Game Control

Ken-Yi Lee

Game Programming, Fall 2020 @ National Taiwan University

Game Programming

- Rendering
- Looping and control
- Math
- Behaviour and navigation (AI)
- Physics
- Animation and effects
- Networking

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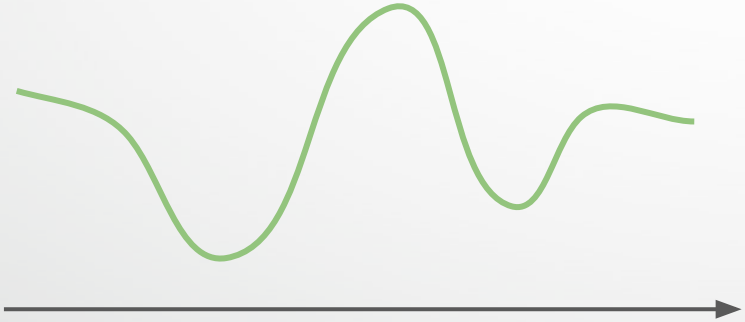
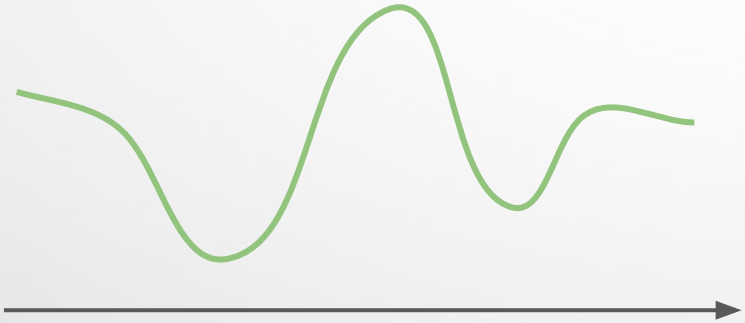


Analog

https://en.wikipedia.org/wiki/Game_controller



Analog

Digital

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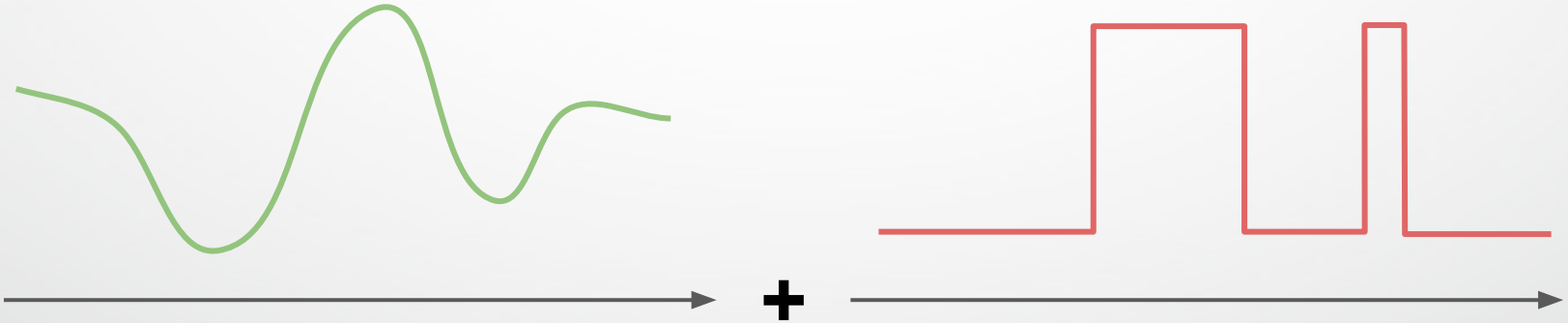

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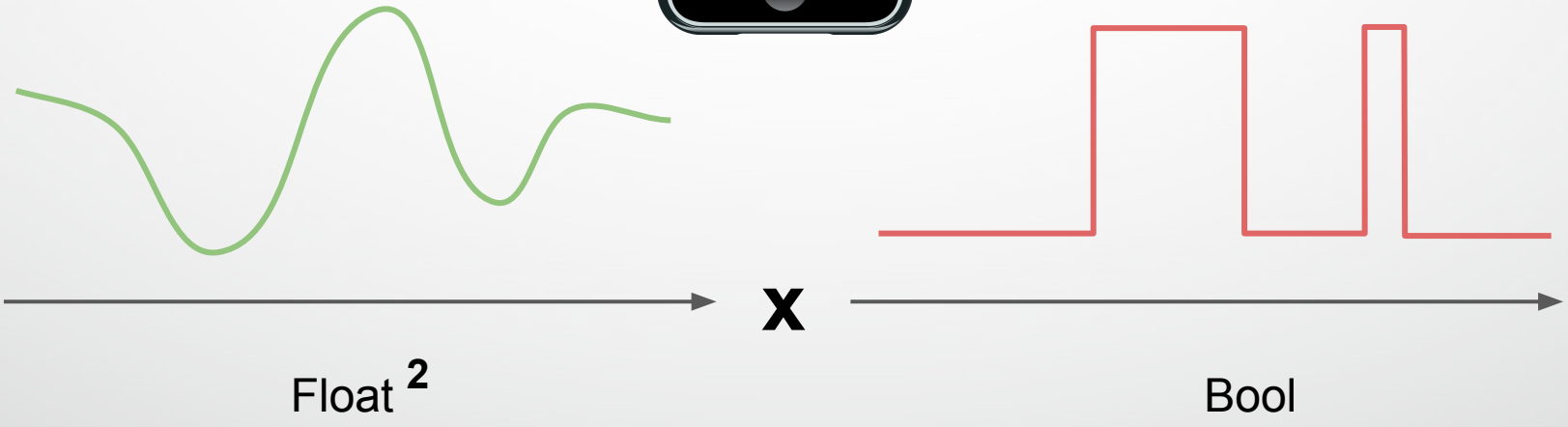
https://en.wikipedia.org/wiki/IPhone



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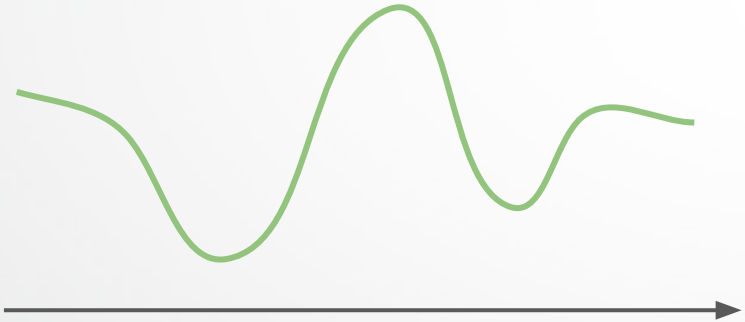

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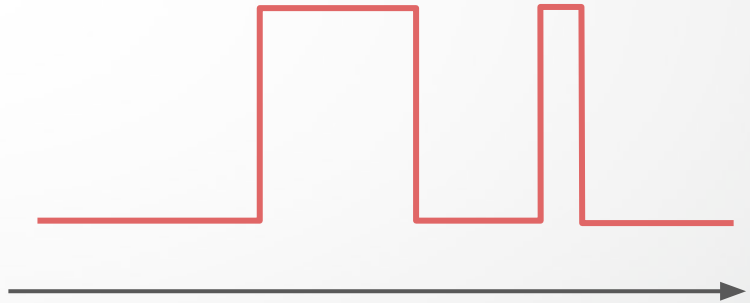

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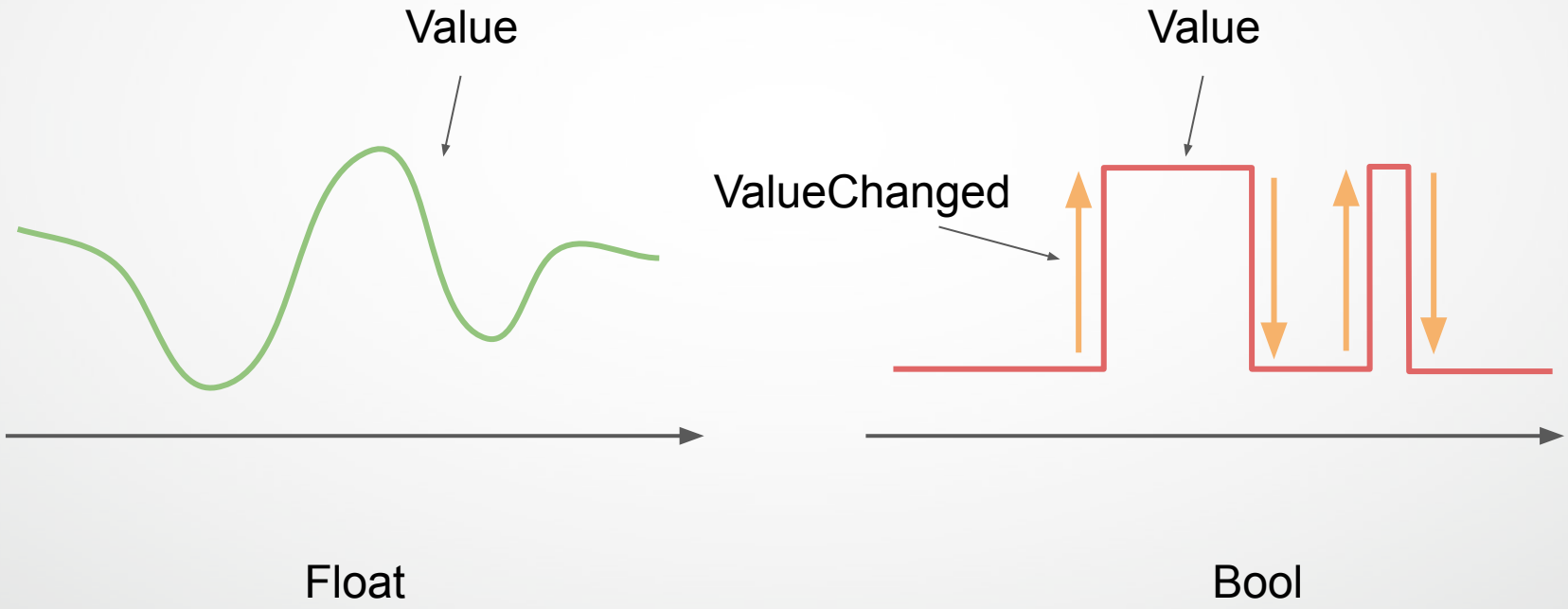

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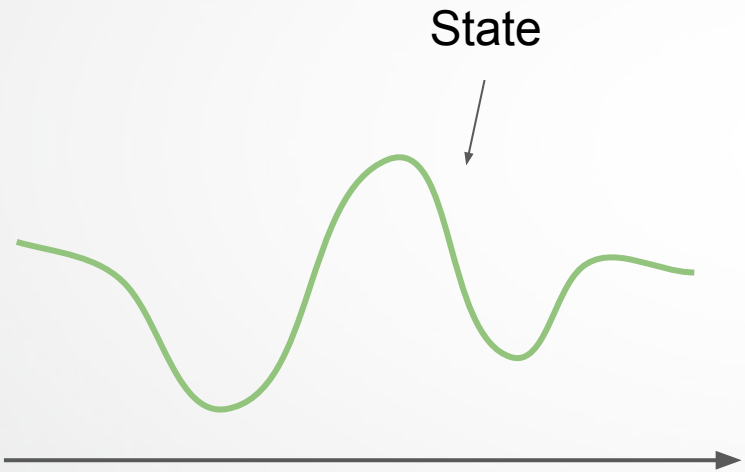

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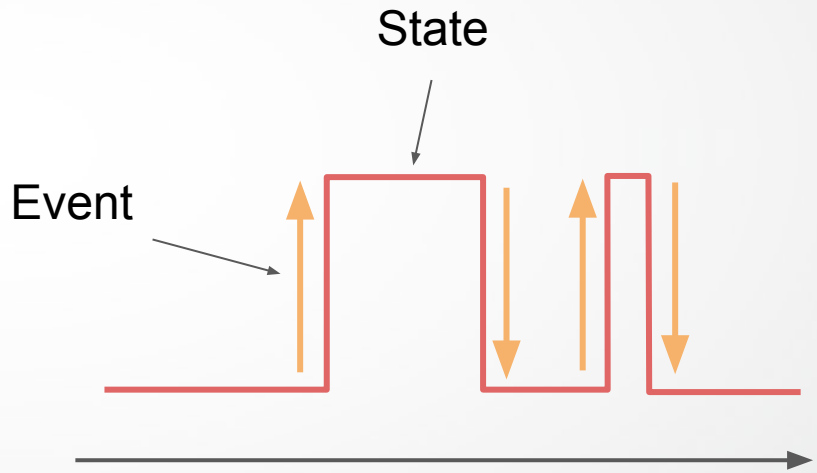

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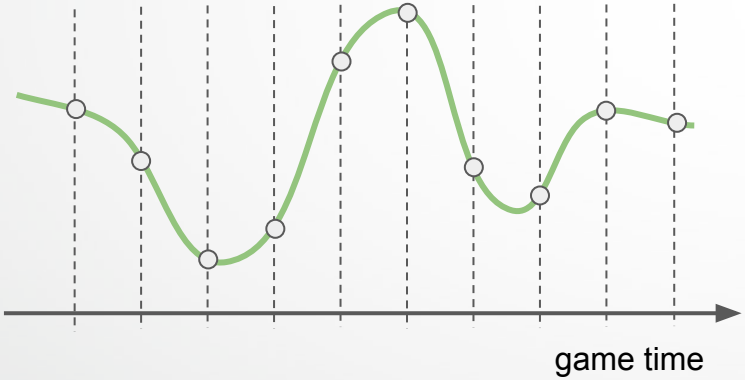

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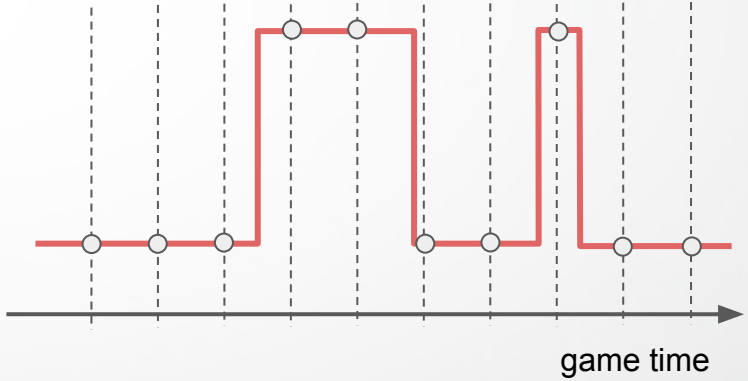

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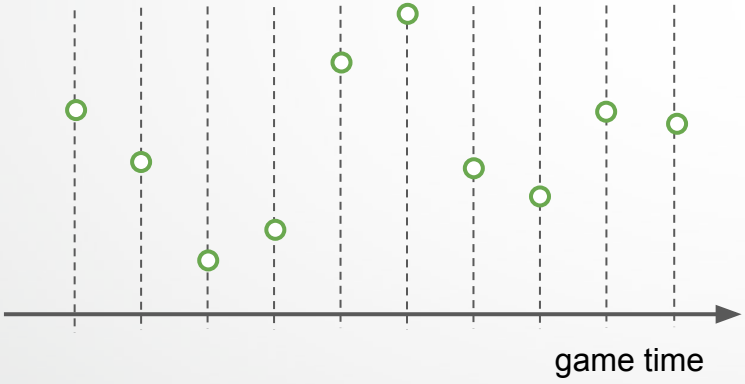

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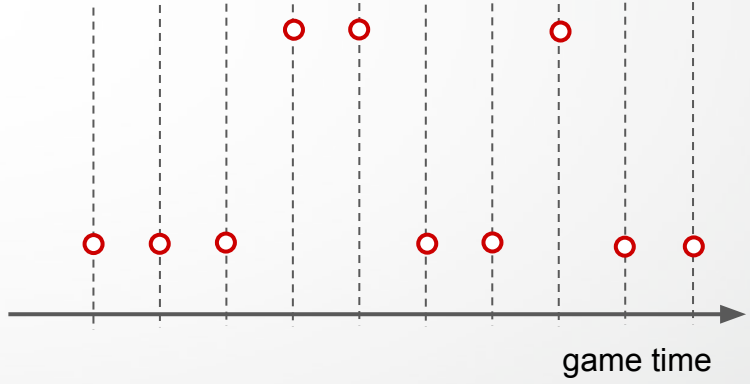
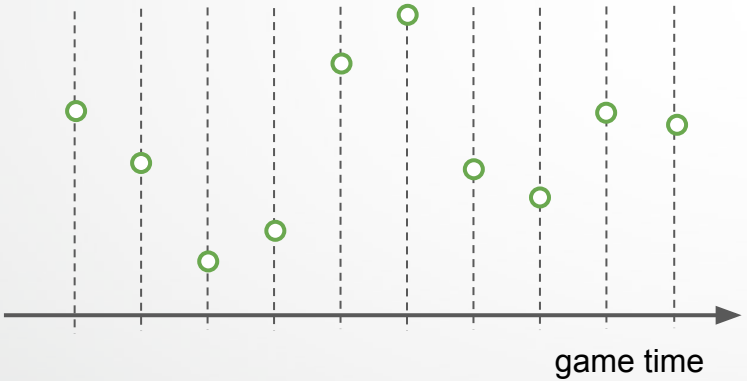


Bool

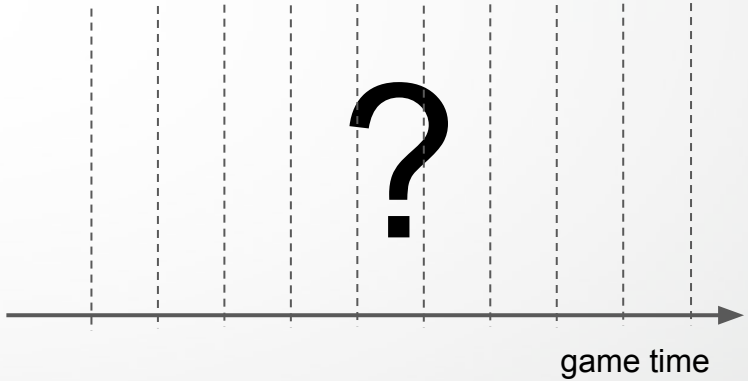
FeisStu

State



Float

to

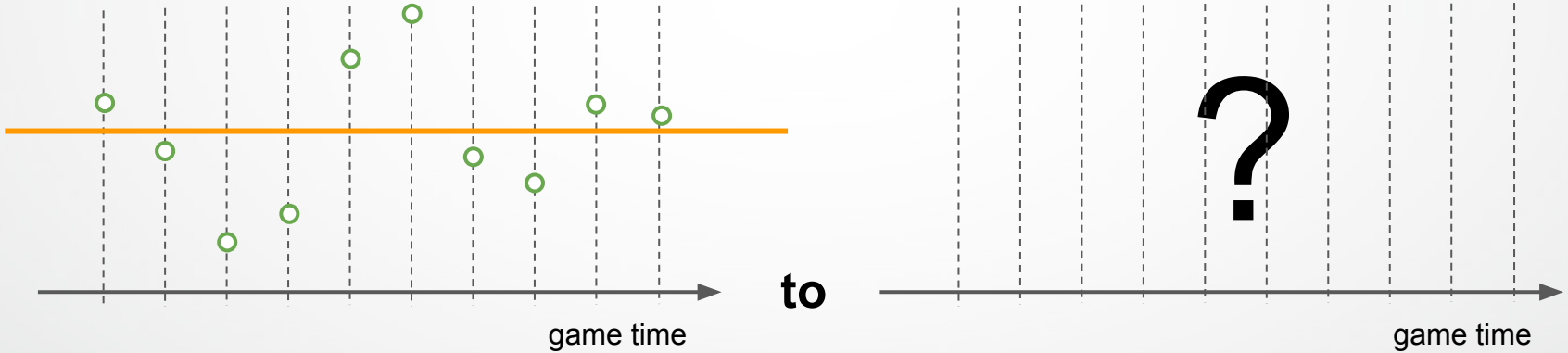


Bool

FeisStu

Value thresholding

State

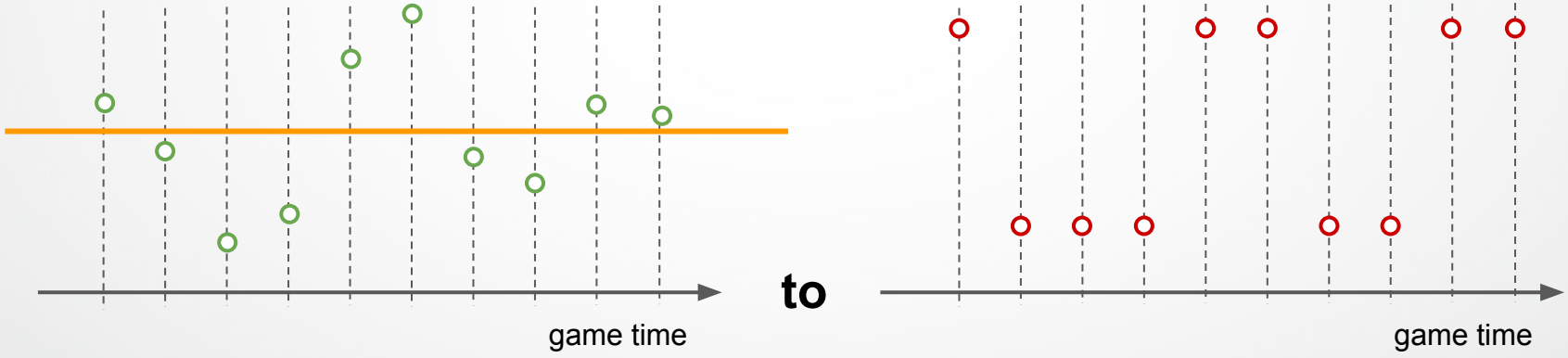


Float

Bool

Value thresholding

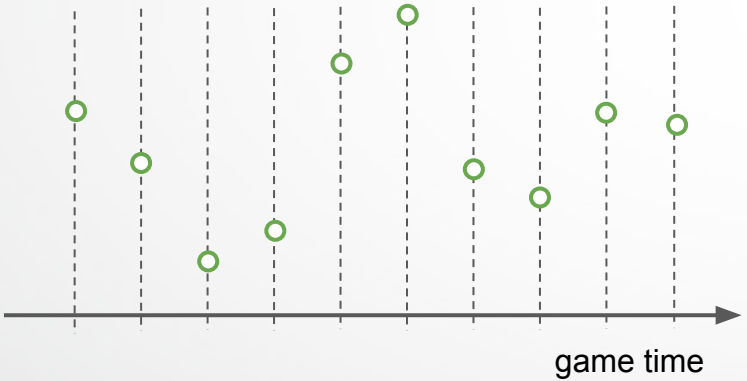
State → State



Float

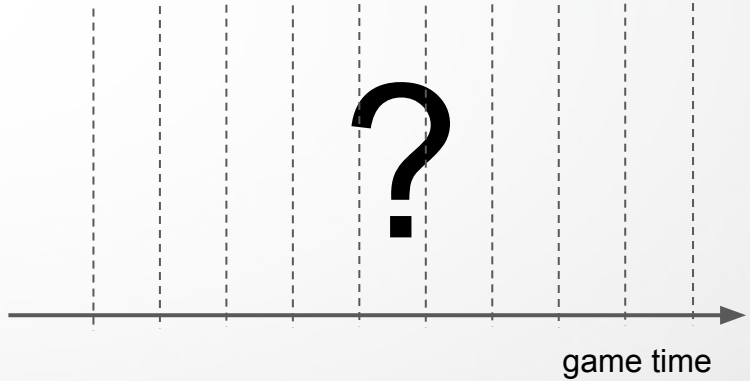
Bool

State



Float

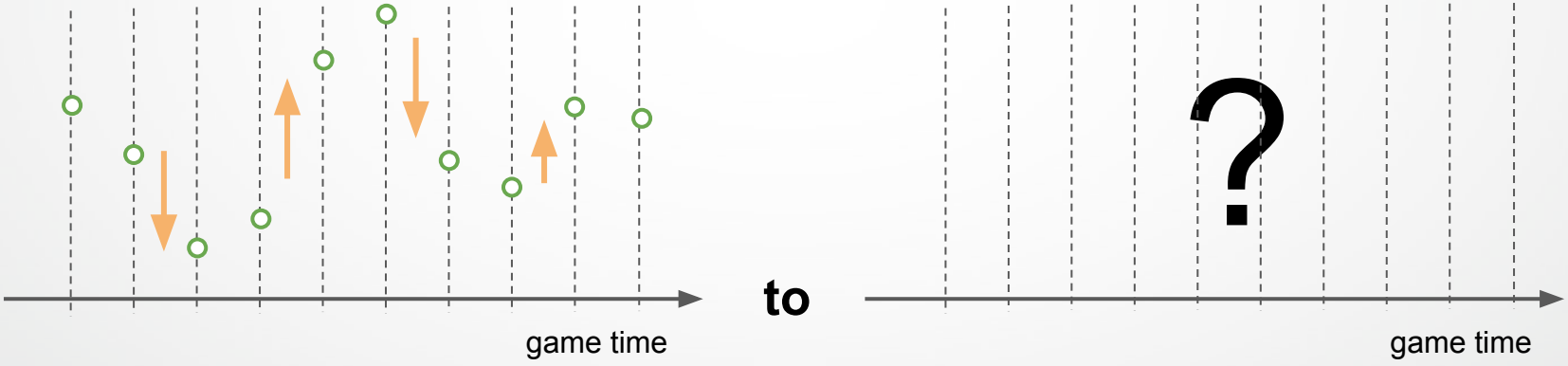
to



Bool

FeisStu

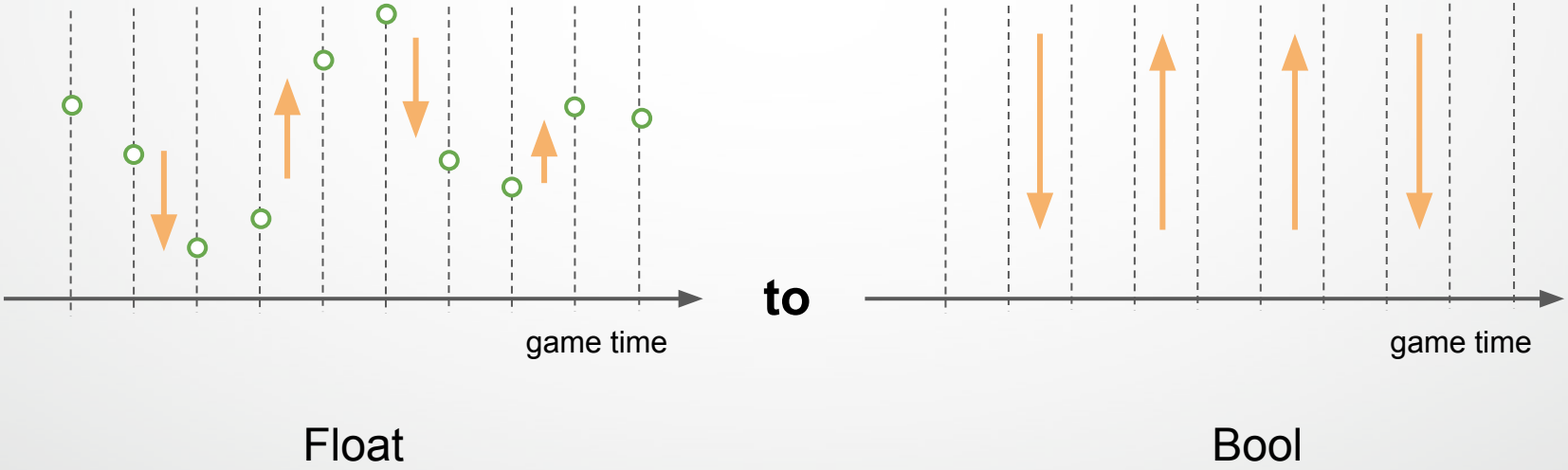
Gradient thresholding State → Event



Float Bool

Gradient thresholding

State → Event



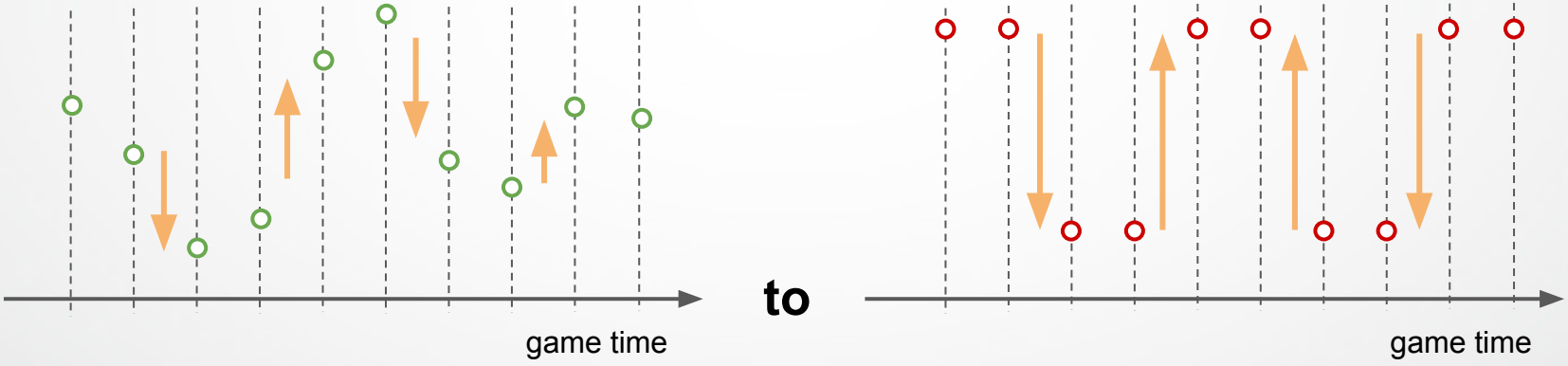
Float

Bool

FeisStu

Gradient thresholding

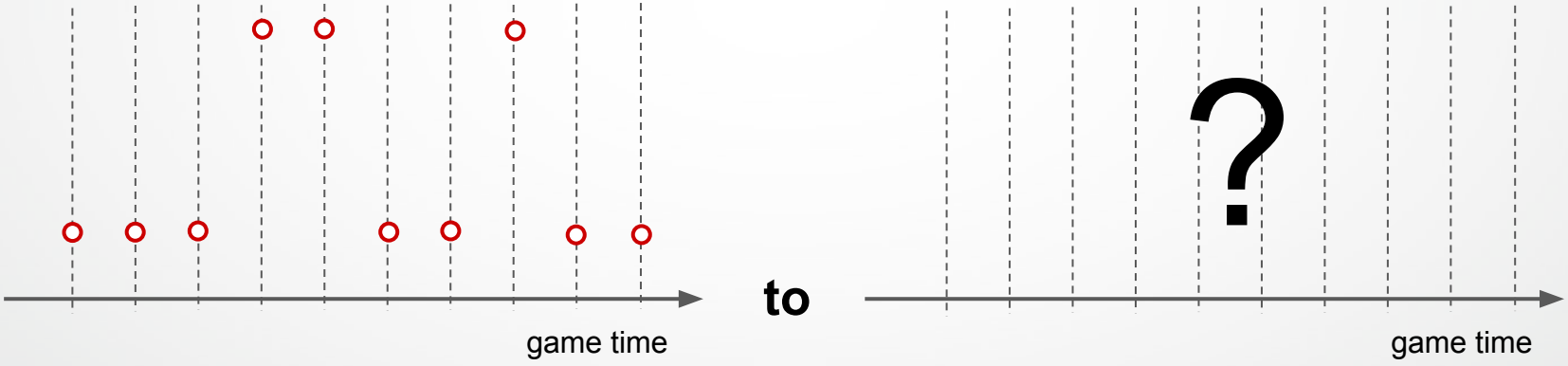
State → Event → State



Float

Bool

State

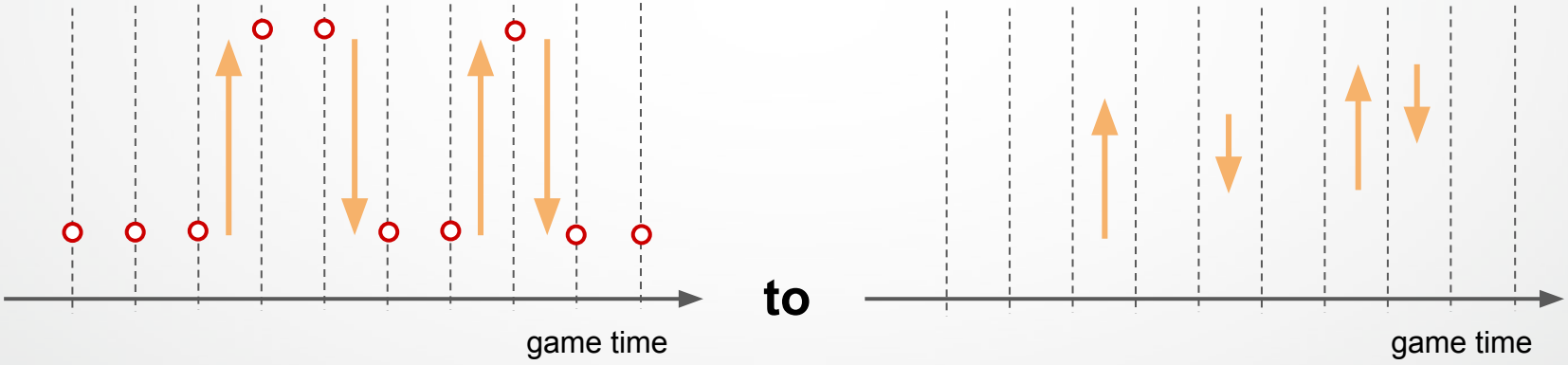


Bool

Float

FeisStu

State → Event

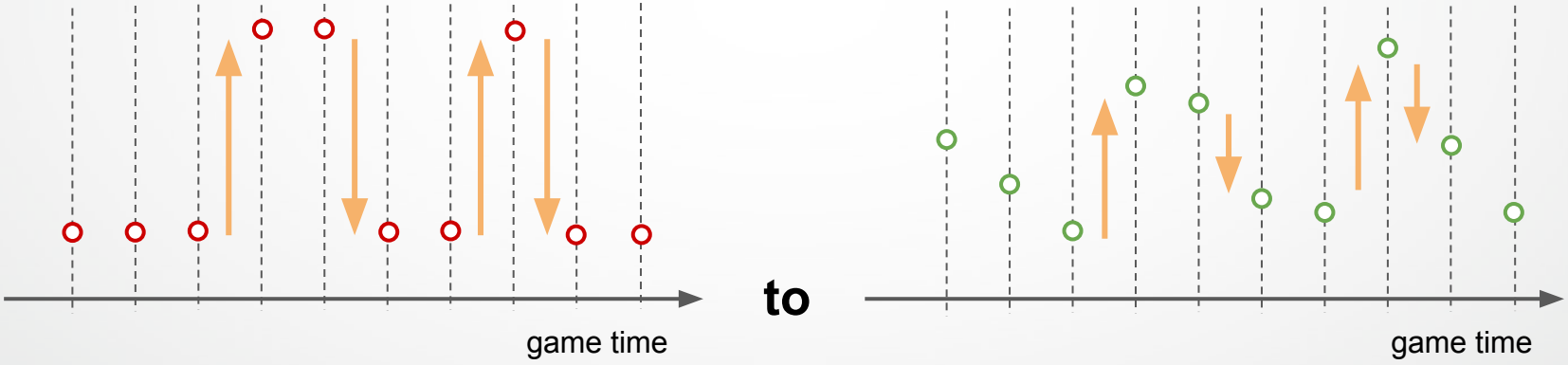


Bool

Float

FeisStu

State → Event → State



Bool

Float

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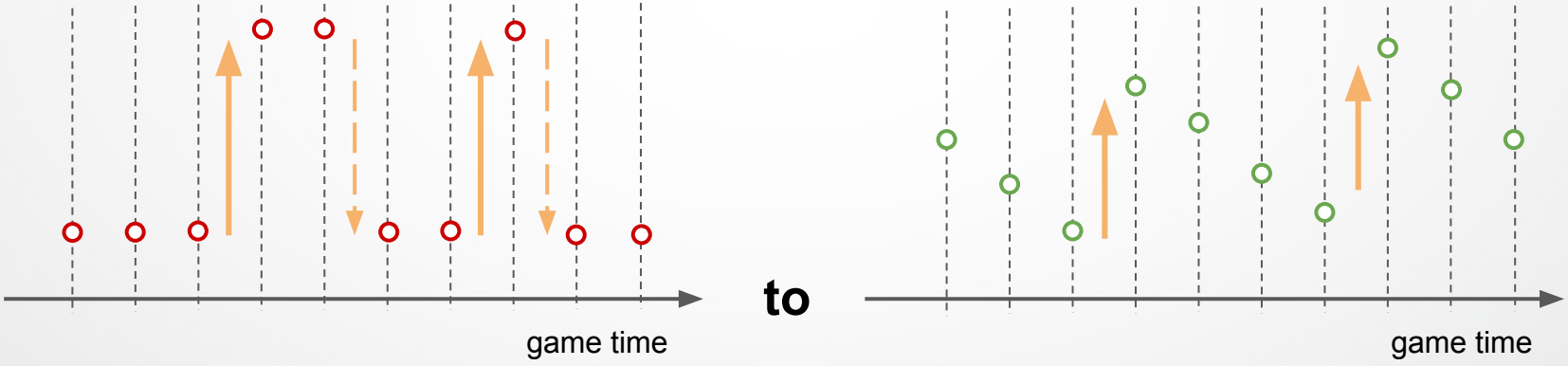
State → Event → State



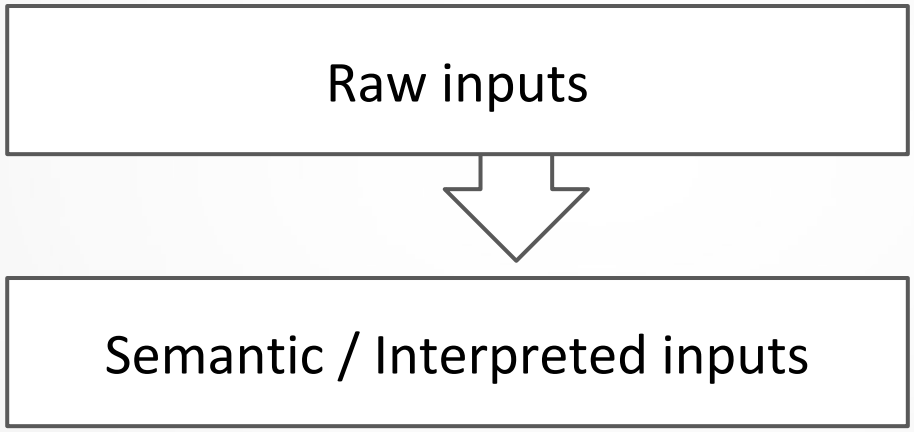
Bool

Float

FeisStu

Raw inputs

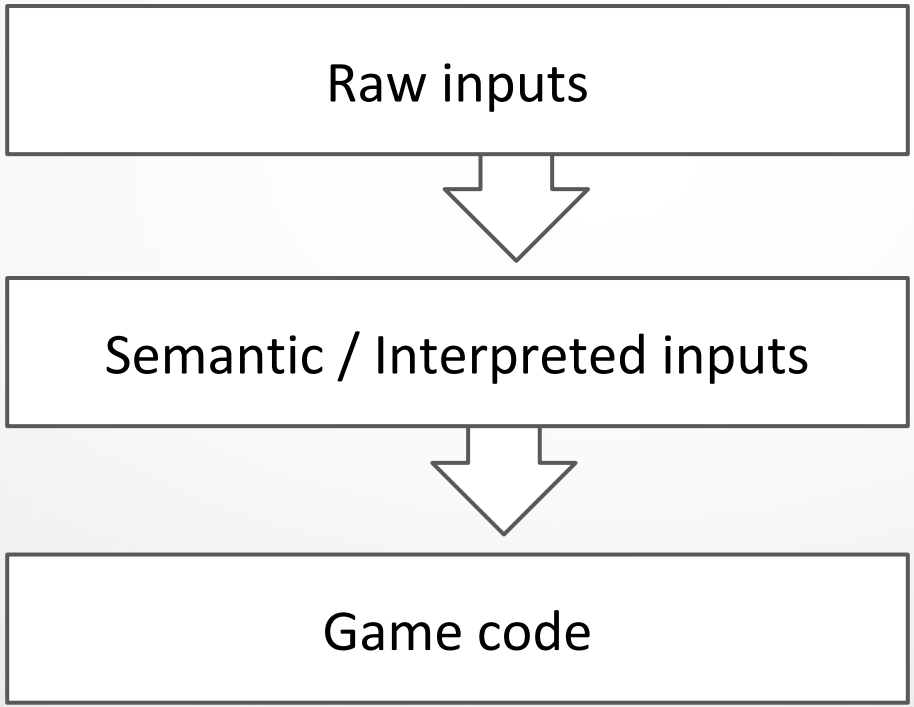
X-Axis,
Button A,
Button B



X-Axis,
Button A,
Button B

MoveHorizontal
Attack
Jump

FeisStu

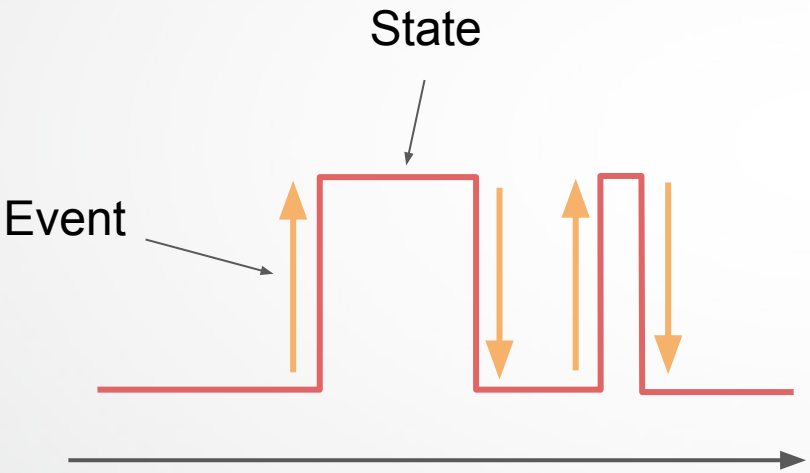


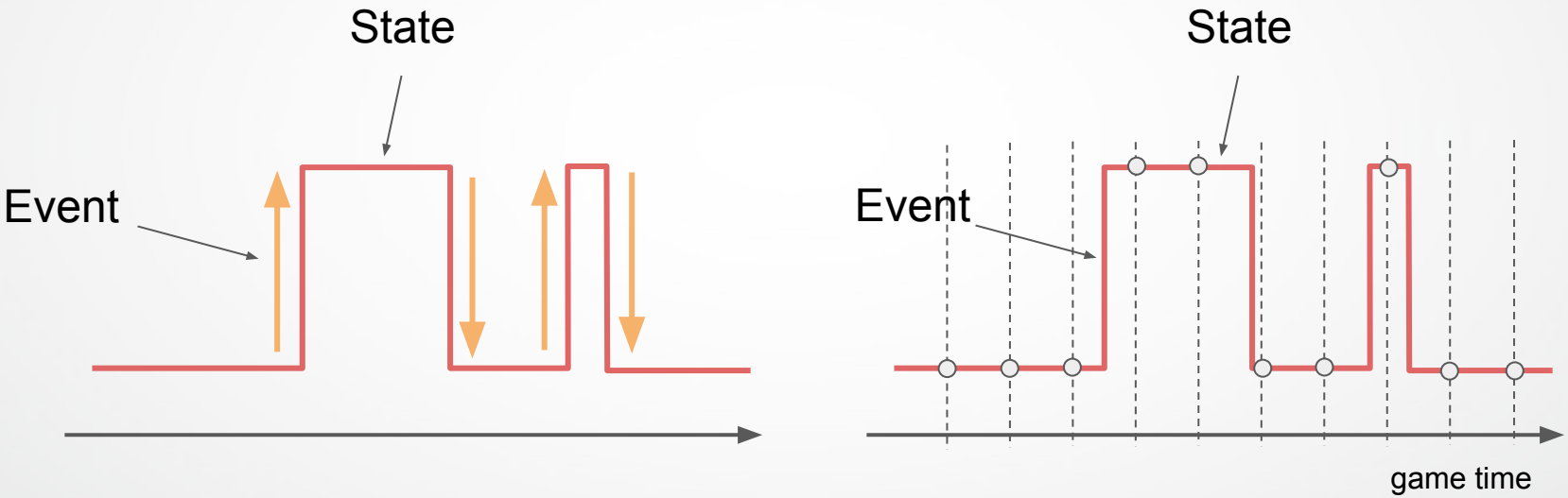
X-Axis,
Button A,
Button B

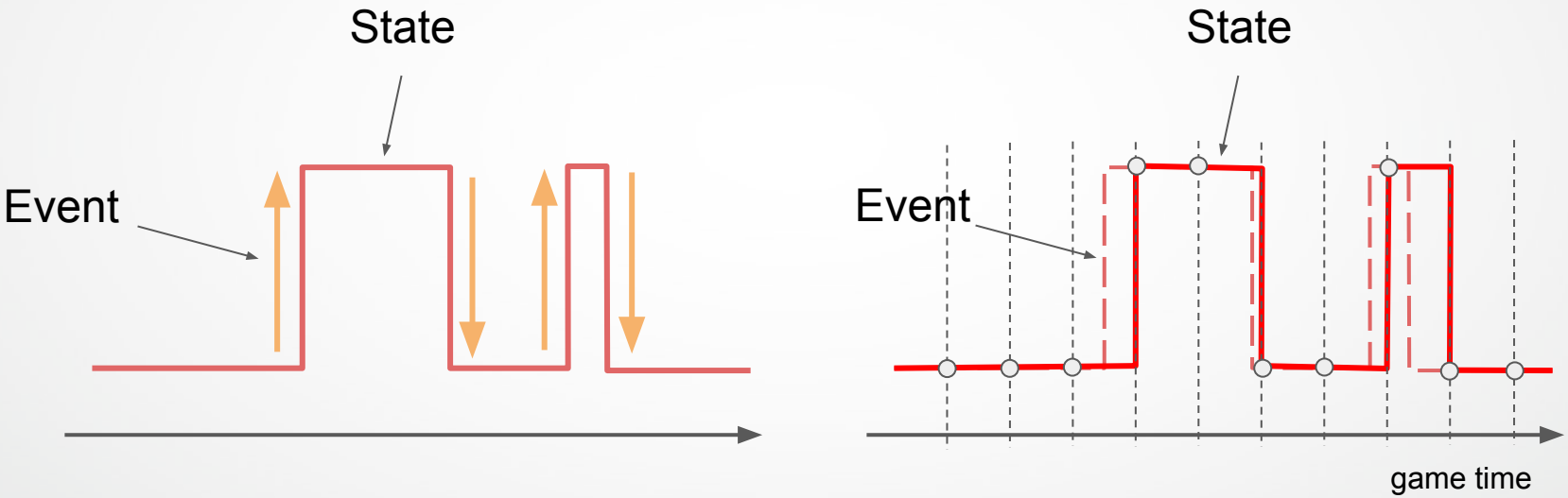
MoveHorizontal
Attack
Jump

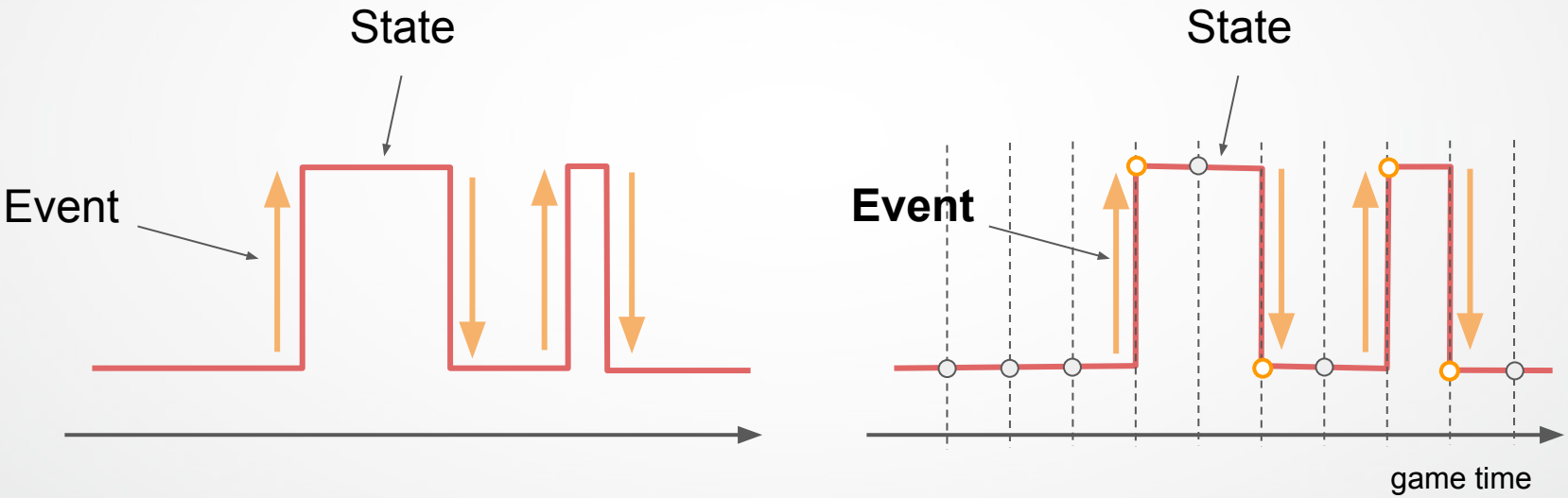
GetState("MoveHorizontal"),
OnEvent("Attack")
OnEvent("Jump")

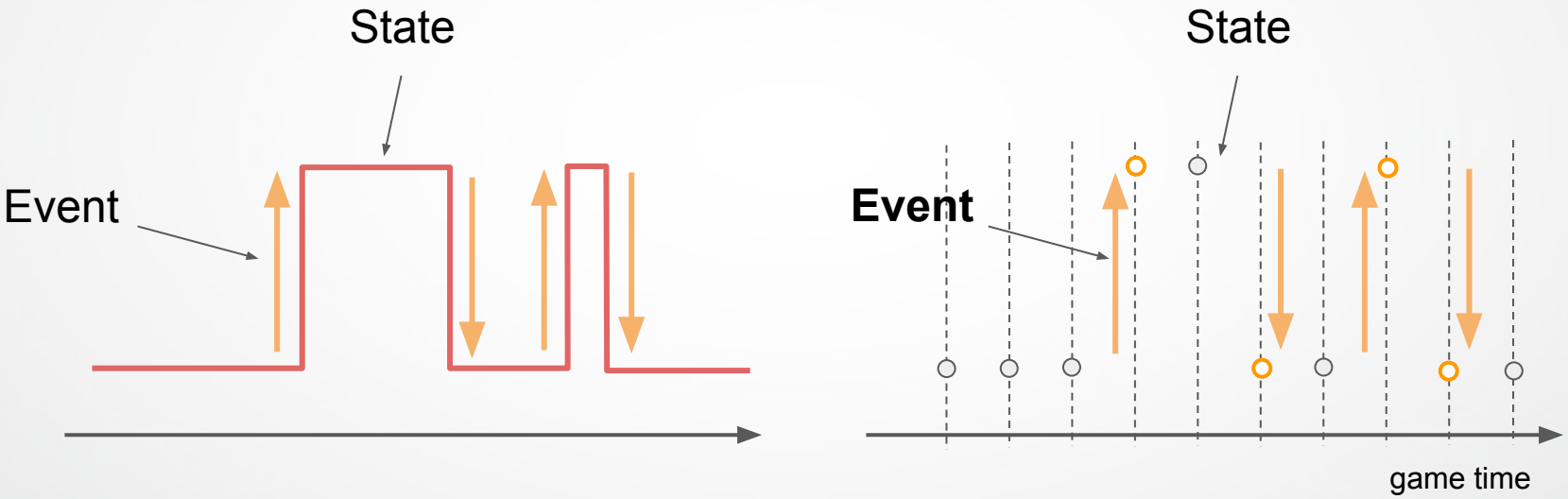
FeisStu

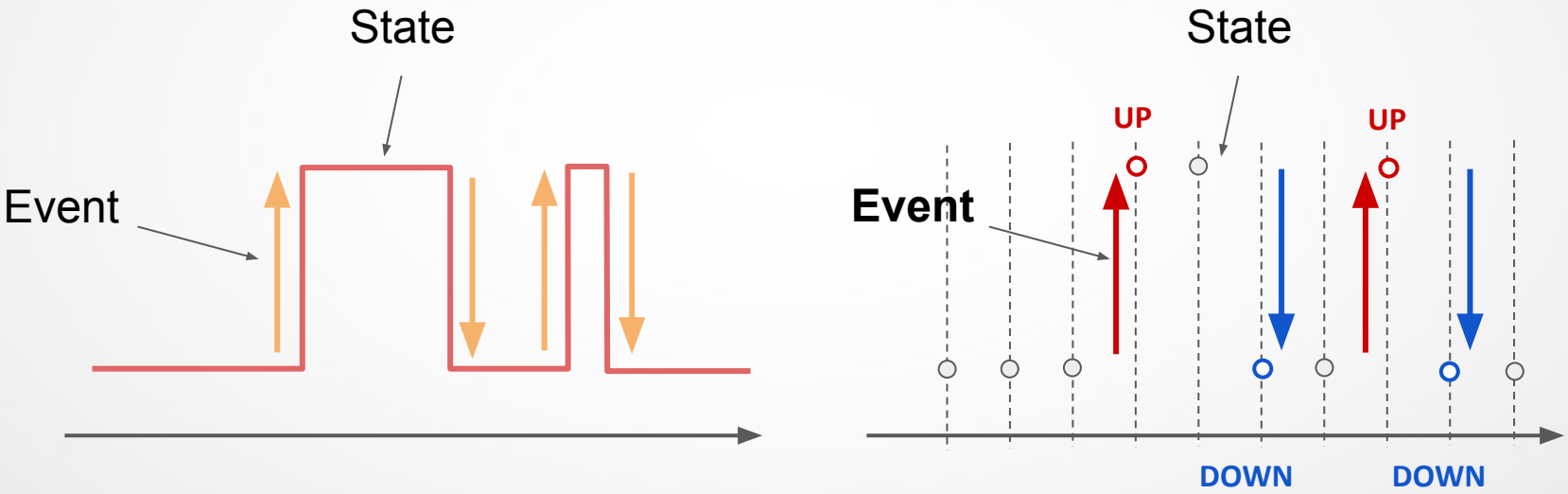

State
Event

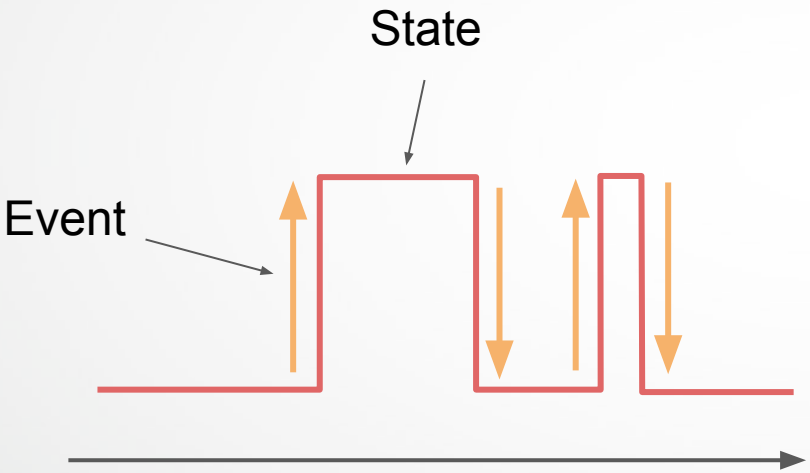

State
Event
State
Event
game time

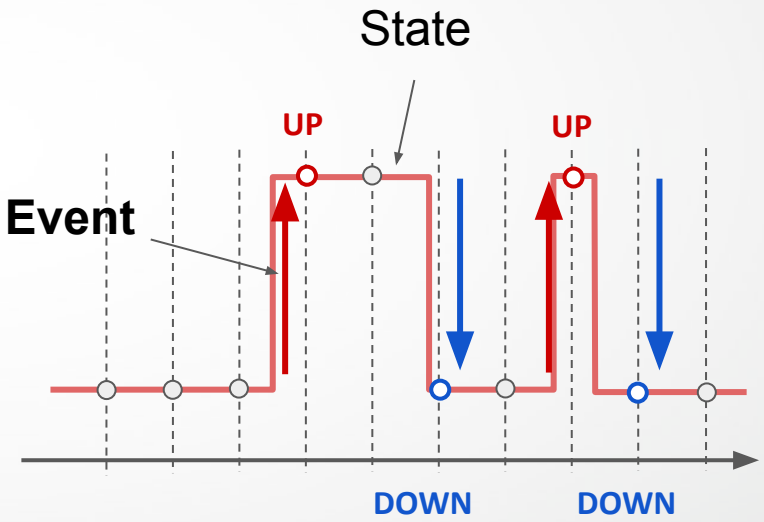

State
Event
State
Event
game time


State
Event
State
Event
game time


State
Event
State
Event
game time


State
Event
State
UP
UP
Event
DOWN
DOWN





FeisStu

UnityEngine.Input

GetAxis	Returns the value of the virtual axis identified by axisName.
GetAxisRaw	Returns the value of the virtual axis identified by axisName with no smoothing filtering applied.
GetButton	Returns true while the virtual button identified by buttonName is held down.
GetButtonDown	Returns true during the frame the user pressed down the virtual button identified by buttonName.
GetButtonUp	Returns true the first frame the user releases the virtual button identified by buttonName.
GetJoystickNames	Retrieves a list of input device names corresponding to the index of an Axis configured within Input Manager.
GetKey	Returns true while the user holds down the key identified by name.
GetKeyDown	Returns true during the frame the user starts pressing down the key identified by name.
GetKeyUp	Returns true during the frame the user releases the key identified by name.
GetMouseButton	Returns whether the given mouse button is held down.
GetMouseButtonDown	Returns true during the frame the user pressed the given mouse button.
GetMouseButtonUp	Returns true during the frame the user releases the given mouse button.

FeisStu

UnityEngine.Input

GetAxis **State**	Returns the value of the virtual axis identified by axisName.
GetAxisRaw	Returns the value of the virtual axis identified by axisName with no smoothing filtering applied.
GetButton	Returns true while the virtual button identified by buttonName is held down.
GetButtonDown	Returns true during the frame the user pressed down the virtual button identified by buttonName.
GetButtonUp **Event**	Returns true the first frame the user releases the virtual button identified by buttonName.
GetJoystickNames	Retrieves a list of input device names corresponding to the index of an Axis configured within Input Manager.
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UnityEngine.Input

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Event triggered in FixedUpdate() or Update() ?

FeisStu

UnityEngine.Input

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GetMouseButton	Returns whethe
GetMouseButtonDown	Returns true during the frame the user pressed the given mouse button.
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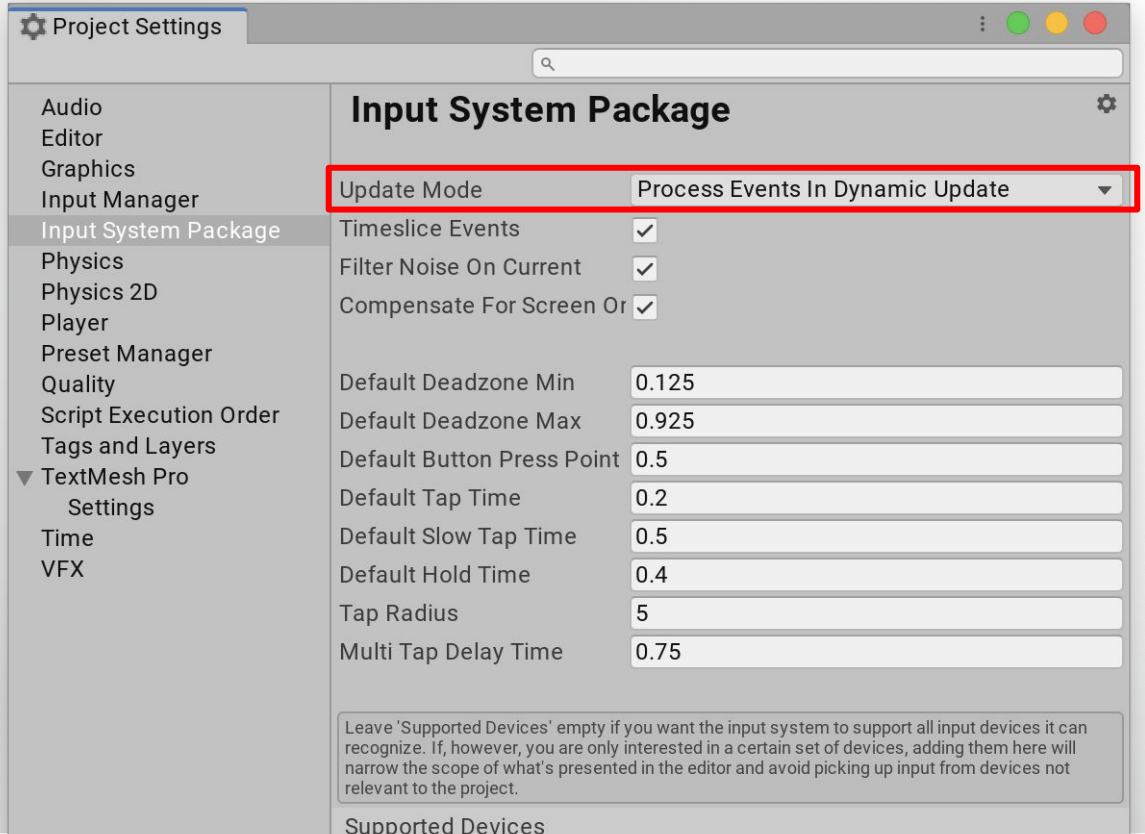
Event triggered in Update()

FeisStu

Input System Package (in Dev)



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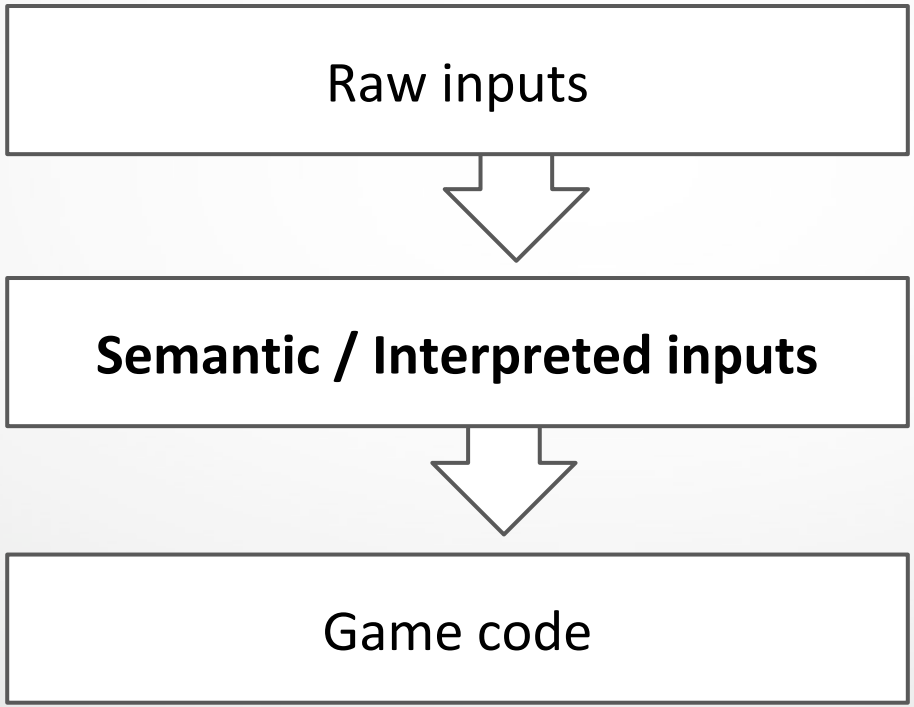


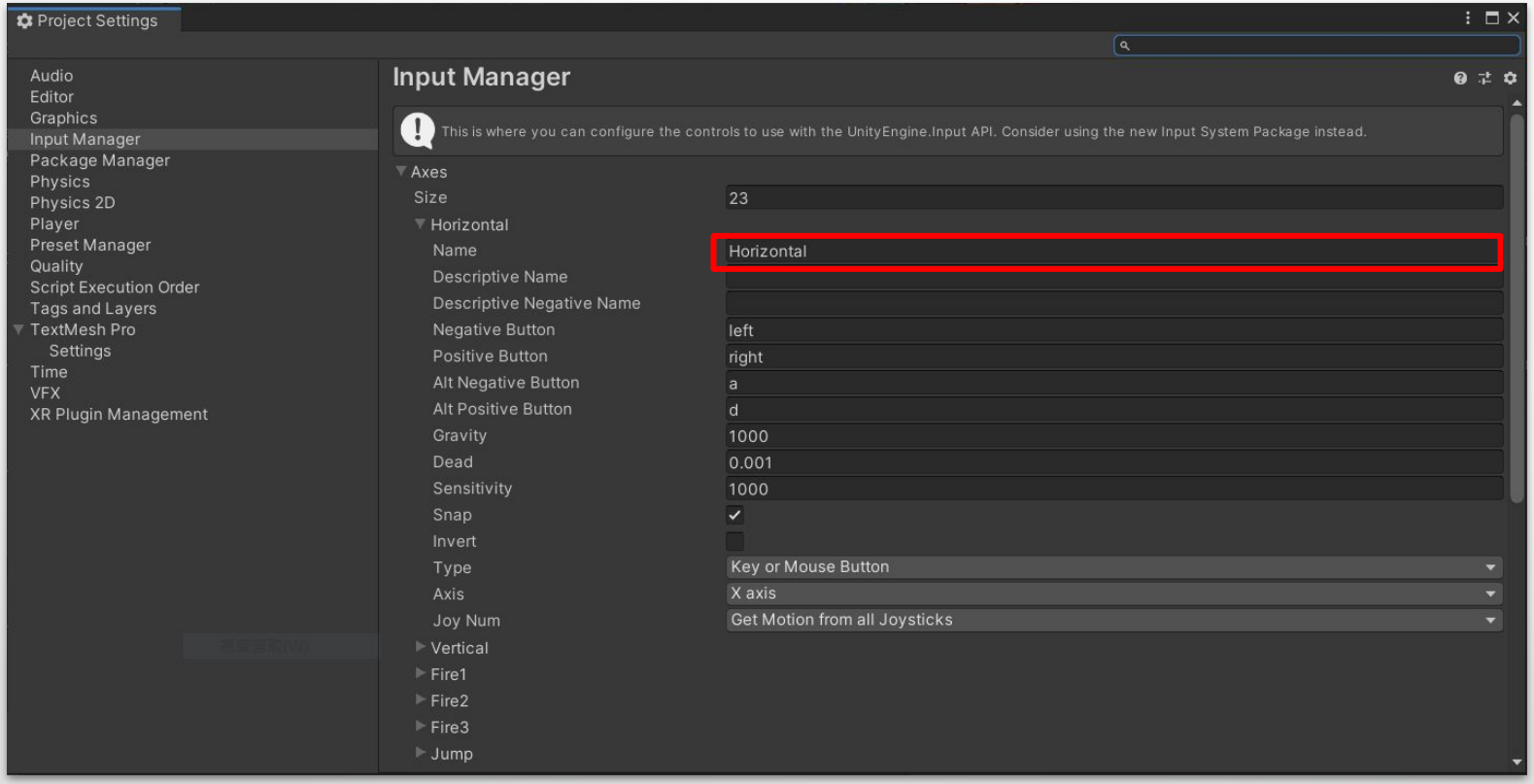
X-Axis,
Button A,
Button B

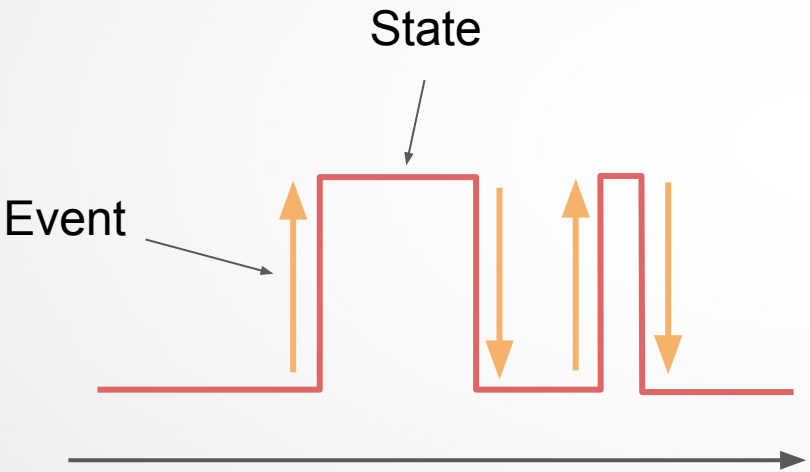
MoveHorizontal
Attack
Jump

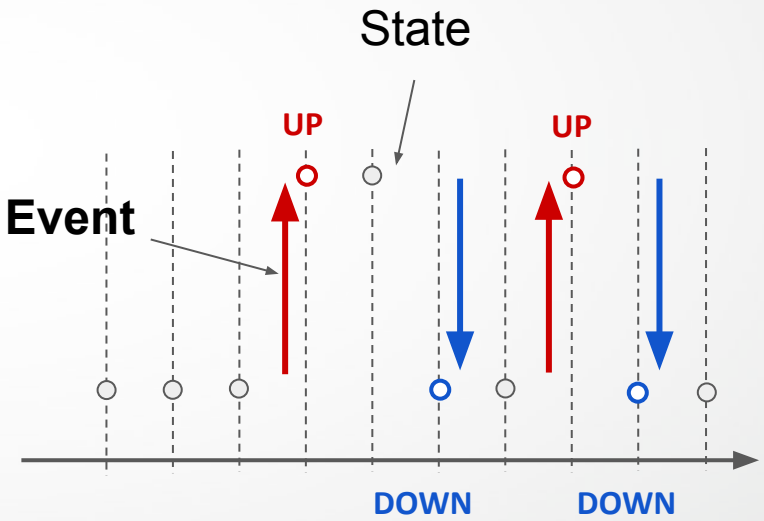
GetState("MoveHorizontal"),
OnEvent("Attack")
OnEvent("Jump")

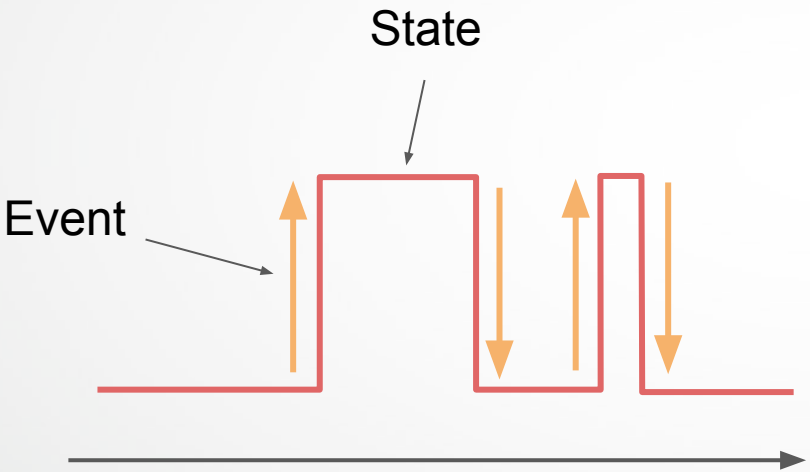
FeisStu

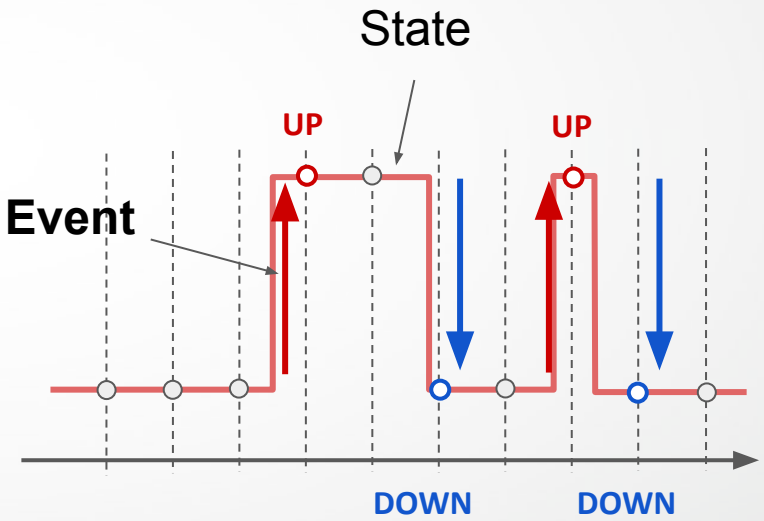
Project Settings > InputManager (Legacy)




State
Event


State
UP
UP
Event
DOWN
DOWN





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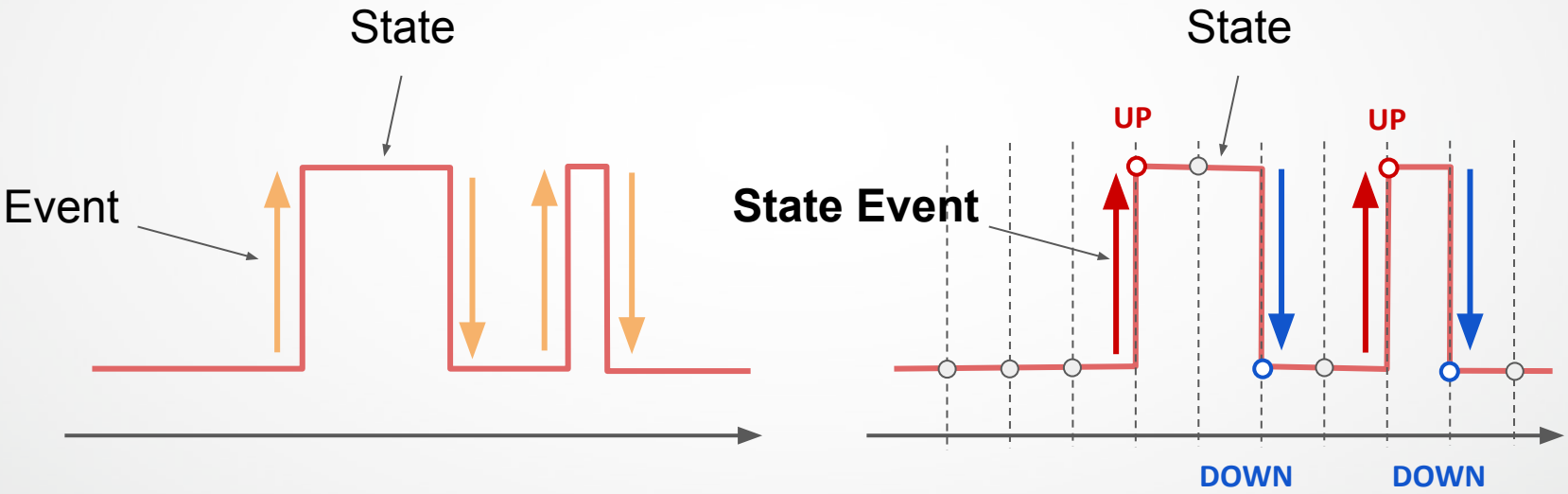
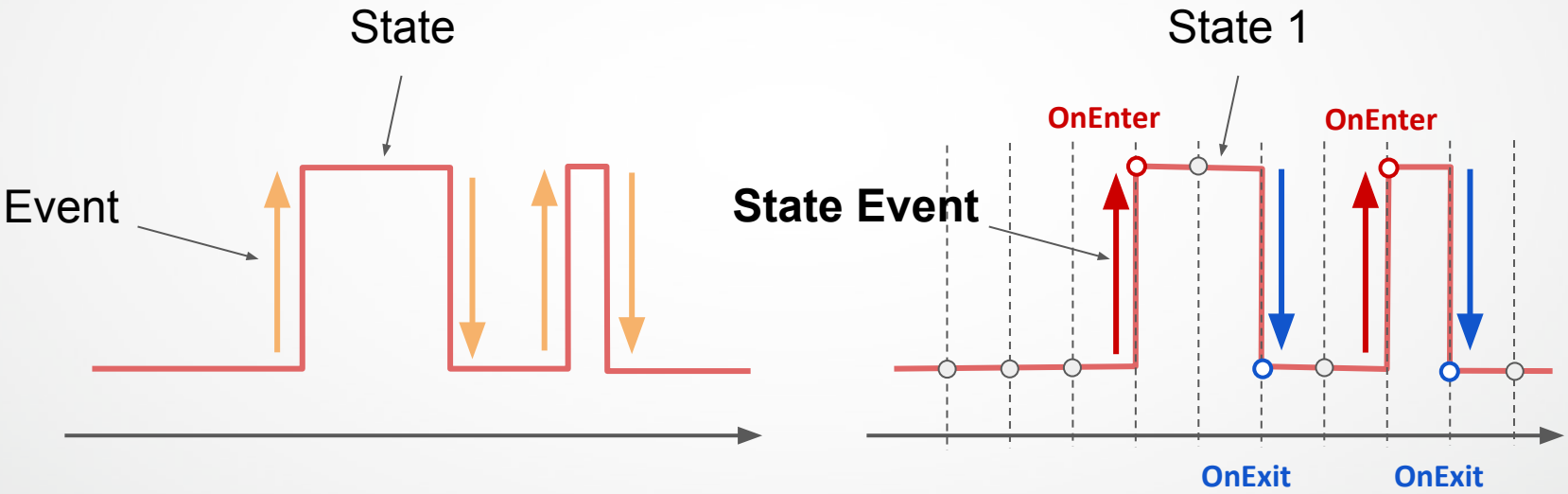
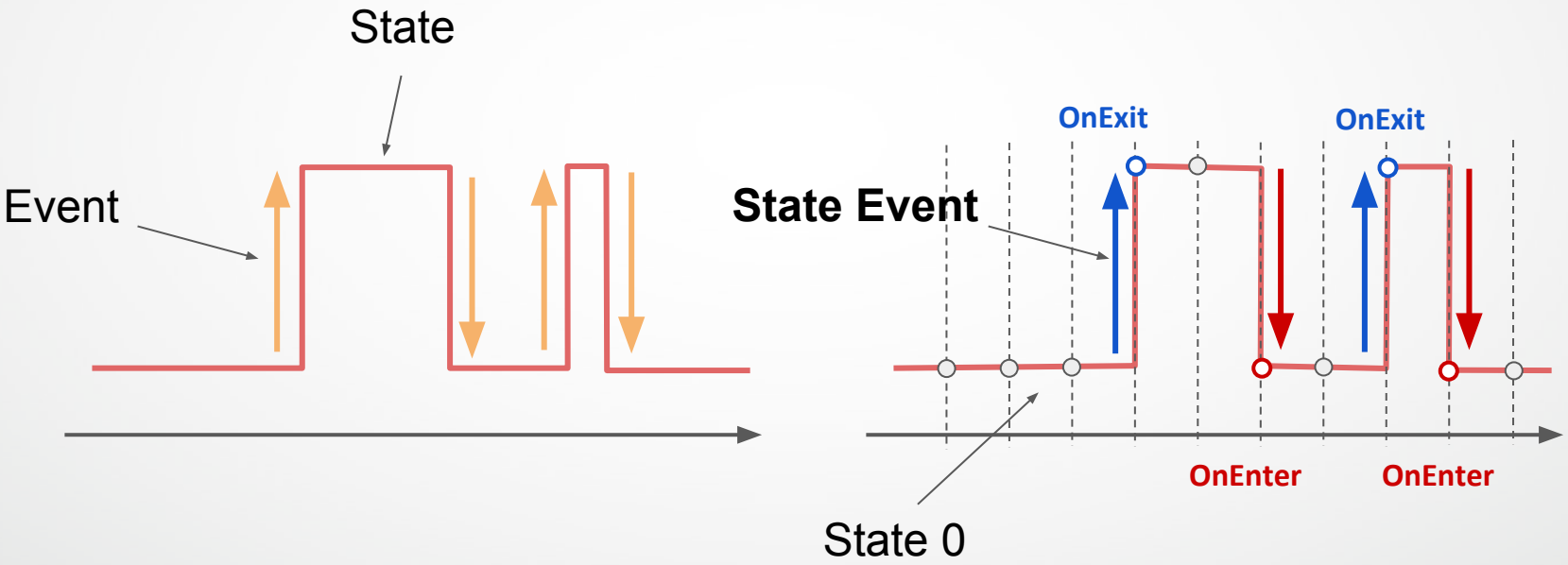
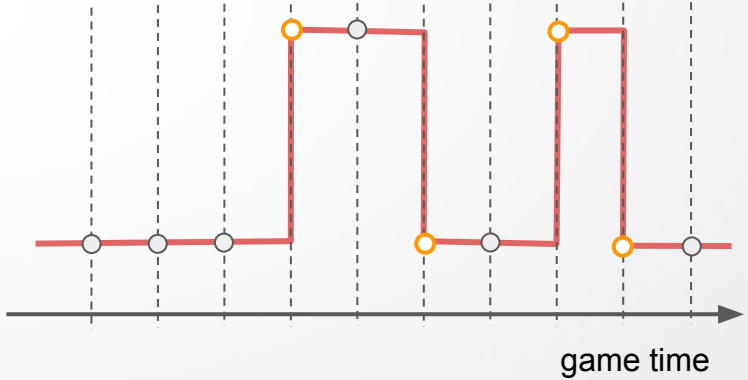

State
Event
State
State Event
UP
UP
DOWN
DOWN

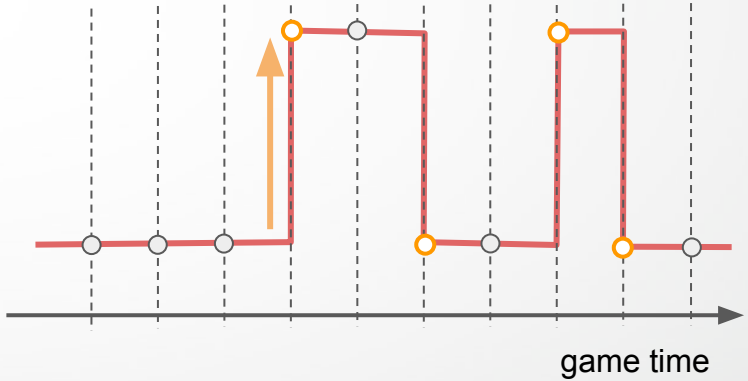

State
Event
State 1
OnEnter
OnEnter
State Event
OnExit
OnExit


State
Event
State Event
OnExit
OnExit
OnEnter
OnEnter
State 0

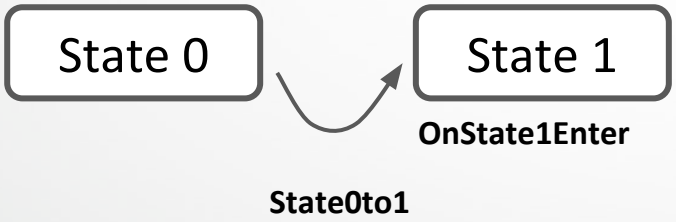
State 0

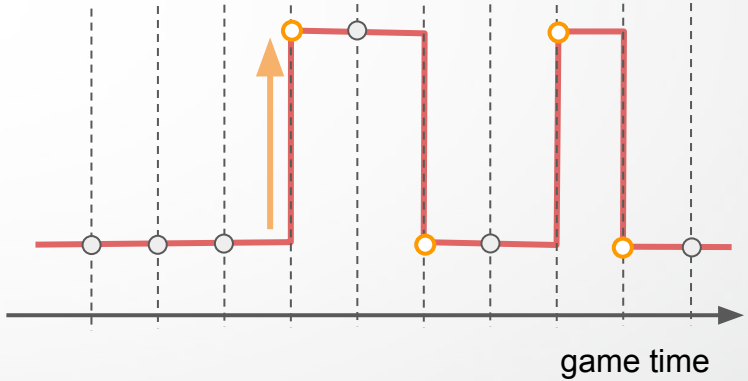
State 1



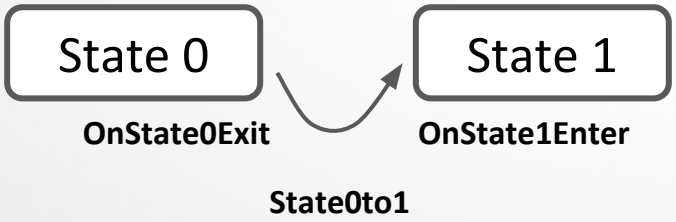


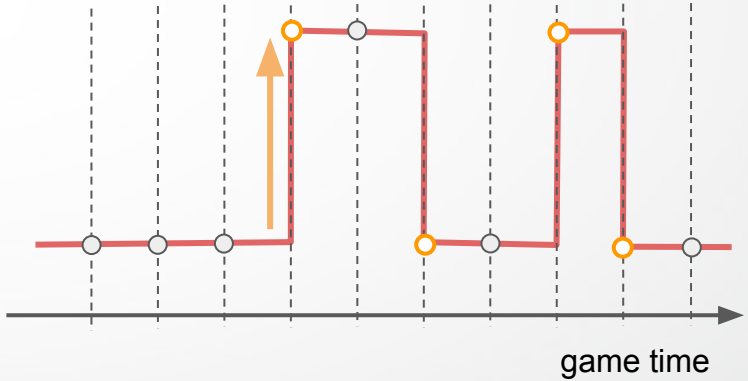
FeisStu

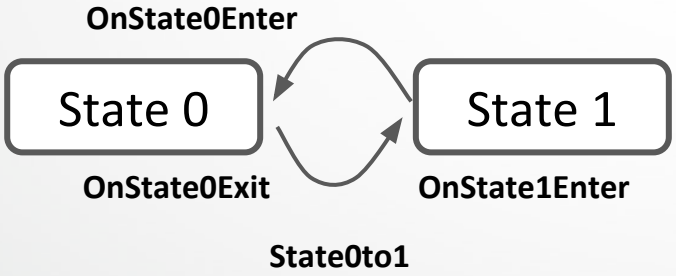


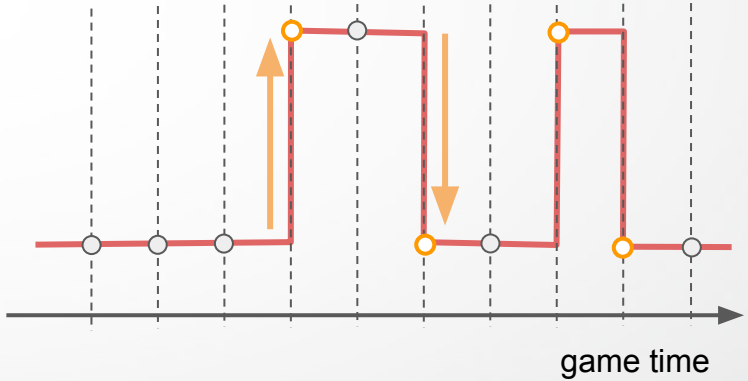


FeisStu

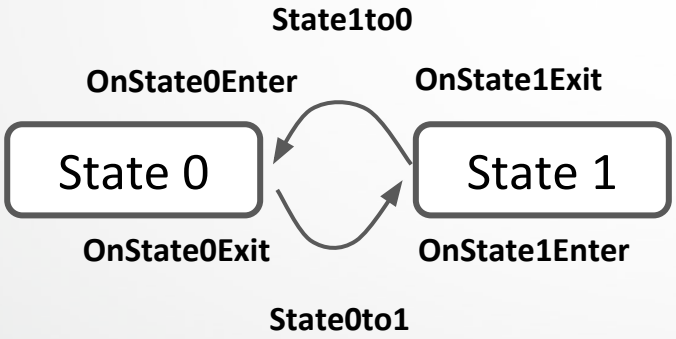

State 0
State 1
OnState0Exit
OnState1Enter
State0to1

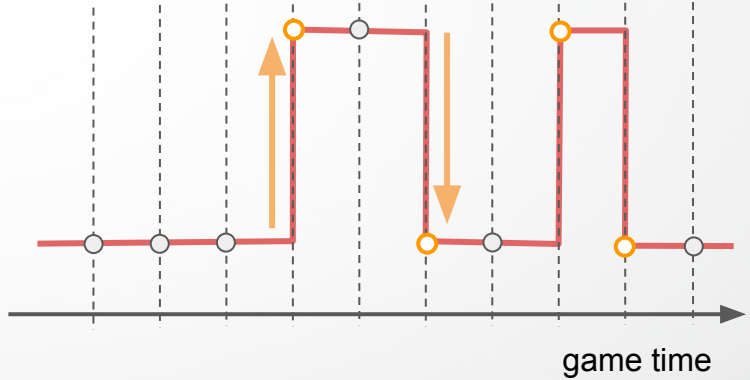

game time


OnState0Enter
State 0
State 1
OnState0Exit
OnState1Enter
State0to1


game time

FeisStu


State1to0
OnState0Enter
OnState1Exit
State 0
State 1
OnState0Exit
OnState1Enter
State0to1


game time

How many button states ?

How many button states ?

Normal

Pressed

How many button states ?

Normal

Pressed

`onMouseDown`

`onMouseEnter`

`onMouseOver`

FeisStu

How many button states ?

Normal

Pressed

`onMouseDown`

`onMouseUp ?`

`onMouseEnter`

`onMouseOver`

FeisStu

How many button states ?

Normal

Pressed

Highlighted

`onMouseDown`

`onMouseUp`

`onMouseEnter`

`onMouseExit`

`onMouseDrag`

`onMouseOver`

FeisStu

How many button states ?

Normal

Pressed

Highlighted

Disabled

`onMouseDown`

`onMouseUp`

`onMouseEnter`

`onMouseExit`

`onMouseDrag`

`onMouseOver`

FeisStu

How many button states ?

Normal

Pressed

Highlighted

Disabled

Clicked ?

`onMouseDown`

`onMouseUp`

`onMouseEnter`

`onMouseExit`

`onMouseDrag`

`onMouseOver`

FeisStu

How many button states ?

Normal

Pressed

Highlighted

Disabled

Clicked ?

onMouseDown

onMouseUp

onMouseUpAsButton

onMouseEnter

onMouseExit

onMouseDrag

onMouseOver

FeisStu

How many button states ?

Normal

Pressed

Highlighted

Disabled

Clicked ?

`onMouseDown`

`onMouseUp`

`onMouseUpAsButton`

`onMouseEnter`

`onMouseExit`

`onMouseDrag`

`onMouseOver`

FeisStu

How many button states ?

Normal

Pressed

Highlighted

Disabled

Clicked ?

`onMouseDown`

`onMouseUp`

`onMouseUpAsButton`

`onMouseEnter`

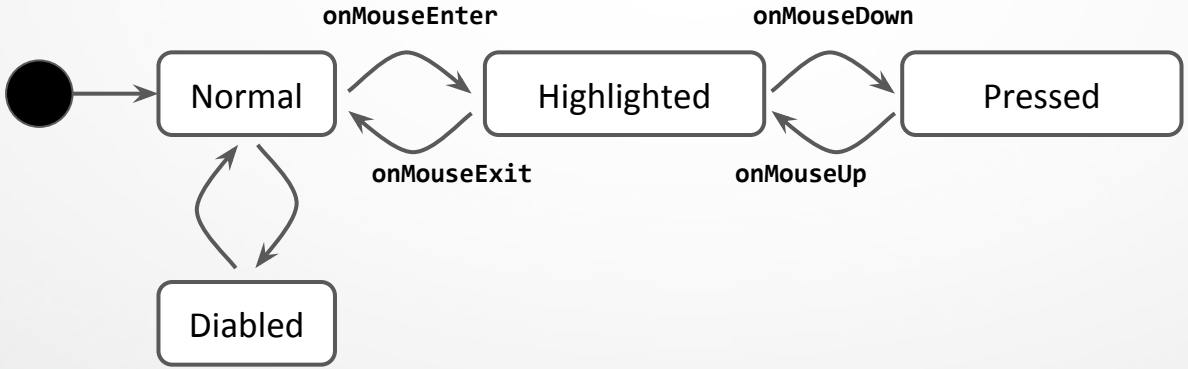
`onMouseExit`

`onMouseDrag`

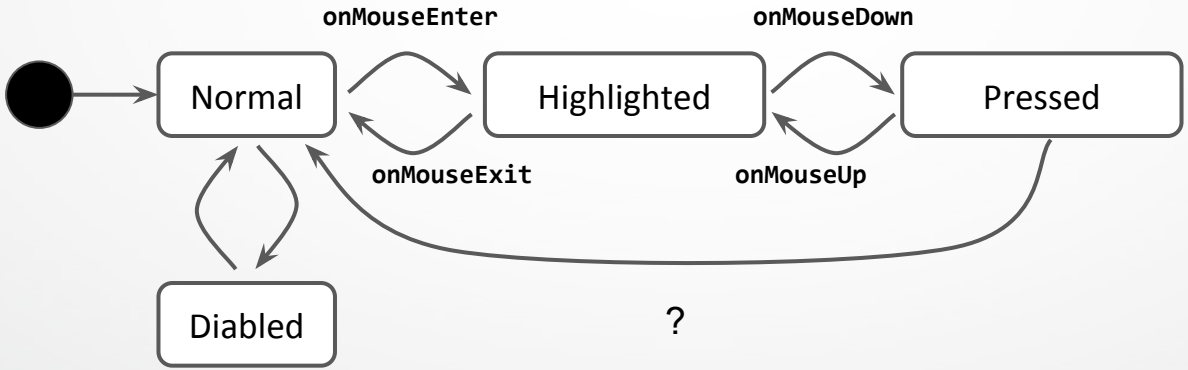
`onMouseOver`

FeisStu

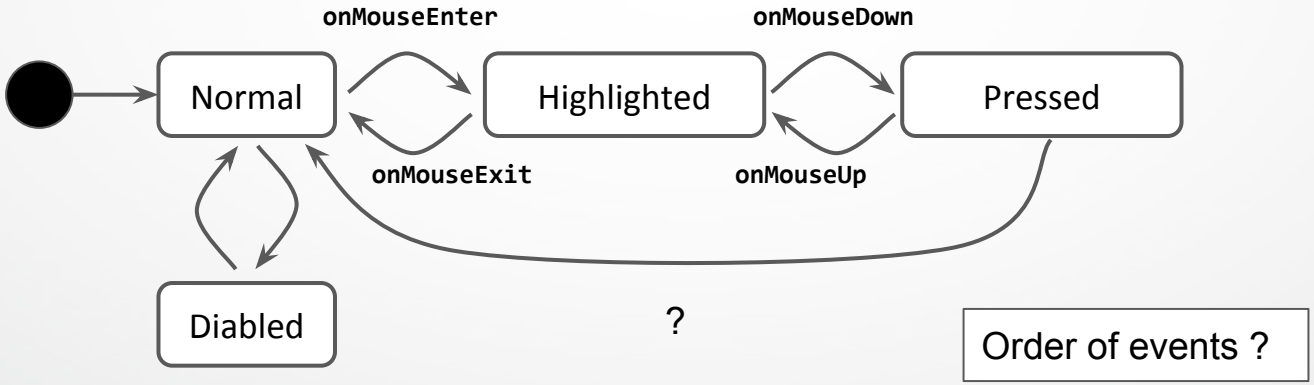
Finite-state machine



Finite-state machine



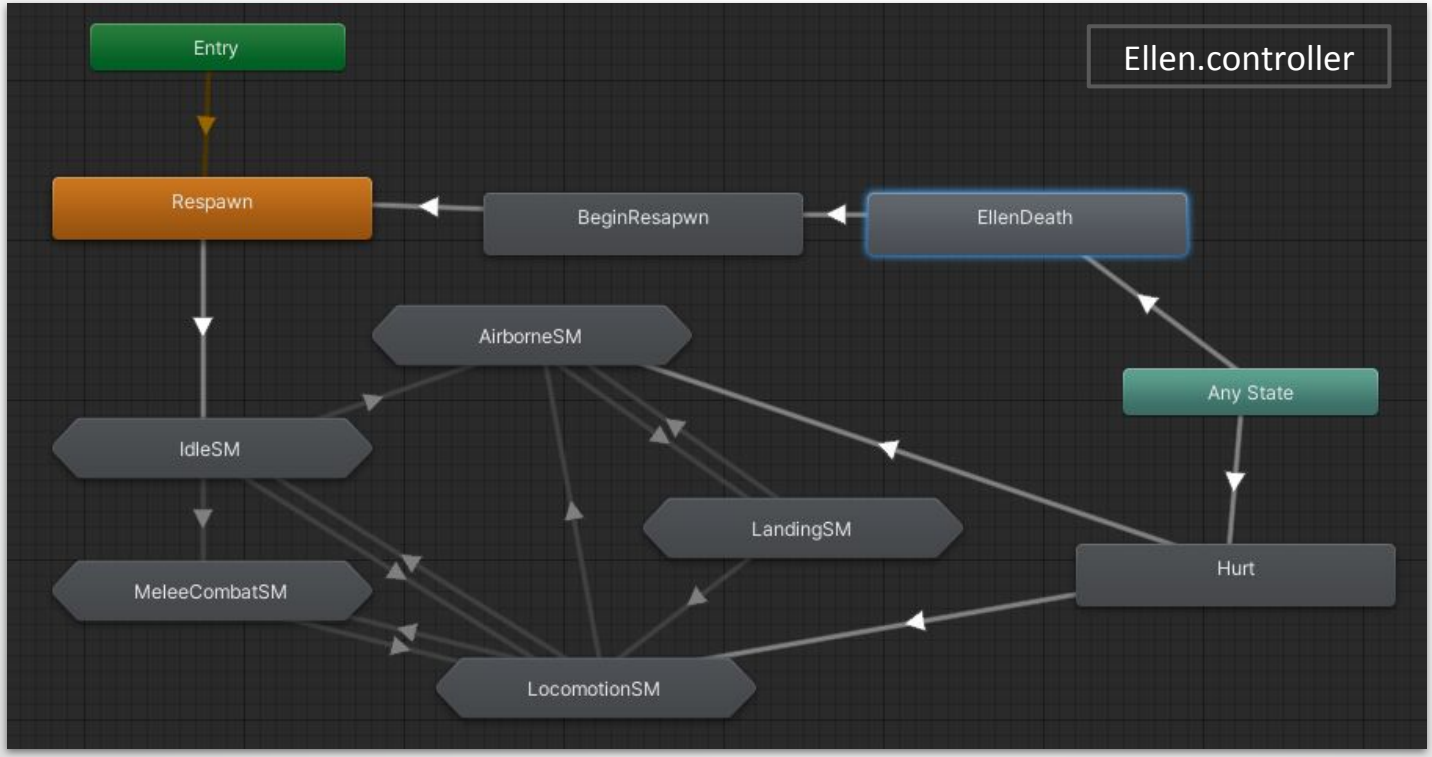
Finite-state machine



FeisStu

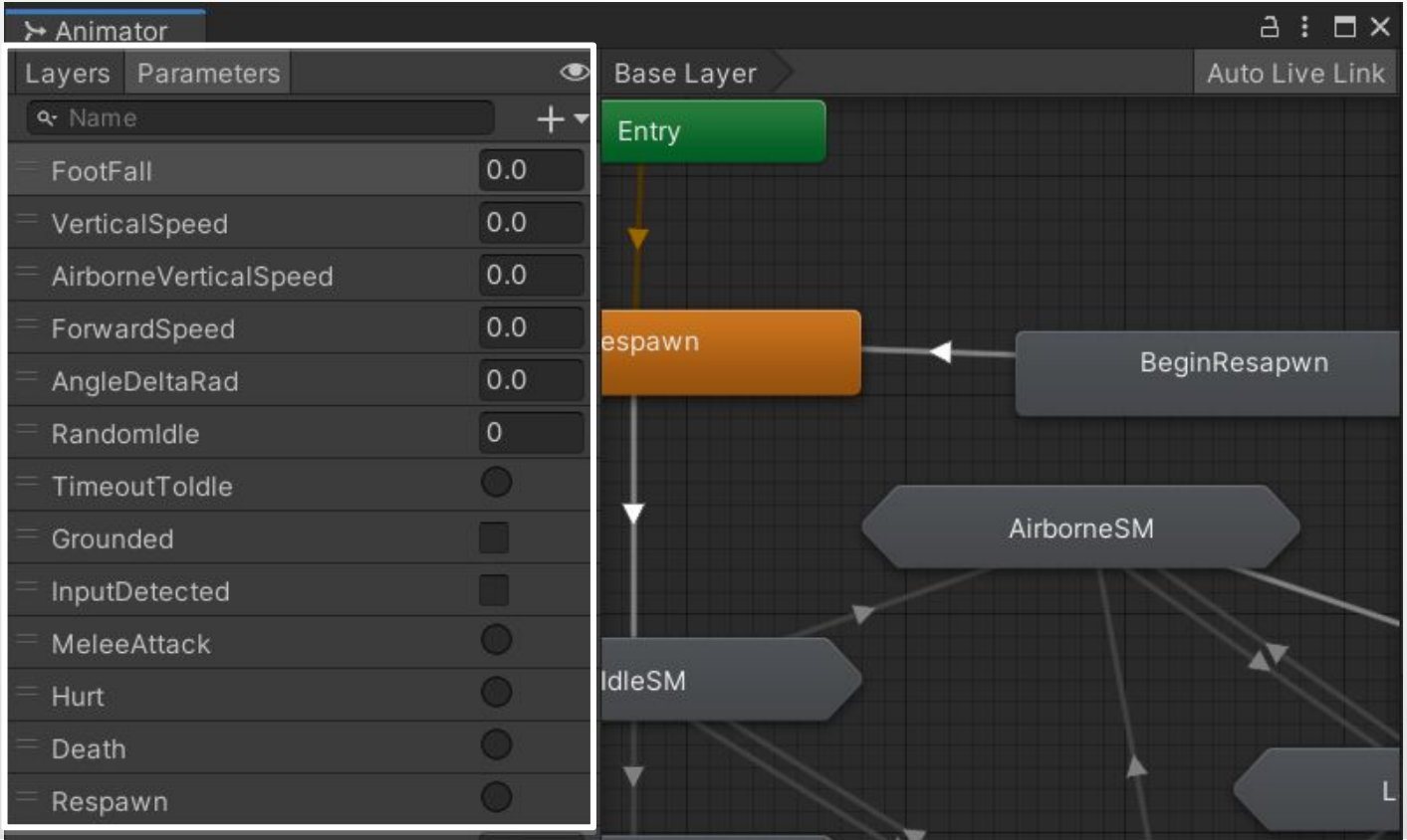

unity Learn
3D Game Kit

Animator Controller

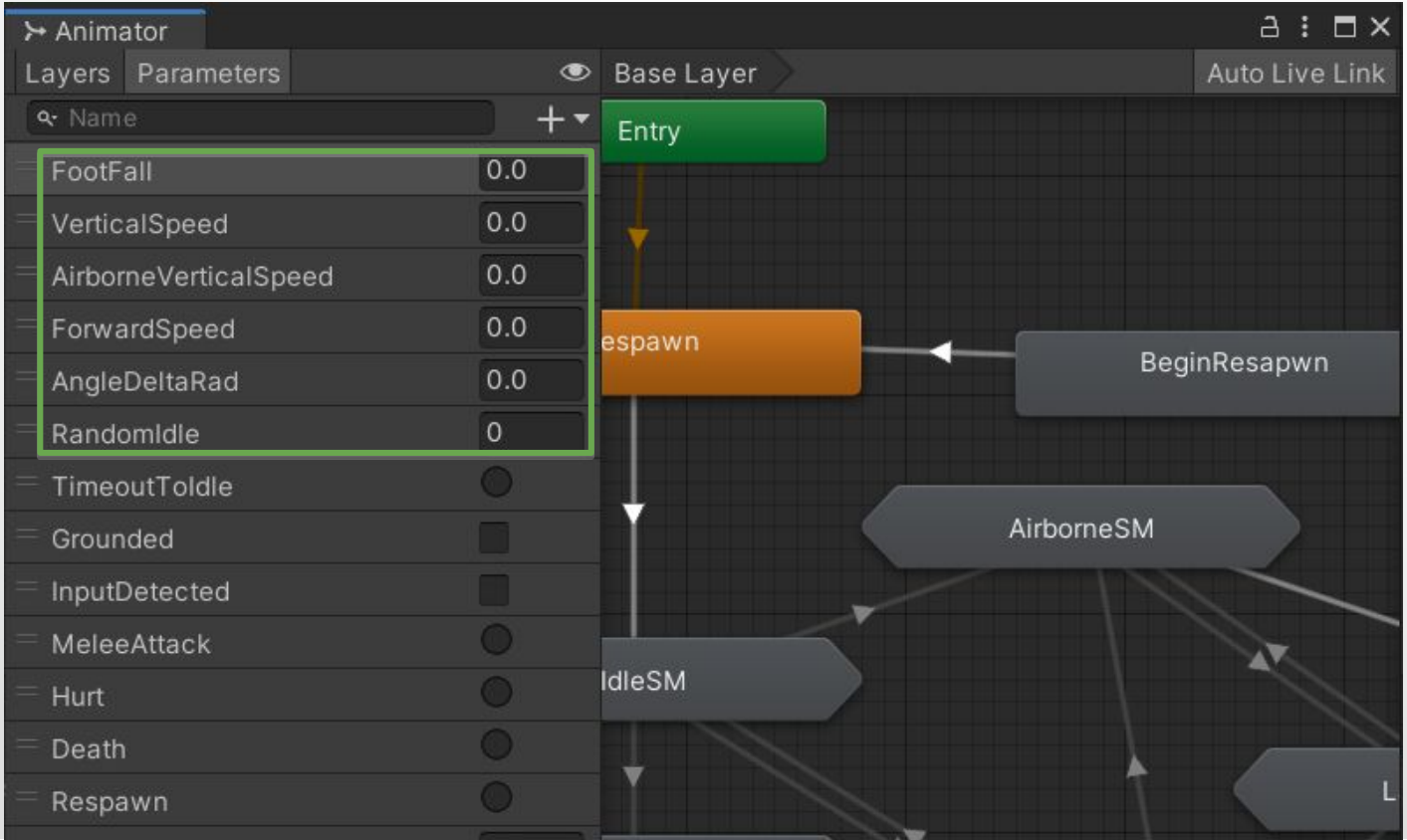


FeisStu

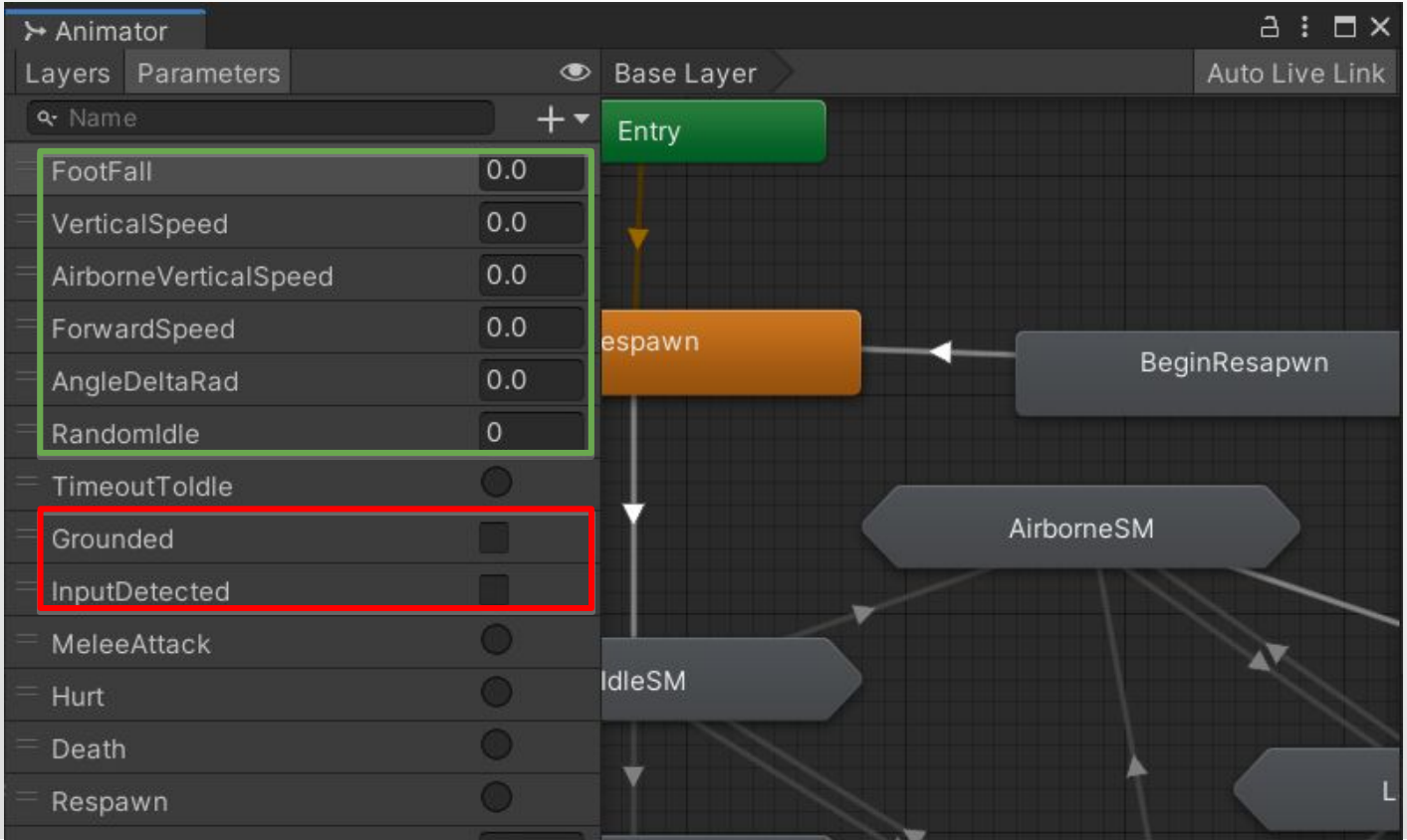
Animator Parameters



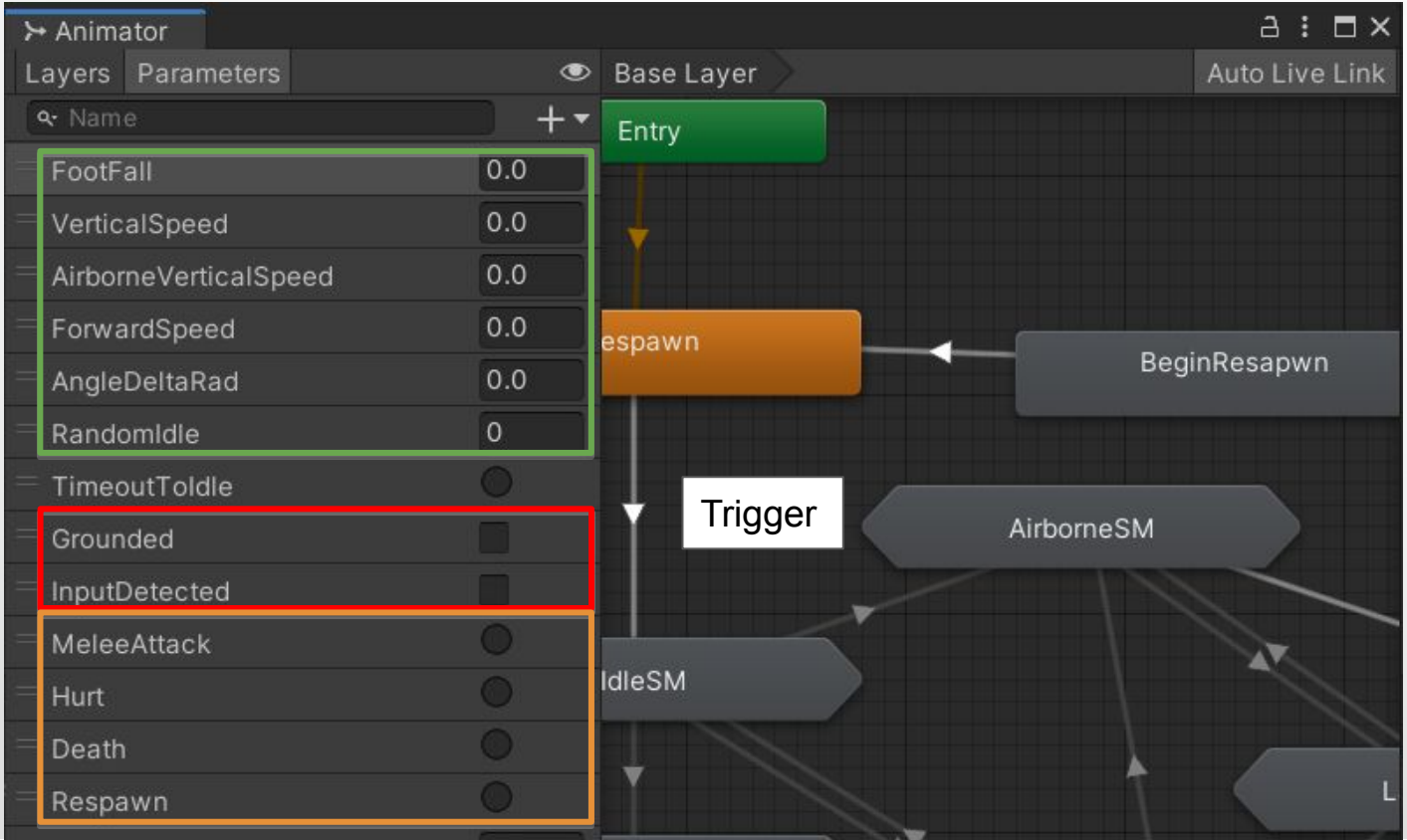
Animator Parameters



Animator Parameters



Animator Parameters

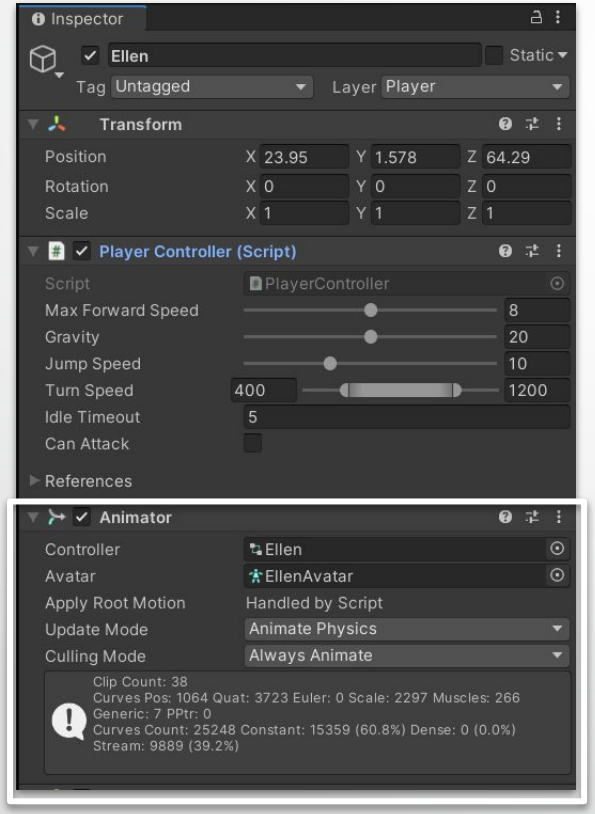


UnityEngine.Animator

SetBool	Sets the value of the given boolean parameter.
SetFloat	Send float values to the Animator to affect transitions.
SetInteger	Sets the value of the given integer parameter.
SetTrigger	Sets the value of the given trigger parameter.

FeisStu

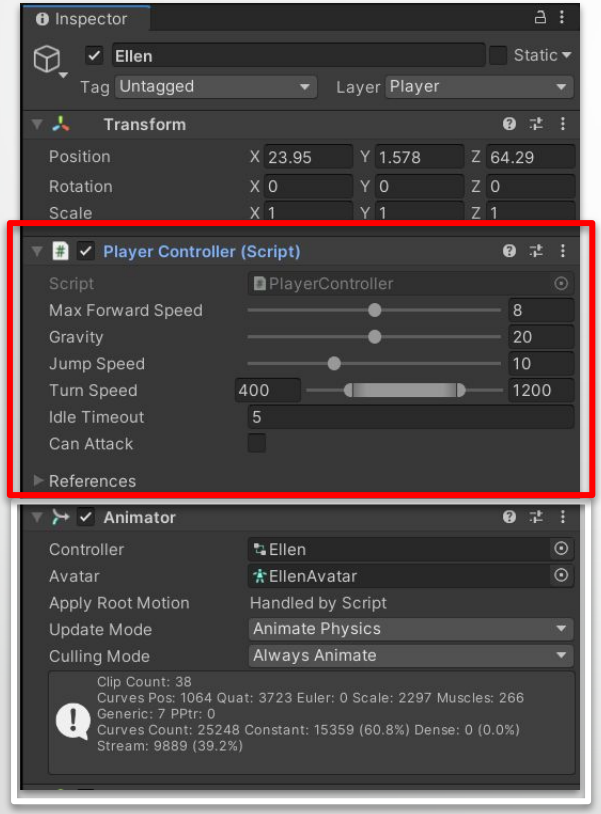
Control the animator with your custom script



Animator

FeisStu

Control the animator with your custom script

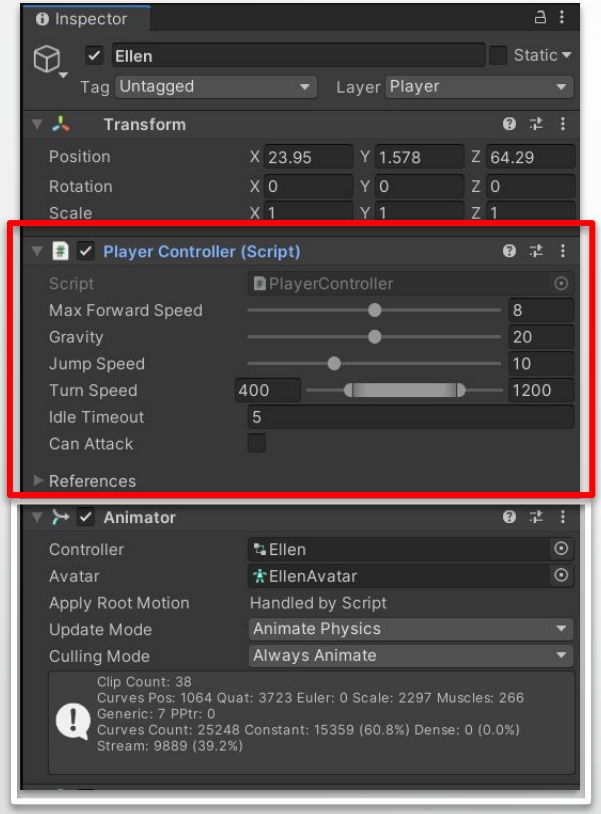


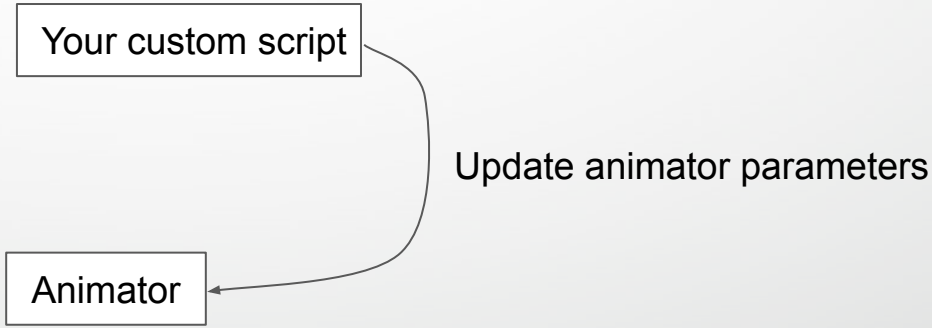
Your custom script

Animator

FeisStu

Control the animator with your custom script





FeisStu

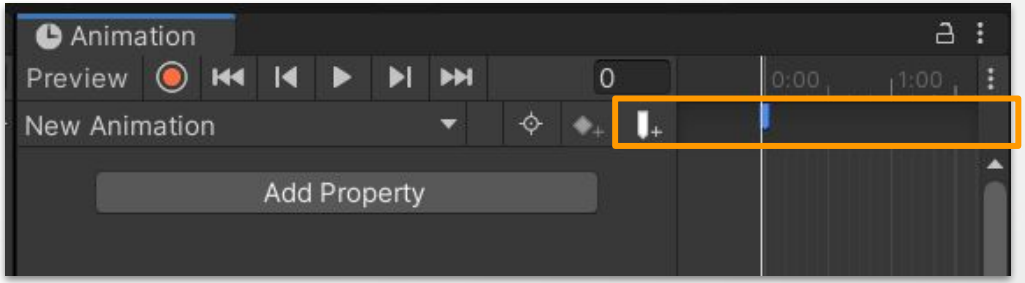
Animation event

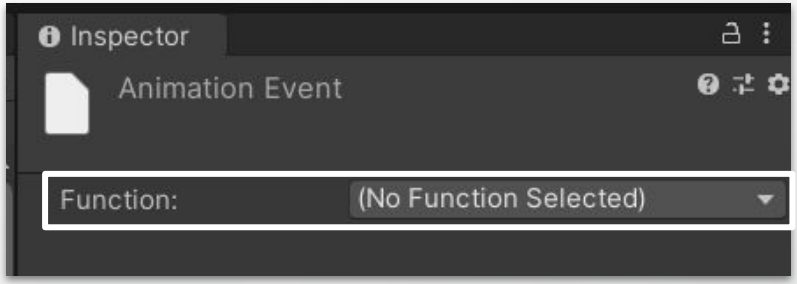
FBX Importer Settings (Inspector) (.fbx)

Animation event

FBX Importer Settings (Inspector) (.fbx)

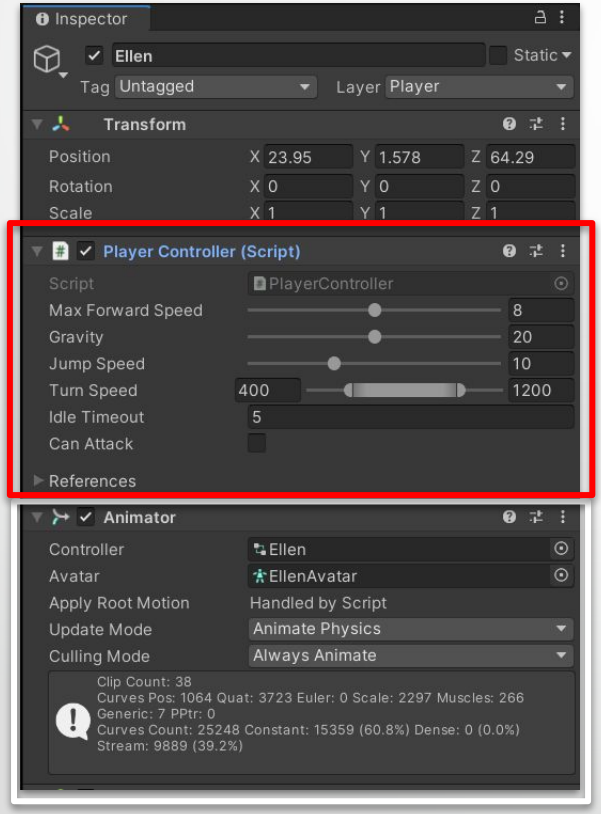
AnimationClip (Animation Window) (.anim)

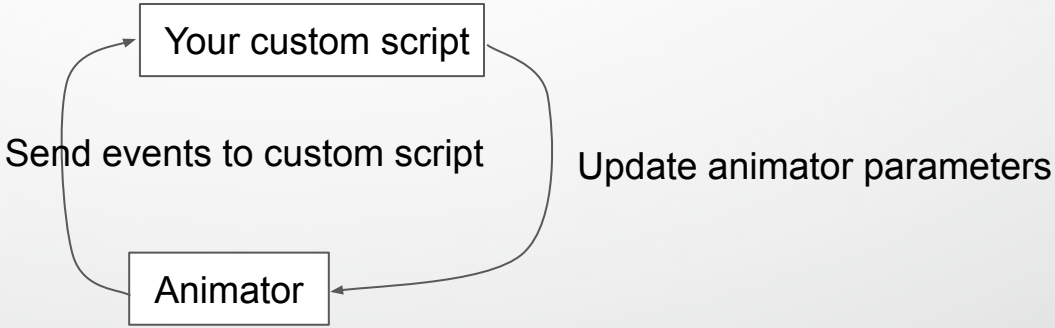




FeisStu

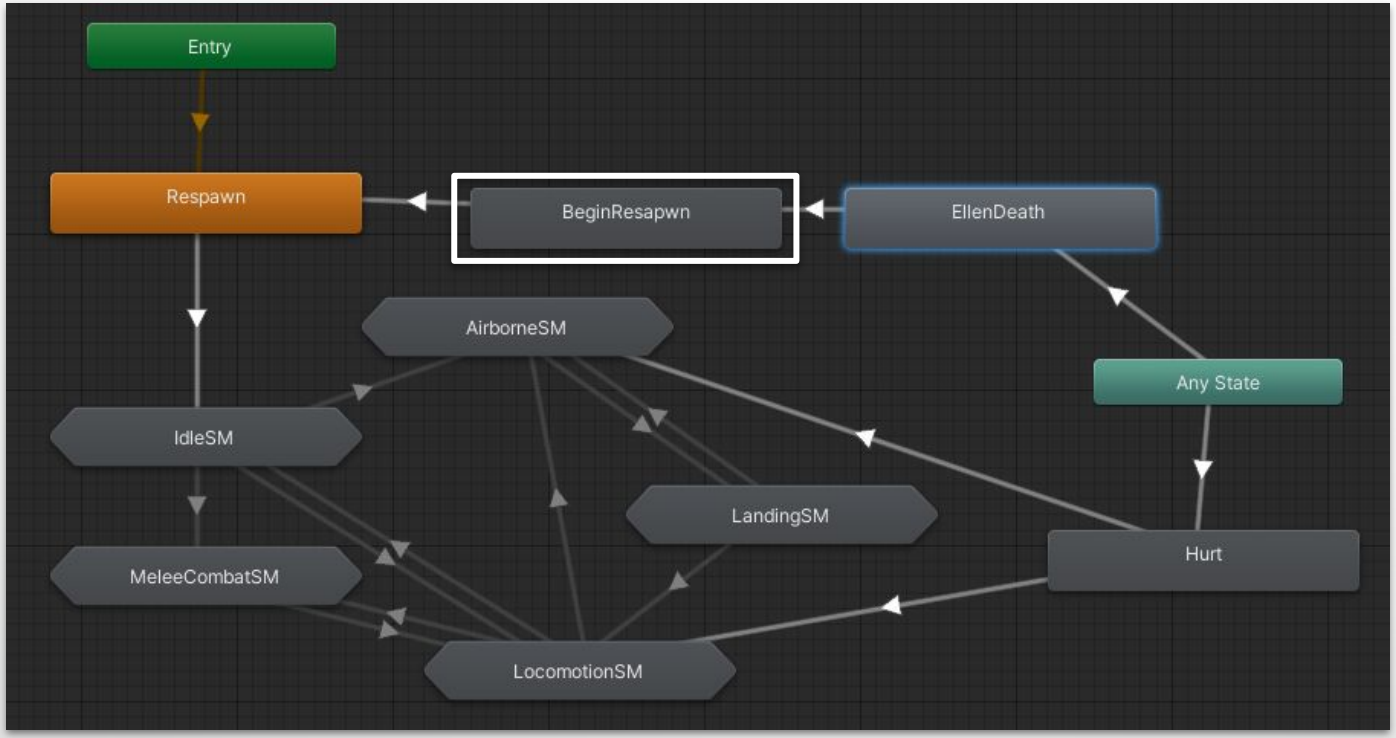
Send animation events to custom script



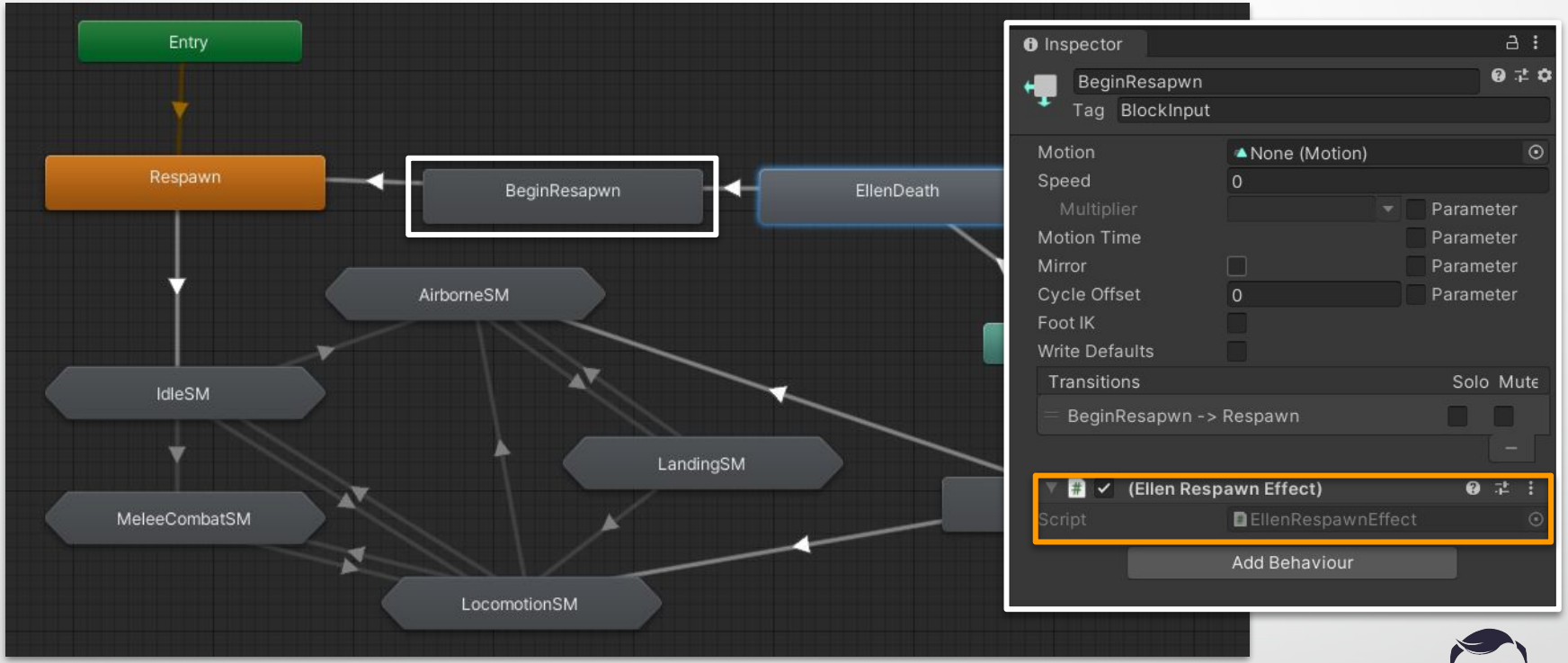


FeisStu

StateMachineBehaviour



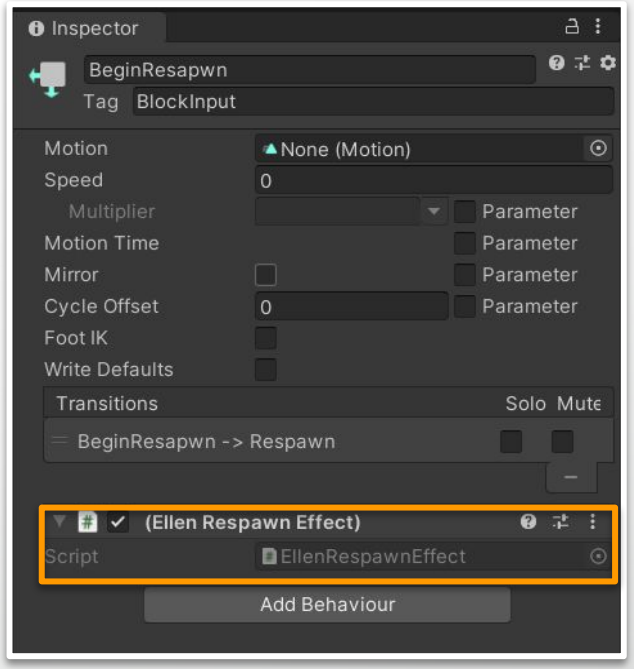
StateMachineBehaviour



FeisStu

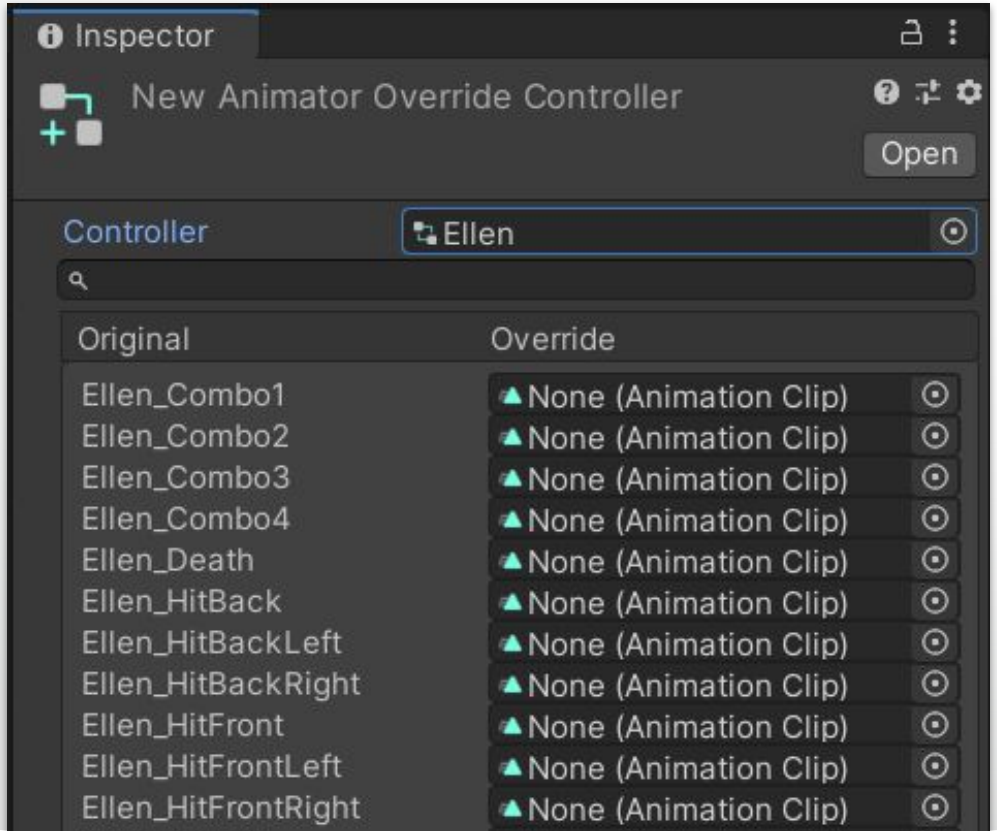
StateMachineBehaviour

```
namespace Gamekit3D
{
    Unity 指令碼 | 0 個參考
    public class EllenRespawnEffect : StateMachineBehaviour
    {
        Unity Message | 3 個參考
        public override void OnStateEnter(
            Animator animator,
            AnimatorStateInfo stateInfo,
            int layerIndex)
        {
            animator.GetComponent<PlayerController>().Respawn();
        }
    }
}
```



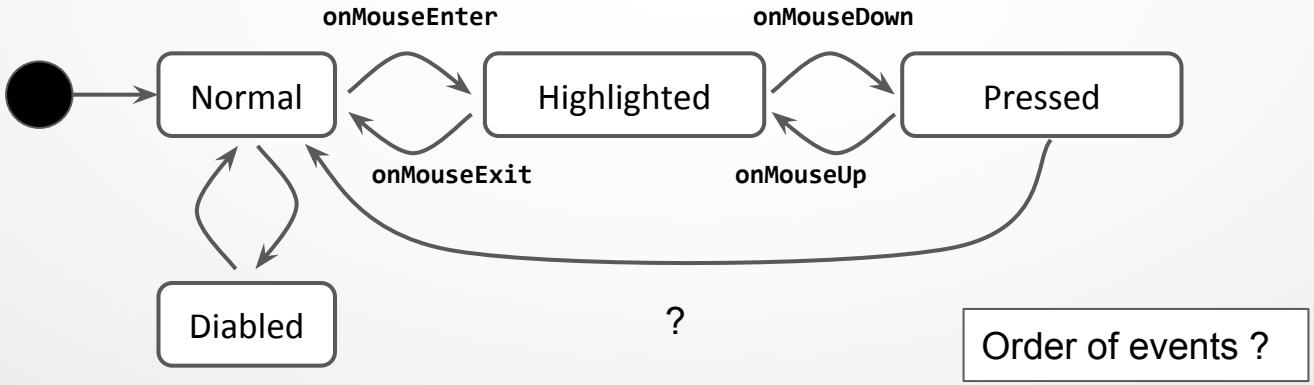
FeisStu

Animator Override Controller

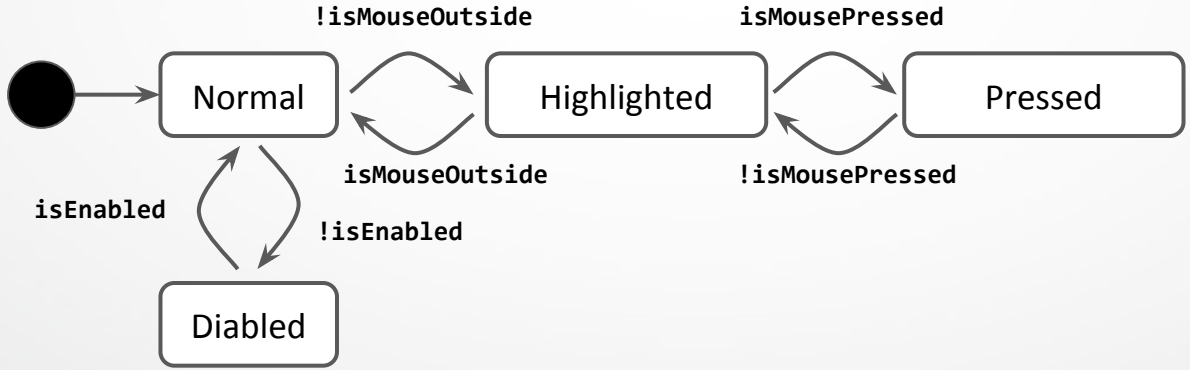


FeisStu

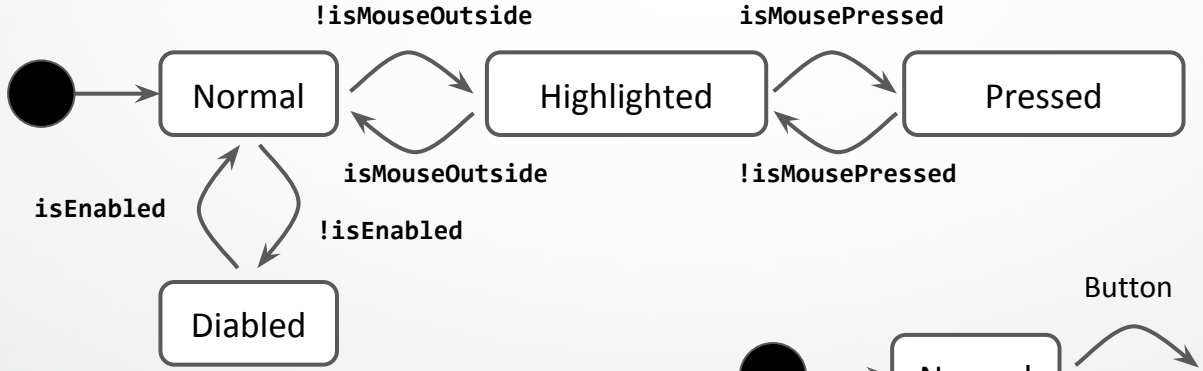
Finite-state machine

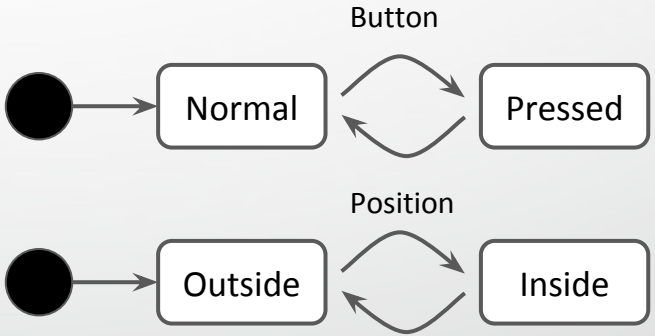


State as triggered event



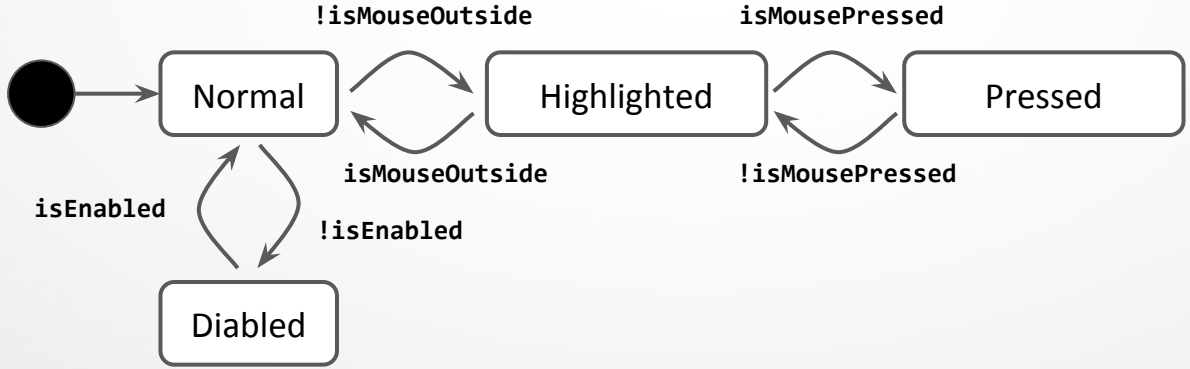
State as triggered event



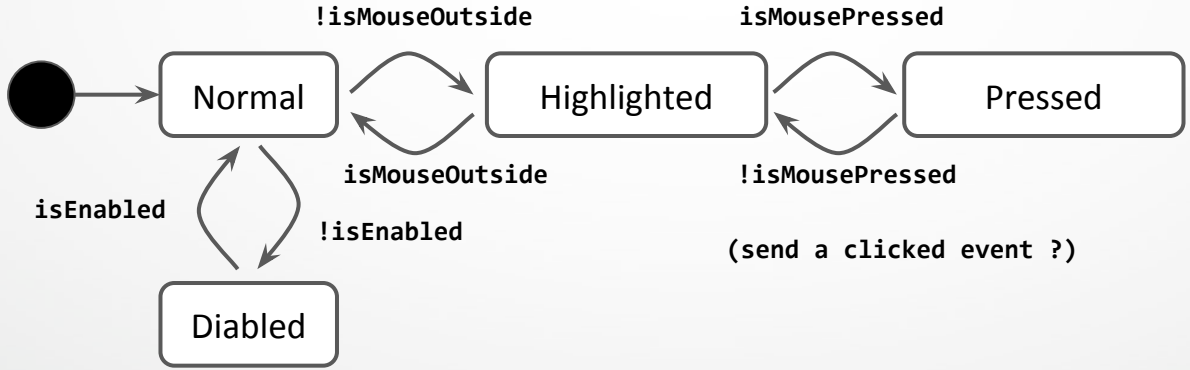


FeisStu

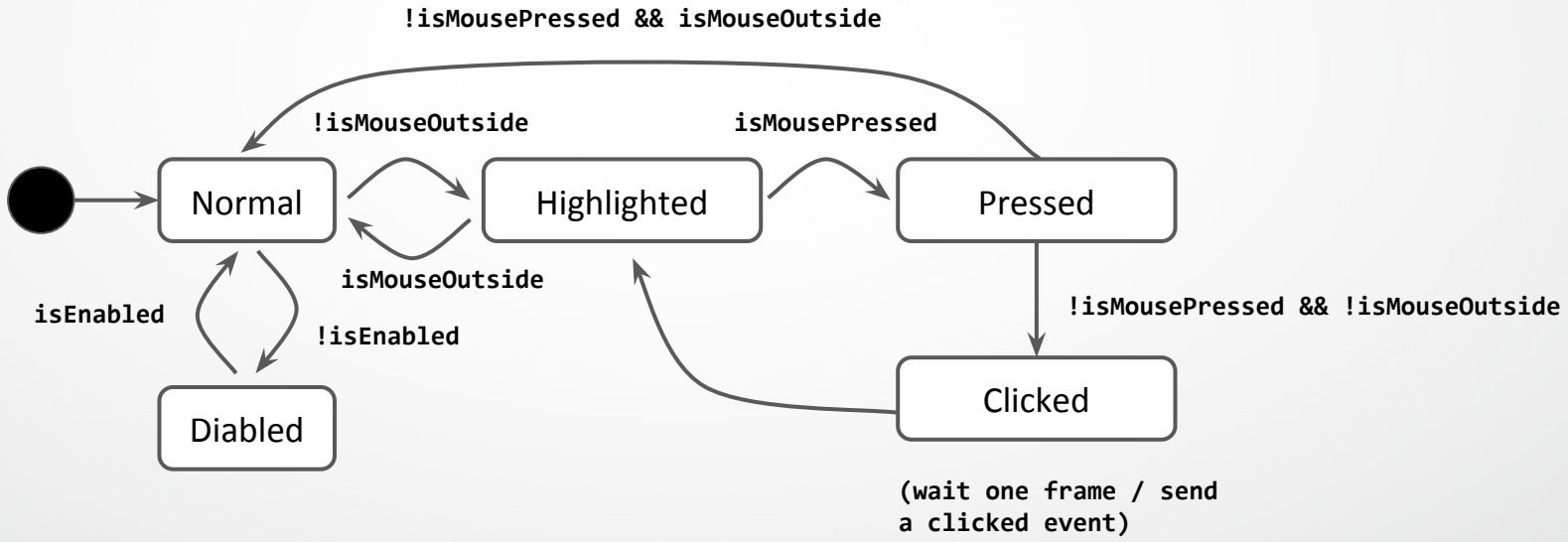
Clicked ?


!isMouseOutside
isMousePressed
Normal
Highlighted
Pressed
isMouseOutside
!isMousePressed
isEnabled
!isEnabled
Diabled

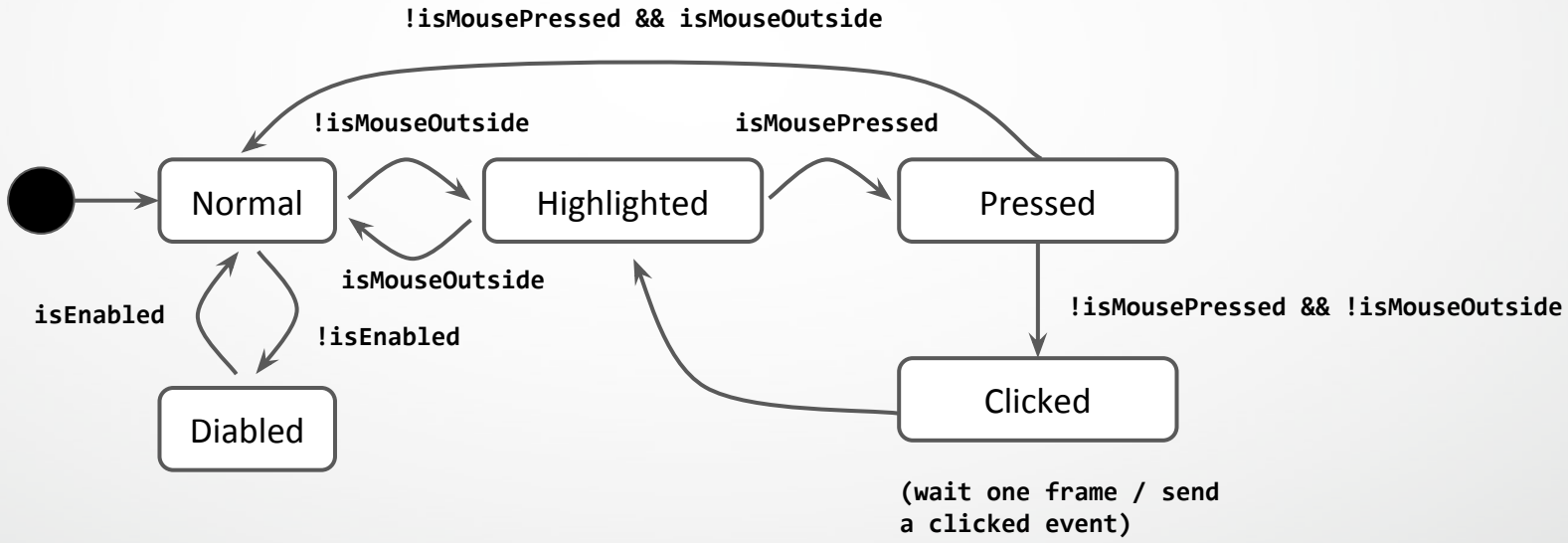
Clicked ?


!isMouseOutside
isMousePressed
Normal
Highlighted
Pressed
isMouseOutside
!isMousePressed
isEnabled
!isEnabled
(send a clicked event ?)
Diabled

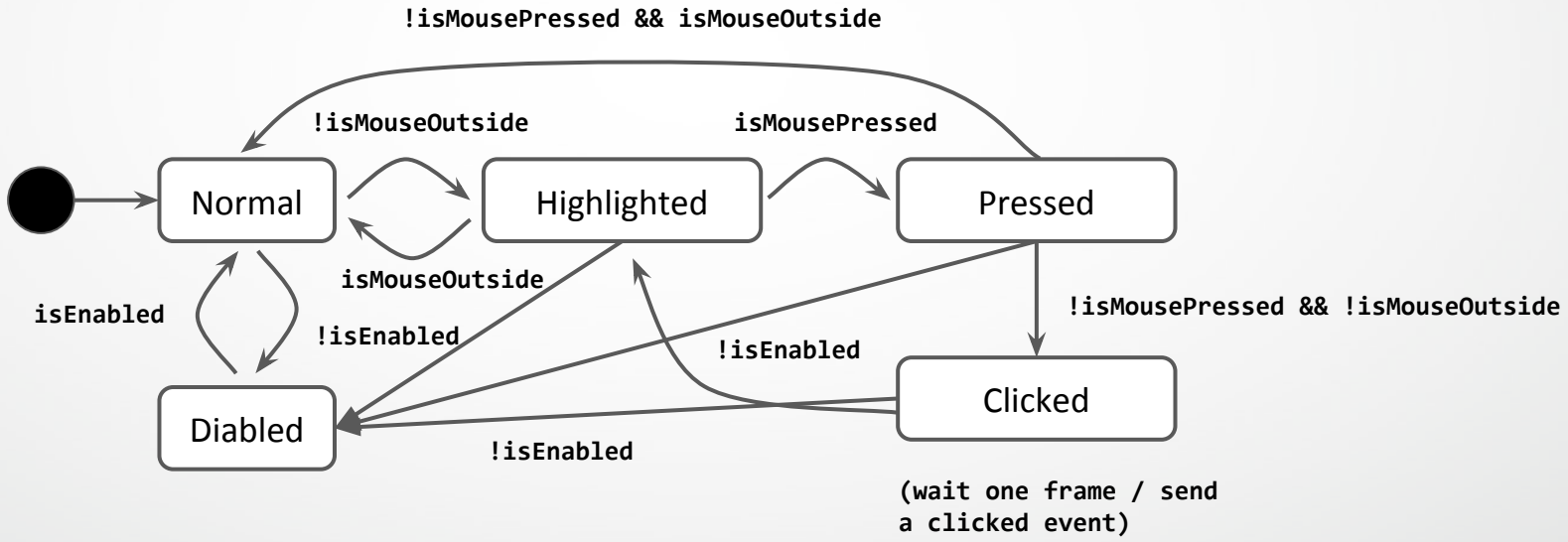
Clicked ?


!isMousePressed && isMouseOutside
!isMouseOutside
isMousePressed
Normal
Highlighted
Pressed
isMouseOutside
isEnabled
!isEnabled
!isMousePressed && !isMouseOutside
Diabled
Clicked
(wait one frame / send
a clicked event)

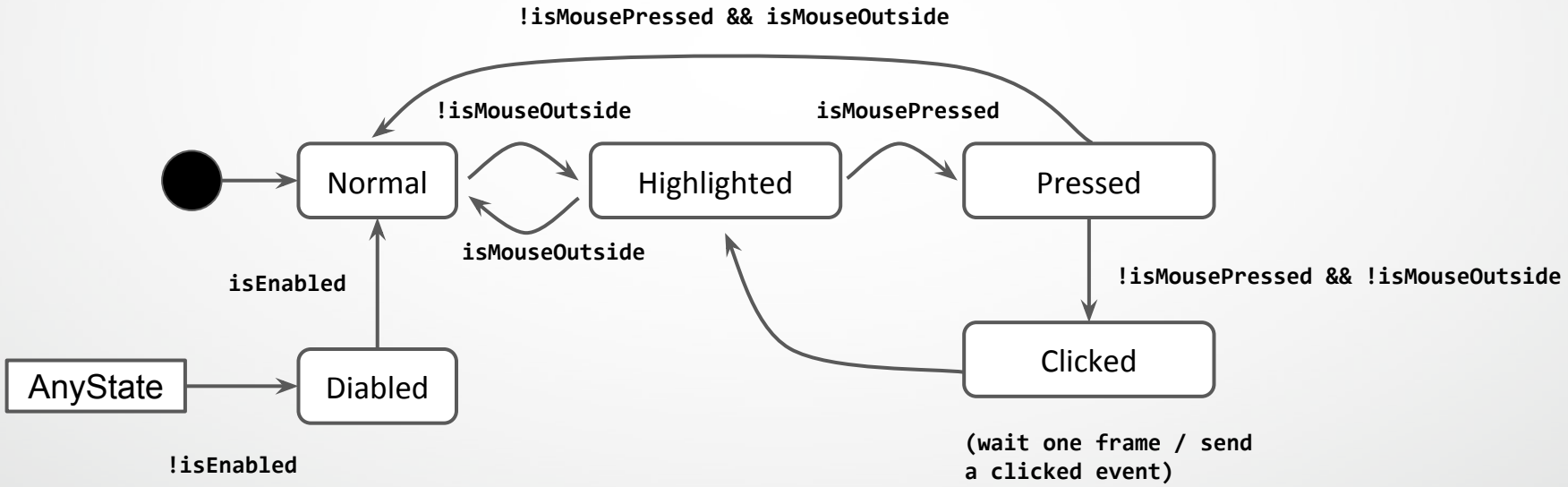
isEnabled = false ?



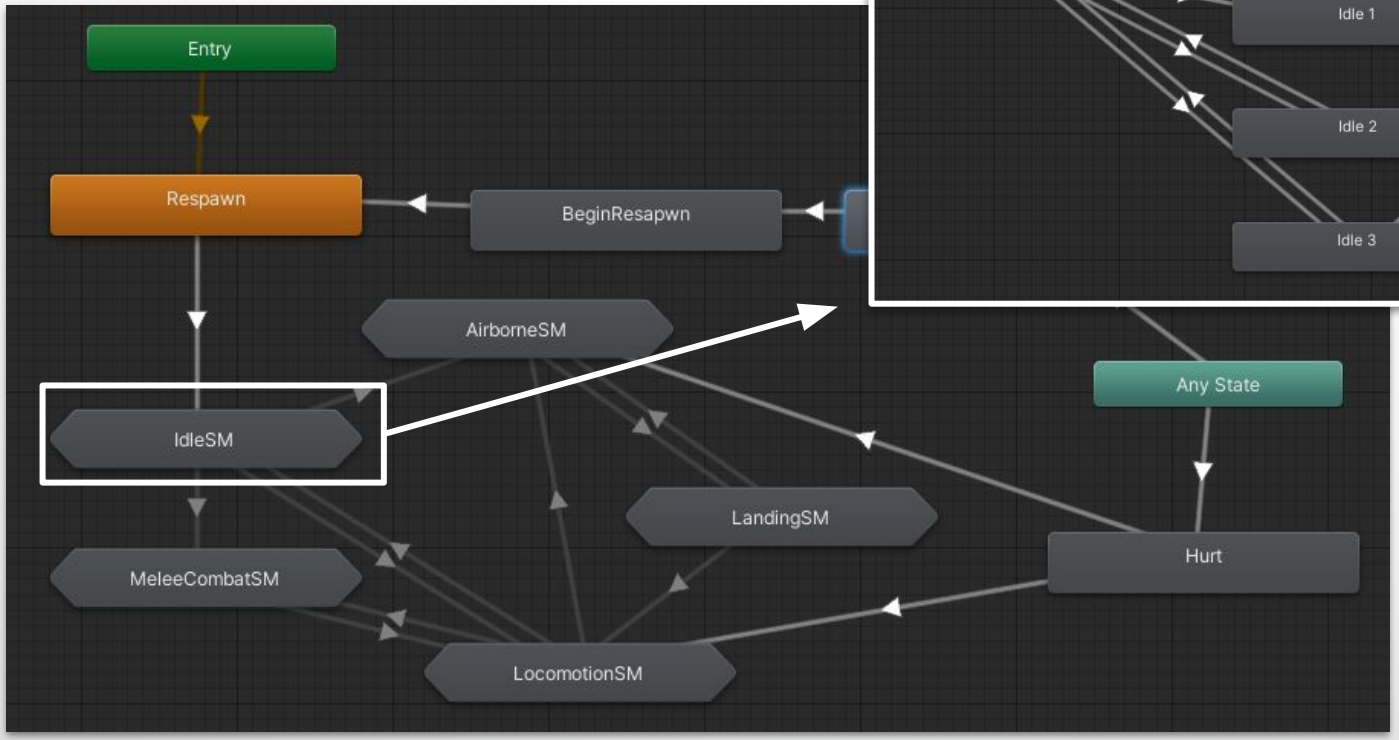
isEnabled = false ?

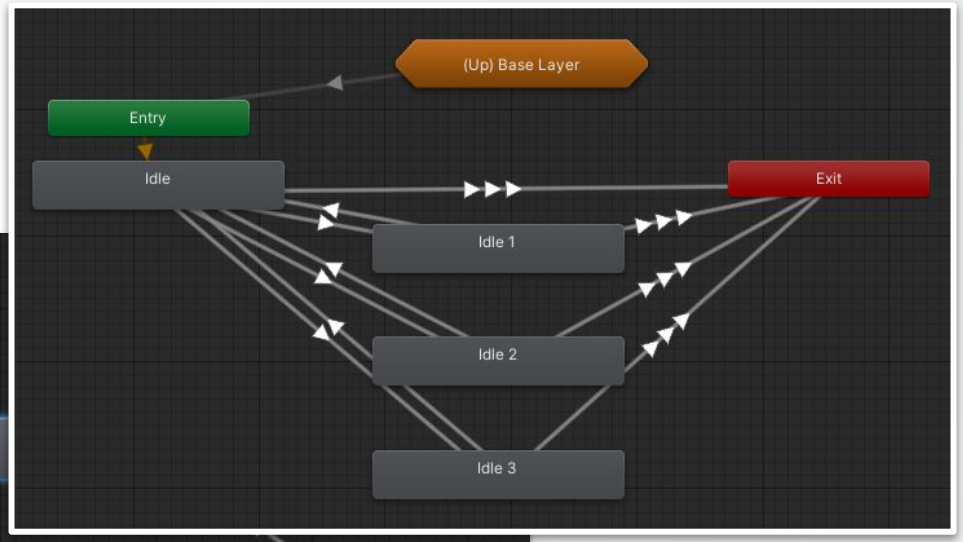


IsEnabled = false ?



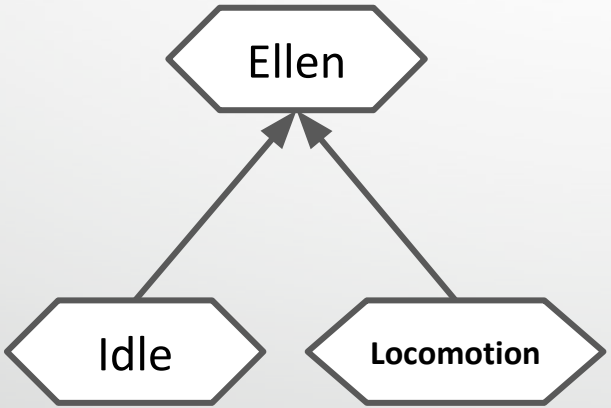
Sub-state machines



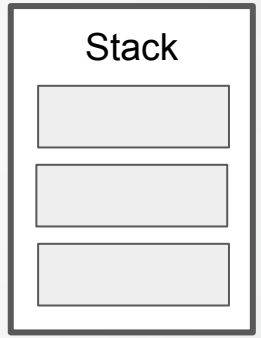


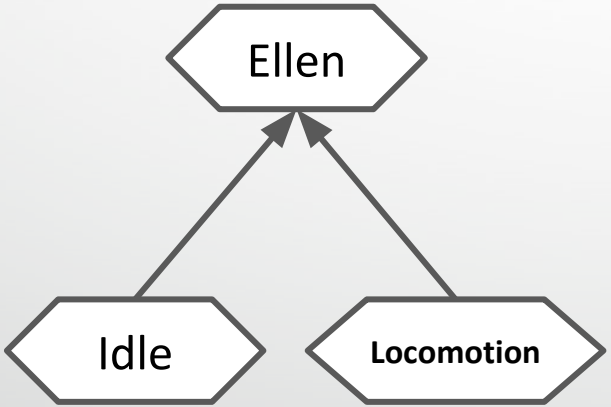
FeisStu

Hierarchical state machine

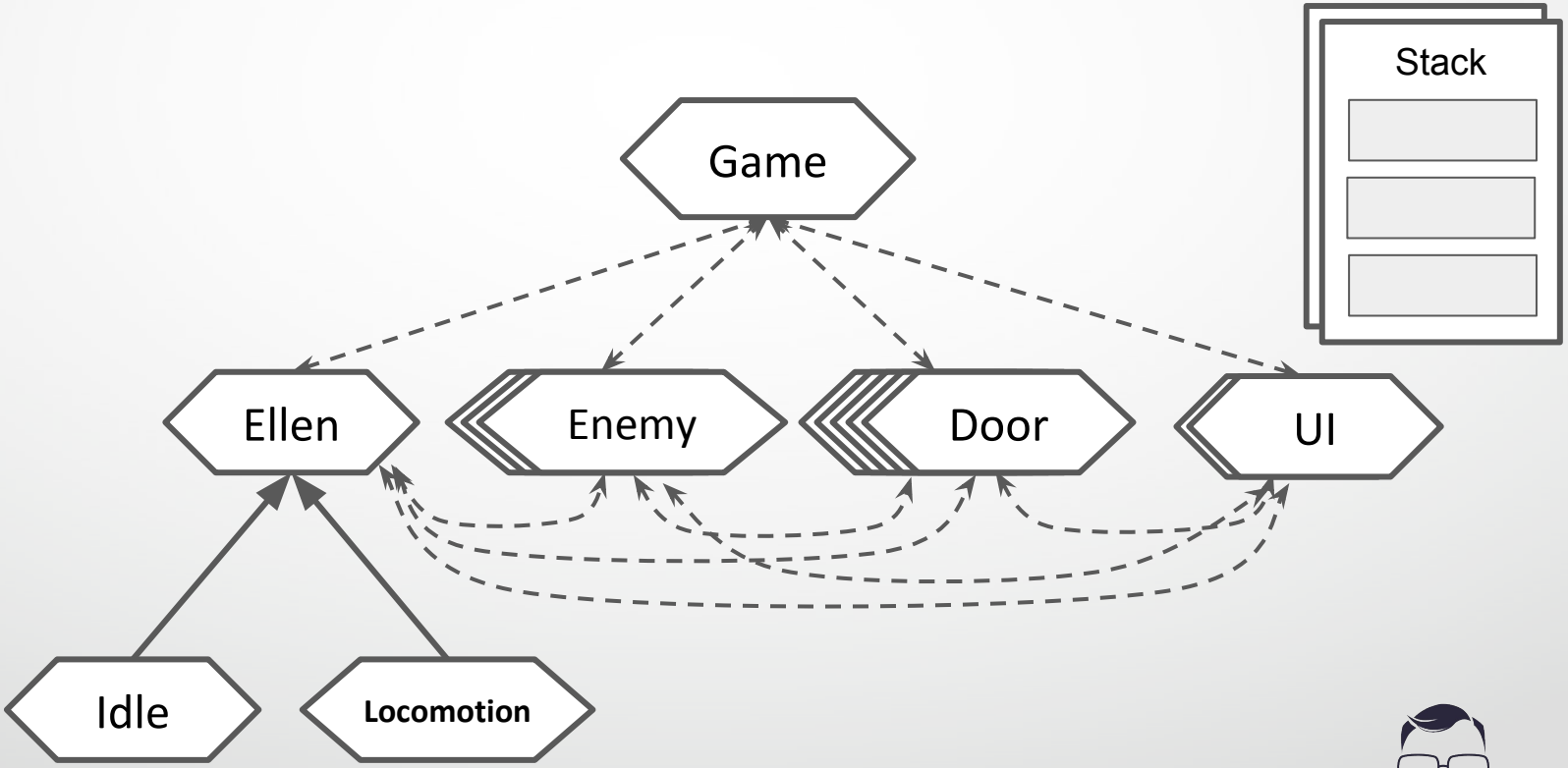


Pushdown automata





Concurrent state machines



FeisStu

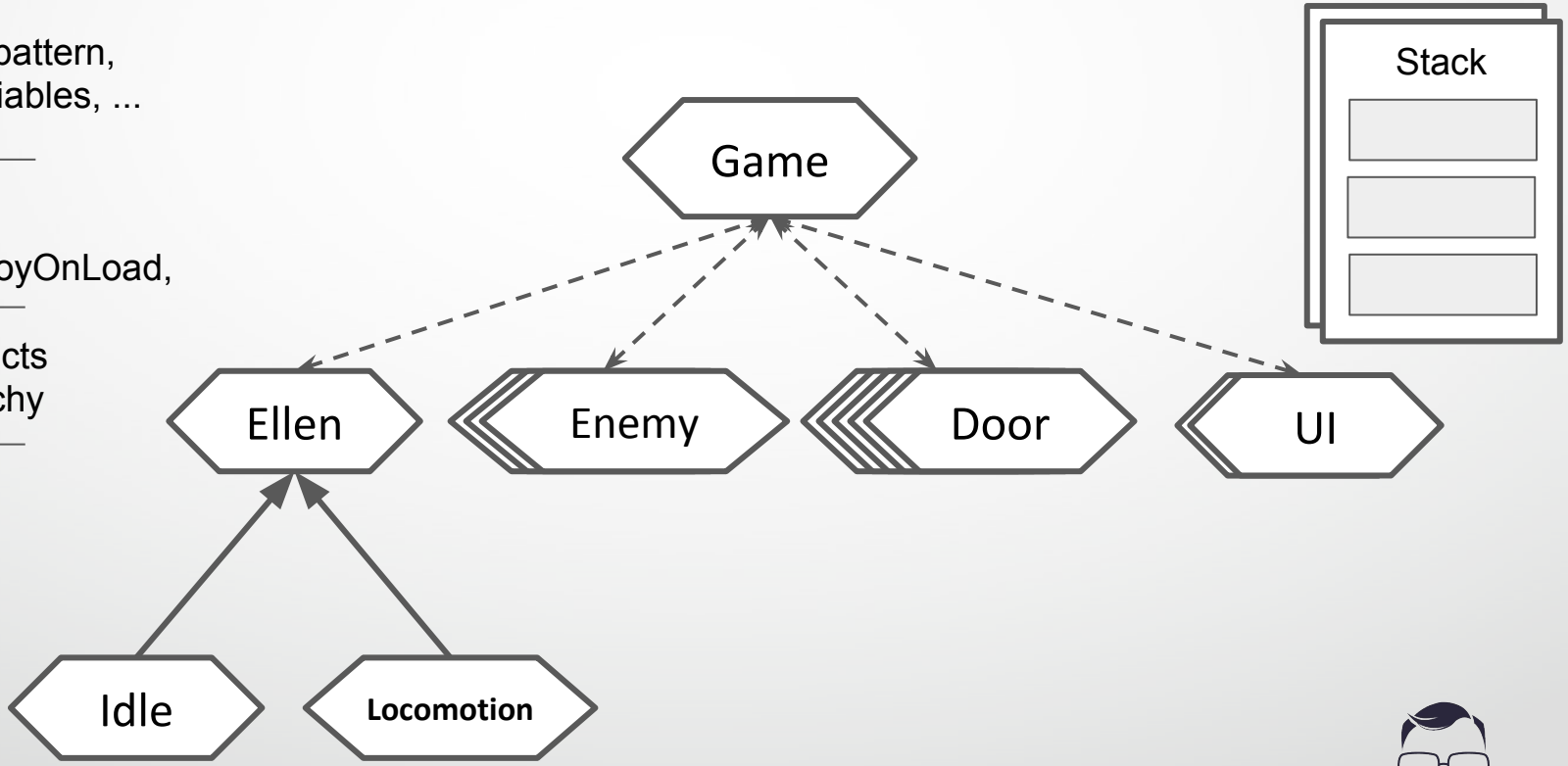
Game state tree / store

Singleton pattern,
Global variables, ...

Scenes,
DontDestroyOnLoad,

GameObjects
in a hierarchy

Animators



FeisStu

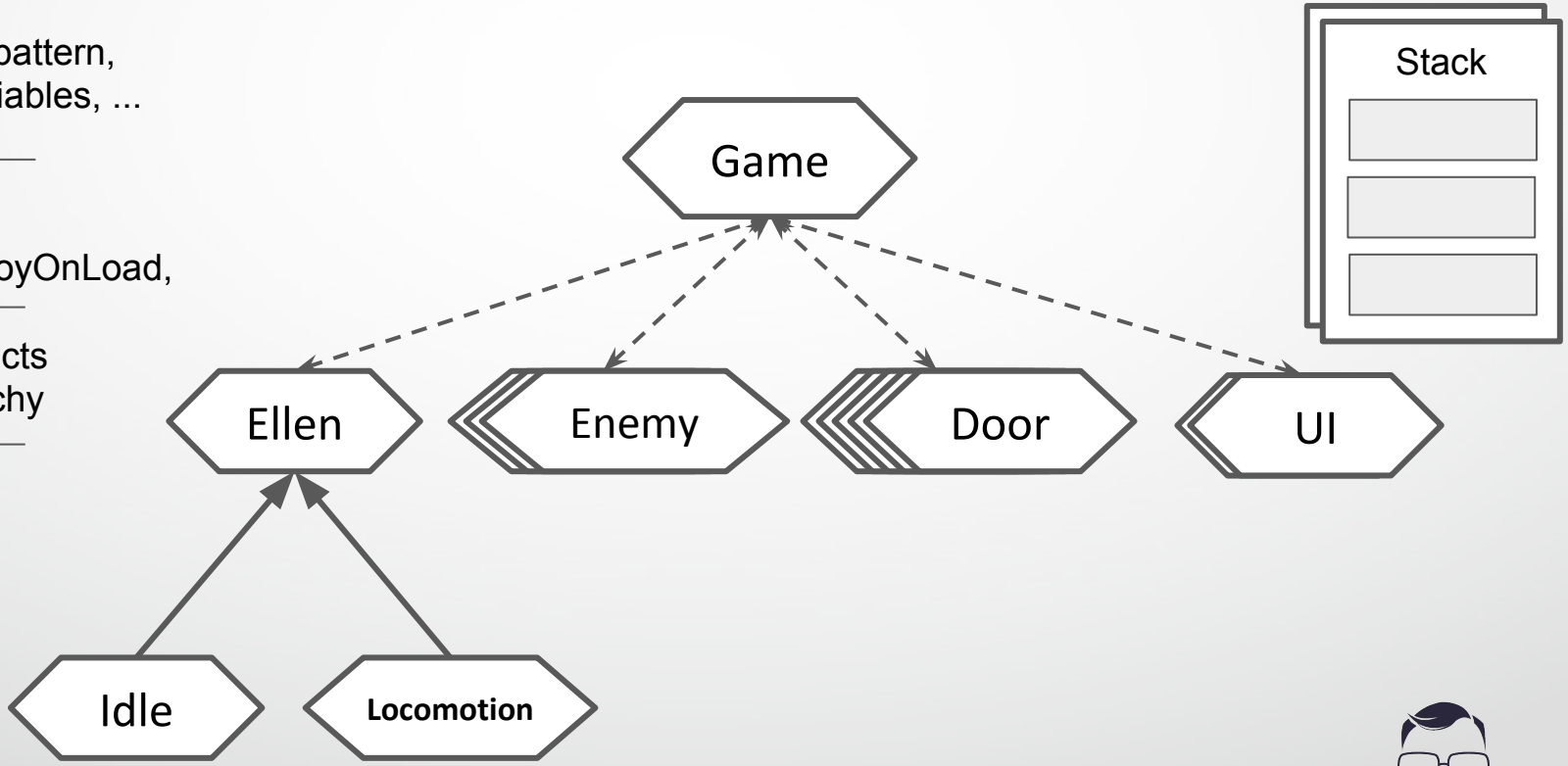
Save / Load?

Singleton pattern,
Global variables, ...

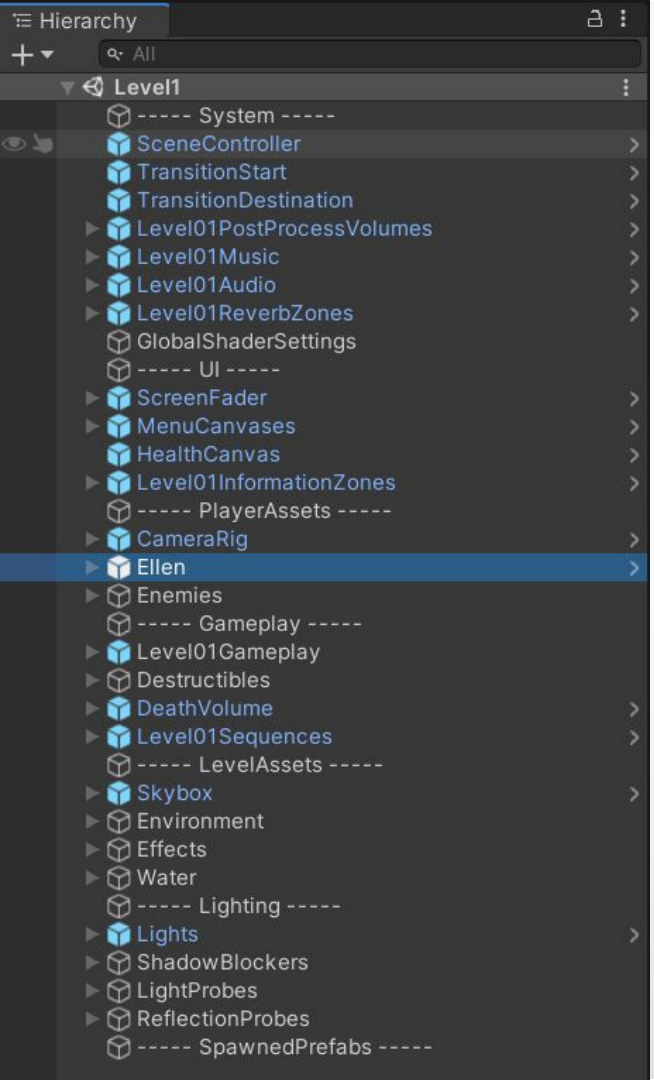
Scenes,
DontDestroyOnLoad,

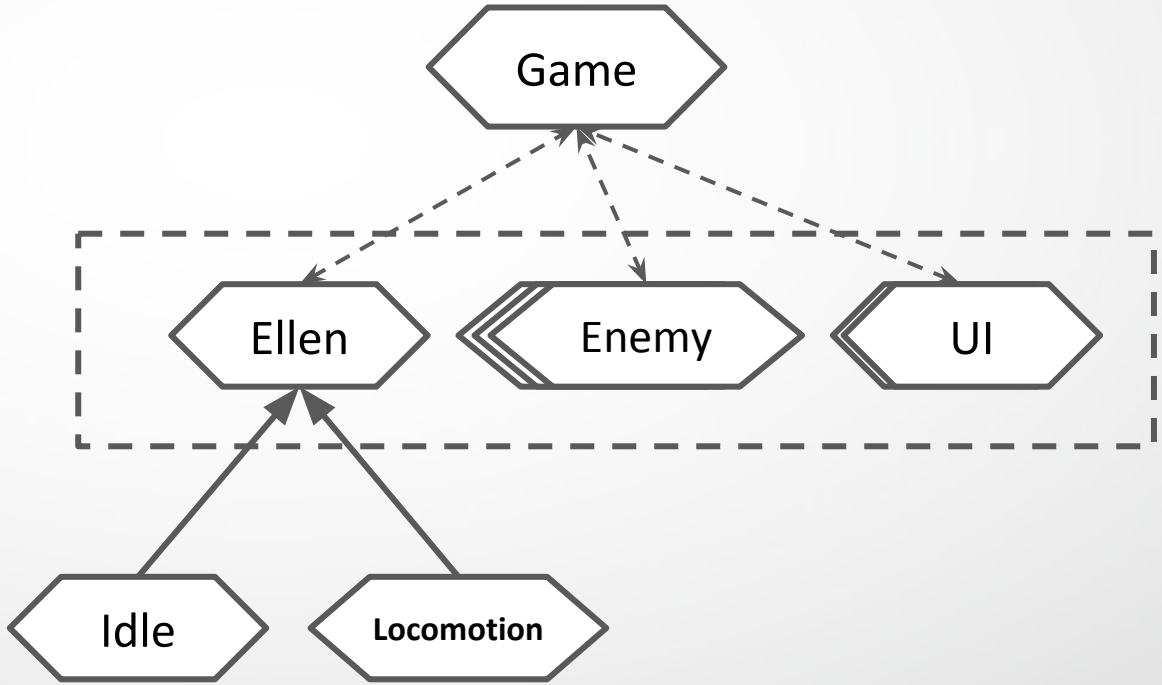
GameObjects
in a hierarchy

Animators



FeisStu


Hierarchy
All
Level1
----- System -----
SceneController
TransitionStart
TransitionDestination
Level01PostProcessVolumes
Level01Music
Level01Audio
Level01ReverbZones
GlobalShaderSettings
----- UI -----
ScreenFader
MenuCanvases
HealthCanvas
Level01InformationZones
----- PlayerAssets -----
CameraRig
Ellen
Enemies
----- Gameplay -----
Level01Gameplay
Destructibles
DeathVolume
Level01Sequences
----- LevelAssets -----
Skybox
Environment
Effects
Water
----- Lighting -----
Lights
ShadowBlockers
LightProbes
ReflectionProbes
----- SpawnedPrefabs -----


Game
Ellen
Enemy
UI
Idle
Locomotion

FeisStu

How to “Pause” a game ?

MonoBehaviour.Update() / FixedUpdate()

- Hold the local state
  - enum State { Normal, Pressed, Highlighted, Disabled, Clicked };
    - with other data members
- Update the local state in Update() / FixedUpdate() or Coroutine with a hierarchical approach.
  - only read other objects' states if possible.
  - only receive / send "state events" if unavoidable
- Apply If-else chain, switch or state pattern

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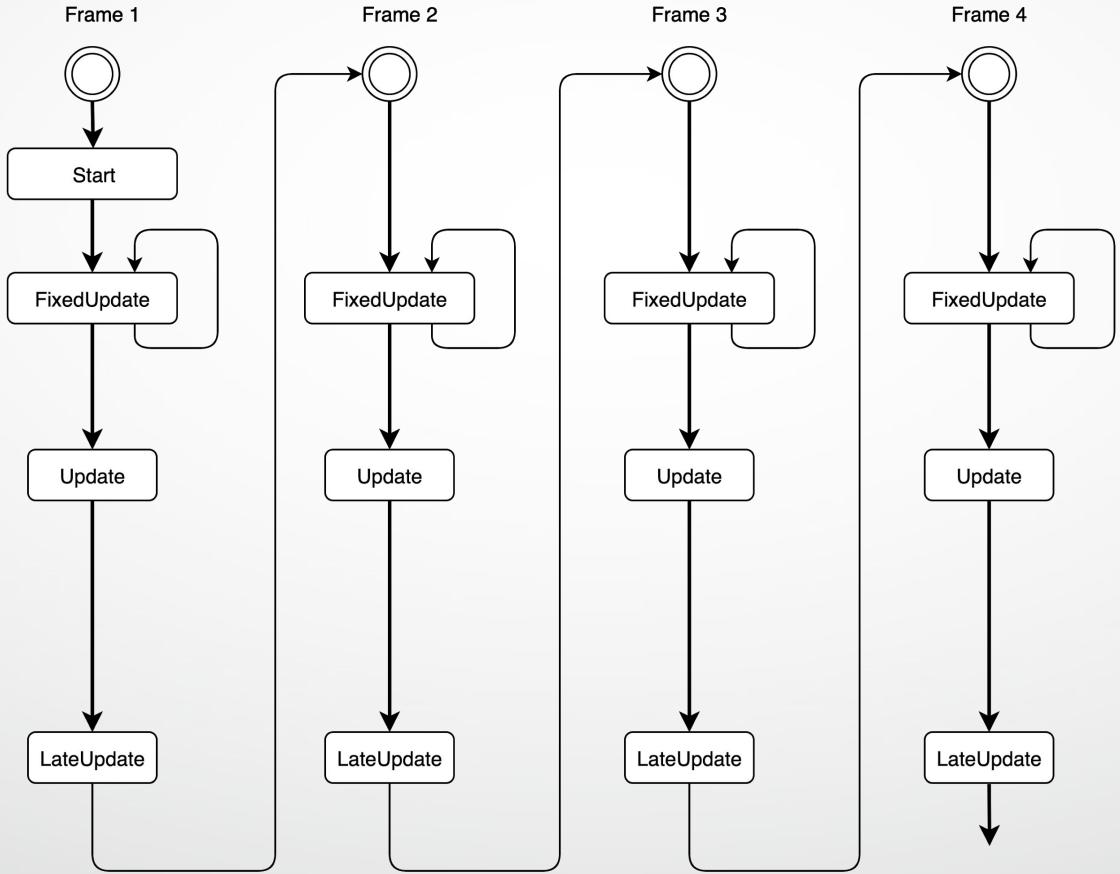
Frame 1
Frame 2
Frame 3
Frame 4
Start
FixedUpdate
FixedUpdate
FixedUpdate
FixedUpdate
Update
Update
Update
Update
LateUpdate
LateUpdate
LateUpdate
LateUpdate

Script Execution Order settings