BEVY UNIVERSITY

DEVELOPMENT ENVIRONMENT SETUP AND WELCOME

- Save time by doing the bevy setup if not already done.
- Then we will do the introduction.

INSTALLATION AND CONFIGURATION OF TOOLS

1. **Install Rust**: rustup, rustc, cargo, clippy, rustfmt.
2. **Configure Editor**: Set up your preferred editor with Rust Analyzer.
3. **Get bevy dependencies** according to your OS.
   https://bevyengine.org/learn/quick-start/getting-started/setup/#installing-os-dependencies
4. **Clone the workshop repository** from GitHub.
   https://github.com/uggla/bevy_university
5. **Compile** the project.

2 WORDS ABOUT US 1/2

- Stats
  - First name: Bastien
  - Last name: Sevajol
- Skills
  - Class: Software engineer
  - Latest Guilde:
  - Age of Experience: x years
  - Preferred weapon: Rust, Python
- Optional traits
  - tbd

2 WORDS ABOUT US 2/2

- Stats
  - First name: René (Uggla)
  - Last name: Ribaud
- Skills
  - Class: Software engineer
  - Previous Class: Solution architect (Cloud / Devops)
  - Latest Guilde: Red Hat
  - Game start: 1998
  - Preferred weapons: Rust / Python
  - Artefact: Openstack Nova
- Optional traits
  - Linux and FLOSS since 1995
  - Previously Ops, Dev today to produce my bugs

QUICK OVERVIEW OF RUST (OPTIONAL)

- Provide an alternative to C/C++ and also higher-level languages
- Multi paradigm language (imperative, functional, object oriented (not fully))
- Fast, safe, and efficient (modern)
- No garbage collector (good for games), ownership and borrow checker
- Dual license MIT and Apache v2.0
- First stable release May 15th, 2015

OVERVIEW OF BEVY

- Data-driven game engine built in Rust
- August 10, 2020 by Carter Anderson
- Dual license MIT and Apache v2.0
- Current version 0.15
- Not stable, breaking changes ~3 months and migration guides
- Fully based on the ECS pattern that encourages clean, decoupled designs
- Lots of features 2D, 3D, UI, Audio...
- Extensible with plugins
- Performant multi-threaded
- Multi platform (Windows, Linux, macOS, Web (Wasm), Android, iOS)

QUICK OVERVIEW OF THE PROJECT AND THE SESSION

- Goals of the Workshop:
  - First, we will follow the Bevy tutorial to understand the basics.
  - Next, we will explore additional concepts, equipping you with the tools to build your own game.
  - Finally we will produce a native and web (wasm) version
- What we will build together.
  - An mockup of Asteroids game.
- Session Overview
  - Provide an explanation of the tasks to be completed (via slides), showcasing the corresponding code. Engage actively by asking questions.
  - Work on the code yourself, and don't hesitate to ask for help if needed.
  - If you encounter any issues, no worries—you can always check out the branch for this specific section.

Paste screenshots of the game.

THE SHORTEST BEVY PROJECT

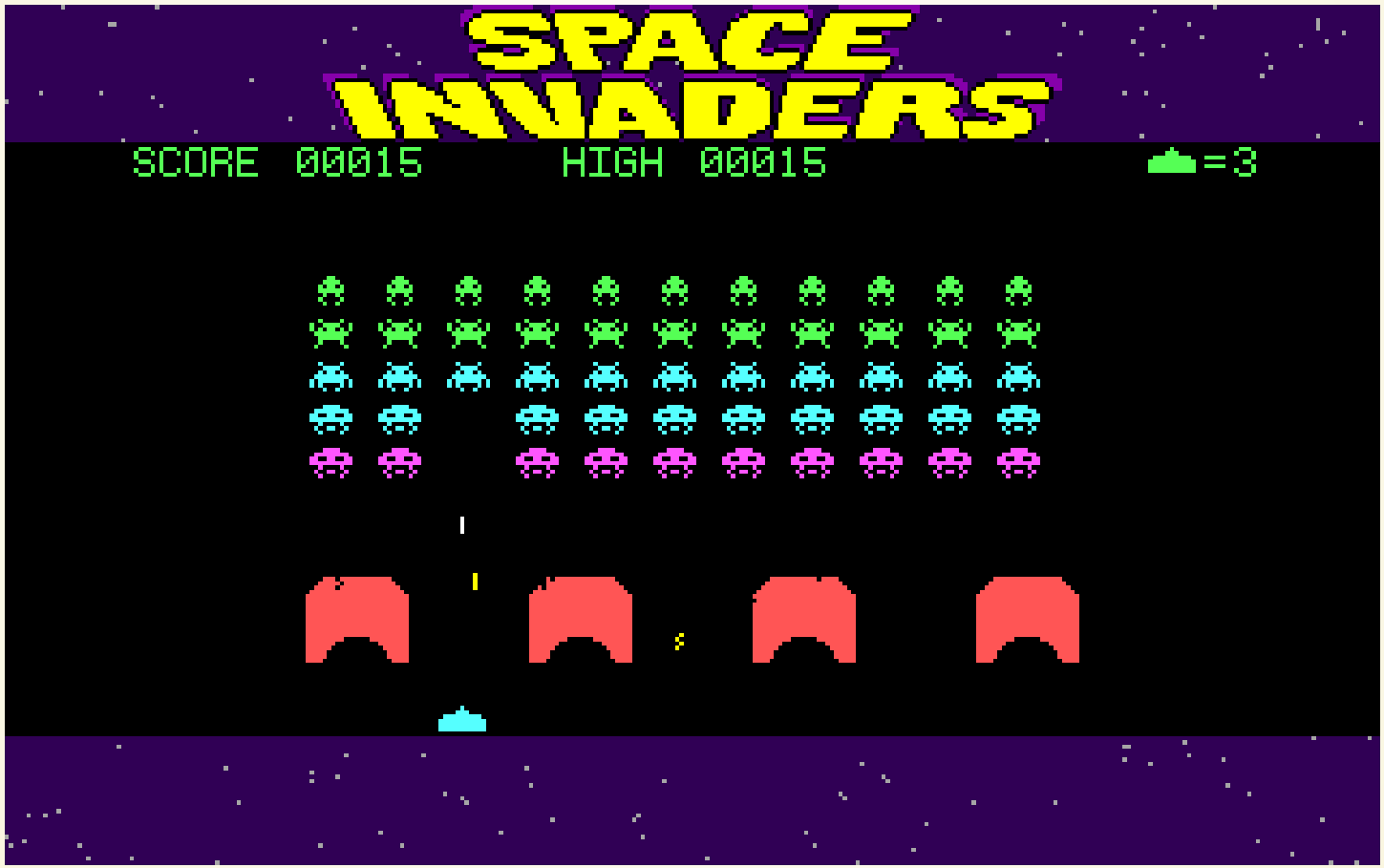
- Builder pattern

```rust
use bevy::prelude::*;

fn main() {
    App::new().run();
}
```

- Initializing resources in the World to store globally available data that we only need a single copy of.
- Adding systems to our Schedule, which can read and modify resources and our entities' components, according to our game logic.
- Importing other blocks of App-modifying code using Plugins.

INTRODUCTION TO THE ECS FRAMEWORK



ENTITY COMPONENT SYSTEM (ECS)

- **Entities**: Abstract game objects.

```
struct Entity(u64);
```

- **Components**: Data associated with entities.

```
#[derive(Component)]
struct Position {
    x: f32,
    y: f32,
}
```

- **Systems**: Logic that operates on entities and their components.

```
fn hello_world() {
    println!("hello world!");
}
```

ANALOGY TO SQL

ECS can be "compared" to an in memory SQL database. With only a big table

- **Entities**: Line in the table.
- **Components**: Columns in the table.
- **Systems**: Stored procedures in which we can query the table.

SYSTEMS AND SCHEDULING IN BEVY

INTRODUCTION TO BEVY SCHEDULER

- **Concept**: Coordinates system execution.
- **Practical Exercise**: Create and schedule systems in Bevy.

Branch	Files	Time
01_systems	src/main.rs	5mn

- The systems are run in parallel so they are not sequentially executed.
- But we can control the order of execution with methods `(after, before, chain)`.

MANIPULATING ENTITIES AND COMPONENTS IN BEVY

DECLARE ENTITIES AND ASSOCIATE COMPONENTS

- **Concept**: Create a Player component.
- Spawn an entity with the Player component.
- Various way of querying the component in a system.
- **Practical Exercise**:

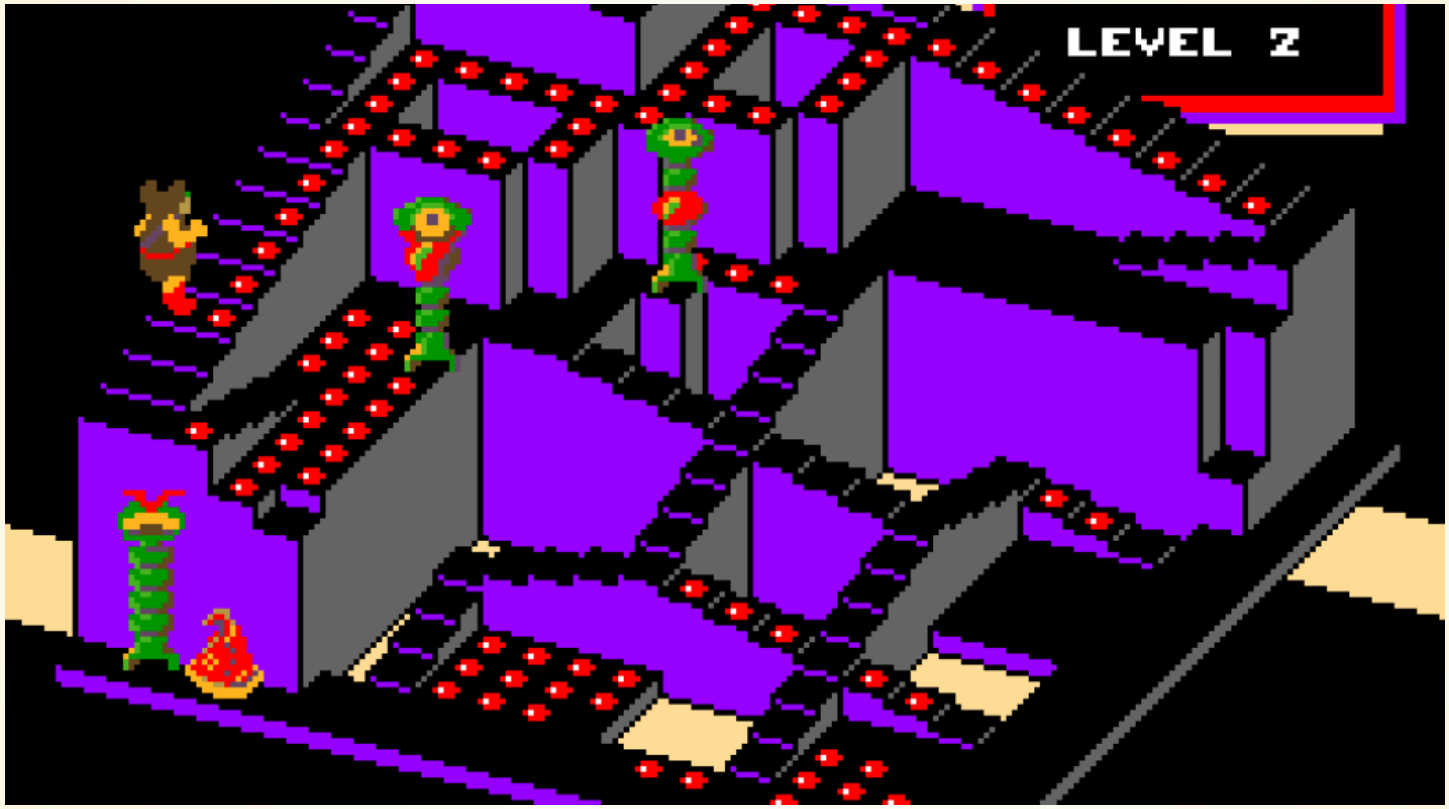
Branch	Files	Time
02-components_and_entity	src/main.rs	5mn

MUT COMPONENT(S) IN ENTITY(IES)

- **Concept**: Various way of querying the Player component in a system and change its name value.
- **Practical Exercise**:

Branch	Files	Time
03-mut_components_and_entities	src/main.rs	5mn

LOAD DEFAULT PLUGINS AND SET A CAMERA



LOAD DEFAULT PLUGINS

- **Concept**: Game loop and window.
- Load the default plugins.
- DefaultPlugins is a PluginGroup, a collection of plugins.
- Define windows size constants and set a window with appropriate size and title.
- my_second_system "update" is now in a 60fps game loop.
- **Practical Exercise**:

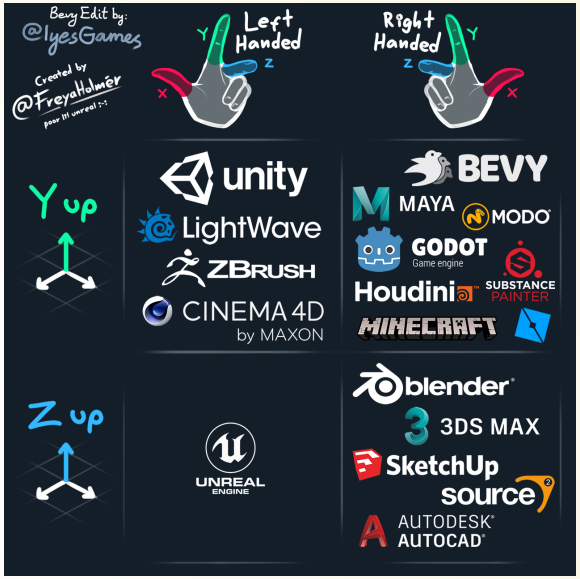
Branch	Files	Time
04-default_plugins	src/main.rs	5mn

SET A 2D CAMERA

- **Concept**: Camera and bundles.
- Modify first_system to spawn a Camera2dBundle or Camera2d (bevy 0.15).
- A bundle is a collection of components but is now not the preferred way to build components but still compatible.
- A required macro is now used to create dependencies between components.
- Coordinate (0,0) at the middle of the screen.
- Spawn a default sprite.
- **Practical Exercise**:

Branch	Files	Time
05-camera	src/main.rs	5mn

- Orientation



RESOURCES AND ASSET SERVER

DISPLAY OUR VESSEL

RESOURCES

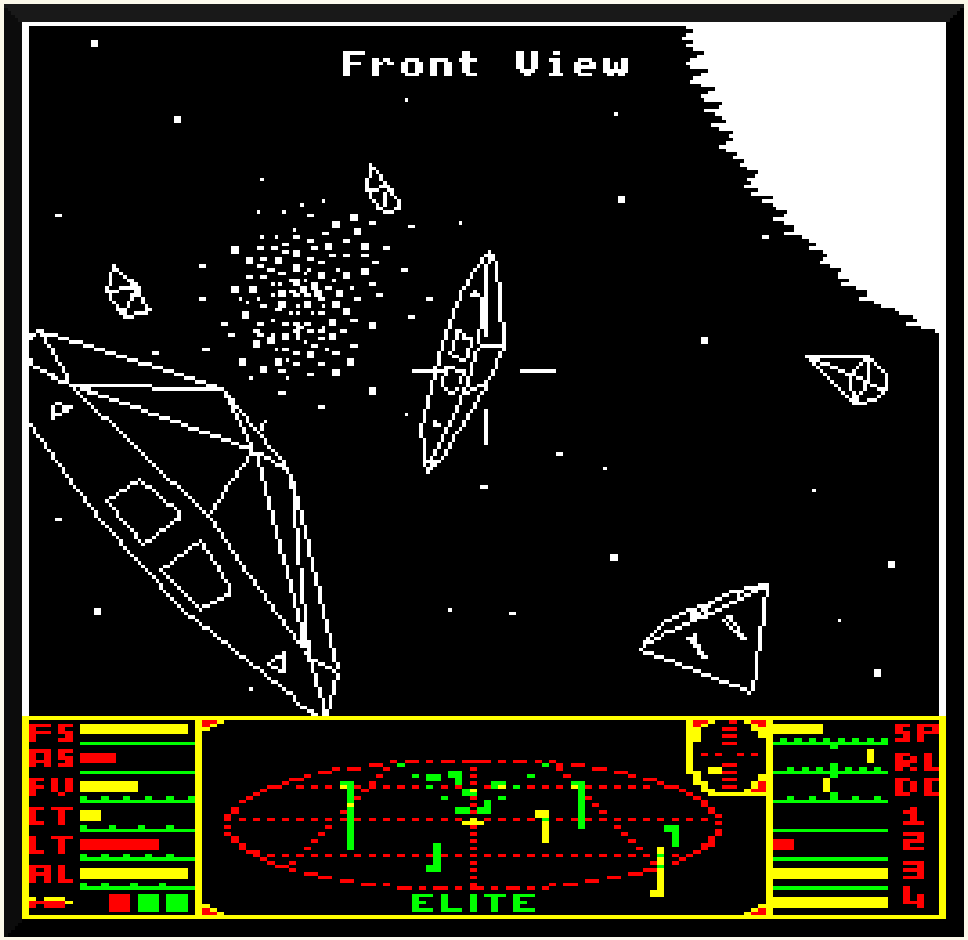
- **Definition**: Shared global data accessible by systems.
- Create a resource CurrentLevel and update it's value in the first_system.
- Resources need to be initialized in our application.
- Read the CurrentLevel resource in the second_system.

ASSET SERVER, IMAGE, TRANSFORM, DISPLAY OUR VESSEL

- Asset server is a builtin resource that read assets from the file system.
- Add an image to the sprite using the asset server.
- The image "sprites/player.png" can be loaded from the assets folder by default.
- Remove the sprite color red and add a transformation to reduce the size by 2.
- **Practical Exercise**:

Branch	Files	Time
06-resources	src/main.rs	5mn

MANAGE THE GAME STATES



STATES

- **Definition:** A state represents a specific mode or phase of your application, enabling systems to be selectively triggered based on the current state.
- While not essential for this mockup, states are highly beneficial. Implementing them from the start helps avoid a time-consuming rework later.
- States must derive the traits `Clone`, `Hash`, `Eq`, `PartialEq`, and `Default`.
- States need to be initialized within the application to be functional.
- Systems can be triggered or executed conditionally based on specific states.
- State information can be read using the `State` resource and updated with the `NextState` resource.
- **Practical Exercise:**

Branch	Files	Time
07-states	src/main.rs	5mn

CREATE YOUR OWN PLUGINS

PLUGINS

- **Definition:** A plugin is a modular unit of functionality that can be added to your application. Plugins help organize code, enable features, and set up the engine's systems, resources, and behaviors in a reusable and scalable way.
- Create a `states.rs` file, define a `StatePlugin`, and implement the `Plugin` trait.
- Refactor the code to move all state-related functionality to the `states.rs` file.
- **Caution:** Ensure the `GameState` struct is made public (`pub`).
- **Practical Exercise:**

Branch	Files	Time
08-plugins	src/main.rs src/states.rs	5mn

USER INPUTS

CREATE A SIMPLE MENU AND ENABLE VESSEL ROTATION

AT THIS POINT, WE HAVE COVERED ALMOST ALL THE FUNDAMENTALS, AND WE WILL INTRODUCE MORE CHANGES IN THE UPCOMING SECTIONS.

REFACTOR STATES PLUGIN TO DISPLAY A MENU

- Add a `Menu` component to tag menu-related entities.
- Add a system `display_menu` to create and display the menu when entering the `GameState::Menu` state.
- The menu consists of a parent entity with a `Node` component and a child entity with a `Text` component.
- Refactor the `start_game` system to handle user inputs from both keyboard and gamepad:
    - Use the `ButtonInput<KeyCode>` resource to detect keyboard inputs.
    - Use a query on the `Gamepad` component to handle gamepad inputs.
- Add a system `despawn_menu` to remove menu entities when exiting the `GameState::Menu` state.
- **Warning:** The application might crash if a camera is not available during state transitions.
- Create a system in `main.rs` to spawn a `Camera2d` when entering the `GameState::Menu` state.

REFACTOR SYSTEMS IN MAIN.RS TO ROTATE THE VESSEL

- Rename `my_first_system` to `setup_vessel`, remove all `println!` calls, and attach the `Player` component to the entity with the sprite component.
- Rename `my_second_system` to `rotate_vessel`, remove all `println!` calls, and keep only `let mut player = players.single_mut();` to perform the query.
- Modify the query to retrieve the entity that has both the `Player` and `Transform` components.
- Rotate the vessel around the Z-axis based on user inputs using `player.rotate_z(PI / 24.0);`.
- **Practical Exercise:**

Branch	Files	Estimated Time
09-inputs	src/main.rs src/states.rs	15 minutes

DEBUG CAMERA

REFACTOR CAMERA INTO A PLUGIN AND ADD A DEBUG CAMERA

- Refactor the camera systems into a `CameraPlugin` for better modularity.
- Add a system `debug_camera` to handle camera adjustments in debug mode.
- The `debug_camera` system should modify the `OrthographicProjection` scale based on user inputs (`W` to zoom in and `X` to zoom out).
- **Practical Exercise:**

Branch	Files	Estimated Time
10-debug_camera	src/main.rs src/camera.rs	5 minutes

DISPLAY ASTEROIDS

CREATE AN ASTEROID PLUGIN THAT SPAWN ASTEROIDS

- Create an `AsteroidPlugin` for better modularity.
-
-
- **Practical Exercise:**

Branch	Files	Estimated Time
11-asteroids	src/main.rs src/camera.rs	5 minutes

PHYSICS WITH RAPIER PLUGIN

INTRODUCING RAPIER

Purpose: Physics simulation for 2D/3D in Bevy.

PRACTICAL EXERCISE

Add basic collision detection between entities.

COMPILATION AND EXPORTATION

BUILDING AND EXPORTING

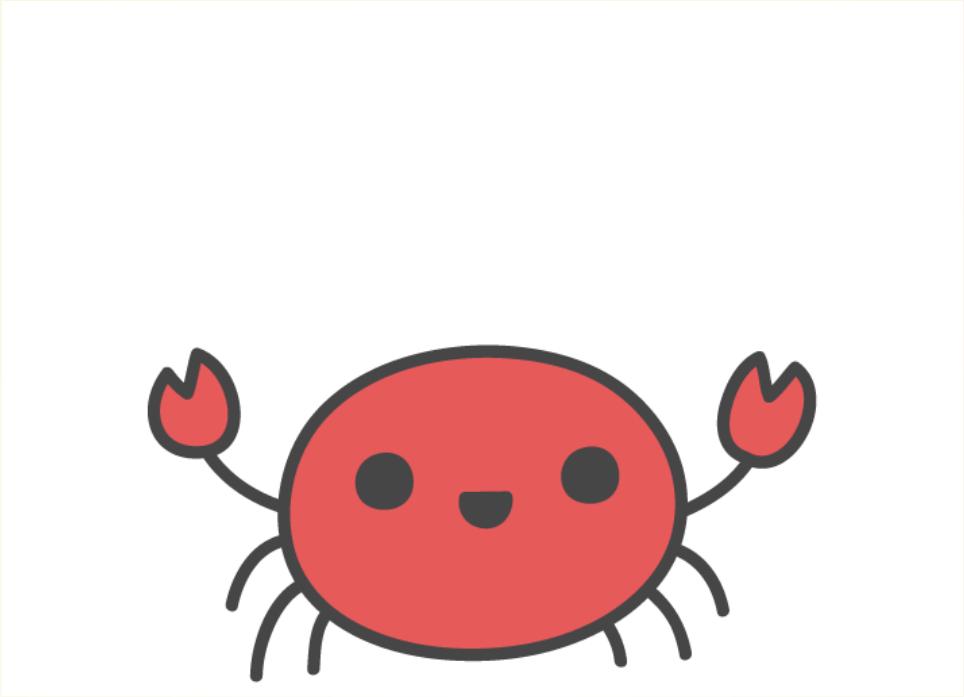
- **Native Compilation**: Test the mockup locally.
- **WebAssembly Compilation**: Deploy on a simple webpage.

PRACTICAL EXERCISE

Integrate the game mockup into a webpage and test the WebAssembly version.

ACHIEVEMENTS AND Q&A

Celebrate our accomplishments and address questions or feedback.



- Bastion Sevajol <bastien@sevajol.fr>
- René Ribaud <rene.ribaud@gmail.com>