UIL COMPUTER SCIENCE WRITTEN TEST

2020 INVITATIONAL A

JANUARY/FEBRUARY 2020

General Directions (Please read carefully!)

1. DO NOT OPEN THE EXAM UNTIL TOLD TO DO SO.

2. There are 40 questions on this contest exam. You will have 45 minutes to complete this contest.

3. All answers must be legibly written on the answer sheet provided. Indicate your answers in the appropriate blanks provided on the answer sheet. Clean erasures are necessary for accurate grading.

4. You may write on the test packet or any additional scratch paper provided by the contest director, but NOT on the answer sheet, which is reserved for answers only.

5. All questions have ONE and only ONE correct answer. There is a 2-point penalty for all incorrect answers.

6. Tests 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 test until told to do otherwise. You may use this time to check your answers.

7. If you are in the process of actually writing an answer when the signal to stop is given, you may finish writing that answer.

8. All provided code segments are intended to be syntactically correct, unless otherwise stated. You may also assume that any undefined variables are defined as used.

9. A reference to many commonly used Java classes is provided with the test, and you may use this reference sheet during the contest. AFTER THE CONTEST BEGINS, you may detach the reference sheet from the test booklet if you wish.

10. Assume that any necessary import statements for standard Java SE packages and classes (e.g., `java.util`, `System`, etc.) are included in any programs or code segments that refer to methods from these classes and packages.

11. NO CALCULATORS of any kind may be used during this contest.

Scoring

1. Correct answers will receive **6 points**.

2. Incorrect answers will lose **2 points**.

3. Unanswered questions will neither receive nor lose any points.

4. In the event of a tie, the student with the highest percentage of attempted questions correct shall win the tie.

STANDARD CLASSES AND INTERFACES – SUPPLEMENTAL REFERENCE

class Object
```
boolean equals(Object anotherObject)
String toString()
int hashCode()
```

interface Comparable<T>
```
int compareTo(T anotherObject)
```
  Returns a value < 0 if this is less than anotherObject.
  Returns a value = 0 if this is equal to anotherObject.
  Returns a value > 0 if this is greater than anotherObject.

class Integer implements Comparable<Integer>
```
Integer(int value)
int intValue()
boolean equals(Object anotherObject)
String toString()
String toString(int i, int radix)
int compareTo(Integer anotherInteger)
static int parseInt(String s)
```

class Double implements Comparable<Double>
```
Double(double value)
double doubleValue()
boolean equals(Object anotherObject)
String toString()
int compareTo(Double anotherDouble)
static double parseDouble(String s)
```

class String implements Comparable<String>
```
int compareTo(String anotherString)
boolean equals(Object anotherObject)
int length()
String substring(int begin)
```
  Returns substring(begin, length()).
```
String substring(int begin, int end)
```
  Returns the substring from index begin through index (end - 1).
```
int indexOf(String str)
```
  Returns the index within this string of the first occurrence of str.
  Returns -1 if str is not found.
```
int indexOf(String str, int fromIndex)
```
  Returns the index within this string of the first occurrence of str,
  starting the search at fromIndex. Returns -1 if str is not found.
```
int indexOf(int ch)
int indexOf(int ch, int fromIndex)
char charAt(int index)
String toLowerCase()
String toUpperCase()
String[] split(String regex)
boolean matches(String regex)
String replaceAll(String regex, String str)
```

class Character
```
static boolean isDigit(char ch)
static boolean isLetter(char ch)
static boolean isLetterOrDigit(char ch)
static boolean isLowerCase(char ch)
static boolean isUpperCase(char ch)
static char toUpperCase(char ch)
static char toLowerCase(char ch)
```

class Math
```
static int abs(int a)
static double abs(double a)
static double pow(double base, double exponent)
static double sqrt(double a)
static double ceil(double a)
static double floor(double a)
static double min(double a, double b)
static double max(double a, double b)
static int min(int a, int b)
static int max(int a, int b)
static long round(double a)
static double random()
```
  Returns a double greater than or equal to 0.0 and less than 1.0.

interface List<E>
class ArrayList<E> implements List<E>
```
boolean add(E item)
int size()
Iterator<E> iterator()
ListIterator<E> listIterator()
E get(int index)
E set(int index, E item)
void add(int index, E item)
E remove(int index)
```

class LinkedList<E> implements List<E>, Queue<E>
```
void addFirst(E item)
void addLast(E item)
E getFirst()
E getLast()
E removeFirst()
E removeLast()
```

class Stack<E>
```
boolean isEmpty()
E peek()
E pop()
E push(E item)
```

interface Queue<E>
class PriorityQueue<E>
```
boolean add(E item)
boolean isEmpty()
E peek()
E remove()
```

interface Set<E>
class HashSet<E> implements Set<E>
class TreeSet<E> implements Set<E>
```
boolean add(E item)
boolean contains(Object item)
boolean remove(Object item)
int size()
Iterator<E> iterator()
boolean addAll(Collection<? extends E> c)
boolean removeAll(Collection<?> c)
boolean retainAll(Collection<?> c)
```

interface Map<K,V>
class HashMap<K,V> implements Map<K,V>
class TreeMap<K,V> implements Map<K,V>
```
Object put(K key, V value)
V get(Object key)
boolean containsKey(Object key)
int size()
Set<K> keySet()
Set<Map.Entry<K, V>> entrySet()
```

interface Iterator<E>
```
boolean hasNext()
E next()
void remove()
```

interface ListIterator<E> extends Iterator<E>
```
void add(E item)
void set(E item)
```

class Scanner
```
Scanner(InputStream source)
Scanner(String str)
boolean hasNext()
boolean hasNextInt()
boolean hasNextDouble()
String next()
int nextInt()
double nextDouble()
String nextLine()
Scanner useDelimiter(String regex)
```

Package `java.util.function`

Interface BiConsumer<T,U>
  void **accept**(T t, U u)

Interface BiFunction<T,U,R>
  R **apply**(T t, U u)

Interface BiPredicate<T,U>
  boolean **test**(T t, U u)

Interface Consumer<T>
  void **accept**(T t)

Interface Function<T,R>
  R **apply**(T t)

Interface Predicate<T>
  boolean **test**(T t)

Interface Supplier<T>
  T **get**()

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Note: Correct responses are based on **Java SE Development Kit 12 (JDK 12)** from Oracle, Inc. All provided code segments are intended to be syntactically correct, unless otherwise stated (e.g., "error" is an answer choice) and any necessary Java SE 12 Standard Packages have been imported. Ignore any typographical errors and assume any undefined variables are defined as used. **For all output statements, assume that the System class has been statically imported using:** `import static java.lang.System.*;`

Question 1.

Which of the following binary numbers is equivalent to the decimal number 253?

A) 11111111 **B)** 11111101 **C)** 11111110 **D)** 11111100 **E)** 11111001

Question 2.

What is the output of the code segment to the right?

A) -1 **B)** 2 **C)** 9 **D)** 13 **E)** 8.5

```
out.print(8 + 5 - 9 * 2 / 4);
```

Question 3.

What is the output of the code segment to the right?

A) Sep
Oct
Nov
Dec

B) Sep\nOct
Nov
Dec

C) Sep
OctNovDec

D) Sep\nOctNov
Dec

E) Sep
OctNov
Dec

```
out.print("Sep\nOct");
out.println("Nov");
out.print("Dec");
```

Question 4.

What is the output of the line of code shown on the right?

A) 1 **B)** 2 **C)** 4
D) 9 **E)** 10

```
out.print("mississipi".indexOf('i'));
```

Question 5.

What is the output of the line of code shown on the right?

A) true

B) false

```
out.print(true && !false || false);
```

Question 6.

What is the output of the code segment to the right?

A) 4 **B)** 3.8 **C)** 3.0 **D)** 4.0 **E)** 3.7

```
int i = 3;
double d = 1.25;
out.print(Math.round(i * d));
```

Question 7.

What is the output of the code segment to the right?

A) 6.0 **B)** 6.125 **C)** 9.25 **D)** 8.75 **E)** 12.5

```
double e = 3.5, f = 2.75;
int j = 3, k = 4;
out.print(e * j + f - k);
```

Question 8.

What is the output of the code segment to the right?

A) 12 8 5

B) 16 5 8

C) 16 5 11

D) 12 5 11

E) 12 5 8

```
int x = 12, y = 5, z = 8;
if(x / y > 2.0)
        z = z + 3;
if(z > 8)
        x = y + z;
out.print(x + " " + y + " " + z);
```

Question 9.

What is the output of the code segment to the right?

A) 6543210

B) 654321

C) 543210

D) 54321

E) 6

```
int c = 6;
while(c > 0)
{
        out.print(c);
        c--;
}
```

Question 10.

What is the output or the error of the code segment to the right?

A) [1, 2, 2, 6, 5]

B) [1, 2, 2, 4, 6]

C) [1, 1, 6, 4, 5]

D) [1, 6, 2, 6, 5]

E) There is no output due to an error.

```
String[] list = {"1","2","3","4","5"};
list[3]="6";
list[2]=list[1];
out.print(Arrays.toString(list));
```

Question 11.

```
public class Q11
{
  public static void main(String[] args) throws IOException
  {
     Scanner f = new Scanner(new File("data.dat"));
     while(f.hasNext())
        out.print(f.next() + " ");
  }
}
```

Which of the following represents the output of the class shown above? You may assume that all necessary import statements are present and correct. The file named `data.dat` contains the following:

                        abcdef

A) a
   b
   c
   d
   e
   f

B) a b c d e f

C) a

D) abcdef

E) There is no output because the class throws an IOException

Question 12.

What is the output of the code segment to the right?

A) 56

B) 36

C) 55

D) 45

E) 44

```
int t = 0;
for(int x = 0;x < 10;x++)
    t += x;
out.print(t);
```

Question 13.

What is the correct order of operations (from left to right) for the operators listed on the right?

A) += && ! + *

B) * + ! && +=

C) ! + * += &&

D) += && + * !

E) ! * + && +=

+= && ! + *

Question 14.

Which of the following values <u>cannot</u> be stored in a variable that is of type `byte`?

A) 32767

B) -32768

C) 32768

D) -32767

E) None of the values shown above can be stored in a variable of type byte.

Question 15.

What is the output of the code segment to the right?

A) [5.0, 4.0, 1.3, 3.5, 5.0, 5.25]

B) [5.0, 5.8, 3.5, 1.3, 6.1, 5.8, 5.25]

C) [5.0, 5.8, 3.5, 1.3, 6.1, 5.8]

D) [5.0, 5.8, 3.5, 1.3, 5.8]

E) [5.0, 5.8, 4.0, 1.3, 3.5, 5.8, 5.25]

```
ArrayList<Double> list = new
ArrayList<Double>();
list.add(5.0);list.add(5.8);list.add(4.0);
list.add(3.5);list.add(6.1);list.add(5.25);
list.remove(2);
list.add(3, 1.3);
list.set(5, list.get(1));
out.print(list);
```

Question 16.

What is the output of the code segment to the right?

A) −6   B) −1   C) 1   D) 4   E) 6

```
String r = "monkey";
String p = "money";
out.print(p.compareTo(r));
```

Question 17.

What is the output of the code segment to the right?

A) 1.56 1.56 1.56

B) 1.56 3.14 2.77

C) No output. Will not compile.

D) No output. Throws a NumberFormatException.

E) No output. Throws a TypeMismatchException.

```
String num = "1.56 3.14 2.77";
double d1 = Double.parseDouble(num);
double d2 = Double.parseDouble(num);
double d3 = Double.parseDouble(num);
out.print(d1 + " " + d2 + " " + d3);
```

Which of the following statements correctly calculates the value of x in the formula shown here?

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

A) `double x = -b + Math.sqrt(Math.pow(b,2) - 4 * a * c) / 2 * a;`

B) `double x = (-b + Math.sqrt(Math.pow(b,2) - 4 * a * c)) / (2 * a);`

C) `double x = (-b + Math.sqrt(Math.pow(2,b) - 4 * a * c)) / 2 * a;`

D) `double x = -b + Math.sqrt(b * b - 4 * a * c) / 2 * a;`

E) `double x = -b + Math.sqrt(b * b - 4 * a * c) / (2 * a);`

How many constructors does the class `Uil` contain?

A) 0

B) 1

C) 2

D) 3

E) 4

```
//Use the following class to answer
//questions 19, 20 and 21.

public class Uil
{
    private int a;
    private String b;

    public Uil()
    {
        out.print("invA ");
    }

    public Uil(int x, String s)
    {
        a = x;
        b = s;
        out.print("cs ");
    }

    public String printUil()
    {
        return b + " " + a + " ";
    }
}
```

What is the output of this client code?

```
Uil uil1 = new Uil();
Uil uil2 = new Uil(12,"invB");
out.print(uil1.printUil());
out.print(uil2.printUil());
```

A) `invA cs 0 null 12 invB`

B) `cs null 0 invB 12`

C) `invA cs invB 12`

D) `invA cs 0 invB 12`

E) `invA cs null 0 invB 12`

What is printed by the following client code that is in a class other than `Uil`?

```
Uil uil = new Uil(240,"district");
int i = uil.a;
String s = uil.b;
out.print(i + " " + s);
```

A) `240 district`

B) `cs 240 district`

C) `cs`

D) `cs district`

E) This code will not compile and prints an error message.

Which of the following methods correctly implements a binary search algorithm? Assume that `list` is sorted in ascending order.

A.
```
public static int binarySearch(String[]
list,String target)
{
  int mid = list.length/2;
  int front = 0;
  int back = list.length-1;
  while(back >= front)
  {
    if(list[mid].equals(target))
      return mid;
    if(target.compareTo(list[mid])>0)
      back = mid - 1;
    else
      front = mid + 1;
    mid = (front + back) / 2;
  }
  return -1;
}
```

B.
```
public static int binarySearch(String[]
list,String target)
{
  int mid = list.length/2;
  int front = 0;
  int back = list.length-1;
  while(back >= front)
  {
    if(list[mid].equals(target))
      return mid;
    if(target.compareTo(list[mid])<0)
      back = mid - 1;
    else
      front = mid + 1;
    mid = (front + back) / 2;
  }
  return -1;
}
```

C.
```
public static int binarySearch(String[]
list,String target)
{
  int mid = list.length/2;
  int front = 0;
  int back = list.length-1;
  while(back >= front)
  {
    if(list[mid].equals(target))
      return mid;
    if(target.compareTo(list[mid])<0)
      front = mid + 1;
    else
      back = mid - 1;
    mid = (front + back) / 2;
  }
  return -1;
}
```

D.
```
public static int binarySearch(String[]
list,String target)
{
  int mid = list.length/2;
  int front = 0;
  int back = list.length-1;
  while(back > front)
  {
    if(list[mid].equals(target))
      return mid;
    if(target.compareTo(list[mid])<0)
      back = mid - 1;
    else
      front = mid + 1;
    mid = (front + back) / 2;
  }
  return -1;
}
```

E. More than one of the above.

Once a method has correctly implemented a binary search algorithm, which of these would represent the tightest correct runtime on an array of n elements?

A) O(n2)

B) O(n)

C) O(1)

D) O(log n)

E) O(n log n)

What is printed by the line of code shown on the right?

A) 25

B) 59

C) 34

D) 2030

E) 1

```
out.print(58^35);
```

What is the output of the code segment to the right?

A) [5, 6, 7, 8]
[9, 0, 1, 2]
[1, 2, 3, 4]

B) [9, 0, 1, 2]
[1, 2, 3, 4]
[5, 6, 7, 8]

C) [1, 2, 3, 4]
[9, 0, 1, 2]
[5, 6, 7, 8]

D) [5, 6, 7, 8]
[1, 2, 3, 4]
[9, 0, 1, 2]

E) There is no output due to an error.

```
int[][] m = new int[3][];
int[] x = {1,2,3,4};
int[] y = {5,6,7,8};
int[] z = {9,0,1,2};
m[0] = z;
m[2] = y;
m[1] = x;
int[] t = m[0];
m[0] = m[1];
m[1] = t;
for(int[] r:m)
    out.println(Arrays.toString(r));
```

Which of the following represents the output of the code segment shown on the right?

A) true true true

B) true true false

C) true false false

D) false true true

E) false false true

```
String s = "325-555-1234";
out.print(s.matches(".{10}") + " ");
out.print(s.matches("\\d+-\\d+-\\d+")+" ");
out.print(s.matches("325\\W555\\S1234"));
```

How many abstract methods does every functional interface contain?

A) 0

B) 1

C) Always more than 1.

D) The number of abstract methods depends on the function of the interface.

E) The number of arguments passed by the lambda expression determines the number of abstract methods in the interface.

Which of the following represents the output of the code segment listed here?

```
ArrayList<String> list = new ArrayList<String>();
list.add("tomato");list.add("ham");
list.add("turkey");list.add("onion");
Set<String> set = new TreeSet<String>();
set.add("ham");set.add("turkey");
set.add("beef");set.add("cheese");
set.add("mustard");set.add("lettuce");
set.addAll(list);
out.print(set);
```

A) [ham, turkey, beef, cheese, mustard, lettuce, tomato, onion]

B) [mustard, ham, turkey, onion, beef, tomato, lettuce, cheese]

C) [beef, cheese, ham, lettuce, mustard, onion, tomato, turkey]

D) [beef, cheese, lettuce, mustard, onion, tomato]

E) [beef, cheese, ham, ham, lettuce, mustard, onion, tomato, turkey, turkey]

Given the statements shown on the right, what is the largest possible value that might be assigned to w?

A) 101

B) 9.5

C) 9

D) 10.5

E) 10

```
Random r = new Random();
int w = (int)(r.nextDouble() * 10 + 0.5);
```

What is the output of the code segment shown on the right?

A) [homecoming]

B) [h, m, c, m, ng]

C) [o, e, o, i]

D) [oeoi]

E) [hmcmng]

```
String a = "homecoming";
String[] p = a.split("aeiou");
out.print(Arrays.toString(p));
```

Consider the method `crunch` shown on the right. What is the output of this segment of client code?

```
//client code
int x = 5;
Integer y = 90,z = 15;
for(int i = 1;i <= 5;i++)
    crunch(x,y,z);
out.print(x + " " + y + " " + z);
```

A) 15 45 480

B) 5 90 15

C) 7 85 30

D) 26 45 480

E) 7 45 480

```
public static void crunch(int x,
Integer y, Integer z)
{
        y -= x;
        z *= 2;
        x += 2;
}
```

Question 32.

The method shown on the right is a partial implementation of the selection sort algorithm. The array list *should be sorted in ascending order.*

Which of the following must replace **<code1>** to ensure that the method will compile and function as intended.

A) 0

B) y

C) i + 1

D) x - 1

E) 1

Question 33.

Which of the following must replace **<code2>** to ensure that the method will compile and function as intended?

A) list[i] < x

B) list[j] < y

C) list[j] > x

D) list[j] < x

E) list[i] > list[j]

Question 34.

If the client code shown here is executed, what is the state of the array list when i equals 3 and the execution of the code has reached the comment?

```
int[] list = {6,7,1,8,2,9,0,5,4,3};
selection(list);
```

A) [1, 2, 0, 5, 4, 3, 6, 7, 8, 9]

B) [0, 1, 2, 8, 7, 9, 6, 5, 4, 3]

C) [1, 2, 6, 7, 8, 9, 0, 5, 4, 3]

D) [1, 2, 3, 7, 8, 9, 0, 5, 4, 6]

E) [0, 1, 2, 3, 7, 9, 6, 5, 4, 8]

```
//Use this implementation of an ascending
//selection sort algorithm to answer
//questions 32 – 34.
public static void selection(int list[])
{
 int x,y;
 for(int i = 0;i < list.length; ++i)
 {
   x = list[i];
   y = i;
   for(int j = <code1>;j < list.length; j++)
     if(<code2>)
     {
        x = list[j];
        y = j;
     }
   list[y] = list[i];
   list[i] = x;
   //comment
 }
}
```

Question 35.

Which of the following shows the output of the code segment shown on the right?

A) 4 2 4

B) 0 6 0

C) 5 9 4

D) 5 1 4

E) There is no output due to an error.

```
int r = 0,p = 6,s = 0;
for(;r < 5;r++)
{
    s = ~s;
    while(p > 1)
    {
        s++;
        p--;
    }
}
out.print(r + " " + p + " " + s);
```

Question 36.
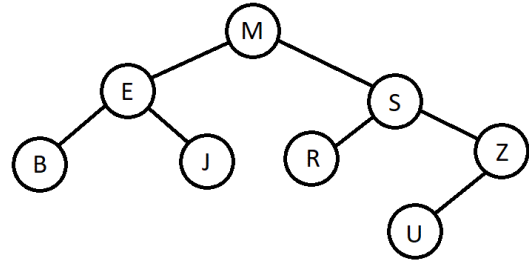
What is the output of the code segment shown on the right?

A) SEptEMbEr

B) sePTemBeR

C) PTBR

D) SEEME

E) september

```
String s1 = "september";
String s2 = "";
for(int i = 0;i < s1.length();i++)
  if(s1.charAt(i) % 2 == 0)
    s2 += (char)(s1.charAt(i) - 32);
out.print(s2);
```

Question 37.

Which of the following represents a pre-order traversal of the binary search tree shown on the right?

A) M E B J S R Z U

B) B J E R U Z S M

C) B E J M R S U Z

D) M E S B J R Z U

E) U Z R J B E S M

Question 38.

Which of the following Boolean expressions is NOT equal to A?

A) $A * (A + B)$

B) $\overline{A + B}$

C) $A + A * B$

D) $A * A$

E) $A + A$

Question 39.

What is the output of the client code shown here given the method `rec` shown on the right. Write your answer in the blank provided on the answer document.

```
        out.print(rec(3));
```

```
public static int rec(int x)
{
  if(x == 0)
    return 7;
  else
    return 2 * rec(--x);
}
```

Question 40.

Write the signed 8-bit binary two's complement representation of -101 in the blank provided on the answer document.