

2019

AP[®]

 CollegeBoard

AP[®] Computer Science A

Scoring Guidelines

© 2019 The College Board. College Board, Advanced Placement, AP, AP Central, and the acorn logo are registered trademarks of the College Board. Visit the College Board on the web: collegeboard.org.

AP Central is the official online home for the AP Program: apcentral.collegeboard.org.

AP[®] COMPUTER SCIENCE A

2019 SCORING GUIDELINES

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 (`*` `*` `÷` `≤` `≥` `<>` `≠`)
- `[]` 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.

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 1: Calendar

Part (a)	<code>numberOfLeapYears</code>	5 points
-----------------	--------------------------------	-----------------

Intent: *Return the number of leap years in a range*

- +1 Initializes a numeric variable
- +1 Loops through each necessary year in the range
- +1 Calls `isLeapYear` on some valid year in the range
- +1 Updates count based on result of calling `isLeapYear`
- +1 Returns count of leap years

Part (b)	<code>dayOfWeek</code>	4 points
-----------------	------------------------	-----------------

Intent: *Return an integer representing the day of the week for a given date*

- +1 Calls `firstDayOfYear`
- +1 Calls `dayOfYear`
- +1 Calculates the value representing the day of the week
- +1 Returns the calculated value

Question-Specific Penalties

- 1 (t) Static methods called with `this`.

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 1: Scoring Notes

Part (a) numberOfLeapYears			5 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Initializes a numeric variable		<ul style="list-style-type: none"> use the variable for loop control only
+1	Loops through each necessary year in the range		<ul style="list-style-type: none"> consider years outside the range
+1	Calls isLeapYear on some valid year in the range	<ul style="list-style-type: none"> do not use a loop 	
+1	Updates count based on result of calling isLeapYear	<ul style="list-style-type: none"> do not use a loop do not initialize the counter 	<ul style="list-style-type: none"> use result as a non-boolean
+1	Returns count of leap years	<ul style="list-style-type: none"> loop from year1 to year2 incorrectly do not initialize the counter 	<ul style="list-style-type: none"> do not use a loop update or initialize the counter incorrectly return early inside the loop
Part (b) dayOfWeek			4 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Calls firstDayOfYear		<ul style="list-style-type: none"> do not use the given year
+1	Calls dayOfYear		<ul style="list-style-type: none"> have arguments out of order
+1	Calculates the value representing the day of the week		<ul style="list-style-type: none"> make any error in the calculation
+1	Returns the calculated value	<ul style="list-style-type: none"> return the value from calling firstDayOfYear or dayOfYear 	<ul style="list-style-type: none"> return a constant value

AP[®] COMPUTER SCIENCE A

2019 SCORING GUIDELINES

Question 1: Calendar

Part (a)

```
public static int numberOfLeapYears(int year1, int year2)
{
    int count = 0;
    for (int y = year1; y <= year2; y++)
    {
        if (isLeapYear(y))
        {
            count++;
        }
    }
    return count;
}
```

Part (b)

```
public static int dayOfWeek(int month, int day, int year)
{
    int startDay = firstDayOfYear(year);
    int nthDay = dayOfYear(month, day, year);
    int returnDay = (startDay + nthDay - 1) % 7;
    return returnDay;
}
```

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.

AP[®] COMPUTER SCIENCE A

2019 SCORING GUIDELINES

Question 2: Step Tracker

Class: <code>StepTracker</code>	9 points
--	-----------------

Intent: *Define implementation of a class to record fitness data*

- +1** Declares all appropriate `private` instance variables

- +2** Constructor
 - +1** Declares header: `public StepTracker(int ____)`
 - +1** Uses parameter and appropriate values to initialize instance variables

- +3** `addDailySteps` method
 - +1** Declares header: `public void addDailySteps(int ____)`
 - +1** Identifies active days and increments count
 - +1** Updates other instance variables appropriately

- +1** `activeDays` method
 - +1** Declares and implements `public int activeDays()`

- +2** `averageSteps` method
 - +1** Declares header: `public double averageSteps()`
 - +1** Returns calculated `double` average number of steps

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 2: Scoring Notes

Class <code>StepTracker</code>			9 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Declares all appropriate <code>private</code> instance variables		<ul style="list-style-type: none"> omit keyword <code>private</code> declare variables outside the class
+2	Constructor		
+1	Declares header: <code>public StepTracker(int ___)</code>	<ul style="list-style-type: none"> omit keyword <code>public</code> 	<ul style="list-style-type: none"> declare method <code>private</code>
+1	Uses parameter and appropriate values to initialize instance variables	<ul style="list-style-type: none"> initialize primitive instance variables to default values when declared 	<ul style="list-style-type: none"> fail to use the parameter to initialize some instance variable fail to declare instance variables initialize local variables instead of instance variables assign variables to parameters
+3	<code>addDailySteps</code> method		
+1	Declares header: <code>public void addDailySteps(int ___)</code>	<ul style="list-style-type: none"> omit keyword <code>public</code> 	<ul style="list-style-type: none"> declare method <code>private</code>
+1	Identifies active days and increments count	<ul style="list-style-type: none"> put valid comparison erroneously in some other method 	<ul style="list-style-type: none"> fail to use the parameter as part of the comparison fail to increment a count of active days fail to increment an instance variable compare parameter to some numeric constant
+1	Updates other instance variables appropriately		<ul style="list-style-type: none"> update another instance variable only on active days update another instance variable inappropriately fail to update appropriate instance variable update a local variable
+1	<code>activeDays</code> method		
+1	Declares and implements <code>public int activeDays()</code>	<ul style="list-style-type: none"> return appropriate count of active days where the instance variables were updated improperly in <code>addDailySteps</code> or <code>activeDays</code> 	<ul style="list-style-type: none"> declare method <code>private</code> return value that is not the number of active days fail to return a value

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 2: Scoring Notes (continued)

Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+2	averageSteps method		
+1	Declares header: public double averageSteps()	<ul style="list-style-type: none"> omit keyword <code>public</code> 	<ul style="list-style-type: none"> declare method <code>private</code>
+1	Returns calculated double average number of steps	<ul style="list-style-type: none"> maintain instance variables improperly but calculate appropriate average fail to handle the special case where no days are tracked 	<ul style="list-style-type: none"> use integer division calculate something other than steps divided by days fail to return

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 2: Step Tracker

```
public class StepTracker
{
    private int minSteps;
    private int totalSteps;
    private int numDays;
    private int numActiveDays;

    public StepTracker(int threshold)
    {
        minSteps = threshold;
        totalSteps = 0;
        numDays = 0;
        numActiveDays = 0;
    }

    public void addDailySteps(int steps)
    {
        totalSteps += steps;
        numDays++;
        if (steps >= minSteps)
        {
            numActiveDays++;
        }
    }

    public int activeDays()
    {
        return numActiveDays;
    }

    public double averageSteps()
    {
        if (numDays == 0)
        {
            return 0.0;
        }
        else
        {
            return (double) totalSteps / numDays;
        }
    }
}
```

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.

AP[®] COMPUTER SCIENCE A

2019 SCORING GUIDELINES

Question 3: Delimiters

Part (a)	<code>getDelimitersList</code>	4 points
-----------------	--------------------------------	-----------------

Intent: *Store delimiters from an array in an `ArrayList`*

- +1 Creates `ArrayList<String>`
- +1 Accesses all elements in array `tokens` (*no bounds errors*)
- +1 Compares strings in `tokens` with both instance variables (*must be in the context of a loop*)
- +1 Adds delimiters into `ArrayList` in original order

Part (b)	<code>isBalanced</code>	5 points
-----------------	-------------------------	-----------------

Intent: *Determine whether open and close delimiters in an `ArrayList` are balanced*

- +1 Initializes accumulator(s)
- +1 Accesses all elements in `ArrayList delimiters` (*no bounds errors*)
- +1 Compares strings in `delimiters` with instance variables and updates accumulator(s) accordingly
- +1 Identifies and returns appropriate `boolean` value to implement one rule
- +1 Identifies and returns appropriate `boolean` values for all cases

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 3: Scoring Notes

Part (a) <code>getDelimitersList</code>			4 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Creates <code>ArrayList<String></code>	<ul style="list-style-type: none"> omit <code><String></code> 	<ul style="list-style-type: none"> omit the keyword <code>new</code>
+1	Accesses all elements in array <code>tokens</code> (<i>no bounds errors</i>)	<ul style="list-style-type: none"> return incorrectly inside the loop 	<ul style="list-style-type: none"> treat <code>tokens</code> as a single string access elements of <code>tokens</code> as if from an <code>ArrayList</code> (e.g., <code>tokens.get(i)</code>)
+1	Compares strings in <code>tokens</code> with both instance variables (<i>must be in the context of a loop</i>)	<ul style="list-style-type: none"> access elements of <code>tokens</code> as if from an <code>ArrayList</code> (e.g., <code>tokens.get(i)</code>) 	<ul style="list-style-type: none"> use <code>==</code> for string comparison treat <code>tokens</code> as a single string
+1	Adds delimiters into <code>ArrayList</code> in original order	<ul style="list-style-type: none"> add a delimiter by accessing <code>tokens</code> incorrectly (e.g., <code>tokens.get(i)</code>) 	<ul style="list-style-type: none"> add a token that is not a delimiter do not maintain the original delimiter order
Part (b) <code>isBalanced</code>			5 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Initializes accumulator(s)	<ul style="list-style-type: none"> initialize inside the loop 	<ul style="list-style-type: none"> initialize an accumulator variable but don't update it
+1	Accesses all elements in <code>ArrayList</code> <code>delimiters</code> (<i>no bounds errors</i>)	<ul style="list-style-type: none"> return incorrectly inside the loop 	<ul style="list-style-type: none"> access elements of <code>delimiters</code> as if from an array (e.g., <code>delimiters[i]</code>)
+1	Compares strings in <code>delimiters</code> with instance variables and updates accumulator(s) accordingly	<ul style="list-style-type: none"> access elements of <code>delimiters</code> as if from an array (e.g., <code>delimiters[i]</code>) 	<ul style="list-style-type: none"> use <code>==</code> for string comparison adjust an accumulator without a guarding condition
+1	Identifies and returns appropriate <code>boolean</code> value to implement one rule	<ul style="list-style-type: none"> check for more closing delimiters (inside a loop) and return <code>false</code> return <code>true</code> if the number of open and close delimiters is the same, and <code>false</code> otherwise (after a loop) 	
+1	Identifies and returns appropriate <code>boolean</code> values for all cases	<ul style="list-style-type: none"> have correct logic with the exception of a loop bounds error, accessing elements as if from an array, or using <code>==</code> for string comparison 	<ul style="list-style-type: none"> initialize accumulator inside a loop fail to check for more closing delimiters inside a loop

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 3: Delimiters

Part (a)

```
public ArrayList<String> getDelimitersList(String[] tokens)
{
    ArrayList<String> d = new ArrayList<String>();
    for (String str : tokens)
    {
        if (str.equals(openDel) || str.equals(closeDel))
        {
            d.add(str);
        }
    }
    return d;
}
```

Part (b)

```
public boolean isBalanced(ArrayList<String> delimiters)
{
    int openCount = 0;
    int closeCount = 0;

    for (String str : delimiters)
    {
        if (str.equals(openDel))
        {
            openCount++;
        }
        else
        {
            closeCount++;
        }

        if (closeCount > openCount)
        {
            return false;
        }
    }

    if (openCount == closeCount)
    {
        return true;
    }
    else
    {
        return false;
    }
}
```

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.

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 4: Light Board

Part (a)	LightBoard	4 points
-----------------	------------	-----------------

Intent: Define implementation of a constructor that initializes a 2D array of lights

- +1 Creates a new `boolean[numRows][numCols]` and assigns to instance variable `lights`
- +1 Accesses all elements in the created 2D array (*no bounds errors*)
- +1 Computes the 40% probability
- +1 Sets all values of 2D array based on computed probability

Part (b)	evaluateLight	5 points
-----------------	---------------	-----------------

Intent: Evaluate the status of a light in a 2D array of lights

- +1 Accesses an element of `lights` as a `boolean` value in an expression
- +1 Traverses specified `col` of a 2D array (*no bounds errors*)
- +1 Counts the number of `true` values in the traversal
- +1 Performs an even calculation and a multiple of three calculation
- +1 Returns `true` or `false` according to all three rules

Question-Specific Penalties

- 1 (z) Constructor returns a value
- 1 (y) Destruction of persistent data

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 4: Scoring Notes

Part (a) <code>LightBoard</code>			4 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Creates a new <code>boolean[numRows][numCols]</code> and assigns to instance variable <code>lights</code>		<ul style="list-style-type: none"> initialize a local variable that is never assigned to <code>lights</code> omit the keyword <code>new</code> use a type other than <code>boolean</code>
+1	Accesses all elements in the created 2D array (<i>no bounds errors</i>)	<ul style="list-style-type: none"> fail to create <code>lights</code> but assume <code>lights[numRows][numCols]</code> 	
+1	Computes the 40% probability	<ul style="list-style-type: none"> use <code>Math.random() <= .4</code> 	<ul style="list-style-type: none"> incorrectly cast to <code>int</code>
+1	Sets all values of 2D array based on computed probability	<ul style="list-style-type: none"> only assign <code>true</code> values 	<ul style="list-style-type: none"> compute a single probability but use it multiple times reverse the sense of the comparison when assigning
Part (b) <code>evaluateLight</code>			5 points
Points	Rubric Criteria	Responses earn the point even if they...	Responses will not earn the point if they...
+1	Accesses an element of <code>lights</code> as a <code>boolean</code> value in an expression		<ul style="list-style-type: none"> access <code>lights</code> as a type other than <code>boolean</code>
+1	Traverses specified <code>col</code> of a 2D array (<i>no bounds errors</i>)		
+1	Counts the number of <code>true</code> values in the traversal	<ul style="list-style-type: none"> access too many or too few items in a single column access a single row instead of a single column 	<ul style="list-style-type: none"> count an item more than once
+1	Performs an even calculation and a multiple of three calculation		<ul style="list-style-type: none"> use <code>/</code> instead of <code>%</code>
+1	Returns <code>true</code> or <code>false</code> according to all three rules	<ul style="list-style-type: none"> have an incorrect column count but use the correct logic 	<ul style="list-style-type: none"> fail to return a value in some case implement counting loop more than once with one loop that is incorrect

AP[®] COMPUTER SCIENCE A 2019 SCORING GUIDELINES

Question 4: Light Board

Part (a)

```
public LightBoard(int numRows, int numCols)
{
    lights = new boolean[numRows][numCols];

    for (int r = 0; r < numRows; r++)
    {
        for (int c = 0; c < numCols; c++)
        {
            double rnd = Math.random();
            lights[r][c] = rnd < 0.4;
        }
    }
}
```

Part (b)

```
public boolean evaluateLight(int row, int col)
{
    int numOn = 0;

    for (int r = 0; r < lights.length; r++)
    {
        if (lights[r][col])
        {
            numOn++;
        }
    }

    if (lights[row][col] && numOn % 2 == 0)
    {
        return false;
    }
    if (!lights[row][col] && numOn % 3 == 0)
    {
        return true;
    }
    return lights[row][col];
}
```

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.