Data organization in the assignment

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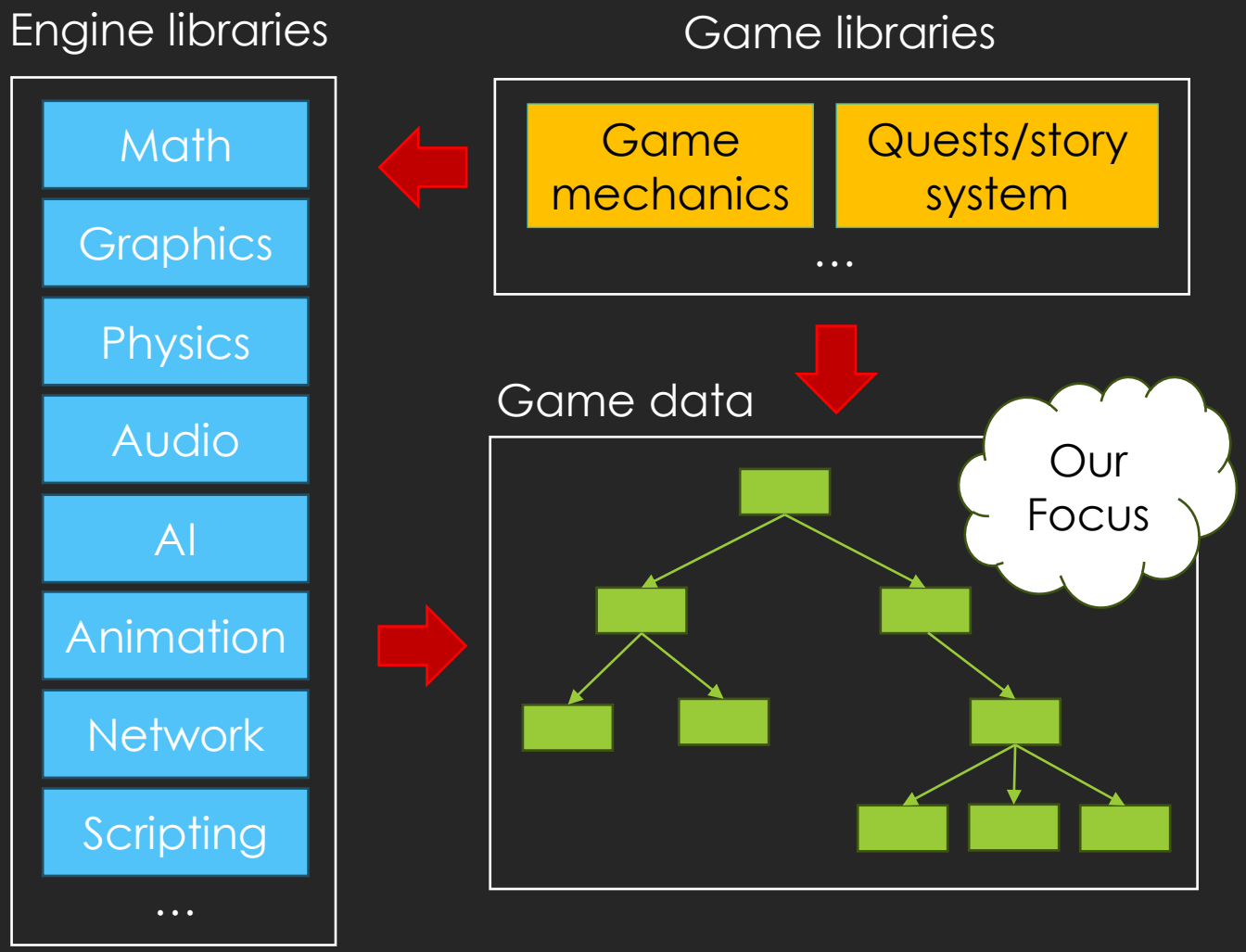
Typical game architecture



Game data: Tree structure

- General enough for games:
  - Game objects are often composed in an acyclic hierarchies, e.g.,:
    - Car – the wheels and doors are attached to the body.
    - Animation skeleton – bones form a tree.
    - Items (like weapons) are attached to an agent/player.
- Simple to implement and easy to traverse (tree DFS, BFS):

```
class GameNode {
    GameNodeWeakPtr parent;
    std::list<GameNodePtr> children;
    …
```

Game data: Tree structure

```
class GameNodeHierarchy { // The only owner of all nodes
    GameNodePtr root;
public:
    static GameNodeHierarchy& instance(); // Singleton

    template<typename NodeType, class... ParameterTypes>
    std::shared_ptr<NodeType> push_back_child(
        GameNodePtr parent,
        ParameterTypes... args);
    …
```

Game data: Component based

- A **component** is a class instance of some Engine/Game library.
  - Holds specific data.
  - May also provide a functionality – code.

- Allows for a **data-driven** approach:
  - Attaching components to a GameNode => Specification of node's purpose in the game.
  - Intuitive and easy to use.

- Also easy to implement:

Component system

```
class Component {
    bool active;
    GameNode* node; // The node this component is attached to.
public:
   virtual ~Component() {} // IMPORTANT: Allows for an inheritance!
   …
```

- We need to extend GameNode to store attached components:

Component system

```
class GameNode {
    …
    std::list<ComponentPtr> components;
public:
    template<typename ComponentType>
    std::shared_ptr<ComponentType> find_component() const;
    void push_back_component(ComponentPtr component);
    …
```

- An important component for a game is a **frame of reference**:

Frame of reference

```
class Frame : public Component { // Frame of reference
    FramePtr parent; // A frame in which this one is defined.
                     // We do not need to know about children.

    Vec3 origin;
    Quat orientation;
    Vec3 scale; // Optional; for uniform scaling use just: float scale;

    mutable Mat44* to_world;  // Cached; compute on demand.
    mutable Mat44* from_world; // Cached; compute on demand.
    …
```

Scripting in C++

- We can define a script component:

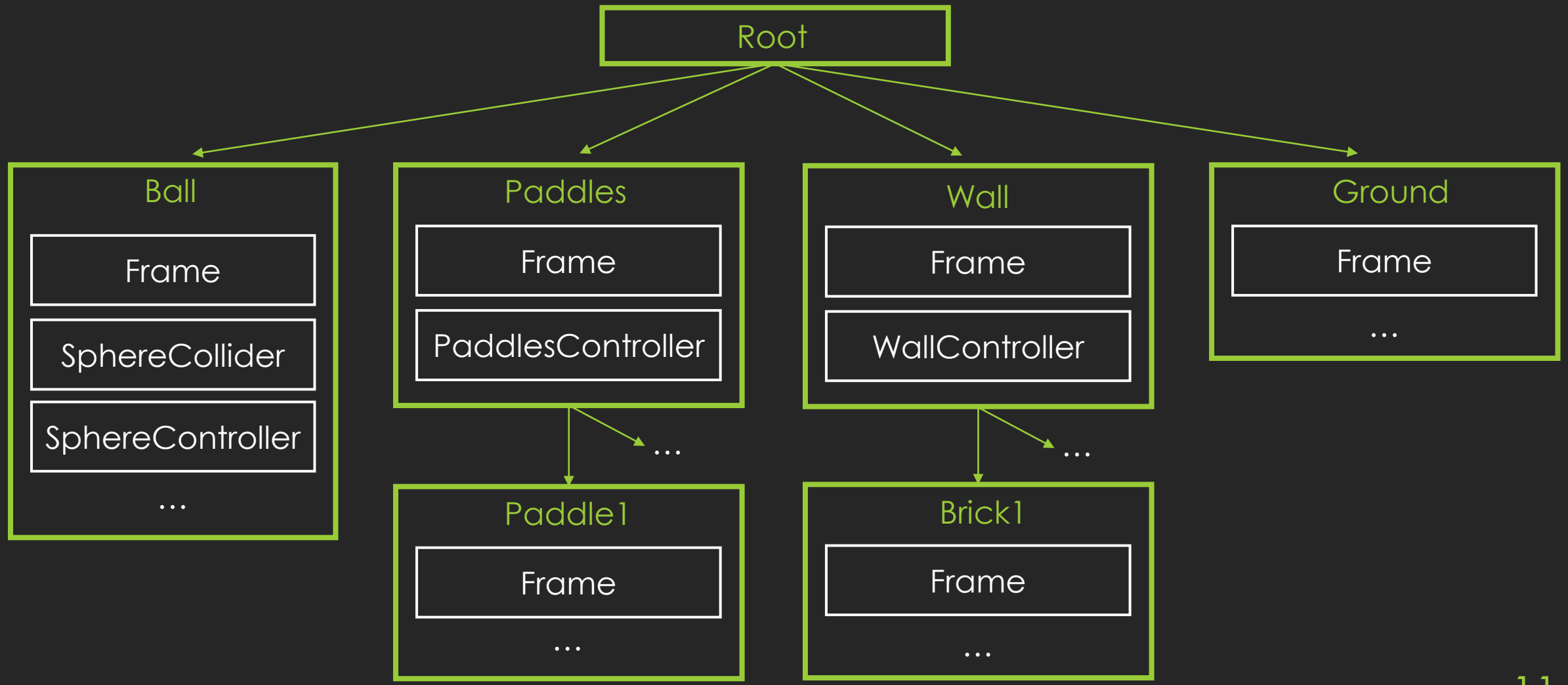
```
class GameScript : public Component {
public:
    virtual void update() {} // To be called by ScriptingEngine
};
```

- A simple scripting engine can then be defined as follows:

Scripting in C++

```
class ScriptingEngine {
    std::list<GameScriptPtr> scripts;
public:
    static ScriptingEngine& instance(); // Singleton
    void update(); // Call 'update' on each script.
    template<typename ScriptType, class... ParameterTypes>
    std::shared_ptr<ScriptType> create_script(ParameterTypes... args) {
        auto script = std::make_shared<ScriptType>(args...);
        scripts.push_back(script); // Keep track of all created scripts.
        return script;
    }
    ...
```

Example: Data hierarchy of our game



Reference

- A sketch of an implementation of the discussed topic is in IS:
  game_data_hierarchy.ZIP