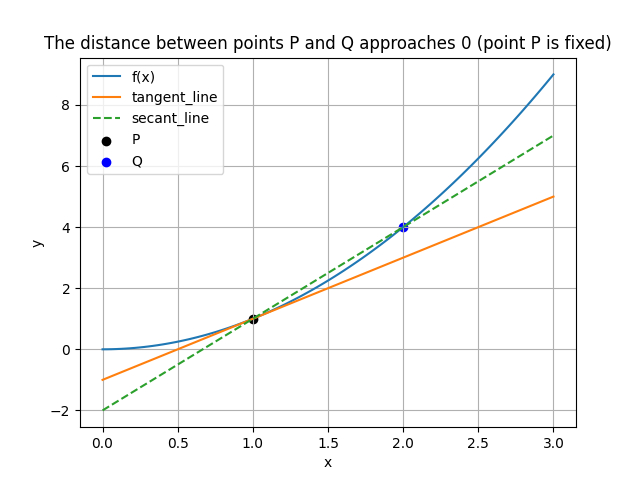
# Unit 1 Derivatives

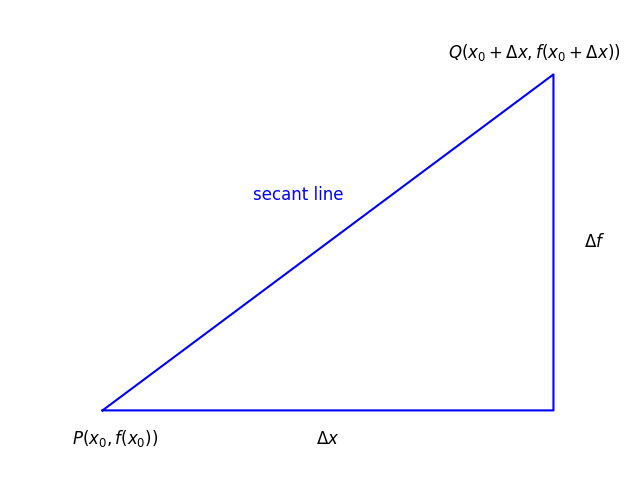
## Lecture 1 What is a derivative?

1. The derivative is the limit of the secant line approaching the tangent line:

* Geometric interpretation:



* Algebraic Explanation:



1. Example:

1. Note:

Tangent Line Equation:

## Lecture 2 Limits and Continuity

1. Limits:
2. Continuity:

* Removable discontinuities of the first type:

or is not defined.

* Jump discontinuities of the first type:
* Infinite discontinuities of the second type:
* Other discontinuities of the second type.

1. Two trigonometric limits:
2. Theorem:

A differentiable function must be continuous:

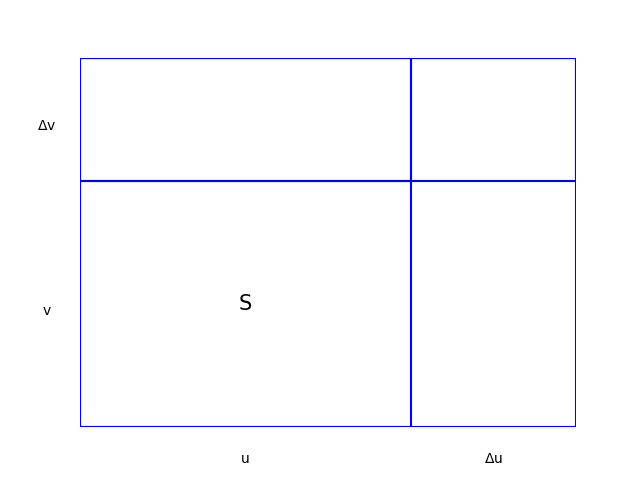
## Lecture 3 Derivative formula

1. General formula:

Proof:

Proof:

Geometric interpretation:



* Note:

1. Special formula：

Proof:

## Lecture 4 Chain Rule and Higher-Order Derivatives

1. Chain Rule:
2. Higher-Order Derivatives：

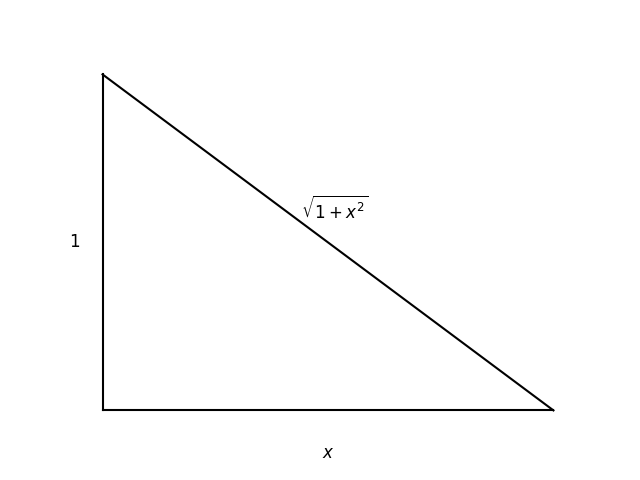
## Lecture 5 Implicit functions and Inverse

1. Implicit function calculation method：

Derivatives () are taken for all terms and finally separated.

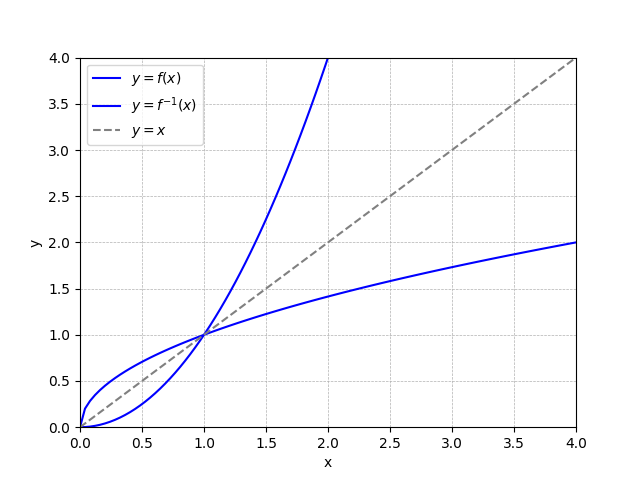
1. Inverse:

* Among them, the nested expressions of trigonometric functions and inverse trigonometric functions can be expressed through geometric substitution：



* Geometric relationship:

Symmetrical with the original function about line .

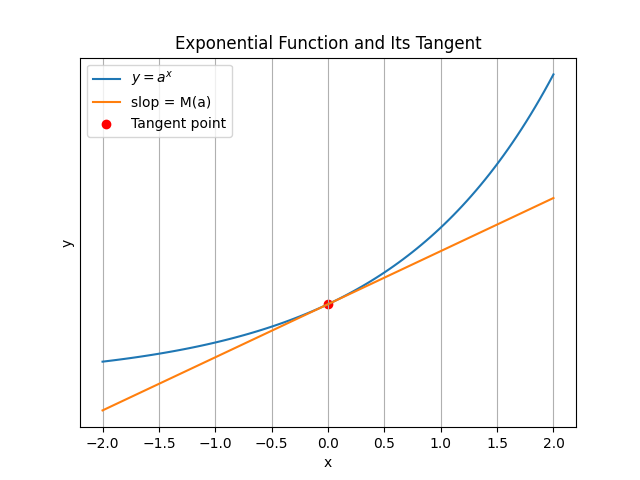


* Notes:

## Lecture 6 Exp and Log function derivatives

1. Exp function:

After analysis,



Consider a slope equal to 1

According to the geometric form of the derivative:

1. Log function: (Inverse )

* Basic theory:

Then, for the exponential function , we have:

According to the chain rule:

1. Derivative Applications:

## Lecture 7 Hyperbolic function

1. Manifestation：
2. Derivative：
3. Theorem:

Trigonometric functions (circular functions):

# Unit 2 Applications of Derivatives

## Lecture 8 Linear and Quadratic approximations

1. Linear approximations: