L3. Introduction to Conditionals

Boolean expressions
The If-Else Construct
And, or, not

What We Cannot Do

We cannot make a computation contingent upon other things.

If the value of the arithmetic expression **`Dice1 + Dice2`** is seven, then increase the value of the variable **`GamesWon`** by one.

The If-Else Construct Solves this Problem

We will introduce this language feature by solving problems about the behavior of a given quadratic

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

on a given interval L <= x <= R.

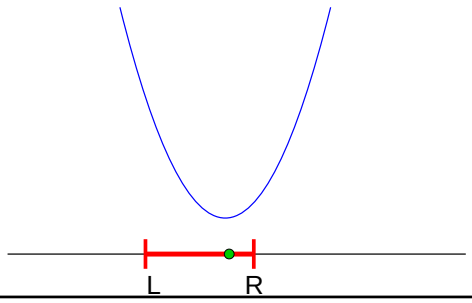
Assume Variables **b, c, L, R** are Initialized

E.g.,

```
b = input('Enter b':)
c = input('Enter c':)
L = input('Enter L':)
R = input('Enter R':)
```

The Situation

$q(x) = x^2 + bx + c$ $\quad x_c = -b/2$



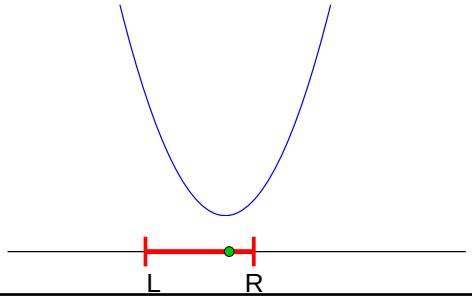
Problem 1

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

No!

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

$x_c = -b/2$

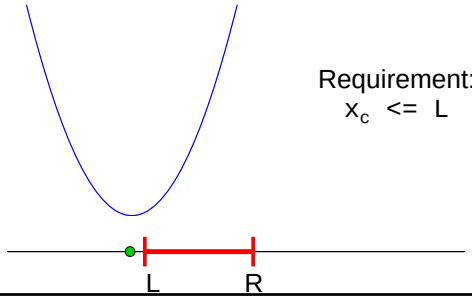


Yes!

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

$x_c = -b/2$

Requirement:
x_c <= L



Solution Fragment

```
xc = -b/2;
if xc <= L
   disp('Yes')
else
   disp('No')
end
```

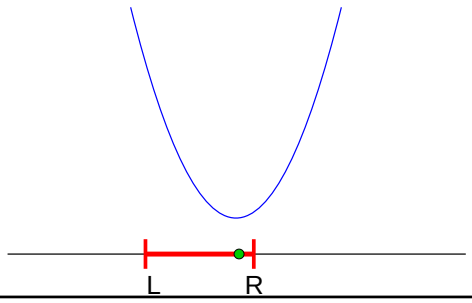
Problem 2

Write a fragment that prints the maximum value that q(x) attains on the interval.

Maximum at L

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

$x_c = -b/2$

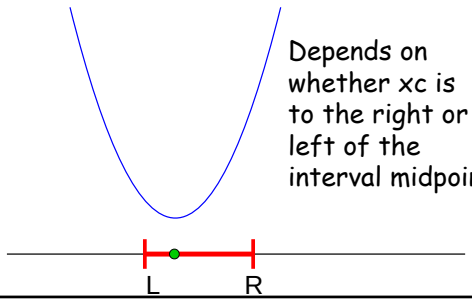


Maximum at R

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

$x_c = -b/2$

Depends on whether xc is to the right or left of the interval midpoint.



Solution Fragment

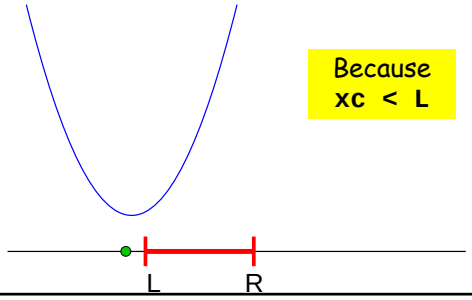
```
xc = -b/2;
Mid = (L+R)/2;
if xc <= Mid
   maxVal = R^2 + b*R + c
else
   maxVal = L^2 + b*L + c
end
```

Problem 3

Write a fragment that prints "yes" if xc is in the interval and "no" if xc is not in the interval.

No!

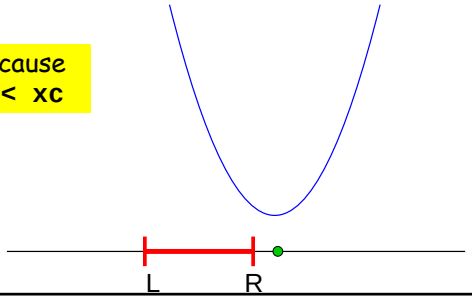
$q(x) = x^2 + bx + c$ $\quad x_c = -b/2$



Because **xc < L**

No!

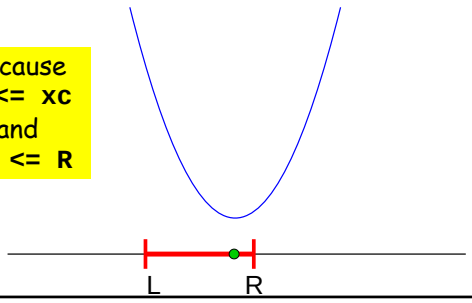
$q(x) = x^2 + bx + c$ $\quad x_c = -b/2$



Because **R < xc**

Yes!

$q(x) = x^2 + bx + c$ $\quad x_c = -b/2$



Because **L <= xc** and **xc <= R**

Solution Fragment

```
xc = -b/2;
if (L <= xc) && (xc <= R)
   disp('Yes')
else
   disp('No')
end
```

Illegal: **L <= xc <= R**

Saying the Opposite

xc is in the interval [L,R] if

`L <= xc` and `xc <= R`

xc is not in the interval [L,R] if

`xc < L` or `R < xc`

Another Solution Fragment

```
xc = -b/2;
if (xc < L) || (R < xc)
   disp('No')
else
   disp('Yes')
end
```

Solution Fragment

```
xc = -b/2;
if (L <= xc) && (xc <= R)
   disp('Yes')
else
   disp('No')
end
```

The `if-else` Construct

```
if  boolean expression
    Commands to execute if the
      expression if TRUE
else
    Commands to execute if the
      expression if FALSE
end
```

Boolean Expressions

`(xc < L) || (R < xc)`

Their value is either true or false.

Made up of comparisons that are either true or false.

Connected by logical operators:
and, or, not

Boolean Expressions

`(xc < L) || (R < xc)`

Their value is either true or false.

Made up of other (simpler) boolean expressions that are connected by boolean operators:
and, or, not

Arithmetic Expressions

```
(x+3)*(y-z)
```

Their value is a number.

Made up of other (simpler) arithmetic expressions that are connected by arithmetic operators:

+ , - , * , /

Relational Operators

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

The And Operator &&

F	F	F
F	T	F
T	F	F
T	T	T

The Or Operator ||

F	F	F
F	T	T
T	F	T
T	T	T

The not Operator ~

F	T
T	F

Question Time

What is the value of **X** and **Y** after the following script is executed:

```
X = 6; Y = 8;
If X < Y
   Y = Y/2;
else
   X = X/2;
end
```

A. X is 3 and Y is 4
B. X is 6 and Y is 8
C. X is 6 and Y is 4
D. X is 3 and Y is 8