Layer-Backed Views

AppKit + Core Animation

Session 217

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AppKit Software Engineer

Before We Begin

Expectations

- Experience with traditional AppKit or UIKit drawing
- No experience with Core Animation is required

Effectively Using Layer-Backed NSViews

- Layer-backed views use Core Animation
- Layer-backing gives smoother, faster animations
  - Animations use less CPU as work is done in the GPU
  - Allows the use of the NSView hierarchy, events, and responder chain
- Historically layer-backed views use traditional AppKit drawing
  - AppKit has had the ability to use layers for many releases

Demo

Animation performance

Effectively Using Layer-Backed NSViews

Agenda

- Drawing
- Animating
  - Contents Updating
  - Synchronized Subview Animations
- Best Practices
  - Text and Font Smoothing
  - Focus Rings
- More Details and Tips

Drawing

Drawing

- Traditional NSView drawing model
- Using Core Animation layers and how they work
- Differences in `-setNeedsDisplay:` for redrawing

Traditional NSView Drawing Model

Custom NSView

Traditional NSView Drawing Model

Custom drawRect: implementation


```
- (void)drawRect:(NSRect)dirtyRect {
    // Fill the contents
    [[NSColor lightGrayColor] set];
    NSRectFill(self.bounds);
    // Draw the border
    [[NSColor grayColor] set];
    NSFrameRect(self.bounds);
    // Draw the title
    [@"Tandem Unicycle" drawInRect:titleRect withAttributes:...];
    // Draw the image
    [image drawInRect:imageRect fromRect:.. operation:.. fraction:..];
}
```

Traditional NSView Drawing Model

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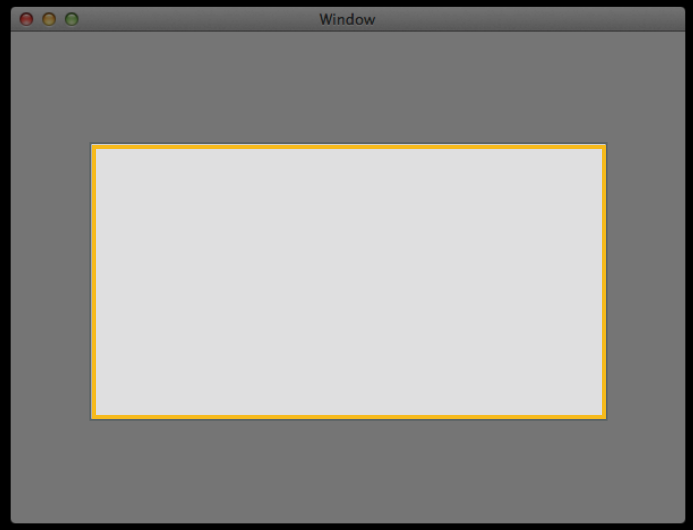


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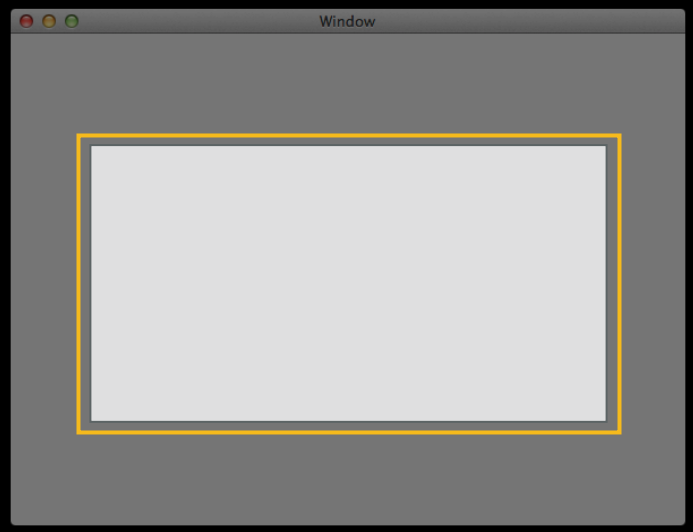


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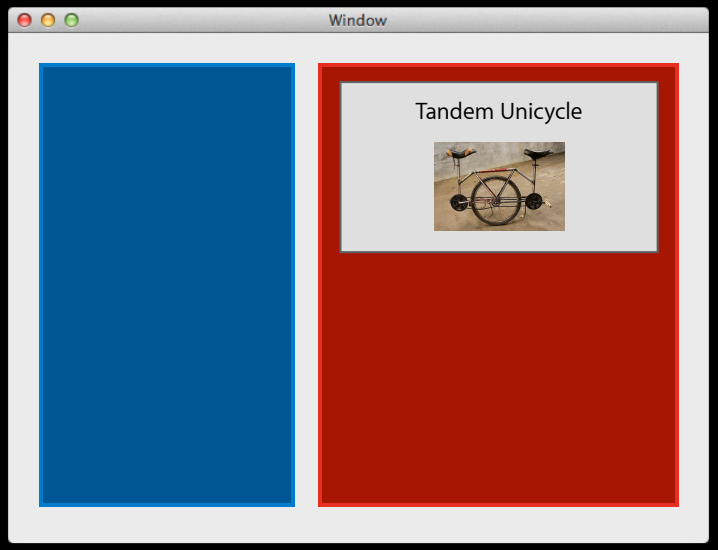
Traditional NSView Drawing Model

What happens in NSWindow draw time

- NSWindow recursively draws all views in a dirty region
- Children draw on top of the parent



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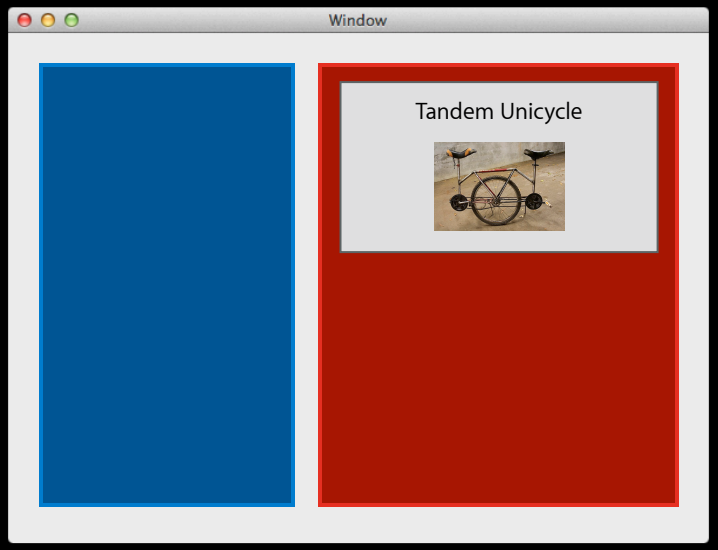

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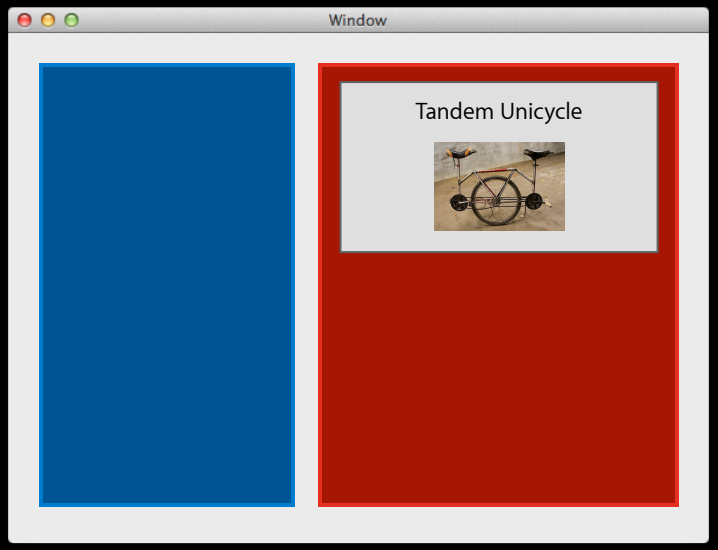

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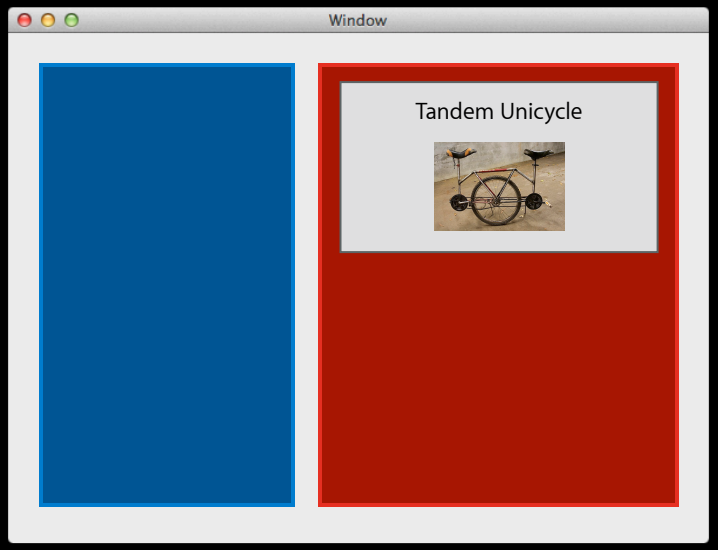

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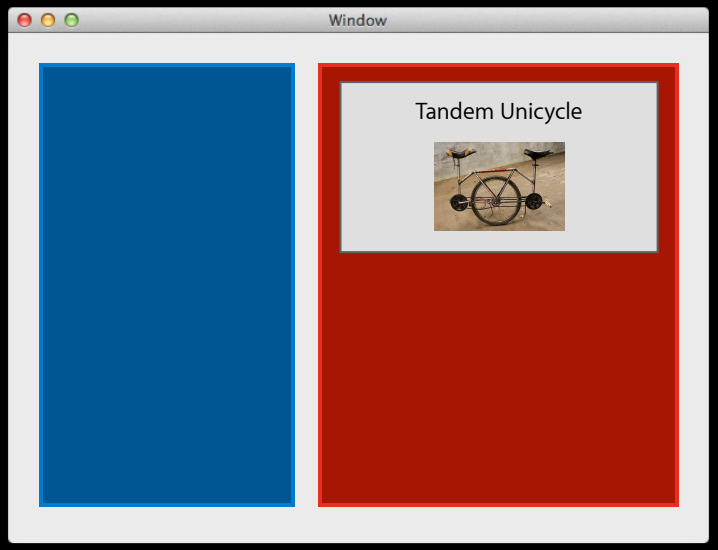

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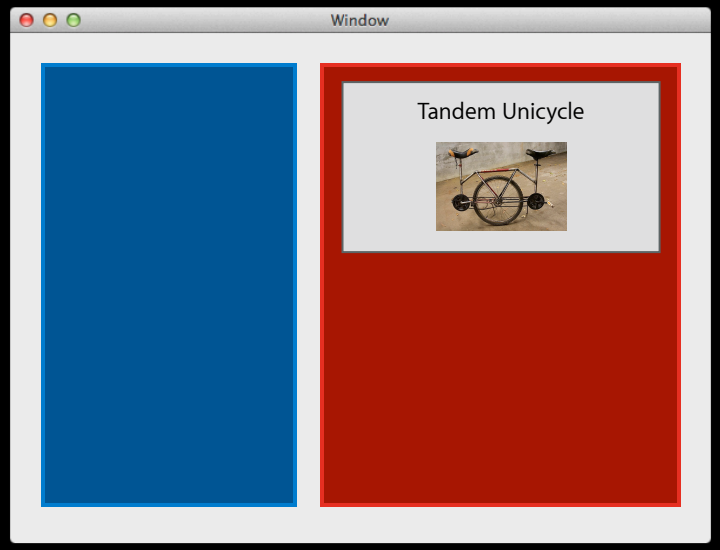
- Similar to drawing into a large image



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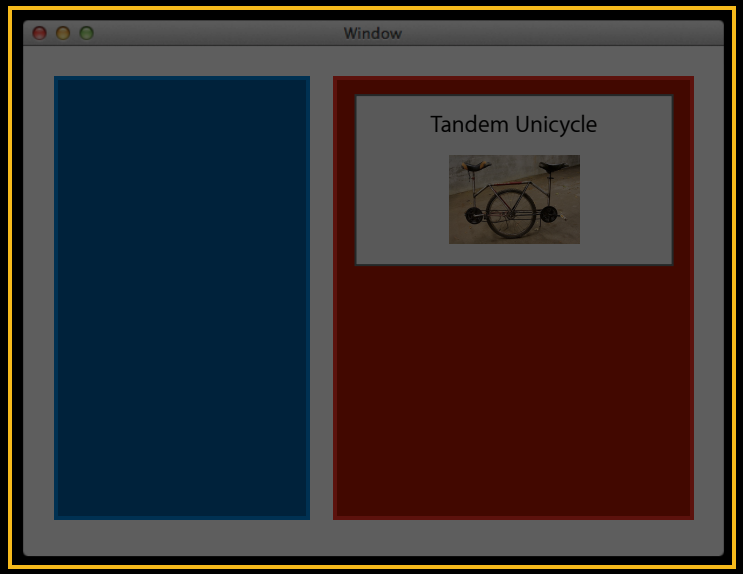
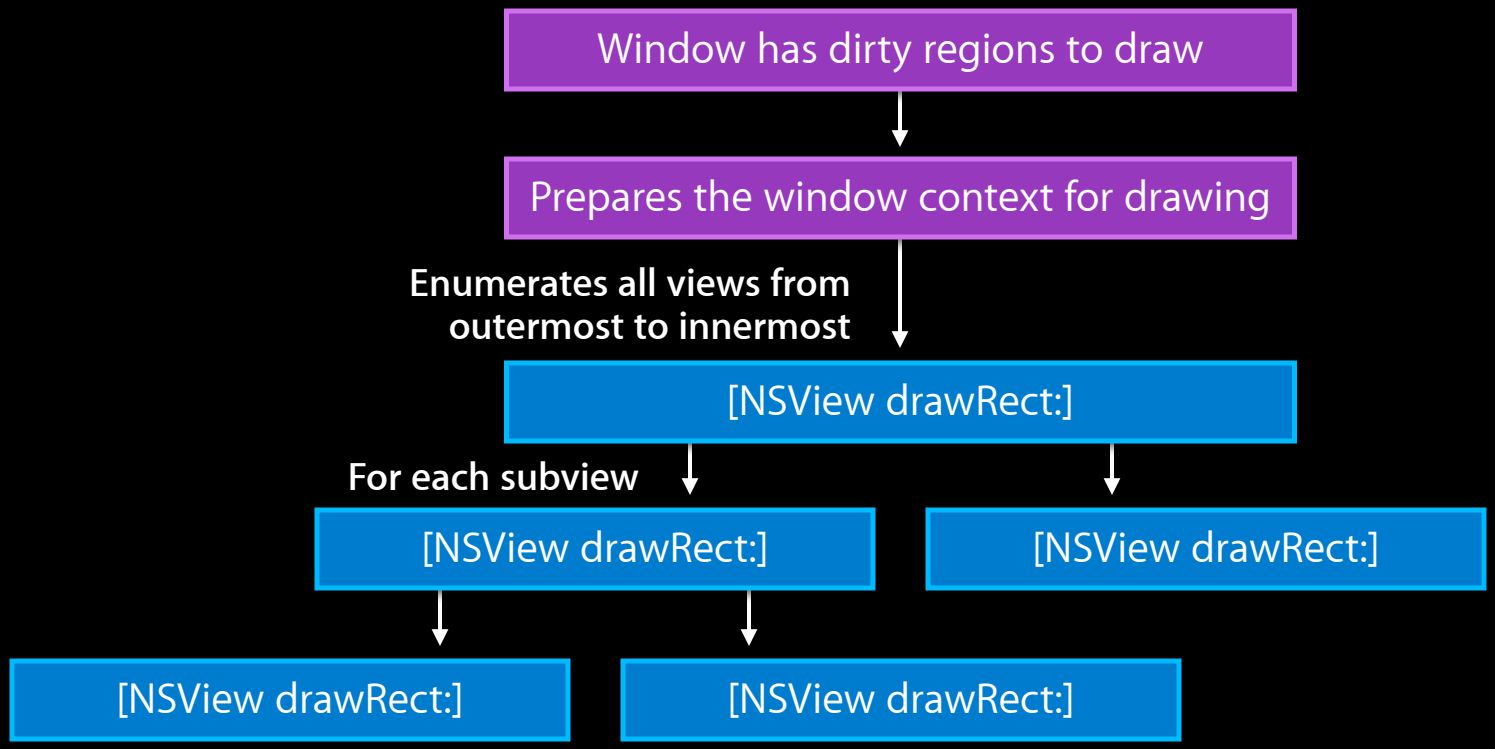


Window Drawing Flow Chart

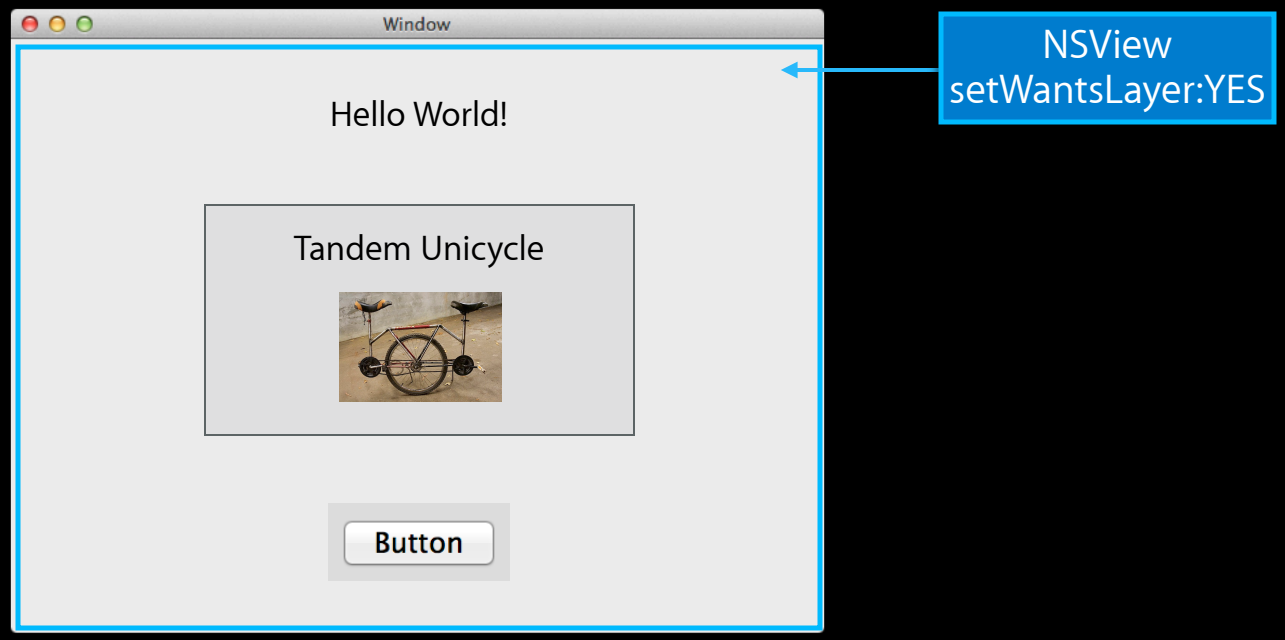


Core Animation and AppKit

How to use Core Animation layers

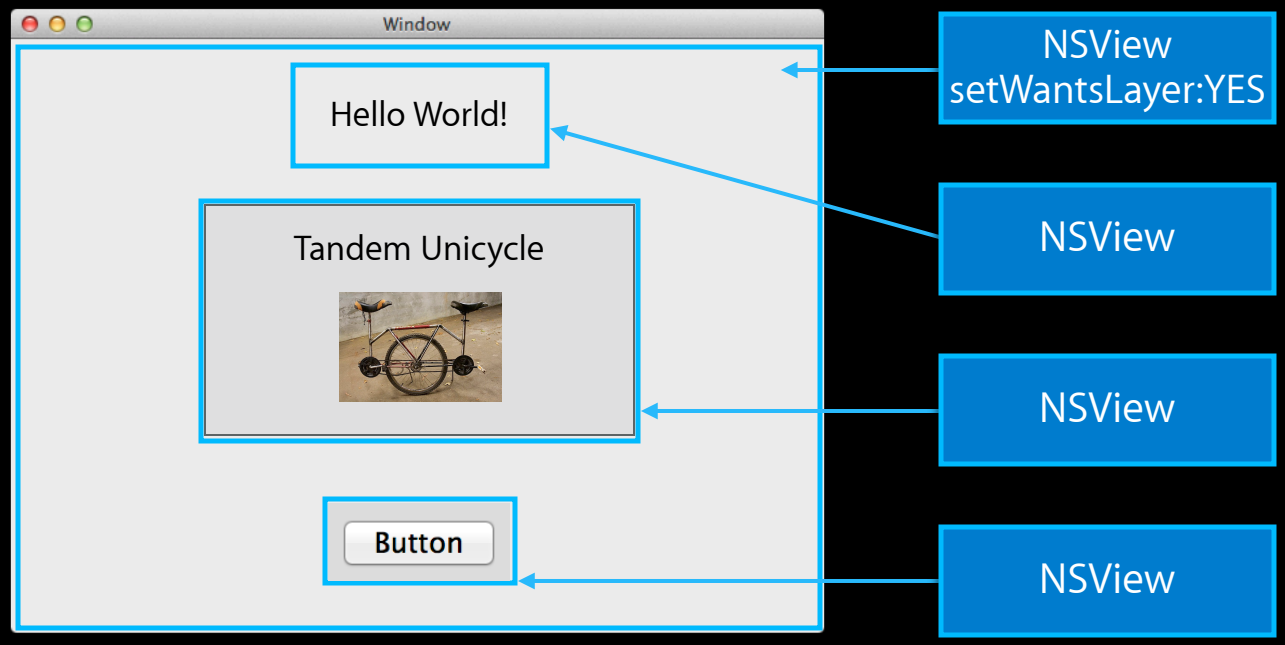
Core Animation and AppKit

Call setWantsLayer:YES on parent NSView



Core Animation and AppKit

All children views become layer-backed



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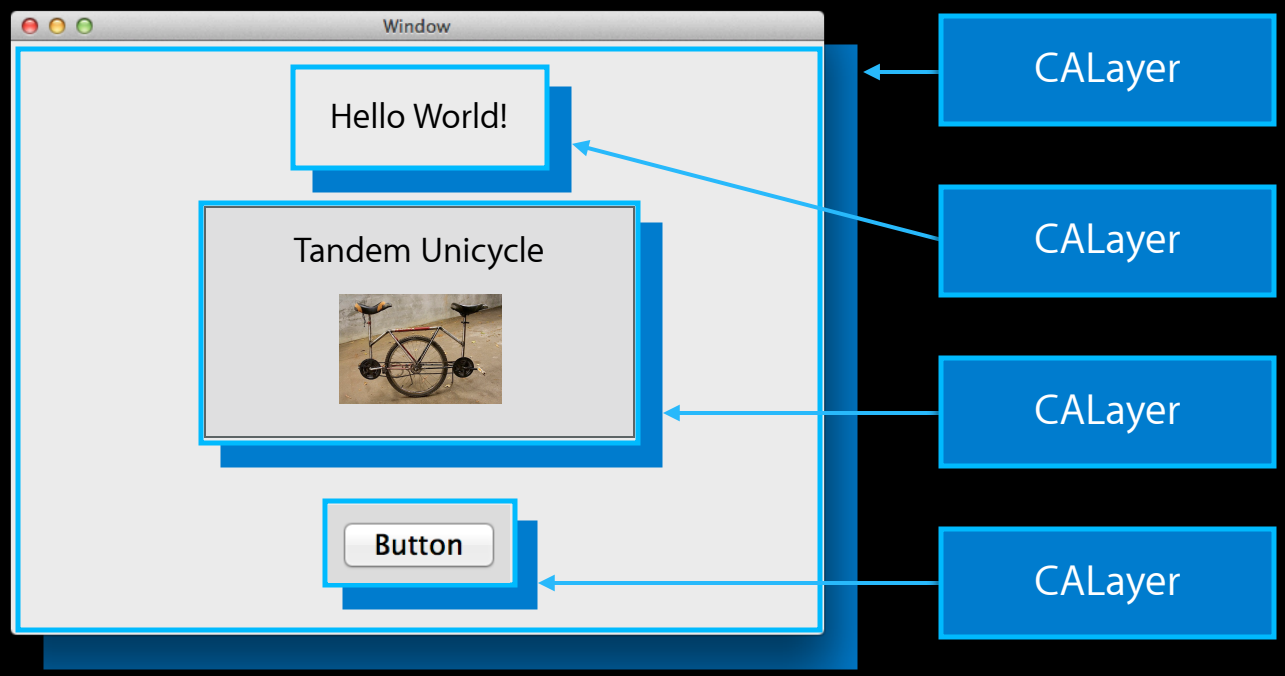
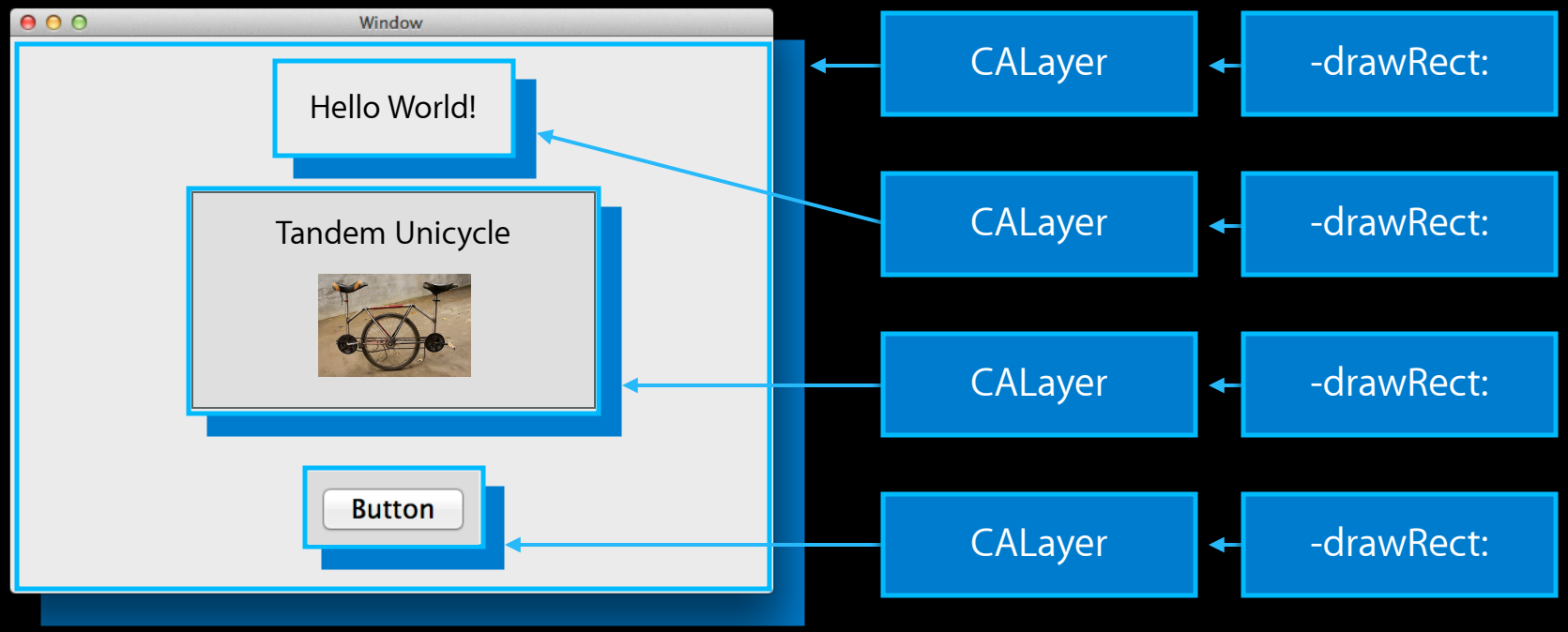
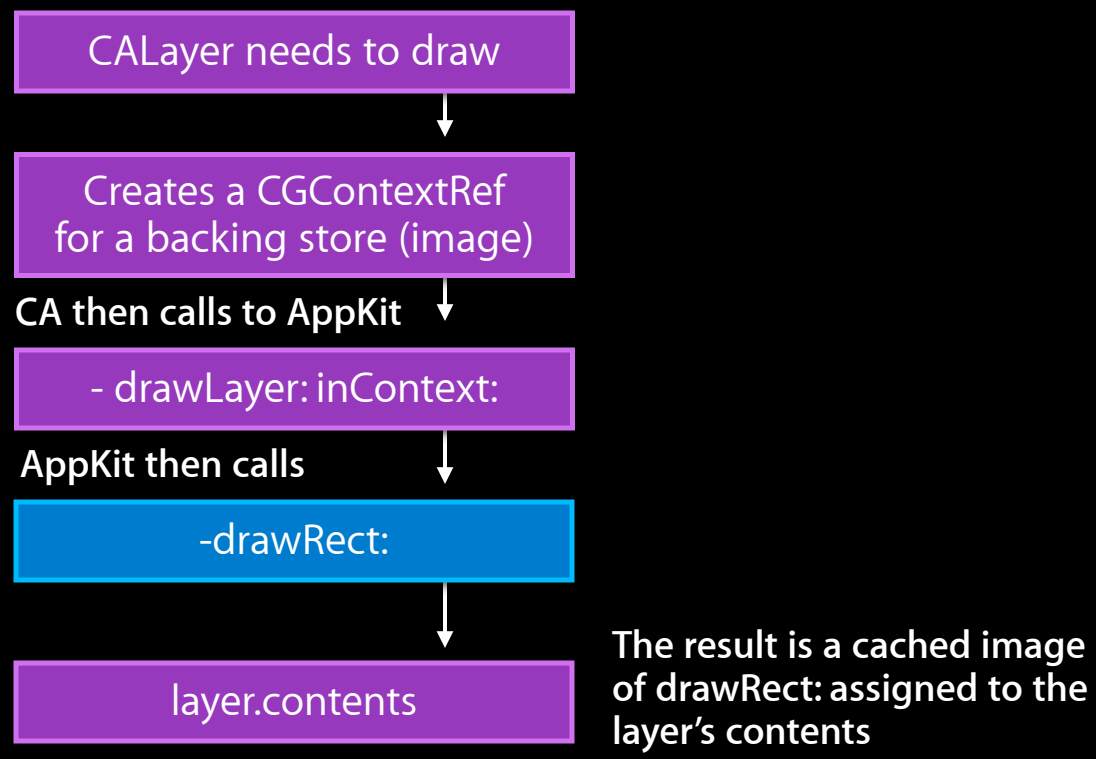


Core Animation and AppKit

Each filled in via drawRect:

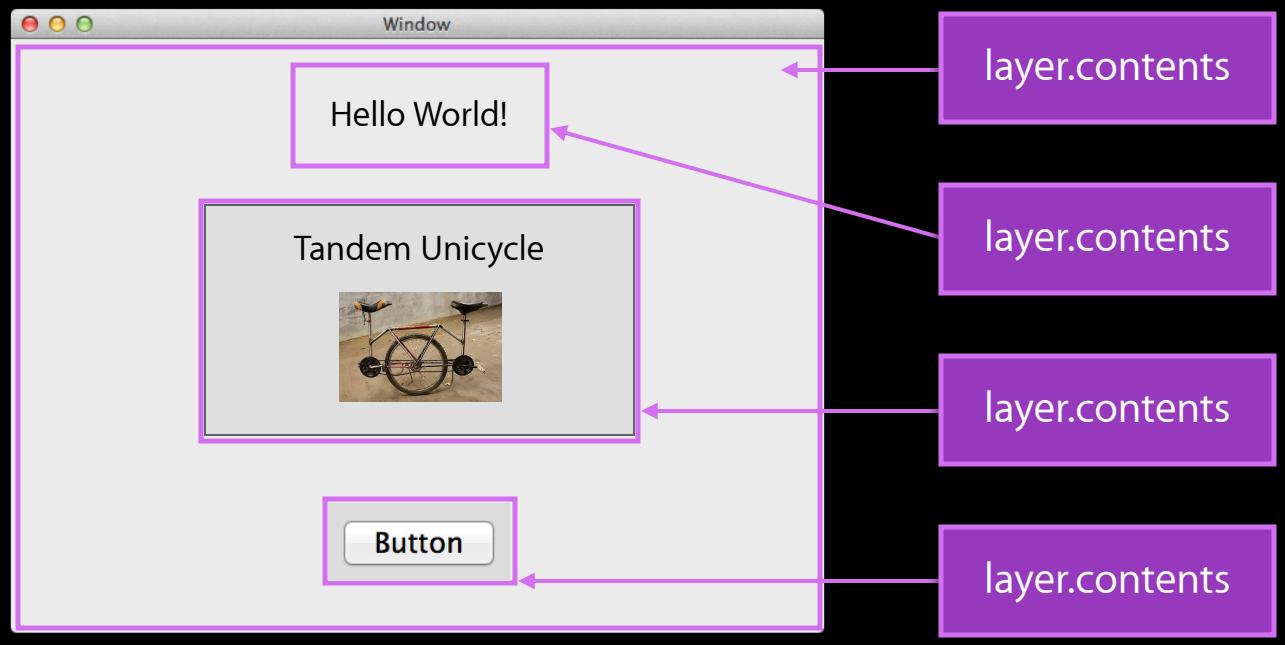


Layer Drawing Flow Chart



Layer Drawing Flow Chart

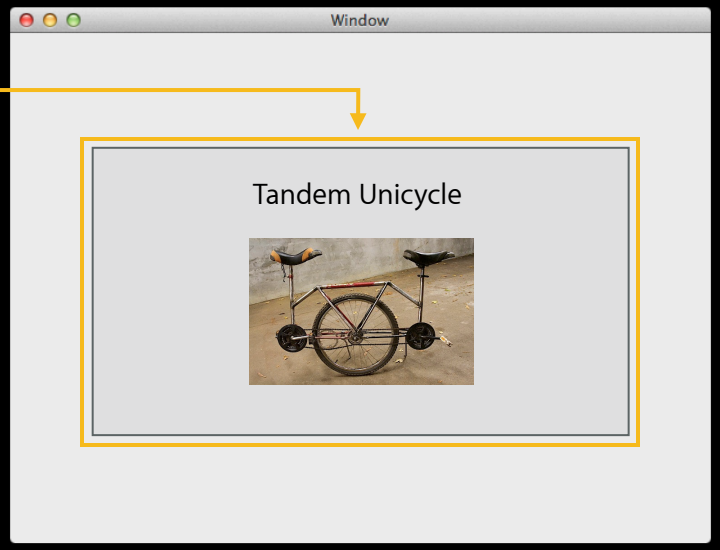
Layer contents are quickly composited to screen



Traditional NSView Drawing Model

Marking a view dirty

- Custom NSView marked as dirty via `setNeedsDisplay:YES`



Traditional NSView Drawing Model

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- Custom NSView marked as dirty via `setNeedsDisplay:YES`
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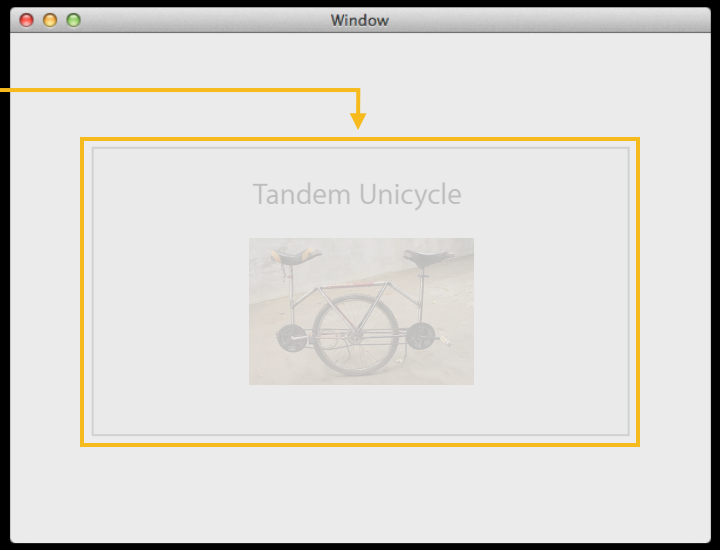
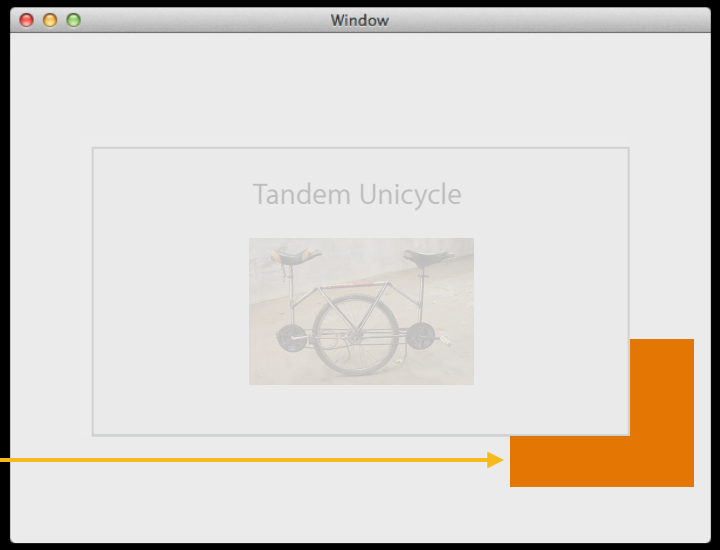


Traditional NSView Drawing Model

Marking a view dirty

- Custom NSView marked as dirty via `setNeedsDisplay:YES`
- NSWindow keeps track of the dirty region
- All NSViews in that region will redisplay
  - Including one like this under the other view



Traditional NSView Drawing Model

Marking a view dirty

- Subsequently, if this view is marked as `setNeedsDisplay:YES`

Traditional NSView Drawing Model

Marking a view dirty

- Subsequently, if this view is marked as `setNeedsDisplay:YES`
- This custom view will also be redrawn

Layers and setNeedsDisplay:

Each layer tracks its own dirty rect

- If this view has `setNeedsDisplay:YES` called on it
  - Only that view is marked as dirty
  - The window is not marked as dirty
  - This custom view will not get redrawn

Layers and setNeedsDisplay:

Each layer tracks its own dirty rect

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Drawing

What we covered

- Traditional NSView drawing model
- Using Core Animation layers and how they work
- Differences in `-setNeedsDisplay:` for redrawing

Animating

Animating in AppKit

The animator proxy

```
@protocol NSAnimatablePropertyContainer

- (id)animator;
...
@end
```

- Implemented on NSView and NSWindow
- An opaque proxy object that can be treated just like original object
- Initiates implied animations on property changes
- The animator proxy starts and possibly drives the animation

Traditional Animating in AppKit

Use the animator proxy (layer-backed or not layer-backed)

- Use the animator proxy object to perform animations

```
NSRect frame = [view frame]; // size: 100, 100
frame.size = NSMakeSize(300, 300);
[[view animator] setFrame:frame];
// At this point the view.frame is still 100, 100
```

The proxy calls `setFrame:` on each step of the animation

- `drawRect:` is then invoked on each step of the animation

Traditional Animating in AppKit

Animations use the animator proxy

size = (100, 100) → size = (175, 175) → size = (250, 250) → size = (300, 300)

drawRect: → drawRect: → drawRect: → drawRect:

Tandem Unicycle

Tandem Unicycle

Tandem Unicycle

Tandem Unicycle

Done by AppKit on the main thread (non-optimal)

Core Animation + Frame Animations

CALayers do not need to have an animator proxy

```
CGRect frame = [layer frame]; // size: 100, 100
frame.size = CGSizeMake(300, 300);
layer.frame = frame; // Implicitly animates
// At this point the layer.frame is 300, 300!
```




Done by CA in a background thread

Core Animation + Frame Animations

CALayers do not need to have an animator proxy

- Layers simply stretch their image contents
- How they stretch is based on various CALayer properties

Done by CA in a background thread

Animating in AppKit with Core Animation

- All changes in Core Animation animate without the need for an animator proxy

```
layer.frame = newLayerFrame; // This will animate
```

- Layer-backed views in AppKit disable layer animations unless you are using the proxy object

```
[[view animator] setFrame:frame];
```

Turns on CALayer animations

Allows the layer to animate the frame

Redrawing Layer-Backed Views

Lion introduced – `[NSView layerContentsRedrawPolicy]`

- This property tells when AppKit should mark the layer as needing display
  - NSViewLayerContentsRedrawDuringViewResize
  - NSViewLayerContentsRedrawOnSetNeedsDisplay
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  - NSViewLayerContentsRedrawNever
- These options only apply to layer-backed views

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Redrawing Layer-Backed Views

`NSViewLayerContentsRedrawDuringViewResize`

- This is the default value for NSView!
- setNeedsDisplay is called whenever the frame changes

It is the most compatible with traditional `drawRect:` animations

```
NSRect frame = [view frame]; // size: 100, 100
frame.size = NSMakeSize(300, 300);
[[view animator] setFrame:frame];
// At this point the view.frame is still 100, 100
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The proxy calls `setFrame:` on each step of the animation

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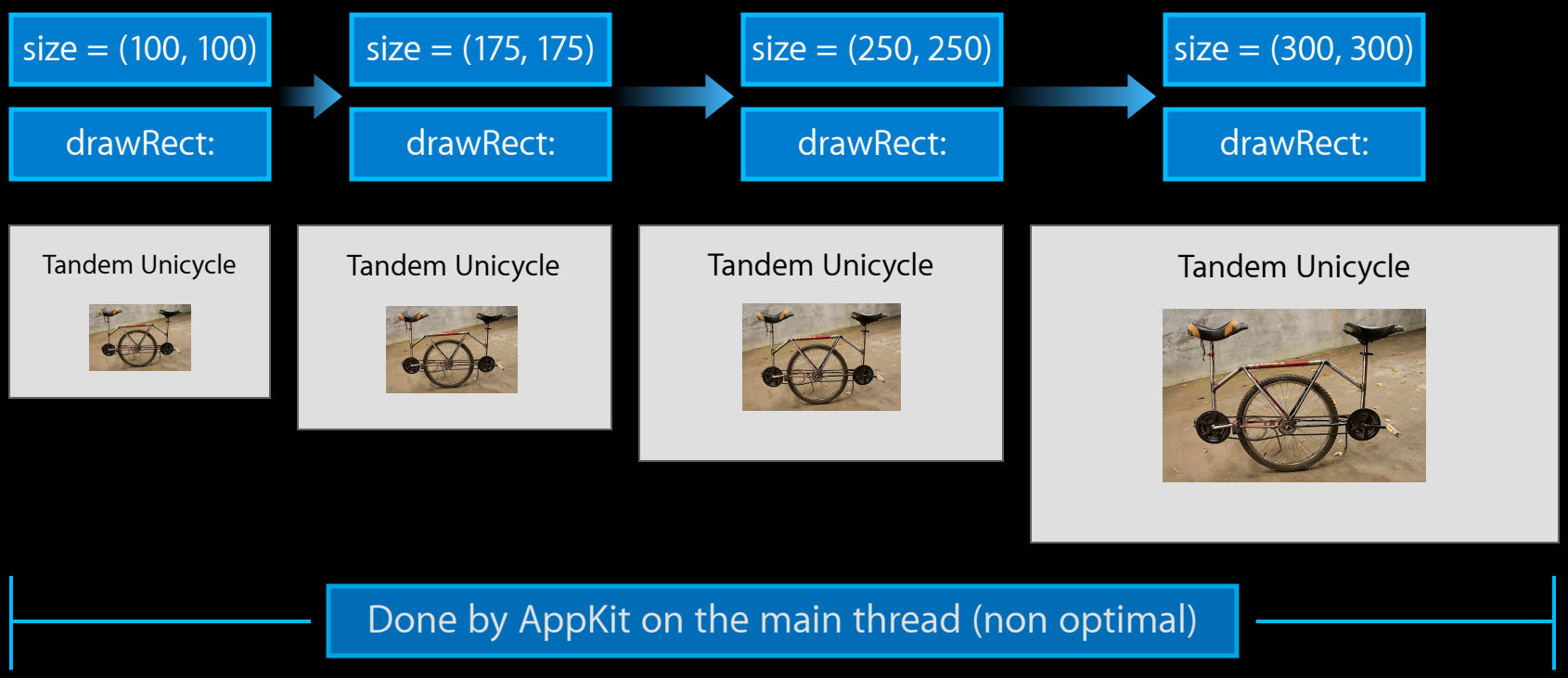
Layer-Backed View

Traditional animations (even when layer-backed)



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Redrawing Layer-Backed Views

`NSViewLayerContentsRedrawOnSetNeedsDisplay`

- Doing: `[view setNeedsDisplay:YES]`
  - Means "invalidate the layer and lazily redraw"
- AppKit does not call `setNeedsDisplay:` when the frame changes!
- NOT the default value
  - Therefore, you MUST set it!

Redrawing Layer-Backed Views

NSViewLayerContentsRedrawOnSetNeedsDisplay

```
NSRect frame = [view frame]; // size: 100, 100
frame.size = NSMakeSize(300, 300);
[[view animator] setFrame:frame]; // Animates via Core Animation
// At this point the view frame is 300, 300!
```




Done by CA in a background thread

Problems with This Approach

`NSViewLayerContentsRedrawOnSetNeedsDisplay`

- Animation driven by Core Animation\
- `drawRect:` is NOT called on each step of the animation
- The contents are stretched

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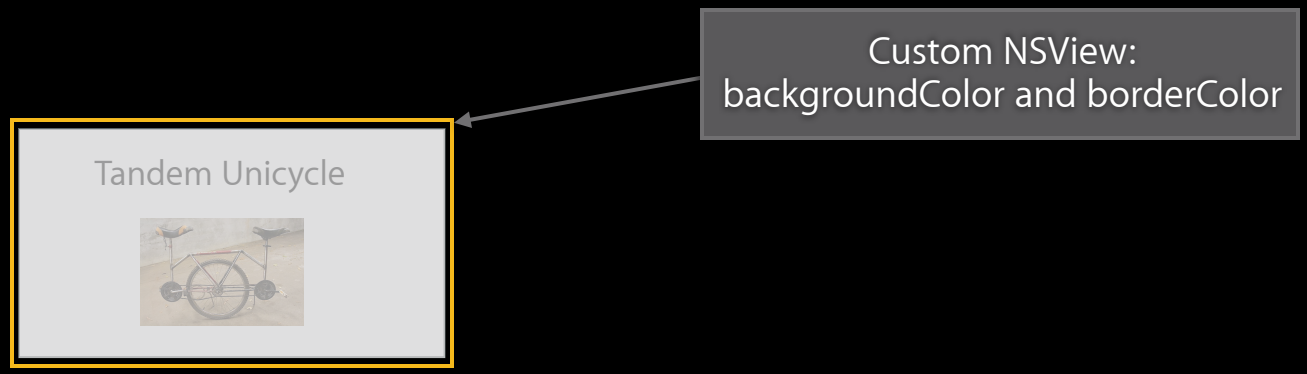
Text is stretched/blurry
and the image is stretched

Solution to This Approach

`NSViewLayerContentsRedrawOnSetNeedsDisplay`

- Be sure to use the proper autoresizingMask or auto layout
- Layout views in Interface Builder or runtime



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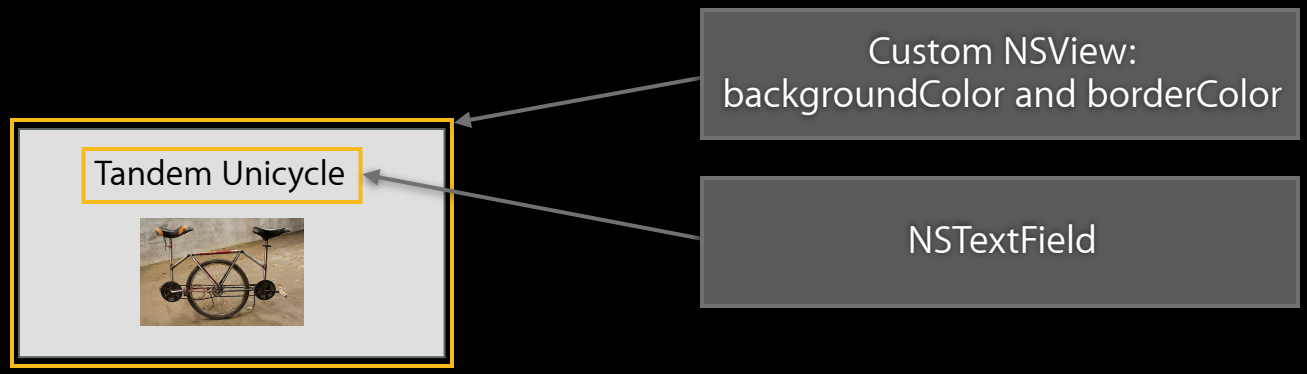

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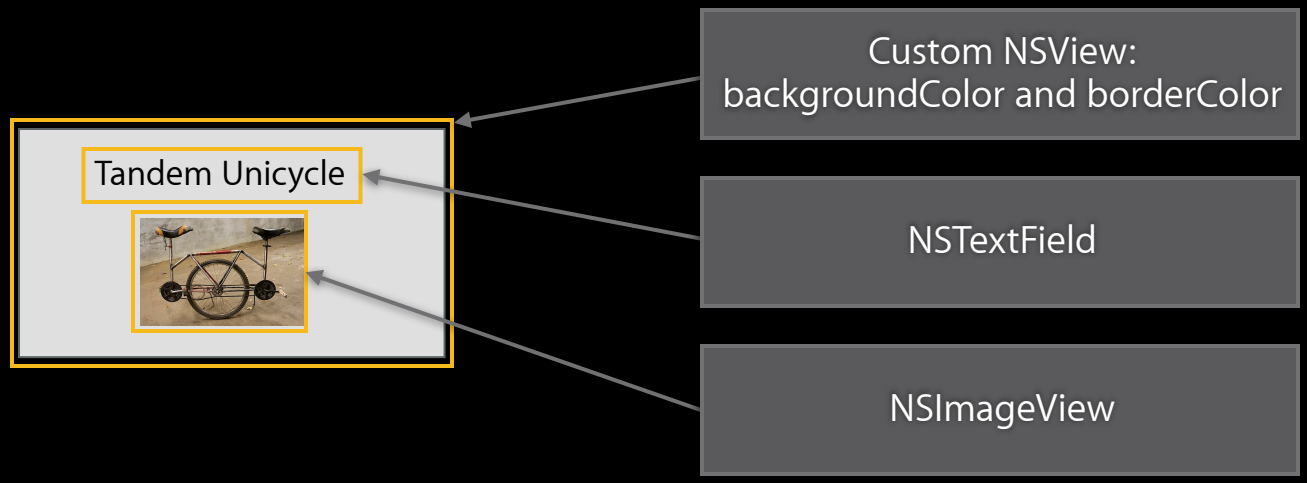

Compositing with Subviews

`NSViewLayerContentsRedrawOnSetNeedsDisplay`

- Animation is smooth and not redrawing (just moving layers)
- Text does not change size
  - Just moves the position
- The individual image view stretches its contents properly

Tandem Unicycle

Tandem Unicycle

Tandem Unicycle

Redrawing Layer-Backed Views

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Redrawing Layer-Backed Views

NSViewLayerContentsRedrawBeforeViewResize

- Redraws the layer once using the "final size" right before the frame animation starts
- Thus uses that "final size" image for the contents while animating
- Contents look crisp at the end of the animation
  - However, they might look shrunken at the start of the animation

Layer-Backed View

NSViewLayerContentsRedrawBeforeViewResize

```
[[view animator] setFrame:(0,0,300,300)];
```

size = (100, 100)

drawRect:

size = (300, 300)

drawRect:

Tandem Unicycle

Layer-Backed View

NSViewLayerContentsRedrawBeforeViewResize

```
[[view animator] setFrame:(0,0,300,300)];
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Tandem Unicycle

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size = (100, 100)

drawRect:

size = (300, 300)

drawRect:

The layer contents will be shrunken and down sampled. This might look bad!

Layer-Backed View

NSViewLayerContentsRedrawBeforeViewResize

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Layer-Backed View

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Redrawing Layer-Backed Views

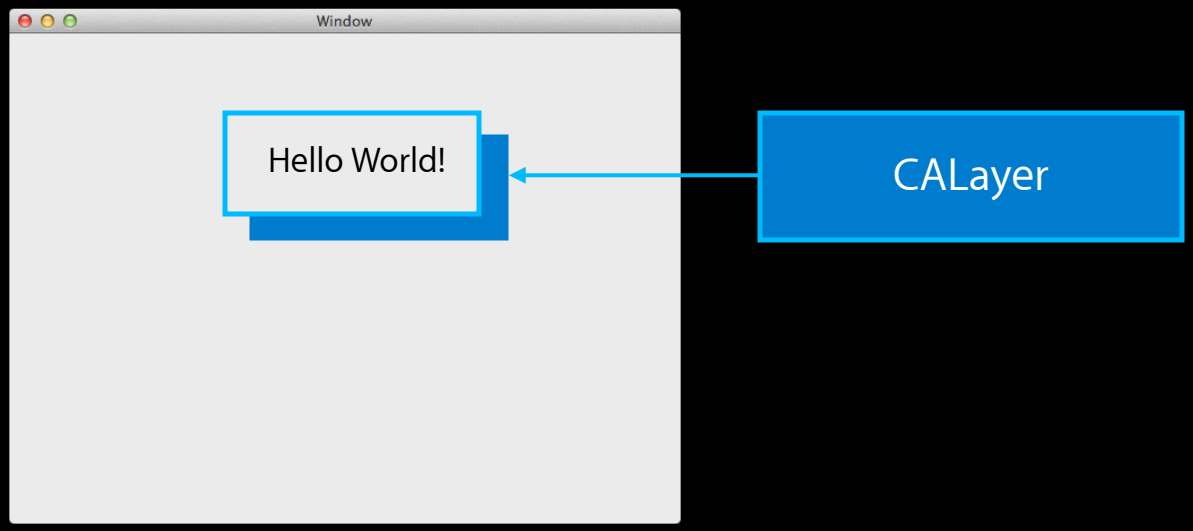
`NSViewLayerContentsRedrawNever`

- Tells the view to never redraw the layer
- Calling `[view setNeedsDisplay:YES]` does nothing!
- Generally, this is only useful in limited cases
- Good for layer-hosted views

Layer-Backed vs. Layer-Hosted

Layer-backed

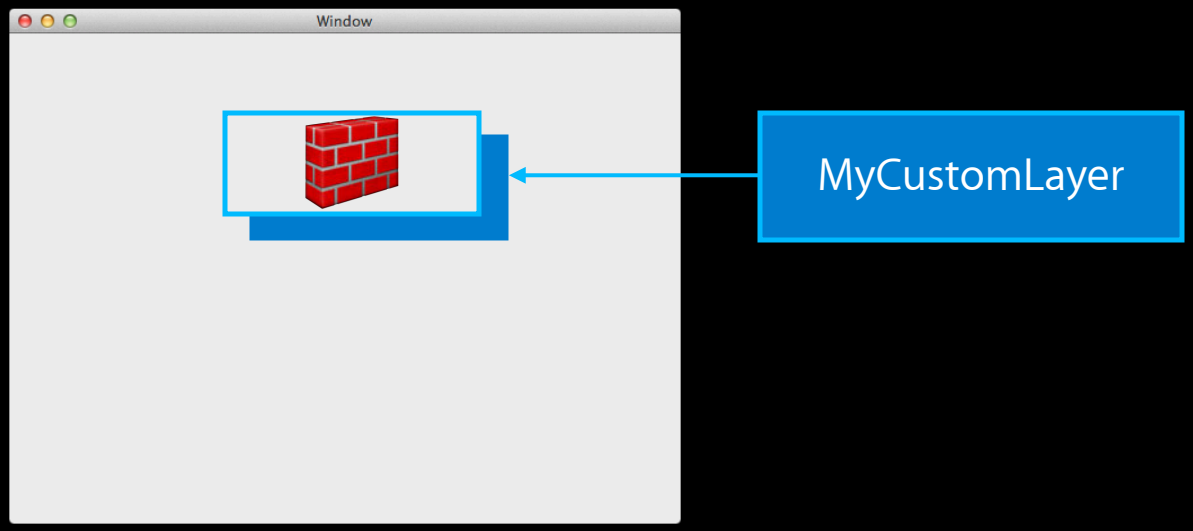
- The layer behind the view is created and managed by AppKit
- AppKit creates and "owns" the layer and will control most properties



Layer-Backed vs. Layer-Hosted

Layer-hosted

- The layer behind the view is assigned by the developer
- Use -[NSView setLayer:]
- AppKit keeps a “hands-off” approach to the layer

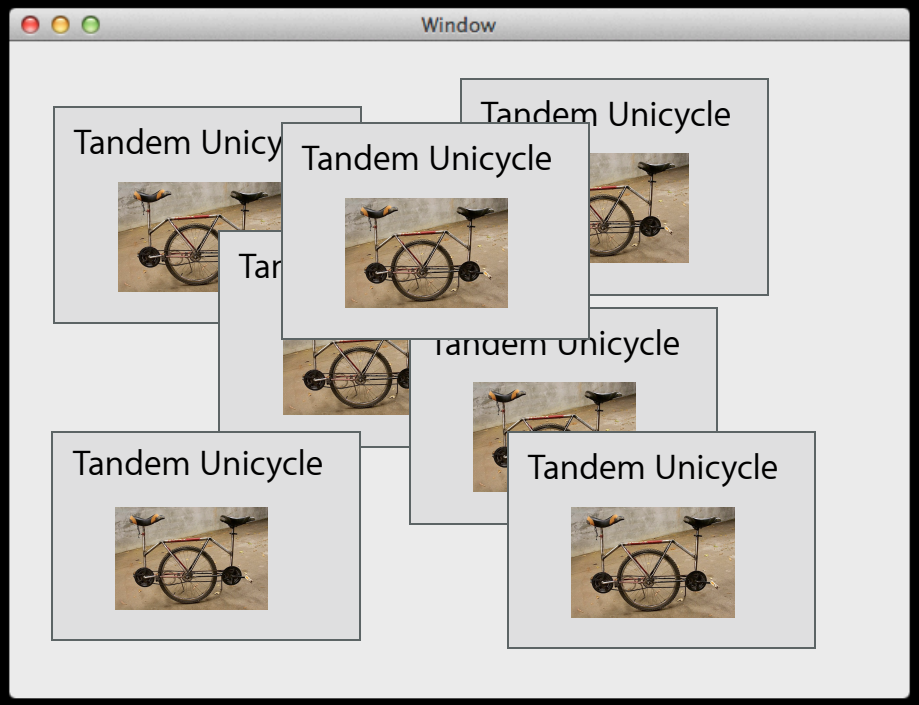


Animating

Contents updating

Great! Animations Are Smooth

…Now memory usage is high!



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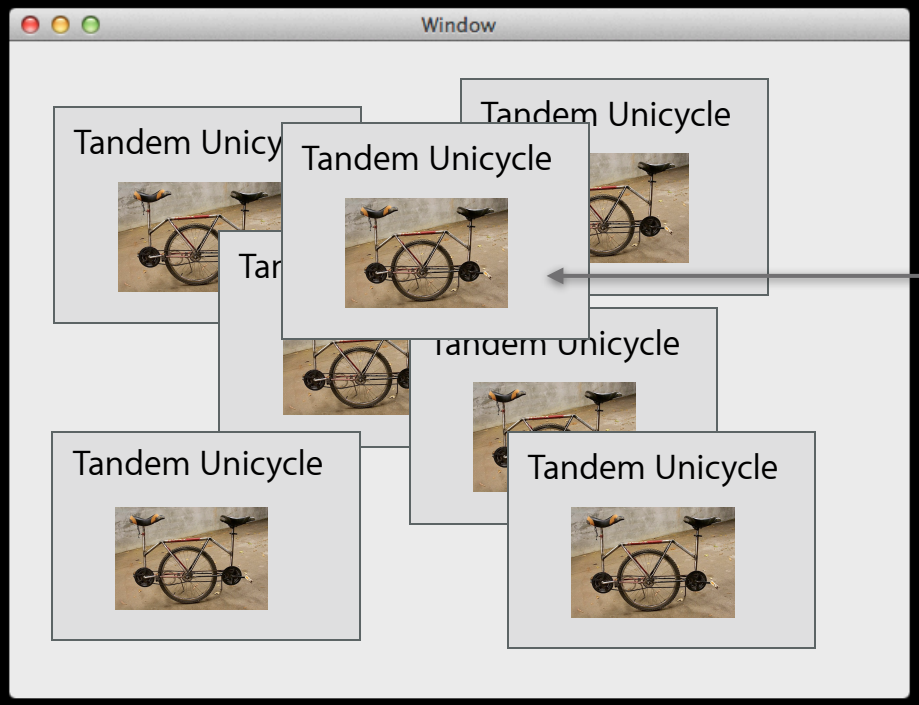


Each CALayer has its own backing image filled in by -drawRect:

Improving Layer-Backed Memory Use

Do not use -drawRect:!

```
- (void)d      t:(NSRect)d      ct {
    // Fil      contents
    [[NSColo      tGray      set];
    NSRectFil      b      ;
    // Draw the
    [[NSColor gra      set];
    NSFrameRect(s      nds);
    // Draw the
    [@"Tandem      cle      vInRect:titleRect withAttributes:...];
    // Draw      age
    [image      nRect:ima      fromRect:.. operation:.. fraction:..];
}
```

Improving Layer-Backed Memory Use

Techniques to save memory

- Use CALayer properties

  `backgroundColor`

  `borderColor`

- Directly set the `layer.contents` (to an image)
  - Share the same contents in multiple views
  - Stretch small images larger

Improving Layer-Backed Memory Use

Understanding CALayer Properties

```
CALayer *layer = [CALayer layer];
layer.backgroundColor = NSColor.whiteColor.CGColor;
layer.borderColor = NSColor.redColor.CGColor;
layer.borderWidth = 2.0;
```

Improving Layer-Backed Memory Use

Understanding CALayer Properties


```
CALayer *layer = [CALayer layer];
layer.backgroundColor = NSColor.whiteColor.CGColor;
layer.borderColor = NSColor.redColor.CGColor;
layer.borderWidth = 2.0;
```

Improving Layer-Backed Memory Use

Understanding CALayer Properties


```
CALayer *layer = [CALayer layer];
layer.backgroundColor = NSColor.whiteColor.CGColor;
layer.borderColor = NSColor.redColor.CGColor;
layer.borderWidth = 2.0;
```

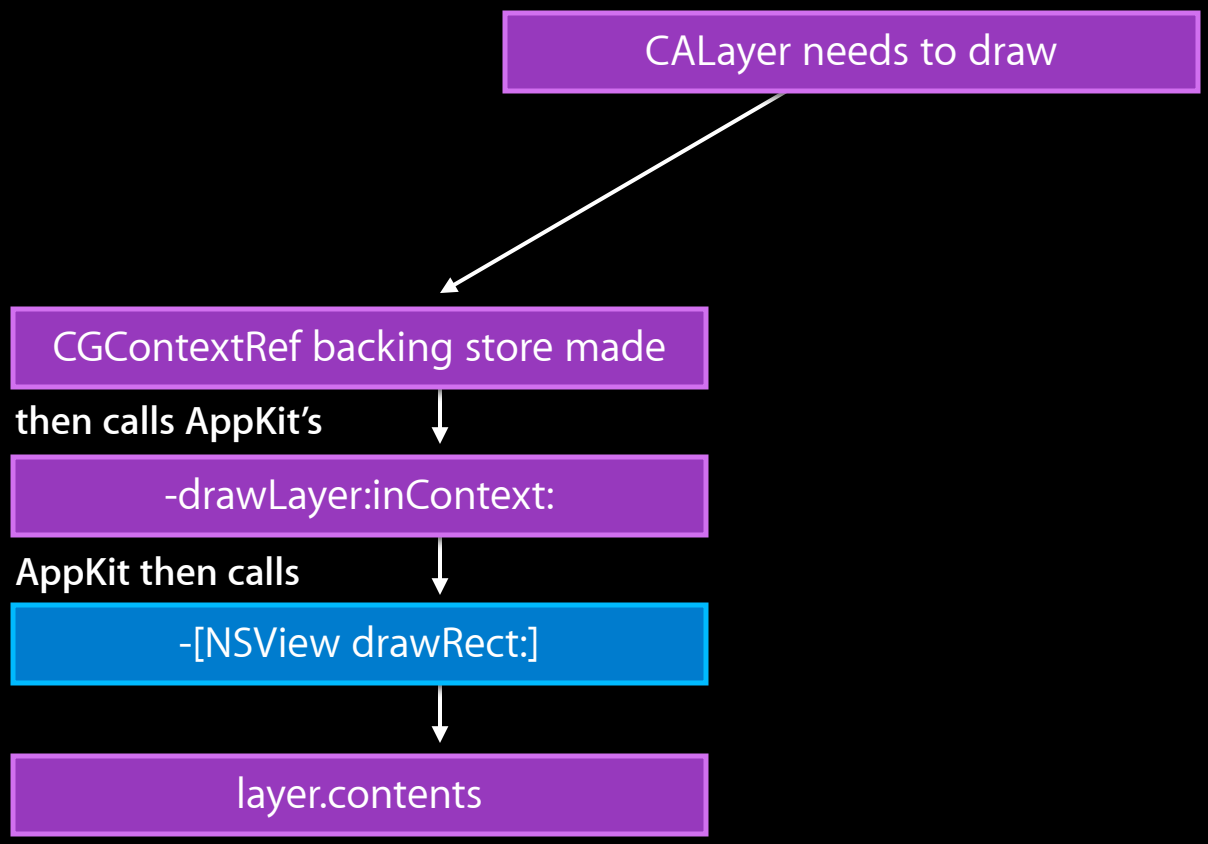
CGColorRef

Improving Layer-Backed Memory Use

Understanding CALayer Properties

```
CALayer *layer = [CALayer layer];
layer.backgroundColor = NSColor.whiteColor.CGColor;
layer.borderColor = NSColor.redColor.CGColor;
layer.borderWidth = 2.0;
layer.contents = [NSImage imageNamed:@"Unicycle"];
```

Traditional Layer Updating Flow Chart



Mountain Lion Layer Updating Flow Chart

Improving Layer-Backed Memory Use

Use -wantsUpdateLayer and -updateLayer


```
- (BOOL)wantsUpdateLayer {
   return YES;
}
- (void)updateLayer {
    self.layer.backgroundColor = NSColor.whiteColor.CGColor;
    self.layer.borderColor = NSColor.redColor.CGColor;
}
```

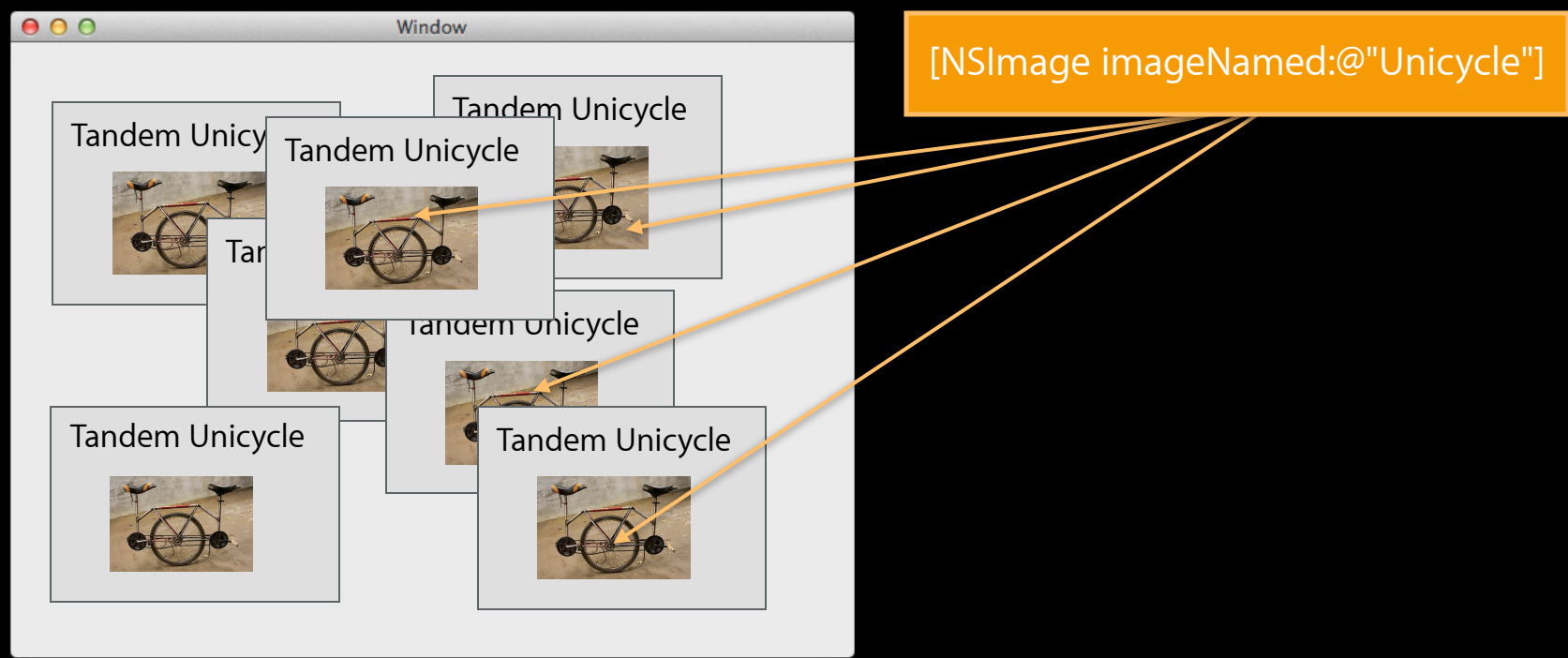
Improving Layer-Backed Memory Use

Alternative to -drawRect:

```
- (void)updateLayer {
    self.layer.backgroundColor = NSColor.whiteColor.CGColor;
    self.layer.borderColor = NSColor.redColor.CGColor;
    self.layer.contents = [NSImage imageNamed:@"Unicycle"];
}
```

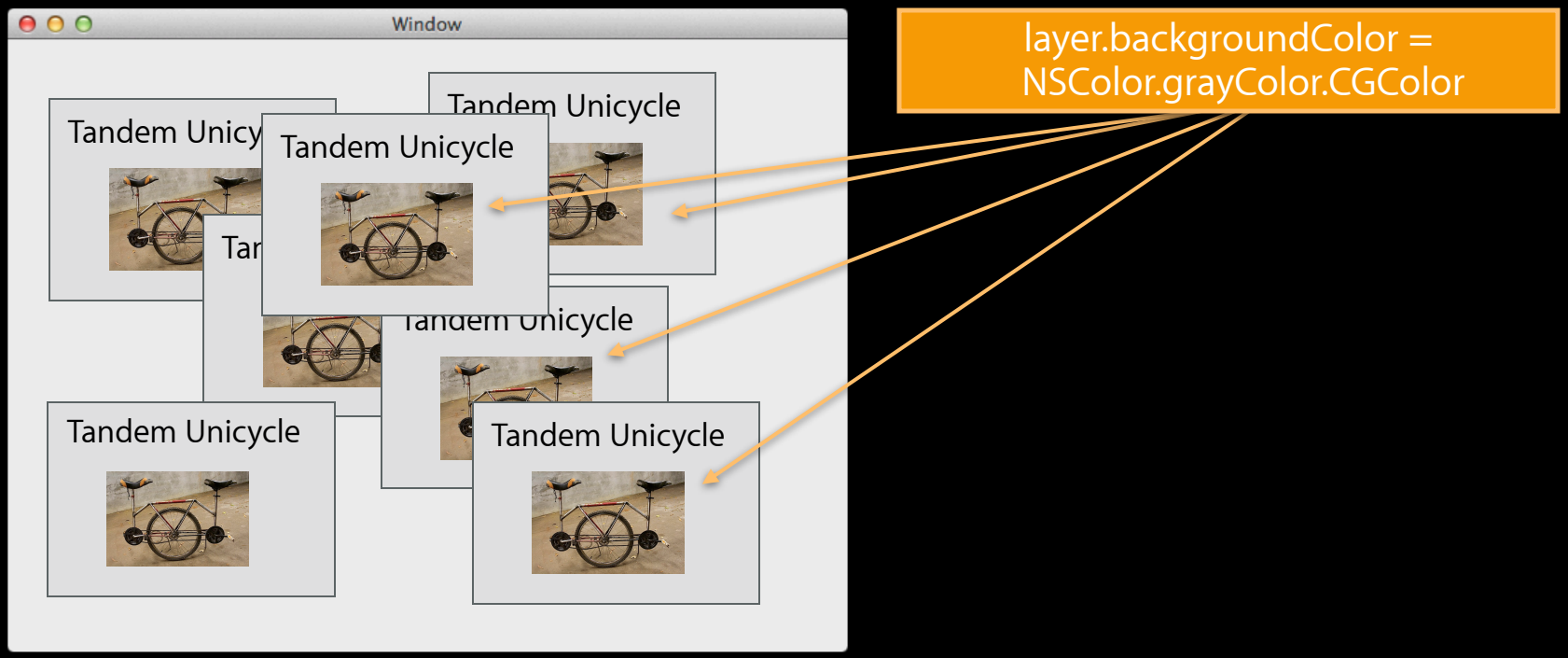
Improving Layer-Backed Memory Use

Share the same layer.contents in multiple views



Improving Layer-Backed Memory Use

Share the same layer.contents in multiple views



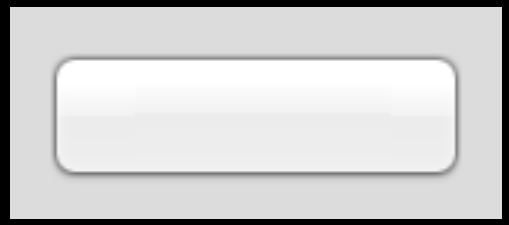
Contents Updating in -updateLayer

Nine part background image such as a button

- Goal is a button that can properly stretch when resized

Contents Updating in -updateLayer

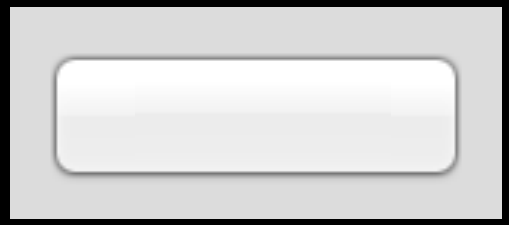
Start with a background view



- Background stretchable image 
- Image is to be shared directly as the contents among all buttons

Contents Updating in -updateLayer

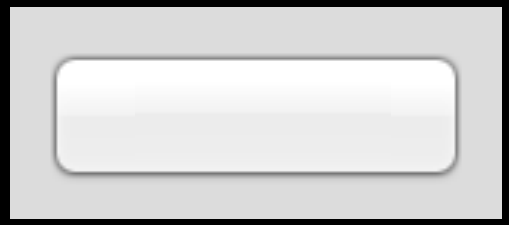
Start with a background view



```
- (void)updateLayer {
    self.layer.contents = [NSImage imageNamed: ]; // Pseudo-code
    self.layer.contentsCenter = CGRectMake(0.5, 0.5, 1e-5, 1e-5);
}
```

Contents Updating in -updateLayer

Start with a background view

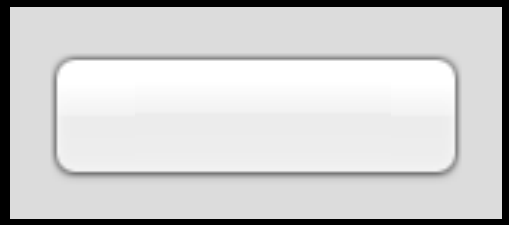


Note that this image is not the size of the view's bounds!

```
- (void)updateLayer {
    self.layer.contents = [NSImage imageNamed: ]; // Pseudo-code
    self.layer.contentsCenter = CGRectMake(0.5, 0.5, 1e-5, 1e-5);
}
```

Contents Updating in -updateLayer

Start with a background view



Note that this image is not the size of the view's bounds!

```
- (void)updateLayer {
    self.layer.contents = [NSImage imageNamed: ]; // Pseudo-code
    self.layer.contentsCenter = CGRectMake(0.5, 0.5, 1e-5, 1e-5);
}
```

This stretches the middle pixel.
See CALayer.h for more information.

Contents Updating in -updateLayer

Start with a background view


```
- (void)layout {
    if (_textField == nil) {
        _textField = [[NSTextField alloc] initWithFrame:frame];
        _textField.title = @"Button";
    } else {
       _textField.frame = // Update the location
    }
    [super layout];
}
```

Contents Updating in -updateLayer

Start with a background view

Works when using auto layout and/or using layer backing


```
- (void)layout {
    if (_textField == nil) {
        _textField = [[NSTextField alloc] initWithFrame:frame];
        _textField.title = @"Button";
    } else {
       _textField.frame = // Update the location
    }
    [super layout];
}
```

Contents Updating in -updateLayer

Dealing with multiple states (a “pressed” state)

```
- (void)updateLayer {
    if (self.pressed) {
        self.layer.contents = [NSImage imageNamed: ];
    } else {
        self.layer.contents = [NSImage imageNamed: ];
    }
    self.layer.contentsCenter = CGRectMake(0.5, 0.5, 1e-5, 1e-5);
}
```

Contents Updating in -updateLayer

Dealing with multiple states (a “pressed” state)

```
- (void)updateLayer {
    if (self.pressed) {
         self.layer.contents = [NSImage imageNamed: ];
    } else {
         self.layer.contents = [NSImage imageNamed: ];
    }
    self.layer.contentsCenter = CGRectMake(0.5, 0.5, 1e-5, 1e-5);
}

- (void)mouseDown:(NSEvent *)event {
     self.pressed = YES;
     [self setNeedsDisplay:YES];
}
```

Contents Updating in -updateLayer

Update the title correctly


```
- (void)setTitle:(NSString *)title {
    _textField.title = title;
    [self setNeedsLayout:YES];
}
```

Contents Updating in -updateLayer

Update the title correctly


```
- (void)setTitle:(NSString *)title {
    _textField.title = title;
    [self setNeedsLayout:YES];
}
```

The title is in a separate view (NSTextField) that redraws itself

Contents Updating in -updateLayer

Update the title correctly


```
- (void)setTitle:(NSString *)title {
    _textField.title = title;
    [self setNeedsLayout:YES];
}
```

The title is in a separate view (NSTextField) that redraws itself

Do NOT call setNeedsDisplay:—the background does not need to redraw!

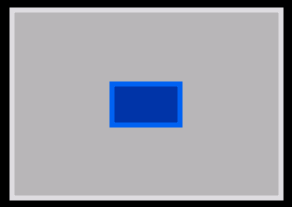
However, the textField location needs updating and re-layout

Animating

Synchronized subview animations

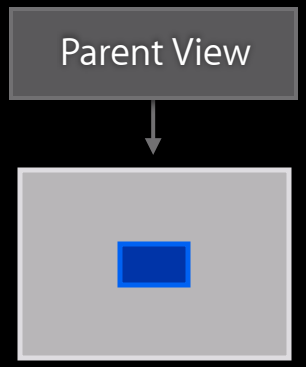
Synchronized Subview Animations

Consider this…



Synchronized Subview Animations

Consider this…



Synchronized Subview Animations

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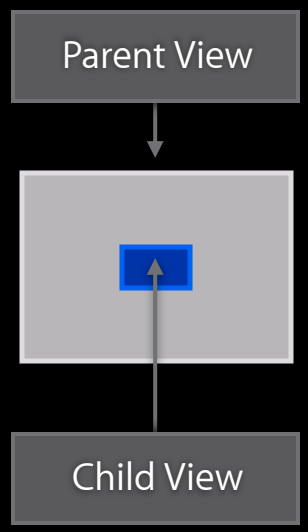
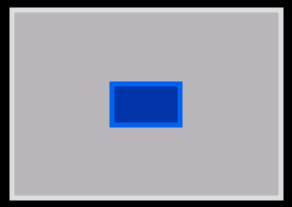


Synchronized Subview Animations

Consider this…

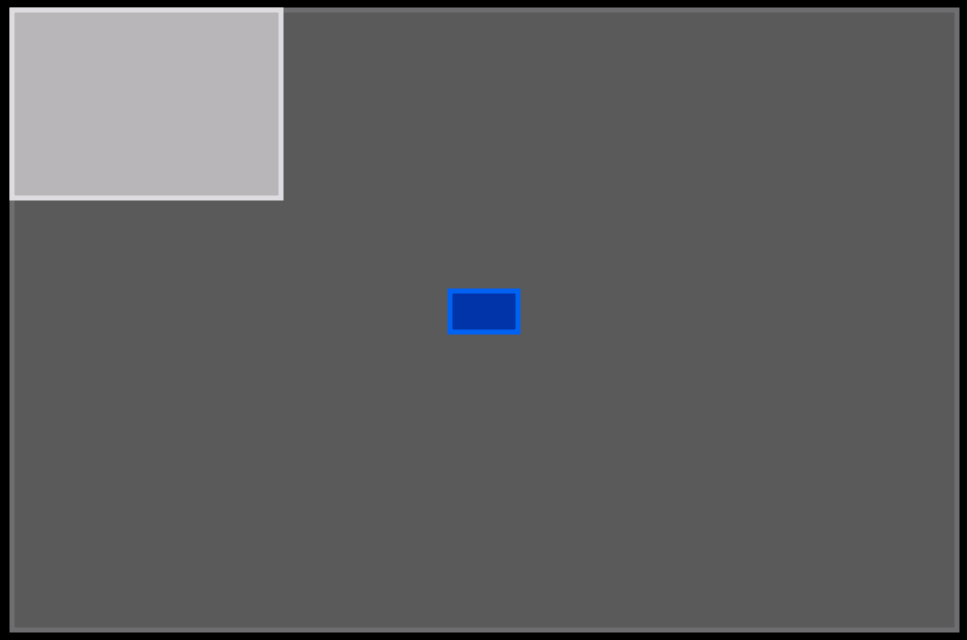
```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```



Synchronized Subview Animations

Consider this…

- The parent view sees itself at its final size
- The child view is moved to the final layout position



Synchronized Subview Animations

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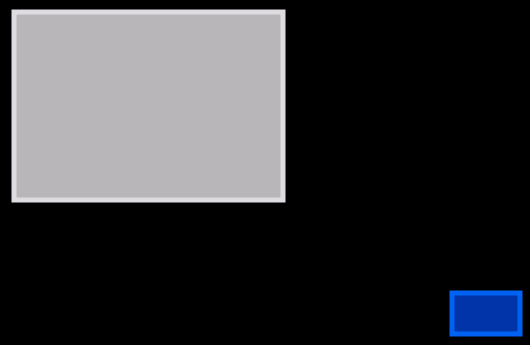
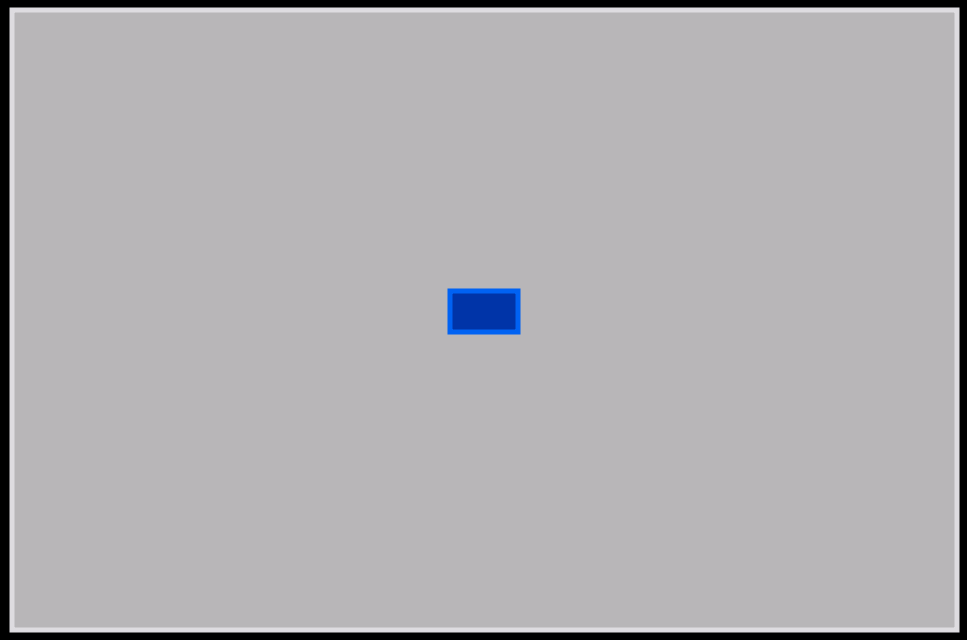


Synchronized Subview Animations

Consider this…

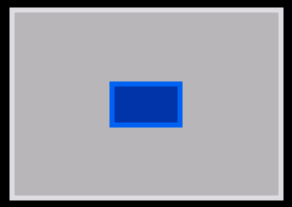
- The parent view sees itself at its final size
- The child view is moved to the final layout position



Synchronized Subview Animations

What we really want is this

```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```



Synchronized Subview Animations

What we really want is this

```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
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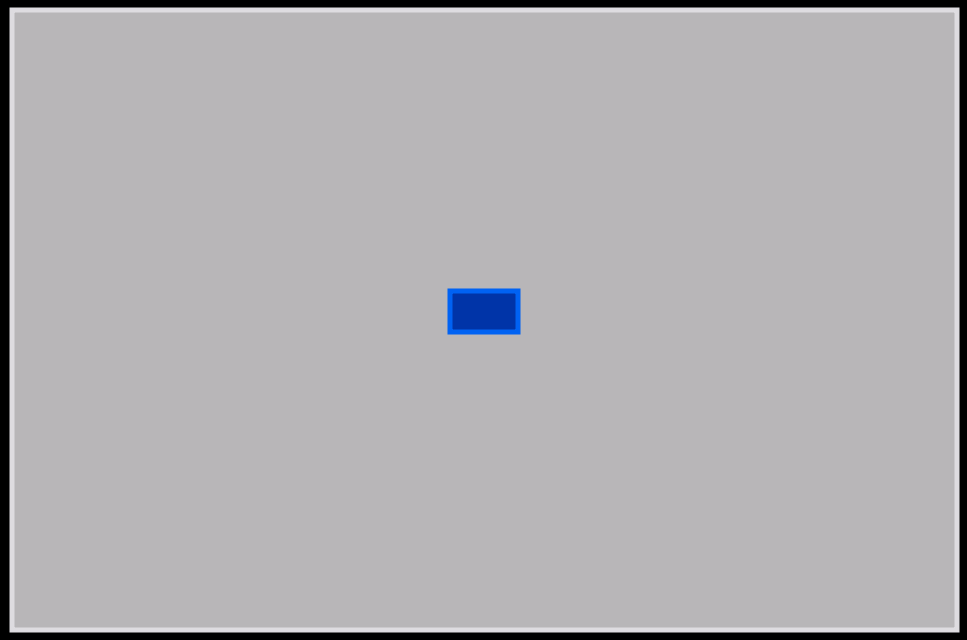


Synchronized Subview Animations

- The NSAnimationContext allows grouping of animations
- Allows one to control animation properties for that group

```
@interface NSAnimationContext : NSObject { }

+ (void)beginGrouping;
+ (void)endGrouping;

+ (NSAnimationContext *)currentContext;

@property NSTimeInterval duration;
@property(retain) CAMediaTimingFunction *timingFunction;

@end
```

Synchronized Subview Animations

New to Mountain Lion allowsImplicitAnimations

- Controls implicit layer animations

```
@interface NSAnimationContext : NSObject { }
...

@property BOOL allowsImplicitAnimation NS_AVAILABLE_MAC(10_8);
...
@end
```

Synchronized Subview Animations

New to Mountain Lion allowsImplicitAnimations

- Defaults to NO
- When `allowsImplicitAnimation == YES`
  - All view/layer animatable properties will animate
  - There is no need to use the `-animator` proxy
  - Allows nesting of animations and side effect animations
    - Such as layout that is done in `setFrame:`
  - Similar to `[UIView setAnimationsEnabled:YES]`
- Only applies to layer-backed (or layer-hosted) views

Synchronized Subview Animations

allowsImplicitAnimations is automatically set

```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```

Synchronized Subview Animations

allowsImplicitAnimations is automatically set

```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```

```
context.allowsImplicitAnimation = YES;
view.frame = 500, 500;
context.allowsImplicitAnimation = NO;
```

Synchronized Subview Animations

allowsImplicitAnimations is automatically set

```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```

Synchronized Subview Animations

allowsImplicitAnimations is automatically set

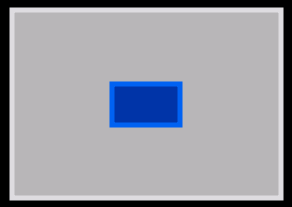
```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```

```
context.allowsImplicitAnimation = YES;
        view.frame = 500, 500;
        // implicitly -layout is called
        subview.frame = // centered frame
context.allowsImplicitAnimation = NO;
```

Synchronized Subview Animations

Keeping frame animations in sync

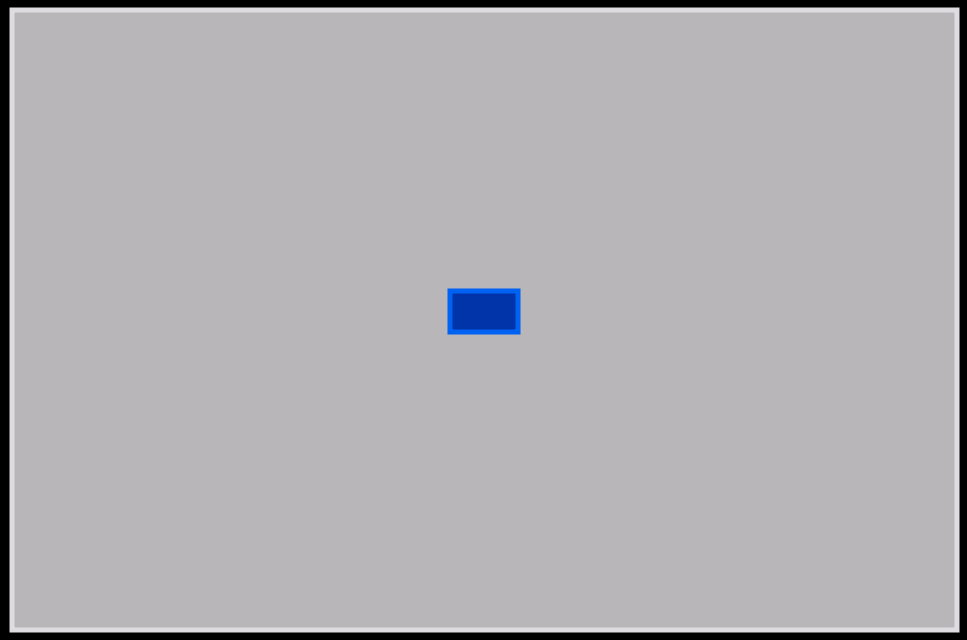
```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```



Synchronized Subview Animations

Keeping frame animations in sync

```
[[parentView animator] setFrame:NSMakeRect(0, 0, 500, 500)];
```



Best Practices

Text and font smoothing

LCD Font Smoothing

Also known as subpixel anti-aliasing

LCD Font Smoothing

Drawing text in a layer

- LCD font smoothing requires an opaque area to composite with
- Normal AppKit drawing composites into one big image

LCD Font Smoothing

Drawing text in a layer

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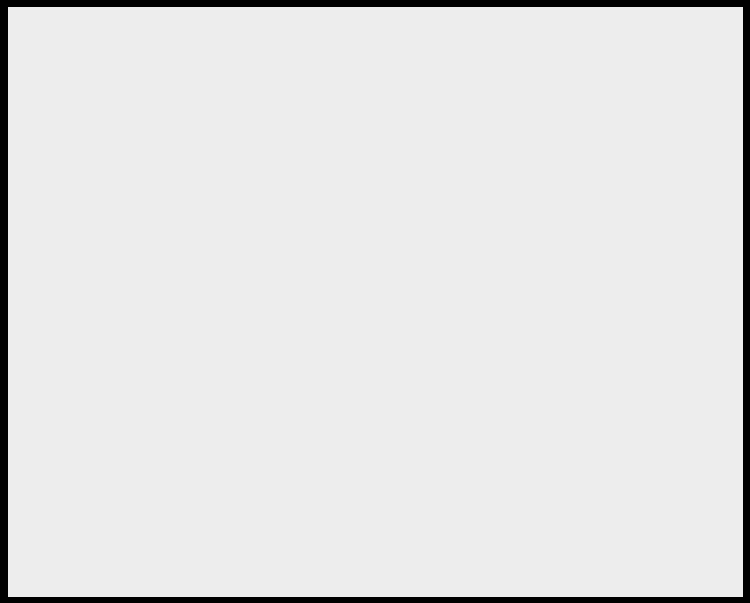


LCD Font Smoothing

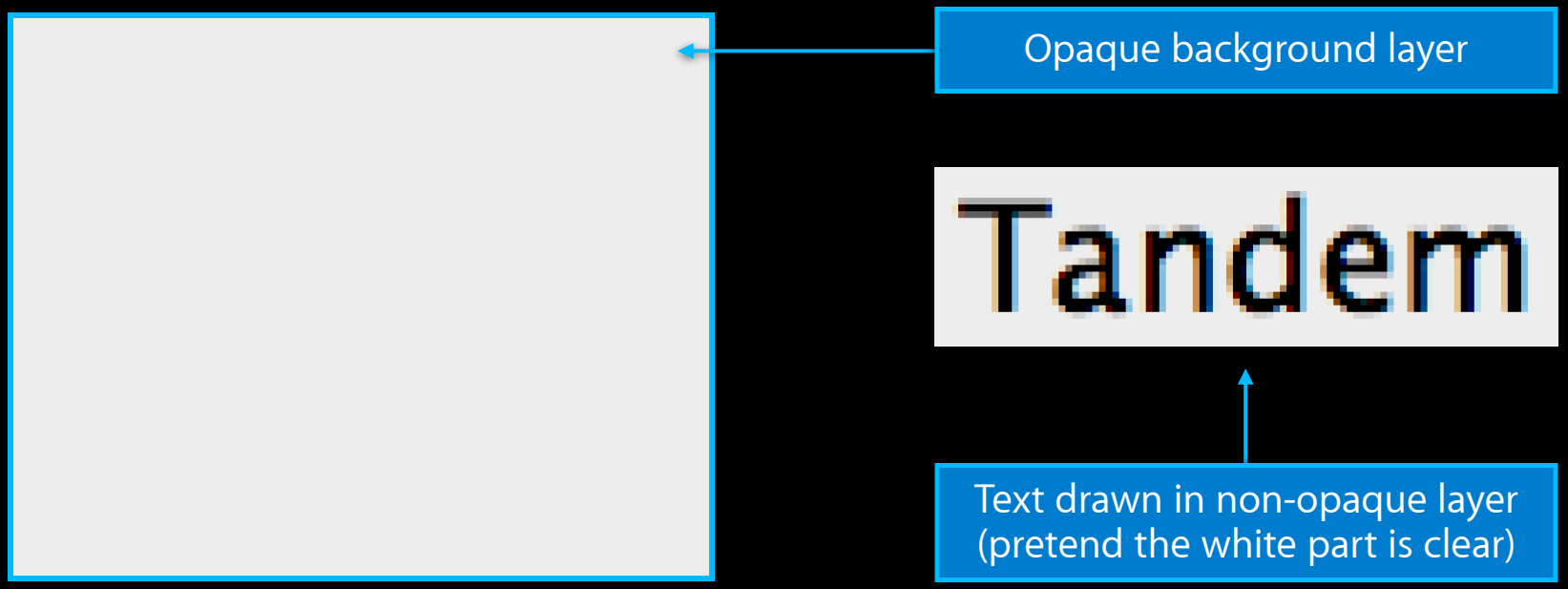
Drawing text in a layer

- LCD font smoothing requires an opaque area to composite with
- Normal AppKit drawing composites into one big image

LCD Font Smoothing

Drawing text in a layer

- Layers draw into their own mini-images which are then composited together



LCD Font Smoothing

Text drawn in non-opaque layer looks bad

- Text appears bolder than it should
  - (Opaque white background shown for clarity)

LCD Font Smoothing

Font smoothing

- Text looks better with font smoothing turned off
  - (Opaque white background shown for clarity)

LCD Font Smoothing

Font smoothing may be turned off by AppKit

- On when the view says YES to isOpaque

[NSView -isOpaque] = NO

[NSView -isOpaque] = YES

LCD Font Smoothing

Font smoothing may be turned off by AppKit

- Manually turn it on when you draw text in a layer in a non-opaque view

[NSView -isOpaque] = NO

LCD Font Smoothing

Font smoothing may be turned off by AppKit

- Manually turn it on when you draw text in a layer in a non-opaque view

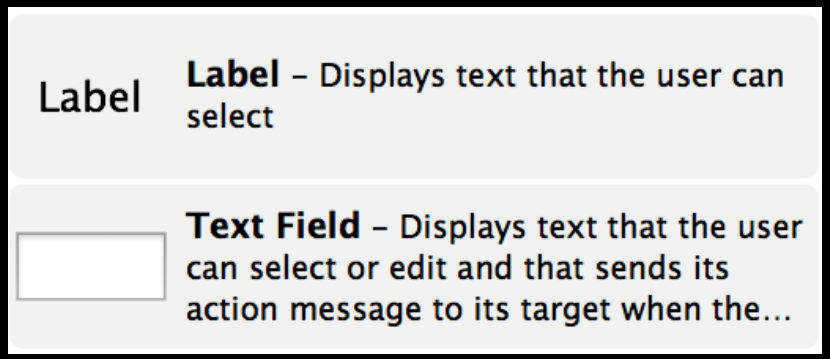
[NSView -isOpaque] = NO

```
CGContextRef ctx =
NSGraphicsContext.currentContext.graphicsPort;
CGContextSetShouldSmoothFonts(ctx, true);
[@"Tandem" drawInRect: ... ];
```

Ideally Use NSTextField!

NSTextField implements LCD font smoothing

- Works even when in a non-opaque layer
- Use NSTextField instead of manually drawing text
- Caveat: Requires at least one opaque ancestor layer



Best Practices

Focus rings

How You Typically Draw Focus Rings

Usually done in -drawRect:

```
- (void)drawRect:(NSRect)dirtyRect {
    // Normal drawing code here ...

    // Draw the focus ring
    if (self.window.firstResponder == self) {
        NSSetFocusRingStyle(NSFocusRingOnly);
        NSRectFill(self.bounds);
    }
}
```

- Note the focus ring draws slightly outside the view's bounds!

Focus Rings and Layers

Focus rings look wrong!

- The focus ring is captured as part of the layer's contents
- The layer clips to its bounds

Focus Rings on Lion

For regular views or layer-backed views

- Use the Lion API

```
- (NSRect)focusRingMaskBounds;
- (void)drawFocusRingMask;
- (void)noteFocusRingMaskChanged;
```

Focus Rings

focusRingMaskBounds

- This is for the enclosing shape of the focus ring
- Only called if your view has focus (is the firstResponder)

```
- (NSRect)focusRingMaskBounds {
    return self.bounds;
}
```

- Return an empty rect to not have a focus ring

Focus Rings

drawFocusRingMask

- Draw your content; the focus ring will automatically appear around it

```
- (NSRect)drawFocusRingMask {
    NSBezierPath *strangeShape = ...;
    [strangeShape fill]; // Focus ring appears around this shape
}
```

Focus Rings

noteFocusRingMaskChanged

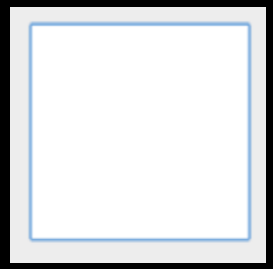
- Tell AppKit when your focus ring has changed
- To invalidate the focus ring shape, call

```
[self noteFocusRingMaskChanged]
```

Focus Rings

How the API works when layer-backed

- The focus ring is drawn into a separate layer



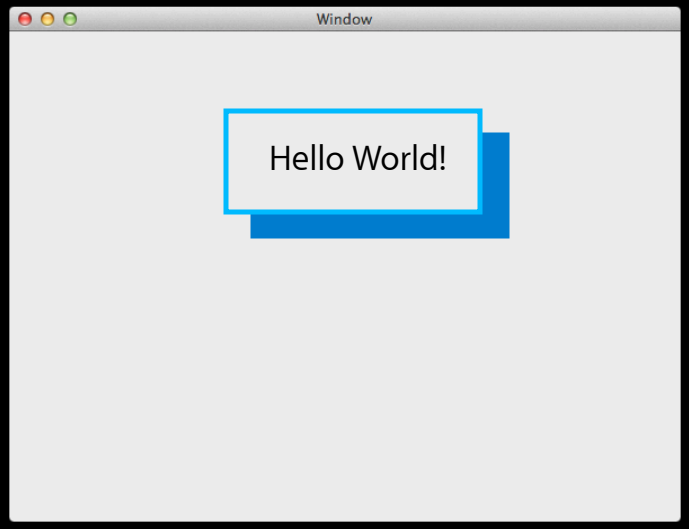
- AppKit adds the layer above the focused view

More Details and Tips

Layer-Backed and Layer-Hosted

CALayer properties that AppKit always manages

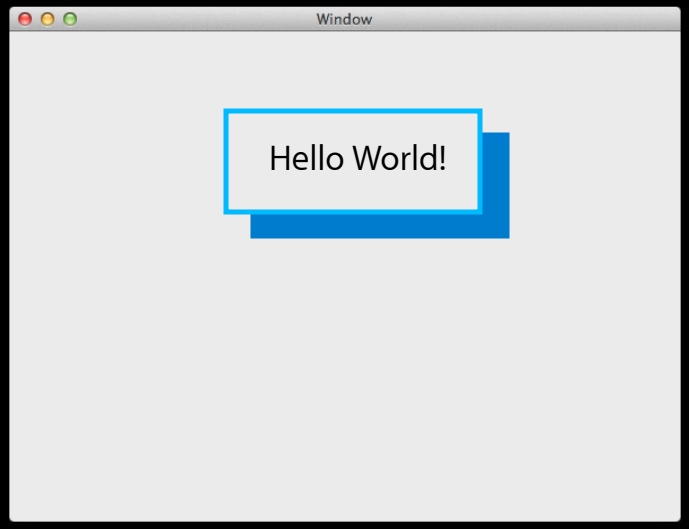
```
geometryFlipped, bounds, frame (implied), position, anchorPoint, transform,
shadow[Color, Offset, Opacity, Radius], hidden, filters, and
compositingFilter
```



Layer-Backed and Layer-Hosted

CALayer properties that AppKit always manages

`geometryFlipped`, `bounds`, `frame` (implied), `position`, `anchorPoint`, `transform`, `shadow[Color, Offset, Opacity, Radius]`, `hidden`, `filters`, and `compositingFilter`



Layers and Coordinates

Prior to Mountain Lion

- Layer coordinates where not equal to view coordinates
- AppKit would vary the anchorPoint
  - `isFlipped = YES`, then the `anchorPoint` is (0, 1)
  - `isFlipped = NO`, then the `anchorPoint` is (0, 0)
- You previously used `–convertPointToLayer:` and `–convertPointFromLayer:`
  - `–convertPointToLayer:` flips the y location based on `–isFlipped`
- Changing the `geometryFlipped` property was still not recommended

Layers and Coordinates

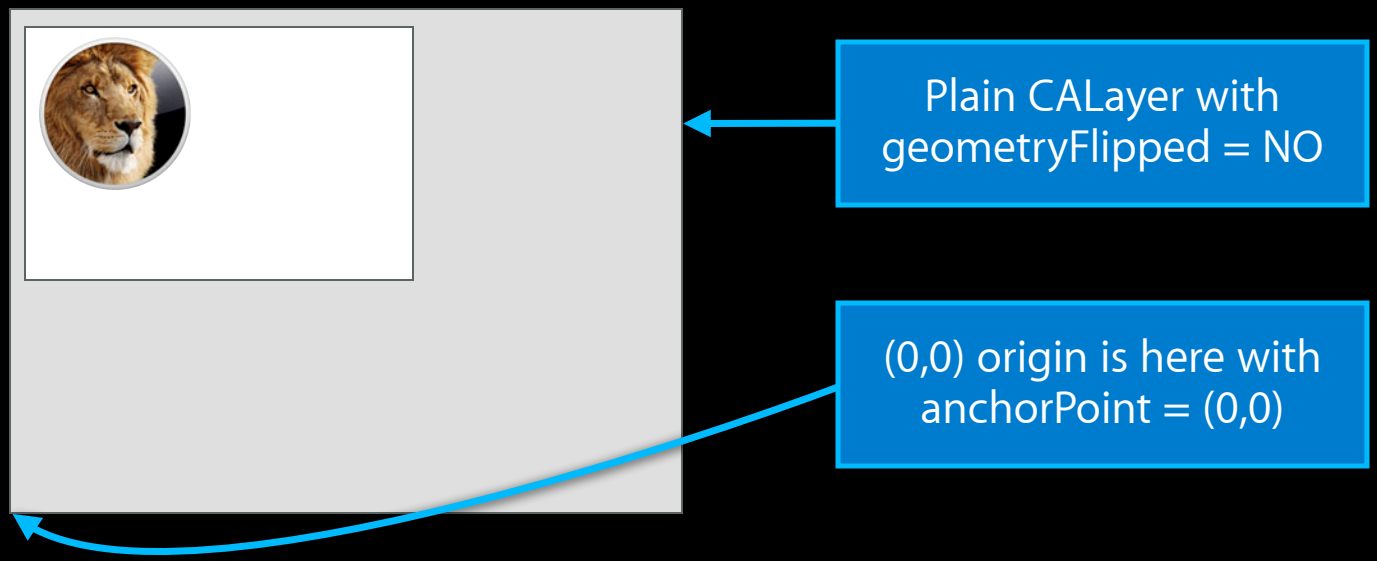
On Mountain Lion and above

- Layer coordinates now equal view coordinates!
- AppKit does not change the `anchorPoint`
  - The `anchorPoint` is always (0, 0)
- AppKit does this by managing `geometryFlipped`
- You do not have to do anything for this!

Layers and Coordinates

Understanding CALayer's geometryFlipped

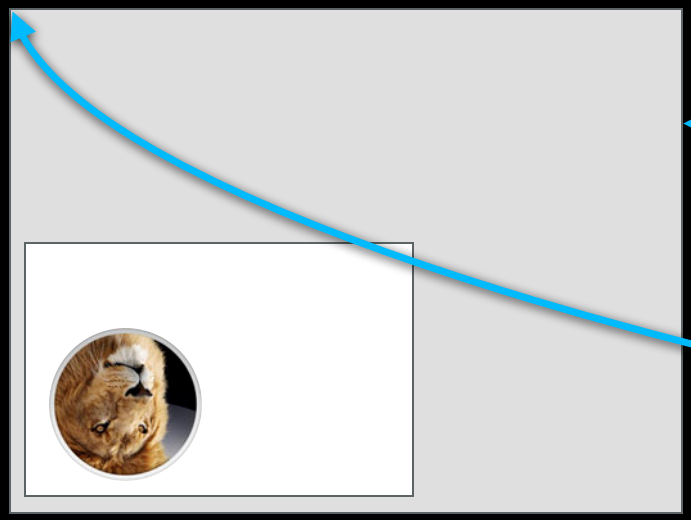
`geometryFlipped` affects the parent layer and all child sublayers



Layers and Coordinates

Understanding CALayer's geometryFlipped

`geometryFlipped` affects the parent layer and all child sublayers



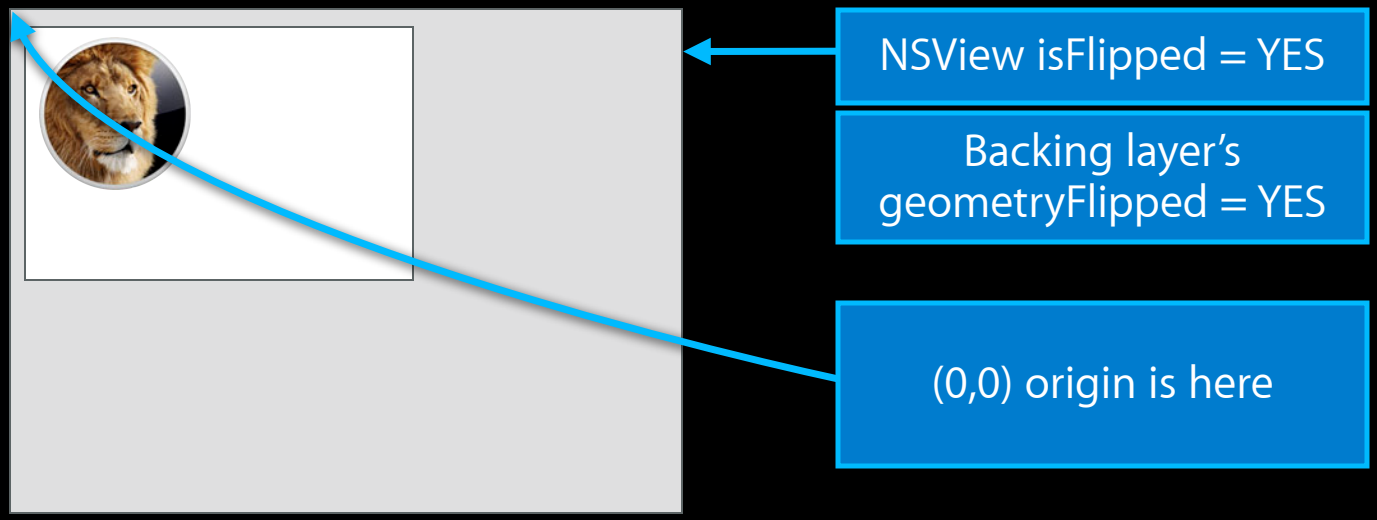
Same CALayer with geometryFlipped = YES

(0,0) origin is here with anchorPoint = (0,0)

Layers and Coordinates

On Mountain Lion

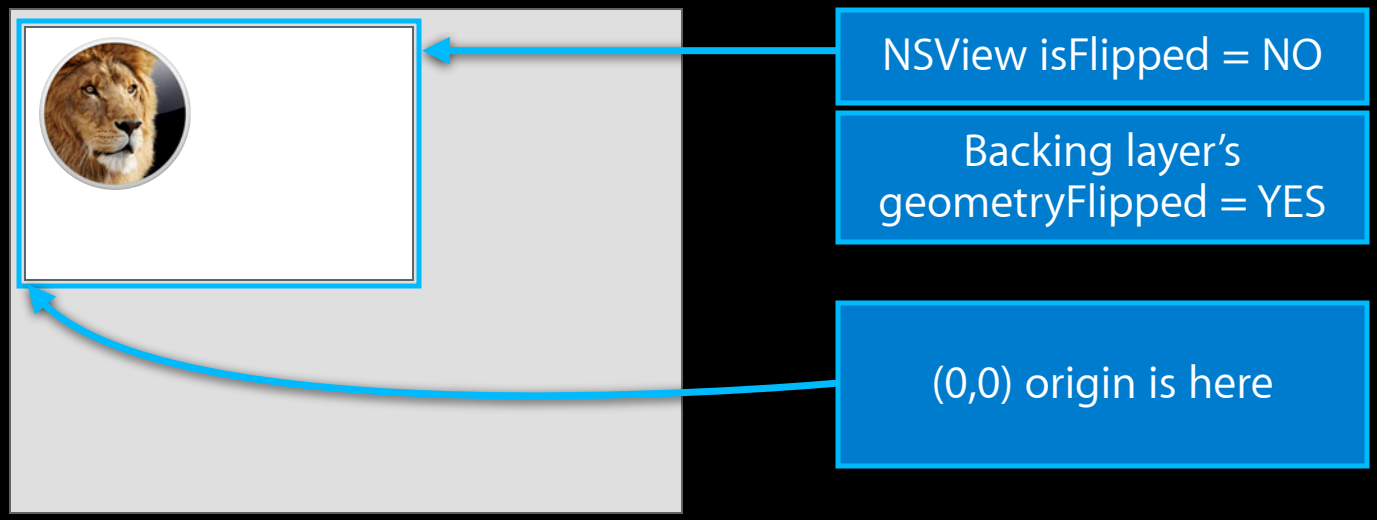
- Layer coordinates equal view coordinates
- This is accomplished by AppKit managing `-[CALayer geometryFlipped]`



Layers and Coordinates

On Mountain Lion

- Layer coordinates equal view coordinates
- This is accomplished by AppKit managing `-[CALayer geometryFlipped]`



Supporting High Resolution

Use a layer-backed NSView and not a direct CALayer

- Avoid using CALayers directly (layer-hosting)
  - No mouse or tracking support
  - No events or responder chain support
  - No automatic High Resolution support
- If you must use a direct CALayer, use the delegate method

```
- (BOOL)layer:(CALayer *)layer
    shouldInheritContentsScale:(CGFloat)newScale
                    fromWindow:(NSWindow *)window
```

You can still use -drawRect:

(Instead of -updateLayer)

- Sometimes it isn't possible to refactor your views to use subviews
- Animating views works fine if the frame size never changes
  - Such as custom buttons or small custom views
- Implementing `drawRect:` and `updateLayer` allows you to support 10.7 and 10.8 when layer-backed

Printing and -drawRect:

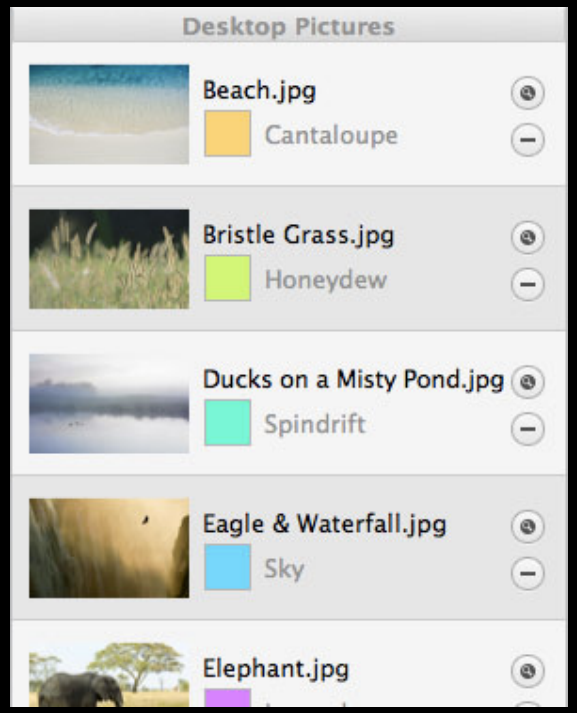
-drawRect: is still used for printing

- Most controls and user interface views don't need to print
- Standard AppKit controls still support `–drawRect:` and will always print correctly
  - NSTextView
  - NSImageView
  - …and others

Legacy Cell Based Controls

Layer-backing does not use layers for each cell

- Cell based NSTableView
  - Cells can not be layer-backed
- Use a View-Based TableView
  - See last year's talk
  - Each view can be layer-backed



Legacy Cell Based Controls

Layer-backing does not use layers for each cell

- NSMatrix
  - Use regular views instead
  - Radio button groups interact together
  - Consider using NSCollectionView
- NSForm
  - Use NSTextFields

Subclassing Standard AppKit Controls

- Most AppKit controls implement `–wantsUpdateLayer` and return `YES`
  - They add subviews and update layer contents with `–updateLayer:`
- However, `–wantsUpdateLayer` returns NO if someone subclasses and overrides any AppKit drawing methods
  - NSView's `–drawRect:`, NSCell's `drawWithFrame:inView:`, `drawInteriorWithFrameInView:`, `drawTitleWithFrame:inView:`, etc.

Subclassing Standard AppKit Controls

- To extend an existing control
  - Implement `–wantsUpdateLayer` and return YES
  - Add extra subviews where necessary in `–layout`
  - Use the existing position methods to customize where AppKit added subviews are located
    - On NSCell: `titleRectForBounds:`, `imageRectForBounds:`, etc.

Conclusion

Take Away Slide

Important stuff

- Use `layerContentsRedrawPolicy = NSViewLayerContentsRedrawOnSetNeedsDisplay`
- Use subviews whenever possible
- When possible use `–wantsUpdateLayer` and `–updateLayer`
  - Directly set the `layer.contents` and `layer.contentsCenter`
- Use NSTextField for adding text to get proper font smoothing
- Use the `–animator` proxy to start animations
- Use the Lion focus ring drawing API

More Information

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Documentation
Core Animation Programming Guide
http://developer.apple.com/

Apple Developer Forums
http://devforums.apple.com

Related Sessions

Advanced Tips and Tricks for High Resolution on OS X	Mission Friday 10:15AM

Labs

Cocoa & Layer-Backed Views on OS X Lab	Essentials Lab B Wednesday 2:00PM
High Resolution on OS X Lab	Essentials Lab B Wednesday 11:30AM
OS X Gestures and Cocoa Lab	Essentials Lab B Thursday 2:00PM
Cocoa and XPC Lab	Essentials Lab A Friday 10:15AM

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