

Question 1: Methods and Control Structures**9 points****Canonical solution**

a.

```
public int walkDogs(int hour)
{
    int dogsToWalk = company.numAvailableDogs(hour);

    if (dogsToWalk > maxDogs)
    {
        dogsToWalk = maxDogs;
    }

    company.updateDogs(hour, dogsToWalk);
    return dogsToWalk;
}
```

4 points

b.

```
public int dogWalkShift(int startHour, int endHour)
{
    int totalPay = 0;

    for (int hour = startHour; hour <= endHour; hour++)
    {
        int dogs = walkDogs(hour);
        int hourPay = 5 * dogs;
        if (dogs == maxDogs || (hour >= 9 && hour <= 17))
        {
            hourPay += 3;
        }
        totalPay += hourPay;
    }
    return totalPay;
}
```

5 points

a. walkDogs

Scoring Criteria		Decision Rules	
1	Calls <code>DogWalkCompany</code> method(s) on <code>company</code>	Responses can still earn the point even if they - fail to save or use the returned value - call <code>numAvailableDogs</code> more than once - only call one of the methods Responses will not earn the point if they - use the incorrect parameter types - call either <code>numAvailableDogs</code> or <code>updateDogs</code> on nothing or on something other than <code>company</code>	1 point
2	Compares available dogs and <code>maxDogs</code> to determine number of dogs to walk	Responses can still earn the point even if they - call <code>numAvailableDogs</code> incorrectly - calculate an incorrect number of dogs that were walked	1 point
3	Calls <code>numAvailableDogs</code> with <code>hour</code> and <code>updateDogs</code> with <code>hour</code> and correct number of dogs to walk (<i>algorithm</i>)	Responses can still earn the point even if they - call either method on nothing or on something other than <code>company</code> Responses will not earn the point if they - calculate an incorrect number of dogs that were walked	1 point
4	Returns calculated value	Responses can still earn the point even if they - calculate an incorrect number of dogs that were walked - call <code>numAvailableDogs</code> multiple times Responses will not earn the point if they - return something other than an <code>int</code> - fail to return a value in some cases - print a value in addition to or instead of returning it	1 point

b. `dogWalkShift`

Scoring Criteria		Decision Rules	
5	Loops from <code>startHour</code> to <code>endHour</code> , inclusive	Responses can still earn the point even if they return from the loop early, as long as bounds would otherwise be correct	1 point
6	Calls <code>walkDogs</code> with <code>int</code> parameter (<i>in the context of a loop</i>)	Responses can still earn the point even if they - fail to save or use the returned value Responses will not earn the point if they - use an incorrect parameter type on any call to <code>walkDogs</code> - call the method on the class or on an object other than <code>this</code> (use of <code>this</code> is optional)	1 point
7	Calculates base pay for an hour	Responses can still earn the point even if they - fail to include the calculation in the loop - call <code>walkDogs</code> incorrectly	1 point
8	Calculates possible bonus for an hour's pay	Responses can still earn the point even if they - call <code>walkDogs</code> multiple times inside the loop - fail to include the calculation in the loop Responses will not earn the point if they - count the bonus twice when both conditions are true - count the bonus only when both conditions are true - count the bonus when it has not been earned - calculate bonus incorrectly	1 point
9	Accumulates total pay (<i>algorithm</i>)	Responses can still earn the point even if they - calculate base pay or bonus incorrectly - fail to return total pay (<i>return not assessed in this part</i>) Responses will not earn the point if they - fail to initialize variable used for total pay - call <code>walkDogs</code> multiple times inside the loop - do not accumulate base and bonus in the context of a loop - return from the loop early	1 point
Question-specific penalties			
None			

Applying the Scoring Criteria

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1-Point Penalty

- v) Array/collection access confusion (`[] get`)
- w) Extraneous code that causes side-effect (e.g., printing to output, incorrect precondition check)
- x) Local variables used but none declared
- y) Destruction of persistent data (e.g., changing value referenced by parameter)
- z) Void method or constructor that returns a value

No Penalty

- Extraneous code with no side-effect (e.g., valid precondition check, no-op)
- Spelling/case discrepancies where there is no ambiguity*
- Local variable not declared provided other variables are declared in some part
- `private` or `public` qualifier on a local variable
- Missing `public` qualifier on class or constructor header
- Keyword used as an identifier
- Common mathematical symbols used for operators ($\times$ • $\div$ $\leq$ $\geq$ $<>$ $\neq$)
- `[]` vs. `()` vs. `<>`
- `=` instead of `==` and vice versa
- `length/size` confusion for array, `String`, `List`, or `ArrayList`; with or without `()`
- Extraneous `[]` when referencing entire array
- `[i,j]` instead of `[i][j]`
- Extraneous size in array declaration, e.g., `int[size] nums = new int[size];`
- Missing `;` where structure clearly conveys intent
- Missing `{ }` where indentation clearly conveys intent
- Missing `()` on parameter-less method or constructor invocations
- Missing `()` around `if` or `while` conditions

Spelling and case discrepancies for identifiers fall under the "No Penalty" category only if the correction can be **unambiguously inferred from context, for example, "ArrayList" instead of "ArrayList". As a counterexample, note that if the code declares `"int G=99, g=0;"`, then uses `"while (G < 10)"` instead of `"while (g < 10)"`, the context does **not** allow for the reader to assume the use of the lower case variable.*

2025 Digital Decision Rules

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No Penalty

- `:` instead of `;` and vice versa
- `,` instead of `;` and vice versa

Question 2: Class**9 points****Canonical solution**

```
public class SignedText
{
    private String firstName;
    private String lastName;

    public SignedText(String first, String last)
    {
        firstName = first;
        lastName = last;
    }

    public String getSignature()
    {
        String sig = "";
        if (!firstName.equals(""))
        {
            sig += firstName.substring(0, 1) + "-";
        }
        sig += lastName;
        return sig;
    }

    public String addSignature(String textStr)
    {
        String sig = getSignature();
        int index = textStr.indexOf(sig);

        if (index == -1)
        {
            return textStr + sig;
        }
        else if (index == 0)
        {
            return textStr.substring(sig.length()) + sig;
        }
        else
        {
            return textStr;
        }
    }
}
```

9 points

SignedText

Scoring Criteria		Decision Rules	
1	Declares class header: <code>class SignedText</code>	Responses will not earn the point if they - declare the class as <code>private</code> - include extraneous code outside the class - include <code>()</code> with or without parameters in the class header	1 point
2	Declares all appropriate <code>private</code> instance variable(s) and constructor initializes instance variable(s) using appropriate parameters	Responses can still earn the point even if they - create and store the signature using only one <code>String</code> instance variable Responses will not earn the point if they - declare any instance variables <code>static</code> - omit <code>private</code> in instance variable declaration - declare variables outside the class - declare an instance variable inside the constructor - fail to use either parameter - assign values to instance variables from an unknown source - assign initial value to local variable instead of instance variable, even if the local variables are declared as <code>private</code> - assign parameter(s) to variable(s) with incompatible data type - return a value from the constructor - define the constructor inside a method or define a method inside the constructor	1 point
3	Declares constructor header: <code>SignedText(String ____, String ____)</code>	Responses will not earn the point if they declare the constructor as <code>private</code> or <code>static</code>	1 point
4	Declares method headers: <code>public String getSignature() public String addSignature(String ____)</code>	Responses will not earn the point if they - omit <code>public</code> in either method header or declare either method as something other than <code>public</code> - use incorrect method name - use incorrect return or parameter type	1 point
5	Compares first name to the empty string	Responses can still earn the point even if they perform the comparison implicitly (e.g., by comparing the string's length to 0)	1 point

6	Determines appropriate signature string in both cases (<i>algorithm</i>)	Responses can still earn the point even if they - fail to return a value in some cases (<i>return from <code>getSignature</code> not assessed</i>) Responses will not earn the point if they - construct the correct string but return something else - define another method inside the signature method or vice versa	1 point
7	Calls <code>String</code> methods using correct syntax throughout the class	Responses can still earn the point even if they - call <code>substring</code> only one time - call <code>indexOf</code>, <code>contains</code>, <code>charAt</code>, or other appropriate methods Responses will not earn the point if they - only call <code>length</code> and/or <code>equals</code> without using other <code>String</code> methods - fail to call at least one <code>String</code> method which accesses elements of a string	1 point
8	Identifies the three required cases for <code>addSignature</code> using appropriate conditions	Responses can still earn the point even if they return an incorrect string in one or more cases	1 point
9	<code>addSignature</code> returns appropriate <code>String</code> in all three cases (<i>algorithm</i>)	Responses can still earn the point even if they - identify one or more of the three cases incorrectly, as long as they are unambiguously no-match, match-start, and match-end - implement <code>getSignature</code> incorrectly Responses will not earn the point if they - call <code>getSignature</code> incorrectly, or incorrectly implement its functionality in <code>addSignature</code> - fail to identify three distinct cases - build correct strings but assign them to cases incorrectly - print the string instead of or in addition to returning it - define another method inside <code>addSignature</code> or vice versa	1 point
Question-specific penalties			
None			

Alternate canonical:

```
public class SignedText
{
    private String signature;

    public SignedText(String first, String last)
    {
        signature = last;
        if (first.length() > 0)
        {
            signature = first.substring(0, 1) + "-" + last;
        }
    }

    public String getSignature()
    {
        return signature;
    }

    public String addSignature(String textStr)
    {
        String result = textStr;
        int index = textStr.indexOf(signature);
        if (index < 0)
        {
            result += signature;
        }
        else if (index == 0)
        {
            result = result.substring(signature.length()) + signature;
        }
        return result;
    }
}
```

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2016 GENERAL SCORING GUIDELINES

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2016 SCORING GUIDELINES

Question 1: Random String Chooser

Part (a)	RandomStringChooser	7 points
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Intent: *Define implementation of class to choose a random string*

- +1** Uses correct class, constructor, and method headers
- +1** Declares appropriate `private` instance variable(s)
- +1** Initializes all instance variable(s) (*point lost if parameter not used in any initialization*)
- +4** Implements `getNext`
 - +1** Generates a random number in the proper range (*point lost for improper or missing cast*)
 - +1** Chooses a string from instance variable using generated random number
 - +1** Updates state appropriately (*point lost if constructor parameter is altered*)
 - +1** Returns chosen string or `"NONE"` as appropriate

Part (b)	RandomLetterChooser	2 points
-----------------	---------------------	-----------------

Intent: *Define implementation of a constructor of a class that extends `RandomStringChooser`*

- +1** `getSingleLetters(str)`
- +1** `super(getSingleLetters(str));` (*point lost if not first statement in constructor*)

2016 CANONICAL SOLUTIONS**Question 1: Random String Chooser**

Part (a):

```
public class RandomStringChooser
{
    private List<String> words;

    public RandomStringChooser(String[] wordArray)
    {
        words = new ArrayList<String>();

        for (String singleWord : wordArray)
        {
            words.add(singleWord);
        }
    }

    public String getNext()
    {
        if (words.size() > 0)
        {
            return words.remove((int) (Math.random() * words.size()));
        }
        return "NONE";
    }
}
```

Part (b):

```
public RandomLetterChooser(String str)
{
    super(getSingleLetters(str));
}
```

2016 SCORING GUIDELINES

Question 2: Log Messages

Part (a) <code>LogMessage</code> constructor	2 points
---	-----------------

Intent: *Initialize instance variables using passed parameter*

- +1 Locates colon
- +1 Initializes instance variables with correct parts of the parameter

Part (b) <code>containsWord</code>	2 points
---	-----------------

Intent: *Determine whether description properly contains a keyword*

- +1 Identifies at least one properly-contained occurrence of `keyword` in `description`
- +1 Returns `true` if and only if `description` properly contains `keyword`
 Returns `false` otherwise (*no bounds errors*)

Part (c) <code>removeMessages</code>	5 points
---	-----------------

Intent: *Remove log messages containing keyword from system log list and return these messages in a new list*

- +1 Accesses all items in `messageList` (*no bounds errors; point lost if no removal attempted*)
- +1 Identifies keyword-containing entry using `containsWord`
- +1 Adds all and only identified entries to new list (*point lost if original order not maintained*)
- +1 Removes all identified entries from `messageList` (*point lost if `messageList` reordered*)
- +1 Constructs and returns new `ArrayList<LogMessage>`

2016 CANONICAL SOLUTIONS

Question 2: Log Messages

Part (a):

```
public LogMessage(String message)
{
    int colon = message.indexOf(":");
    machineId = message.substring(0, colon);
    description = message.substring(colon + 1);
}
```

Part (b):

```
public boolean containsWord(String keyword)
{
    if (description.equals(keyword))
    {
        return true;
    }
    if (description.indexOf(keyword + " ") == 0)
    {
        return true;
    }
    if (description.indexOf(" " + keyword + " ") != -1)
    {
        return true;
    }
    if (description.length() > keyword.length())
    {
        if ((description.substring(description.length() -
                                   keyword.length() - 1).equals(
                                   " " + keyword)))
        {
            return true;
        }
    }
    return false;
}
```

Part (c):

```
public List<LogMessage> removeMessages(String keyword)
{
    List<LogMessage> removals = new ArrayList<LogMessage>();

    for (int i = 0; i < messageList.size(); i++)
    {
        if (messageList.get(i).containsWord(keyword))
        {
            removals.add(messageList.remove(i));
            i--;
        }
    }
    return removals;
}
```

2016 SCORING GUIDELINES

Question 3: Crossword

Part (a)	<code>toBeLabeled</code>	3 points
-----------------	--------------------------	-----------------

Intent: Return a *boolean* value indicating whether a crossword grid square should be labeled with a positive number

- +1** Checks `blackSquares[r][c]`
- +1** Checks for black square/border above and black square/border to the left (*no bounds errors*)
- +1** Returns `true` if square should be labeled with positive number; returns `false` otherwise

Part (b)	Crossword constructor	6 points
-----------------	-----------------------	-----------------

Intent: Initialize each square in a crossword puzzle grid to have a *color* (*boolean*) and an *integer label*

- +1** `puzzle = new Square[blackSquares.length][blackSquares[0].length];`
(or equivalent)
- +1** Accesses all locations in `puzzle` (*no bounds errors*)
- +1** Calls `toBeLabeled` with appropriate parameters
- +1** Creates and assigns new `Square` to location in `puzzle`
- +1** Numbers identified squares consecutively, in row-major order, starting at 1
- +1** On exit: All squares in `puzzle` have correct color and number (*minor errors covered in previous points ok*)

Question-Specific Penalties

- 2** (p) Consistently uses incorrect name instead of `puzzle`
- 1** (q) Uses `array[].length` instead of `array[num].length`

2016 CANONICAL SOLUTIONS**Question 3: Crossword**

Part (a):

```
private boolean toBeLabeled(int r, int c, boolean[][] blackSquares)
{
    return (!(blackSquares[r][c]) &&
            (r == 0 || c == 0 || blackSquares[r - 1][c] ||
             blackSquares[r][c - 1]));
}
```

Part (b):

```
public Crossword(boolean[][] blackSquares)
{
    puzzle = new Square[blackSquares.length][blackSquares[0].length];
    int num = 1;

    for (int r = 0; r < blackSquares.length; r++)
    {
        for (int c = 0; c < blackSquares[0].length; c++)
        {
            if (blackSquares[r][c])
            {
                puzzle[r][c] = new Square(true, 0);
            }
            else
            {
                if (toBeLabeled(r, c, blackSquares))
                {
                    puzzle[r][c] = new Square(false, num);
                    num++;
                }
                else
                {
                    puzzle[r][c] = new Square(false, 0);
                }
            }
        }
    }
}
```

2016 SCORING GUIDELINES

Question 4: String Formatter

Part (a)	<code>totalLetters</code>	2 points
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Intent: Calculate the total number of letters in a list of words

- +1** Accesses all strings in `wordList` and adds length of each to accumulated count
(no bounds errors)
- +1** Initializes and returns accumulated count

Part (b)	<code>basicGapWidth</code>	2 points
-----------------	----------------------------	-----------------

Intent: Calculate the minimum number of spaces (basic gap width) to be placed between each word in the formatted string

- +1** Calls `totalLetters` correctly and uses result
- +1** Returns correct calculated value

Part (c)	<code>format</code>	5 points
-----------------	---------------------	-----------------

Intent: Return a formatted string consisting of words from `wordList` separated by one or more spaces

- +1** Calls `basicGapWidth` and `leftoverSpaces` correctly and uses results
- +1** Adds all strings in `wordList` to formatted string in original order (no bounds errors)
- +1** Inserts *basicGapWidth* spaces between each pair of words in formatted string
- +1** Inserts one space between first *leftoverSpaces* pairs of words in formatted string
- +1** Initializes and returns formatted string (no extra or deleted characters)

2016 CANONICAL SOLUTIONS**Question 4: String Formatter**

Part (a):

```
public static int totalLetters(List<String> wordList)
{
    int total = 0;

    for (String word : wordList)
    {
        total += word.length();
    }
    return total;
}
```

Part (b):

```
public static int basicGapWidth(List<String> wordList, int formattedLen)
{
    return (formattedLen - totalLetters(wordList)) / (wordList.size()-1);
}
```

Part (c):

```
public static String format(List<String> wordList, int formattedLen)
{
    String formatted = "";
    int gapWidth = basicGapWidth(wordList, formattedLen);
    int leftovers = leftoverSpaces(wordList, formattedLen);

    for (int w = 0; w < wordList.size() - 1; w++)
    {
        formatted = formatted + wordList.get(w);
        for (int i = 0; i < gapWidth; i++)
        {
            formatted = formatted + " ";
        }
        if (leftovers > 0)
        {
            formatted = formatted + " ";
            leftovers--;
        }
    }
    formatted = formatted + wordList.get(wordList.size() - 1);

    return formatted;
}
```