1. Let $X \subset \mathbb{R}^n$ be a finite set with the property that the pairwise distance between any two points of X are all the same. Prove that $|X| \leq n+1$.

2. A *spherical two distance set* of $\mathbb{R}^n$ is a two distance set all of whose vectors have unit length. Using a modification of the method that was done in class, prove that maximal number of such a set $\alpha(n)$ is $\leq n(n+3)/2$.

3. Let $A_1, A_2..., A_m$ be k element subsets of $\{1, 2, 3..., n\}$. Assume that their pairwise intersection have only two sizes (i.e., $|A_i \cap A_j|$ can take only two values). Prove that $m \leq 1 + n(n+1)/2$.

4. Let $x \in \mathbb{F}_2^n$ be a non-zero vector. Show that it is orthogonal to exactly half of vectors in $\mathbb{F}_2^n$ ($\mathbb{F}_2$ is the two element field, and the inner product is the usual one inherited from $\mathbb{R}^n$).