Object Oriented Concepts

- In some cases we’ll learn the concepts prior to learning the terminology.

- Other times we’ll hear the terms, before we know what they mean.

- In either case, what we call the concepts are just as important as the concepts themselves.

- If you want to talk “OO” with others, you will need to learn the vocabulary.
OO Languages

What makes a language an Object-Oriented?

- The goal of OOP is abstraction.
- In general you will see three big terms used:
  - Encapsulation
  - Inheritance
  - Polymorphism (this has multiple meanings)
- Weisfeld adds an additional one:
  - Composition

What is procedural programming?

- Procedural Programming consists of writing procedures that take in some data as input and provide output.
  - Data is distinct from the process. It has no relation to the procedure.
  - Programs process data as defined by the procedure.
  - Likewise the functions written in the program have no direct relationship with each other.
  - Programmer is all knowing, beginning to end.
How is OOP different?

- In Object Oriented Programming (OOP) the data and the functions that operate on that data are bundled together into an object.
  
  - Objects are *self-contained entities that maintain their own data.*
  
  - A program uses objects that *interact* to solve a problem.
  
  - Abstraction *hides the unnecessary details from the programmer.*

What is not OO programming?

- You can write *procedural code* in any language, including Java.

- Simply using *functions* or *classes* in your program does *not* make it Object Oriented.
Procedural data design.

- In addition to the parameters, all the functions share access to the global variables.
- If data is changed by FunctionA, the other functions use the new value.

Object Oriented data design.

- The data and related functions are encapsulated together.
- The object is a self contained entity, and other objects cannot inadvertently change its data.
Learning OO

“The most difficult problem in teaching object-oriented programming is getting the learner to give up the global knowledge of control that is possible with procedural programs, and rely on the local knowledge of objects to accomplish their tasks.”

(Beck and Cunningham OOPSLA '89)

Let’s try an example.

- Write a procedural program for calculating the average salaries for each department (Accounting, HR, IT) in a company.

- Assume I have the following input file:

```
1, Joe, Smith, HR, 40000
2, George, Jettson, Accounting, 50000
3, Bill, Gannon, HR, 45000
4, Fred, Flintstone, IT, 65000
5, Barney, Bubble, Accounting, 58000
6, James, Kirk, IT, 70000
7, John, Doe, HR, 30000
8, Jane, Doe, IT, 85000
9, Marge, Simpson, HR, 25000
10, Alice, Krabden, Accounting, 42000
```
What did you come up with?

■ A *procedural* approach may take the form of:
  ■ Read the file, line by line and load the data into variables or perhaps an array or list.
  ■ Once the data is loaded calculate the average salary for each department, by summing up and dividing by the number of individuals in the department.
  ■ Print out or display the resulting calculations.

What would an Object Oriented approach look like?

■ Use a *FileLoader* object to load the data and create objects (Departments and Employees).
■ Each *Employee* object knows information about itself, like it’s id, name, salary.
■ Each *Department* object knows information about itself, like which Employees are in the department.
■ Once the data is loaded I can have each Department object provide me with the average salary of its employees.
How do objects interact?

In OO terminology objects in our program interact by sending messages to each other.

FileLoaderFrank, please load the Edit1.txt file.

Ok. Let me introduce you to DepartmentAccounting, DepartmentHR and DepartmentIT.

DepartmentAccounting, what is your average salary?

$49,000

DepartmentIT, what is your average salary?

$73,333.33

Another program

Using a procedural design, what would I do if I wanted to create a program that found the maximum salary in a dept?

Most likely you will copy the program and change it to use new calculations.

How does the same problem work with my OO design?

I can reuse my existing objects, and just add a new behavior to the department object.
One more example...

- Create a procedural program that takes input from the user as to their weight, and outputs to the screen their weight on the other planets.

- The formulas you will need are as follows:
  - Mercury = .37 * weight
  - Venus = .876 * weight
  - Mars = .381 * weight
  - Jupiter = 2.637 * weight
  - Saturn = 1.151 * weight
  - Uranus = .79 * weight
  - Neptune = 1.12 * weight
  - Pluto = .025 * weight

- weight = the weight on Earth.

procedural View

- Mercury = .37 * weight
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OO Model

- Calculations are distributed and contained within various objects.