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Maya API (http://www.stepanjirka.com/category/maya-api/) / 14 Jun 2016

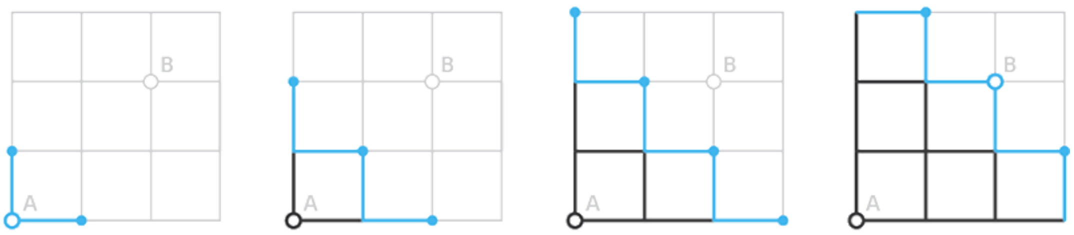
Maya API: Shortest path between vertices

Have you ever wondered how to find the shortest path between vertices on mesh? I have. Here's the code.

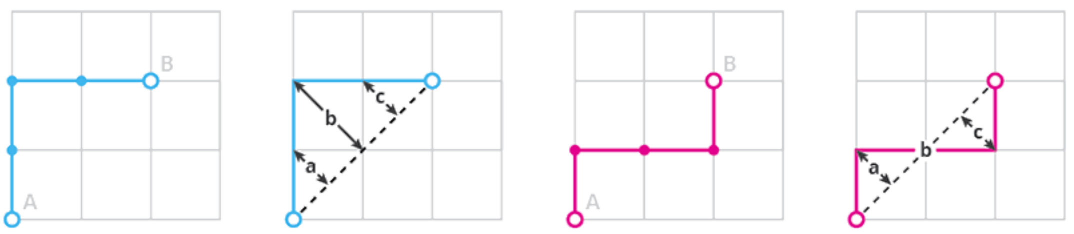
I have recently decided to update few of my custom Maya tools from MEL to API. The most useful one, Planarize Edge Tool, was frankensteined from ZenTools (https://www.creativecrash.com/maya/script/zentools), which contains all sort of useful functions for with vertices. Now that I moved to C++, I had to come up with my own solution for finding the shortest path between multiple vertices I could do that, I needed to cover a simple two-point scenario.

Shortest path between two vertices

Lets say we have even square mesh and vertices A and B. Since all edges have the same length (weight), the shortest path between A and B will be the one with least iterations. In the following example it is four. In every iteration the path grafts to all connected point increasing the search radius until the end vertex is reached.



As you probably noticed, this method itself does't produce a single path, rather a whole tree. To narrow it down we have to apply son Following illustration shows two paths, both are results of the previous example. By measuring deviation of each path from a straight between the two end-vertices, we can figure out which one is the most "direct" path. As you can see total deviation (a+b+c) is smaller the second path. The deciding factor could be actually anything – corner angle, edge length, vertex index or color.



Implementation

We begin by initializing the storage variables and by extracting the base mesh and the end vertices from active selection.

```
MDagPath m_path;
MStringArray m_pointPath;
MDoublePath m_pathDev;
int iterCounter;

// Get info about selected mesh and vertices
MSelectionList selectionList;
status = MGlobal::getActiveSelectionList(selectionList, true);

MObject component;
status = selectionList.getDagPath(0, m_path, component);
```

Now we have to convert the vertex data in correct format. For certain operations we'll use vertices in form of a component object, in cases it is easier to work with vertex indices in numeric format.

```
// Extracting vertices from component
MIntArray indices;

MFnSingleIndexedComponent componentFn(component);
status = componentFn.getElements(indices)

MFnSingleIndexedComponent startVertexFn();
```

```
startVertex.create(MFn::kMeshVertComponent, &status);
startVertexFn.addElement(indices[0]);

// Finally calling the main function
MString shortestPath;
status = extendPath(startVertexFn.object(), indices[0], indices[1], shortestPath);
```

‘Inception’

The *extendPath* function does all the magic thanks to *MItMeshVertex::getConnectedVertices()* method, which lists point on the other s
each edge connected to given vertex. In the first loop we call this function using the start point, in every next round it uses vertices co
in the previous iteration. This repeats until we reach the target vertex. It is a good idea to limit the number of iterations to number of a
vertices, to prevent infinite loop. Notice how we use the path deviation to choose between multiple paths pointing to the same vertex

```
inline MStatus extendPath(MObject& component, const int& start, const int& target, MString& path)
{
    MStatus status(MStatus::kSuccess);

    MFnMesh meshFn(m_path, &status);

    // Iteration counter to prevent infinite loop
    iterCounter++;
    if( iterCounter >= meshFn.numVertices() )
        return MStatus::kFailure;

    // This component will store vertices for next iteration
    MFnSingleIndexedComponent compList;
    compList.create(MFn::kMeshVertComponent, &status);

    MItMeshVertex vertexIt(m_path, component, &status);
    for (vertexIt.reset(); !vertexIt.isDone(); vertexIt.next())
    {
        int parentIndex = vertexIt.index();

        // Graft path to all connected vertices
        MIntArray connected;
        vertexIt.getConnectedVertices(connected);

        for (unsigned c = 0; c < connected.length(); c++)
        {
            int index = connected[c];

            // Calculate deviation between path and direct line between end vetices
            MPoint first;
            MPoint parent;
            MPoint last;
            status = meshFn.getPoint(start, first, MSpace::kWorld);
            status = meshFn.getPoint(parentIndex, parent, MSpace::kWorld);
            status = meshFn.getPoint(target, last, MSpace::kWorld);
            double deviation = pointLineDistance(parent, first, last) + m_pathDev[parentIndex];

            // In case we already have a shorter path to current vertex, ignore the new one
            if (deviation >= m_pathDev[index] && m_pointPath[index].numChars()>0)
                continue;

            // Extend path to current vertex
            m_pathDev[index] = deviation;
            m_pointPath[index] = m_pointPath[parentIndex] + parentIndex + ";";

            // If we found the target vertex return the shortest path
            if (index == target) {
                path = m_pointPath[index];
                return MStatus::kSuccess;
            }

            compList.addElement(index);
        }
    }

    // If we didn't find the end point, run another iteration using new vertex collection
    return extendPath(compList.object(), start, target, path);

    return MStatus::kFailure;
}
```

This function generates path in a string format containing vertex indices separated by semilocon e.g. *“1;2;3;4;5;6”*. For a bit more API fri
result use the following function to converted it into a numeric array.

```
inline MIntArray stringToIntArray(const MString& path)
{
    MStringArray pathStrArray;
    path.split(';', pathStrArray);

    MIntArray pathIntArray;
    for (unsigned s = 0; s < pathStrArray.length(); s++)
        pathIntArray.append(pathStrArray[s].asInt());

    return pathIntArray;
```