# Abstract

# Acknowledgements

# Introduction

## Overview

## Objectives of Project

# Graphical Processing Units

## Introduction

## Pipeline

## Writing Shaders

# Vector Graphics

## Introduction

Vector graphics are a form of digital images. They specify shapes within the image as opposed to individual pixels as in the bitmap format. Since they are already in a pixel format, they can be converted to pixels at runtime. This is called rendering. Performing this action later in the process means the pixels created can be tuned to the use case. Vector images can be rendered at any resolution while retaining clarity and sharpness. This disconnect between resolution and the data required means that high resolution images can be created from files with small memory sizes.

## Spline, B-Spline and Bezier Curve

Vector graphics are made up of lines and splines. Splines are any curved line. They can either be closes, enclosing an area completely, or open, where the beginning and end of the spline are 2 distinct and non-overlapping points. Commonly, B-splines are used in vector graphics. These splines are defined by a series of Bezier curves.

The Bezier method of defining curves involves interpolation between a set of points and then interpolating from the points which result from the 1st series of interpolations. For a quadratic curve, 3 points would be used. These would be referred to as control points. For the given series A, B, and C; A would be interpolated with B to get Z and B would be interpolated with C to get Y. Then Z and Y would be interpolated to get the point on the curve. Each of these interpolations would be done with the same value of t. T is increased as you move along the curve. T of 0 is the beginning of the curve, T of .5 is halfway through the curve and 1 is the end of the curve. Cubic Bezier curves are used as well. These have 4 control points. Z is then the result of interpolating A and B and Y is the result of C and D.

## GPU rendering

This all comes at the cost of having to do the rendering process at some point. In real time applications, this rendering must happen often enough to appear continuous.

### B-Spline method

Lohit Petikam, Ken Anjyo and Taehyun Rhee (Petikam et al., 2021)were referring to the Blinn-Loop method (Loop & Blinn, 2005) when talking about vector rendering not being applicable for their use case. The method described in this paper

### Grid method

# Technology

## Introduction

## GPU integration & profiling

### Unreal

### Unity

### Godot & 3rd party

## Tool creation

### Unreal

### Unity

### Godot

## Shader Framework

### Unreal

### Unity

### Godot

* Does not support tessellation nor geometry shaders natively.

# Methodology & Design

# Implementation

## Sprints

# Results & Conclusions

# References

Loop, C., & Blinn, J. (2005). *Resolution independent curve rendering using programmable graphics hardware*. 1000. https://doi.org/10.1145/1186822.1073303

Petikam, L., Anjyo, K., & Rhee, T. (2021). Shading Rig: Dynamic Art-directable Stylised Shading for 3D Characters. *ACM Transactions on Graphics (TOG)*, *40*(5). https://doi.org/10.1145/3461696