

# Integration: a big picture

Fundamental idea of integration: adding up infinitely many infinitesimal contributions to a total

Flavors so far:

- ▶ integration over a line segment (i.e., a region in  $\mathbb{R}^1$ ):

$$\int_a^b f(x) dx \text{ or } \int_{[a,b]} f dx$$

- ▶ integration over a planar region  $R$  (i.e., a region in  $\mathbb{R}^2$ ):

$$\iint_R f dA$$

- ▶ integration over a solid region  $D$  (i.e., a region in  $\mathbb{R}^3$ ):

$$\iiint_D f dV$$

So far, have:

- ▶ integration over a flat one-dimensional region
- ▶ integration over a flat two-dimensional region
- ▶ integration over a flat three-dimensional region

Two ways to generalize:

- A. go up in dimension
- B. look at non-flat things:

(a) integration over a curve  $C$  in plane or space:  $\int_C f ds$

(b) integration over a surface  $S$  in space:  $\iint_S f dA$

Will focus on B after a few words on A.