Results from the 2018 AP Computer Science A Exam

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Outline

- The Course
- The Reading
- The Exam
- The Results
- Recommendations
- Resources
- Questions

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Description

The AP Computer Science A course introduces students to computer science with fundamental topics that include:

- problem solving
- design strategies and methodologies
- organization of data (data structures)
- approaches to processing data (algorithms)
- analysis of potential solutions
- ethical and social implications of computing.

From the Computer Science A Course Description

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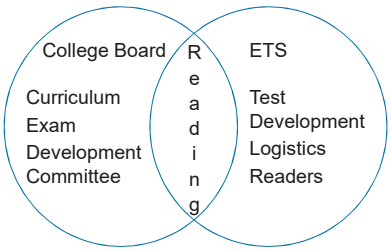
Who's who



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Exam History

- 1984 First Examination (Pascal)
- 1988 Exam split into A and AB (A subscore)
- 1992 A subscore eliminated
- 1995 Case study introduced
- 1999 C++
- 2004 Java
- 2008 GridWorld case study introduced
- 2009 Last year of AB exam
- 2014 Last year of GridWorld Case Study
- 2015 AP CS A Labs introduced
- 2016 Time rebalanced in exam
- 2017 CS Principles launches

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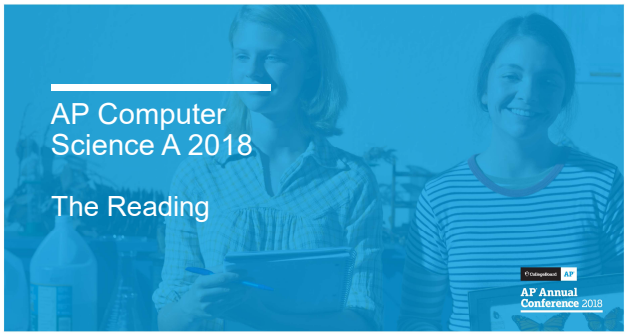

Process

Off site

- Last year
  - Free-response questions
  - Preliminary rubrics
- This May
  - Chief Reader
    - Rubrics
    - Scoring notes
    - Canonical solutions
  - Exam Leaders & College Board CIA
    - Refine these components

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Process

Onsite - Prereading

- **Pre-reading**
- Question Leaders
  - Vet the rubrics
  - Develop reader training
  - Train the table leaders
- Table Leaders
  - Vet the training
  - Prepare mentoring support for readers

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Process

Onsite - Reading

- **Reading**
- Question Leaders
  - Train readers
- Table Leaders
  - Mentor readers
  - Assist in applying the rubric
- Readers read!
  - 8:00 am – 5:00 pm for 7 days
  - 7.5 hours reading exams
  - 2x15-minute break, 1-hour lunch

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Process

Reader Training

- Consistency checks
  - Training packs
  - Partner system
  - Split packs
  - Check-reading
  - Reading Management System (RMS) metrics
- Operational exam readers usually read one question the entire reading

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Process

Other Activities

- **Readers do more than read**
  - Social lounge (hotel)
  - Opening night reception
  - Toy night (Pedagogical Practices)
  - Meet the DC and College Board Forum
  - Professional Night
  - Dine out night

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Stats

	2018	2012
Exams	~66,000	~22,500
Readers	264	119
Table Leaders	35	17
Question Leaders	22	17
Exam Leaders	2	2

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The Exam

Appendix A: AP Java Subset

- Outlines the features of Java that may appear on the AP Computer Science A Exam.
- No free response questions require constructs outside the subset.
- The AP Java subset is NOT intended to restrict content of courses
- The subset itself will need to be supplemented in order to address all topics in a typical introductory curriculum.

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The Exam

Solutions

- Solutions not restricted to the subset
- All correct solutions earn full credit*
- Solutions may utilize any standard Java constructs or classes *
- Some minor errors are ignored

*Except where prohibited

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The 2018 Exam

- Multiple choice was 1.5 hours
- Free response was 1.5 hours
  - Students had 22.5 minutes per free response question to
    - Read
    - Understand
    - Design/solve
    - Code
    - Check solutions

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2018 Exam Questions

- Q1: Frog Simulation
  - Determine if a hopping frog reaches a goal
  - Find the proportion of successful simulations
- Q2: WordPair List
  - Add filtered Pairs of array elements to a List
  - Count number of pairs with same components
- Q3: CodeWord Checker
  - Design a class that uses String methods from the AP Java subset to validate String inputs
- Q4: Array Tester
  - Return elements in column of 2D array
  - Determine if a square array is a Latin Square

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2018 Exam Questions

Frog Simulation

- Call a method, `hopdistance`, to adjust the frog's position
- Return true if the frog reaches its goal
- Return false if the frog hops backwards beyond the starting position
- Return false if the frog has taken `maxHops` hops without reaching the goal
- Call a method simulate
- Calculate the proportion of times the method returned true
- This question tested the student's ability to:
  - *Write program code to call methods*
  - *Write program code to satisfy methods using expressions, conditional statements, and iterative statements.*

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2018 Exam Questions

WordPair List

- This question tested the student's ability to:
- *Write program code to define a new type by creating a class; and*
- *Write program code to create objects of a class and call methods; and*
- *Write program code to create, traverse, and manipulate elements in 1D array or ArrayList objects.*

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2018 Exam Questions

Code Word Checker

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2018 Exam Questions

Latin Square

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Q1: Frog Simulation

Part (a)

The following example shows a declaration of a `FrogSimulation` object for which the goal distance is 24 inches and the maximum number of hops is 5. The table shows some possible outcomes of calling the `simulate` method.

```
FrogSimulation sim = new FrogSimulation(24, 5);
```

	Values returned by `hopDistance()`	Final position of frog	Return value of `sim.simulate()`
Example 1	`5, 7, -2, 8, 6`	24	`true`
Example 2	`6, 7, 6, 6`	25	`true`
Example 3	`6, -6, 31`	31	`true`
Example 4	`4, 2, -8`	-2	`false`
Example 5	`5, 4, 2, 4, 3`	18	`false`

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Q1: Frog Simulation

Part (a)

Example Solution

```
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;
}
```

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Q1: Frog Simulation

Part (a)

Scoring Rubric

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	

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Q1: Frog Simulation

Part (a)

Scoring Notes & CR Report

Rubric Criteria	Responses earn the point if they...	Responses will not earn the point if they...
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
Initializes and accumulates the frog's position at most maxHops times (must be in context of a loop)		• do not use a loop
Determines if a distance representing multiple hops is at least goalDistance	• use some number of hops * hopDistance() as the frog's final position	

Common Misconceptions/Knowledge Gaps	Responses that Demonstrate Understanding

Students failed to call the FrogSimulation instance method hopDistance from within the FrogSimulation class correctly.
`position = sim.hopDistance();`
`position = FrogSimulation.hopDistance();`
`position = obj.hopDistance();`
	`position = hopDistance();`
	`position = this.hopDistance();`

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Q1: Frog Simulation

Part (b)

(b) Write the `runSimulations` method, which performs a given number of simulations and returns the proportion of simulations in which the frog successfully reached or passed the goal. For example, if the parameter passed to `runSimulations` is `400`, and 100 of the 400 `simulate` method calls returned `true`, then the `runSimulations` method should return `0.25`.

Complete method `runSimulations` below. Assume that `simulate` works as specified, regardless of what you wrote in part (a). You must use `simulate` appropriately to receive full credit.

```
/** Runs num simulations and returns the proportion of simulations in which the frog
 *  successfully reached or passed the goal.
 *  Precondition: num > 0
 */
public double runSimulations(int num)
```

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Q1: Frog Simulation

Part (b)

Example solution

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

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

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Q1: Frog Simulation

Part (b)

Rubric

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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Q1: Frog Simulation

Part (b)

Scoring Notes & CR Report

Rubric Criteria	Responses earn the point if they...	Responses will not earn the point if they...
Calls simulate the specified number of times (no bounds errors)	• do not use the result of calling simulate	• do not use a loop
Initializes and accumulates a count of true results		• initialize the count inside a loop • do not use a loop
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
Returns calculated value		• calculate values using non-numeric types • return a count of simulations

Students used improper casting to produce a double quotient from two integer values

```
int count = 0;
for (int x = 0; x < num; x++)
   if (simulate())
      count++;

return (double)(count / num);
```

Cast an integer variable as a double within the calculation

```
int count = 0;
for (int x = 0; x < num; x++)
   if (simulate())
      count++;

return (double)count / num;
```

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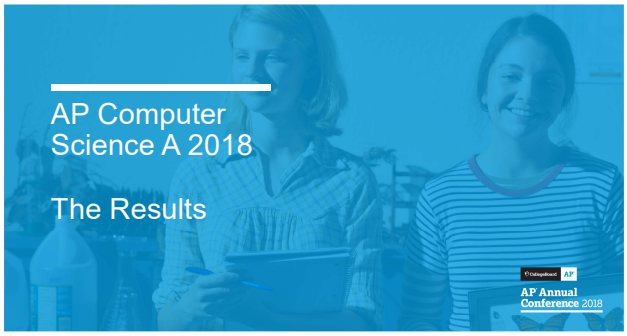
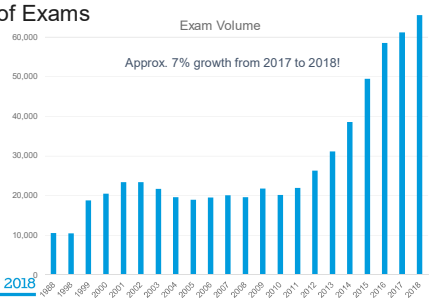


Number of Exams



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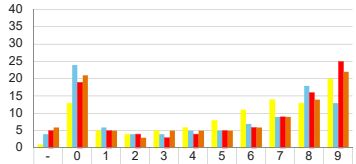
Percentage of Exams Receiving Raw Score



	-	0	1	2	3	4	5	6	7	8	9
Frog	1	13	5	4	5	6	8	11	14	13	20
WordPair	4	24	6	4	4	5	5	7	9	18	13
CodeWord	5	19	5	4	3	4	5	6	9	16	25
Array Tester	6	21	5	3	5	5	5	6	9	14	22

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Raw Score Distribution

	Q1	Q2	Q3	Q4
Mean (no -/0)	5.34 (6.21)	4.38 (6.10)	5.11 (6.65)	4.75 (6.48)
Std Deviation	3.14	3.53	3.61	3.62

The first means and standard deviations are official.

The means with (no -/0) are estimates from last day of reading.

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Grade Setting

The Chief Reader, ETS content assessment specialists, College Board representatives, and ETS statisticians are involved in a grade-setting meeting where the data and analyses are presented, including comparisons with previous years, and at which the parties establish and agree to mapping raw scores to reported grades of 1 to 5.

1 = No recommendation
2 = Possibly qualified
3 = Qualified
4 = Well qualified
5 = Extremely well qualified

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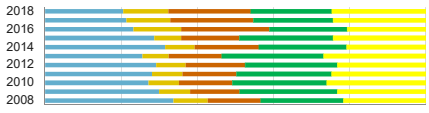
Score Distribution (1-5) (Percentage)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	33.7	29.9	27.1	28	29.1	25.5	31.5	28.6	23.2	21.3	20.5
2	9	8.1	8	8	7.8	6.9	7.7	7.1	12.5	11.5	11.8
3	13.9	13.1	14	14.2	15.6	14	16.9	15.3	23.2	21.9	21.7
4	21.7	25.6	24.8	25	24.2	26.7	23	24.6	20.4	20.9	21.3
5	21.7	23.3	26.1	24.8	23.3	26.9	20.9	24.4	20.7	24.4	24.7

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Recommendations

- Discuss/practice test-taking skills

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Test-Taking Skills

- Read the question
- Write legibly
- Clearly indicate answer on page
  ~~cross out unwanted code~~
- Eschew obfuscation
- Use reference material
- Read part (b) even if unable to do part (a)
- Test solution using examples
- Use top-down design
  especially when time is short
- Preconditions are your friends
- Read the question

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Recommendations

- Discuss/practice test-taking skills
- Address the common errors

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Common Errors

- Failure to read question closely
- Use of new object without construction
- Confusion of == and equals
- Confusion between lists and arrays
- Accessing too many/few elements in array/list
- Reimplementation of helper functions
- Use of enhanced for loop when not appropriate
- Failure to test for and handle boundary cases
- Confusion as to how and when to return values
- Confusion between local and instance variables
- Failure to understand the problem abstraction

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Recommendations

- Discuss/practice test-taking skills
- Address the common errors
- Use material from the reading

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Available Material

- http://apcentral.collegeboard.com
- Released free response questions
- Scoring guidelines
- Student performance Q & A (question intent, common errors, recommendations to teachers)
- Sample responses and commentary
- Teacher community on AP Central
- College Board workshops/summer institutes
- Facebook group (unofficial)

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Recommendations

- Discuss/practice test-taking skills
- Address the common errors
- Use material from the reading
- Become a reader

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Resources

- http://apcentral.collegeboard.com
  AP Central: AP info, course descriptions, materials
- http://www.collegeboard.com
  College Board: general info about CB, the AP program
- https://apcommunity.collegeboard.org/
  Discussion groups for AP teachers
- https://www.facebook.com/groups/APComputerScienceTeachers/
  Facebook group (unofficial)
- Email me: ap@cigas.net

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