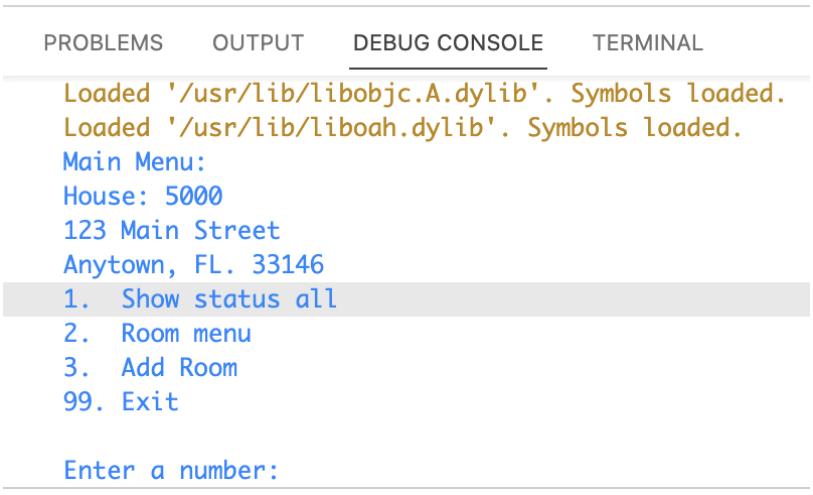
Problem Statement: We want to create a vector to add to our original smart home system. This will allow us to add more than the set number of lights, blinds, and rooms. We want to create a house to put these attributes in. The house will have different rooms with unique number of blinds and lights.

Class Design:	**Method Description: Comments in some of code**
Vec:	
_init(); void	//resets all attributes
_clear(); void	//clears the vector
_create(); void	//creates an empty or null vector
_resize(int); int	//resizes the vector when adding or removing
_addValue(); int	//adds value to vector
removeValue(); template A	//removes value in vector
getSize(); int	//returns size of vector
isEmpty(); bool	//checks to see if vector is empty
isFull(); bool	//checks to see if vector is full and needs to resize
House:	
addRoom(); void	//adds a room to the vector
menu_home(); void	//menu method
getHouseID(); int	//returns the id of a house
getHouseName(); string	//returns the name of a house
getHouseAdd1(); string	//returns the address 1 of house
getHouseAdd2(); string	//returns the address 2 of house
getNextRoomID(); int	//returns the id of the next room in vector
getNextLightID(); int	//returns the id of the next light in vector
getNextBlindID(); int	//returns the id of the next blind in vector
Room:	
room_menu(); void	//room menu method
addLight(); void	//adds light to vector
addBlind(); void	//adds blind to vector
setRoomID(): void	//sets the room ID value
setRoomName(); void	//sets the name of the room
setRoomLocation(); void	//sets the location of a room in the house
setLightState(); void	//sets the state of a light
setNumLights(); void	//sets the number of lights
setNumBlinds(); void	//sets the number of blinds
setBlind(); void	//sets the status of a blind
getRoomID(); int	//returns the room id
getRoomName(); string	//returns the name of a room
getRoomLocation(); string	//returns the location of a room

getBlindID(); int	//returns the id of a blind
getBlindLocation(); string	//returns the location of a blind
getOCState(); string	//returns the open close state of blind
getRLState(); string	//returns the raise lower state of blind
getNumBlinds(); int	//returns the number of blinds in vector
getLightID(); int	//returns the id of a light
getLigthName(); string	//returns the name of a light
getLightState(); string	//returns the state of a light(ON OFF)
getNumLights(); int	//returns the number of lights in a vector
Blind:	
setID(); void	//sets the id of blind
setName(); void	//sets the name of blind
setBlind(); void	//sets the state of the blind
getID(); int	//returns the if of blind
getName(); string	//returns the name of blind
blindOpenState(); bool	//sets the OC state of blind
blindRaiseState(); bool	//sets the RL state of blind
Light:	
setID(); void	//sets the id of light
setName(); void	//sets the name of light
setState(); void	//sets the state of light
getID(); int	//returns the id of light
getState(); bool	//returns the state of light
getName(); string	//returns the name of light
ostream&	//all print overloading methods
vec(); house(); light(); blind();	//all constructors that initialize data



Vec.h:

```
#include "hw.h"

using namespace std;

template<class A>
class Vec {
private:
    A *_data;
    int _size;
    int _max;

    void _init();
    void _clear();
    void _create();
int _resize(int);
public:
    Vec();  // default constructor
    A& at(int);

    int addValue(A);
    A removeValue();

    int getSize() { return _size; }
    bool isEmpty();
    bool isFull();

    ostream& print(ostream&);

};

template<class A>
A& Vec<A>::at(int i){ // .at() implementation
    return _data[i];
}

template<class A>
Vec<A>::Vec() {
    _init();
}
```

```
template<class A>
void Vec<A>::_init() {
    _data = NULL;
    _size = 0;
    _max = _size;
}

template<class A>
void Vec<A>::_clear() {
    if (!isEmpty()) {
        delete[] _data;
    }
    _init();
}

template<class A>
void Vec<A>::_create() {
    _clear();
    _max = 1;
    _data = new A[_max];
}

template<class A>
int Vec<A>::_resize(int inc) {
    if (isEmpty()) {
        _create();
    } else {
        _max = _max + inc;
        A *newData = new A[_max];
        int numVals = _size;
        if (inc<0) numVals = numVals + inc;
        _size = numVals;
        for(int i=0;i<numVals;i++) newData[i] = _data[i]; // *(newData+i) = *(_data+i
        delete[] _data;
        _data = newData;
    }
    return _max;
}

template<class A>
bool Vec<A>::isEmpty() {
```

```
    if (_size==0) return true;
    else return false;
}

template<class A>
bool Vec<A>::isFull() {
    if (_size==_max) return true;
    else return false;
}

template<class A>
int Vec<A>::addValue(A val) {
    if (_data==NULL) {
        _create();
        _data[_size] = val;
        _size++;
    } else if (isFull()) {
        _max = _resize(1);
        _data[_size] = val;
        _size++;
    } else {
        _data[_size] = val;
        _size++;
    }
    return _max;
}

template<class A>
A Vec<A>::removeValue() {
    A val;
    if (!isEmpty()) {
        val = _data[_size-1];
        _max = _resize(-1);
    }
    return val;
}

template<class A>
ostream& Vec<A>::print(ostream &out) {

    if (_data==NULL) out << "Vector not created\n";
```

```
    else if (isEmpty()) out << "Vector is empty\n";
    else {
        for(int i=0;i<_size;i++) {
            out << "data[" << i << "] = " << _data[i] << endl;
        }
    }
    return out;
}
```

Light.h:

```
#ifndef LIGHT_H_
#define LIGHT_H_
#include "vec.h"
using namespace std;

class light {
private:
    int id;
    string name;
    bool state;
public:
    //constructor
    light();
    light(int, string);

    //setters
    void setId(int);
    void setName(string);
    void setState(bool);

    //getters
    int getId();
    bool getState();
    string getName();
};

#endif
```

Light.cpp:

```
#include "light.h"

//constructor
light::light() {
    state = false;
}
light::light(int iD, string n){
    id=iD;
    name=n;
    state=false;
}

//setter methods  for light
void light::setId(int iD){
    id=iD;
}

void light::setName(string n){
    name=n;
}

void light::setState(bool s){
    state=s;
}

//getters
int light::getId(){
    return id;
}

string light::getName(){
    return name;
}

bool light::getState(){
    if (state==true){return true;}
    else return false;
}
```

Blinds.h:

```
#ifndef BLIND_H
#define BLIND_H
#include "light.h"

using namespace std;

class blind {

private:
    int id;
    string name;
    bool ocState;
    bool rlState;

public:
    int open;
    int close;
    int raise;
    int lower;

    //construct
    blind();
    blind(int,string);

    //setters
    void setId(int);
    void setName(string);
    void setBlind(char);

    //getters
    int getId();
    string getName();
    bool blindOpenState();
    bool blindraiseState();
};

#endif
```

Blinds.cpp:

```
#include "blinds.h"
```

```
//contruct

blind::blind() {
    id=0;
    name = " ";
    open = 0;
    close = 1;
    raise = 0;
    lower = 1;
    ocState = false;
    rlState = false;
}

blind::blind(int i, string n){
    id=i;
    name=n;
    open = 0;
    close = 1;
    raise  = 0;
    lower =1;
    ocState = false;
    rlState = false;
}

//setters
void blind::setId(int i){
    id=i;
}

void blind::setName(string l){
    name=l;
}

void blind::setBlind(char x) {
    if (x=='o'){
        open=1;
        ocState=true;
        close =0;
    }
```

```
    else if (x=='c'){
        close=1;
        open=0;
        ocState=false;
        raise=0;
        lower=1;
        rlState=false;
    }

    else if (u=='r'){
        ocState=true;
        raise=1;
        lower=0;
        rlState=true;
        open=1;
        close=0;
    }

    else if (x=='l'){
        lower=1;
        rlState=false;
        raise=0;
    }
}

//getters

int blind::getId() {
    return id;
}

string blind::getName() {
    return name;
}

bool blind::blindOpenState() {
    return ocState;
}

bool blind::blindraiseState() {
    return rlState;
```

```
}
```

Room.h:

```
#ifndef ROOM_H_
#define ROOM_H_
#include "blinds.h"

using namespace std;
class room {
private:
    int id; //room id
    string name; //room name
    string location; //room location
    int Numlights;
    Vec<light> lights; //vector of lights
    int NumBlinds; //number of blinds
    Vec<blind> blinds; //vector of blinds

public:
    room();//contructor
    room(int&, string, string);//constructor with parameters
    void room_menu(int&,int&);//menu
    void addLight(int&);//light
    void addBlind(int&);//blind

//setters
    //rooms
    void setRoomID(int);
    void setRoomName(string);
    void setRoomLocation(string);
    //lights
    void setLightState(int,bool);
    void setNumLights(int);
    //blinds
    void setNumBlinds(int);
    void setBlind(int,char);

//getters
    //room
    int getRoomID();
```

```
    string getRoomname();
    string getRoomlocation();

    //blinds
    int getBlindID(int);
    string getBlindLocation(int);
    string getOCState(int);
    string getRLState(int);
    int getNumBlinds();

    //lights
    int getLightId(int);
    string getLightName(int);
    string getLightState(int);
    int getNumLights();

    ostream& lightoverload(ostream&);//print
    ostream& blindoverload(ostream&);//print
    ostream& printRoom(ostream&);//print
};

#endif
```

Room.cpp:

```
#include "room.h"


room::room() {
    id = -1;
    name="";
    location="";
    Numlights=-1;
    NumBlinds=-1;
}

room::room(int& nextRoom_ID, string n, string l){
    id=nextRoom_ID;
    name=n;
    location=l;
    Numlights=0;
    NumBlinds=0;
```

```
    nextRoom_ID++;
}


void room::room_menu(int& next_light_id, int& next_blind_id){ // room menu implementation
    int topmenu=0;
    while(topmenu!=98){
            cout<<"\nRoom Menu:\n"<<"\n";
            cout<<"Room: "<<id<<", "<<name<<", "<<location<<"\n\n";
            cout<<"1. Show status all\n";
            cout<<"2. On.Off Light\n";
            cout<<"3. Open/Close Blind\n";
            cout<<"4. Raise/Lower Blind\n";
            cout<<"5. Add Light\n";
            cout<<"6. Add Blind\n";
            cout<<"98. Return to Top Menu\n";
            cout<<"99. Exit\n\n";
    cout<<"Enter a number: ";
        int input;
        cin >> input;
                if(cin.fail()){
                        cin.clear();
                        cin.ignore(99,'\n');
                        cout<<"\nINVALID SELECTION\n";
                }
                else if(input==99){
                        abort();
                }
                else if(input==98){
                        topmenu=98;
                }
        else if(input==97){
            if(!blinds.isEmpty()){
                blinds.removeValue();
                NumBlinds--;
                next_blind_id--;
            }
        }
        else if(input==96){
            if(!lights.isEmpty()){
            lights.removeValue();
```

```
    Numlights--;
    next_light_id--;
    }
}
else if(input==1){
    cout<<"\n";
    printRoom(cout);
}
        else if(input==2){
    if(lights.isEmpty()){
                    cout<<"There are no lights yet.";
    }
    else{
        cout<<"\n List of lights: ";
        lightoverload(cout);
              cout<<"Which light would you like to toggle? ";
        cin>>input;
              if(cin.fail()){
                    cin.clear();
           cin.ignore(99,'\n');
                    cout<<"\nINVALID SELECTION\n";
         }
        else{
           cout<<"\n";
           lights.at(input-1).setState(!lights.at(input-1).getState());
        }
    }
}
        else if(input==3){
              if(blinds.isEmpty()){
                    cout<<"There are no blinds yet.";
              }
    else{
        cout<<"\n List of blinds: ";
        blindoverload(cout);
        cout<<"\n Which blind would you like to toggle?";
        cin>>input;
              if(cin.fail()){
                    cin.clear();
                    cin.ignore(99,'\n');
                    cout<<"\nINVALID SELECTION\n";
```

```
        }
        else{
            cout<<"\n";
            if(!blinds.at(input-1).blindOpenState()){
                blinds.at(input-1).setBlind('o');
            }
            else if(blinds.at(input-1).blindOpenState()){
                blinds.at(input-1).setBlind('c');
            }
               }
    }
}
else if(input==4){
               if(blinds.isEmpty()){
                     cout<<"There are no blinds yet.";
               }
               else{
                     cout<<"List of blinds: ";
                     blindoverload(cout);
                     cout<<"Which blind would you like to toggle? ";
                     cin>>input;
                  if(cin.fail()){
                        cin.clear();
                        cin.ignore(99,'\n');
                        cout<<"INVALID SELECTION";
            }
        else{
            cout<<"\n";
                     if(!blinds.at(input-1).blindraiseState()){
                           blinds.at(input-1).setBlind('r');
                     }
                     else if(blinds.at(input-1).blindraiseState()){
                           blinds.at(input-1).setBlind('l');
            }
                   }
            }
}


        else if(input==5){
    addLight(next_light_id);
        } else if(input==6){addBlind(next_blind_id);}
```

```
            }
            }

void room::addLight(int& next_light_id){
    Numlights++;
    string ln;
        cout<<"Enter light name "<<next_light_id<<": ";
    getline(cin >> ws, ln);
        light temp;
        temp=light(next_light_id,ln);
        lights.addValue(temp);
        next_light_id++;
}
void room::addBlind(int& next_blind_id){
    NumBlinds++;
        string bn;
        cout<<"Enter name of blind number "<<next_blind_id<<": ";
    getline(cin >> ws, bn);
        blind temp;
        temp =blind(next_blind_id,bn);
        blinds.addValue(temp);
        next_blind_id++;}

void room::setRoomID(int i){id = i;}

void room::setRoomName(string n){name=n;}

void room::setRoomLocation(string l) {location=l;}
void room::setLightState(int i, bool s){
    if (i<1||i>Numlights){cout<<"Light Doesnt exist"<<endl;}
    else lights.at(i).setState(s);}

void room::setNumLights(int i){
    Numlights=i;}

void room::setNumBlinds (int i){
    NumBlinds=i;}

void room::setBlind (int i, char s){
    if (i<1||i>NumBlinds){cout<<"This blind does not exist"<<endl;}
    else blinds.at(i).setBlind(s);}
```

```
// all getter  methods
//methods for room
int room::getRoomID(){
    return id;
}

string room::getRoomname(){
    return name;
}

string room::getRoomlocation(){
    return location;
}
    // all functions for lights
int room::getLightId(int i){ //light id
    if (i<1||i>Numlights){cout<<"This light does not exist"<<endl;return -1;}
    else return lights.at(i).getId();}

string room::getLightName(int i){ //name of light
    if (i<1||i>Numlights){return "This light does not exist";}
    else return lights.at(i).getName();}

string  room::getLightState(int i){ //state of light
    if (i<1||i>Numlights){return "This light does not exist";}
    else if (lights.at(i).getState()==false){return "OFF";}
    else return "ON";}

int room::getNumLights(){
    return Numlights;}
int room::getBlindID(int i){
    if (i<1||i>NumBlinds){
    cout<<"This blind does not exist\n";
    return -1;}
    else return blinds.at(i).getId();
}

string room::getBlindLocation(int i){ // checks blind location
    if (i<1||i>NumBlinds){
            return "This blind does not exist\n";
    }
```

```
    else
    return blinds.at(i).getName();
}

string room::getOCState(int i){ // checks blind open/ closed
    if (i<1||i>NumBlinds){
            return "This light does not exist";
    }
    else if (blinds.at(i).blindOpenState()==false){
        return "Closed";
    }
    else
        return "Open";
}
string room::getRLState(int i){ // checks blind raised/ lowered
    if (i<1||i>NumBlinds){
            return "This light does not exist";
    }
    else
    if (blinds.at(i).blindraiseState()==false){
        return "Lowered";
    }
    else
        return "Raised";
}

int room::getNumBlinds(){
    return NumBlinds;
}

//print
ostream& room::lightoverload(ostream &out){
    for(int i=0;i<Numlights;i++){
        out<<i+1<<". "<<lights.at(i).getName()<<" State: "<<lights.at(i).getState();
        }
    out<<"\n";
    return out;
}

ostream& room::blindoverload(ostream &out){
        for(int i=0;i<NumBlinds;i++){
```

```
        out<<i+1<<". "<<blinds.at(i).getName()<<" Open state: "<<blinds.at(i).blindOpenState()<<" Raised state:
"<<blinds.at(i).blindraiseState();
        }
        out<<"\n";
        return out;
}

ostream& room::printRoom(ostream &out){
    out<<""<< name <<" Id: "<<id<<" Location: "<<location;
    if(lights.isEmpty()){
        out<<"THERE ARE NO LIGHTS IN THIS ROOM.";
    //  return out;
    }
    else if(!lights.isEmpty()){
        out<<"Lights: ";
        for(int i=0;i<Numlights;i++){
            out<<lights.at(i).getName()<<" Id: "<<lights.at(i).getId()<<" State: "<<lights.at(i).getState();
        }
        out<<"\n";
    //  return out;
    }

        if(blinds.isEmpty()){
                out<<"THERE ARE NO BLINDS IN THIS ROOM.\n";
         //      return out;
        }
        else if(!blinds.isEmpty()){
        out<<"Blinds: ";
        for(int i=0;i<NumBlinds;i++){
                    out<<"\n        "<<blinds.at(i).getName()<<" Id: "<<blinds.at(i).getId()<<" Open State: "<<blinds.at(i).blindOpenState()<<"
Raised State: "<<blinds.at(i).blindraiseState();
            }
        out<<"\n";
    //  return out;
    }
    return out;
}
```

House.h:

```
#ifndef HOUSE_H_
```

```
#define HOUSE_H_
#include "room.h"
using namespace std;

class house {
private:
    int  id; //house id
    string name; //house name
    string address1; //house address line 1
    string address2; //house address line 2
    string loginname; //loginname
    string password; //password
    Vec<room> rooms; // room vector
    int next_room_id;
    int next_light_id;
    int next_blind_id;

public:
    house();//constructor
    house(int, string, string, string);//constructor with parameters
    void addRoom();//add a room to house function
    void menu_home();//menu method

//getters
    int getHouseID();
    string getHouseName();
    string getHouseAdd1();
    string getHouseAdd2();
    int getNextRoomID();
    int getNextLightID();
    int getNextBlindID();

    ostream& room_menu(ostream&);//print function
    ostream& print_house(ostream&);//print function
};

#endif
```

House.cpp:

```
#include "house.h"
```

```
//constructor: initiallizing the values for the attributes of house
house::house(){
    id = -1;
    name = "";
    address1 = "";
    address2="";
    loginname="username";
    password="password";
    next_room_id =-1;
    next_light_id =-1;
    next_blind_id =-1;
}
//setting the inputted values for the attributes of house
house::house(int i, string n, string a1, string a2){
    id = i;
    name = n;
    address1 = a1;
    address2 = a2;
    loginname="username";
    password="password";
    next_room_id  = 100;
    next_light_id = 200;
    next_blind_id  = 300;
}

//implementation of our house menu

void house::menu_home(){
    do {
        cout << "Main Menu:"<<endl;
        cout<<"House: "<<id<<endl;
        cout<<address1<<endl;
        cout<<address2<<endl;

        cout<<"1.  Show status all"<<endl;
        cout<<"2.  Room menu"<<endl;
        cout<<"3.  Add Room"<<endl;
        cout<<"99. Exit"<<endl<<endl;
        cout<<"Enter a number: "<<endl;
```

```
        int input;
        cin >> input;
        if(cin.fail()){
            cin.clear();
            cout<<"INVALID SELECTION"<<endl;
        }
        else if(input==99){break;}
        else if(input==97){
            if(!rooms.isEmpty()){
                rooms.removeValue();
                next_room_id --;}
        }
        else if(input==1){print_house(cout);
        }
        else if(input==2){
            if(!rooms.isEmpty()){
            cout<<"List of rooms: "<<endl;
            room_menu(cout);
            cout<<"Which room would you like? ";
            cin>>input;
            rooms.at(input-1).room_menu(next_light_id, next_blind_id);
            }
            else{
            cout<<endl<<"There are no rooms created";
            }
        }
        else if(input==3){
            addRoom();
        }
        else{
            input=0;
        }
    }while(true);
}

void  house::addRoom(){
    string n;
    string l;
    int room_index = next_room_id -99;
                //room menu add
                id=next_room_id ;
```

```
            cout<<"Enter room name: ";
            getline(cin >> ws, n);
        cout<<"Enter the location of "<<n<<": ";
        getline(cin >> ws, l);
        room temp;
        temp = room(next_room_id ,n,l);
        rooms.addValue(temp);
}

//getters
int house::getHouseID(){
    return id;
}
string house::getHouseName(){
    return name;
}
string house::getHouseAdd1(){
    return address1;
}
string house::getHouseAdd2(){
    return address2;
}
int house::getNextRoomID (){
    return next_room_id ;
}
int house::getNextLightID(){
    return next_light_id;
}
int house::getNextBlindID(){
    return next_blind_id ;
}
 //printer
ostream& house::room_menu(ostream &out){
        int room_number = next_room_id -100;
        for(int i=0;i< room_number ;i++){
            out<<i+1<<". "<<rooms.at(i).getRoomname();
        }out<<"\n";  return out;
}

ostream& house::print_house(ostream &out){
    if(rooms.isEmpty()){
```

```
            cout<<"\nNo more rooms created. ";
    }
    else{
        int room_number = next_room_id -100;
        for(int i=0;i<room_number;i++){
            out<<"\n";
            rooms.at(i).printRoom(cout);
        }
    }
    return out;
}
ostream& operator<<(ostream &out, house &h){
    h.print_house(out);
    return out;
}
```