



Building A Virtual Babel: Mono In Second Life

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FOSDEM 2010**








Second Life At 6



Second Life In 2003


World Map

LEGEND

-  Start Area
-  Attraction
-  Mature Area
-  Sandbox Region
-  Coming Soon
-  Possible Region Expansion
-  Expensive Region



Second Life Today

600
miles² of land

25K
cores

87K
peak concurrency

80M
running scripts

US\$47M
user-to-user
transactions/mo

150 +
countries

800GB
new content/day

US\$10M
exchanged/mo

40M
user hours/mo

390TB
content

769K
repeat logins/mo

12Gb
data/s

- Animations
- Dancing
- Vehicles
- Seats
- Games, guns
- Doors, elevators, teleporters
- Big, tiny, non-human avatars
- Chickens, dogs, bunnies, wildlife
- Customizable hair, shoes, furniture
- In world vendors and web sales



Scripting Second Life

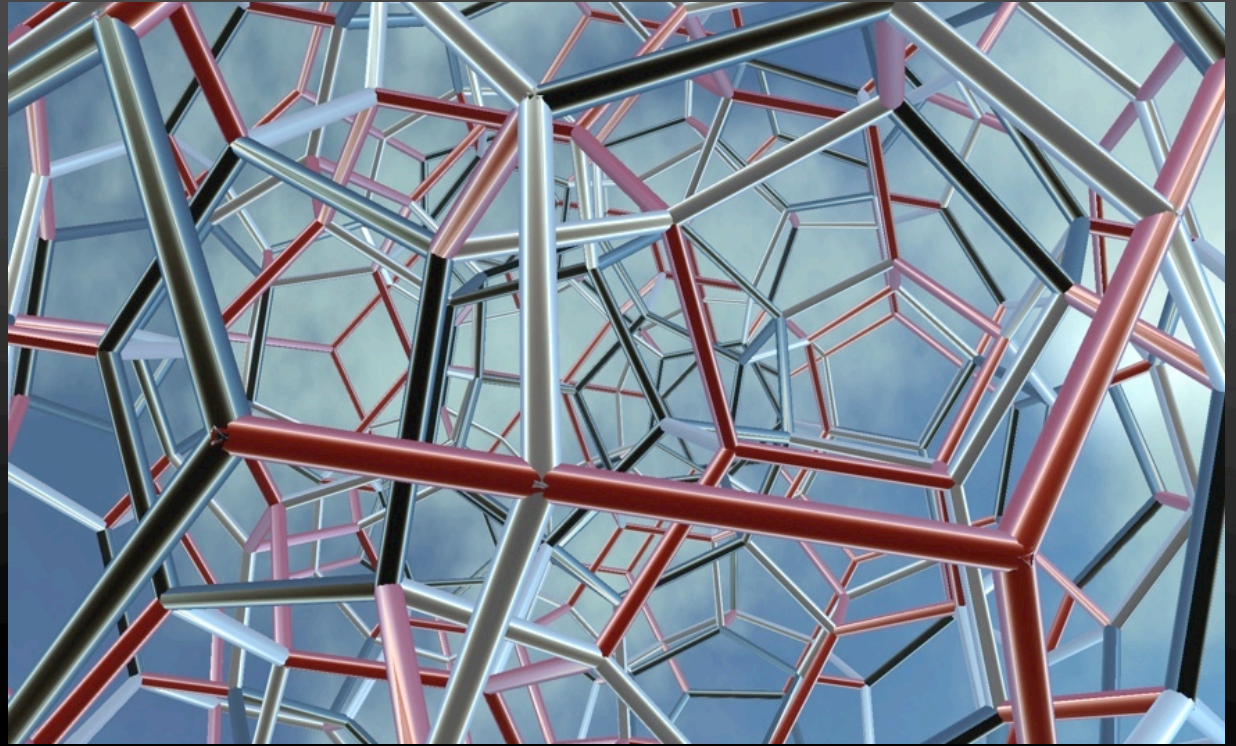


Image Suzanne Graves

- **Scripts in prims**
- **Prims linked to make objects**
- **Sensors and effectors via library calls**
- **Communication via IM, email, XMLRPC, HTTP**
- **Untrusted code**
- **2000 scripts per process**
- **Migration between processes**

- C-Like Language
- Vectors and Rotations (DSL!)
- Static Types (6!)
- Heterogenous Lists
- States
- Textbook 16KB Bytecode VM
- Easy Migration
- Easy Scheduling
- Easy Sandboxing (Maybe?)
- Slow
- Inconsistent

```
default
{
    state_entry()
    {
        llSay(0, "Hello, Avatar!");
    }

    touch(integer total_number)
    {
        llSay(0, "Touched.");
    }
}
```

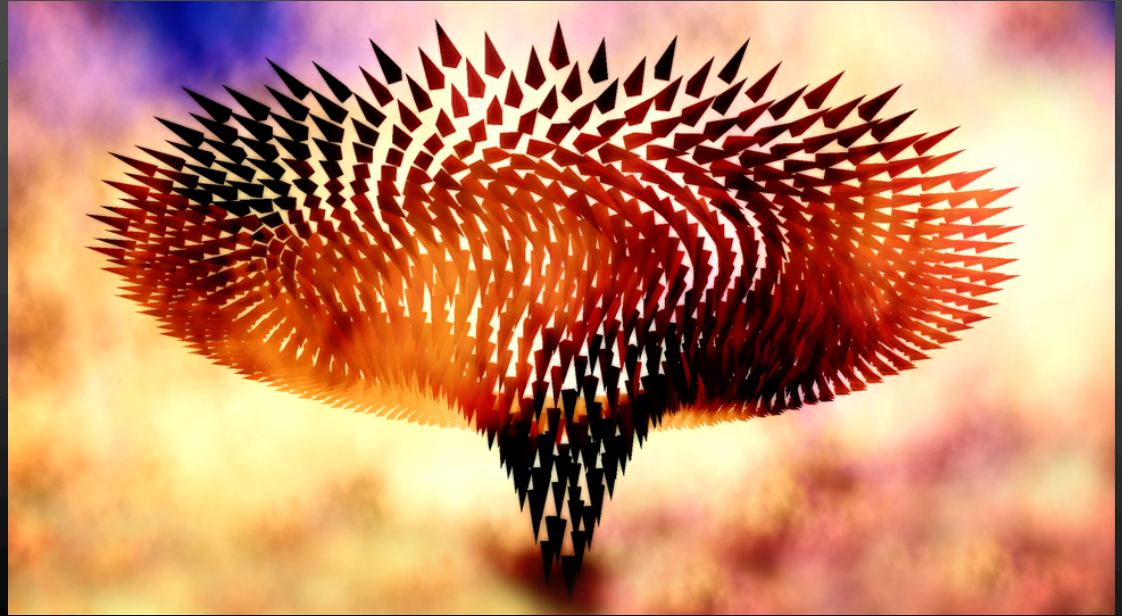


Image Ganymedes Costagravas

- Rewrite assemblies for concurrency and mobility
- Induce stack state (Verification)
- Rewrite bytecode (Reflection.Emit, RAIL, cecil)
- Inject microthreading (JavaGoX, Brakes)
- Serialize stack and heap, transfer assemblies
- Migrate assemblies between app domains to unload
- Subvert profiler for resource limitation

Migrating Managed Pointers

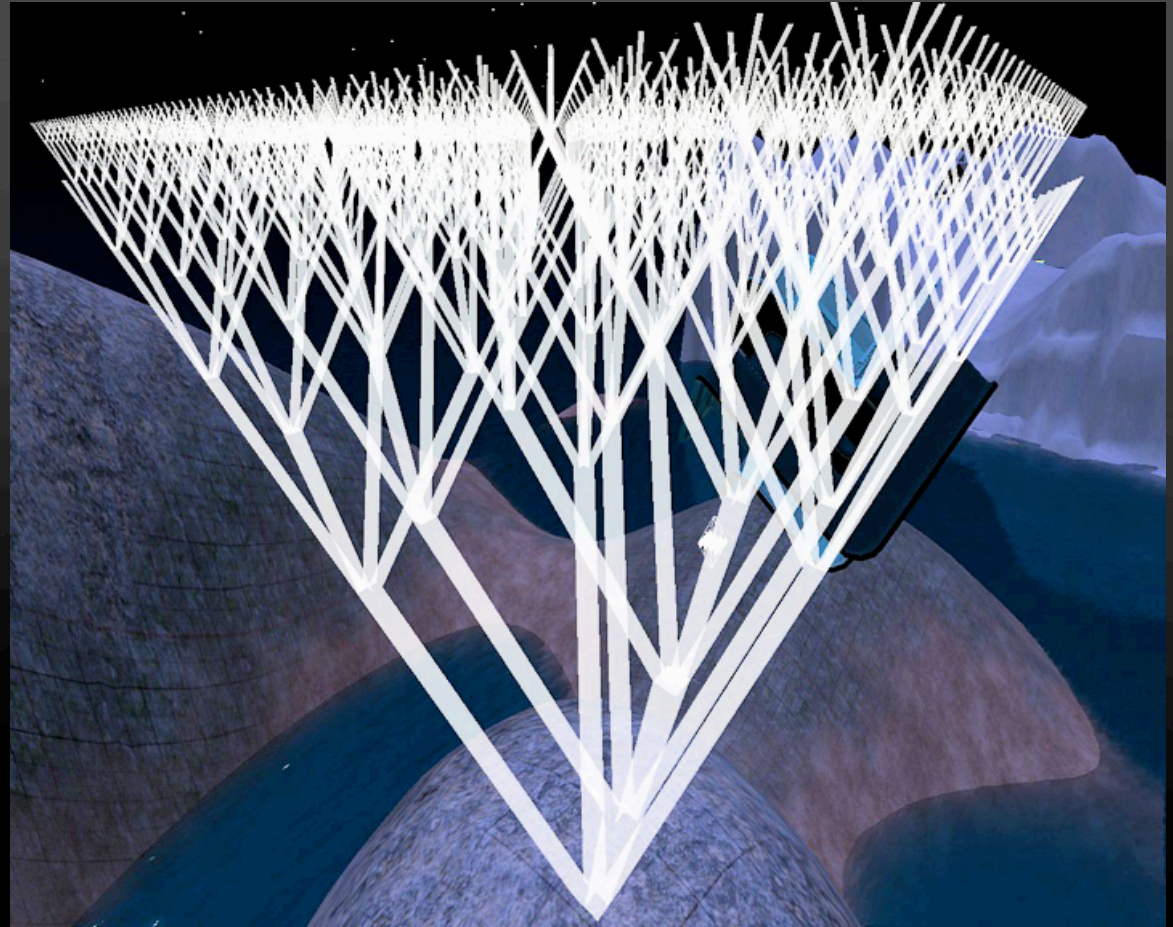


Image Bettina Tizzy

- LSL value semantics
- CIL pushes MP
- Can't copy to heap
- Step back through CIL
- Copy operands to heap
- Run CIL on restore
- Resynthesise MP
- Microthread all CIL

Memory Allocation Monitoring

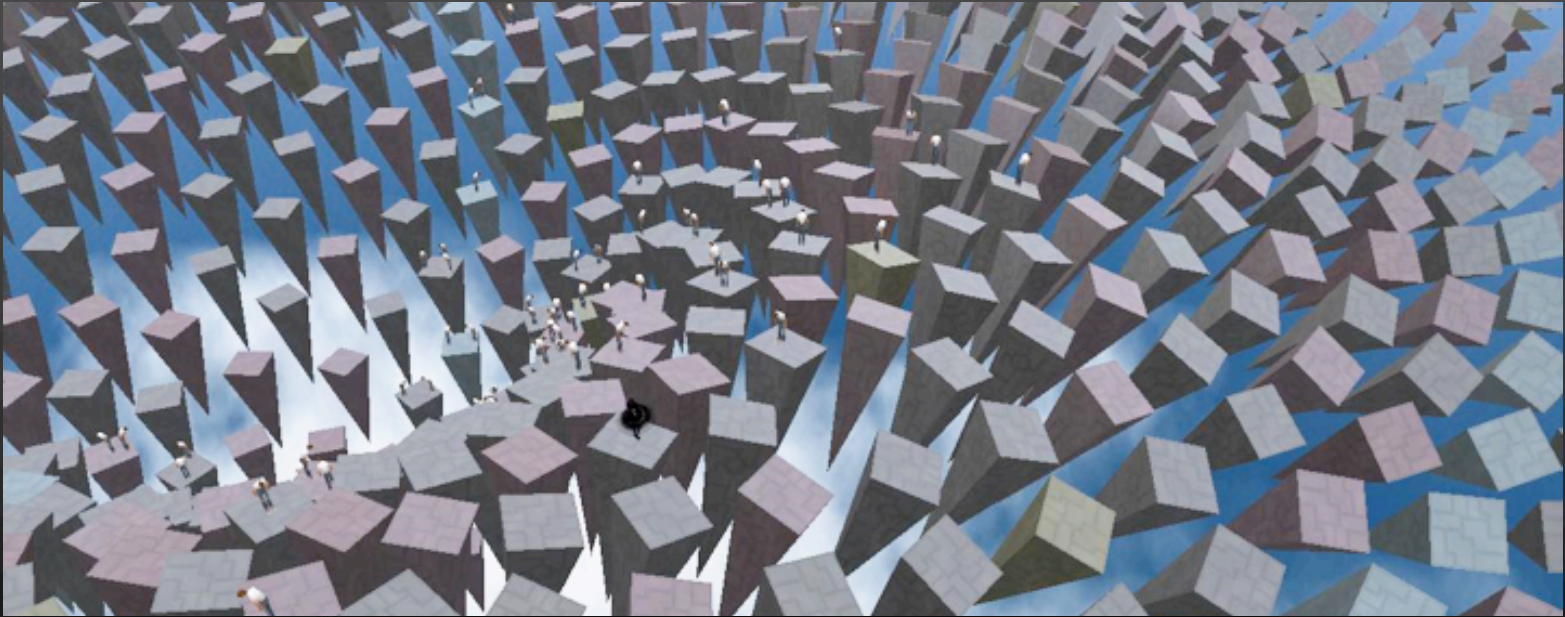


Image Ka Rasmuson

- **Walk object tree between time slices**
- **Concatenation allows rapid memory consumption**
- **Limit length of lists and strings**
- **Hard limit on allocation size**
- **Exceptions would have been better**
- **Lucky scheduling gives temporary memory boost**
- **Yield whenever memory limit might be reached**

- **Check time at yield points**
- **System call gates execution**
- **Execution time very variable**
- **Adaptive timer skipping**
- **Flywheel exploits**
- **Marshalling new bottle neck**

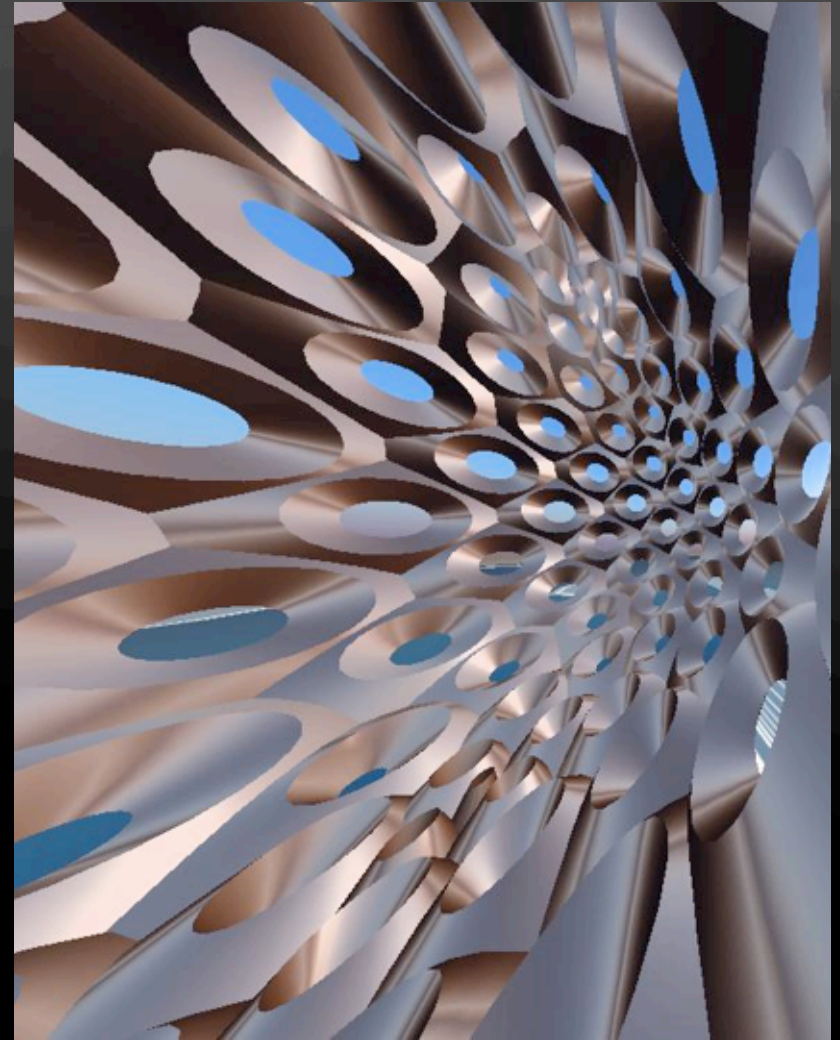


Image juria yoshikawa

Managed Execution After A SEGV



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- **Emergency state save**
- **Mono replaces handlers**
- **Disable garbage collection**
- **Chain signal handlers**
- **Definitely void warranty**
- **Contributed signal chaining**

Memory Model

- **Script Limits**
- **Resource Pools**
- **Big Scripts**
- **Efficient Scripts**
- **Bytecode Sharing**

C#

- Arrays
- Primitive Types
- Enumerations
- User Defined Types
- Exceptions
- Ecosystem



Image Betina Tizzy

Complete UThreadInjector

- Full CIL Instruction Set
- RAIL or Cecil?
- Generics?

Image Gita Rau



Build Sandbox

- Moonlight?
- CoreCLR Security?
- Embedded Mono?
- Assembly Markup?

Image Raul Crimson



C# API



Image Gita Rau

- **Library.IIFoo Methods**
- **System.Collections**
- **System.Security.Cryptography**
- **XML?**
- **Web?**
- **.NET to Silverlight machinery?**

C# Types

```
list l = ["foo",42]
```

```
ArrayList l = new ArrayList(new object[]{"foo",42})
```

```
List l = new List().Add("foo").Add("42");
```

```
HttpRequest(url, [HTTP_METHOD, "POST"]);
```

```
Library.HttpRequest(url, new ArrayList(new object[]{"HTTP_METHOD", "POST"});
```

```
new HttpRequest().Url(url).Method("POST").Request();
```

- **Vector**
- **Quaternion**
- **Parsing and Formatting**
- **ArrayList or object[]**
- **FooBuilders?**
- **Versioning?**

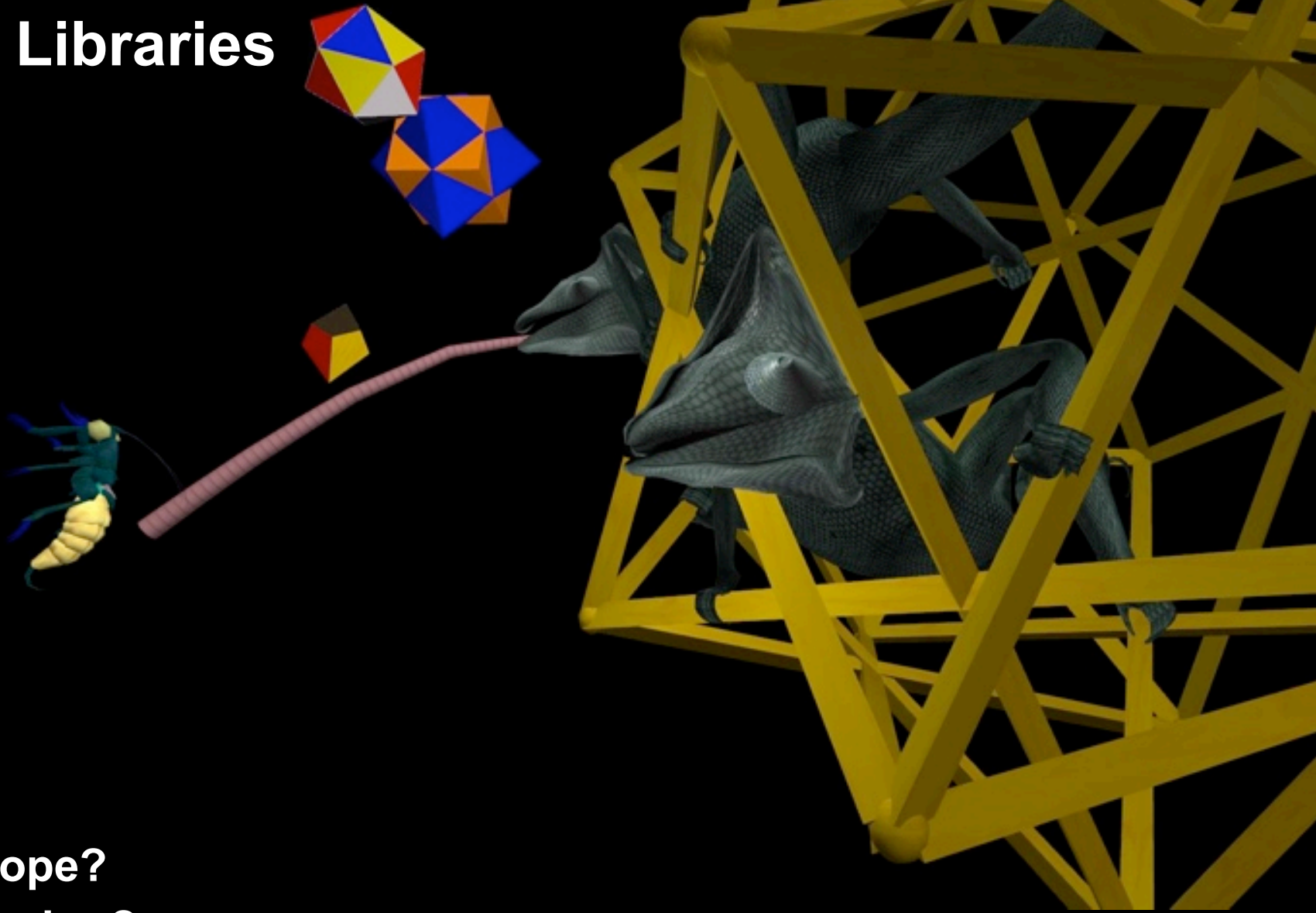
C# Event Handling

```
public class EventExample : Script
{
    public override void OnRez(int param)
    {
        Touch = new Script.TouchDelegate(Touch);
    }

    void Touch(int num)
    {
        Library.llSay(0, "Turning off...");
        Touch = null;
    }
}
```

- **Subclass SecondLife.Script**
- **Override OnFoo Event Handlers**
- **Register Delegates**
- **Events?**

C# Libraries



- Scope?
- Naming?
- Versioning?

Future

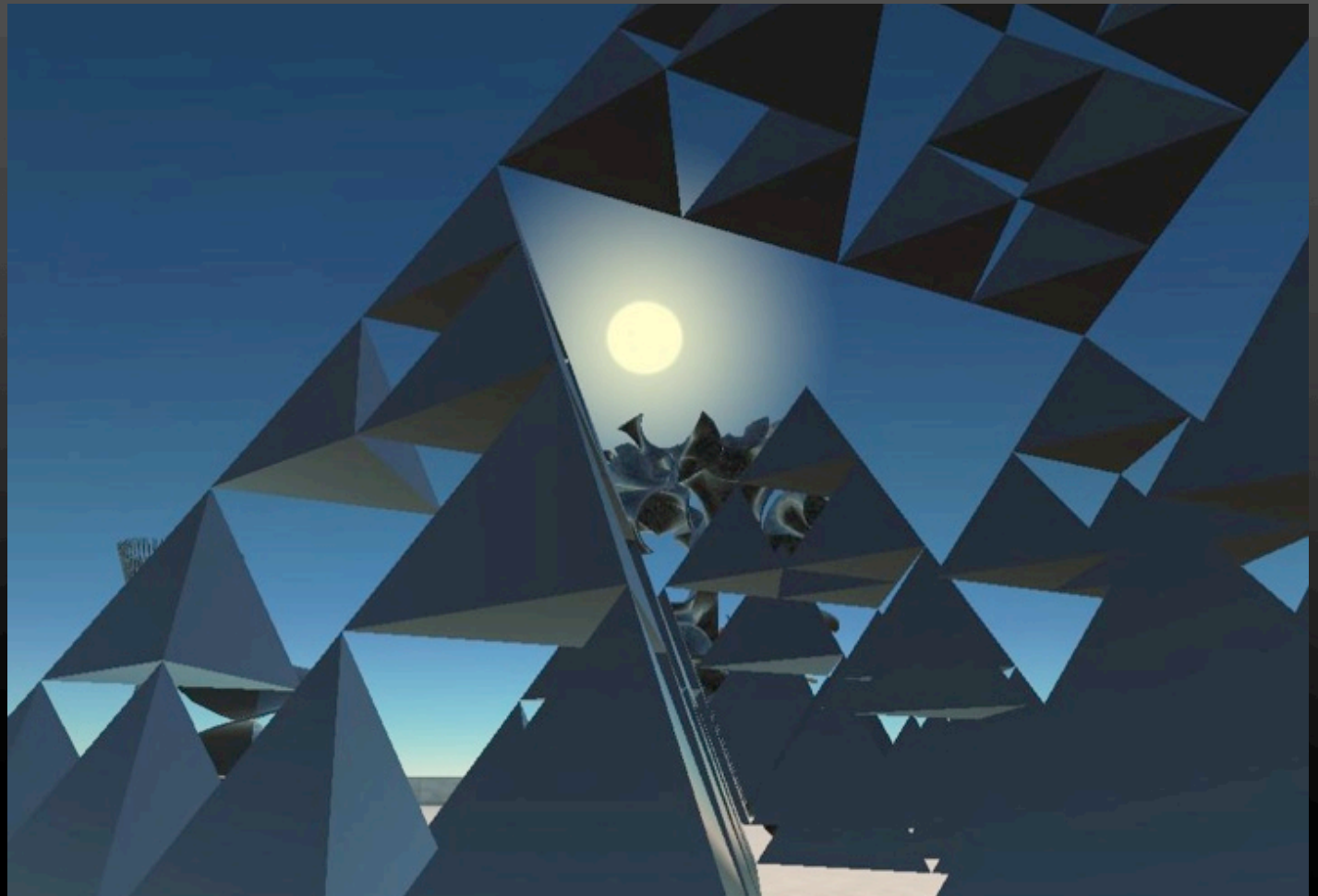


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- **F#/Boo/Haskell...**
- **IronPython/Ruby/JS...**
- **IDE Integration**
- **Client Side Scripting**
- **Debugging?**

How Can You Help?

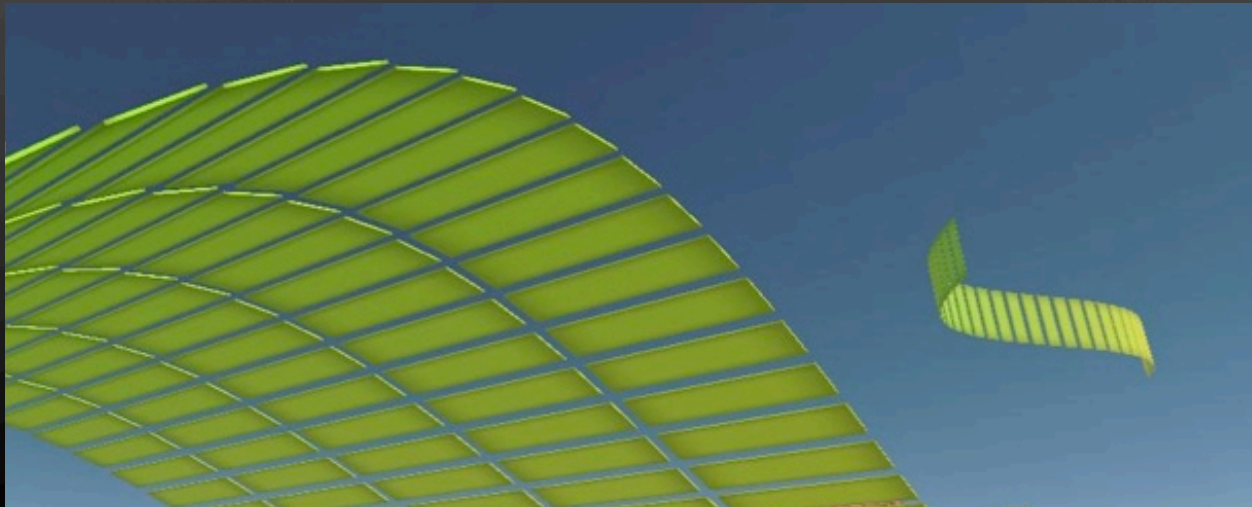


Image Atomo Hosho

- **Publish current C# API soon**
- **Public C# beta this summer**
- **Snowglobe open source viewer**
- **Talk now!**

Thank You



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