1. Contact Information
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2. Abstract
The polyhedral unfolding problem can be described as follows: Can a polyhedron in $\mathbb{R}^3$ be unfolded into a simple polygon in $\mathbb{R}^2$? A vertex unfolding finds a solution such that the faces are connected at vertices, but the interiors are potentially disjoint. In the paper Vertex Unfoldings of Simplicial Manifold, the authors present such a method for any triangulated two-manifold. We have implemented this algorithm, and we have also explored the possibility of reconnecting disjoint interiors. Our modular implementation of this algorithm incorporates the areas of geometry, topology, numerical analysis, graph theory, visualization, and software engineering. In this talk, we investigate the implications of a concrete application of computational mathematics, and introduce an open problem in computer science.

3. Discussion Problem
A triangle is defined by three vertices. Suppose we have a list of faces (as in Table 2) and a list of vertex coordinates (such as the list in Table 1). These triangles are embedded in $\mathbb{R}^3$, as shown in Figure 1. Consider the following alternating ordering of the triangles and vertices:
Table 1. The coordinates of the vertices

<table>
<thead>
<tr>
<th></th>
<th>x</th>
<th>y</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>v1</td>
<td>40.6266</td>
<td>28.3457</td>
<td>-1.10804</td>
</tr>
<tr>
<td>v2</td>
<td>40.0714</td>
<td>30.4443</td>
<td>-1.10804</td>
</tr>
<tr>
<td>v3</td>
<td>40.7155</td>
<td>31.1438</td>
<td>-1.10804</td>
</tr>
<tr>
<td>v4</td>
<td>42.0257</td>
<td>30.4443</td>
<td>-1.10804</td>
</tr>
<tr>
<td>v5</td>
<td>43.4692</td>
<td>28.3457</td>
<td>-1.10804</td>
</tr>
<tr>
<td>v6</td>
<td>37.5425</td>
<td>28.3457</td>
<td>14.5117</td>
</tr>
<tr>
<td>v7</td>
<td>37.0303</td>
<td>30.4443</td>
<td>14.2938</td>
</tr>
<tr>
<td>v8</td>
<td>37.6244</td>
<td>31.1438</td>
<td>14.5466</td>
</tr>
<tr>
<td>v9</td>
<td>38.8331</td>
<td>30.4443</td>
<td>15.0609</td>
</tr>
<tr>
<td>v10</td>
<td>40.1647</td>
<td>28.3457</td>
<td>15.6274</td>
</tr>
<tr>
<td>v11</td>
<td>29.0859</td>
<td>28.3457</td>
<td>27.1468</td>
</tr>
<tr>
<td>v12</td>
<td>28.6917</td>
<td>30.4443</td>
<td>26.7527</td>
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<tr>
<td>v13</td>
<td>29.1490</td>
<td>31.1438</td>
<td>27.2099</td>
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<tr>
<td>v14</td>
<td>30.0792</td>
<td>30.4443</td>
<td>28.1402</td>
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<tr>
<td>v15</td>
<td>31.1041</td>
<td>28.3457</td>
<td>29.1650</td>
</tr>
<tr>
<td>v16</td>
<td>16.4508</td>
<td>28.3457</td>
<td>35.6034</td>
</tr>
</tbody>
</table>

Table 2. The face information

<table>
<thead>
<tr>
<th></th>
<th>v7</th>
<th>v6</th>
<th>v1</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1</td>
<td>v7</td>
<td>v6</td>
<td>v1</td>
</tr>
<tr>
<td>f2</td>
<td>v1</td>
<td>v2</td>
<td>v7</td>
</tr>
<tr>
<td>f3</td>
<td>v8</td>
<td>v7</td>
<td>v2</td>
</tr>
<tr>
<td>f4</td>
<td>v2</td>
<td>v3</td>
<td>v8</td>
</tr>
<tr>
<td>f5</td>
<td>v9</td>
<td>v8</td>
<td>v3</td>
</tr>
<tr>
<td>f6</td>
<td>v3</td>
<td>v4</td>
<td>v9</td>
</tr>
<tr>
<td>f7</td>
<td>v10</td>
<td>v9</td>
<td>v4</td>
</tr>
<tr>
<td>f8</td>
<td>v4</td>
<td>v5</td>
<td>v10</td>
</tr>
<tr>
<td>f9</td>
<td>v12</td>
<td>v11</td>
<td>v6</td>
</tr>
<tr>
<td>f10</td>
<td>v6</td>
<td>v7</td>
<td>v12</td>
</tr>
<tr>
<td>f11</td>
<td>v13</td>
<td>v12</td>
<td>v7</td>
</tr>
<tr>
<td>f12</td>
<td>v7</td>
<td>v8</td>
<td>v13</td>
</tr>
</tbody>
</table>

\[ f_{12} - v_{13} - f_{11} - v_{12} - f_{9} - v_{6} - f_{10} - v_{7} - f_{1} - v_{1} - f_{2} - v_{7} - f_{3} - v_{2} - f_{4} - v_{8} - f_{5} - v_{3} - f_{6} - v_{9} - f_{7} - v_{4} - f_{8} \]

This is an ordering such that between two consecutive faces, there is a vertex that is incident on both faces. We wish to embed these faces in \( \mathbb{R}^2 \) such that the chain above remains a connected chain in the embedding, but none of the faces overlap. How can we do this?
4. Questionaire

Question 4.1. What year are you and what is your major?

Question 4.2. Did Brittany speak clearly and convey the material in an understandable manner?

Question 4.3. Did David speak clearly and convey the material in an understandable manner?

Question 4.4. If you attempted to read the paper before class, what was your initial reaction to reading it?

Question 4.5. What is one thing that you learned during this talk?

Question 4.6. What is one thing that we could have done better during this presentation?

Question 4.7. Would you be interested in taking a class that explored different research areas and involved a large project such as the one described in today’s talk?

Question 4.8. Is polyhedra unfolding as an interesting problem for you?

Question 4.9. Do you have any other comments/questions/suggestions?