# Integralrechnung

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

  $F(x) + C = \int f(x)dx$ - Stammfunktion von $f(x)$
- Hauptsatz der Integral- und Differentialrechnung

$$\int_a^x f(x)dx = F(x); \quad \int_a^b f(x)dx = F(b) - F(a)$$

$\Rightarrow$ Integration einer Funktion - die Suche nach ihrer Stammfunktion

# Integrationsregeln

$\frac{d}{dx}F(x) = f(x), \quad F(x) + C = \int f(x)dx$

- $f(x) = x^a, \quad F(x) = \frac{x^{a+1}}{a}, a \neq -1$
- $f(x) = x^{-1} = \frac{1}{x}, \quad F(x) = ln(|x|)$
- $f(x) = sin(x), \quad F(x) = -cos(x)$
- $f(x) = cos(x), \quad F(x) = sin(x)$

Kettenregel $\rightarrow$ Substitutionsregel
Produktregel $\rightarrow$ partielle Integration

# Integrationsregeln

$\frac{d}{dx}F(x) = f(x), \quad F(x) + C = \int f(x)dx$

## Substitutionsregel

- Kettenregel $\frac{d}{dx}F(g(x)) = \frac{dF(g(x))}{dg}\frac{dg(x)}{dx}$
- Substitutionsregel $F(g(x)) + C = \int \frac{dF(g(x))}{dg}\frac{dg(x)}{dx}dx$
- $g(x) = z, \quad F(z) + C = \int \frac{dF(z)}{dz}\frac{dz}{dx}dx$
- $\frac{dF(z)}{dz} = f(z)$ oder $\frac{dF(g(x))}{dg} = f(g(x))$
- $\frac{dz}{dx}dx = dz$ oder $\frac{dg(x)}{dx}dx = dg$

$$\int_a^b f(g(x))\frac{dg(x)}{dx}dx = \int_{g(a)}^{g(b)} f(z)dz$$

# Integrationsregeln

$\frac{d}{dx}F(x) = f(x), \quad F(x) + C = \int f(x)dx$

## partielle Integration

- Produktregel $\frac{d}{dx}\left(f(x)g(x)\right) = g(x)\frac{df(x)}{dx} + f(x)\frac{dg(x)}{dx}$
- partielle Integration

  $f(x)g(x) + C = \int g(x)\frac{df(x)}{dx}dx + \int f(x)\frac{dg(x)}{dx}dx$

  $\int f(x)\frac{dg(x)}{dx}dx = f(x)g(x) - \int g(x)\frac{df(x)}{dx}dx + C$

  $$\int_a^b f(x)\frac{dg(x)}{dx}dx = f(x)g(x)|_a^b - \int_a^b g(x)\frac{df(x)}{dx}dx$$