# Unit 6 – ICS4U – Arrays & Algorithms

Sample Test, Wednesday May 8, 2023

Name: _____

Total	Knowledge	Communication	Thinking	Application
(96)	(22)	(24)	(26)	(24)

Knowledge

1. For each sorting algorithm, colour in the 2 apples that trade places in the first swap.   /3

   (a) Bubble sort

   (b) Selection sort

   (c) Quicksort

   4 7 3 1 8 2 5
   4 7 3 1 8 2 5
   4 7 3 1 8 2 5

2. Sort each array using the algorithm indicated.   /8

Bubble sort:

6	5	4	7	2

Selection Sort:

6	1	9	5	8	4	2

Mergesort:

3	8	4	1	7	5	9	0

Quick Sort: (1ST pass only)

5	0	6	9	7	8	3	2
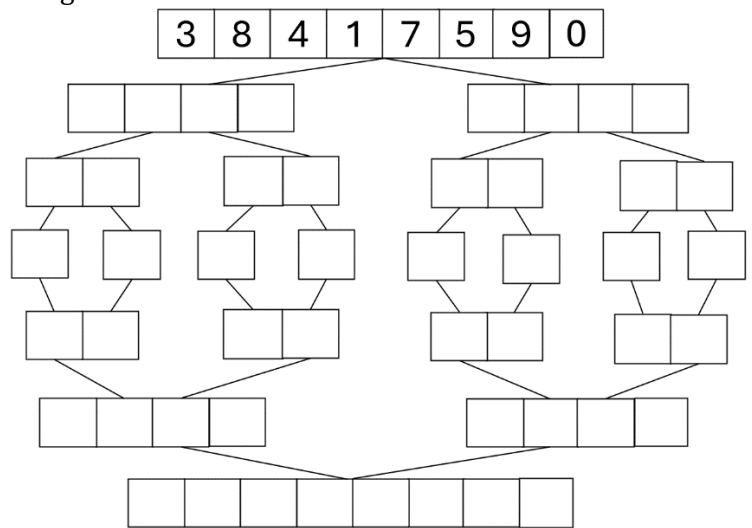
3. Trace the search of this array to find '7' using BOTH linear search and binary search.
   When drawing on the array, label the binary search and label the linear search.   /6

For Binary Search:

Low	High	Mid

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
5	6	7	10	11	13	14	15	16	17	19	20	21	23	25

4. Using the pictures shown, fill in the code for this game of Farm Swap.   /5

The picture information:	The code:
1 2 3 4 5	`int field [][]={{___, ____, ____, ____, ____},`
The grid information:	`                  {___, ____, ____, ____, ____},`
	`                  {___, ____, ____, ____, ____}};`
	`int row = ____;`
	`int col = ____;`
	`JButton pics[]=new JButton[_____*_____];`
	`Panel grid=new Panel(new GridLayout(_____,_____));`
	`int m=0;`
	`for(int i=0; i<_____; i++){`
	`    for(int j=0; j<_____; j++){`
	`        pics[m]=new JButton`
	`         (createImageIcon(_____[i][j]+".jpg"));`
	`        pics[m].addActionListener(this);`
	`        pics[m].setActionCommand(m +"");`
	`        grid.add(pics[m]);`
	`        m++;`
	`    }`
	`}`
	`add(grid);`

Communication

5. Each of the following images were taken from pictorial representations of algorithms.
   Identify the algorithm shown and explain your choice.   /4

   Point form is fine in this section. **Multiple correct answers exist; be careful to explain**.

Image	Which Algorithm?	Why that Algorithm?
		The picture has This is found in _____ as
		The picture has This is found in _____ as

6. Provide the phrase or term indicated. /10

(a) In quicksort, a partition is finished when this is in its correct place.

(b) Wrote Mergesort.

(c) The second method, besides divide, used by Mergesort.

(d) The first sorting algorithm that was actually coded.

(e) The edge guard for a[x-1][y].

(f) The edge guard for a[x][y+1].

(g) Tony Hoare won the Turing award for this algorithm in 1980.

(h) The n in big-Oh notation stands for this.

(i) Quicksort does this much more purposefully than Bubblesort.

(j) Why an algorithm would have (log n) their algorithm speed.

(k) Finding the location of an item in an array.

7. Describe the trade-offs for each of the following things. Use one sentence for the positive and another for the negative. /4

(a) Bubble sort

Positive:. . . . .

. . . .

Negative: . . . .

. . . .

(b) Linear Search

Positive:. . . . .

. . . .

Negative: . . . .

. . . .

8. In the documentary *The Secret Rules of Modern Living*, Marcus du Sautoy points out some key changes of algorithms over time. Fill in this chart to outline the changes he discusses. /6

Single word answers are fine, as long as it is the complete answer.

	Ancient Times	1950s	2000s
At that time, who (or what) wrote the algorithms?			
At that time, who (or what) were the algorithms written for?			
An example of an algorithm developed at that time.			

Thinking

9. Assume that you have a grid that is 9 (rows) x 6 (cols).   /4
(a) How many JButtons do you need? . . . .
(b) Given the JButton's actionCommands, determine each button's (x, y) position in the int tracking array.

4 (......., ...)	36 (......., ...)	43 (......., ...)

10. Which **sorting** algorithm is the best choice for each situation?   /5
_____ (a) The list of names is sorted; you add one element to the front. You have extra memory.
_____ (b) The array not randomized; it is very large. You just have enough memory to hold it.
_____ (c) The char array is in reverse order, but it is only 62 elements long.
_____ (d) You have lots of extra memory and the double array is in random order.
_____ (e) You have a list of the first 10 million digits of PI. You have no extra memory.

11. In each case, which **search** would be the best choice?   /5
_____ (a) You have a list of heights, ordered from smallest to greatest.
_____ (b) You are looking up a word in a dictionary.
_____ (c) You are looking up a definition in a dictionary to find the word that goes with it.
_____ (d) You are looking up a student ID in a list with no apparent order.
_____ (e) You are looking up a student ID in a list ordered by student last name.

12. Put these algorithm speeds in order.   13. What speeds are these array algorithms?   /8
(1 is fastest, 6 is slowest)
__ $O(n)$ (a) Swap   _____
__ $O(n!)$ (b) Quicksort   _____
__ $O(\log n)$ (c) Binary Search   _____
__ Constant time   (d) Bubble sort (average case)   _____
__ $O(n \log n)$ (e) BogoSort   _____
__ $O(n^2)$ (f) Linear Search   _____

14. Circle **and correct** 4 errors in the binary search method.   /4

```
public int binarySearch (int a[], int x, int low, int high  {

   if (low > high)
        return -1;

   int mid = (low + high)/2;

   if (a[mid] = x)
        return mid;

   else if (a[mid] < x);
        return binarySearch(a, x, mid+1, high);

   else if
        return binary(a, x, low, mid-1);
}
```

Application ⇨

15. Create a program that reads in information from a text file similar to the one on the right. Then produce the output below, inserting the file's input:

/6

> I love going to my **turnip** class. My best friend **Sal** is taking **turnip** with me. **Sal** and I both enjoy **hopping** around **turnip** class while writing our detailed notes with **ketchup** on **tree trunks**.

note.txt -... — ☐ ✕

File   Edit   Format   View   Help

turnip
Sal
ketchup
tree trunks
hopping
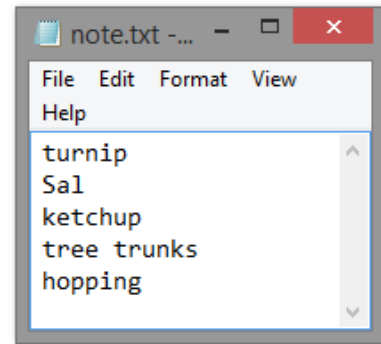
```
BufferedReader in;
try {
    in = new BufferedReader (new FileReader (_____));
    _____ noun = in.readLine();
    String friend = in.readLine();
    String liquid = _____.readLine();
    String surface = in.readLine();
    String verb = in._____();

    System.out.println("_____" + _____ + "_____");
    System.out.println(_____+"_____"+_____+"_____"+_____);
    System.out.println("_____"+_____+"around"+_____+"_____");
    System.out.println("_____"+_____);
    System.out.println("_____"+_____);

    in._____ ();
} catch (IOException e)  {
    System.out.println ("Error opening file " + e);
}
```

16. Write the java method for the Farm Swap game that assigns a carrot (3) to each element in the `field` array. Its name is `carrotsEveryWhere`. The variables `row` and `col` track the dimensions for the array. Make sure that the new array is updated on the screen using `redraw`. The method has no parameters, and returns nothing.

```
public _____ _____(_____)
{
    for (_____)
    {
        for (_____)
        {
            field [____] [____] = ____;
        }
    }
    _____ ();
}
```

/6

1 2 3 4 5

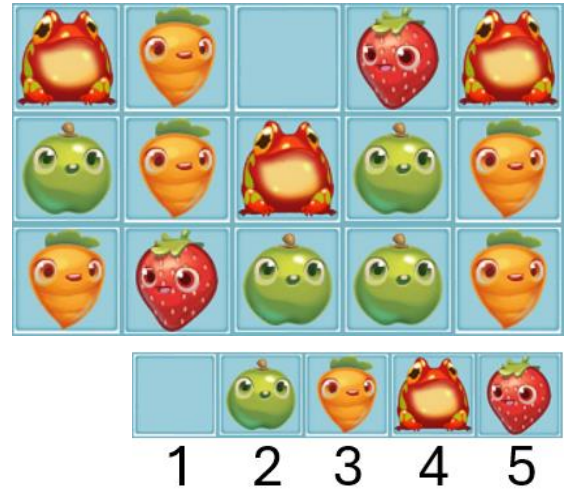17. Fill in the neighbours chart for the center element.   /5

Up-Left	Up	Up-Right
field[_____][_____]	field[_____][_____]	field[_____][_____]
Left	Clicked Element	Right
field[_____][_____]	field[i][j]	field[_____][_____]
Down-Left	Down	Down-Right
field[_____][_____]	field[_____][_____]	field[_____][_____]

18. In the game Farm Swap, you get extra points every time you get a frog (4) over an apple (2). In the screen shown, the user would get two extra points.

Code a method that returns the number of frogs over apples in a global array named `field`. The variables `row` and `col` track the dimensions for the array.

The method has no parameters but will return an integer.

/7