The ‘TrakWorks’ system is a networking system that allows for reading/writing game object data across a local area network (LAN), via a server-client relationship.

**Objective**

The objective of this system includes, but is not limited to:

* Sending game object data across a LAN network
* Allowing for additional unknown game object data
* Undemanding integration into other projects

**3rd Party Libraries**

Third party libraries to be utilised:

* RakNet
  + A networking middleware developed by Oculus VR
* Bootstrap
  + Graphics middleware with basic application functionality
* OpenGL
  + Programming interface for rendering vector graphics

**Mathematical Operations**

The main mathematical operation involved in developing a networking system is network theory. This defines networks as a series of graphs made up of nodes and edges, each node being a client/server and each edge being the connection between them.

Graphical user interface, application

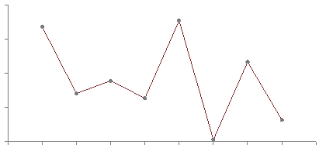
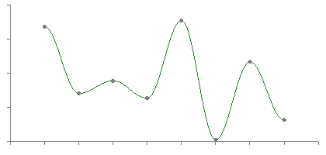
Description automatically generatedNetwork theory helps us to understand the relationship between the client/s and/or server/s, by analysing this relationship we can identify any flaws or improvements to the system. The image below demonstrates a simple client/server relationship:

**Mathematical Operations Cont.**

Another mathematical operation used in networking is number theory. This is simply the study of relationships between numbers, but how is this useful? Number theory helps us understand how different sub-systems of the network interact with each other, allowing for us to take complete control over the functionality and optimization of the system.

**Advanced Algorithms**

There are many algorithms involved in networking but the main algorithms that will be implemented in the ‘TrakWorks’ networking system are; cosine interpolation and universal data packaging.

Cosine interpolation is the simplest interpolation function that offers smooth transitions between each adjacent segment, or in our case between each frame update. It works by orienting a piece of a cosine wave in such a way that it provides smooth transitions between each point. Below is the difference between linear and cosine interpolation:

Universal data packaging in this scenario is an algorithm that will take any form of data and package it to be used within the ‘TrakWorks’ server-client system. This could be done in a variety of ways, namely using a base ‘Data’ struct/class that has virtual functions that can be overridden by the user of the system. In this way a new data object can be created and structured to store any piece of data for the server-client system to handle.

**Integration**

For the ‘TrakWorks’ system to be integrated into other applications the client project will be compiled into a dynamic linked library (.dll), while the server project will remain a separate executable (.exe). In this way any other developer can install the .dll and .exe files, link them to their C++ project via Linker and ideally work with minimum effort.

**Modularity**

The ‘TrakWorks’ system will be modular in the sense that the use of its functions and input parameters will be overridden by the user. I.e. for the client input data a generic data type will be created that the user can override to replace with their own custom data. This will allow for the system to be integrated into almost any application.

Another way in which this system will be modular is how it handles client ‘game objects’, as they too will be overridable. This is slightly different from how the data works as instead of the member variables being overridable the individual read/write functions will be virtual to allow overriding. For instance, the user can overwrite the write function to send an additional message to all clients on the server, i.e. printing a custom message.

**References**

* *RakNet documentation* (no date) *RakNet: Main Page*. Available at: http://www.jenkinssoftware.com/raknet/manual/Doxygen/main.html (Accessed: May 2, 2023).
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* *Number theory* (2023) *Encyclopædia Britannica*. Encyclopædia Britannica, inc. Available at: https://www.britannica.com/science/number-theory (Accessed: May 2, 2023).
* (no date) *Interpolation methods*. Available at: http://paulbourke.net/miscellaneous/interpolation/ (Accessed: May 2, 2023).