GIVEN THE ABOVE POSSIBLE CONDITIONAL PROBABILITY DENSITIES, THE PROBABILITY OF CORRECT EDGE DETECTION IS

\[ P_{\text{det}} = \int_{G_t} P(G|\text{edge}) dG, \]

WHERE \( G_t \) IS A CHosen THRESHOLD. THE PROBABILITY OF FALSE EDGE DETECTION IS

\[ P_{\text{false}} = \int_{G_t} P(G|\text{no edge}) dG, \]

THE PROBABILITY OF MISCLASSIFYING (correct for false or false for correct) IS

\[ P_e = [1 - P_{\text{det}}] P(\text{edge}) + P_{\text{false}} P(\text{no-edge}). \]

\( P_e \) IS MINIMIZED USING THE MAXIMUM LIKELIHOOD TEST (BAYES DECISION RULE) IF \( G_t \) (THRESHOLD) IS CHosen SUCH THAT AN EDGE IS DETERMINED TO BE PRESENT WHEN

\[ \frac{P(G|\text{edge})}{P(G|\text{no-edge})} \geq \frac{P(\text{no-edge})}{P(\text{edge})}. \]

THE NEYMAN-PEARSON DECISION STRATEGY APPROACH IS TO SELECT AN ACCEPTABLE FIXED \( P_{\text{false}} \) AND ASSOCIATED \( G_t \) THAT MINIMIZES \( P_e \).

THE MAIN DIFFICULTY IS DETERMINING THE CONDITIONAL PROBa.

FURTHERMORE, AS THE ILLUMINATION VARIES OVER THE IMAGE, THE \( G_t \)'S SHIFT. ALSO, GRADIENT WORKS GENERATE NOISE. THE IMAGE MAY NEED TO BE SMOOTHED (LOW PASS FILTERED) OR MEDIAN FILTERED PRIOR TO USING A GRADIENT (DERIVATIVE/ LAPLACIAN) FILTER. INCREASING THE FILTER SIZE MAY BE SUFFICIENT.
3. 25 pts.
(a) Find the image resulting from application of the given 2x2 window to the given 4x4 image.
(b) What type of operator is this, what is, in general, the result of its application to the image, and what is its strength and weakness?

\[
\begin{array}{cc}
-2 & 1 \\
1 & 0 \\
\end{array}
\]

\[
\begin{array}{cccc}
30 & 35 & 40 & 45 \\
25 & 30 & 35 & 40 \\
20 & 25 & 30 & 35 \\
20 & 25 & 30 & 35 \\
\end{array}
\]

(A)

\[
\begin{array}{cccc}
0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 \\
1 & 5 & 5 & 1 \\
0 & 0 & 0 & 0 \\
\end{array}
\]

Appears that we have horizontal edge detected.

\[I_{i,j} \rightarrow h, \quad h = \text{pixel intensity}\]

Type: Unbiased op. - Not derivative

Application: Edge detector (possibly) (Isotropic)

Strength: Seems to work well for all edge directions

Weaknesses: (1) Magnifies noise (All擅长用PS 2013)
(2) Can't tell direction of edge formation (Isotropic)