CS100 **March 16, 2000**
Prelim 2 **7:30 PM – 9:00 PM**

_____ _____
(Print last name, first name, middle initial/name) (Student ID)

Statement of integrity: I did not, and will not, break the rules of academic integrity on this exam:

_____
(Signature)

Circle Your Section:

	Tuesday				Wednesday				Thursday
	PH 219	HO 401	HO 306	PH 403	PH 307	HO 401	HO 306	HO 320	HO 306
12:20				13 Yan					
1:25	1 Holland-Minkley	2 Yan	11 Artemov		6 Holland-Minkley	7 Rohde	10 Fan	14 Hande	12 Artemov
2:30	3 Holland-Minkley	5 Yan				8 Artemov			
3:35		4 Fan				9 Artemov			

Instructions:

- Read all instructions *carefully*, and read each problem *completely* before starting it!
- This test is closed book – no calculators, reference sheets, or any other material allowed.
- Initial or sign each page.
- Conciseness, clarity, and style all count. Show all work and comment code fragments to receive partial credit.
- Arrays are *not* allowed.
- You may *not* alter the structures surrounding blanks and boxes. **Only one statement or expression per blank!**
- Use the backs of pages if you need more space or scrap. You may request additional sheets from a proctor.
- If you supply multiple answers, we will grade only *one*.

Core Points:

1. _____ **(27 points)** _____

2. _____ **(15 points)** _____

3. _____ **(37 points)** _____

4. _____ **(21 points)** _____

Total: _____ **/ (100 points)** _____

Bonus Points: _____ **/ (9 bonus points)** _____

Problem 1 [27 points] *Nested Loops*

Write a program that reads a non-ascending sequence of even integers. Assume that the user enters only even integers. For each integer *n* , print a row of *n* stars (`*`). Your program must center each row of `*`s underneath the top row. Do not print any blank spaces at the beginning of the first row. A non-positive integer terminates the sequence. You must have comments for major variables, each loop, and a comment describing exactly how many blank spaces printed on each row before the `*`s.

Example: For the input sequence `10 4 4 2 -2`, the output would be

```
**********
 ****
 ****
  **
```

```
public class Problem1 {
   public static void main(String[] args) {
      TokenReader in = new TokenReader(System.in);
```

```
   }
}
```

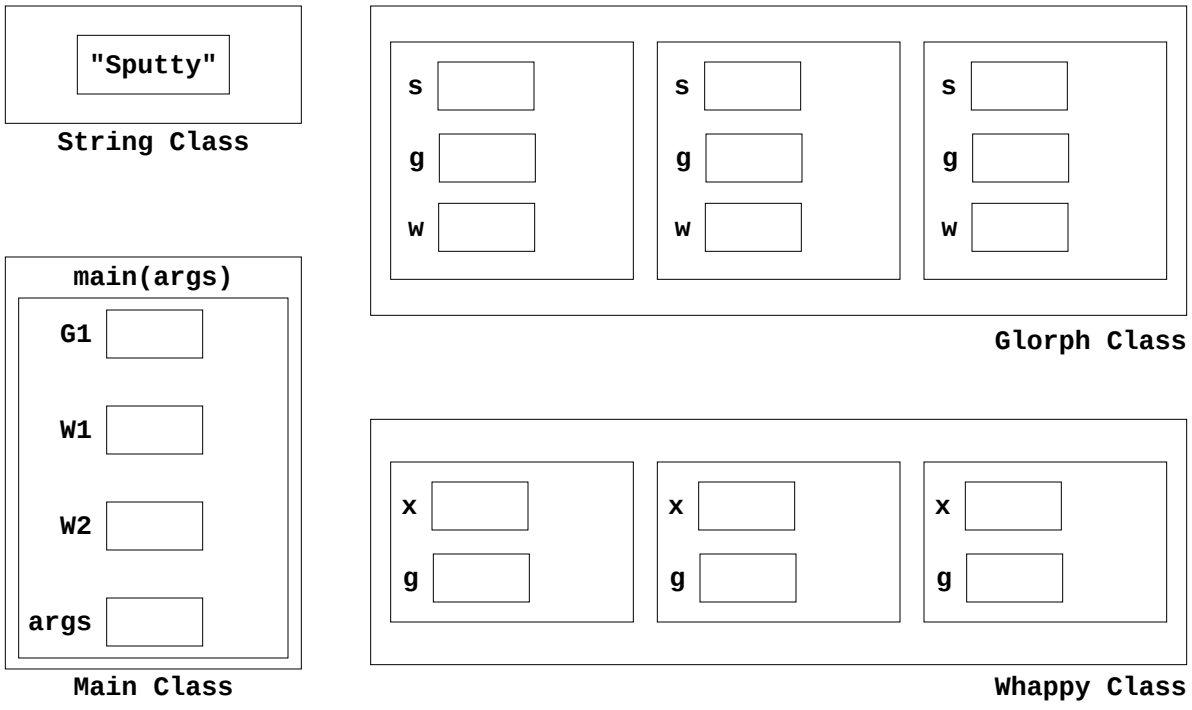
Problem 2 [15 points] *Tracing*

Fill in the box scope diagram below for the following code. For non-reference variables (**`int`**, **`double`**, **`boolean`**, etc.), write the value in the corresponding box. For reference variables, write **`null`** or draw an arrow from the reference variable to the object box. Fill in all default values for *instance* variables. If a variable has undetermined contents, draw a question mark ("?"). To update the contents of a variable, cross off the old contents and write the new contents nearby. "Cross off" means "draw a single, tidy **X** over the value or on the arrow." You *MUST* use only the boxes we've drawn for you.

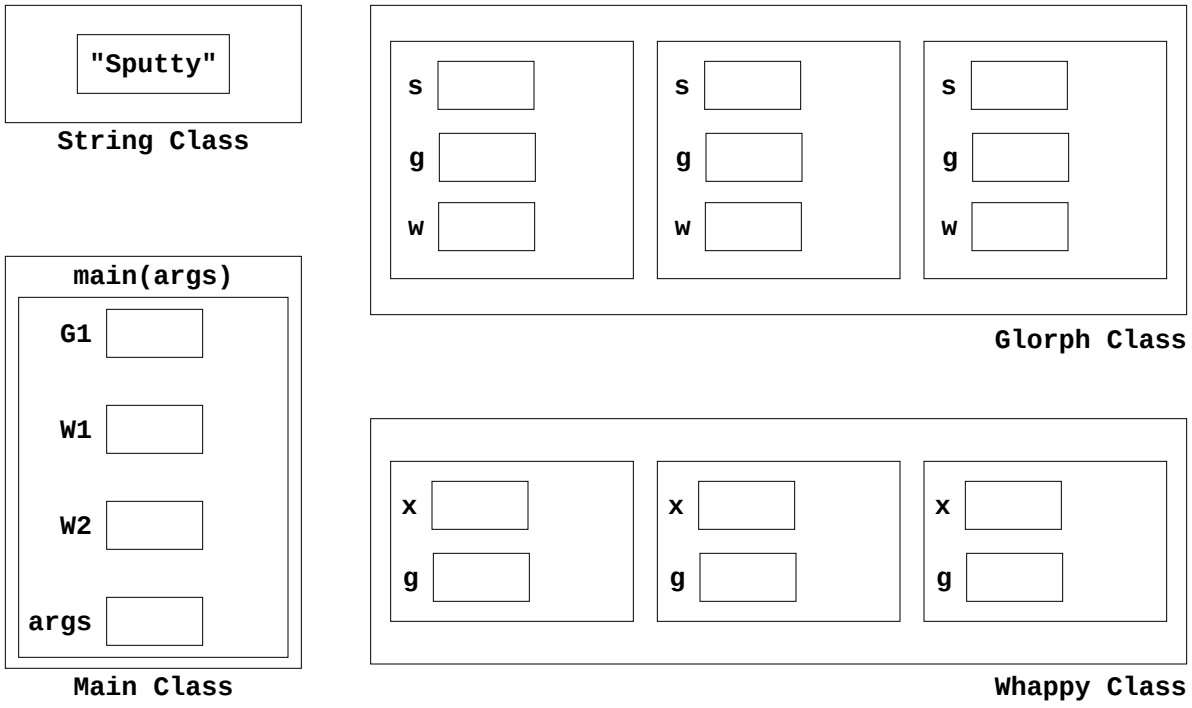
Note: We have provided a surplus of object boxes. You **must** cross off the unused *object* box(es). See the next page for spare boxes. **You must indicate which diagram we should grade!** Otherwise, we will choose just one to grade.

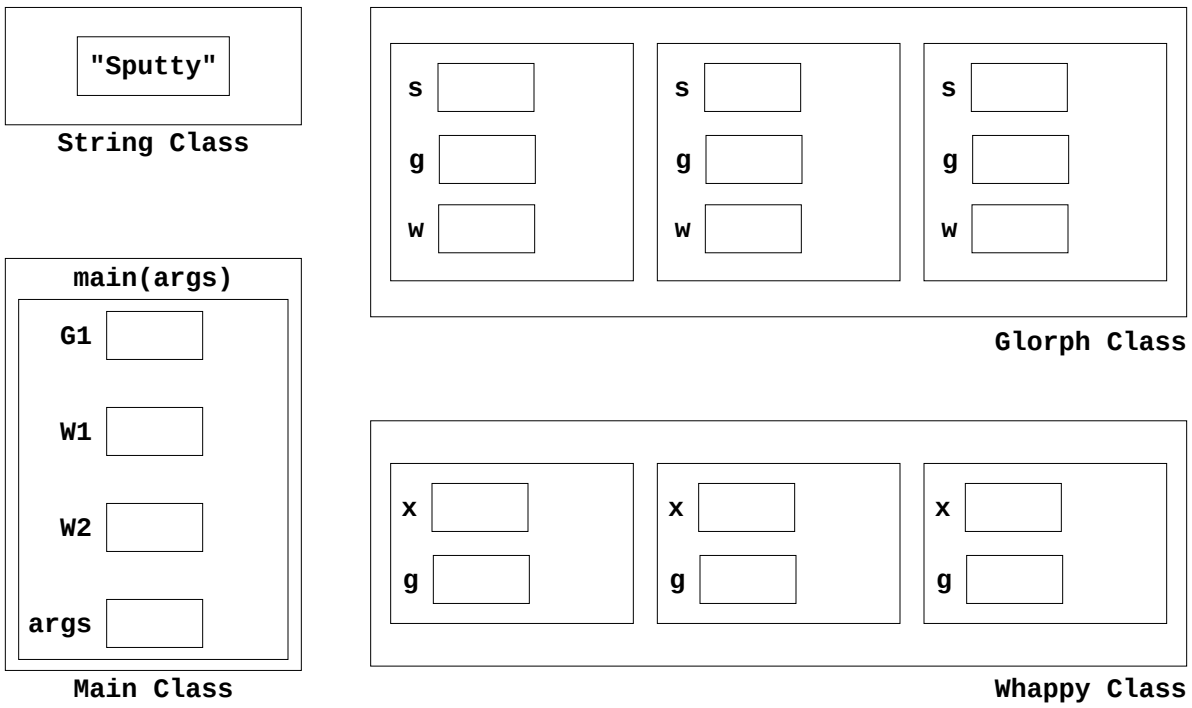
```
public class Problem2 {
   public static void main(String[] args) {
      Glorph G1 = new Glorph();
      Whappy W1 = new Whappy();
      G1.w=W1;
      W1.g=new Glorph();
      W1.g.w=W1;
      G1.w.g.s="sputty";
      ++W1.x;
      Whappy W2;
      new Whappy();
      ++G1.w.g.w.x;
      // Fill in diagram up to this point!
   }
}
```

```
class Glorph {
   String s;
   Glorph g;
   Whappy w;
}
class Whappy {
   int x;
   Glorph g;
}
```



Spare Boxes for Problem 2





Problem 3 [37 points] *OOP: Design a class; See the figure in Problem 4 for a picture*

Fill in the ***3 blanks*** and ***2 boxes*** below to complete the code for a class **`Worker`** to represent people working in a company. Each **`Worker`** has exactly the following instance variables – do *not* define additional instance variables:

- **`id`**: her or his ID number (an integer).
- **`boss`**: a reference to the **`Worker`**, if any, who is her or his boss.

Each **`Worker`** has exactly the following methods – do *not* define additional methods or constructors:

- **`owner()`**: return the reference to the *owner* of the company, the "top-most" **`Worker`** who has no boss.
- **`describe()`**: return a **`String`** that contains the ID, ID of the boss, and ID of owner. For the case of the owner, use `"NO BOSS"` in place of the boss's ID. You must include labels for each item! For example, a returned **`String`** might be `"ID: 10, ID for boss: NO BOSS, ID for owner: 10"`.

Notes: This approach means a **`Worker`** does not "know" its underlings – there are no links "down."

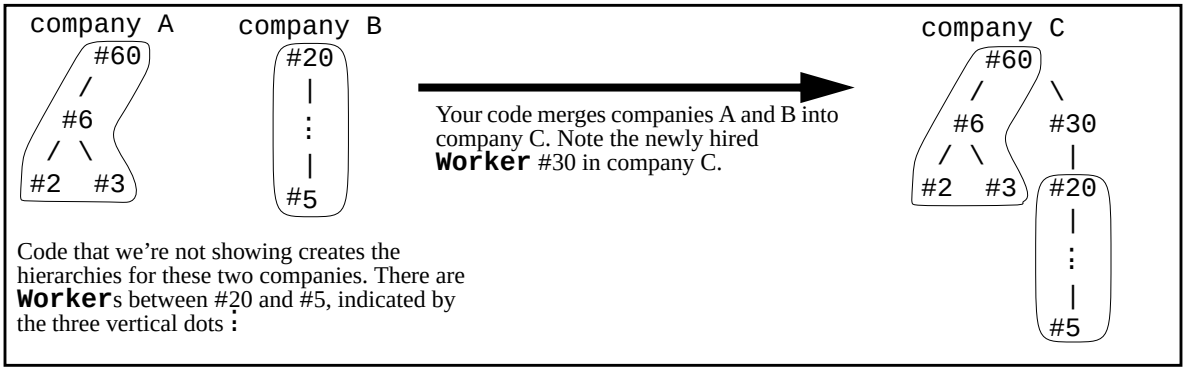
```
class Worker {

   _____________________________________ ; // ID

   _____________________________________ ; // reference to boss

   // Return reference to owner. For full credit, use a loop!
   Worker owner() {
```

```
   } // method owner

   // Return a String containing IDs of self, boss, and owner

   ____________________ describe()   { // Fill in the return type!
```

```
   } // method describe
} // class Worker
```

Problem 4 [21 points] *OOP: Using a class*

This problem uses a Main Class called **`Problem4`** that accesses class **`Worker`** from Problem 3. Assume that class **`Worker`** has been completely and correctly defined. The **`main`** method instantiates **`Worker`**s and establishes the links that relate **`Worker`**s and their bosses. Let the notation #*w* represent the **`Worker`** whose ID is *w*. The figure below shows the links for companies A, B, and C using **`Worker`** IDs. Thus, the owner of company A is #60, the **`Worker`** whose ID is 60. Also, #60 is the boss of #6, who is the boss of #2 and #3:



Fill in the 7 blanks to complete method **`main`**, below. Assume different companies have different **`Worker`**s, and hence, different owners. Thus, two companies are the same if they have the same owner. **Read the comments!**

```
public class Problem4 {
   public static void main(String[] args) {
      Worker sixty;       // Worker #60
      Worker five;        // Worker #5
      Worker x; Worker y; // References to unspecified and different Workers

      // Establish companies A, B, and others.
      // Make $x$ and $y$ refer to instances of different Workers.

         ⇕  Code That We're Not Showing, So Don't Ask!

      // Use $thirty$ to establish company C as shown in the figure, above.
      // Use variables $sixty$ and $five$, which refer to #60 and #5, resp.
         Worker thirty = _____; // Instantiate #30

         _____; // Set ID of #30 to 30

         _____; // Link #30 and #60

         _____; // Link #30 and #20
      // Print a description of the owner of the company where $x$ works
         _____
      // If $y$ and $x$ work for the same company, do nothing. Otherwise,
      // print a description of the owner of the company where $y$ works.
         _____

         _____
   } // method main
} // class Problem4
```

Use instance variables **`id`** and **`boss`** and methods **`owner()`** and **`describe()`** from class **`Worker`** in Problem 3.

Bonus: [9 bonus points] *Don't work on this until 100% done with CORE problems!*
Do NOT attempt any of these bonus problems until you have completed ***all*** the core problems. Do NOT answer any bonus problems that you're not sure how to answer:
+ (Mostly) correct answers will be rewarded with bonus points.
0 Unanswered bonus problems will be neither penalized or rewarded.
– (Mostly) incorrect answers will be penalized bonus points.

B1) [2 bonus pts] How many total possible Project points are there? _____

How many of those are required for a perfect Project score? _____

B2) [2 bonus pts] Prof. Yan posted an IMPORTANT message on the newsgroup about a "secret weapon" for loops.

What was his or JavaLive's **two-word** term for the secret weapon? _____ _____

Let the two blanks _____ _____ represent that two-word term. Now, using that term, what is a suitable _____ _____ for a loop to fill an empty tank with 100 liters of water in 50 seconds? Assume that variable **`time`** measures the number of elapsed seconds.

B3) [2 bonus pts] Write method **`owner()`** recursively, i.e. without using loops. (Recall: you were required to use a loop for your solution in Problem 3.)

B4) [2 bonus pts] Recall that class **`Parthon`** on Project 4 has instance variables **`parent`**, **`youngestChild`**, **`olderSibling`** and method **`describe`**. (You don't need the other instance variables and methods for this problem.) Write a recursive method **`dtd()`** to describe all the teenage descendants of a **`Parthon`**. You may also describe some or all of the **`Parthon`**'s siblings' descendants. The descendants of a **`Parthon`** are itself, its children, its children's children, etc. Teenagers have ages between 13 and 19, inclusive.

B5) [1 bonus pt] Suppose we add to class **`Worker`** a constructor **`Worker(i,b)`** that initializes its **`id`** to **`i`** and its **`boss`** to **`b`**. Draw the picture of worker relationships established by the code below. (Draw in the style of the figure in Problem 4, not in the style of box/scope diagrams.)

```
new Worker(1,
    new Worker(2,
        new Worker(3,
            new Worker(4, null)
        ).boss
    )
);
```

draw your picture here