AI Exp- 8

Unification

Team- Automata lab

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Problem chosen: Unification

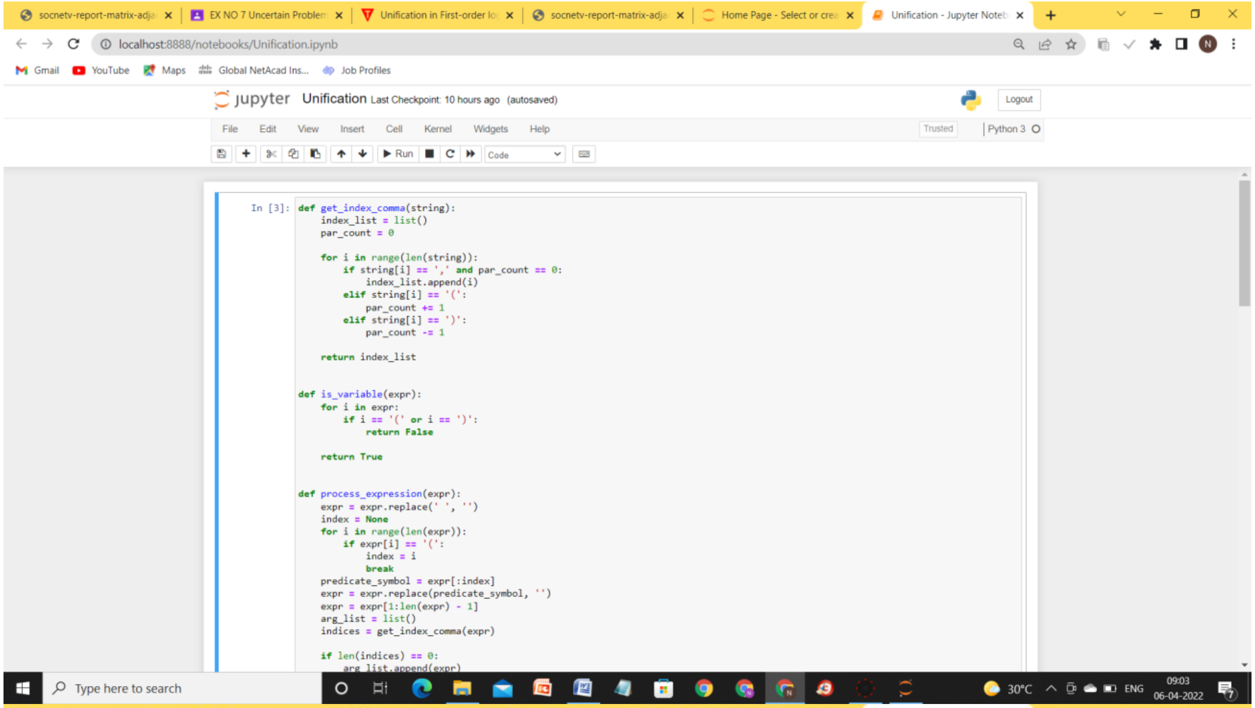
Problem statement: Unification is a process of making two different logical atomic expressions identical by finding a substitution. Unification depends on the substitution process.

Code & Output:

```
def get_index_comma(string):
    index_list = list()
    par_count = 0

    for i in range(len(string)):
        if string[i] == ',' and par_count == 0:
            index_list.append(i)
        elif string[i] == '(':
            par_count += 1
        elif string[i] == ')':
            par_count -= 1

    return index_list



def is_variable(expr):
    for i in expr:
        if i == '(' or i == ')':
            return False

    return True



def process_expression(expr):
    expr = expr.replace(' ', '')
    index = None
    for i in range(len(expr)):
        if expr[i] == '(':
            index = i
            break
    predicate_symbol = expr[:index]
    expr = expr.replace(predicate_symbol, '')
    expr = expr[1:len(expr) - 1]
    arg_list = list()
    indices = get_index_comma(expr)

    if len(indices) == 0:
        arg_list.append(expr)
    else:
        arg_list.append(expr[:indices[0]])
        for i, j in zip(indices, indices[1:]):
            arg_list.append(expr[i + 1:j])
        arg_list.append(expr[indices[len(indices) - 1] + 1:])

    return predicate_symbol, arg_list


def get_arg_list(expr):
    _, arg_list = process_expression(expr)

    flag = True
    while flag:
        flag = False
        for i in arg_list:
            if not is_variable(i):
                flag = True
                _, tmp = process_expression(i)
                for j in tmp:
                    if j not in arg_list:
                        arg_list.append(j)
                arg_list.remove(i)

    return arg_list


def check_occurs(var, expr):
    arg_list = get_arg_list(expr)
    if var in arg_list:
        return True

    return False


def unify(expr1, expr2):
```

```
if is_variable(expr1) and is_variable(expr2):

    if expr1 == expr2:

        return 'Null'

    else:

        return False

elif is_variable(expr1) and not is_variable(expr2):

    if check_occurs(expr1, expr2):

        return False

    else:

        tmp = str(expr2) + '/' + str(expr1)

        return tmp

elif not is_variable(expr1) and is_variable(expr2):

    if check_occurs(expr2, expr1):

        return False

    else:

        tmp = str(expr1) + '/' + str(expr2)

        return tmp

else:

    predicate_symbol_1, arg_list_1 = process_expression(expr1)

    predicate_symbol_2, arg_list_2 = process_expression(expr2)
```

```
# Step 2
if predicate_symbol_1 != predicate_symbol_2:
    return False
# Step 3
elif len(arg_list_1) != len(arg_list_2):
    return False
else:
    # Step 4: Create substitution list
    sub_list = list()

    # Step 5:
    for i in range(len(arg_list_1)):
        tmp = unify(arg_list_1[i], arg_list_2[i])

        if not tmp:
            return False
        elif tmp == 'Null':
            pass
        else:
            if type(tmp) == list:
                for j in tmp:
                    sub_list.append(j)
                    else:
                        sub_list.append(tmp)

            # Step 6
            return sub_list



if __name__ == '__main__':

    f1 = 'Q(X,X)'
    f2 = 'Q(Z,f(Z))'
    #f1 = 'Q(a, g(x, a), f(y))'
    #f2 = 'Q(a, g(f(b), a), x)'

    result = unify(f1, f2)
    if not result:
        print('The process of Unification failed!')
    else:
        print('The process of Unification successful!')
        print(result)
```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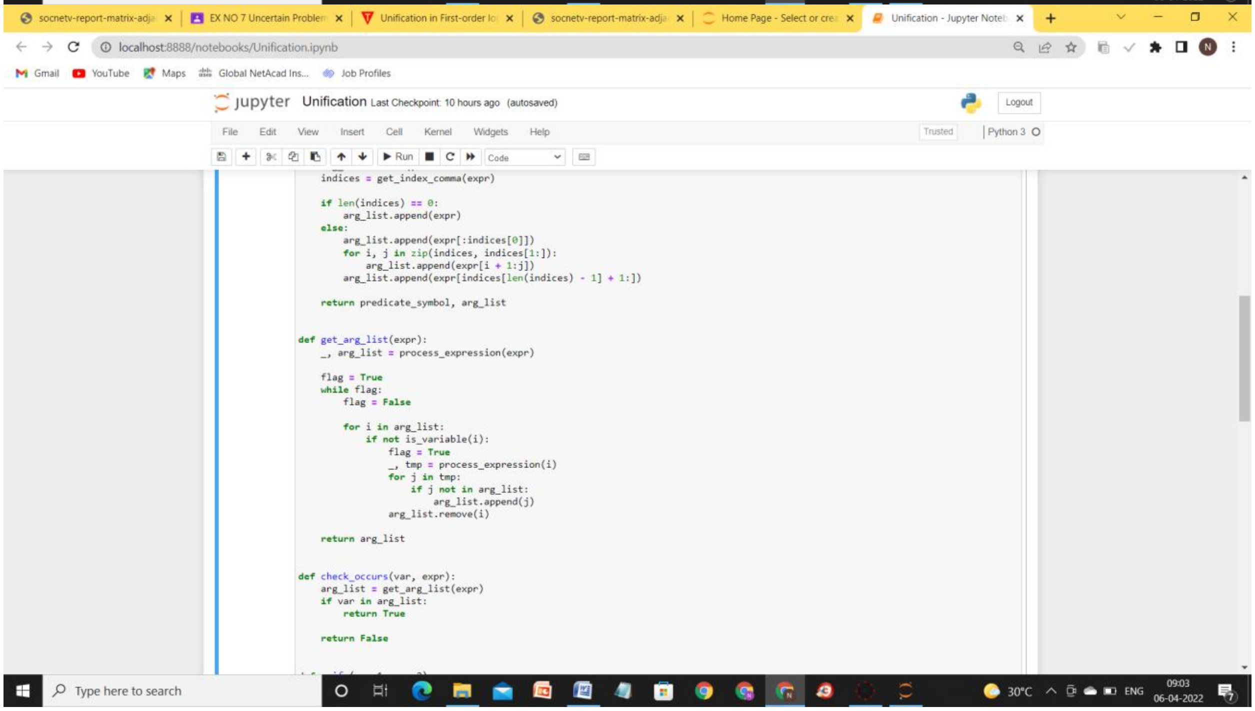
```
In [3]: def get_index_comma(string):
            index_list = list()
            par_count = 0

            for i in range(len(string)):
                if string[i] == ',' and par_count == 0:
                    index_list.append(i)
                elif string[i] == '(':
                    par_count += 1
                elif string[i] == ')':
                    par_count -= 1

            return index_list


        def is_variable(expr):
            for i in expr:
                if i == '(' or i == ')':
                    return False

            return True


        def process_expression(expr):
            expr = expr.replace(' ', '')
            index = None
            for i in range(len(expr)):
                if expr[i] == '(':
                    index = i
                    break
            predicate_symbol = expr[:index]
            expr = expr.replace(predicate_symbol, '')
            expr = expr[1:len(expr) - 1]
            arg_list = list()
            indices = get_index_comma(expr)

            if len(indices) == 0:
                arg_list.append(expr)
```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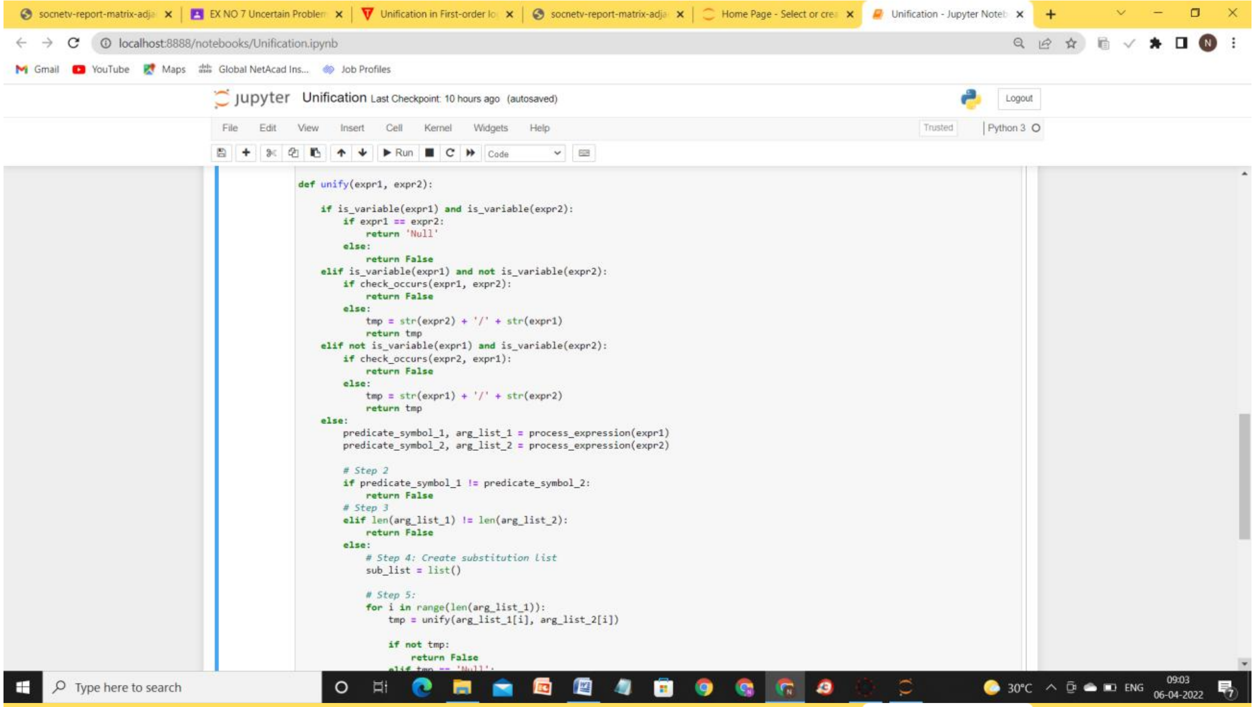
```
            indices = get_index_comma(expr)

            if len(indices) == 0:
                arg_list.append(expr)
            else:
                arg_list.append(expr[:indices[0]])
                for i, j in zip(indices, indices[1:]):
                    arg_list.append(expr[i + 1:j])
                arg_list.append(expr[indices[len(indices) - 1] + 1:])

            return predicate_symbol, arg_list


        def get_arg_list(expr):
            _, arg_list = process_expression(expr)

            flag = True
            while flag:
                flag = False

                for i in arg_list:
                    if not is_variable(i):
                        flag = True
                        _, tmp = process_expression(i)
                        for j in tmp:
                            if j not in arg_list:
                                arg_list.append(j)
                        arg_list.remove(i)

            return arg_list


        def check_occurs(var, expr):
            arg_list = get_arg_list(expr)
            if var in arg_list:
                return True

            return False
```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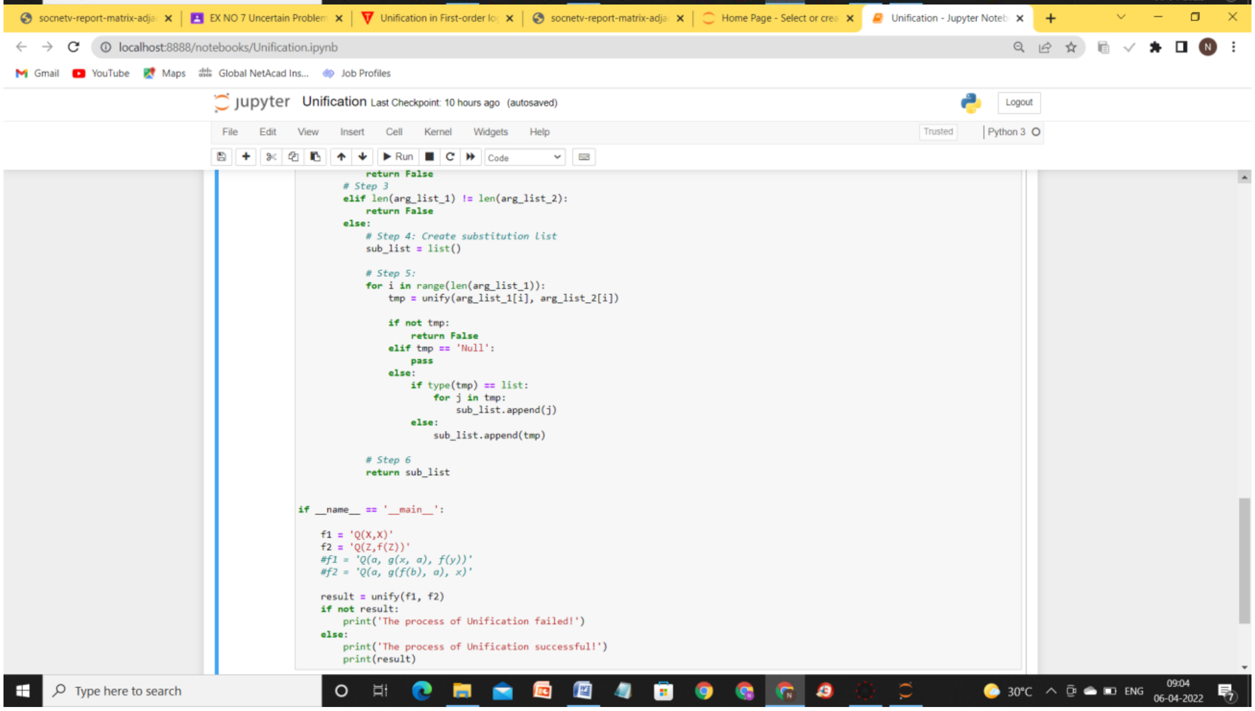
```
def unify(expr1, expr2):

    if is_variable(expr1) and is_variable(expr2):
        if expr1 == expr2:
            return 'Null'
        else:
            return False
    elif is_variable(expr1) and not is_variable(expr2):
        if check_occurs(expr1, expr2):
            return False
        else:
            tmp = str(expr2) + '/' + str(expr1)
            return tmp
    elif not is_variable(expr1) and is_variable(expr2):
        if check_occurs(expr2, expr1):
            return False
        else:
            tmp = str(expr1) + '/' + str(expr2)
            return tmp
    else:
        predicate_symbol_1, arg_list_1 = process_expression(expr1)
        predicate_symbol_2, arg_list_2 = process_expression(expr2)

        # Step 2
        if predicate_symbol_1 != predicate_symbol_2:
            return False
        # Step 3
        elif len(arg_list_1) != len(arg_list_2):
            return False
        else:
            # Step 4: Create substitution list
            sub_list = list()

            # Step 5:
            for i in range(len(arg_list_1)):
                tmp = unify(arg_list_1[i], arg_list_2[i])

                if not tmp:
                    return False
                elif tmp == 'Null':
```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                tmp = unify(arg_list_1[i], arg_list_2[i])

                if not tmp:
                    return False
                elif tmp == 'Null':
                    pass
                else:
                    if type(tmp) == list:
                        for j in tmp:
                            sub_list.append(j)
                    else:
                        sub_list.append(tmp)

            # Step 6
            return sub_list


if __name__ == '__main__':

    f1 = 'Q(X,X)'
    f2 = 'Q(Z,f(Z))'
    #f1 = 'Q(a, g(x, a), f(y))'
    #f2 = 'Q(a, g(f(b), a), x)'

    result = unify(f1, f2)
    if not result:
        print('The process of Unification failed!')
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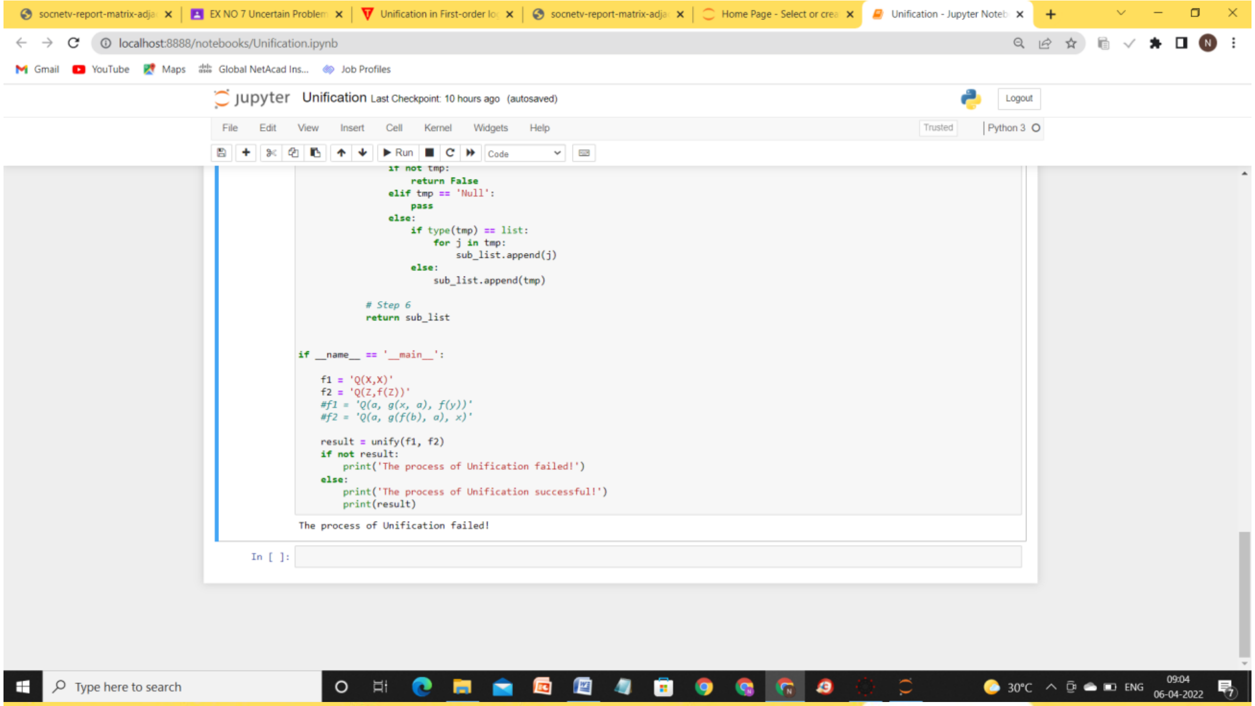
```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```
The process of Unification failed!
```

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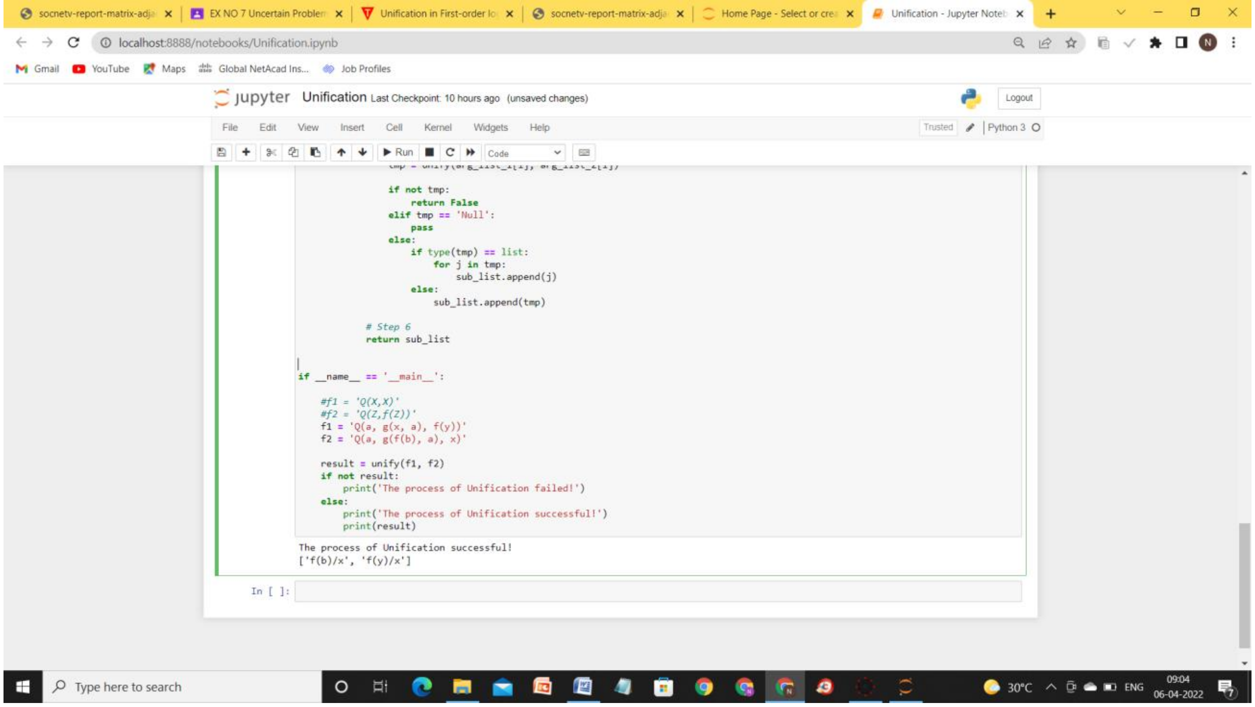
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if __name__ == '__main__':

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        print(result)
```

```
The process of Unification successful!
['f(b)/x', 'f(y)/x']
```

Result:

The problem statement for Unification is solved.