**Definition:**

The Composite Pattern allows you to compose objects into tree structures to represent part-whole hierarchies. Composite lets clients treat individual objects and compositions of objects uniformly.

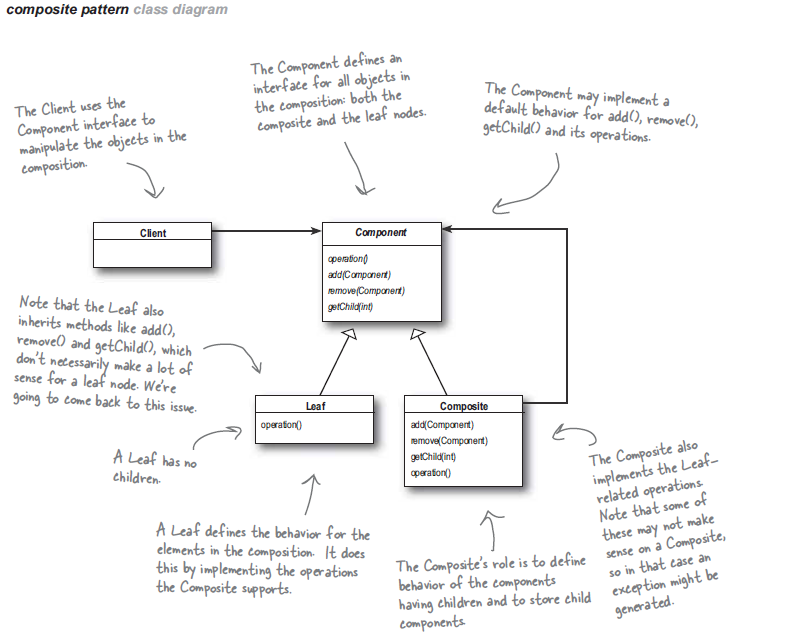
Composite design pattern is one among the 23 popular design patterns identified by Gang of Four (GoF).

**The Composite Pattern has four participants:**

* 1. **Component** – Component declares the interface for objects in the composition and for accessing and managing its child components. It also implements default behavior for the interface common to all classes as appropriate.
  2. **Leaf** – Leaf defines behavior for primitive objects in the composition. It represents leaf objects in the composition.
  3. **Composite** – Composite stores child components and implements child related operations in the component interface.
  4. **Client** – Client manipulates the objects in the composition through the component interface.

Composite and leaf are derived from Component.

Composite is a container class - which can store many other Components.



Example:

The program shows an Electronic system.

The system contains the following type of components.

\* Resistor

\* Capacitor

\* ICChip

\* PCB

All these components share the common features of "**ElectronicComponet**" abstract class.

In terms of Composite pattern, the class "**ElectronicComponent**" acts as the "Component".

The Resistor & Capacitor classes acts like Leafs since they don't have further subdivision.

ICChip s contains many Resistors and Capacitors inside it, so it will be a Composite of Electronic Components.

Furthermore, the PCB (Printed Circuit board) can contains, Resistor, Capacitor and ICChips on it. So that also is a Composite Electronic Component.

Simply, all Electronic Components has some common feature that it accept a Voltage

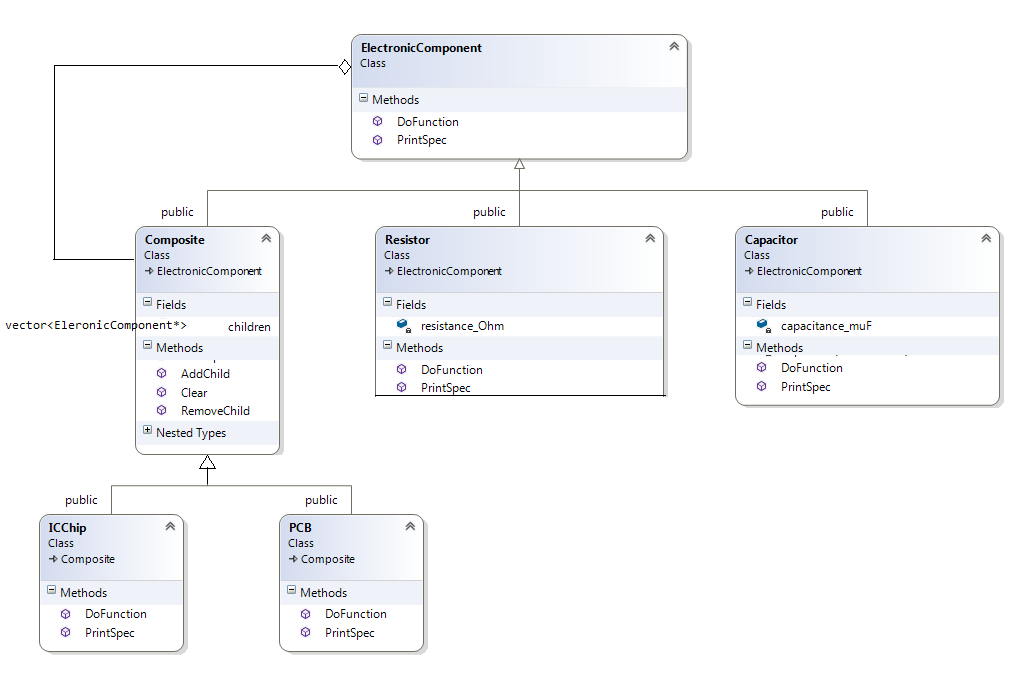
And Current as Input and generates a varied value of Voltage and current as Output.

So a function named DoFunction() is there which does the components actual processing.

Also all electronic components will have a specification.

For e.g. Resister has X number of Ohms, and Capacitor has X micro fared etc.

So a function named PrintSpec() is there which prints the component spec.



//The COMPONENT class which declares the common functionalities of all Electronic //Components.

class ElectronicComponent

{

public:

virtual void PrintSpec(ostream& ostr, string prefix = "") = 0;

virtual void DoFunction(float& voltage, float& current) = 0;

};

//Leaf Class Register & Capacitor which extends ElectronicComponent.

class Resistor :public ElectronicComponent

{

float resistance\_Ohm; // Resistance value of resistor.

Resistor() {}

public:

Resistor(float ohm) :resistance\_Ohm(ohm) {}

void PrintSpec(ostream& ostr, string prefix = "")

{

ostr << prefix.c\_str() << "Resistor (" << resistance\_Ohm << " Ohm )\n";

}

//Performs the Resistor's real function of modifying input Voltage & Current

//Now I just put a printing of Voltage and current as place holder.

void DoFunction(float& voltage, float& current)

{

cout << endl << "Resistor Input (" << voltage << " V ," << current << "

Amp) Resistance = " << resistance\_Ohm << endl;

}

};

class Capacitor :public ElectronicComponent

{

float capacitance\_muF; //Capacitance value in micro fared.

Capacitor() {}

public:

Capacitor(float muF) :capacitance\_muF(muF){}

void PrintSpec(ostream& ostr, string prefix = "")

{

ostr << prefix.c\_str() << "Capacitor (" << capacitance\_muF << " muF )\n";

}

void DoFunction(float& voltage, float& current)

{

cout << endl << "Capacitor Input (" << voltage << " V ," << current << " Amp) Capacitance = " << capacitance\_muF << endl;

}

};

class Composite : public ElectronicComponent

{

protected:

vector<ElectronicComponent\*> children; //Child components list.

public:

//An iterator type is defined which can be used from Composite class

//To perform extensive operations on the Children list like Insert, Search etc.

//This is provided just for Ease of use for Composite class developers.

typedef typename vector<ElectronicComponent\*>::iterator ChildIterator;

Add a Component to the child list. Check to avoid duplication of same child in the

list.

void AddChild(ElectronicComponent\* child)

{

ChildIterator itr = find(children.begin(), children.end(), child);

if (itr == children.end())

{

children.push\_back(child);

}

}

//Remove a component from the child list if it exist there.

void RemoveChild(ElectronicComponent\* child)

{

ChildIterator itr = find(children.begin(), children.end(), child);

if (itr != children.end())

{

children.erase(itr);

}

}

//Remove all child from the list.

void Clear()

{

children.clear();

}

virtual ~Composite()

{

}

};

ICChip is a COMPOSITE class which consists of many ElectronicComponents -such as Resistors & Capacitors, so it can be said a ***Composite of ElectronicComponents***.

Thus it is inherited from -Composite<ElectronicComponent>. This makes it a container class of -other ElectronicComponents and at the same time it, it by itself -an ElectronicComponent.

class ICChip :public Composite

{

public:

void PrintSpec(ostream& ostr, string prefix = "")

{

ostr << prefix.c\_str() << "ICChip With " << children.size() <<

" Components " << endl;

for (unsigned int i = 0; i < children.size(); i++)

{

ostr << prefix.c\_str();

children[i]->PrintSpec(ostr, "\t");

}

}

void DoFunction(float& voltage, float& current)

{

cout << endl << "ICChip Input (" << voltage << " V ," << current << " Amp)";

for (unsigned int i = 0; i < children.size(); i++)

{

children[i]->DoFunction(voltage, current);

}

}

};

class PCB :public Composite

{

public:

void PrintSpec(ostream& ostr, string prefix = "")

{

ostr << prefix.c\_str() << "PCB With " << children.size() << " Components " << endl;

for (unsigned int i = 0; i < children.size(); i++)

{

ostr << prefix.c\_str();

children[i]->PrintSpec(ostr, "\t");

}

}

void DoFunction(float& voltage, float& current)

{

cout << endl << "PCB Input (" << voltage << " V ," << current << " Amp) ";

for (unsigned int i = 0; i < children.size(); i++)

{

children[i]->DoFunction(voltage, current);

}

}

};

int main()

{

Resistor r1(50), r2(70); //Define Resistors

Capacitor c1(200), c2(300); //Define Capacitors

ICChip ic1; //Create a Chip

ic1.AddChild(new Resistor(2000)); // Add a Resistor inside the ICChip

ic1.AddChild(new Capacitor(1000)); // Add a Capacitor inside the ICChip

PCB pcb1; //Make PCB Object and add the Resistor, Capacitors and ICChip on it

pcb1.AddChild(&r1);

pcb1.AddChild(&c1);

pcb1.AddChild(&c2);

pcb1.AddChild(&ic1);

pcb1.AddChild(&ic1); // Duplicate child entries are ignored.

cout << "\n=========== Printing the PCB Spec ==========" << endl;

pcb1.PrintSpec(cout);

float v = 110, i = 5;

cout << "\n=========== DoFunction(110,5) of PCB ==========" << endl;

pcb1.DoFunction(v, i);

cout << "\n=========== Removing c2 from PCB ==========" << endl;

pcb1.RemoveChild(&c2);

cout << "\n=========== Printing the PCB Spec ==========" << endl;

pcb1.PrintSpec(cout);

getchar();

return 0;

}