-Arrays-

Fundamentals to programming I

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Content

Arrays-Definition

- Also called arrangements.
- Data structure containing a collection of data of the same type.

Arrays-Properties

- They are used as containers to store related data.
- All the data included in the array is of the same type.
- The size of the Array is established when it is created.
- To access the Array data, the position it occupies within the set must be used.

Arrays-Declaration

- Square brackets are used to indicate that it is an Array and not a simple variable.

one-dimensional array

```
type name[ ];
```

```
type [ ] name;
```

two-dimensional array

```
type name[ ] [ ];
```

```
type [ ] [ ] name;
```

Arrays-Creation

- They are created with the "new" operator.

one-dimensional

```
int [ ] ages = new int [ 15 ];
```

two-dimensional

```
int [ ] [ ] temperatures = new int [10] [16];
```

Arrays-Use

- Indexes are used to access the elements of an array.

one-dimensional

```
float[] notas = new float[3];
```

notas[0] =2

notas[1] =5

notas[2] =6

two-dimensional

```
int [][] matrix=new int[4][5];

matrix[0][0]=15;
matrix[0][1]=21;
matrix[0][2]=18;
matrix[0][3]=9;
matrix[0][4]=15;

matrix[1][0]=10;
matrix[1][1]=52;
matrix[1][2]=17;
matrix[1][3]=19;
matrix[1][4]=7;

matrix[2][0]=19;
matrix[2][1]=2;
matrix[2][2]=19;
matrix[2][3]=17;
matrix[2][4]=7;

matrix[3][0]=92;
matrix[3][1]=13;
matrix[3][2]=13;
matrix[3][3]=32;
matrix[3][4]=41;
```

Arrays-Initialization in the declaration

- You can assign an initial value to the elements of an Array in the declaration itself.

```
int vector[] = {1, 2, 3, 5, 7};
int matriz[][] = { {1,2,3}, {4,5,6} };
```

Arrays-Manipulation Examples

- Operations are done component by component.

one-dimensional

```
static float media (float datos[])
{
  int   i;
  int   n = datos.length;
  float suma = 0;

  for (i=0; i<n; i++)
      suma = suma + datos[i];

  return suma/n;
}
```

two-dimensional

```
public static void mostrarMatriz (double matriz[][])
{
  int i,j;
  int filas = matriz.length;
  int columnas = matriz[0].length;

  // Recorrido de las filas de la matriz

  for (i=0; i<filas; i++) {

      // Recorrido de las celdas de una fila

      for (j=0; j<columnas; j++) {

          System.out.println ( "matriz["+i+"]["+j+"]="
                               + matriz[i][j] );
      }
  }
}
```

Character string

- The java.lang.String class is used to represent character strings in Java. It includes different methods that help us with character string operations.

Character string-substring

- The "substring" method allows us to get a substring.

```
String java="Java";
String s = java.substring(0,3);
System.out.println(s);                    // Jav
```

Character string-charAt

- The "charAt (n)" method returns the character that is in position n of the string.

```
String java="Java";
char c = java.atChar(2);
System.out.println(c);                    // v
```

Character string-indexOf

- The "indexOf (s)" method returns the position of a substring within a string.

```
String java="Java";
int p = java.indexOf("av");
System.out.println(p);                    // 1
```

Character string-replace

- The "replace (old, new)" method replaces substrings.

```
String java="Java";
java.replace("ava","ini");
System.out.println(java);                    // Jini
```

Character string-equals

- The "equals (s)" method is used to whether two strings are equals.

```
if (s.equals("Hola")) {
    ...
}
```

Character string-startsWith

- The method "starts with (s)" tells us if a string starts with a certain prefix.

```
if (s.startsWith("get")) {
    ...
}
```

Character string-endsWith

- The "endsWith (s)" method tells us if a string ends with a certain suffix.

```
if (s.endsWith(".html")) {
    ...
}
```

Character string-length

- The "length" method tells us the length of the string

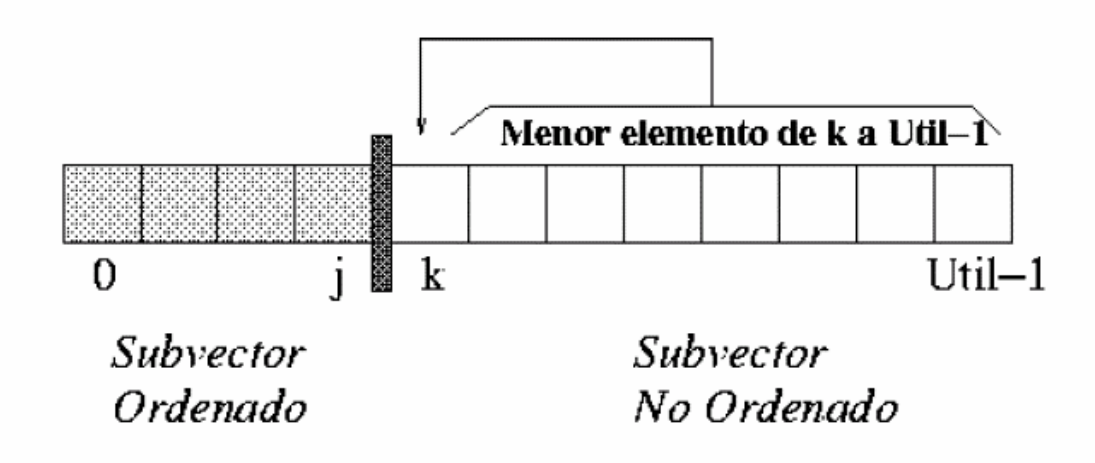
```
String saludo = “Hola”;
int longitud = saludo.length();
```

Sorting algorithms

- sort by selection.
- insertion sort.
- Direct exchange ordering (Bubblesort).
- QuickSort

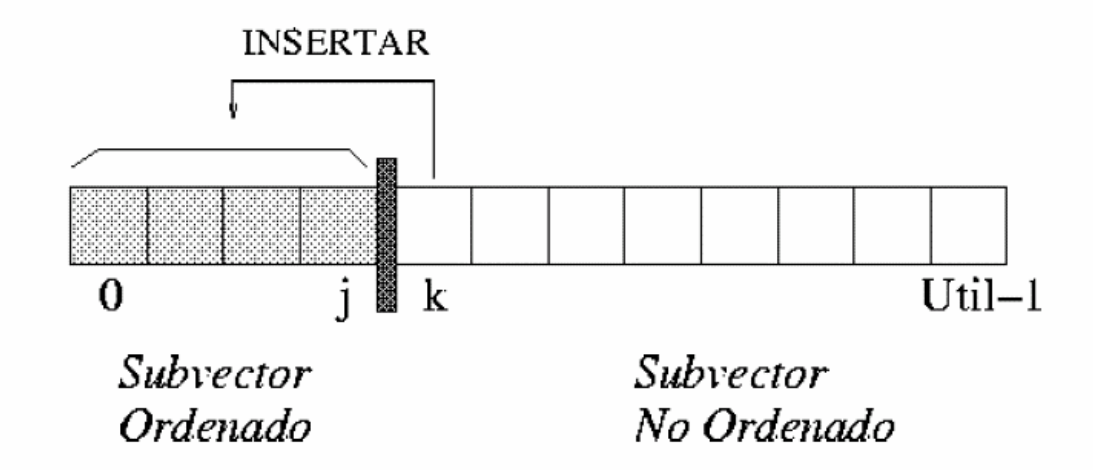
Sorting algorithms

- Selection sort
  - Procedure: In each iteration, the smallest element of the unordered subset or subvector is selected and exchanged with the first element of this.
  - Greater efficiency
  - Complexity: n squared
  - Method: selection



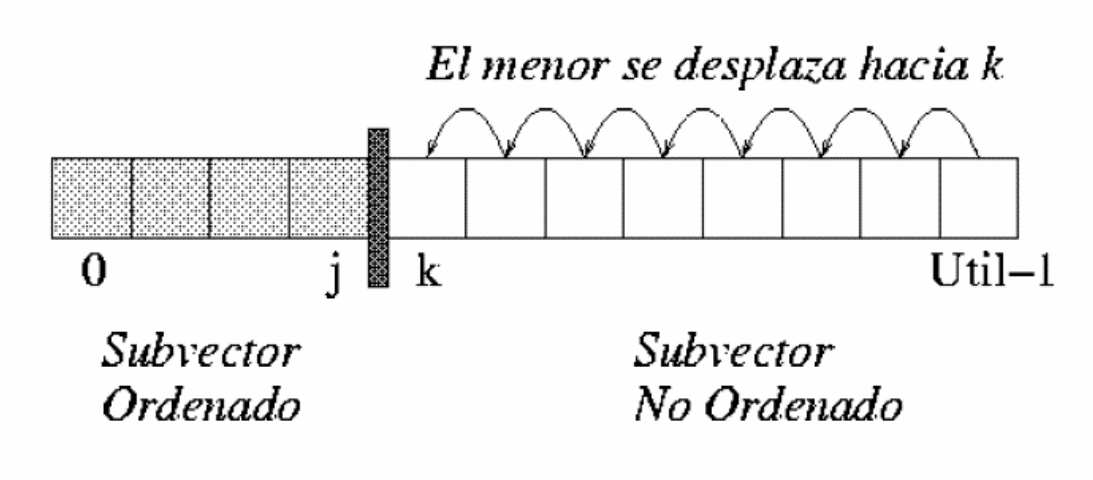
Sorting algorithms

- Insertion sort
  - Procedure: In each iteration, an element from the unordered subvector is inserted at the correct position within the ordered subvector.
  - Greater efficiency
  - Complexity: n squared/2
  - Method: insert
  - Example: a deck of cards



Sorting algorithms

- Direct exchange ordering (Bubblesort)
  - Lower efficiency
  - Complexity: n squared
  - Method: exchange
  - Is more simple



Sorting algorithms

- QuickSort
  - Procedure: Reposition the other elements of the list on each side of the pivot, so that on one side are all the lesser than him, and on the other the greater
  - Greater efficiency
  - Complexity: n log n or n squared in the worst case
  - Method: partition

Sorting algorithms

- Linear search or Sequential search
  - Process :It is compared sequentially, one by one.

```
1
2  public class BusquedaLineal {
3      //Linear search for an element in a vector
4      // - Returns the position of "data" in the vector
5      // - If "data" is not in the vector, returns -1
6      public static void main (String[]args) {
7          double  []a={9.0,5.0,3.0,4.0,8.0,2.0};
8          Search(a,4.0);
9      }
10
11     static void Search (double vector[], double dato)
12     {
13     int i;
14     int N = vector.length;
15     int pos = -1;
16
17
18     for (i=0; (i<N) && (pos==-1); i++)
19
20     if (vector[i]==dato)
21     pos = i;
22     System.out.println(pos);
23
24     }
25 }
```

Sorting algorithms

- Binary search
  - Pre-condition: Must be ordered
  - Process :
    - The searched data is compared with the element in the center of the vector
    - If they match, we have found the desired data.
    - If the data is greater than the central element of the vector, we have to find the data in the second half of the vector.
    - If the data is less than the central element of the vector, we have to find the data in the first half of the vector.

Sorting algorithms

- Binary search

```
// recursive implementation
// Usage: binSearch (vector, 0, vector.length-1, data)
static int binSearch
(double v[], int izq, int der, double buscado){
int centro = (izq+der)/2;
if (izq>der)
return -1;
else if (buscado==v[centro])
return centro;
else if (buscado<v[centro])
return binSearch(v, izq, centro-1, buscado);
else
return binSearch(v, centro+1, der, buscado);
}
// Iterative implementation
// Use: binSearch (vector, data)
static int binSearch (double v[], double buscado){
int izq = 0;
int der = v.length-1;
int centro = (izq+der)/2;

while ((izq<=der) && (v[centro]!=buscado)) {

if (buscado<v[centro])
der = centro - 1;
else
izq = centro + 1;
centro = (izq+der)/2;
}
```

Requirements

- JDK >=1.8
- MS Windows, MacOS, GNU/Linux: Oracle
  - jdk-8u261-windows-i586.exe
  - jdk-8u261-windows-x64.exe
  - jdk-8u261-macosx-x64.dmg
  - jdk-8u261-linux-x64.tar.gz (Optional)
- GNU/Linux: Ubuntu

Code

- Selection sort

```
1
2  public class insercion {
3      public static void main (String[]args) {
4          int []a={3,8,6,4};
5          OrdInsercion(a);
6      for (int i = 1; i <= a.length; i++) {
7          System.out.println(a[i-1]+" ");
8      }
9      }
10
11     private static void OrdInsercion(int[] A) {
12         int aux, i;
13         for (int j = 1; j < A.length; j++) {
14             aux = A[j];
15             i = j-1;
16             while (i>-1 && A[i]>aux) {
17                 A[i+1]= A[i];
18                 i = i-1;
19             }
20             A[i+1] = aux ;
21
22         }
23         // TODO Auto-generated method stub
24
```

Code

- Selection sort

```
2  public class Seleccion {
3
4          public static void main(String[] args){
5          int b[]={5,9,3,4,55,26,74};
6          OrdSleccion(b);
7          for (int i = 1; i <= b.length; i++) {
8              System.out.println(b[i-1]+" ");
9          }
0
1          }
2          private static void OrdSleccion(int[] a) {
3              // TODO Auto-generated method stub
4                for (int i = 0; i < a.length - 1; i++)
5                 {
6                         int min = i;
7                         for (int j = i + 1; j < a.length; j++)
8                         {
9                                 if (a[j] < a[min])
0                                 {
1                                         min = j;
2                                 }
3                         }
4                         if (i != min)
5                         {
6                                 int aux= a[i];
7                                 a[i] = a[min];
8                                 a[min] = aux;
```

Code

- Insertion sort

```
1
2  public class insercion {
3      public static void main (String[]args) {
4          int []a={3,8,6,4};
5          OrdInsercion(a);
6      for (int i = 1; i <= a.length; i++) {
7          System.out.println(a[i-1]+" ");
8      }
9      }
10
11     private static void OrdInsercion(int[] A) {
12         int aux, i;
13         for (int j = 1; j < A.length; j++) {
14             aux = A[j];
15             i = j-1;
16             while (i>-1 && A[i]>aux) {
17                 A[i+1]= A[i];
18                 i = i-1;
19             }
20             A[i+1] = aux ;
21
22         }
23         // TODO Auto-generated method stub
24
```

Code

- Direct exchange ordering (Bubblesort)

```
1
2  public class burbuja {
3      public static void main (String []args) {
4          int []n = {4,10,2,9};
5          int []o = new int [4];
6          o=OrdBurbuja(n);
7          System.out.println(o[0]+","+o[1]+","+o[2]+","+o[3]);
8      }
9
10     public static int [] OrdBurbuja(int[]n) {
11         int aux;
12         int t = n.length;
13         for (int i = 1; i < t; i++) {
14             for (int k = t-1; k>= i;k--) {
15                 if(n[k] < n[k-1]) {
16                     aux = n[k];
17                     n[k] = n[k-1];
18                     n[k-1]= aux ;
19                 }
20             }
21         }
22         return n ;
23     }
24
25 }
```

Code

- QuickSort

```
11    static void QS(int[] vector, int primero, int ultimo){
12         int i=primero, j=ultimo;
13         int pivote=vector[(primero + ultimo) / 2];
14         //divide y venceras , ve por partes
15         int aux;
16
17         do
18         {
19              while(vector[i]<pivote) i++;
20              while(vector[j]>pivote) j--;
21
22              if (i<=j)
23              {
24                   aux=vector[j];
25                   vector[j]=vector[i];
26                   vector[i]=aux;
27                   i++;
28                   j--;
29              }
30         }
31         while (i<=j);
32
33         if(primero<j)
34         {
35              QS(vector,primero, j);
36         }
37
38         if(ultimo>i)
39         {
40             QS(vector,i, ultimo);
41         }
```

References - Web pages

- https://elvex.ugr.es/decsai/java/
- https://es.wikipedia.org/wiki/Algoritmo_de_ordenamiento
- https://es.wikipedia.org/wiki/Quicksort
- https://gl-epn-programacion-ii.blogspot.com/2010/06/metodos-de-ordenamiento.html
- https://sites.google.com/a/espe.edu.ec/programacion-ii/home/a1-arreglos/algoritmos-de-ordenacion-y-busqueda
- https://slideplayer.es/slide/1383043/
- https://www.youtube.com/watch?v=_tUncS0AsNE

References - Books

- Java programming basics of Marco Aedo

Thanks for your attention!...