Guidelines: Please justify all answers in a succinct (yet complete) manner. In particular, when presenting an algorithm the code if any should be presented at a high level. A full algorithm will contain the input, the output, and any loop invariants.

1. Linear Algebra
   Suppose that you are given the vectors \( P_1, \ldots, P_k \in \mathbb{R}^d \) that define the subspace
   \[
   W = \{ \alpha_1 P_1 + \cdots + \alpha_k P_k \mid \alpha_i \in \mathbb{R} \}
   \]
   show how to write \( W \) as the solution to a set of linear constraints, i.e.
   \[
   W = \{ x \in \mathbb{R}^d \mid Ax = 0 \}
   \]
   Suppose you are given a subspace as a set of constraints \( Ax = 0 \) show how one could write it as a set of generators.

2. Convex Closure
   We said that a set \( C \subset \mathbb{R}^d \) is convex if for any two points \( p \) and \( q \) in \( C \) the line segment \([p,q]\) is contained in \( C \). Let \( Q = \{ P_1, \ldots, P_k \} \subset \mathbb{R}^d \).
   In class we defined to objects:

   **Definition 0.1.** (a) The convex closure \( CC(Q) \) to be the smallest convex set containing \( Q \).

   (b) \( ConvexComb(Q) = \{ \alpha_1 p_1 + \cdots + \alpha_k p_k \mid \alpha_1 + \cdots + \alpha_k = 1 \text{ and } \alpha_i \geq 0 \} \)

   Show that \( CC(Q) = ConvexComb(Q) \).

3. Line Segment Intersection Test
   As pointed out in class to test proposed in class in the case when to two segments are co-linear the test may fail, bug 162082.
   Describe the problem and a solution.