

Exponential Functions

Laws of Exponents

$$a^x a^y = a^{x+y}$$

$$\frac{a^x}{a^y} = a^{x-y}$$

$$(a^x)^y = a^{xy} = (a^y)^x$$

$$(ab)^x = a^x b^x$$

$$(-2xz^3)^3 (-x^2y^4z^3)^3$$

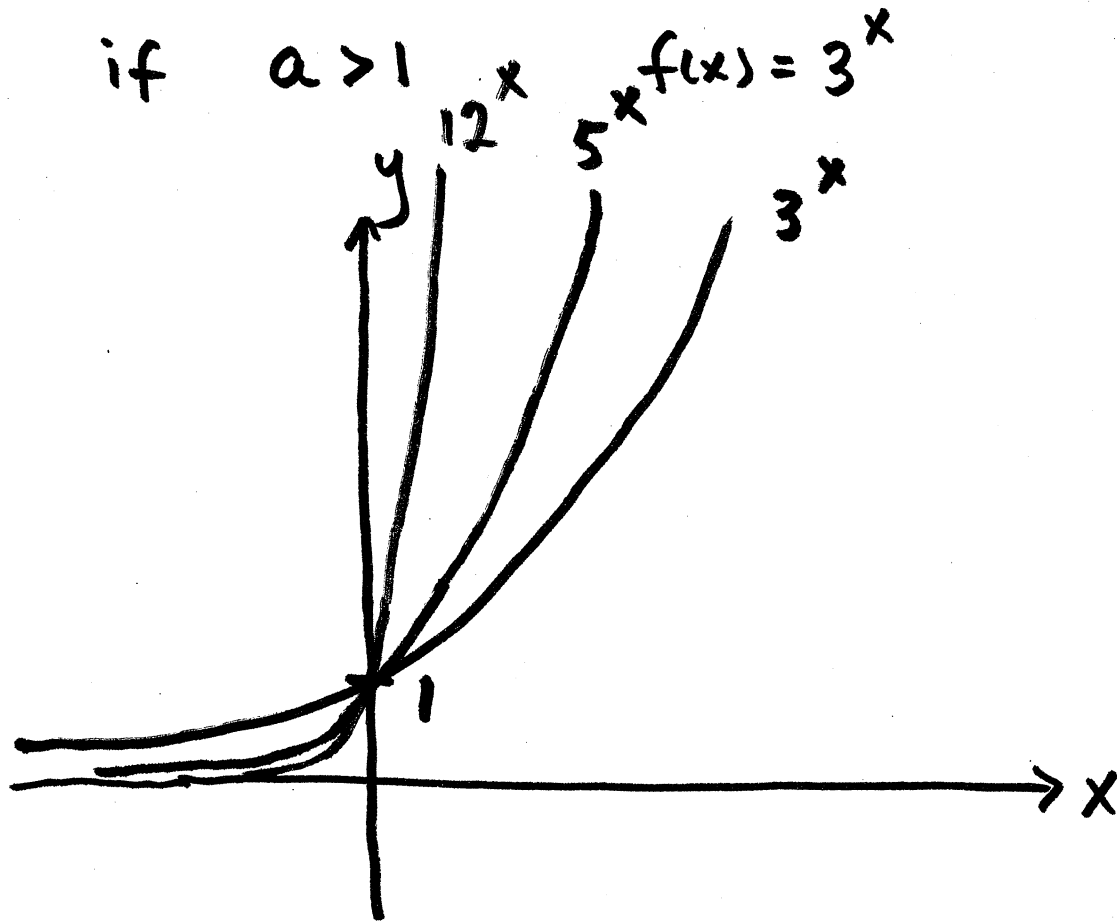
$$= (-2)^3 x^3 z^9 \cdot (-1)^3 x^6 y^{12} z^9$$

$$= (-8)(-1) x^9 z^{18} y^{12} = 8x^9 z^{18} y^{12}$$

Graph of $f(x) = a^x$

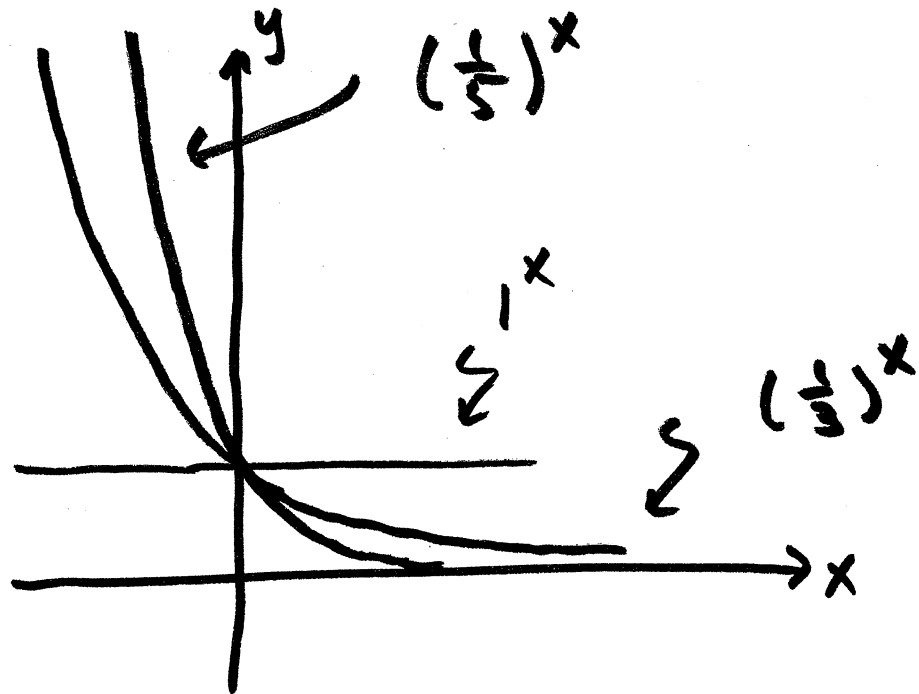
a is a positive number

if $a > 1$



the function is
increasing

$$0 < a < 1$$

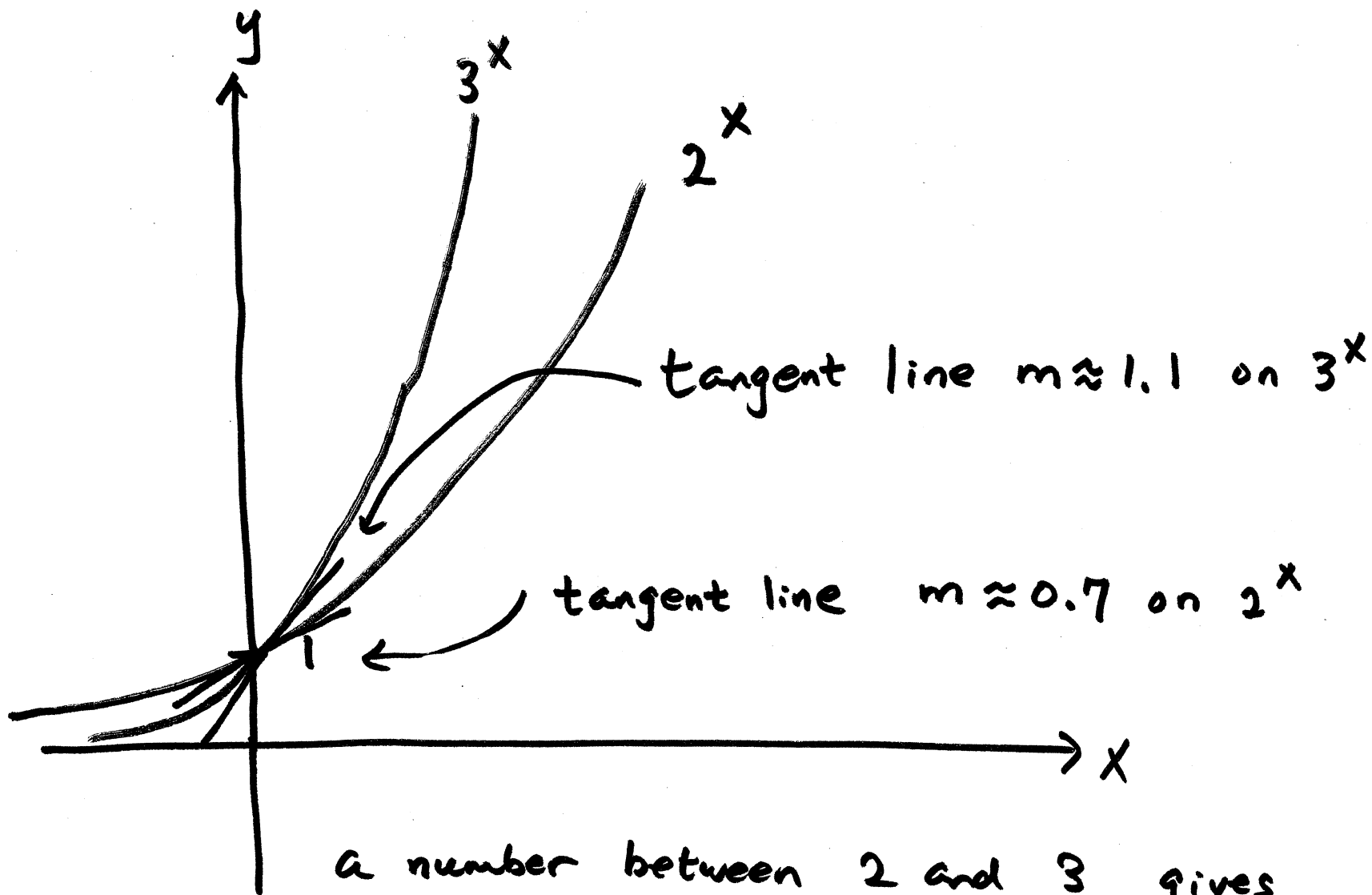


function is decreasing

$(\frac{1}{3})^x$ is the reflection of 3^x
about y-axis

$$(\frac{1}{3})^x = (3^{-1})^x = 3^{-x}$$

when $a=1$ $a^x = 1^x = 1$



a number between 2 and 3 gives
slope $m=1$ at $(0,1) \rightarrow e \approx 2.71828$
 e is irrational and transcendental

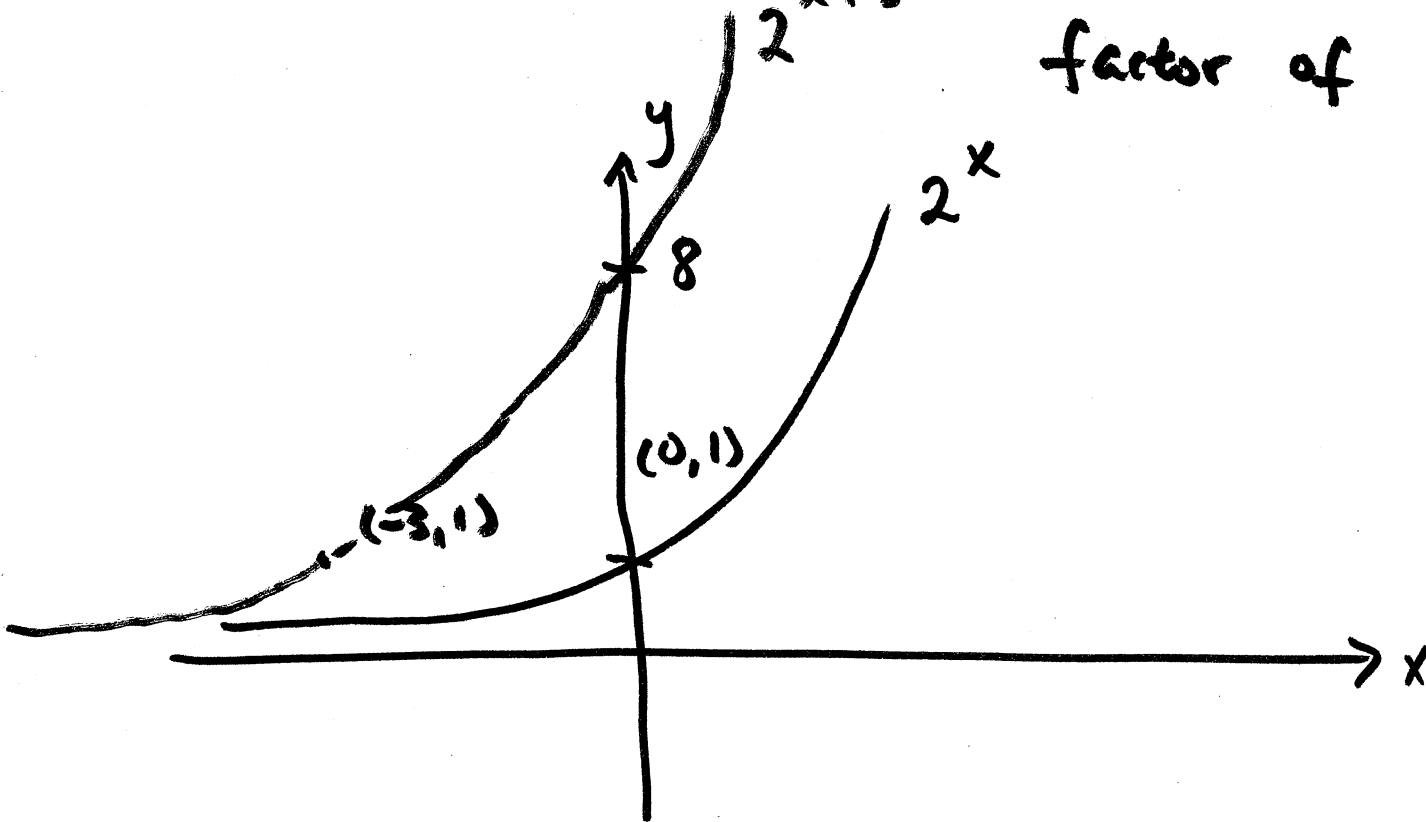
$$f(x) = 2^{x+3}$$

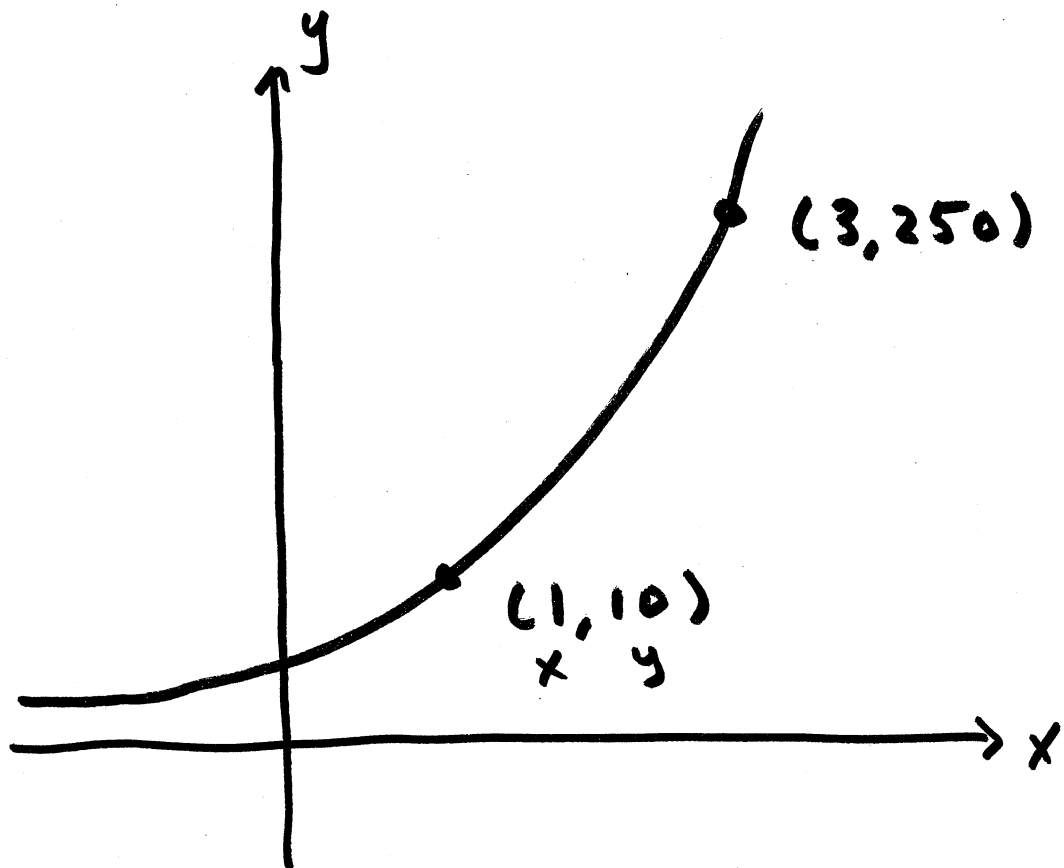
is 2^x shifted LEFT by 3

$$= 2^x \cdot 2^3$$

$$= 8 \cdot (2^x)$$

vertically stretched 2^x by
factor of 8





Find function of
the form

$$f(x) = C \cdot a^x$$

$$(1, 10)$$

$$10 = C \cdot a$$

$$(3, 250)$$

$$250 = C \cdot a^3$$

$$C = \frac{10}{a}$$

$$250 = \frac{10}{a} a^3 = 10a^2$$

$$a^2 = 25$$

$$a = 5 \text{ or } \cancel{-5}$$

(increasing)

Substitution

divide one by another

by division $\frac{250}{10} = \frac{ca^3}{ca} = a^2$
 $a = 5$

so $f(x) = C(5)^x$

use either point to find C

$(1, 10)$ $10 = C \cdot 5$ so ~~$C = 5$~~ $C = 2$

$$f(x) = 2(5^x)$$

About the number e

- Named in honor of the Swiss mathematician Leonard Euler (pronounced *oi-ler*).
- The famous Euler's Identity is $e^{i\pi} + 1 = 0$
 - "most beautiful theorem in mathematics" (*The Mathematical Intelligencer*)
 - "greatest equation ever" (*Physics World*)
- Irrational and transcendental
 - 1,000,000,000,000 known digits (Kondo & Yee, 2010).

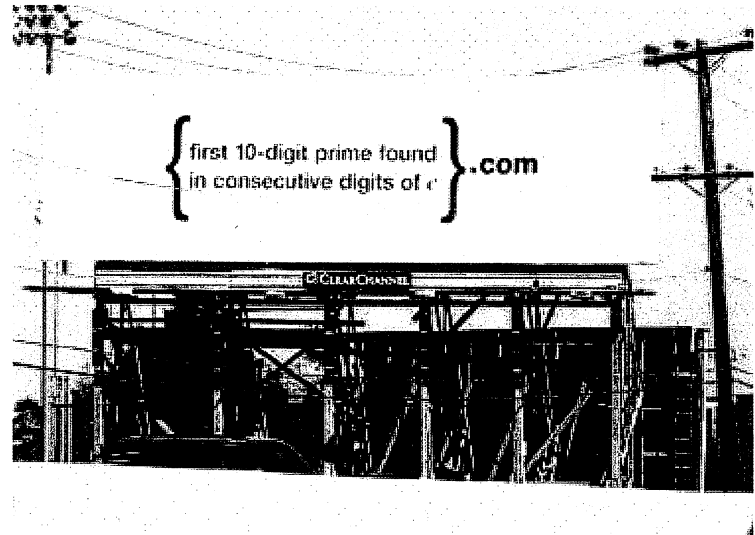
e is a fascinating number...

$$e = 2 + \frac{1}{1 + \frac{1}{5 + \frac{1}{10 + \frac{1}{14 + \frac{1}{18 + \dots}}}}} = 1 + \frac{2}{1 + \frac{1}{6 + \frac{1}{10 + \frac{1}{14 + \frac{1}{18 + \dots}}}}}$$

$$e = \sum_{n=0}^{\infty} \frac{1}{n!} = 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \dots$$

$$e = 2 \left(\frac{2}{1}\right)^{1/2} \left(\frac{2}{3} \frac{4}{3}\right)^{1/4} \left(\frac{4}{5} \frac{6}{5} \frac{6}{7} \frac{8}{7}\right)^{1/8} \dots$$

Recruiting billboard by Google
(it reads "first 10-digit prime
found in
Consecutive digits of e")



MA 161 SI Sessions

Corey Kwok, Jason Miller,
Selena Staun

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