# Aggregation and Composition lab

Students should separate themselves into groups of 2 to 3. The students should read the following design specifications and decide how they want to make their system work. The each student will take a part of the system and code that with the goal of making it work with their partner’s code. Obviously there needs to be communication back and forth to make sure they systems line up, but each part should be built individually by a student. If you are not here on the day that this is started you can try to find a group with other students that were also not here. If you cannot find a group please bring this to the instructor’s attention as he will assist you in finding a group.

The assignment will be graded on the systems satisfaction of the follow design points. Concentrate on where responsibilities should lie and how data is accessed. Coordinate carefully with your teammates so that the project is consistent in terms of naming, style and design ideas. I am mostly looking for main ideas within this lab, do not get caught up with details unless they are specifically asked for by the directions.

# Procurement

The procurement side of the construction firm manages **equipment** (and the people that use it) of which only certain workers are trained to use. Workers also have time cards which detail when and how they work. Workers work in shifts (either morning, afternoon, or night).

Main Requirements:

* Procurement has-an Equipment
* Equipment has-a Worker
* TimeCard is-part-of Worker

Additional Requirements:

* Procurement is a class which will coordinate equipment and employees with the construction side of the project. Procurements job is to hold a record of each employee and provide a single point of contact for recruiting additional employees to a job.
* Equipment has a name. Equipment also has a cost to use (money) which will be enumerated later in the driver section. Equipment also have valid times when it can be used. For instance some equipment may only be used at night. Additionally, some jobs do not allow more than 1 of a particular piece of equipment to work at a time, or require more than 1 of something to get a job done (i.e. 2 cranes to put up a new roofing structure).
  + Each worker has a set of equipment (that procurement tracks, since that is their property) that is dedicated to him and likewise each worker uses that set of equipment to complete his job. An electrician needs equipment (wires, nails, electrical housings…) to do his job. Likewise a backhoe needs a worker to do their job. Worker and Equipment have a 1 to 1 relationship.
* Worker will have a name (and other personal information) and a salary. It will defer and shift or work related inquiries to the TimeCard.
* TimeCard coordinates when a worker can work – he cannot work on multiple projects on the same shift. Additionally, he may work morning, afternoon, and/or night.

# Construction

On the Construction side we have a team that is led and managed by a Foreman. The foreman needs to request/rent equipment from Procurement when needed for the least amount of money possible. ConstructionTeams must pay workers by shift which will add to the cost of the project. Unfortunately there are times when workers are assigned to a project but cannot do their job (because they are waiting on someone else). It is the foreman’s job to coordinate this.

* ConstructionTeam has-a Project
* ConstructionTeam has-a Worker (workers are added as they are used on the project)
* ConstructionTeam is-part-of Foreman
* Project has a number of equipment needs (in order to complete the project). **Equipment needs may come in order or may be done concurrently** (one equipment job may need to be done before another, or certain things may need to be done at the same time).
* Projects should also know the type of project it is and the length of the project
* It is the **foreman’s job to request equipment from procurement** when needed (meaning he is the only one who knows about the procurement side, meaning project or construction team should not request equipment). He also coordinates when equipment can work (by the worker’s timecard) and by the order of needed equipment.
* For each worker in the construction team the foreman has to pay additional expenses it terms of coordination. **The cost per shift increases by 10%** (of the total equipment cost) **per worker**.
* For each day the project runs the Construction team must also pay $1000 dollars for coordination of the project. (If the project is not started yet the fee is only $200 dollars.)

A final note

Worker is the only class shared between the two sides, and thus there needs to be some level of coordination on how the worker class will work. It is okay if there are two worker classes (1 for procurement and 1 for construction), but make sure the class names reflect this. Be careful with your class names as well. I realize ideas and plans change but update class and variable names **before** submitting the project.

# Driver (test-driven-design)

This is where you will **test** the structures made in the other parts of the lab. This is only a test of the system to see if it works, not the final system a client would use. Note that the program should be able to handle any amount of data of the following type (**so none of this should be hardcoded outside of the driver**). Additionally, I do not want **ANY** input from a user. This is just a test and therefore you may hardcode this in (again, so long as it stays in the driver). If you hardcode things outside of the driver you are no longer testing the system but instead you are limiting it to those constraints.

Equipment provided to Procurement:

* Procurement needs 2 cement truck/pouring systems.
  + 1 truck only works at night, the other can work all three shifts.
  + Cement trucks cost $850 a shift
* Procurement also needs 5 carpenter/carpentry sets of equipment.
  + Each carpenter can only work 1 shift at a time (Union stuff)
    - Cannot work consecutive shifts
  + Carpenters are paid $200 per shift
* Procurement needs 1 crane
  + The crane can only work morning or night shifts
  + The crane costs $2500 per shift (yes this is a cheap crane)
* Procurement also needs 2 backhoe’s
  + These can work any shifts
  + The backhoe costs $150 per shift
* Procurement also need 3 electrician/electrical sets of equipment
  + Each electrician will only work morning and afternoon shifts
  + Electricians cost $250 per shift.
  + If they work both shifts they get a $100 bonus
* Procurement also will have 2 plumbers/plumbing sets of equipment
  + Plumbers have no Union and thus can work any shift
  + Plumbers are paid $70 a shift

A construction team should be created to coordinate the following projects:

* There should be house building project created:
  + The house first must have a backhoe clear the lot. It will take 2 shifts and only 1 backhoe can work at a time (2 would get in each other’s way). 1 shift for a Carpenter, Electrician, and plumber will be needed to coordinate the design plans for the project.
  + Then it will need to pour the foundation 2 cement truck’s shifts are needed. At the same time 1 plumber and 1 electrician must be on the shift to coordinate (if 1 truck is used then the electrician and plumber must be on for both shifts).
  + The house then needs 12 carpenter shifts, 3 electrician shifts, and 1 plumber shift to complete the majority of the structure.
  + The crane is needed to build the roof which will take 3 shifts to complete. At the same time there needs to be all 5 carpenters available (otherwise the crane can’t do its job).
* A Project to repair another home in the neighborhood will require the following:
  + 6 carpenter shifts are needed first to assess the damages of this home.
  + 1 plumber and then 1 electrician is needed to make initial repairs. They must coordinate their efforts so the plumber and electrician must work at the same time. The crane is also needed for 1 shift with 1 carpenter and can be done at the same time as other repairs or separately.
  + The house then needs to sit for 2 shifts while certain elements cure. After which 1 plumber, 1 carpenter, and 1 electrician is needed to inspect the repairs thus far (they can be on the same shift or other).
  + Lastly, 2 electrician shifts and 2 carpentry shifts are needed to put finishing touches on this property.
* There should also be an event center/meeting room project
  + This project must use 9 backhoes shifts to clear the lot before any construction can take place.
  + All 3 electricians are needed (at the same shift) to coordinate a problem caused by a careless backhoe driver. Luckily for the schedule this only takes 1 shift (once all 3 get to work that is).
  + Then 4 cement trucks/equipment will be needed to pour the foundation. 2 plumber shifts will be needed to coordinate with the foundation team and 1 electrician shift.
  + The second phase of building will need a crane for 2 shift and will need a minimum of 2 carpenters on staff. It will take 10 carpenter shifts to fully complete.
  + The third phase of construction will need 4 carpenter shifts, 2 shifts of the crane, 3 electrician shifts and 1 plumber shift.
  + The last phase will take 6 carpenter shifts and 1 crane shift to finish the roof.

# Program Output

The output should show a day by day (shift by shift) view of what project has which resources. It is up to you and your system as to how best to show this. The whole goal of the program is to find the most efficient uses of resources and time for each project that needs to be coordinated. That being said, this is a very difficult problem to tackle and I will be satisfied with your construction projects just being completed at all. At the end it should also show the total expenses and time taken (you do not necessarily need to start them all on day 1 morning 1).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | House | Repairs | Event Center | Open |
| Day 1 (morning) | Backhoe (Greg)  Electrician (Bill)  Carpenter (John)  Plumber (Tom) | Carpenter (Troy)  Carpenter (Mike)  Carpenter (Jess)  Carpenter (Will) | Backhoe (Tim) | Plumber (Pete)  Crane (Roddy)  Cement (Steve)  Cement (Kyle)  Electrician (Bob)  Electrician (Adam) |
| Day 1  (Afternoon) | Backhoe (Greg) | Plumber (Pete)  Electrician (Adam) | Backhoe (Tim) | Carpenter (Troy)  Carpenter (Mike)  Carpenter (Jess)  Carpenter (Will)  Carpenter (John)  Plumber (Tom)  Crane (Roddy)  Cement (Steve)  Cement (Kyle)  Electrician (Bob)  Electrician (Bill) |
| Day 1  (Night) | … | … | … | … |
| \_\_\_\_\_\_\_\_\_\_  Day 1:  (Expenses) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  3,000 | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  2,100 | \_\_\_\_\_\_\_\_\_\_\_\_\_  1,450 |  |