**Main Method():**

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Regstration No: SP21-BCS-OO2

\*/

import java.util.\*;

import java.lang.\*;

import java.util.Arrays;

public class runner{

        public static void main(String[] args){

// rectangle class

rectangle r1 = new rectangle(4, 5);

rectangle r2 = new rectangle(10, 5);

rectangle r3 = new rectangle(r2);

System.out.println();

System.out.println(r3.equals(r2));

rectangle temp = r1.compareArea(r3);

temp.display();

// account class

account a1 = new account(1000, 2000, "3630243093223");

account a2 = new account(345353, 1998, "3630243034523");

a1.display();

System.out.println(a1.checkValidCnic());

a1.deposit(5000);

a1.display();

account a3 = new account(a2);

a3.display();

System.out.println();

System.out.println(a3.equals(a2));

// Point class

point p1 = new point(6, 7);

point p2 = new point(4, 5);

p1.checkOrigin();

point temp = p1.addTwoPoints(p2);

temp.display();

point temp\_2 = p1.addThreePoints(p2, temp);

temp.display();

// Strudent class

int[] array = {45, 46, 47, 48, 49};

int[] array\_2 = {50, 51, 52, 53, 54, 55};

student s1 = new student("Sam", array);

student s2 = new student("Hafif", array\_2);

student s3 = new student("Sam", array\_2);

s1.compareAverage(s2);

s1.display();

s2.display();

s3.display();

// book Class

String[] sub\_array\_1 = {"Science", "Studies", "Population", "Economy", "Environment"};

String[] sub\_array\_2 = {"Math and Science", "Physics", "Population", "Economy", "Logics"};

book b1 = new book("Sam", sub\_array\_1);

book b2 = new book("Sam Edwards", sub\_array\_2);

b1.compareAuthors(b2);

b1.compareChapters(b2);

book temp = new book(b2);

temp.display();

b1.display();

b2.display();

// departments class

String[] dep = {"EE", "CS", "AI", "DS", "OOP"};

university u1 = new university("Comsats", dep, "Islamabad", "Hafif");

university u2 = new university("Bahira", dep, "Islamabad", "Sam");

u1.addDepartments("BBA");

u1.checkLocation("Islamabad");

u1.compareDepartments(u2);

**Question1:**

class rectangle{

private int length;

private int width;

// default constructor

public rectangle(){

}

// one argument constructor

public rectangle(int val\_length){

if(val\_length > 0){

this.length = val\_length;

}

else{

System.out.println("Add the right length!");

}

}

// two argument constructor

public rectangle(int val\_length, int val\_width){

// length check

if(val\_length > 0){

this.length = val\_length;

}

else{

System.out.println("Add the right length!");

}

// width check

if(val\_width > 0){

this.width = val\_width;

}

else{

System.out.println("Add the right width!");

}

}

public rectangle(rectangle r\_prime){

this.length = r\_prime.length;

this.width = r\_prime.width;

}

// setters

public void setLength(int val\_length){

if(val\_length > 0){

length = val\_length;

}

else{

System.out.println("Add the right length!");

}

}

public void setWidth(int val\_width){

if(val\_width > 0){

width = val\_width;

}

else{

System.out.println("Add the right width!");

}

}

// getters

public int getLength(){

return length;

}

public int getWidth(){

return width;

}

public void display(){

System.out.println("-------------------\nThe rectangle has a length of: " + length);

System.out.println("The rectangle has a width of: " + width);

}

public void area(){

int area = length \* width;

System.out.println("The rectangle has an area of: " + area);

}

public boolean checkSquare(){

if(this.length == this.width){

return true;

}

else{

return false;

}

}

public boolean equals(rectangle r){

if(this.length == r.length && this.width == r.width){

return true;

}

else{

return false;

}

}

public rectangle compareArea(rectangle r\_prime){

int default\_area = this.length \* this.width;

int given\_area = r\_prime.length \* r\_prime.width;

this.display();

r\_prime.display();

if(default\_area > given\_area){

return this;

}

else{

return r\_prime;

}

}

}

**Question2:**

class account{

private int balance;

private int yearOfOpening;

private String cnic;

// default constructor

public account(){

}

// argument constructor

public account(int money){

if(money > 0){

this.balance = money;

}

}

public account(int money, int year, String cnic\_number){

if(money > 0){

this.balance = money;

}

else{

System.out.println("Add the right amount of money");

}

if(year > 1900){

this.yearOfOpening = year;

}

else{

System.out.println("Add the right year");

}

if(cnic\_number.length() == 13){

this.cnic = cnic\_number;

}

}

// copy constructor

public account(account a\_prime){

this.balance = a\_prime.balance;

this.yearOfOpening = a\_prime.yearOfOpening;

this.cnic = a\_prime.cnic;

}

public boolean equals(account a){

if(this.balance == a.balance && this.yearOfOpening == a.yearOfOpening && this.cnic == a.cnic){

return true;

}

else{

return false;

}

}

// setters

public void setBalance(int money){

if(money > 0){

this.balance = money;

}

}

// getters

public int getBalance(){

return balance;

}

public int deposit(int add\_money){

if(add\_money > 0){

balance += add\_money;

}

return balance;

}

public int withdraw(int take\_money){

if(take\_money <= balance){

balance -= take\_money;

}

return balance;

}

public void display(){

System.out.println("-------------------\nYour Current Balance is: " + balance);

System.out.println("Year of opening is: " + yearOfOpening);

System.out.println("Your cnic number is: " + cnic);

}

public boolean checkValidCnic(){

if(cnic.length() == 13){

return true;

}

else{

return false;

}

}

}

**Question3:**

class point{

private int x;

private int y;

// default constructor

public point(){

}

// default constructor

public point(int val\_x){

this.x = val\_x;

}

// argument constructor

public point(int val\_x, int val\_y){

this.x = val\_x;

this.y = val\_y;

}

// copy constructor

public point(point p\_prime){

this.x = p\_prime.x;

this.y = p\_prime.y;

}

public boolean equals(point p){

if(this.x == p.x && this.y == p.y){

return true;

}

else{

return false;

}

}

// setters

public void setX(int val\_x){

x = val\_x;

}

public void setY(int val\_y){

y = val\_y;

}

// getters

public int getX(){

return x;

}

public int getY(){

return y;

}

public void display(){

System.out.println("-------------------\nThe point is at x: " + x);

System.out.println("The point is at y: " + y);

}

public void move(int x\_axis, int y\_axis){

x += x\_axis;

y += y\_axis;

System.out.println("The rectangle has now at x: " + x\_axis + " and y: " + y\_axis);

}

public boolean checkOrigin(){

if(this.x == 0 && this.y == 0){

return true;

}

else{

return false;

}

}

public point addTwoPoints(point p\_prime){

int x\_point = this.x + p\_prime.x;

int y\_point = this.y + p\_prime.y;

point p\_added = new point(x\_point, y\_point);

return p\_added;

}

public point addThreePoints(point p\_prime\_1, point p\_prime\_2){

int x\_point = this.x + p\_prime\_1.x + p\_prime\_2.x;

int y\_point = this.y + p\_prime\_1.y + p\_prime\_2.y;

point p\_added = new point(x\_point, y\_point);

return p\_added;

}

}

**Question 4:**

class student{

private String name;

private int[] result\_array = new int[5];

// default constructor

public student(){

}

// one argument constructor

public student(String student\_name){

this.name = student\_name;

}

// argument constructor

public student(String student\_name, int[] grades\_array){

this.name = student\_name;

if(grades\_array.length <= 5){

for(int i = 0; i < grades\_array.length; i++){

result\_array[i] = grades\_array[i];

}

}

else{

for(int i = 0; i < result\_array.length; i++){

result\_array[i] = grades\_array[i];

}

}

}

// copy constructor

public student(student s\_prime){

this.name = s\_prime.name;

for(int i = 0; i < this.result\_array.length; i++){

this.result\_array[i] = s\_prime.result\_array[i];

}

}

public boolean equals(student s){

boolean check = false;

if(this.name == s.name){

for(int i = 0; i < this.result\_array.length; i++){

if(this.result\_array[i] == s.result\_array[i]){

check = true;

}

else{

check = false;

}

}

}

return check;

}

// setters

public void setName(String student\_name){

name = student\_name;

}

public void setArray(int[] grades\_array){

if(grades\_array.length <= 5){

for(int i = 0; i < grades\_array.length; i++){

result\_array[i] = grades\_array[i];

}

}

else{

for(int i = 0; i < result\_array.length; i++){

result\_array[i] = grades\_array[i];

}

}

}

// getters

public String getName(){

return name;

}

public int[] getArray(){

return result\_array;

}

public int average(){

int sum = 0;

int average = 0;

for(int i = 0; i < result\_array.length; i++){

sum += result\_array[i];

}

average = sum/result\_array.length;

return average;

}

public void compareAverage(student s\_prime){

if(this.average() > s\_prime.average()){

System.out.println("This array has greater average than the given one: " + this.average());

}

else{

System.out.println("The given one has greater average than this one: " + s\_prime.average());

}

}

public void display(){

System.out.println("-------------------\nThe name of the student is: " + name);

System.out.println("Grades of student are: ");

for(int i = 0; i < result\_array.length; i++){

if(result\_array[i] != 0){

System.out.println(result\_array[i]);

}

}

}

}

**Question 5:**

class book{

String author;

String[] chapterName = new String[5];

// default constructor

public book(){

}

// three argument constructor

public book(String writer, String[] array){

this.author = writer;

this.chapterName = array;

}

// copy constructor

public book(book b\_prime){

this.author = b\_prime.author;

for(int i = 0; i < this.chapterName.length; i++){

this.chapterName[i] = b\_prime.chapterName[i];

}

}

public boolean equals(book b){

boolean check = false;

if(this.author == b.author){

for(int i = 0; i < this.chapterName.length; i++){

if(this.chapterName[i] == b.chapterName[i]){

check = true;

}

else{

check = false;

}

}

}

return check;

}

public boolean compareAuthors(book b\_prime){

if(this.author.equals(b\_prime.author)){

return true;

}

else{

return false;

}

}

public boolean compareChapters(book b\_prime){

boolean check = true;

for(int i = 0; i < this.chapterName.length; i++){

if(!this.chapterName[i].equals(b\_prime.chapterName[i])){

check = false;

}

}

return check;

}

void set\_values(String writer, String[] array){

author = writer;

chapterName = array;

}

boolean checkIfAuthorStartsWithA(){

char check = author.charAt(0);

if(check == 'A'){

return true;

}

else{

return false;

}

}

boolean checkIfAuthorStartsWithA(String chapter\_name){

boolean check = true;

for(int i = 0; i < chapterName.length; i++){

if(chapterName[i].equals(chapterName)){

check = true;

}

else{

check = false;

}

}

if(check == true){

return true;

}

else{

return false;

}

}

void display(){

System.out.println("The name of the author is: " + author);

System.out.println("Chapter names are");

for(int i = 0; i < chapterName.length; i++){

System.out.print(chapterName[i] + " ");

}

System.out.println();

}

}

**Question 6:**

class university{

private String uniName;

private String location;

private String rectorName;

private String[] departments = new String[20];

// default constructor

public university(){

}

public university(university u\_prime){

this.uniName = u\_prime.uniName;

this.location = u\_prime.location;

this.rectorName = u\_prime.rectorName;

for(int i = 0; i < departments.length; i++){

this.departments[i] = u\_prime.departments[i];

}

}

public boolean equals(university u){

boolean check = false;

if(this.uniName == u.uniName && this.rectorName == u.rectorName && this.location == u.location){

for(int i = 0; i < departments.length; i++){

if(this.departments[i] == u.departments[i]){

check = true;

}

else{

check = false;

}

}

}

return check;

}

// setters

public void setUniName(String name){

this.uniName = name;

}

public void setRectorName(String rector\_name){

this.rectorName = rector\_name;

}

public void setLocation(String place){

this.location = place;

}

public void setdDepartments(String[] array){

this.departments = array;

}

// getters

public String getUniName(){

return uniName;

}

public String getRectorName(){

return rectorName;

}

public String getLocation(){

return location;

}

public String[] getdDepartments(){

return departments;

}

// all argument constructor

public university(String name, String[] array, String place, String rector\_name){

if(name.length() > 2){

this.uniName = name;

}

else{

System.out.println("Small in length. Add right user name!");

}

if(array.length >= 20){

this.departments = array;

}

else{

System.out.println("Size is smaller!");

}

if(place.length() > 2){

this.location = place;

}

else{

System.out.println("Small in length. Add right user name!");

}

if(rector\_name.length() > 2){

this.rectorName = rector\_name;

}

else{

System.out.println("Small in length. Add right user name!");

}

}

public void addDepartments(String abc){

for(int i = 0; i < departments.length; i++){

if(departments[i] == null){

departments[i] = abc;

break;

}

}

}

public boolean checkLocation(String place){

if(location.equalsIgnoreCase(place)){

return true;

}

else{

return false;

}

}

public boolean compareDepartments(university u\_prime){

if(this.departments.length > u\_prime.departments.length){

return true;

}

else{

return false;

}

}

public void display(){

System.out.println("The name of the university is: " + uniName);

System.out.println("Location of university is: " + location);

System.out.println("Rector name is: " + rectorName);

System.out.println("Departments names are and its length is " + departments.length);

for(int i = 0; i < departments.length; i++){

if(departments[i] == null){

continue;

}

System.out.print(departments[i] + " ");

}

System.out.println();

}

}