726. Number of Atoms

```
/*
    Time complexity: O(m^2+mlogm+n)
    Extra space complexity: O(2m+2m+2m+2m) (formula_array,stack,tmp array,count map)
*/
class Solution {
    public:
        void store_in_array(std::string& formula,std::vector<string>& result){
            formula="("+formula+")1";
            int n=formula.size();
            int i=0,j=0;
            while(i<n){
                char c=formula[i];
                if(c==')') {
                    result.push_back(")");
                    if(!isdigit(formula[i+1])) result.push_back("1");
                    i++;
                }
                else if(c=='(') {
                    result.push_back("(");
                    i++;
                }
                else if(isupper(c)){
                    std::string atom="";
                    atom+=c;
                    for(j=i+1;j<n;++j){
                        c=formula[j];
                        if(!islower(c)) break;
                        atom+=c;
                    }
                    i=j;
                    result.push_back(atom);
                    if(!isdigit(formula[j])) result.push_back("1");
                }
                else if(isdigit(c)){
                    std::string number="";
                    number+=c;
                    for(j=i+1;j<n;++j){
                        c=formula[j];
                        if(!isdigit(c)) break;
                        number+=c;
                    }
                    i=j;
                    result.push_back(number);
                }
            }
        }
```

```
std::string countOfAtoms(std::string formula) {
    int n=formula.size();

    std::vector<std::string> formula_array;

    // O(n)
    store_in_array(formula,formula_array);

    std::stack<std::pair<std::string,int>> st;

    int m=formula_array.size();
    int i=0;
    //O(m^2)
    while(i<m){
        std::string e=formula_array[i];
        if(e=="(") {
            st.push({"(",0});
            i++;
        }
        else if(e!=")" && isupper(e[0])){
            st.push({e,stoi(formula_array[i+1])});
            i+=2;
        }
        else if(e==")"){ // O(m)
            int w=stoi(formula_array[i+1]);
            std::vector<std::pair<std::string,int>> tmp;
            while(!st.empty() && st.top().first !="("){
                st.top().second*=w;
                tmp.push_back(st.top());
                st.pop();
            }
            if(!st.empty()) st.pop();
            for(auto& e: tmp) st.push(e);
            i+=2;
        }
    }
// Compute the frequency of each atom: O(mlogm)
            std::map<std::string,int> count;
            while(!st.empty()){
                count[st.top().first]+=st.top().second;
                st.pop();
            }

            // Generate the answer
            std::string ans="";
            for(auto p: count){
                ans+=p.second==1?p.first:(p.first+std::to_string(p.second));
            }
            return ans;
        }
};


/*
    "H2O"
    "Mg(OH)2"
    "Mg(H2O)N"
    "K4(ON(SO3)2)2"
    "TpNO(OTp2(SO3)4(MgNo2)13)2"
*/

// Todo: Try to improve it to O(mlog m) time complexity
```