2018

AP CollegeBoard

AP Computer Science A

Scoring Guidelines

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Apply the question assessment rubric first, which always takes precedence. Penalty points can only be deducted in a part of the question that has earned credit via the question rubric. No part of a question (a, b, c) may have a negative point total. A given penalty can be assessed only once for a question, even if it occurs multiple times or in multiple parts of that question. A maximum of 3 penalty points may be assessed per question.

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 (× • ÷ $\leq$ $\geq$ <> ≠)
- `[]` 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,* "ArayList" *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.*

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Question 1: Frog Simulation

Part (a)	`simulate`	**5 points**

Intent: *Simulate the distance traveled by a hopping frog*

+1 Calls `hopDistance` and uses returned distance to adjust (or represent) the frog's position

+1 Initializes and accumulates the frog's position at most `maxHops` times (*must be in context of a loop*)

+1 Determines if a distance representing multiple hops is at least `goalDistance`

+1 Determines if a distance representing multiple hops is less than starting position

+1 Returns `true` if goal ever reached, `false` if goal never reached or position ever less than starting position

Part (b)	`runSimulations`	**4 points**

Intent: *Determine the proportion of successful frog hopping simulations*

+1 Calls `simulate` the specified number of times (*no bounds errors*)

+1 Initializes and accumulates a count of `true` results

+1 Calculates proportion of successful simulations using `double` arithmetic

+1 Returns calculated value

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Question 1: Scoring Notes

Part (a) `simulate`			**5 points**
Points	Rubric Criteria	Responses earn the point if they...	Responses will not earn the point if they...
+1	Calls `hopDistance` and uses returned distance to adjust (or represent) the frog's position	• use `hopDistance()` as a position, like `hopDistance() < 0`	• only use `hopDistance()` as a count, like `hopDistance() < maxHops`
+1	Initializes and accumulates the frog's position at most `maxHops` times (*must be in context of a loop*)		• do not use a loop
+1	Determines if a distance representing multiple hops is at least `goalDistance`	• use some number of hops `*` `hopDistance()` as the frog's final position	
+1	Determines if a distance representing multiple hops is less than starting position		
+1	Returns `true` if goal ever reached, `false` if goal never reached or position ever less than starting position	• have checks for all three conditions and correct return logic based on those checks, even if a check did not earn a point	• do not check all three conditions • only check for `goalDistance` after the loop • only check for starting position after the loop
Part (b) `runSimulations`			**4 points**
Points	Rubric Criteria	Responses earn the point if they...	Responses will not earn the point if they...
+1	Calls `simulate` the specified number of times (*no bounds errors*)	• do not use the result of calling `simulate`	• do not use a loop
+1	Initializes and accumulates a count of `true` results		• initialize the count inside a loop • do not use a loop
+1	Calculates proportion of successful simulations using `double` arithmetic	• perform the correct calculation on an accumulated value, even if there was an error in the accumulation	• fail to divide by the parameter
+1	Returns calculated value		• calculate values using nonnumeric types • return a count of simulations

Question 1: Frog Simulation

Part (a)

```
public boolean simulate()
{
   int position = 0;

   for (int count = 0; count < maxHops; count++)
   {
      position += hopDistance();
      if (position >= goalDistance)
      {
         return true;
      }
      else if (position < 0)
      {
         return false;
      }
   }
   return false;
}
```

Part (b)

```
public double runSimulations(int num)
{
   int countSuccess = 0;

   for (int count = 0; count < num; count++)
   {
      if(simulate())
      {
         countSuccess++;
      }
   }
   return (double)countSuccess / num;
}
```

These canonical solutions serve an expository role, depicting general approaches to solution. Each reflects only one instance from the infinite set of valid solutions. The solutions are presented in a coding style chosen to enhance readability and facilitate understanding.

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Question 2: Word Pair

Part (a)	`WordPairList`	**5 points**

Intent: *Form pairs of strings from an array and add to an* `ArrayList`

+1 Creates new `ArrayList` and assigns to `allPairs`

+1 Accesses all elements of `words` (*no bounds errors*)

+1 Constructs new `WordPair` using distinct elements of `words`

+1 Adds all necessary pairs of elements from word array to `allPairs`

+1 **On exit:** `allPairs` contains all necessary pairs and no unnecessary pairs

Part (b)	`numMatches`	**4 points**

Intent: *Count the number of pairs in an* `ArrayList` *that have the same value*

+1 Accesses all elements in `allPairs` (*no bounds errors*)

+1 Calls `getFirst` or `getSecond` on an element from list of pairs

+1 Compares first and second components of a pair in the list

+1 Counts number of matches of pair-like values

Question-Specific Penalties

-1 (z) Constructor returns a value

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Question 2: Scoring Notes

Part (a) `WordPairList`			**5 points**
Points	Rubric Criteria	Responses earn the point if they...	Responses will not earn the point if they...
+1	Creates new `ArrayList` and assigns to `allPairs`	• `allPairs = new ArrayList();` • `allPairs = new ArrayList<>();` • `this.allPairs = ...`	• initialize a local variable that is never assigned to `allPairs`
+1	Accesses all elements of `words` (*no bounds errors*)		
+1	Constructs new `WordPair` using distinct elements of `words`		
+1	Adds all necessary pairs of elements from word array to `allPairs`	• have a loop bounds error • add unnecessary pairs	• improperly add to an `ArrayList`, e.g., `allPairs.get(i) = x;` • only add consecutive pairs `(words[i], words[i+1])`
+1	**On exit:** `allPairs` contains all necessary pairs and no unnecessary pairs	• improperly add to an `ArrayList`, e.g., `allPairs.get(i) = x;` • have a loop bounds error	• add pairs (i, i) or (i, j) where i > j
Part (b) `numMatches`			**4 points**
Points	Rubric Criteria	Responses earn the point if they...	Responses will not earn the point if they...
+1	Accesses all elements in `allPairs` (*no bounds errors*)		• access elements of `allPairs` as array elements (e.g., `allPairs[i]`)
+1	Calls `getFirst` or `getSecond` on an element from list of pairs		
+1	Compares first and second components of a pair in the list		• compare using ==
+1	Counts number of matches of pair-like values		• fail to initialize the counter

Return is not assessed in part (b).

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Question 2: Word Pair

Part (a)

```
public WordPairList(String[] words)
{
   allPairs = new ArrayList<WordPair>();

   for (int i = 0; i < words.length-1; i++)
   {
      for (int j = i+1; j < words.length; j++)
      {
         allPairs.add(new WordPair(words[i], words[j]));
      }
   }
}
```

Part (b)

```
public int numMatches()
{
   int count = 0;

   for (WordPair pair: allPairs)
   {
      if (pair.getFirst().equals(pair.getSecond()))
      {
         count++;
      }
   }
   return count;
}
```

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Question 3: Code Word Checker

Class: `CodeWordChecker`	**9 points**

Intent: *Define implementation of a class to determine if a string meets a set of criteria*

+1 Declares header: `public class CodeWordChecker implements StringChecker`

+1 Declares all appropriate `private` instance variables

+3 Constructors

- **+1** Declares headers: `public CodeWordChecker(int __, int __, String __)` and `public CodeWordChecker(String __)`
- **+1** Uses all parameters to initialize instance variables in 3-parameter constructor
- **+1** Uses parameter and default values to initialize instance variables in 1-parameter constructor

+4 `isValid` method

- **+1** Declares header: `public boolean isValid(String __)`
- **+1** Checks for length between min and max inclusive
- **+1** Checks for unwanted string
- **+1** Returns `true` if length is between min and max and does not contain the unwanted string, `false` otherwise

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Question 3: Scoring Notes

Class `CodeWordChecker`			**9 points**
Points	Rubric Criteria	Responses earn the point if they…	Responses will not earn the point if they…
+1	Declares header: `public class CodeWordChecker implements StringChecker`	• omit keyword `public`	• declare class `private` • declare class `static`
+1	Declares all appropriate `private` instance variables		• declare variables as `static` • omit keyword `private` • declare variables outside the class
+3	Constructors		
+1	Declares headers: `public CodeWordChecker (int __, int __, String __)` and `public CodeWordChecker (String __)`	• omit keyword `public`	• declare method `static` • declare method `private`
+1	Uses all parameters to initialize instance variables in 3-parameter constructor		• fail to declare instance variables • initialize local variables instead of instance variables • assign variables to parameters
+1	Uses parameter and default values to initialize instance variables in 1-parameter constructor	• initialize instance variables to default values when declared	• fail to declare instance variables • initialize local variables instead of instance variables • assign variables to parameters
+4	`isValid` method		
+1	Declares header: `public boolean isValid (String __)`		• fail to declare method `public` • declare method `static`
+1	Checks for length between min and max inclusive		• fail to use instance variables • fail to declare the method header
+1	Checks for unwanted string		• fail to use instance variables • fail to declare the method header
+1	Returns `true` if length is between min and max and does not contain the unwanted string, `false` otherwise	• have incorrect checks for length and/or containment, but return the correct value based on those checks	• fail to declare the method header • fail to return in all cases • only check one substring location for containment

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Question 3: Code Word Checker

```
public class CodeWordChecker implements StringChecker
{
   private int minLength;
   private int maxLength;
   private String notAllowed;

   public CodeWordChecker(int minLen, int maxLen, String symbol)
   {
      minLength = minLen;
      maxLength = maxLen;
      notAllowed = symbol;
   }

   public CodeWordChecker(String symbol)
   {
      minLength = 6;
      maxLength = 20;
      notAllowed = symbol;
   }

   public boolean isValid(String str)
   {
      return str.length() >= minLength && str.length() <= maxLength &&
             str.indexOf(notAllowed) == -1;
   }

}
```

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Question 4: Latin Squares

Part (a)	`getColumn`	**4 points**

Intent: *Create a 1-D array that contains the values from one column of a 2-D array*

+1 Constructs a new `int` array of size `arr2D.length`

+1 Accesses all items in one column of `arr2D` (*no bounds errors*)

+1 Assigns one element from `arr2D` to the corresponding element in the new array

+1 **On exit:** The new array has all the elements from the specified column in `arr2D` in the correct order

Part (b)	`isLatin`	**5 points**

Intent: *Check conditions to determine if a square 2-D array is a Latin square*

+1 Calls `containsDuplicates` referencing a row or column of `square`

+1 Calls `hasAllValues` referencing two different rows, two different columns, or one row and one column

+1 Applies `hasAllValues` to all rows or all columns (*no bounds errors*)

+1 Calls `getColumn` to obtain a valid column from `square`

+1 Returns `true` if all three Latin square conditions are satisfied, `false` otherwise

Question-Specific Penalties

-1 (r) incorrect construction of a copy of a row

-1 (s) syntactically incorrect method call to any of `getColumn()`, `containsDuplicates()`, or `hasAllValues()`

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Question 4: Scoring Notes

Part (a) `getColumn`			**4 points**
Points	Rubric Criteria	Responses earn the point if they…	Responses will not earn the point if they…
+1	Constructs a new `int` array of size `arr2D.length`		• only create an `ArrayList`
+1	Accesses all items in one column of `arr2D` (*no bounds errors*)	• declare the new array of an incorrect size and use that size as the number of loop iterations	• switch row and column indices
+1	Assigns one element from `arr2D` to the corresponding element in the new array		• use `ArrayList` methods to add to array
+1	**On exit:** The new array has all the elements from the specified column in `arr2D` in the correct order		• switch row and column indices • do not use an index when assigning values to the array
Part (b) `isLatin`			**5 points**
Points	Rubric Criteria	Responses earn the point if they…	Responses will not earn the point if they…
+1	Calls `containsDuplicates` referencing a row or column of `square`	• reference any row or column of `square`, even if the syntax of the reference is incorrect	
+1	Calls `hasAllValues` referencing two different rows, two different columns, or one row and one column	• reference any two distinct rows, two distinct columns, or a row and column of `square`, even if the syntax of the reference is incorrect	
+1	Applies `hasAllValues` to all rows or all columns (*no bounds errors*)		• only reference one array in the call to `hasAllValues`
+1	Calls `getColumn` to obtain a valid column from `square`		• reverse parameters
+1	Returns `true` if all three Latin square conditions are satisfied, `false` otherwise	• test the three sets of conditions and return the correct value	

Return is not assessed in Part (a).

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Question 4: Latin Squares

Part (a)

```
public static int[] getColumn(int[][] arr2D, int c)
{
   int[] result = new int[arr2D.length];

   for (int r = 0; r < arr2D.length; r++)
   {
      result[r] = arr2D[r][c];
   }
   return result;
}
```

Part (b)

```
public static boolean isLatin(int[][] square)
{
   if (containsDuplicates(square[0]))
   {
      return false;
   }

   for (int r = 1; r < square.length; r++)
   {
      if (!hasAllValues(square[0], square[r]))
      {
         return false;
      }
   }

   for (int c = 0; c < square[0].length; c++)
   {
      if (!hasAllValues(square[0], getColumn(square, c)))
      {
         return false;
      }
   }

   return true;
}
```

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