DS 221: Introduction to Scalable Systems
Mid Term Exam 1
Answer Keys

1. Find the diameter and bisection width of:
   a. 6-D torus

   - Diameter: The diameter in a torus network corresponds to the path from the center of the space to a corner. **Ans:** $6P^{1/6}$.
   - Bisection width: Can be found using induction. For 2D, it is $P^{1/2}$. For 3D: $P^{2/3}$. For 6D: $P^{5/6}$.

   b. a 9-D hypercube.

   - Diameter: Number of bits = number of dimensions = **9**.
   - Bisection width: $P/2 = 2^9/2 = \mathbf{256}$.

2. Pictorial illustration of a 2D matrix decomposition using a 2×4 process grid in which the row dimension is divided using the block distribution and the column dimension is divided using a block cyclic distribution.

P_0	P_1	P_2	P_3	P_0	P_1	P_2	P_3	$\cdots$	$\cdots$
P_4	P_5	P_6	P_7	P_4	P_5	P_6	P_7	$\cdots$	$\cdots$
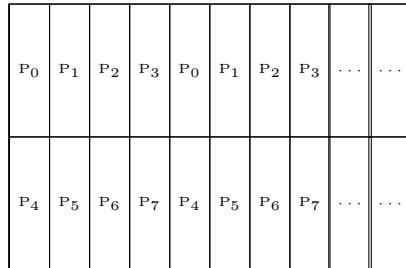
3. Pseudo code for solver - **Straightforward**.

4. Reducing the space complexity of directory scheme - **Using tagged directory scheme - i.e., reducing both the number of cache line and number of presence bits**.

5. Mapping of LU decomposition and assignment to processors.