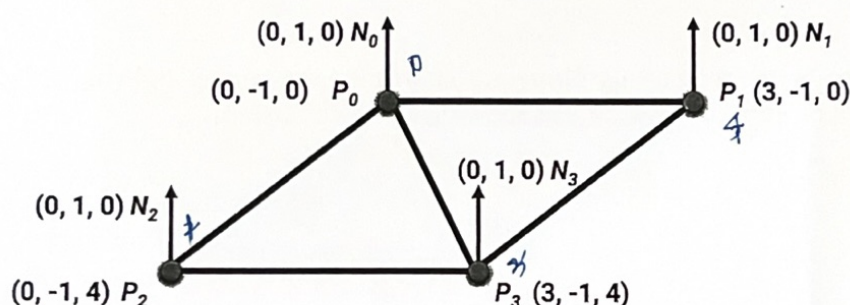




Midterm

1. What are the three pillars (major topics) of computer graphics? (6%)
2. If you would like to render the following quad with a vertex buffer and an index buffer:



- (a) Illustrate the content of the vertex buffer? (the vertex data should include vertex normals) (4%)
  - (b) Illustrate the content of the index buffer? (4%)
3. Why do we define the attributes (position, normal) of vertices in **Object Space** instead of in **World Space**? State the two advantages of using a world transformation (8%)
  4. When representing the coordinate of a 3D point  $(x, y, z)$ , what is the advantage of using the **Homogeneous Coordinate**  $(x, y, z, 1)$ ? (4%)
  5. Assume you want to scale an object which is centered at  $(3, 6, 9)$ , describe how to construct a scaling matrix that can scale the object by 2 times and keep its center unchanged (6%)
  6. Please answer the following questions about camera and projection:
    - (a) In **interactive graphics**, what is the most common **camera model** used for rendering (3%)
    - (b) Before projection, why do we need to transform a vertex to **Camera Space**? (6%)
    - (c) Describe how a **camera matrix** is constructed (6%)
    - (d) What are the major differences between an **orthographic projection** and a **perspective projection**? (6%)
  7. Please answer the following questions about **hidden surface removal**:
    - (a) Please describe **Painter's algorithm** and state its disadvantages (6%)
    - (b) Please describe how modern graphics engines determine the closest surfaces to a camera. You should write down the technique's name and describe how it works. (6%)



8. Please answer the following questions about shaders:
- (a) What are the major changes from **OpenGL 1.1** (fixed function pipeline) to **OpenGL 2.0**? (6%)
  - (b) What are the major goals of a **vertex shader** and a **fragment shader**? (6%)
9. **Scanline rasterization** and **barycentric coordinates** are two methods for a **rasterizer** to **generate fragments** and **interpolate per-fragment data**. Please describe how these two methods work. (8%)
10. Please briefly describe the purposes of the following operations in the graphics pipeline:
- (a) Clipping (3%)
  - (b) Back-face culling (3%)
  - (c) Stencil test (3%)
11. Please describe the reason that **Gouraud shading (per-vertex lighting)** might **blur out the highlights** on surface. How do you solve this problem? (6%)