

# OpenRA: Mods, Actors, Traits

# References

[1] OpenRA wiki modding guide:

<https://github.com/OpenRA/OpenRA/wiki/Modding-Guide>

[2] OpenRA Book:

<https://www.openra.net/book/glossary.html>

[3] Delft Students On Software Architecture - OpenRA:

<https://delftswa.github.io/chapters/openra/>

# Scope

What is this about?

- Overview of the concept
- How to map to bevy?
- Next step

What is this NOT about?

- Detailed implementation (how mods/traits are imported)

# Mods

- “Everything is a mod (including RA - which is loaded by default).” [1]

```
./mods
├── all
├── cnc
├── common
├── d2k
├── modcontent
├── ra
└── ts
```

# Mods

“The only file which is ***absolutely required*** for a mod is `mod.yaml`” [1]

- `rules` contains MiniYaml files describing how to assemble actors (units/buildings/etc)
- `maps` contains maps.
- `tilesets` contains MiniYaml files describing the various tilesets -- temperate, snow, etc.
- `chrome` contains MiniYaml files describing the UI chrome
- `uibits` contains various textures used by the chrome
- `bits` contains various loose in-game assets -- SHPs, etc.

```
./mods/ra
├── audio
├── bits
├── chrome
├── chrome.yaml
├── cursors.yaml
├── hotkeys.yaml
├── icon-2x.png
├── icon-3x.png
├── icon.png
├── installer
├── maps
├── metrics.yaml
├── missions.yaml
├── mod.yaml
├── rules
├── sequences
├── tilesets
├── uibits
├── weapons
└── ZoodRangmah.ttf
```

# Actors

What are actors?

- “An actor is the entity part of the *entity-component-system*.” [2]
- “All units/structures/most things in the map are Actors. Actors contain a collection of traits.” [1]

Defined in `.yaml` files in `rules` directory

# Actor Example

```
# mods/ra/rules/infantry.yaml
DOG:
  Inherits: ^Soldier
  # Some Traits ...
  AttackLeap:
    Voice: Attack
    PauseOnCondition: attacking || attack-cooldown
  # ...
```

“**Inherits** technically isn't a trait, it is a MiniYaml mechanism that is explained in the chapter 2 link above.” [2]

# Loading Trait for Actor

```
// OpenRA.Game/GameRules/ActorInfo.cs
namespace OpenRA {
    public class ActorInfo {
        public ActorInfo(ObjectCreator creator, string name, MiniYaml node) {
            // ...
        }

        static TraitInfo LoadTraitInfo(ObjectCreator creator,
            string traitName, MiniYaml my)
        {
            // ...
        }
    }
}
```



# Traits

- “Traits consist of an info class and a class that does stuff.” [1]
- “Technically a *trait info* is the *component* part of the *entity-component-system* architecture.” [2]
- “Traits consist of an info class and a class that does stuff.” [1]

BUT there is a catch

# Traits

- “There is one instance of the infoclass shared across all actors of the same type. Each actor gets its own instance of the trait class itself.” [1]
- “Infoclasses are responsible for instantiating their corresponding trait class -- see `ITraitInfo`, and `TraitInfo` for the trivial implementation of this. [1]”

# TraitInfo

- The info class seems like a builder that Create a trait class

```
public abstract class TraitInfo : ITraitInfoInterface {  
    // Value is set using reflection during TraitInfo creation  
    [FieldLoader.Ignore]  
    public readonly string InstanceName = null;  
  
    public abstract object Create(ActorInitializer init);  
}
```

# Info Class Example

```
// OpenRA.Mods.Cnc/Traits/Attack/AttackLeap.cs
// namespace OpenRA.Mods.Cnc.Traits
//
// inherits TraitInfo class
[Desc("Move onto the target then execute the attack.")]
public class AttackLeapInfo : AttackFrontalInfo, Requires<MobileInfo> {
    // ...
    public override object Create(ActorInitializer init)
    {
        return new AttackLeap(init.Self, this);
    }
}
```

# Trait Class Example

```
// OpeOpenRA.Mods.Cnc/Traits/Attack/AttackLeap.cs
// namespace OpenRA.Mods.Cnc.Traits
public class AttackLeap : AttackFrontal { // inherits Actor class
    // ...
    public override Activity GetAttackActivity(
        Actor self, AttackSource source, in Target newTarget,
        bool allowMove, bool forceAttack, Color? targetLineColor
    ) {
        return new LeapAttack(self, newTarget, allowMove,
            forceAttack, this, info, targetLineColor);
    }
}
```

# Activity

- “Things an actor can be doing are represented as Activity subclasses. Actor has a queue of these.” [1]
- Seems like actions between actors. Can probably think of it as **systems** that operate on two or more actors.

OpenRA.Mods.Cnc/Activities

- Infiltrate.cs
- LayMines.cs
- LeapAttack.cs
- Leap.cs
- Teleport.cs
- VoxelHarvesterDockSequence.cs

# Traits and Inheritance

**TraitInfo** is the base class for all info classes

Problem:

- Complexity
- How to decouple?
- Can we reduce the complexity?
- Do we have to recreate the complexity in bevy?

Trait inheritance [example](#): AttackLeapInfo, and AttackLeap

# Thoughts on the Next Step

- A deeper dive into the implementation
- A min playable mods

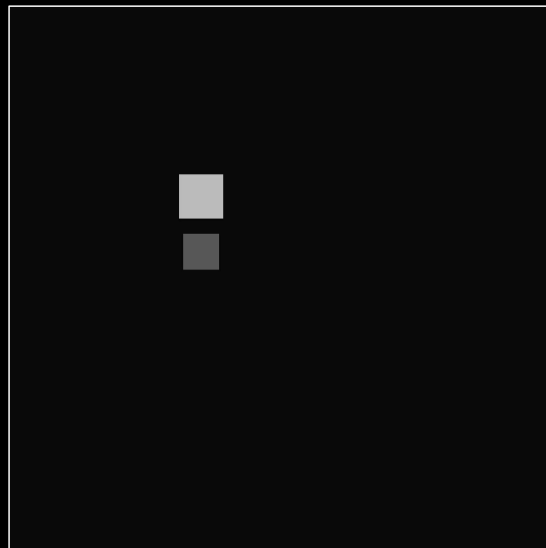


# Bevy ECS

bevy\_snake as an example

# Demo

- GitHub: [https://github.com/marcusbuffett/bevy\\_snake](https://github.com/marcusbuffett/bevy_snake)
- Tutorial: <https://mbuffett.com/posts/bevy-snake-tutorial/>



# ECS

Entities	Components
(Snake)	SnakeHead, SnakeSegment, (DefaultComponents), Position, Size
(Food)	Food, (DefaultComponents), Position, Size

Systems	Components	Non-component Args
setup		Commands, ColorMaterial
spawn_snake		Commands, Materials, SnakeSegments
Snake_eating	Position, Food, SnakeHead	Commands, GrowthEvent

Incomplete....