1. Consider a non-leaf node of a $B^+$-tree index on an integer attribute with three pointers.
   (a) (2 points) Give a set (possibly empty) of values (not pointers) that might be in the node.

   (b) (6 points) For each pointer, describe to what it points.

2. (4 points) What does ACID stand for?

3. (4 points) What does BASE stand for?

4. (4 points) Explain the CAP theorem.
5. (4 points) Consider a $k$-nn classification problem where $n$ is the number of items in the dataset. If $k > n$, what can we say about the prediction of a new item $i$? Why?

6. (4 points) Consider the set of elements $\{A, B, C, D, E\}$. Assume $\{A, B, C\}$ is a large 3-item set. List all known large item sets.

7. (3 points) What is the canonical algorithm for clustering?

8. (4 points) Assume a recommender system has users rate items on a 1-5 scale. Before any ratings are made on an item, what would be a reasonable prediction for how user $u$ would like the item?

9. (3 points) What is TF-IDF?

10. (3 points) When does dynamic hashing increase the size of the hash table?
11. (8 points) Write a single SQL query to find for every hero the name of the last quest completed. Output the name of the hero and the quest.

12. (8 points) Write a single SQL query to find the player login and quest names such that all of that player’s heroes have completed that quest.

13. (8 points) Write a single SQL query to find the names of each quest and all of the heroes who have not completed that quest.
14. (10 points) Draw an ER diagram representing faculty. Faculty can be tenure-track or lecturer, but not both. All faculty have a university ID and a name. Tenure-track faculty have a boolean tenured attribute and a research area. Lecturers have a contract length attribute. Tenure-track faculty mentor other tenure-track faculty. One mentor can lead many faculty, but each faculty has exactly one mentor.
15. (10 points) Consider a relation \( R = (A, B, C, D, E) \) and the set of functional dependencies \( \mathcal{F} = \{ AB \to CDE, E \to A \} \).

(a) (5 points) List all of the candidate keys of \( R \).

(b) (10 points) Construct a BCNF decomposition. Prove whether or not your decomposition is DP.