Indigo Shader Language and Winter

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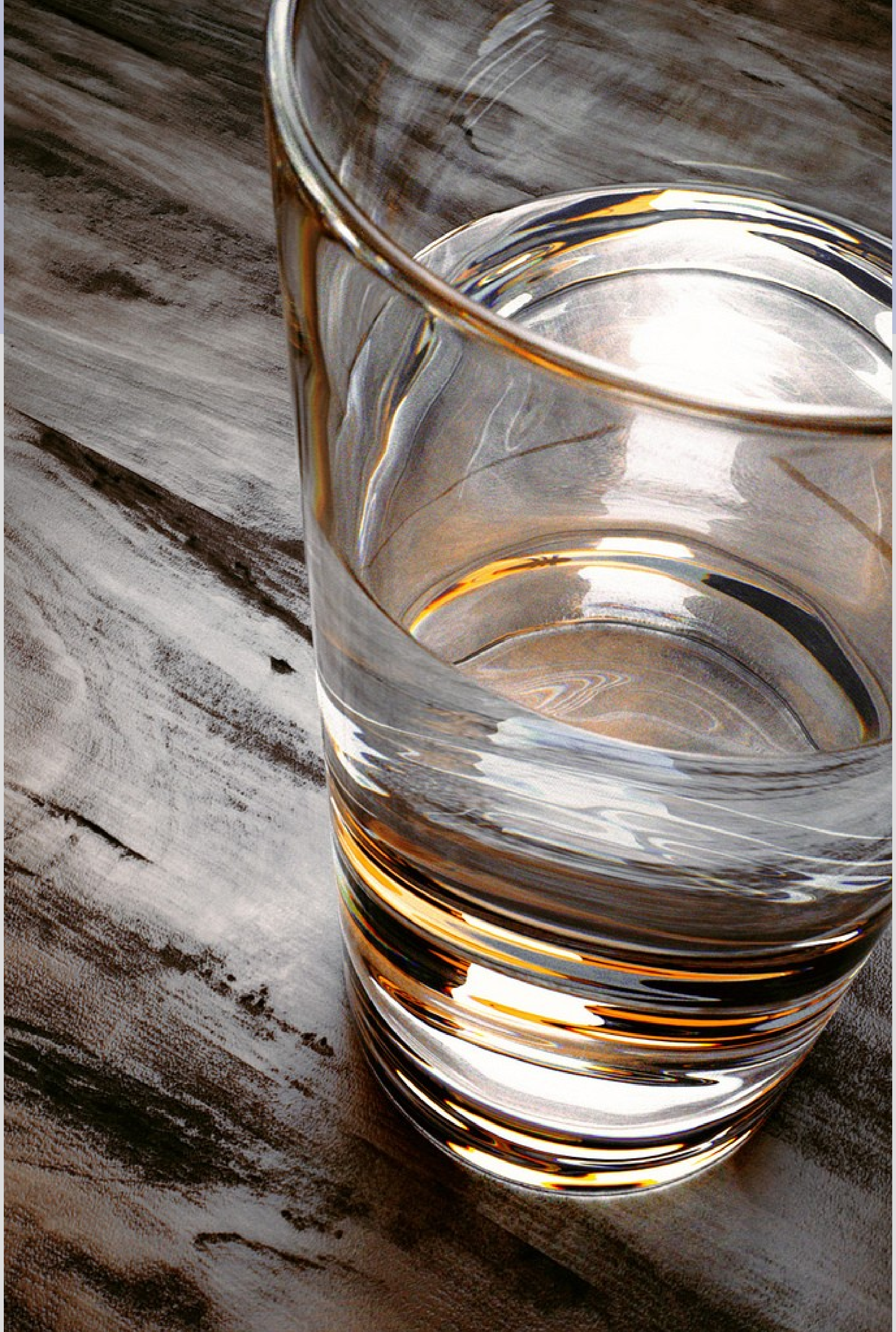
Talk contents

- Background – Indigo Renderer
- Indigo Shader Language
- The Winter programming language

Indigo Renderer

- Photorealistic rendering software
- An unbiased ray tracer
- Main product of Glare Technologies Limited

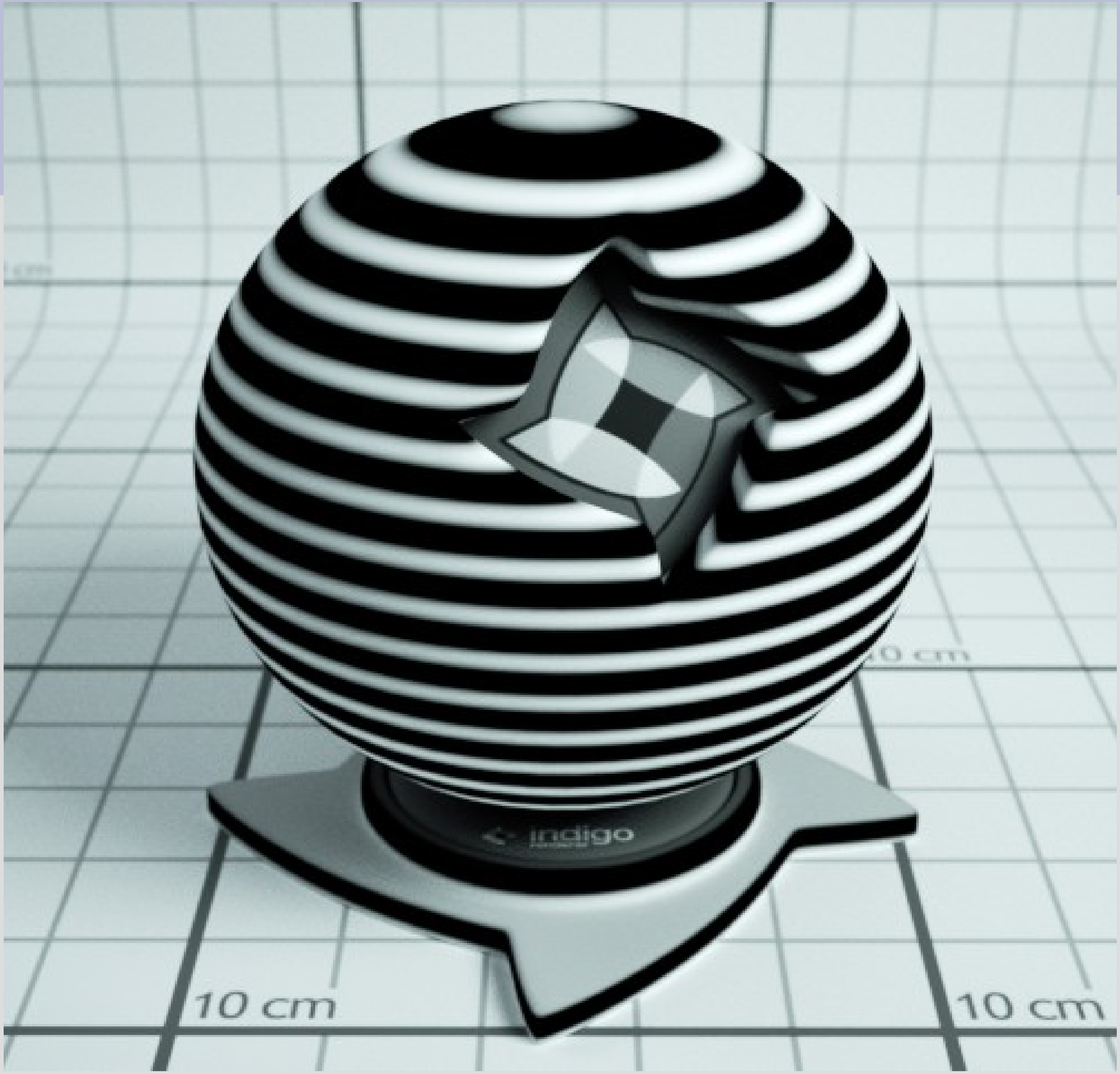
ANN ARBOR
THE CHANGE FUNCTION
THE DISPOSSESSED



Indigo Shader Language

- Embedded language used for customising material appearance
- User can write a small program to control e.g. the colour of a material
- Example:

```
def eval(vec3 pos) vec3 :
	vec3(sin(pos.z * 1000.0))
```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Indigo Shader Language

- Statically typed
- Functional
- Safe (no pointers etc..)
- JIT compiled using LLVM
- Efficient execution using vector types allowing SSE codegen.
- Performance similar to SSE-optimised C++.
- Compiled shaders can be run concurrently in different threads

Demo!

- Demo of Indigo Renderer with realtime shader editing

Introducing Winter

- Winter is a more general purpose programmable language in development
- Descendent of Indigo Shader Language
- Primary design goals:
    - High Level
    - Functional
    - Safe (well defined semantics, no pointers etc..)
    - High performance for engineering, scientific computing, and computer graphics
    - Implicit Parallelism
    - Embeddable (in a host C++ program)
    - Backends:
        - LLVM JIT for x86, x64
        - GPU: OpenCL or CUDA

Simple Program

- Simple Program:

```
def main(float x, float y) float :
      x + y
```

Let clauses

```
def f(float x) float :
      let
            z = 2.0
            y = 3.0
      in
            y + z
def main() float : f(0.0)
```

Structures and operator overloading

```
struct s { float x, float y }

def op_add(s a, s b) : s(a.x + b.x, a.y + b.y)

def main() float : x(s(1, 2) + s(3, 4))
```

Higher order functions

```
def compose(function<float, float> f, function<float, float> g) :
    \(float x) : f(g(x))

def addOne(float x) : x + 1.0
def mulByTwo(float x) : x * 2.0
def main() float :
    let
        z = compose(addOne, mulByTwo)
    in
        z(1.0)
```

Implicit Parallelism

The basic idea here is that map and fold (reduce) are elementary functions
That divide the problem into chunks when possible, and distribute across computational units. (CPU cores, GPUs, network?)

WIP!

```
def f(float x) float : pow(x, 1 / 2.2)


def main(array<T> a) : array<T>
    map(f, a)
```

The future of Winter

- Implement parallelising backend
- Implement GPU backends
- I hope to open source Winter at some point.

Thank you

- Thank you for your time!