Game Programming with DXFramework

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The Big Picture

- DirectX is a general hardware interface API
- Goal: Unified interface for different hardware
- Much better than the past
  - Programs had to be coded for specific hardware

DXFramework is a Simple DirectX Game Engine

DXFramework goals:

- Simplicity
- 2D support
- Object oriented design
- Instruction by example

Types of Games to Create

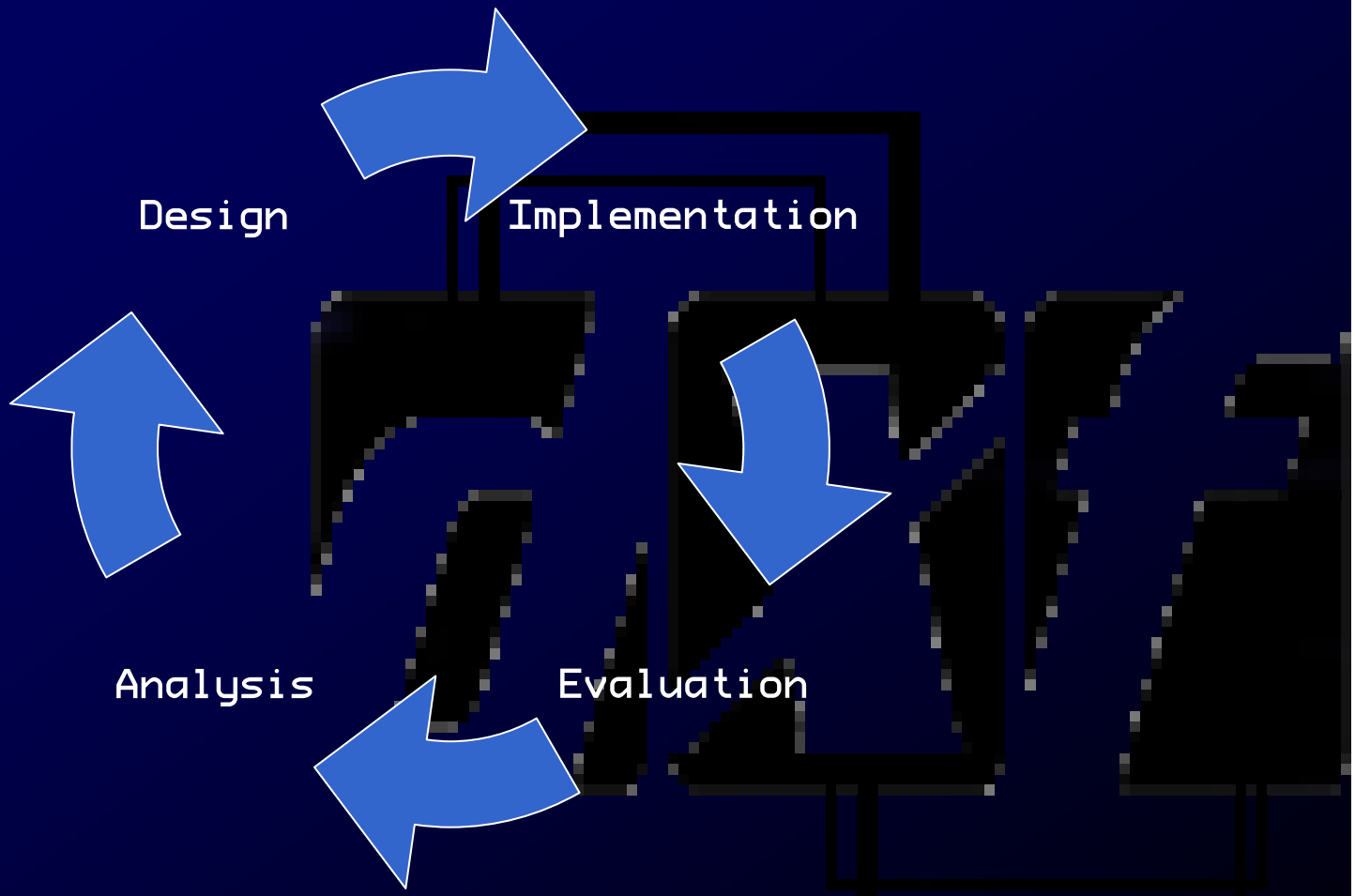
Simple!

Fun!

Easy!

(2D!)

Iterative Development



Student Games

Only the final projects are available on the web (not the arcade games)

Fall 2004 (DXFramework 0.9.3):

http://ai.eecs.umich.edu/soar/Classes/494/showcase-2004/Games.htm

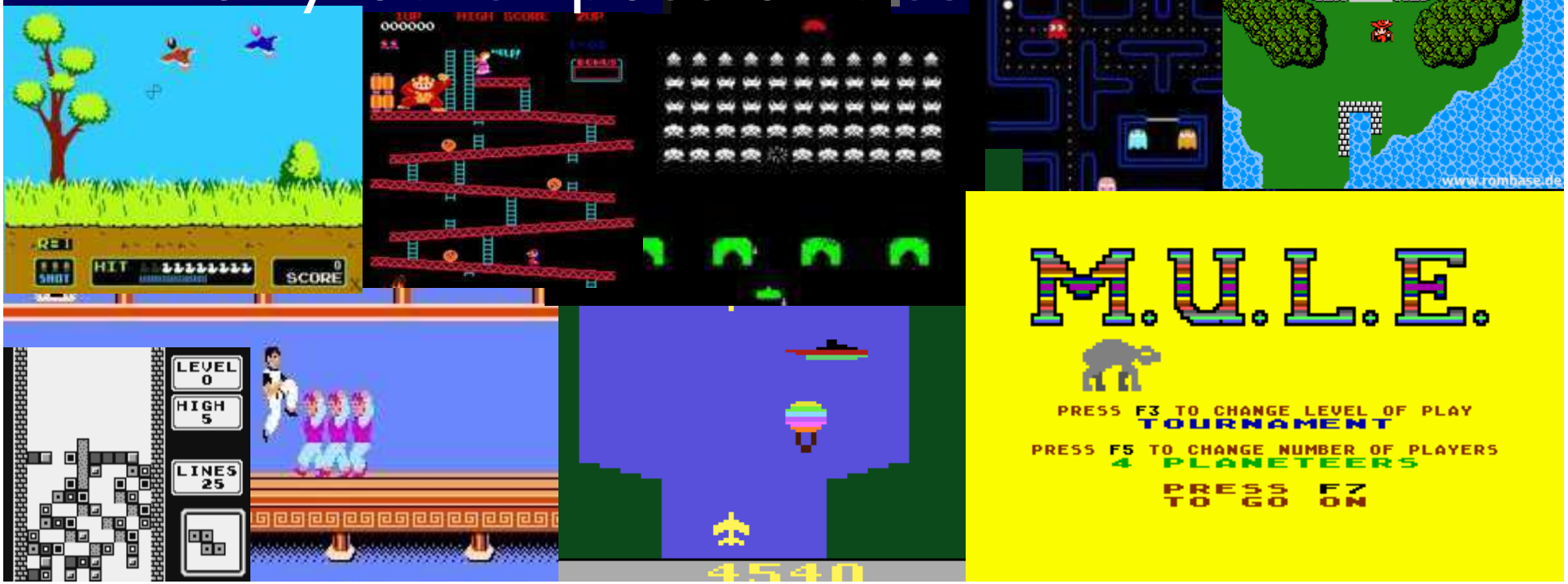
Fall 2005 (DXFramework 0.9.6):

http://ai.eecs.umich.edu/soar/Classes/494/showcase-2005.htm

Arcade Game Demo

DXF Capabilities

- Genres: arcade, action, puzzle, role playing, adventure, strategy
  - Top down, side view, isometric
- Many other possibilities!



DXF Capabilities

- Sounds & Music
  - Midi background, sound effects
  - simple pan & volume control
- Input
  - Keyboard and mouse
  - Joystick possible: use USB joystick and be prepared to turn it in with your game!

DXF and DXUT

- Microsoft's DirectX utility library
  - Included with DirectX SDK
- Included with DXFramework
  - 'dxut' project
- See DirectX samples for more on DXUT and DirectX

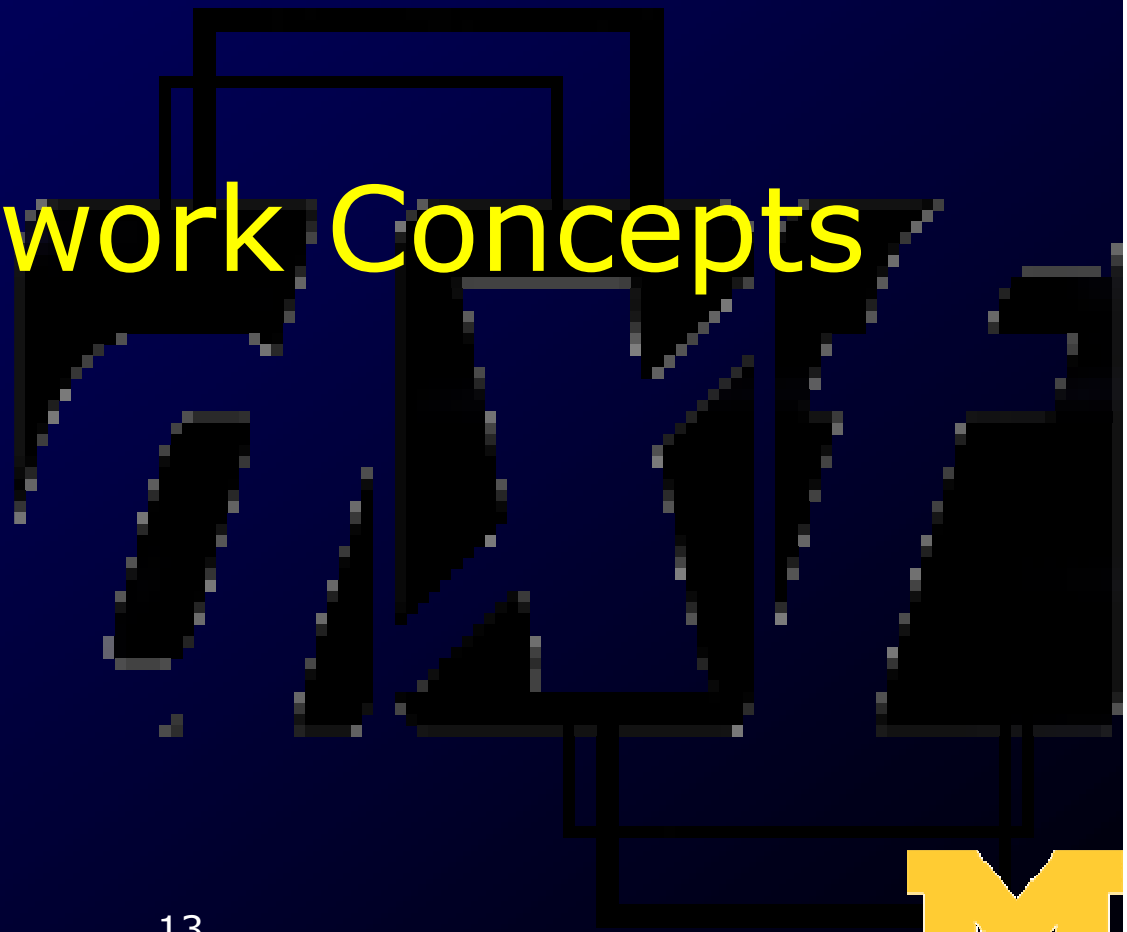
DXF Prerequisites

- Windows 2000/XP
- Microsoft Visual Studio 2005
- Latest DirectX SDK
- Windows SDK
- Python interpreter
- Creativity

Installation

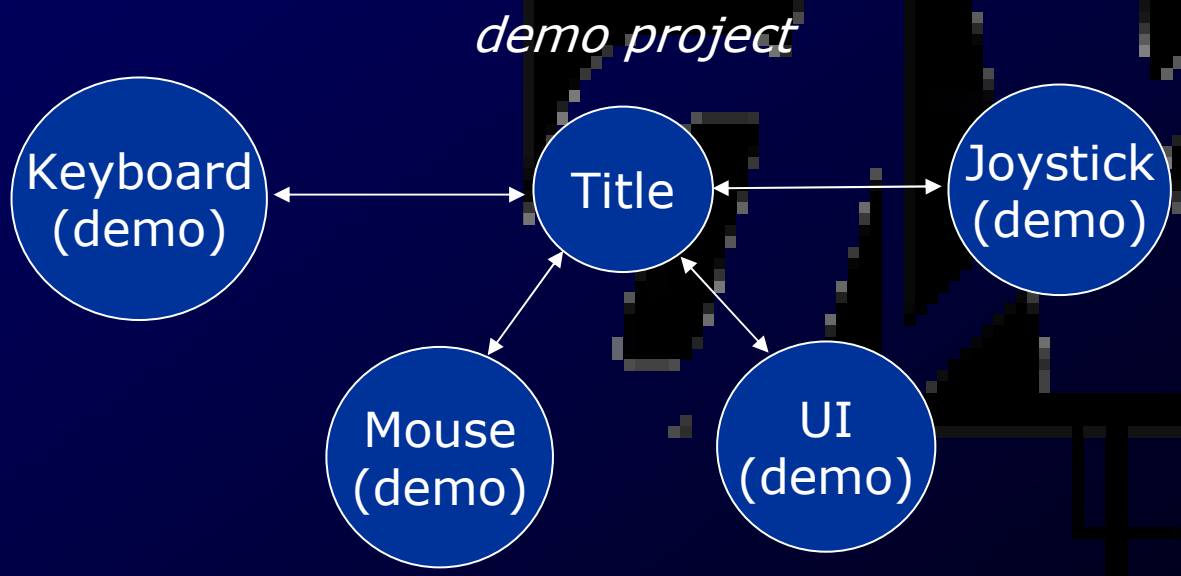
- Refer to Getting Started guide:
  - http://dxframework.org/wiki
- Generally speaking:
  - Install Visual Studio & SDKs
  - Configure Visual Studio
  - Download and Extract package

DXFramework Concepts

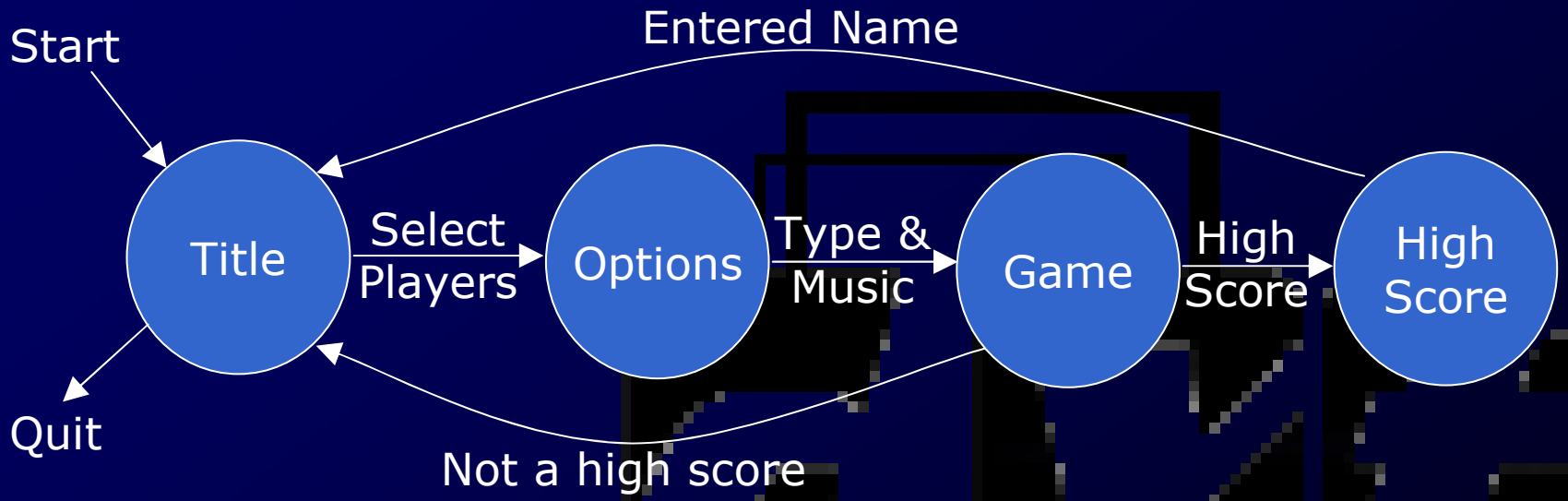


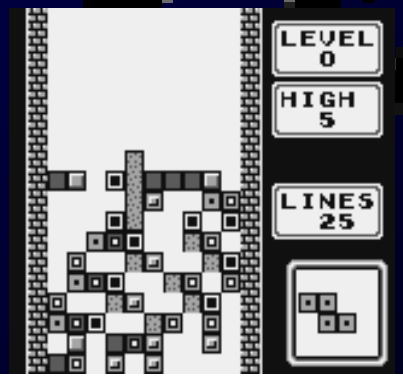
A DXF Application is a graph of Game States

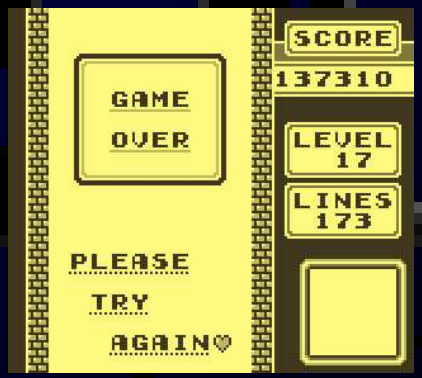
- You create your game by defining game states (extending a GameState class) and the conditions for transitioning between them



Tetris as a graph of states

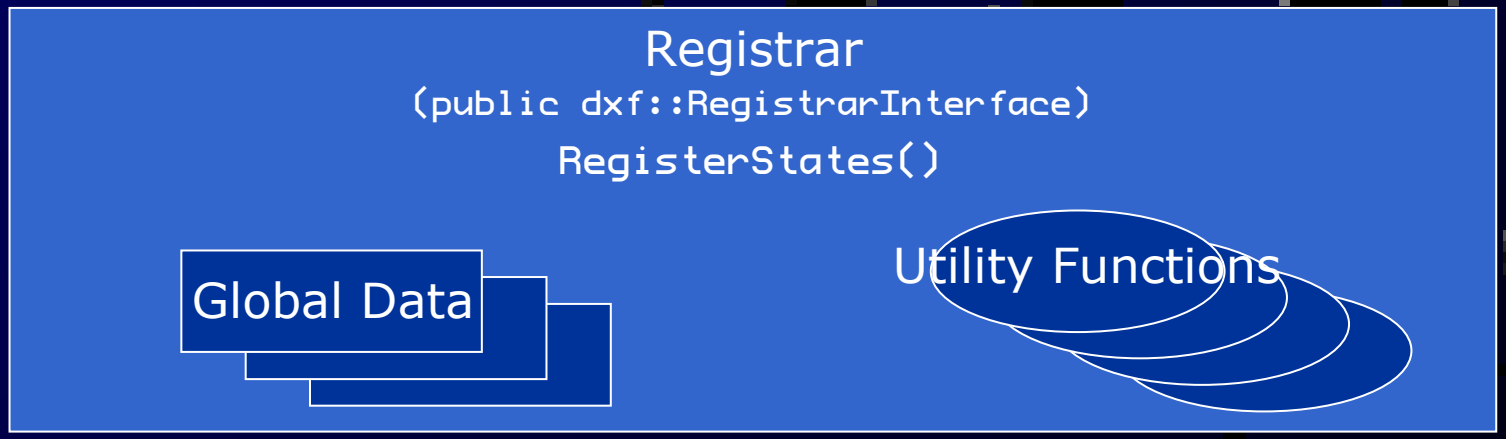




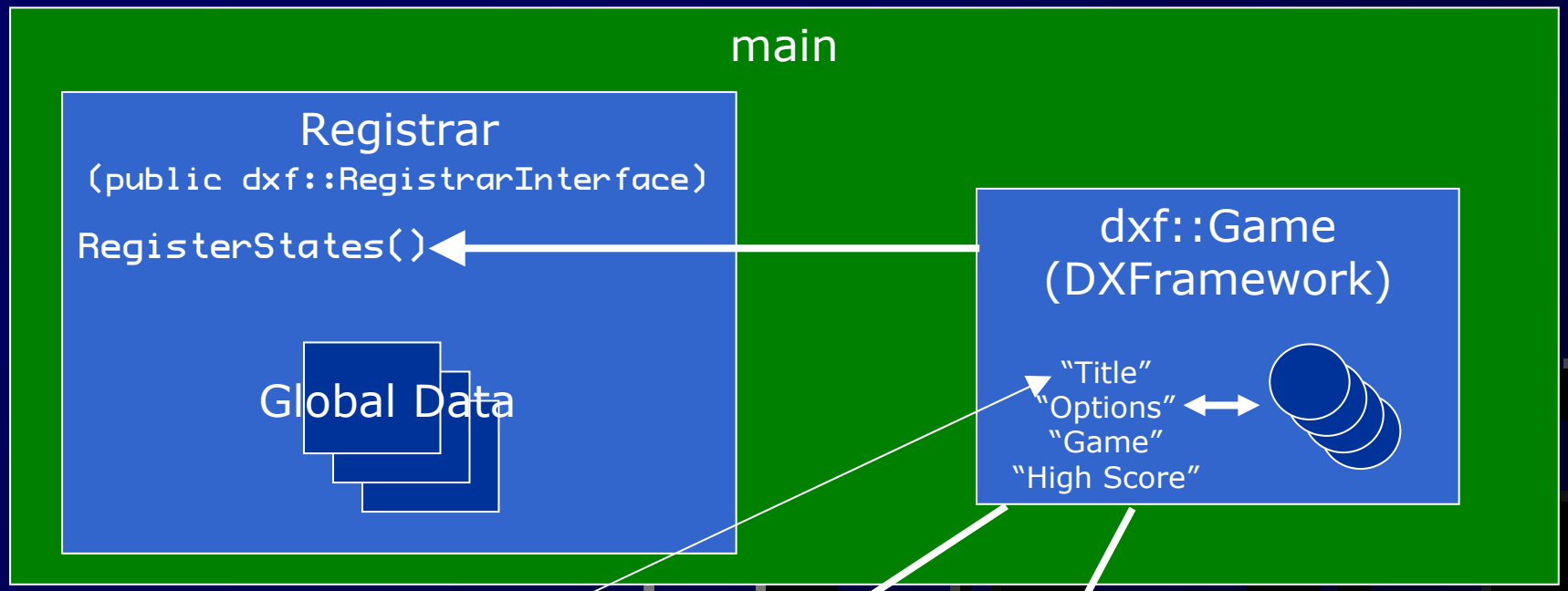


Global Data (data shared across states)

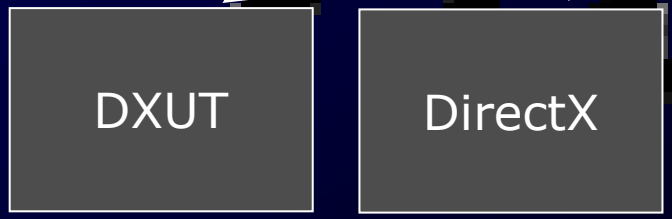
- What about global data?
  - High scores
  - Option settings
- Store global data in the Registrar
  - The registrar is part of your project



Initialization



The first state registered is used as the initial state!

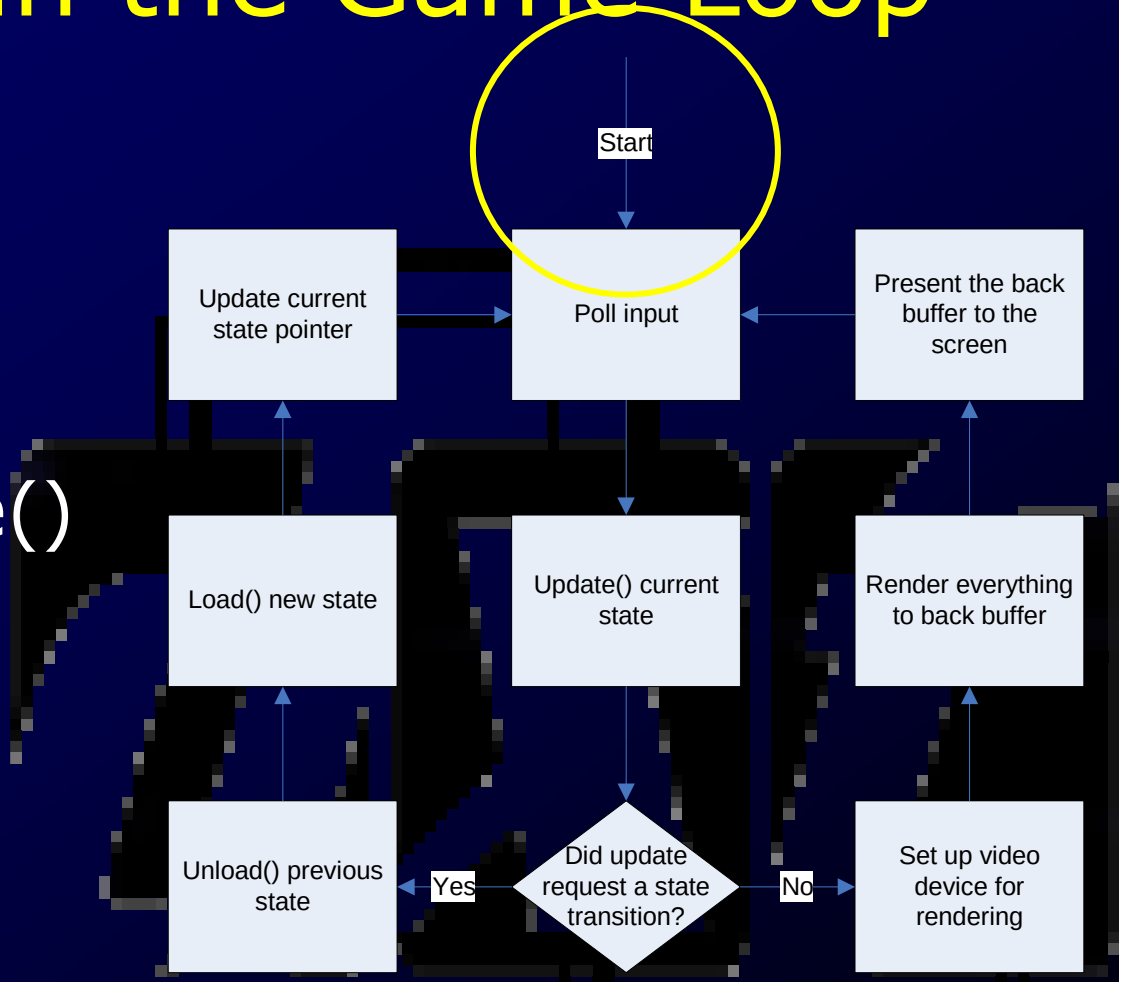


Execution

- The next thing main() does is call Run()
  - This starts the main loop: Input→Update→Render
  - Each iteration of this loop represents a frame
- This loop executes as fast as possible
  - DXF uses variable discrete
  - Faster hardware runs faster
  - Time elapsed is available to Update()
- When Run() exits, so does the program

Key Points in the Game Loop

- Load()
- Update()
- Render2D()
- DXFChangeState()
- Unload()



Creating States

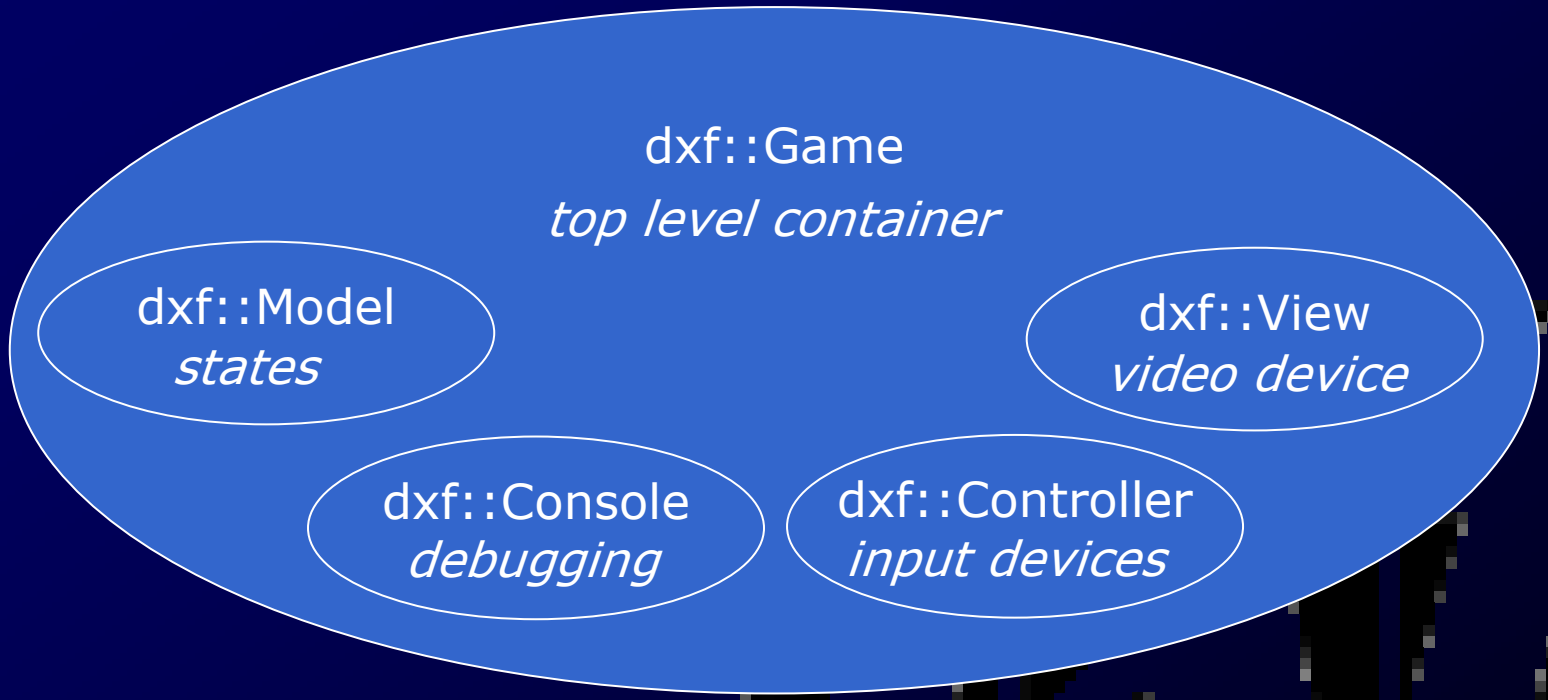
- Extend dxf::GameState2D
  - Implement the necessary functions
- Need a complex GUI?
  - Extend dxf::GameStateGUI instead
- Need sub-states?
  - Advanced topic
  - Extend dxf::StateManager as well

Registering States

- Registrar
  - RegisterStates()
  - DXFRegisterState(string, state pointer)

```
const std::wstring Registrar::kTitle = L"Title";
const std::wstring Registrar::kKeyboard = L"Keyboard";
…
dxf::DXFRegisterState(kTitle, Title::Instance());
dxf::DXFRegisterState(kKeyboard, Keyboard::Instance());
…
dxf::DXFChangeState(Registrar::kKeyboard);
```

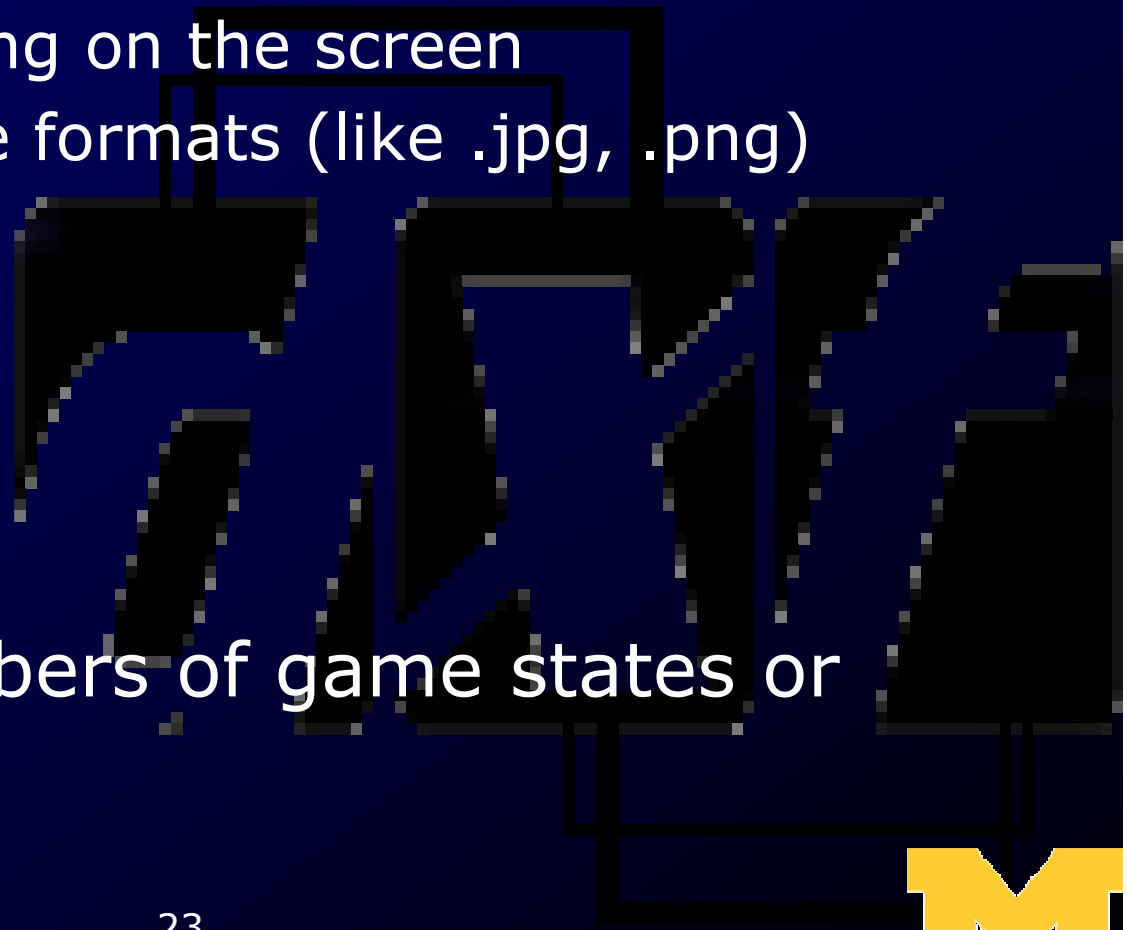

DXF Engine Architecture



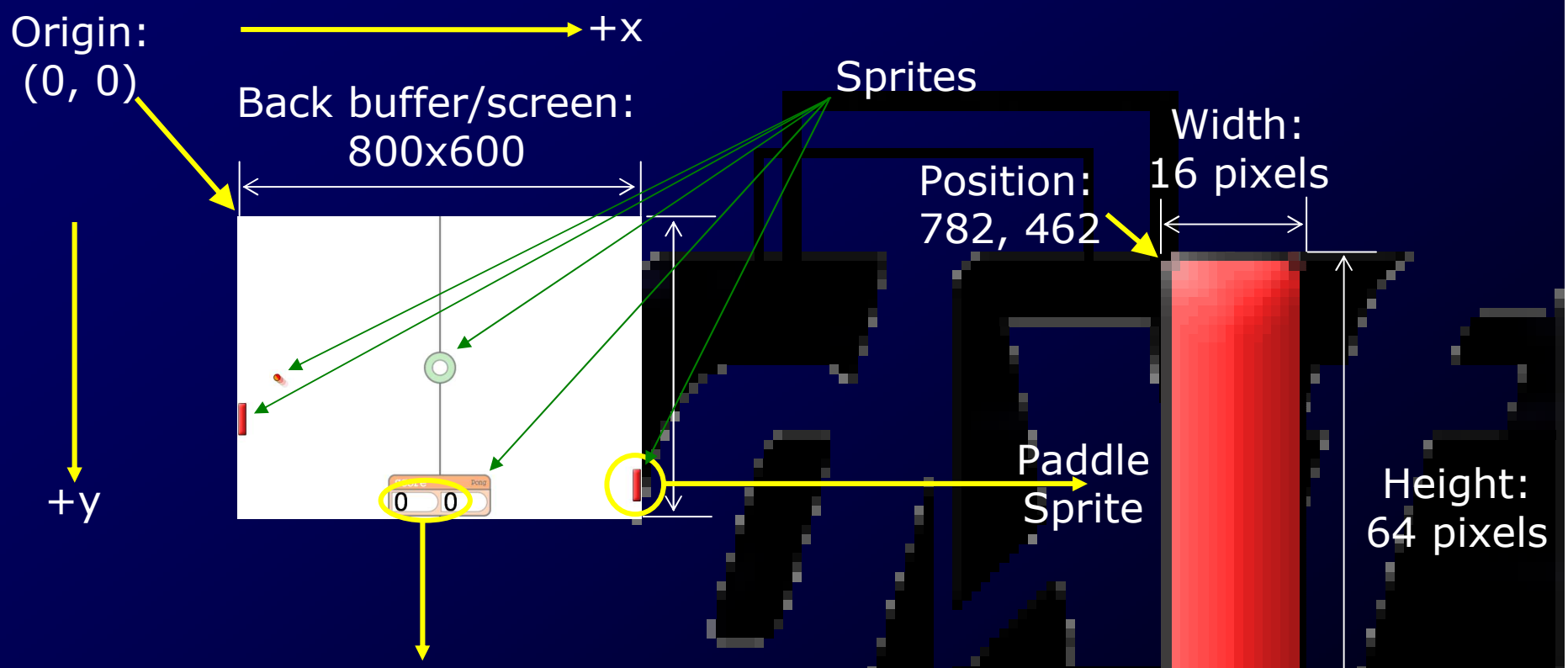
Other DXF Components

- Sprites
  - Almost everything on the screen
  - Many acceptable formats (like .jpg, .png)
- Sounds
- Fonts
- Console

- All usually members of game states or registrar



Sprites are Everywhere!

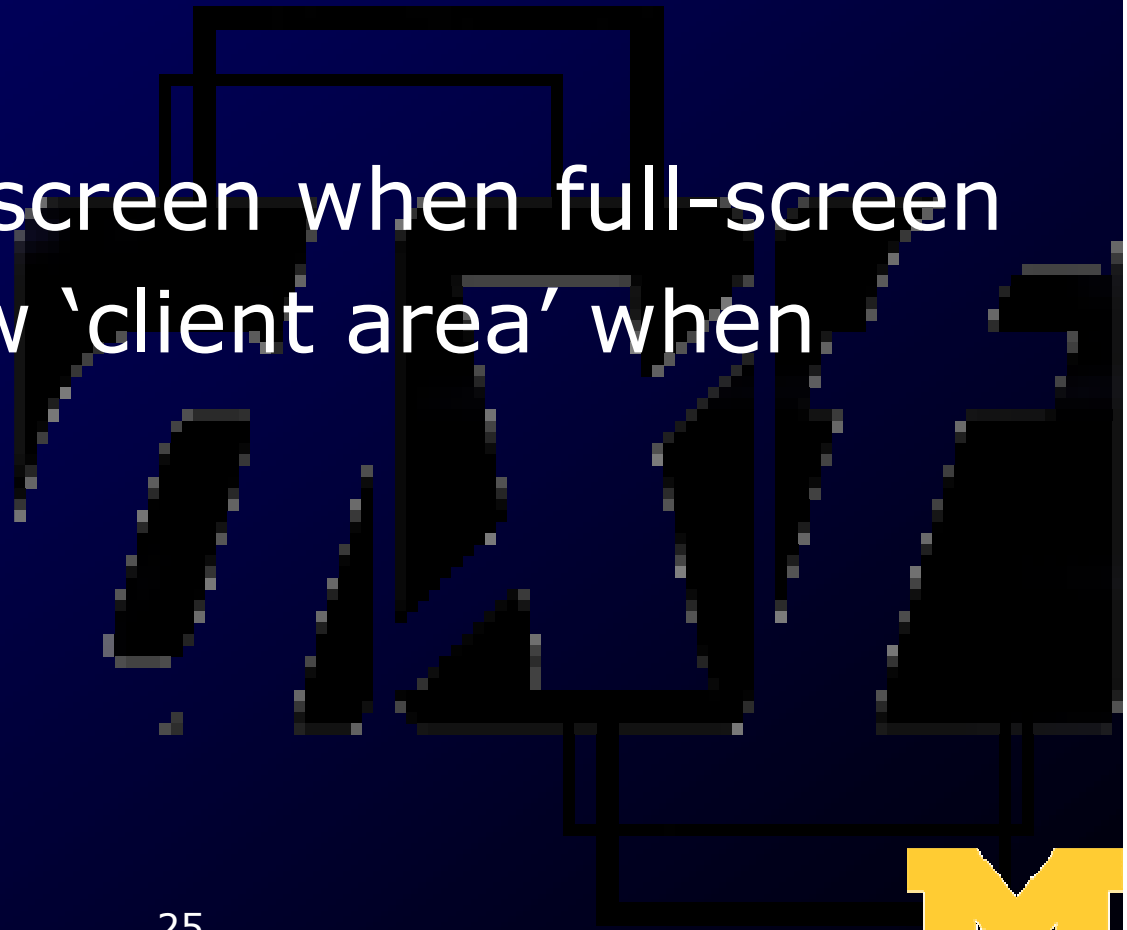


Zeros (text) are not sprites, they are created by special Font object

The Back Buffer

- Sprite ‘cache’ or ‘canvas’

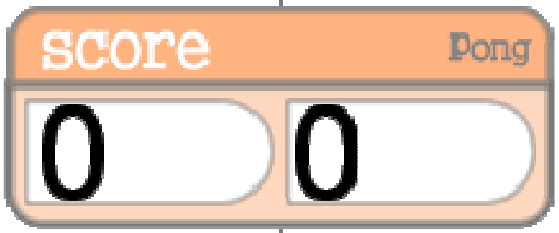
- Same size as screen when full-screen
- Size of window ‘client area’ when windowed



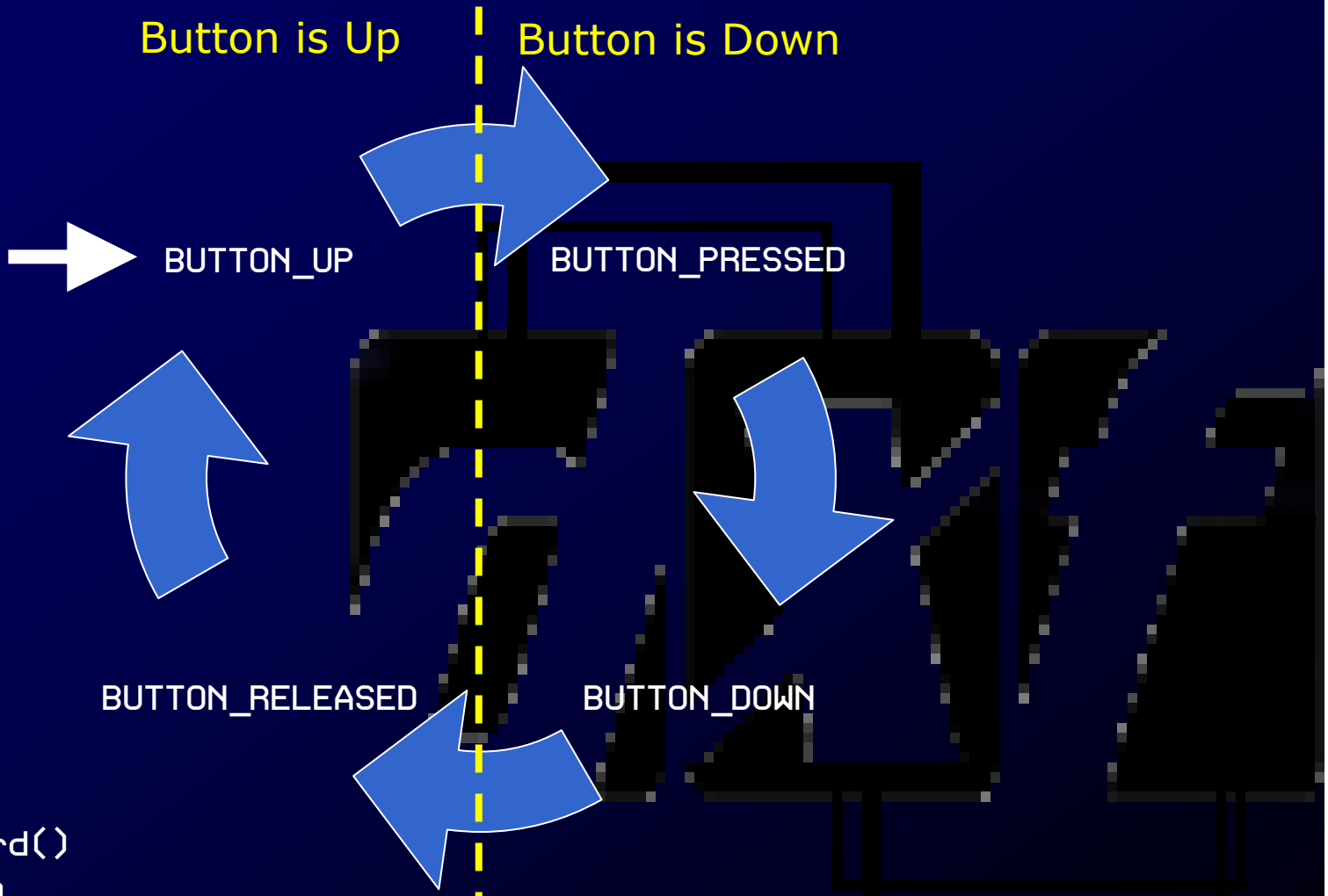
Drawing to the Back Buffer (Render2D)

```
Pong::Render2D() {
    center.Render2D();
    scoreboard.Render2D();
    font.Render2D(…);
    font.Render2D(…);
    left.Render2D();
    right.Render2D();
    …
    ball.SetAnimation(1);
    ball.SetColor(…);
    ball.Render2D(…);
    ball.SetColor(…);
    ball.Render2D(…);
    ball.SetColor(…);
    ball.Render2D(…);
    ball.SetColor(…);
    …
    ball.Render2D();
}
```

```
Title::Load() {
    DXFSetClear(true);
    DXFSetClearColor(WHITE);
}
```



Button Input



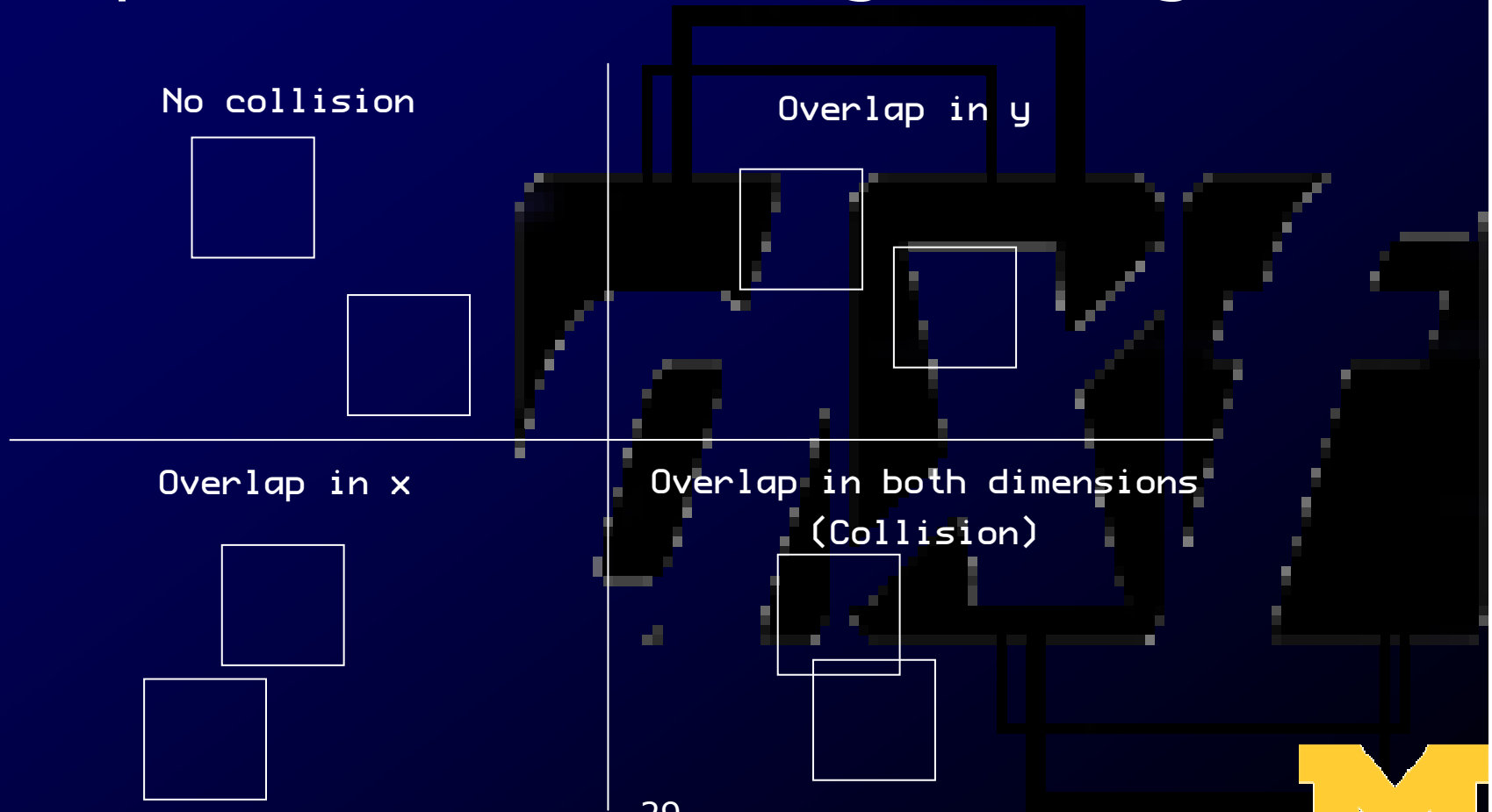

```
DXFCheckKeyboard()
DXFCheckMouse()
DXFCheckJoystick()
```

Mouse Input

- `DXFGetMousePosition()`
  - Returns X,Y position on back buffer
- Passing this to Sprite's CheckIntersection function is useful
  - See Button in DXFramework-Demo
  - Very recent bug fix, see discussion or FAQ for details, or download a new copy of the framework

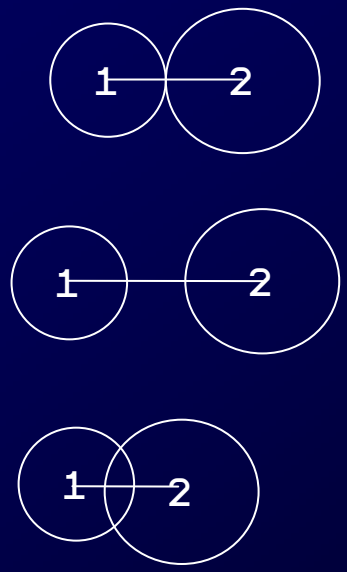
Collision Detection

- Simple: Check bounding rectangles



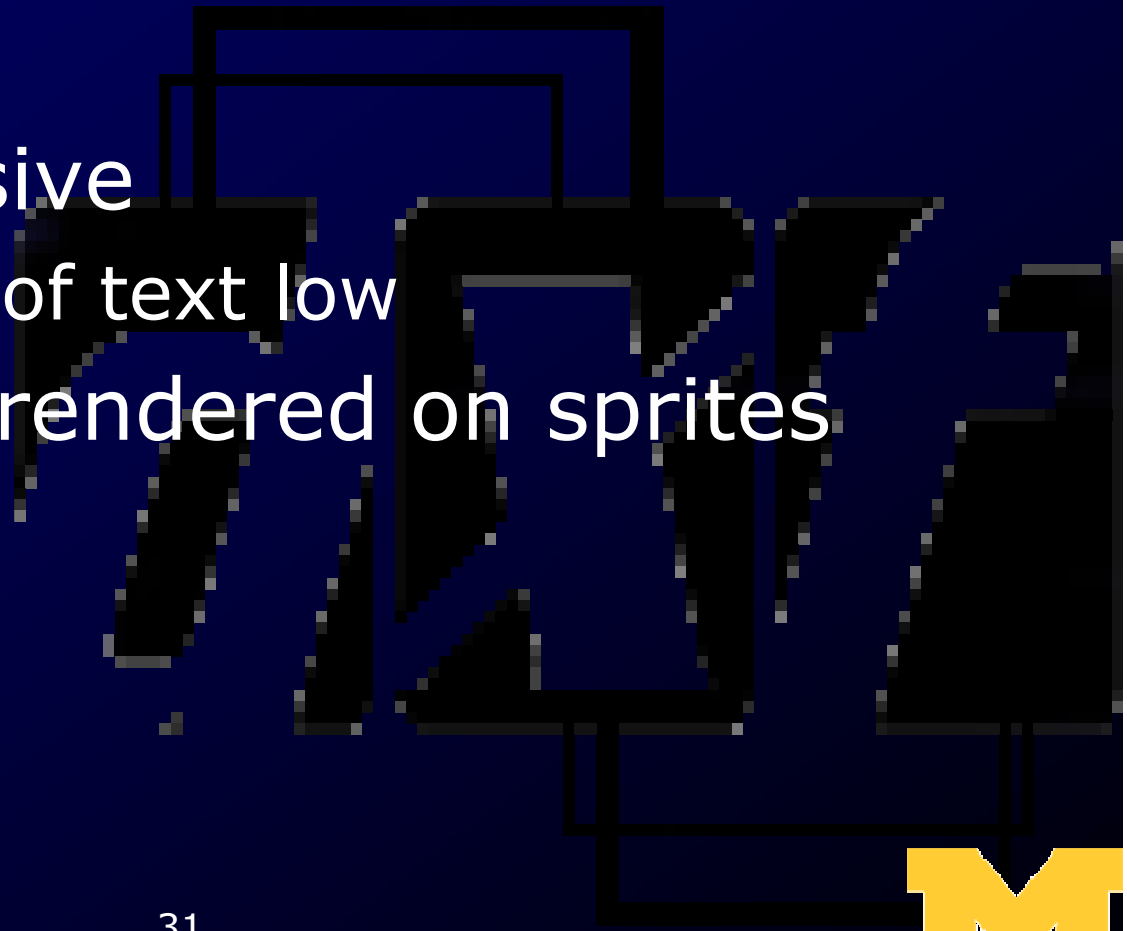
Collision Detection

- Simple: Check bounding circles
  - Distance between center points
  - Collision if distance between center points is less than sum of radii



Fonts

- Use the font class to draw text to screen
- Text is expensive
  - Keep amount of text low
- Consider text rendered on sprites



Sounds

- Use sound class for sounds
- Wave files, Midi files, MP3, others
  - Ogg? Not sure
- Usage similar to sprites
  - Create using filename
  - 'Render' using Play

The DXF Console

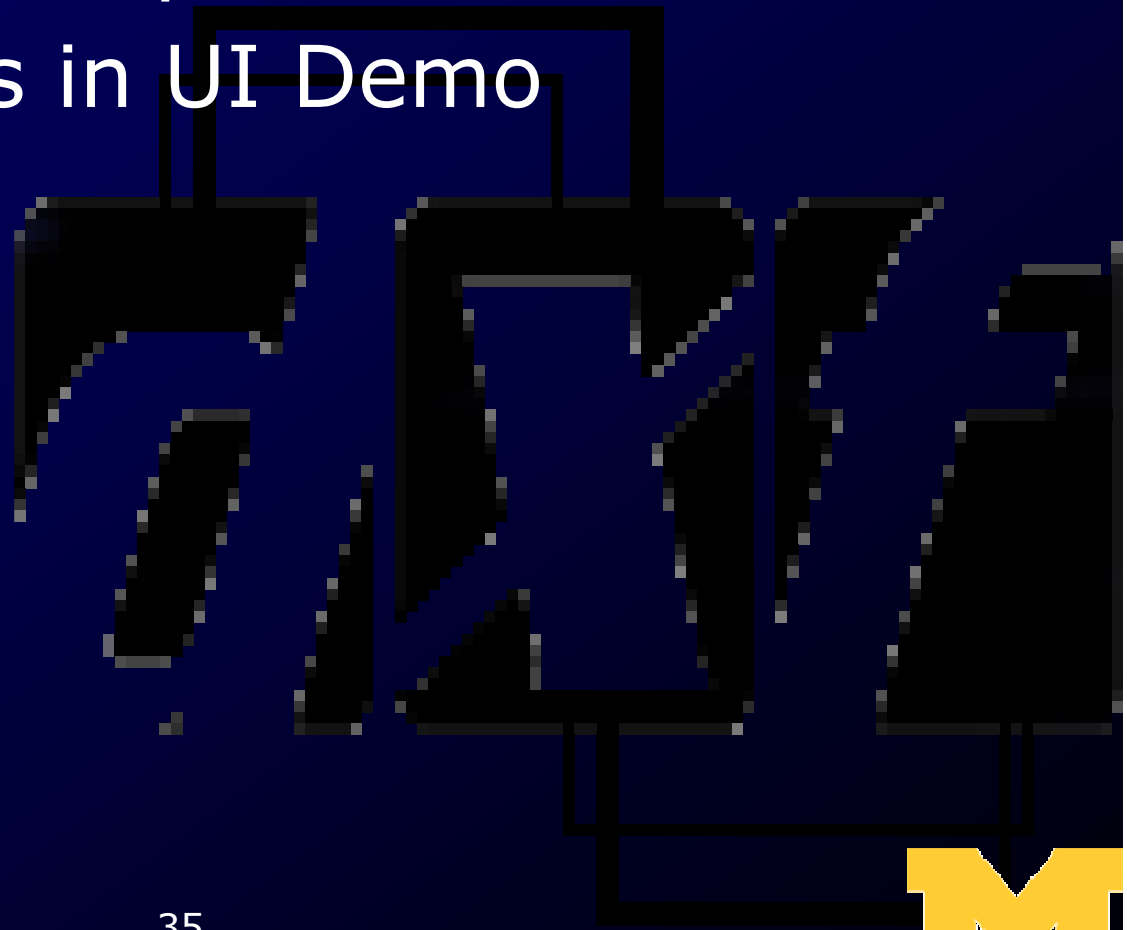
- Essential debugging tool
  - No stdout available!
  - A decent substitution
- ` key toggles
- Output using Console::output like you would use cout:
  - `Console::output << "The number is: " << x << std::endl;`
- Output is flushed only when a newline is encountered!

Creating and Registering Custom Commands

- Registrar's other function registers custom console commands
- Define command in global scope with correct function signature
- Pass pointer and string to DXFRegisterCommand

Using the DXUT GUI with DXFramework states

- Program by example
- See comments in UI Demo



Questions? Need help?

- I'm here to help
- Check the FAQ on the Wiki
  - I'll fill in content as I get it
- Post in the discussion forum
- Send me mail to schedule an appointment
  - voigtjr@gmail.com
  - 3828 CSE Building