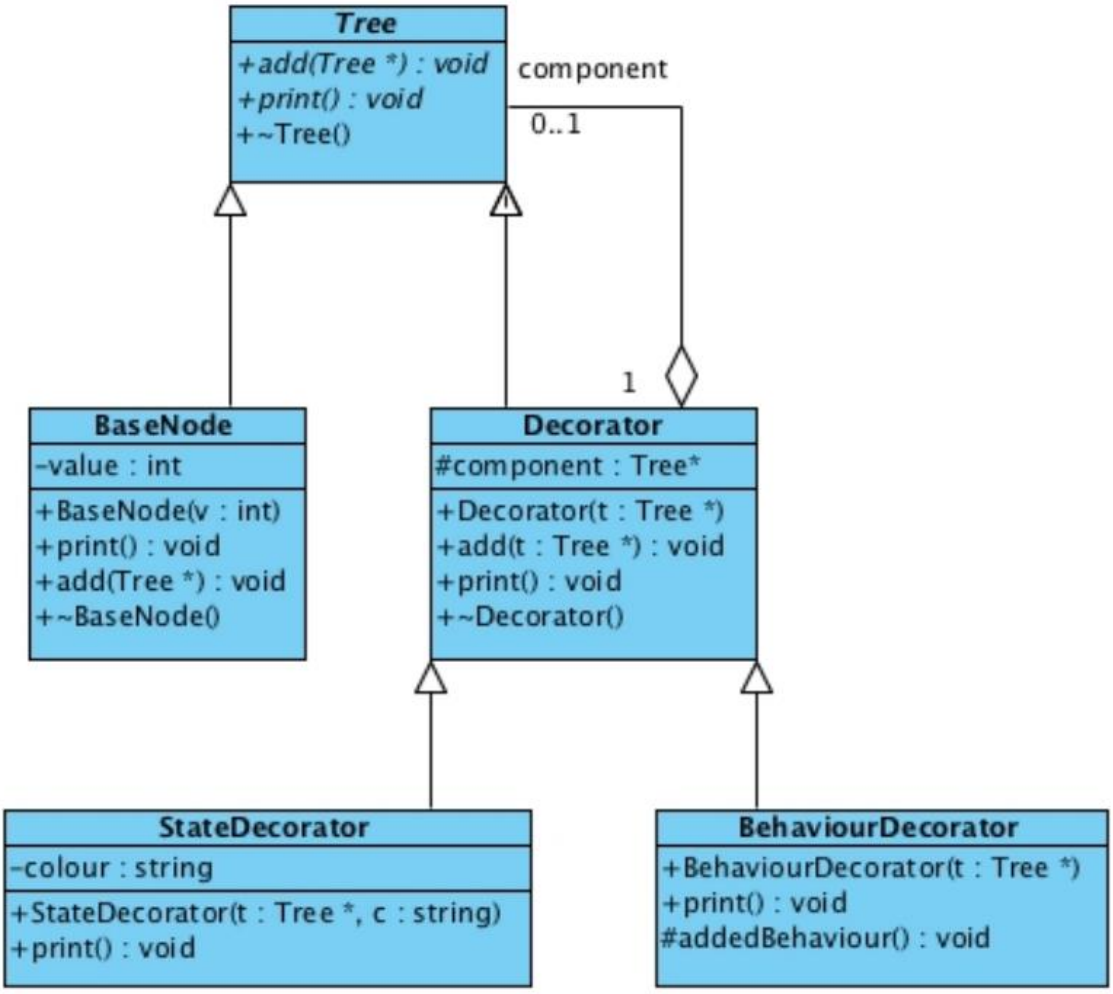
```
  g2.addGraphic(e3);
  g2.addGraphic(g1);
  std::cout<<"g1 = "<<std::endl;
  g1->print();
  std::cout<<"g2 = "<<std::endl;
  g2.print();
  /*
    g2 is on the stack and therefore not necessary to explicitely call delete
for the structure.
   */
  return 0;
}


/*

 g2
 |-1-> e3
 |-2-> g1
       |-2.1-> e1
       |-2.2-> e2

 */
```

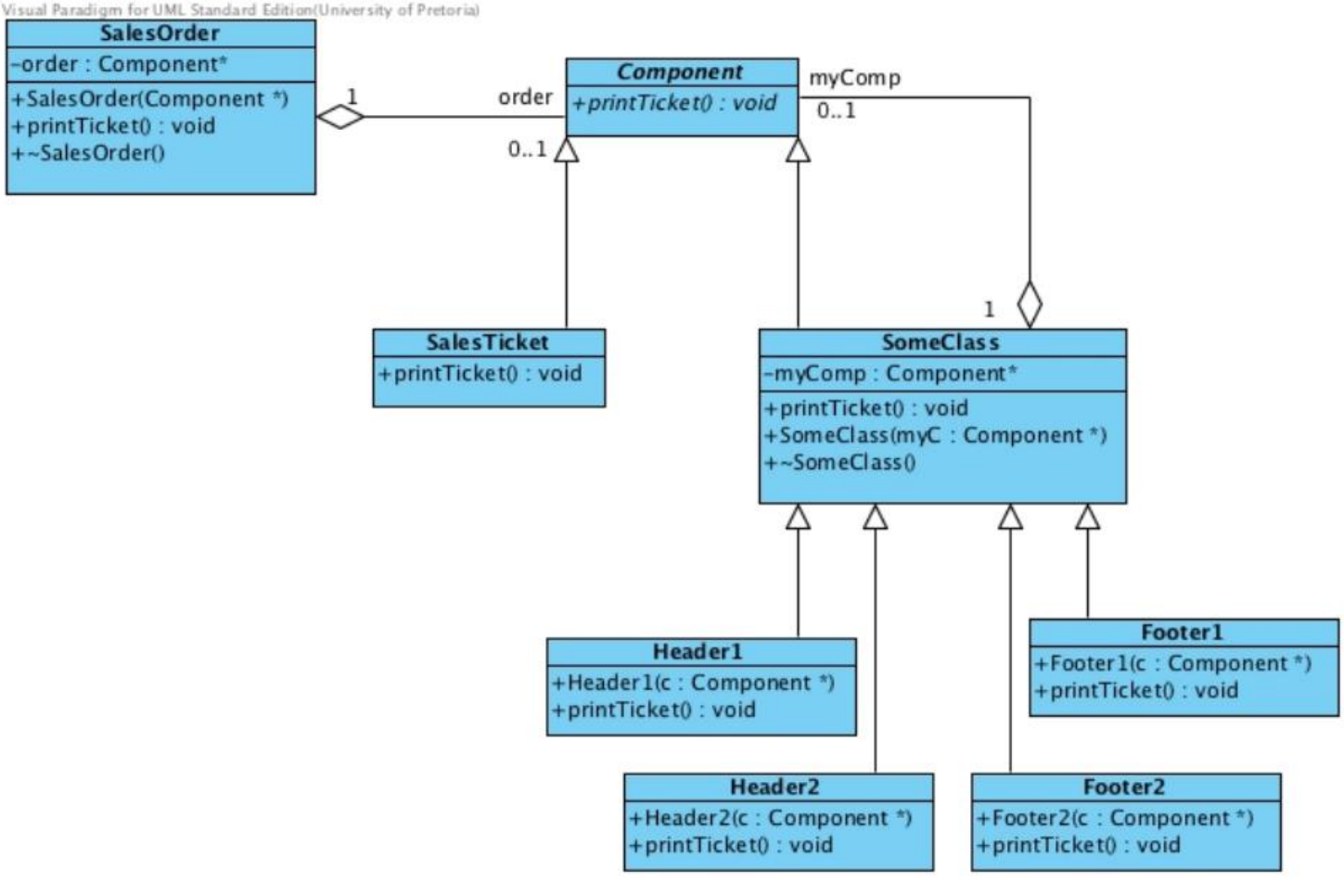
Decorator

Name	Classification	Strategy
Decorator	Structural	Delegation (Object)
Intent		
Attach additional responsibilities to an object dynamically. Decorators provide a flexible alternative to subclassing for extending functionality. ([1]:175)		

12.2.2 Structure



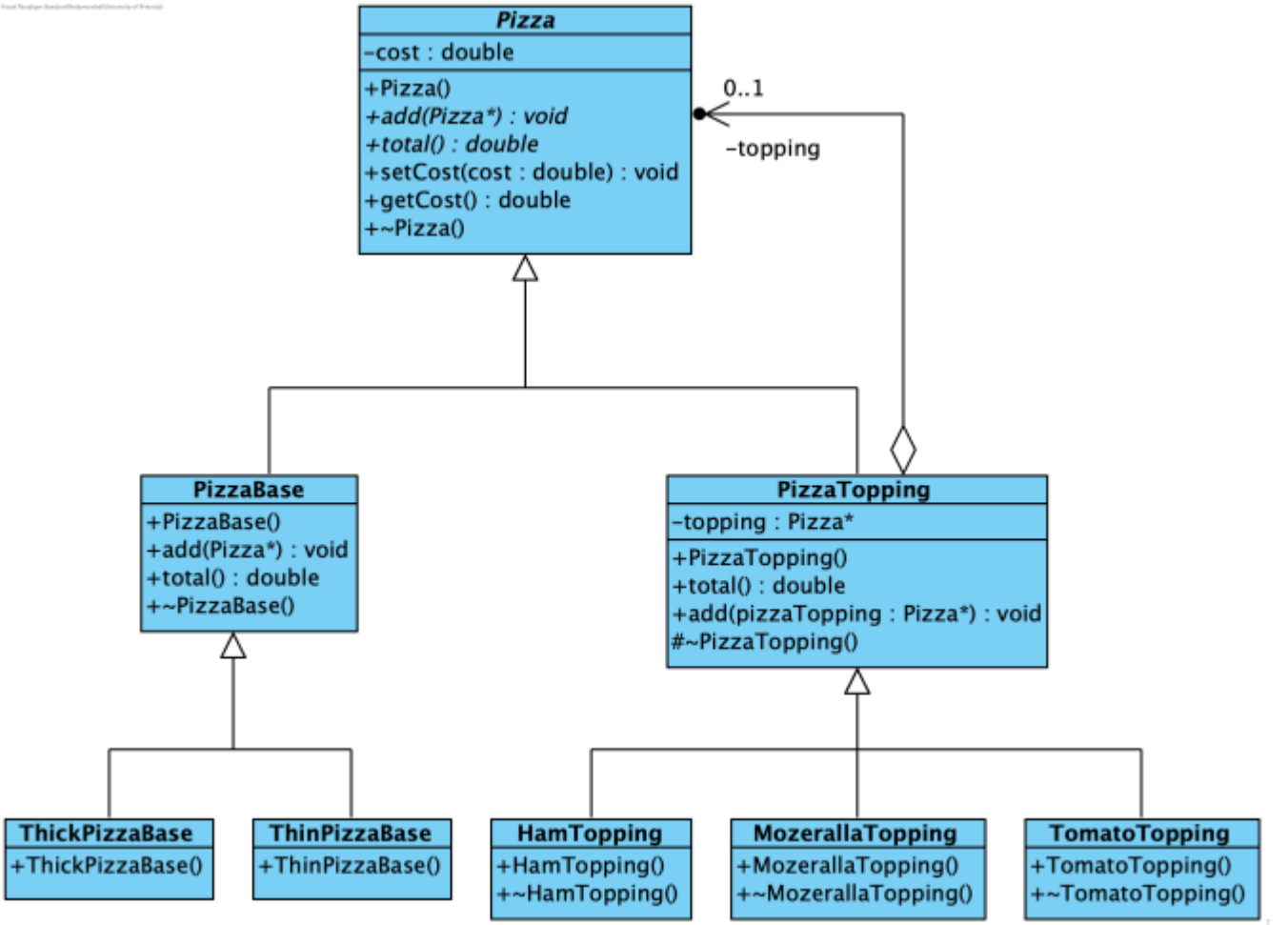




```cpp
#include <iostream>

using namespace std;

class Component {
  public:
    virtual void printTicket() = 0;
  virtual ~Component() {};
};

class SalesTicket: public Component {//concrete component
  public:
    void printTicket();
  virtual ~SalesTicket() {};
};

void SalesTicket::printTicket() {
  cout<<"List of items purchased"<<endl;
}

class SomeClass: public Component {//decorator
  public:
    virtual void printTicket();
    SomeClass(Component* myC);
    // Need to add a destructor - MUST be virtual
    virtual ~SomeClass();
  private:
    Component *myComp;
};



SomeClass::SomeClass(Component* myC) {
  myComp = myC;
}

void SomeClass::printTicket() {
  if (myComp)
    myComp->printTicket();
}

SomeClass::~SomeClass(){
  delete myComp;
}

class Header1: public SomeClass {//concrete decorator
  public:
    Header1(Component* c);
    void printTicket();
```

```
};

Header1::Header1(Component* c) : SomeClass(c) { }

void Header1::printTicket() {
  cout<<"Welcome to the Crazy Zone"<<endl;
  SomeClass::printTicket();
}


class Header2: public SomeClass {//concrete decorator
  public:
    Header2(Component* c);
    void printTicket();
};

Header2::Header2(Component* c) : SomeClass(c) { }

void Header2::printTicket()
{
  cout<<"Shopping at the Crazy Zone"<<endl;
  SomeClass::printTicket();
}


class Footer1: public SomeClass {//concrete decorator
  public:
    Footer1(Component* c);
    void printTicket();
};

Footer1::Footer1(Component* c) : SomeClass(c) { }

void Footer1::printTicket() {
  SomeClass::printTicket();
  cout << "It was a pleasure doing" <<
          " business with you"<<endl;
}

class Footer2: public SomeClass {//concrete decorator
  public:
    Footer2(Component* c);
    void printTicket();
};

Footer2::Footer2(Component* c) : SomeClass(c) { }

void Footer2::printTicket() {
  SomeClass::printTicket();
```

```
  cout << "Enjoy your day"<<endl;
}

class SalesOrder {
  public:
    SalesOrder(Component*);
    void printTicket();
    ~SalesOrder();
  private:
    Component* order;
};




SalesOrder::SalesOrder(Component* c) : order(c) {}

void SalesOrder::printTicket() {
  order->printTicket();
}

SalesOrder::~SalesOrder(){
    delete order;
}

int main() {

    SalesOrder* s = new SalesOrder(new Footer1(
                            new Header1(
                            new SalesTicket)));
      // Note: SalesTicket is being decorated.

    s->printTicket();

    // Destruct all relevant objects
    delete s;

  return 0;
}

/*
 Example of output:

 Welcome to the Crazy Zone
 List of items purchased
 It was a pleasure doing business with you

 */
//
```


Pizza
-cost : double
+Pizza()
+add(Pizza*) : void
+total() : double
+setCost(cost : double) : void
+getCost() : double
+~Pizza()
0..1
-topping
PizzaBase
+PizzaBase()
+add(Pizza*) : void
+total() : double
+~PizzaBase()
PizzaTopping
-topping : Pizza*
+PizzaTopping()
+total() : double
+add(pizzaTopping : Pizza*) : void
#~PizzaTopping()
ThickPizzaBase
+ThickPizzaBase()
ThinPizzaBase
+ThinPizzaBase()
HamTopping
+HamTopping()
+~HamTopping()
MozerallaTopping
+MozerallaTopping()
+~MozerallaTopping()
TomatoTopping
+TomatoTopping()
+~TomatoTopping()

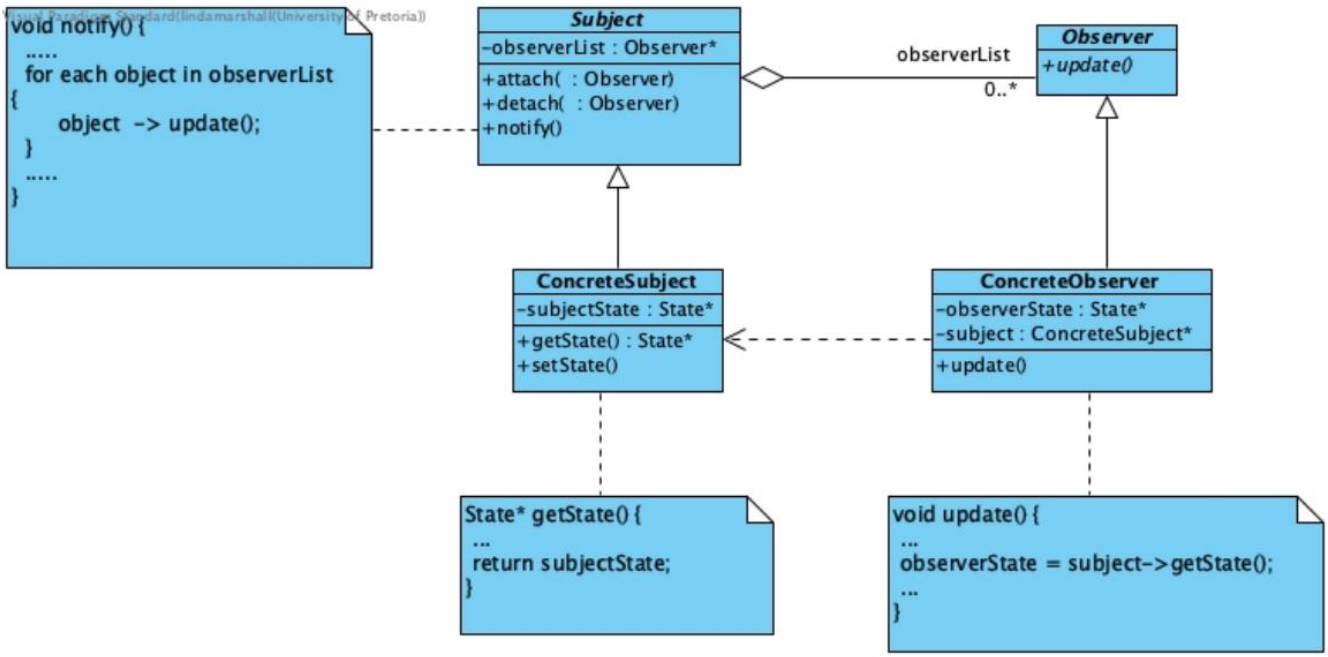
```cpp
//  Pizza.cpp
//
//
//  Created by Linda Marshall on 2017/08/20.
//
//
#include <iostream>

using namespace std;

class Pizza { //component
public:
    Pizza() {
        cost = 0.0;
    };
    virtual void add(Pizza*) = 0;
    virtual double total() = 0;
    void setCost(double cost) {
        this->cost = cost;
    };
    double getCost() {
        return cost;
    };
    virtual ~Pizza() {} ;
private:
    double cost;
};

class PizzaBase : public Pizza {//concrete component
public:
    PizzaBase() {};
    virtual void add(Pizza*) {};
    virtual double total() {
        return getCost();
    };
    ~PizzaBase() {};
};

class ThinPizzaBase : public PizzaBase {//concrete component
public:
    ThinPizzaBase() {
```

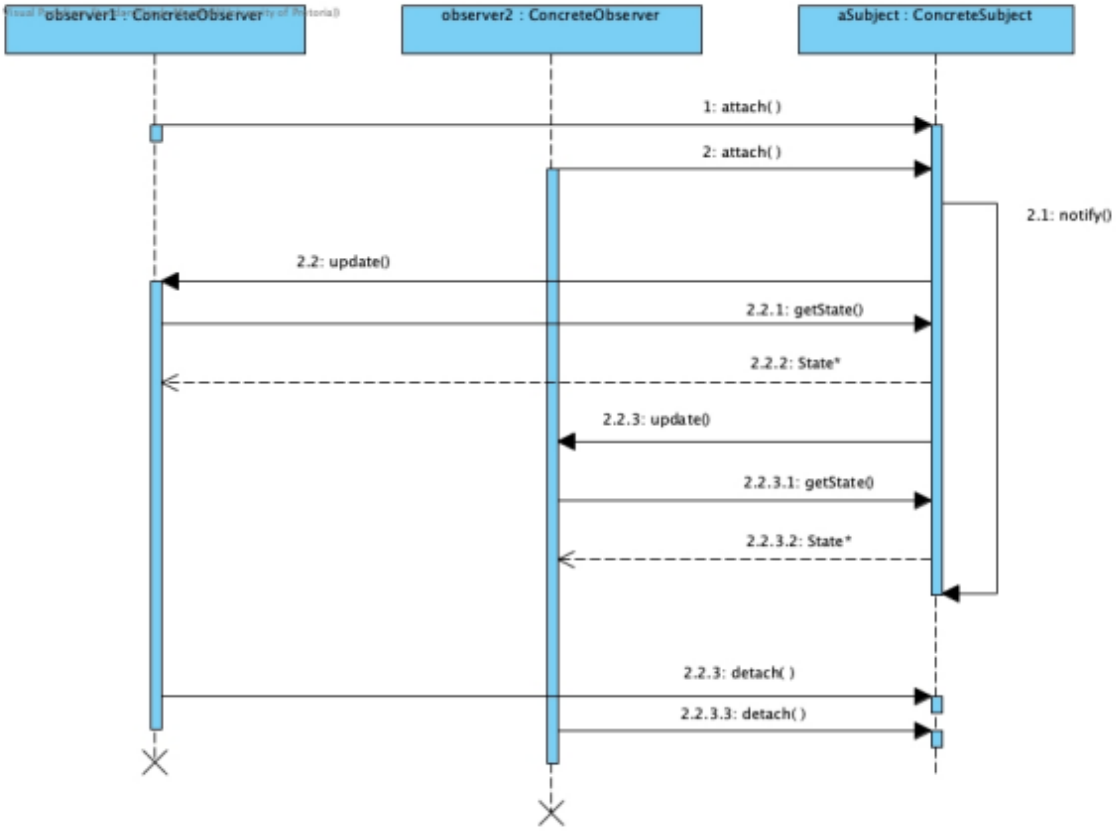
```
        cout << "Creating a thin base" << endl;
        setCost(15.00);
    };

};

class ThickPizzaBase : public PizzaBase {//concrete component
public:
    ThickPizzaBase() {
        cout << "Creating a thick base" << endl;
        setCost(25.00);
    };
};

class PizzaTopping : public Pizza {//decorator
public:
    PizzaTopping() {
        topping = 0;
    };
    virtual double total() {
        // cout << "In PizzaTopping total" << endl;
        if (topping == 0) {
            return getCost();
        } else {
          return getCost() + topping->total();
        }
    };
    virtual void add(Pizza* pizzaTopping) {
        cout << "In PizzaTopping add" << endl;
        if (topping == 0){
            topping = pizzaTopping;
        } else {
            topping->add(pizzaTopping);
        }

    };
protected:
    ~PizzaTopping() {delete topping; };
private:
    Pizza* topping;
};

class TomatoTopping : public PizzaTopping {
public:
    TomatoTopping() : PizzaTopping() {
        cout << "Creating tomato topping" << endl;
        setCost(5.00);
    };
```

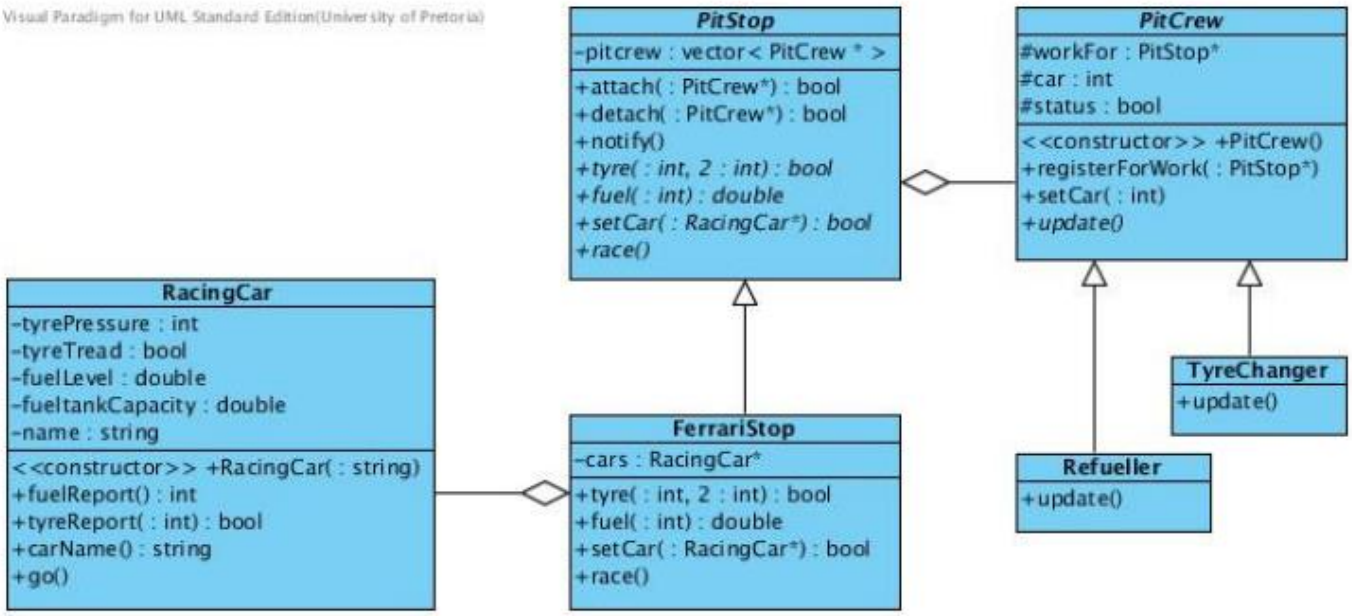
```
    ~TomatoTopping() {};
};

class MozerallaTopping : public PizzaTopping {
public:
    MozerallaTopping() : PizzaTopping() {
        cout << "Creating Mozeralla topping" << endl;
        setCost(10.00);
    };
    ~MozerallaTopping() {};
};

class HamTopping : public PizzaTopping {
public:
    HamTopping() : PizzaTopping() {
        cout << "Creating ham topping" << endl;
        setCost(15.00);
    };
    ~HamTopping() {};
};


int main() {
    Pizza* myPizza;
    myPizza = new TomatoTopping();
    myPizza->add(new MozerallaTopping());
    myPizza->add(new HamTopping());
    myPizza->add(new HamTopping());
    myPizza->add(new ThickPizzaBase());
    cout << "Cost = " << myPizza->total() << endl;


    delete myPizza;

    return 0;
}

/* Program output:

 Creating tomato topping
 Creating Mozeralla topping
 In PizzaTopping add
 Creating ham topping
 In PizzaTopping add
 In PizzaTopping add
 Creating ham topping
 In PizzaTopping add
 In PizzaTopping add
 In PizzaTopping add
```

```
Creating a thick base
In PizzaTopping add
In PizzaTopping add
In PizzaTopping add
In PizzaTopping add
Cost = 70

*/
```

Observer


void notify() {
.....
for each object in observerList
{
object -> update();
}
.....
}
Subject
-observerList : Observer*
+attach(: Observer)
+detach(: Observer)
+notify()
observerList
0..*
Observer
+update()
ConcreteSubject
-subjectState : State*
+getState() : State*
+setState()
ConcreteObserver
-observerState : State*
-subject : ConcreteSubject*
+update()
State* getState() {
...
return subjectState;
}
void update() {
...
observerState = subject->getState();
...
}


observer1 : ConcreteObserver
observer2 : ConcreteObserver
aSubject : ConcreteSubject
1: attach( )
2: attach( )
2.1: notify()
2.2: update()
2.2.1: getState()
2.2.2: State*
2.2.3: update()
2.2.3.1: getState()
2.2.3.2: State*
2.2.3: detach( )
2.2.3.3: detach( )


Visual Paradigm for UML Standard Edition(University of Pretoria)
PitStop
-pitcrew : vector< PitCrew * >
+attach(: PitCrew*) : bool
+detach(: PitCrew*) : bool
+notify()
+tyre(: int, 2 : int) : bool
+fuel(: int) : double
+setCar(: RacingCar*) : bool
+race()
PitCrew
#workFor : PitStop*
#car : int
#status : bool
<<constructor>> +PitCrew()
+registerForWork(: PitStop*)
+setCar(: int)
+update()
RacingCar
-tyrePressure : int
-tyreTread : bool
-fuelLevel : double
-fueltankCapacity : double
-name : string
<<constructor>> +RacingCar(: string)
+fuelReport() : int
+tyreReport(: int) : bool
+carName() : string
+go()
FerrariStop
-cars : RacingCar*
+tyre(: int, 2 : int) : bool
+fuel(: int) : double
+setCar(: RacingCar*) : bool
+race()
TyreChanger
+update()
Refueller
+update()

.

Examples:

```cpp
#include <iostream>
#include <string>
#include <vector>

using namespace std;

class RacingCar {
  public:
    RacingCar(string);
    int fuelReport();
    bool tyreReport(int);
    string carName();
    void go();
  private:
    int   tyrePressure[4];
    bool   tyreTread[4];
    double fuelLevel;
    double fueltankCapacity;
    string name;
};


class PitCrew;

class PitStop { // Subject
  public:
    bool attach(PitCrew*);   // register
    bool detach(PitCrew*);   // deregister
    void notify();
    virtual bool tyre(int,int) = 0;
    virtual double fuel(int) = 0;
    virtual bool setCar(RacingCar*) = 0;
    virtual void race() = 0;
  private:
    vector<PitCrew*> pitcrew;
};

// An observer
class PitCrew {
  public:
    PitCrew() : car(1), workFor(0), status(0) {};
    void registerForWork(PitStop*);
    void setCar(int);
    virtual void update() = 0;
    // need to refuel and change tyres
  protected:
    PitStop* workFor;
    int car;
    bool status;
```

```
};


bool PitStop::attach(PitCrew* person) {
  pitcrew.push_back(person);
  person->registerForWork(this);
  return true;
};

bool PitStop::detach(PitCrew* person) {
  bool found = false;

  vector<PitCrew*>::iterator it = pitcrew.begin();
  while ((it != pitcrew.end()) && (! found)) {
    if (*it == person) {
      found = true;
      pitcrew.erase(it);
    }
    ++it;
  }
  return found;
}


void PitStop::notify(){
  vector<PitCrew*>::iterator it = pitcrew.begin();
  for (it = pitcrew.begin(); it != pitcrew.end(); ++it){
    (*it)->update();
  }
}


// Helper function
void printWorkshopStatus(PitStop* p) {
  cout << "Fuel for car 1 = " << p->fuel(1) << endl;
  for (int i = 1; i <= 4; i++) {
    cout << "Tyre for car 1, tyre " << i << " = " << p->tyre(1,i) << endl;
  }

  cout << "Fuel for car 2 = " << p->fuel(2) << endl;
  for (int i = 1; i <= 4; i++) {
    cout << "Tyre for car 2, tyre " << i << " = " << p->tyre(2,i) << endl;
  }
}

class FerrariStop : public PitStop { // concrete subject
  public:
    bool tyre(int,int);
    double fuel(int);
```

```
    bool setCar(RacingCar*);
    void race();
  private:
    RacingCar* cars[2];
};



bool FerrariStop::tyre(int car, int tyre) { // Need some error checking here
  return cars[car-1]->tyreReport(tyre-1);
}

double FerrariStop::fuel(int car) { // Need some error checking here
  return cars[car-1]->fuelReport();
}

bool FerrariStop::setCar(RacingCar* car) {
  static int carId = 0;
  if (carId < 2) {
    cars[carId] = car;
    carId++;
    return true;
  }
  return false;
}

void FerrariStop::race() {
  int input;
  cout << "Type in a number [0 stops]:";
  cin >> input;
  while (input != 0) {
    if ((input % 2) == 0) {
      cars[0]->go();
    } else {
      cars[1]->go();
    }
    printWorkshopStatus(this);
    notify();
    cout << "Type in a number [0 stops]";
    cin >> input;
  }
}

void PitCrew::registerForWork(PitStop* employer) {
  workFor = employer;
}

void PitCrew::setCar(int c) {
  car = c;
```

```
}

// Concrete observer1
class TyreChanger : public PitCrew {
  public:
    virtual void update();
};

void TyreChanger::update() {
  cout << "Tyre changer for car " << car << " status is " << status << endl;
  if (status == 0) {
    cout << "Check tyre status" << endl;
    bool tyreStatus = false;
    for (int i = 1; i <= 4; i++)
      tyreStatus = tyreStatus && workFor->tyre(car,i);
    if (tyreStatus) {
      status = 1;
      cout << "Need to change all tyres" << endl;
    }
  } else
    status = 0;
}

// Concrete observer2
class Refueller : public PitCrew {
  public:
    virtual void update();
};

void Refueller::update() {
  cout << "Refeuller for car " << car << " status is " << status << endl;
  if (status == 0) {
    cout << "Check fuel status" << endl;
    double fuelStatus = workFor->fuel(car);
    cout << "  fuel status is: " << fuelStatus << endl;
    if (fuelStatus < 20) {
      status = 1;
      cout << "Need to add fuel" << endl;
    }
  } else
    status = 0;
}




RacingCar::RacingCar(string n) : name(n) {
  for (int i = 0; i < 4; i++) {
    tyrePressure[i] = 4;
```

```
    tyreTread[i] = true;
  }
  fueltankCapacity = 100;
  fuelLevel = 100;
}

int RacingCar::fuelReport() {
  return fuelLevel / fueltankCapacity * 100;
}

bool RacingCar::tyreReport(int tyre) {
  return tyrePressure[tyre] && tyreTread[tyre];
}

string RacingCar::carName() {
  return name;
}

void RacingCar::go() {
  int input;
  cout << "Type in any value: " << endl;
  cin >> input;
  if ((input % 2) == 0) {
    // Do the tyres
    if ((input % 3) == 0) {
      tyreTread[input%4] = false;
    } else {
      tyrePressure[input%4] = false;
    }
  } else {
    // Do the fuel
    fuelLevel -= 5;
  }

}




int main() {

  RacingCar* car[2];
  car[0] = new RacingCar("Ferrari One");
  car[1] = new RacingCar("Ferrari Two");

  PitStop* ferrariWorkshop = new FerrariStop();
//  FerrariStop* ferrariWorkshop = new FerrariStop();

  ferrariWorkshop->setCar(car[0]);
```

```
  ferrariWorkshop->setCar(car[1]);

  printWorkshopStatus(ferrariWorkshop);

/*
  for (int i = 0; i < 10; i++) {
    car[0]->go();

    printWorkshopStatus(ferrariWorkshop);
  }
*/

  PitCrew* refueller = new Refueller();
  refueller->setCar(2);
  ferrariWorkshop->attach(refueller);

  PitCrew* tyreMech = new TyreChanger();
  ferrariWorkshop->attach(tyreMech);


  ferrariWorkshop->race();

  return 0;
}
```

Prison example:

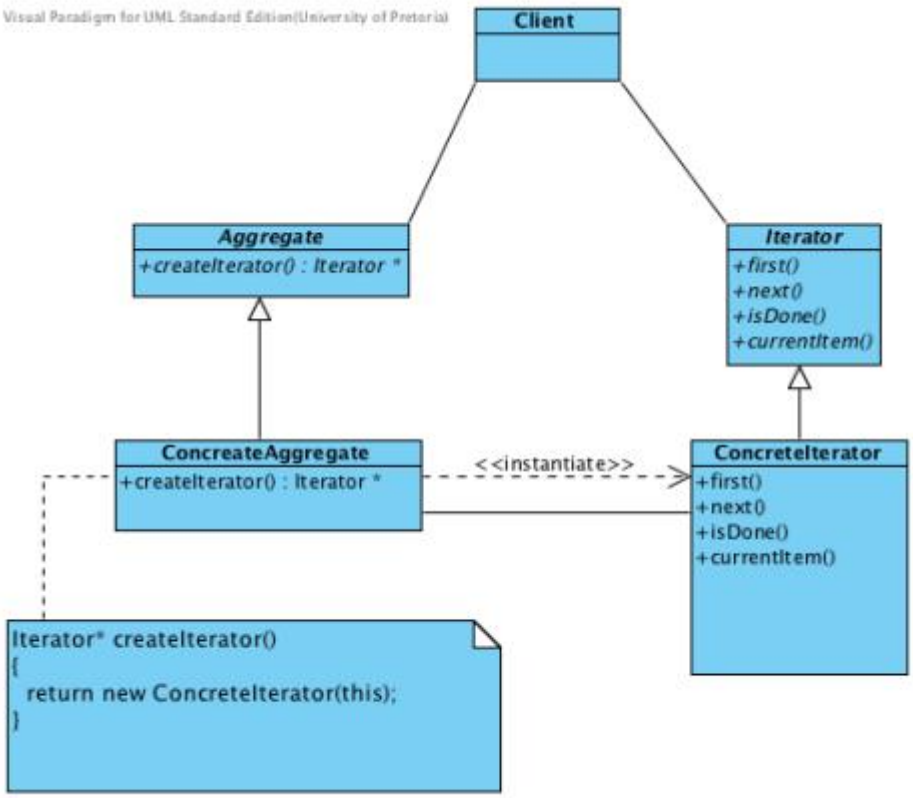
```
class Subject
{

    public:

        Subject(char value, int x, int y);
        Subject();
        ~Subject();
        bool attach(Observer* o);
        void notify();
    private:
        vector <Observer*> mObservers;
        char mValue;
        int mX;
        int mY;

};
```

```
bool Subject::attach(Observer* o)
{
    mObservers.push_back(o); //adding the observer to vector of mObservers


    return true;
}

void Subject::notify()
{
    vector<Observer*>::iterator it = mObservers.begin();
    for(it = mObservers.begin(); it != mObservers.end(); ++it)
    {
        (*it)->update();
    }

}
```

```
class BorderGuard : public Observer , public Human
{

    public:

        BorderGuard(int xCoords, int yCoords, Prisoner *p);
        virtual ~BorderGuard();
        void update();
    private:
        Prisoner* mprisoner;

};

#endif
```

Iterator:

Name	Classification	Strategy
Iterator	Behavioural	Delegation
Intent		
Provide a way to access the elements of an aggregate object sequentially without exposing its underlaying representation ([3]:257)		



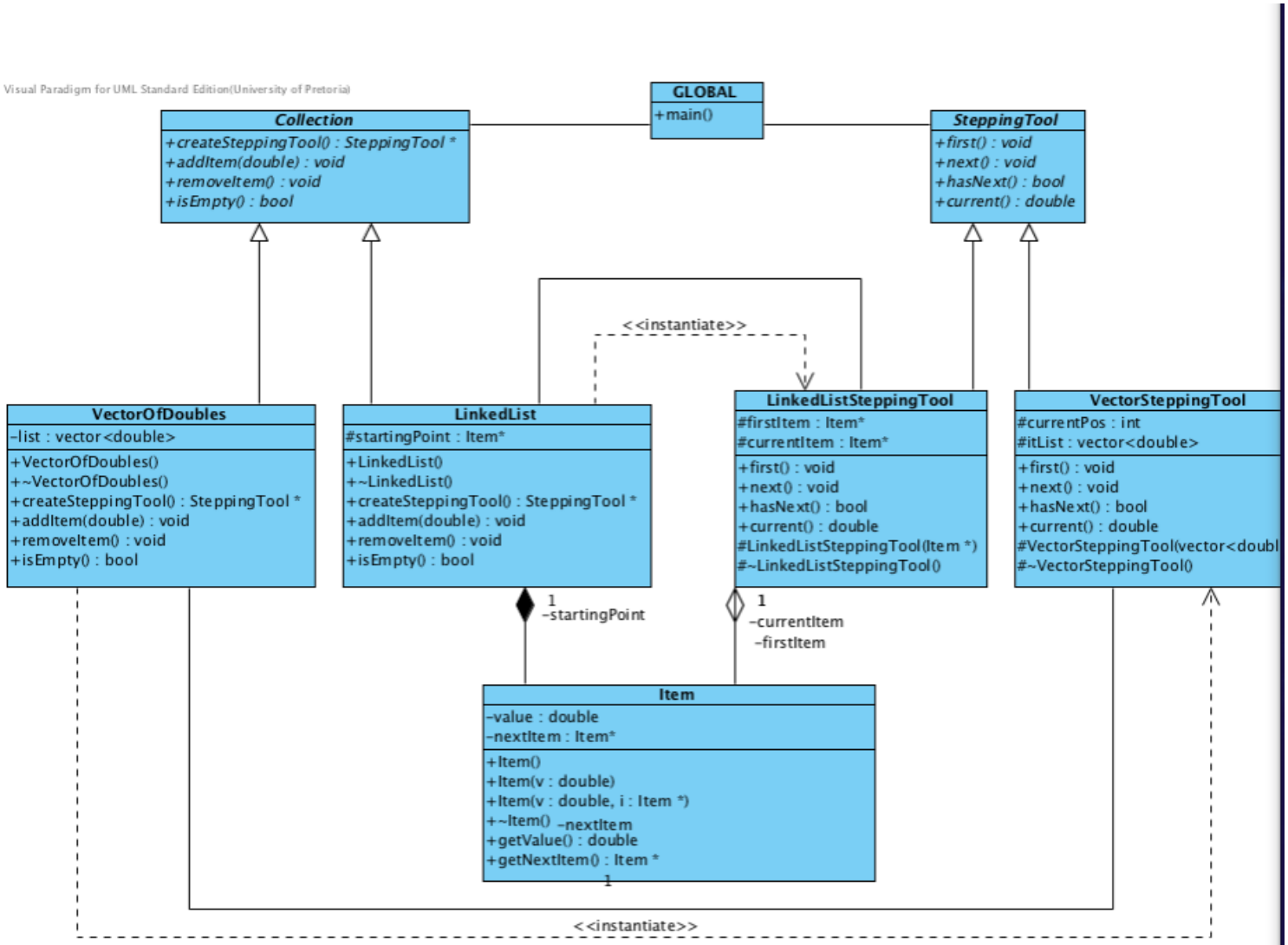


Figure 2: Class Diagram of a system illustrating the implementation of the iterator design pattern

Participant	Entity in application
Iterator	SteppingTool
Concrete Iterators	VectorSteppingTool, LinkedListSteppingTool
Aggregate	Collection
Concrete Aggregates	VectorOfDoubles, LinkedList
createIterator() :Iterator*	createSteppingTool():SteppingTool*
first(), next(), isDone(), currentItem()	first(), next(), hasNext():bool, current():double
Client	main()

Iterator

Example:

```
#ifndef _QUEUE_H
#define _QUEUE_H

    #include "Node.h"
    #include "QueueIterator.h"

    template <typename T>
    class Queue{
        friend class QueueIterator<T>;
        public:
            Queue();
            void enqueue(T e);
            T dequeue();
            bool isEmpty();
            QueueIterator<T> begin();
            QueueIterator<T> end();
        private:
            Node<T>* head;
    };

    #include "Queue.cpp"

#endif
```

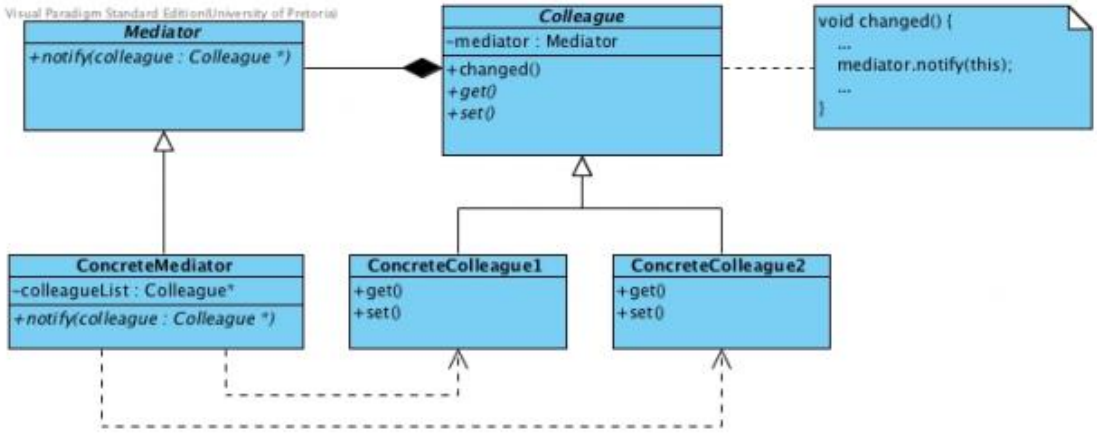
```cpp
#ifndef _QUEUEITERATOR_C
#define _QUEUEITERATOR_C

  #include <iostream>
  using namespace std;
  #include "QueueIterator.h"
  #include "Queue.h"
  #include "Node.h"

  template <typename T>
  QueueIterator<T>::QueueIterator() : head(0), current(0) {}

  template <typename T>
  QueueIterator<T>::QueueIterator(const Queue<T>& source, Node<T>* p) : head(source.head), current(p){}

  template <typename T>
  T& QueueIterator<T>::operator*(){
      return current->element;
  }

  template<typename T>
  QueueIterator<T> QueueIterator<T>::operator++(){
      if (this != nullptr)
          this->current = this->current->next;
      return *this;
  }

  template <typename T>
  bool QueueIterator<T>::operator==(const QueueIterator<T>& rhs) const{
      return current == rhs.current;
  }

#endif
```

```
#ifndef _QUEUEITERATOR_H
#define _QUEUEITERATOR_H

//  #include "Node.h"
//  #include "Queue.h"
  template <typename T>
  class Queue;

  template <typename T>
  class Node;

  template <typename T>
  class QueueIterator {
    friend class Queue<T>;
    public:
      QueueIterator();
      T& operator*();
      QueueIterator<T> operator++();
      bool operator==(const QueueIterator<T>&) const;
    protected:
      QueueIterator(const Queue<T>&, Node<T>*);
      Node<T>* head;
      Node<T>* current;
  };

  #include "QueueIterator.cpp"

#endif
```

```cpp
#ifndef _QUEUEITERATOR_C
#define _QUEUEITERATOR_C

#include <iostream>
using namespace std;
#include "QueueIterator.h"
#include "Queue.h"
#include "Node.h"

template <typename T>
QueueIterator<T>::QueueIterator() : head(0), current(0) {}

template <typename T>
QueueIterator<T>::QueueIterator(const Queue<T>& source, Node<T>* p) : head(source.head), current(p){}

template <typename T>
T& QueueIterator<T>::operator*(){
    return current->element;
}

template<typename T>
QueueIterator<T> QueueIterator<T>::operator++(){
    if (this != nullptr)
        this->current = this->current->next;
    return *this;
}

template <typename T>
bool QueueIterator<T>::operator==(const QueueIterator<T>& rhs) const{
    return current == rhs.current;
}

#endif
```

Mediator:

Name	Classification	Strategy
Mediator	Behavioural	Delegation
Intent		
Define an object that encapsulates how a set of objects interact. Mediator promotes loose coupling by keeping objects from referring to each other explicitly, and it lets you vary their interaction independently. ([1]:273)		



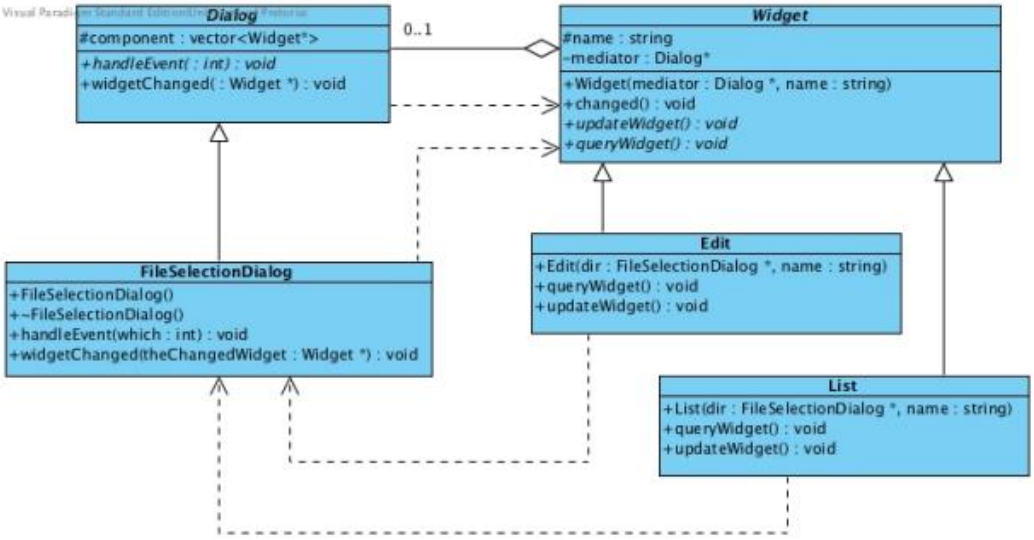


Figure 2: Class Diagram of a partial implementation of a file selection dialog

to be able to observe how the pattern operates. This example was adapted from [2]. The following table summarises how the implementation relates to the participants of this pattern:

Participant	**Entity in application**
Mediator	Dialog
Concrete Mediator	FileSelectionDialog
Colleague	Widget
Concrete Colleague	List, Edit
changed()	changed()
notify()	widgetChanged(: Widget)
get()	queryWidget()
set()	updateWidget()

Examples

```
#ifndef CHATTER_H
#define CHATTER_H

#include <string>


using namespace std;

class Chatroom;

class Chatter { // Colleague
  public:
    Chatter();
    virtual void receiveMessage(string) = 0;
    virtual void sendMessage() = 0;
    void reg(Chatroom*);
    void leave();
    virtual ~Chatter();
  protected:
    Chatroom* chatroom;
    int       myId;
};


class Student : public Chatter {
  public:
    Student();
    virtual void receiveMessage(string);
    virtual void sendMessage();
};


class Lecturer : public Chatter {
  public:
    Lecturer();
    virtual void receiveMessage(string);
    virtual void sendMessage();
};

#endif
```

```cpp
#include <iostream>
//#include <vector>
#include <sstream>

#include "Chatter.h"
#include "Chatroom.h"


Chatter::Chatter() {
  chatroom = 0;
  myId=-1;
}

void Chatter::reg(Chatroom* cr){
  chatroom = cr;
  myId = chatroom->registerMe(this);
}

void Chatter::leave(){
  chatroom->leave(myId);
}

Chatter::~Chatter() {
    //delete chatroom;
    chatroom = 0;
    myId = -1;
}

Student::Student() : Chatter() {
  cout<<"Creating Student"<<endl;
}

void Student::receiveMessage(string msg){
  cout<<myId<<" received msg from "<<msg<<endl;
}

void Student::sendMessage(){
  string toId;
  string msg;
  cout<<"Student "<<myId<<" send message to? ";
  getline(cin,toId,'\n');

  cout<<"Student "<<myId<<" message? ";
  getline(cin,msg,'\n');

  ostringstream convert;
  convert << myId;
  chatroom->talkTo(atoi(toId.c_str()),convert.str()+": "+msg);
}
```

```
void Student::sendMessage(){
  string toId;
  string msg;
  cout<<"Student "<<myId<<" send message to? ";
  getline(cin,toId,'\n');

  cout<<"Student "<<myId<<" message? ";
  getline(cin,msg,'\n');

  ostringstream convert;
  convert << myId;
  chatroom->talkTo(atoi(toId.c_str()),convert.str()+": "+msg);
}


Lecturer::Lecturer() : Chatter() {
  cout<<"Creating Lecturer"<<endl;
}

void Lecturer::receiveMessage(string msg){
  cout<<myId<<" received msg from "<<msg<<endl;
}

void Lecturer::sendMessage(){
  string msg;
  cout<<"Lecturer "<<myId<<" message? ";
  getline(cin,msg,'\n');

  chatroom->broadcast(msg);
}
```

```
#ifndef CHATROOM_H
#define CHATROOM_H

#include <string>
#include <vector>

#include "Chatter.h"

using namespace std;

class Participant {
  public:
    int       id;
    Chatter*  chatter;
};

class Chatroom {  // Mediator
  public:
    Chatroom();
    int registerMe(Chatter*); // register yourself and receive your id
    void broadcast(string);
    bool talkTo(int,string);
    void leave(int);
//    virtual ~Chatroom();  // Will need to implement.  Cannot remove chatters but can make them 0
                            // The Participants in the vector can then be removed.
  protected:
    vector<Participant*> participant;
    int              nextId;
};

class ModuleChatroom : public Chatroom {  // Concrete Mediator
  public:
    ModuleChatroom(string);
//    virtual ~ModuleChatroom();
  protected:
    string name;
};


#endif
```

```cpp
Chatroom::Chatroom() : nextId(0) {}

int Chatroom::registerMe(Chatter* me){
  Participant* person = new Participant();
  person->chatter = me;
  person->id      = nextId++;
  participant.push_back(person);
  cout<<person->id<<" has just registered."<<endl;
  return person->id;
}

void Chatroom::broadcast(string msg) {
  // Must check is the participant is still registered before sending the message.
  vector<Participant*>::iterator it;

  for (it = participant.begin(); it != participant.end(); ++it) {
    (*it)->chatter->receiveMessage("Broadcast: "+msg);
  }
}

bool Chatroom::talkTo(int id, string msg){
  // Must check is the participant is still registered before sending the message.
  vector<Participant*>::iterator it;
  bool found = false;

  it = participant.begin();
  while ((it != participant.end()) && (!found)) {
    if ((*it)->id == id) {
      found = true;
      (*it)->chatter->receiveMessage(msg);
    } else {
      it++;
    }
  }
  return found;
}
```

```
bool Chatroom::talkTo(int id, string msg){
  // Must check is the participant is still registered before sending the message.
  vector<Participant*>::iterator it;
  bool found = false;

  it = participant.begin();
  while ((it != participant.end()) && (!found)) {
    if ((*it)->id == id) {
      found = true;
      (*it)->chatter->receiveMessage(msg);
    } else {
      it++;
    }
  }
  return found;
}

void Chatroom::leave(int id) {
  vector<Participant*>::iterator it;
  bool found = false;
  int count = 0;

  it = participant.begin();
  while ((it != participant.end()) && (!found)) {
    if ((*it)->id == id) {
      found = true;
    } else {
      it++;
      count++;
    }
  }
  if (found) {
    cout<<(*it)->id<<" has just left."<<endl;
    participant.erase(it);

  }
}


ModuleChatroom::ModuleChatroom(string n)  {
  name = n;
}
```