

Observer Design Pattern implementation:

My implementation of the observer design strategy takes advantage of the arena and its knowledge of all the entities that are in our simulation. I realized that the arena would be the best candidate to be the subject in my implementation of the observer strategy. I modified my arena to be my subject by creating several new pointer vectors that would keep track of the robot sensors and light and food entities. Therefore, when it comes time to notify and update the observers it would have all the info about those entities and can pass them along to its observers.

```
// All entities mobile and immobile.
std::vector<class ArenaEntity *> entities_;

// A subset of the entities — only those that can move.
std::vector<class ArenaMobileEntity *> mobile_entities_;
// A subset of the entities — lights only
std::vector<class ArenaEntity *> light_entities_;
// A subset of the entities — lights only
std::vector<class ArenaEntity *> food_entities_;
// All of the lightsensors in the arena
std::vector<class LightSensor* > lightsensor_observers_;
// All of the foodsensors in the arena
std::vector<class FoodSensor* > foodsensor_observers_;
```

My choice for the observers of the arena was a bit tricky at first. It was a choice between making the robots observer or the sensors of each robot directly the observers of the arena. I end up implementing the strategy with the sensors as the observers of the arena because first it would mean less methods being called since if the robot itself was the observer it would then need update its sensor whenever it was updated itself.

```
void Arena::RegisterLightSensorObserver(LightSensor* ob){
    lightsensor_observers_.push_back(ob);
}
void Arena::RegisterFoodSensorObserver(FoodSensor* ob){
    foodsensor_observers_.push_back(ob);
}

void Arena::Notify(){ // called at each timesupdate
    for (auto observer: lightsensor_observers_) {
        observer->update(light_entities_);
    }
    for (auto observer: foodsensor_observers_) {
        observer->update(food_entities_);
    }
}
```

When the arena is creating robots it also registers the pointers to the sensor of that robot. Then the notify function is called at each times stamp update and that updates all the sensor with a vector all the entities its tracking.

Alternative implementation:

Another way of implanting this would be have robots as the observes of the light and foods in the arena. The arena entities (lights and food) would be the subject in this design. In this way those entities would notify the robot of its position every time the motion behavior update the pose of that entity.

Strategy design pattern implementation:

I implemented the strategy pattern in the way that robots exhibit different behaviors towards entities with the arena. I created different motion handler classes that inherit from the parent class. In particular, I have 4 different motion handler child classes that represents the four different behaviors robots exhibit (fear, love, explore, and aggression). Each of the classes then implement the update velocity function and thereby allowing it to implemented it with respect to the behaviors that class is representing.

```
// assigning the appropriate motion handler with respect to the robot type
switch(get_robot_type()){
case(kAggressive):
motion_handler_ = new MotionHandlerRobotAggressive(this);
break;
case(kLove):
motion_handler_ = new MotionHandlerRobotLove(this);
break;
case(kCoward):
motion_handler_ = new MotionHandlerRobotCoward(this);
break;
case(kExplore):
motion_handler_ = new MotionHandlerRobotExplore(this);
break;
default: break;
}
```

Alternatives implementation:

Another way the behaviors could have be implanted would be by having a lengthy switch statement within the single motion handler robot class's update velocity function. The cases of this switch statement would be the robot's behavior type and according set the velocity. That inefficiency in this implementation would that a single class would be taking care of so much. Its also not optimal for the future because behaviors can changed, added and removed.

Feature enhancements:

I think with more time and more resources it would be more intuitive to have robots as observers of the arena. I played with this idea and tried it but it requires a lot of time because I would have to deal with pointer and creating several methods to communicate the updates. I also would want to have a state object that I pass into the update function of the observers instead of passing an entire vector. Lastly, I would like to have the light sensor visible on the robot which is something I didn't have time to do in this iteration