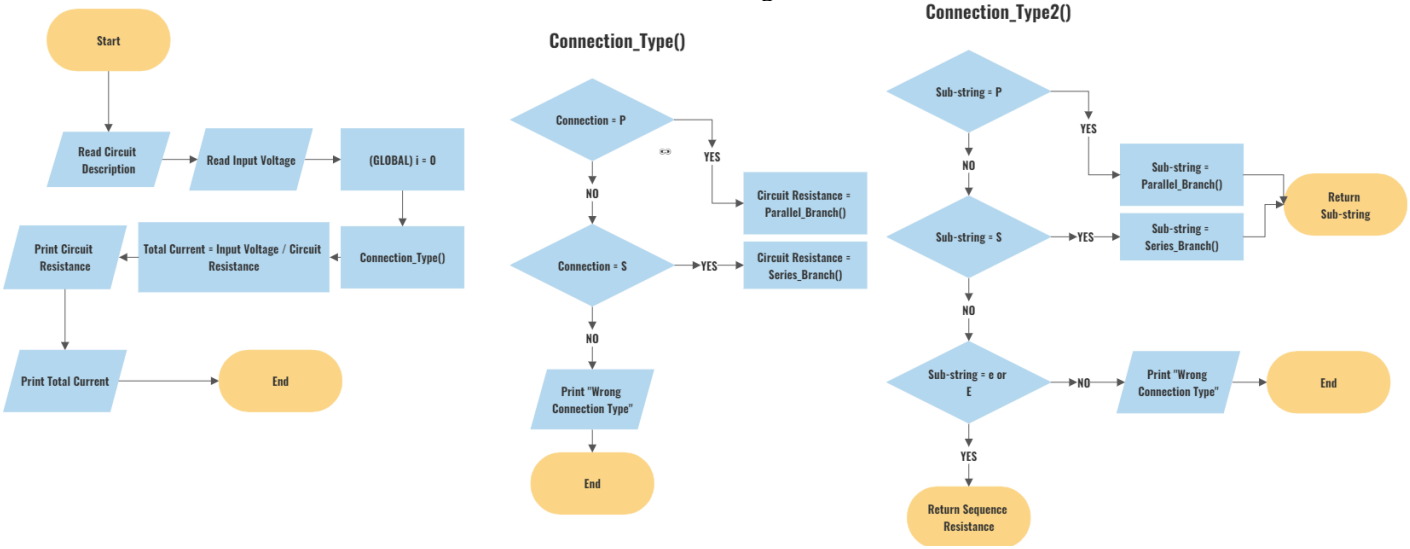
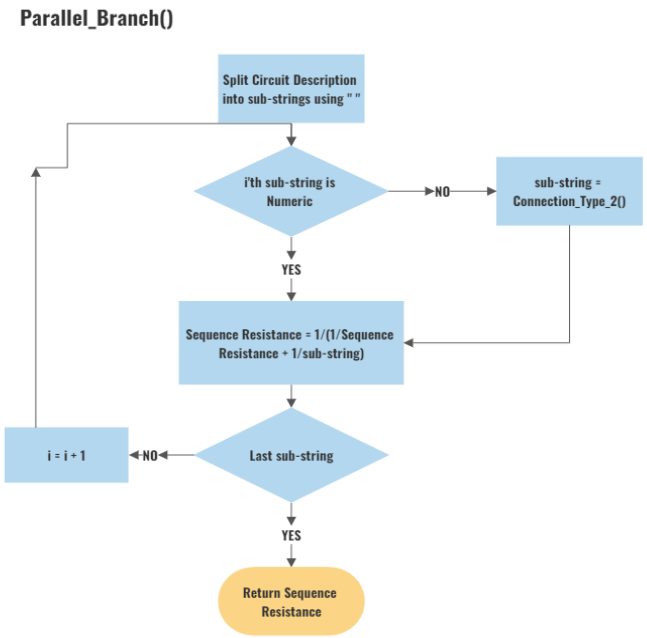
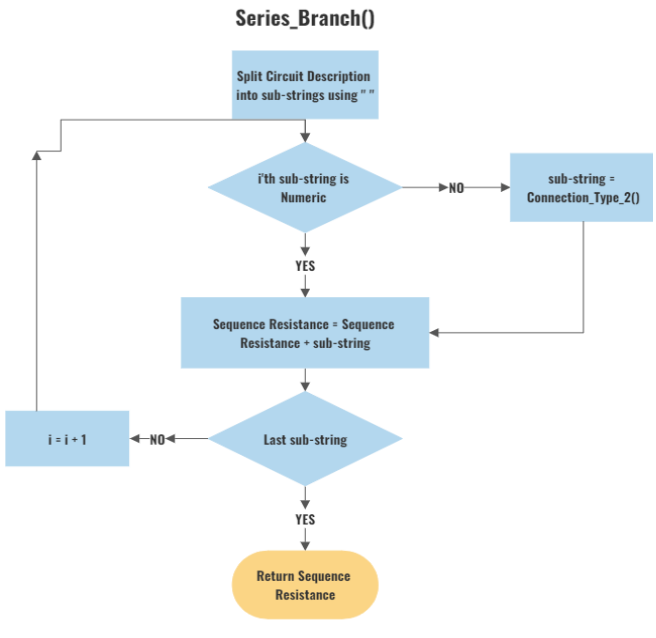
```cpp
#define _CRT_SECURE_NO_WARNINGS
#include <bits/stdc++.h>

using namespace std;

double parallel_branch(string circuit_desc);
double series_branch(string circuit_desc);

// Global Itterator
int i = 0;

int main()
{
    // Main quantities
    double circuit_resistance{};
    double circuit_voltage{};

    // Get the circuit description from the user in one line.
    cout << "Circuit Description: ";
    string circuit_desc;
    getline(cin, circuit_desc);

    cout << "Voltage Applied: ";
    cin >> circuit_voltage;



    // Call the desired function depending on the type of connection
    if(circuit_desc[0] == 'P')
        circuit_resistance = parallel_branch(circuit_desc.erase(0, 2)); // .erase(0, 2) will erase the connection type and the following space "P "
    else if (circuit_desc[0] == 'S')
        circuit_resistance = series_branch(circuit_desc.erase(0, 2));
    else
    {
        // Check for wrong connection type.
        cout << "Wrong Circuit Description" << endl;
        return 1;
    }

    // Output the Final values
    cout << "Circuit Equivalent Resistance: " << circuit_resistance << endl;
    cout << "Total Circuit Current: " << circuit_voltage / circuit_resistance << endl;

    return 0;
}


// Calculates the value of a series sequence, uses recursion if necessary
double series_branch(string circuit_desc)
{
    // Initialize the current series resistance
    double circuit_resistance{0};
    string temp; int j{};

    do
    {
        // Chop the string into mini strings consisting of 1 value.
        j = circuit_desc.find(" ", i+1);
        if(j != string::npos)
            temp = circuit_desc.substr(i, j-i);
        else
            return circuit_resistance;

        i = j+1;

        // If numerical then do necessary computation
        if(!isalpha(temp[0]))
        {
            circuit_resistance += stod(temp);
        }
        // Else if not, check for subseries with in the main series, using recursion
        else
        {
            if(temp[0] == 'P')
                circuit_resistance += parallel_branch(circuit_desc);
            else if (temp[0] == 'S')
                circuit_resistance += series_branch(circuit_desc);
            else if (temp[0] == 'e' || temp[0] == 'E')
                return circuit_resistance;
            else
            {
                cout << "Wrong Circuit Description" << endl;
                exit(1);
            }
        }
    }
    while(1);
}

// Calculates the value of a series sequence, uses recursion if necessary similar to previous function
double parallel_branch(string circuit_desc)
{
    int j{};
    double circuit_resistance{0};
    string temp;
```

```
    do
    {
        j = circuit_desc.find(" ", i+1);

        if(j != string::npos)
            temp = circuit_desc.substr(i, j-i);
        else
            return circuit_resistance;

        i = j+1;

        if(!isalpha(temp[0]))
        {
            if(!circuit_resistance)
                circuit_resistance = stod(temp);
            else
                 circuit_resistance = 1/(1/circuit_resistance + 1/stod(temp));
        }
        else
        {
            if(temp[0] == 'P')
                circuit_resistance = (circuit_resistance) ? 1/(1/circuit_resistance + 1/parallel_branch(circuit_desc)) : parallel_branch(circuit_desc);
            else if (temp[0] == 'S')
                circuit_resistance = (circuit_resistance) ? 1/(1/circuit_resistance + 1/series_branch(circuit_desc)) : series_branch(circuit_desc);
            else if (temp[0] == 'e' || temp[0] == 'E')
                return circuit_resistance;
            else
            {
                cout << "Wrong Circuit Description" << endl;
                exit(1);
            }
        }

    }
    while(1);
}
```

Recursive Program





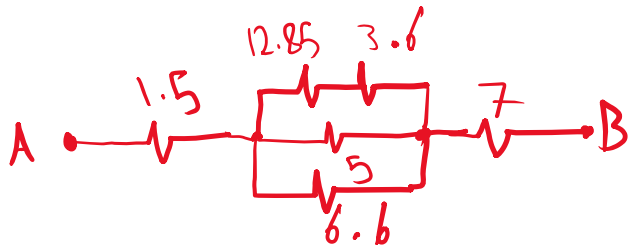


1. **Circuit description:** *S 1.5 P S 12.85 3.6 e 5 6.6 e 7 E*
   Voltage applied: *3.8*

```
Circuit Description: S 1.5 P S 12.85 3.6 e 5 6.6 e 7 E
Voltage Applied: 3.8
Circuit Equivalent Resistance: 10.9254
Total Circuit Current: 0.347814
```

$$R_{eq} = 1.5 + \left(\frac{1}{(12.85+3.6)} + \frac{1}{5} + \frac{1}{6.6}\right)^{-1} + 7$$

$$R_{eq} = 10.925\ \Omega \quad , \quad I_{total} = \frac{V}{R_{eq}} = \frac{3.8}{10.925} = 0.348\ Amps$$



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2. **Circuit description:** *S L 2.5 5.2 e 4.7 8 E*
   Voltage applied: 9

```
Circuit Description: S L 2.5 5.2 e 4.7 8 E
Voltage Applied: 9
Wrong Circuit Description
```

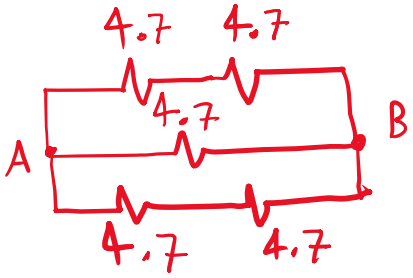
---

3. **Circuit description:** *P S 4.7 4.7 e 4.7 S 4.7 4.7 e E*
   Voltage applied: *7*

```
Circuit Description: P S 4.7 4.7 e 4.7 S 4.7 4.7 e E
Voltage Applied: 7
Circuit Equivalent Resistance: 2.35
Total Circuit Current: 2.97872
```

$$R_{eq} = \left(\frac{1}{4.7+4.7} + \frac{1}{4.7} + \frac{1}{4.7+4.7}\right)^{-1}$$

$$R_{eq} = 2.35\ \Omega \quad , \quad I_{total} = \frac{V}{R_{eq}} = \frac{7}{2.35} = 2.98\ Amps$$



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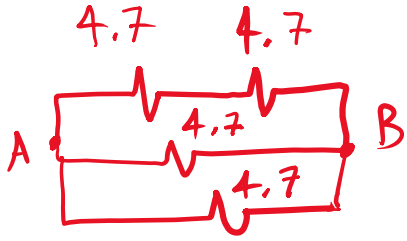
4. **Circuit description:** *P S 4.7 4.7 e 4.7 4.7 E*
Voltage applied: *9*

```
Circuit Description: P S 4.7 4.7 e 4.7 4.7 E
Voltage Applied: 9
Circuit Equivalent Resistance: 1.88
Total Circuit Current: 4.78723
```

$$R_{eq} = \left(\frac{1}{4.7 + 4.7} + \frac{1}{4.7} + \frac{1}{4.7}\right)^{-1}$$

$$R_{eq} = \ 1.88\ \Omega \quad , \quad I_{total} = \frac{V}{R_{eq}} = \frac{9}{1.88} = 4.79\ Amps$$



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5. **Circuit description:** *Z S 8.2 3.1 e 1.3 7.8 E*
Voltage applied: *5*

```
Circuit Description: Z S 8.2 3.1 e 1.3 7.8 E
Voltage Applied: 5
Wrong Circuit Description
```

---

6. **Circuit description:** *P S 8.2 3.1 e S 1.3 7.8 e E*
Voltage applied: *5*

```
Circuit Description: P S 8.2 3.1 e S 1.3 7.8 e E
Voltage Applied: 5
Circuit Equivalent Resistance: 5.04069
Total Circuit Current: 0.991928
```

$$R_{eq} = \left(\frac{1}{8.2 + 3.1} + \frac{1}{1.3 + 7.8}\right)^{-1}$$

$$R_{eq} = \ 5.04\ \Omega \quad , \quad I_{total} = \frac{V}{R_{eq}} = \frac{5}{5.04} = 0.99\ Amps$$