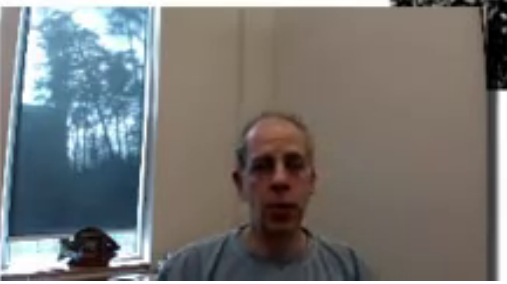
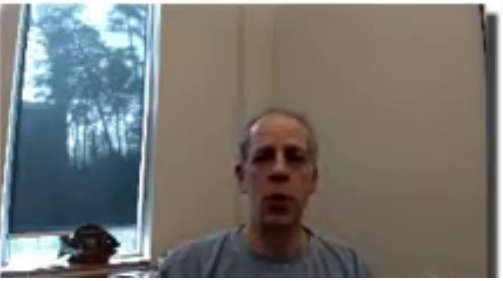
Automatic Segmentation is Tough!

By Doolittle

Automatic Segmentation is Tough!



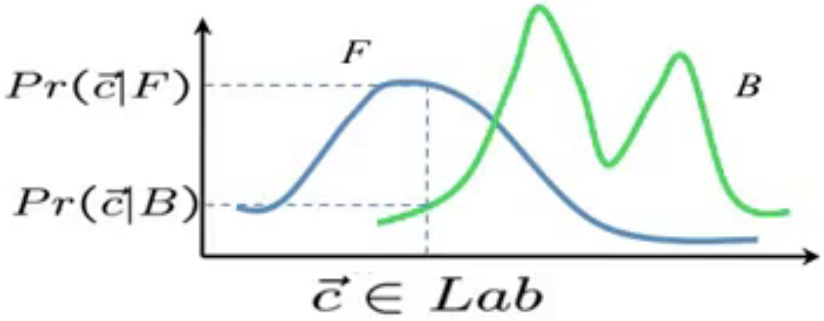
Interactive image segmentation

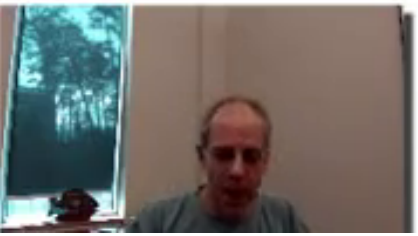


Step1 – Feature Distribution Estimation

- Estimate the color distribution on scribbles

- Each pixel is assigned a probability to belong to F or B:



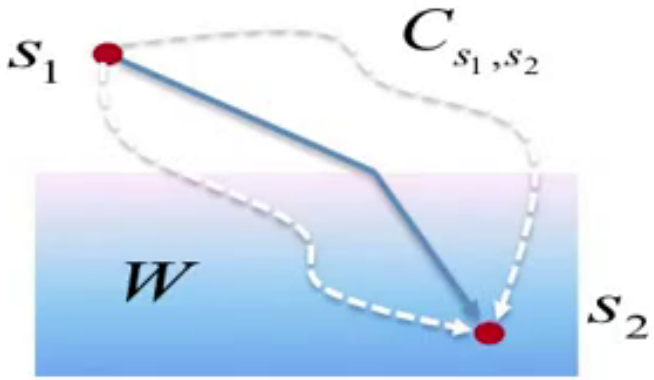


$$P_F(x) = \frac{Pr(\vec{c_x}|F)}{Pr(\vec{c_x}|F) + Pr(\vec{c_x}|B)}$$

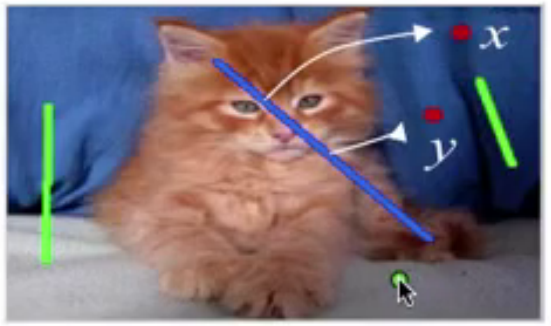
Step2 – Weighted Distance Transform

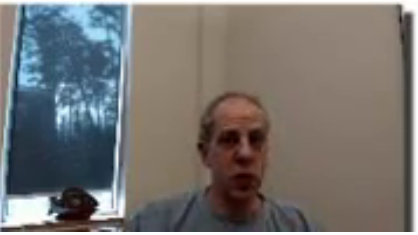
Weighted Geodesic Distance

$$d(s_1, s_2) := \min_{C_{s_1,s_2}} \int_{C_{s_1,s_2}} W\, ds$$



- Computed in linear time!





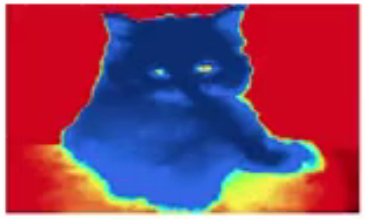
Weighted Distance Transform (cont'd)

$$W := |\nabla P_F(x) \cdot \vec{C'}_{s_1,s_2}(x)|$$

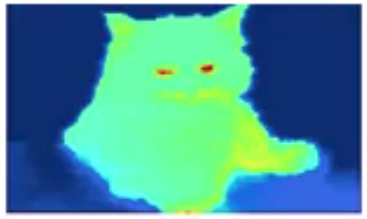
$$D_l(x) := \min_{s \in \Omega_l} d(s,x), \quad l \in \{F, B\}$$

- Pixels are classified by comparing $D_F(x)$ and $D_B(x)$

$P_F(x)$

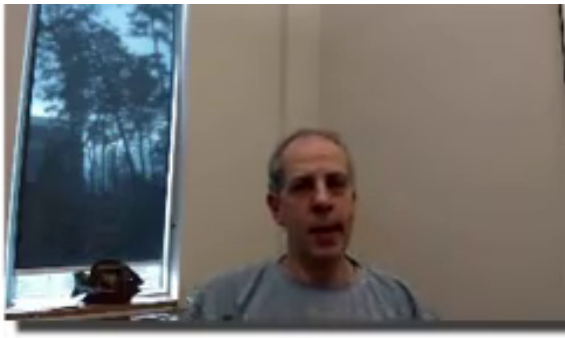


$D_F(x)$



$D_B(x)$

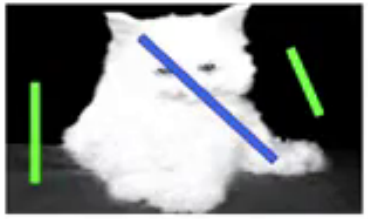
Weighted Distance Transform



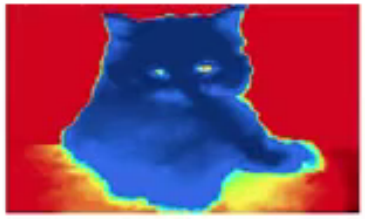
$$W := |\nabla P_F(x) \cdot \vec{C}'_{s_1,s_2}(x)|$$

$$D_l(x) := \min_{s \in \Omega_l} d(s,x), \quad l \in \{F, B\}$$

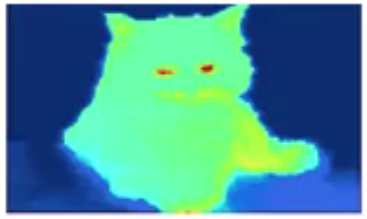
- Pixels are classified by comparing $D_F(x)$ and $D_B(x)$



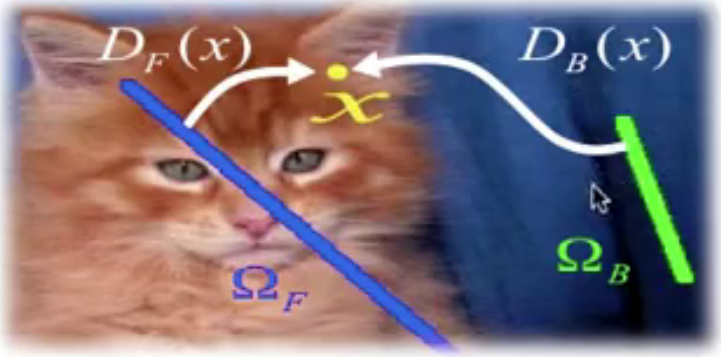
$P_F(x)$



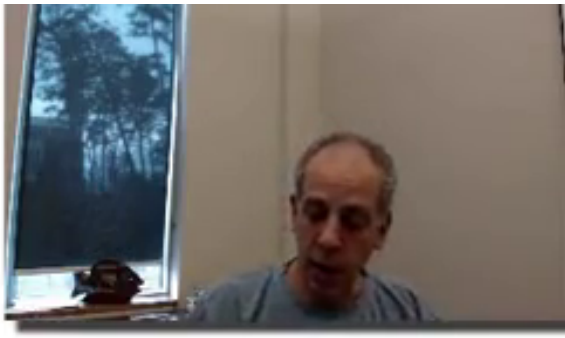
$D_F(x)$



$D_B(x)$



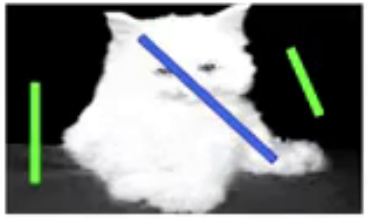
Weighted Distance Transform



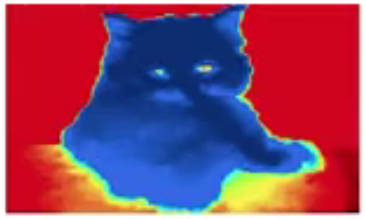
$$W := |\nabla P_F(x) \cdot \vec{C}'_{s_1,s_2}(x)|$$

$$D_l(x) := \min_{s \in \Omega_l} d(s,x), \quad l \in \{F, B\}$$

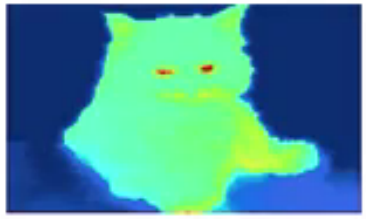
- Pixels are classified by comparing $D_F(x)$ and $D_B(x)$



$P_F(x)$



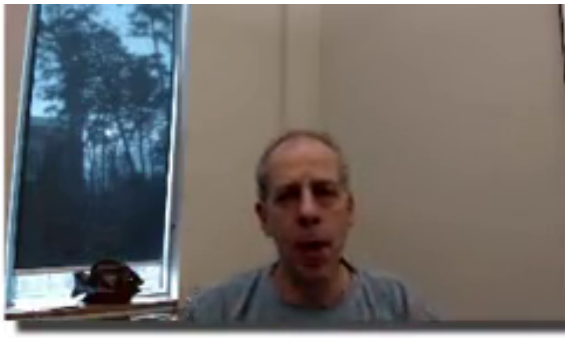
$D_F(x)$



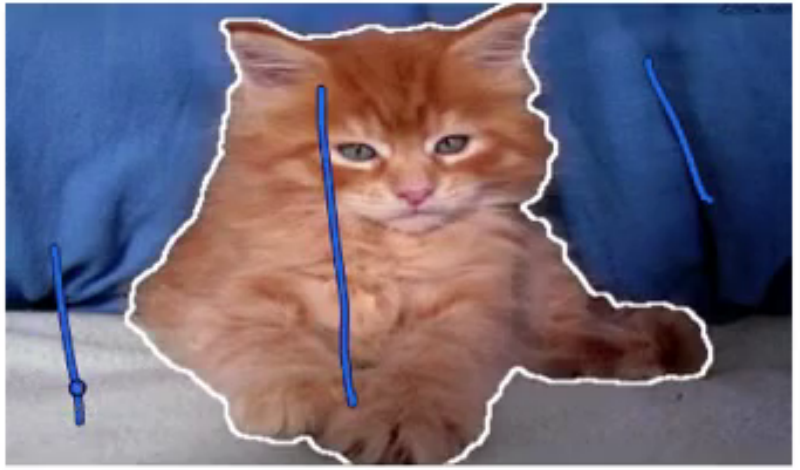
$D_B(x)$

binary segmentation

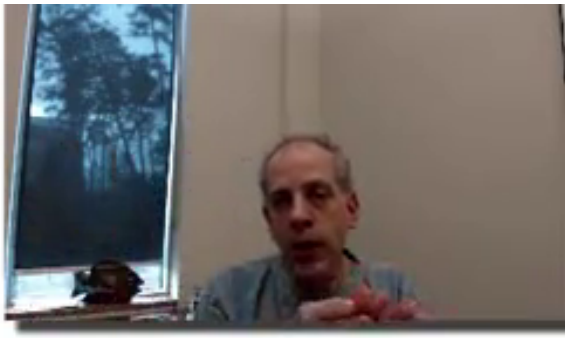
Step3 – Refine



- Automatically create a narrow band and new scribbles.
  - Band boundaries serve as “new scribbles”

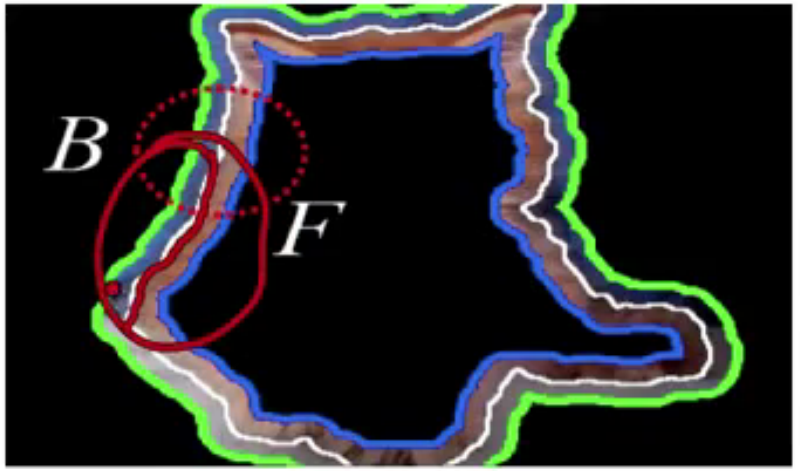


Step3 – Refine

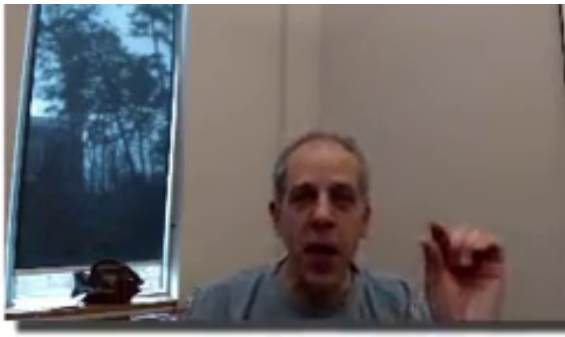


- Automatically create a narrow band and new scribbles.
  - Band boundaries serve as “new scribbles”

p_F

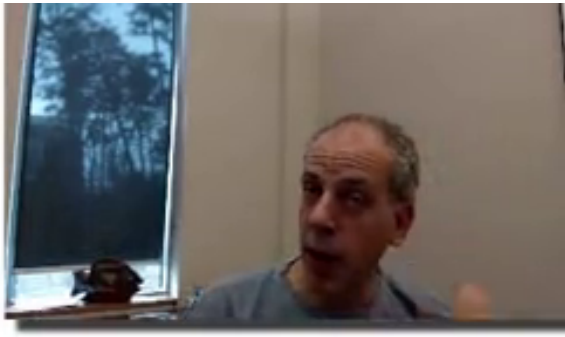


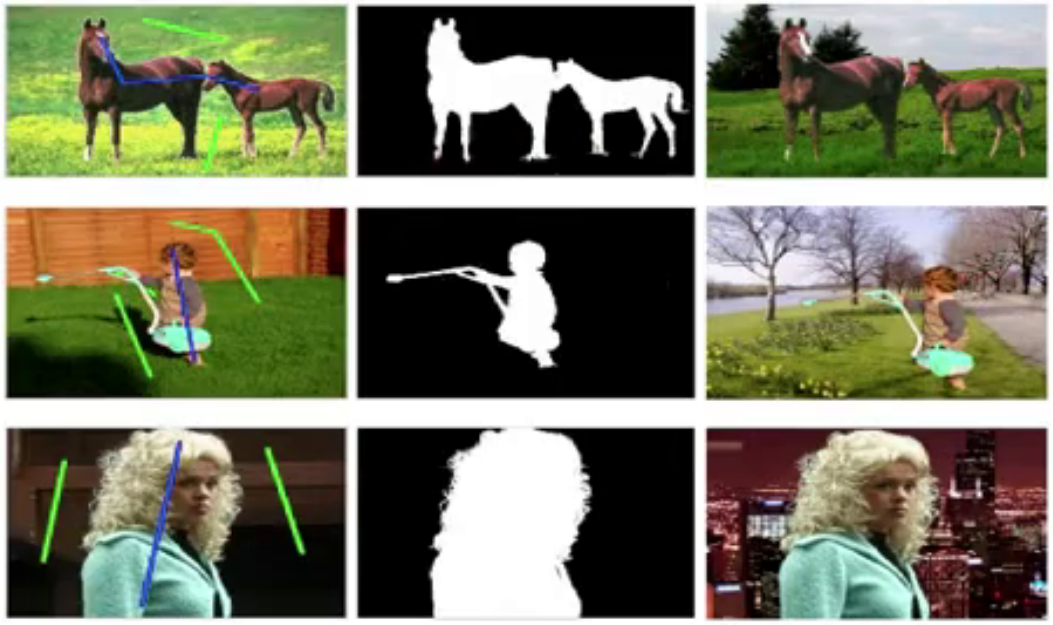
Step3 – Refine

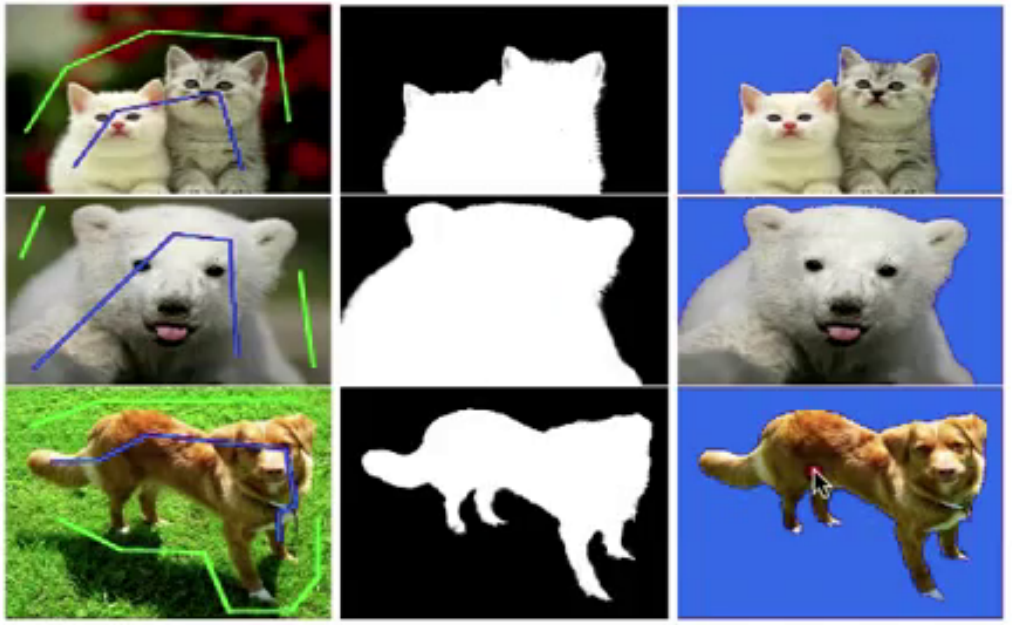


- Automatically create a narrow band and new scribbles.
  - Band boundaries serve as “new scribbles”

Examples







Scribble Robustness