Naive Bayes model is built on the assumption of conditional independence.

If we have 2 pixels x_i and x_j, $i \neq j$,

x_i and x_j are independent given $C=c$.

So I agree with $p(x_i, x_j \mid c) = p(x_i \mid c)\, p(x_j \mid c)$

But x_i and x_j are marginal independent if $p(x_i, x_j) = p(x_i)\, p(x_j)$

Now we marginalize over C. C is the class from 0 to 9

$$
\begin{aligned}
p(x_i, x_j) &= \sum_{C=0}^{9} p(x_i, x_j, c) \\
&= \sum_{C=0}^{9} p(x_i, x_j \mid c)\, p(c) \\
&= \sum_{C=0}^{9} p(x_i \mid c)\, p(x_j \mid c)\, p(c) \quad \text{by conditional independence}
\end{aligned}
$$

we notice that

$$
\begin{aligned}
p(x_i)\, p(x_j) &= \sum_{C=0}^{9} p(x_i, c) \sum_{C=0}^{9} p(x_j, c) \\
&= \sum_{C=0}^{9} p(x_i \mid c)\, p(c) \sum_{C=0}^{9} p(x_j \mid c)\, p(c) \quad \text{by Bayes' Rule} \\
&\neq \sum_{C=0}^{9} p(x_i \mid c)\, p(x_j \mid c)\, p(c) = p(x_i, x_j)
\end{aligned}
$$

Therefore we conclude that

$$p(x_i, x_j) \neq p(x_i)\, p(x_j)$$

So x_i x_j are not marginally independent