

Entity Component System

Seminar Programming Experience

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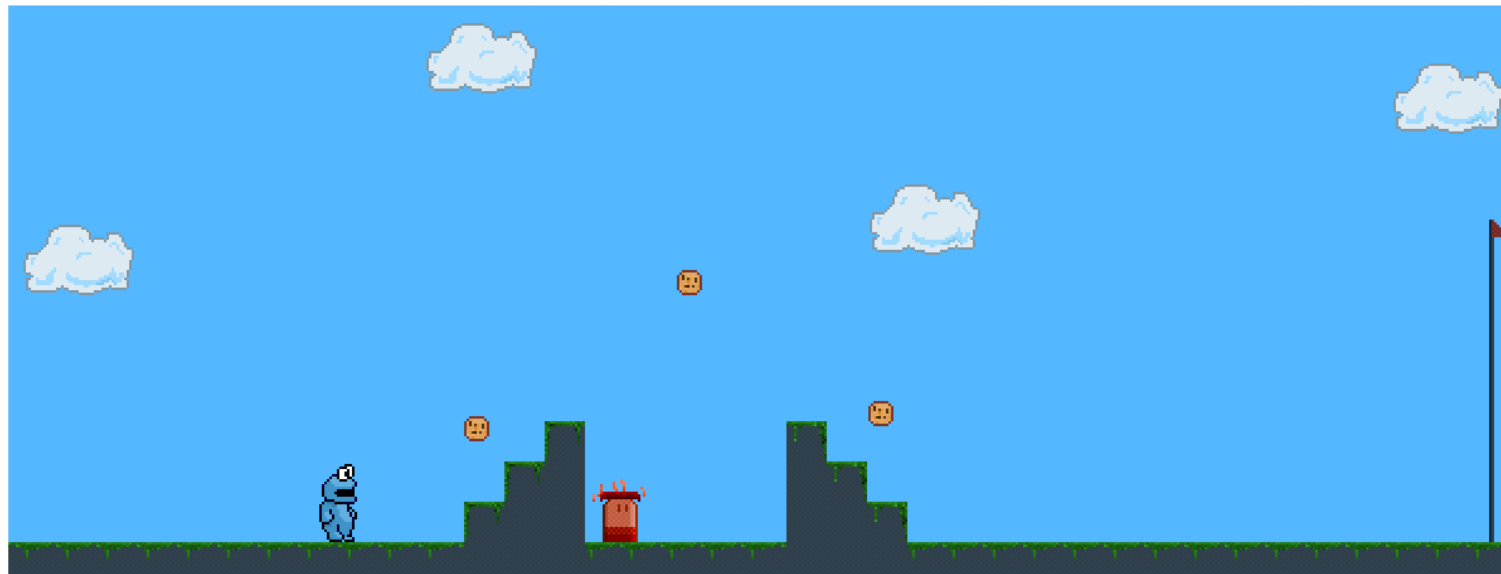
Prof. Dr. Robert Hirschfeld, Jens Lincke, Stefan Ramson

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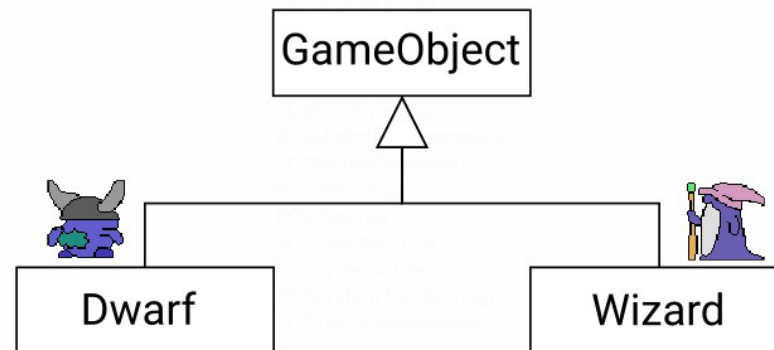
Introduction

An Entity Component System (ECS) is

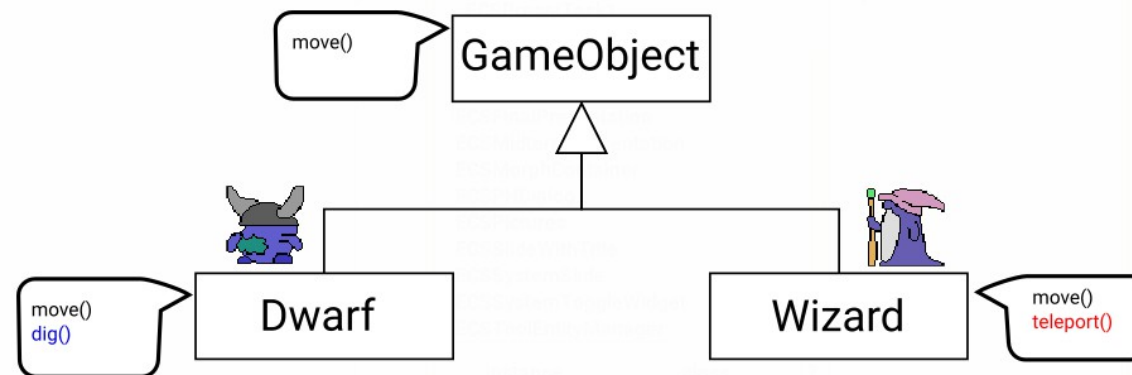
- a software pattern
- non-object-oriented
- used in games and simulations



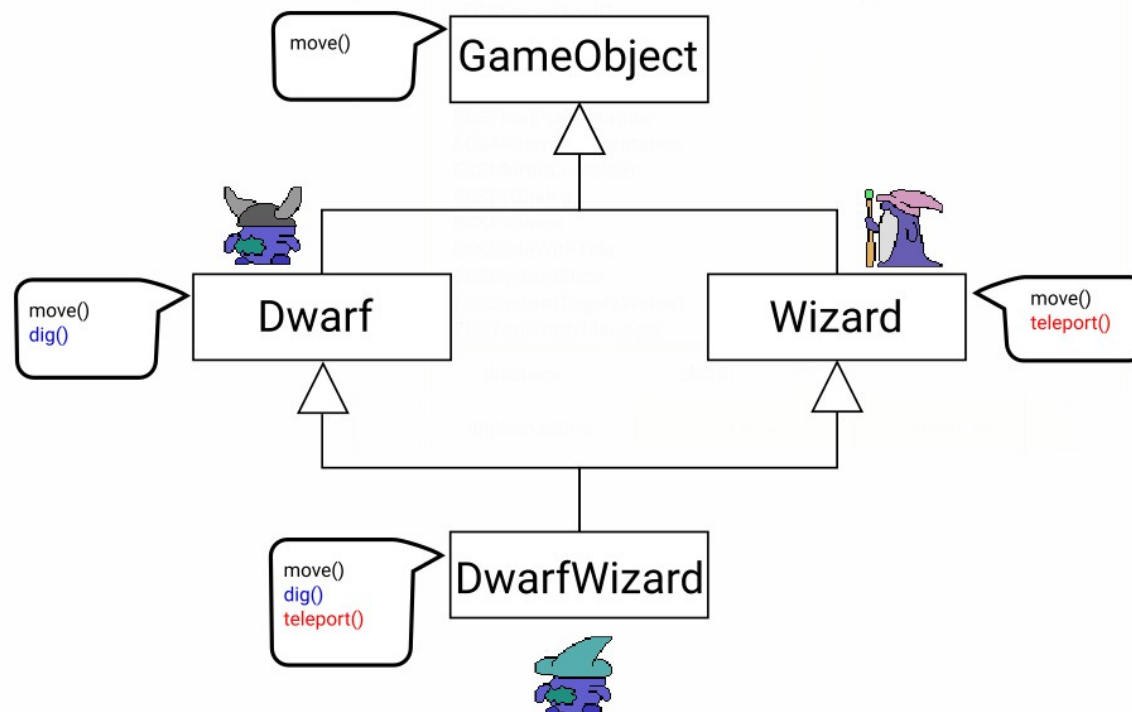
Building a Game with Inheritance



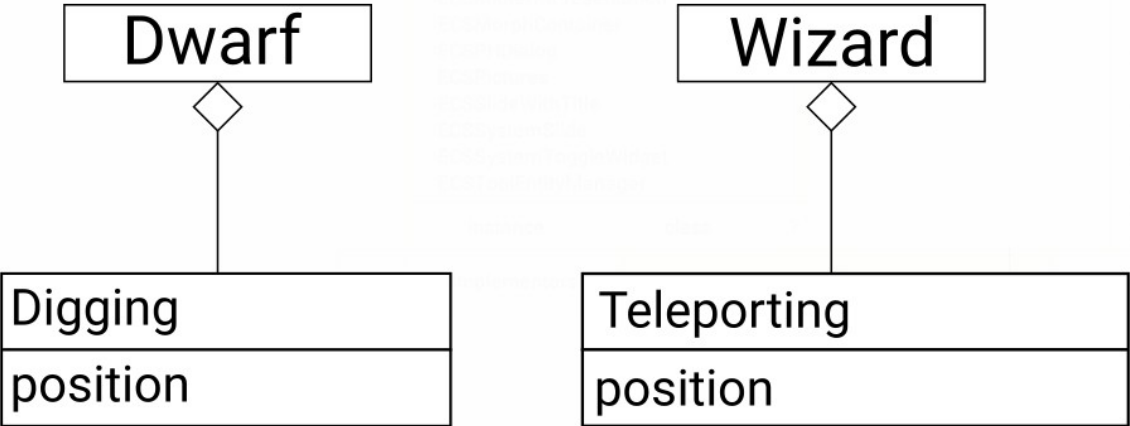
Building a Game with Inheritance



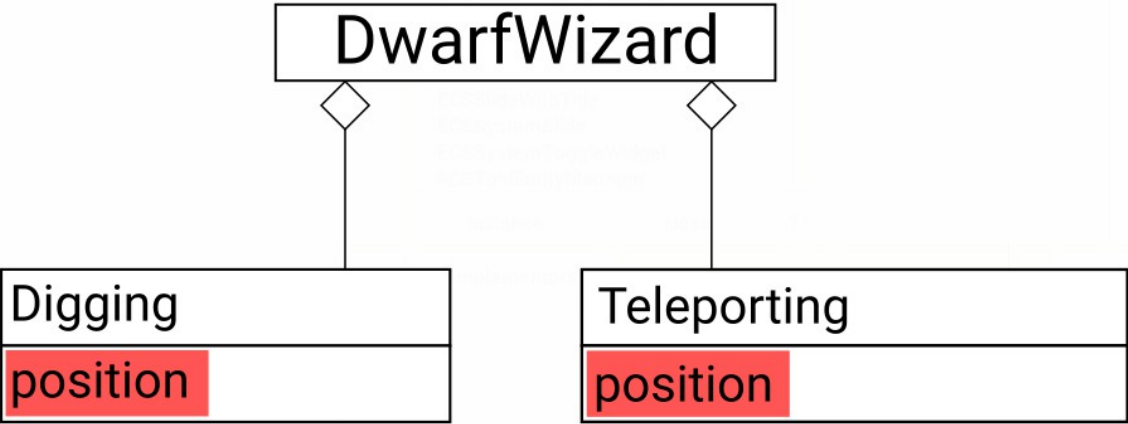
Building a Game with Inheritance



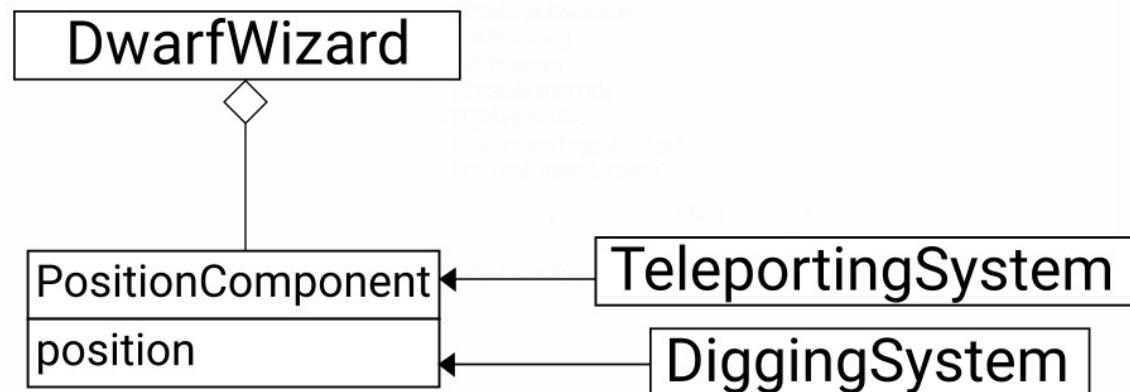
Composition



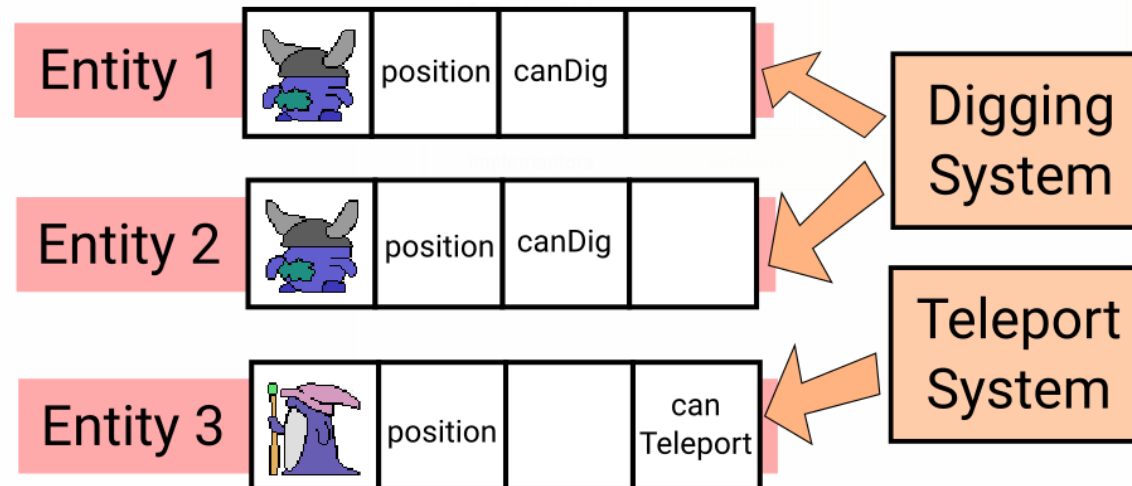
Composition



Introducing Systems



Entities group together components
Components contain data
Systems contain behavior



Working with premade components and systems

☒ ECSRenderingSystem



☒ ECSMovementSystem



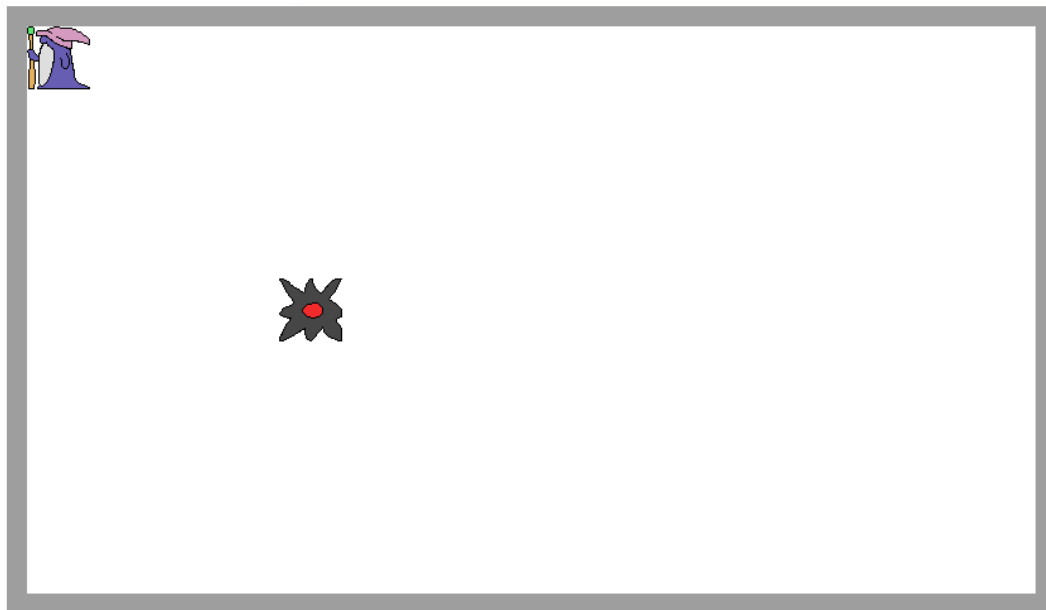
No entity chosen

Entities ▾



Creating your own components and systems

- ☒ ECSRenderingSystem
- ☒ ECSMovementSystem
- ☒ ECSInputSystem
- ☒ ECSCollisionSystem
- ☒ ECSDamageSystem
- ☒ ECSHealthSystem

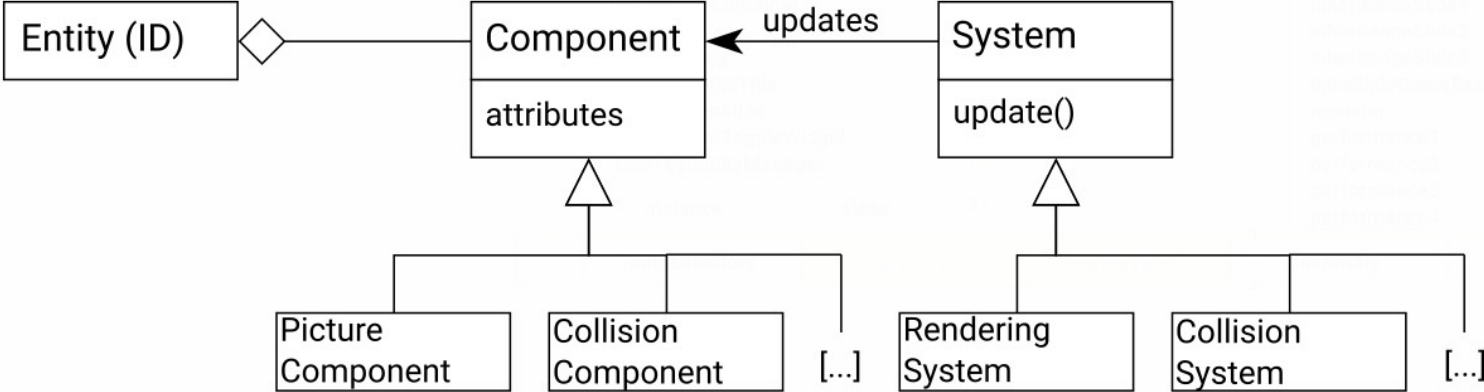


Entities ▾



No entity chosen

Architecture



Small Example Game

- ☒ ECSRenderingSystem
- ☒ ECSMovementSystem
- ☒ ECSInputSystem
- ☒ ECSCollisionSystem
- ☒ ECSResolveCollisionSystem
- ☒ ECSDamageSystem
- ☒ ECSHealthSystem
- ☒ ECSShootSystem
- ☒ ECSInflameSystem
- ☒ ECSBurnSystem
- ☒ ECSSpawnSystem
- ☒ ECSFollowSystem
- ☒ ECSCooldownSystem
- ☒ ECSTeleportSystem
- ☒ ECSDestroySystem
- ☐ +




Entities ▾ +

No entity chosen

Performance

ordered
by
Entities


Entity 1

	position	collision	velocity
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Entity 2




	position	collision
---	----------	-----------

Entity 3

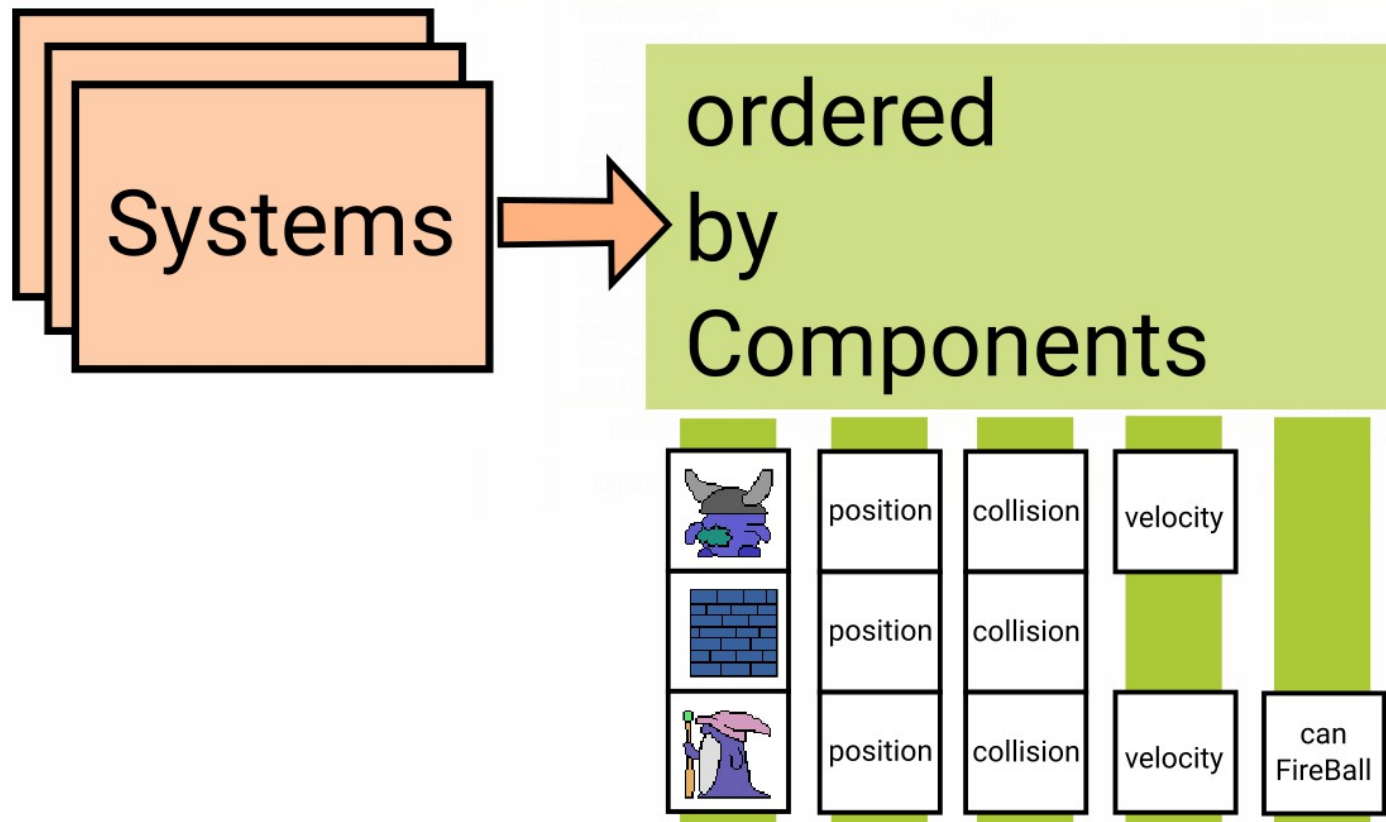
	position	collision	velocity	can FireBall
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Performance

ordered
by
Components

	position	collision	velocity	
	position	collision		
	position	collision	velocity	can FireBall




Performance



Performance

ordered
by
Components

ordered
by
Entities

Entity 1		position	collision	velocity	
Entity 2		position	collision		
Entity 3		position	collision	velocity	can FireBall

Encapsulated Behavior and Debugging

- ☒ ECSRenderingSystem
- ☒ ECSMovementSystem
- ☒ ECSInputSystem
- ☒ ECSCollisionSystem
- ☒ ECSDamageSystem
- ☒ ECSHealthSystem
- ☐ ECSDebugCollisionSystem
-



No entity chosen

Entities ▾

Serialization

```
class Enemy {
    position: 10@10
    collision: #deadly
    picture: monsterPicture
    follows: playerId
}
```

Enemy

position: 10@10

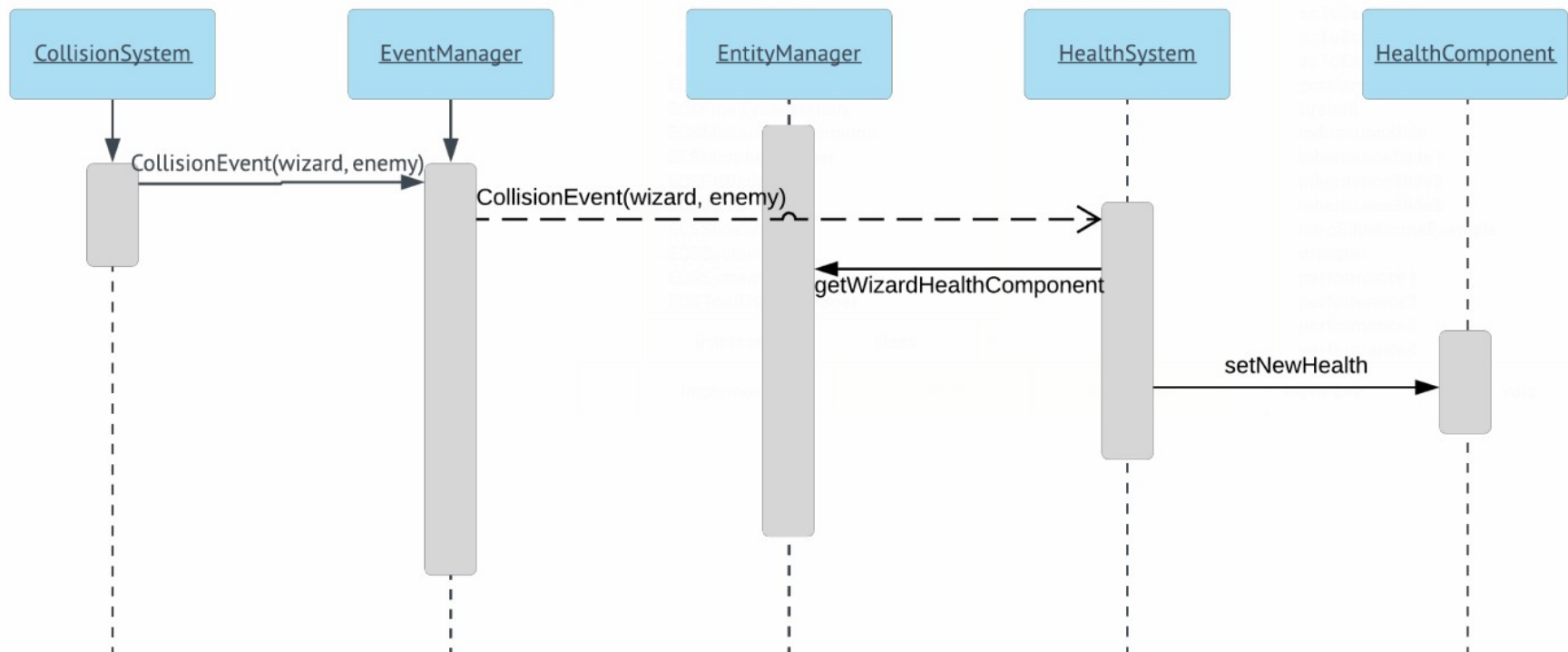
collision: #deadly

picture: monsterPicture

follows: playerId



Event Handling



Summary

Advantages

- decouples multiple domains
- simplifies code reuse
- data-oriented design
- multi-threaded design

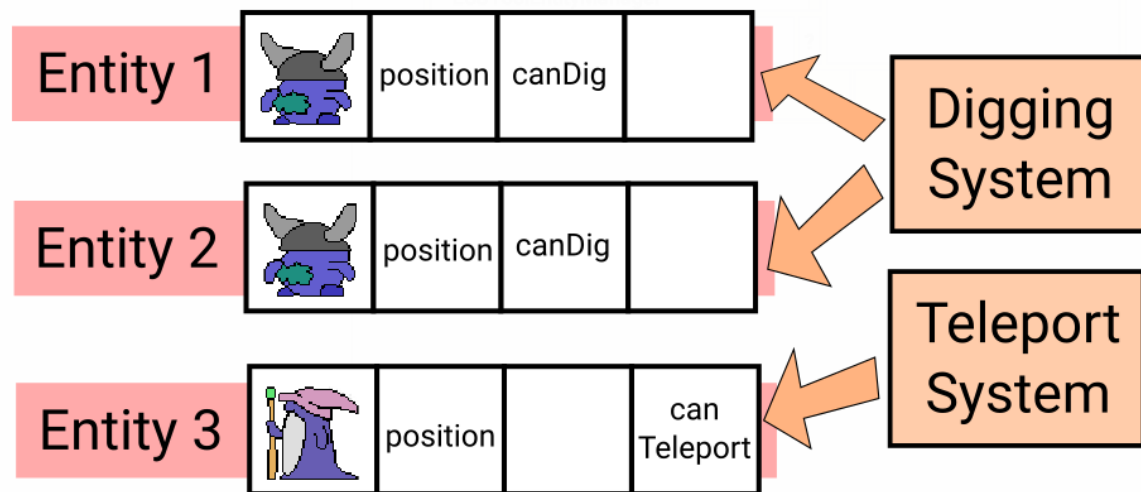
Disadvantages

- adds indirection (complexity)
- inter system communication

Summary

An Entity Component System (ECS)

- consists of entities (identities), components (basic data) and systems (behaviour)
- has to be combined with other patterns for certain use cases
- prevents diamond of death



Questions?