System Project

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System Project

1-Find a regular expression that accepts the language and implement it

The language $\{w \in \Sigma^* | \ w$ contains exactly one double letter$\}$. For example, **baaba** has exactly one double letter, but **baaaba** has two double letters.

Answer:

Regular expression

$$[((ab)^* \cup b \cup \varepsilon)\, aa\, (bU\,(ba)^* UE)] \cup [((ba)^* \cup aU\varepsilon)\, bb\, ((ab)^* \cup a \cup \varepsilon)]$$

Code:

```
package system.project;

import java.util.Scanner;
import java.util.regex.Matcher;
import java.util.regex.Pattern;

public class SystemProject {

    public static void main(String[] args) {

        Scanner sc = new Scanner (System.in);
        String A = sc.next();

        Pattern P = Pattern.compile("[ab]*");
        Matcher m = P.matcher(A);
```

System Project

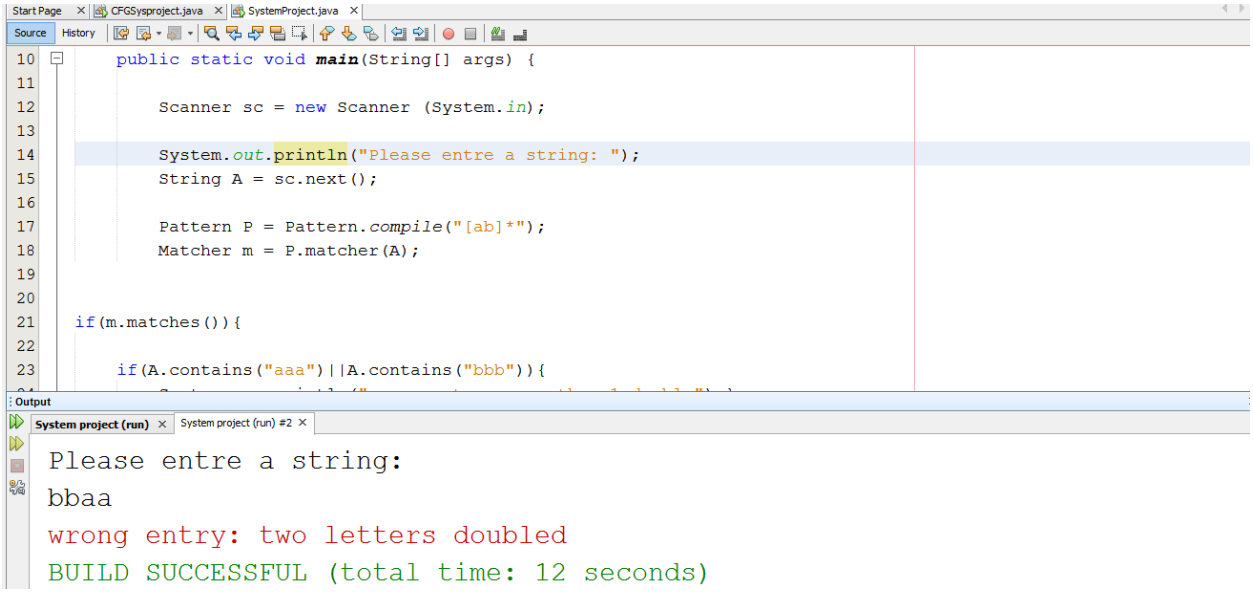
```
if(m.matches()){

    if(A.contains("aaa")||A.contains("bbb")){
        System.err.println("wrong entry: more than 1 double");}
    else if(A.contains("aa")&&A.contains("bb")){
            System.err.println("wrong entry: two letters doubled");
    }else if(!A.contains("aa")&&!A.contains("bb")){
            System.err.println("wrong entry: does not contain double letters");
    }
    else{ System.out.println("Accepted");
    }
}else
    System.err.println("wrong entry: letters not a or b");

}}
```

Out put:-

-RE 2 letter doubled



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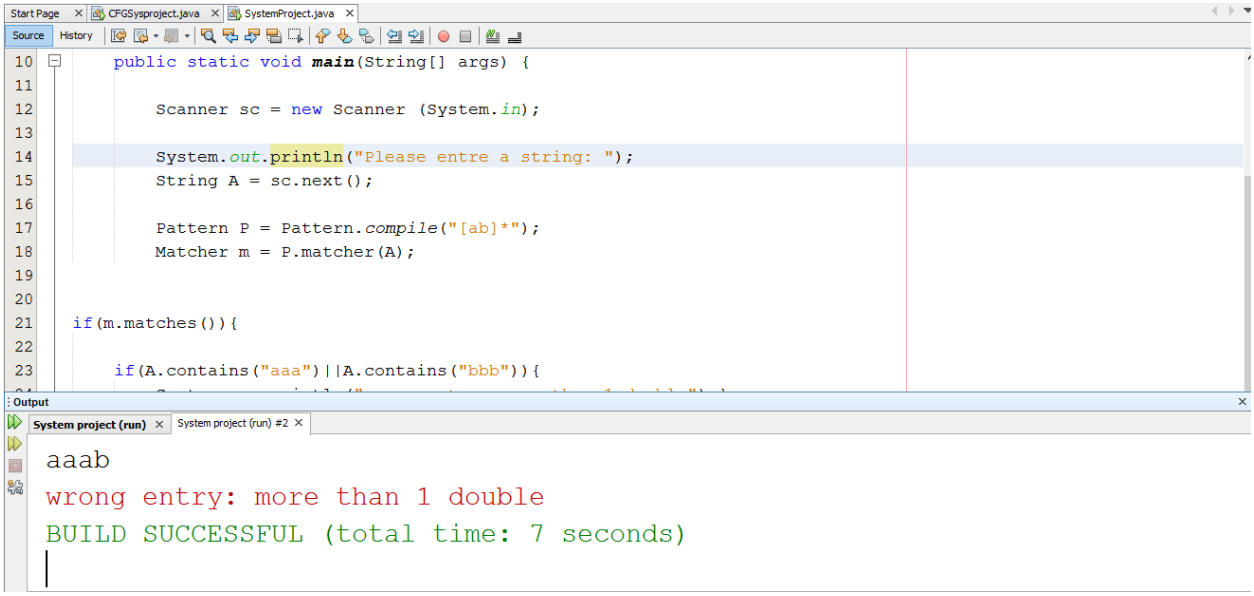
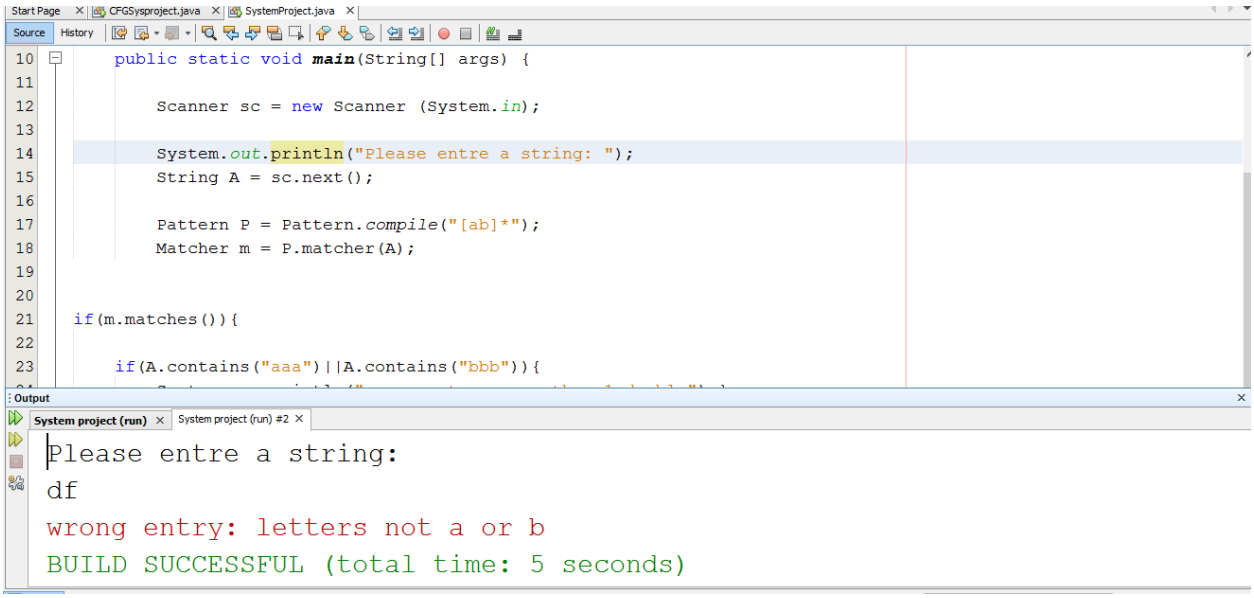
-RE letter is more than doubled



-RE not ab



System Project

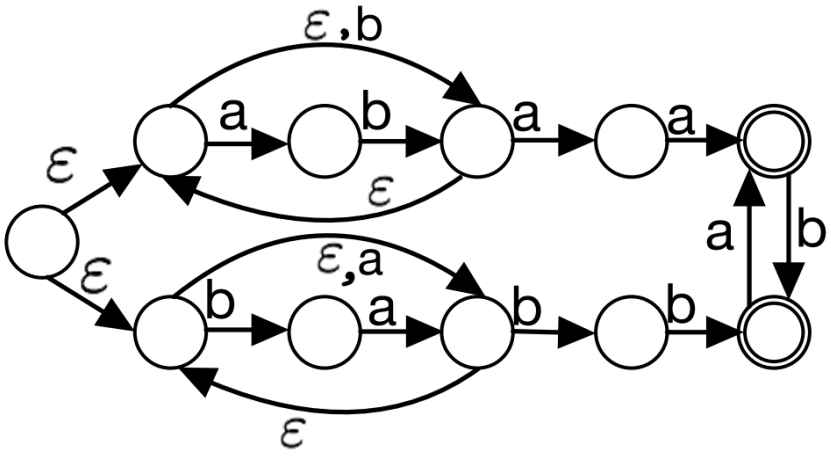
-RE accept

```
        Matcher m = P.matcher(A);


if(m.matches()){

    if(A.contains("aaa")||A.contains("bbb")){
        System.err.println("wrong entry: more than 1 double");}
    else if(A.contains("aa")&&A.contains("bb")){
            System.err.println("wrong entry: two letters doubled");
    }else if(!A.contains("aa")&&!A.contains("bb")){
            System.err.println("wrong entry: does not contain double letters");
    }
    else{ System.out.println("Accepted");
    }
```

```
ut - System project (run)
Please entre a string:
babababaa
Accepted
BUILD SUCCESSFUL (total time: 3 seconds)
```

2. Find the corresponding NFA for the Regular expression in question

1, then implement it.



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Code:

```
#include <bits/stdc++.h>
using namespace std;

int transition(int state, char ch, string s, char ch2)
{
    if(s[0] == 'a' && s[2] == 'a' || s[0] == 'b' && s[2] == 'a' || s[0] == 'a' && s[1] == 'a')
    {
        if(state == 1)
        {
            if(ch == 'a' && ch2 == 'a')
                return 4;
            else if(ch == 'a' && ch2 == 'b')
                return 2;
            else if(ch == 'b' && ch2 == 'a')
                return 3;
        }
        else if(state == 2 && ch == 'b')
            return 3;
        else if(state == 3)
        {
            if(ch == 'a' && ch2 == 'a')
                return 4;
            else
                return 1;
        }
        else if(state == 4 && ch == 'a')
            return 5;
        else if(state == 5 && ch == 'b')
            return 6;
        else if(state == 6 && ch == 'a')
            return 5;
        else
            return 0;
    }
    else
```

System Project

```
else
{
    if(state == 1)
    {
        if(ch == 'b' && ch2 == 'b')
            return 4;
        else if(ch == 'b' && ch2 == 'a')
            return 2;
        else if(ch == 'a' && ch2 == 'b')
            return 3;
    }
    else if(state == 2 && ch == 'a')
        return 3;
    else if(state == 3)
    {
        if(ch == 'b' && ch2 == 'b')
            return 4;
        else
            return 1;
    }
    else if(state == 4 && ch == 'b')
        return 6;
    else if(state == 6 && ch == 'a')
        return 5;
    else if(state == 5 && ch == 'b')
        return 6;
    else
        return 0;
}
```

System Project

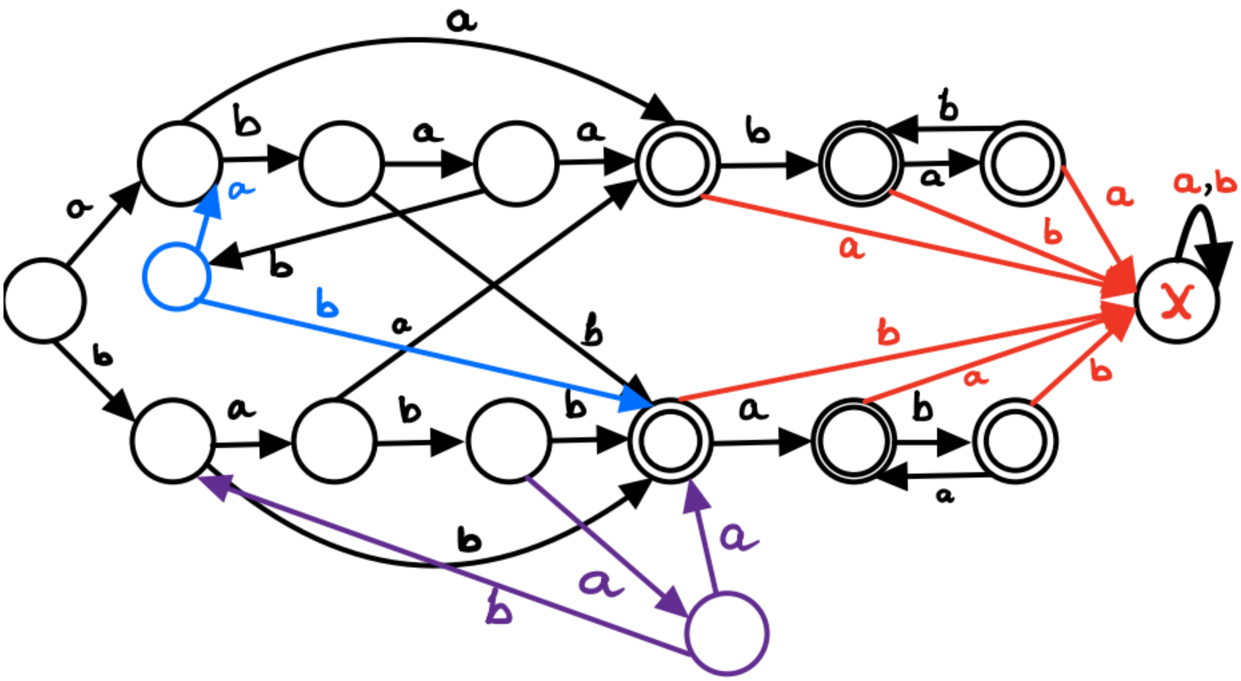
```
}


int accept(int state)
{
    if(state == 5 || state == 6)
        return 1;
    else
        return 0;
}

int main()
{
    string s;
    int state=1;
    cin>>s;
    for(int i = 1; i<=s.length(); i++)
    {
        int newstate = transition(state, s[i-1], s, s[i]);
        state = newstate;
    }
    if(accept(state))
        cout<<"Accept"<<endl;
    else
        cout<<"Reject"<<endl;
}
```

3. Convert the NFA to DFA, then implement it

System Project



Code:

System Project

```cpp
#include <bits/stdc++.h>
using namespace std;

int transition(int state, char ch) {
    if(state == 1 && ch == 'a')
        return 2;
    else if(state == 1 && ch == 'b')
        return 9;
    else if(state == 2 && ch == 'a')
        return 5;
    else if(state == 2 && ch == 'b')
        return 3;
    else if(state == 3 && ch=='a')
        return 4;
    else if(state == 3 && ch=='b')
        return 12;
    else if(state == 4 && ch == 'a')
        return 5;
    else if(state == 4 && ch == 'b')
        return 8;
    else if(state == 5 && ch == 'b')
        return 6;
    else if(state == 5 && ch == 'a')
        return 0;
    else if(state == 6 && ch == 'a')
        return 7;
    else if(state == 6 && ch == 'b')
        return 0;
    else if(state == 7 && ch== 'a')
        return 0;
    else if(state == 7 && ch == 'b')
        return 6;
    else if(state == 8 && ch == 'a')
        return 2;
```

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```
    else if(state == 8 && ch == 'a')
        return 2;
    else if(state == 8 && ch == 'b')
        return 12;
    else if(state == 9 && ch == 'a')
        return 10;
    else if(state == 9 && ch == 'b')
        return 12;
    else if(state == 10 && ch == 'a')
        return 5;
    else if(state == 10 && ch == 'b')
        return 11;
    else if(state == 11 && ch == 'a')
        return 15;
    else if(state == 11 && ch == 'b')
        return 12;
    else if(state == 12 && ch == 'a')
        return 13;
    else if(state == 12 && ch == 'b')
        return 0;
    else if(state == 13 && ch== 'a')
        return 0;
    else if(state == 13 && ch == 'b')
        return 14;
    else if(state == 14 && ch == 'a')
            return 13;
    else if(state == 14 && ch == 'b')
        return 0;
    else if(state == 15 && ch=='a')
        return 12;
    else if(state == 15 && ch == 'b')
        return 9;
}
```

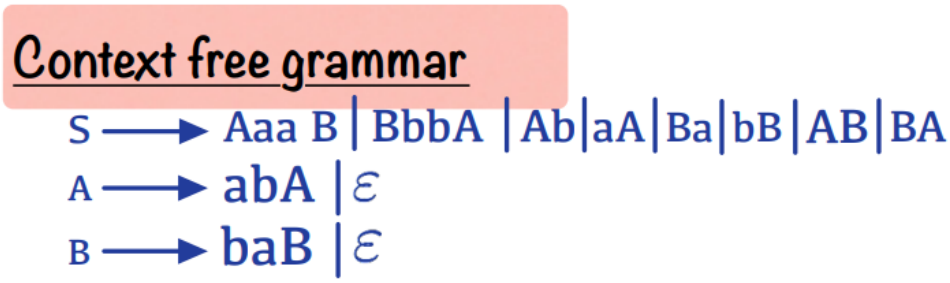
System Project

```
int accept(int state)
{
    if(state == 5 || state == 6 || state == 7 || state == 12 || state == 13 || state == 14)
        return 1;
    else
        return 0;
}

int main()
{
    cin.tie(0)->sync_with_stdio(0);
    string s;
    int state=1;
    cin>>s;
    for(int i=0; i<s.size(); i++)
    {
        int newstate = transition(state, s[i]);
        state = newstate;
    }
    if(accept(state))
        cout<<"Accept"<<endl;
    else
        cout<<"Reject"<<endl;
}
```

4. Find the corresponding CFG for the Regular expression in question

1, then implement it



Code:

System Project

```java
package cfg.sysproject;

import java.util.Random;
import java.util.Scanner;

public class CFGSysproject {

    public static void main(String[] args) {

        Scanner sc = new Scanner(System.in);
        System.out.println("would you like to double the a or the b? true = a , false = b ");
        Boolean choice = sc.nextBoolean();

            int min1 = 0;
            int max1 = 10;
            int length_of_string = (int)Math.floor(Math.random()*(max1-min1+1)+min1);
            int before_double = (int)Math.floor(Math.random()*(max1-min1+1)+min1);
            int after_double = Math.abs(length_of_string -(2+before_double));
```

```java
            if(choice==true){
            char[] c = new char[before_double];
            for(int i = before_double-1;i>0;i=i-2){
                c[i]='b';
                c[i-1]='a';
            }
            String A = String.copyValueOf(c)+"aa";
//              System.out.println(A);

            char[] d = new char[after_double+1];
           for(int i=0; i<after_double;i=i+2){
               d[i]='b';
               d[i+1]='a';
           }
           String B = String.copyValueOf(d);
//            System.out.println(B);


            String fullstring = A+B;
           System.out.println(fullstring);
    }
```

System Project

```
    else{
     char[] c = new char[before_double];
            for(int i = before_double-1;i>0;i=i-2){
                c[i]='a';
                c[i-1]='b';
            }
            String A = String.copyValueOf(c)+"bb";
//            System.out.println(A);

            char[] d = new char[after_double+1];
           for(int i=0; i<after_double;i=i+2){
               d[i]='a';
               d[i+1]='b';
           }
           String B = String.copyValueOf(d);
//           System.out.println(B);


           String fullstring = A+B;
          System.out.println(fullstring);
    }
```

Out put:-

-CFG double a

```
     char[] c = new char[before_double];
            for(int i = before_double-1;i>0;i=i-2){
                c[i]='a';
                c[i-1]='b';
            }
            String A = String.copyValueOf(c)+"bb";
//            System.out.println(A);

            char[] d = new char[before_double];
           for(int i=0; i<after_double;i=i+2){
               d[i]='a';
               d[i+1]='b';
           }
           String B = String.copyValueOf(d);
```

```
ut - CFG Sysproject (run)
would you like to double the a or the b? true = a , false = b
true
abababababaababababa
BUILD SUCCESSFUL (total time: 4 seconds)
```

System Project

- CFG double b

```
        char[] c = new char[before_double];
                for(int i = before_double-1;i>0;i=i-2){
                    c[i]='a';
                    c[i-1]='b';
                }
                String A = String.copyValueOf(c)+"bb";
//                System.out.println(A);

                char[] d = new char[before_double];
               for(int i=0; i<after_double;i=i+2){
                   d[i]='a';
                   d[i+1]='b';
               }
               String B = String.copyValueOf(d);
```

```
ıt - CFG Sysproject (run)
run:
would you like to double the a or the b? true = a , false = b
false
babababababbab
BUILD SUCCESSFUL (total time: 4 seconds)
```

System Project

Another answer:

```
#include <bits/stdc++.h>
using namespace std;

int main()
{
    cin.tie(0)->sync_with_stdio(0);
    string s;
    char news[100];
    int x=0, n=0, A=0, aa=0, B=0, bb=0, Ab=0, aA=0, Ba=0, bB=0;
    cin>>s;
    n=s.length();

    for(int i=0; i<n; i+=2)
    {
        if(s[i] == 'a' && s[i+1] == 'b' && s[i+2] == 'b' && s[i+3] != 'b')
        {
            news[x]='A';
            news[++x]='b';
            i++;
        }
        else if(s[i] == 'a' && s[i+1] == 'a' && s[i+2] == 'b' && s[i+3] != 'b')
        {
            news[x]='a';
            news[++x]='A';
            i++;
        }
        else if(s[i] == 'b' && s[i+1] == 'a' && s[i+2] == 'a' && s[i+3] != 'a')
        {
            news[x]='B';
            news[++x]='a';
            i++;
        }
```

System Project

```
    else if(s[i] == 'b' && s[i+1] == 'b' && s[i+2] == 'a' && s[i+3] != 'a')
    {
        news[x]='b';
        news[++x]='B';
        i++;
    }
    else if(s[i]=='a' && s[i+1] == 'b')
    {
        news[x]='A';
        news[++x]='A';
    }
    else if( s[i-1] != 'a' && s[i]=='a' && s[i+1] == 'a' && s[i+2] != 'a')
    {
        news[x]='a';
        news[++x]='a';
    }
    else if(s[i-1] != 'b' && s[i]=='b' && s[i+1] == 'b' && s[i+2] != 'ba')
    {
        news[x]='b';
        news[++x]='b';
    }
    else if(s[i]=='b' && s[i+1] == 'a')
    {
        news[x]='B';
        news[++x]='B';
    }
    x++;
}
```

System Project

```
    for(int i=0; i<x; i+=2)
    {
        if(news[i]=='A' && news[i+1]=='b')
            Ab+=1;
        else if(news[i]=='a' && news[i+1]=='A')
            aA+=1;
        else if(news[i]=='B' && news[i+1]=='a')
            Ba+=1;
        else if(news[i]=='b' && news[i+1]=='B')
            bB+=1;
        else if(news[i]=='A' && news[i+1]=='A')
            A+=1;
        else if(news[i]=='B' && news[i+1]=='B')
            B+=1;
        else if(news[i]=='a' && news[i+1]=='a')
            aa+=1;
        else if(news[i]=='b' && news[i+1]=='b')
            bb+=1;
    }
    if(Ab == 1 && A >= 0 && B == 0 && aa == 0 && bb == 0 && aA == 0 && Ba == 0 && bB == 0)
        cout<<"Accept"<<endl;
    else if(Ab == 0 && A >= 0 && B == 0 && aa == 0 && bb == 0 && aA == 1 && Ba == 0 && bB == 0)
        cout<<"Accept"<<endl;
    else if(Ab == 0 && A >= 0 && B >= 0 && aa == 0 && bb == 0 && aA == 0 && Ba == 1 && bB == 0)
        cout<<"Accept"<<endl;
    else if(Ab == 0 && A >= 0 && B >= 0 && aa == 0 && bb == 0 && aA == 0 && Ba == 0 && bB == 1)
        cout<<"Accept"<<endl;
    else if(Ab == 0 && A >= 0 && B >= 0 && aa == 0 && bb == 1 && aA == 0 && Ba == 0 && bB == 0)
        cout<<"Accept"<<endl;
    else if(Ab == 0 && A >= 0 && B >= 0 && aa == 1 && bb == 0 && aA == 0 && Ba == 0 && bB == 0)
        cout<<"Accept"<<endl;
    else
        cout<<"Reject"<<endl;
}
```