Game Programming with DXFramework

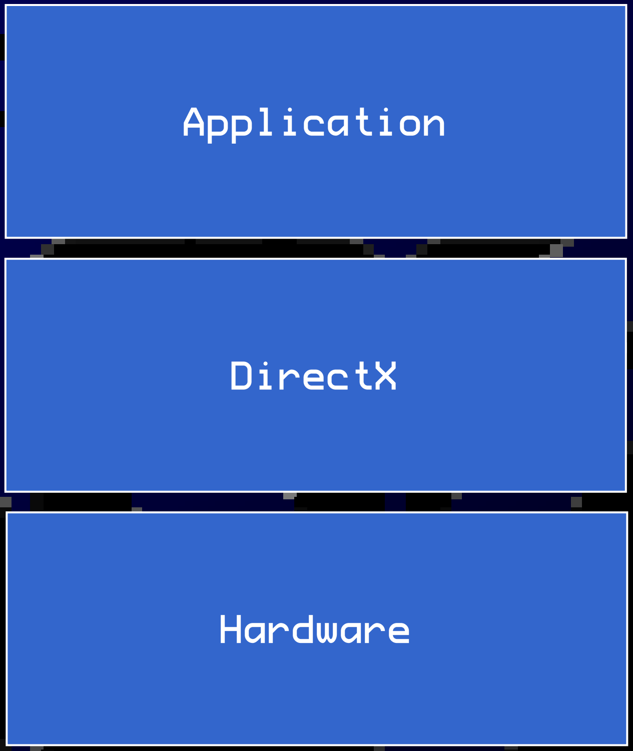
Jonathan Voigt

University of Michigan

Fall 2005

DirectX from 30,000 Feet

- 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

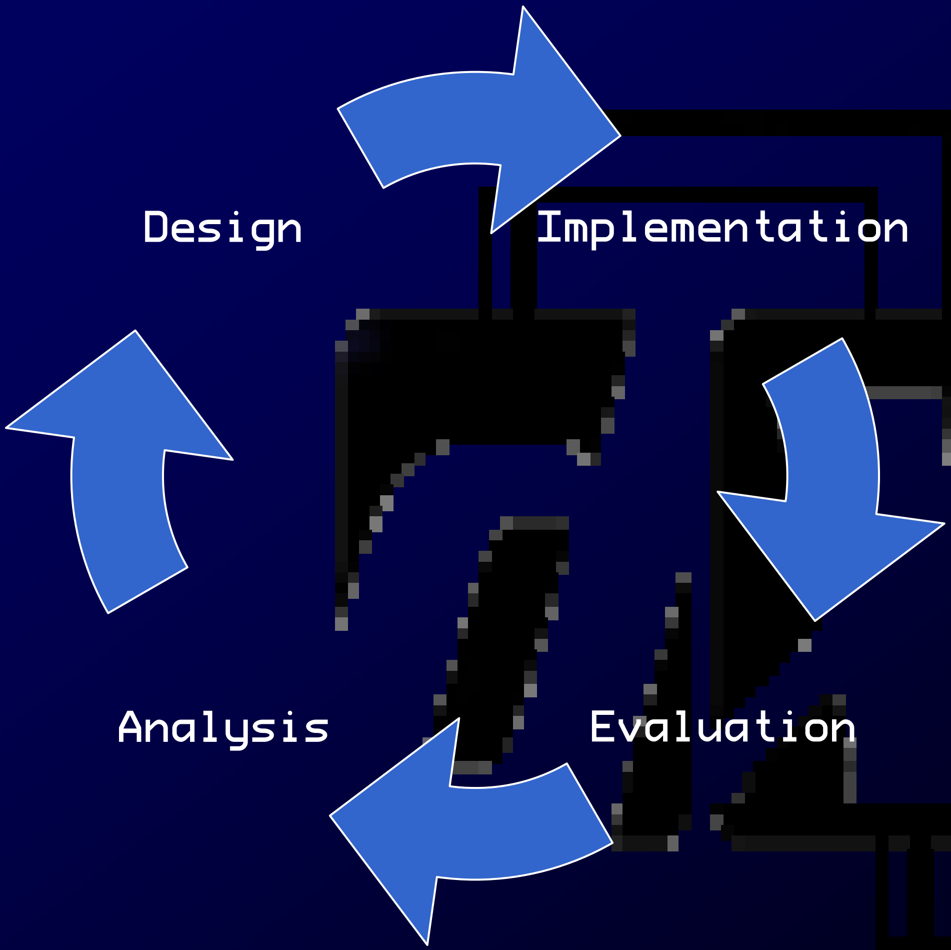
Simple!

Fun!

Easy!

(2D!)

Incremental Development



Arcade Game Demos Fall 2004

Tea Party

Rigger and Trigger

DodgemBall

All of these games used DXFramework 0.9.3 in fall 2004

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 SDK
- DXF’s major change since 0.9.3
- Included with package in `dxf/engine/common`
  - In DXFramework-Engine project
- See DirectX samples for more on DXUT and DirectX

DXF Prerequisites

- Windows 2000/XP
- Microsoft Visual Studio .NET 2003
- DirectX SDK (August or June 2005)

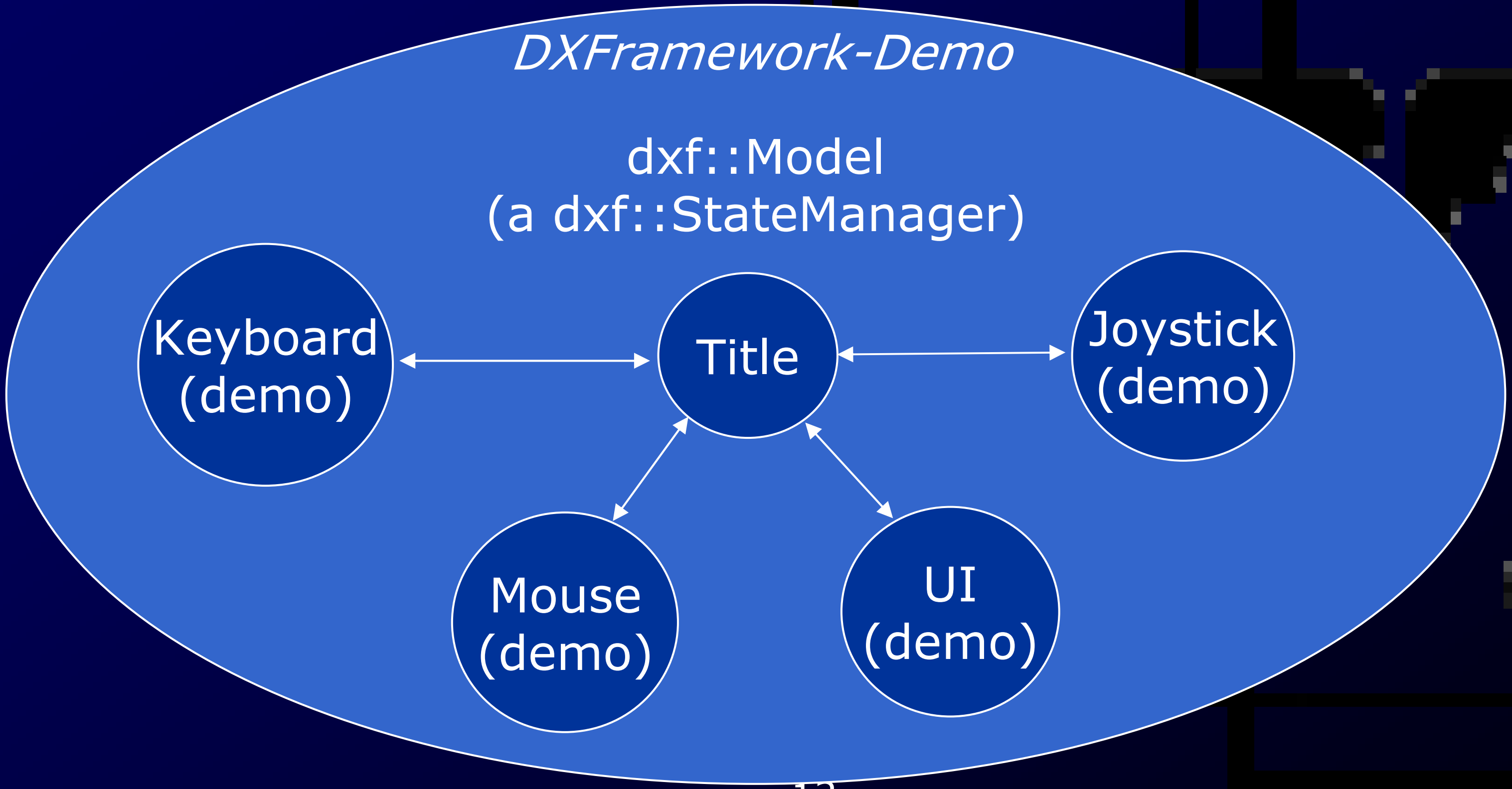
- Creativity

Installation

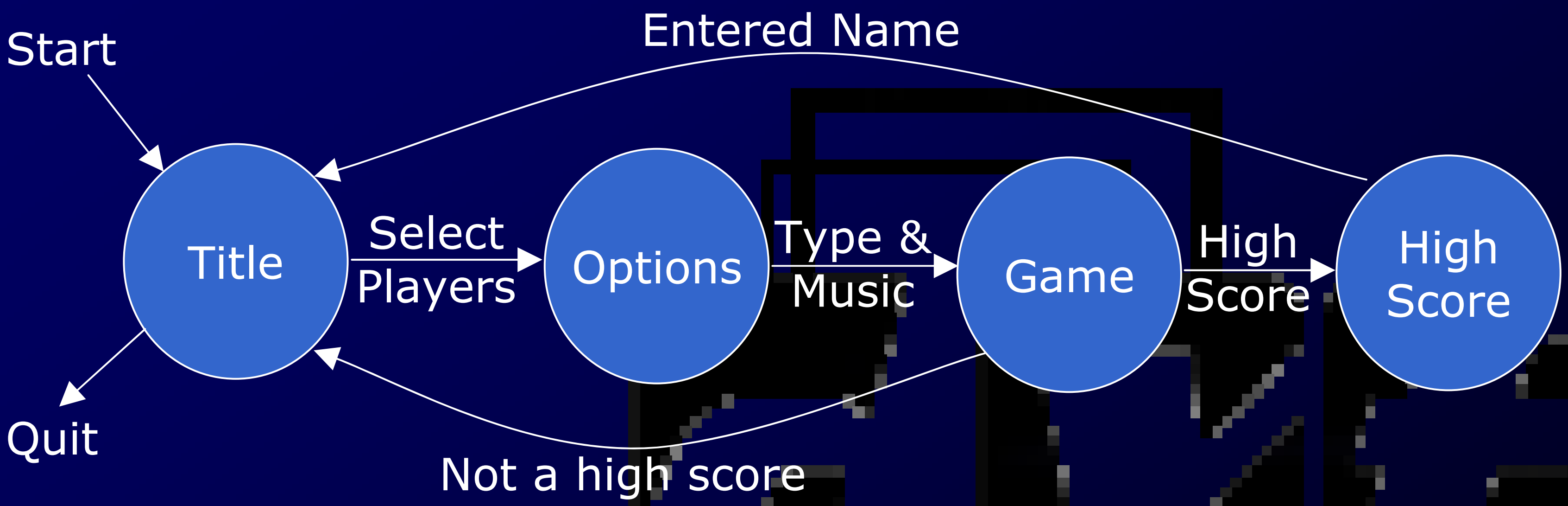
- Refer to Getting Started guide:
  - http://winter.eecs.umich.edu/dxf-wiki/
- Generally speaking:
  - Download and Extract
  - Install template files
  - Restart all instances

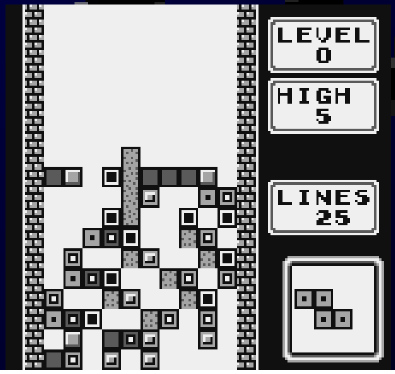
A DXF Application is a graph of Game States

- You create your game by defining game states and the conditions for transitioning between them



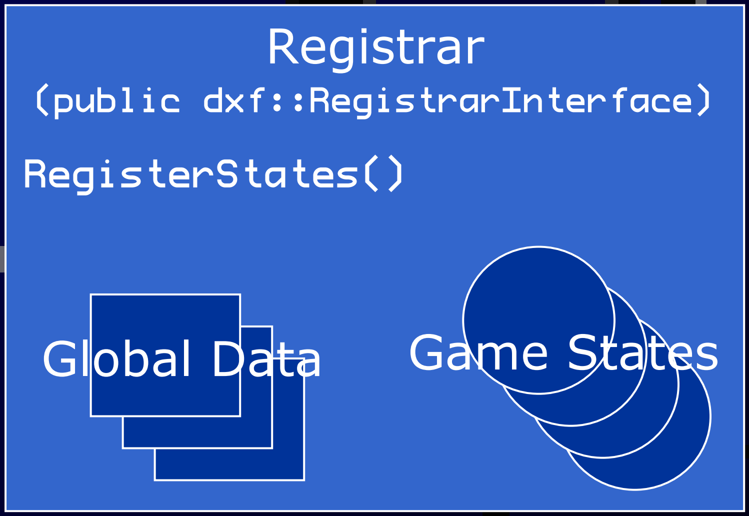
Tetris as a graph of states



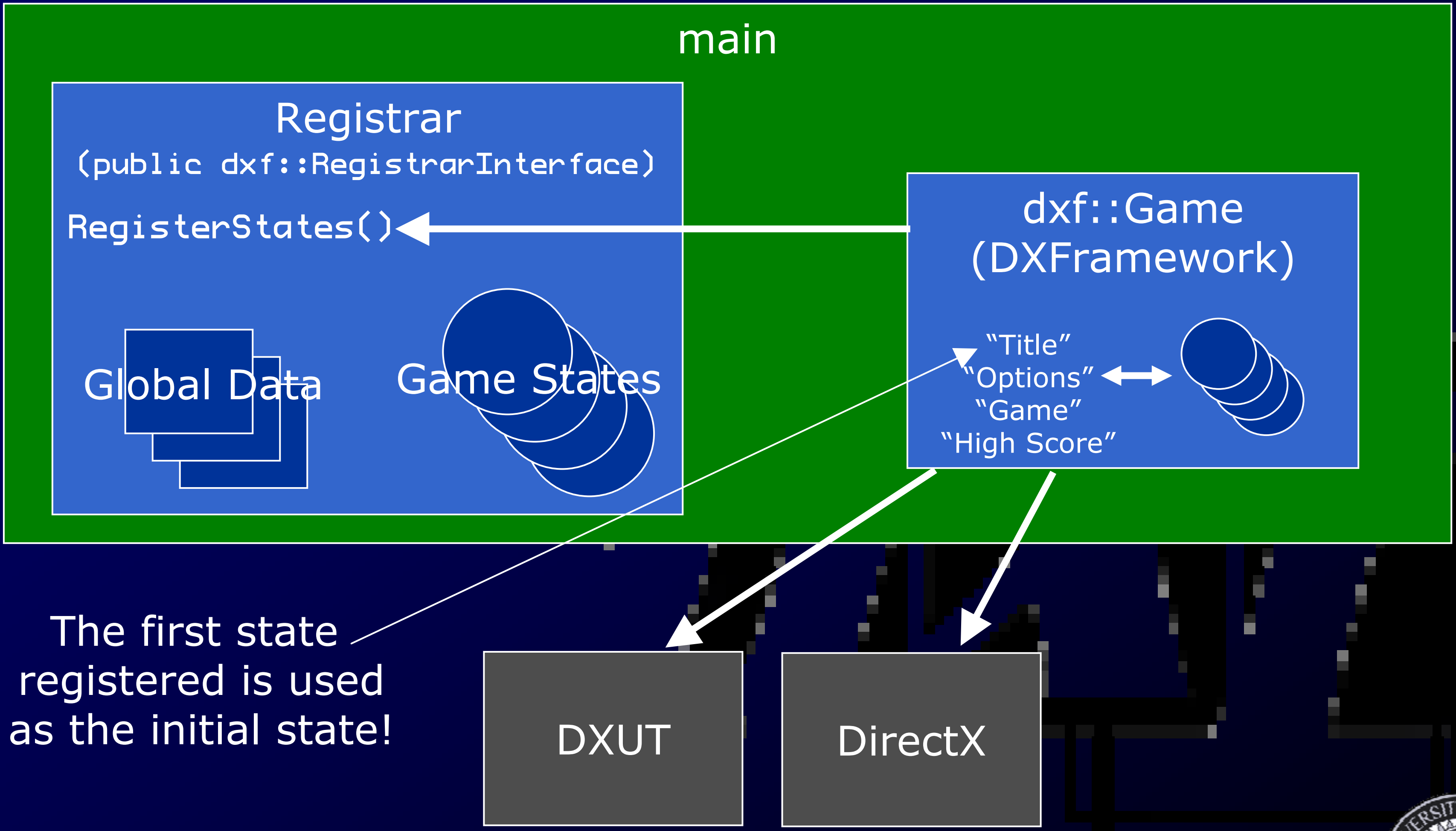


Global Data (data shared across states)

- What about global data?
  - High scores
  - Option settings
- Store states and their global data in the Registrar



Initialization



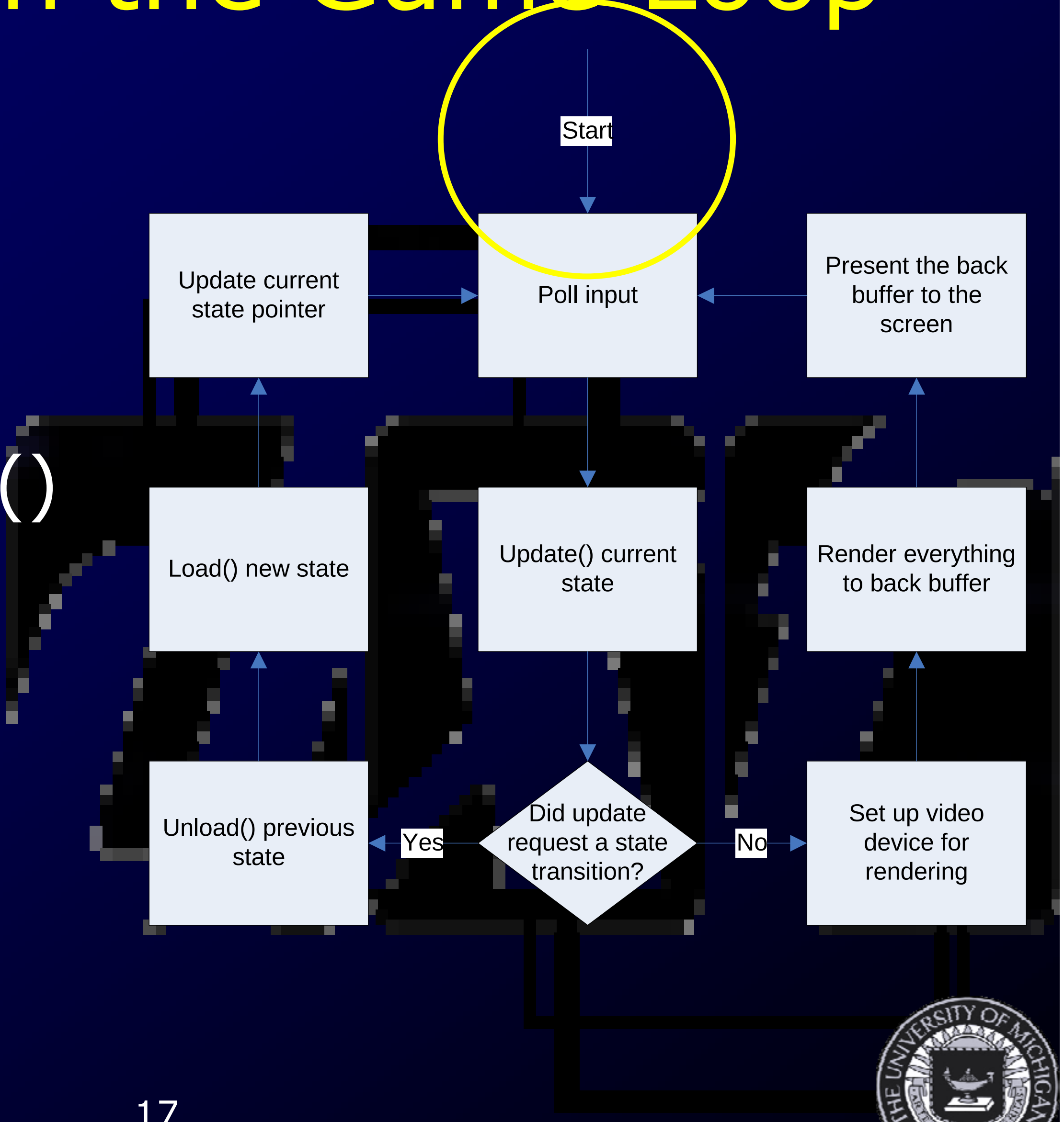
The first state registered is used as the initial state!

Execution

- 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 as a parameter to the Update() function

Key Points in the Game Loop

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



Start
Update current state pointer
Poll input
Present the back buffer to the screen
Load() new state
Update() current state
Render everything to back buffer
Unload() previous state
Yes
Did update request a state transition?
No
Set up video device for rendering

Creating States

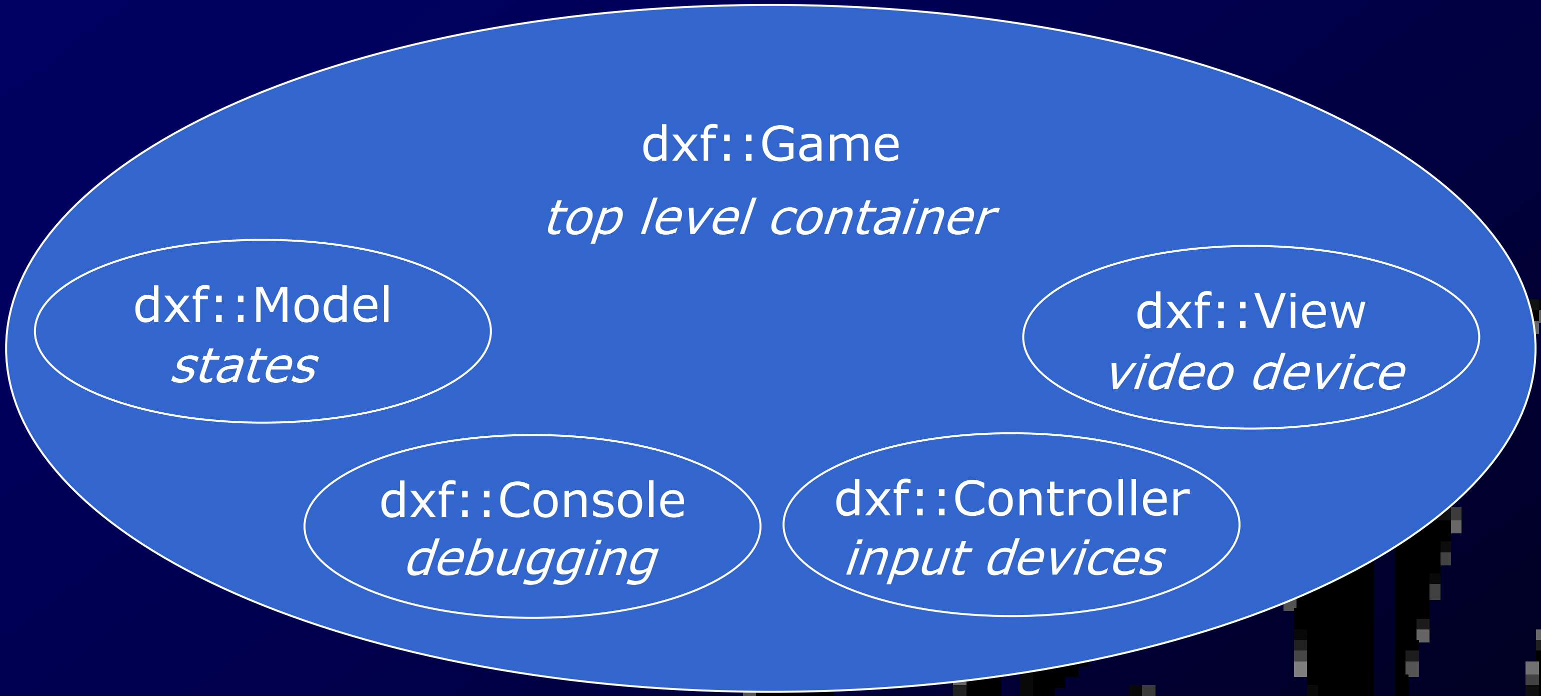
- Extend dxf::GameState
  - Implement the necessary functions
- Need a complex GUI?
  - Extend dxf::GUI as well
- Need sub-states?
  - Extend dxf::StateManager as well

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);
dxf::DXFRegisterState(kKeyboard, &keyboard);
…
dxf::DXFChangeState(Registrar::kKeyboard);
```

DXF Engine Architecture

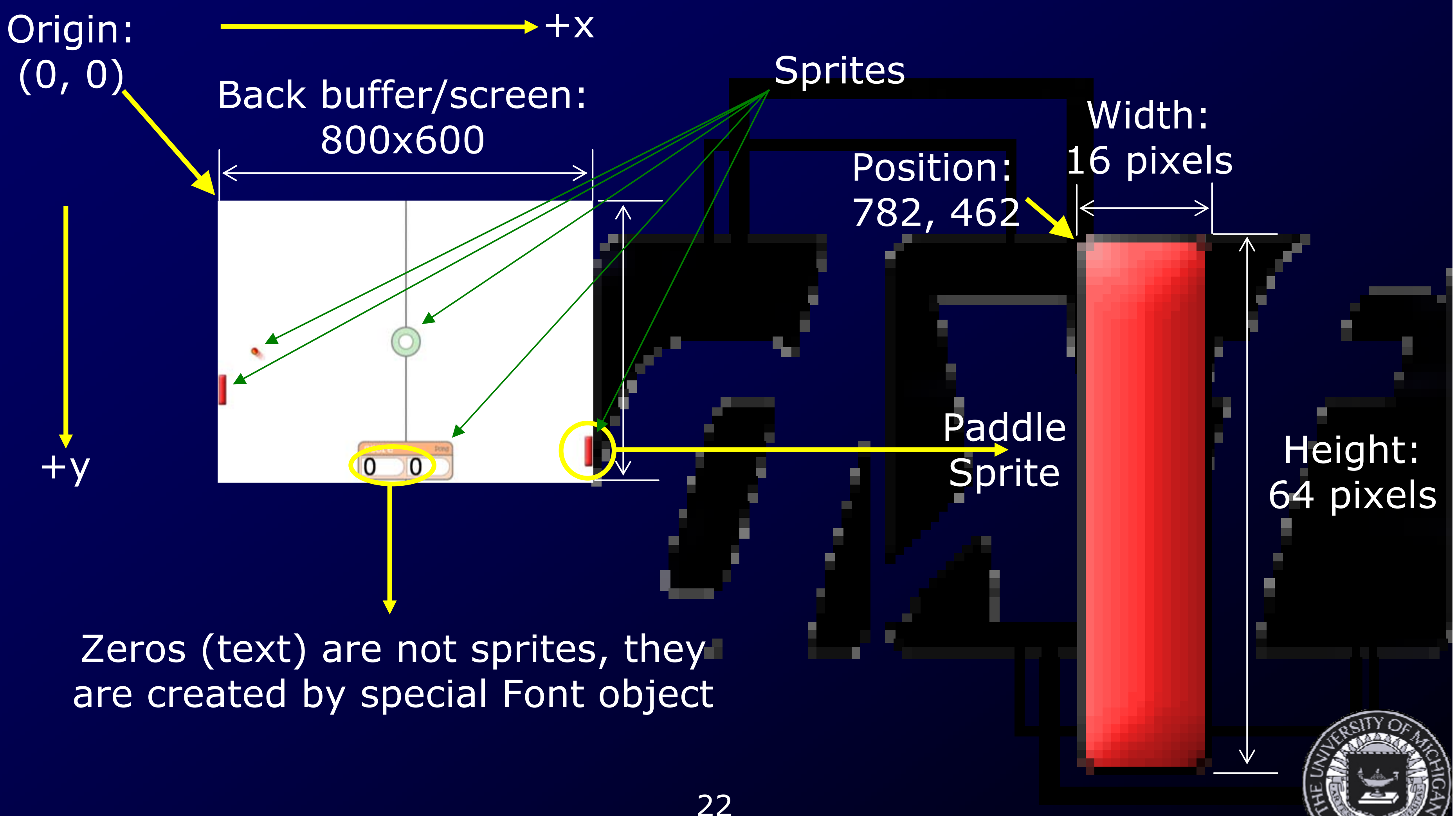


Other DXF Components

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

- All usually members of game states or registrar

Sprites are Everywhere!

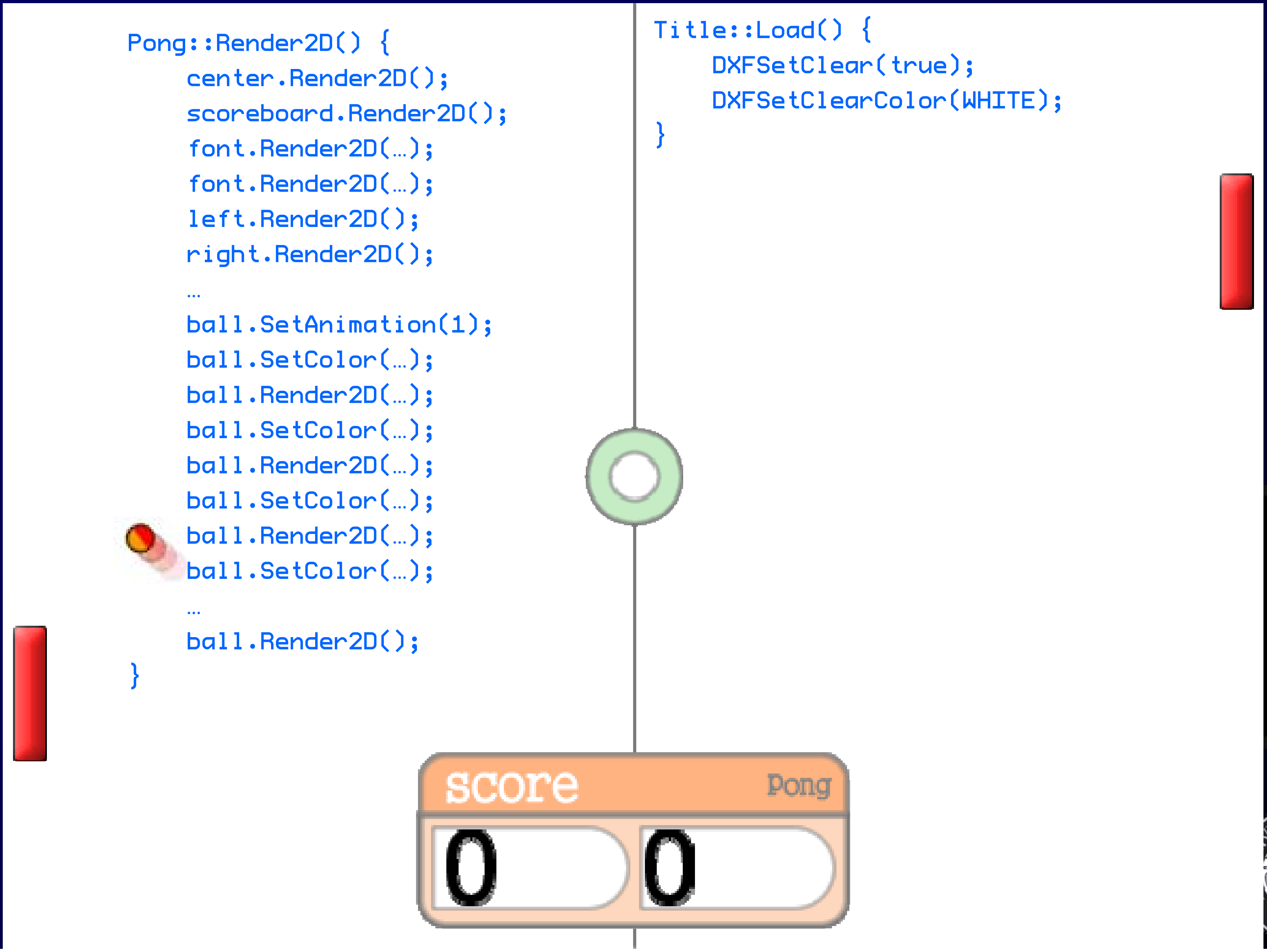


Zeros (text) are not sprites, they are created by special Font object

The Back Buffer

- Sprite ‘cache’
- Order matters
- Same size as screen when fullscreen
- Size of window ‘client area’ when windowed

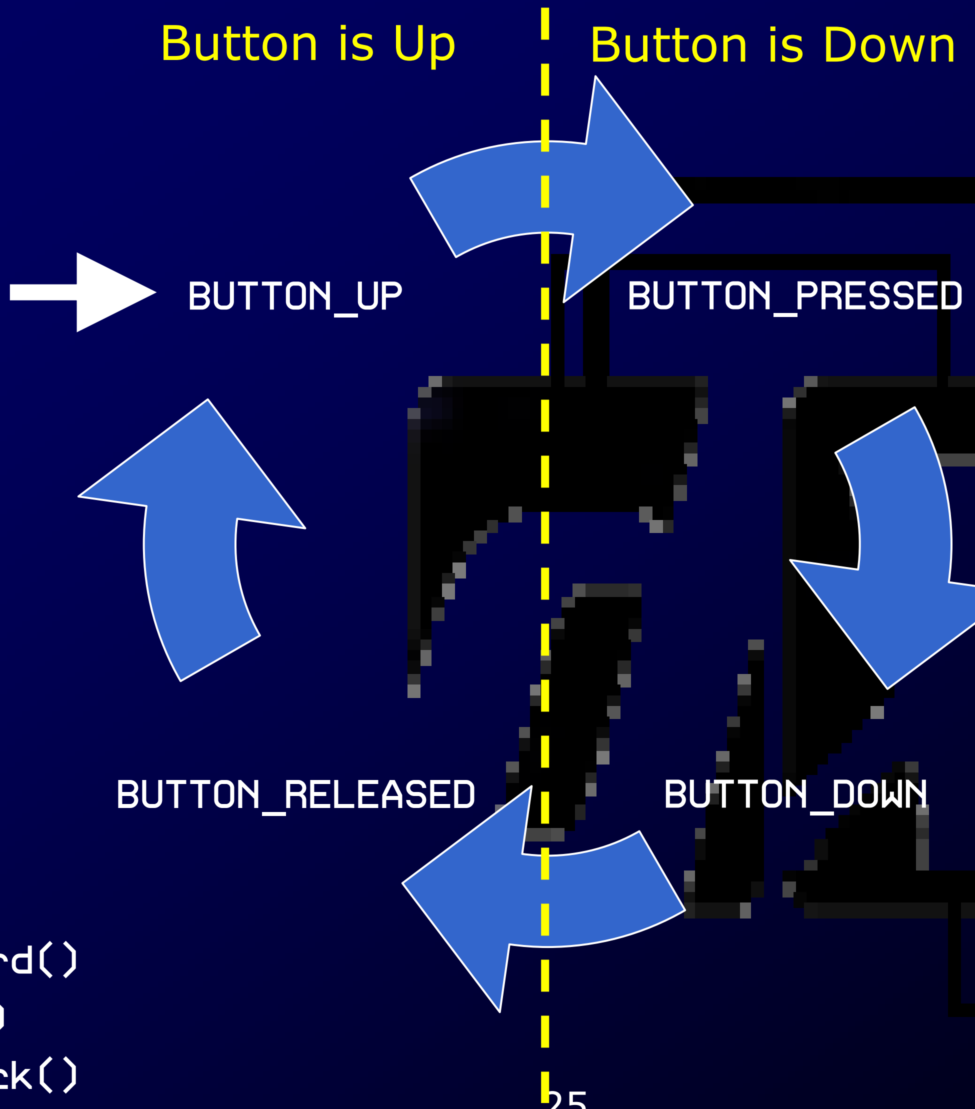
Drawing to the Back Buffer (Render2D)



```
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



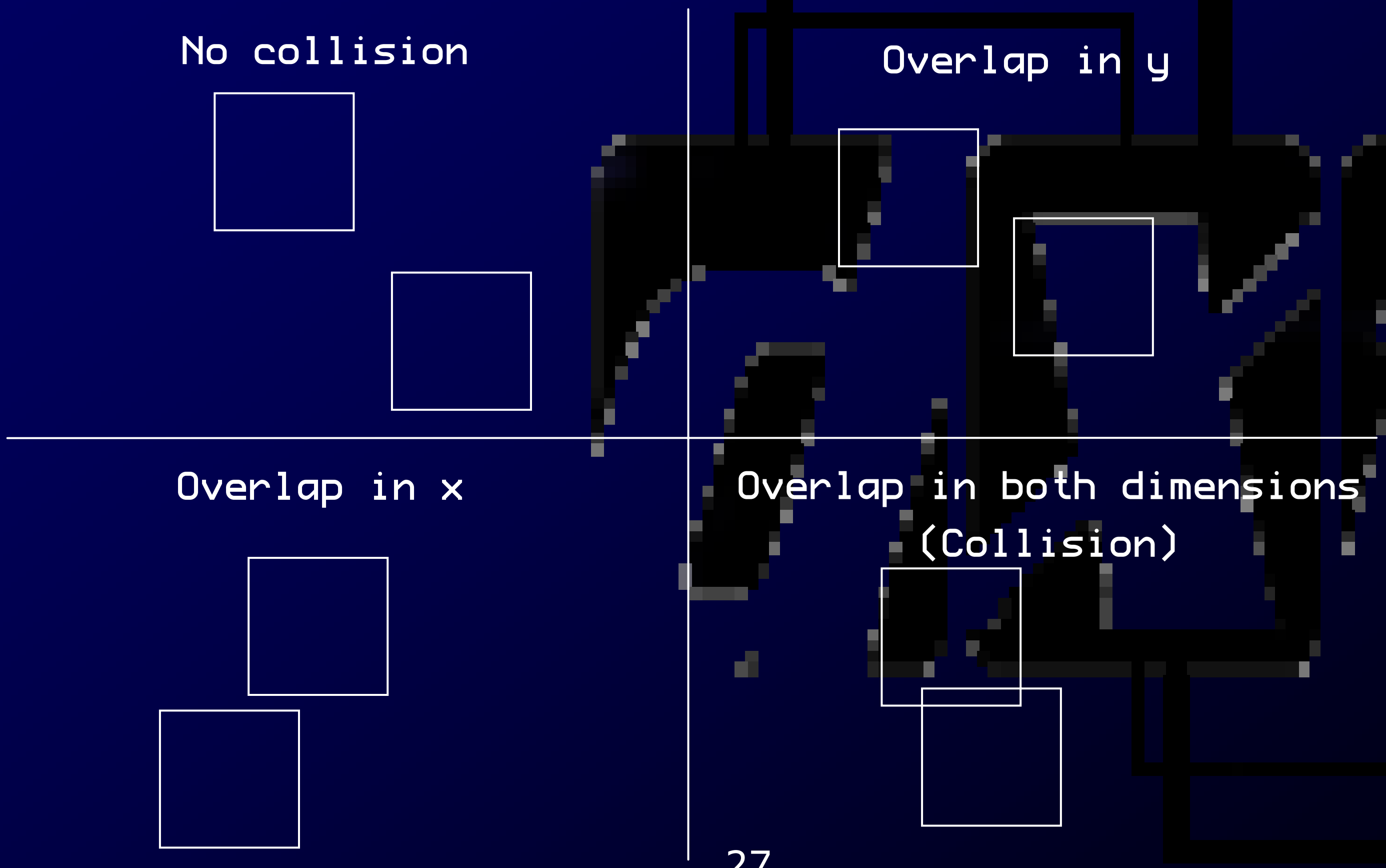
```
DXFCheckKeyboard()
DXFCheckMouse()
DXFCheckJoystick()
```

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

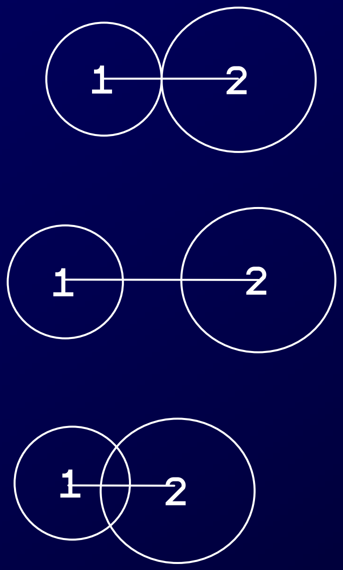
Collision Detection

- 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 CTools discussion forum
- Send me mail to schedule an appointment
  - voigtjr@gmail.com
  - 1101 Beal Ave (ATL Building) Room 155