Immediate Mode GUI – Theory and Example

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What is GUI?

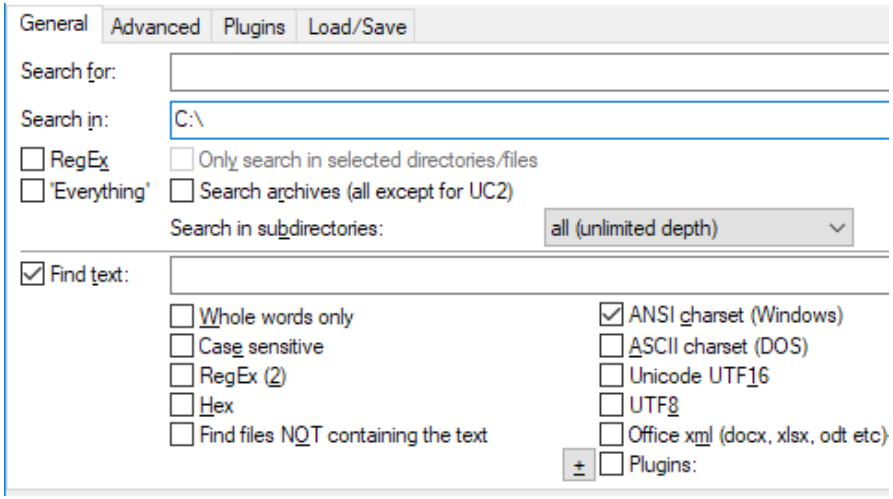
Graphical User Interface (GUI)

aka Head-Up Display (HUD)

- Displays information
- Handles interaction
  - Mouse, touch, keyboard, other controllers…

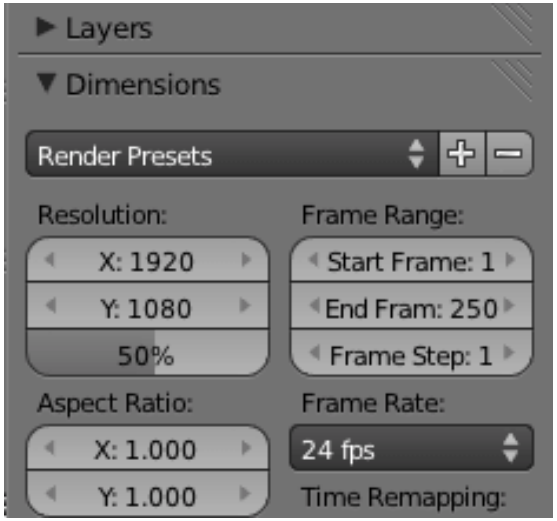
Implementation

1. Default system controls
   - (Used in desktop apps)
   - Pure system API: WinAPI 
   - C++ library: Qt, wxWidgets, …
   - Another programming language: C#, Java, …



Implementation

1. Default system controls
2. Custom rendering
   - (Used in games, graphics apps)
   - Library: Scaleform, Dear ImGui, …
   - Your own implementation



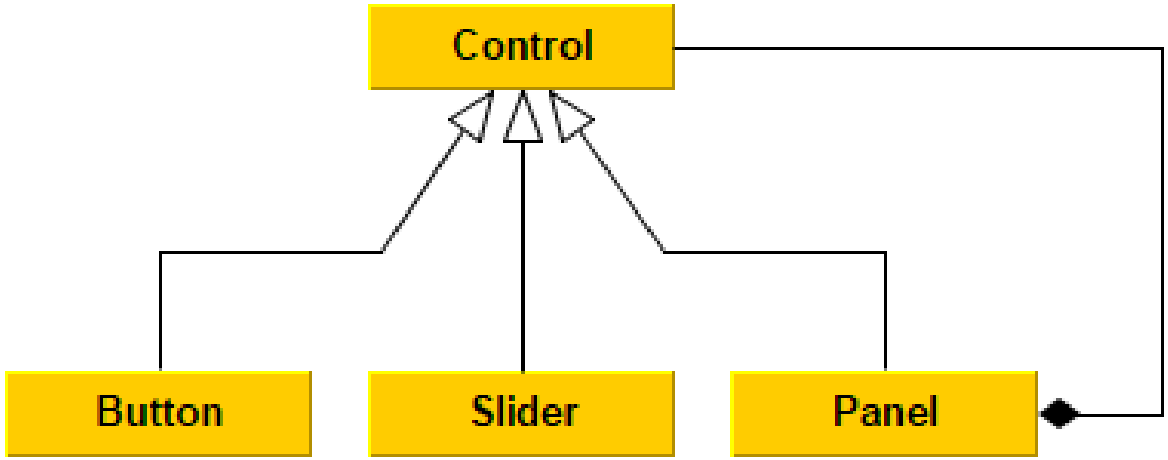
Architecture

Object-oriented – seems to be the most natural architecture for GUI

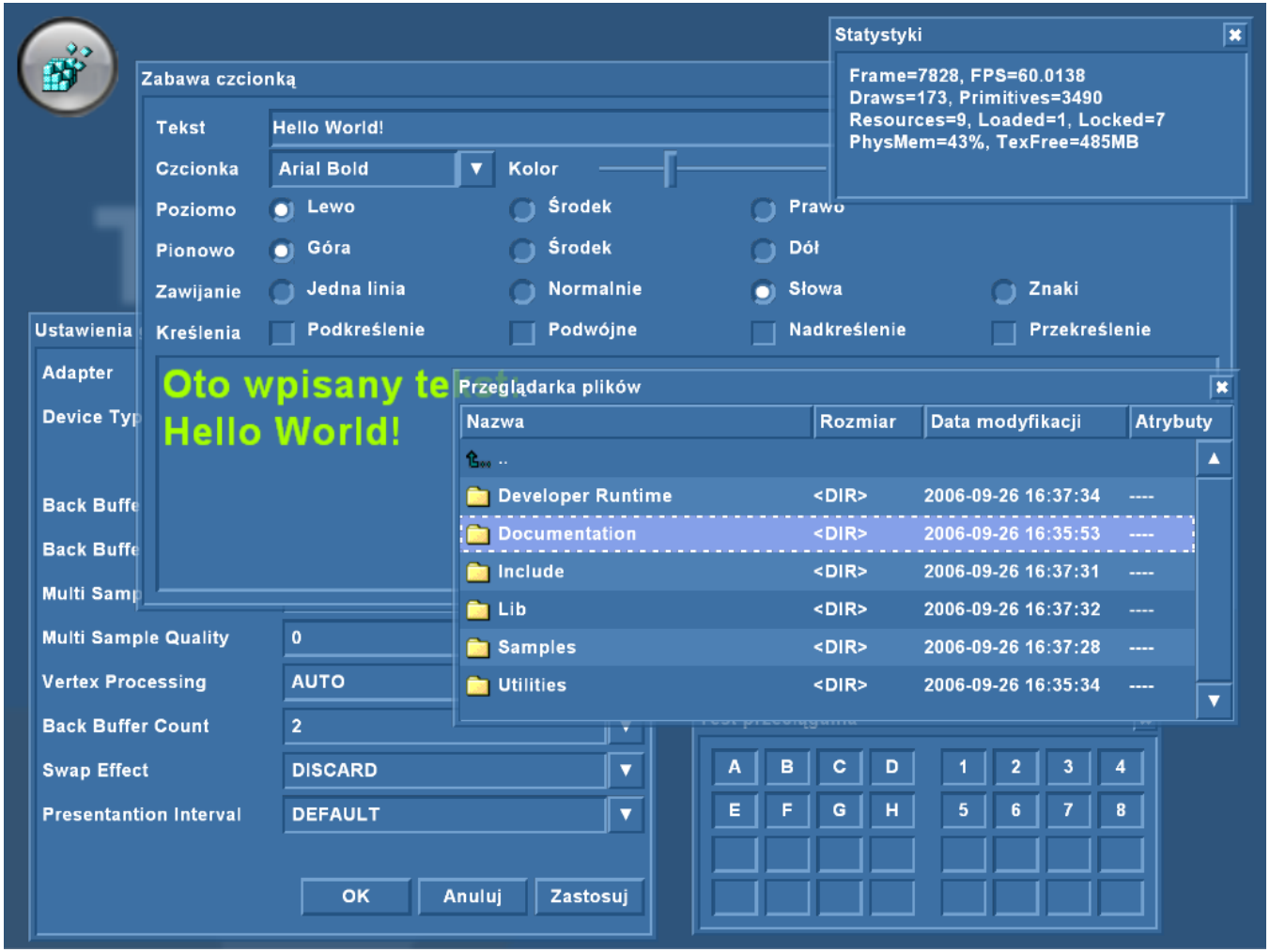
- Class hierarchy for types of controls
- Design patterns, e.g. composite
- Fields: Position, Size, …
- Methods: Show, Hide, Enable, Disable, …

Architecture

Object-oriented – seems to be the most natural architecture for GUI



Example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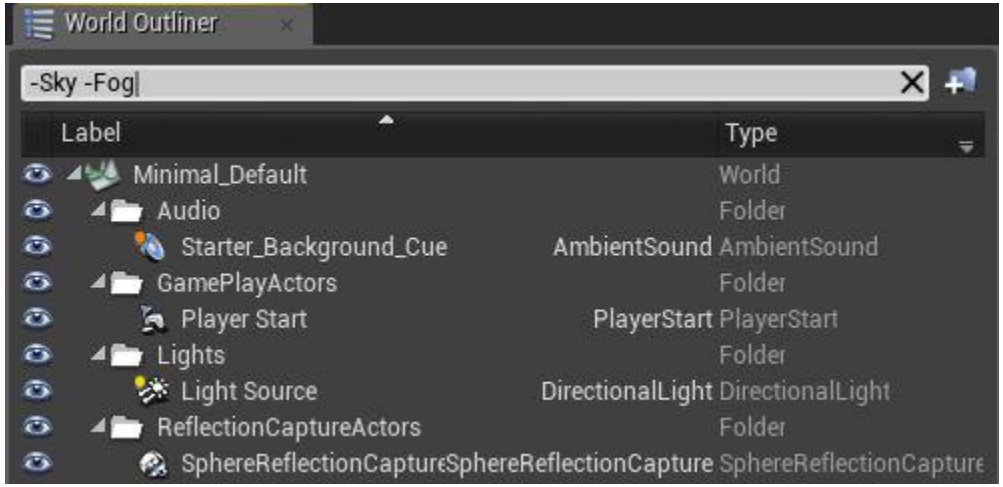
Draws=173, Primitives=3490
Resources=9, Loaded=1, Locked=7
PhysMem=43%, TexFree=485MB
Zabawa czcionką
Tekst
Hello World!
Czcionka
Arial Bold
Kolor
Poziomo
Lewo
Środek
Prawo
Pionowo
Góra
Środek
Dół
Zawijanie
Jedna linia
Normalnie
Słowa
Znaki
Kreślenia
Podkreślenie
Podwójne
Nadkreślenie
Przekreślenie
Oto wpisany te
Hello World!
Przeglądarka plików
Nazwa
Rozmiar
Data modyfikacji
Atrybuty
Developer Runtime <DIR> 2006-09-26 16:37:34 ----
Documentation <DIR> 2006-09-26 16:35:53 ----
Include <DIR> 2006-09-26 16:37:31 ----
Lib <DIR> 2006-09-26 16:37:32 ----
Samples <DIR> 2006-09-26 16:37:28 ----
Utilities <DIR> 2006-09-26 16:35:34 ----
Ustawienia
Adapter
Device Typ
Back Buffe
Back Buffe
Multi Samp
Multi Sample Quality
0
Vertex Processing
AUTO
Back Buffer Count
2
Swap Effect
DISCARD
Presentantion Interval
DEFAULT
OK
Anuluj
Zastosuj
A B C D 1 2 3 4
E F G H 5 6 7 8

Some thoughts

- Actual objects also form a hierarchy
  - Every control is positioned relative to its parent
- Similar to how games represent scene
  - High-level approach found in game engines – hiearchy of objects



Immediate mode GUI – idea

- On low level (DirectX, OpenGL, Vulkan), rendering is stateless – „immediate mode”
  - Sequence of draw calls repeated every frame

- SetShader
- SetTexture
- DrawTriangles
- SetTexture
- DrawTriangles
- …

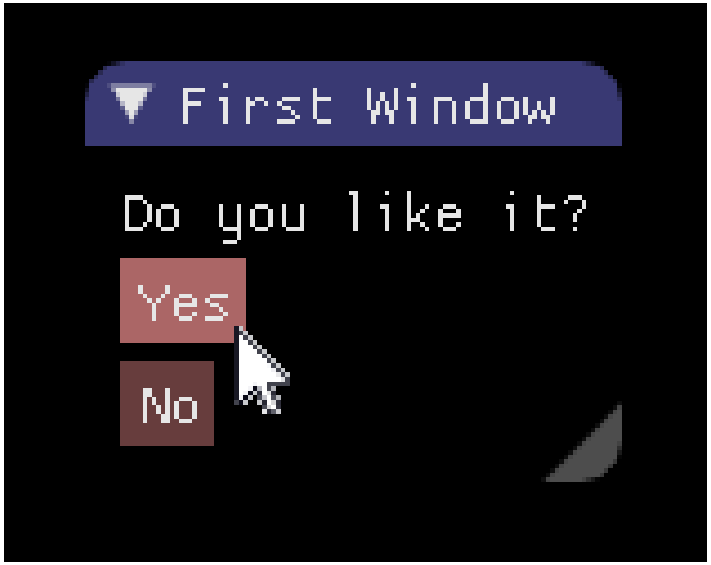
- What if… we could render GUI this way?

Dear ImGui

- https://github.com/ocornut/imgui
- C++ library
  - Bindings to many languages available
- License: MIT
- Author: Omar Cornut (game developer)
- Suited for real-time rendering
  - Efficient
  - Graphics API agnostic

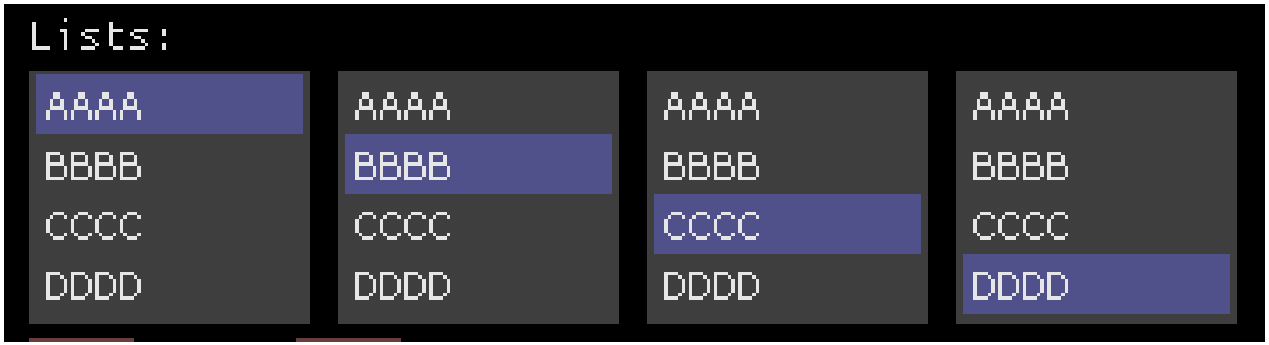
Example code

```
if(ImGui::Begin("First Window"))
{
    ImGui::Text("Do you like it?");
    ImGui::Button("Yes");
    ImGui::Button("No");
    ImGui::End();
}
```



Q: How are controls positioned?

- Automatic – each control in new row
- You can change this:
  - PushItemWidth(item_width), SameLine()
  - Columns: Columns(count)
  - Grouping: BeginGroup(), EndGroup()
  - Full control: GetCursorPos(), SetCursorPos(local_pos)



Q: How do I handle feedback?

You receive it the same moment you define a control

```
ImGui::Text("Do you really want to quit?");
if(ImGui::Button("Yes"))
    ExitProgram();
if(ImGui::Button("No"))
    CloseThisWindow();
```

Q: Where is value of controls?

- In your own variables
- You pass pointers to them as you define controls

```
float volume = 0.7f;
bool mute = true;

ImGui::SliderFloat("Volume", &volume, 0.0f, 1.0f);
ImGui::Checkbox("Mute", &mute);
```

Q: How about other state?

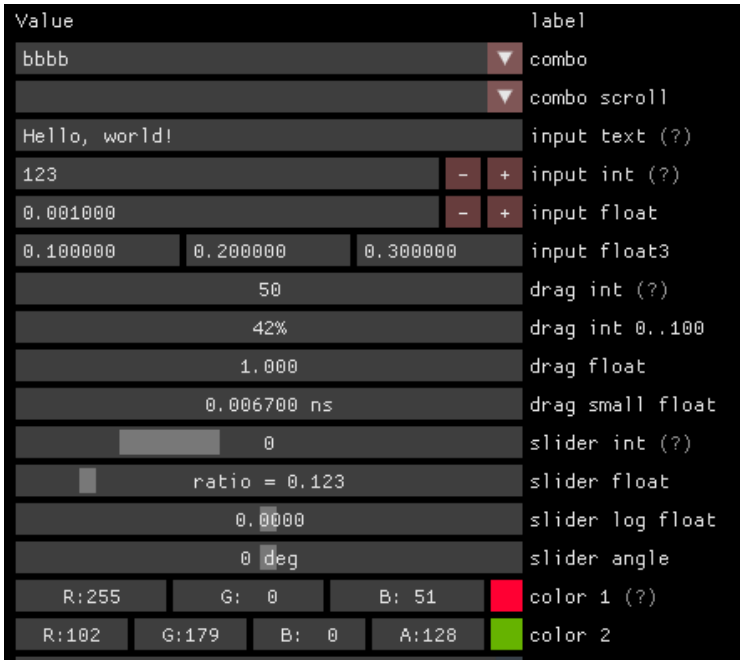
- There is other state
  - Window position & size, focus, text selection, …
- Kept inside ImGui library
  - So it’s not truly stateless…
- Controls are identified by hash from their labels
  - If not unique, you can use "Label##UNIQUE_ID"
  - You can also scope your labels: PushID(), PopID()

Q: How to render?

- If your frame has Update() and Render():
  - Do all ImGui inside Update()
  - Inside Render() you must render it yourself
- For rendering you receive a sequence of:
  - Vertex array
  - Index array
  - Texture ID
  - Scissor rectangle
- Examples available for: DirectX 9, 10, 11, OpenGL, Vulkan, Allegro, …

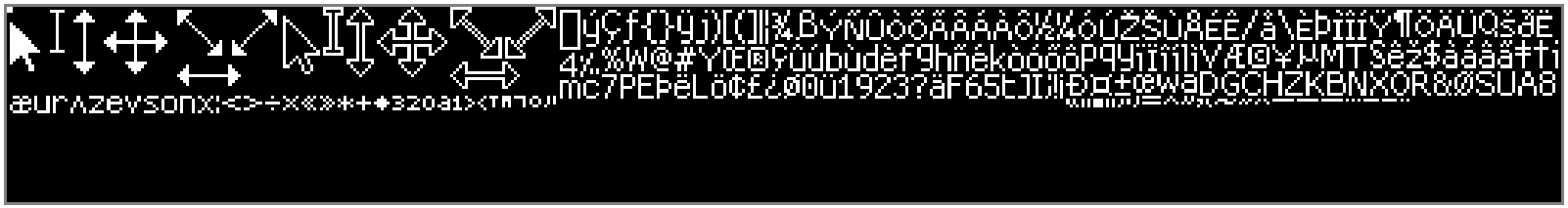
Features: Property grid

- Suited to provide editing of properties of various types
  - bool, int, float, string, enum
  - vec2, vec3, vec4, color



Features: Fonts

- Supports TTF fonts, loaded into atlas texture
- You receive data for this texture,
  need to upload it to GPU by yourself



Live demo

Conclusion

- Dear ImGui is good for:
  - Internal in-game GUI for debugging purposes
    - Easy to use
    - Efficient to render
- Dear ImGui is not good for:
  - Fully-featured game editor
    - Not well suited for complicated GUI, better use system controls
  - Final game HUD
    - No possibility of skinning or making it look pretty
- You can always make your own implementation
  - Based on idea of Immediate Mode GUI!

Thank you

Questions?