- 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)

Announcements:

- Project 1 (P1) due Thurs, 9/6, at 11pm
- Pay attention to Academic Integrity
- You can see any TA for help, not just your discussion TA
- Consulting
  - Matlab consultants at ACCEL Green Rm (Carpenter Hall 2nd fl. computing facility)
  - 5-10pm Sunday to Thursday
- Just added CS1112? Tell your discussion TA to add you in CS1112 CMS (and tell CS1110 to drop your from their CMS)
- Piazza – "Q & A system" for all students in CS1112. Use it for clarification only—do not ask (answer) homework questions and do not give hints on homework. Will be monitored by TAs. Available tomorrow.

Quick review

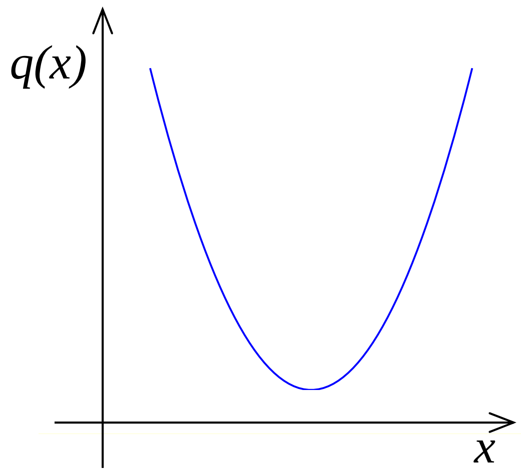
- Variable
  - A named memory space to store a value
- Assignment operator: =
  - Let x be a variable that has a value. To give variable y the same value as x, which statement below should you write?

    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

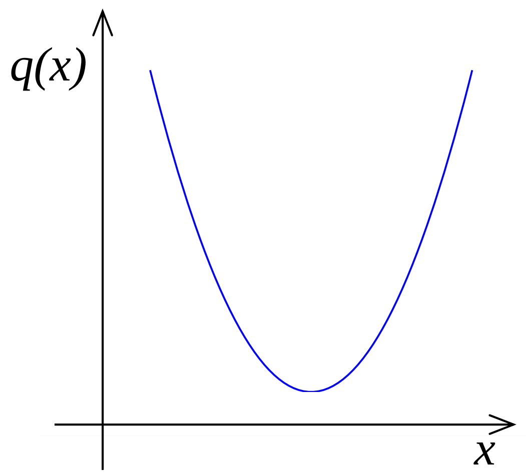
$$q(x) = x^2 + bx + c$$



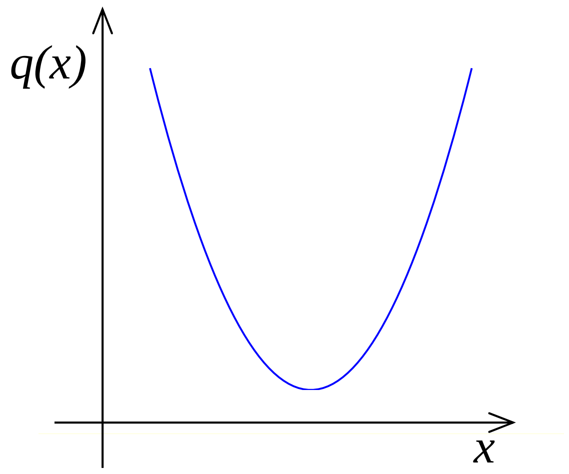
on the interval $[L\ ,\ R]$:

- 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 $[L\ ,\ R]$?

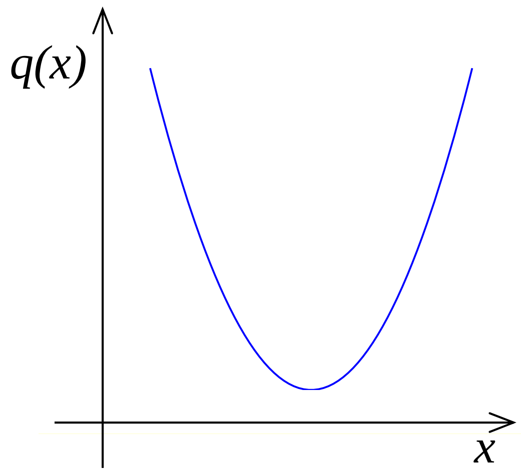
- What are the critical points?



- 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.

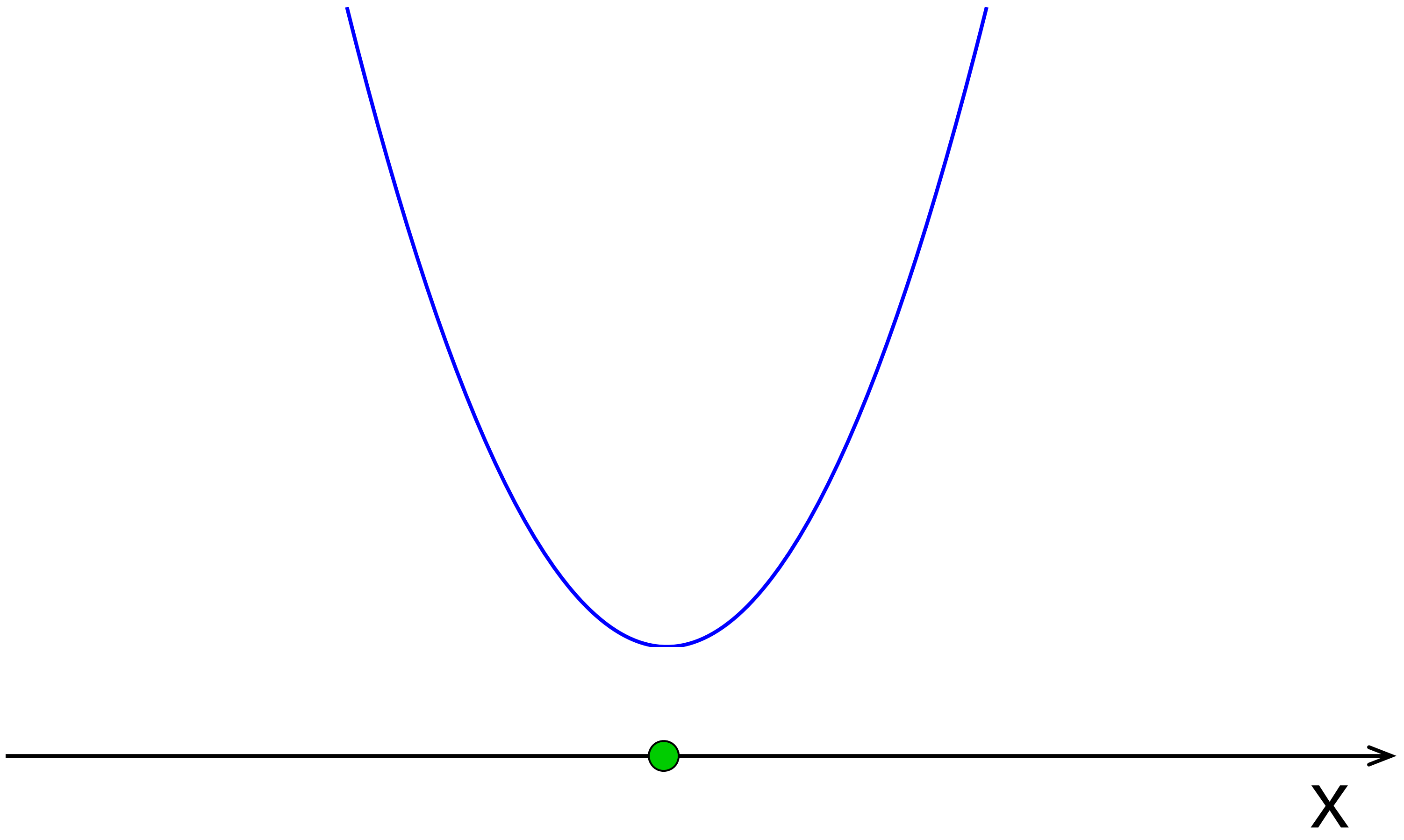
```
% Quadratic q(x) = x^2 + bx + c
b = input('Enter b: ');
c = input('Enter c: ');
L = input('Enter L: ');
R = input('Enter R: ');
```

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

The Situation

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

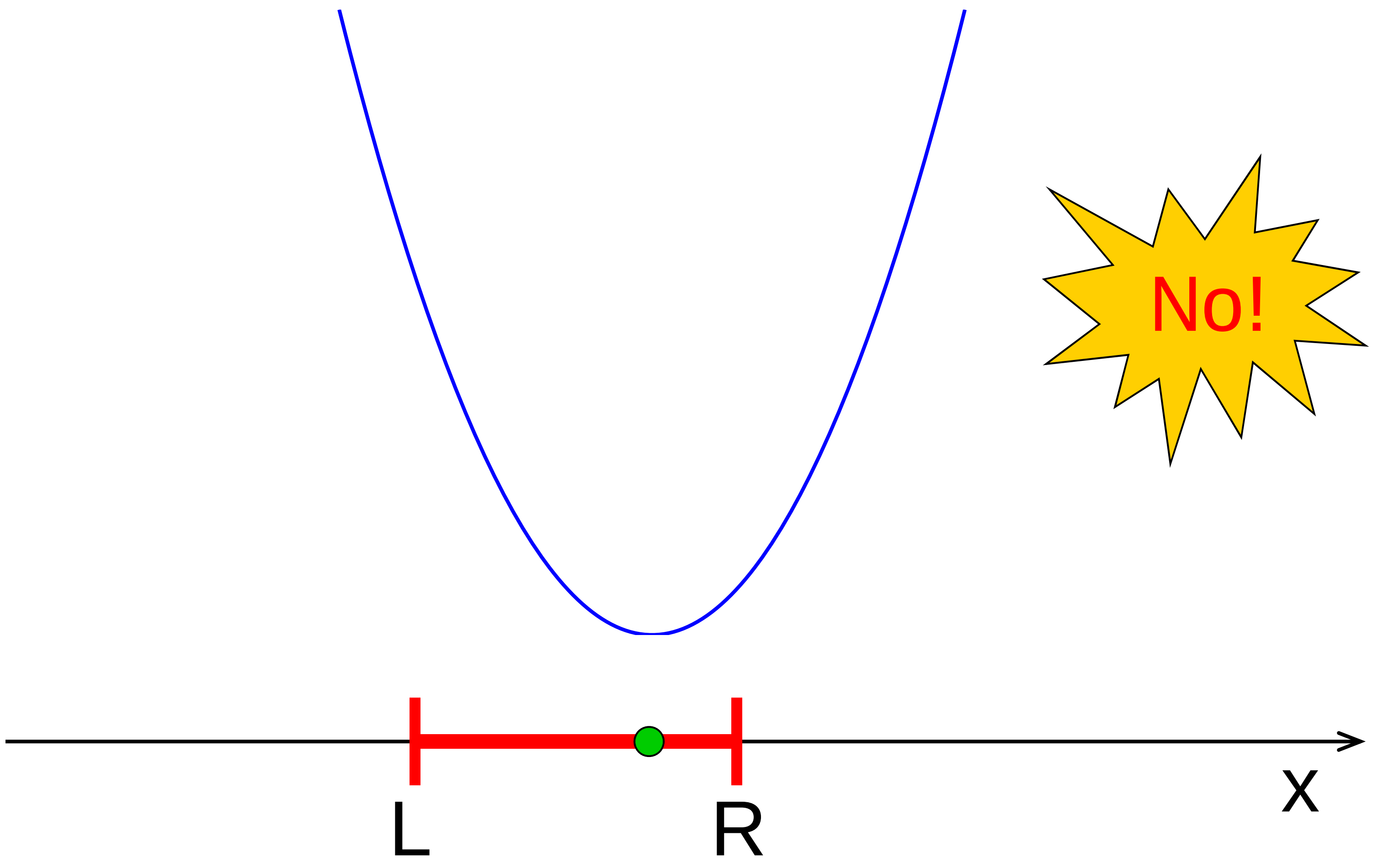
● $x_c = -b/2$



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

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

● $x_c = -b/2$



No!

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
```

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;
                                    disp(‘Yes’)

if  ___________

    fprintf(‘Yes\n’)
else
    disp(‘No’)
end
```

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
```

```
% 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
```

```
% 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 $q(R)$?

```
% 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 $\boxed{\textit{boolean expression1}}$

statements to execute if $\boxed{\textit{expression1}}$ *is true*

elseif $\boxed{\textit{boolean expression2}}$

statements to execute if $\boxed{\textit{expression1}}$ *is false*

but $\boxed{\textit{expression2}}$ *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)

Modified Problem 3

Write a code fragment that prints “yes” if xc is in the interval and “no” if it is not.

So what is the requirement?

```
% Determine whether xc is in
% [L,R]
xc = -b/2;

if _________________

   disp('Yes')
else
   disp('No')
end
```

So what is the requirement?

```
% Determine whether xc is in
% [L,R]
xc = -b/2;

if L<=xc && xc<=R

   disp(‘Yes’)
else
   disp(‘No’)
end
```

The value of a boolean expression is either true or false.

```
(L<=xc) && (xc<=R)
```

This (compound) boolean expression is made up of two (simple) boolean expressions. Each has a value that is either *true* or *false*.

Connect boolean expressions by boolean operators:

and	or	not
`&&`	`||`	`~`