Small Team, Huge Game, and Lua

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About Natural Selection 2

- UWE formed in Oct. 2006 in San Francisco, CA
- Core team of 9 with several others around the world
- NS2 is a sequel to a modification of the game Half Life
- Custom game engine
Two very unique teams
Online multiplayer
Hybrid first person shooter/real time strategy
Dynamic Environments
Natural Selection 2 is an immersive, multiplayer shooter that pits aliens against humans in a strategic and action-packed struggle for survival. It seamlessly combines shooter and RTS/strategy gameplay. Key Features: Two Unique Sides: Whether you play as one of the elite marine Frontiersmen or the vicious alien Kharraa, you must use...

Genre: Action, Strategy, Indie
Release Date: Oct 30, 2012

View all 10 screenshots
Watch all 2 trailers
Engine written in C++
Gameplay written entirely in Lua

```lua
function Player:GetGravityAllowed()
    // No gravity when on ladders or on the ground.
    return not self:GetIsOnLadder() and not self:GetIsOnGround()
end

function Player:GetMoveDirection(moveVelocity)
    if self:GetIsOnLadder() then
        return GetNormalizedVector(moveVelocity)
    end

    local up = Vector(0, 1, 0)
    local right = GetNormalizedVector(moveVelocity):CrossProduct(up)
    local moveDirection = up:CrossProduct(right)
    moveDirection:Normalize()
    return moveDirection
end

function Player:OnUseTarget(target)
end

function Player:OnUseEnd()
end

function Player:EndUse(deltaTime)
    if not self:GetIsUsing() then
        return
    end
```

---

The game's gameplay is entirely written in Lua, a lightweight scripting language for game development. The code snippet above shows a function for determining whether gravity is allowed based on whether the player is on a ladder or on the ground. It also includes a function for getting the move direction, taking into account whether the player is on a ladder and adjusting the direction accordingly.
Lua source shipped with the game
Overview

- Lua integration within the game engine
- OOP without the hierarchy
- Script errors
- Open development
Hooking into the engine

- Two ways the game code is notified of engine events
- Global events
- Entity events
Global events

local function OnClientDisconnected(reason)
    Shared.Message("You were disconnected: ", .. reason)
end

Event.Hook("ClientDisconnected", OnClientDisconnected)

Event.Hook("Console_hello_world",
    function() Shared.Message("Hello Lua Workshop!") end)
Entity events

First, what is an entity?

- Persistent networked object
- Server -> Clients
- Prediction
- Lag compensation
- Container for physics, graphics, etc
- Queryable

Player, Structure, Door, Weapon, Health pack, etc
Entity events

- From engine to specific entity
- Automatically networked

Player::OnInitialized()
Player::OnDestroy()
Player::OnProcessMove(move)
OOP without the hierarchy

Traditional Hierarchy

Entity
  Actor
    BlendedActor
    ScriptActor
      LiveScriptActor
        Structure
          Hive
          Armory
            AdvancedArmory
        Player
          Marine
            JetpackMarine
          Alien
            Skulk
            Fade
            Gorge
Problems with the hierarchy

Where to add new functionality?

CloakedActor

LiveScriptActor
  Structure
    Hive
    Armory
Problems with the hierarchy

Where to add new functionality?

LiveScriptActor

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Where to add new functionality?

LiveScriptActor

Structure

  CloakedActor?
    Hive
    Armory

Player

  Alien
Problems with the hierarchy

Where to add new functionality?

LiveScriptActor
  CloakedActor?
    Structure
      CloakedActor?
        Hive
      Armory
    CloakedActor?
      Player
        CloakedActor?
          Alien
Problems with the hierarchy

Overrides lead to bugs:

```lua
function Marine:OnKill()
    Player.OnKill(self)
    self:RemovePoints(10)
end
```
Problems with the hierarchy

Overrides lead to bugs:

function Marine:OnKill()
  -- The Marine sometimes respawns very fast!
  if self:CheckForQuickRespawn() then
    self:RespawnQuick()
  else
    Player.OnKill(self)
    self:RemovePoints(10)
  end
end
OOP without the hierarchy

Traditional Hierarchy

Entity
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The Overly Responsible LiveScriptActor

- Being alive, health, and armor
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- Being alive, health, and armor
- Game effects (on fire, cloaked, etc)
The Overly Responsible LiveScriptActor

- Being alive, health, and armor
- Game effects (on fire, cloaked, etc)
- Scoring
The Overly Responsible LiveScriptActor

- Being alive, health, and armor
- Game effects (on fire, cloaked, etc)
- Scoring
- Team
The Overly Responsible LiveScriptActor

- Being alive, health, and armor
- Game effects (on fire, cloaked, etc)
- Scoring
- Team
- Energy
The Overly Responsible LiveScriptActor

- Being alive, health, and armor
- Game effects (on fire, cloaked, etc)
- Scoring
- Team
- Energy
- Construction
The Overly Responsible LiveScriptActor

- Being alive, health, and armor
- Game effects (on fire, cloaked, etc)
- Scoring
- Team
- Energy
- Construction
- Using
- Orders
- Power
- Researching
- Stunning
- Upgrading
Mixins

- Where to add new functionality?
- Overrides
What is a Mixin?

- A piece of functionality
- "Attaches" itself to an object
- Is NOT organized within a hierarchy
LiveMixin

LiveMixin = { type = "Live" }

function LiveMixin:__initmixin()
    self.health = 100
end

function LiveMixin:TakeDamage(amt)
    self.health = self.health - amt
end

function LiveMixin:Heal(amt)
    self.health = self.health + amt
end
Adding mixins to an object

local player = Server.CreateEntity("Player")

InitMixin(player, LiveMixin)

player:TakeDamage(50)
player:Heal(10)
function InitMixin(entity, mixin)
    for name, func in pairs(mixin) do
        entity[name] = func
    end
end
local CloakableMixin = { type = "Cloak" }

-- Uncloak when taking damage.
function CloakableMixin:TakeDamage()
  self:Uncloak()
end
How to handle overrides

local CloakableMixin = { type = "Cloak" }

-- Uncloak when taking damage.
function CloakableMixin:TakeDamage()
  self:Uncloak()
end

function LiveMixin:TakeDamage()
How to handle overrides

- Only call the first function attached?
- Require explicit calls to specific mixins?
- Call all the functions attached?
How to handle overrides

- Only call the first function attached?
- Require explicit calls to specific mixins?
- **Call all the functions attached.**
function InitMixin(entity, mixin)

    for name, func in pairs(mixin) do
        if entity[name] == nil then
            entity[name] = func
        else
            AddFunctionToCallerList(entity, name, func, mixin)
        end
    end

end

d-function

How to handle overrides

local player = Server.CreateEntity("Player")

InitMixin(player, LiveMixin)
InitMixin(player, CloakableMixin)

player:Cloak()
player:TakeDamage(50)
assert(not player:GetIsCloaked())
Cool picture break
function Bomb:Explode()
    local nearbyEnts = GetNearbyEnts(10)
    for i = 1, #nearbyEnts do
        nearbyEnts[i]:TakeDamage(25)
    end
end
end
function Bomb:Explode()

local nearbyEnts = GetNearbyEnts(10)
for i = 1, #nearbyEnts do
    nearbyEnts[i]:TakeDamage(25)
end

end
function Bomb:Explode()

    local nearbyEnts = Get NearbyEnts (10, "Live")
    for i = 1, #nearbyEnts do
        nearbyEnts[i]:TakeDamage(25)
    end

end
109 Mixins in NS2

- PowerSourceMixin
- ModelMixin
- FireMixin
- FreeLookMoveMixin
- FollowMoveMixin
- OrdersMixin
- PathingMixin
- PickupableMixin
- PointGiverMixin
- ...

Script Errors

- Line number
- Call stack
- State
- Automatic collection
Script Errors

[Client] Script Error #1

Filename: lua/LiveMixin.lua
Line: 456

Message: lua/LiveMixin.lua:456: attempt to compare number with string

Stack:
- AddHealth lua/LiveMixin.lua:456
- OnWeld lua/WeldableMixin.lua:37
- PerformWeld lua/Weapons/Marine/Welder.lua:232
- OnPrimaryAttack lua/Weapons/Marine/Welder.lua:149
- PrimaryAttack lua/Player.lua:709
- HandleAttacks lua/Player.lua:2377
- HandleButtons lua/Player.lua:2567
- HandleButtons lua/Marine.lua:475
- OnProcessMove lua/Player.lua:1563
- lua/Marine.lua:944
- [C]:-1

Ignore | Ignore Always | Exit
Script Errors

Errors:

1: lua/LiveMixin.lua:456: attempt to compare number with string

Call Stack:

AddHealth lua/LiveMixin.lua:456
OnWeld lua/WeldableMixin.lua:38
PerformWeld lua/Weapons/Marine/Welder.lua:232
OnPrimaryAttack lua/Weapons/Marine/Welder.lua:149
PrimaryAttack lua/Player.lua:709
HandleAttacks lua/Player.lua:2377
HandleButtons lua/Player.lua:2567
HandleButtons lua/Marine.lua:475
OnProcessMove lua/Player.lua:1563
lua/Marine.lua:944
[C]:-1

Locals:

- self
  - recentHealthChanged = 0
  - visibleClient = 0
  - timeLastHealed = 0
  - sighted = 0
  - researchProgress = 0
  - researchingId = 1
  - alive = 1
  - vortexed = 0
  - underConstruction = 0
  - teamNumber = 1
  - techId = 76
  - health = '10'
function WeldableMixin:OnWeld()
    self:AddHealth("10")
end
### Top Reported Errors

<table>
<thead>
<tr>
<th>#</th>
<th>Error Description</th>
<th>File Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td>bad argument #1 to '?' (string expected, got no value)</td>
<td>lua/acl/shared.lua:16</td>
</tr>
<tr>
<td>73</td>
<td>) expected near 'ply'</td>
<td>lua/acl/shared.lua:16</td>
</tr>
<tr>
<td>69</td>
<td>'?) expected near 'physics'</td>
<td>lua/effects/bodyshotinit.lua:17</td>
</tr>
<tr>
<td>54</td>
<td>attempt to call method 'inVehicle' (a nil value)</td>
<td>gamemodes/perp/gamemodes/cld_vehicles.lua:98</td>
</tr>
<tr>
<td>51</td>
<td>Tried to use a NULL entity!</td>
<td>d cow's weapons.lua/effects/effect_mad_gunsmoke/init.lua:41</td>
</tr>
<tr>
<td>50</td>
<td>Tried to use a NULL entity!</td>
<td>d cow's weapons.lua/effects/effect_mad_gunsmoke/init.lua:22</td>
</tr>
<tr>
<td>45</td>
<td>Module not found!</td>
<td>gamemodes/perp/gamemodes/cld_modules/radio.lua:15</td>
</tr>
<tr>
<td>42</td>
<td>bad argument #2 to 'CreateFont' (table expected, got number)</td>
<td>lua/acl/shared.lua:16</td>
</tr>
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</tr>
<tr>
<td>39</td>
<td>attempt to call method 'ChatPrint' (a nil value)</td>
<td>LuaCmd:1</td>
</tr>
</tbody>
</table>
Script Errors

Details
error #1210070651 base 7,041 reports 1,625 reporters first seen 9 days ago

Error

gamemodes/perp/gamemode/cl_modules/radio.lua:15: Module not found!

Call Stack
1. require - [C]:-1
2. unknown - gamemodes/perp/gamemode/cl_modules/radio.lua:15
3. include - [C]:-1
4. unknown - gamemodes/perp/gamemode/cl_init.lua:44
Open Development

- Bug fixes
- Optimizations
- Gameplay features
Open Development

Rounds Played

Players

Player Nationalities

Maps

Wins By Round Length

Round Lengths

Wins

Many bots have been harmed during the development of this site.
Open Development
Open Development

- e_X_w Shotgun by Naaacen
- Colonial Marines - Exo Suit by Nomad
- Compact LMG by Ice
- Pink Hello Kitty Rifle
- Custom Shotgun Mod by Nick
- Hello Kitty Rifle by T9fucksGiven.jpg
- Blood Gorge by CYNICAL_MASS
- Colonial Marines
- Colonial Marines - Hands by Nomad
- J13 Elite Crosshairs by Pizza Supreme
Open Development

Marine vs Marine

NATURAL SELECTION
MARINE vs MARINE
Thank You!