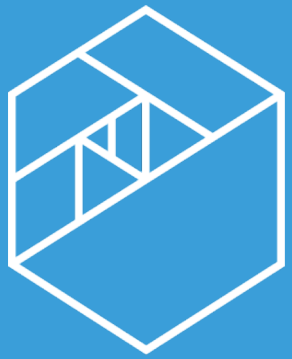


Lesson 6:

Maximum and Minimum

Introduction

METIS

Lecture Overview:

Goals of the lecture:

1. Find the maximum and minimum of a function

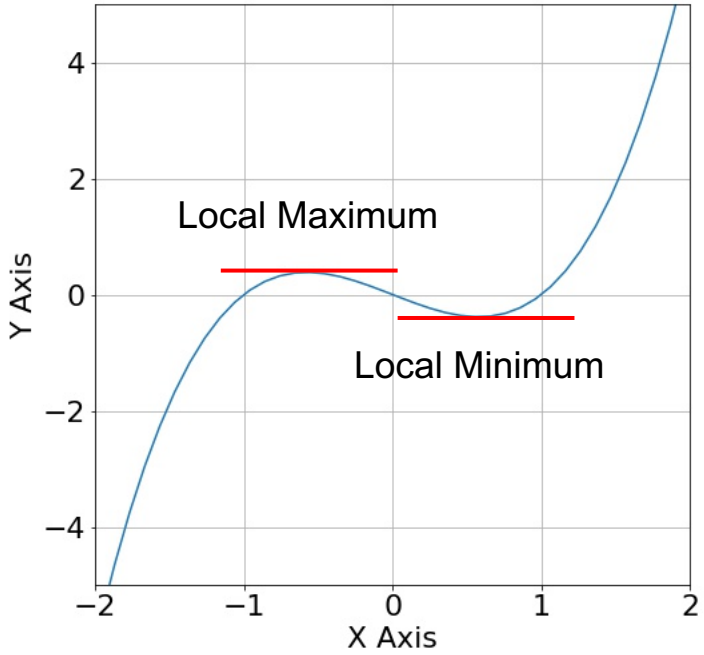
Maximum and Minimum

METIS

Finding Maximum and Minimum

$$f(x) = x^3 - x$$

For which values of x do we have a maximum and/or minimum?

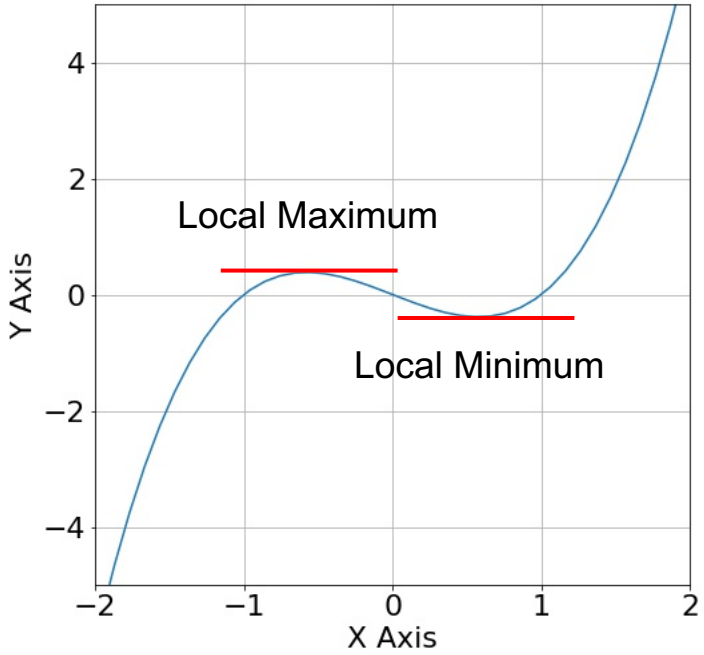


Finding Maximum and Minimum

$$f(x) = x^3 - x$$

For which values of x do we have a maximum and/or minimum?

$$f'(x) = 3x^2 - 1 = 0$$



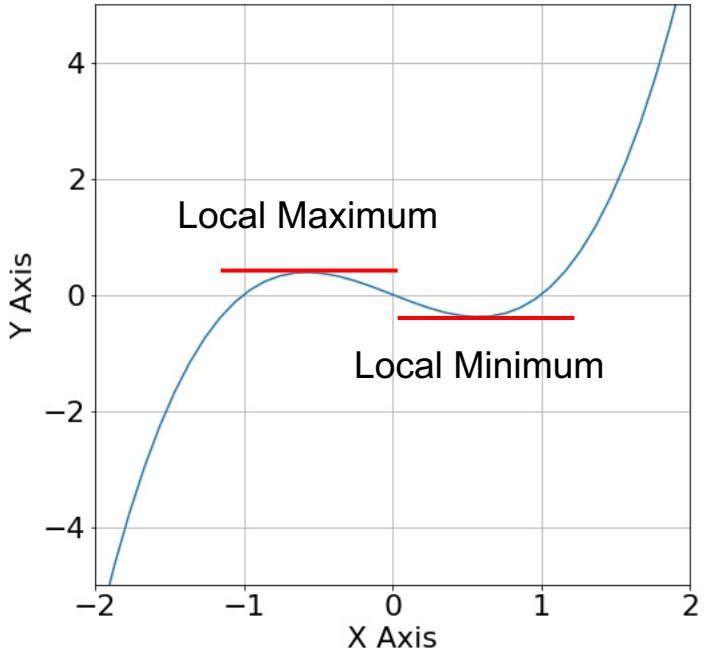
Finding Maximum and Minimum

$$f(x) = x^3 - x$$

For which values of x do we have a maximum and/or minimum?

$$f'(x) = 3x^2 - 1 = 0$$

$$3x^2 = 1$$



Finding Maximum and Minimum

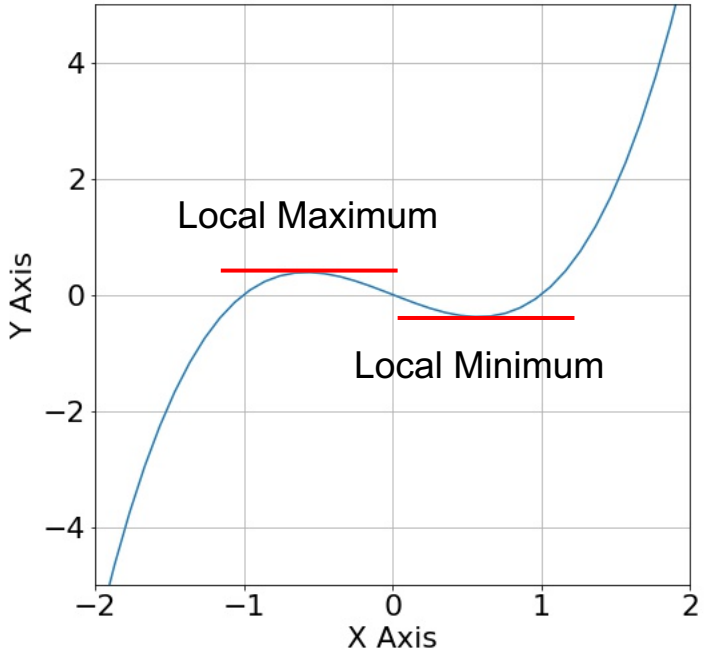
$$f(x) = x^3 - x$$

For which values of x do we have a maximum and/or minimum?

$$f'(x) = 3x^2 - 1 = 0$$

$$3x^2 = 1$$

$$x^2 = \frac{1}{3}$$



Finding Maximum and Minimum

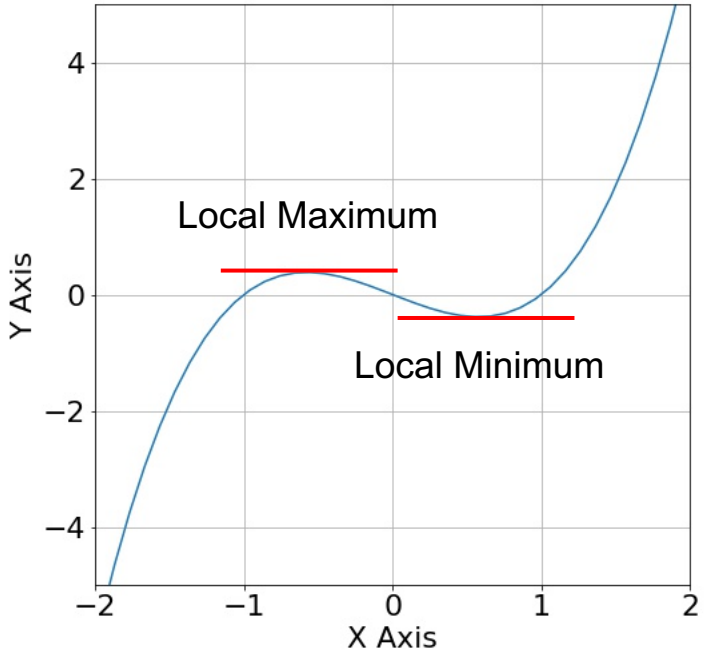
$$f(x) = x^3 - x$$

For which values of x do we have a maximum and/or minimum?

$$f'(x) = 3x^2 - 1 = 0$$

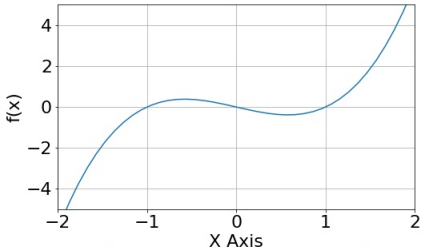
$$3x^2 = 1$$

$$x^2 = \frac{1}{3} \qquad x = \pm\sqrt{\frac{1}{3}} = \pm 0.54$$



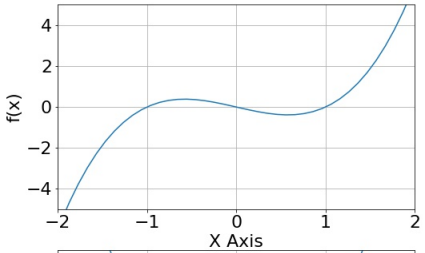
Concavity-Convexity

$$f(x) = x^3 - x$$

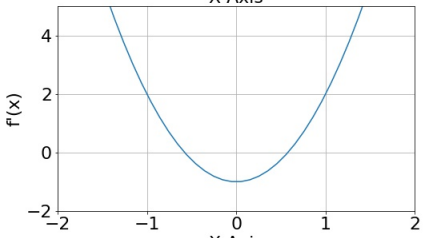


Concavity-Convexity

$$f(x) = x^3 - x$$

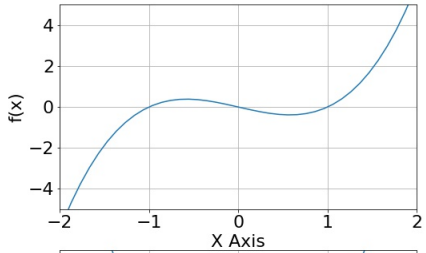


$$f'(x) = 3x^2 - 1$$

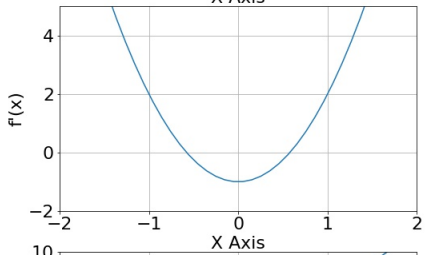


Concavity-Convexity

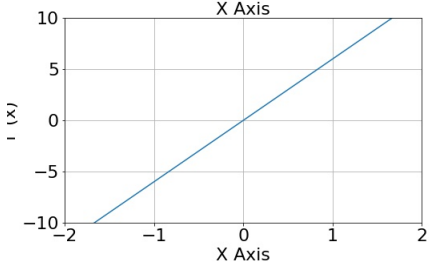
$$f(x) = x^3 - x$$



$$f'(x) = 3x^2 - 1$$



$$f''(x) = 6x$$

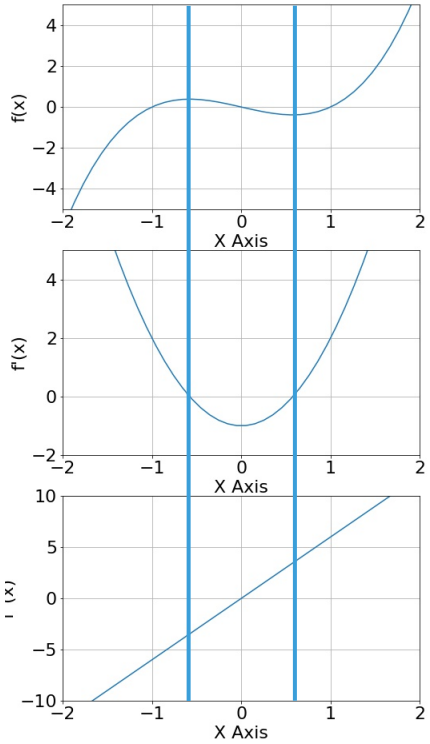


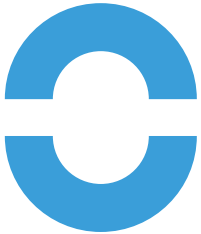
Concavity-Convexity

$$f(x) = x^3 - x$$

$$f'(x) = 3x^2 - 1$$

$$f''(x) = 6x$$





Concave shapes f ’’(x) < 0

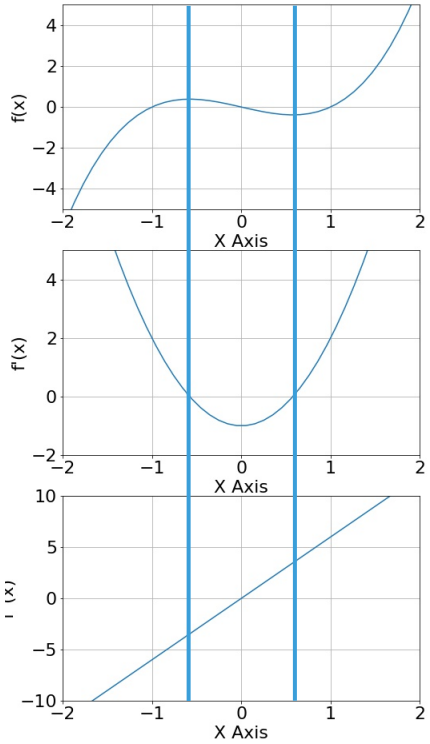
Convex shapes f ’’(x) > 0

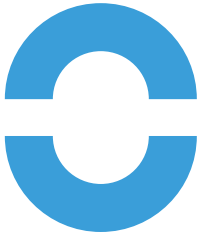
Concavity-Convexity

$$f(x) = x^3 - x$$

$$f'(x) = 3x^2 - 1$$

$$f''(x) = 6x$$





Concave shapes f ’’(x) < 0

Convex shapes f ’’(x) > 0

Definition:

Maximum: f ’(x) = 0 and f ’’(x) < 0

Minimum: f ’(x) = 0 and f ’’(x) > 0

Neither: f ’(x) = 0 and f ’’(x) = 0

Problem 1:

Problem 1:

Find the point where there is a maximum or minimum, and determine if it is a maximum or minimum.

$$f(x) = 60x - x^2$$

Problem 1:

Problem 1:

Find the point where there is a maximum or minimum, and determine if it is a maximum or minimum.

$f(x) = 60x - x^2$

$f'(x) = 60 - 2x = 0$

$60 = 2x$

$x = 30$

$f''(x) = -2$

$-2 < 0 \Rightarrow$ Concave

At $x = 30$ there is a Maximum

QUESTIONS?