Outline

4 Multimedia Programming with JavaScript and CreateJS

4.1 HTML5, JavaScript and Multimedia

4.2 CreateJS Libraries

4.3 Slideshow Example with CreateJS

4.4 Generation of JavaScript Code

Literature:

www.createjs.com
www.gskinner.com

HTML5

- WHATWG:
  “Web Hypertext Application Technology Working Group”
  - Founded in 2004 by individuals from Apple, Mozilla Foundation, and Opera
  - Editor of WHATWG specs, Ian Hickson, now at Google
  - Response to slow development of W3C standards for HTML
  - Opposition against XML dominance in W3C HTML standards
- HTML5
  - Collection of various technologies, being unbundled now
  - Realized in leading browsers, in parallel to standardization process
  - Since 2007, W3C HTML working group takes WHATWG HTML5 as starting point for refining HTML
- Multimedia features in HTML5:
  - Audio & video elements
  - “Canvas” 2D graphics element
  - Support for OpenGL 3D graphics (“WebGL”)

Immediate and Retained Mode Graphics

- Immediate mode:
  - Application directly draws on graphics surface
  - Application has full responsibility, must re-issue adequate drawing commands in case of changes
- Retained mode:
  - Graphics library contains model of objects to be rendered
  - Graphics library takes over part of the responsibility for updating display in case of changes
- Types of retained mode data structures (increasing sophistication):
  - Display list
  - Hierarchical display list
  - Scene graph

HTML5 Canvas Element

- Origin:
  - Apple MacOS X WebKit component 2004
  - Later adopted in Gecko engine and Opera browser
  - Standardized by WHATWG
- Idea: 2D graphics surface
  - Rendering of graphics through JavaScript drawing API
- Attention: Immediate mode graphics
  - Danger of low performance
  - Additional programming techniques needed (e.g. pre-rendering of canvas)
  - Libraries/frameworks to approach retained mode graphics

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CreateJS - Idea and History

- Grant Skinner, March 2012: “Announcing CreateJS”
  - Private project with high ambitions
  - Has quickly won support from major industry players: Adobe, Microsoft, AOL, Mozilla foundation
- Basic idea: HTML5 canvas for Flash-educated developers
  - Creates abstraction layer on top of (pixel-based) HTML5 canvas
  - EaselJS: Hierarchical display list, mouse interaction mode
- Uses Metaphors very close to Flash terms
  - Stage, Timeline, Tween, Movieclip, ….

Libraries in CreateJS

- EaselJS
  - Assistance in working with HTML5 canvas
  - Hierarchical display list, interaction model, helper classes
- TweenJS
  - “Tweening" library for JavaScript (= interpolation of object properties)
- SoundJS
  - Cross-Browser audio support for HTML5
- PreloadJS
  - Assistance in pre-loading assets, like graphics, sound, code
  - Uses queues and supports multiple connections
- Movieclip
  - Analogy to Flash “swf” movieclips
  - Not meant for use in manually written programs
  - Currently ***not*** part of standard EaselJS

CreateJS Embedding in HTML

- Make library accessible, e.g. by loading from network:

```
<script "http://code.createjs.com/
     createjs-2013.12.12.min.js"></script>
```

- Provide “init” function to be called after loading of HTML is complete
- Provide HTML5 canvas element and associate with “init” function

```
<!DOCTYPE html>
<html>
<head>
  <meta charset="utf-8">
  <script src="http://code.createjs.com/…"></script>
  <script>
    function init() { … CreateJS API usage … }
  </script>
</head>
<body onload="init();">
  <canvas id="myCanvas" width=… height=…></canvas>
</body>
</html>
```

CreateJS Stage and HTML5 Canvas

- Stage *(Bühne):*
  - Frequently used metaphor for the space for animated program behavior
- **`createjs.Stage`** class:
  - To be instantiated in script code
  - HTML id of stage element as parameter for constructor (or selection through classical means, e.g. DOM)
- For naming the window use HTML window title
- Stage contents are not organized as full scene graph here!
- Stage contents have to be added and made visible explicitly (hierarchical display list):
  - **`stage.addChild()`**
  - **`stage.update()`** (or "tick" method calling update() regularly)

Example: Pre-Loading Assets (1)

```
var manifest = [
     "pics/tiger.jpg",
     "pics/elephant.jpg",
     "pics/jbeans.jpg",
     "pics/peppers.jpg",
     "pics/butterfly.jpg"
];

var loader = new createjs.LoadQueue(false);
// do not use XMLHttpRequest
loader.addEventListener("fileload", handleFileLoad);
loader.addEventListener("complete", handleComplete);
loader.loadManifest(manifest);
```

Example: Pre-Loading Assets (2)

```
var images = new Array();
var imagecount = 0;

function handleFileLoad(event) {
     if (event.item.type == "image") {
          images[imagecount] = event.result;
          imagecount++;
     }
}

function handleComplete() {
     proceed after all assets have been loaded
}
```

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CreateJS JavaScript Kernel for Slideshow

```
var timeline = new createjs.Timeline({}, null,{loop: true});
for (var i=0; i<imagecount; i++) {
      var image = new createjs.Bitmap(images[i])
            .set({x: 50, y: 50, visible: false});
      stage.addChild(image);
      timeline.addTween(createjs.Tween
            .get(image)
            .wait(4000*i)
            .to({visible: true})
            .wait(4000)
            .to({visible: false}));
      }
createjs.Ticker.setFPS(30);
createjs.Ticker.addEventListener("tick", stage);
timeline.gotoAndPlay();
```

Method Chaining in CreateJS

- Many methods return the object on which they were invoked as result
- Chains of method calls: simple to write and easy to read
- Example:

```
new createjs.Bitmap(images[i])
      .set({x: 50, y: 50, visible: false});
```

- Technique often used in modern JavaScript frameworks

Tweens in CreateJS

- Tween = Interpolation
- Modifies properties of graphical object over time
- Methods used here:

  `tween.get(`*`object`*`)` Obtain target object to modify

  `tween.to(`*`prop-values`*`)` Modification of properties,
  specified as object containing property/value pairs;

  may specify additional time duration for linear interpolation

  `tween.wait(`*`msecs`*`)` Pause for a specified time

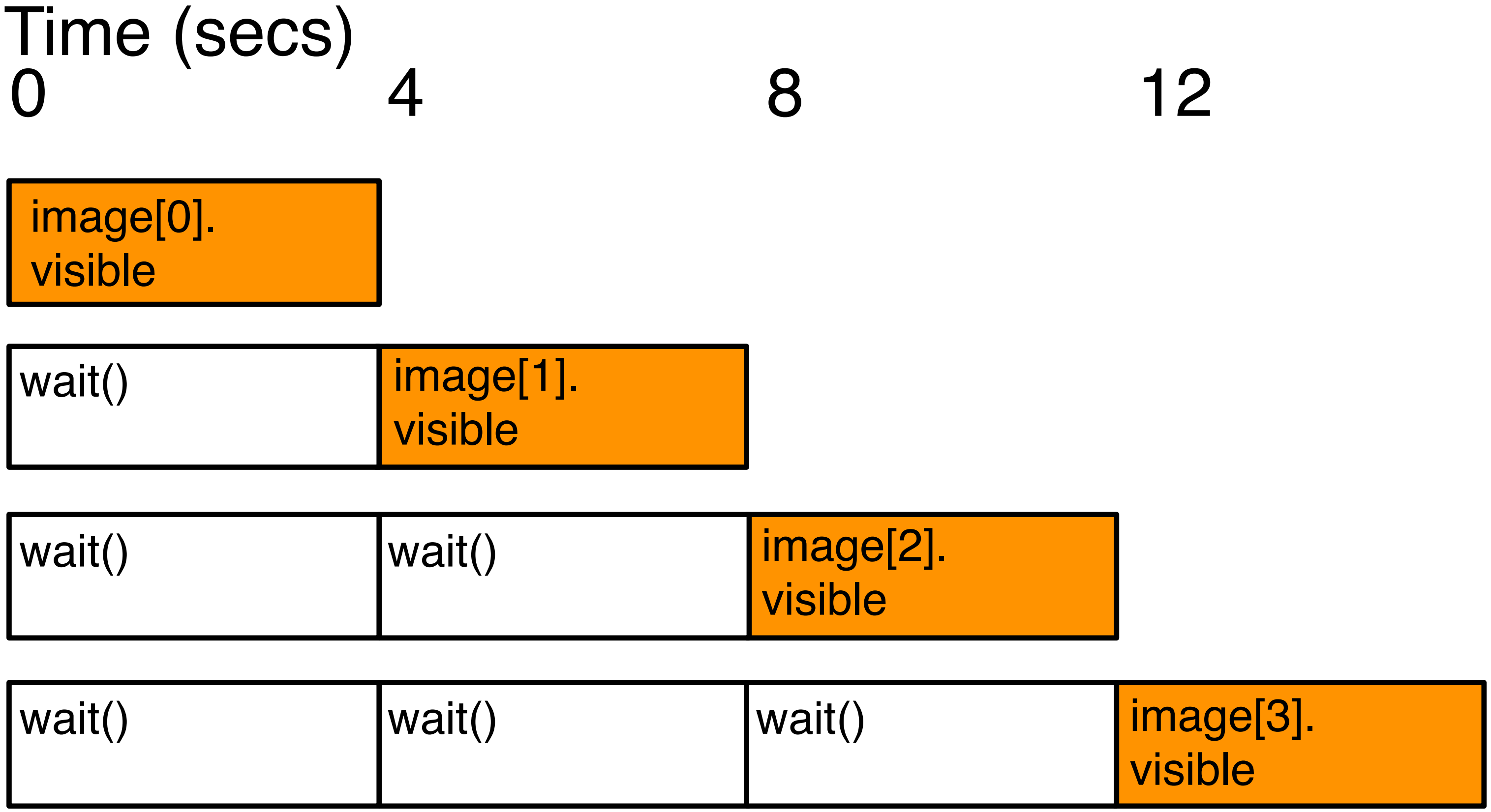
- Automatic updates work only if an event listener for the “tick” event of the Ticker class is registered.
- Stage as parameter:
  Citing “**`createjs.com`**” on **`Stage`**:

  > “Each time its Stage/tick method is called, it will render its display list to its target canvas.”

Timeline in CreateJS

- Timeline object:
  - Provides temporal structure to execute several tweens
- Constructor parameters:
  - Array of tweens to add (alternatively add with `addTween()`)
  - Object defining labels to be addressed in “goto” method calls
  - Initial timeline properties as object, for instance `{loop: true}`
- Looping timeline causes embedded tweens to be executed repeatedly
- Executing timeline at a defined point in time (time in msecs or label):
  - `gotoAndPlay()`
  - `gotoAndStop()`

Timeline for Slideshow Example



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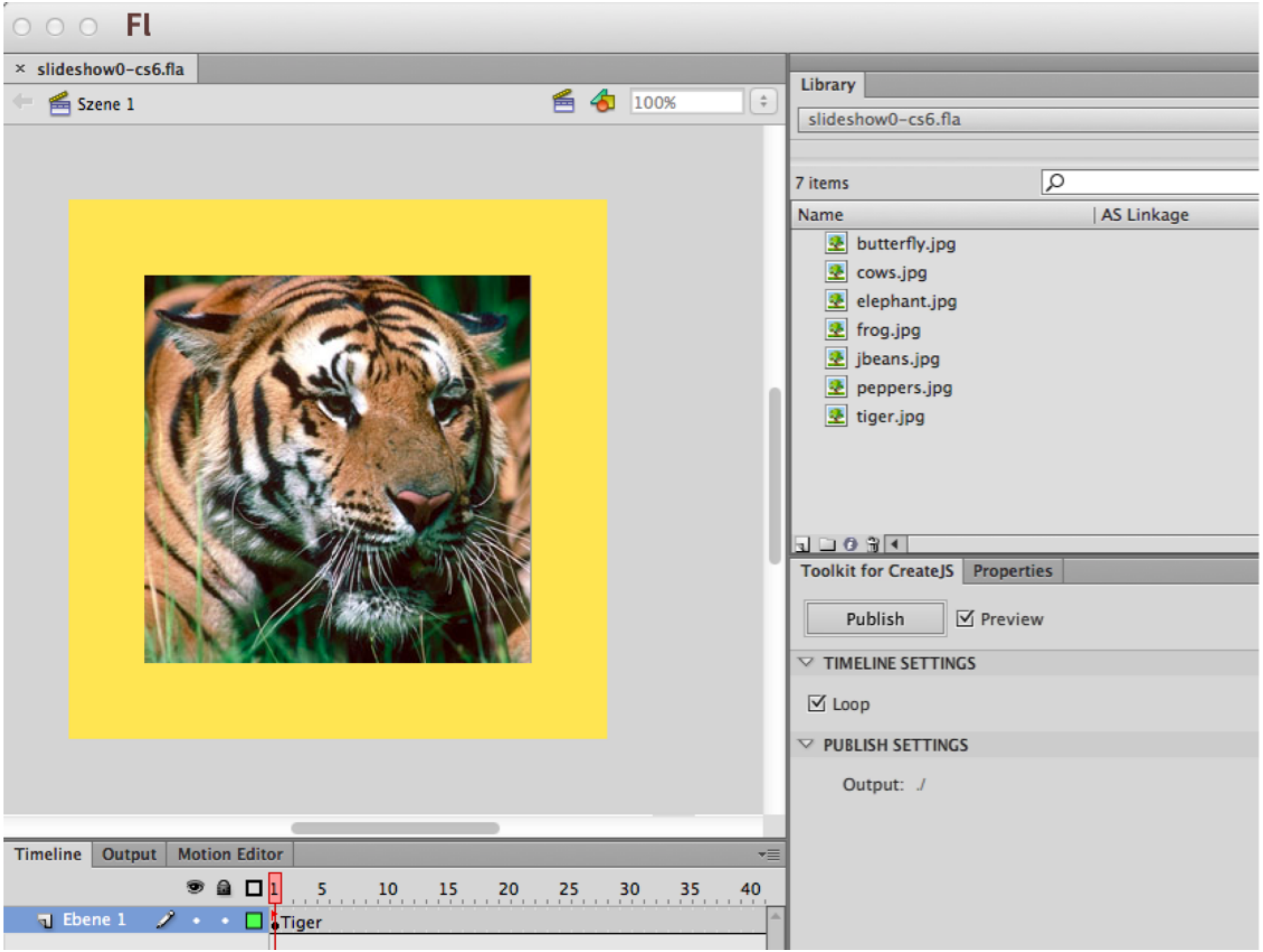
Flash Toolkit for CreateJS

- Adobe-suported plug-in for “Flash Pro” authoring system
- Provides additional exporting function
  - Standard export: As “swf” (shockwave flash) file for Flash player
  - Added export: JavaScript/CreateJS code, relatively well readable

Publishing CreateJS Code from Flash



Created JavaScript Code (Excerpt)

```
(function (lib, img, cjs) {

var p; // shortcut to reference prototypes

// stage content:
(lib.slideshow0 = function(mode,startPosition,loop) {
        this.initialize(mode,startPosition,loop,
        {Tiger:0,Elephant:96,JellyBeans:192,Peppers:289,Butterfly:3

        // Layer 1
        this.instance = new lib.tiger();
        this.instance.setTransform(50,50);
…
        this.timeline.addTween(cjs.Tween.get({})
          .to({state:[{t:this.shape},{t:this.instance}]})
          .to({state:[{t:this.instance_1}]},96)
          .to({state:[{t:this.instance_2}]},96)
           …
          .wait(96)); …
```