

UIKit Dynamics 101

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About Me

- Senior iOS Developer
- Black Pixel
- Primary Author “Pro
iOS 5 Tools”
- Giver of talks



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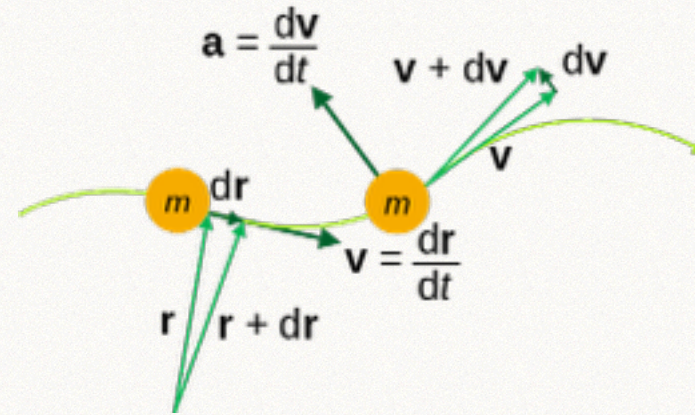


Syllabus

- Dynamics API
- Implementation
- Tips and Tricks



Dynamics



http://en.wikipedia.org/wiki/Equations_of_motion



Dynamics

The branch of mechanics that deals with the motion and equilibrium of systems under the action of forces, usually from outside the system.

<http://dictionary.reference.com/browse/dynamics?s=t>



Dynamics in music enhances the song. Dynamics in inflection makes a presentation more interesting. Dynamics are meant to enhance transitions and animations in your apps.

Dynamics API

- Dynamic Items
- Behaviors
- Animators



Dynamic Items

```
@protocol UIDynamicItem <NSObject>

@property (readwrite) CGPoint center;
@property (readonly) CGRect bounds;
@property (readwrite) CGAffineTransform transform;

@end
```



Dynamic Items

```
@interface UIView : UIResponder<NSCoding, UIAppearance,  
UIAppearanceContainer, UIDynamicItem>
```

```
@interface UICollectionViewLayoutAttributes : NSObject  
<NSCopying, UIDynamicItem>
```



Dynamic Items

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@interface UIView : UIResponder<NSCoding, UIAppearance,  
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```

```
@interface UICollectionViewLayoutAttributes : NSObject  
<NSCopying, UIDynamicItem>
```



Behaviors

- Subclasses of UIDynamicBehavior
- Define how UIDynamicItems interact



Using Behaviors

- Built-in behaviors
- Compound behaviors
- Completely custom behaviors



UIAttachmentBehavior, UICollisionBehavior, UIGravityBehavior, UIDynamicItemBehavior, UIPushBehavior, and UISnapBehavior

Use `addChildBehavior:` on compound behaviors

Completely custom behaviors: Look at existing behaviors as a guide or give the behavior an action block for per-step logic.

Gravity Behavior

```
// The default value for the gravity vector is (0.0, 1.0)
// The acceleration for a dynamic item subject to a (0.0, 1.0)
gravity vector is downwards at 1000 points per second2.
@property (readwrite, nonatomic) CGVector gravityDirection;

@property (readwrite, nonatomic) CGFloat angle;
@property (readwrite, nonatomic) CGFloat magnitude;
- (void)setAngle:(CGFloat)angle magnitude:(CGFloat)magnitude;
```



Attachment Behavior

```
@property (readonly) UIAttachmentBehaviorType attachedBehaviorType;  
  
@property (readwrite) CGPoint anchorPoint;  
  
@property (readwrite) CGFloat length;  
@property (readwrite) CGFloat damping; // 1: critical damping  
@property (readwrite) CGFloat frequency; // in Hertz
```



Snap Behavior

```
NS_CLASS_AVAILABLE_IOS(7_0) @interface UISnapBehavior :
UIDynamicBehavior

// The point argument is expressed in the reference coordinate
system
- (id)initWithItem:(id <UIDynamicItem>)i snapToPoint:(CGPoint)p;

@property (nonatomic, assign) CGFloat damping; // damping value
from 0.0 to 1.0. 0.0 is the least oscillation.

@end
```



Collision Behavior

- Allows dynamic items to interact and “collide”
- Can define boundaries
- Delegate has callbacks for collision detection
- Behaviors have identifiers



2 types – Item and Boundary; boundaries have identifiers
Have a CPU cost

Push Behavior

- Applies a “pushing” force between dynamic items
- Continuous or instantaneous
- Magnitude is in “UIKit Newtons”



A continuous force vector with a magnitude of 1.0, applied to a 100 point x 100 point view whose density value is 1.0, results in view acceleration of 100 points / second² in the direction of the vector.

Can be turned off with the “active” flag

Dynamic Item Behavior

- Changes base item properties
- Linear velocity
- Angular velocity



allowsRotation, angularResistance, angularVelocityForItem:, density, elasticity, friction, resistance,

Compound Behaviors

- Behavior by composition
- Create own designated initializer
- Maintain internal collection of behaviors



Compound Behaviors

- (void)addChildBehavior:(UIDynamicBehavior *)b;
- (void)removeChildBehavior:(UIDynamicBehavior *)b;



Custom Behaviors

- Define per-step animations
- Performance can be an issue

```
// When running, the dynamic animator calls the  
action block on every animation step.  
@property (nonatomic, copy) void (^action)(void);
```



Animators

- Controls the physics engine
- Controls the behaviors in the universe
- Maintains the context of the “world”



UIDynamicAnimator

```
@interface UIDynamicAnimator: NSObject  
  
@end
```



UIDynamicAnimator

```
@interface UIDynamicAnimator: NSObject  
- (instancetype)initWithReferenceView:(UIView*)view;  
@end
```



UIDynamicAnimator

```
@interface UIDynamicAnimator: NSObject

- (void)addBehavior:(UIDynamicBehavior *)b;
- (void)removeBehavior:(UIDynamicBehavior *)b;
- (void)removeAllBehaviors;

@end
```



UIDynamicAnimator

```
@interface UIDynamicAnimator: NSObject  
- (NSArray*)itemsInRect:(CGRect)rect;  
- (void)updateItemUsingCurrentState:(id <UIDynamicItem>)i;  
@property (...) BOOL running;  
- (NSTimeInterval)elapsedTime;  
@end
```



Animator Delegate

```
@protocol UIDynamicAnimatorDelegate <NSObject>

@optional
- (void)dynamicAnimatorWillResume:(UIDynamicAnimator*)a;
- (void)dynamicAnimatorDidPause:(UIDynamicAnimator*)a;

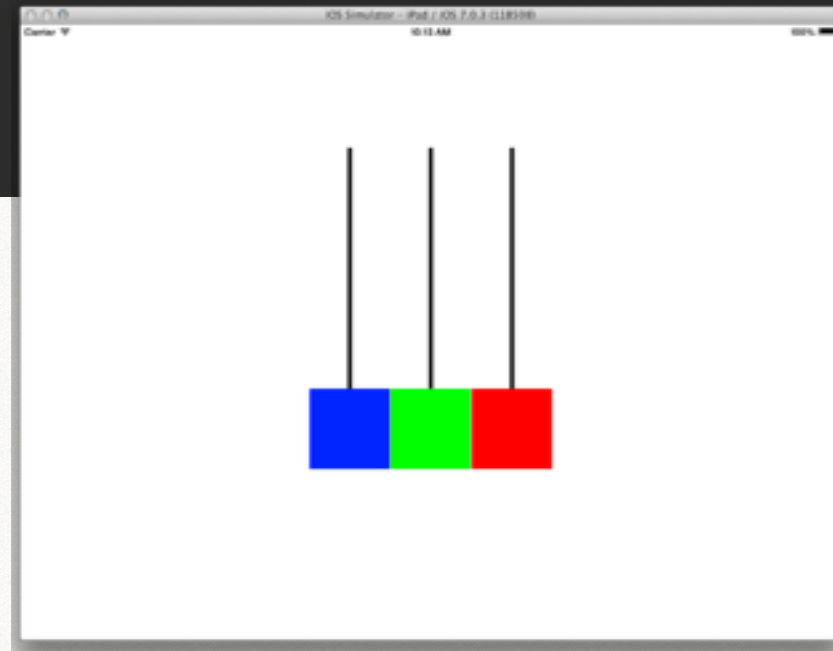
@end
```



Demo

<https://github.com/whilethis/UIKit-Dynamics-101>





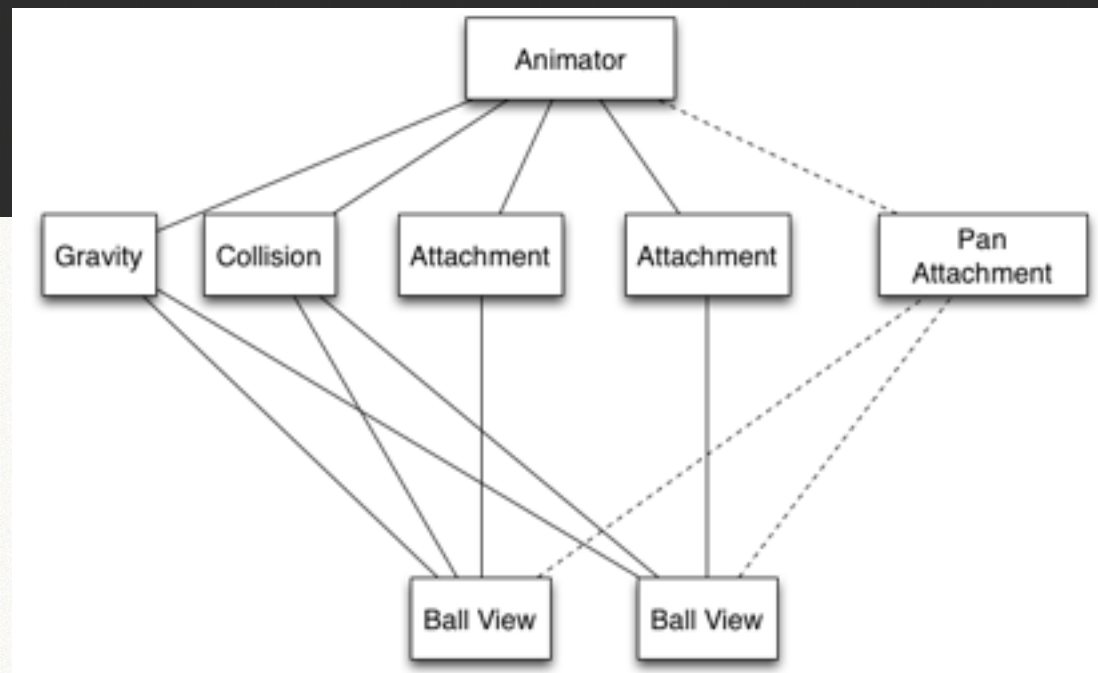
Newton's Cradle

III

Building the Cradle

- Think in terms of interactions
- Keep it simple (for now)
- Build a behavior tree





Behavior Tree



Code!

<https://github.com/whilethis/UIKit-Dynamics-101>



Tips

- Think interactions
- Compound behaviors
- Limit work in the action block



Design Considerations

- Not a replacement for Core Animation
- Meant to enhance, not distract



Another tool in the toolbox

Questions



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Thank You

