Expressions, Statements, and Control Structures

Announcements

- Assignment 2 out, due next Wednesday, February 1.
    - Explore the Java concepts we've covered and will be covering.
    - Unleash your creative potential!

YEAH Hours

- **Y**our **E**arly **A**ssignment **H**elp **Hours**.
- Review session going over major points of the assignment.
- Tonight at **7:00PM** in Braun Auditorium.
- Should be available on SCPD tomorrow.

Highlights from Emails

CS is not lame,
Too many essays are lame,
Prove I'm not just fuzz.

I play Temple Run,
And like to watch the sky and,
Waste time with haikus.

Sending Messages

- To call a method on an object stored in a variable, use the syntax

  ***object*.*method*(*parameters*)**

- For example:

```
label.setFont("Comic Sans-32");
label.setColor(Color.ORANGE);
```

Operations on the **`GObject`** Class

The following operations apply to all **`GObjects`**:

object.**`setColor`**(*color*)
Sets the color of the object to the specified color constant.

object.**`setLocation`**(*x*, *y*)
Changes the location of the object to the point (*x*, *y*).

object.**`move`**(*dx*, *dy*)
Moves the object on the screen by adding *dx* and *dy* to its current coordinates.

Standard color names defined in the **`java.awt`** package:

`Color.BLACK`
`Color.DARK_GRAY`
`Color.GRAY`
`Color.LIGHT_GRAY`
`Color.WHITE`

`Color.RED`
`Color.YELLOW`
`Color.GREEN`
`Color.CYAN`

`Color.BLUE`
`Color.MAGENTA`
`Color.ORANGE`
`Color.PINK`

Graphic courtesy of Eric Roberts

Drawing Geometrical Objects

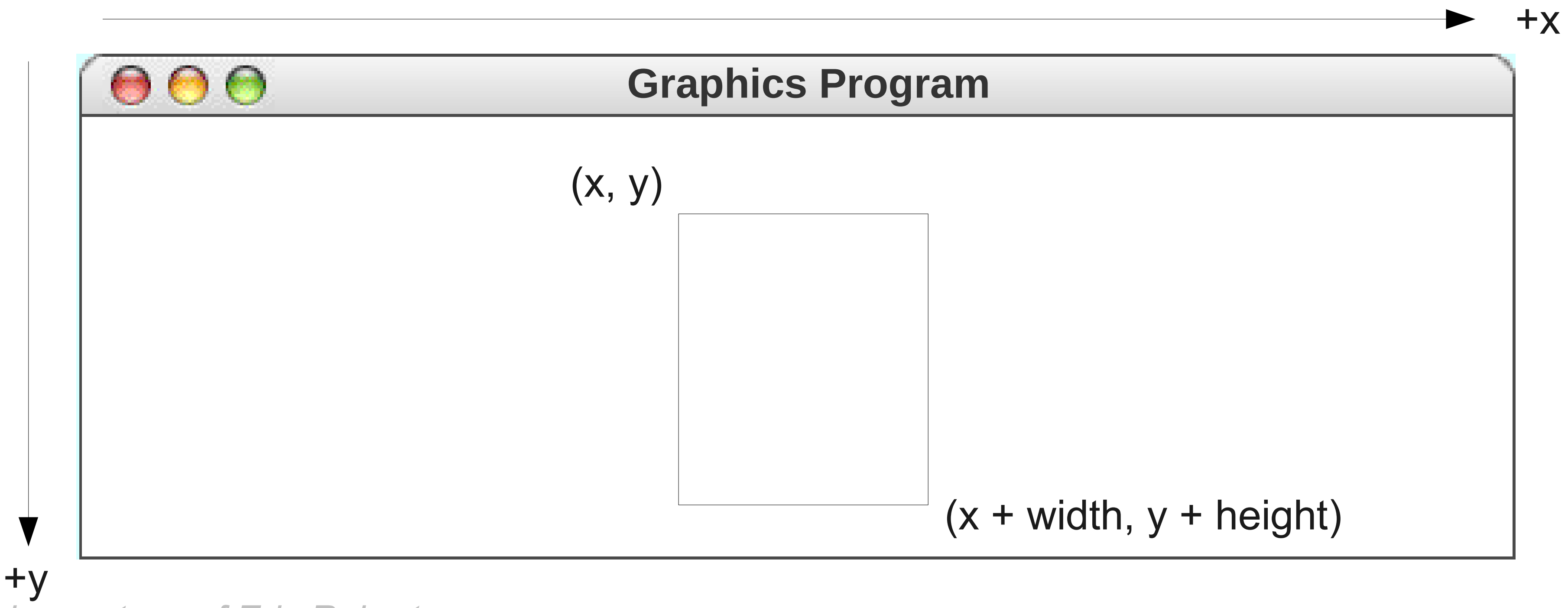
Graphic courtesy of Eric Roberts

Drawing Geometrical Objects

Constructors

new GRect(*x*, *y*, *width*, *height*)

Creates a rectangle whose upper left corner is at (*x*, *y*) of the specified size



Graphic courtesy of Eric Roberts

Drawing Geometrical Objects

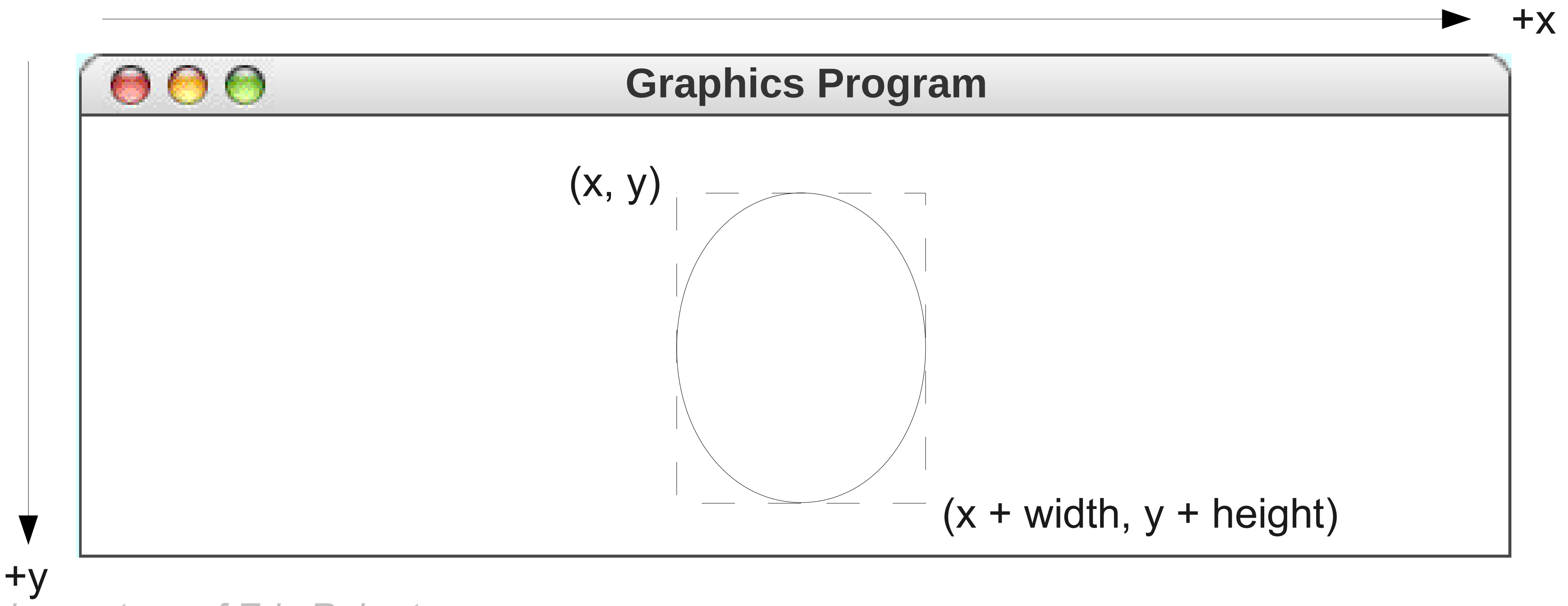
Constructors

`new GRect(` *x*, *y*, *width*, *height***`)`**

Creates a rectangle whose upper left corner is at (*x*, *y*) of the specified size

`new GOval(` *x*, *y*, *width*, *height***`)`**

Creates an oval that fits inside the rectangle with the same dimensions.



Graphic courtesy of Eric Roberts

Drawing Geometrical Objects

Constructors

`new GRect(` *x*, *y*, *width*, *height*)

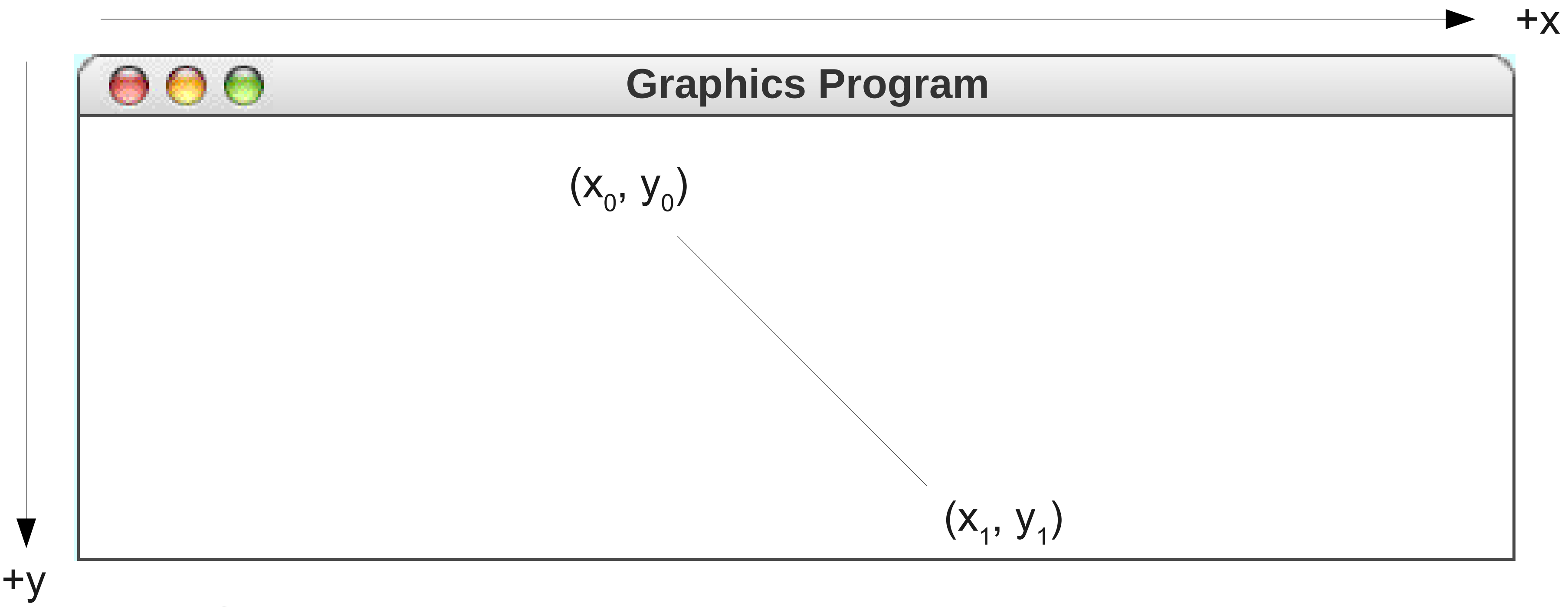
Creates a rectangle whose upper left corner is at (*x*, *y*) of the specified size

`new GOval(` *x*, *y*, *width*, *height*)

Creates an oval that fits inside the rectangle with the same dimensions.

`new GLine(` x_0, y_0, x_1, y_1)

Creates a line extending from (x_0, y_0) to (x_1, y_1).



Graphic courtesy of Eric Roberts

Drawing Geometrical Objects

Constructors

new GRect(*x*, *y*, *width*, *height***)**

Creates a rectangle whose upper left corner is at (*x*, *y*) of the specified size

new GOval(*x*, *y*, *width*, *height***)**

Creates an oval that fits inside the rectangle with the same dimensions.

new GLine(x_0, y_0, x_1, y_1**)**

Creates a line extending from (x_0, y_0) to (x_1, y_1).

Methods shared by the **GRect** and **GOval** classes

*object***.setFilled(***fill***)**

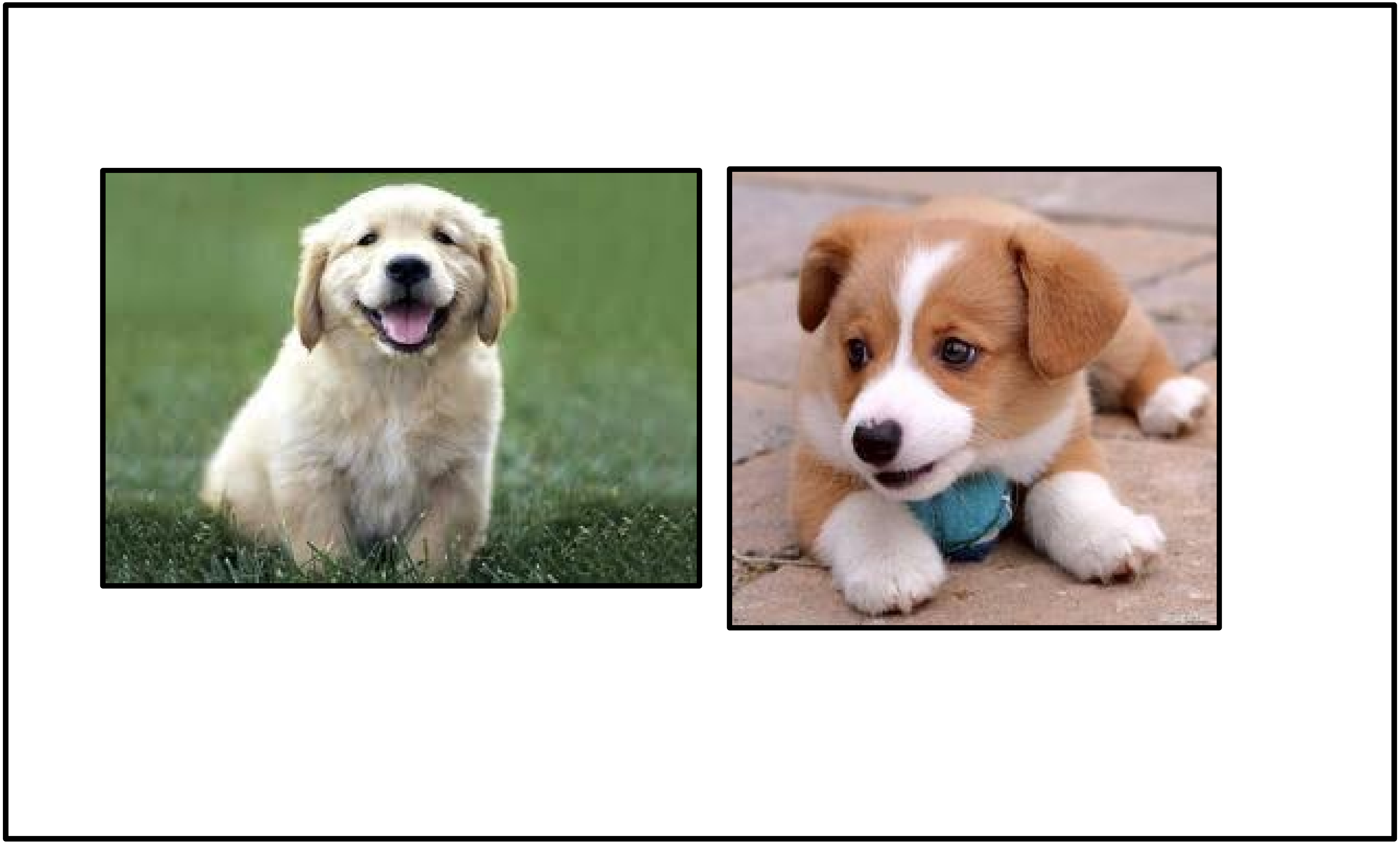
If *fill* is **true**, fills in the interior of the object; if **false**, shows only the outline.

*object***.setFillColor(***color***)**

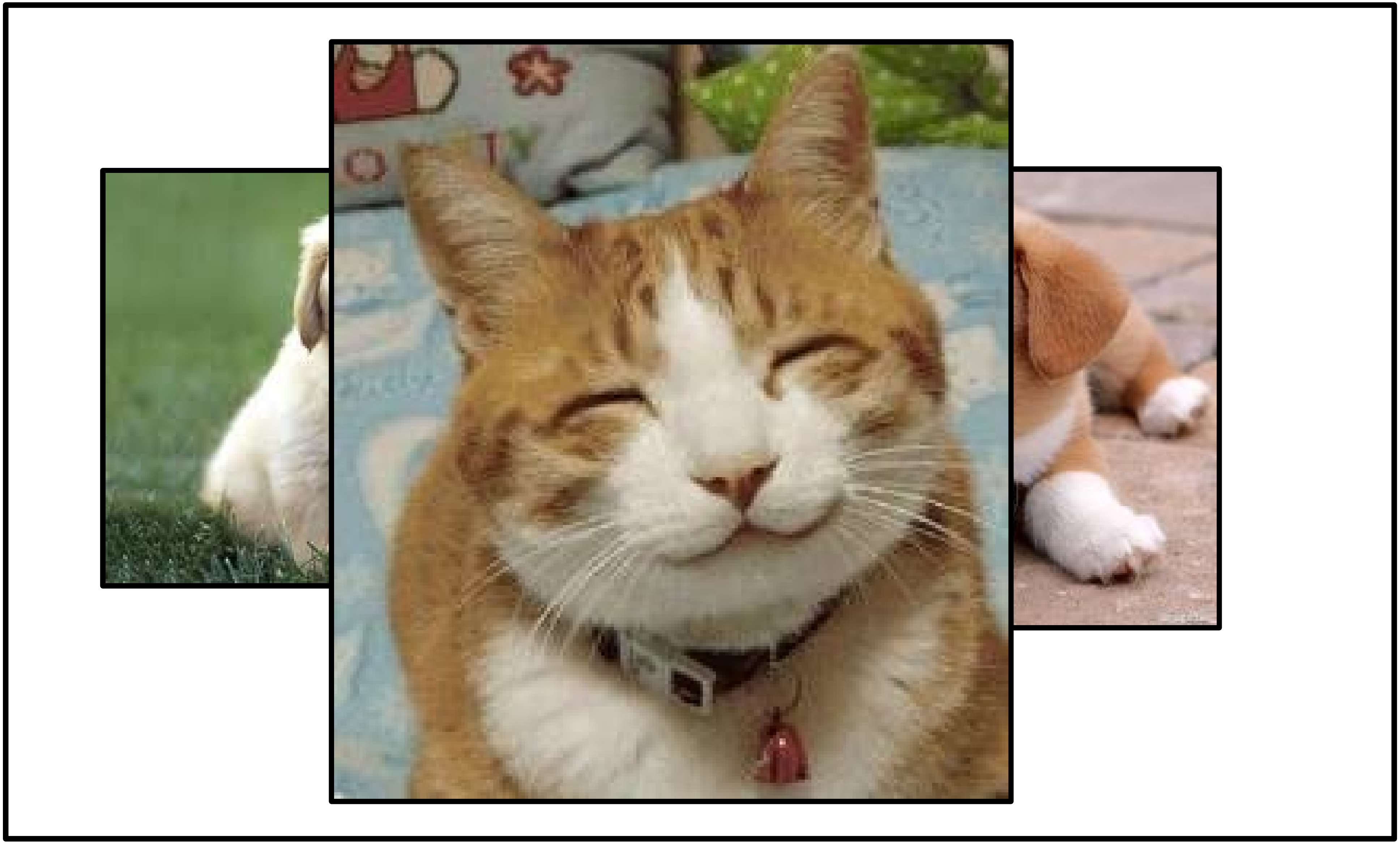
Sets the color used to fill the interior, which can be different from the border.

Graphic courtesy of Eric Roberts

The Collage Model



The Collage Model



Constants

- Not all variables actually *vary*.
- A **constant** is a name for a value that never changes.
- Syntax (defined outside of any method):

```
private static final type name = value;
```

- By convention, constants are named in UPPER_CASE_WITH_UNDERSCORES to differentiate them from variables.

Magic Numbers

- A **magic number** is a number written in a piece of code whose meaning cannot easily be deduced from context.

```
double weight = 9.8 * (m - 14);
```

- Constants make it easier to read code:

```
double weight = GRAVITY * (m - TARE_MASS);
```

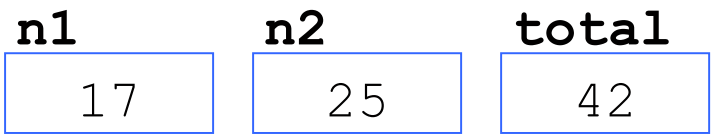
- Avoid magic numbers in your code by using constants.

Expressions

```
class Add2Integers extends ConsoleProgram {
   public void run() {
      println("This program adds two numbers.");
      int n1 = readInt("Enter n1: ");
      int n2 = readInt("Enter n2: ");
      int total = n1 + n2;
      println("The total is " + total + ".");
   }
}
```

n1	n2	total
17	25	42

```
class Add2Integers extends ConsoleProgram {
   public void run() {
      println("This program adds two numbers.");
      int n1 = readInt("Enter n1: ");
      int n2 = readInt("Enter n2: ");
      int total = n1 + n2;
      println("The total is " + total + ".");
   }
}
```



n1 17

n2 25

total 42

Expressions

- Variables and other values can be used in **expressions**.
- Some familiar mathematical operators:
  - `+` (addition)
  - `-` (subtraction)
  - `*` (multiplication)
  - `/` (division)

Fun with Division

Size of the Graphics Window

Methods provided by **`GraphicsProgram`** class

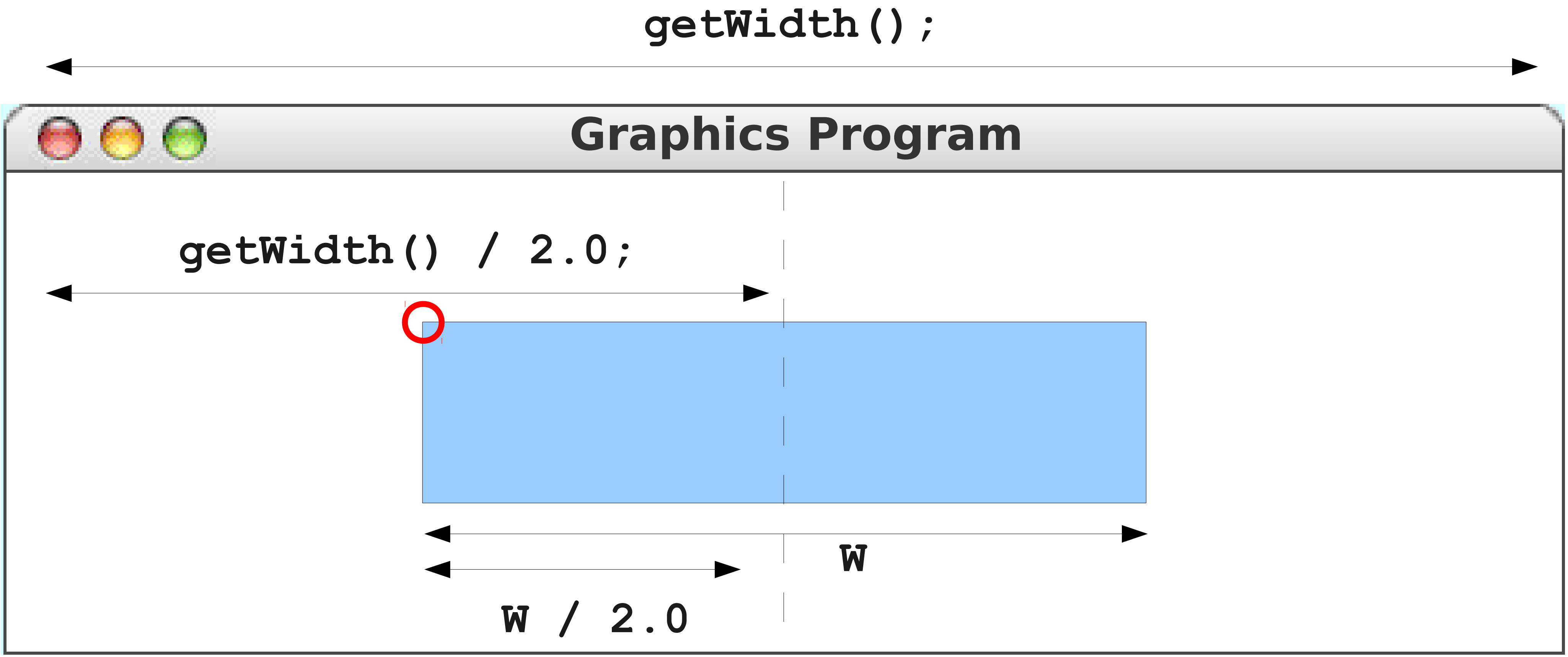
`getWidth()`
Returns the width of the graphics window.

`getHeight()`
Returns the height of the graphics window.

Note: receiver of these calls is the **`GraphicsProgram`** itself, so we don’t need to specify a separate object as receiver.

Based on slides by Eric Roberts

Centering an Object



```
x = (getWidth() / 2.0) - (W / 2.0);
x = (getWidth() - W) / 2.0;
```

The Remainder Operator

- The special operator `%` computes the **remainder** of one value divided by another.
- For example:
    - **`15 %  3 =  0`**
    - **`14 %  8 =  6`**
    - **`21 %  2 =  1`**
    - **`14 % 17 = 14`**

Operator Precedence

- Java's mathematical operators have the following precedence:
  - `()` *(highest)*
  - `* / %`
  - `+ -` *(lowest)*
- Operators of equal precedence are evaluated left-to-right.

A Useful Shorthand

- Commonly, programs contain code like this:

```
x = x + 1;             y = y * 137;
z = z / 14;            w = w - 3;
```

A Useful Shorthand

- Commonly, programs contain code like this:

```
x = x + 1;                    y = y * 137;
z = z / 14;                   w = w - 3;
```

- The statement

variable = ***variable op value*** ;

can be rewritten as

variable op= ***value*** ;

A Useful Shorthand

- Commonly, programs contain code like this:

```
x += 1;                      y *= 137;
z /= 14;                     w -= 3;
```

- The statement

  variable **=** ***variable op value*** ;

  can be rewritten as

  variable op**=** ***value*** ;

Another Useful Shorthand

- In the special case of writing

  ```
  variable = variable + 1;
  ```

  we can instead write

  ```
  variable ++;
  ```

- In the special case of writing

  ```
  variable = variable - 1;
  ```

  we can instead write

  ```
  variable --;
  ```

Boolean Expressions

- A **boolean expression** is a test for a condition (it is either **`true`** or **`false`**).
- Value comparisons:

`==`	“equals”	(note: not single **`=`**)
`!=`	“not equals”	(cannot say **`<>`**)
`>`	“greater than”	
`<`	“less than”	
`>=`	“greater than or equal to”	
`<=`	“less than or equal to”	

Based on slides by Mehran Sahami

Logical Operators

- We can apply **logical operators** to boolean values to produce new values.
- Logical **NOT**: `!p`
  - `!p` is `true` if `p` is `false`; `!p` is `false` if `p` is `true`.
- Logical **AND**: `p && q`
  - `p && q` is `true` when both `p` and `q` are true.
- Logical **OR**: `p || q`
  - `p || q` is `true` when `p` is true, `q` is true, or both `p` and `q` are true.
- Order of precedence given above.

Short-Circuit Evaluation

- Cute observations:
    - `true || p` is always `true`.
    - `false && p` is always `false`.
- The logical operators **short-circuit**: if the answer is known from the left operand, the right side is not computed.
- Example: The code

```
boolean b = (x == 0) || ((y / x) < 20)
```

will never divide by zero.

Based on slides by Mehran Sahami

Control Statements Revisited

Control Structures in Karel

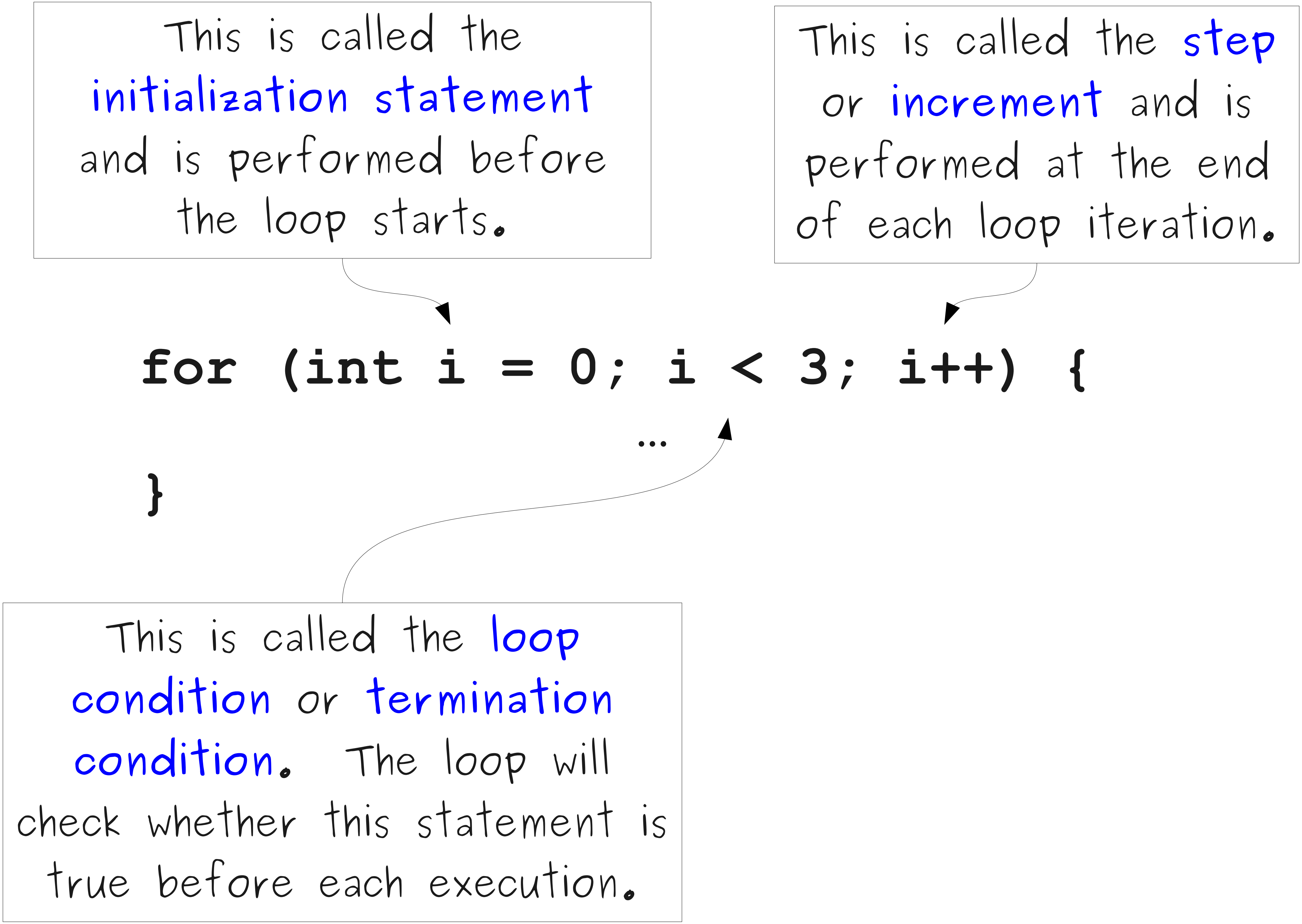
```
for
if
while
```

Control Structures in Karel

`for`

`if`

`while`



This is called the **initialization statement** and is performed before the loop starts.

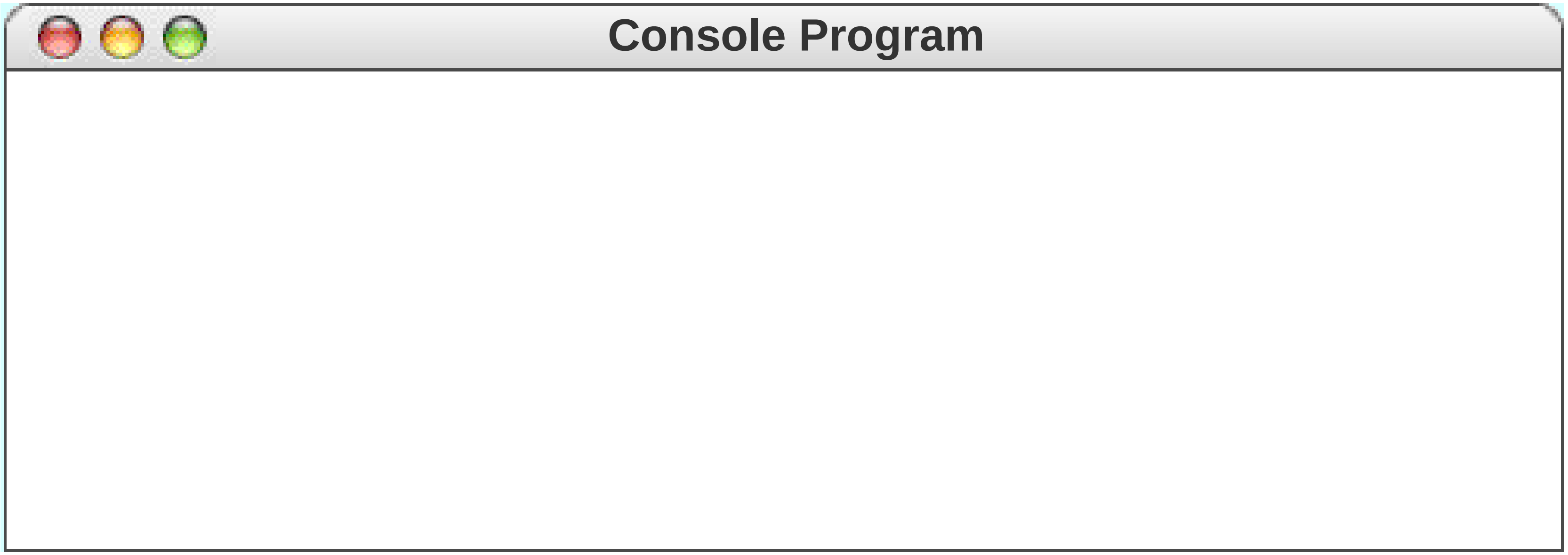
This is called the **step** or **increment** and is performed at the end of each loop iteration.

```
for (int i = 0; i < 3; i++) {
                 ...
}
```

This is called the **loop condition** or **termination condition**. The loop will check whether this statement is true before each execution.

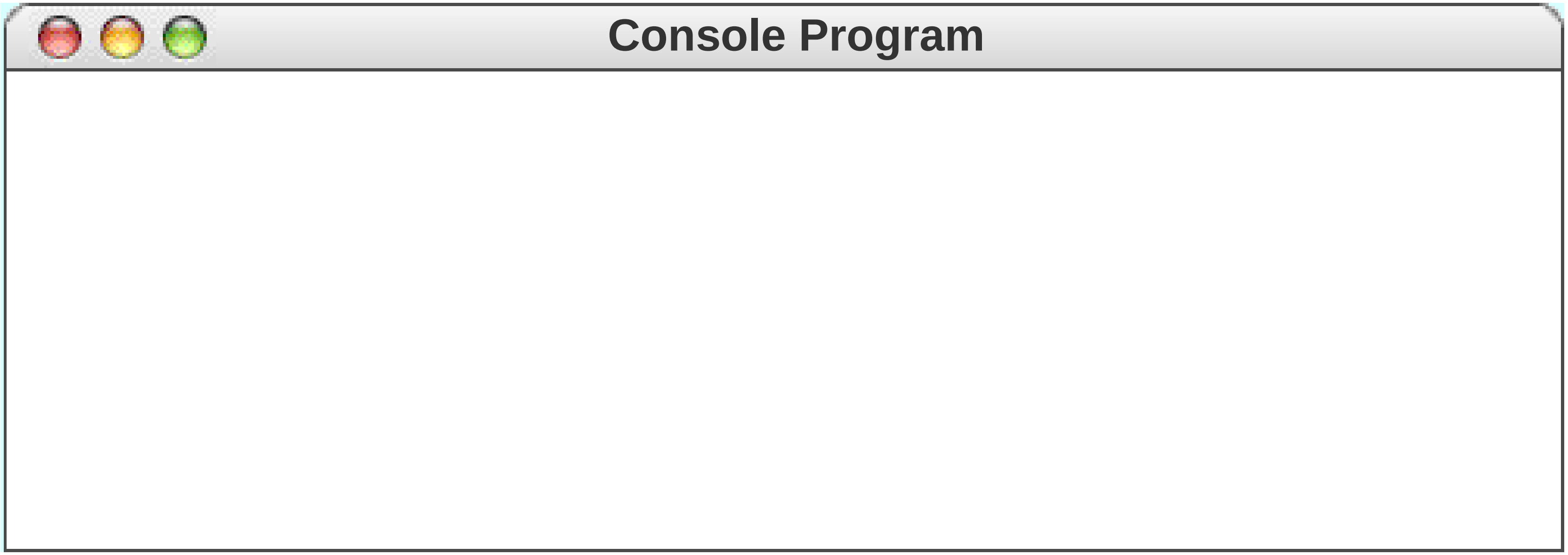
Nyan nyan nyan nyan, nyan nyan nyan nyan nyan, nyan, nyan nyan nyan …

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```



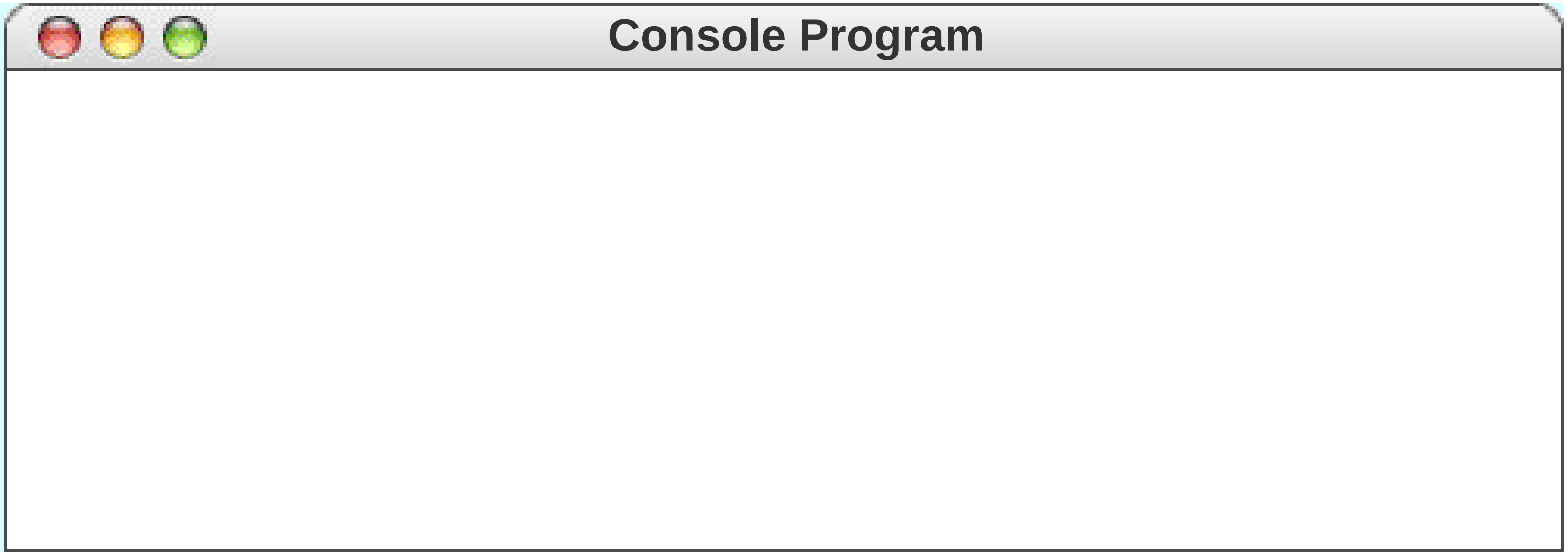
```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

int i 0



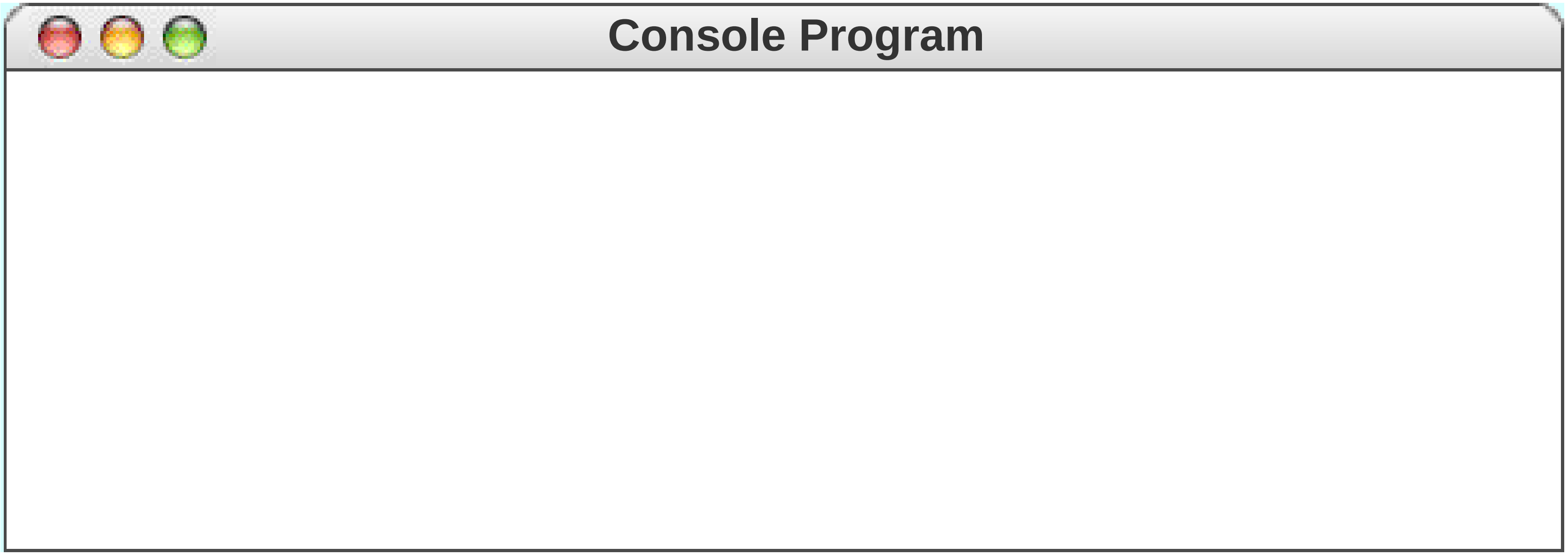
```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

int i 0



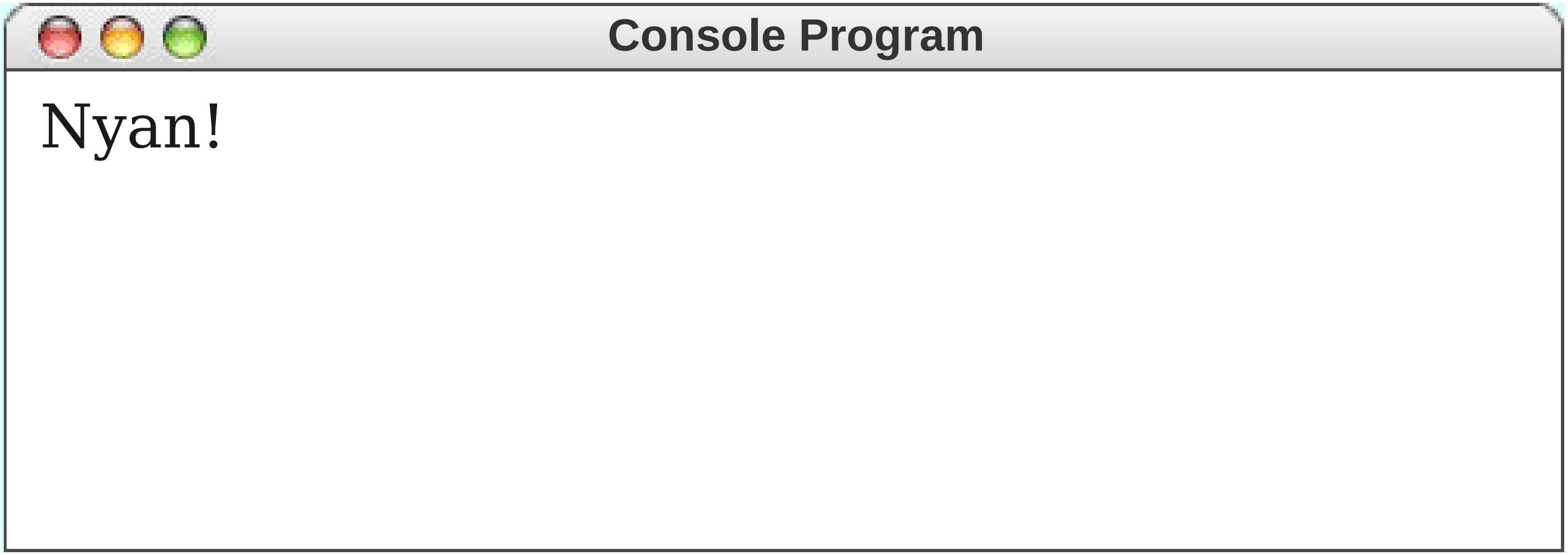
```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

int i 0



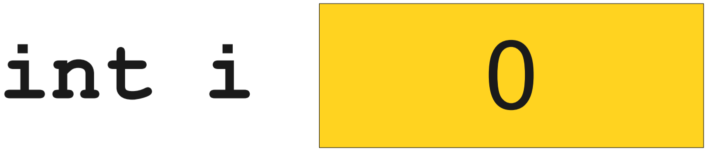
```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

int i 0



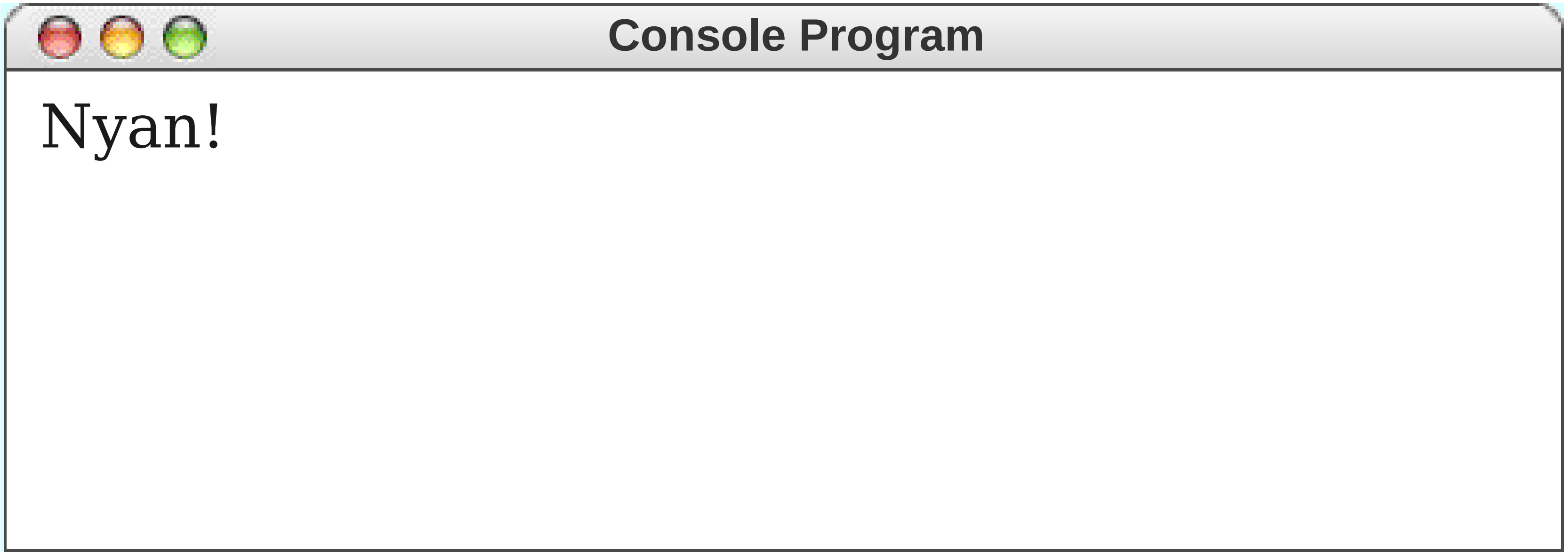
```
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```



int i

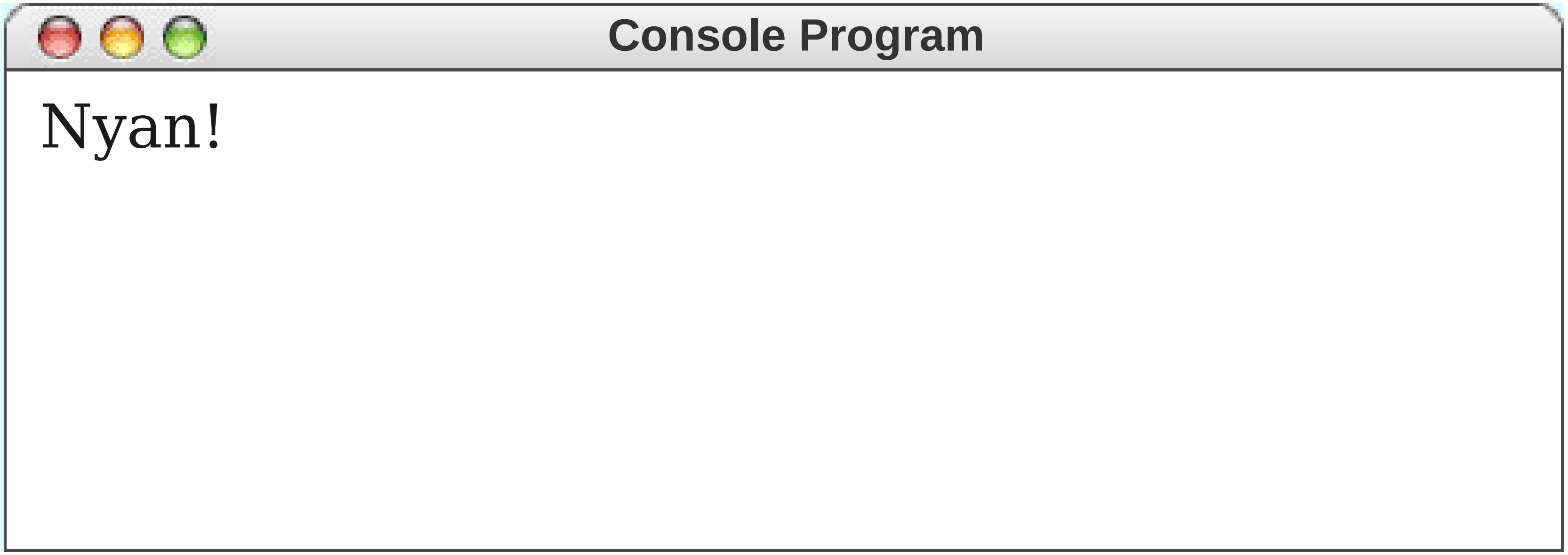
0



```
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

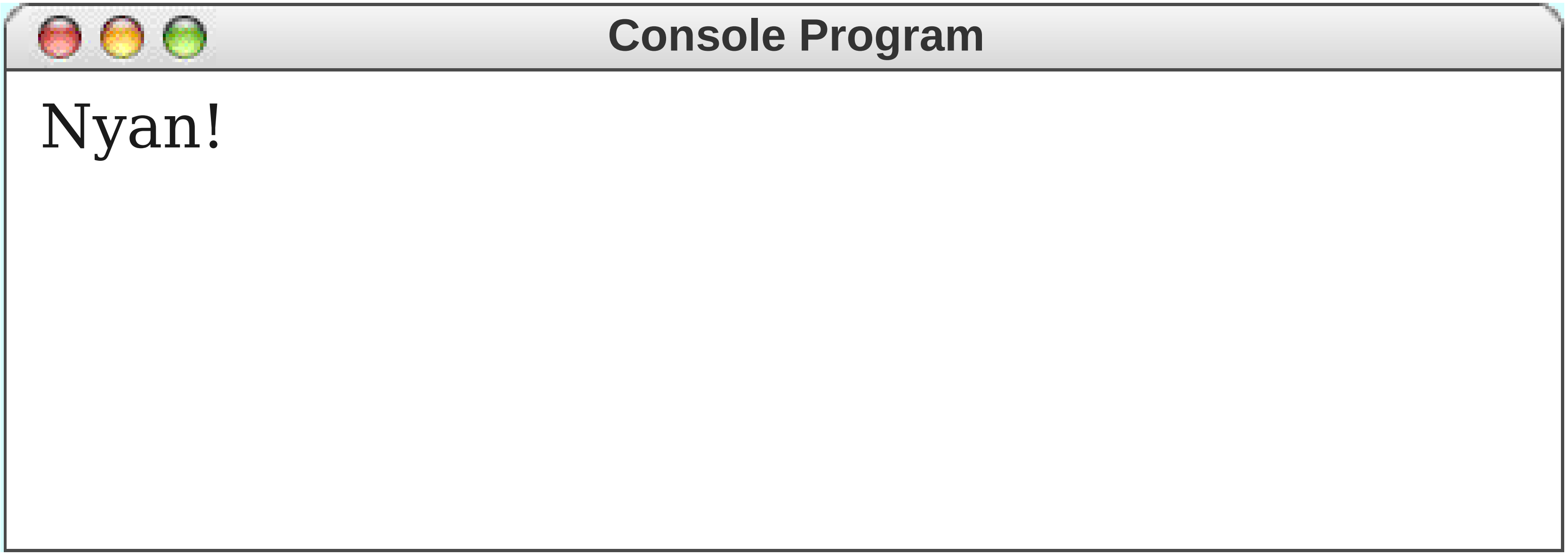
int i 1



```
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

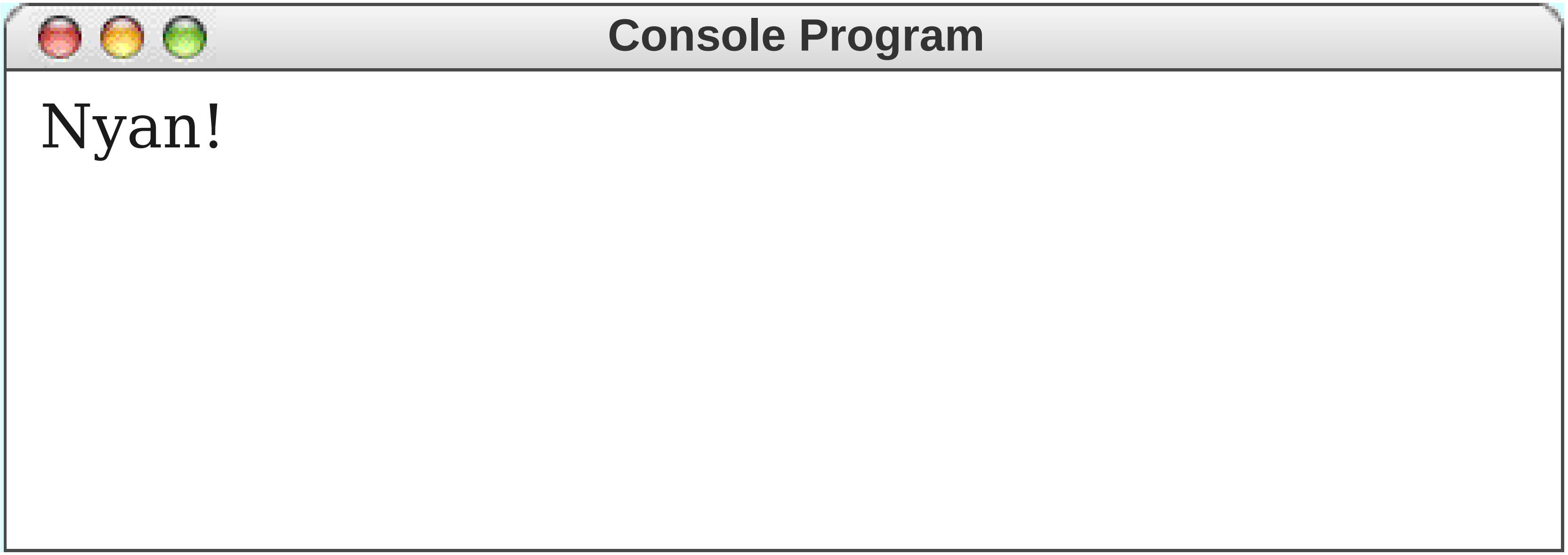
int i 1



```
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

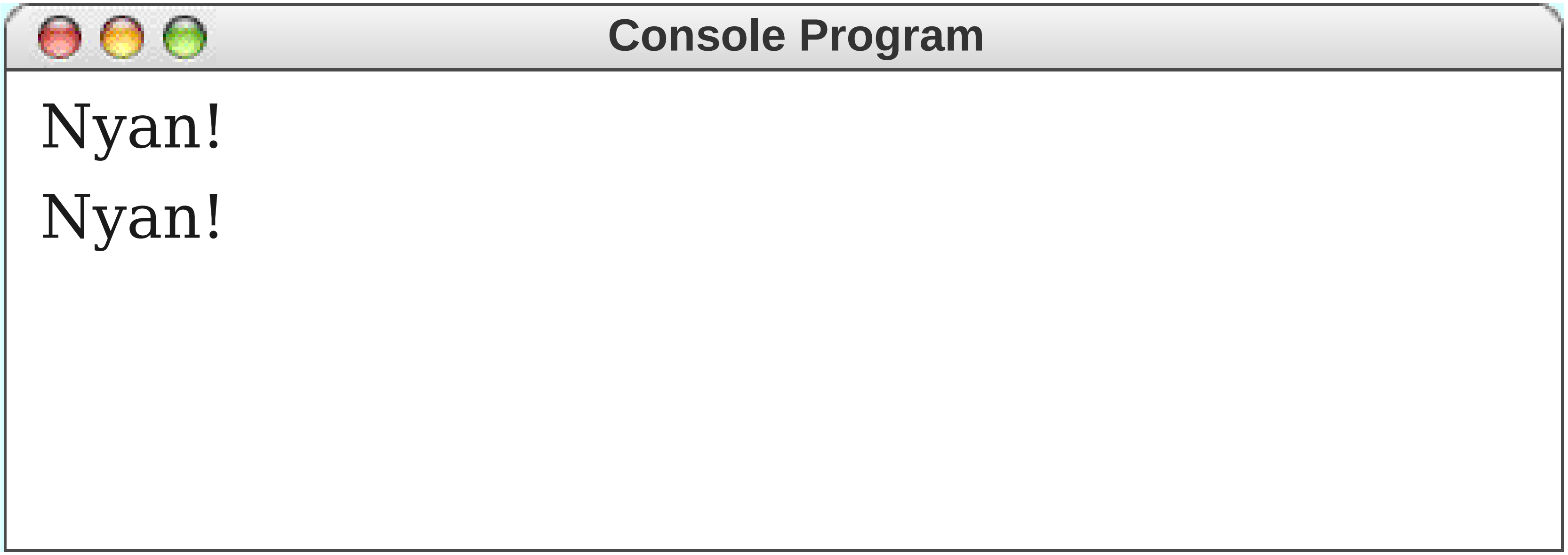
int i 1



```
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

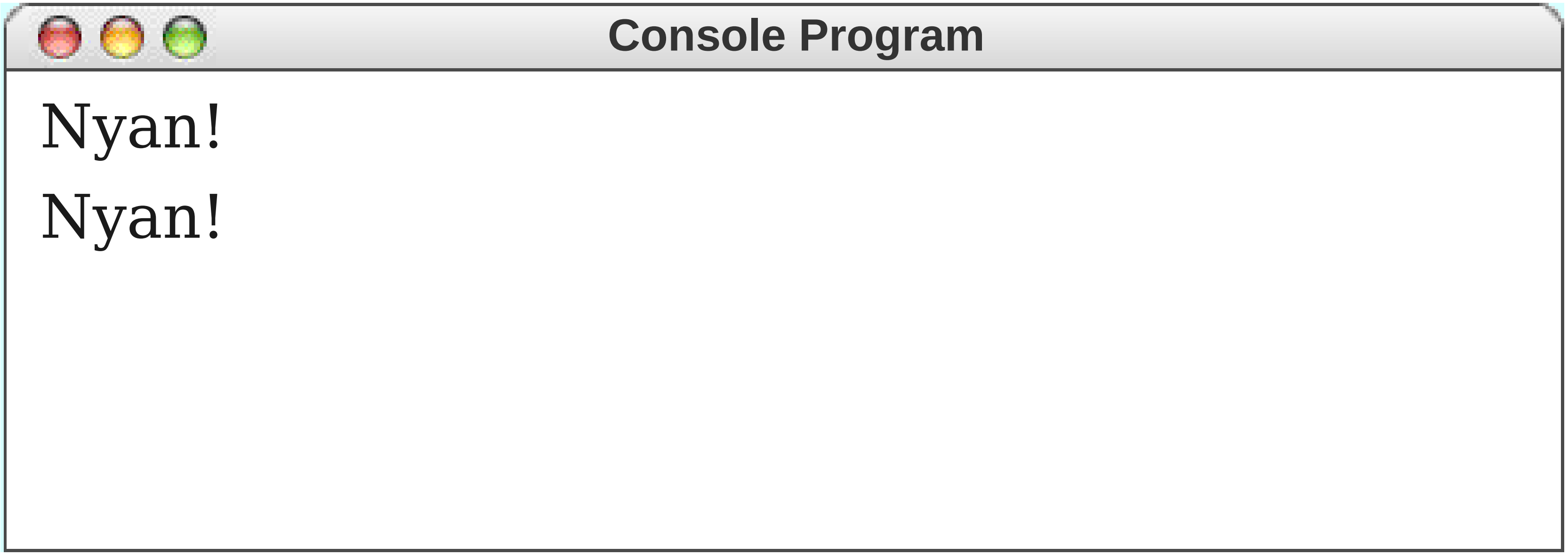
int i 1



```
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

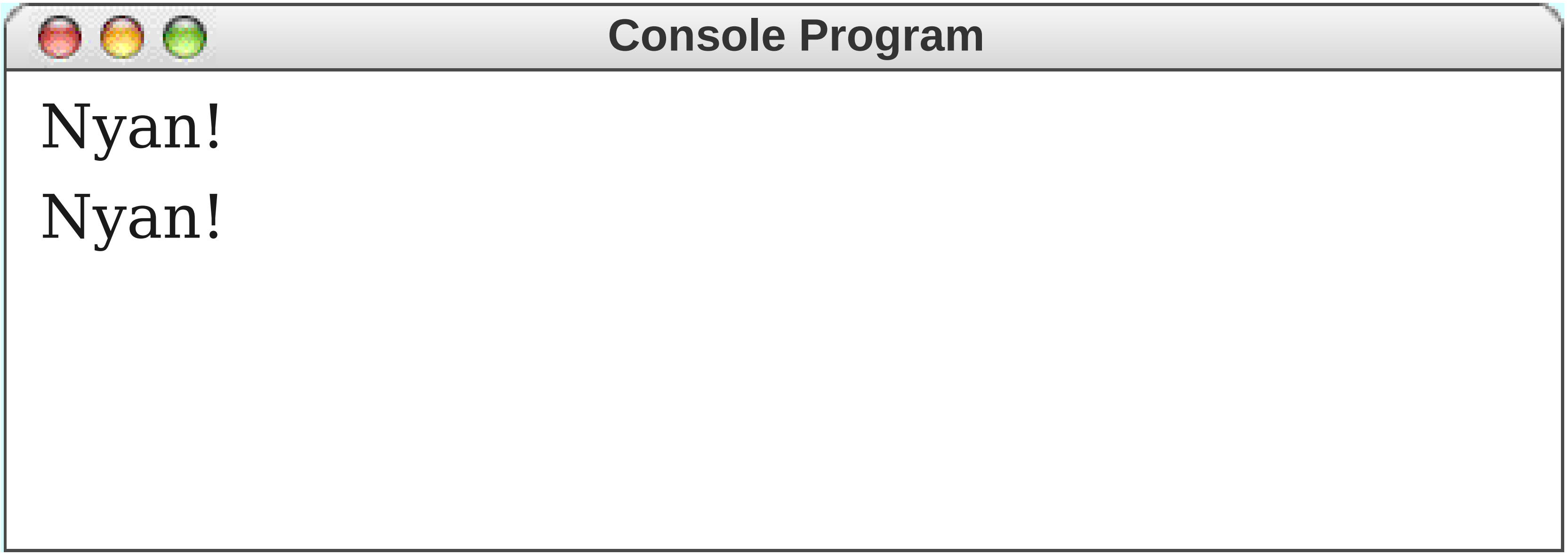
```
int i   1
```



```
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

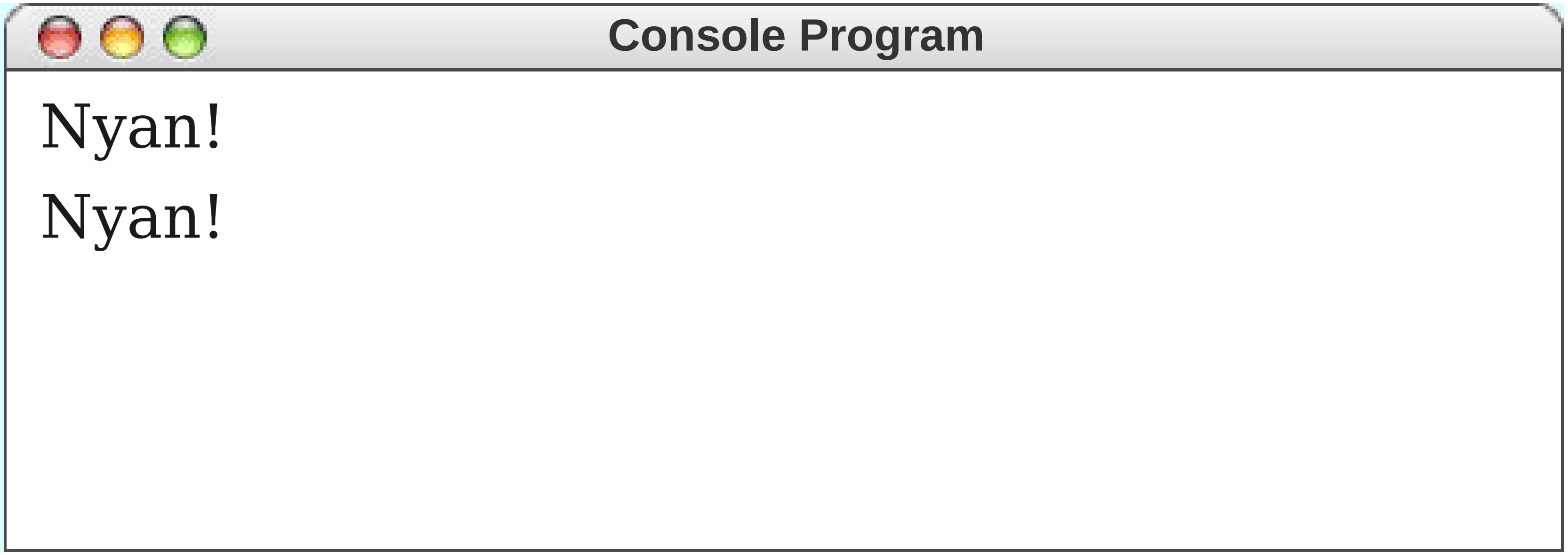
`int i` 2



```
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

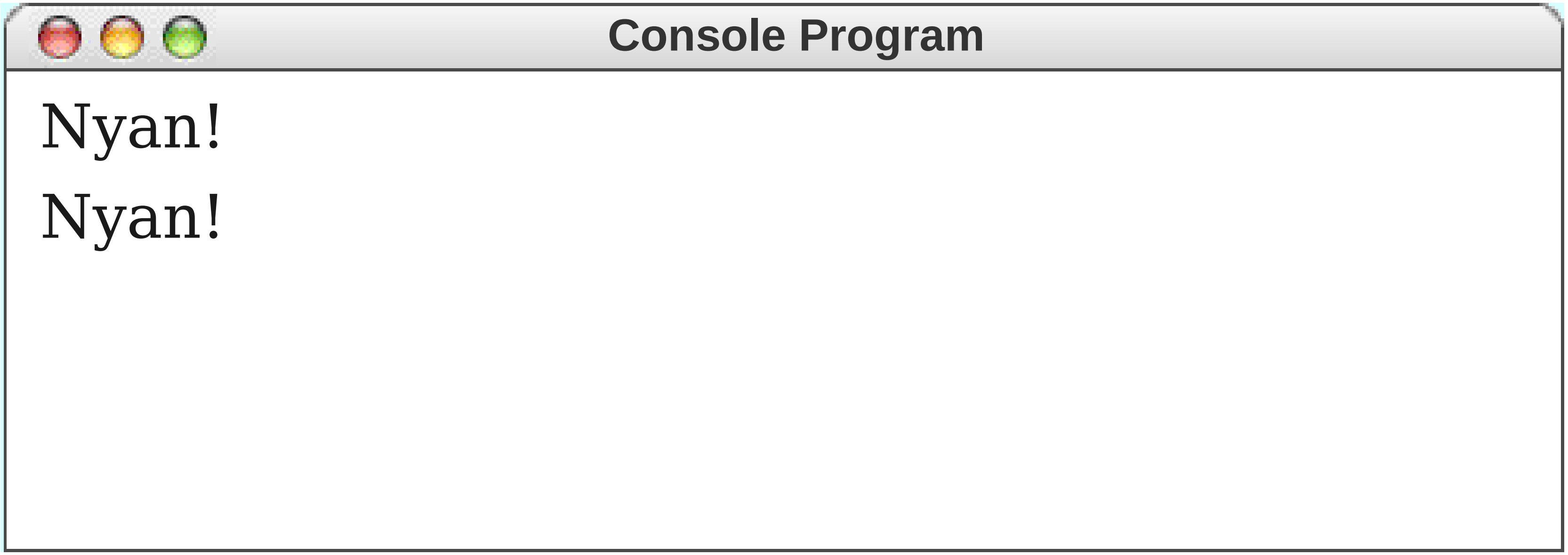
int i 2



```
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

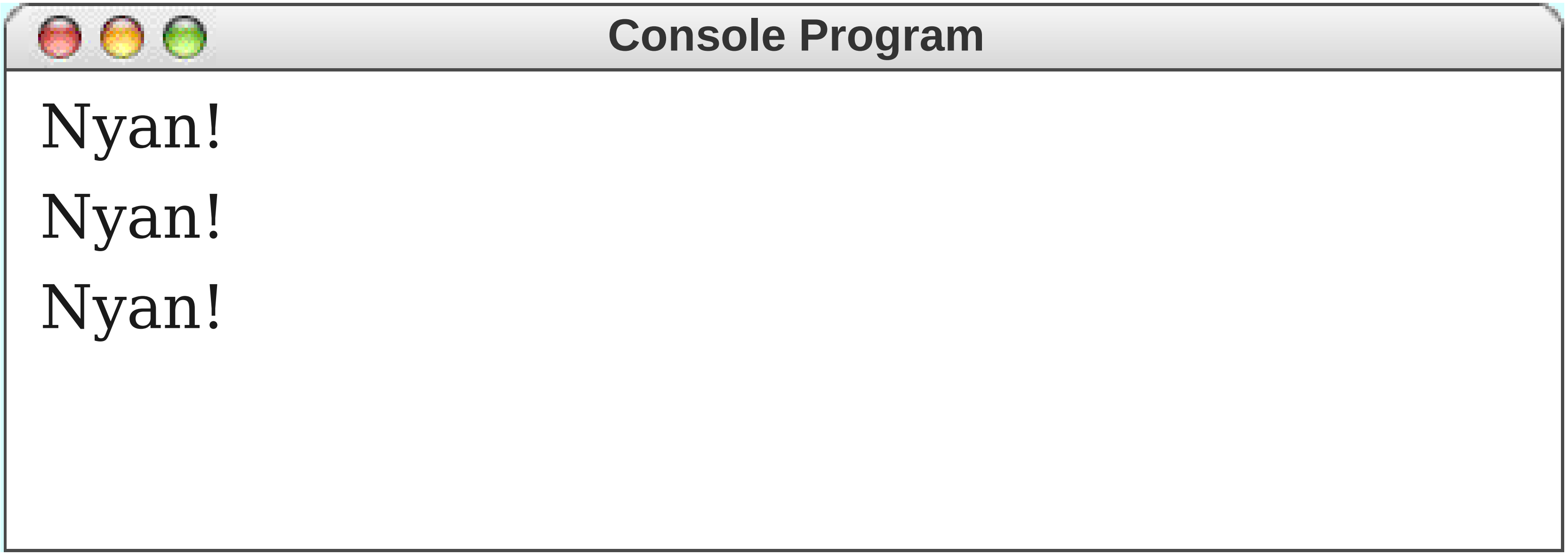
int i 2



```
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
      println("Nyan!");
}
```

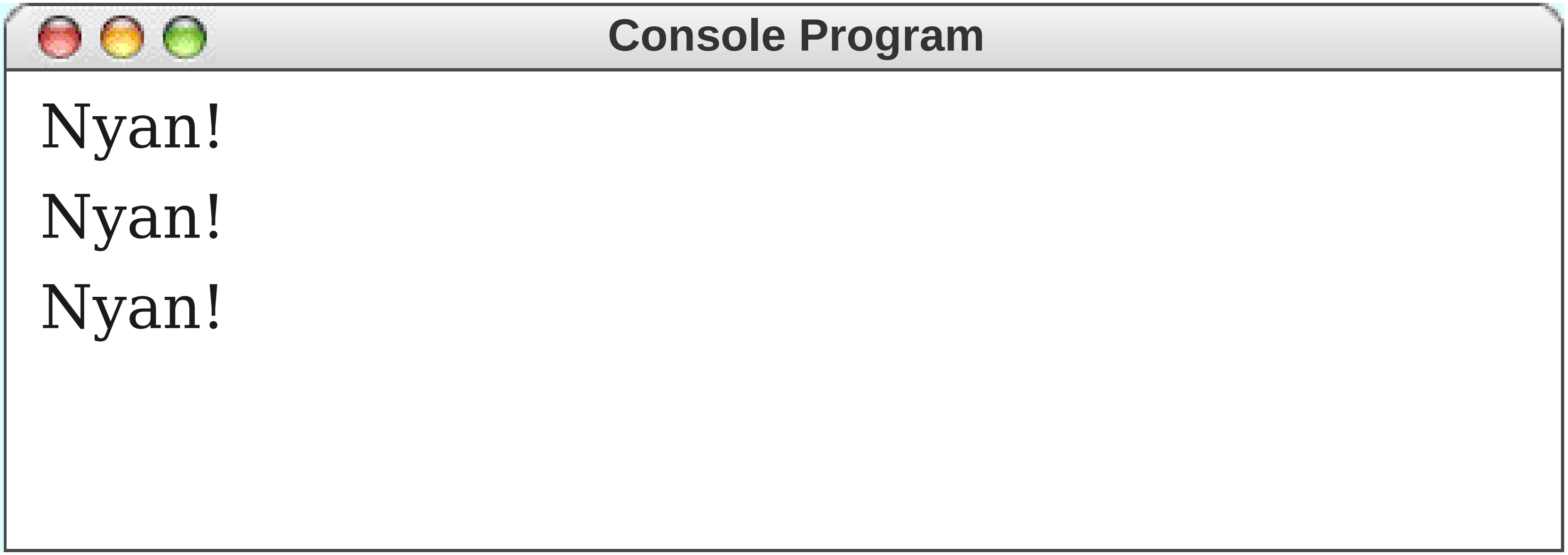
int i 2



```
Nyan!
Nyan!
Nyan!
```

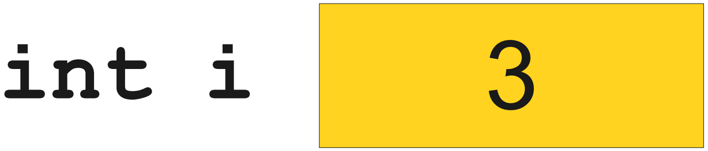
```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

int i 2



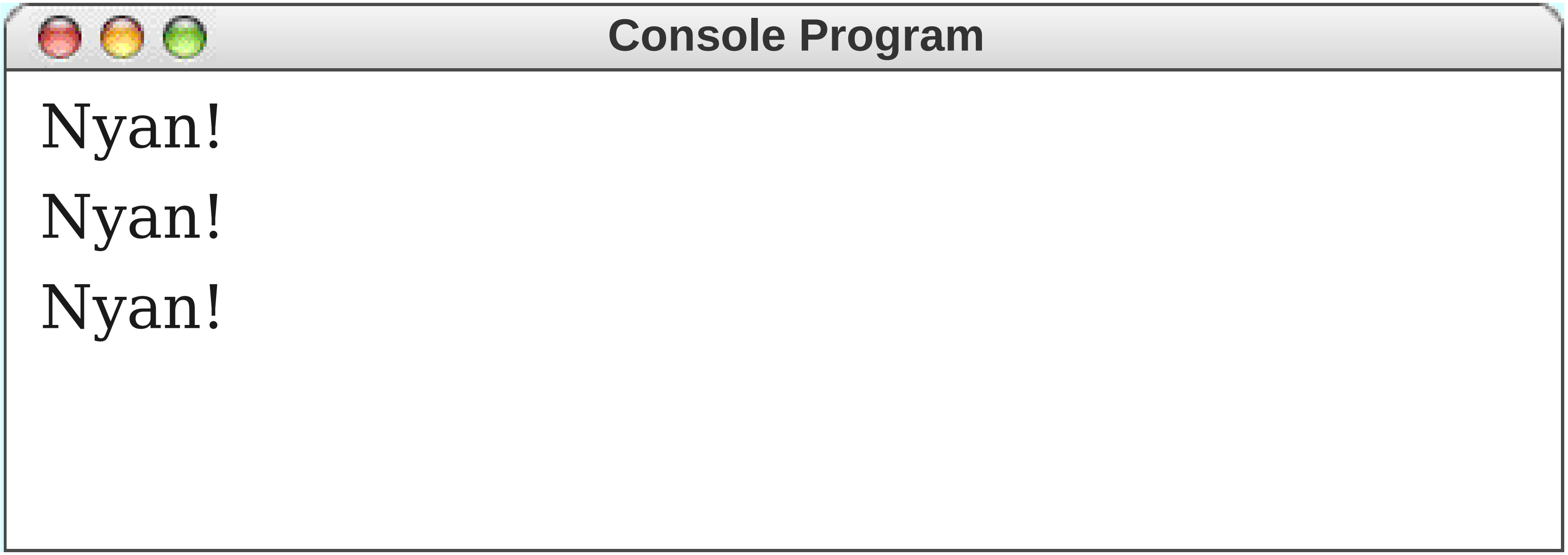
```
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```



int i

3

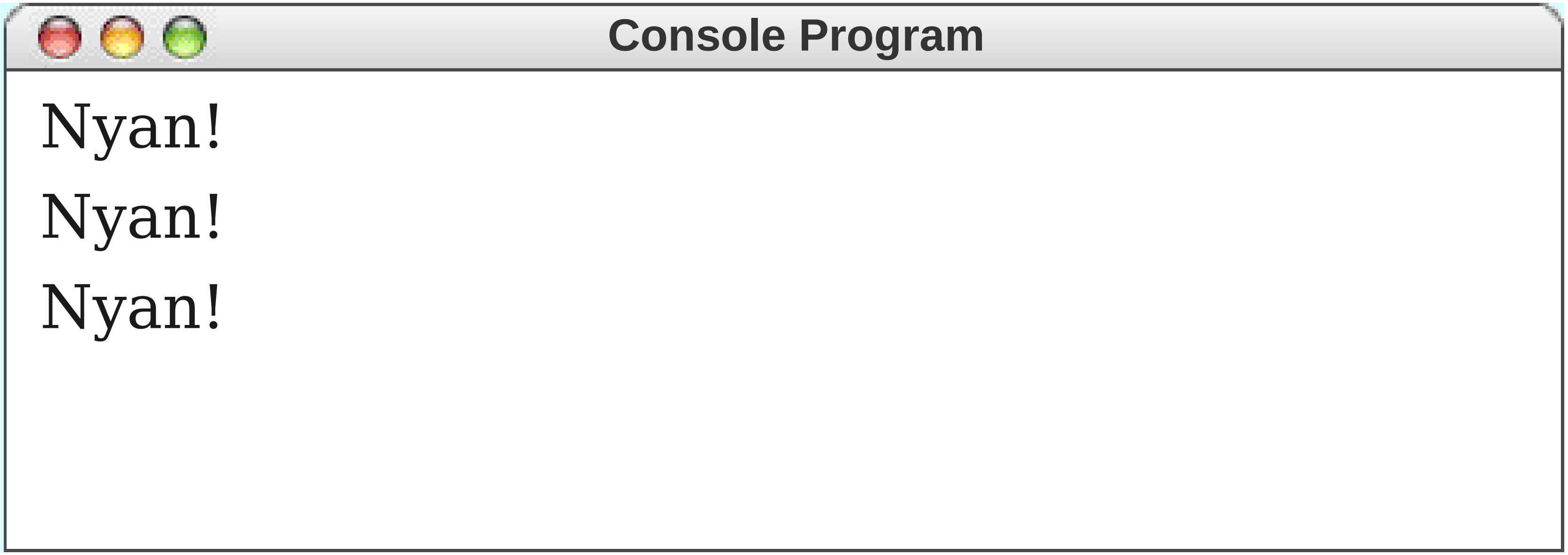


Console Program

```
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

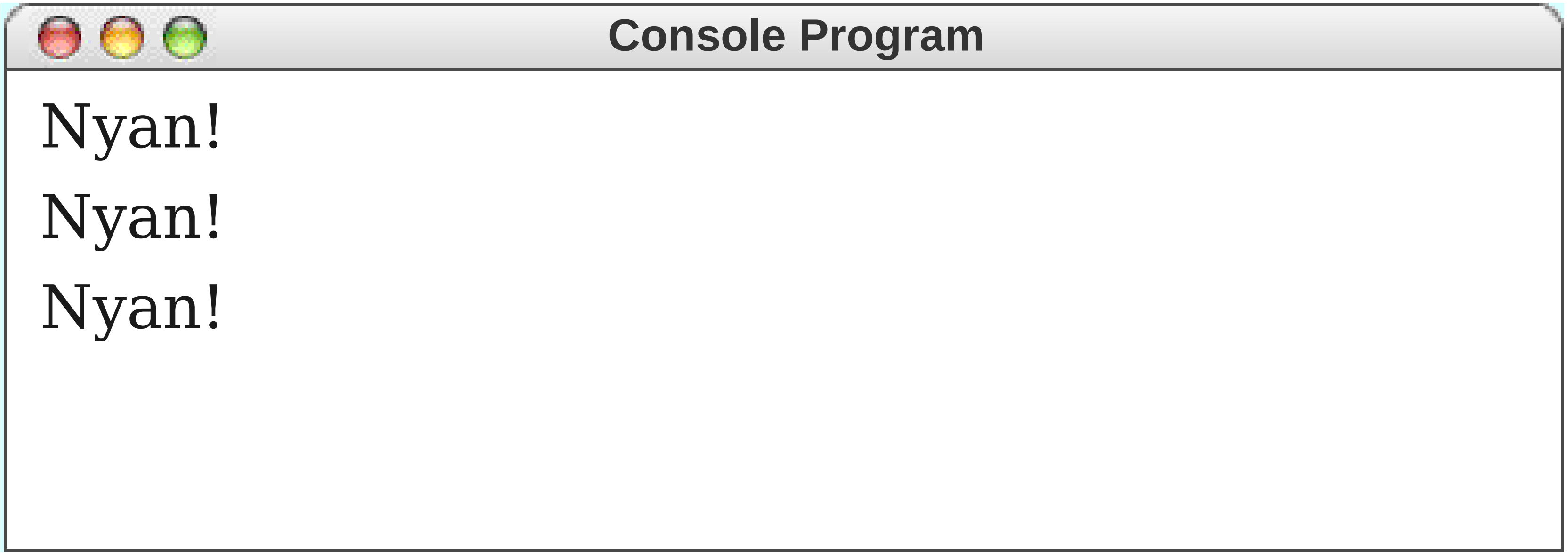
int i 3



```
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

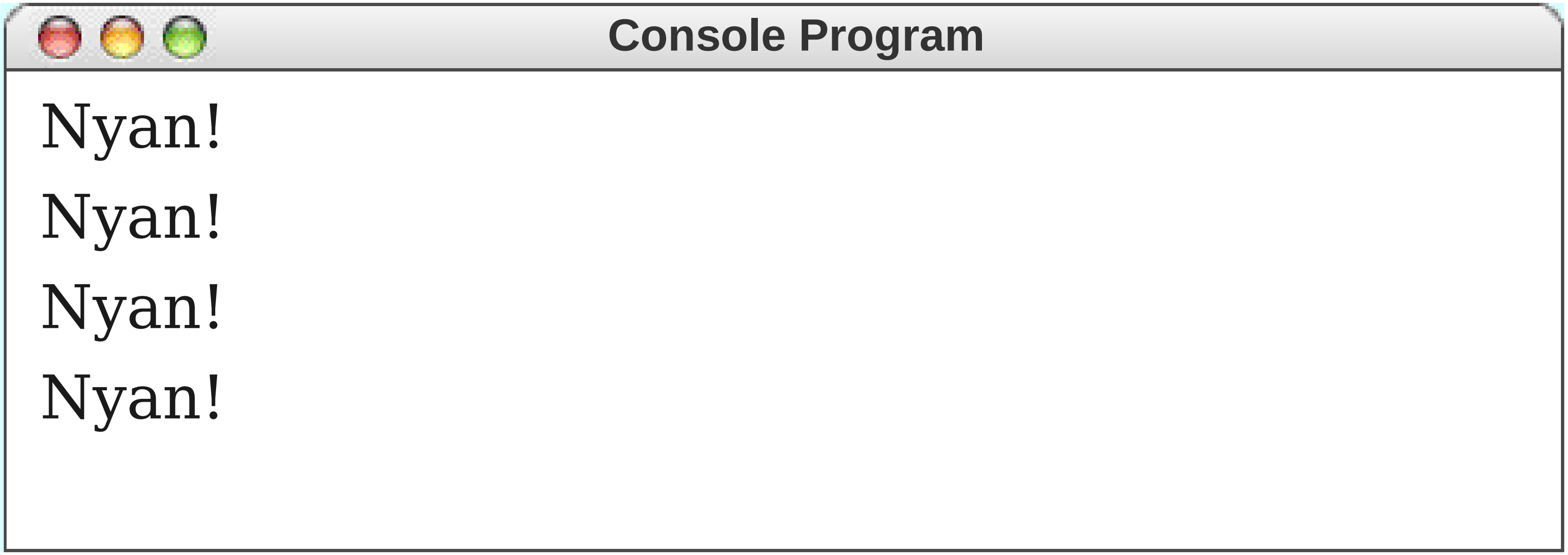
```
int i   3
```



```
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
     println("Nyan!");
}
```

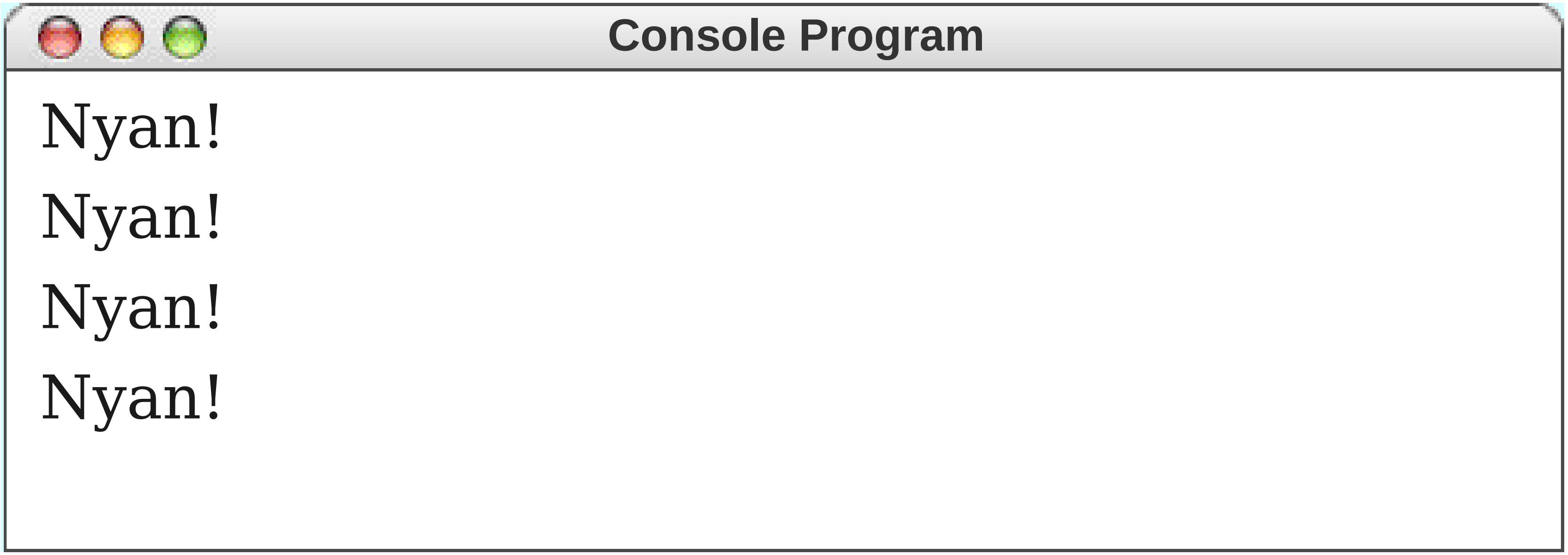
int i 3



```
Nyan!
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

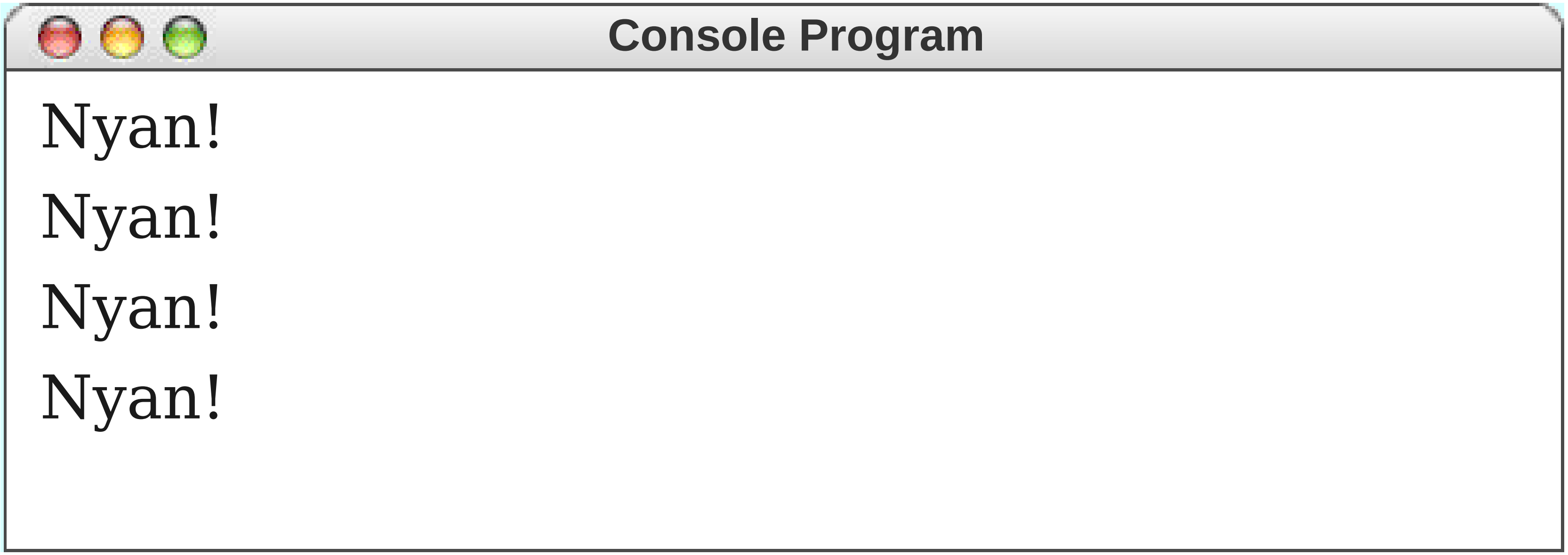
int i 3



```
Nyan!
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

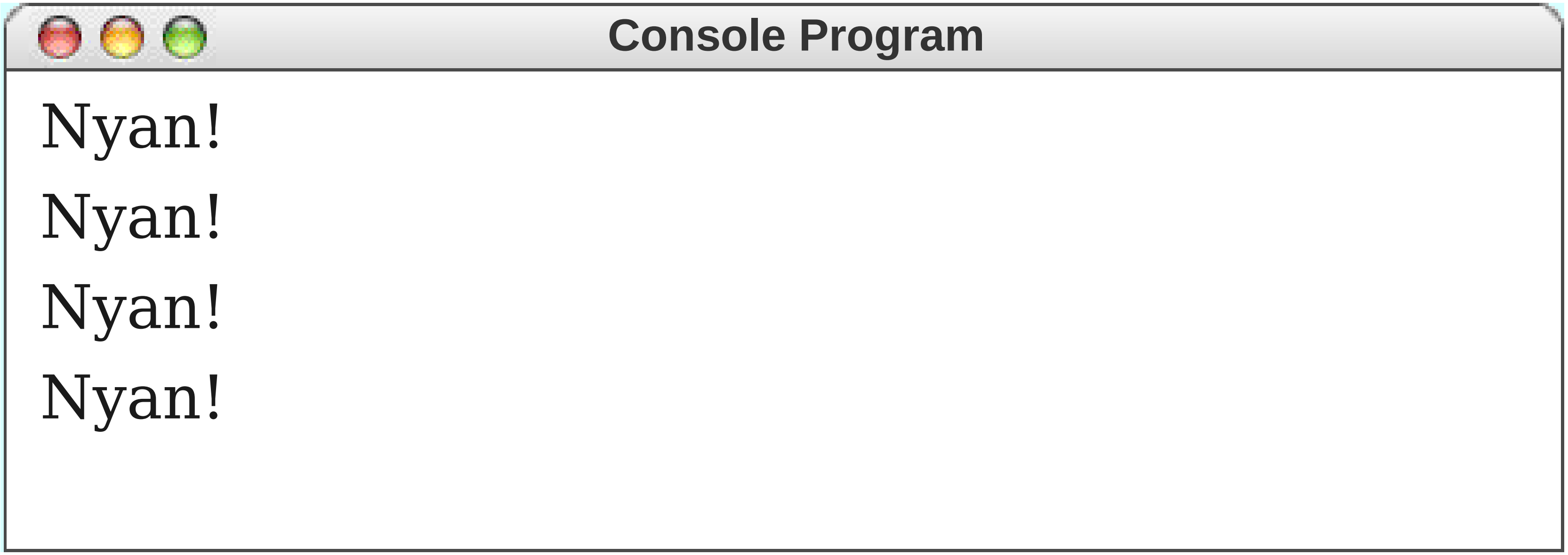
```
int i   4
```



```
Nyan!
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

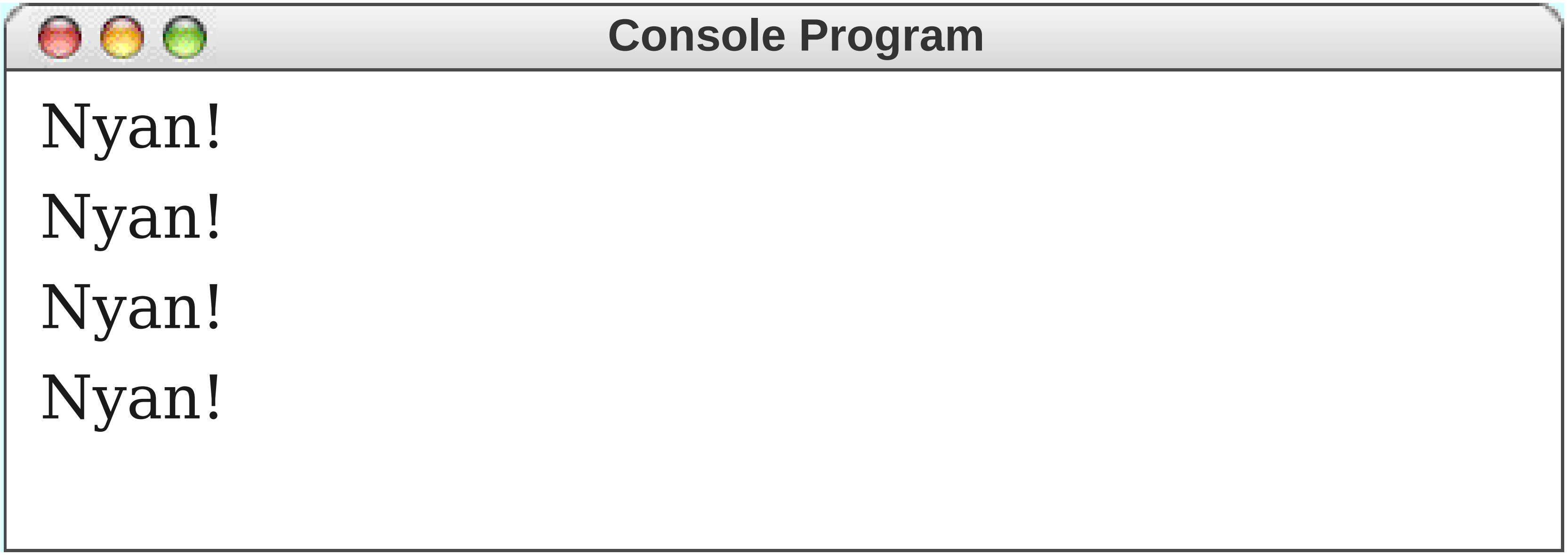
int i 4



```
Nyan!
Nyan!
Nyan!
Nyan!
```

```
for (int i = 0; i < 4; i++) {
    println("Nyan!");
}
```

int i 4



Console Program

```
Nyan!
Nyan!
Nyan!
Nyan!
```