How to do well on the AP CS Free Response

2015 Questions

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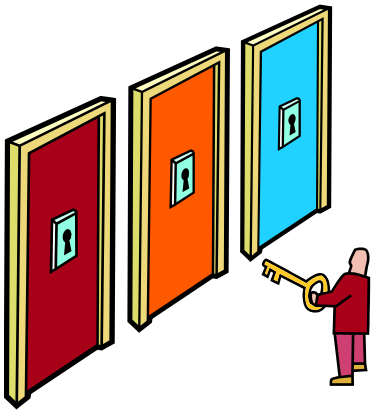
AP Free Response Questions



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AP A Free Response Topics

Array / Array or Arrays

– for and for each loops, nested loops, array of arrays concepts

Make a Class - Basic

– create a basic class with instance variables, constructors, and methods

ArrayList of References / Strings

– get,set,remove,add,size – levels of abstraction

Make a Class - Interface / Abstract

– implement / extend – looks like this topic is back

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Free Response Strategies

-Read all 4 questions before writing anything

-answer the easiest question 1st

-most times question 1 is the easiest

-see if part B calls part A and so on

-many times part C consists of A and B calls

-write something on every question

-write legibly / use **PENCIL**!!!!!!!!!!

-keep track of your time

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Free Response Strategies

- When writing methods
  - use parameter types and names as provided
  - do not redefine the parameters listed
  - do not redefine the methods provided
  - return from all return methods
  - return correct data type from return methods

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Free Response Strategies

-When writing a class or methods for a class

  -know which methods you have

  -know which instance variables you have

  -check for public/private on methods/variables

  -return from all return methods

  -return correct data type from return methods

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Free Response Strategies

- When extending a class
  - know which methods the parent contains
  - have the original class where you can see it
  - make sure you have super calls
  - check for public/private on methods/variables
  - make super calls in sub class methods as needed

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Free Response Strategies

-When extending abstract / implementing interface

  -know which methods the parent contains

  -have the original class where you can see it

  -make sure you have super calls

  -check for public/private on methods/variables

  -make super calls in sub class methods as needed

  -implement all abstract methods in sub class

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AP A Free Response Topics

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Make a Class - Interface / Abstract

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Arrays and Array of Arrays

One question on the A test free response will require you to manipulate an array and / or an array of arrays.

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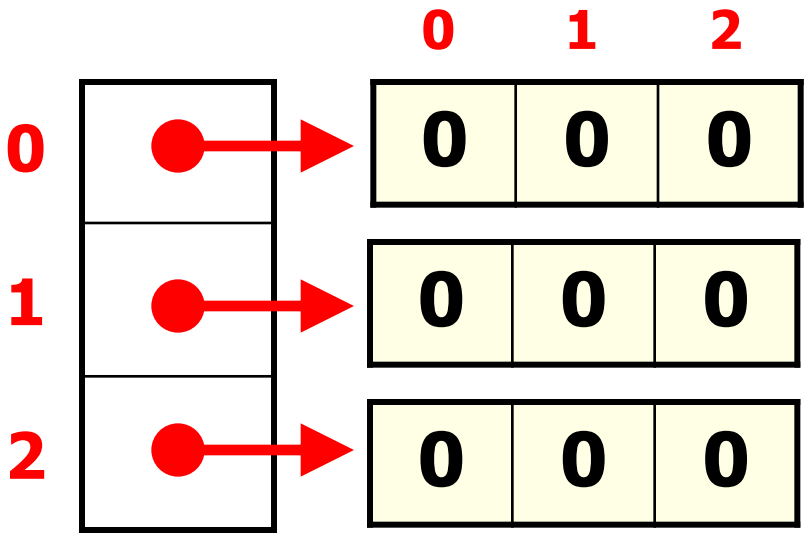
What is a matrix?

A matrix is an array of arrays.

```
int[][] mat = new int[3][3];
```



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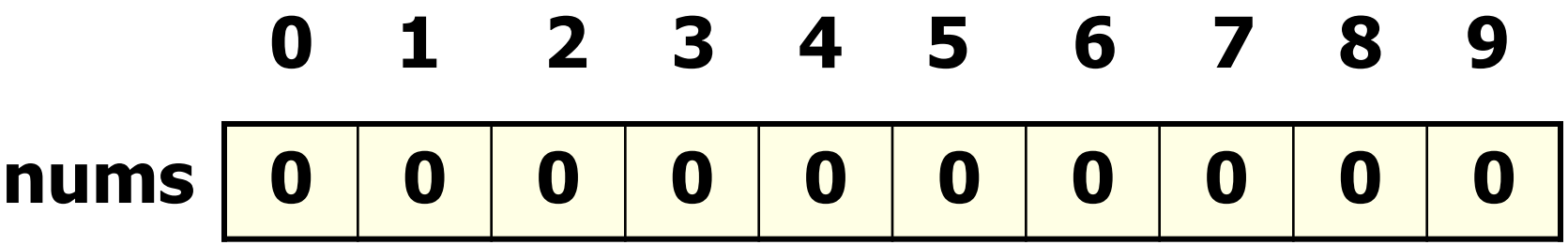
AP A - Arrays

```
int[] nums = new int[10];    //Java int array
```



An array is a group of items all of the same type which are accessed through a single identifier.

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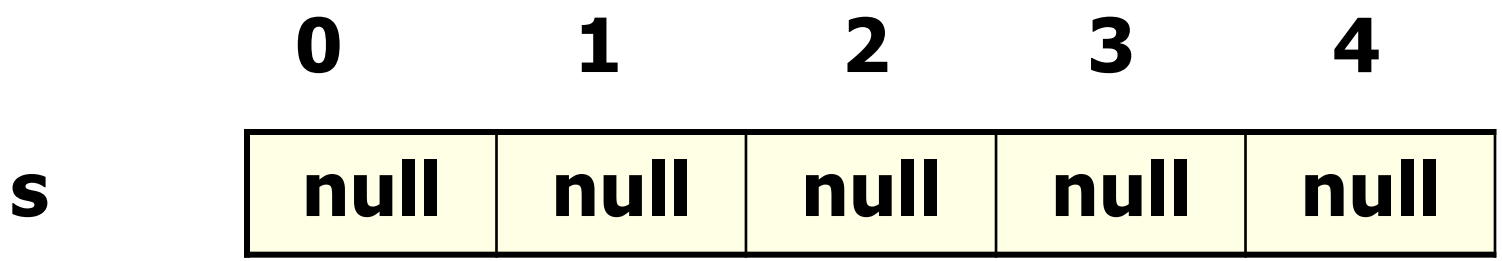
AP A - Arrays

```
String[] s = new String[5];
```



Arrays are automatically filled with values when instantiated.

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Matrix Variables

```
int size = 40;

int[][] mat = {{5,7,9,2},
               {5,3,4,6},
               {7,0,8,9}};

int[][] intMat = new int[size][size];
        //intMat is filled with zeros - 0s
```

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Matrix Variables

```
String[][] words = new String[4][4];
        //words is filled with null


double[][] dMat = new double[3][3];
        //dMat is filled with 0.0
```

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Printing Spots

```
int[][] mat = {{5,7,9,2,1,9},
               {5,3,4},
               {3,7,0,8,9}};

out.println(mat[2][1]);
out.println(mat[1][2]);
out.println(mat[0][3]);
out.println(mat[2][4]);
```

OUTPUT

```
7
4
2
9
```

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Printing Spots

```
int[][] mat = {{5,7,9,2,1,9},
               {5,3,4},
               {3,7,0,8,9}};

out.println(mat[7/4][0]);
out.println(mat[1*2][2]);
out.println(mat.length);
out.println(mat[0].length);
```

OUTPUT

5
0
3
6

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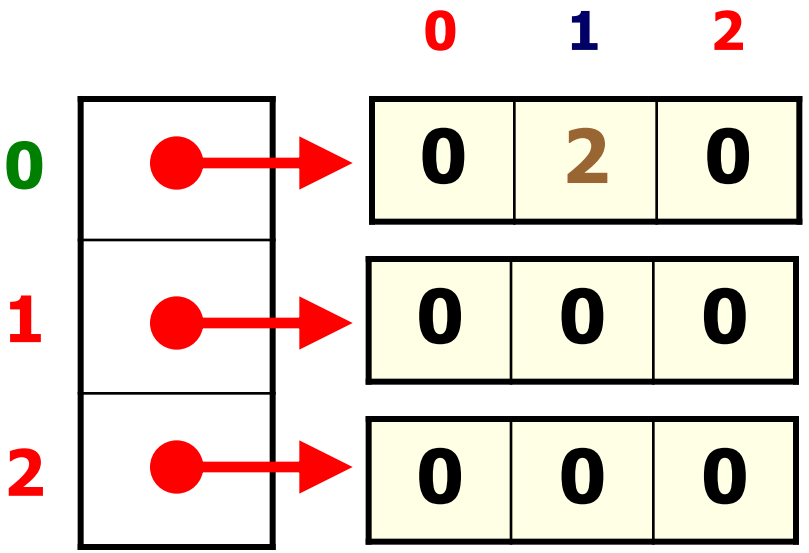
What is a matrix?

A matrix is an array of arrays.

```
int[][] mat = new int[3][3];
mat[0][1]=2;
```

Which array?

Which spot?



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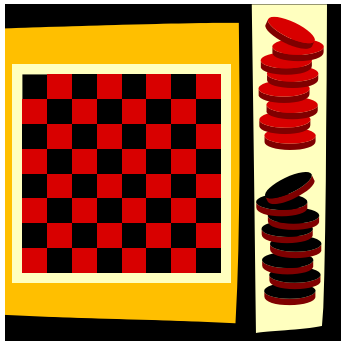
Assigning Matrix Values

	0	1	2	3	4
0	0	0	0	5	0
1	0	0	0	0	0
2	0	0	7	0	0
3	0	0	0	0	0
4	0	3	0	0	0

```
mat[2][2]=7;
mat[0][3]=5;
mat[4][1]=3
```



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Assigning Matrix Values

```
for( int r = 0; r < mat.length; r++)
{
  for( int c = 0; c < mat[r].length; c++)
  {
       mat[r][c] = r*c;
  }
}
```

if mat was 3x3

0	0	0
0	1	2
0	2	4

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Nested Loop Review

```
int outer=1;
      //start      //stop      //increment
for(outer=1;  outer<=2;     outer++)
{
        //start      //stop    //increment
    for(int inner=1;  inner<=2;   inner++)
      out.println(outer + " " + inner);
    out.println();
}
```

OUTPUT

```
1 1
1 2

2 1
2 2
```

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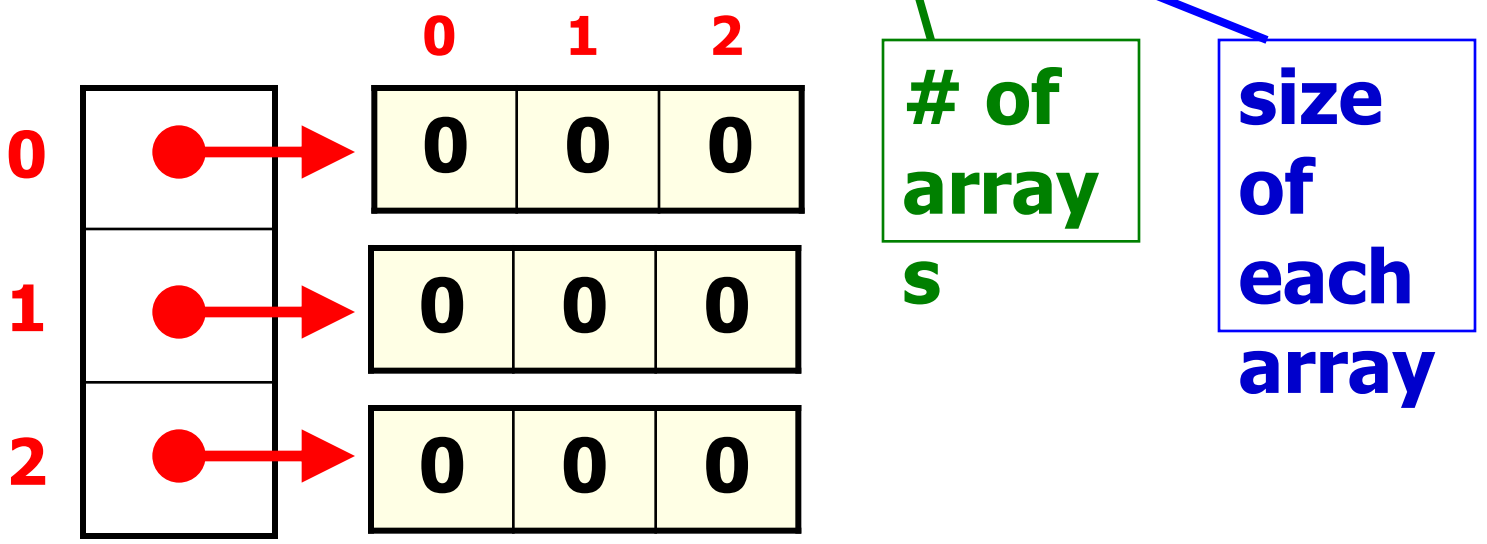
What is a matrix?

A matrix is an array of arrays.

```
int[][] mat = new int[3][3];
```



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Printing an Array

```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};

out.println(Arrays.toString(mat[0]));

out.println(Arrays.toString(mat[1]));
```

OUTPUT

```
[5, 7]
[5, 3, 4, 6]
```

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Printing an Array

```
int[] nums = {1,2,3,4,5,6,7};
for(int r=0; r<nums.length; r++)
{
    out.println(nums[r]);
}
```

length returns the # of elements/items/spots in the array!!!

OUTPUT

```
1
2
3
4
5
6
7
```

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Printing a Matrix

```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};

for(int r=0; r<mat.length; r++)
{
    for(int c=0; c<mat[r].length; c++)
    {
        out.print(mat[r][c]);
    }
    out.println();
}
```

OUTPUT

```
5 7
5 3 4 6
0 8 9
```

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Printing a Matrix

```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};

for( int[] row : mat )
{
  for( int num : row )
  {
    System.out.print( num + " ");
  }
  System.out.println();
}
```

OUTPUT

```
5 7
5 3 4 6
0 8 9
```

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2015 AP A

Free Response

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```
public static int arraySum( int[] arr )
{
    int sum = 0;
    for( int item : arr )
        sum = sum + item;
    return sum;
}
```

2015
Question 1
part A

```
public static int[] rowSums( int[][] arr2D )
{
  int[] ret = new int[arr2D.length];
  for( int i = 0; i < ret.length; i++ )
      ret[i] = arraySum(arr2D[i]);
  return ret;
}
```

2015 Question 1 part B

```
public static boolean isDiverse( int[][] arr2D )
{
   int[] totals = rowSums( arr2D );
   for( int i = 0; i < totals.length-1; i++ )
   {
       for( int j = i+1; j < totals.length; j++)
          if( totals[i] == totals[j] )
               return false;
   }
   return true;
}
```

This version is kinda lame, but I assume most students will do something like this.

2015 Question 1 part C – ver 1

```
public static boolean isDiverse( int[][] arr2D )
{
  int[] totals = rowSums( arr2D );
  ArrayList<Integer> used;
  used = new ArrayList<Integer>();
  for( int item : totals )
  {
     if( used.contains( item) )
        return false;
     else
        used.add( item );
   }
   return true;
}
```

2015 Question 1 part C – ver 2

This algorithm is more interesting and more of what I would expect from my students that participate in contests.

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A+ Lab Assignments that cover the same matrix concepts as FR question # 1 ::

- **Magic Square and Spiral Matrix**
- **Forest and Tic-Tac-Toe**
- **Codes and Ciphers**

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AP A
Make a Class

One question on the A test free response will require that you create a class sometimes using inheritance and sometimes not.

You will need to create instance variables, constructors, and methods.

The 2015 question was a class question that involved strings.

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Class Components

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classes

```
public class Triangle
{
   private int sideA;
   private int sideB;
   private int sideC;
```

Instance variables

Instance variables store the state information for an object.

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constructors

```
public Triangle(int a, int b, int c)
{
   sideA=a;
   sideB=b;
   sideC=c;
}
```

Initialization Constructor

Constructors are similar to methods. Constructors set the properties of an object to an initial state.

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modifier methods

```
public void setSideA(int a )
{
    sideA=a;
}
```

Modifier methods are methods that change the properties of an object.

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accessor methods

```
public int getSideA()
{
  return sideA;
}
```

Accessor methods are methods that retrieve or grant access to the properties of an object, but do not make any changes.

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String

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String

frequently used methods

Name	Use
substring(x,y)	returns a section of the string from x to y not including y
substring(x)	returns a section of the string from x to length-1
length()	returns the # of chars
charAt(x)	returns the char at spot x
indexOf(c)	returns the loc of char c in the string, searching from spot 0 to spot length-1
lastIndexOf(c)	returns the loc of char c in the string, searching from spot length-1 to spot 0

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Strings

```
String sent = "alligators rule";
String find = "gato";

System.out.println( sent.indexOf( find ) );
System.out.println( sent.indexOf( "dog" ) );
System.out.println( sent.substring( 3 , 6 ) );
System.out.println( sent.substring( 6 ) );
```

OUTPUT

```
4
-1
iga
tors rule
```

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2015 AP A

Free Response

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2015 Question 2

```
public class HiddenWord
{
  private String word;

   public HiddenWord( String w )
   {
     word = w;
   }

   public String getHint( String guess )
   {
     String ret = "";
     for( int i = 0; i < word.length(); i++)
     {
           if( word.substring(i,i+1).equals(guess.substring(i,i+1)) )
             ret += word.substring( i, i+1);
           else if( word.indexOf( guess.substring(i,i+1))!=-1)
             ret += "+";
           else
             ret += "*";
     }
     return ret;
   }

}
```

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A+ Lab Assignments that cover the same string concepts as FR question # 2 ::

- **HexChecker, MorseCode**
- **Rock-Paper-Scissors**
- **Etch-A-Sketch**

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ArrayList

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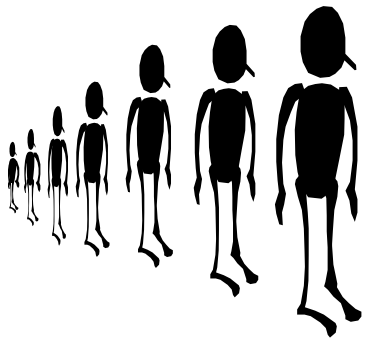
AP A - ArrayList

A typical ArrayList question involves putting something into an ArrayList and removing something from an ArrayList.



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AP A - ArrayList

Arraylist is a class that houses an array.

An ArrayList can store any type.

All ArrayLists store the first reference at spot / index position 0.

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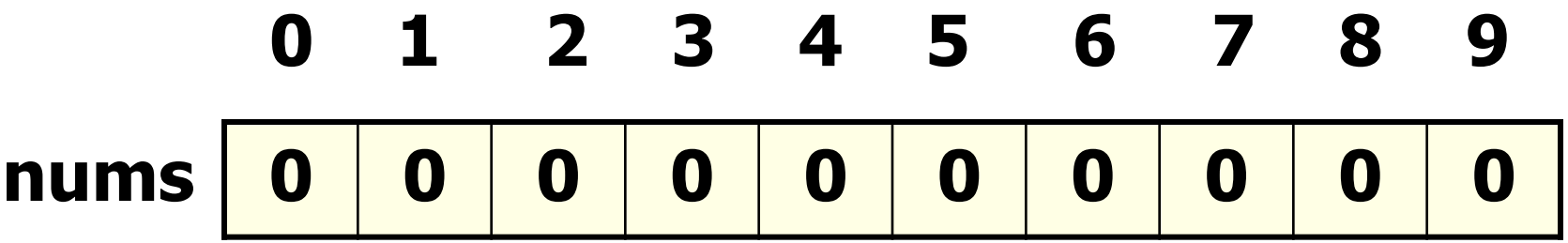
AP A - ArrayList

```
int[] nums = new int[10];          //Java int array
```



An array is a group of items all of the same type which are accessed through a single identifier.

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ArrayList

frequently used methods

Name	Use
add(item)	adds item to the end of the list
add(spot,item)	adds item at spot – shifts items up->
set(spot,item)	put item at spot z[spot]=item
get(spot)	returns the item at spot return z[spot]
size()	returns the # of items in the list
remove()	removes an item from the list
clear()	removes all items from the list

```
import  java.util.ArrayList;
```

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AP A - ArrayList

```
List ray = new ArrayList();
ray.add("hello");
ray.add("whoot");
ray.add("contests");
out.println(((String)ray.get(0)).charAt(0));
out.println(((String)ray.get(2)).charAt(0));
```

OUTPUT

```
h
c
```

ray stores Object references.

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AP A - ArrayList

```
List<String> ray;
ray = new ArrayList<String>();
ray.add("hello");
ray.add("whoot");
ray.add("contests");
out.println(ray.get(0).charAt(0));
out.println(ray.get(2).charAt(0));
```

OUTPUT

```
h
c
```

ray stores String references.

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AP A - ArrayList Removal

```
int spot=list.size()-1;
while(spot>=0)
{

   if(list.get(spot).equals("killIt"))
      list.remove(spot);

   spot--;

}
```

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AP A - ArrayList Removal

```
for(int i=list.size()-1; i>=0; i--)
{

   if(list.get(i).equals("killIt"))
      list.remove(i);

}
```

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AP A - ArrayList Removal

```
int spot=0;
while(spot<list.size())
{
   if(list.get(spot).equals("killIt"))
      list.remove(spot);
   else
      spot++;
}
```

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2015 AP A

Free Response

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2015 Question 3 part A

```
public int getValueAt( int row , int col )
{
  for( SparseArrayEntry item : entries )
  {
    if( item.getRow()==row && item.getCol()==col)
      return item.getValue();
  }
  return 0;
}
```

You must know ArrayList!

2015 Question 3 - part B

```
public void removeCol( int col )
{
  for( int i = entries.size()-1; i>=0; i--)
 {
   SparseArrayEntry e = entries.get(i);
   if( e.getCol()==col)
   {
     entries.remove(i);
    }
   else if ( e.getCol()>col)
   {
     SparseArrayEntry up;
     up = new SparseArrayEntry( e.getRow(), e.getCol()-1, e.getValue() );
     entries.set( i, up);
   }
 }
 numCols--;
}
```

You must know ArrayList!

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A+ Lab Assignments that cover the same list concepts as FR question # 3 ::

- **MadLib, WordList, Numbers, and Toys**
- **Moving Shapes**
- **BlackJack – 21**

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AP A - Abstract/Interface

A typical Abstract/Interface question requires that a class be written that extends the abstract class or implements the interface and that all abstract method(s) be implemented.

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AP A - Abstract/Interface

Abstract classes are used to define a class that will be used only to build new classes.

No objects will ever be instantiated from an abstract class.

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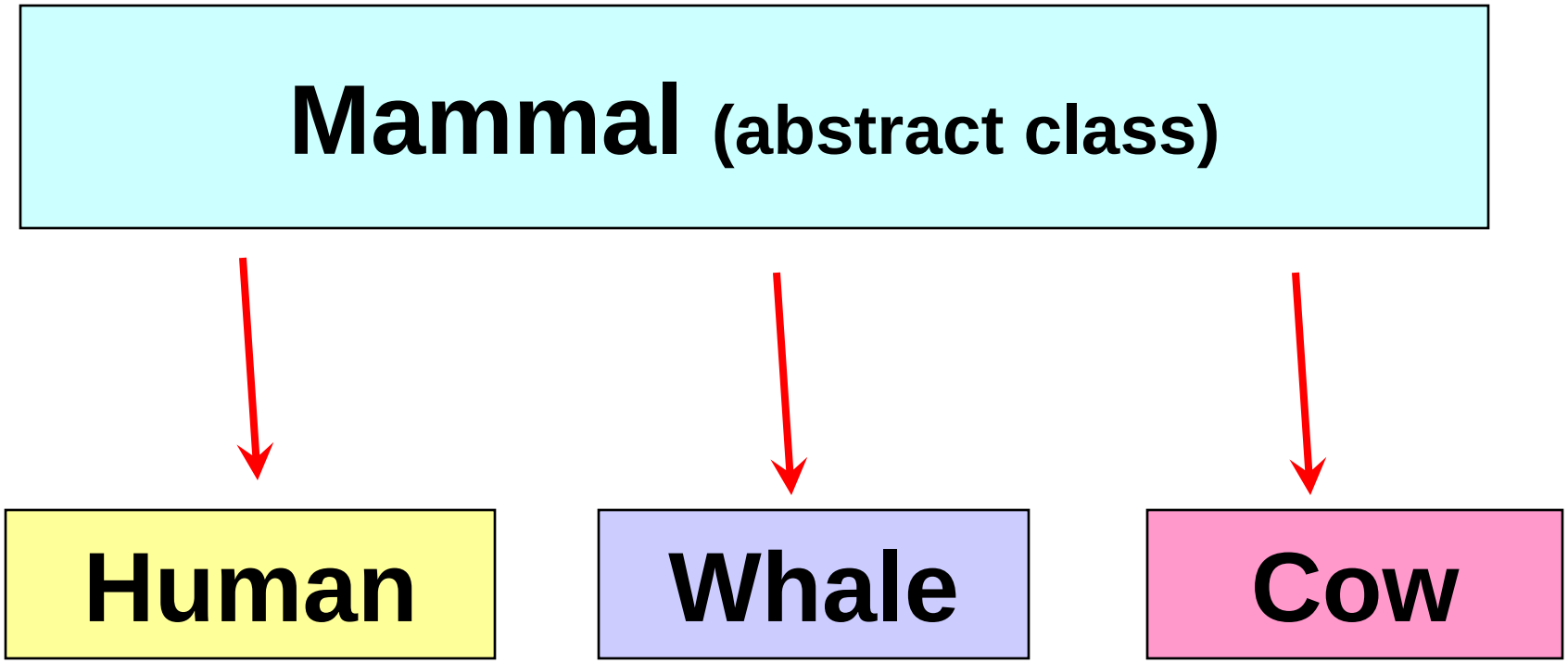
AP A - Abstract/Interface



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AP A - Abstract/Interface

Any sub class that extends a super abstract class must implement all methods defined as abstract in the super class.

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AP A - Abstract / Interface

```
abstract class Monster{
   private String myName;

   public Monster()   {
      myName ="";
   }

   public Monster(String name)   {
       myName =name;
   }

   public String getName()   {
      return myName;
   }

   public abstract void talk( );

   public String toString() {
      return myName + "\n";
   }
}
```

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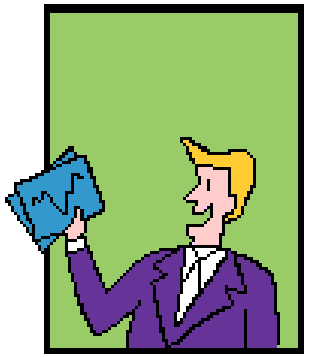
AP A - Abstract/Interface

Why define talk as abstract?

```
public abstract void talk( );
```

Does each Monster say the exact same thing?



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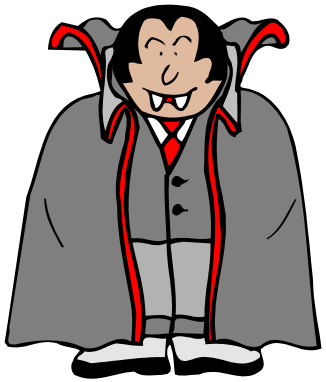
Vampire



```
class Vampire extends Monster
{
  public Vampire( String name )
  {
    super(name);
  }

  public void talk()
  {
    out.println("Vampire " + getName() +
                                    " say \"I want to drink your blood!\"");
  }
}
```

Sub Class

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AP A - Abstract/Interface

```
public abstract class APlus
{
  public APlus(int x)
    //constructor code not shown

  public abstract double goForIt();

  //other fields/methods not shown
}
```

Pet
Item

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AP A - Abstract/Interface

```
public class PassAPTest extends APlus
{
  public PassAPTest(int x)
  {
    super(x);
  }

  public double goForIt()
  {
    double run=0.0;
    //write some code   -   run = x*y/z
    return run;
  }

  //other fields/methods not shown
}
```

```
public abstract class APlus
{
  public APlus(int x)
    //constructor code not shown

  public abstract double goForIt();

  //other fields/methods not shown
}
```

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AP A - Abstract/Interface

```
public interface Exampleable
{
   int writeIt(Object o);
   int x = 123;
}
```

Methods are public abstract!
Variables are public static final!

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AP A - Abstract/Interface

```
public interface Exampleable
{
   public abstract int writeIt(Object o);
   public static final int x = 123;
}
```

Methods are public abstract!
Variables are public static final!

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AP A - Abstract/Interface

An interface is a list of abstract methods that must be implemented.

An interface may not contain any implemented methods.

Interfaces cannot have constructors!!!

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AP A - Abstract/Interface

Interfaces are typically used when you know what you want an Object to do, but do not know how it will be done.

If only the behavior is known, use an interface.

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AP A - Abstract/Interface

Abstract classes are typically used when you know what you want an Object to do and have a bit of an idea how it will be done.

If the behavior is known and some properties are known, use an abstract class.

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2015 AP A

Free Response

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```
public interface NumberGroup
{
  boolean contains( int val );
}
```

2015
Question 4
Part A

```
public class Range implements NumberGroup
{
  private int low;
  private int high;

  public Range( int lo, int hi)
  {
    low = lo;
    high = hi;
  }

  public boolean contains( int val )
  {
    return val >= low && val <= high;
  }
}
```

2015
Question 4
Part B

```
public class MultipleGroups implements NumberGroup
{
  private List<NumberGroup> groupList;

  //constructors , other methods, and such not shown

  public boolean contains( int val )
  {
    for( NumberGroup item : groupList )
    {
       if( item.contains( val) )
         return true;
     }
    return false;
  }
}
```

2015 Question 4 Part C

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A+ Lab Assignments that cover the same class concepts as FR question # 4 ::

- **Tic Tac Toe**
- **Lots of games**

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AP A Free Response Topics

Array / Array or Arrays

– for and for each loops, nested loops, array of arrays concepts

Make a Class - Basic

– create a basic class with instance variables, constructors, and methods

ArrayList of References / Strings

– get,set,remove,add,size – levels of abstraction

Make a Class - Interface / Abstract

– implement / extend – looks like this topic is back

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Free Response Strategies

-Read all 4 questions before writing anything

-answer the easiest question 1st

-most times question 1 is the easiest

-see if part B calls part A and so on

-many times part C consists of A and B calls

-write something on every question

-write legibly / use **PENCIL**!!!!!!!!!!

-keep track of your time

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Free Response Strategies

- When writing methods
  - use parameter types and names as provided
  - do not redefine the parameters listed
  - do not redefine the methods provided
  - return from all return methods
  - return correct data type from return methods

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Free Response Strategies

-When writing a class or methods for a class

  -know which methods you have

  -know which instance variables you have

  -check for public/private on methods/variables

  -return from all return methods

  -return correct data type from return methods

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Free Response Strategies

- When extending a class
  - know which methods the parent contains
  - have the original class where you can see it
  - make sure you have super calls
  - check for public/private on methods/variables
  - make super calls in sub class methods as needed

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Free Response Strategies

-When extending abstract / implementing interface

  -know which methods the parent contains

  -have the original class where you can see it

  -make sure you have super calls

  -check for public/private on methods/variables

  -make super calls in sub class methods as needed

  -implement all abstract methods in sub class

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