



**1. Matching [ 7 pts ]**

Select the **best** word for each of the definitions below by writing the appropriate letter in the blank beside the word.

1. \_\_\_\_\_ A recursively defined data structure in which each node can have up to two children.
  2. \_\_\_\_\_ An input stream typically associated with the keyboard.
  3. \_\_\_\_\_ A class which provides the ability to split up Strings based on some delimiter.
  4. \_\_\_\_\_ A collision resolution method in which spaces are tried with an increasing number of skipped spaces in between until an open one is found.
  5. \_\_\_\_\_ A block of code that is always run whether or not an exception is thrown in the corresponding try block.
  6. \_\_\_\_\_ The term for causing an exception to occur and propagate up the stack.
  7. \_\_\_\_\_ A class which wraps some other class to provide more convenient functionality.
- A. Standard Input
  - B. Binary Tree
  - C. Standard Output
  - D. String Tokenizer
  - E. Standard Error
  - F. Linear Probing
  - G. Try-catch
  - H. Exception
  - I. Finally
  - J. Stream
  - K. External Chaining
  - L. Quadratic Probing
  - M. Collision
  - N. Load Factor
  - O. Rehash
  - P. Decorator Class
  - Q. Quadratic Probing
  - R. Enumeration
  - S. Throw

## 2. Swap [ 10 pts ]

A java programmer wrote the following code:

```
public class Swapper{
    public static void swap(int a, int b){
        int temp=a;
        a=b;
        b=a;
    }//swap
    public static void main(String[] args){
        int x=3;
        int y=57;
        swap(x,y);
        System.out.println("x = " + x +" y = " + y);
    }//main
}//class Swapper
```

The java programmer expected the output to be

x = 57 y = 3

- 1 (a) Is this the actual output? If not, what is the correct output?
- 4 (b) If the program did not work as the programmer expected, explain why. If it did work as expected, explain why it works.

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Another java programmer wrote the following code:

```
public class ArraySwapper{
    public static void swap(int[] data, int index1, int index2){
        int temp=data[index1];
        data[index1]=data[index2];
        data[index2]=temp;
    }//swap
    public static void main(String[] args){
        int[] data={9,33};
        swap(data,0,1);
        System.out.println("data[0] = "+data[0]+" data[1] = "+data[1]);
    }//main
}//end class ArraySwapper
```

The java programmer expected the output to be

data[0] = 33 data[1] = 9

- 1 (c) Is this the actual output? If not, what is the correct output?
- 4 (d) If the program did not work as the programmer expected, explain why. If it did work as expected, explain why it works.

### 3. Exceptions [ 10 pts ]

Given the following code fragment (with some lines numbered on the left- note that the line numbers do not affect the code's functionality):

```
    try{
1:        x=3;
2:        somethingHere();
3:        y=7;
    }
    catch(IOException ioe) {
4:        System.err.println(ioe);
    }
    catch(NumberFormatException nfe) {
5:        System.err.println(nfe);
    }
    catch(Exception e) {
6:        System.err.println(e);
    }
    finally {
7:        System.out.println("all done");
    }
8: System.out.println("the end.");
```

Write **in the correct order** the *line numbers* for the lines that execute in the code above if

5 (a) **somethingHere()** does not throw any type of Exception.

5 (b) **somethingHere()** throws a IOException.

**4. File IO [ 16 pts ]**

Write the method `public Object readObjectFromFile(String filename)` which

1. opens `filename` appropriately to read Objects
2. reads an Object from it
3. ensures that everything is properly closed
4. returns the Object read from the stream
5. if any errors occur, the message "An error occurred" is printed to standard output

You may wish to remember the following classes from P3:

- `FileInputStream`
- `ObjectInputStream`

```
public Object readObjectFromFile(String filename) {
```

```
}
```

## 5. HashTables [ 15 pts ]

- 7 (a) Show the resulting HashTable when the following <key,data> pairs are added. The un-modded hashCode for the key is given in parenthesis after the pair. (You may add to the front or to the back, whichever you prefer).
- <"Americana", "Offspring"> (98)
  - <"Ten", "Pearl Jam"> (65)
  - <"Siamese Dream", "Smashing Pumpkins"> (2)
  - <"6teen Stone", "Bush"> (77)
  - <"Throwing Copper", "Live"> (43)
  - <"Nevermind", "Nirvana">(13)
  - <"Freaky Styley", "Red Hot Chili Peppers">(7)

The HashTable is of size 5 and uses external chaining. (Hint: you will be drawing a picture to answer this question). You may show only the **data** in your drawing.

- 4 (b) Explain what a collision is, and why they are a problem.

- 4 (c) Besides external chaining, name and explain another collision resolution method used in HashTables.

## 6. Useful Tools [ 10 (+5) pts ]

For this question you may choose to do **either** (a) **or** (b) for the full 10 points, or you may do **both** for **+5 extra credit**. If you do both, it will be assumed that whichever you write first is to be graded for 10 points, and whichever is second is to be graded for 5 points of extra credit, unless you indicate otherwise. You may wish to recall that Enumeration is declared as

```
public interface Enumeration{
    public boolean hasMoreElements();
    public Object nextElement();
} //end Enumeration
```

- (a) Write the method **public void printEnum(Enumeration e)** which prints out all elements in the Enumeration **e**, one per line.
- (b) Write the method **public String lastWord(String s)** which returns the last word in the String. Words are delimited by whitespace (space, tab, or newline)- the default delimiter for **StringTokenizer**. If **s** is the empty String, this method should return the empty String, **""**. You may assume that **s** is not *null*.

## 7. HashTables [ 16 pts ]

Give the following HashNode class:

```
public class HashNode{
    private Object data;
    private Object key;
    private HashNode next;
    public HashNode(Object k, Object d){key=k; data=d;}
    public void setData(Object d){data=d;}
    public Object getData() {return data;}
    public void setKey(Object k){key=k;}
    public Object getKey() {return key;}
    public void setNext(HashNode n) {next=n;}
    public HashNode getNext() {return next;}
} //class HashNode
```

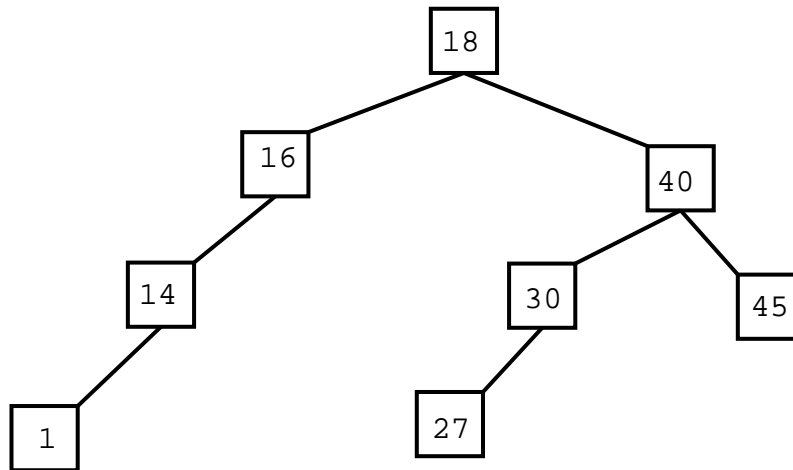
Write the method **public void add(Object key, Object data)** in class **HashTable**. You may write any helper methods you wish. The HashTable is externally chained- you may add to the front or the back of the chain, whichever you prefer.

```
public class HashTable {
    private HashNode [] hTable;
    public HashTable(int size) {
        hTable=new HashNode[size];
    } //HashTable(int)
    public int getHashKey(Object key) {
        return Math.abs(key.hashCode() % hTable.length);
    }
    public void add(Object key, Object data){
        // YOUR CODE GOES HERE

    }
}
```

## 8. Binary Search Trees [ 16 pts ]

Given the following BST:



- 4 (a) Add 0, 15, 35, 47 (in that order) to the tree, and draw the resulting tree. You only need to draw the final tree. Draw your changes on the tree above.
- 4 (b) Perform an preorder traversal of the **original** tree, printing each node, and write the output:
- 4 (c) Perform an postorder traversal of the **original** tree, printing each node, and write the output:
- 4 (d) Perform an inorder traversal of the **original** tree, printing each node, and write the output: