



Артём Несиоловский

Тестирование игрового движка Amazon Lumberyard

Подходы и инструменты

Автор: Артём Несиоловский, SDET, Amazon

Опыт

- GeForce Experience
- Lineage II
- Cut the Rope
- Yandex.Images
- Amazon Lumberyard



SDET в Lumberyard QA



Доклад

- Движок
- Покрытие тестами
- Автоматизация - ошибки
- Примеры инструментов
- Баги ;)



Амазон делает игры?!



+

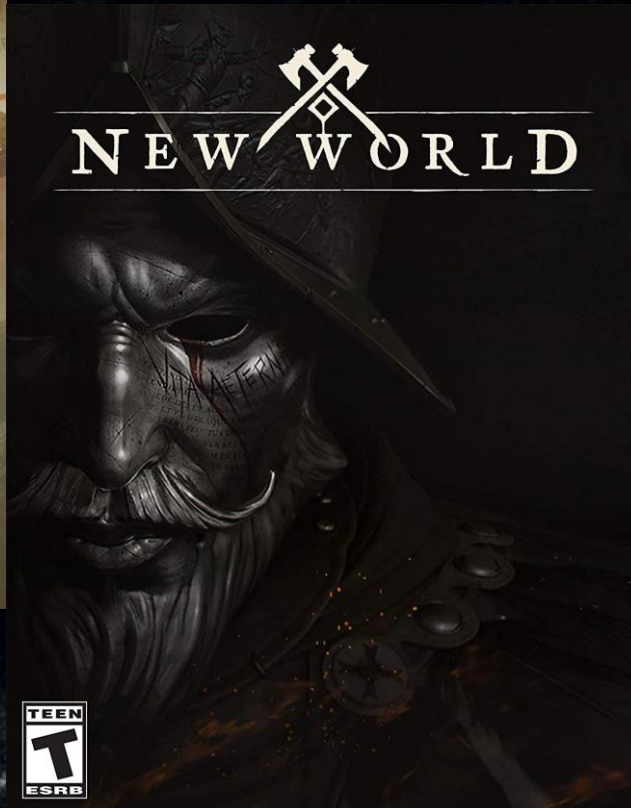
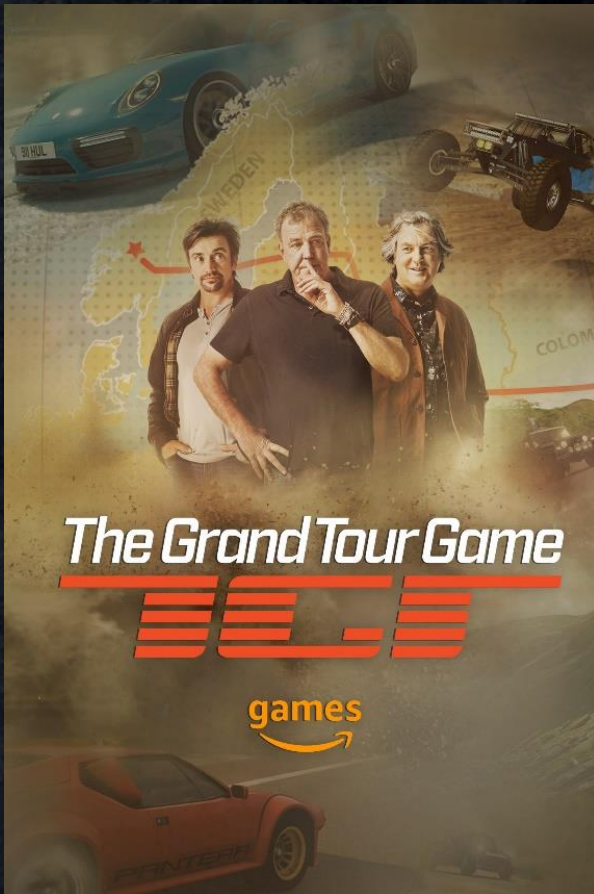


+

amazon
game studios

С чего все начиналось

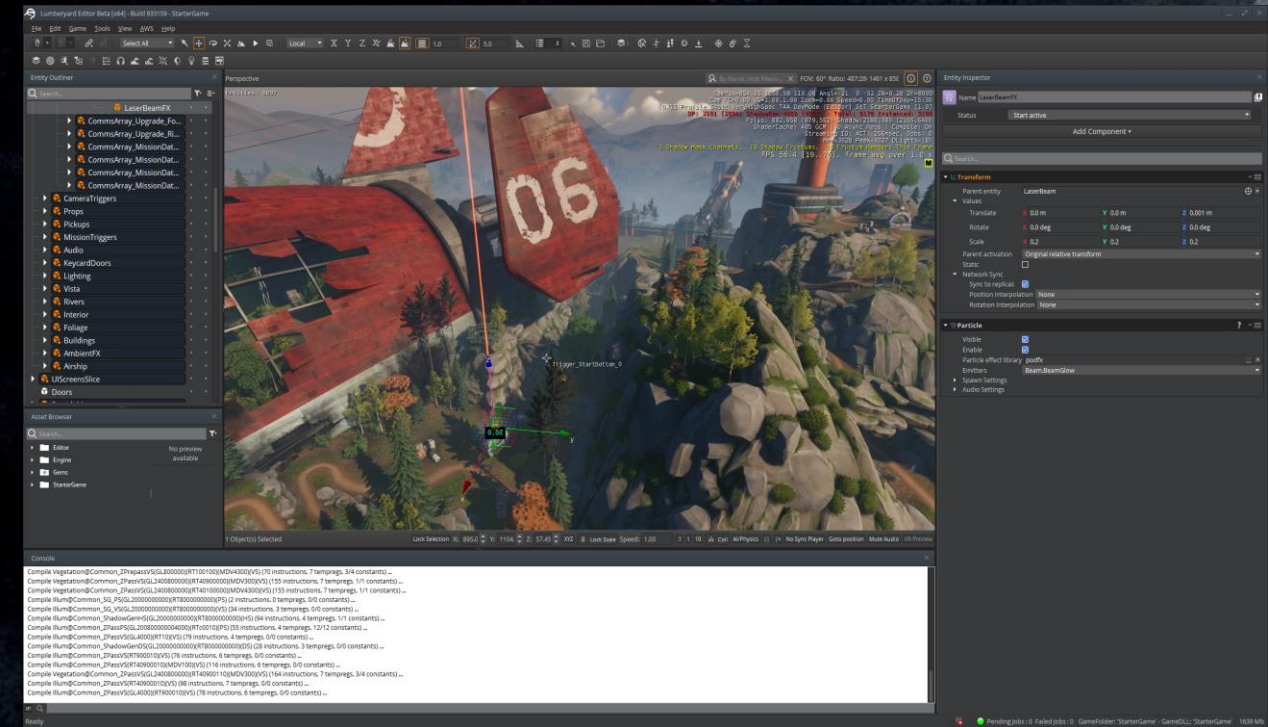
- Crytek, FarCry, CryEngine 3
- ???
- Amazon Lumberyard!



Игровой Движок

Двигатель (набор API для построения игры)

Редактор (создавать уровни)



Amazon Lumberyard

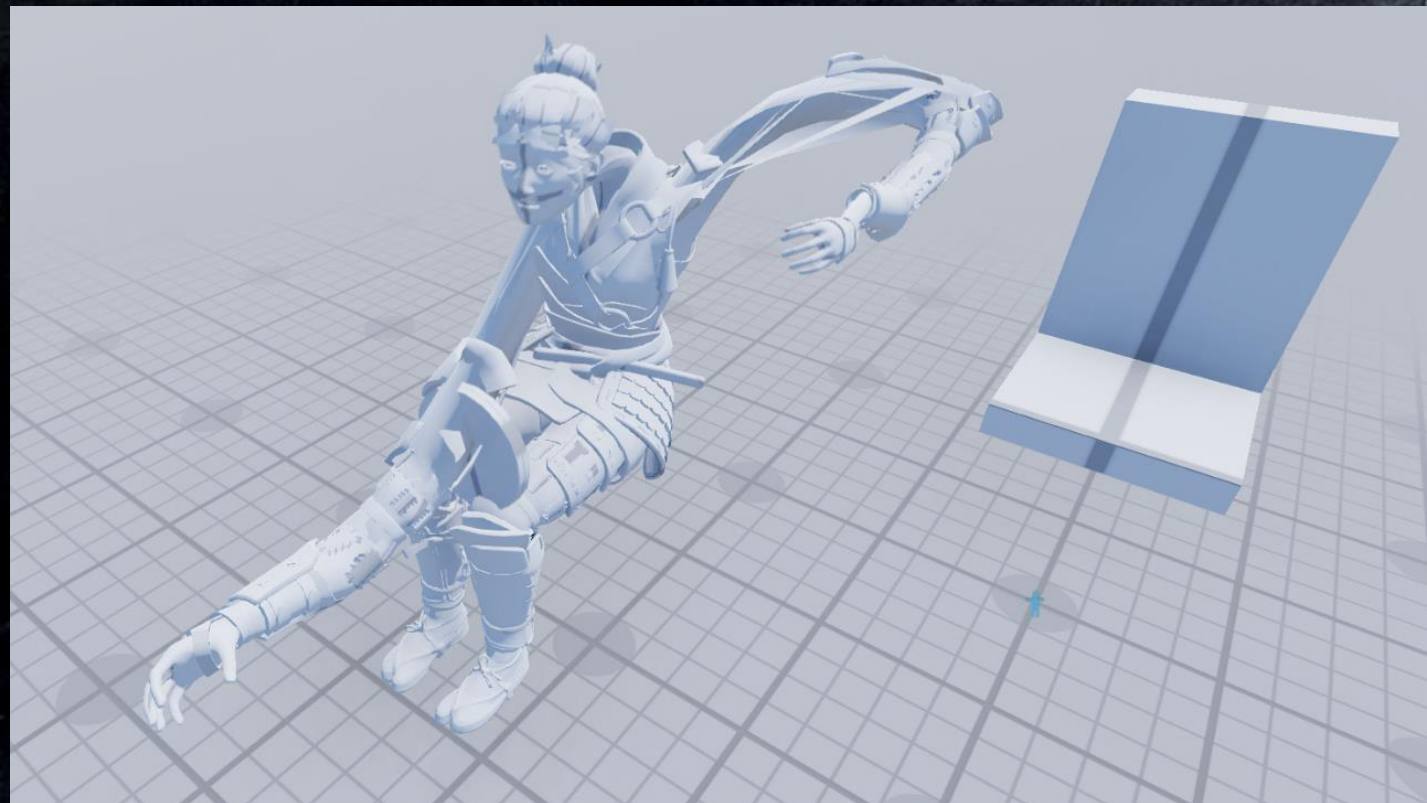
www.Bandicam.com

The screenshot displays the Amazon Lumberyard game engine interface. The main view is a perspective camera showing a futuristic, metallic tunnel with blue lighting and a robot character in the foreground. The interface includes several panels:

- Entity Outliner:** Lists various game entities such as AIWaveTriggerVolume, AirshipPodOuterZone, Interactables, CameraTriggers, Props, Pickups, MissionTriggers, Audio, KeycardDoors, Lighting, Vista, Rivers, Interior, Foliage, Buildings, AmbientFX, Airship, UIScreensSlice, Doors, and ParticleManager.
- Entity Inspector:** Shows details for the selected entity, including its name (WaveTriggerVolume_CombatZone) and various properties like CamPos, Cam Fov, DX11 Profile, and ShaderCache.
- Asset Browser:** Shows a search bar and a list of assets, including Editor, Engine, Gems, and StarterGame.
- Console:** Displays warning messages: "[Warning] XML parser: not well-formed (invalid token) at line 1".
- Bottom Panel:** Shows the status bar with coordinates (X: 1107.89, Y: 1223.65, Z: 53.46), lock selection, speed (0.10), and other engine settings.

Как тестировать движок?

- Редактор и инструменты
- Уровни и игры
- Инфраструктура и совместимость



Особенности проекта



Платформы –
PC, Mac, iOS,
Android, PS4,
Xbox One, VR



Продукт для
разработчиков
и для геймеров



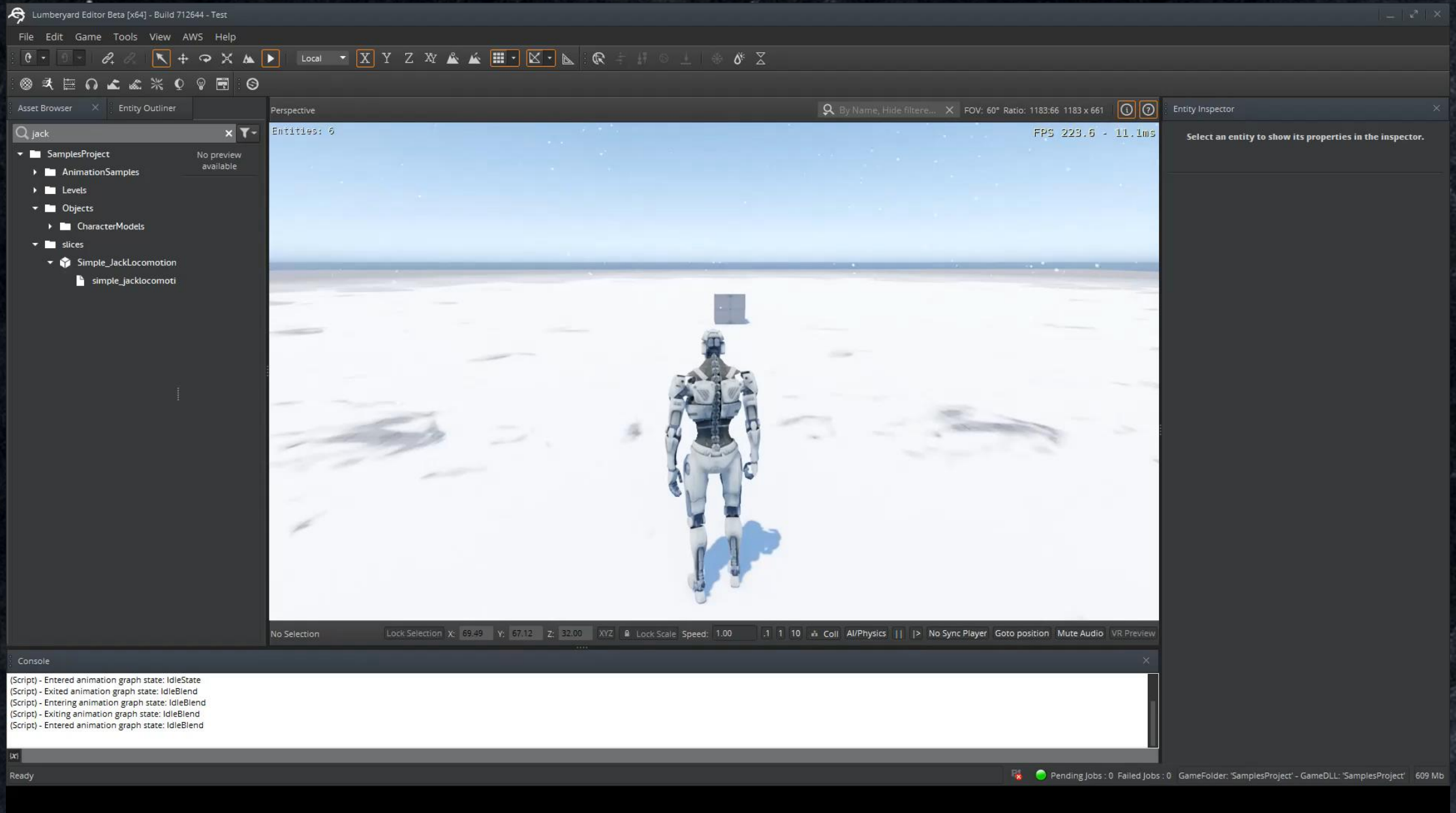
Максимально
широкий спектр
возможных
игровых жанров

Очень много интерфейса

The screenshot displays a complex 3D software interface. On the left, a 3D viewport shows a character model in a perspective view. The top menu bar includes 'File', 'Edit', 'Layouts', 'View', and 'Help'. Below the menu is an 'OpenGL Render Window' with 'View' and 'Camera' options. The right side of the interface is divided into several panels: 'Simulated Object' (showing a hierarchy of joints like 'Left Arm', 'L_arm_JNT', etc.), 'Simulated Object Inspector', 'Simulated Object Colliders', 'Skeleton Outliner' (with a search bar and a list of joints), 'Attributes' (with tabs for 'Attributes', 'Parameters', 'Anim Graph Palette', 'Actor Manager', 'Game Controller', 'Node Groups'), and 'Recorder' (with a time view and filters for 'Motions Only', 'States Only', and 'Events'). A central white box with black text reads: 'Contains 3014 sections and 11978 cases.' The bottom of the interface features an 'Anim Graph' window showing a motion graph with nodes like 'idle_motion', 'Parameters0', 'SimulatedObject0', and 'FinalNode0'. The status bar at the bottom indicates '41 FPS - 2ms (589 FPS)'.

Contains 3014 sections and 11978 cases.

Взаимодействие компонентов



Множество условий

The screenshot displays the Lumberyard Editor Beta interface. At the top, the title bar reads "Lumberyard Editor Beta [x64] - Build 913731 - map1". A watermark "www.Bandicam.com" is visible across the top. The main 3D viewport shows a character model standing on a grid floor, with a yellow cube floating above. The interface includes several panels: "Asset Editor" on the left, "Entity Outliner" below it, and "Asset Browser" at the bottom left. On the right, the "Entity Inspector" panel is open, showing properties for an entity named "ryn". The "Transform" section includes fields for Translate (X: 503.552, Y: 531.787, Z: 32.0 m), Rotate (X: 0.0 deg, Y: 0.0 deg, Z: 0.0 deg), and Scale (X: 1.0, Y: 1.0, Z: 1.0). The "Actor" section shows "Actor asset" as "rin_skeleton_newgeo" and "Material" as "rinActor". The "Anim Graph" section shows "Anim graph" as "superanimgraph" and "Motion set asset" as "Advanced_RinLocom". The bottom status bar indicates "Speed: 0.01", "No Sync Player", and "Goto position".

Entity Inspector

Name: ryn

Status: Start active

Add Component

Search...

Transform

Parent entity: []

Values

Translate: X 503.552 Y 531.787 Z 32.0 m

Rotate: X 0.0 deg Y 0.0 deg Z 0.0 deg

Scale: X 1.0 Y 1.0 Z 1.0

Parent activation: Original relative transform

Static:

Network Sync

Sync to replicas:

Position Interpolation: None

Rotation Interpolation: None

Actor

Actor asset: rin_skeleton_newgeo

Material: rinActor

Attach To

Attachment type: None

Options

Draw skeleton:

Draw character:

Draw bounds:

Skinning method: Dual quat skinning

Preview

LOD Level: 0

Anim Graph

Anim graph: superanimgraph

Motion set asset: Advanced_RinLocom

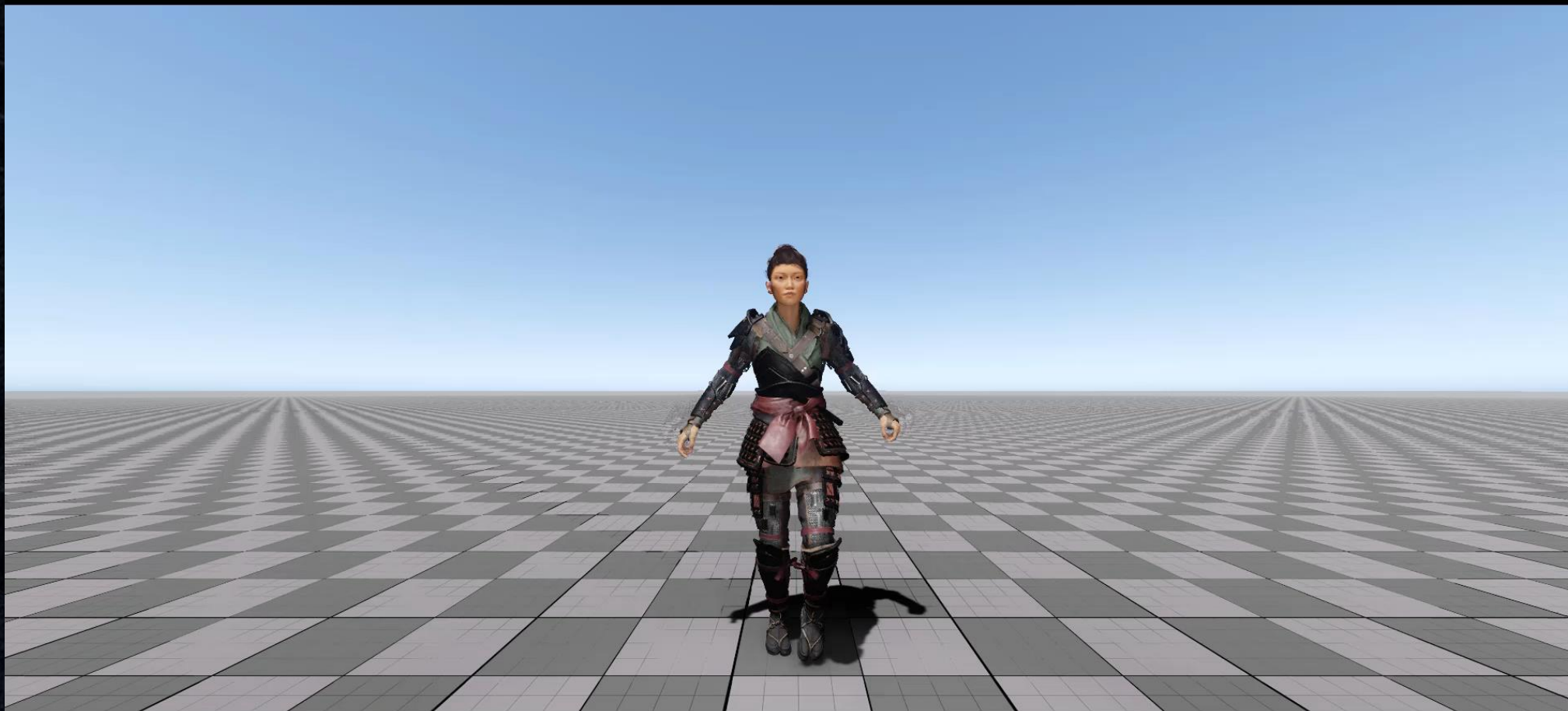
Active motion set: Advanced_RinLocomotion

Debug visualization:

Parameters

Speed: 0.01 .1 1 10 Coll AI/Physics |> No Sync Player Goto position Mute Audio VR Preview

Недетерминированные системы



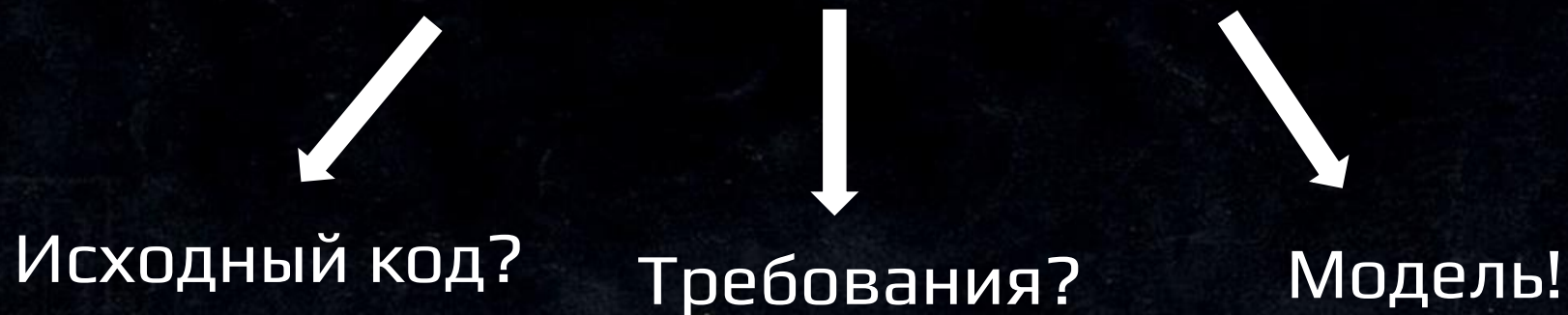
Анимация и физика

The screenshot displays the Lumberyard software interface, which is used for character animation and physics simulation. The main window shows a 3D perspective view of a character model in a futuristic, metallic suit. The interface is divided into several panels:

- Top Panel:** Contains the menu bar (File, Edit, Layouts, View, Help) and the "www.BANDICAM.COM" watermark.
- Left Panel:** Includes the "OpenGL Render Window" and "View Camera" controls.
- Center Panel:** The main 3D viewport showing the character model in a perspective view. The status bar at the bottom indicates "152 FPS - 2ms (619 FPS)".
- Right Panel:** Contains the "Simulated Object" inspector, "Simulated Object Colliders", and "Attributes" panels. The "Simulated Object" panel shows a tree view of the skeleton joints, including "Left Arm", "L_arm_JNT", "L_elbow_JNT", and "L_wrist_JNT". The "Attributes" panel shows the "Advanced_RinLocomotion.animgraph" with various parameters like "Softness factor", "Gravity factor", and "Simulation update rate".
- Bottom Panel:** Features the "Anim Graph" and "Recorder" panels. The "Anim Graph" shows a sequence of nodes including "idle_motion", "SimulatedObject0", and "FinalNode0". The "Recorder" panel shows a timeline with "Motions Only", "States Only", and "Events" filters.

Как определить покрытие?

- 12к+ тест кейсов.
- Большинство критических багов находится во время Ad-hoc.
- Как оценить покрытие системы тестами?



АСС моделирование

АСС model – Attribute, Component, Capability

- Components – существительные – viewport, window, game entity, texture, etc.
- Capabilities – глаголы – renders, provides, calculates, moves, etc.
- Attributes – прилагательные – fast, scalable, secure, etc.

Viewport демо

The screenshot displays a game engine interface with a central 3D viewport. The viewport shows a perspective view of a flat, grid-patterned floor extending to a horizon under a clear blue sky. The interface includes a menu bar at the top with options like File, Edit, Game, Tools, View, AWS, and Help. A toolbar below the menu bar contains various icons for navigation and editing. On the left side, there is an Entity Outliner showing a hierarchy with 'DefaultLevelSetup' selected, and an Asset Browser showing folders for Editor, Engine, Gems, and SamplesProject. On the right side, the Entity Inspector is open, displaying properties for the selected entity 'DefaultLevelSetup'. The inspector shows the Transform component with values for Translate (X: 512, Y: 512, Z: 100), Rotate (X: 0.0, Y: 0.0, Z: 0.0), and Scale (X: 1.0, Y: 1.0, Z: 1.0). Below the Transform component, the Environment Probe component is visible, with settings for Visible, On initially, Color (255, 255, 255), Diffuse multiplier (1.0x), Specular multiplier (1.0x), Area dimensions (102 x 102 x 200), Sort priority (0), Resolution (Default (256)), Box projected (unchecked), Box height (20.0), Box length (20.0), Box width (20.0), Attenuation falloff (0.0), Cubemap Generation (Cubemap asset: default_level_c...), and Options (View distance multiplier: 1.0x, Minimum spec: Low, Voxel GI mode: None, Use VisAreas: checked, Indoor only: unchecked, Affects this area only: checked, Volumetric fog only: unchecked, Volumetric fog: checked). At the bottom, the Console shows two messages: '[AssetCatalog] - Registering asset "levels/test_viewport/tags.txt" via AssetSystem message, but type is not set.' and '[AssetCatalog] - Registering asset "levels/test_viewport/level.pak" via AssetSystem message, but type is not set.'

www.Bandicam.com

Entity Outliner

Asset Browser

Entity Inspector

Transform

Environment Probe

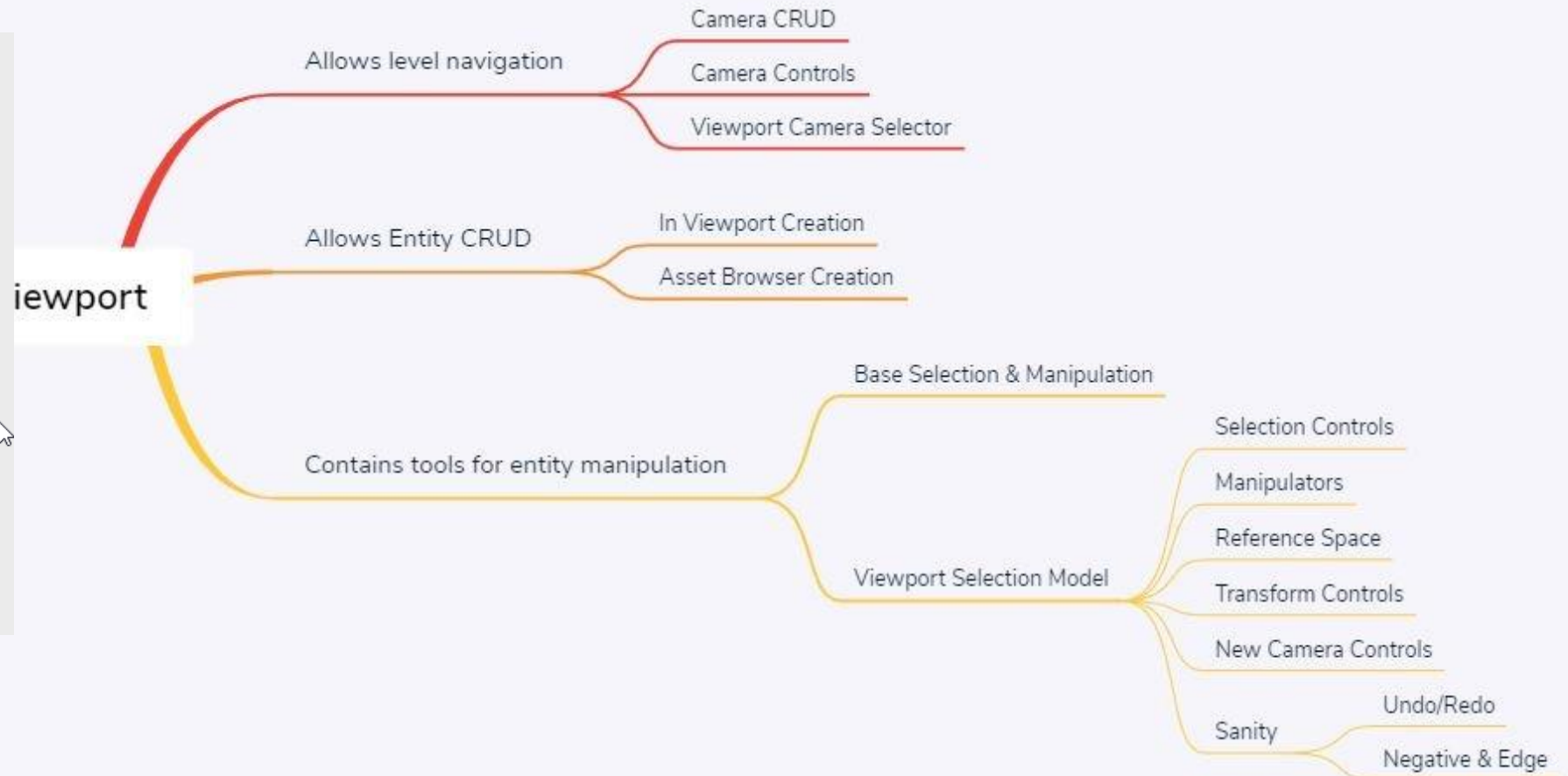
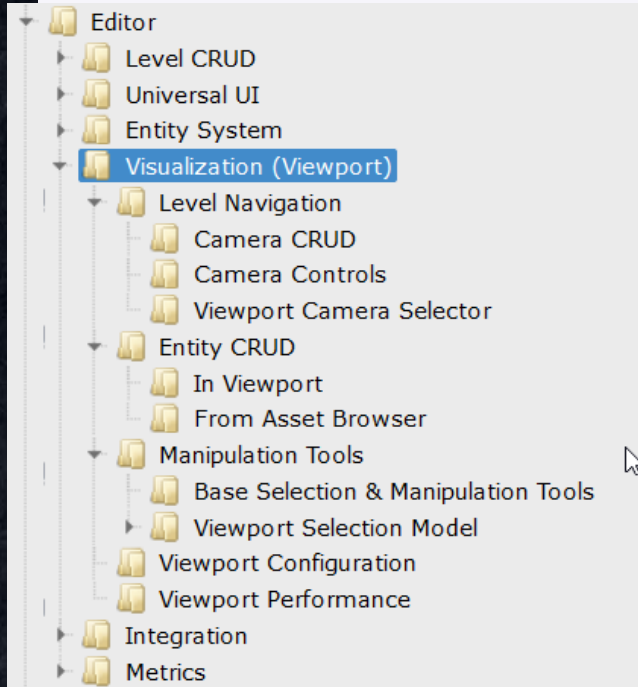
Console

1 Object(s) Selected

Lock Selection X: 512.00 Y: 512.00 Z: 100.00 XYZ Lock Scale Speed: 0.10 .1 1 10 Coll AI/Physics || |> No Sync Player Goto position Mute Audio VR Preview

[AssetCatalog] - Registering asset "levels/test_viewport/tags.txt" via AssetSystem message, but type is not set.
[AssetCatalog] - Registering asset "levels/test_viewport/level.pak" via AssetSystem message, but type is not set.

ACC модель Viewport



АСС модель движка в целом



Результаты и выводы

- АСС моделирование выявило не покрытые области.
- Значительно сократилось кол-во Blocker & Critical багов, находимых после Full Test Pass.
- АСС модели становятся источником правды для фичей для всех участников команды.



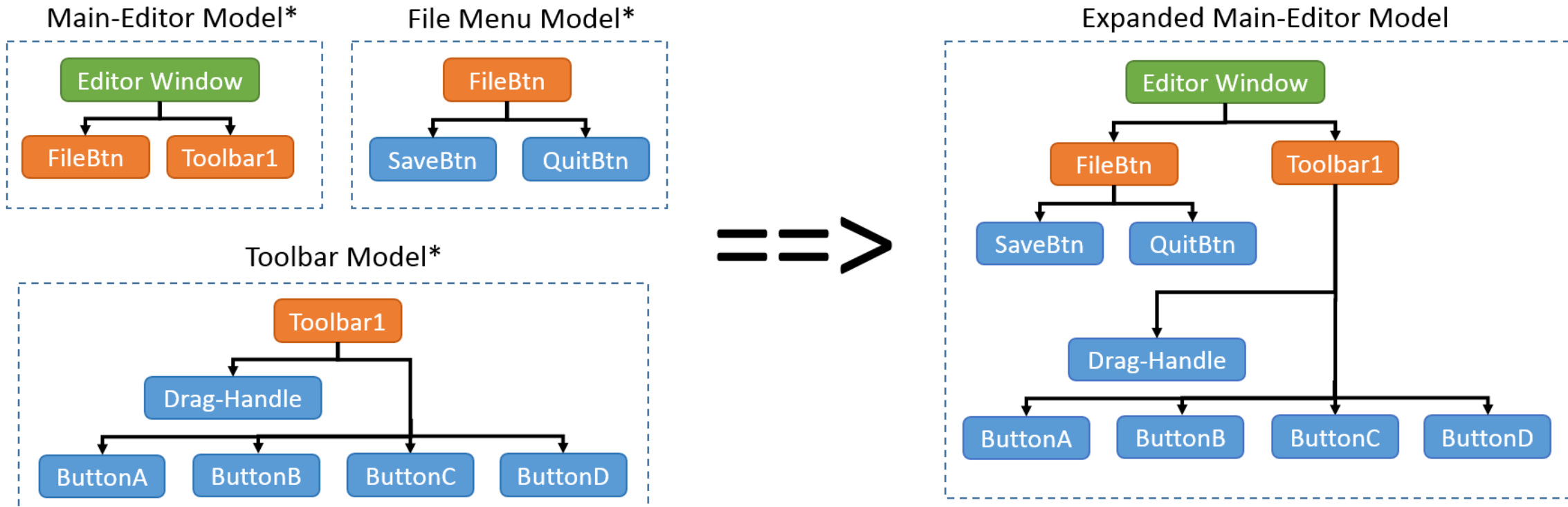
Автоматизация



Автоматизация UI – GUI Joe

Froglogic – Squish for QT

Composite Elements Architecture



* - Each exist in their own file

Проблемы

- С - Стабильность
- Отсутствие функционала
- Скорость работы



Решение

- Shiboken + PySide
- Headless automation
- Автоматизируем не только для тестирования

Qt for Python

Qt classes and functions exported to Python

Shiboken

Generator that exposes C++ classes to Python

CPython API

Qt 5 Libraries

Platforms

PC
XboxOne
PS4
Mobile



Lumberyard

Engine
Tools
Launchers



S3
Quicksight



LYTestTools

pytest

Test Helpers

Custom test
functionality



Взаимодействие с Lumberyard

Взаимодействия фреймворка с движком происходит через:

- Subprocess args, IO.
- Logs.
- Remote console (through networking).
- Image capturing.
- Python APIs.



real-time in
lumberyard

Vegetation Demo

The screenshot displays a game engine interface with a central perspective view of a terrain. The terrain is a light blue-grey color, with a dark blue area on the right side. The interface includes several panels:

- Entity Outliner:** Located at the top left, it shows a search bar and a list of entities, including "DefaultLevelSetup".
- Asset Browser:** Located at the bottom left, it shows a search bar and a tree view of assets. The tree view includes folders like "Engine", "Gems", "SamplesProject", "Levels", and "slices". Under "slices", there are several asset icons and names, such as "Advanced_RinLocomoti", "showroom_basic_001.si", "showroom_basic_001_n", "showroom_endcap_001", "showroom_endcap_001", and "Simple_JackLocomoti".
- Entity Inspector:** Located at the top right, it shows a search bar and a list of entities, with a message "Select an entity to show its properties in the inspector."
- RollupBar (LEGACY):** Located in the middle right, it contains a "Terrain" section with buttons for "Modify", "Vegetation", "Layer Painter", "Mini Map", "Holes", "Environment", and "Move Area". Below this is a "Modify Terrain" section with buttons for "Flatten", "Smooth", "Rise/Lower", and "Pick Height".
- Brush Settings:** Located at the bottom right, it contains a "Rise/Lower" button, a "Pick Height" button, a "Outside Radius" slider set to 108.07, a "Sync Radius for all Types" checkbox, an "Inside Radius" slider set to 0.00, a "Hardness" slider set to 0.32, a "Height" slider set to 31.00, and a "Noise Settings" section with an "Enable Noise" checkbox.

The interface also features a top menu bar with "File", "Edit", "Game", "Tools", "View", "AWS", and "Help". A watermark "www.Bandicam.com" is visible in the top center. The status bar at the bottom right shows "FPS 71.7" and "15.8ms".

Vegetation Level



Код теста

```
launcher.deploy()  
launcher.launch()  
launcher.run(test_tools.launchers.phase.TimePhase(launcher_stability_timeout, launcher_stability_timeout))  
  
assert launcher.is_alive(), "Launcher crashed within the tested stability timeframe."  
launcher.stop()
```


Код параметризации

```
test_platforms = [  
    pytest.param("win_x64_vs2017", "profile",  
"LargeWorldsTest", "all", "LY-96757-MergedMeshStreamOverflow",  
    pytest.param("darwin_x64", "profile", "LargeWorldsTest",  
"all", "LY-96757-MergedMeshStreamOverflow",  
]
```

```
@pytest.mark.parametrize("platform, configuration, project,  
spec, level", test_platforms)  
class TestMergedMesh(object):
```


Запускаем тест

www.Bandicam.com

Asset Processor

Status: Idle...

Project: LargeWorldsTest

Last Scan: 00:00.624 | Analysis: 00:01.946 | Processing: 00:00.599

LargeWorldsTest

Administrator: Command Prompt - lmb_r_test.cmd pytest -v

```
\\largeworlds\\legacy_vegetation\\ly967
No handlers could be found for logger "
===== test sess
platform win32 -- Python 2.7.12, pytest
cachedir: Tests\largeworlds\legacy_vege
rootdir: E:\nesiolov_test\lyengine\dev\
plugins: test-tools-0.0.0, timeout-1.2.
collected 3 items
```

```
Tests\largeworlds\legacy_vegetation\ly9
ng for tmp path c:\users\nesiolov\appda
Found existing tmp path, deleting
Creating tmp path
Configuring Artifact Manager with path
Running setup assistant
Arguments: ['--enablecapability', 'rung
1']
Setting project LargeWorldsTest from E:
Logger: Creating log dir: E:\nesiolov_
eamOverflow]
Creating Windows launcher
Starting asset processor
Setting AP platform to: pc
8792.00005531 - INFO - [MainThread] - t
```

```
CamPos=22.81 22.81 89.99 Angle= 0 0 -44 ZH=0.28 ZF=1024
Cam FOV=34 VS=1.00/1.00 Zoom=0.00 Speed=10.00 TimeOfDay=13:30
DX11 Profile 64bit VeryHighSpec NT TAA DevMode Set Ly=36757-mergedMeshstreamoverflow [0.0]
DP: 9257 (9259) ShadowGens:9929 (9923) - Total: 9287 Instance: 9287
Polys: 315,541 (281,599) Shadow:214,913 (254,218)
ShaderCache: 1 GCM | 1 Async Reqs | Compiler: On
Streaming IO: ACT: 0msec, Jobs: 0
Map Command, Checkpoint Loads: 0
Mem=1972 Peak=1974 Dlights=(1)
1 Shadow Mask Channels, 0 Shadow Frustums, 0 Frustum Renders This Frame
FPS 58.9 [48.74], frame avg over 1.0 s
```

game tech



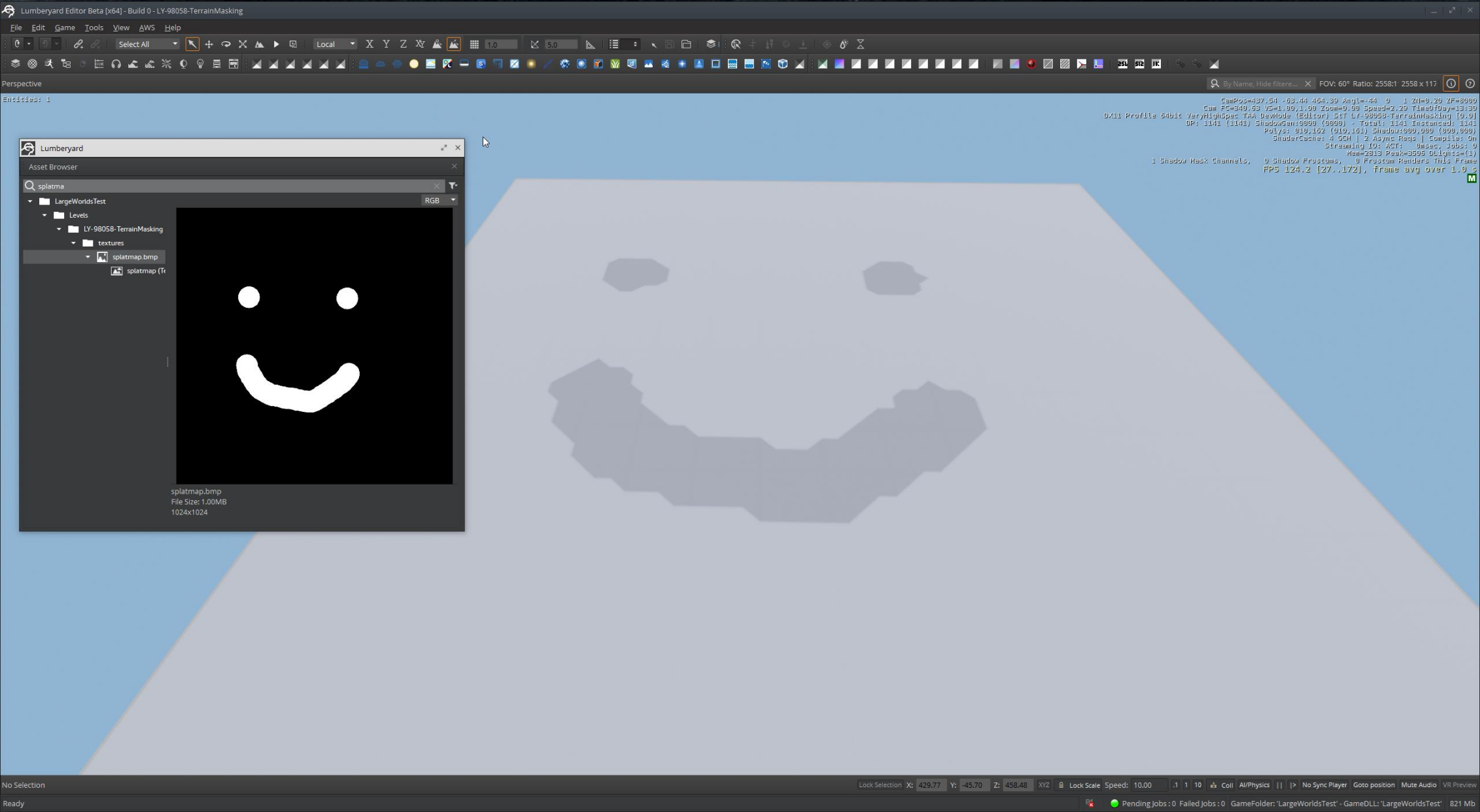
Более сложный вариант

```
editor.deploy()
```

```
editor.launch(['--runpython',  
os.path.join(os.path.dirname(__file__), 'EditorScripts',  
'ly98058.py'), '--runpythonargs', level])
```

```
editor.run(  
test_tools.launchers.phase.WaitForLauncherToQuit(editor,  
120))
```


Тестовый уровень



Python-скрипт для редактора

```
terrain.set_layer_brush_color("Cobblestones", 1.0,  
0.0, 0.0)
```

```
terrain.set_layerPainter_brush_mask_layer_name("Co  
bblestones")
```

```
terrain.paint_layer("Cobblestones", 0.0, 0.0, 0.0,  
True)
```


Продолжение

```
terrain.set_layerPainter_brush_radius(26.0)
terrain.set_layerPainter_brush_detail_intensity(0.0)
terrain.set_layerPainter_brush_mask_layer_name("")
terrain.set_layer_brush_color("Default", 0.0, 0.0, 1.0)

for x in range (40, 43):
    for y in range (40, 43):
        terrain.paint_layer("Default", x, y, 0.0, False)
```


Запускаем скрипт

The screenshot shows a game engine interface with a central window titled "Asset Processor". The window displays a table of asset processing jobs and a "Lumberyard" logo. The console window on the left shows the execution of a script.

www.Bandicam.com

Asset Processor

Status: Idle

Project: LumberyardTest

Root: E:\nesiolov\engine\dev\Assets

Processer Backlog

Status	Source	Completed	Platform	Job Key
Failed	scriptcanvas/object_script...	18:25:08.367 Nov ...	all	CreateJobs_60862728-7C06-4A65-9C25-9FA-MAE211993
Compl	Config/Editor.xml	18:47:48.840 Nov ...	pc	xml
Compl...	Levels/MultiplatformVegTest...	16:46:47.860 Nov ...	pc	Dynamic Slice
Compl...	Levels/LY_102241_TouchBend...	16:47:32.052 Nov ...	pc	Level Builder Job
Compl...	Levels/SimpleTouchBending/...	18:47:30.128 Nov ...	pc	Level Builder Job
Compl...	Levels/WaterSample/halfSph...	16:48:05.092 Nov ...	pc	rgb
Compl...	Levels/WaterSample/pool2.cof...	16:48:06.452 Nov ...	pc	rgb
Compl...	Levels/WaterSample/heatSp...	18:48:10.044 Nov ...	pc	
Compl...	Objects/WaterSample/parame...	18:48:16.576 Nov ...	pc	
Compl...	Levels/TouchBendingTest/LB...	16:48:28.078 Nov ...	pc	
Compl...	AnimationSamples/Advanced...	18:48:29.108 Nov ...	pc	
Compl...	EngineAssets/Systems/Carhe...	18:48:35.240 Nov ...	pc	

Event Log Details

Status: Source: Message

Connecting to the Asset Processor.

Version: 0.0.0.0 - BETA

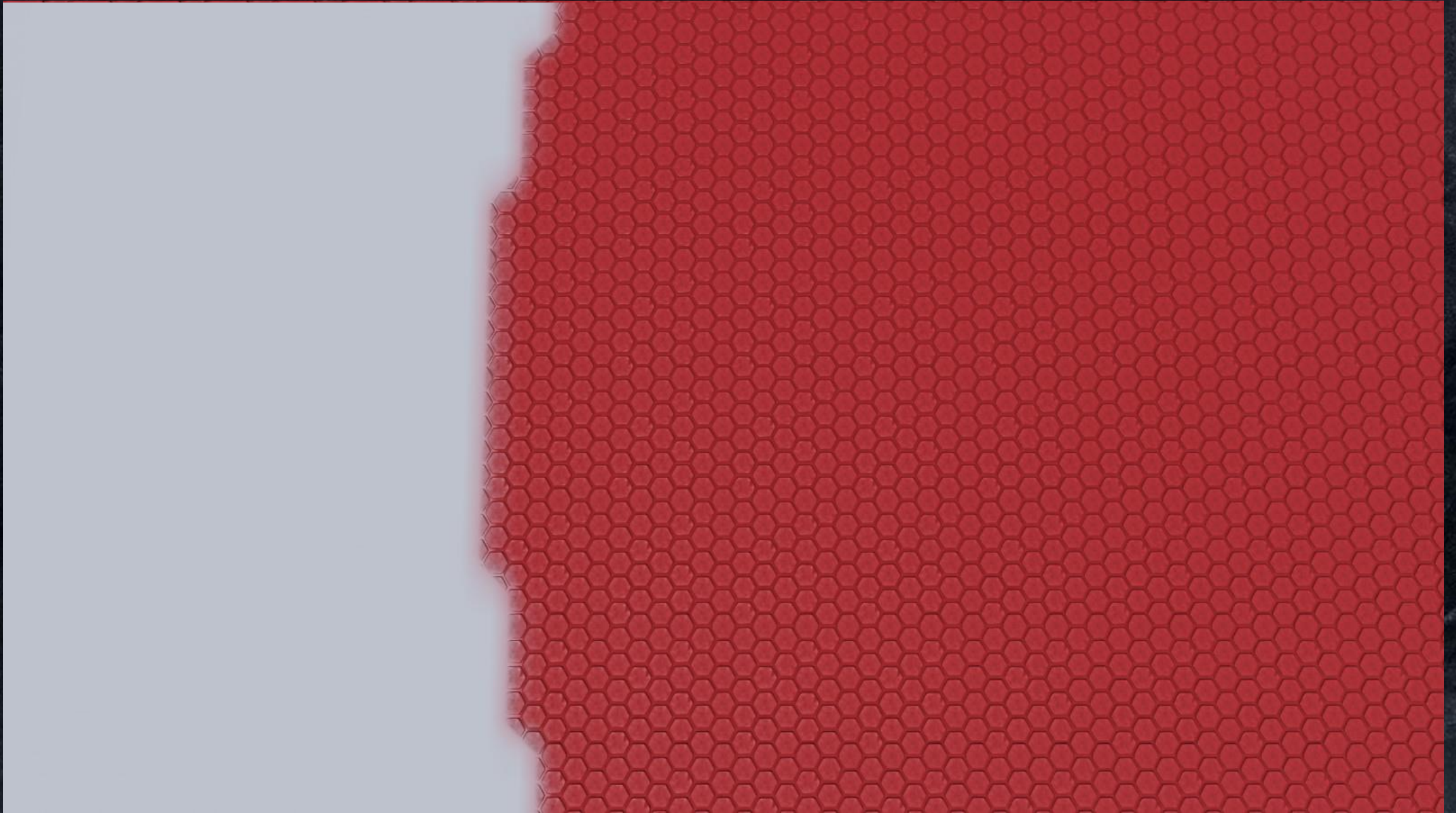
Lumberyard and related materials Copyright © 2019 Amazon Web Services, Inc. All rights reserved. Lumberyard is a service provided by Amazon Web Services, Inc. or its affiliates. All other trademarks are the property of their respective owners. See the Terms of Service for the Amazon Web Services Customer Agreement.

```
Administrator: Command Prompt
est.ini', '--junitx
\\largeworlds\legs
No handlers could b
=====
platform win32 -- P
cachedir: Tests\lar
rootdir: E:\nesiol
plugins: timeout-1.
collected 1 item

Tests\largeworlds\
a\temp\temp_vn
Found existing tmp
Creating tmp path
Configuring Artific
Running setup assis
Arguments: ['--enab
1']
Setting project Lar
Logger: Creating lo
Creating windows le
Starting asset proc
Setting AP platform
7270.99990845 - INF
```

game tech

Скриншоты



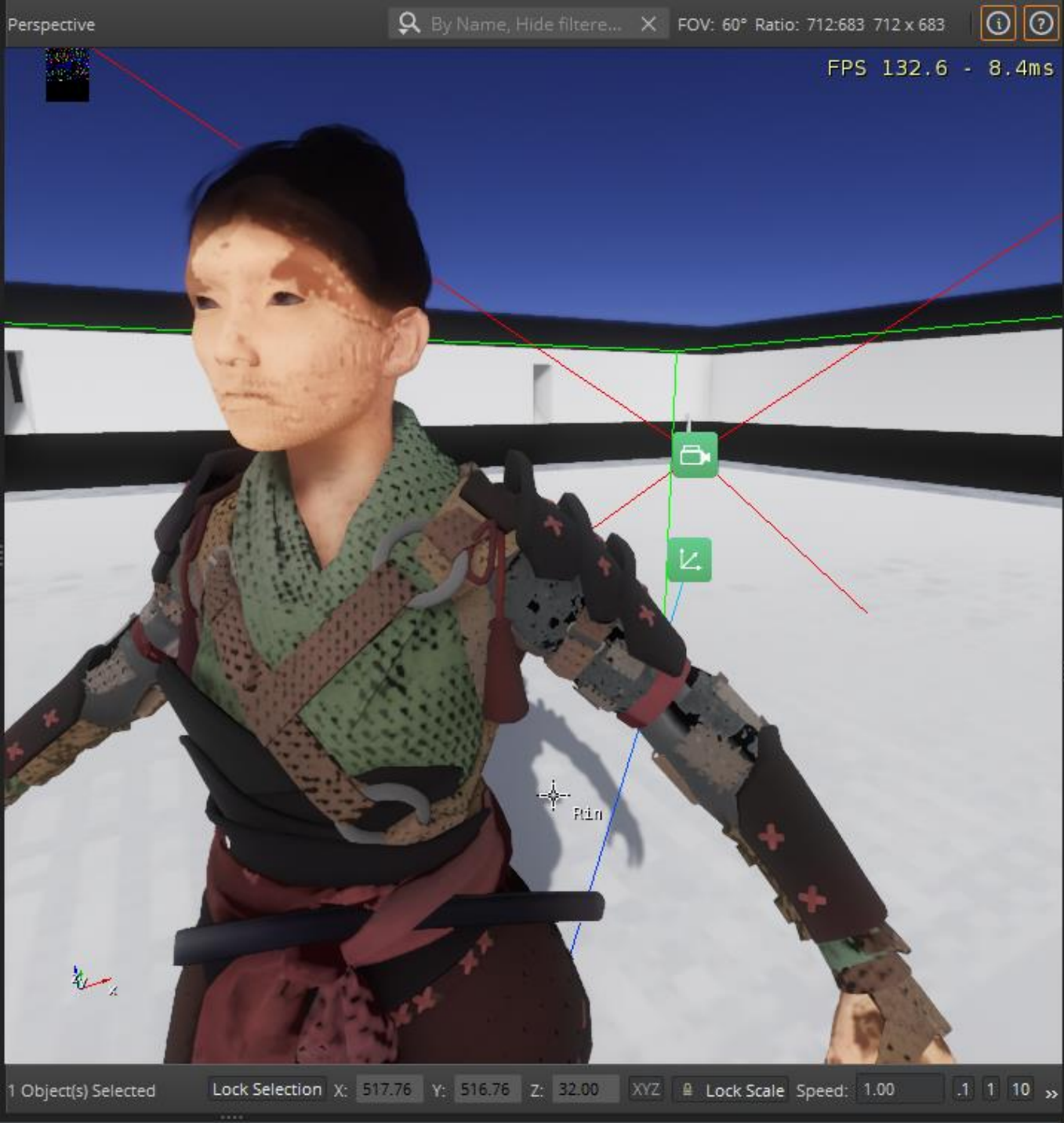
Графика





Rin

здорового человека

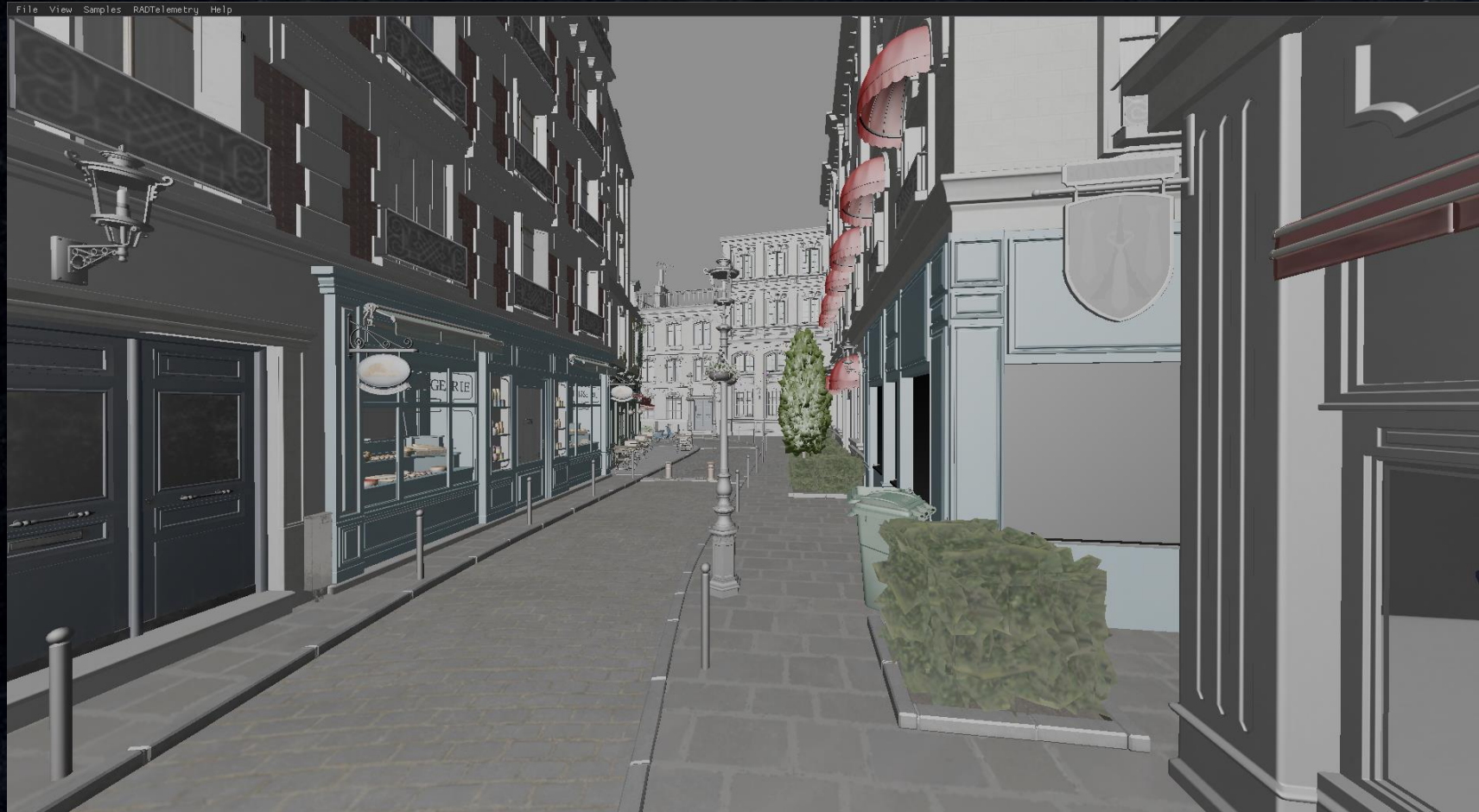


Rin курильщика

Сравниваем скриншоты



Сравниваем скриншоты

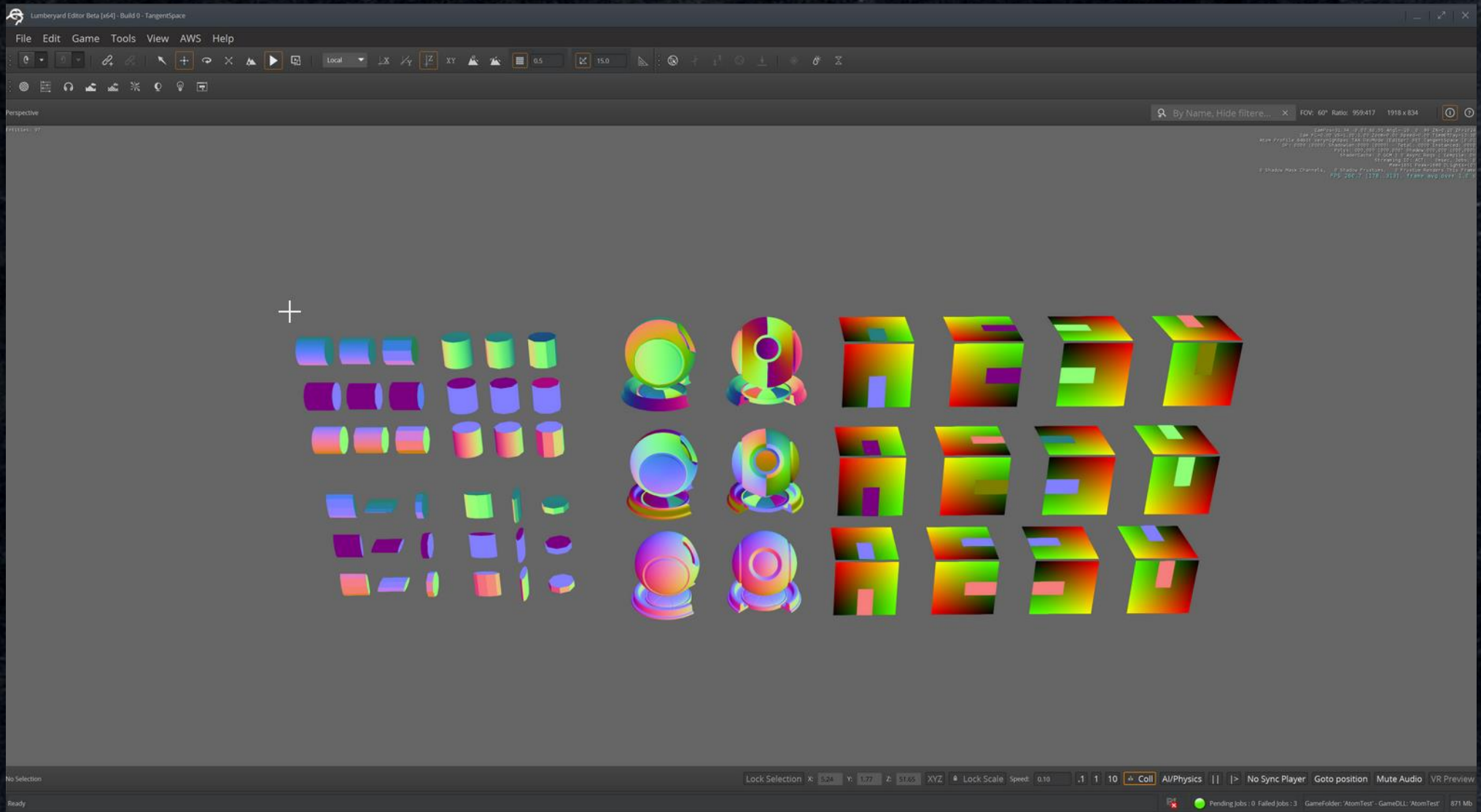


Diff

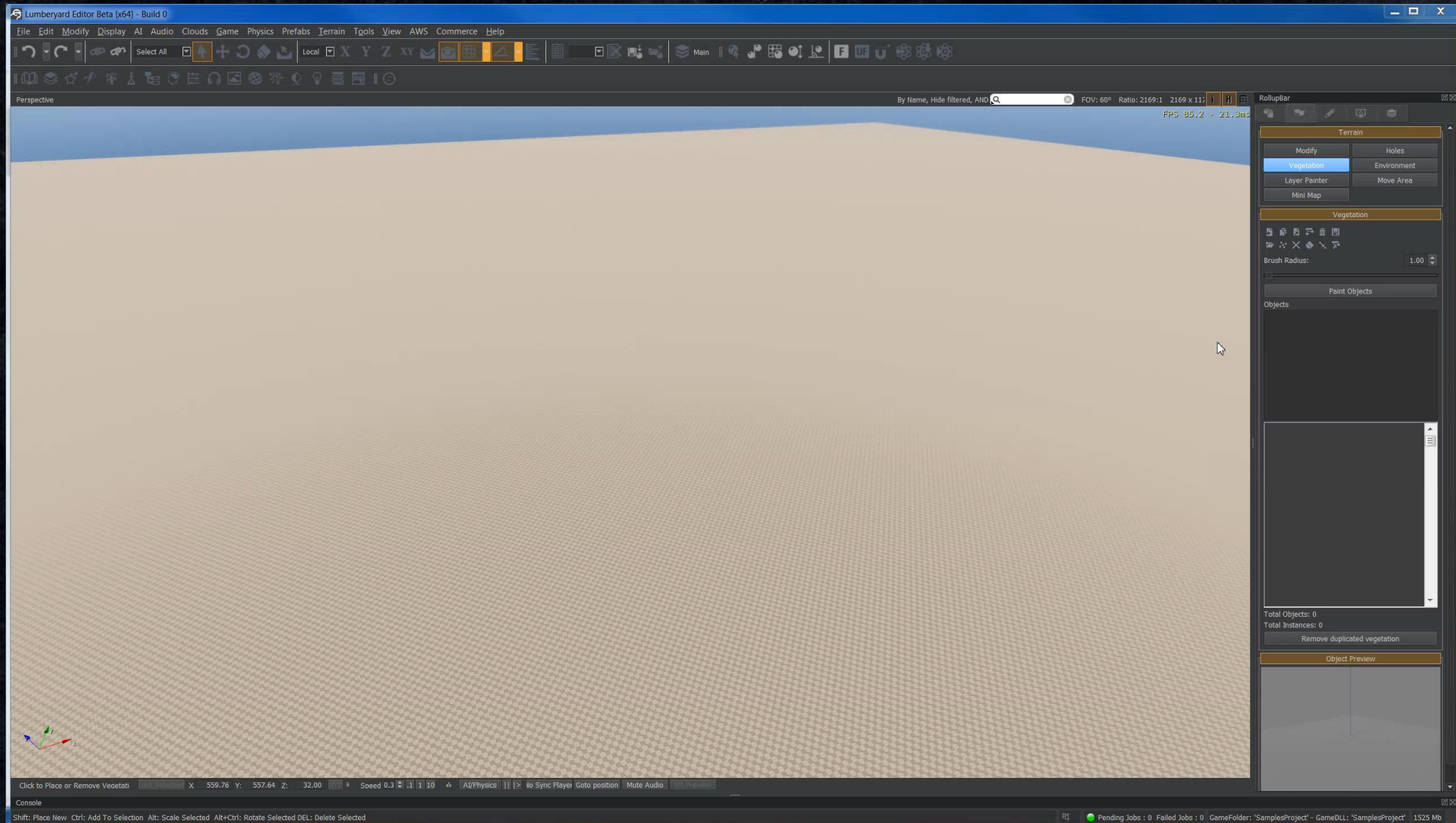


Quaternion structural similarity: a new quality index for color images.
By Kolaman A1, Yadid-Pecht O, 2011

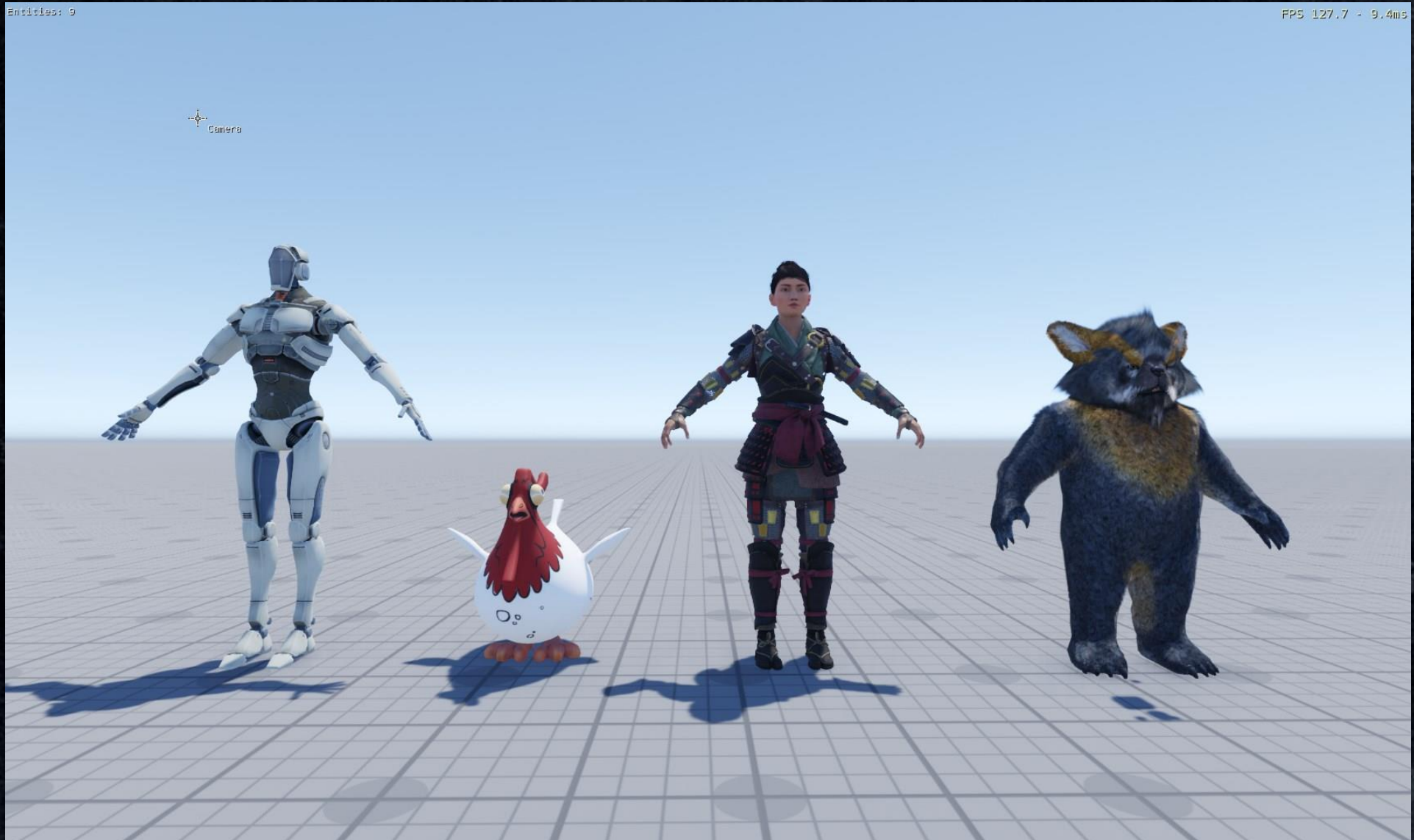
Графика



Бой с тенью



Аксессуары



Черные деревья

The screenshot shows the Lumberyard Editor Beta interface. The main view is a 3D perspective view of a game environment. A white robot character is standing in the foreground. The background features a large, dark, industrial structure with a red and white color scheme. The ground is a mix of brown and grey. There are several black, conical trees scattered throughout the scene. The interface includes several panels: an Entity Outliner on the left showing a hierarchy of objects, an Asset Browser below it, a Console at the bottom left displaying various warnings and errors, and an Entity Inspector on the right showing properties for the selected object. The top of the window has a menu bar and a toolbar. A watermark for 'www.BANDICAM.COM' is visible in the top right corner.

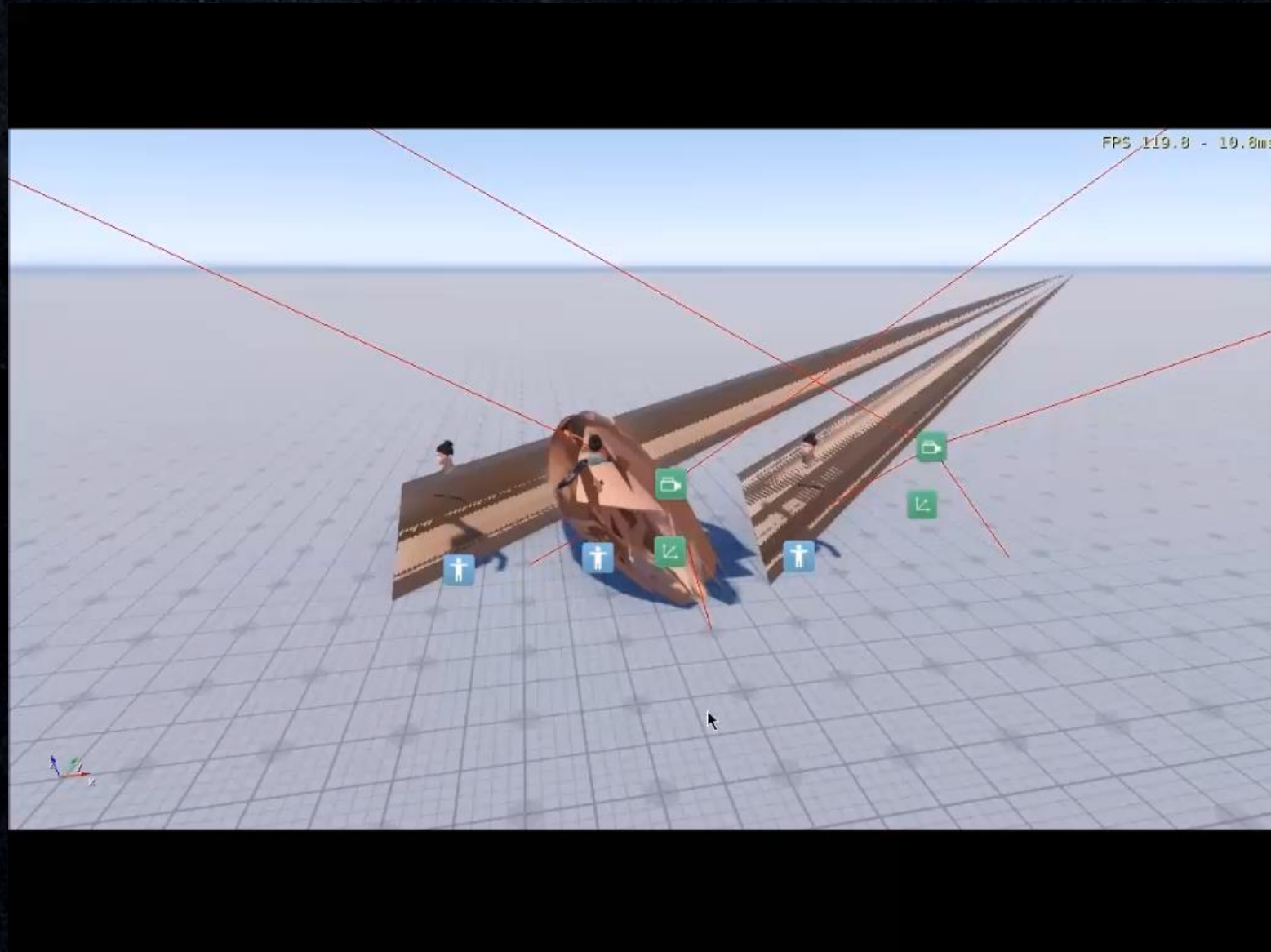
```
[Script] - State Group Set to = : world_location  
[Script] - State Set to = : forest  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine1  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine2  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine3  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightShoulder  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine1  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine2  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine3  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightShoulder  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine1  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine2  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightSpine3  
[Warning] (EmotionFX) - Invalid anim graph parameter name: AnimWeightShoulder  
[Warning] Failed to find material for footstep sounds in FXLib footstep_jump_landlight, SurfaceIdx: -1  
[Warning] Failed to find material for footstep sounds in FXLib footstep, SurfaceIdx: -1  
[Warning] Failed to find material for footstep sounds in FXLib footstep, SurfaceIdx: -1
```

The Asset Processor window displays the Lumberyard Asset Processor interface. It shows the status of the processor, the project name, and the root path. The 'Assets' section is currently empty. The 'Connections' section shows a table of assets with columns for Status, Source, Platform, Job Key, and Completed. The 'Logs' section is also empty.

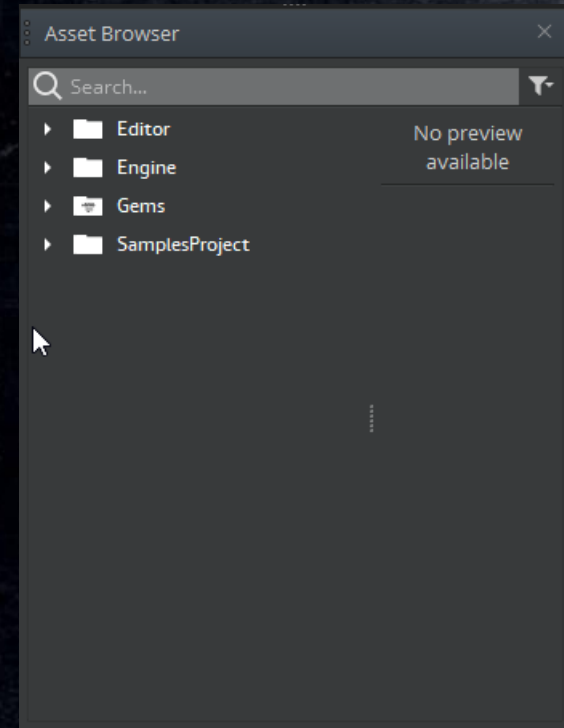
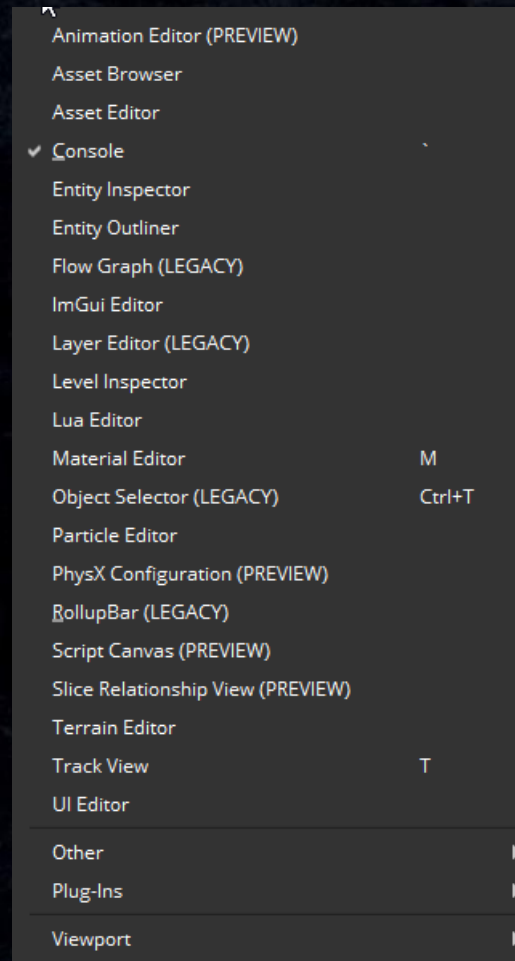
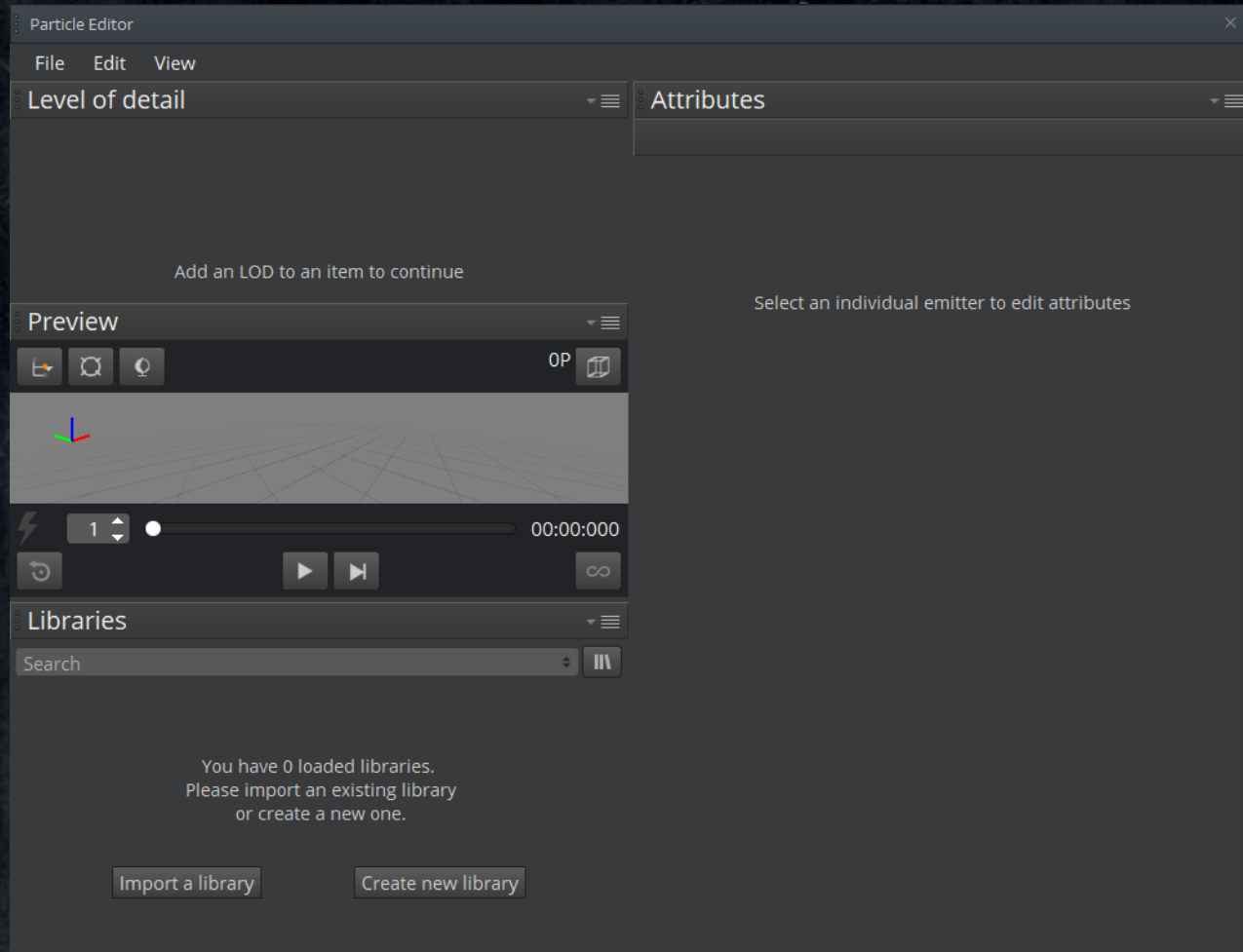
Status	Source	Platform	Job Key	Completed
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The screenshot shows the Windows taskbar and Start menu. The Bandicam application is running, and the Start menu is open, showing the 'Screen Recording - Fullscreen' option. The taskbar shows the system tray with the time 00:00:00 and 0 bytes / 532.8GB. The Start menu shows the 'Home' button and the 'Get Started' button. The 'Screen Recording - Fullscreen' option is highlighted, and the 'Stop recording' button is visible.

Не все можно поймать



Интерфейс



Игровые компоненты



Игровые компоненты

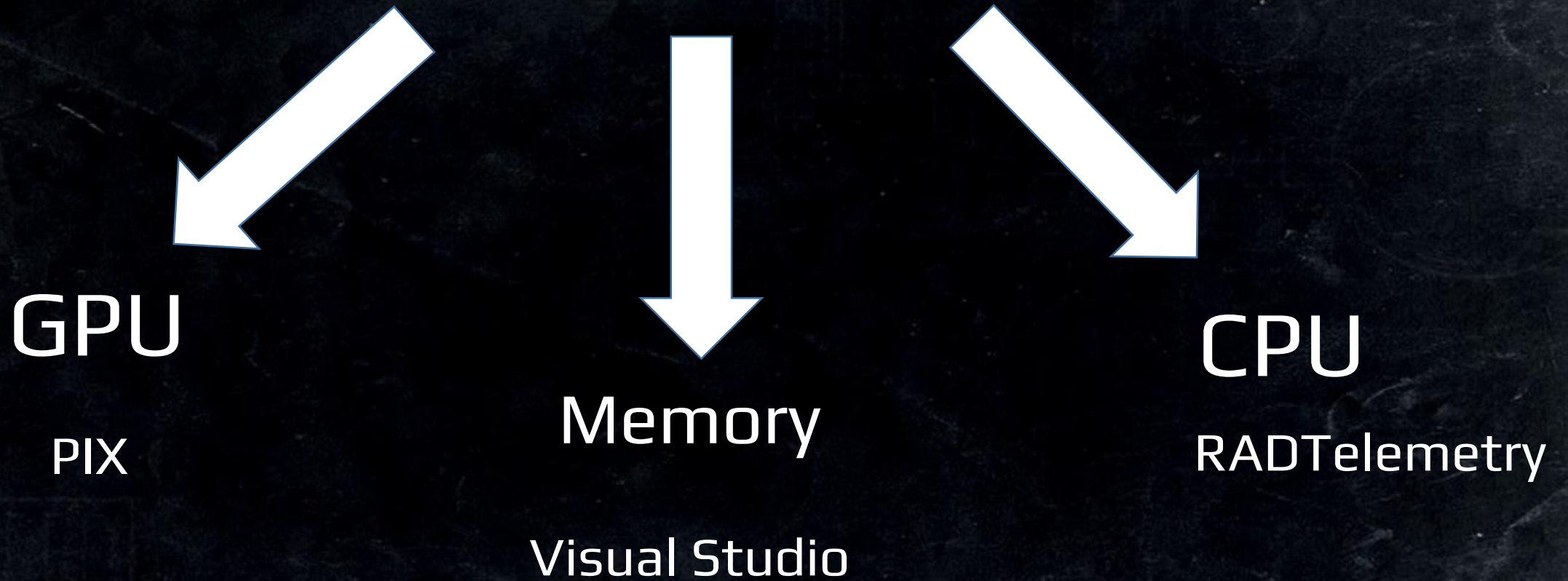


100500 скриншотов

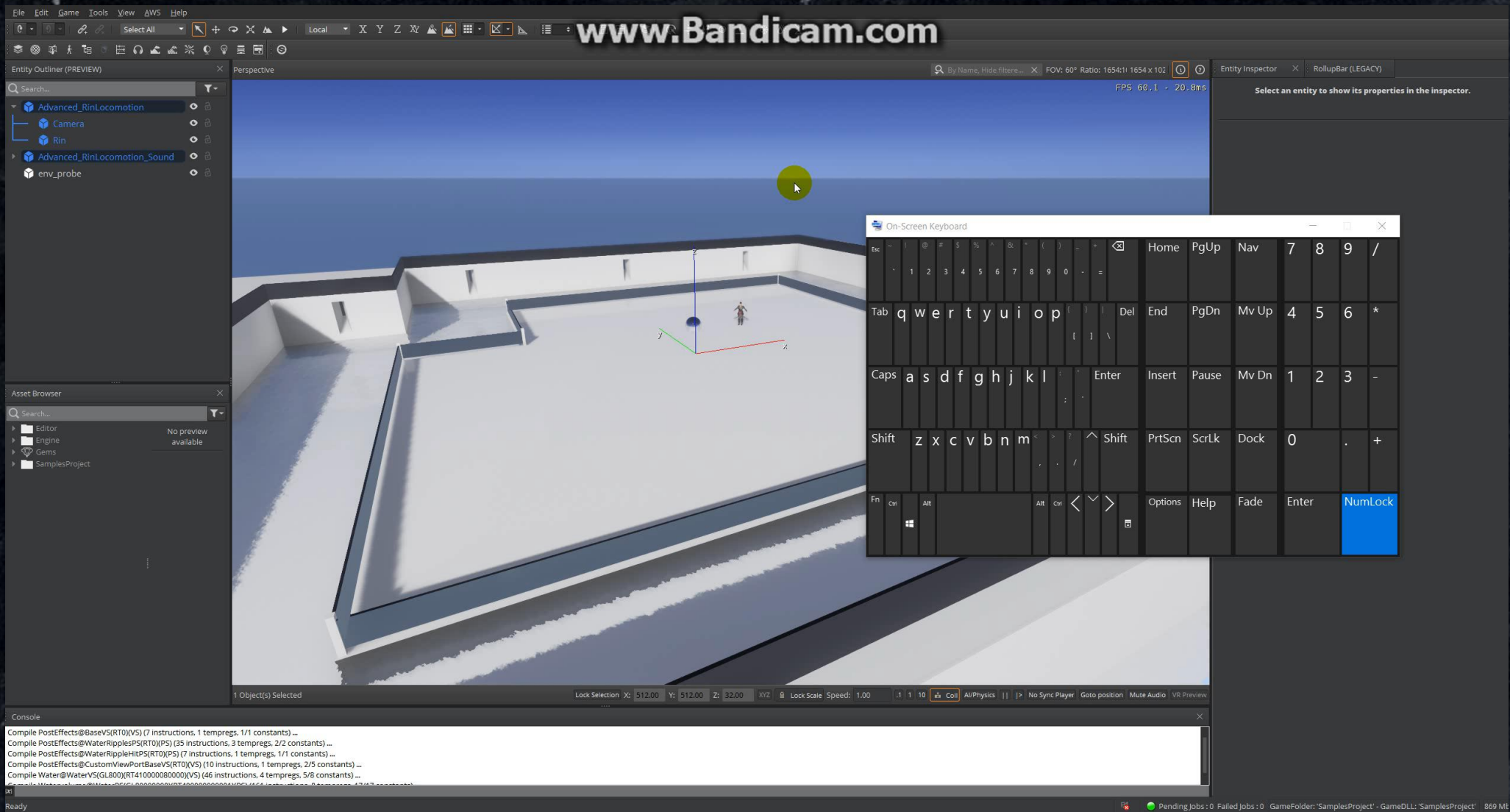
Как тестировать графику без зависимости от платформ?

- WARP - Windows Advanced Rasterization Platform.
- Не зависим от различий в драйверах.
- Не зависим от различий в железках.

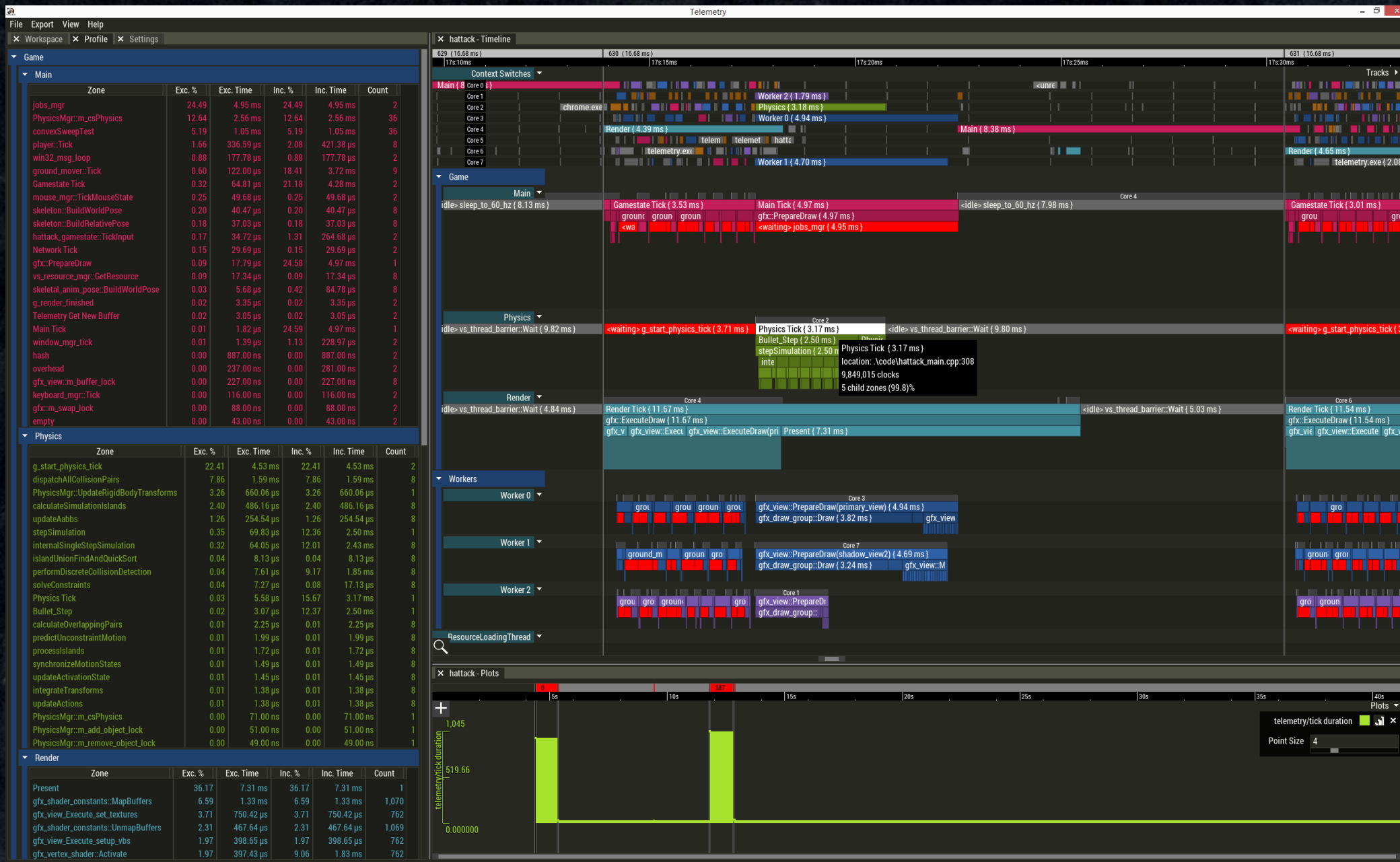
Производительность



Input Lag



RADTelemetry



И где здесь AWS?



Используется в тестировании:

- EC2
- Device Farm
- S3
- Quicksight
- CloudWatch

Тестируем интеграцию:

- CloudCanvas
- Amazon GameLift
- Twitch



Резюме по автоматизации

- There is no silver bullet
- Plug-and-play framework
- Скриншоты, vegetation
- Software Renderer, RADTelemetry



Заключение

<https://aws.amazon.com/lumberyard> - скачать движок бесплатно и без смс

<https://doc.qt.io/qtforpython/shiboken2/index.html> - Shiboken the Binding Generator (C++ Qt to Python)

<https://docs.microsoft.com/en-us/windows/win32/direct3darticles/directx-warp> - Windows Software Renderer

<http://www.radgametools.com/telemetry.htm> - RAD Telemetry, CPU Performance Profiling

<https://aws.amazon.com/gametech> - AWS Game Tech

Приходите к нам!

<https://www.amazon.jobs/en/teams/amazon-game-studios>

Вопросы и ответы



Спасибо!

<https://www.linkedin.com/in/yinmute/>