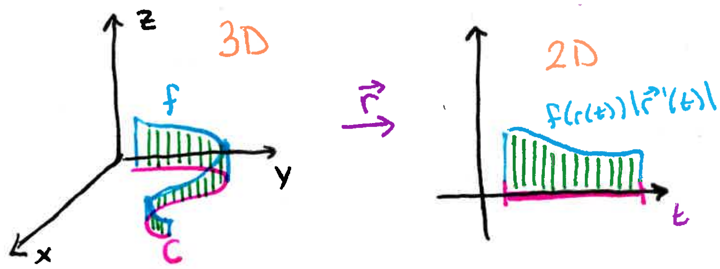
Where we've been (16.1 – 16.7) and where we're going (16.8 – 16.9)

Line Integrals:

- Scaler function

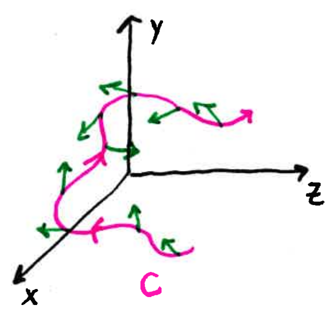
$$\int_C f\,ds = \int_a^b f(r(t))\,|\vec{r}\,'(t)|\,dt$$



* Accumulation of f over C
or Area of f over C

- Vector Function

$$\int_C \vec{F}\cdot d\vec{r} = \int_a^b \underbrace{\vec{F}(r(t))\cdot\vec{r}\,'(t)\,dt}$$



* Amount of $\vec{F}$ going in the direction of C

Theorems

① $\vec{F}$ Conservative | Line Integrals with vector functions

$\boxed{\text{FTC}}$ $\int_C \nabla f\cdot d\vec{r} = f(r(b)) - f(r(a))$ C any curve

② $\vec{F}$ Not Conservative | Line Integrals with vector function (2 vars)

$\boxed{\text{Green's}}$ $$\int_C \vec{F}\cdot d\vec{r} = \int_C P\,dx + Q\,dy = \iint_D \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dA$$

C positive orientation, simple, closed

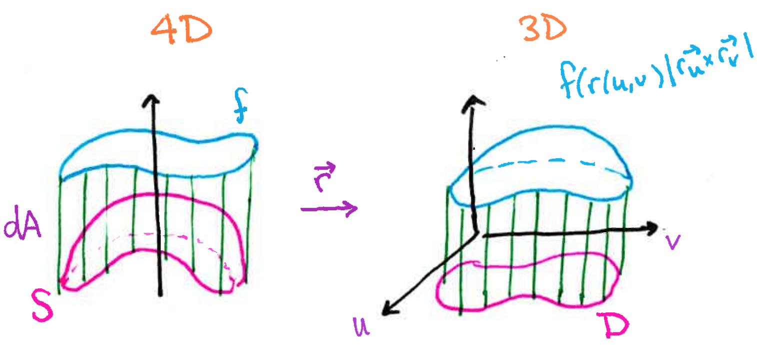
Where we've been and where we're going

MVC

Surface Integrals:

- Scalar functions

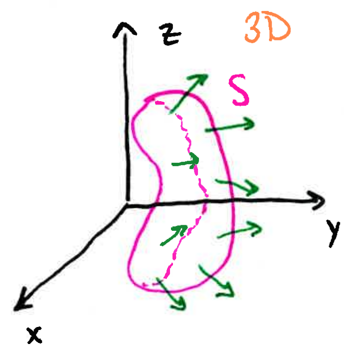
$$\iint_S f\,dS = \iint_D f(r(u,v))\,|\vec{r}_u \times \vec{r}_v|\,dA$$



★ Accumulation of f over S or Volume of f over S

- Vector Functions

$$\iint_S \vec{F}\cdot d\vec{S} = \iint_D \vec{F}(r(u,v))\cdot(\vec{r}_u \times \vec{r}_v)\,dA$$



★ Amount of $\vec{F}$ going through S

Theorems

③ $\vec{F}$ not Conservative | Line Integrals with Vector Functions (3 vars)

$\boxed{\text{Stoke's}}$ ~ Green's theorem for functions of 3 variables

④ $\vec{F}$ Not Conservative | Surface Integrals with Vector Functions

$\boxed{\text{Divergence}}$