

24

Substitution

Chain rule
and FTC

$$\int f'(u(x))u'(x)dx = f(u(x)) + C$$

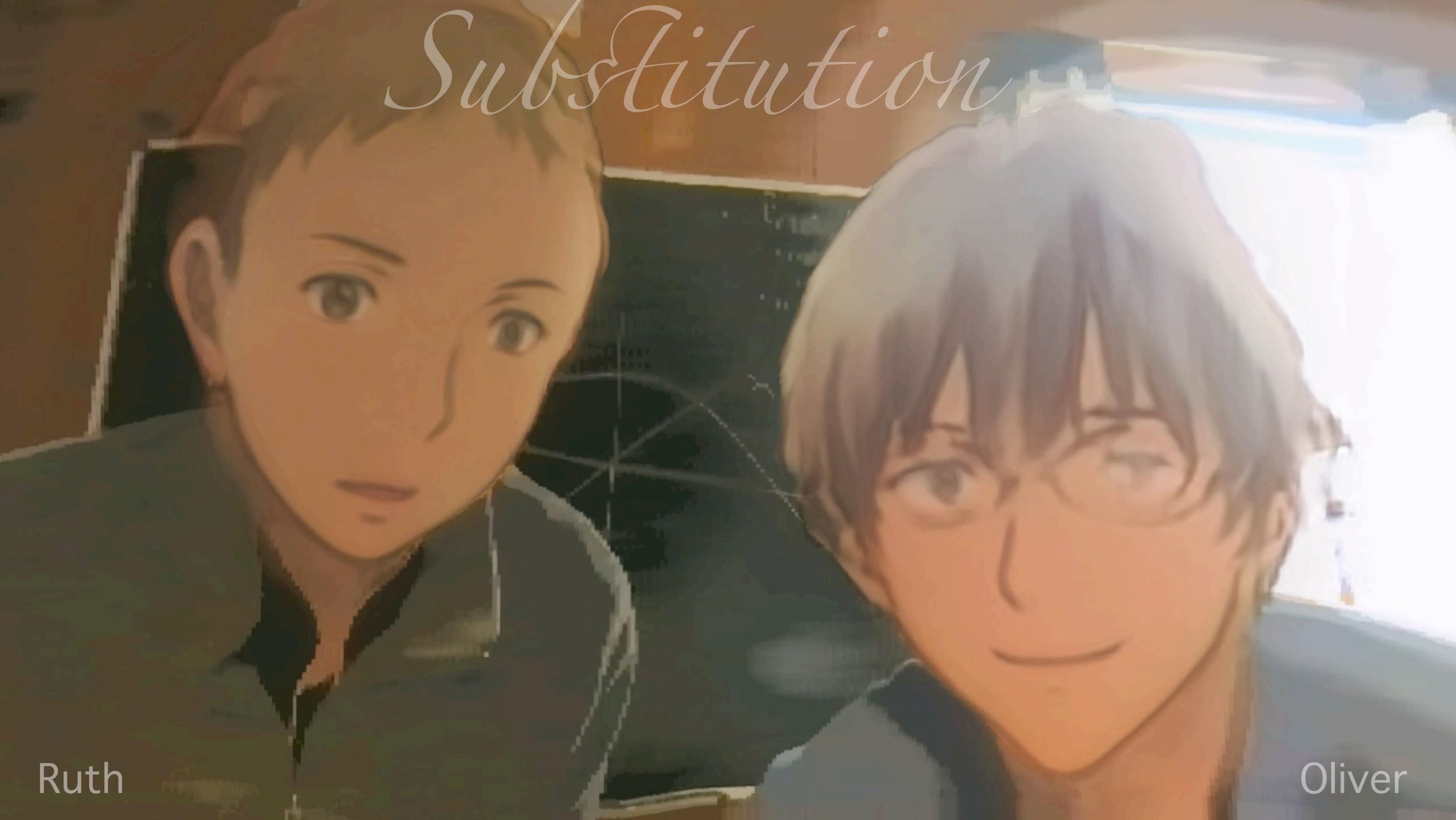
Example

$$\int \cos(\tan(x)) \frac{1}{\cos^2(x)} dx = \sin(\tan(x)) + C$$

$$u = \tan(x)$$

$$du = \frac{1}{\cos^2(x)} dx$$

Substitution



Ruth

Oliver

PLAN



1. Poll

2. The chain rule

3. Basic

4. Advanced

5. Jam

POLL

$$\int \frac{1}{x \log(x)} dx =$$

A $\log^2(x)/2 + C$

B $\frac{1}{\log(x)x} + C$

C $\log(\log(x)) + C$

D $\log(x) + C$

EXAMPLE

$$\int \sin(x^2)x \, dx$$

$$u = x^2$$
$$du = 2x \, dx$$

$$\int \sin(u) \frac{du}{2} = -\frac{\cos(u)}{2} + C = -\frac{\cos(x^2)}{2} + C$$

CHAIN RULE

The method of substitution is a reverse of the chain rule

$$\frac{d}{dx}G(u(x)) = g(u(x))u'(x)$$

$$\int g(u(x))u'(x) dx = G(u(x)) + C$$

BEGINNING



Queen's Gambit 2020

BASIC EXAMPLES

A

$$\int e^{(x+1)} dx$$

B

$$\int \cos(x^2) 2x dx$$

C

$$\int \frac{x}{1+x^2} dx$$

PRACTICE



Queen's Gambit 2020

PRACTICE

A

$$\int \sqrt{x+2} \, dx$$

B

$$\int \sin(x^5)x^4 \, dx$$

C

$$\int \sin(\sin(x))\cos(x) \, dx$$

HARDER



Queen's Gambit 2020

HARDER

3 out of 2
people have
trouble with
fractions.

A

$$\int \frac{1+x}{1+x^2} dx$$

B

$$\int e^{-4x^2} x dx$$

C

$$\int \frac{1+x}{1-x^2} dx$$



THE FINAL

Queen's Gambit 2020

Two tougher examples

A $\int \frac{x}{1+x^4} dx$

B $\int \frac{x^3}{\sqrt{1+x^2}} dx$

LET'S PLAY



1 \$10,000 CASH IMMEDIATELY	2 BRAND NEW HOME BUT YOU CAN NEVER SELL IT OR MOVE	3 UNLIMITED FREE MEDICAL CARE FOR LIFE
4 FREE RENT/ MORTGAGE FOR 6 MONTHS	PICK TWO	5 BRAND NEW LUXURY CAR. YOU CAN NEVER SELL OR OWN ANOTHER CAR
6 PERFECT CREDIT SCORE	7 UNLIMITED AIRLINE TICKETS FOR LIFE	8 FREE GROCERIES FOR FIVE YEARS

if finished, which 2 of the above 2 options for you?

JAM Pick two
you can do!

$$\int e^{-x^2} dx$$

$$\int x^2 e^{-x^2} dx$$

$$\int x e^{-x^2} dx$$

$$\int \log(x)/x dx$$

HOLIDAYWATCH

Passover

Ramadan

Holi

Easter

Wellness day

The End