RTVis WebGPU Tutorial

By your hosts:
Lucas Melo - lmelo@cg.tuwien.ac.at
Lukas Herzberger - herzberger@cg.tuwien.ac.at

PLEASE STAND BY

The tutorial will begin shortly

In the meantime:

```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

RTVis WebGPU Tutorial

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Lucas Melo - lmelo@cg.tuwien.ac.at
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WELCOME!

Please clone our repo:

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git clone https://github.com/Welko/rtvis-webgpu-tutorial
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This tutorial is...

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✔️ Chill

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❌ Not a lecture - no science today

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✔️ Copy-paste friendly

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❌ Not long enough - 90 minutes

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❌ Not long enough - 90 minutes

✔️ Low-level

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```

Our goal: trees

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WebGPU

✔️ Web API to access GPU capabilities

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WebGPU

✔️ Web API to access GPU capabilities

✔️ Released last year! 2023

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```

WebGPU

- ✔️ Web API to access GPU capabilities
- ✔️ Released last year! 2023
- ✔️ Closer to Vulkan than to OpenGL

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```

Data

Baumkataster bzw. Bäume Standorte Wien

Trees in Vienna

https://www.data.gv.at/katalog/dataset/c91a4635-8b7d-43fe-9b27-d95dec8392a7

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Tasks

Compute	Render
Task 1 - Compute Shader Basics Task 2 - Processing Real Data	Task 3 - Render an Image Task 4 - Render Trees as Markers
Bonus Task - Compute and Render Heatmap	

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```

RTVis WebGPU Tutorial

PLEASE SET UP YOUR ENVIRONMENTS

Make sure that your computer can run WebGPU

Setup instruction in our repo:

```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Tutorial Structure

We'll use JavaScript!

You will edit:
- tutorial.js
- shaders/

Solutions to all tasks can be found in the tasks/ folder

```
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```

GPU Parallelism

GPUs are good at running **many threads** in parallel

But only if each thread is executing **the same code**

Useful for **processing** lots of data **independently**

Useful for **displaying** lots of data (aka **rendering**)

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```

Task 0 - Initialize WebGPU

(5 minutes)

Not all browsers support WebGPU yet

Does yours?

Your playground: `tutorial.js`

```
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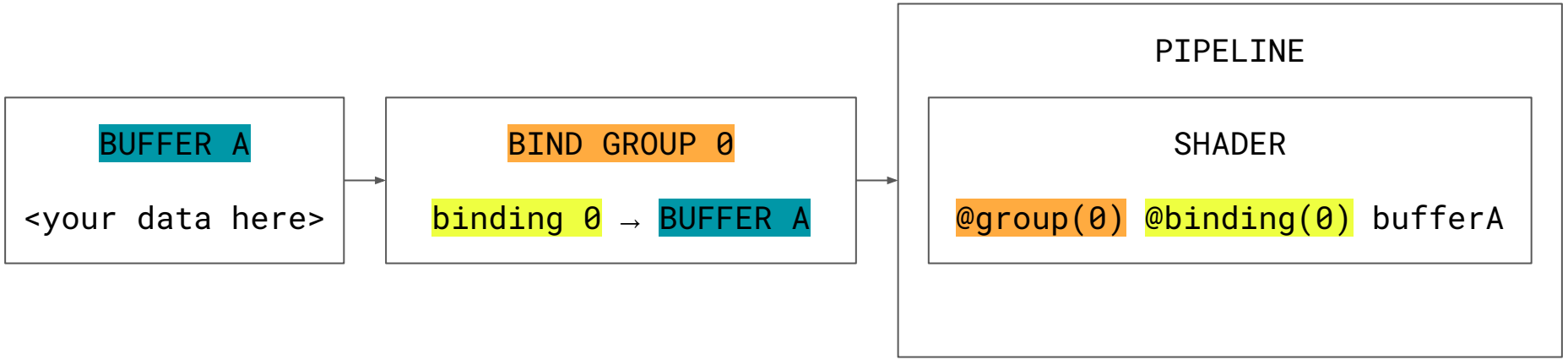
```

Task 1 - Compute Shader Basics

(15 minutes)

From buffer to shader




```
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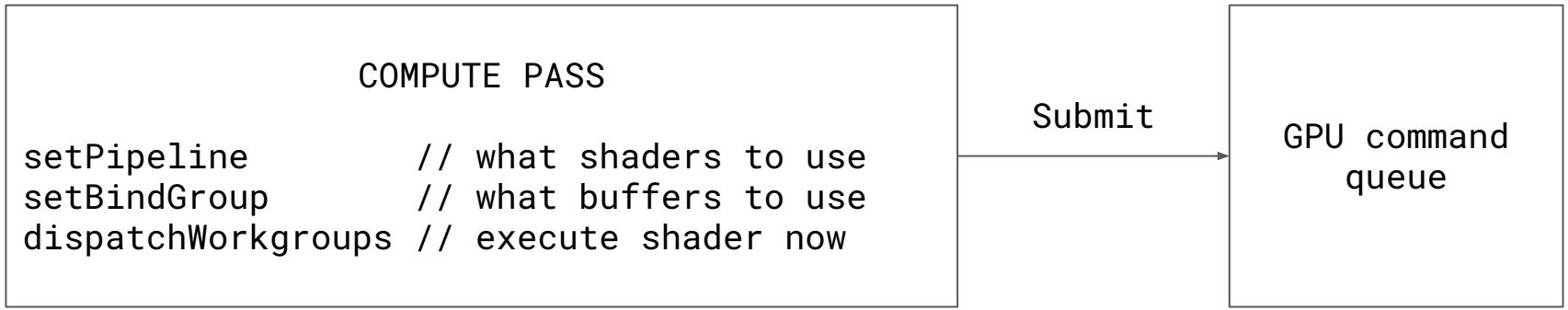
```

Task 1 - Compute Shader Basics

(15 minutes)

Why this matters




```
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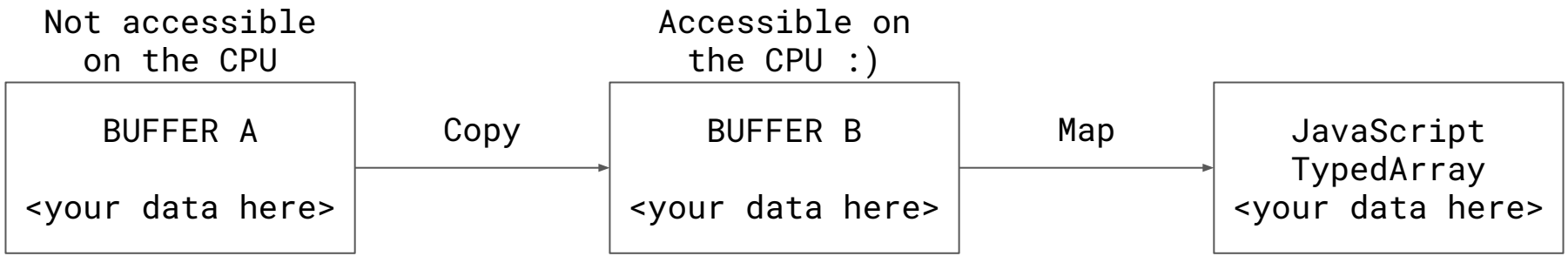
```

Task 1 - Compute Shader Basics

(15 minutes)

Reading a GPU buffer on the CPU




```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 2 - Processing Real Data

(20 minutes)

LOADER.loadTrees() provides a TreeStore

```
TreeStore

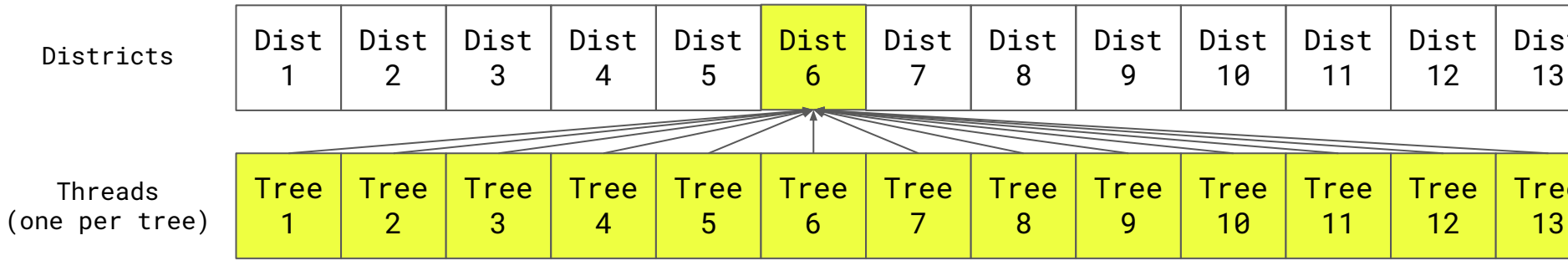
getNumTrees(): number
getInfoBuffer(): Float32Array
getCoordinatesLatLonBuffer(): Float32Array
...
```

```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 2 - Processing Real Data

(20 minutes)

Concurrent writing into buffer

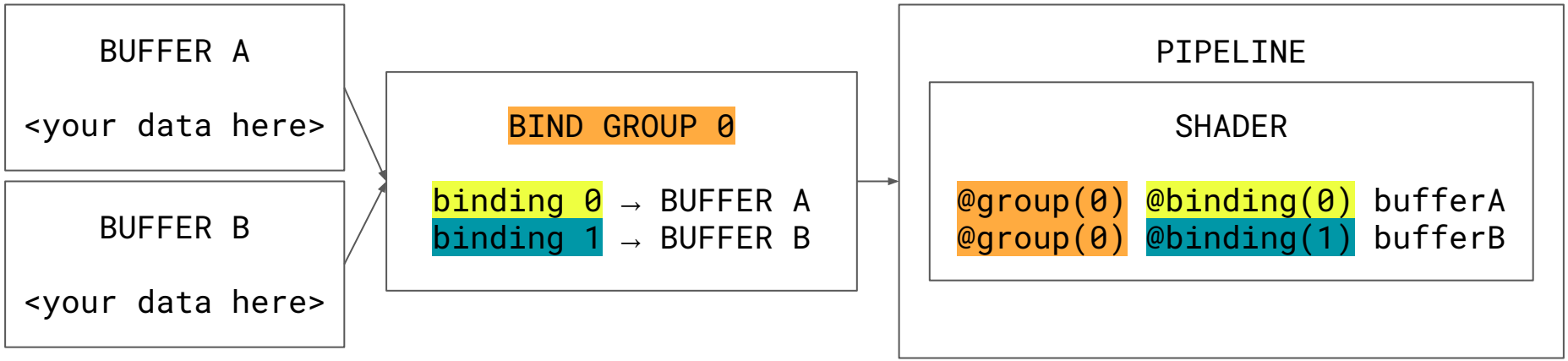



```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 2 - Processing Real Data

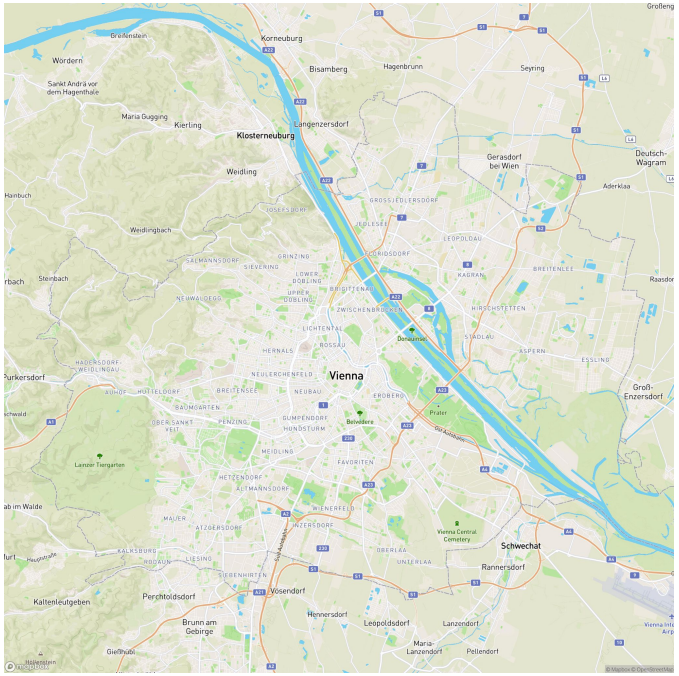
(20 minutes)

Two buffers now




```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 3 - Render an Image

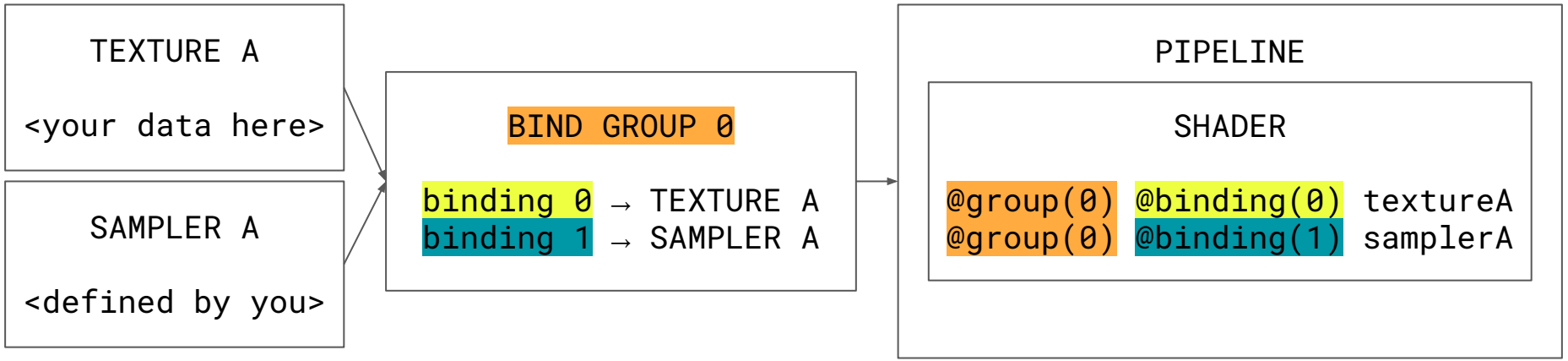



```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 3 - Render an Image

(15 minutes)

Binding textures/samplers is the same




```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

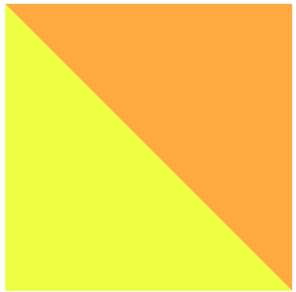
Task 3 - Render an Image

(15 minutes)

Drawing without vertex buffers

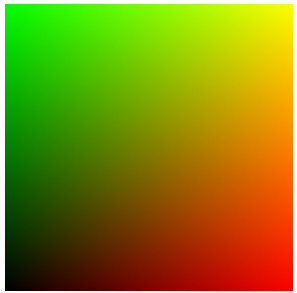
VERTICES

```
[-1, -1]
[-1,  1]
[ 1, -1]
[ 1,  1]
[-1,  1]
[ 1, -1]
```



UVS

```
[0, 0]
[0, 1]
[1, 0]
[1, 1]
[0, 1]
[1, 0]
```



```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 3 - Render an Image

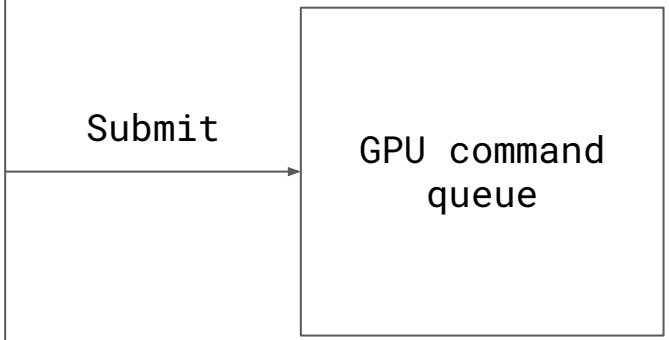
(15 minutes)

Render pass kinda the same

```
                RENDER PASS

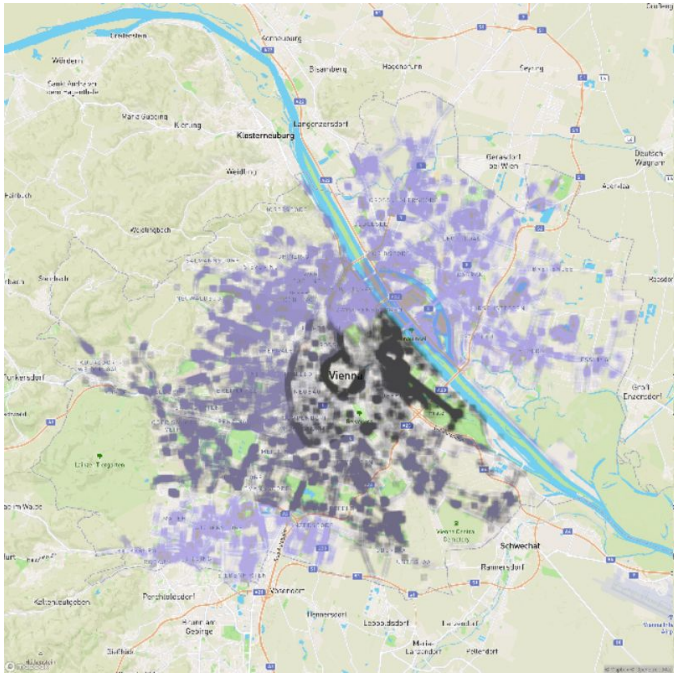
setIndexBuffer  //   not used in
setVertexBuffer //   this tutorial

setPipeline  // what shaders to use
setBindGroup // what buffers to use
draw         // execute shader now
```



`git clone https://github.com/Welko/rtvis-webgpu-tutorial`

Task 4 - Render Trees as Markers

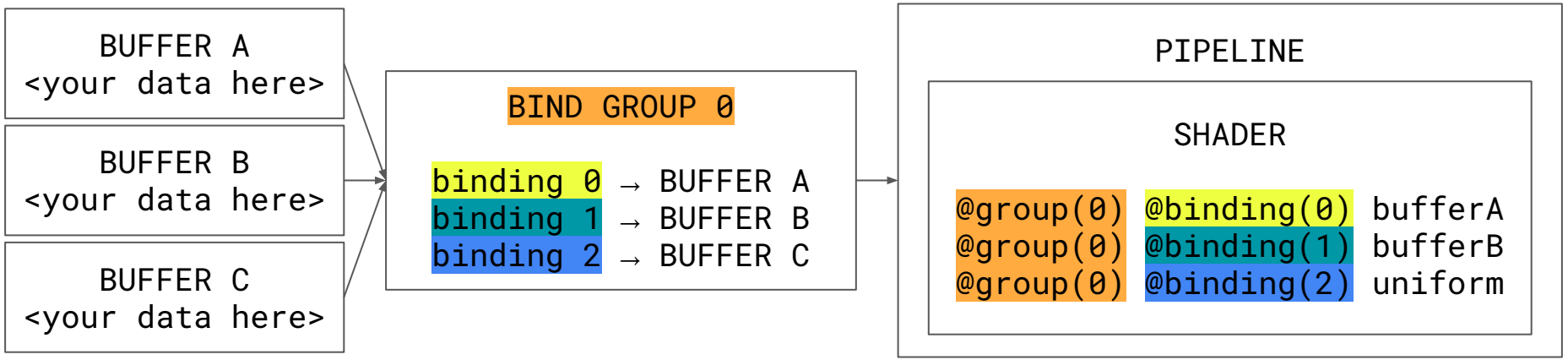



```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 4 - Render Trees as Markers

(35 minutes)

Three buffers now

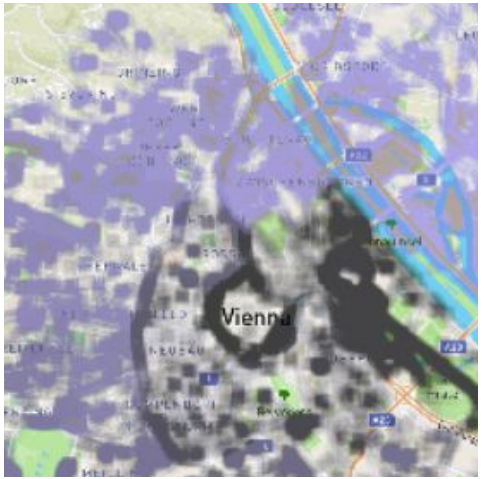



```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Task 4 - Render Trees as Markers

(35 minutes)

Mapping district to sequential color scheme = **BAD IDEA**




```
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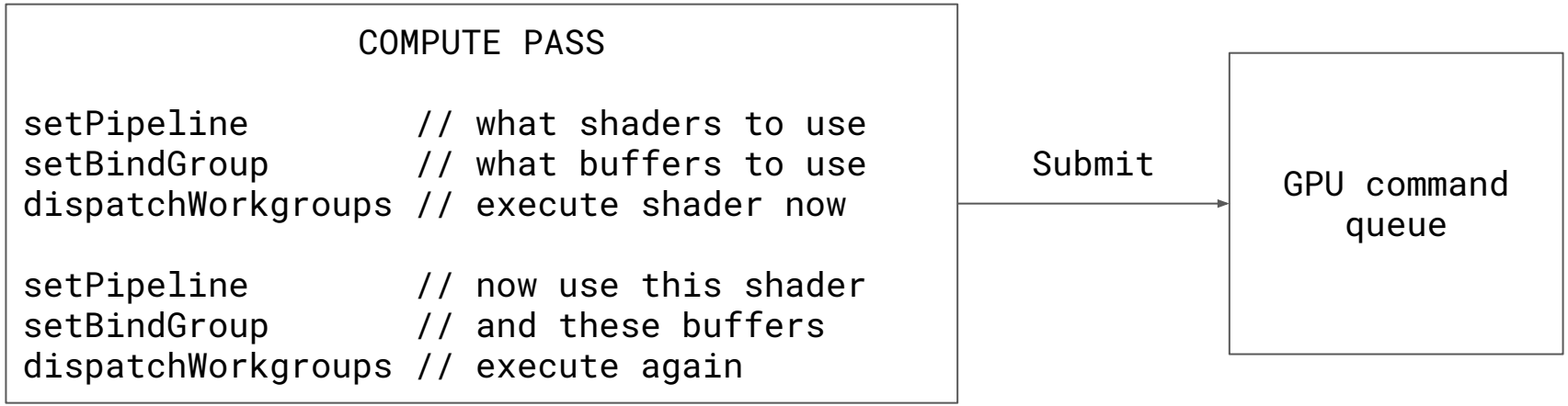
```

Task 4 - Render Trees as Markers

(35 minutes)

Multiple dispatches in one compute pass




```
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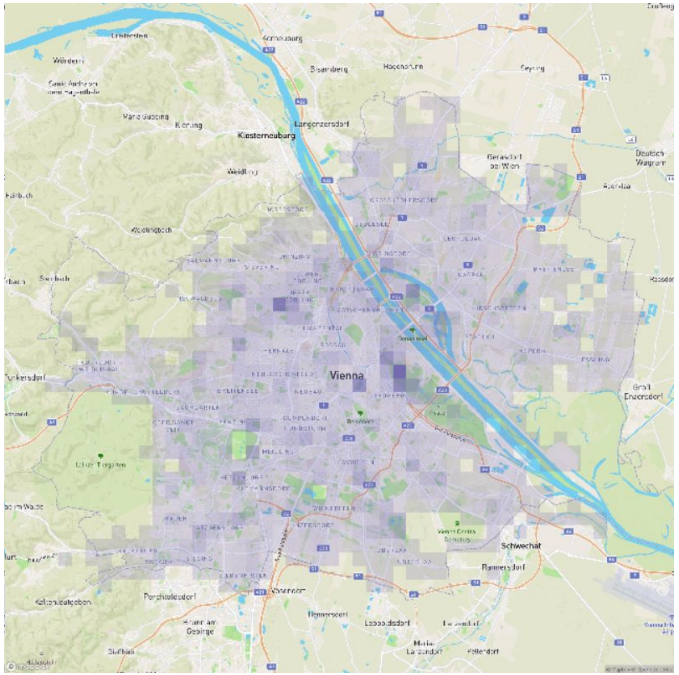
```

Bonus Task - Compute and Render Heatmap




```
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```

Bonus Task - Compute and Render Heatmap

Grid as one-dimensional buffer

0	1	2	3	4	5	6	7	8	9	10	11	12	13	1

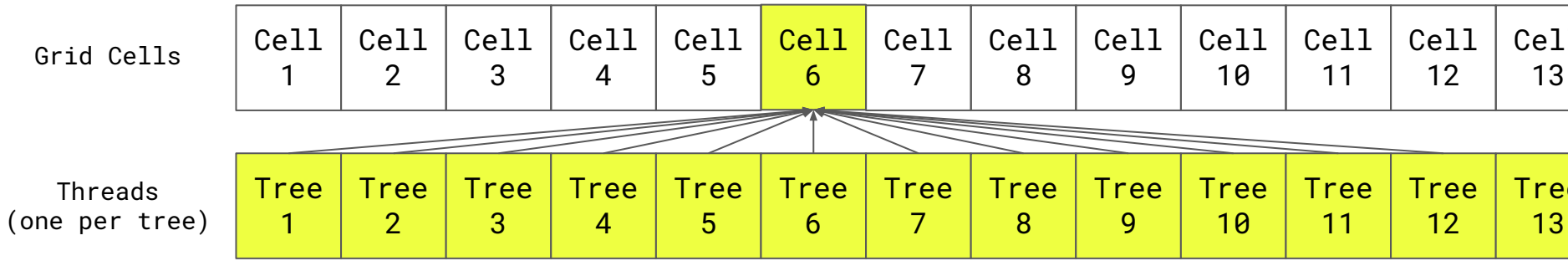
Index from xy: `index = y * width + x`

0	1	2	3
4	5	6	7
8	9	10	11

```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Bonus Task - Compute and Render Heatmap

Concurrent writing into buffer




```
git clone https://github.com/Welko/rtvis-webgpu-tutorial
```

Bonus Task - Compute and Render Heatmap

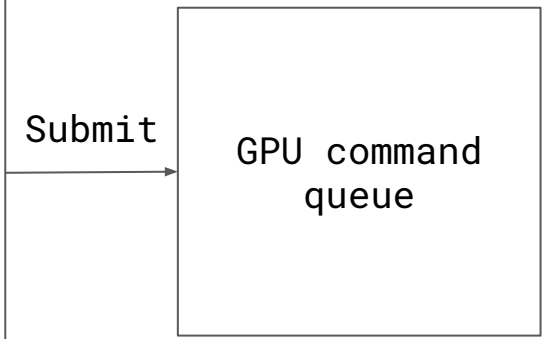
One bind group, many pipelines

```
                    COMPUTE PASS

setBindGroup        // what buffers to use

setPipeline         // what shaders to use
dispatchWorkgroups  // execute shader now

setPipeline         // now use this shader
dispatchWorkgroups  // execute again with same buffers
```

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THANK YOU FOR PARTICIPATING

Questions? Contact us!

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