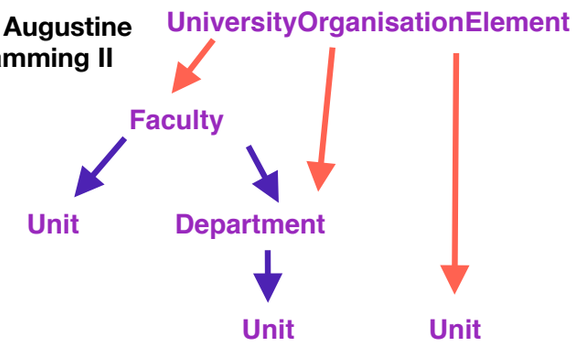
The University of the West Indies, St. Augustine
COMP 3607 Object Oriented Programming II
2020/2021 Semester 1
Lab Tutorial - Week 6



This tutorial focuses on design patterns and code refactoring.

Learning Objectives:

- Write code to implement any of the following design patterns:
  - **Singleton**, **Composite**, **Command**
  - Refactor code to implement a particular design pattern.

1. Refactor the supplied code for the Agent class so that the agent keeps track of the number of requests made for a reference to the agent using the **Singleton** design pattern.
2. Write code create a composite hierarchy of objects using the **Composite** design pattern. It should model a university's organisational elements where a faculty can consist of departments or units, and a department can consist of one or more units. Units do not contain anything further. Suppose they all have employees. Write code so that a countEmployees( ) method works on any university organisational element.

UniversityOrganisationalElement	Faculty	Department	Unit

3. Consider the class diagram shown in Figure 1 which illustrates the details of classes that model a remote control that can turn on and turn off a light using the **Command** pattern.

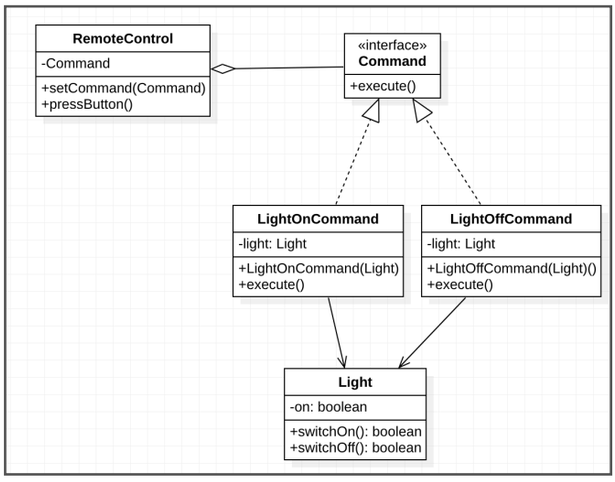


Figure 1

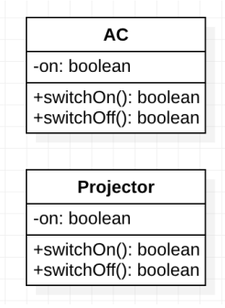


Figure 2

(a) Write code to implement the functionality illustrated in the diagram using the **Command** pattern.

(b) Refactor your code from part (b) so that two additional classes, AC and Projector, are accommodated by the remote control - shown in Figure 2.

(c) Introduce an *OnOffDevice* interface that adds further abstraction so that a standard command be used by the remote to control any type of device