Here was the attempted clarification of eq.(2.32) from text in class:

\[
\frac{1}{2^n} \sum_{0 \leq x < 2^n} (-1)^{x \cdot z} = \frac{1}{2^n} \sum_{x_{n-1}=0}^{1} \sum_{x_{n-2}=0}^{1} \cdots \sum_{x_0=0}^{1} (-1)^{x_{n-1}z_{n-1} + \cdots + x_0z_0} \\
= \frac{1}{2} \sum_{x_{n-1}=0}^{1} (-1)^{x_{n-1}z_{n-1}} \cdots \frac{1}{2} \sum_{x_0=0}^{1} (-1)^{x_0z_0} \\
= \frac{1}{2} (1 + (-1)^{z_{n-1}}) \cdots \frac{1}{2} (1 + (-1)^{z_0}) \\
= \delta_{z_{n-1},0} \cdots \delta_{z_0,0} \\
= \delta_{z,0}
\]

Equivalently,

\[
\frac{1}{2^n} \sum_{0 \leq x < 2^n} (-1)^{x \cdot z} = \frac{1}{2^n} \sum_{x_{n-1}=0}^{1} \sum_{x_{n-2}=0}^{1} \cdots \sum_{x_0=0}^{1} (-1)^{x_{n-1}z_{n-1} + \cdots + x_0z_0} \\
= \prod_{i=0}^{n-1} \frac{1}{2} \sum_{x_i=0}^{1} (-1)^{x_i z_i} \\
= \prod_{i=0}^{n-1} \frac{1}{2} (1 + (-1)^{z_i}) \\
= \prod_{i=0}^{n-1} \delta_{z_i,0} \\
= \delta_{z,0}
\]

For \( n = 2 \), that looks like

\[
\frac{1}{2^2} \sum_{0 \leq x < 2^2} (-1)^{x_0z_0 + x_1z_1} = \frac{1}{4}((-1)^0 + (-1)^{z_0} + (-1)^{z_1} + (-1)^{z_0 + z_1}) \\
= \frac{1}{4} \sum_{x_1=0}^{1} \sum_{x_0=0}^{1} (-1)^{x_1z_1 + x_0z_0} \\
= \frac{1}{2} \sum_{x_1=0}^{1} (-1)^{x_1z_1} \frac{1}{2} \sum_{x_0=0}^{1} (-1)^{x_0z_0} \\
= \frac{1}{2} (1 + (-1)^{z_1}) \frac{1}{2} (1 + (-1)^{z_0}) \\
= \delta_{z_1,0} \delta_{z_0,0} \\
= \delta_{z,0}
\]