In this homework assignment, we work on convex set examples including Voronoi diagram (2.7, 2.9), quadratic function (2.10), general sets (2.12), probability (2.15) and dual cones (2.30). The first assignment reviews the concept of the null space in linear algebra. The second assignment works on the set enumeration. The last two assignments utilize Matlab to practice the set operations. The six exercises worth 1 point each (graded by completion). The first two assignment worth 3 points each (graded by content). The last two assignment worth 4 points each (graded by content). Thus, the total points are 20.

I Exercises from textbook chapter 2: 2.7, 2.9, 2.10, 2.12, 2.15, 2.30

II Assignments

II. 1. Range and Null space: Given an expression $Ax$ where 
\[
A = \begin{pmatrix}
2 & 4 & 6 & 8 & 1 \\
1 & -1 & 2 & 0 & -1 \\
3 & 0 & 7 & 4 & 0
\end{pmatrix}
\]
Identify the null space of $A$ and $A^T$. Express your solution with the basis of the space.

II. 2. Implicit and explicit description of the convex set. Given set $\{x|Ax \leq b\}$ where the equation $Ax \leq b$ is described as follows.
\[
\begin{align*}
-x_1 + 5x_2 & \leq 8 \\
4x_1 - x_2 & \leq 6 \\
-x_2 & \leq 2 \\
-6x_1 - 5x_2 & \leq 13
\end{align*}
\]
Express the set with explicit enumeration of a basis.

II. 3. Use Matlab or other mathematical tools to implement. Find the range and null space of matrix $A = \begin{pmatrix}
1 & 1 & 2 \\
2 & 2 & 4 \\
2 & 3 & 5
\end{pmatrix}$ and its transpose. Validate the results with your own calculation.

II. 4. Use Matlab or other mathematical tools to implement. Find the range and null space of matrix $A = \begin{pmatrix}
1 & 1 & 1 & 1 & 0 \\
1 & 1 & 0 & -1 & 0 \\
0 & -1 & 1 & 1 & 1 \\
1 & 0 & 1 & 0 & 1
\end{pmatrix}$ and its transpose. Validate the results with your own calculation.