A Flex 4 Component’s life cycle

Mrinal Wadhwa

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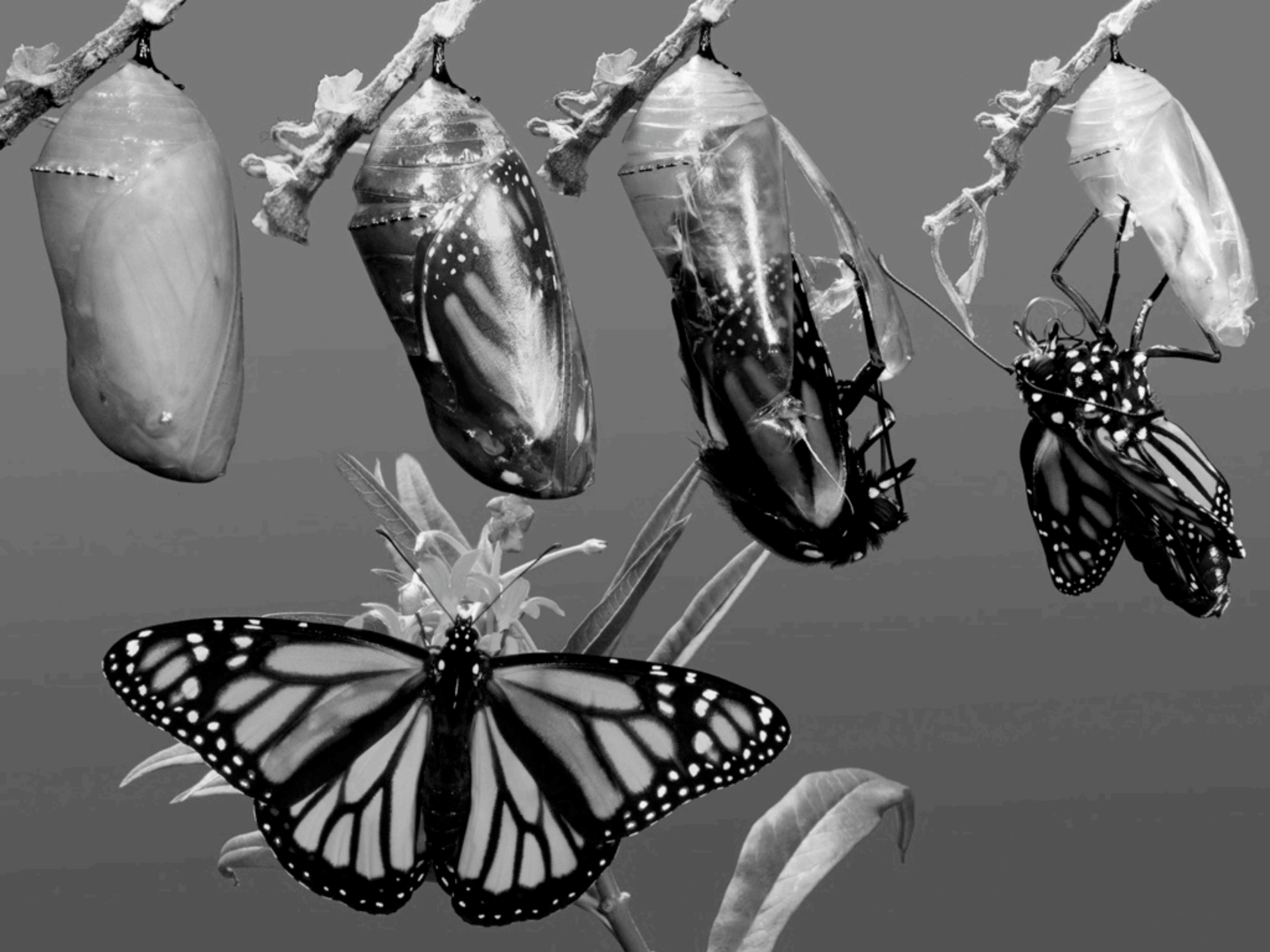
What is a life cycle?



Why does a Flex component need a life cycle?

Flex applications run in the Flash Player

What Flex can do is a subset of what the Flash Player can do, not a superset.

so to understand flex components better, lets take a deeper look at how the flash player works ...

Frames

Frames

everything is done in frames ...

Frame Rate

the number of frames processed per second (fps)

Frame Rate

you can suggest the player a frame rate you would like your swf to have ...

Frame Rate

```
[SWF(width=”800”,height=”600”,frameRate=”60”)]
```

OR

```
stage.frameRate = 60;
```

OR

```
<s:Application frameRate=”60” ... >
```

Frame Rate

lets look at some code to see what the player does with this suggestion …

view code

Frame Rate

some observations from our experiment ....

Frame Rate

the player tries its best to maintain the suggested frame rate, but there are no guarantees ...

Frame Rate

the actual framerate achieved may be lower or higher than what we suggested ...

Frame Rate

browsers can force a lower framerate on the flash player ...

Frame Rate

In Firefox and Safari, frame rate falls to about 10 if the Tab running the swf is out of focus ...

Frame Rate

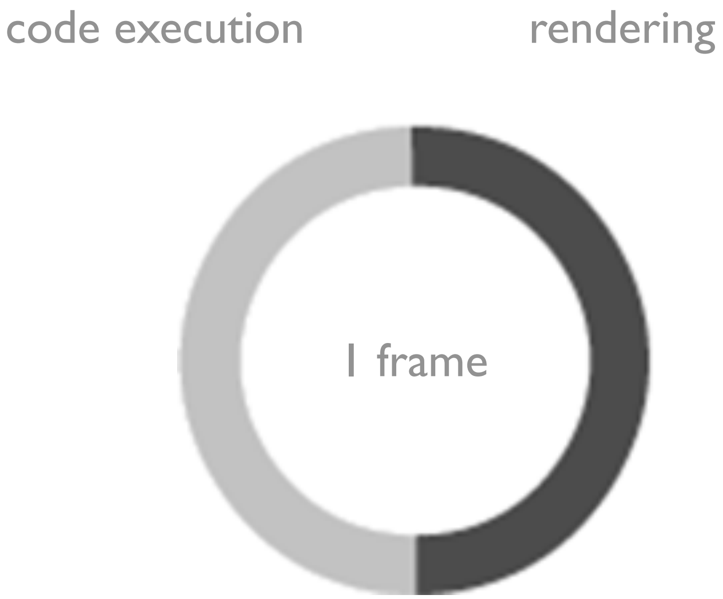
In Safari if window is minimized,
framerate falls to zero ..

now lets take a deeper look at what happens inside each frame ..

now lets take a deeper look at what happens inside each frame ..

lets look at some more test code first ..

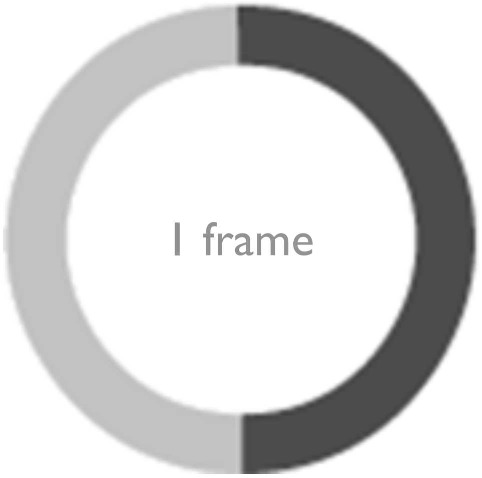
view code



the length of the track represents the time taken by this frame

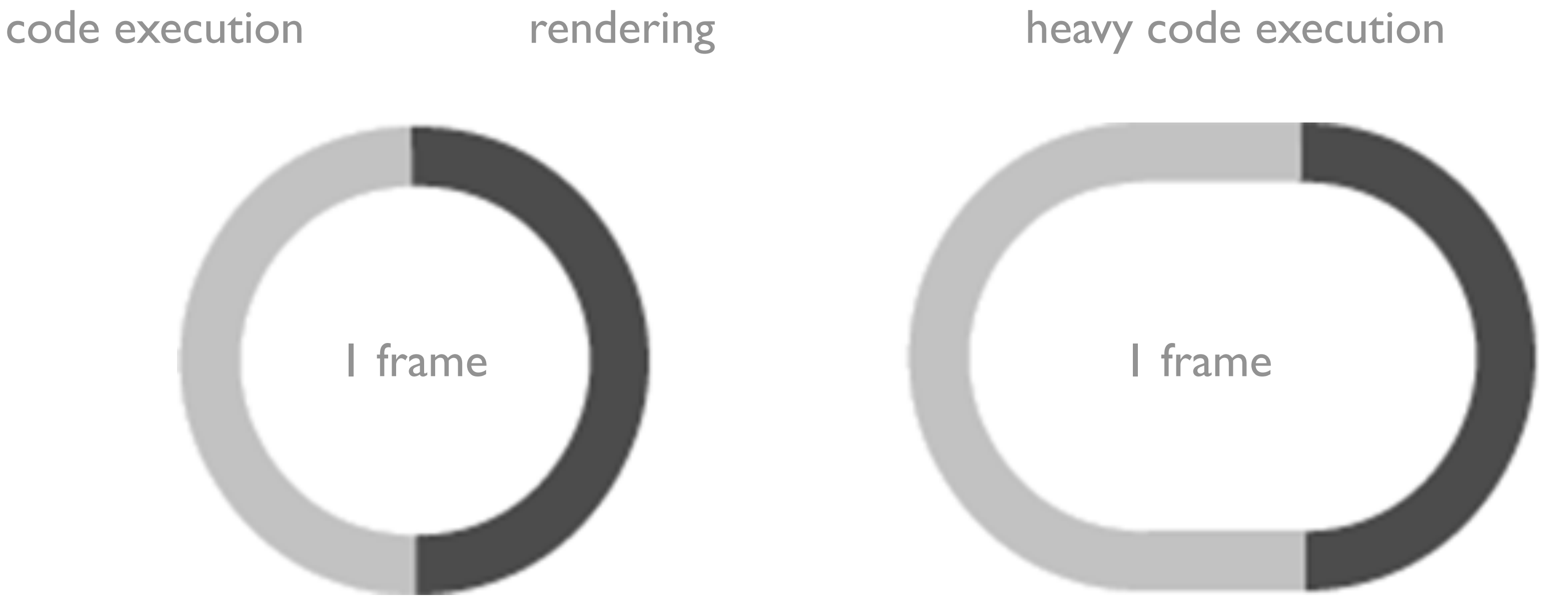
what we saw in our experiment ..

code execution rendering



the length of the track represents the time taken by this frame

what we saw in our experiment ..



code execution

rendering

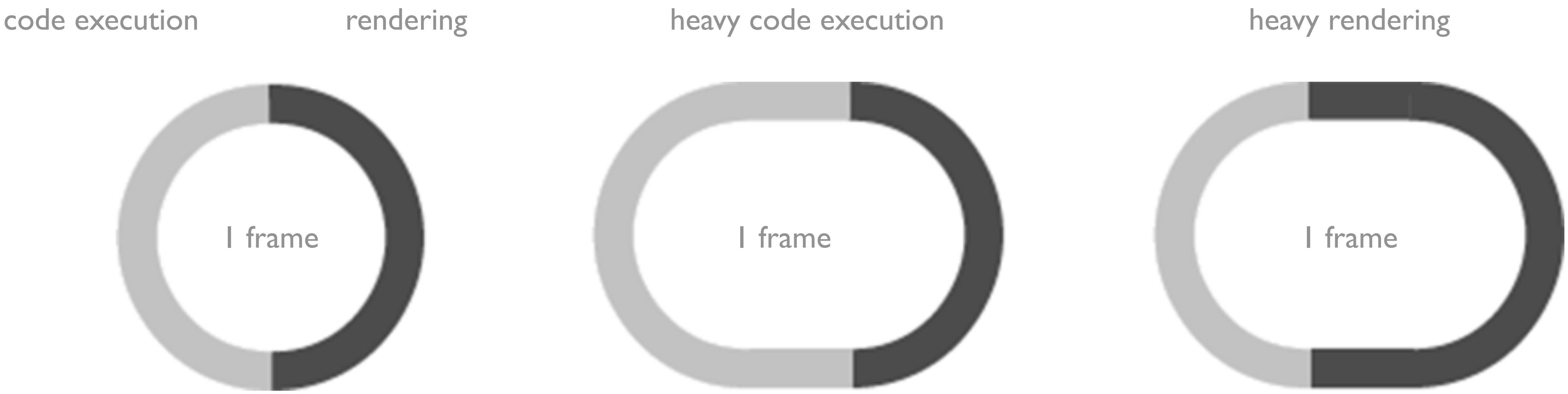
heavy code execution

1 frame

1 frame

the length of the track represents the time taken by this frame

what we saw in our experiment ..



code execution

rendering

heavy code execution

heavy rendering

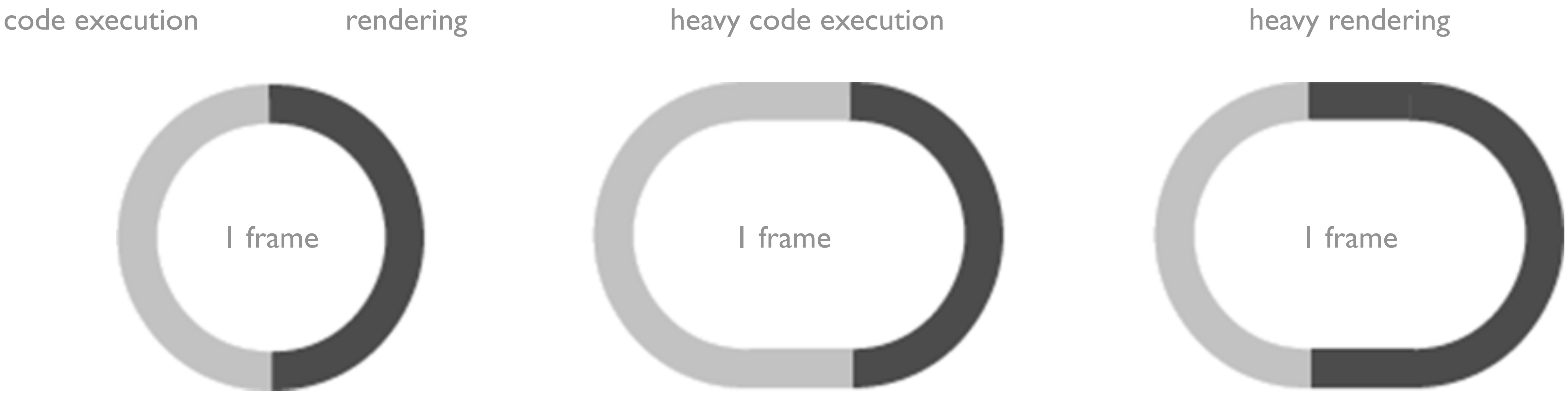
1 frame

1 frame

1 frame

the length of the track represents the time taken by this frame

Ted Patrick called this ...



code execution

rendering

heavy code execution

heavy rendering

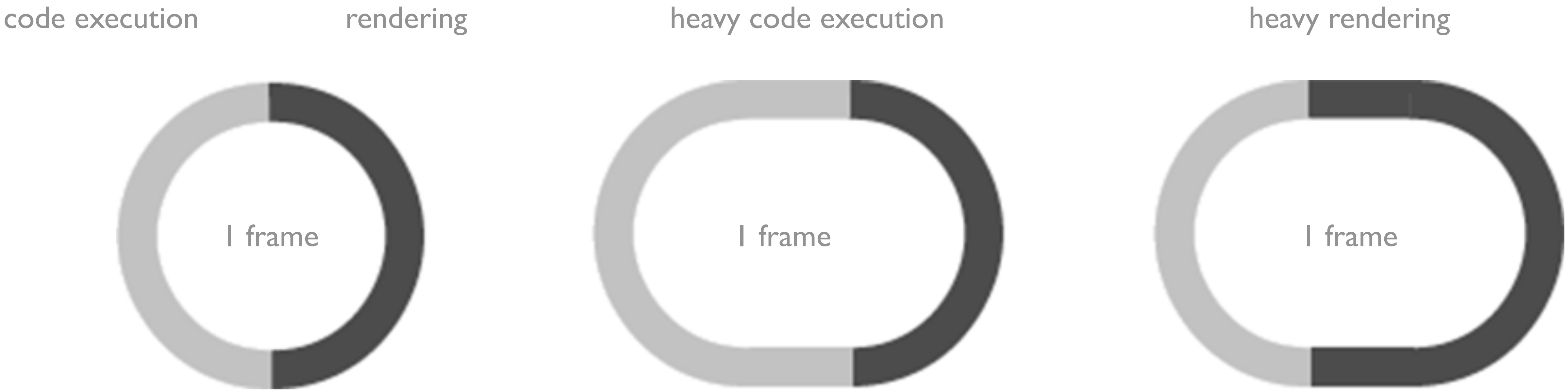
1 frame

1 frame

1 frame

the length of the track represents the time taken by this frame

The Elastic Racetrack



the length of the track represents the time taken by this frame

Sean Christmann did some more research on this ...

The Marshal

he proposed AVM2 is controlled by something he called the Marshal ..

The Marshal

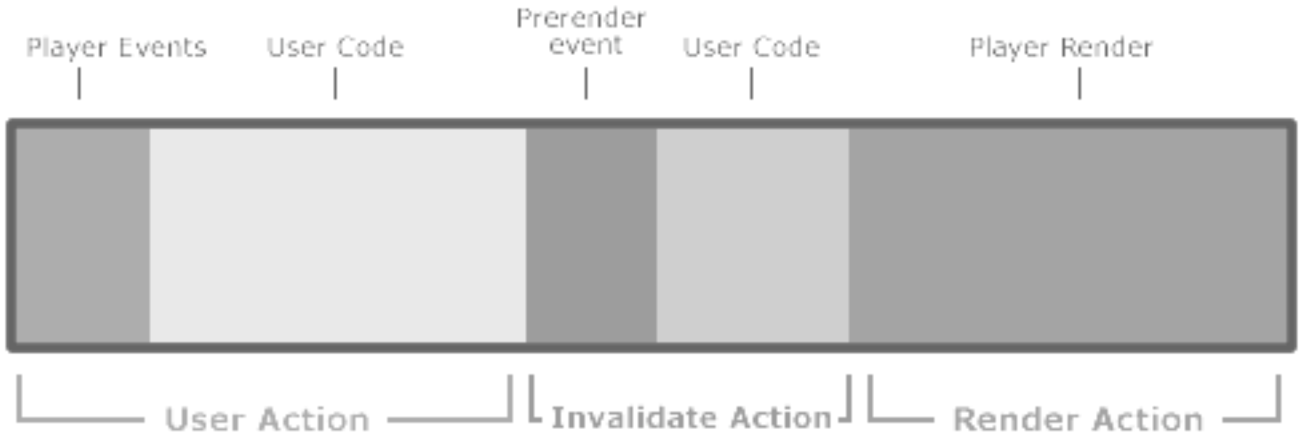
the marshal is responsible for carving out time slices ...

The Marshal

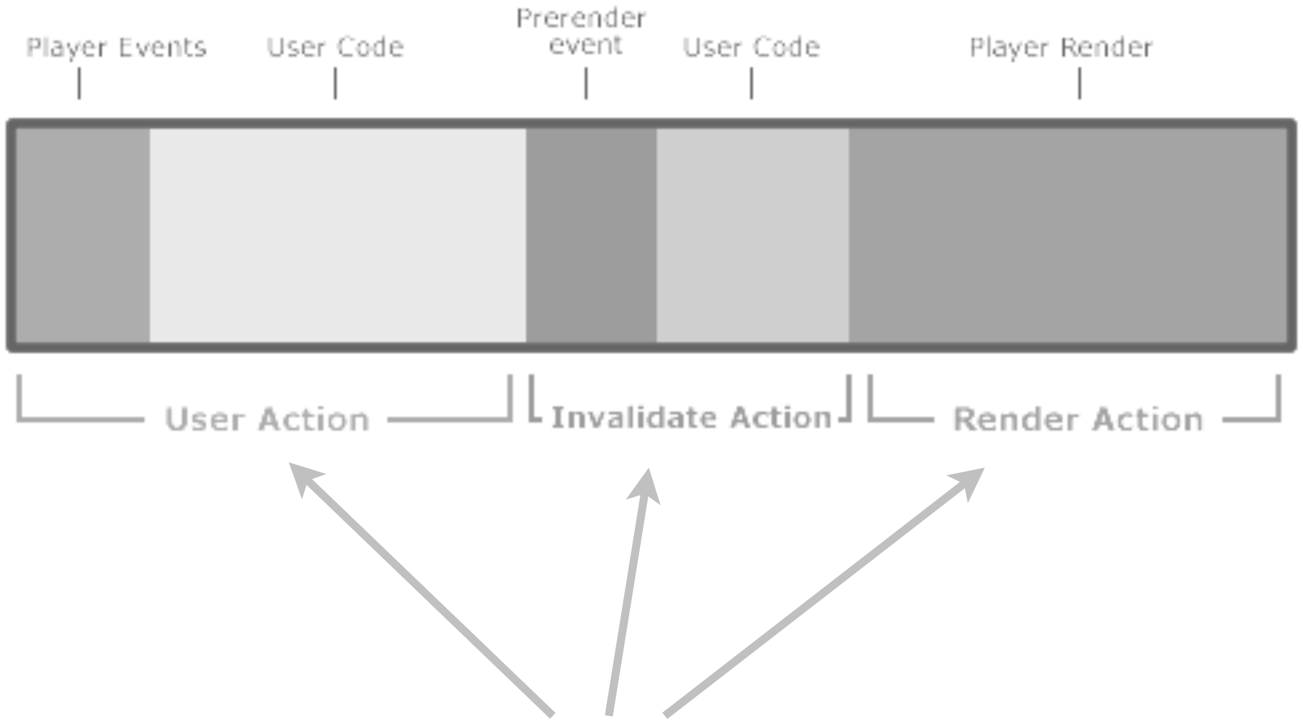
the duration of a slice can vary based on your OS,browser etc.

just for our discussion lets assume a slice is 20ms long ..

A Marshaled Slice

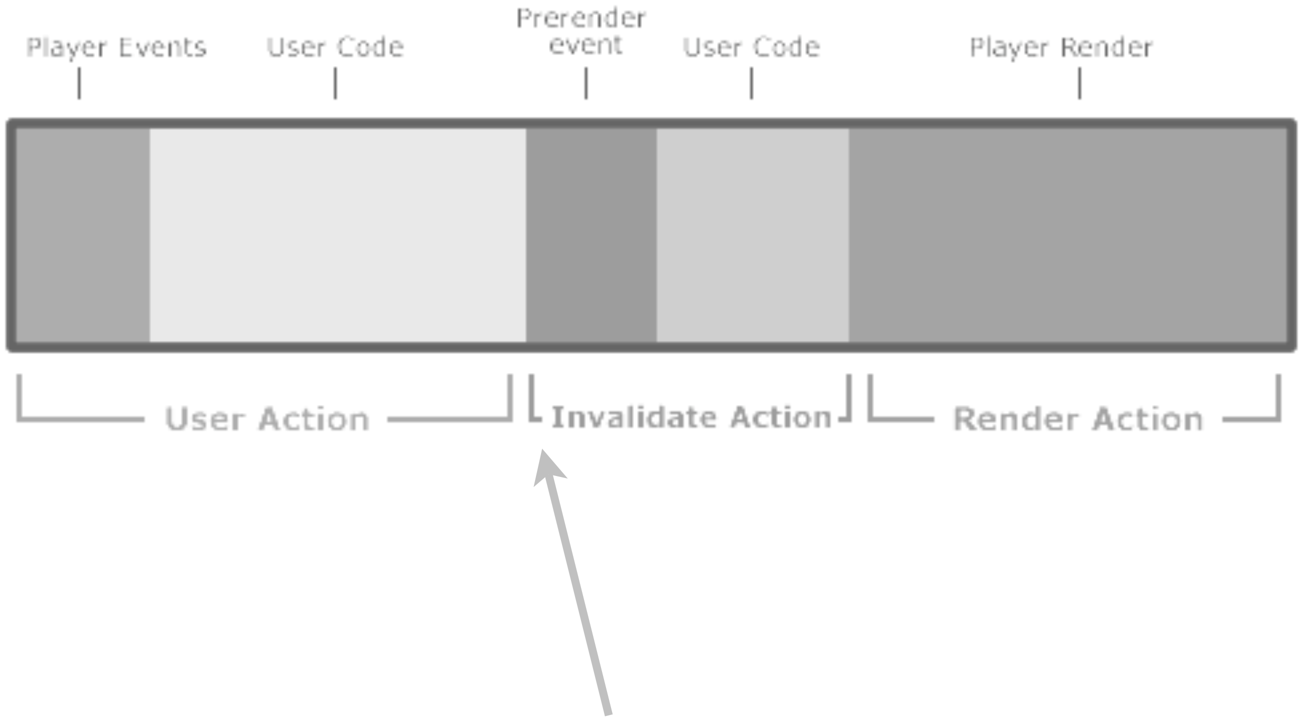


A Marshaled Slice



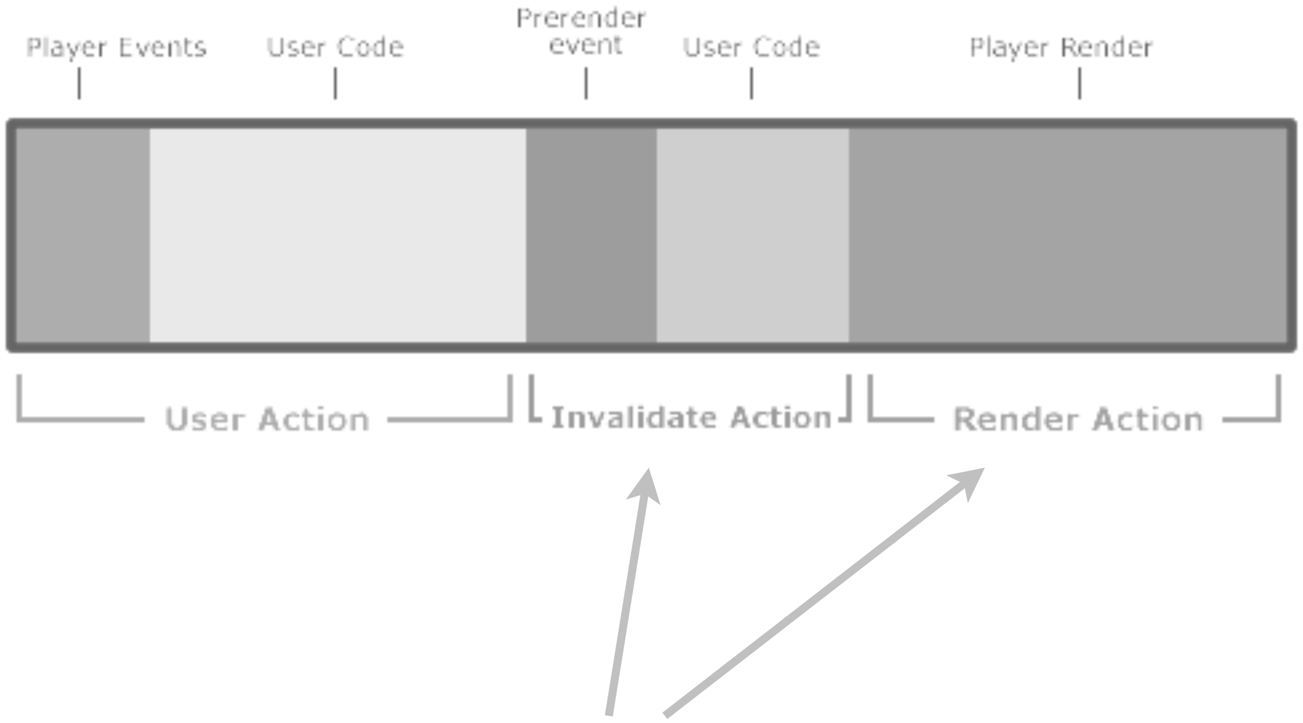
but all these actions may not happen on each slice ...

A Marshaled Slice



Flash Player’s Event.RENDER event is fired at this point

A Marshaled Slice



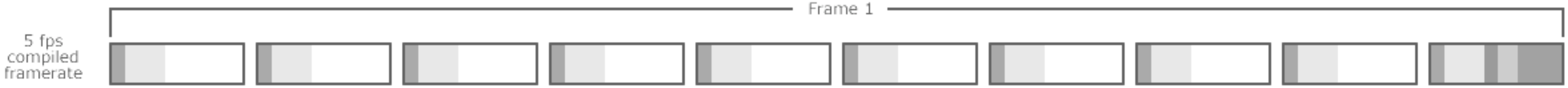
invalidate action and render action only happen in the last slice of a frame ..

lets experiment with some more code ...

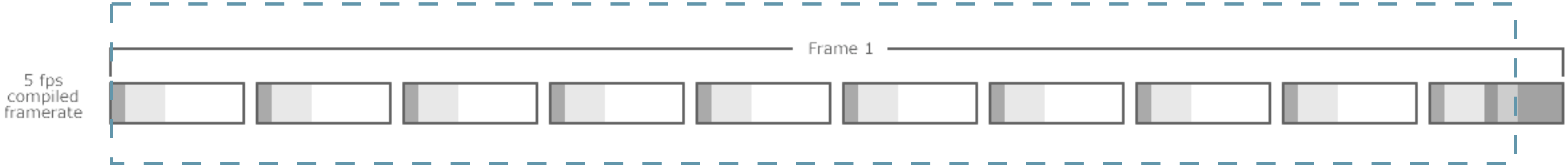
view code

so from our experiment the marshal does seem
to be carving out 20ms slices ...

with 20ms slices ...

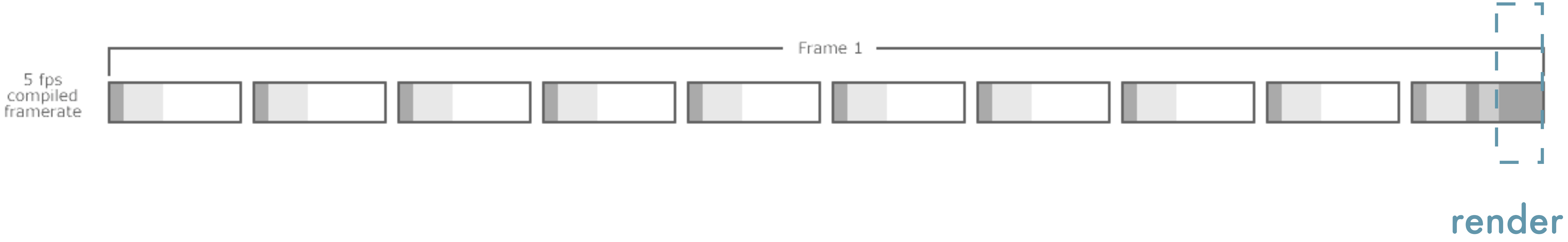


with 20ms slices ...

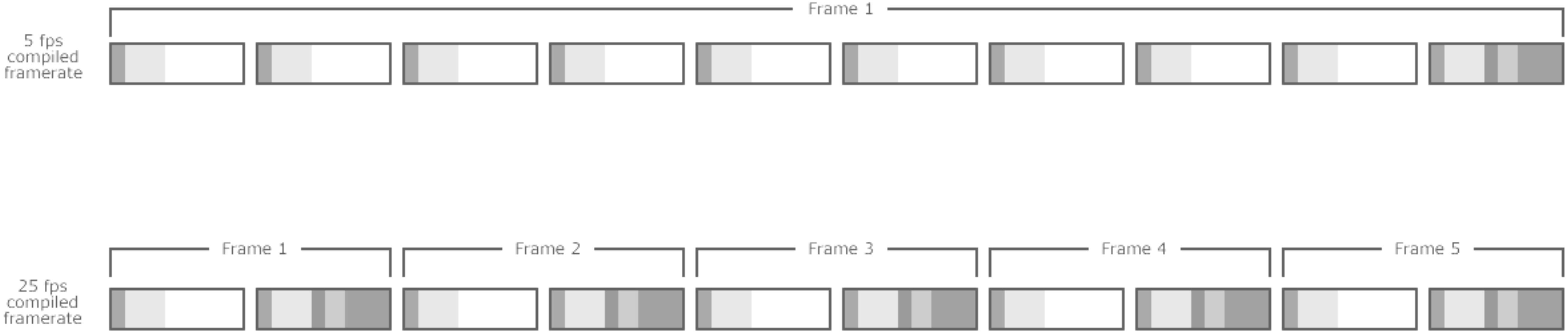


code execution

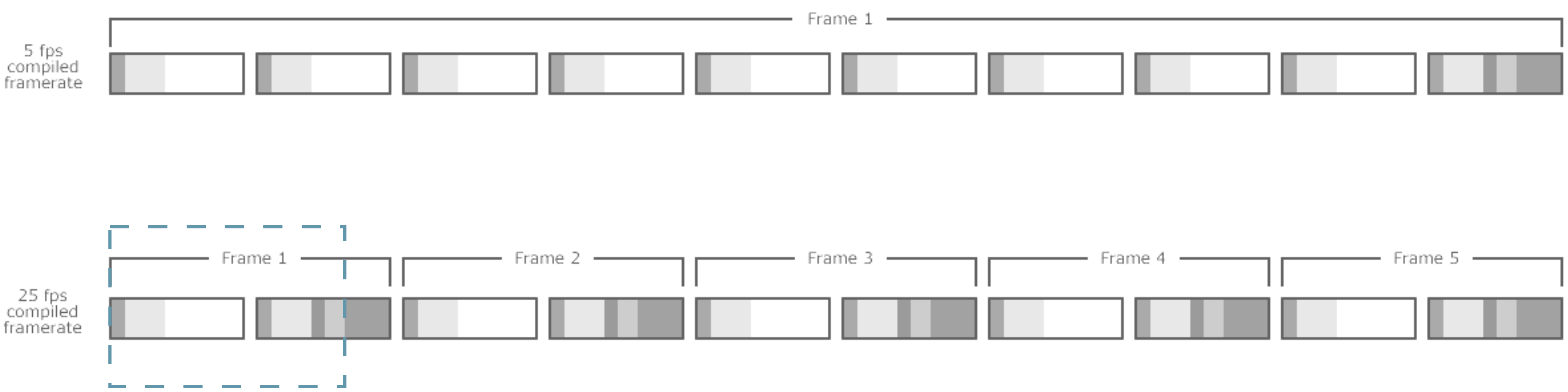
with 20ms slices ...



with 20ms slices ...

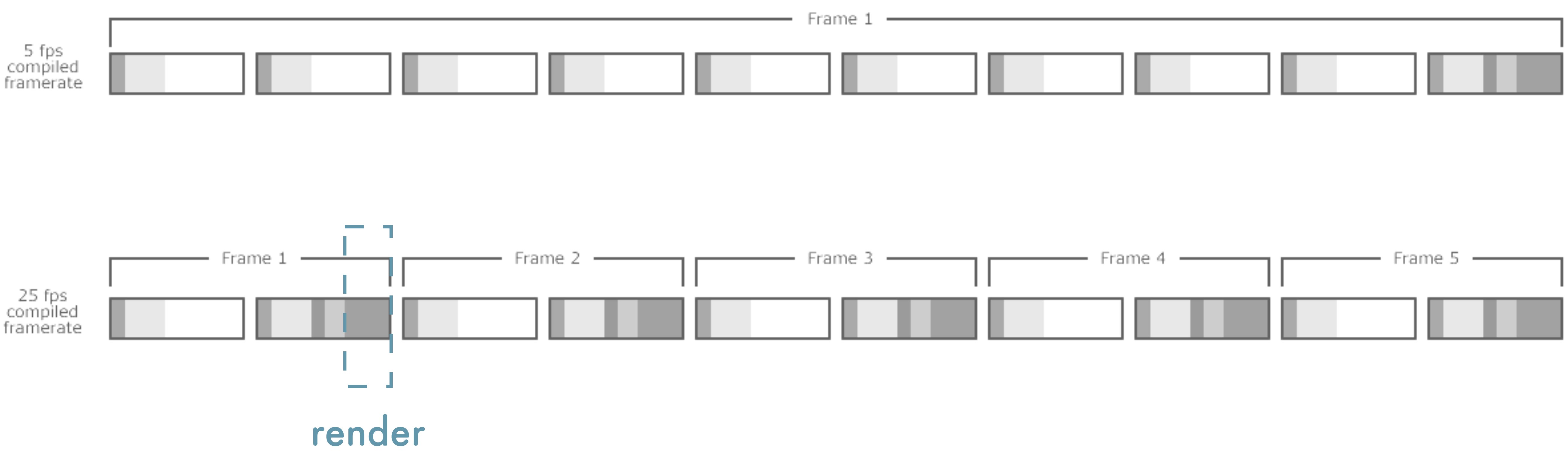


with 20ms slices ...

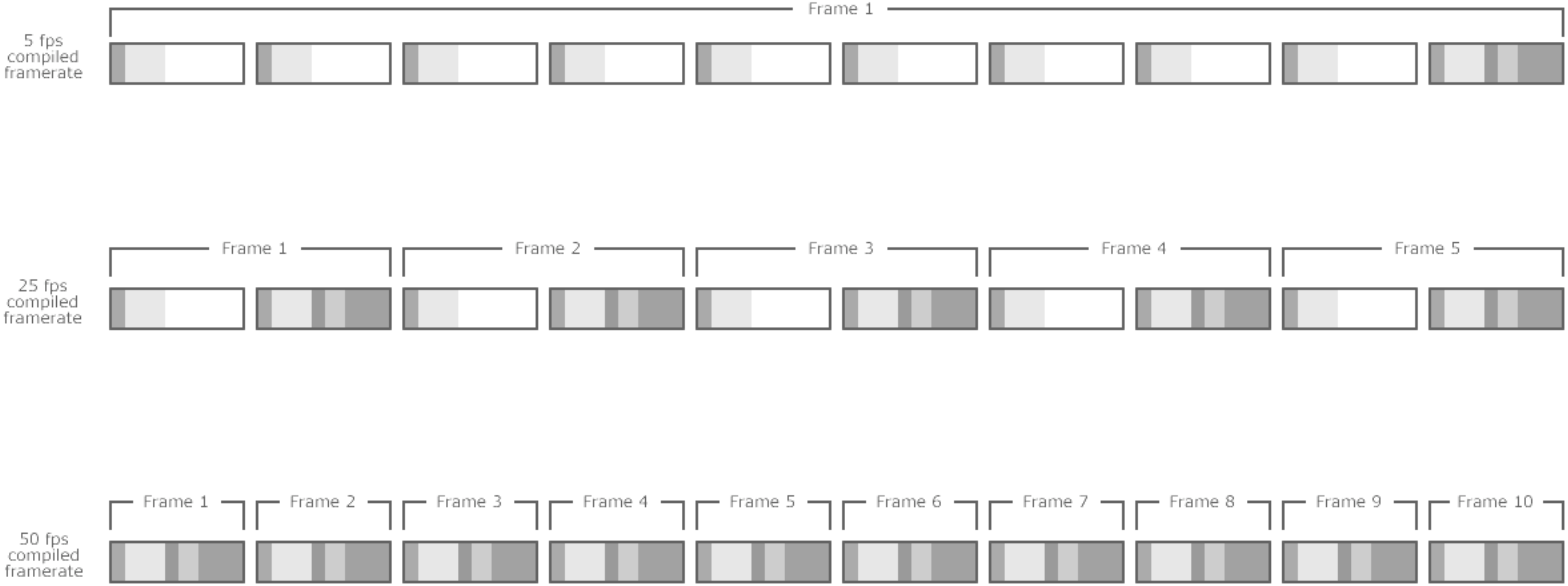


code execution

with 20ms slices ...



with 20ms slices ...



the marshal pre calculates the number of slices ...

long running code execution or render segments can extend a given slice beyond 20ms

this may or may not cause the the duration of the frame to increase ...

A swfs actual framerate won’t exceed the Marshals rate defined for the player instance ...

Code can be executed more often then the compiled framerate ...

i.e in a single frame calculation can happen many times but rendering happens only once at the end

Code can be executed more often then the compiled framerate ...

i.e in a single frame calculation can happen many times but rendering happens only once at the end

This is very significant

now lets come back to our original question ...

Why does a Flex component need a life cycle?

Since code can execute more often than rendering .. you could potentially do calculations that have no effect ...

for example, lets say you change the width of a component ...

this will cause the component, its container
(and its containers container, so on ...),
its surrounding components etc. to recalculate size
and positioning of themselves and all their children ..

i.e a lot of calculation will happen.

now in the next code segment you change width of your component again .... all that calculation will happen again ...

now since code segments can execute more times than render segments ...

your first set of calculations for change in width could potentially be useless ..

… this is the main reason a component needs a life cycle

performance

so what is the life cycle of a component ...

BIRTH

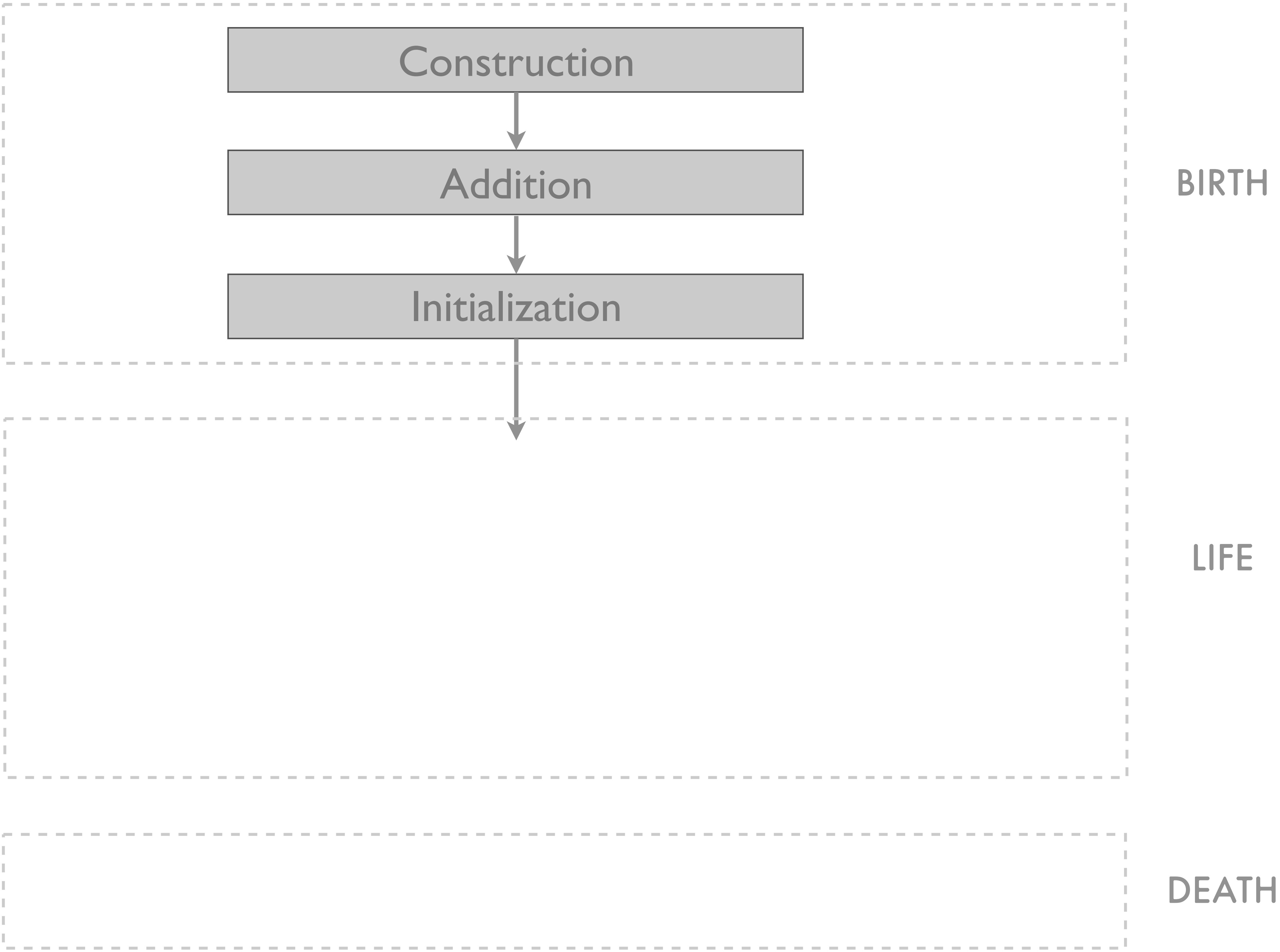
BIRTH

LIFE

BIRTH

LIFE

DEATH



Construction

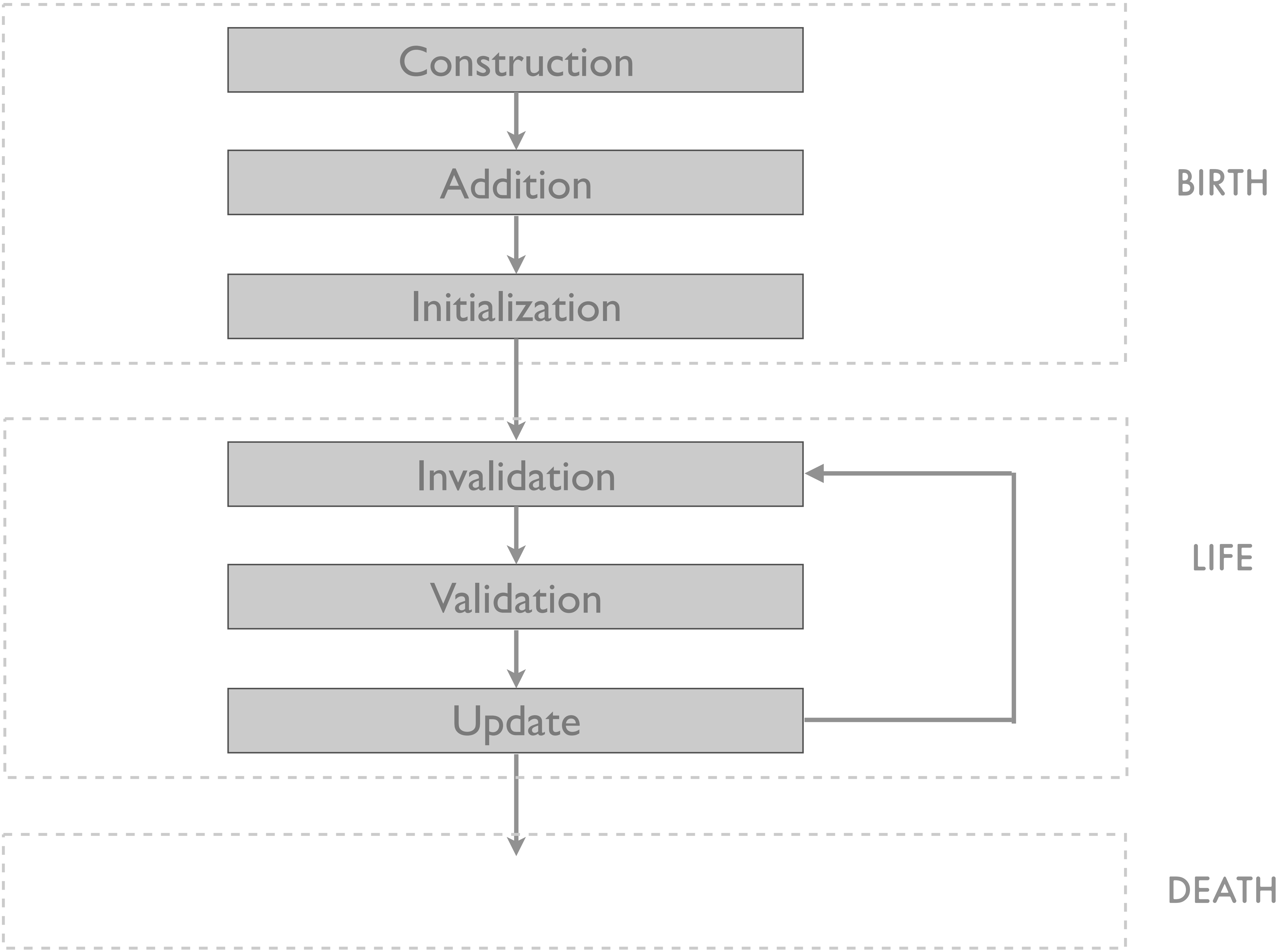
Addition

Initialization

BIRTH

LIFE

DEATH



Construction

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Initialization

BIRTH

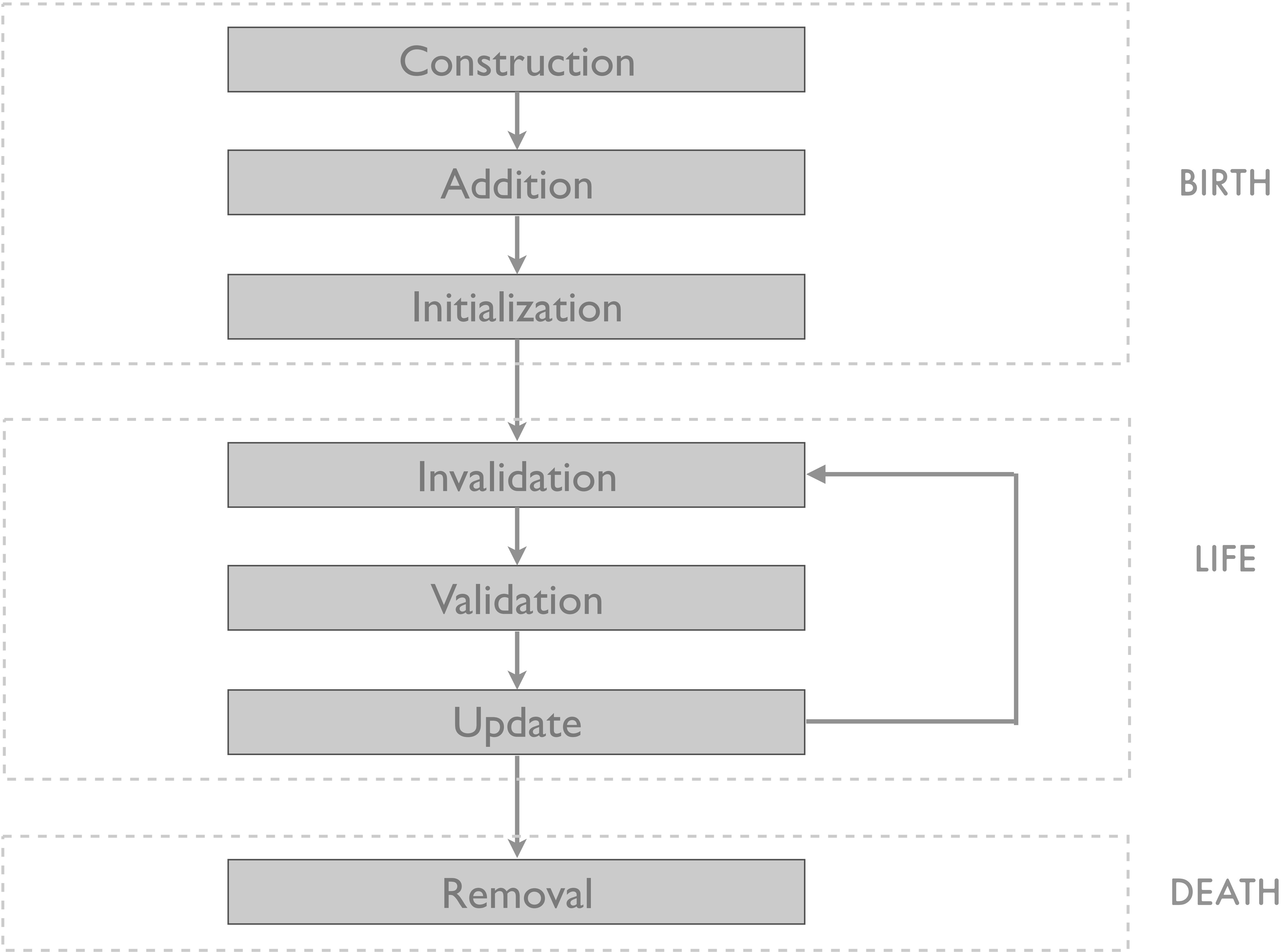
Invalidation

Validation

Update

LIFE

DEATH


Construction
Addition
Initialization
BIRTH
Invalidation
Validation
Update
LIFE
Removal
DEATH

lets setup some breakpoints and walk
through some code as we look at
each of these phases ..

Construction

```
var b:MyButton = new MyButton();
```

- not much happens in this phase
- thats good because Constructors are not JIT
- the component is given a name in FlexSprite
- event listeners are added

Addition

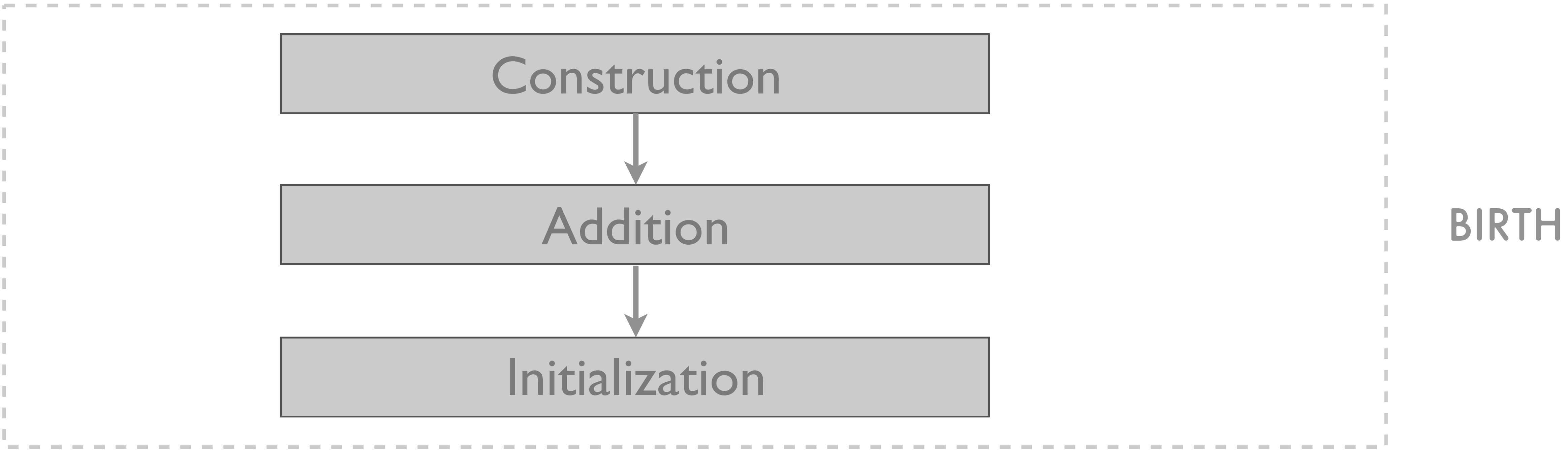
```
this.addChild(b);
```

- calls addingChild(), $addChild() and childAdded()
- a lot happens in addingChild(),
- child's parent and document properties are set etc.
- $addChild() is the flash player method that adds the component to the display list
- childAdded() calls the initialize() method of the child if not initialized

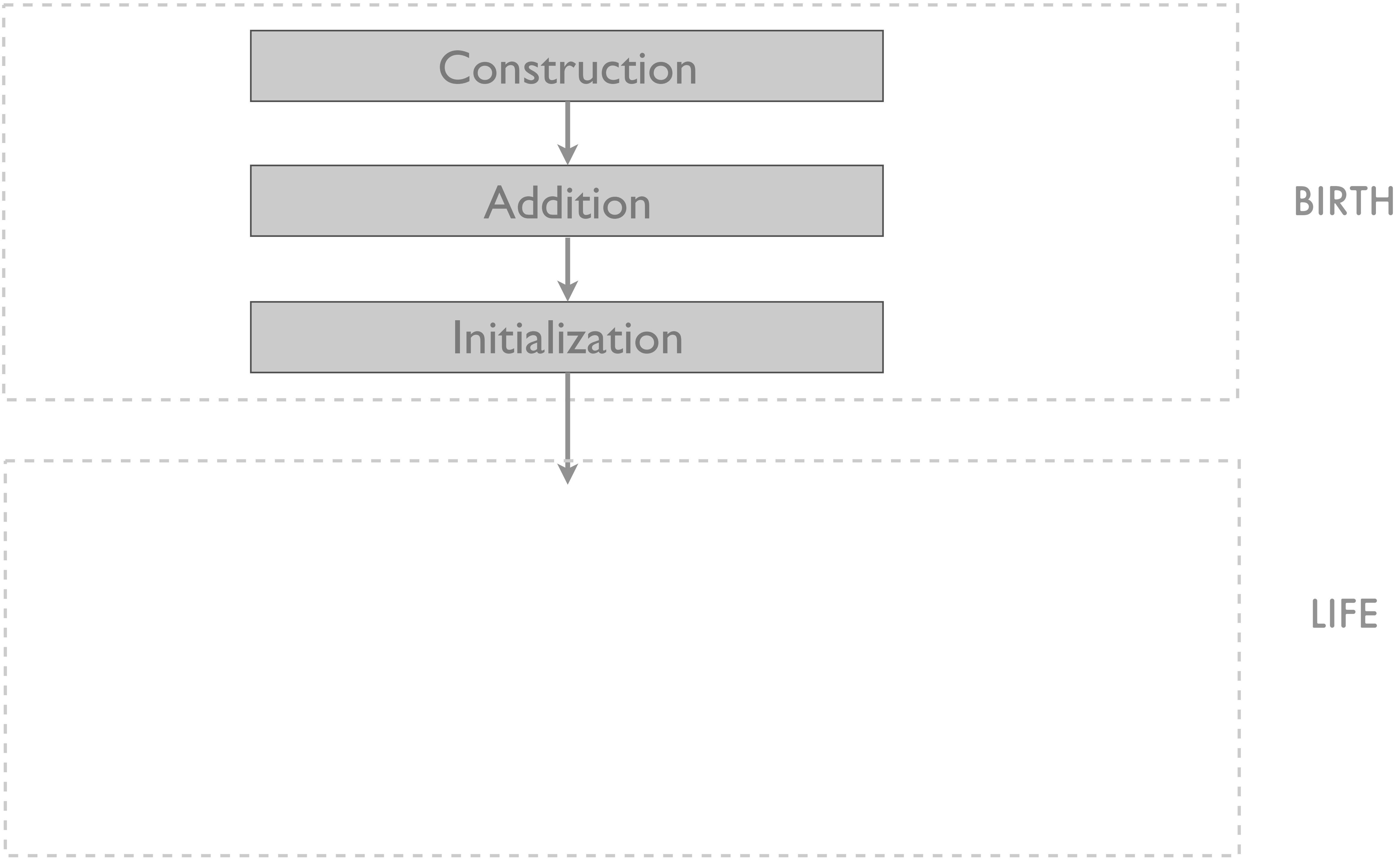
Initialization

```
initialize();  // called by the parent’s childAdded
```

- fires FlexEvent.PREINITIALIZE when it starts
- calls createChildren() .. where children of this component are created and added to itself
- fires FlexEvent.INITIALIZED when it ends



a component has been born ...



Construction

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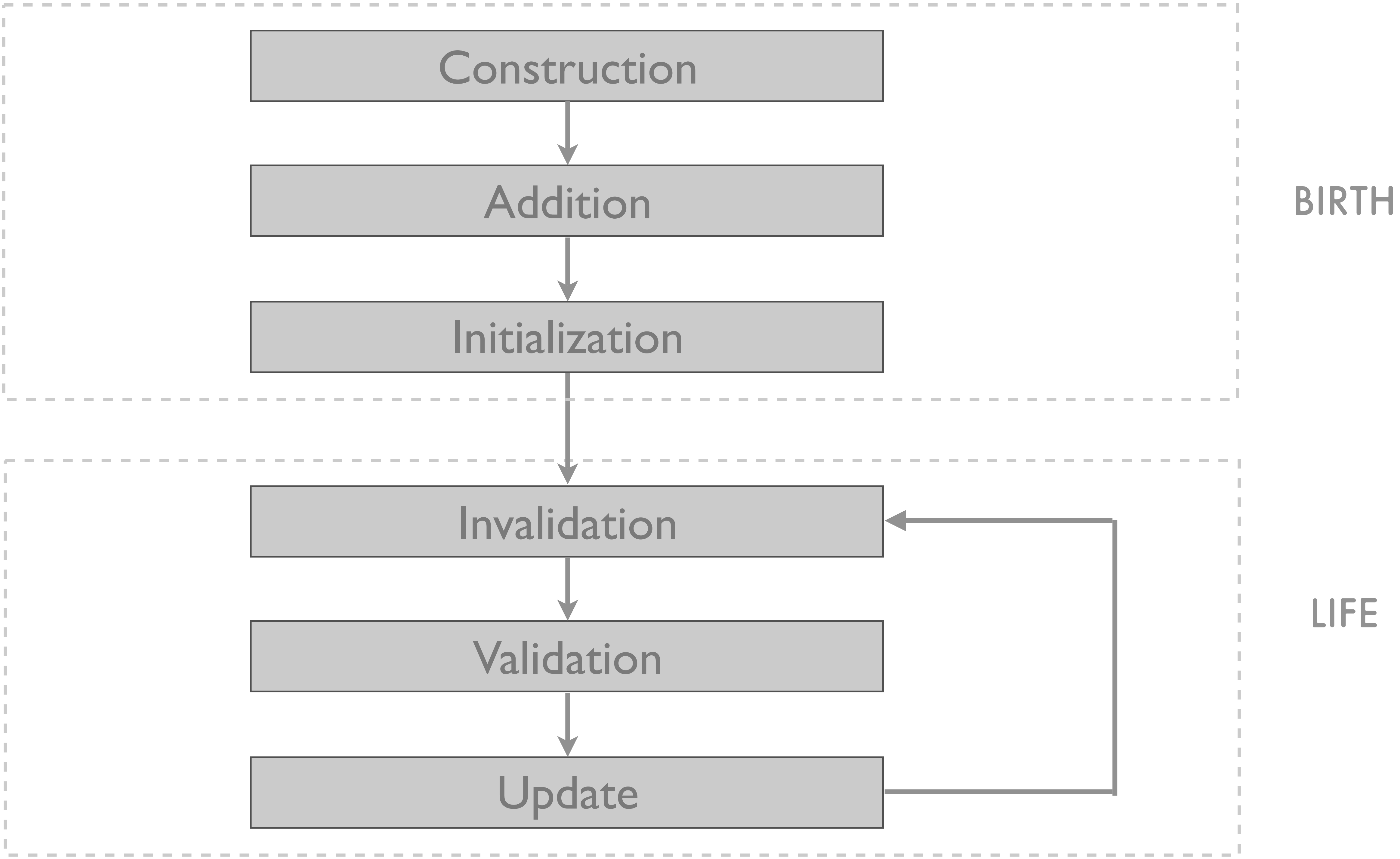
LIFE



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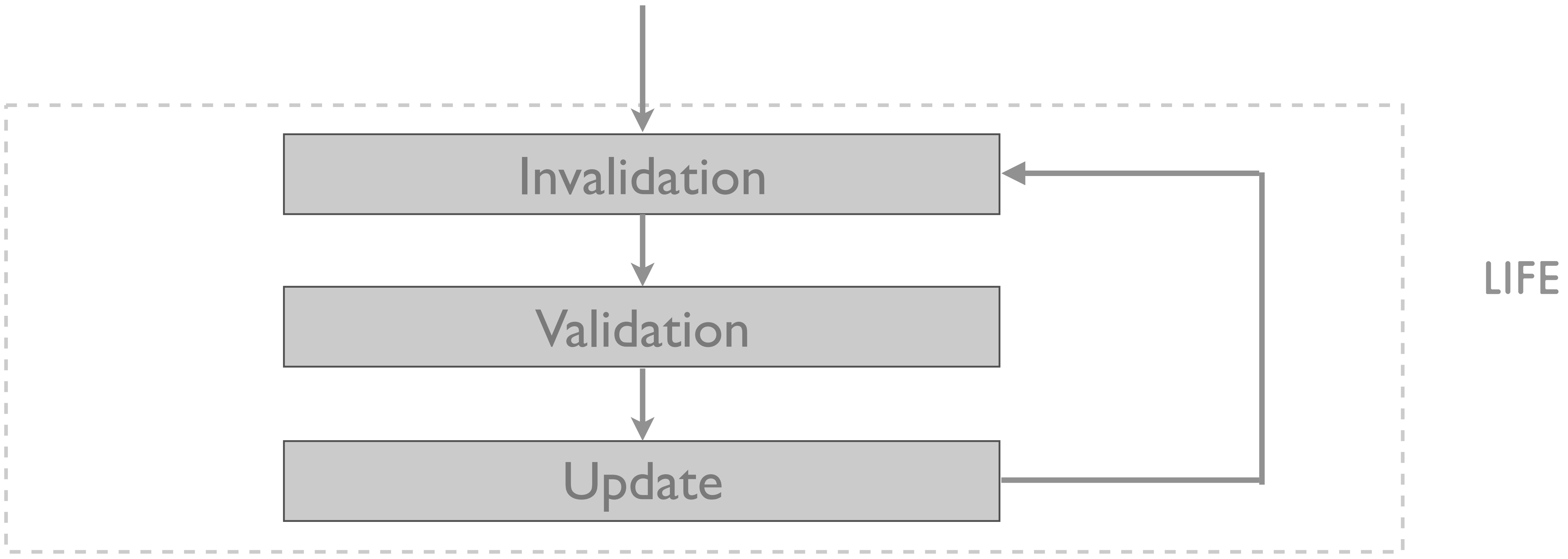
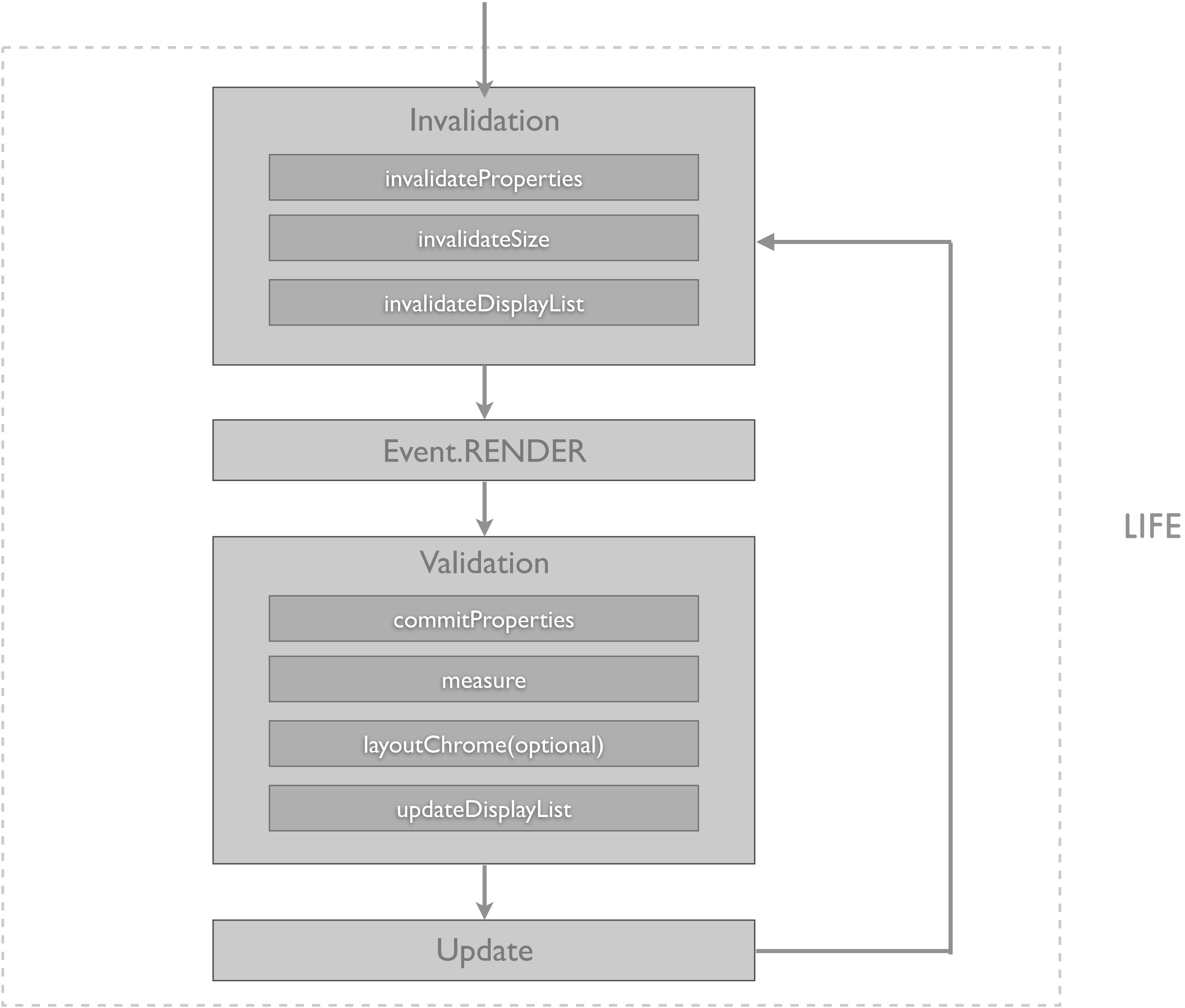

Invalidation
Validation
Update
LIFE



Invalidation

invalidateProperties

invalidateSize

invalidateDisplayList

Event.RENDER

Validation

commitProperties

measure

layoutChrome(optional)

updateDisplayList

Update

LIFE

Invalidation/Validation cycle (Life)

this is how the framework defers calculations to the end of the frame, just before rendering ...

Invalidation/Validation cycle (Life)

when a property changes...

- its new value is stored in a temp variable,
- a dirty flag is set,
- and invalidate methods are called.

Invalidation/Validation cycle (Life)

the LayoutManager keeps track of invalidated components

Invalidation/Validation cycle (Life)

the invalidation methods tell the LayoutManager that a component is now in an invalid state

Invalidation/Validation cycle (Life)

LayoutManger listens for Event.RENDER and calls corresponding validate methods when the render event occurs

Invalidation/Validation cycle (Life)

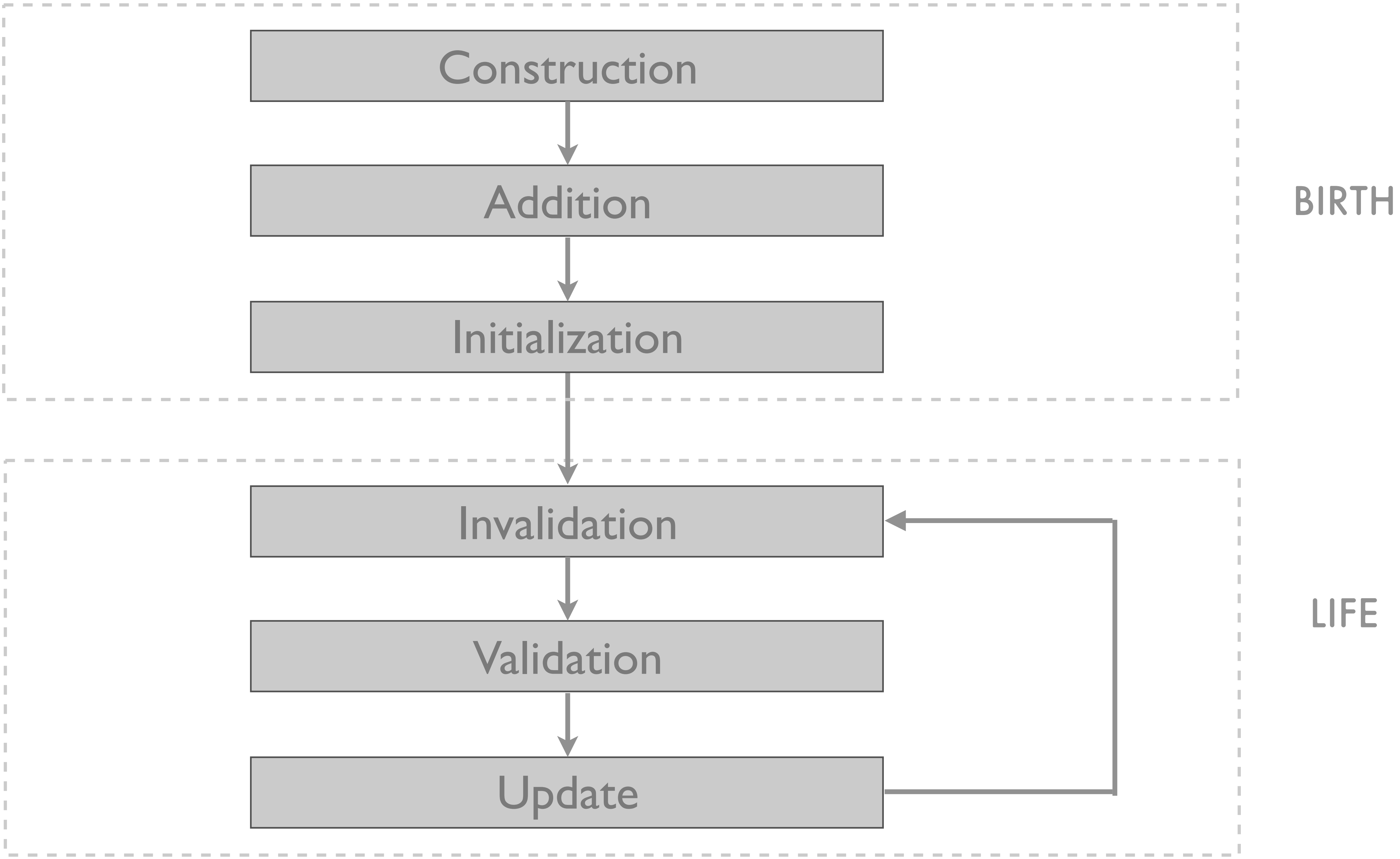
invalidateProperties → commitProperties

invalidateSize → measure

invalidateDisplayList → updateDisplayList

Invalidation/Validation cycle (Life)

finally an UPDATE_COMPLETE event is dispatched



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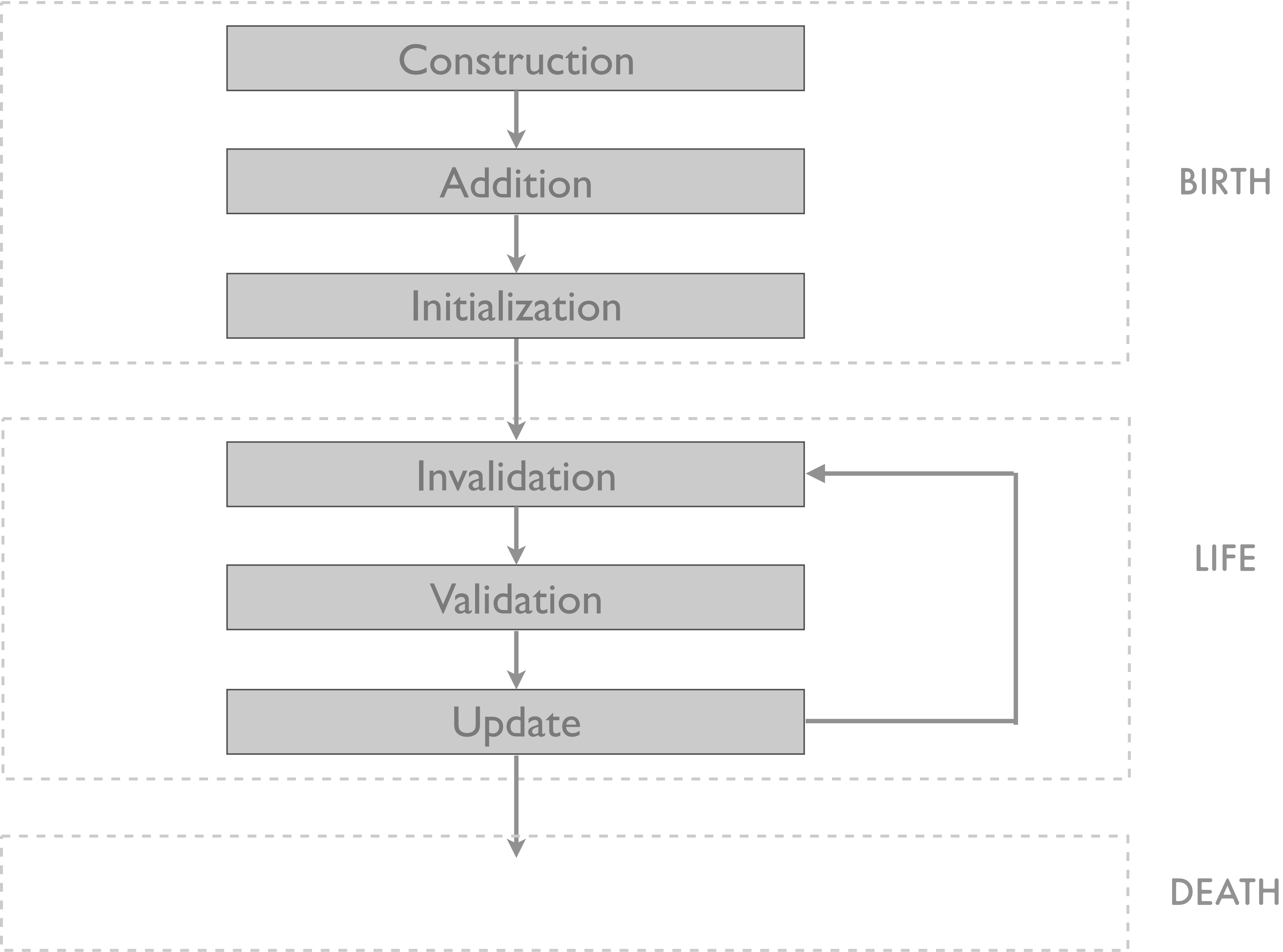
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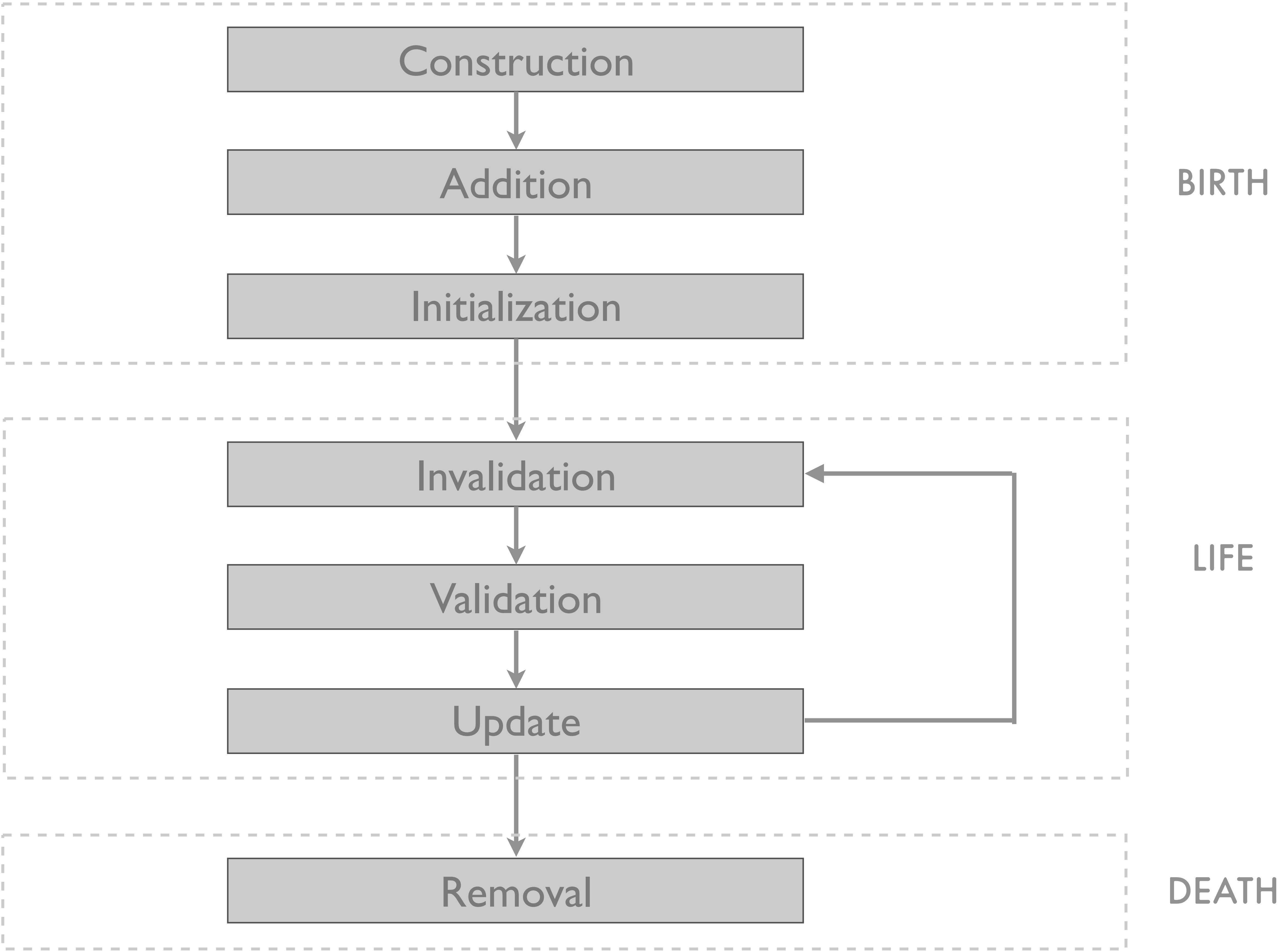

BIRTH

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LIFE

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Validation

Update

DEATH

Removal

Removal (death)

```
this.removeChild(b);
```

- $removeChild() is the flash player method that removes the component from the display list

All that we saw till now has been the same since Flex 2 and Flash Player 9 ..

maybe even before that, I’m not sure

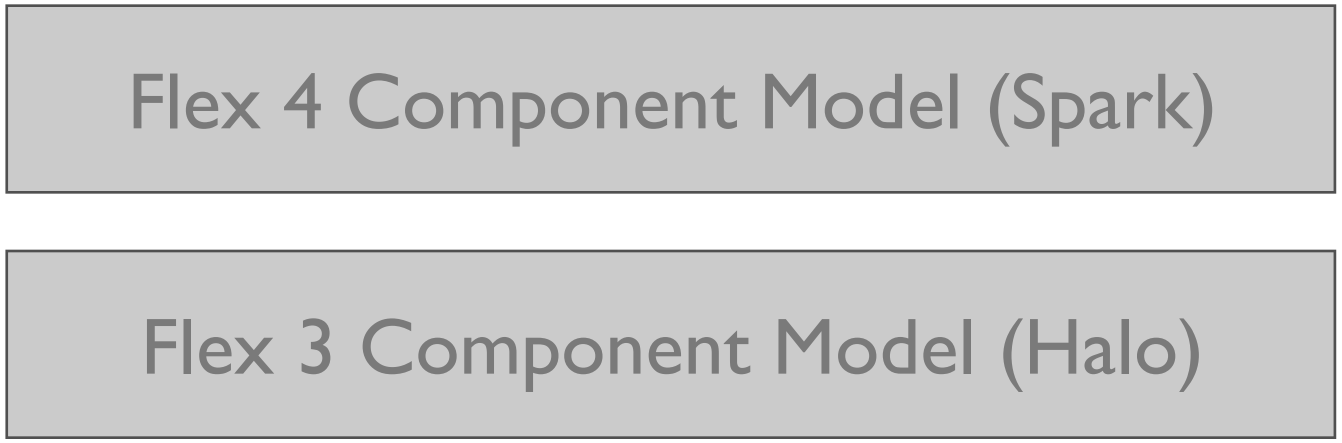
So what has changed in Flex 4?

not much ....

not much ....

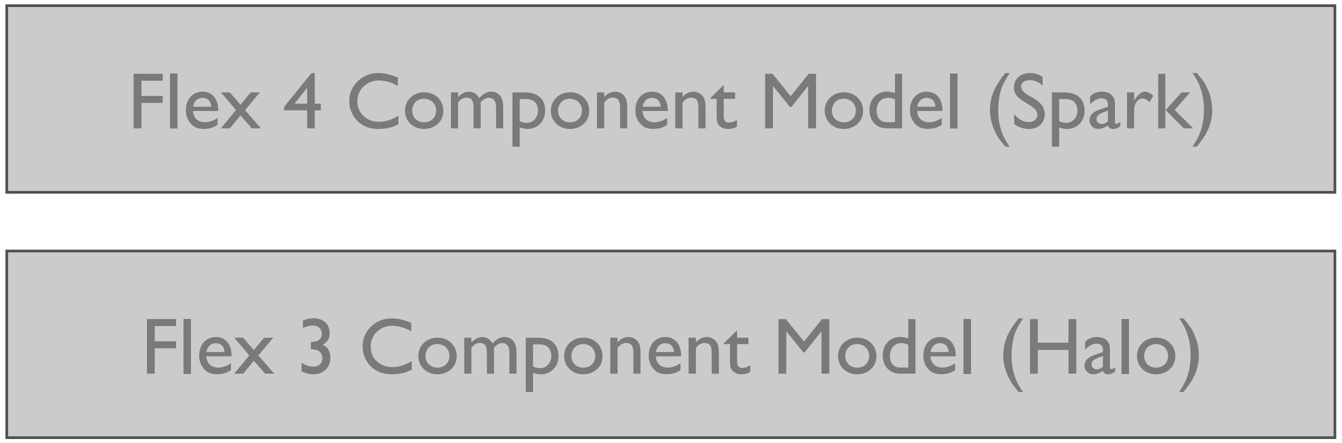
at least from a life cycle perspective ..

Flex 3 Component Model (Halo)



Flex 4 Component Model (Spark)

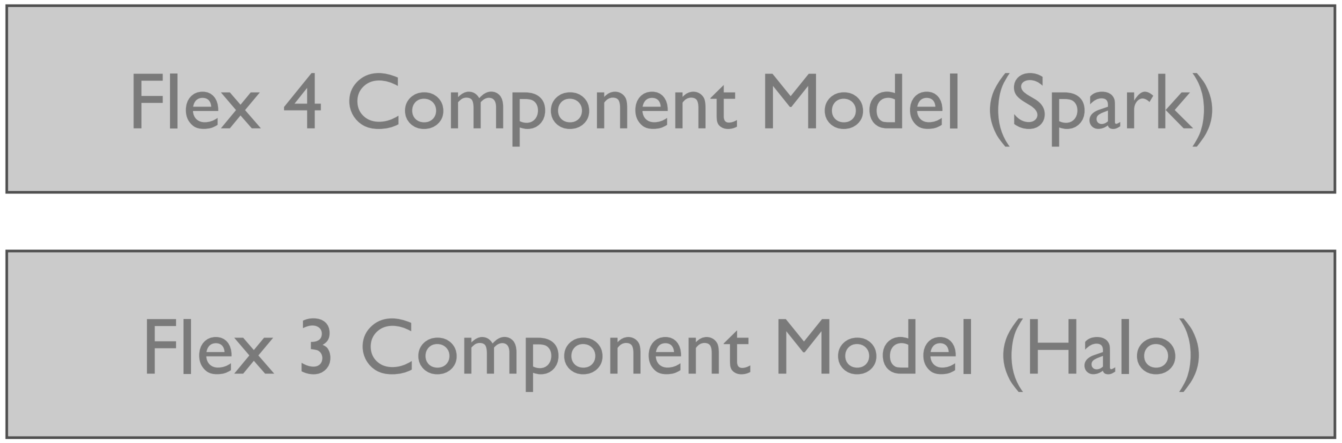
Flex 3 Component Model (Halo)



Flex 4 Component Model (Spark)

Flex 3 Component Model (Halo)

Spark is built on top of Halo ....



Flex 4 Component Model (Spark)

Flex 3 Component Model (Halo)

SkinnableComponent extends UIComponent ...

SkinnableComponent lives the same life cycle ...

the Skin is a child to the component
and lives its own life cycle ...

lets step through some more code …

some observations ...

createChildren() of SkinnableComponent calls validateSkinState() which in turn calls attachSkin() ...

attachSkin() creates the skin and adds it as a child ...

which in turn kicks off the life cycle of the skin

attachSkin() also calls findSkinParts() which looks though the children of the skin and populates our declared static part references

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findSkinParts() calls partAdded() for all the static parts it finds

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findSkinParts() calls partAdded() for all the static parts it finds

also throws an exception if it does not find a required part

at a later time, when you create a dynamic part
using createDynamicPartInstance()

that method calls partAdded() as well

?

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