HW3: Belief Propagation

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CS 6320 - 3D Computer Vision
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Please submit a zip file containing a PDF document (solutions to the problems).

1. You have 2 Boolean variables ($x_1, x_2 \in \{0, 1\}$) and 3 equations as shown below:

$$\begin{aligned} 2x_1 - 3x_2 &= -3 \\ x_1 + 5x_2 &= 5 \\ 6x_1 - 4x_2 &= -4 \end{aligned}$$

   Show the factor graph and use Belief propagation to solve the equations. Please show the messages in each iteration till the algorithm terminates. [50 points]

2. You are given two images: I1 (2x2 pixel grid) and I2 (2x3 pixel grid) as shown in Figure 1. Find the match for every pixel in the first image I1. Every pixel $p(x, y)$ in I1 can be matched to a pixel $p'(x, y)$ or $p'(x + 1, y)$ in I2. In other words, every pixel in I1 can have only two disparity states $[0, 1]$: 0 when $p(x, y)$ is matched to $p'(x, y)$, and 1 when $p(x, y)$ is matched to $p'(x + 1, y)$. The unary for a pixel $p(x, y)$ (cost function that depends only on a single pixel in I1) is given by:
   $U(0) = |p(x, y) - p'(x, y)|,\ U(1) = |p(x, y) - p'(x + 1, y)|$
   The pairwise function depends on the states of two nearby pixels (in the image I1) and is given by:
   $P(0, 0) = 0,\ P(0, 1) = 10,\ P(1, 0) = 10,\ P(1, 1) = 0$
   Use Belief propagation to solve the matching problem. Please show the messages in each iteration till the algorithm terminates. [50 points]

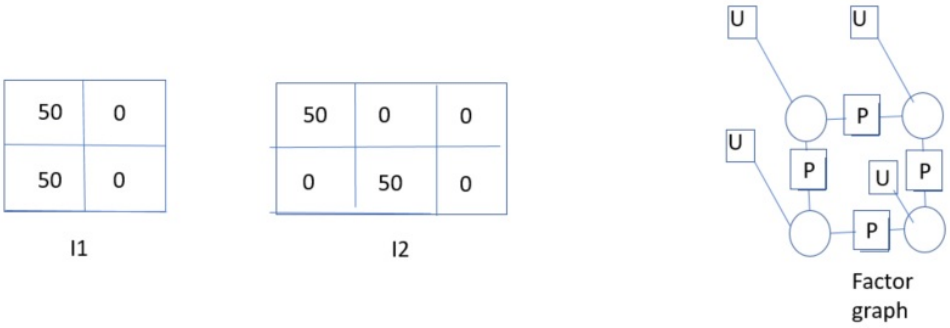

Figure 1: