********** OUTPUT **********

NOT PROVIDED. UTILISE THE COMMENTED STRINGS TO TEST THE EXECUTION.

*** CODE ***

```
/*
Online Java - IDE, Code Editor, Compiler

Online Java is a quick and easy tool that helps you to build, compile, test your programs online.
*/

public class Main
{
   public static void main(String[] args) {
      System.out.println("Welcome to Online IDE!! Happy Coding :)");

      System.out.println("This will be simple example at moment demonstrating if there is arbitrage");
      System.out.println("To keep it simple, it will initially compare each currency against only one other currency");
      System.out.println("Then it will branch to another and then return back to original currency");
      System.out.println("I will try to explore several routes to return back to original currency");
      System.out.println("The program will report arbitrage and loss.");


       // not sure how to store the integer arrays into a larger container..
       // perhaps create a 3d array... but not worrying at moment.

       // this is to verify no arbitrage

      // this is the same on horizontal and vertical
      // This is not the best measure since if the position varies on the matrix, it will fail.
      // However if this is introduced in the array, it will be heterogenous elements.
      // Will need to use an object or similar.....
      //and perform conversions to doubles.....

      // The code is currently designed to support matrix of currencies with conversion factors
      // The data is inputted to exactly match the currencies below on the horizontal and vertical axis
      // The program could be extended to change position of these on either axis.

      // This would entail creating another character array for currencies.
```

```
    //use this as alternative if simplified version of symbols are required....
     //String [] currency = {'$','€','¥','£','S','C','A','H'};



     String originalInput;

    /*
    //char[] currency = {'£','$','€','D'};
    double currencies [][] =   {
                                            {1.00,1.25,1.16,2.28},
                        {0.80,1.00,0.93,1.82},
                        {0.86,1.08,1.00, 1.96},
                        {0.44,0.55,0.51,1.00},

                         };
     */

   String[] currency = {"$","€","¥","£","CHF","CA$","AU$","HK$"};

   double currencies [][] = {

        {1.0,     0.9277,        155.7380,      0.7984,        0.9072,        1.3681,
        1.5141,         7.8141},
        {1.0779,        1.0,    167.8700,      0.8606,        0.9779,        1.4747,
        1.6320,         8.4228},
        {0.0064,        0.0060,        1.0,     0.0051,        0.0058,        0.0088,
        0.0097,         0.0502},
        {1.2525,        1.1620,        195.0616,      1.0,    1.1363,        1.7136,
        1.8964,         9.7871},
        {1.1023,        1.0226,        171.6638,      0.8800,        1.0,    1.5080,
        1.6689,         8.6132},
        {0.7309,        0.6781,        113.8333,      0.5836,        0.6631,        1.0,
        1.1067,         5.7115},
        {0.6605,        0.6127,        102.8615,      0.5273,        0.5992,        0.9036,
        1.0,    5.1610},
        {0.1280,        0.1187,        19.9304,       0.1022,        0.1161,        0.1751,
        0.1938,         1.0},

};



    double[] conversionUnits = new double[currencies[0].length];

     // since no indication of which currency is which, it will use indexof- at first index of 2d
array.


    // NORMAL CONDITIONS **********************

    String input = "£";
    String output = "$";
```

```
    double amount = 3.00;
    int inputRow=0;
    int outputRow=0;

    int column=0;
    int inputCurrency=0;
    int outputCurrency=0;

   double convertedValue=0;
   double convertedBack=0;
   double convertedBack1=0;

   double convertedValue_initial=0;

   double reverse_conversion=0;

   //double temp=0;
   double temp1=0;

  for (int i=0; i<currencies[0].length; i++)
  {
     //NEED SOMETHING IN HERE TO KEEP CONVERSION FACTOR. SO WHEN IT HITS THE k
LOOP, IT CAN USE IT TO GET BACK.
     //IT KNOWS HOW TO CONVERT BACK TO J LOOP.
     // SO THIS VALUE HAS TO BE STORED IN J LOOP.

     column=0;

      for (int j=0; j<currencies[0].length; j++)
     {
        System.out.println("\n********In the J loop********");
        column=0;
         if (i!=currencies.length-1)
        {
           if (currency[i]==currency[j])
           {
              j++;
           }
        }

  // this is used to find position of the currency on the matrix.
  // although strictly speaking it should be alligned to the table of data

    input=currency[i];
    output=currency[j];
    originalInput=currency[i];

    System.out.println(input+"  " +String.format("%.2f",amount) + " to be converted to " +
output+"\n");

    // Does it really have to do this, if i, j and m loops are exactly alligned against length of
currency array
    // and the data in currencies array is alligned against currency array?
```

```
     for (String c: currency)
     {
        //System.out.println("This is the value of c: " + c);

        //System.out.println("Converted from: " + input);
        //System.out.println("Converted to: " + output);

        if (c==output)   // in this test case $
        {
           //System.out.println("***Output****");
           //System.out.println("Detected a: " + output + " in row: " + (column));

           outputCurrency=column;
        }

        if (c==input)  // in this test case £
        {
           //System.out.println("***Input***");
           //System.out.println("Detected a: " + input + " in column: " + (column));

           inputCurrency=column;

        }
        column++;
     }

   System.out.println("CONVERSION**************");

   System.out.println("This is the initial amount: " + input+ String.format("%.2f",amount));
   System.out.println("This is the conversion factor: " +
currencies[outputCurrency][inputCurrency]);

    System.out.println("This is conversion: " + output  +
String.format("%.2f",(amount/currencies[outputCurrency][inputCurrency] )) + "  " +
input+"=>"+output);

    convertedValue = (amount / currencies[outputCurrency][inputCurrency]);


   //conversionUnits[j]= currencies[inputCurrency][outputCurrency]; // THIS WILL BE USED IN
LOOP K SO THAT IT CAN GET BACK TO I.

   //  NEED EXTRA CODE HERE TO TAKE IT BETWEEN ADDITIONAL CURRENCIES (PERHAPS
ANOTHER FOR LOOP)
   // BUT THIS TIME IT HAS TO SKIP IF ITS THE SAME CURRENCY OR IF IT IS THE CURRENCY
PROCESSED ABOVE.
   // THE PREVIOUS CURRENCY PROCESSED WILL BE POSITION AT C.  THERE IS UCCRENLT NOT
INDEX NOTATION DUE TO FOR EACH LOOP
   // THE COLUMN VARIABLE REFERS

    System.out.println("This is the conversion factor: " +
currencies[inputCurrency][outputCurrency]);
    System.out.println("This is conversion: " + input  +
```

```
String.format("%.2f",(convertedValue/currencies[inputCurrency][outputCurrency])) +  "  " +
output+"=>"+input);

    convertedBack =  convertedValue/currencies[inputCurrency][outputCurrency];

    if (convertedBack>amount)
    {
       System.out.println("************ARBITRAGE.....***********");
       System.out.println("Difference of: " + input+ String.format("%.2f",(convertedBack -
amount)));
    }

     if (convertedBack<amount)
    {
       System.out.println("************LOSS OF CURRENCY.....***********");
       System.out.println("Difference of: " + input+ String.format("%.2f",(amount -
convertedBack)));
    }

    System.out.println("\n\n");
    //---------------------------------

         for (int k=0; k<currencies[0].length; k++)  // the first location will be (0,1), this is £ to $
     {
        System.out.println("In the K loop");
        column=0;

         if (k!=currencies.length-1)
        {
           /*
           System.out.println("This is currency k: " + currency[k]);
           System.out.println("This is input: " + input);
           System.out.println("This is output: " + output);
           System.out.println("This is currency i: " + currency[i]);
           System.out.println("This is currency j: " + currency[j]);
           */

           if (currency[k]==currency[j] || currency[k]==currency[i] || currency[k]==input ||
currency[k]==output)
           {
              System.out.println("INSIDE!!!!!");
              continue;
           }
        }


  // this is used to find position of the currency on the matrix.
  // although strictly speaking it should be alligned to the table of data

     //**********************************
    // NEED EXTREME WORK HERE SINCE IN THE K LOOP, IT SHOULD NOT TRY TO CONVERT
AGAIN TO SAME CURRENCY PROCESSED IN IN
    // This is unrealted to   if (currency[k]==currency[j] || currency[k]==currency[i] )
```

```
    //SO AS PART OF I LOOP, NEED TO STORE COLUMN IN AN ARRAY AND ENSURE THE INPUT
CAN NOT BE THE SAME....
    // ALSO AS PART OF THE J LOOP, NEED TO KEEP TRACK OF THE OUTPUTS TO ENSURE IT IS
NOT CONVERTED AGAIN TO THESE.....

//**********************************************************************************
**********************************

     input=currency[j];  // this will be £
     output=currency[k]; // this will be $

     // it will use convertedValue from loop j
     System.out.println(input+"  " +String.format("%.2f",convertedValue) + " to be converted to
" + output+"\n");

     for (String c: currency)
     {
        //System.out.println("This is the value of c: " + c);

        //System.out.println("Converted from: " + input);
        //System.out.println("Converted to: " + output);

        if (c==output)   // in this test case $
        {
           //System.out.println("***Output****");
           //System.out.println("Detected a: " + output + " in row: " + (column));

           outputCurrency=column;
        }

        if (c==input)  // in this test case £
        {
           //System.out.println("***Input***");
           //System.out.println("Detected a: " + input + " in column: " + (column));

           inputCurrency=column;

        }
        column++;
     }

    System.out.println("\nCONVERSION**************1234");


    System.out.println("This is the initial amount: " + input+
String.format("%.2f",convertedValue));
    System.out.println("This is the conversion factor: " +
currencies[outputCurrency][inputCurrency]);

     System.out.println("1This is conversion: " + output  +
String.format("%.2f",(amount/currencies[outputCurrency][inputCurrency] )) +  "  " +
currency[i]+"=>"+input+"=>"+output);

     temp1=convertedValue;
```

```
    //reverse_conversion = currencies[inputCurrency][outputCurrency];

    convertedValue_initial = (amount / currencies[outputCurrency][inputCurrency]);
    //temp=convertedValue;

   //  NEED EXTRA CODE HERE TO TAKE IT BETWEEN ADDITIONAL CURRENCIES (PERHAPS
ANOTHER FOR LOOP)
   // BUT THIS TIME IT HAS TO SKIP IF ITS THE SAME CURRENCY OR IF IT IS THE CURRENCY
PROCESSED ABOVE.
   // THE PREVIOUS CURRENCY PROCESSED WILL BE POSITION AT C.  THERE IS UCCRENLT NOT
INDEX NOTATION DUE TO FOR EACH LOOP
   // THE COLUMN VARIABLE REFERS

    System.out.println("This is the conversion factor: " +
currencies[inputCurrency][outputCurrency]);
    System.out.println("2This is conversion: " + input  +
String.format("%.2f",(convertedValue_initial/currencies[inputCurrency][outputCurrency])) +  "
" + currency[i]+"=>"+input+"=>"+output+"=>"+input);

    convertedValue=convertedValue_initial/currencies[inputCurrency][outputCurrency];

     if (temp1<convertedValue)
    {
       System.out.println("************ARBITRAGE.....***********");
       System.out.println("Difference of: " + input+ String.format("%.2f",(convertedValue -
temp1)));
    }

     if (temp1>convertedValue)
    {
       System.out.println("************LOSS OF CURRENCY.....***********");
       System.out.println("Difference of: " + input+ String.format("%.2f",(temp1 -
convertedValue)));
    }


    //It does not know conversion factor euro to pound since its not done this conversion or
reverse yet.

    column=0;

    for (String c: currency)
     {
        //System.out.println("This is the value of c: " + c);

        //System.out.println("Converted from: " + input);
        //System.out.println("Converted to: " + output);

        if (c==output)   // in this test case $
        {
           //System.out.println("***Output****");
           //System.out.println("Detected a: " + output + " in row: " + (column));
```

```
            outputCurrency=column;
        }

        if (c==currency[i])  // in this test case £
        {
            //System.out.println("***Input***");
            //System.out.println("Detected a: " + input + " in column: " + (column));

            inputCurrency=column;

        }
        column++;
    }

     System.out.println("\n1This is " + output+ String.format("%.2f",convertedValue_initial) + " with conversion factor " + currencies[inputCurrency][outputCurrency] +  " back to original: " + currency[i]);


    System.out.println("This is conversion: " + originalInput  + String.format("%.2f",(convertedValue_initial/currencies[inputCurrency][outputCurrency])) +  " " + currency[i]+"=>"+input+"=>"+output+"=>" + currency[i]);

    convertedBack =  convertedValue_initial/currencies[inputCurrency][outputCurrency];

    if (convertedBack>amount)
    {
        System.out.println("************ARBITRAGE.....**********");
        System.out.println("Difference of: " + originalInput +String.format("%.2f",(convertedBack - amount)));
    }

     if (convertedBack<amount)
    {
        System.out.println("************LOSS OF CURRENCY.....**********");
        System.out.println("Difference of: " + originalInput +String.format("%.2f",(amount - convertedBack)));
    }


    // This is repeated of above... For instance in current flow above it is doing:
    //£ => $ => Euro => $ => £
    //However need to do:
    //£ => $ => Euro => £


    System.out.println("\n");
    System.out.println("This will now convert: " + input +  String.format("%.2f",convertedValue) + " back to original " + currency[i]);

    // it has to process this again to find correct conversion factor to initial currency....

    column=0;
```

```
    for (String c: currency)
     {
        if (c==currency[i])   // in this test case $
        {
           //System.out.println("***Output****");
           //System.out.println("Detected a: " + output + " in row: " + (column));

           inputCurrency=column;
        }

        if (c==input)  // in this test case £
        {
           //System.out.println("***Input***");
           //System.out.println("Detected a: " + input + " in column: " + (column));

           outputCurrency=column;

        }
        column++;
     }


    conversionUnits[j]= currencies[inputCurrency][outputCurrency];


    System.out.println("This is the conversion factor back to original: " + conversionUnits[j]);

    System.out.println("This is conversion: " + originalInput  +
String.format("%.2f",(convertedValue/conversionUnits[j])) +  "  " +
currency[i]+"=>"+input+"=>"+output+"=>" + "=>" + input + "=>" + currency[i]);


    convertedBack1 =  convertedValue/conversionUnits[j];

    if (convertedBack1>amount)
    {
       System.out.println("************ARBITRAGE.....***********");
       System.out.println("Difference of: " + originalInput +String.format("%.2f",
(convertedBack1 - amount)));
    }

     if (convertedBack1<amount)
    {
       System.out.println("************LOSS OF CURRENCY.....***********");
       System.out.println("Difference of: " + originalInput +String.format("%.2f",(amount -
convertedBack1)));
    }

    System.out.println("\n\n");


    for (int m=0; m<currencies[0].length; m++)  // the first location will be (0,1), this is £ to $
     {
        System.out.println("In the m loop");
```

```
        column=0;

         if (m!=currencies.length-1)
        {

           if (currency[m]==currency[k] || currency[m]==currency[i] || currency[m]==input ||
currency[m]==output)
           {
              System.out.println("INSIDE!!!!!");
              continue;
           }
        }

        input=currency[k];  // this will be £
    output=currency[m]; // this will be $

    // it will use convertedValue from loop j
    System.out.println(input+"  " +String.format("%.2f",convertedValue_initial) + " to be
converted to " + output+"\n");

    for (String c: currency)
    {
       //System.out.println("This is the value of c: " + c);

       //System.out.println("Converted from: " + input);
       //System.out.println("Converted to: " + output);

       if (c==output)   // in this test case $
       {
          //System.out.println("***Output****");
          //System.out.println("Detected a: " + output + " in row: " + (column));

          outputCurrency=column;
       }

       if (c==input)  // in this test case £
       {
          //System.out.println("***Input***");
          //System.out.println("Detected a: " + input + " in column: " + (column));

          inputCurrency=column;

       }
       column++;
    }

   System.out.println("\nCONVERSION**************4567");



   System.out.println("This is the initial amount: " + input+
String.format("%.2f",convertedValue_initial));
   System.out.println("This is the conversion factor: " +
currencies[outputCurrency][inputCurrency]);
```

```
    System.out.println("1This is conversion: " + output  +
String.format("%.2f",(convertedValue_initial/currencies[outputCurrency][inputCurrency] )) + "
"+  currency[i]+"=>"+input+"=>"+output+"=>" + currency[i] + "=>" + output);

    temp1=convertedValue_initial;

    reverse_conversion = convertedValue_initial/currencies[outputCurrency][inputCurrency];

    //convertedValue_initial = (amount / currencies[outputCurrency][inputCurrency]);
    //temp=convertedValue;

   //  NEED EXTRA CODE HERE TO TAKE IT BETWEEN ADDITIONAL CURRENCIES (PERHAPS
ANOTHER FOR LOOP)
   // BUT THIS TIME IT HAS TO SKIP IF ITS THE SAME CURRENCY OR IF IT IS THE CURRENCY
PROCESSED ABOVE.
   // THE PREVIOUS CURRENCY PROCESSED WILL BE POSITION AT C.  THERE IS UCCRENLT NOT
INDEX NOTATION DUE TO FOR EACH LOOP
   // THE COLUMN VARIABLE REFERS

    System.out.println("This is the conversion factor: " +
currencies[inputCurrency][outputCurrency]);
    System.out.println("2This is conversion: " + input  +
String.format("%.2f",(convertedValue_initial/currencies[outputCurrency][inputCurrency]/curr
encies[inputCurrency][outputCurrency])) +  "  " + currency[i]+"=>"+input+"=>"+output+"=>" +
currency[i] + "=>" + output +"=>"+ input);


convertedValue=convertedValue_initial/currencies[inputCurrency][outputCurrency]/currencie
s[outputCurrency][inputCurrency];

     if (temp1<convertedValue)
    {
       System.out.println("************ARBITRAGE.....***********");
       System.out.println("Difference of: " + input+ String.format("%.2f",(convertedValue -
temp1)));
    }

     if (temp1>convertedValue)
    {
       System.out.println("************LOSS OF CURRENCY.....***********");
       System.out.println("Difference of: " + input+ String.format("%.2f",(temp1 -
convertedValue)));
    }


    //It does not know conversion factor euro to pound since its not done this conversion or
reverse yet.

    column=0;

    for (String c: currency)
     {
        //System.out.println("This is the value of c: " + c);
```

```
        //System.out.println("Converted from: " + input);
        //System.out.println("Converted to: " + output);

        if (c==output)   // in this test case $
        {
           //System.out.println("***Output****");
           //System.out.println("Detected a: " + output + " in row: " + (column));

           outputCurrency=column;
        }

        if (c==currency[i])  // in this test case £
        {
           //System.out.println("***Input***");
           //System.out.println("Detected a: " + input + " in column: " + (column));

           inputCurrency=column;

        }
        column++;
     }

     //address this
     System.out.println("\n1This is " + output+ String.format("%.2f",reverse_conversion) + "
with conversion factor " + currencies[inputCurrency][outputCurrency] +  " back to original: " +
currency[i]);


    System.out.println("This is conversion: " + originalInput  +
String.format("%.2f",(reverse_conversion/currencies[inputCurrency][outputCurrency])) + "   "
+   currency[i]+"=>"+input+"=>"+output+"=>" + currency[i] + "=>" + output + "=>" +
originalInput);

    convertedBack =  reverse_conversion/currencies[inputCurrency][outputCurrency];

    if (convertedBack>amount)
    {
       System.out.println("************ARBITRAGE.....**********");
       System.out.println("Difference of: " + originalInput +String.format("%.2f",(convertedBack
- amount)));
    }

     if (convertedBack<amount)
    {
       System.out.println("************LOSS OF CURRENCY.....**********");
       System.out.println("Difference of: " + originalInput +String.format("%.2f",(amount -
convertedBack)));
    }


    // This is repeated of above... For instance in current flow above it is doing:
    //£ => $ => Euro => $ => £
    //However need to do:
```

```
    //£ => $ => Euro => £


    System.out.println("\n");
    System.out.println("This will now convert: " + input +  String.format("%.2f",convertedValue)
+ " back to original " + currency[i]);

    // it has to process this again to find correct conversion factor to initial currency....

    column=0;

    for (String c: currency)
     {
        if (c==currency[i])   // in this test case $
        {
           //System.out.println("***Output****");
           //System.out.println("Detected a: " + output + " in row: " + (column));

           inputCurrency=column;
        }

        if (c==input)  // in this test case £
        {
           //System.out.println("***Input***");
           //System.out.println("Detected a: " + input + " in column: " + (column));

           outputCurrency=column;

        }
        column++;
     }


    conversionUnits[j]= currencies[inputCurrency][outputCurrency];


    System.out.println("This is the conversion factor back to original: " + conversionUnits[j]);

    System.out.println("This is conversion: " + originalInput  +
String.format("%.2f",(convertedValue/conversionUnits[j])) +   "  " +
currency[i]+"=>"+input+"=>"+output+"=>" + currency[i] + "=>" + output + "=>" + input + "=>" +
originalInput);


    convertedBack1 =  convertedValue/conversionUnits[j];

    if (convertedBack1>amount)
    {
       System.out.println("************ARBITRAGE.....***********");
       System.out.println("Difference of: " + originalInput +String.format("%.2f",
(convertedBack1 - amount)));
    }

     if (convertedBack1<amount)
```

```
    {
       System.out.println("**********LOSS OF CURRENCY.....**********");
       System.out.println("Difference of: " + originalInput +String.format("%.2f",(amount -
convertedBack1)));
    }

    System.out.println("\n\n");



     }




}


}
}


}
}
```