

This question paper consists
of **6** printed pages each
of which is identified by the Code **COMP5821M**

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School of Computing

May 2018

COMP5821M: Geometric Processing

Answer all FIVE questions

ANSWER ON THE TEST PAPER

Time allowed: 2 hours

CLOSED BOOK EXAM: NO PRINTED MATERIALS ALLOWED

CALCULATORS NOT REQUIRED

Question 1:

Given the input shown,

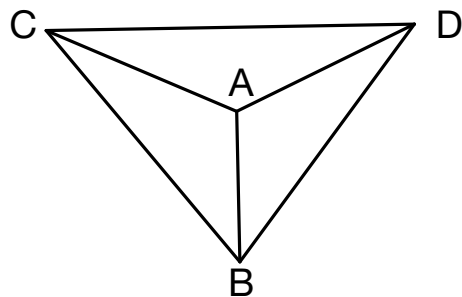
- i) Construct a directed edge data structure (show all arrays) **[5 marks]**
- ii) Is the mesh manifold? You may assume that there are no intersections between triangles except at edges. Give details of how you reached your conclusion. **[5 marks]**

Input:

```
Vertex 0  0.00  0.00 -1.00
Vertex 1  0.00  0.00  0.00
Vertex 2  1.00  0.00  0.00
Vertex 3  0.00  1.00  0.00
Vertex 4  0.00  0.00  1.00
Face 0  0  2  1
Face 1  0  1  3
Face 2  0  3  2
Face 3  1  2  4
Face 4  1  4  3
Face 5  1  3  2
```

Question 2:

- i) Given the tetrahedral mesh shown with the vertex positions listed, use uniform weighted approximation to find the vertex with largest Laplace-Beltrami operator for the function values listed. **[6 marks]**
- ii) Explain how you can use this computation to smooth a surface. **[4 marks]**



Vertex	Position	Value
A	$(0, 1, 0)$	2
B	$(1, 0, 0)$	0.5
C	$(0, 0, 1)$	1
D	$(1, 1, 1)$	3

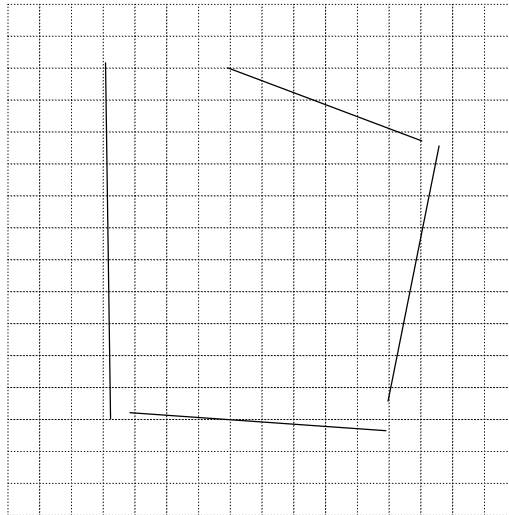
Question 3:

A colleague at work has given you recursive render code for a set of L-system plants & trees. Unfortunately, they are slow to render, have interpenetrating triangles, and are not textured. You have therefore been asked to convert the render code into models that can be loaded as part of the regular render pipeline. Describe the steps you would need to take to convert the code into properly parameterised models ready for texturing. **[10 marks]**

Question 4:

The shape shown has been incorrectly modelled.

- i) Using the grid provided, use a distance field to repair this model. Show all work. **[5 marks]**
- ii) Describe at least one problem caused by this method (for this shape). **[2 marks]**
- iii) Describe at least one method of accelerating this task. **[3 marks]**



Question 5:

Given the triangular mesh below, show the results of the following operations:

- | | | |
|------|-------------------------------|-----------|
| i) | Collapsing edge AB | [2 marks] |
| ii) | Inserting a vertex on edge AB | [2 marks] |
| iii) | Collapsing face ABC | [3 marks] |
| iv) | Inserting a face at C | [3 marks] |

