

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

(1) The largest factor of a number (the user supplies the number):

number = 24, largest factor = 12

Answer:

```
int main() {
    int number;
    cout << "Enter an integer that is larger than 1: ";
    cin >> number;
    if (number <= 1) exit(1);

    int factor = number - 1;
    while ((number % factor) > 0) factor--;
    cout << "The largest factor is: " << factor << endl;
    return 0;
}
```

(2) An empty diamond of stars (the user supplies the height)

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

Answer:

```
int main() {
    int r, c, ht;
    cout << "Enter an odd integer as the height: ";
    cin >> ht;
    if ((ht <= 0) || ((ht % 2) == 0)) exit(1);
    int mid = ht / 2 + 1;

    for (r = mid; r >= 1; r--) {
        for (c = 1; c <= ht; c++) {
            if (c == r || c == (ht + 1 - r)) cout << "*";
            else cout << " ";
        }
        cout << endl;
    }

    for (r = 2; r <= mid; r++) {
        for (c = 1; c <= ht; c++) {
            if (c == r || c == (ht + 1 - r)) cout << "*";
            else cout << " ";
        }
        cout << endl;
    }

    return 0;
}
```

(3) An X of stars (the user supplies the height)

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

```
int main() {
    int r, c, ht;
    cout << "Enter an odd integer as the height: ";
    cin >> ht;
    if ((ht<= 0) || ((ht % 2) == 0)) exit(1);

    for (r = 1; r <= ht; r++) {
        for (c = 1; c <= ht; c++) {
            if (c == r || c == (ht + 1 - r)) cout << "*";
            else cout << " ";
        }
        cout << endl;
    }

    return 0;
}
```

(4) A pattern of 0's surrounded by *'s (the user supplies height and width)

```
*****
*0*0*0*0*0*
*****
*0*0*0*0*0*
*****
```

```
int main() {
    int r, c, ht, width;
    cout << "Enter a height and width: ";
    cin >> ht >> width;

    for (r = 1; r <= ht; r++) {
        for (c = 1; c <= width; c++) {
            if ((r % 2 == 0) && (c % 2 == 0))
                cout << "0";
            else cout << "*";
        }
        cout << endl;
    }

    return 0;
}
```

(5) A multiplication table (user supplies the size)

```
1 2 3 4 5 6
```

```

-----
1* 1 2 3 4 5 6
2* 2 4 6 8 10 12
3* 3 6 9 12 15 18
4* 4 8 12 16 20 24
5* 5 10 15 20 25 30
6* 6 12 18 24 30 36

```

```

int main() {
    int r, c, size;
    cout << "Enter a positive integer as the size: ";
    cin >> size;
    if (size <= 0) exit(1);

// output here is designed for sizes up to 10
    cout << "    ";
    for (c = 1; c <= size; c++)
        cout << " " << c << " ";
    cout << endl;

    cout << "    ";
    for (c = 1; c <= size; c++)
        cout << "---";
    cout << endl;

    for (r = 1; r <= size; r++) {
        cout << r << "* ";
        for (c = 1; c <= size; c++) {
            if (r * c < 10) cout << " ";
            cout << r * c << " ";
        }
        cout << endl;
    }

    return 0;
}

```

(6) Sum of the digits of a number (user supplies the number)

number = 245, sum of digits = 11

```

int main() {
    int n;
    cout << "Enter a positive integer: ";
    cin >> n;
    if (n <= 0) exit(1);

    int sum = 0;
    while (n > 0) {
        sum = sum + n % 10;
        n = n / 10;
    }
    cout << "The digit sum is: " << sum << endl;

    return 0;
}

```