*Multiplayer Snake Game*

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*Abstract* — We will build a snake game in python using pygame library. This python binary will be controlled by an external C++ backend, which will need to handle decisions about movements of the players on the screen of the multiplayer python snake game. The C++ backend oversees determining who will be the server, and who will be the clients. Only one player can be the server. When the server received all client's messages a message handler will distribute global coordinates / collision logic to each player's snake python game.

Keywords — Thread Synchronization, Game Design, Named Pipes, Network Communication, Python, C++.

# Introduction

We have implemented a network multiplayer snake game, that allows multiple players to connect to a server and play the game a bit more competitively. Since the current gaming scene tends to lean heavily towards games that multiple people can play together, we, as gamers, wanted to extend a classic game to a more modern multiplayer scenario.

Our project is primarily divided into 4 major components:

• The Game

• The Backend

• The Server

• The Clients.

These components are explained in detail in the following sections.

# The Componenets

## **The Game**

We started with building a snake game, purely in Python. Python’s pygame library provides a quick and easy way to implement quality games in a short amount of time and hence our snake game was built using pygame. Each player will have one instance of the game running. Each instance is a Python thread which is synchronized with the rest of the threads. We current have a support for up to 4 players playing simultaneously.

## **The Server**

The server acts as the host of a game. Any player can be the server, by using the ‘-s’ option. The server starts a socket that is bound to the server’s IP Address, and is listening to the Post 8080 by default. The server is responsible for accepting connections from different players, and assigning them a player index, so as to differentiate one player from the other.

The server itself uses multiple threads to divide the functionality to different pieces.

* The Observer Thread: Responsible for checking if the server is running, every 5ms. In case the server fails, the game should end, disconnecting all the players, to avoid any socket connection exceptions.
* The Main Thread: This is the thread that is responsible for communicating with the client threads, maintaining socket descriptors for each client and handling error conditions. The main thread is also responsible for communicating with the backend for fetching the global state of the game. This game state is provided to all the clients, to ensure a consistent gaming environment.
* The Message Thread: Responsible for handing messages to and from the clients, for example, to start the game or to end the game.
* The Key Thread: This thread is responsible for communicating with the Python frontend and the C++ backend, for example, reading messages from the FIFO pipe, sending various messages back to the client, informing them that the server has left the game, or that the food/ apple has repositioned itself to a new location, or if a snake is dead or alive, etc.
* The Time Thread: Responsible for synchronizing the timing/ screen refreshes for all the individual instances of the python frontend.

## **The Client**

Each non-server entity in the game is a client. A client connects to a server, and then waits for a game to start. Like the server, the client uses multiple threads to divide it functionality into smaller, manageable pieces.

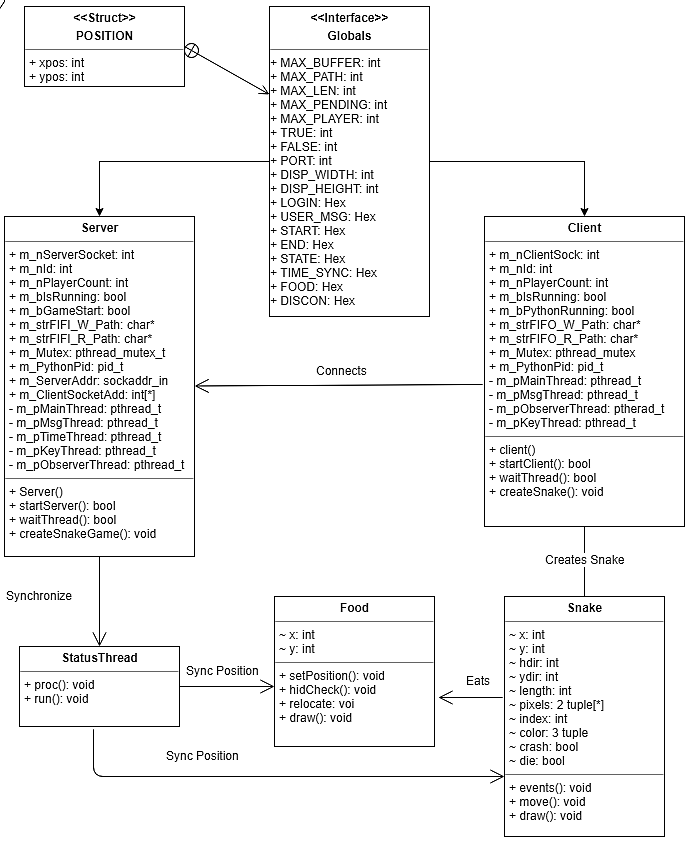
* The Observe Thread: This thread checks if the client is up and running every 5ms. If, at any point in time, the fails/ crashes, that instance will be destroyed, and the said player will be disconnected from the game.
* The Main Thread: This is the main communication thread function, this in charge of connecting to the server via a socket. It's other main role is to read important messages from the server pertaining to state information about the other players, time synchronization, the state of the apple, start and end messages from the server, and message that other players are disconnected.
* The Message Thread: This thread is responsible for sending a message to the server, as long as it is running.
* The Client Key Thread: this is the thread that will control the messages between the python frontend and the backend C++, which will open and read from a FIFO pipe the messages from the python frontend and send the various messages back to the server. These messages include that the client exited from his game, that the apple has been eaten and relocated, the state of the snake (alive/dead), their id, and each snake's location, and whether the client has won or not.

## **The Backend**

The Backend is responsible for determining which player acts as the server, initializing he server, connecting clients to the server based on the arguments passed to the executable.

# Diagrams

## Class Diagram



a. Globals: This a header file that simply describes all the static attributes for our game, for example, the maximum number of players, the size of the game window, certain Boolean constants, etc. These values are stored in the back-end to reduce/ avoid using magic constants and updating certain game-wide global variables becomes easier.

b. Position: this is a struct, that is defined in the “globals” header file. This struct is used to define the position of an item, in the game, be it, a snake or food for the snake.

c. Server: This class encapsulates the server for the game. Any player can choose to be a server by using the “-s” option while running the game. The function of this class is to start a TCP server bound to the host’s IP address, listening on the port that is specified in the globals header file. The server then waits for all the players to connect. (specified by the MAX\_PLAYER in globals) Once all the players have connected to the server, the server initializes the game and sends the required game data to all the connected clients.

d. Client: Each client represents a (non-server) player in the game. The client is responsible for instantiating a snake object based on the parameters provided to it by the server, for example, the player index.

e. Snake: The snake class encapsulates an in-game snake, that is controlled by one player. Each snake object is constantly listening for key-events. On the appropriate key event (left, right, up or down) the events function will update the parameters of the snake respectively.

f. Food: The food class represents the food, once consumed, will increase the length of the snake.

g. StatusThread: This class is responsible for thread synchronization amongst all the players and ensures that all the players have consistent copy of the game.

## Activity Diagram

TODO: Add Activity Diagram and

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