Expansion Moves, Approximation Bound, and Slanted Surfaces

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CS 664 Lecture #9 Machine Vision 10/2/01

Swap moves not equal to an approximation algorithm

1	2	3

a,b,c

$$d(a,b) = d(b,c) = \frac{k}{2} \quad d(a,c) = k$$

Cost of having label a next to label b

	1	2	3
a	0	k	k
b	k	0	k
c	2	2	0

a	b	c

Total cost to have this setup is k

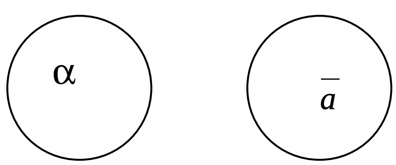
Minium cost would be to have this arrangement

c	c	c

Cost = 4

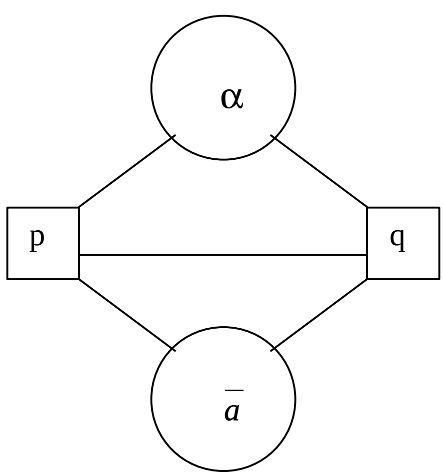
α, f

find f'=avgerage minium of E($\tilde{f}$) f when α - expansion of f



$\bar{a}$

α compete with everyone else



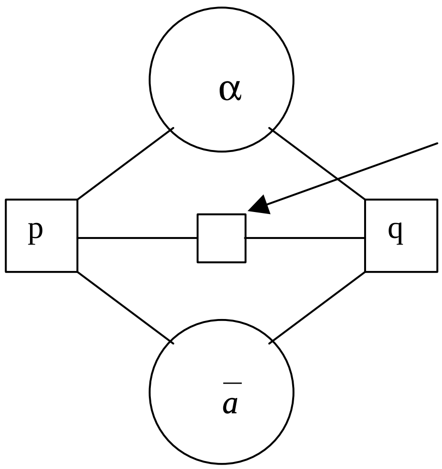
d-link costs not a problem

n-link costs are a problem

In event of assign p & q to $\bar{a}$ no n-link cost for same terminal

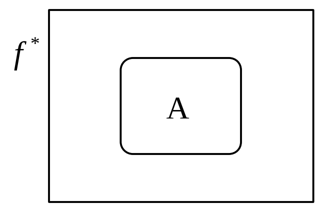
When f(p) ≠ f(q) then there is a cost

No Cost or Free f’(p) = f’(q) = α
Should be expensive when f’(p)≠f’(q)
Should be expensive when f’(p) = f’(q) = $\bar{a}$ if and only if f(p) ≠ f(q)



Edge splitting between p,q with a “gadget”

Optimality Proof



$\hat{f}$ a local minimum with respects to α - expansion for all α
f^* global minimum

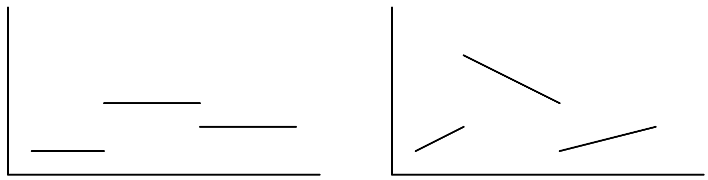
$$E(\hat{f}) \leq 2E(f^*)$$
$$A = \{p \mid f^*(p) = a\}$$

f^a expand $\hat{f}$ to make A=α
$\hat{f}$ local minimum $E(f) \leq \hat{E}(f^a)$
$E_A(f)$ = Energ involving A
data + smoothness
c(p,l) discontinuities p,q
p∈ A p or q ∈ A

$$E_A(\hat{f}) \leq E_A(f^a) \leq E_A(f^*)$$
$$\sum_A E_A(\hat{f}) \leq E_A(f^a)$$
$$E(\hat{f}) \leq E(f^*) + l\,\#disc(f^*)$$
$$E(\hat{f}) \leq 2E(f^*)$$

POTTS MODEL

Potts model prefers piecewise constant solutions



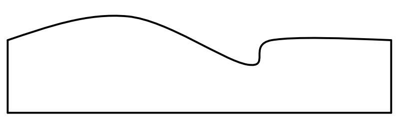
Ideal for the potts model

$\mathcal{L}$ varies

Set $\mathcal{L} = Z^+ \{0,1,..,16\}$

Sloped surface looks like connected components with segmentation

Consider each segment



Find a plane that best explains the intensities of the segment

Hypothesize a plane J that will fit this segment

Eventually, find a plane equation for the segment with a slope

These plane equations become $\mathcal{L}$

Now run again using the new label set.

One of the plane equations using the potts model will win.