Announcements:

- Project 1 (P1) due Thurs, 9/9, at 11pm
- Pay attention to Academic Integrity
- TAs: See any TA for help, not just your section instructor
- Consulting
  - Matlab consultants at ACCEL Green Rm (Engrg Library 2nd fl. computing facility)
  - 4-10pm Sunday to Thursday (except 9/12, 9/13)
- You need to attend the section in which you are enrolled
- Just added CS1112? Tell your discussion TA to add you in CS1112 CMS (and tell CS1110 to drop your from their CMS).
- Register your clicker with Cornell CIT (see course website)

- **Previous Lecture (and lab):**
  - Variables & assignment
  - Built-in functions
  - Input & output
  - Good programming style (meaningful variable names; use comments)

- **Today's Lecture:**
  - Branching (conditional statements)

Quick review

- ## Variable
  - A named memory space to store a value

- ## Assignment operator: =
  - Let x be a variable that has a value. To give variable y the same value as x, which statement below should you write?

    x = y   or   y = x

- ## Script (program)
  - A sequence of statements saved in an m-file
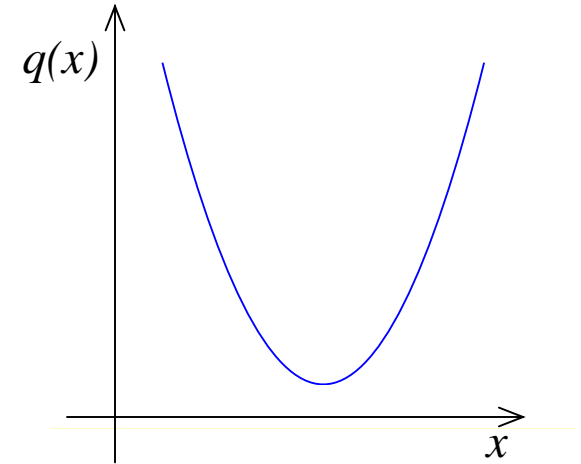
- ## ; (semi-colon)
  - Suppresses printing of the result of assignment statement

- So far, all the statements in our scripts are executed in order

- We do not have a way to specify that some statements should be executed only under some condition

- We need a new language construct…

Consider the quadratic function
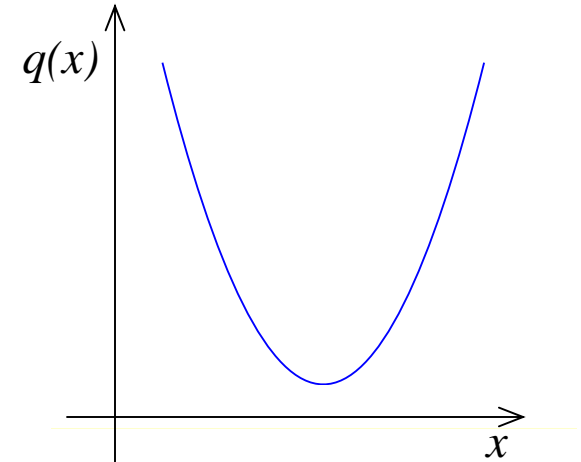
$$q(x) = x^2 + bx + c$$
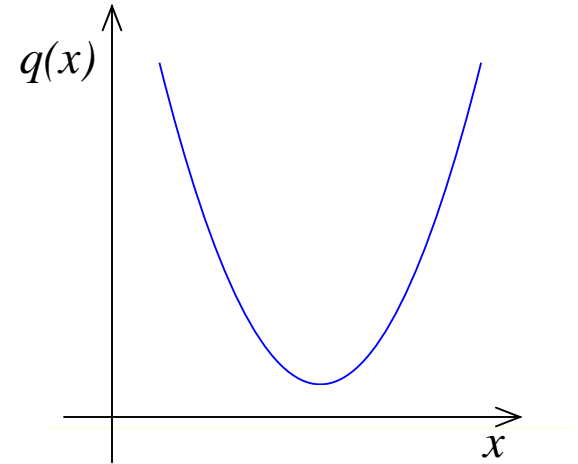
on the interval $[L, R]$:

Consider the quadratic function

$$q(x) = x^2 + bx + c$$
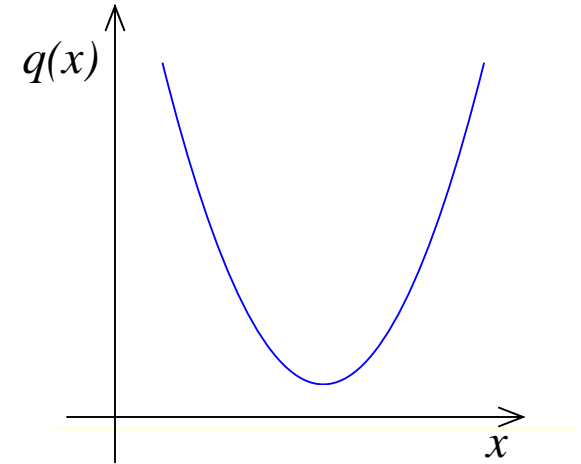
on the interval $[L , R]$:

- Is the function strictly increasing in $[L , R]$?
- Which is smaller, $q(L)$ or $q(R)$?
- What is the minimum value of $q(x)$ in $[L , R]$?

■ What are the critical points?

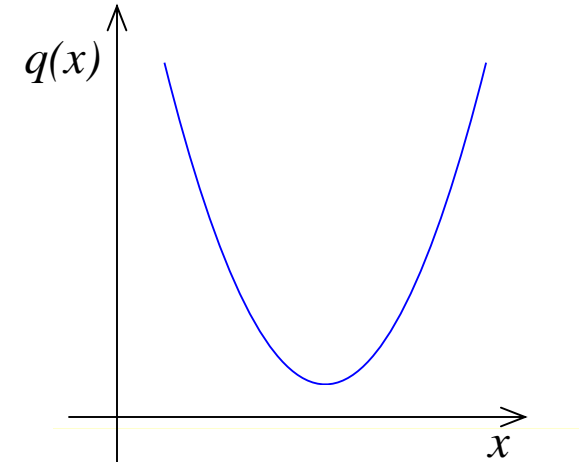- **What are the critical points?**
  - End points: $x = L$, $x = R$
  - $\{\ x\mid q'(x) = 0\ \}$

- **What are the critical points?**
  - End points: $x = L$, $x = R$
  - $\{ \, x \mid q'(x) = 0 \, \}$

$$q(x) = x^2 + bx + c$$

$$q'(x) = 2x + b$$

$$q'(x_c) = 0 \Rightarrow x_c = -\frac{b}{2}$$

Problem 1

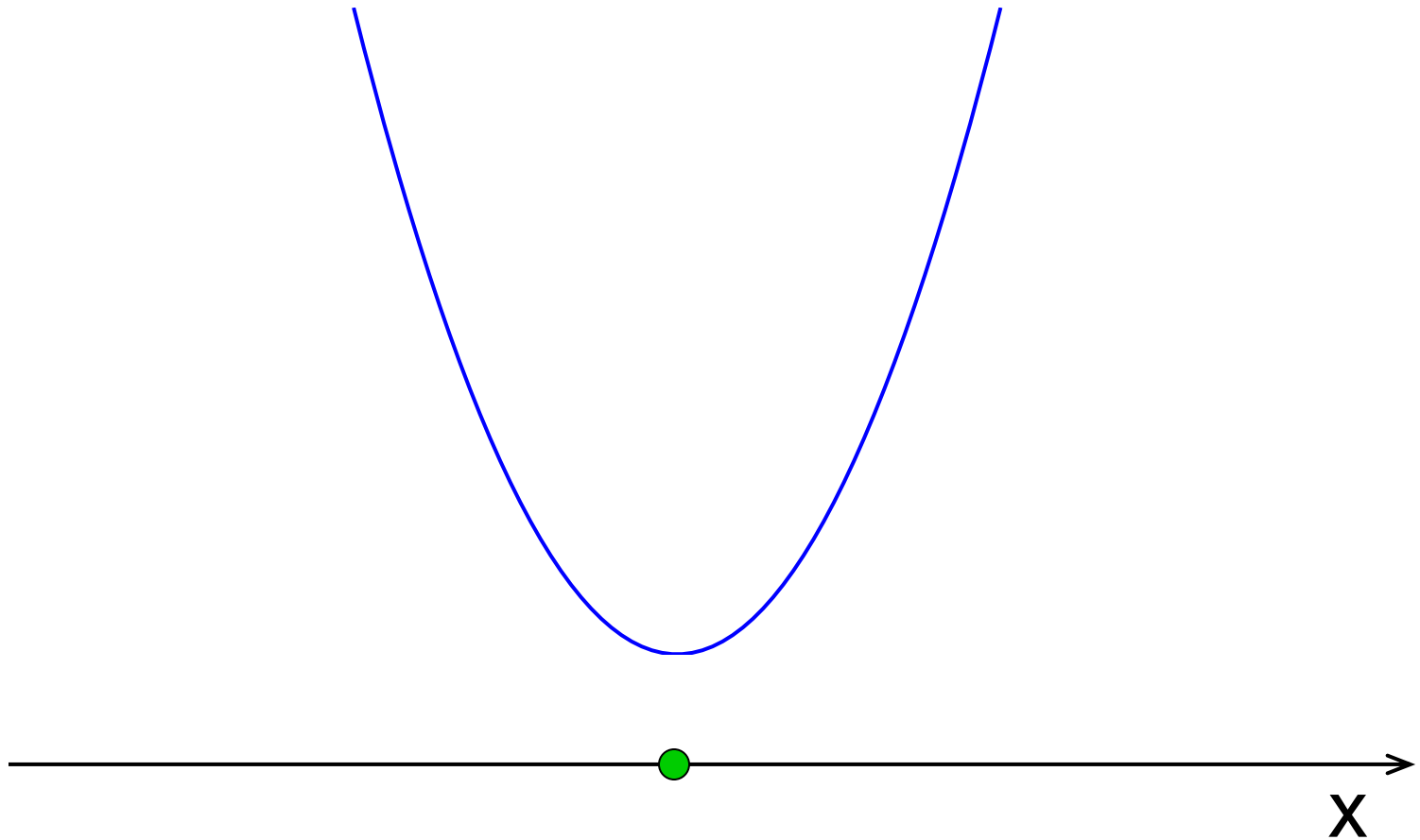Write a code fragment that prints "yes" if q(x) increases across the interval and "no" if it does not.

```
% Quadratic q(x) = x^2 + bx + c
b = input('Enter b: ');
c = input('Enter c: ');
L = input('Enter L: ');
R = input('Enter R: ');
```

```
% Determine whether q increases
% across [L,R]
xc = -b/2;
```

The Situation

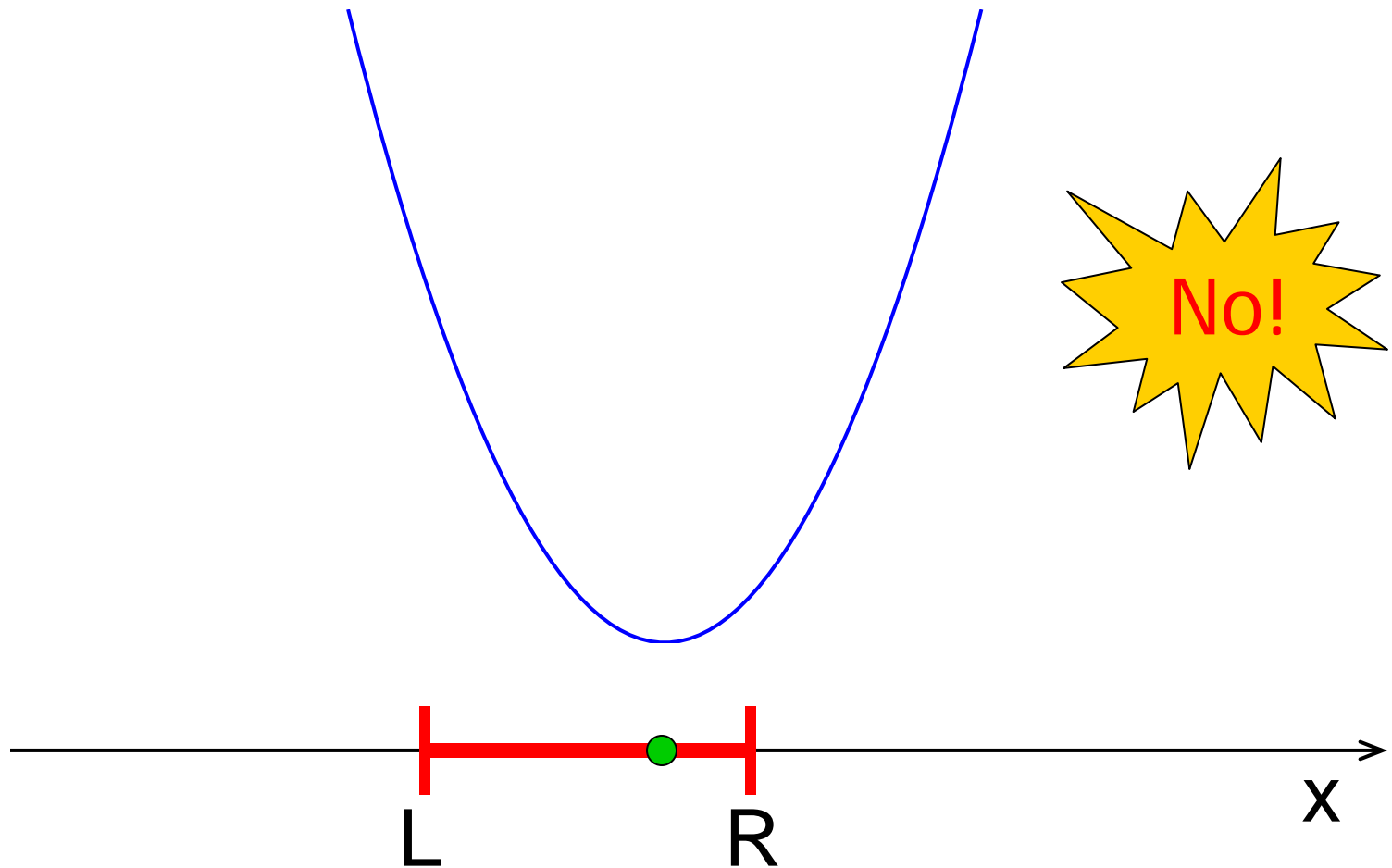$$q(x) = x^2 + bx + c$$

$$\bullet \quad x_c = -b/2$$

X

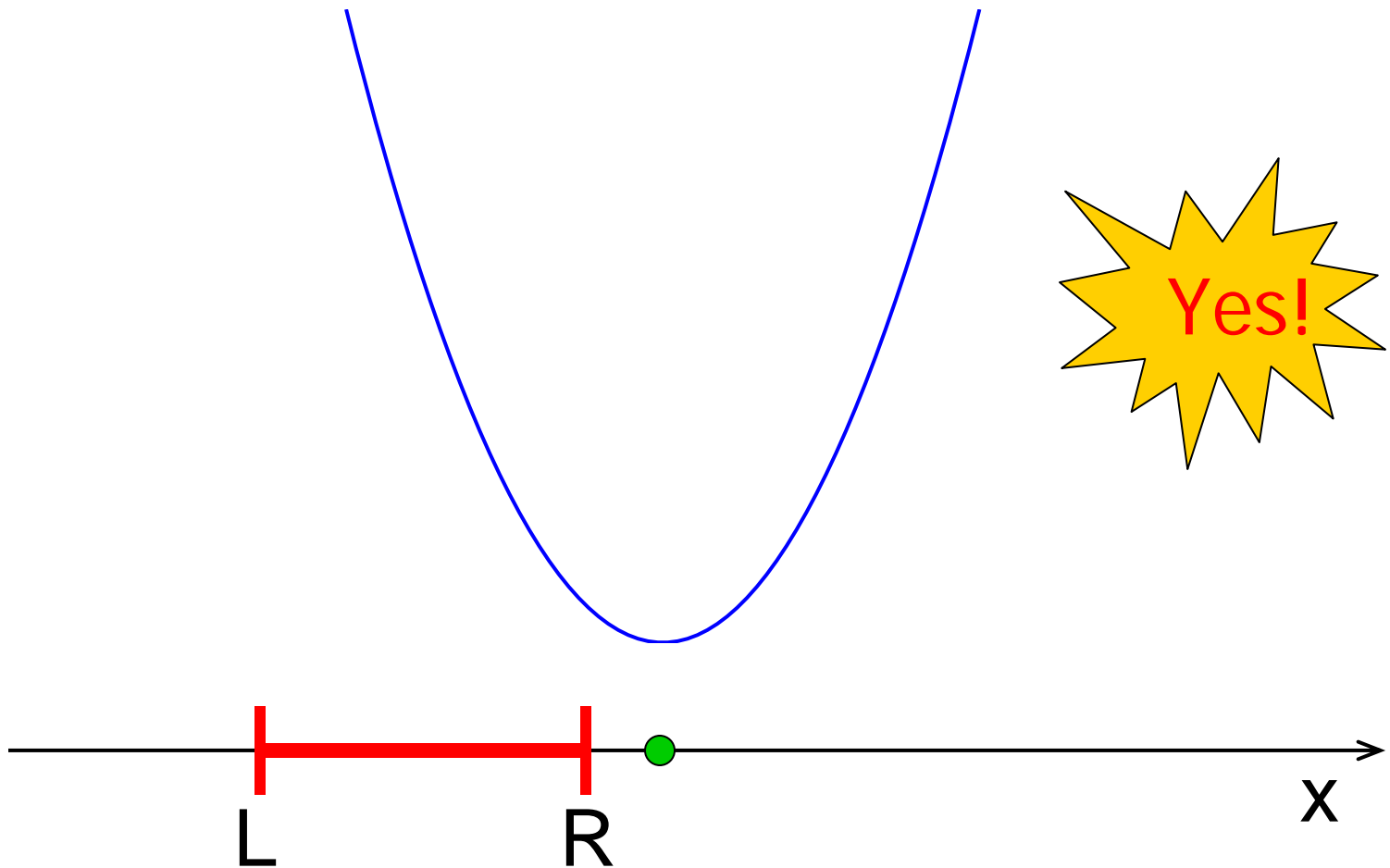# Does q(x) increase across [L,R]?

$$q(x) = x^2 + bx + c$$

$\bullet \; x_c = -b/2$

No!

L   R

X

Does q(x) increase across [L,R]?

$$q(x) = x^2 + bx + c$$

● $x_c = -b/2$

Yes!

L   R

X

So what is the requirement?

```
% Determine whether q increases
% across [L,R]
xc = -b/2;


if _____

    fprintf('Yes\n')
else
    fprintf('No\n')
end
```

Relational Operators

`<`	Less than
`>`	Greater than
`<=`	Less than or equal to
`>=`	Greater than or equal to
`==`	Equal to
`~=`	Not equal to

So what is the requirement?

```
% Determine whether q increases
% across [L,R]
xc = -b/2;


if xc <= L

    fprintf('Yes\n')
else
    fprintf('No\n')
end
```

So what is the requirement?

```
% Determine whether q increases
% across [L,R]
xc = -b/2;

if _____
```
disp('Yes')

fprintf('Yes\n')
```
else
    disp('No')
end
```
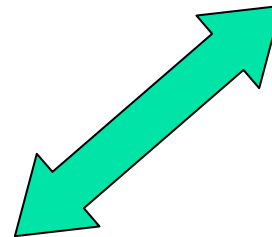
Consider the quadratic function

$$q(x) = x^2 + bx + c$$

on the interval $[L, R]$:

- Is the function strictly increasing in $[L, R]$?
- Which is smaller, $q(L)$ or $q(R)$?
- What is the minimum value of $q(x)$ in $[L, R]$?

Problem 2

Write a code fragment that prints
"qleft is smaller"
if q(L) is smaller than q(R).
If q(R) is smaller print
"qright is smaller."

Algorithm v0

Calculate q(L)

Calculate q(R)

If q(L) < q(R)

      print "qleft is smaller"

Otherwise

      print "qright is smaller"

Algorithm v0.1

Calculate x_c

If distance $\overline{x_c L}$ is smaller than distance $\overline{x_c R}$

    print "qleft is smaller"

Otherwise

    print "qright is smaller"

Do these two fragments do the same thing?

```
% given x, y
if  x>y
    disp('alpha')
else
    disp('beta')
end
```

```
% given x, y
if  y>x
    disp('beta')
else
    disp('alpha')
end
```

A: yes   B: no

Algorithm v1

Calculate x_c

If distance $\overline{x_c L}$ is smaller than distance $\overline{x_c R}$

    print "qleft is smaller"

Otherwise

    print "qright is smaller or equals qleft"

Algorithm v2

Calculate x_c

If distance $\overline{x_cL}$ is same as distance $\overline{x_cR}$

    print "qleft and qright are equal"

Otherwise, if $\overline{x_cL}$ is shorter than $\overline{x_cR}$

    print "qleft is smaller"

Otherwise

    print "qright is smaller"

```
% Which is smaller, q(L) or q(R)?

xc= -b/2;   % x at center
if (abs(xc-L) == abs(xc-R))
    disp('qleft and qright are equal')
elseif (abs(xc-L) < abs(xc-R))
    disp('qleft is smaller')
else
    disp('qright is smaller')
end
```

```matlab
% Which is smaller, q(L) or q(R)?

qL= L*L + b*L + c;   % q(L)
qR= R*R + b*R + c;   % q(R)
if (qL == qR)
    disp('qleft and qright are equal')
elseif (qL < qR)
    disp('qleft is smaller')
else
    disp('qright is smaller')
end
```

```matlab
% Which is smaller, q(L) or q(R)?

qL= L*L + b*L + c;   % q(L)
qR= R*R + b*R + c;   % q(R)
if (qL == qR)
    disp('qleft and qright are equal')
    fprintf('q value is %f\n', qL)
elseif (qL < qR)
    disp('qleft is smaller')
else
    disp('qright is smaller')
end
```

Consider the quadratic function

$$q(x) = x^2 + bx + c$$

on the interval $[L, R]$:

What if you only want to know if $q(L)$ is close to $q(R)$?

```matlab
% Is q(L) close to q(R)?

tol= 1e-4;  % tolerance
qL= L*L + b*L + c
qR= R*R + b*R + c
if (abs(qL-qR) < tol)
  disp('qleft and qright similar')
end
```

Name an important parameter and define it with a comment!

Do these two fragments do the same thing?

% given x, y
if x>y
   disp('alpha')
else
   disp('beta')
end

% given x, y
if x>y
   disp('alpha')
end
if y>=x
   disp('beta')
end

A: yes   B: no

Simple `if` construct

`if`   *boolean expression*

    statements to execute if expression is true

`else`

    statements to execute if expression is false

`end`

Even simpler `if` construct

`if`   *boolean expression*

   statements to execute if expression is true

`end`

The `if` construct

`if`   *boolean expression1*

   statements to execute if *expression1* *is true*

`elseif` *boolean expression2*

   statements to execute if *expression1* *is false*
   but *expression2* *is true*

   ⋮

`else`

   statements to execute if all previous conditions
   are false

`end`

Can have any number of elseif branches but at most one else branch

Things to know about the `if` construct

- _____ branch of statements is executed

- There can be _____ **elseif** clauses

- There can be _____ **else** clause

- The **else** clause _____ in the construct

- The **else** clause _____ (boolean expression)

Things to know about the `if` construct

- **At most one** branch of statements is executed

- There can be any number of `elseif` clauses

- There can be at most one `else` clause

- The `else` clause must be the last clause in the construct

- The `else` clause does not have a condition (boolean expression)

Consider the quadratic function

$$q(x) = x^2 + bx + c$$

on the interval $[L , R]$:

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