

7-8

CS 1401, Exam #4, TR version

Date: Tuesday, November 26, 2013

Name (please type legibly, ideally in block letters):

$$\frac{60}{60} = \frac{100}{100}$$

November 26, 1607, is the birthday of John Harvard, who founded the Harvard College now known as the Harvard University, one of the top universities in the world.

1. List, in detail, contributions of US scientists to computing. What motivated their discoveries -- e.g., punchcards? computers?

One important contribution is the UNIVAC computer. Developed for military use at Los Alamos, it took punchcard input and was able to do complex calculations.

Another important US contribution was Bell Lab's development of the C programming language. A higher level language, it allows programmers to generically program code instead of using machine-specific assembly.

$$\frac{12}{12}$$

10/10

2a. Companies support discoveries because they often bring more profit than what we invested. The profitability of a discovery can be measured by the ratio of its profit to the amount of investment made into this discovery. Write a method named *profitability* that, given the profit p caused by the discovery and the investment i , returns the corresponding ratio. In your method, throw an exception to take into account situations when the investment is zero.

2b. Throw an additional exception when the investment is negative.

2c. Call (invoke) your method *profitability* in the *main* method to compute the profitability of a discovery. Use try-catch in your main method to catch the two exceptions and print the corresponding error messages. On the example when a company earns \$10,000,000 profit after an investment of \$2,000,000, trace, step by step, how the computer will perform the needed computations, and check that the result is indeed correct.

```

a) public static double profitability(double p, double i) throws IllegalArgumentException
{
    if (i == 0) throw new IllegalArgumentException("Cannot divide by zero.");
    return p/i;
}

b) // add after if(i==0) line
    else if (i < 0) throw new IllegalArgumentException("Investment cannot be negative.");

c) public static void main(String[] Args)
{
    // use p = 10,000,000 + i = 2,000,000
    try
    {
        double profitRatio = profitability(10000000, 2000000);
    }
    catch (IllegalArgumentException e)
    {
        System.out.println(e.getMessage());
    }
}

```

Trace:

main

profit Ratio 5

profitability

P 10000000

I 2000000

if i == 0 fail

if i < 0 fail

return 5

10/10

3a. Define a class *Discovery* whose objects are discoveries. The description of each discovery should contain its title, the corresponding investment, and the corresponding profit. Your class should contain a constructor method, get- and set-methods, and a method for computing the discovery's profitability.

3b. Use your class in the *main* method to define a new object *computer* of type *Discovery*; assume that it earned the profit of \$10,000,000,000 after an investment of \$10,000,000. Compute and print his productivity. While you are computing, the profit increased to \$20,000,000,000. Use the set-methods to update the values in the corresponding object, and compute and print its updated profitability.

3c. Trace your program step-by-step.

```
a) public class Discovery
{
    private String title;
    private double investment, profit;

    // default constructor
    public Discovery ()
    {
        title = "Empty Discovery";
        investment = 1;
        profit = 1;
    }

    public Discovery (String t, double i, double p)
    {
        title = t;
        investment = i;
        profit = p;
    }

    public String getTitle ()
    {
        return title;
    }

    public double getInvestment ()
    {
        return investment;
    }

    public double getProfit ()
    {
        return profit;
    }

    public void setTitle (String t)
    {
        title = t;
    }
}
```

```
public void setInvestment (double i)
{
    investment = i;
}

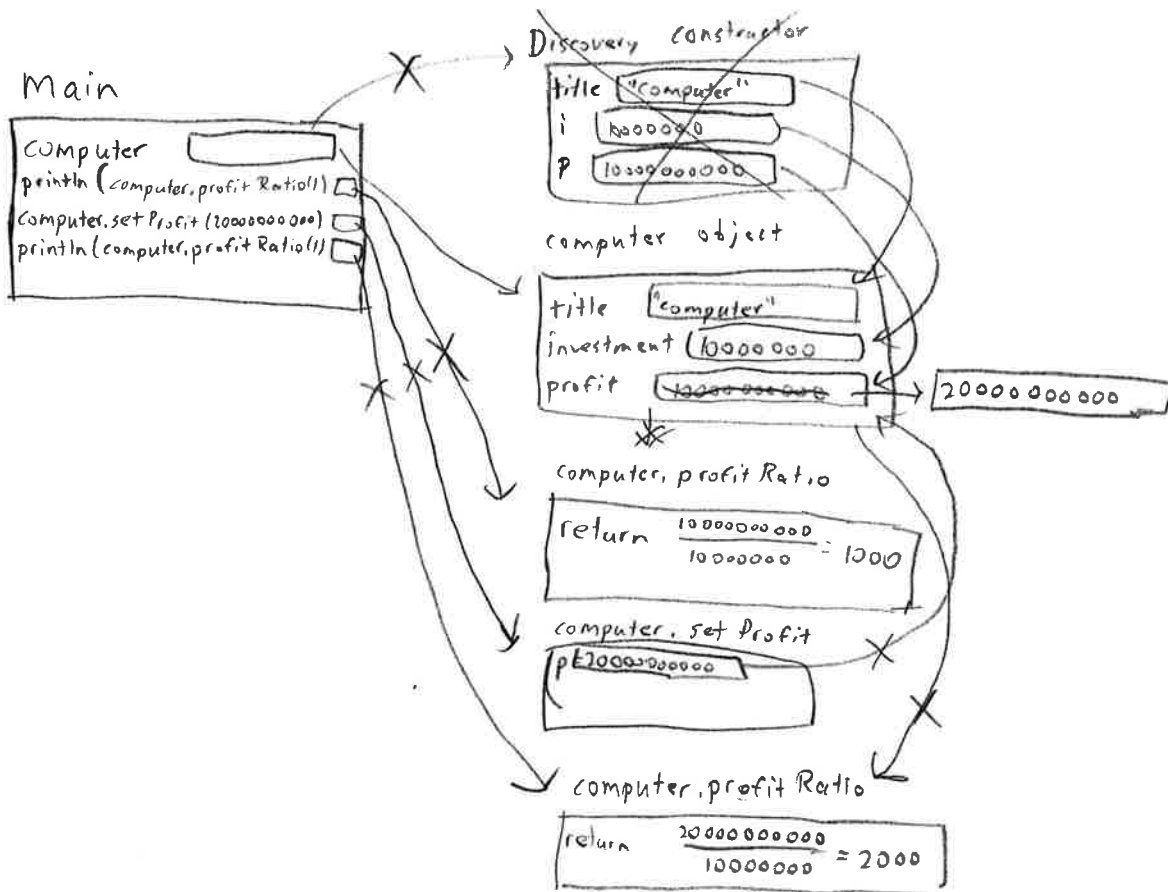
public void setProfit (double p)
{
    profit = p;
}

public double profitRatio ()
{
    // divide by 0 ok w/ double, no catch
    // needed
    return p/i;
}
}
```

```
b) public static void main (String[] arg)
{
    Discovery computer = new Discovery ("computer",
                                        10000000, 10000000000);

    System.out.println (computer.profitRatio());
    computer.setProfit (20000000000);
    System.out.println (computer.profitRatio());
}
```

c) on back



print area

```
1000  
2000
```

- 4a. Write a method that, given an array of discoveries, returns the title of the most profitable discovery.
- 4b. Test your method in the main program, by applying it to two discoveries: computer and car; assume that the profit from the car discovery is \$100,000,000,000 and the investment was \$10,000,000,000. Trace the resulting code.
- 4c. Describe general rules for black-box and white-box program testing.

```

a) public static String mostProfitable(Discovery[] array)
{
    double highDouble = array[0].profitRatio();
    String highTitle = array[0].getTitle();
    for (int i = 1; i < array.length; i++)
    {
        if (array[i].profitRatio() > highDouble)
        {
            highDouble = array[i].profitRatio();
            highTitle = array[i].getTitle();
        }
    }
    return highTitle;
}

```

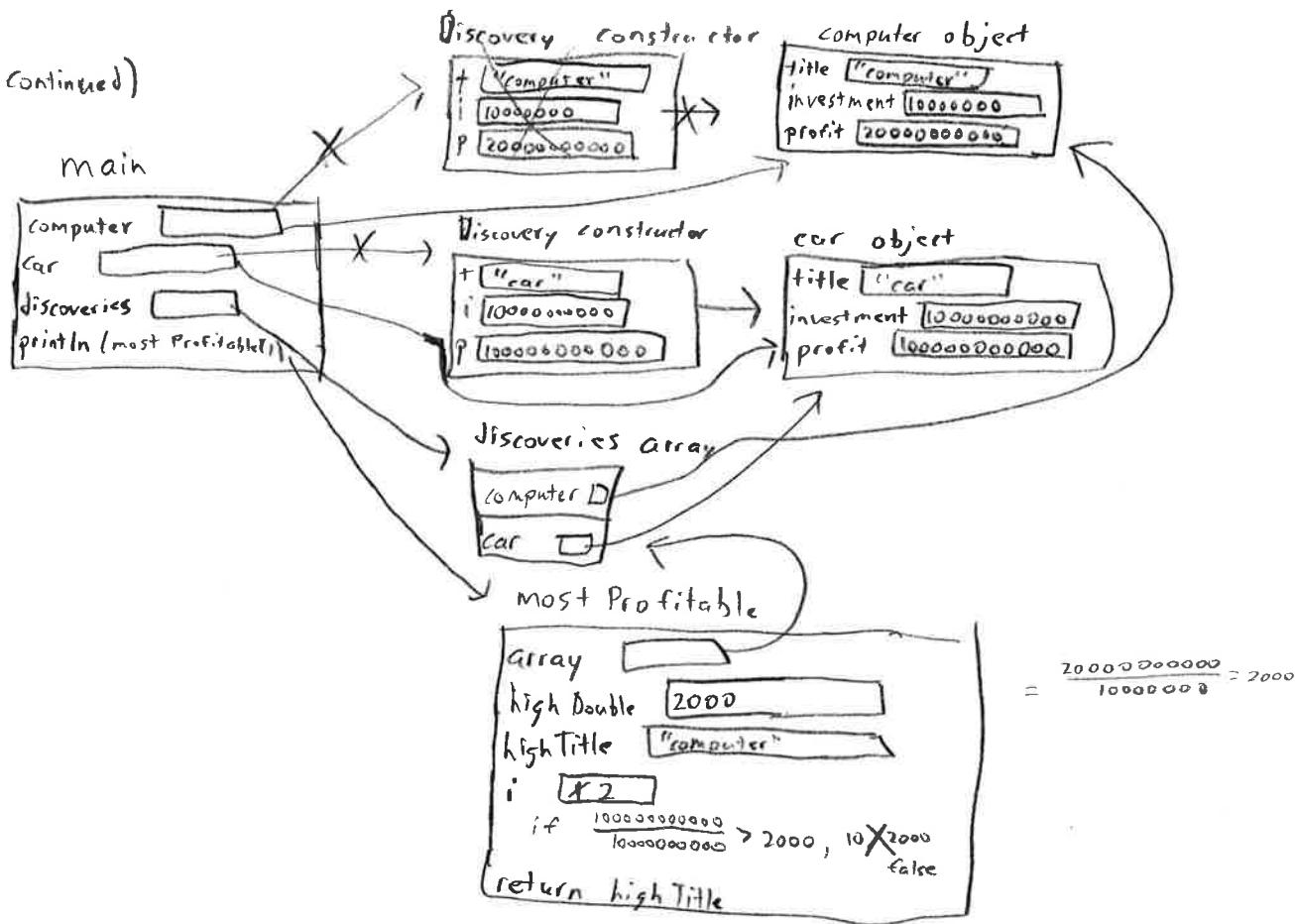
```

b) public static void main(String[] args)
{
    Discovery computer = new Discovery("computer", 10000000, 200000000000);
    Discovery car = new Discovery("car", 10000000000, 1000000000000);
    Discovery[] discoveries = { computer, car };
    System.out.println(mostProfitable(discoveries));
}

```

Trace + c on back

b continued)



print area

computer

- c) For black box testing, use extreme values, common values, and random values to test. For white box testing, test each branch of a program (if/else statements, switches, loops) to confirm proper functionality.

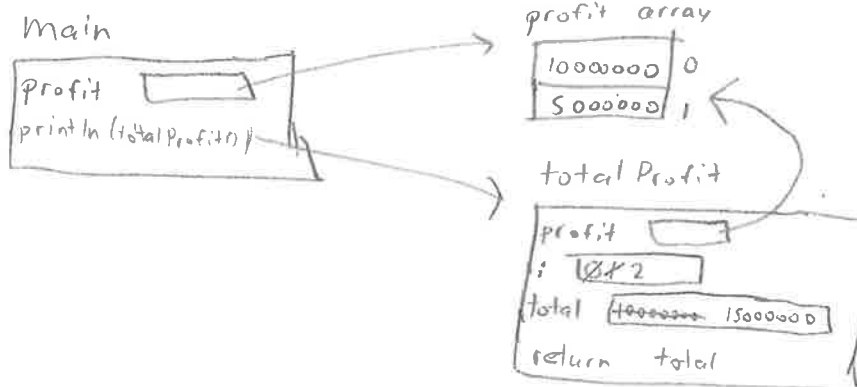
10/10

5a. Write a method that, given the array *profit* of profits from different discoveries made by the company staff, returns the profit from all the discoveries made by the company.

5b. In the main method, apply your code to the array consisting of two values 10,000,000 and 5,000,000; trace your code, step-by-step, and check that your method returns the correct number 10,000,000 + 5,000,000 = 15,000,000.

```
a) public static double totalProfit(double[] profit)
{
    double total = 0;
    for (int i = 0; i < profit.length; i++) total += profit[i];
    return total;
}
```

```
b) public static void main(String[] args)
{
    double[] profit = { 10000000, 5000000 };
    System.out.println(totalProfit(profit));
}
```



print area

15000000

10/10

6. Give at least two reasons why it is not ethical to use someone's patented idea without paying the proper royalties. For example, is it fair to the author of the original idea? Is it fair to the company that paid money to develop this idea? Is it fair to the users who will suffer from lack of new developments if -- due to lack of profit -- companies will stop investing in them?

One reason it is not ethical is because patent theft discourages invention. Inventions help society advance, so a decrease in invention is bad for society, and unethical.

Another reason is because it hurts commerce. If the company or person is deprived of profits from their patent, then they cannot invest that money in new inventions, more employees, more equipment, and many other things that drive the economy. A healthy economy is vital for society to thrive.