

University of Texas at Austin

High School Computer Science Competition - 2013

General Directions:

- 1) DO NOT OPEN EXAM UNTIL TOLD TO DO SO.
- 2) **NO CALCULATOR OF ANY KIND MAY BE USED.**
- 3) There are 40 questions on this contest exam. You have 45 minutes to complete this contest. If you are in the process of actually writing an answer when the signal to stop is given, you may finish writing that answer.
- 4) Papers may not be turned in until 45 minutes have elapsed. If you finish the test before the end of the allotted time, remain at your seat and retain your paper until told to do otherwise. Use this time to check your answers.
- 5) All answers must be written on the answer sheet/Scantron card provided. Indicate your answers in the appropriate blanks provided on the answer sheet or on the Scantron card. Clean erasures are necessary for accurate Scantron grading.
- 6) You may place as many notations as you desire anywhere on the test paper, but not on the answer sheet or Scantron card which are reserved for answers only.
- 7) You may use additional scratch paper attached to the back of this exam.
- 8) All questions have ONE and only ONE correct (BEST) answer. There is a penalty for all incorrect answers. **All provided code segments are intended to be syntactically correct, unless syntax error is an option among the answers.**
- 9) A reference to commonly used Java classes is provided at the end of the test, and you may use this reference sheet during the contest. You may detach the reference sheets and scratch paper from the test booklet, but **DO NOT DO SO UNTIL THE CONTEST BEGINS.**
- 10) Assume that any necessary import for standard Java packages and classes (e.g. `.util`, `ArrayList`, etc.) are included in any programs or code segments that refer to methods from these classes and packages.

Scoring:

- 1) All questions will receive **6 points** if answered correctly; no points will be given or subtracted if unanswered; **2 points** will be deducted for an incorrect answer.

QUESTION 1	<p>What does 11111110_2 minus AB_{16} equal?</p> <p>A. $1A9_{16}$ B. $F1_{16}$ C. AB_{16} D. 65_{16} E. 53_{16}</p>	
QUESTION 2 <p>What is output by the code to the right?</p> <p>A. 336 B. -2 C. -5</p> <p>D. -9 E. -27</p>	<pre>int x2; x2 = 5 * 4 + 37 / 10 - 2 * 2 * 2 * 2 * 2; System.out.print(x2);</pre>	
QUESTION 3 <p>What is output by the code to the right?</p> <p>A. 3 B. 6</p> <p>C. 7 D. 9</p> <p>E. There is no output due to a syntax error.</p>	<pre>int x3 = 0; for(int j = 0; j <= 3; j++) { x3++; ++x3; } x3++; System.out.print(x3);</pre>	
QUESTION 4 <p>What is output by the code to the right?</p> <p>A. 3 B. 6 C. 8</p> <p>D. 11 E. 12</p>	<pre>String st1 = "The_Tower"; String st2 = st1.substring(6, 9); String st3 = st1 + st2; System.out.print(st3.length());</pre>	
QUESTION 5 <p>What is output by the code to the right?</p> <p>A. 7 .1 B. 6 0.1 C. 6 5</p> <p>D. 7 5.0 E. 7 0.1</p>	<pre>double[] ds = {.1, 5, 0.0, 0, 1.5, 2.1, 0}; System.out.print(ds.length); System.out.print(" " + (ds[1] + ds[3]));</pre>	
QUESTION 6 <p>What is output by the code to the right?</p> <p>A. 57 B. 56 C. 55</p> <p>D. 20 E. 19</p>	<pre>int x6 = 53; int y6 = x6 % 17 + 17 % x6; System.out.print(y6);</pre>	
QUESTION 7 <p>How many combinations of values of the boolean variables p, q, and r will result in s being set to false?</p> <p>A. 1 B. 3 C. 4</p> <p>D. 7 E. 8</p>	<pre>boolean p, q, r; // code in initialize p, q, and r boolean s = !(p && !q) !r;</pre>	

<p>QUESTION 8</p> <p>What is output by the code to the right?</p> <p>A. 01 B. 013 C. 1</p> <p>D. 12 E. 02</p>	<pre>System.out.print(0); int x = 4; int y = 8; if(y < x) System.out.print(1); if(x / y == 0) System.out.print(2); else if(x != y) System.out.print(3);</pre>
<p>QUESTION 9</p> <p>Given classes <code>Residence</code> and <code>Dorm</code> to the right, what is output by the following client code?</p> <pre>Residence r1 = new Residence(); Residence r2 = new Residence(-2); System.out.print(r1 + " " + r2);</pre> <p>A. 0 -2</p> <p>B. id id</p> <p>C. -1 -2</p> <p>D. -1 2</p> <p>E. There is no output due to a syntax error in the code.</p>	<pre>public class Residence { private int id; public Residence() { id = -1; } public Residence(int i) { id = i; } public String toString() { return "" + id; } } public class Dorm extends Residence {</pre>
<p>QUESTION 10</p> <p>Given classes <code>Residence</code> and <code>Dorm</code> to the right, what is output by the following client code?</p> <pre>Residence r3 = new Dorm(); Dorm d4 = new Dorm(150); System.out.print(r3 + " " + d4);</pre> <p>A. -1 150300</p> <p>B. -1 300150</p> <p>C. -20 300150</p> <p>D. -2-1 150300</p> <p>E. There is no output due to a syntax error in the code.</p>	<pre>private int rooms; public Dorm() { rooms = -2; } public Dorm(int r) { super(r * 2); rooms = r; } public String toString() { return rooms + super.toString(); } }</pre>
<p>QUESTION 11</p> <p>What is output by the code to the right?</p> <p>A. 72 B. 64 C. 63</p> <p>D. 8 E. 0</p>	<pre>int m = 72; int n = 63; System.out.print(n & m);</pre>
<p>QUESTION 12</p> <p>What is output by the code to the right?</p> <p>A. 0.0 B. 3.7 C. 6.0</p> <p>D. 6.4 E. 7.0</p>	<pre>double x12 = 3.7; double y12 = Math.floor(x12) + Math.ceil(x12); System.out.print(y12);</pre>

QUESTION 13

What is output by the code to the right?

- A. ACB B. A
 C
 B

D. A E. AC
 B
 CB

```
System.out.print("A");  
System.out.println("CB");
```

QUESTION 14

What is output by the code to the right?

- A. -0012.5 B. val: -12.5
C. val:-12.500 D. -12.50
E. val:-0012.5

```
double x14 = -12.50;
System.out.printf("val:%07.1f", x14);
```

QUESTION 15

What is output by the line in the client code to the right marked `//1` ?

- A. 2 3 6 B. 5 5 5
C. 2 3 7 D. 2 3 5
E. 4 1 5

```
public int m1(int x, int y) {
    x *= 2;
    y /= 2;
    return x + y;
}
```

```
public int m2(int x) {
    int y = x % 10;
    int z = m1(y, x);
    return x + z - y;
}
```

QUESTION 16

What is output by the line in the client code to the right marked `// 2` ?

- A. 20 20 B. 12 35 C. 12 20
D. 35 35 E. 12 19

```
public int m3(int x, int y) {
    int z = m1(m2(x), m2(y));
    z -= 10;
    return z - 10;
}
```

QUESTION 17

What is output by the line in the client code to the right marked `// 3` ?

- A. -20 B. -10 C. 0
- D. 10 E. No output due to runtime error.

```
// client code
int x = 2;
int y = 3;
int z = m1(x, y);
System.out.print(x + " " + y + " " + z); // 1

x = 12;
y = m2(x);
System.out.print(x + " " + y); // 2
```

QUESTION 18

What is output by the line in the client code to the right marked `//4` ?

- A. 5 3 7 B. 3 0 5
C. 0 0 0 D. 5 3 0
E. 5 7 3

```
x = 0;
y = 0;
System.out.print(m3(x, y)); // 3

z = 5;
x = 3;
y = m3(x, z);
System.out.print(x + " " + y + " " + z); //4
```

<p>QUESTION 19</p> <p>What is returned by the method call <code>manip(4, 2)</code>?</p> <p>A. 23 B. 13 C. 10</p> <p>D. 5 E. 3</p>	<pre>public int manip(int x, int y) { int z = x * y; x++; --y; z = -(x * y) + z; return z; }</pre>
<p>QUESTION 20</p> <p>What is output by the code to the right?</p> <p>A. 2.35 B. 2.25</p> <p>C. 0.35 D. 0.25</p> <p>E. There is no output due to a syntax error.</p>	<pre>double a1 = 12.350; double b1 = a1 % 10.1; System.out.print(b1);</pre>
<p>QUESTION 21</p> <p>What is output by the code to the right?</p> <p>A. 20 B. 171 C. 180</p> <p>D. 200 E. 220</p>	<pre>String stars = ""; for(int i = 0; i <= 10; i++) for(int j = 0; j < 20; j++) stars += "*"; System.out.print(stars.length());</pre>
<p>QUESTION 22</p> <p>What is output by the code to the right?</p> <p>A. 1 3 B. 2 3.0 C. 1 3.0</p> <p>D. 2 3.6 E. 1 2.999999999</p>	<pre>double a22 = 1.6; int x22 = 3; System.out.print((int) a22 + " " + (double) x22);</pre>
<p>QUESTION 23</p> <p>How many combinations of values of the <code>boolean</code> variables <code>p</code> and <code>q</code> will result in <code>r</code> being set to <code>true</code>?</p> <p>A. 1 B. 2</p> <p>C. 3 D. 4</p> <p>E. There is no output due to a syntax error.</p>	<pre>boolean p, q; // code in initialize p and q boolean r = p ^ q;</pre>
<p>QUESTION 24</p> <p>What is output by the code to the right?</p> <p>A. false 4 B. false 3 C. true 3</p> <p>D. There is no output due to a syntax error.</p> <p>E. There is no output due to a runtime error.</p>	<pre>Object obj = "bevo"; System.out.print(obj.equals(null)); System.out.print(obj.length());</pre>
<p>QUESTION 25</p> <p>What is output by the code to the right?</p> <p>A. 4, 7, 2, 5 B. 01234 C. 47252</p> <p>D. iiiii E. 4, 7, 2, 5, 2</p>	<pre>int[] data5 = {4, 7, 2, 5, 2}; for(int i : data5) System.out.print(i);</pre>

<p>QUESTION 26</p> <p>What is output by the code to the right?</p> <p>A. ala B. alamo</p> <p>C. amo D. alam</p> <p>E. There is no output due to a syntax error.</p>	<pre>String st6 = "alamo"; st6 = st6.length() < 5 ? st6.substring(2) : st6.substring(0,3); System.out.print(st6);</pre>
<p>QUESTION 27</p> <p>Given classes <code>Loot</code> and <code>Purple</code> to the right what is output by the following client code?</p> <pre>Loot.show(); Loot.drop();</pre> <p>A. <code>LootPlunk</code></p> <p>B. <code>PlunkLoot</code></p> <p>C. <code>LootShiny</code></p> <p>D. <code>ShinyLoot</code></p> <p>E. There is no output due to a syntax error in the client code.</p>	<pre>public class Loot { public void show() { System.out.print("Loot"); } public void drop() { System.out.print("Plunk"); } }</pre>
<p>QUESTION 28</p> <p>What is output by the client code marked section 1?</p> <p>A. <code>false false</code> B. <code>false true</code></p> <p>C. <code>true false</code> D. <code>true true</code></p> <p>E. There is no output due to a syntax error in section 1 of the client code.</p>	<pre>public class Purple extends Loot { public void show() { System.out.print("Shiny"); } }</pre> <pre>// section 1 start Loot t81 = new Loot(); Loot t82 = new Loot(); System.out.print(t81.equals(t82)); System.out.print(" " + (t81 == t82)); // section 1 stop</pre>
<p>QUESTION 29</p> <p>What is output by the client code marked section 2?</p> <p>A. <code>ShinyPlunk</code> B. <code>Loot</code></p> <p>C. <code>LootPlunk</code> D. <code>Shiny</code></p> <p>E. There is no output due to a syntax error in section 2 of the client code.</p>	<pre>// section 2 start Loot t91 = new Loot(); Purple p91 = new Purple(); t91.show(); p91.drop(); // section 2 stop</pre>
<p>QUESTION 30</p> <p>What is output by the client code marked section 3?</p> <p>A. <code>Shinytruefalse</code></p> <p>B. <code>Loottruefalse</code></p> <p>C. <code>Loottruetrue</code></p> <p>D. <code>Shinytruetrue</code></p> <p>E. There is no output due to a syntax error in section 3 of the client code.</p>	<pre>// section 3 start Loot t31 = new Purple(); t31.show(); System.out.print(t31 instanceof Object); System.out.print(t31 instanceof Purple); // section 3 stop</pre>

<p>QUESTION 31</p> <p>What is output by the code to the right?</p> <p>A. false[1, 2, 3][3]</p> <p>B. true[3, 1, 3, 2][3, 3]</p> <p>C. true[1, 2, 3][3]</p> <p>D. false[3, 1, 3, 2][3, 3]</p> <p>E. The output will vary from one run of the program to the next.</p>	<pre>int[] data = {3, 1, 3, 2}; TreeSet<Integer> ts; ts = new TreeSet<Integer>(); HashSet<Integer> hs; hs = new HashSet<Integer>(); for(int x31 : data) { ts.add(x31); hs.add(x31); } System.out.print(ts.equals(hs)); hs.remove(1); hs.remove(2); System.out.print(ts); System.out.print(hs);</pre>
<p>QUESTION 32</p> <p>What is output by the code to the right?</p> <p>A. 15</p> <p>B. 30</p> <p>C. 34</p> <p>D. 68</p> <p>E. There is no output due to a runtime error.</p>	<pre>public String stManip(String st) { if(st.length() < 3) return st + st; else return stManip(st.substring(1)) + stManip(st.substring(3)); } // client code String st30 = "The_Drag"; String st31 = stManip(st30); System.out.print(st31.length());</pre>
<p>QUESTION 33</p> <p>What is output by the code to the right?</p> <p>A. Infinity Infinity</p> <p>B. Infinity NaN</p> <p>C. There is no output due to a syntax error.</p> <p>D. There is no output due to a runtime error.</p> <p>E. 2000000000 and then a runtime error occurs</p>	<pre>double a33 = 1.5; double b33 = a33 - 1.5; double c33 = -a33 + 1.5; System.out.print(a33 / b33); // 1 System.out.print(" " + (b33 / c33)); // 2</pre>
<p>QUESTION 34</p> <p>Which sorting algorithm has a best case, average case, and worst case order of $O(N^2)$ for its traditional implementation?</p> <p>A. merge sort B. radix sort C. insertion sort D. quicksort E. selection sort</p>	
<p>QUESTION 35</p> <p>What is output by the code to the right?</p> <p>A. [6, 4, 3] B. [5, 3, 1, 2, 0, 6]</p> <p>C. [6, 5, 4] D. [5, 4, 1, 2, 0, 6]</p> <p>E. There is no output due to a runtime error.</p>	<pre>List<Integer> list5; list5 = new ArrayList<Integer>(); list5.add(5); list5.add(3); list5.add(1, 2); list5.set(4, 2); list5.add(0, 6); list5.remove(2); System.out.print(list5);</pre>

QUESTION 36

Which of the following Java expressions is equivalent to the formula to the right? $r1$, $r2$, and $r3$ are variables of type double.

- A. $1.0 / 1.0 / r1 + 1.0 / r2 + 1.0 / r3$
- B. $1 / 1 / r1 + 1 / r2 + 1 / r3$
- C. $1 / r1 + 1 / r2 + 1 / r3$
- D. $1 / (1 / r1 + 1 / r2 + 1 / r3)$
- E. None of A through D are correct.

$$\frac{1}{\frac{1}{r1} + \frac{1}{r2} + \frac{1}{r3}}$$

QUESTION 37

Assume method `sample(int[] data)` is $O(N^2)$ where $N = \text{data.length}$. When method `sample` is passed an array with `length = 2,000` it takes 1 second for method `sample` to complete. If method `sample` is then passed an array with `length = 10,000` what is the expected time it will take method `sample` to complete?

- A. 25 seconds
- B. 20 seconds
- C. 10 seconds
- D. 5 seconds
- E. 1 second

QUESTION 38

What is the order (Big O) of method `build` to the right? $N = \text{data.length}()$. Pick the most restrictive correct answer.

- A. $O(1)$
- B. $O(\log N)$
- C. $O(N)$
- D. $O(N \log N)$
- E. $O(N^2)$

```
public int[] build(String data) {
    int[] result
        = new int[data.length()];
    final int LIMIT = data.length() - 5;
    for(int r = 0; r < LIMIT; r++)
        for(int c = 0; c < 5; c++)
            result[r] = data.charAt(r + c);
    return result;
}
```

QUESTION 39

Which of the following can replace **#1** in the code to the right so that the `Structure` class compiles without error?

- A. `E`
- B. `Set`
- C. `_1`
- D. `anyType`
- E. All of A through D are correct.

```
public class Structure<#1> {
    private ArrayList<#1> con;

    public Structure() {
        con = new ArrayList<#1>();
    }

    public void add(#1 e) { con.add(e); }

    public #1 get() { return con.get(0); }

    public #1 remove() {
        return con.remove(0);
    }

    public boolean isEmpty() {
        return con.size() == 0;
    }
}
```

Assume **#1** has been replaced correctly.

QUESTION 40

What type of data structure does the `Structure` class implement?

- A. min heap
- B. linked list
- C. set
- D. queue
- E. array based list

Standard Classes and Interfaces — Supplemental Reference

class java.lang.Object

- o boolean equals(Object other)
- o String toString()
- o int hashCode()

interface java.lang.Comparable<T>

- o int compareTo(T other)
Return value < 0 if this is less than other.
Return value = 0 if this is equal to other.
Return value > 0 if this is greater than other.

class java.lang.Integer implements Comparable<Integer>

- o Integer(int value)
- o int intValue()
- o boolean equals(Object obj)
- o String toString()
- o int compareTo(Integer anotherInteger)
- o static int parseInt(String s)

class java.lang.Double implements Comparable<Double>

- o Double(double value)
- o double doubleValue()
- o boolean equals(Object obj)
- o String toString()
- o int compareTo(Double anotherDouble)
- o static double parseDouble(String s)

class java.lang.String implements Comparable<String>

- o int compareTo(String anotherString)
- o boolean equals(Object obj)
- o int length()
- o String substring(int begin, int end)
Returns the substring starting at index begin and ending at index (end - 1).
- o String substring(int begin)
Returns substring(from, length()).
- o int indexOf(String str)
Returns the index within this string of the first occurrence of str. Returns -1 if str is not found.
- o int indexOf(String str, int fromIndex)
Returns the index within this string of the first occurrence of str, starting the search at the specified index.. Returns -1 if str is not found.
- o charAt(int index)
- o int indexOf(int ch)
- o int indexOf(int ch, int fromIndex)
- o String toLowerCase()
- o String toUpperCase()
- o String[] split(String regex)
- o boolean matches(String regex)

class java.lang.Character

- o static boolean isDigit(char ch)
- o static boolean isLetter(char ch)
- o static boolean isLetterOrDigit(char ch)
- o static boolean isLowerCase(char ch)
- o static boolean isUpperCase(char ch)
- o static char toUpperCase(char ch)
- o static char toLowerCase(char ch)

class java.lang.Math

- o static int abs(int a)
- o static double abs(double a)
- o static double pow(double base, double exponent)
- o static double sqrt(double a)
- o static double ceil(double a)
- o static double floor(double a)
- o static double min(double a, double b)
- o static double max(double a, double b)
- o static int min(int a, int b)
- o static int max(int a, int b)
- o static long round(double a)
- o static double random()
Returns a double value with a positive sign, greater than or equal to 0.0 and less than 1.0.

interface java.util.List<E>

- o boolean add(E e)
- o int size()
- o Iterator<E> iterator()
- o ListIterator<E> listIterator()
- o E get(int index)
- o E set(int index, E e)
Replaces the element at index with the object e.
- o void add(int index, E e)
Inserts the object e at position index, sliding elements at position index and higher to the right (adds 1 to their indices) and adjusts size.
- o E remove(int index)
Removes element from position index, sliding elements at position (index + 1) and higher to the left (subtracts 1 from their indices) and adjusts size.

class java.util.ArrayList<E> implements List<E>

class java.util.LinkedList<E> implements List<E>, Queue<E>

Methods in addition to the List methods:

- o void addFirst(E e)
- o void addLast(E e)
- o E getFirst()
- o E getLast()
- o E removeFirst()
- o E removeLast()

class java.util.Stack<E>

- o boolean isEmpty()
- o E peek()
- o E pop()
- o E push(E item)

interface java.util.Queue<E>

- o boolean add(E e)
- o boolean isEmpty()
- o E peek()
- o E remove()

class java.util.PriorityQueue<E>

- o boolean add(E e)
- o boolean isEmpty()
- o E peek()
- o E remove()

interface java.util.Set<E>

- o boolean add(E e)
- o boolean contains(Object obj)
- o boolean remove(Object obj)
- o int size()
- o Iterator<E> iterator()
- o boolean addAll(Collection<? extends E> c)
- o boolean removeAll(Collection<?> c)
- o boolean retainAll(Collection<?> c)

class java.util.HashSet<E> implements Set<E>

class java.util.TreeSet<E> implements Set<E>

interface java.util.Map<K,V>

- o Object put(K key, V value)
- o V get(Object key)
- o boolean containsKey(Object key)
- o int size()
- o Set<K> keySet()
- o Set<Map.Entry<K, V>> entrySet()

class java.util.HashMap<K,V> implements Map<K,V>

class java.util.TreeMap<K,V> implements Map<K,V>

interface java.util.Map.Entry<K,V>

- o K getKey()
- o V getValue()
- o V setValue(V value)

interface java.util.Iterator<E>

- o boolean hasNext()
- o E next()
- o void remove()

**interface java.util.ListIterator<E> extends
java.util.Iterator<E>**

Methods in addition to the Iterator methods:

- o void add(E e)
- o void set(E e)

class java.lang.Exception

- o Exception()
- o Exception(String message)

class java.util.Scanner

- o Scanner(InputStream source)
- o boolean hasNext()
- o boolean hasNextInt()
- o boolean hasNextDouble()
- o String next()
- o int nextInt()
- o double nextDouble()
- o String nextLine()
- o Scanner useDelimiter(String pattern)

Computer Science Answer Key

UTCS HS Contest

1. E	11. D	21. E	31. C
2. D	12. E	22. C	32. B
3. D	13. A	23. B	33. B
4. E	14. E	24. D	34. E
5. D	15. D	25. C	35. E
6. E	16. C	26. A	36. D
7. A	17. A	27. E	37. A
8. E	18. B	28. A	38. C
9. C	19. E	29. C	39. E
10. D	20. B	30. D	40. D

Notes:

The clause "Choose the most restrictive correct answer." is necessary because per the formal definition of Big O, an algorithm that is $O(N^2)$ is also $O(N^3)$, $O(N^4)$, and so forth.

24. `obj.length()` causes is a syntax error. The declared type of `obj` is `Object` thus only methods from the `Object` class may be called without casting to `String`.