

Practice problems on loops and nested loops: Write C++ programs to produce the output described in each of the following problems.

The appropriate loop of a C++ program is shown for each example. In each case, this loop should be placed into a C++ program along with any necessary declarations of variables.

For each problem there are many other ways to write the loops.

(1) A triangle of stars (the user supplies the height):

```
*
**
***
****
```

```
for (r = 1; r <= max; r++) {
    for (c = 1; c <= r; c++)
        cout << "*";
    cout << endl;
}
```

(2) Another triangle of stars (the user supplies the height)

```
  *
 ***
*****
*****
```

```
spaces = max;
for (r = 1; r <= max; r++) {
    spaces--;
    for (c = 1; c <= spaces; c++)
        cout << " ";
    for (c = 1; c <= 2*r - 1; c++)
        cout << "*";
    cout << endl;
}
```

(3) Another triangle of stars (the user supplies the height)

```
  *
 ***
*****
***
 **
  *
```

```
spaces = max;
rows = max + max - 1;
for (r = 1; r <= rows; r++) {
    if (r <= max) spaces--;
    else spaces++;
    for (c = 1; c <= spaces; c++)
        cout << " ";
    for (c = spaces + 1; c <= max; c++)
        cout << "*";
    cout << endl;
}
```

(4) A double rectangle of stars (the user supplies height and width)

```
* * * * *
* * * * *
* * * * *
* * * * *
* * * * *
```

```
for (r = 1; r <= rows; r++) {
    for (c = 1; c <= cols; c++)
        cout << "* ";
    cout << endl;
    if (r < rows) {
        for (c = 1; c <= cols - 1; c++)
            cout << " *";
        cout << endl;
    }
}
```

(5) A table of powers of 2 (user supplies the number)

```
2 to the power 0 is 1
2 to the power 1 is 2
2 to the power 2 is 4
2 to the power 3 is 8
```

```
power = 1;
for (r = 0; r <= max; r++) {
    cout << "2 to the power " << r << " is " << power << endl;
    power *= 2;
}
```

(6) A table of factorials (user supplies the number)

```
1! = 1 = 1
2! = 2 x 1 = 2
3! = 3 x 2 x 1 = 6
4! = 4 x 3 x 2 x 1 = 24
5! = 5 x 4 x 3 x 2 x 1 = 120
```

```
factorial = 1;
for (r = 1; r <= max; r++) {
    cout << r << "! = ";
    for (c = r; c >= 1; c--) {
        cout << c;
        if (c > 1) cout << " x ";
        else cout << " = ";
    }
    factorial *= r;
    cout << factorial << endl;
}
```