Announcements

- Nebojsa Jojic talks fri, Mon Tues
- Project 1 → "plan" to me this thurs
  - Presentation (due date) Apr 23
- Office hours Wed 2:30-3:30

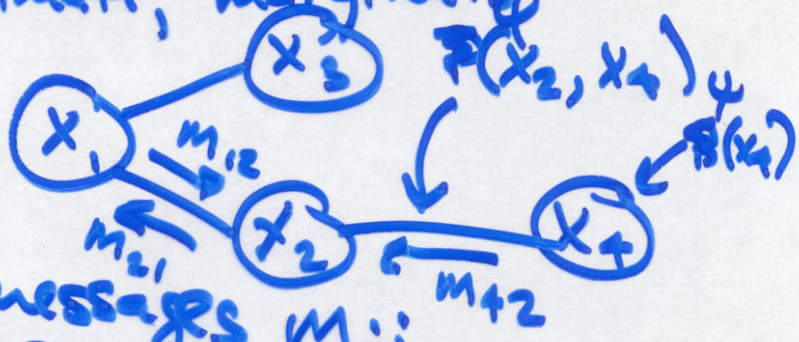
4 BP
1 EM
1 GC

TODAY

1. recap BP 2. app in vision 3. discuss

RECAP BP

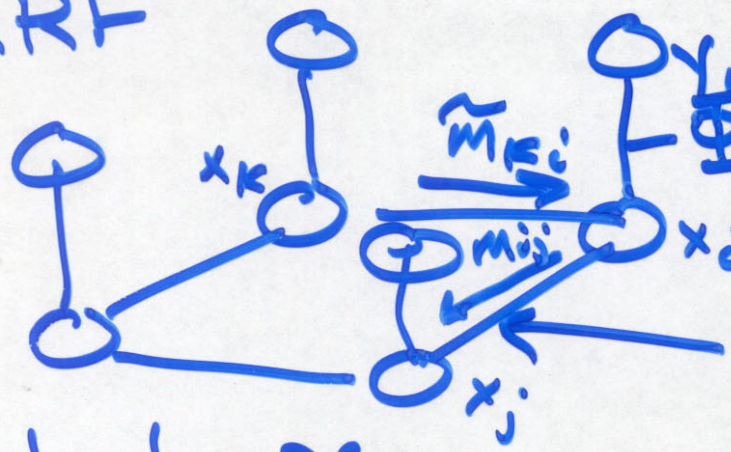
- given $x_1, \ldots, x_n$, $\psi(x_i, x_j)$ or $\psi(x_i \mid x_j)$ — ψ - potential functions
  - → inference: find most probable values
    MAP estimate, marginals
- graphical model



- solve by passing messages m_{ij}
  - repeat until fixed point
  - order is flexible → faster convergence
- no loops - provably converges to right answer
- loops - often still works

Basic formulation for vision probs (Freeman)

MRF



y_i - observation (image)

$\Phi(x_i, y_i)$ - data term

x_i - model (scene)

$\Psi(x_i, x_j)$ - neighborhood term (smoothness)

joint prob: $P(x_1, \ldots, x_n, y_1 \ldots y_n) \sim \prod \Psi(x_i, x_j) \prod \Phi(x_i, y_i)$

messages from x_i to x_j

$$m_{ij}(x_j) = \alpha \sum_{x_i} \Psi(x_i, x_j)\, \Phi(x_i, y_i) \prod_{k \in N(i) - j} \tilde{m}_{ki}(x_i)$$

(a vector) → gives info about x_j

belief of node i: $b_i(x_i) = \alpha\, \Phi(x_i, y_i) \prod_{j \in N(i)} m_{ji}(x_i)$

↑ marginal probs (sum-product alg)

MAP: replace $\sum$ with Max

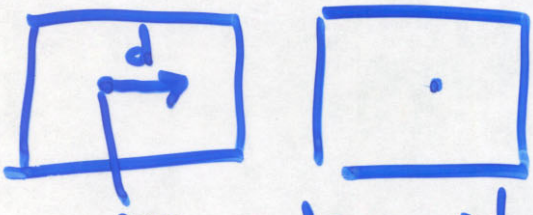
"max-product" alg

Can write these updates in matrix form (see Weiss's tree notes)

- but be careful $\begin{bmatrix} a \\ b \\ c \end{bmatrix} * \begin{bmatrix} d \\ e \\ f \end{bmatrix} = \begin{bmatrix} ad \\ be \\ cf \end{bmatrix}$

Stereo

Prob: ∀ pixels in left image find d



x_i = disparity at pixel i $\quad y_i$ = intensity diff

$\phi(x_i, y_i) = ke^{-y_i^2}$

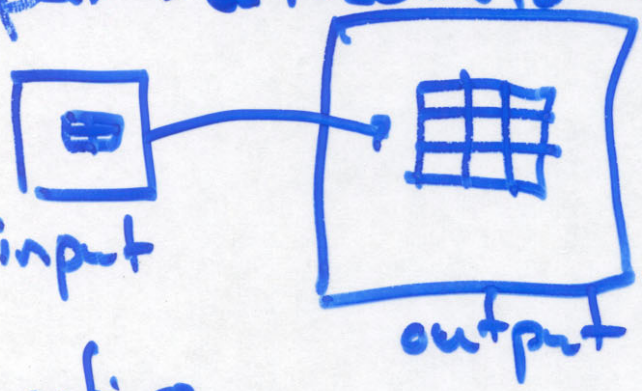
data term

$\psi(x_i, x_j) = ke^{-V(x_i, x_j)}$

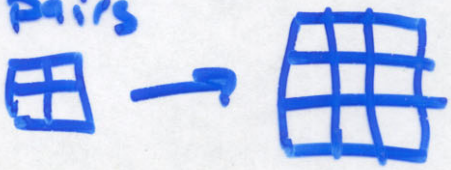
$V(x_i, x_j) = \begin{cases} 0 & \text{if } x_i = x_j \\ 1 & \text{otherwise} \end{cases}$

$f(\nabla I_i)$

Super-resolution



Train on lots of pairs



Objectives

① use training data to predict high res patch

data term $\phi(x_i, y_i) = ke^{-\|x_i - y_i\|^2}$

x_i = training patch, y_i = observed patch

② make sure neighboring patches fit together