



EECS 498 : Game Engine Architecture

Winter 2025 Mid-Semester Exam - Answers Packet

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Topic	Score
Game Engine Landscape, History & Misc	/ 40
C++ and IDE Pragmatics	/ 20
Lua and Composition	/ 20
Engine Architecture and Lifecycle Functions	/ 20
Total	/ 100
Total (canvas normalized)	/ 250



Yeah! This is it! Stay cool, and rock on and stuff.
Think of it like a big, bad, final boss or something.

Mmmph. Ok kid. Let's see what you're made of.
May scored 37 / 100. Think you can top that?



Good evening. Before we begin, please repeat after me.
"I have neither given nor received unauthorized aid on this examination, nor have I concealed any violations of the honor code."



name / signature

username

date



Game Engine Landscape, History & Misc

1

The architecture of our course engine (your engine at the conclusion of homework9) is accurately described as an "ECS" **(circle one below)**

___/1

Yes No

2

In designing their Playstation operating system, Sony decided to utilize the open-source Free Berkeley Software Distribution, rather than the more-popular Linux operating system. What is the best rationale for why? **(circle one below)**

___/1

Avoid publishing changes Avoid Licensing Fees Sony created FreeBSD Personnel Fit

3

While Data-Oriented Programming has increased in popularity in certain fields, Object-Oriented programming remains dominant. Why? **(circle one below)**

___/1

Cache Utilization Reduced dev time / cost Security Requirements Licensing Parallelism

4

This course's engine API most closely resembles that of **(circle one below)**

___/1

Jolt Unreal Godot Unity Flash

5

Today's integrated engines (such as Unity, Unreal, etc) are wildly popular, but some prefer to use other categories of engine in search of- **(circle two)**

___/1

Improved Documentation Beginner Friendliness Minimalism Feature-Fullness Community Support

6

It is often perilous to alter a container while it is being iterated through. What are two ways to deal with this problem? **(circle two)**

___/1

Collect-then-alter Alter-then-collect Try-then-catch Backwards iteration.

7

The 2D affine transformation matrix is a _____ matrix (rows x columns) **(circle one below)**

___/1

1x1 2x2 3x3 3x4 2



Game Engine Landscape, History & Misc

8

Match each term below with its single most-reasonable definition at the bottom of the page. Do so by drawing a line between two boxes. Each box may only be connected to one line. There will be nine lines total.

___/9

Engines defined by “endless” features

Beginner Engines

A chunk of logic that allows itself to be interrupted / suspended.

\$500k+ License Fee

Engines that channel “Made in a cave... with a box of scraps!”

Coroutine

The world’s most popular game distribution channel.

Minimalist Engines

MIT Scratch is a perfect example of one

Steam

Pauses / suspends a coroutine

\$35,000

Unity decision. Made a strong case for open-source game engines.

Install Fees

Cost of a Playstation 1 development kit

Integrated Engines

Early days of the Unreal Engine

Yield



Game Engine Landscape, History & Misc

9

___/8

Match each term below with its single most-reasonable definition at the bottom of the page. Do so by drawing a line between two boxes. Each box may only be connected to one line. There will be eight lines total.

AABB

Rotate my character

Analogous to a "collider"

Do nothing. Win.

Powered by b2ContactListener

Translate and scale my character

Bullet

Havok

1	0	0
0	1	0
0	0	1

b2Fixture

2	0	2
0	2	3
0	0	1

Open Source

0	-1	0
1	0	0
0	0	1

Algorithm

OnTriggerEnter

Commercial



Game Engine Landscape, History & Misc

10

___/8

Match each term below with its single most-reasonable definition at the bottom of the page. Do so by drawing a line between two boxes. Each box may only be connected to one line. There will be eight lines total.

In-House Engine

Easy Recruiting

In-House Engine

Royalties Owed

In-House Engine

Highly Customizable

In-House Engine

Expensive

Off-The-Shelf Engine

The "Secret Sauce"

Off-The-Shelf Engine

Good Community

Off-The-Shelf Engine

Decima Engine

Off-The-Shelf Engine

Game Maker



Game Engine Landscape, History & Misc

11

___/8

Match each term below with its single most-reasonable definition at the bottom of the page. Do so by drawing a line between two boxes. Each box may only be connected to one line. There will be eight lines total.

Concatenate

A lua bug

```
for k,v in ipairs(my_table) do
```

A lua bug

```
setmetatable(child, {_index = parent})
```

..

The default scope for lua variables

Loop Iteration

```
setmetatable(instance, parent)
```

Global scope

```
Characters = {"Austin", "Jacob", "Junwen"}  
for i = 0, #Characters do
```

Inheritance

Addition

+

Scope that requires a keyword to use

Local scope



C++ and IDE Pragmatics

```

1  #include <iostream>
2  #include "A.h"
3  #include "B/B.h"
4
5  int main()
6  {
7      // Code that uses
8      // all libraries here
9      return 0;
10 }
11

```



A game engine project that utilizes two non-STL libraries (A and B)
 Library A is header-only. Library B is header-and-binary
 (lib B is installed globally with a binary called "B").

12

___/3

Consider only the Linux operating system / clang for the following questions. Please distinguish between upper-case I and the lower-case l

Write the include / header flag(s) needed to compile the above script.
 (ie, what you would put into a Makefile)

Note : Assume the preprocessor does not include root directory by default.

13

___/3

Write the library flag(s) needed to compile the above script.
 (ie, what you would put into a Makefile)

14

___/3

Write a full Makefile (housed in the root) that compiles the code with clang++, has O3 optimization, and has an output binary named "game_engine_lin"

```
main:
```



C++ and IDE Pragmatics

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___/2

A friend has implemented an expensive collision-detection algorithm for their chess-like, grid-based game, but is now having performance problems.

For their gameplay mechanics, they only need to know if any Actor* exists at a given cell position (int x, int y) or if it is empty. Provide a reasonable data structure that answers in O(1) time.

Briefly explain how it can be used to answer the query.

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___/9

While developing a survival / scavenging / crafting game, you begin to encounter performance issues. Your colleague (from MSU) is a fine programmer, but you believe performance may be improved.

```
1 struct Character {
2
3     std::string name;
4     char type;
5     int score;
6     int hunger;
7     int health;
8     int lives;
9     Image* sprite;
10    Inventory* inventory;
11};
```

Character objects for an arcade-style survival / scavenging game.

```
1 health -= hunger
2 if (health <= 0)
3     lives -= 1;
```

Game design pseudocode describing how hunger impacts health and how health impacts life count every frame of the game.



C++ and IDE Pragmatics

Approximately how large is the full Character struct in bytes? Ignore optimizations and issues such as alignment / padding (**hint : use the glossary**).

If we were to ignore / strip out data members that are irrelevant to the previous game design pseudocode, what size (in bytes) does our struct become?

If we compute with this stripped-down object instead of the full Character struct, roughly how many more objects can we fit in cache? (2x more? 3x more?) (very rough is fine)

Write a very cache-friendly implementation of the game design pseudocode

```
// Add your new / altered data structure(s) here.
// Assume they get "automatically" filled with data.

int num_chars; // "automatically" gets set to the number of characters.

int main()
{
    // Perform the computation for all characters here.

    return 0;
}
```



Lua and Composition

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___/10

resources/component_types/CutsceneManager.lua

```
CutsceneManager = {
```

```
}
```



Lua and Composition

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___/10

resources/component_types/CharacterSelectManager.lua

```
CharacterSelectManager = {
```

```
}
```



Lua and Composition

resources/component_types/Character.lua

```
Character = {
```

```
}
```



Engine Architecture and Lifecycle Functions

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__/9

							(7,-3)
(0,0)							

Frame #2 (input coming early frame : **up**)

Frame #3 (input coming early frame : **right**)

Frame #4 (input coming early frame : **right**)

Frame #5 (input coming early frame : **right**)

Frame #6 (input coming early frame : **up**)

Frame #7 (input coming early frame : **right**)

Frame #8 (input coming early frame : **none**)

Frame #9 (input coming early frame : **up**) 13



Engine Architecture and Lifecycle Functions

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__/10

game_engine_uniqname/src/Actor.h

```
class Actor
{
public:
    bool active;
    void OnStart();
    void OnDestroy();
    LuaRef GetComponentByKey(const string & key);
    static Actor* GetActorByID(int actor_id);

    // A c++ function that may be called from lua.
    // It "registers" a provided lua function (with a particular component key)
    // to receive network data should any network data arrive for it.
    void Connect(string comp_key, LuaRef receive_function); // TODO : implement.

    // A c++ function that may be called from lua.
    // It "unregisters" all network functions associated with this actor.
    void Disconnect(); // TODO : implement.

    // TODO : Add one instance data structure below. Efficiency = full points.

};
```



Engine Architecture and Lifecycle Functions

game_engine_uniqname/src/Actor.cpp

```
// This may be called from lua. LuaBridge has been properly configured.
void Actor::Connect(string comp_key, LuaRef receive_function)
{

}
}
```

game_engine_uniqname/src/Actor.cpp

```
// This may be called from lua. LuaBridge has been properly configured.
void Actor::Disconnect()
{

}
}
```



Engine Architecture and Lifecycle Functions

game_engine_uniqname/src/NetMessage.h

```
// A data structure that represents a message from the server / other clients.
class NetMessage
{
public:
    int actor_id; // Use these two fields to reach relevant lua components.
    std::string component_key;
    std::string data; // Deliver this to lua functions.
};
```

game_engine_uniqname/src/Network.cpp

```
// This function gets called automatically when net data arrives for this actor.
// Reminder : Calling a lua function on a component requires a "self-reference"
// of the component to be "sent-in" (check Glossary for example).
// NOTE : Do not call the lua function if the actor isn't active
// or if the component isn't enabled.
// Assume NetMessage objects will only arrive here for components that are
// currently connected on actors that actually exist (Ie, no need to check your
// data structure).
```

```
void Network::OnNetworkDataArrived(const NetMessage & message)
```

```
{
```

```
}
```




Engine Architecture and Lifecycle Functions

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__/1

Name your new engine and draw its logo ->
(you need not keep the name "A2 Engine")

Thanks for
playing



Prepared by Maylen Meguri, (Donna, May, and Mags' artist) specifically for the students of 498

