

# Gemini

# Lua Scripting for iOS Games



James Norton  
@jnorton  
Lua Workshop 2012



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- Similar API to the Corona™ SDK
- Open source with MIT License



# Why use scripting?



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- Provides higher abstraction that can increase productivity.
- Level designers and non-programmers can work with it.

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- Provides higher abstraction that can increase productivity.
- Level designers and non-programmers can work with it.
- Functionality can be changed without recompiling during development.



# Features



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- 2D Layer based rendering

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- Event Driven

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- Event Driven
- Graphics elements
- Physics
- Sound
- Scene Management

# Layers

- Provide depth
- Parallax effect
- Blending functions
- Render callbacks

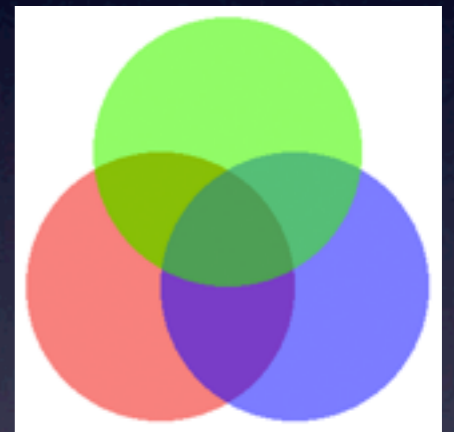




# Layer Blending

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- Use any OpenGL blending functions
- Example: alpha blend (transparency)
  - (GL\_SRC\_ALPHA, GL\_ONE\_MINUS\_SRC\_ALPHA)
- Example: additive blend (particle system)
  - (GL\_ONE, GL\_ONE)





# Render Callbacks

- Render layers using custom Objective C code / OpenGL
- Example: scrolling background

Frame 0  
(C/C++/Objective C)



Frame 1  
(Lua)



# Events

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- EnterFrame - fires every render loop



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- Scene events
- Timer - execute code after a delay
- Physics events - collisions



# Graphics Elements

- Sprites
- Lines
- Rectangles
- Circles
- Polygons
- Text via Text Candy™
- Display Groups



# Physics



- Uses **Box2D** Physics
- All graphics elements can have physics properties
- Bodies, fixtures, joints, forces, etc.
- All Box2D body types supported (dynamic, static, kinematic)
- Collision events

# Sound

- Based on the ObjectiveAL API

- Sound Effects



- Music





# Transitions

- Alter a display objects properties over time
- Position, size, color, etc.
- Can be used to product “canned” animations or effects



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# Scene Management

## The Director API



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- Scene transition effects
  - slide
  - page curl

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## The Director API

- Scenes are collections of layers and the objects they contain
- Scene transition effects
  - slide
  - page curl
- Scene management Events
  - createScene
  - *sceneWillEnter*
  - sceneEntered
  - *sceneWillExit*
  - sceneExited
  - destroyScene



# Implementation

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- Libraries of C methods that delegate to methods on Objective C objects

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- Libraries includes factory method to create objects



# Implementation

- Libraries of C methods that delegate to methods on Objective C objects
- Libraries includes factory method to create objects
- Use metatables to define custom “types”  
e.g., `createMetatable(L, GEMINI_RECTANGLE_LUA_KEY, rectangle_m);`

# Custom Lua Types

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- Wrap Objective C functionality in Lua “objects”



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- Wrap Objective C functionality in Lua “objects”
- Create, manipulate, and destroy Objective C objects from Lua
- Custom types defined in C “libraries” with library factory methods as well as instance methods

# Representing Objective C Types in Lua

- Userdata - provides a block of raw memory with no predefined Lua operations
- Can store anything here - we will store pointer to our Objective C object



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```
lua_newuserdata(lua_State *, size_t size)
```

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# Metatables

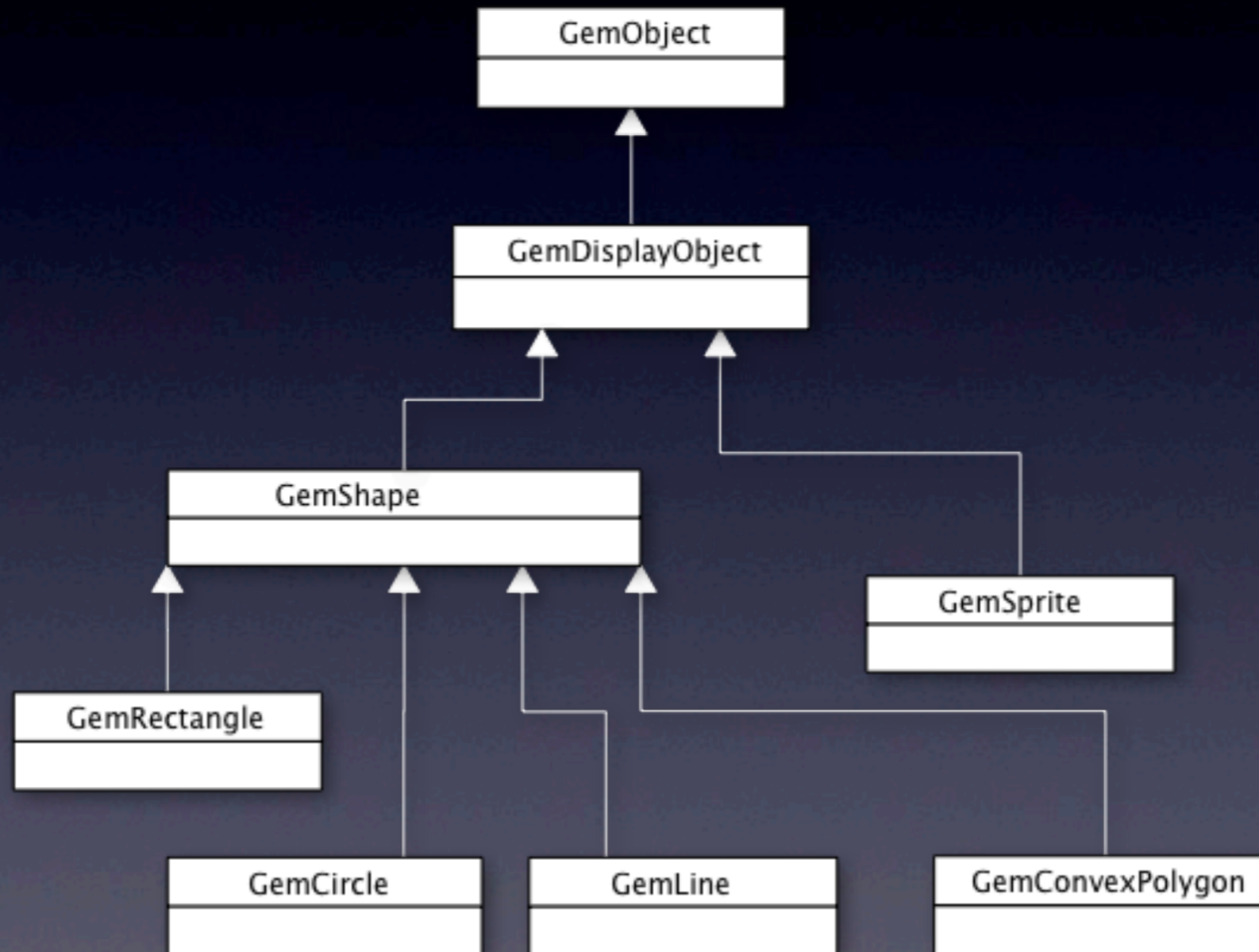
- Tables that can change the behavior of other tables or userdata
- Used to assign a 'type' to userdata

# Metatables

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- Tables that can change the behavior of other tables or userdata
- Used to assign a 'type' to userdata
- Can hold method mappings for userdata

# Gemini Classes





# GemObject.h

```
@interface GemObject : NSObject {
    NSMutableDictionary *eventHandlers;
    lua_State *L;
    int selfRef;
    int propertyTableRef;
    int eventListenerTableRef;
    NSString *name;
}

@property (nonatomic) int selfRef;
@property (nonatomic) int propertyTableRef;
@property (nonatomic) int eventListenerTableRef;
@property (readonly) lua_State *L;
@property (nonatomic, retain) NSString *name;

-(id) initWithLuaState:(lua_State *)luaState LuaKey:(const char *)luaKey;
-(BOOL)getBooleanForKey:(const char*) key withDefault:(BOOL)dflt;
-(double)getDoubleForKey:(const char*) key withDefault:(double)dflt;
-(int)getIntForKey:(const char*) key withDefault:(int)dflt;
-(NSString *)getStringForKey:(const char*) key withDefault:(NSString *)dflt;
-(void)setBOOL:(BOOL)val forKey:(const char*) key;
-(void)setDouble:(double)val forKey:(const char*) key;
-(void)setInt:(int)val forKey:(const char*) key;
-(void)setString:(NSString *)val forKey:(const char*) key;
-(BOOL)handleEvent:(GemEvent *)event;
@end
```

# GemObject Initializer

```
-(id) initWithLuaState:(lua_State *)luaState LuaKey:(const char *)luaKey {
    self = [super init];
    if (self) {
        L = luaState;

        __unsafe_unretained GemObject **lgo = (__unsafe_unretained GemObject **)lua_newuserdata(L, sizeof(self));
        *lgo = self;
    }

    return self;
}
```

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-(id) initWithLuaState:(lua_State *)luaState luaKey:(const char *)luaKey {
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        luaL_getmetatable(L, luaKey);
        lua_setmetatable(L, -2);

    }

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```



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        *lgo = self;

        luaL_getmetatable(L, luaKey);
        lua_setmetatable(L, -2);

        // append a lua table to this user data to allow the user to store values in it
        lua_newtable(L);
        lua_pushvalue(L, -1); // make a copy of the table because the next line pops the top value
        // store a reference to this table so our object methods can access it
        propertyTableRef = luaL_ref(L, LUA_REGISTRYINDEX);

        // set the table as the user value for the Lua object
        lua_setuservalue(L, -2);

    }

    return self;
}
```

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        propertyTableRef = luaL_ref(L, LUA_REGISTRYINDEX);

        // set the table as the user value for the Lua object
        lua_setuservalue(L, -2);

        // create a table for the event listeners
        lua_newtable(L);
        eventListenerTableRef = luaL_ref(L, LUA_REGISTRYINDEX);

    }

    return self;
}
```

# GemObject Initializer

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-(id) initWithLuaState:(lua_State *)luaState luaKey:(const char *)luaKey {
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        *lgo = self;

        luaL_getmetatable(L, luaKey);
        lua_setmetatable(L, -2);

        // append a lua table to this user data to allow the user to store values in it
        lua_newtable(L);
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        // store a reference to this table so our object methods can access it
        propertyTableRef = luaL_ref(L, LUA_REGISTRYINDEX);

        // set the table as the user value for the Lua object
        lua_setuservalue(L, -2);

        // create a table for the event listeners
        lua_newtable(L);
        eventListenerTableRef = luaL_ref(L, LUA_REGISTRYINDEX);

        lua_pushvalue(L, -1); // make another copy of the userdata since the next line will pop it off
        selfRef = luaL_ref(L, LUA_REGISTRYINDEX);
    }

    return self;
}
```



# The Library Bindings

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    - :setFillColor, :insert, etc.

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- Libraries consist of two classes of functions
  - Library functions
    - Factory methods
    - Methods that effect global state
  - Object methods attached via metatables
    - :setFillColor, :insert, etc.
    - index, newIndex, \_\_gc, etc.

# Important typedefs for Registering a Library

```
typedef int (*lua_CFunction) (lua_State *L);
```

```
typedef struct luaL_Reg {  
    const char *name;  
    lua_CFunction func;  
} luaL_Reg;
```



# Library Binding Function

```
int luaopen_display_lib (lua_State *L){
```

```
}
```

# Library Binding Function

```
int luaopen_display_lib (lua_State *L){
    // create meta tables for our various types ////////////

    // .... other types not shown for brevity ////////////

    // lines
    createMetatable(L, GEMINI_LINE_LUA_KEY, line_m);

    // rectangles
    createMetatable(L, GEMINI_RECTANGLE_LUA_KEY, rectangle_m);

    ////////// finished with metatables ////////////

}
```

# Library Binding Function

```
int luaopen_display_lib (lua_State *L){
    // create meta tables for our various types ////////////

    // .... other types not shown for brevity ////////////

    // lines
    createMetatable(L, GEMINI_LINE_LUA_KEY, line_m);

    // rectangles
    createMetatable(L, GEMINI_RECTANGLE_LUA_KEY, rectangle_m);

    //////////// finished with metatables ////////////

    // create the table for this library and populate it with
    // our functions
    luaL_newlib(L, displayLib_f);

    return 1;
}
```



# Display Library Function Mapping

```
// the mappings for the library functions
static const struct luaL_Reg displayLib_f [] = {
    {"newLayer", newLayer},
    {"newGroup", newDisplayGroup},
    {"newLine", newLine},
    {"newRect", newRectangle},
    {"newCircle", newCircle},
    {"newShape", newShape},
    {NULL, NULL}
};
```

# Mapping for the Rectangle Methods

```
// mappings for the rectangle methods
static const struct luaL_Reg rectangle_m [] = {
    {"__gc", genericGC},
    {"__index", rectangleIndex},
    {"__newindex", rectangleNewIndex},
    {"setFillColor", rectangleSetFillColor},
    {"setGradient", rectangleSetGradient},
    {"setStrokeColor", rectangleSetStrokeColor},
    {"setStrokeWidth", rectangleSetStrokeWidth},
    {"delete", genericDelete},
    {"addEventListener", addEventListener},
    {"removeEventListener", removeEventListener},
    {"applyForce", applyForce},
    {NULL, NULL}
};
```

# Rectangle Factory Method

Lua:

```
local rectangle = display.newRect(x, y, width, height)
```



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Lua:

```
local rectangle = display.newRect(x, y, width, height)
```

C Factory Method:

```
static int newRectangle(lua_State *L){  
  
    GLfloat x = luaL_checknumber(L, 1);  
    GLfloat y = luaL_checknumber(L, 2);  
    GLfloat width = luaL_checknumber(L, 3);  
    GLfloat height = luaL_checknumber(L, 4);  
  
    GemRectangle *rect = [[GemRectangle alloc] initWithLuaState:L  
        X:x Y:y Width:width Height:height];  
    [[((GemGLKViewController *)([Gemini shared].viewController))  
        .director getDefaultScene] addObject:rect];  
  
    return 1;  
}
```

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- Cannot use dynamic libraries on iOS



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- Must use static linking

# Adding Object Bindings

- Cannot use dynamic libraries on iOS
- Must use static linking
- Best way to do this is to modify linit.c

# Opening Our Library in linit.c

```
static const luaL_Reg loadedlibs[] = {
    {"_G", luaopen_base},
    {LUA_LOADLIBNAME, luaopen_package},
    {LUA_COLIBNAME, luaopen_coroutine},
    {LUA_TABLIBNAME, luaopen_table},
    {LUA_IOLIBNAME, luaopen_io},
    {LUA_OSLIBNAME, luaopen_os},
    {LUA_STRLIBNAME, luaopen_string},
    {LUA_BITLIBNAME, luaopen_bit32},
    {LUA_MATHLIBNAME, luaopen_math},
    {LUA_DBLIBNAME, luaopen_debug},

    {NULL, NULL}
};
```



# Opening Our Library in linit.c

```
extern int luaopen_display_lib (lua_State *L);
```

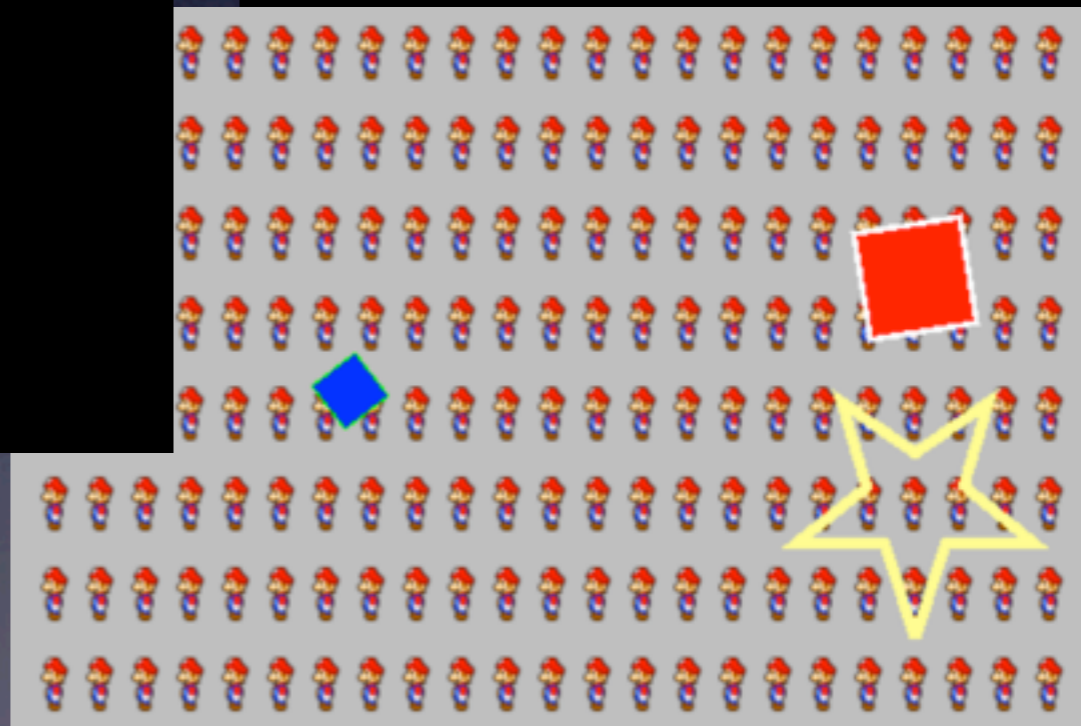
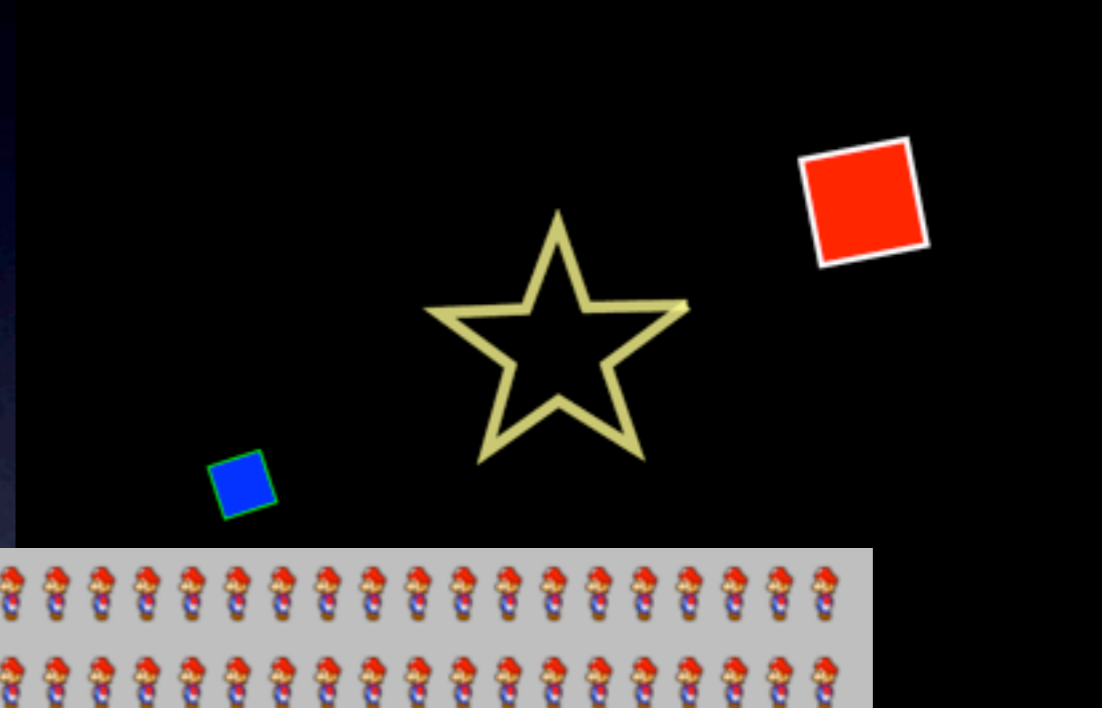
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};
```

# Opening Our Library in linit.c

```
extern int luaopen_display_lib (lua_State *L);
```

```
static const luaL_Reg loadedlibs[] = {  
    {"_G", luaopen_base},  
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    {LUA_STRLIBNAME, luaopen_string},  
    {LUA_BITLIBNAME, luaopen_bit32},  
    {LUA_MATHLIBNAME, luaopen_math},  
    {LUA_DBLIBNAME, luaopen_debug},  
    "display", luaopen_my_math_lib,  
    {NULL, NULL}  
};
```

# Demos





# What's Next?

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- New features

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  - More scene transitions



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  - Scene loading
- Support for more third party tools (level builders, etc.)



# Questions?

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- [Blog http://blog.stokedsoftware.com](http://blog.stokedsoftware.com)
- [Twitter @jnorton](#)
- Box2D - <http://box2d.org>
- ObjectAL - <http://kstenerud.github.com/ObjectAL-for-iPhone/>