Differentiation (1A)

- A

Please send corrections (or suggestions) to youngwlim@hotmail.com.

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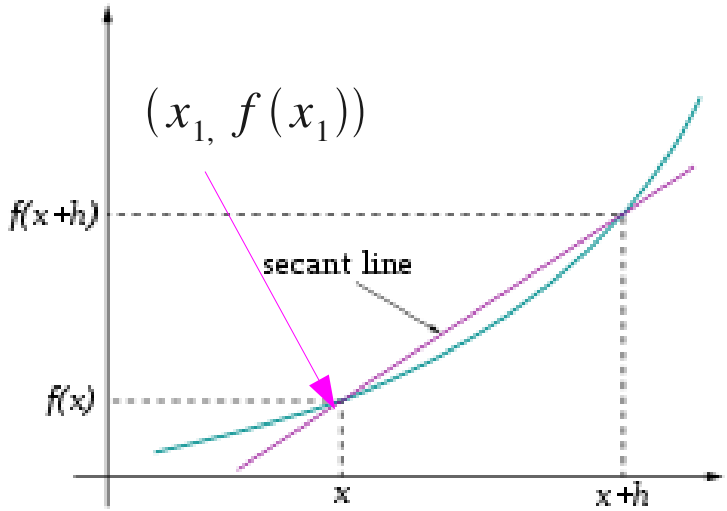
8/18/10

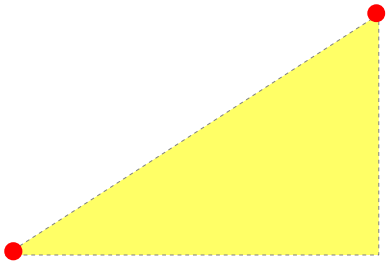
Triangle and Slope

$$y = f(x)$$

$$\frac{f(x_1 + h) - f(x_1)}{h}$$



$(x_1 + h, f(x_1 + h))$



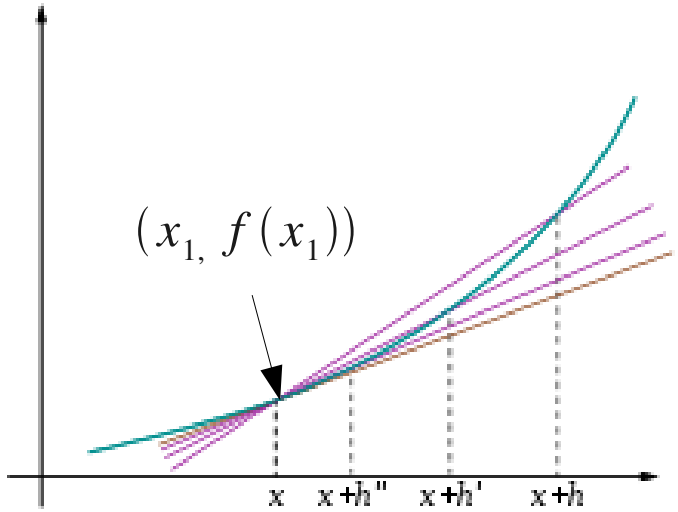
$(x_1, f(x_1))$

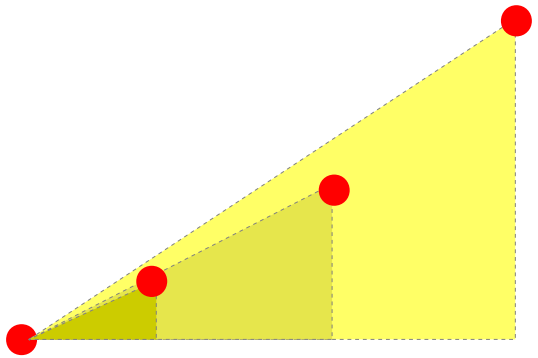
Many Smaller Triangles and Slopes

$$y = f(x)$$

$$\frac{f(x_1 + h) - f(x_1)}{h}$$

$$h \rightarrow h' \rightarrow h''$$





$(x_1 + h, f(x_1 + h))$

$(x_1 + h', f(x_1 + h'))$

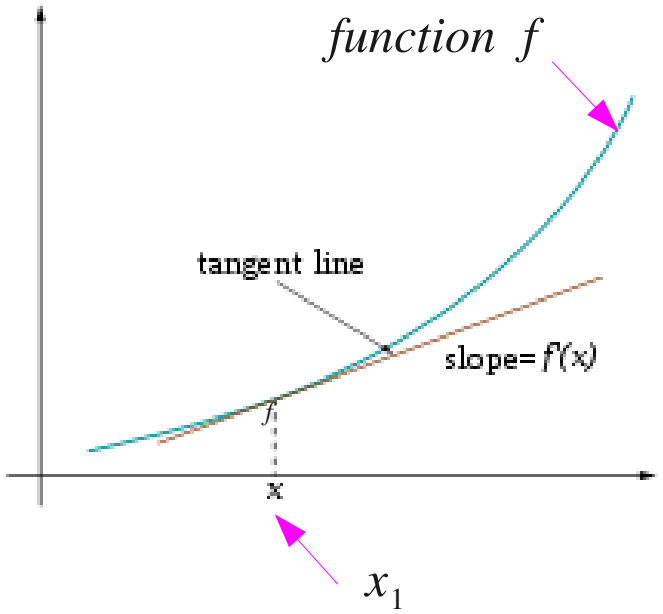
$(x_1 + h'', f(x_1 + h''))$

$(x_1, f(x_1))$

The Limit of Triangles and Slopes

$$y = f(x)$$

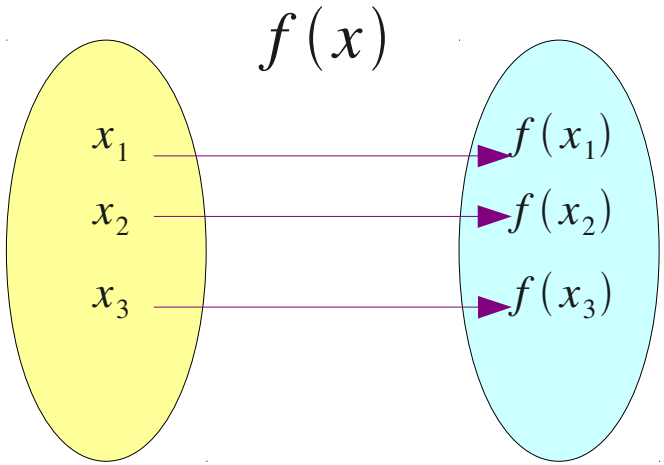
$$\lim_{h \to 0} \frac{f(x_1 + h) - f(x_1)}{h}$$



The derivative of the function f at x_1

The Derivative as a Function

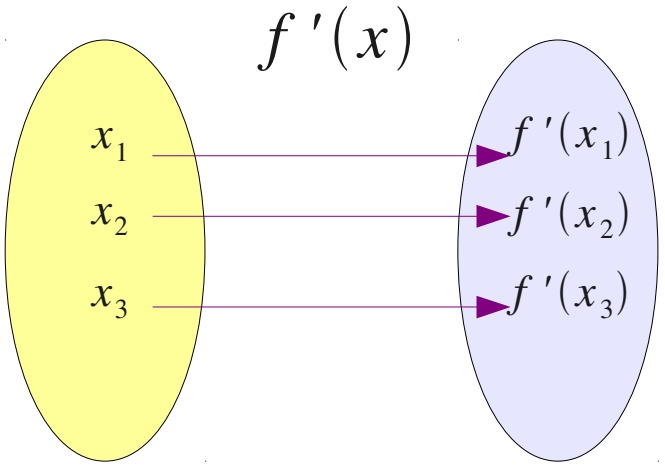
$$y = f(x)$$



Derivative Function

$$y' = f'(x)$$

$$= \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$



The Derivative Notations

Largrange's Notation

$$y' = f'(x)$$

Leibniz's Notation

$$\frac{dy}{dx} = \frac{d}{dx} f(x)$$

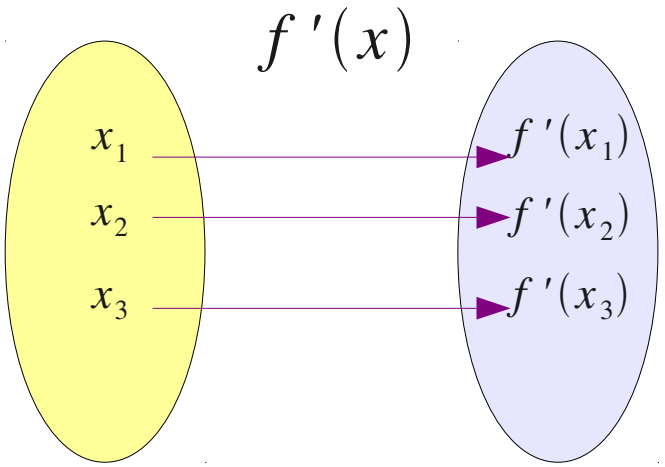
This is not a ratio.

Newton's Notation

$$\dot{y} = \dot{f}(x)$$

Euler's Notation

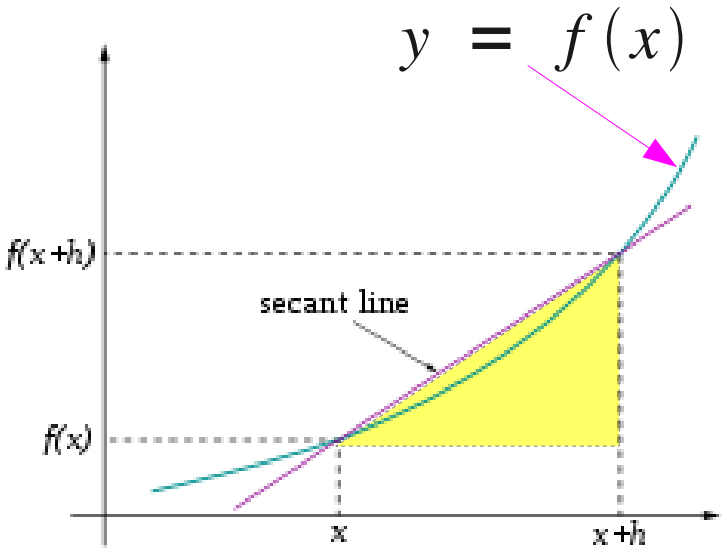
$$D_x y = D_x f(x)$$

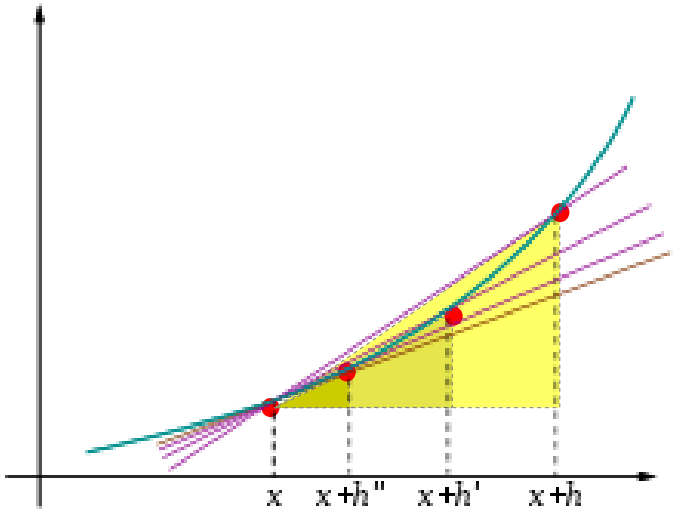


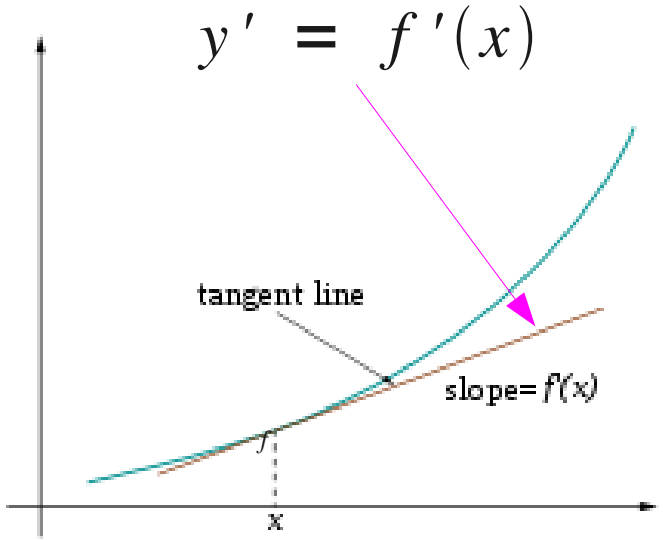
$$= \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

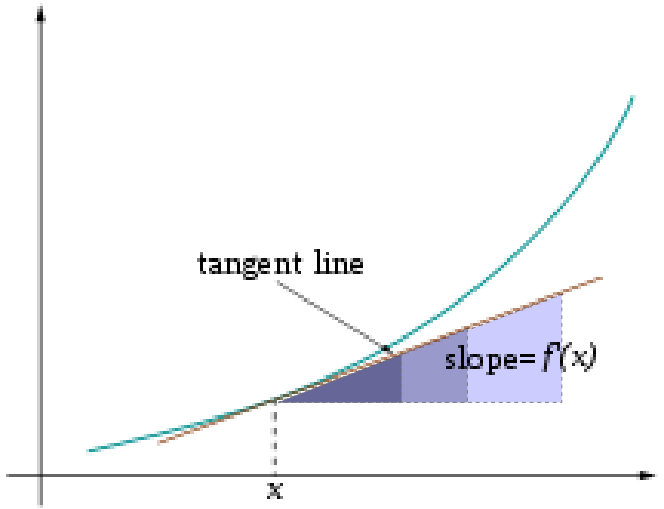
x is an independent variable
→ Derivative with respect to x

Another Kind of Triangles and Slopes (1)

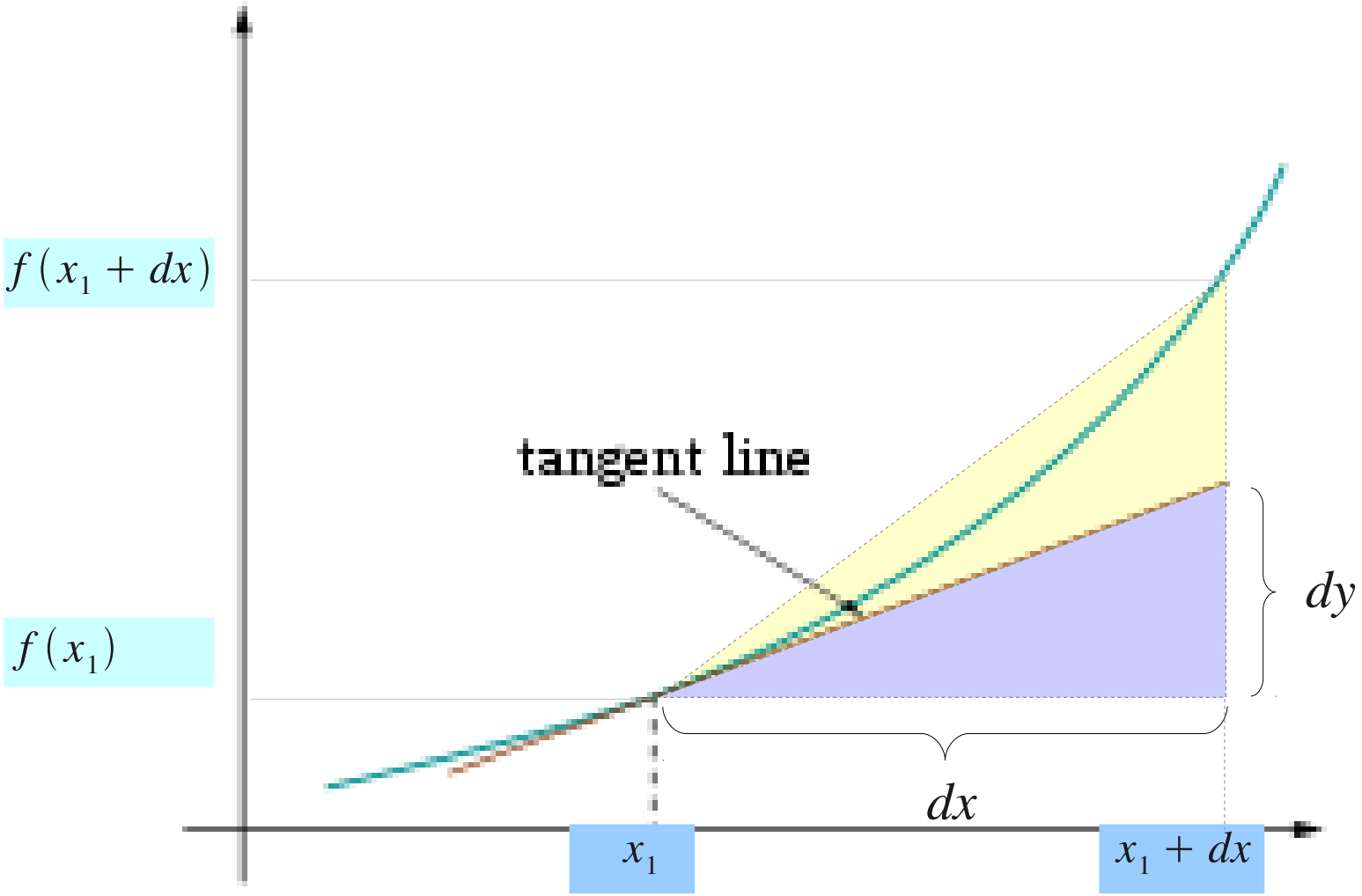








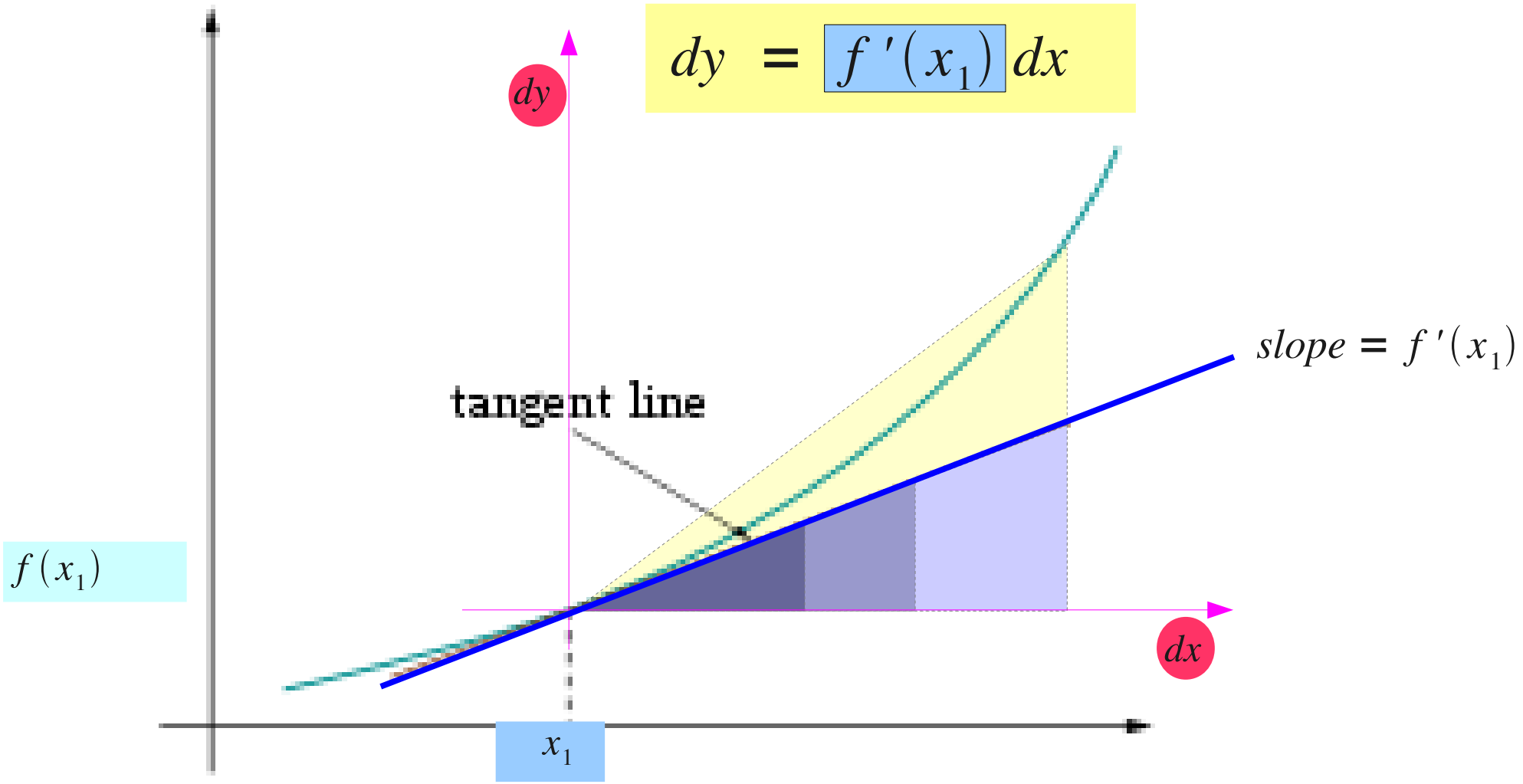
Another Kind of Triangles and Slopes (2)



Another Kind of Triangles and Slopes (3)

Line equation in the new coordinate.

$$dy = f'(x_1)\,dx$$

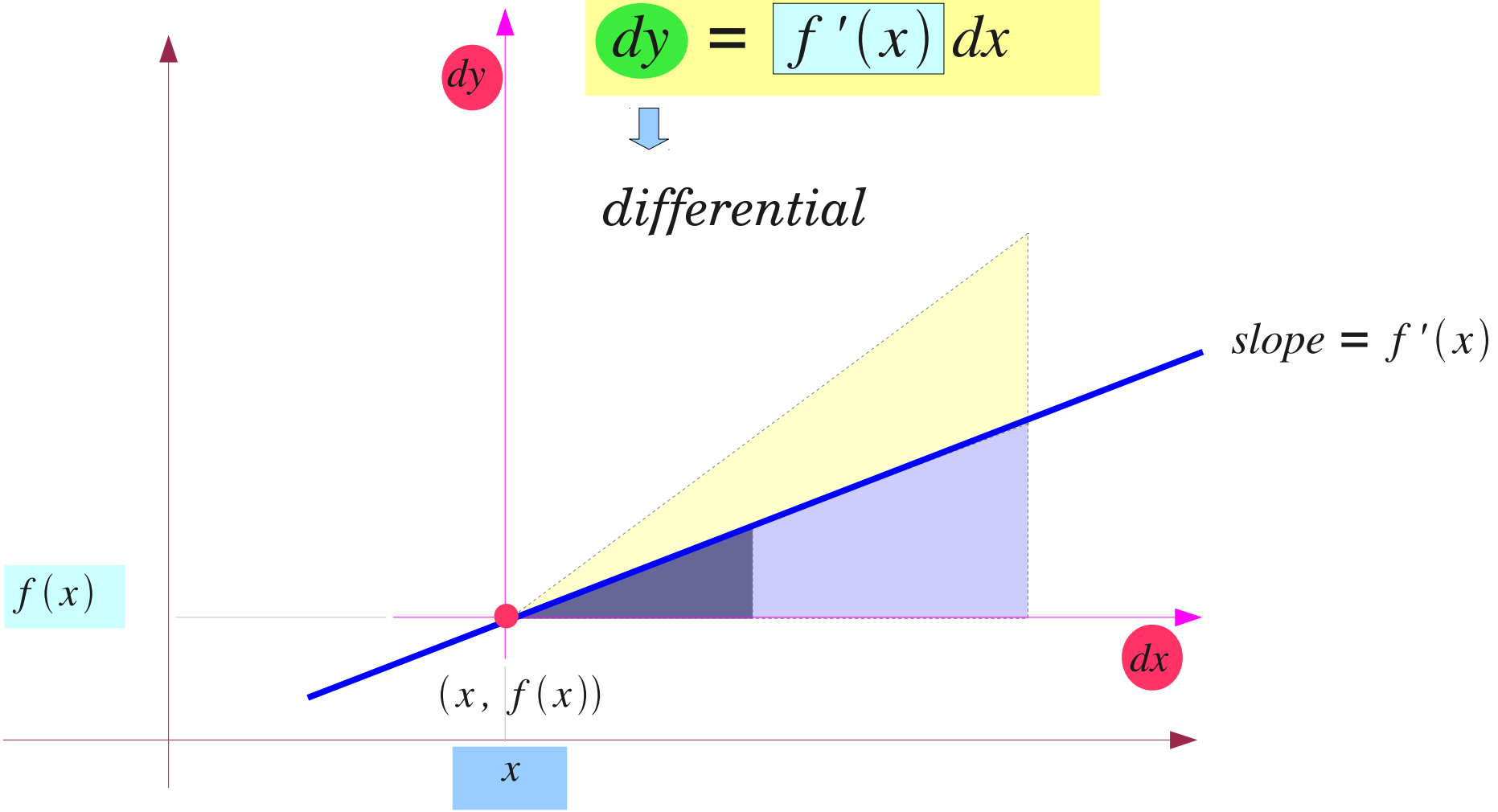


The Differential of a Function

Line equation in the new coordinate.

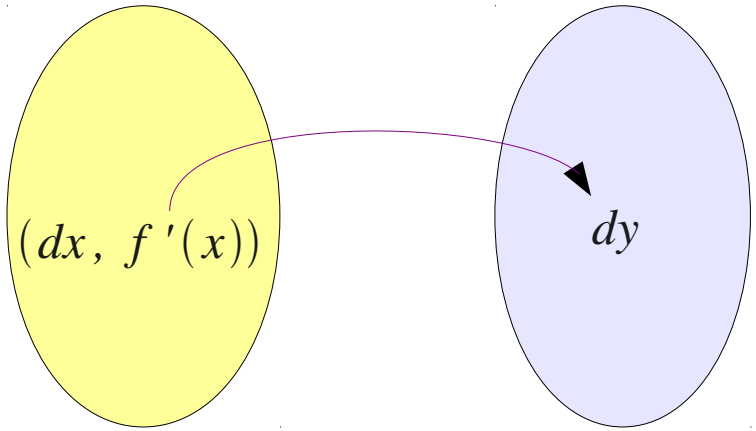
$$dy = f'(x)\,dx$$

differential



*The **differential** of a function **f(x)** of a single real variable **x** is the function of two independent real variables **x** and **dx** given by*

$$dy = f'(x)\,dx$$



$$\frac{dy}{dx} = f'(x)$$

$$= \frac{d}{dx} f(x)$$

ratio

not a ratio

$$dy = \frac{df}{dx}\,dx$$

a

References

[1] http://en.wikipedia.org/
[2] http://planetmath.org/
[3] Blitzer, R. “Algebra & Trigonometry.” 3rd ed, Prentice Hall
[4] Smith, R. T., Minton, R. B. “Calculus: Concepts & Connections,” Mc Graw Hill
[5] Thomas, et. al, “Thomas' Calculus”, 11th ed, Addison Wesley
[5] 홍성대, “기본/실력 수학의 정석,”성지출판