CS354p Lab 7: Networking

This lab will explore the basics of working with network functionality in Unreal and understanding the principles of using replicated variables and RPCs. You will create a thrilling multiplayer game built around random counting. While not exactly "game of the year" material, this will give you an idea of how to get started on networking!

Getting Started (Complete Before Class)

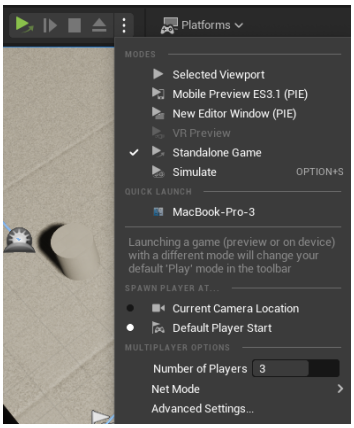
Create a new project named `Lab7` from a blank template building on C++. You can choose whether or not to include starter content. Go ahead and include the Mannequin assets in your Content folder, so you can see the other player characters more clearly. Set up a map with at least three Player Starts positioned to face each other. You may want to put some assets in the scene to make it easier to discern where the specific players are spawning.

Create a C++ subclass that inherits from `ACharacter` called `Lab7Character`. We only need to add WASD controls to this character, so you can attach the input bindings in `Lab7Character`, or you can create a `APlayerController` called `Lab7PlayerController` if you want to be more "correct." Either way, create a BP of your `Lab7Character` called `Lab7CharacterBP`, and add a Mannequin to the skeletal mesh. Set this to be the default pawn to spawn into the scene via your `Lab7GameModeBase`.

Make sure everything compiles and that's it! We'll be adding any additional functionality during the lab.

Testing Networking in the Editor (Complete Before Class)

For the sake of simplicity, we are only going to test the networking locally in Editor. In practice, this is no substitute for testing across a network, but it will be sufficient for the minimum networking specification of the current assignment. For testing purposes, we'll switch Play Mode to "Standalone Game." This will ideally have slightly fewer quirks than playing in "Selected Viewport." You can set the number of players you want to simulate under Multiplayer Options → Number of Players. You will also want to set the Net Mode to "Play as Listen Server" since we're assuming the game's host will also be a player.



Creating a Replicated Variable

We will now add a replicated variable to the `Lab7Character` class. The first thing we'll want to do is add the include:

```
#include "Net/UnrealNetwork.h"
```

This will allow us to access the networking features.

For the sake of demonstrating functionality, we will need to add both a `Count` integer and a `UTextRenderComponent` to display our current "score." `Count` will be replicated using RepNotify, which means when the variable's value changes, this change will be replicated to all other clients. We will give `Count` a `UPROPERTY` macro that looks like this:

```
UPROPERTY(ReplicatedUsing = OnRep_Count)
int32 Count;
```

To ensure this variable is replicated, we need to add it to our override of `GetLifetimeReplicatedProps`. This function will look something like this:

```
void ALab7Character::GetLifetimeReplicatedProps(TArray<FLifetimeProperty>&
OutLifetimeProps) const
{
    Super::GetLifetimeReplicatedProps(OutLifetimeProps);

    DOREPLIFETIME(ALab7Character, Count);
}
```

We now need to make this `OnRep_Count` function, and we'll want to create some function that will be executed when `OnRep_Count` is called on the client. We'll call this function `DisplayCount` since that's what we'll do when `Count` is incremented. `DisplayCount` will update a Text Render Component to display a local (unreplicated) GUI showing the other players' scores. We will

create a `UTextRenderComponent` called `CountText` and then attach this component to our `Lab7Character` in the `Lab7Character`'s constructor using the usual `CreateDefaultSubobject` function. Once you've successfully attached this component, go to `Lab7CharacterBP` and make sure the text is displaying in a nice, visible location.

Calling RepNotifies

We now need a way to increment `Count` so we can test its replication. For the sake of simplicity, we'll do this by having each Playable Character call a function `IncrementScore` on a time set to a random timer length. Don't make the timer length too short, or it will be hard to monitor all your network activity, but also don't make it too long, or you'll have to wait. Probably 3-5 seconds is a good first guess.

The function `IncrementScore` will increment `Count`, call `DisplayCount` locally to update this Character's score, and then again call `IncrementScore` on a timer. Note, we don't want this timer to be repeating, since we want its time to be randomized between calls. When `Count` is incremented in `IncrementScore`, it will call `OnRep_Count` on the other clients, so we should have `OnRep_Count` call the function `DisplayCount` as well. This should let all the other players see each others' scores.

At this point, when you test your code, you should see each Playable Character with their score displayed above their head (or where ever you put your Text Render Component).

Calling RPCs

The next step is to make some "win condition" that is verified on the server, and which updates the state for the clients. To do this, we're going to create a couple functions. `Server_DeclareWinner()` will have the specifier macro: `UFUNCTION(Server, Reliable, WithValidation)`, and this fucntion will require `Implementation` and `Validate` thunks. This function will be called when a Playable Character's `Count` reaches 10 or higher. For the sake of simplicity (and cruel irony), winning the game makes you leave it...i.e. we'll `Destroy` the `Lab7Character` that won the game, while the others keep counting.

This is not very interesting behavior, but to do more exciting things to our `Lab7Character`s, we'll probably need to access the `PlayerArray` in the `GameState` class. You are welcome to try out something fancier (and certainly such experimentation will only help on the networking assignment), but we'll be coming back to `GameState` soon if you are unsure how to use it.

Since we're Destroying the `Lab7Character` through the server, this destruction needs to be replicated to the clients. If you'd like to play around with some of the other features of networking, you can try adding some of these calls:

- A `HasAuthority()` boolean to select functionality based on whether the code is currently executing on the server or a client

- A `NetMulticast()` to execute code both on the server and all the clients

While our current lab is a bit too trivial to need these, you can add On Screen Debug Message to get an idea of what's happening where when you call these.

Submission

After you're satisfied, collect some video footage showing the system in action. Also screenshot exciting parts of your code, and submit these files plus the project code via your GitLab account and include a link to your video via Youtube. Link your repository as your Canvas submission.