Unreal engine 4 tutorial c pdf

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This page has a short programming guide for a simple application in UE4 on Linux. It also has links to pages that we find useful. Call the UE4 launcher from the UE4 folder as follows: $./Engine/Binaries/Linux/Linux/UE4Editor Create a new project When you open the project manager, select the C-code tab and the Basic Code project. Take care of the boxes below, leave the chosen option with the starting content: Option with starter content will populate your world with some standard objects. In the case of the World Plan of the Basic Code, there will be a table, two chairs, two light sources and a strange statue on the table. Call the Fast Start Project (or whatever you want) and create a new project in the creation of the project. UE4 will take some time to generate start-up files and open an editor. Create a new C- class for your actor in the file in the new Class C bar menu: The Choose Parent Class menu opens. As an actor is the most basic class in Unreal Engine, let's use the actor as a parent class: The name of your new actor menu will open. Let's call the new Class FloatingActor. Next click Create a class: If you already want, you can click the compilation in the toolbar at the top of the editor and see the compilation. Write and write your code C' Now we want to give some behavior to this new actor. Look for a project created by UE4 and open the project/workspace in the editor of your choice. Unreal must have created a project folder in: Documents/Unreal Projects Should be a subflander with the name of your project, in our case quickstart. This folder will be filled with everything UE4 has created, including the new Class C: the two files marked in the picture above are project files for tCreator (.pro) and Codelite (.workspace). Open one of them in IDE of your choice. In FloatingActor.h, turn on the variable through the following line before closing the class definition: float RunningTime; Change the behavior of the actor class in the FloatingActor.cpp behavior code, let's add the code shortly before the end of AFloatingActor::Tick: FVector NewLocation and GetActorLocation () method; DeltaHeight float (FMath::Sin (RunningTime) - FMath::Sin (RunningTime)); NewLocation.s. Delta Get 20.0f; Scale our height 20 times the running time and DeltaTime; SetActorLocation (Newlocation); This code will make the actor's position in the th vary depending on the sinus time of the time modeling clock, in practice makes it latverify up to down, accelerating and slowing down within the range of motion. A code-twister from the example we just created: CodeLite with code from an example we just created: If you want, you can click compile again in the toolbar at the top of the editor and Compile. Add geometry to your Actor In The Unreal editor, go to Content Browser at the bottom of the editor and expand an element of the list called Classes C. There you'll find a Fast Start folder that contains your new class of actor, FloatingActor. Now you can create a floatingActor instance in your world by dragging the sphere icon that represents it into the level editor. The instance will be selected in both the level editor and the World Outliner on the right (see arrows), where it will be called FloatingActor1. Your components will be visible in the partbar, which you can open on the right. Adding a cone Once in the detail panel, right, select Add Component, and in the retractable menu that opens, select the cone: This will add a cone-like geometry to your FloatingActor instance: Change the Cone Attributes Now click on it and drag it until it's a good position. In addition, you can dilute your position by moving the coordinates of your reference center directly to the Transform attribute in the detail panel: Check the compilation click app in the toolbar at the top of the editor and watch the compilation. Click the play button on the toolbar and see the cone of the subleas and go down! When you're tired, click Pause. Navigating the scene with the UE4 level editor Navigating the scene with the UE4 editor is not so intuitive. Below is a rundown of what you can do. Esq Action Management Mouse. Drag Moves the camera back and forth and rotates the world right and left. Mouse Deer. Drag rotates the viewport camera. Mouse Deer. Esq. Drag moves up and down. Retographic view (top, front, side) Esq Mouse. Mouse Deer. Drag the pans with the camera. Mouse Deer. Esq. Drag zoom with the camera. F focuses the camera on the chosen object. The best way to jump from camera to camera is from one object to another. In UE4, you can also use WASD keys. They are enabled by default and you can use them whenever you clicked right, meaning you will continue to use the correct mouse button to navigate this way. These controls are reflected on the arrow keys to provide alternative access and are only valid in perspective mode. Control Action W Numpad8 Up Move the Camera Forward. S -1 Numpad2 Down Move Camera Back. In Numpad4 On the left, move the camera to the left. D Numpad6 Right Move the camera to the right. E. Numpad9 Page Up Moves The Camera Up. In (K. Numpad7 Page Dn moves the camera down. B (K. Numpad1 zoom out of the camera (fov increases). C Numpad3 zoom with the camera (reduces FOV). If you zoom in, the field of vision (FOV) will remain when you set up Mouse button. You can find additional navigation commands on the UE4 Viewport Controls guide page. Take a look over there! Invent and create! Now continue your progress and make a tutorial: Level Designer Fast Start. Below is an image of what you'll be building: See also how to import geometric and architectural objects from other programs such as Blender. To learn more about object lighting and how to globally illuminate a scene by identifying ways to treat indirect lighting, see the following tutorials: Also, with what you already know, try this: Add a particle system component to a floating actor. There are some ready-made in the default content of your project. Use the macro of unreal Engine UProperty to expose a variable that contains the magnitude of the floating actor's movement, rather than using a permanent uam. Take a look at the tutorial on variables, timers and events. Turn on the X and Y axes in periodic motion. Multiply the DeltaTime value by 0.6 to 1.4, so the floating actor seems to move freely. Additional information: Actor's manual page. See other programming training courses. Final floatingActor.h code: Copyright 1998-2016 Epic Games, Inc. All rights reserved. Removed from: // #pragma times #include GameFramework/Actor.h #include FloatingActor.h UCLASS () class QUICKSTART_API AFloatingActor : public actor - GENERATED_BODY () public: // Sets default values for the properties of this actor AFloatingActor (); It is called when the game begins or when the virtual void BeginPlay () override; Called every virtual tick of the frame void (Delta Seconds) override; floatTime; FloatingActor.cpp: Copyright 1998-2016 Epic Games, Inc. All rights reserved. Removed from: // #include Faststart.h #include FloatingActor.h // Sets the default values of AFloatingActor:::AFloatingActor () // Set this actor to call Tick () each frame. You can turn it off to improve performance if you don't need it. PrimaryActorTick.bCanEverTick - truth; Called when the game begins or when AFloatingActor's void has created:::BeginPlay () - Super:::BeginPlay FVector NewLocation - GetActorLocation (); DeltaHeight float (FMath::Sin (RunningTime) - FMath::Sin (RunningTime)); NewLocation.s. Delta Get 20.0f; Scale our height 20 times the running time and DeltaTime; SetActorLocation (Newlocation); Using other unrealistic templates comes with a series of standard templates for different types of games. They will appear in the Tab New Project Installation: Not the example above, we chose Vexicle para jogos simple de persegui'o e dire'o. Carrege-o e-voke-vera de um ambiente de jogo com-n-com-n-curro padrao e c'mera situada na posi'o acima do carro: Espere todos so shaders terem sido compilados (aparecer na janela de comando de onde voc' invocou o UE4) e depois clique Play: Voc' vere um ambiente de dire'o onde voc podere guiar o carro usando as teclas padr'o W-S-A-E outras pr'ximas para troca de marcha, etc. Salve este jogo e saia. Ao entrar novamente, se houverem projetos salvos, o Unreal Launcher abre na aba Projects, mostrando quais projetos est'o salvos em seu computador: Onde eu acho mais conte'do? O site da Unreal possui muitos examples: links to teis Unreal C Is Awesome! This is a guide on how to learn how to write C code in Unreal Engine 4 (UE4). Don't worry, programming C in Unreal Engine is fun, and isn't really hard to get started with! We like to think of Unreal C as helping the NHS because we have so many features that will help make the NHS easier for everyone. Before we continue, it is important that you are already familiar with C or other programming language. This page is written with the assumption that you have some experience with C, but if you know C, Java, or JavaScript, you should find many aspects familiar. If you come in with no programming experience at all, we have you covered as well! Check out our blueprint Visual Scripting guide and you'll be on your way. You can create whole games with Blueprint scripts! You can write standard SH code in UE4, but you'll be most successful after reading this guide and learning the basics of the Unreal programming model. We'll talk more about it as we go along. Two methods are available to create new gameplay elements C and Blueprint UE4: C and Blueprint Visual Scripting. Using THES, programmers add basic gameplay systems that designers can then build on or off to create custom gameplay for a level or game. In these cases, the programmer works in a text editor (such as Notepad) or IDE (usually Microsoft Visual Studio or Apple's Xcode), and the designer works for the Blueprint editor at UE4. Gameplay api and framework classes are available for both of these systems, which can be used separately but show their true strength when used in combination to complement each other. What does this actually mean, though? This means that the engine works best when programmers create gameplay building blocks in the NHS and designers take these blocks and make interesting gameplay. With this help, let's look at a typical workflow for a programmer who creates building blocks for a designer. In this case, we will create a class that will be expanded later with the help of designer or programmer. That's what it's all about. We're going to create some properties that the designer can install and we're going to get new values out of these properties. The whole process is very easy to use the tools and macros we provide you with. The master class the first thing we're going to do is use the Master Class in the editor to create a basic C class that will be expanded by Blueprint later. The picture below shows the first step of the master, where we create a new actor. The second step in the process informs the master of the name of the class that you want generated. Here's the second step with the default name used. Once you decide to create a class, the master will generate files and open the development environment so you can start editing it. Here is the definition of the class that is generated for you. For more information about the Master Class, click here. #include GameFramework/Actor.h #include MyActor.h UCLASS () class AMyActor : public AActor - GENERATED_BODY () public: // Sets defaults for the properties of this actor AMyActor (); Called each frame by a virtual void Tick (float DeltaSeconds) override; Protected: / Called when the game starts or when the virtual void BeginPlay (redefining) Master Class spawns your class with The Help of BeginPlay and Tick, listed as overload. BeginPlay is an event that lets you know the actor has entered the game in a game state. This is a good place to initiate gameplay logic for your class. The tick is called once per frame with the amount of time that has passed since the last call. You can make any repetitive logic there. However, if you don't need this functionality, it's best to remove it to save a small amount of performance. If you remove it, make sure to remove the string into the constructor that indicated the tick should occur. The constructor below contains the line in question. AMyActor::AMyActor () / / Set this actor to call Tick () each frame. You can turn this off to improve performance if you don't need it. PrimaryActorTick.bCanEverTick - truth; Creating a Property Show in the editor We have our class, so now we can create some properties that designers can install in the editor. Exposing properties for an editor is easy with UPROPERTY Specifier. All you have to do is put UPROPERTY (EditAnywhere) on the line above your property declaration as seen from the class below. UCLASS () class AMyActor : public AActor GENERATED_BODY () public: UPROPERTY (EditAnywhere) int32 TotalDamage; ... That's all you need to do to be able to edit this value in an editor. There are more ways to control how and where it is edited. This is done by passing on more information to the () Specifier. For example, if you want TotalDamage to appear in the related property section, you can use the categorization feature. This is evidenced by the property declaration below. Below. Category Damage) int32 TotalDamage; When a user looks at editing this property, it now appears under the title Damage along with any other properties that you have marked with that category name. It's a great way to put widely used settings together for editing by designers. Now let's expose the same property for Blueprint. UPROPERTY (EditAnywhere, BlueprintReadWrite, Damage Category) int32 TotalDamage; As you can see, there is a Specifier to make the property available for reading and writing in the drawing charts. There is a separate specifier, BlueprintReadOnly, which you can use if you want the property to be seen as const in the drawings. There are quite a few options for controlling how the property is exposed to the editor. To see more options, click here. Before we continue the section below, let's add a few properties to this sampling class. There is already a property to control the total amount of damage this actor will have to deal with, but let's do that further and make that damage happen over time. The code below adds one designer settable property and one that is visible to the designer but not fickle by them. UCLASS () class AMyActor : public AActor - GENERATED_BODY () public: UPROPERTY (EditAnywhere, BlueprintReadWrite, Damage category) int32 TotalDamage; UPROPERTY (EditAnywhere, BlueprintReadWrite, Damage Category) Swim DamageTimeInSeconds; UPROPERTY (BlueprintReadOnly, VisibleAnywhere, Transitional, Damage Category) DamagePerSecond float; ... }; DamageTimeInSeconds is a property that a designer can change. The DamagePerSecond property is a calculated value using designer settings (see the following section). VisibleAnywhere Specifier notes this property as considered but not edited. Transitional specifier means it will not be saved or downloaded from the disk; It is designed to produce a un unstable value, so there is no need to store it. The image below shows the properties as part of the default class. Setting the default values in the default settings for properties in the designer works the same way as a typical class C. Below are two examples of setting defaults in a designer and equivalent in functionality. AMyActor::AMyActor DamageTimeInSeconds - 1,0f; AMyActor:::AMyActor () : TotalDamage (200), DamageTimeInSeconds (1.0f) - Here's the same kind of properties after adding default values in the designer. To support the design set properties, each instance also downloads values from instance data for the object. This data is used after the designer. You can create defaults based on design values by connecting to the PostInitProperties call chain. Here's an example of a process where and DamageTimeInSeconds are design values. Even if they are indicated by the designer, you can still provide a provide defaults for them, as we did in the example above. If you don't provide the default for the property, the engine will automatically set the property to zero or zero in the case of pointer types. AMyActor void::P ostInitProperties () - Super::P ostInitProperties DamagePerSecond - TotalDamage / DamageTimeInSeconds; Here's the same kind of properties after we've added PostInitProperties () code that you see above. Hot reboot Here is a cool feature of Unreal that you may be surprised if you are used to programming C in other projects. You can compile your changes into C-q without closing the editor! There are two ways to do this: with an editor still working, go ahead and build out Visual Studio or Xcode as you normally would. The editor will discover the newly composed DLLs and reboot your changes instantly! If you're attached to a snug, you'll need to disconnect first so that Visual Studio allows you to build. Or simply click the compilation button on the editor's main toolbar. You can use this feature in the sections below as we advance through the tutorial. Expanding the C-Class with Blueprints So far, we've created a simple gameplay class with Master Class C and added some features for the designer to install. Now let's see how the designer can start to create unique classes from our humble beginnings here. The first thing we're going to do is create a new Blueprint class from our AMyActor class. Note in the image below that the name of the selected base class is shown as MyActor instead of AMyActor. This intentionally and hides the naming conventions used by our tools from the designer, making the name friendlier to them. Once Select is selected, you create a new default Blueprint class. In this case, I set the name CustomActor1, as you can see in the browser image below. This is the first class that we are going to customize with our designer hats on. The first thing we're going to do is change the defaults for our damage properties. In this case, the designer changed TotalDamage to 300 and the time it takes to deliver this damage to 2 seconds. That's how properties now appear. Our estimated cost does not correspond to what we would have expected. It should be 150, but it is still the default value of 200. The reason for this is that we only calculate damage for a second value after the properties have been initiated during the download process. Changes in running time in the editor are not taken into account. There is a simple solution to this problem because the engine notifies the target when it has been changed in the editor. The code below shows the added hooks needed to calculate the resulting value when you change in the editor. Void ostInitProperties() - Super::P ostInitProperties (); РассчитатьВалюсы (); Пустота Пустота DamagePerSecond - TotalDamage / DamageTimeInSeconds; #if WITH_EDITOR AMyActor::P stEditChangeProperty (FPropertyChangedEvent) - CalculateValues (); Super::P sEditChangeProperty (PropertyChangedEvent); One #endif to point out that the PostEditChangeProperty method is located inside the editor-specific #ifdef. This is to ensure that building your game only compiles the code you really need, removing any additional code that can increase the size of your overpercem unnecessarily. Now that this code has been compiled, The DamagePerSecond is in line with what we would expect, as seen in the picture below. Call functions across the border C and Blueprint So far we have shown how to expose properties to drawings, but there is one last introductory theme that we need to cover before diving deeper into the engine. Creating game systems, designers will have to be able to call on the functions created by the programmer. The programmer should also be able to name the features implemented in the drawings from the NHS code. Let's start with the first creation of the CalculateValues feature from the drawings. Exposing the function of blueprints is as simple as exposing properties. Only one macro is required, placed before the declaration of the function! A snippet of the code below shows what you need to do. UFUNCTION (BlueprintCallable, Damage Category) Void CalculateValues (); The UFUNCTION macro level exposes the function of the NHS to the reflection system. The BlueprintCallable option provides it with a Blueprint virtual machine. Each Blueprint disclosure feature requires a category associated with it, so the right-click context menu works properly. The image below shows how the category affects the context menu: As you can see, the feature is selected from the Damage category. The drawing code below shows a change in TotalDamage value followed by a call to recalculate the dependent data. This uses the same function that we added earlier to calculate our dependent property. Much of the engine is exposed to drawings using the UFUNCTION macro(so that people can create games without writing C. However, the best approach is to use C- to create basic game systems and critical performance code with drawings used to tweak behavior or create composite behaviors from building blocks C. Now that designers can name our code. This approach allows the SH code to name the functions defined in the drawings. We often use this approach to notify designers of an event they can react to in their opinion. Often this involves spawning effects or other visual influences such as concealing or unhiding the actor. A snippet of the code below shows the function that is being implemented UFUNCTION (BlueprintImplementableEvent, (BlueprintImplementableEvent, The void is called CommKpp. This feature is called, like any other function of the NHS. Under the covers, Unreal Engine generates a basic C feature implementation that understands how to call in Blueprint VM. This is commonly referred to as Thunk. If the drawing in question does not provide the body with the function for this method, then the function behaves just like the function of the NHS without the body behaving: it does nothing. What if you want to provide the default implementation by allowing the drawing to override the method? UFUNCTION () macro has the ability to do this too. The code fragment below shows the changes you need in the title to achieve this goal. UFUNCTION (BlueprintNativeEvent, Category Damage) void calledFromCpp (); This version still generates a thunking method to call in Blueprint VM. So, how do you make it happen by default? The tools also create a new declaration of features that looks like _Implementation. You have to provide this version of the feature or your project will not be able to link. Here's the implementation code for the declaration above. Nulling AMyActor::CalledFromCpp_Implementation () / Do something cool here - Now this version of the feature is called when the drawing in question does not override the method. Note that in previous versions of the _Implementation build tools, the declaration was automatically generated. In versions 4.8 and up, you should clearly add that to the headline. Now that we've gone through the general gameplay of a programmer and working with designers to build out gameplay features, it's time for you to choose your own adventure. You can either continue to work with this document to learn more about how we use the SH in the engine, or you can go straight to one of our samples that we include in the launcher to get a more hands-on experience. Diving deeper I see you are still with me on this adventure. It's cool. The following topics revolve around what our gameplay class hierarchy looks like. In this section, we'll start with the basic building blocks and talk about how they relate to each other. Here we're here to see how Unreal Engine uses both heritage and composition to create custom gameplay features. Gameplay classes: Objects, Actors and Components there are 4 main class types that you get from for most gameplay classes. These are UObject, AActor, UActorComponent and UStruct. Each of these building blocks is described in the following sections. Of course, you can create types that don't flow from any of these classes, but they won't participate in features that are built into the engine. Typical uses of classes created outside the UObject hierarchy are: integrating third-party libraries, packing certain OS functions, and so on. Unrealistic (UObject) Базовый строительный блок в двигателе </function> </function> UObject. This class, in conjunction with UClass, provides a number of the most important engine services: Reflection properties and methods serializing the properties of the UObject Garbage Search Collection by the name of Customized Values for Properties Network Support properties and methods Each class that comes from UObject has a monochrome UClass created for it that contains all the metadata about the class instance. UObject and UClass together are at the root of everything that makes an object of gameplay during their lifetime. The best way to think about the difference between UClass and UObject is that UClass describes what a copy of UObject will look like, what properties are available for serialization, networking and so on. Most gameplay development does not involve direct receipt from UObject, but is instead from AActor and UActorComponent. You don't need to know the details of how UClass or UObject works in order to write gameplay code, but it's good to know that these systems exist. AActor AActor is a UObject that should be part of the gaming experience. Actors are either placed on a level by a designer or created while performing using gameplay systems. All objects that can be placed in a level extend from this class. Examples include AStaticMeshActor, ACameraActor and APointLight. Because AActor comes from UObject, it uses all the standard features listed in the previous section. Actors can be clearly destroyed by gameplay code (C or Blueprints) or a standard garbage collection mechanism when the level of ownership is unloaded from memory. Actors are responsible for the behavior of the objects of your game at a high level. AActor is also a basic type that can be reproduced during communication. During network replication, Actors can also disseminate information to any UActorComponents they have that require network support or synchronization. Actors have their own behavior (specialization through inheritance), but they also act as containers for the hierarchy of the components of the actor (specialization through composition). This is done through a RootComponent actor who contains a single USceneComponent, which in turn can contain many others. Before the actor can be placed in a level, he must contain at least one component of the scene from which the actor will draw his translation, rotation and scale. Actors have a number of events that are called during their life cycle. The list below is a simplified set of events illustrating the lifecycle: BeginPlay: Called when an actor first appears during a gameplay. Tick: Called once in the frame to do the work over time. EndPlay: Called when an object leaves the gameplay space. See Actors for a more detailed discussion of the AActor class. Runtime life cycle Slightly higher, discussed the subset of the actor's life cycle. For actors featured in the Understanding the life cycle is quite easy to imagine: Actors are loaded and come into existence and eventually the level is unloaded and the actors are destroyed. Spawning an actor is a little more difficult than creating a normal object in the game because the actors have to be registered with different execution time systems to serve all their needs. You need to establish the original location and rotation for the actor. Physics may have to know about this. The manager responsible for telling the Actor a tick should know. And so on. Because of this we have a method dedicated to spawning an actor, SpawnActor (a member of UWorld). When the actor successfully appears, the engine will call its Method BeginPlay and then Tick on the next frame. Once the actor has lived his life, you can get rid of him by calling to destroy. During this process, EndPlay will be launched, allowing you to execute custom logic before the Actor goes to collect the garbage. Another option to control how long an actor exists is to use a participant lifespan. You can set the amount of time in the actor's designer or with other code during the run. Once that amount of time has expired, the actor will automatically destroy called upon him. To learn more about spawning actors see the Spawning Actors page. The components of UActorComponent Actor Components (UActorComponent class) have their own behavior and are generally responsible for functionality that is divided between many types of actors, such as providing visual grids, particle effects, camera perspectives and interaction physics. While actors often get high goals related to their overall role as your game, Actor Components usually perform separate tasks that support these higher-level goals. Components can also be attached to other components or may be the root component of the actor. The component can only attach to one parent component or actor, but it can have many baby components attached to itself. Imagine a tree of components. The child's components are positioned, rotated, and scaled in relation to the parent component or actor. While there are many ways to use actors and components, one way to think about the relationship between the actor and the component is that actors can answer the question, What's this thing? while components can answer, What is this thing made of? RootComponent is a member of AActor that keeps the top level of the component in the component tree ticking - components tick as part of the actor's tick function. (Don't forget to call Super::::Tick when writing your own Tick feature.) Dissecting the character in the first person to illustrate the connection between AActor and his UActorComponents, let's dig in that is created when you create a new project based on a first-person template. In the picture below is a tree component for the FirstPersonal FirstPersonCharacter RootComponent is CapsuleComponent. To CapsuleComponent are attached ArrowComponent, a component of the grid and FirstPersonCameraComponent. The sheet is a Mesh1P component that is the parent of FirstPersonCameraComponent, which means that the mesh is in the first person in relation to the first-person camera. Visually this component tree looks like the image below, where you see all the components in 3D space except the grid component. This component tree is attached to one Class actor. As you can see from this example, you can create complex gameplay objects using both inheritance and composition. Use inheritance when you want to set up an existing AActor or UActorComponent. Use the composition when you want to have many different types of AActor to share functionality. UStruct To use UStruct, you don't have to expand from any particular class, you just flag the structure with USTRUCT () and our build tools will do the basic work for you. Unlike UObject, UStruct does not collect garbage. If you create dynamic instances of them, you have to manage their life cycle yourself. UStruct should be a simple type of data that has the support of UObject reflection for editing in Unreal Editor, drawing manipulation, serialization, networking, and so on. Now that we've talked about the basic hierarchy used in our gameplay class building, it's time to pick your way again. You can read about our gameplay classes here, head to our samples in the launcher, armed with more details, or continue to dig deeper into our C's features to create games. Diving Deeper is still good, it is clear that you want to know more. Let's keep going into how the engine works. Unreal System Reflection Blog Post: Unreal Ownership System (Reflection) Gameplay Classes use special markups, so before we go for them, let's look at some of the basics of the Unreal property system. UE4 uses its own reflection implementation, which allows for dynamic features such as garbage collection, serialization, network replication, and Blueprint/C' communication. These features are a failure in, meaning you have to add the right markup for your types, otherwise Unreal will ignore them rather than generate reflection data for them. Here's a quick overview of the baseline markup: UCLASS () - Used to say Unreal to generate reflection data for the class. The class must be derived from UObject. USTRUCT () - Used to say Unreal to generate reflection data for the structure. GENERATED_BODY - UE4 replaces this with all the necessary template code that is generated for the type. UPROPERTY () - Allows you to use the UCLASS or USTRUCT member variable as UPROPERTY. has many uses. This can allow the variable to be reproduced, serialized, and accessed from drawings. They are also used by a garbage collector to track how much there's in UObject. UFUNCTION () - Allows you to use the UCLASS or USTRUCT method as UFUNCTION. UFUNCTION can allow a method of class to be called out of the drawings and used as an RPC, among other things. Here is an example of the UCLASS declaration: #include MyObject.h UCLASS (Blueprintable) class UMyObject : public UObject - GENERATED_BODY () public: MyUObject (); UPROPERTY (BlueprintReadOnly, EditAnywhere) Float SampleProperty; UFUNCTION (BlueprintCallable) Void ExampleFunction (); }; You will first notice the inclusion of MyObject.generated.h. UE4 will generate all the reflection data and put it in this file. You should include this file as the last inclusion in the title file that announces your type. UCLASS, UPROPERTY and UFUNCTION mark-ups in this example include additional e-holes. They are not required, but some common clarifications have been added for demonstration purposes. They allow us to specify certain behaviors or properties. Blueprintable - This class can be expanded by a blueprint. BlueprintReadOnly - This property can be read from the drawing, but not written. EditAnywhere - This property can be edited by property windows, archetypes and copies. Category - Determines under which section the property is displayed in the Editor's Detailed Information view. This is useful for organizational purposes. BlueprintCallable - This feature can be called by drawings. There are too many clarifications here, but the following references can be used as a reference: The UCLASS List of U.S. U.S. USTRUCT USTRUCT-Object Designers/Iterators is a very useful tool for iteration in all copies of a certain type of UObject and its subclasses. Find ALL current UObject copies for (TObjectIterator'lt;UObject)gt; It; (It) - UObject CurrentObject - It; UE_LOG (LogTemp, Log, TEXT (UObject Found: % s), CurrentObject-'gt;GetName()) You can limit the search area by giving a more specific type to the iterator. Suppose you had a class called UMyClass from UObject. You can find all the instances of this class (and the ones that flow from it) like this: for (TObjectIterator'lt; UMyClass)gt; It; Using object iterators in a PIE (Play In Editor) can lead to unexpected results. Because the editor is loaded, the object iter will return all UObject instances created for your copy of the game world, in addition to those just used by the editor. Actor-iterators work in the same way as object iterators, but only work for objects that originate from AActor. Actor Iterators have no problem marked above, and will only return objects used by the current game world instance. When creating Iterator, the actor must give him a pointer to a copy of UWorld. классы UObject, такие как</UMyClass> </UObject> </UObject> provide a GetWorld method to help you. If you're not sure, you can check out the ImplementsGetWorld method on UObject to see if it implements the GetWorld method. APlayerController- MyPC - GetMyPlayerControllerFromSomewhere (); UWorld - World - MyPC-gt;GetWorld As iterators of objects, you can provide a certain class to get only objects that are / or flow from this class for (TActorIterator'lt;AEnemy)gt; It's; (It) Since AActor comes from UObject, you can use TObjectIterator to find instances of AActors as well. Just be careful in PIE! Memory Management and Garbage Collection In this section we go to basic memory management and the garbage collection system in UE4. Wiki: UObjects' garbage collection and dynamic memory distribution and garbage collection uses a reflection system to implement a garbage collection system. When collecting garbage, you don't have to manually manage the removal of UObject instances, you just need to maintain valid links to them. Your classes must be sourced from UObject in order to be included for garbage collection. Here's a simple example of the class we'll use: UCLASS () Class MyGCType : Public UObject and GENERATED_BODY () There is a concept called a root set in a garbage collector. The root set is a list of objects that, as the collector knows, will never be collected by garbage. The object will not collect debris as long as there is a link path from the object at the root set to the object in question. If there is no such pathway to root data, it is called unattainable and will be collected (removed) the next time the garbage collector is launched. The engine is launched by a garbage collector at certain intervals. Any UObject that is stored in UPROPERTY or in the UE4 container class (e.g. TArray) is considered a reference for garbage collection purposes. Let's start with a simple example. CreateDoomedObject void () - MyGCType- DoomedObject - NewObject The aforementioned feature creates a new UObject, but does not store a pointer on it in any UPROPERTY or UE4 container, and this is not part of the root set. Eventually, the garbage collector will find that the object is unavailable and destroy it. Actors and actors collecting garbage usually do not collect garbage except during the stop level. Once spawned, you have to manually call the wipe on them to remove them from the level without finishing the level. They will be removed from the game immediately and then completely removed in the next round of garbage collection. This is a more common case when you have actors with UObject properties. UCLASS () Class AMyActor : Public AActor and GENERATED_BODY () Public: UPROPERTY () MyGCType' SafeObject; MyGCType' DoomedObject; AMyActor : Super (ObjectInitializer) - SafeObject - ОбреченныйОбъект</MyGCType> </MyGCType> </AEnemy> </AEnemy> } }; The Void SpawnMyActor (UWorld, FVector Location, FRotator Rotation) - World---'zgt;spawnActor'lt;AMyActor(Location, Rotation); When we call the aforementioned function, we spawn an actor in the world. The actor's designer creates two objects. One gets assigned to UPROPERTY, the other is a bare pointer. Because Actors are automatically part of the root dataset, SafeObject will not collect debris because it can be reached from a root set object. DoomedObject, however, will not fare so well. We're not labeling it with UPROPERTY, so the collector doesn't know what the links are now, and end up destroying it, leaving a dangling pointer. When UObject is going to trash, all UPROPERTY links to it will be void for you. This makes it safe for you to check if the object has been collected by garbage or not. if (MyActor- 'gt;SafeObject!) - nullptr) / Using SafeObject - This is important since, as mentioned earlier, actors who have been destroyed have encouraged them not to be removed until the garbage collector is working again. You can check the IsPendingKill method to see if UObject expects to remove it. If this method returns to the truth, you should consider the object dead and not use it. UStructs UStructs, as mentioned earlier, are designed for the lightweight version of UObject. Thus, UStructs cannot be collected by garbage. If you have to use dynamic instances of UStructs, you can use smart pointers instead, which we'll go to later. Non-UObject Links Normal OBJECTS (not sourced from UObject) may also be able to add a link to an object and prevent garbage collection. To do this, the object must be derived from FGCObject and redefine its AddReferencedObjects method. FMyNormalClass Class : public FGCObject - public: UObject' SafeObject; FMyNormalClass (UObject) : SafeObject (Object) - Void AddReferencedObjects (FReferenceCollector) Collector) override - Collector.AddReferencedObject (SafeObject); We use FReferenceCollector to manually add a hard link to the UObject we need and don't want the garbage to be collected. When an object is removed and its destructor is launched, the object automatically clears all the links it has added. The Unreal Engine prefix naming class provides tools that generate code for you during the build process. These tools have some naming expectations for classes and cause warnings or errors if the names don't meet expectations. The list of class prefixes below delineates what the tools expect. Classes received from an actor are pasted on A, such as AController. Classes obtained from the facility are pasted on U, such as UComponent. Enums, set-top box with E, such as EFortificationType. Interface classes are usually shoved i, for example Pattern classes are prefixed by T, such as TArray. Classes that flow from SWidget (Slate UI) are edged by S, for example, zlt;/AMyActor Everything else is prefixed by the F, such as FVector. Numerical types Because different platforms have different sizes for basic types such as short, int and long, UE4 provides the following types that you should use as an alternative: int8/uint8: 8-bit signed/unsigned integer int16/uint16: 16-bit signed/unsigned integer int32/uint32: 32-bit signed/unsigned integer in t64/uint64: 64-bit signed/unsigned floating toy numbers are also supported by standard float types (32-bit) and double (64-bit). Unreal Engine has a template, TNumericLimits, to search for minimum and maximum ranges, the type of value can hold. For more information, click here. Strings UE4 provides several different classes to work with strings, depending on your needs. Full theme: FString FString's Line Processing is a mutated string, similar to std::string. FString has a great set of techniques in order to make it easy to work with strings. To create the new FString, use text: FString MyStr and TEXT (Hello, Unreal 4!). Full theme: FString API FText FText is similar to FString, but is designed for localized text. Use the NSLOCTEXT macro to create the new FText. This macro occupies the name space, key and value for the default language: FText MyText and NSLOCTEXT (Game UI, Health Warning Message, Low Health!) you can also use LOCTEXT macro, so you only have to determine the name space once per file. Make sure to not edrid it at the bottom of the file. GameUI.cpp #define LOCTEXT_NAMESPACE Game UI/... FText MyText - LOCTEXT (Health Prevention Message!) / #undef LOCTEXT_NAMESPACE/ File End Full Theme: FText API FName A FName stores a typically repetitive line as an ID to save the memory and time of the processor when comparing them. Instead of storing a full line many times on each object that refers to it, FName uses the smaller storage footprint index that appears on that line. This stores the contents of the line once, saving the memory when that line is used in many objects. The FName comparison is quick because UE4 can simply check its index values to see if they match, without having to do the character behind the comparison symbol. Full theme: FName API TCHAR Type TCHAR is used as a way to store symbols, not dependent on the character set used, which may differ between platforms. Under the hood of the line, UE4 uses TCHAR arrays to store data in UTF-16 coding. You can access raw data with the overloaded dereference operator that returns TCHAR. Full theme: Characters This is necessary for some features such as FString::P rintf, where the %s string format is indicated expects TCHAR instead of FString. FString Str1 - TEXT (World); int32 Val1 No 123; FString Str2 - FString::P rintf (TEXT (Hello, %s! The FChar class provides a set of static utilities. to work with individual TCHAR characters. TCHAR Upper('A'); TCHAR Lower and FChar::ToLower (Upper); The 'a' Type FChar is defined as TChar'lt;TCHAR'gt; (as listed in the API). Full theme: TChar API containers are classes whose primary function is to store data collections. The most common of these classes are TArray, TMap and TSet. Each one is dynamically sized, and so will grow to any size you need. Full theme: TArray API containers Of these three containers the main container you will use in Unreal Engine 4 is TArray, it functions just like std::vector does, but offers a lot more functionality. Here are some common operations: TArray - GetActorArrayFromSomewhere Tells how many elements (AActors) are currently stored in ActorArray. int32 ArraySize - ActorArray.Num (); TArrays are based on 0 (the first element will be on index 0) int32 Index No 0; Attempts to get an element on this Actor index - the first actor ActorArray.Addy (NewActor); Adds an item to the end of the array only if it is not yet in the ActorArray.AddUnique array); Won't change the array because NewActor has already been added / Removes all 'NewActor' instances from the ActorArray array.Remove (NewActor); Removes an item in the index / Items above the index will be moved down one to fill the empty ActorArray space.RemoveAt (Index); A more efficient version of 'RemoveAt', but does not support the order of ActorArray elements.RemoveAtSwap (Index); Removes all items in the ActorArray.Empty array TArray has the added benefit of having its garbage items collected. This assumes that TArray stores UObject received pointers. UCLASS : UObject and GENERATED_BODY // ... RESTPERTY () Actore GarbageColctor; DEBRIS () Tarray TArray<AActor*> AnotherGarbageCollectedArray; We'll cover the garbage collection in detail in a later section. Full theme: TArrays Complete theme: TArray API TMap TMap is a set of key pair values similar to std::map. TMap has quick methods of finding, adding and deleting items based on their key. You can use any type for the key, as long as it has the GetTypeHash feature identified for it, which we will go later. Let's say you created a grid-based tincture and had to store and request what part is on each square. TMap will provide you with an easy way to do this. If the board is small and always the same size, there may be better ways to solve this problem, but for this example let's assume that the board is larger with relatively few parts. enum class EPieceType - king, queen, rook, bishop, knight, pawn; structure FPiece and int32 Тип EPieceType; FIntPoint</AActor*> </AActor*> </AActor*> </TCHAR> </TCHAR> FPiece (int32 InPlayerId, EPieceType InType, FIntVector InPosition) : PlayerId (InPlayerId), Type (InType), Position (InPosition) FBoard class - private: / Using TMapMap, we can refer to each part of our position T'Map lt;FIntPoint, fpiece'gt; Data; Public: bool HasPieceAtPosition (FIntPoint position) - Return Data.Contains (Position); FPiece GetPieceAtPosition (FIntPoint Position) - Data Return (position) ; invalid AddNewPiece (int32 PlayerId, EPieceType, FIntPoint position) - FPiece NewPiece (PlayerId, Type, Position); Data.Add (Позиция, NewPiece); - Invalid MovePiece (FIntPoint OldPosition, FIntPoint NewPosition) - FPiece Piece (data)OldPosition); Piece.Position - NewPosition; Data.Remove Data.Add (NewPosition, Piece); - Void DeletePieceAtPosition (Position FIntPoint) - Data.Remove (Position); Full theme: TMaps Full Theme: TMap API TSet A TSet keeps a collection of unique values similar to std::set. Although TArray supports set-like behavior using AddUnique and Contains methods, TSet has faster implementations of these operations and protects against the automatic addition of non-unsuluaned elements. TSet<AActor*> ActorSet - GetActorSetFromSomewhere (); Int32 Size - ActorSet.Num(); Adds an item to the set if the set no longer contains it AActor' NewActor - GetNewActor (); ActorSet.Add (NewActor); Check if an item is in the set if (ActorSet.Contains (NewActor)/ / / Remove an item from the ActorSet.Remove (NewActor) set; Removes all items from the ActorSet.Empty set Creates TArray, which contains elements of your TSet TArray/lt;AActor/ArrayFromSet - ActorSet.Array (); Full theme: TSet API Container Iterators Using iterators, you can cycle through each element of the container. Here's an example of what the iterator syntax looks like with TSet. Void DeleteDeadEnemies (TSet - EnemySet) / Start at the beginning of the set, and iterate to the end of the set for (Auto EnemyIterator and EnemySet.CreateIterator (); EnemyIterator; EnemyIterator) / The operator receives the current AEnemy Enemy element EnemyIterator; If (Enemy.Health No. 0) / 'RemoveCurrent' is supported by TSets and TMaps EnemyIterator.RemoveCurrent (); Other supported operations can be used with iterators: / Moves the iterator back one element --EnemyIterator; Moves the iterator forward/back to some shift, where Offset is more an EnemyIterator and Offset integrator; Enemyterer - - Displacement; Receives the index of the current element int32 Index - EnemyIterator.GetIndex(); Resets the iterator on the first element of EnemyIterator.Reset() For each cycle the iterators are good, but can be a little cumbersome if you just want to cycle through each item once. Each container class also supports for everyone syntax for над элементами. TArray и TSet возвращение</AEnemy*> </AActor*> </AActor*> </FIntPoint,> </FIntPoint,> element, while TMap returns a couple of key values. TArray TArray<AActor*> ActorArray - GetArrayFromSomewhere (); for (AActor) OneActor : ActorArray) -/ // TSet - Same as TArray TSet'lt;AActor'gt; ActorSet - GetActorSetFromSomewhere (); for (AActor' UniqueActor : ActorSet) / / : TMap - Iterator returns the key value of the pair TMap'lt;FName, AActor'gt; NameToActorMap - GetMapFromSomewhere (); for (auto KVP : NameToActorMap) - FName Name - KVP. The key Actor and KVP. Meaning; // ... } Keep in mind that the automatic keyword does not automatically indicate pointers or links. As in the previous example, you may need to add an appropriate notation if you are using auto. Using your own types with TSet/TMap (Hash Functions) TSet and TMap requires the internal use of hash functions. Most types of UE4 that are usually stored in TSet or used as a key in TMap already define their own hash functions. If you're creating your own class and would like to use it in TSet, or as a key in TMap, you'll need to provide a hash feature that takes a const pointer or link to your type and returns uint32. This return value is known as the object hash code and must clearly identify the object. This means that two type objects that are considered equal should always return the same hash code. FMyClass class - uint32 ExampleProperty1; uint32 ExampleProperty2; Hash Function friend uint32 GetTypeHash (Const FMyClass- MyClass) -/ HashCombine - a utility for combining two hash values. uint32 HashCode - HashCombine (MyClass.ExampleProperty1, MyClass.ExampleProperty2); The return of HashCode; For demonstration purposes, two objects that are equal / must always return the same hash code. ExampleProperty1 - RHS. ExampleProperty1 and LHS. ExampleProperti2 - RHS. ExampleProperty2; } }; Now TSet and TMap'lt;FMyClass, ...'gt; will use the correct hashing feature when hashing keys. If you use pointers as keys (i.e. TSet) to implement the getTypeHash (const FMyClass' MyClass) as well. Blog Post: UE4 Libraries You Should Know About the UE4 Libraries

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