Each problem below is worth one failed assignment.

1. **Non-Uniform Sampling with Replacement** (1 bonus point)

   Given a finite set $A = \{a_1, a_2, \ldots, a_n\}$ and a vector of probabilities of the same size $p = (p_1, p_2, \ldots, p_n)$, a non-uniform sample of size $m$ with respect to probabilities $p$ is a set $S$ of size $m$ where for each $s$ in $S$, $P[s = a_i] = p_i$.

   Write a function that accepts two arrays, corresponding to $A$ and $p$ above and an integer $m$ and produces a non-uniform sample from set $A$ with respect to $p$ of size $m$. Verify that your function by checking that for large $m$ the proportion of $S$ equaling $a_i$ is approximately $p_i$.

2. **Kernel Density Estimation in 2D** (1 bonus point)

   Create a function that will compute a two dimensional KDE given two arrays, $x$ and $y$ and a bandwidth. Use a bivariate gaussian kernel. The bandwidth in this case will be the common diagonal variance of the gaussian kernel.