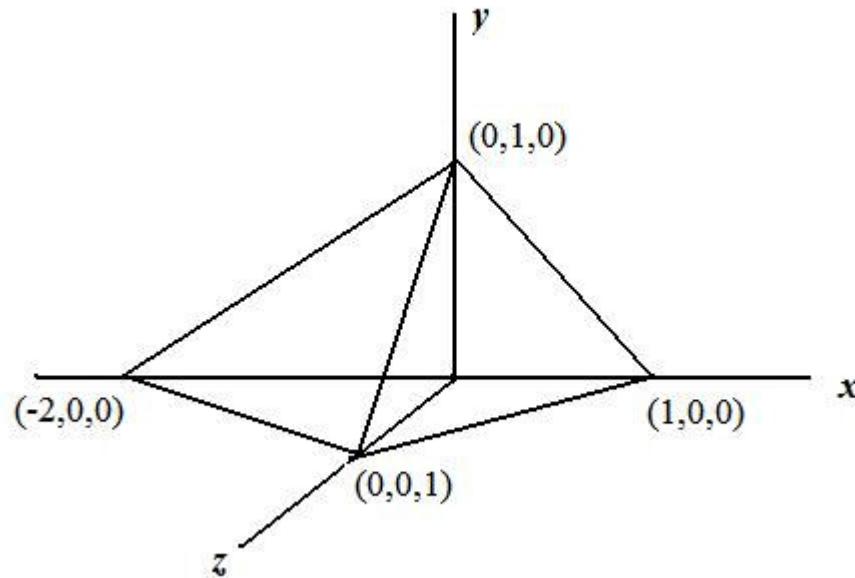*Instructions: Answer all three questions in the bluebook provided. 75 min, closed book/notes.*

1.

(a) Construct a <u>polyhedral</u> <u>volumetric</u> representation for the given 4-sided figure. Specify all elements of the representation explicitly.

(b) Construct a <u>sweep</u> representation for the given tetrahedron. Specify all elements of the representation explicitly.

2. Suppose we use Nelson's associative memory based system to recognize two classes of objects: cubes and elongated cubes. Cubes are 3-D rectangles with length=width=height, elongated cubes have length>width, width=height. Assume some facets of each are covered in red wool, some in green wool, some in red paper, the rest in green paper.

(a) What would be a good selection of the set of keys if we expected considerable noise, clutter and occlusion when using the recognizer? Explain.

(b) Describe a single-pass associative memory algorithm that would use these same keys. How would the training of this system differ from training of Nelson's two-pass scheme?

(c) What is the advantage of the two-pass approach of Nelson's over a single-pass approach?

3. Consider the 3D polyhedral object P where all its six faces are identical equilateral triangles. In the view of P shown below, three of P's six faces are visible.

    (a) How many topologically distinct characteristic views does P have? Justify your answer.

    (b) Define the *span* of an aspect graph as the greatest distance between any two nodes, ie. the maximum number of edges that must be traversed to get between nodes in the graph. Find the span of the aspect graph of P.