CPSC 453 – Self-test – Oct 7-8, 2019

1) Who developed the first interactive graphics system:

√ Ivan Sutherland at MIT?

☐ Alvy Ray Smith At the University of Utah?

☐ Marceli Wein and Nestor Burtnyk at the NRC?

2) What is the value of $\sin\left(\frac{\pi}{4}\right)$? $\frac{\sqrt{2}}{2}$

3) What does it mean that vector multiplication is distributive over addition?

For dot product: $\vec{A} * (\vec{B} + \vec{C}) = \vec{A} * \vec{B} + \vec{A} * \vec{C}$ and $(\vec{A} + \vec{B}) * \vec{C} = \vec{A} * \vec{C} + \vec{B} * \vec{C}$

For cross product: $\vec{A} \times (\vec{B} + \vec{C}) = \vec{A} \times \vec{B} + \vec{A} \times \vec{C}$ and $(\vec{A} + \vec{B}) \times \vec{C} = \vec{A} \times \vec{C} + \vec{B} \times \vec{C}$

4) Does the equality $\vec{a}(\vec{b} \cdot \vec{c}) = (\vec{a} \cdot \vec{b})\vec{c}$ hold for any vectors $\vec{a}, \vec{b}, \vec{c}$? Some vectors? Never? Justify your answer.

Does not hold for all vectors, e.g. if $\vec{a}$ is not parallel to $\vec{c}$.
Does hold in some cases, e.g. when one of the argument vectors is 0, or if the three vectors are perpendicular to each other (in which case the results is also 0).

5) Consider vectors defined as follows:

```
struct V3f
{
        float x, y, z;
        V3f(float x1, float y1, flat z1)
                {x=x1; y=y1; z = z1}
        V3f()
                {x=0; y=0; z=0}
};
```

Define the overloaded operator ^ for computing the cross product of two vectors in C++.

```
V3f operator^(V3f a, V3f b)
{
        V3f c;
        c.x =  a.y * b.z - a.z * b.y;
        c.y = - a.x * b.z + a.z * b.x;
        c.z =  a.x * b.y - a.y * b.x;
        return c;
}
```

or

```
V3f operator^(V3f a, V3f b)
{
        return (a.y * b.z - a.z * b.y, - a.x * b.z + a.z * b.x, a.x * b.y - a.y * b.x);
}
```

6) Write the transformation matrix for rotating by angle α around the x axis in 3D.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\alpha & -\sin\alpha \\ 0 & \sin\alpha & \cos\alpha \end{bmatrix}$$

7) Point P has homogeneous coordinates $[4\ \ 2\ \ 1\ \ 0.5]^T$. What are its x, y, z coordinates in 3D?

$$(8, 4, 2)$$

7) Which of the following operation(s) cannot be performed as matrix multiplication unless homogeneous coordinates are used:

√ Translation

☐ Scaling with respect to the origin of the coordinate system

☐ Parallel projection

√ Perspective projection

☐ Rotation with respect to the origin of the coordinate system

8) What is Rodrigues's formula for?

Rotation about an arbitrary axis.

9) What is the "canonical view volume"

Volume bound by planes $x = -1, x = 1;\ y = -1, y = 1;\ z = -1, z = 1$.

10) Oblique projections are a special case of:

☐ Orthographic projections

√ Parallel projections

☐ One-point perspective

☐ Two-point perspective

☐ Three-point perspective