PS2B: Geometry Problem Set for Week 2

Help

The **due date** for this homework is **Mon 17 Nov 2014 3:00 PM CST**.

The quiz concerns the following polyhedron:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

☐ **In accordance with the Coursera Honor Code, I (Kevin Zhu) certify that the answers here are my own work.**

Question 1

Write down the ID of the constraints that are activated by the point $(0.8, 0.4, 1.6)$?

For instance, if you decide that your answer is C_1, C_2, C_4, enter ``1 2 4" separated by spaces.

Question 2

Select all the correct properties of the point $(0.8, 0.4, 1.6)$. The polyhedron is recalled here:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

- Determine how many constraints it activates.
- Determine the rank of the activated constraints.
- Is it feasible?
- Is it a vertex?

Answer the questions below.

- [ ] It is not a vertex of the polyhedron
- [ ] Rank of the activated constraints is 2
- [ ] It activates 3 constraints.
- [ ] It activates just a single constraint
- [ ] The rank of the activated constraints is 3.
- [ ] It activates no constraint
- [ ] It is a vertex of the polyhedron.
- [ ] It is not a feasible point
- [ ] It is feasible.

Question 3

We consider a point that activates the constraints $\{C_1, C_2, C_3\}$, i.e, lies at the intersection of the faces represented by C_1, C_2, C_3. We recall the polyhedron below for your convenience:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

Which of the following are true:

- The faces represented by C_1, C_2, C_3 intersect at $v_1 : (0, 0, 0)$ but this is not a vertex of the polyhedron.
- The faces represented by C_1, C_2, C_3 intersect at $v_1 : (0.8, 0.4, 0.6)$ and a vertex of the polyhedron.
- The faces represented by C_1, C_2, C_3 intersect outside the polyhedron.
- The faces represented by C_1, C_2, C_3 can never be made to intersect each other.

Question 4

We consider a point that activates the constraints $\{C_1, C_2, C_5\}$, i.e, lies at the intersection of the faces represented by C_1, C_2, C_5. We recall the polyhedron below for your convenience:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

Which of the following are true:

- The faces intersect at the point $(0.8, -0.3, 2.5)$.
- The faces intersect at a point that is outside the polyhedron.
- The faces do not intersect at a point.
- The faces intersect at a vertex $(1, -2, 0)$.

Question 5

We consider a point that activates the constraints $\{C_2, C_4, C_5\}$, i.e, lies at the intersection of the faces represented by C_2, C_4, C_5. We recall the polyhedron below for your convenience:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

Which of the following are true:

- The faces do not intersect
- The faces intersect but outside the polyhedron.
- The faces intersect at a point that is a vertex of the polyhedron.

Question 6

Which of the following directions is a ray of the polyhedron? We recall the polyhedron below for your convenience:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

- $(0,1,0)$
- $(1,-1,1)$
- $(-1,0,1)$
- $(-1,2,0)$
- $(-2,-1,0)$

Question 7

Consider the vertex v_1 that activates constraints $\{C_1, C_2, C_3\}$. Select all the adjacent vertices. We recall the polyhedron below for your convenience:

$$\begin{array}{rrrcll} x & +2y & -z & \leq & 1 & \leftarrow C_1 \\ 2x & +y & & \leq & 2 & \leftarrow C_2 \\ x & -2y & & \leq & 0 & \leftarrow C_3 \\ & y & -2z & \leq & 3 & \leftarrow C_4 \\ x & -y & +z & \leq & 2 & \leftarrow C_5 \end{array}$$

- $(0.8,0.4,1.6)$
- $(0,0,0)$
- $(1,0.5,-0.5)$
- $(0.2,0.2,0.2)$
- $(0.8,0.4,0.6)$

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