



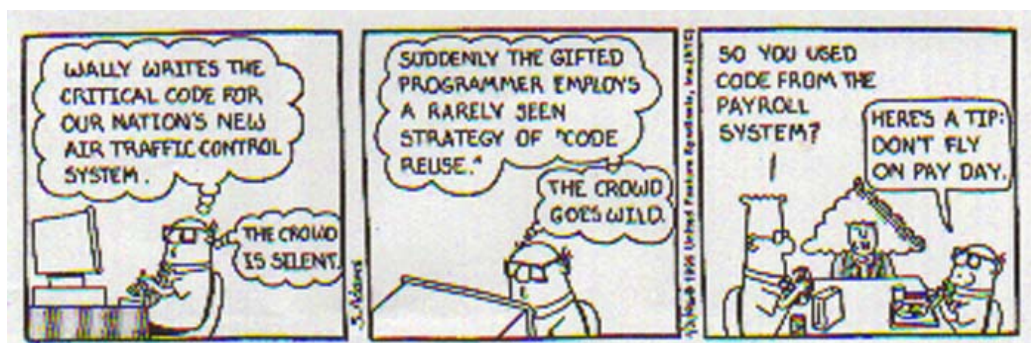


AP Computer Science A Inheritance Basics

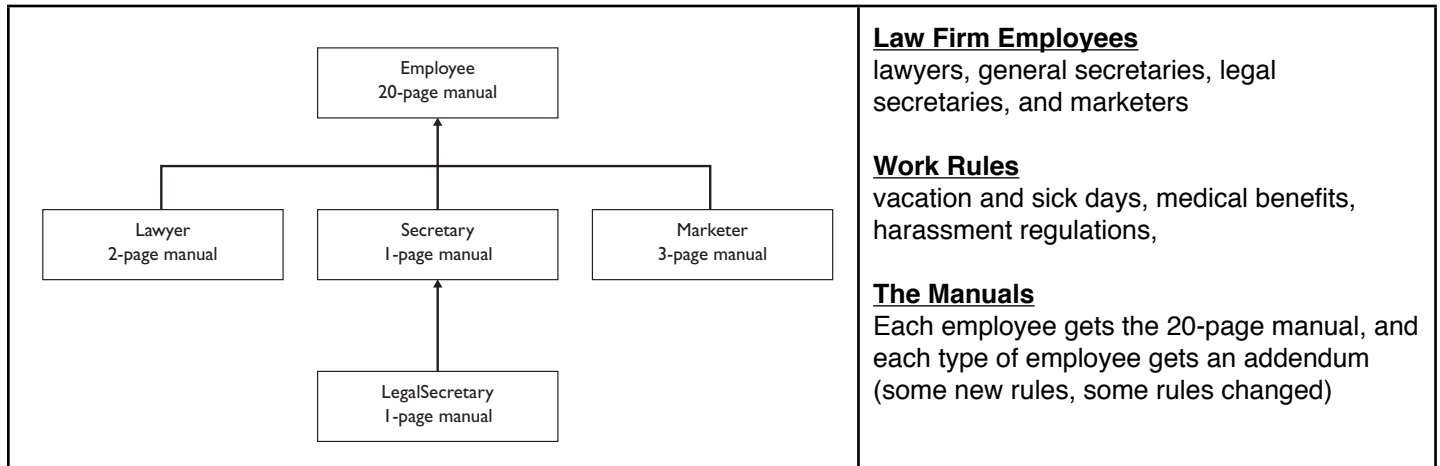
1970's Code Was Bad

 <p>AND THEN WE'LL BUILD A SECOND PROTOTYPE AND...</p> <p>IT'S NOT IN THE BUDGET</p> <p>OH, SUDDENLY IT'S MY FAULT FOR CARING ABOUT THE BUDGET.</p>	<p>Projects became more complex and frequently would go over budget</p>
 <p>HOW'S YOUR PROJECT COMING ALONG?</p> <p>IT'S A STEAMING PILE OF FAILURE.</p> <p>IT'S LIKE FIFTEEN DRUNKEN MONKEYS WITH A JIGSAW PUZZLE.</p> <p>HOW'S YOUR PROJECT COMING ALONG?</p> <p>FINE.</p> <p>© Scott Adams, Inc./Dist. by UFS, Inc.</p>	<p>More complex projects also had more bugs and were more likely to malfunction</p>
 <p>HOW LONG WILL YOUR PROJECT TAKE IF I ADD TWO PEOPLE?</p> <p>ADD ONE MONTH FOR TRAINING, ONE MONTH FOR THE EXTRA COMPLEXITY, AND ONE MONTH TO DEAL WITH THEIR DRAMA.</p> <p>BUT AFTER ALL OF THAT...</p> <p>THEY'LL BE AS USEFUL AS THIS MEETING.</p>	<p>Adding more people to projects made the problems WORSE (See: The Mythical Man Month by Fred Brooks)</p>
 <p>CARL QUIT. HE'S THE ONLY ONE WHO KNOWS HOW TO PROGRAM THE LEGACY SYSTEM.</p> <p>IT CAN'T BE THAT HARD. GO FIGURE IT OUT.</p> <p>FRACK.</p>	<p>Roughly 90% of time spent on projects was maintaining legacy code, only 10% on new code. Old code was commonly disorganized, redundant (ex: early GUI code), poorly commented, etc. Updating code generally lead to new bugs.</p>

Code Reuse -



Hierarchies



Why would it be a worse idea to create a 22 page manual for Lawyers, a 21 page manual for Secretaries, etc?

General Hierarchy Ideas

- 1) It's useful to be able to specify a broad set of rules that will apply to many related groups (the 20-page manual).
- 2) It's also useful to be able to specify a smaller set of rules specific to a particular group, and to be able to replace some rules from the broad set
- 3) Employee's in the Hierarchy follow an ____-__ relationship

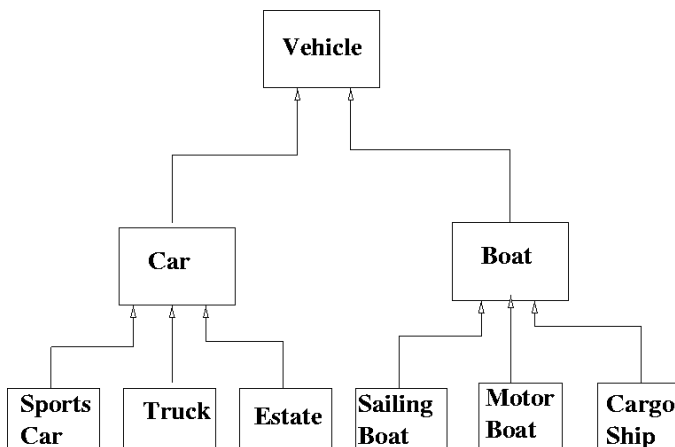
Is-A Relationship -

Example: Lawyer Is-A _____. LegalSecretary Is-A _____ and a _____.

If a class A has an IS-A relationship with class B, then class A can fill in for class B.

Example: If a Secretary gets sick, then a _____ can fill in for them.

Inheritance Hierarchy -



Extending a Class

The Situation

Employees	Hours / Week	Salary	Weeks Paid Vacation	Vacation Form	Special
Lawyer	40	\$40,000	3	Pink	Handle Lawsuit
Secretary	40	\$40,000	2	Yellow	Take Dictation
Legal Secretary	40	\$45,000	2	Yellow	File Legal Briefs
Marketer	40	\$50,000	2	Yellow	Advertise

Bad Java Code

<pre>public class Employee { public int getHours() { return 40; } public double getSalary() { return 40000.0; } public int getVacationDays() { return 10; } public String getVacationForm() { return "yellow"; } }</pre>	<pre>public class Secretary { public int getHours() { return 40; } public double getSalary() { return 40000.0; } public int getVacationDays() { return 10; } public String getVacationForm() { return "yellow"; } // this is the only added behavior public void takeDictation(String text) { System.out.println("Dictating text: " + text); } }</pre>
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What We'd Like To Do

```
public class Secretary {
    copy all the methods from the Employee class.

    // this is the only added behavior
    public void takeDictation() {
        System.out.println("I know how to take dictation.");
    }
}
```

We want the Secretary class to “get” all the methods from the Employee class - we accomplish this with _____.

Some Vocab

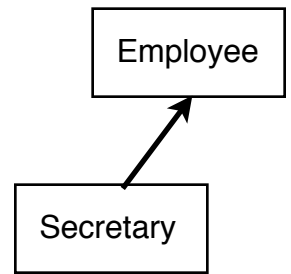
Inheritance - technique that allows a derived class to extend the functionality of a base class, inheriting all of its state and behavior.

Superclass (parent / base) -

Subclass (child / derived) -

Extends -

Single Inheritance -



General Java Code

```
public class <name> extends <superclass> {
    ...
}
```

Secretary Class Using Inheritance

```
public class Secretary extends Employee {
    public void takeDictation(String text) {
        System.out.println("Dictating text: " + text);
    }
}
```

Client Code

```
public static void main(String[] args) {
    Syso("Employee: ");
    Employee theo = new Employee();
    Syso(theo.getHours() + ", " + theo.getSalary() + ", " + theo.getVacationDays() + ", " + theo.getVacationForm());
    System.out.println();

    Secretary tracy = new Secretary();
    Syso(tracy.getHours() + ", " + tracy.getSalary() + ", " + tracy.getVacationDays() + ", " + tracy.getVacationForm());
    tracy.takeDictation("Hello World!");
    System.out.println();
}
```

Output:

Overriding Methods

The Secretary class only needed to add new functionality, but the other classes (Marketer, Lawyer, LegalSecretary) need to change inherited functionality. This is accomplished by overriding the inherited methods.

Override -

```
public class Lawyer extends Employee {
    // overrides getVacationDays from Employee class
    public int getVacationDays() {
        return 15;
    }

    // overrides getVacationForm from Employee class
    public String getVacationForm() {
        return "pink";
    }

    // this is the Lawyer's added behavior
    public void sue() {
        System.out.println("I'll see you in court!");
    }
}
```

```
public class LegalSecretary extends Secretary {
    // overrides getSalary from Employee class
    public double getSalary() {
        return 45000.0;
    }

    // new behavior of LegalSecretary objects
    public void fileLegalBriefs() {
        System.out.println("I could file all day!");
    }
}
```

Client Code

```
public static void main(String[] args) {
    Syso("Lawyer: ");
    Lawyer ali = new Lawyer();
    Syso(ali.getHours() + ", " + ali.getSalary() + ", " + ali.getVacationDays() + ", " + ali.getVacationForm());
    ali.sue();
    System.out.println();

    LegalSecretary tracy = new LegalSecretary();
    Syso(bryce.getHours() + ", " + bryce.getSalary() + ", " + bryce.getVacationDays() + ", " + bryce.getVacationForm());
    bryce.takeDictation("cool");
    bryce.fileLegalBriefs();
    System.out.println();
}
```

Output:

Super Type Variables / Sub Type Data - A Okay! (reverse, not so much)

```
Employee e1 = new Employee();      Employee e2 = new Lawyer();      Employee e3 = new Secretary();
Secretary s1 = new Employee();      Secretary s2 = new Secretary();  Secretary s3 = new LegalSecretary();
LegalSecretary ls1 = new LegalSecretary();  LegalSecretary ls2 = new Secretary();
```