2 Development of multimedia applications

2.1 Multimedia authoring tools - Example Macromedia Flash

Background: History, Context

Flash Authoring Tool: A Quick Tour

SWF Format

2.2 Elementary concepts of ActionScript

2.3 Interaction in ActionScript

2.4 Media classes in ActionScript

2.5 Data access und distributed applications in ActionScript

The Expectations

“I like to think that if Rembrandt or Monet were alive today, they would be using Macromedia Flash MX and would be amazed by the level of creative expression they could achieve. Flash is a paintbrush that advances exponentially every year [...].”

Gary Grossman, Director of Engineering, Macromedia Inc.

The Purpose of Multimedia Authoring Tools

- Multimedia programs are complex:
  - Usage of special libraries
    - (2D) graphics primitives
    - Converters for media formats
    - Playback components
  - High data volume
    - Requires special techniques like client/server, caching, …
  - Synchronization issues
    - Some streams in stepwise synchronicity (e.g. audio track for video)
  - Interaction techniques
    - Flexible reaction to user actions
- Multimedia content is often created by non-technical people
- Authoring tools
  - Try to hide much of the complexity (using standard patterns and libraries)
  - Development environment accessible to non-technical people

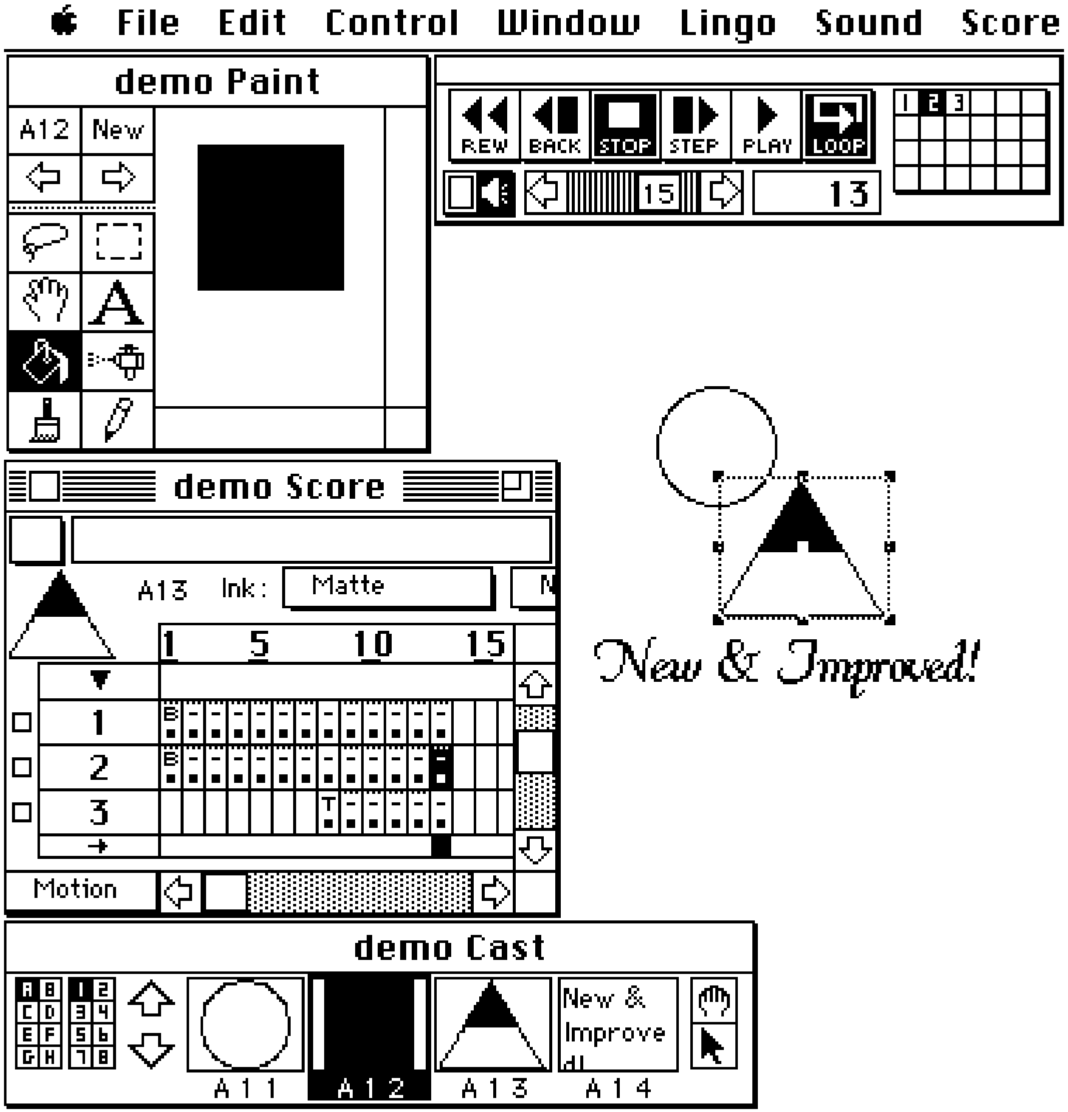
Macromedia Inc.: History

Not to be confused with the Munich-based training company “Macromedia” !

- 1984: *Macromind*
  (Jamie Fenton, Marc Carter, Mark Pierce)
  - *VideoWorks* (Joe Sparks)
    - » first timeline metaphor?
  - 1988: *VideoWorks* renamed to *Director*
- 1991:
  - Merger between *Macromind* and *Paracomp*
    - » 3D modeling tool *Swivel 3D*
  - Merger between *Macromind-Paracomp* and *Authorware*
    - » Courseware authoring tool *Authorware*
- 1996: New CEO *Rob Burgess* changes focus to Web publishing
  - HTML authoring tool *DreamWeaver*
- 1997:
  - Macromedia acquires *FutureWave Software*
    - » Key product *FutureSplash* renamed *Macromedia Flash*
- 2001:
  - Merger between Macromedia and *Allaire Systems* (*ColdFusion* server)

VideoWorks screenshot

- 1985-88



Flash: History

- Jonathan Gay:
  - Software developer for *Silicon Beach Software* (starting in high school...)
  - Involved in various ground-breaking Macintosh applications: Airborne!, DarkCastle (1987), SuperPaint II, IntelliDraw (drawings with behaviour)
- 1993: Foundation of *FutureWave Software*
  - Goal: Develop sketching software (*SmartSketch*) for the new “pen computer” and the PenPoint operating system from the company GO
  - GO (and later EO) computers failed
- 1995-96: *SmartSketch* becomes *FutureSplash Animator*
  - Ported to Macintosh and Windows
  - Extended with 2D animation features
  - From the beginning targeted at delivery over the Web
  - Well accepted by important customers (e.g. Microsoft, Disney)
- 1996: FutureWave bought by Macromedia
  - FutureWave Splash becomes *Macromedia Flash 1.0*

EO

Flash vs. Director

- Director:
  - 10 years older than Flash
  - Designed for development of interactive CD-ROMs
  - Integrated programming language *Lingo*
  - Oriented towards bitmap graphics
  - Starting from Version 7: integration of Flash content
- Flash:
  - Designed for content delivery over the Internet *(streaming)*
  - Oriented towards vector graphics
  - Early versions (up to version 3) extremely simple in their interaction possibilities, later versions with increasing support for scripting

Shockwave Plugins

- Shockwave:
  - General name for Web plugins playing Macromedia content
- *Shockwave for Director:*
  - Often simply called *Shockwave* plugin!
  - Plays content created with Director (Shockwave Movies)
  - File types: .dcr, .dir, .dxr
  - MIME type:
    application/x-director
- *Shockwave Flash*
  - Often called *Flash* plugin, different from Shockwave plugin!
  - Plays content in SWF (Shockwave Flash)format
  - File types: .swf, .spl (from FutureSplash)
  - MIME types:
    application/x-shockwave-flash
    application/futuresplash

Shockwave Flash (SWF)

- SWF is often pronounced as “swiff”
- File format for execution-ready presentations
  - Originally the proprietary compiled format of Flash presentations
  - Can be produced by various programs, not only Macromedia Flash
    - E.g. open-source, multi-platform scripting language SSWF http://sswf.sourceforge.net/
- Specification of SWF publicly available:
  - http://www.OpenSWF.org/
- Flash browser penetration over 95%
- Players exist for many platforms:
  - PDAs
  - Mobile phones (in particular the *i-Mode* system from NTT DoCoMo)
  - Java
  - ...

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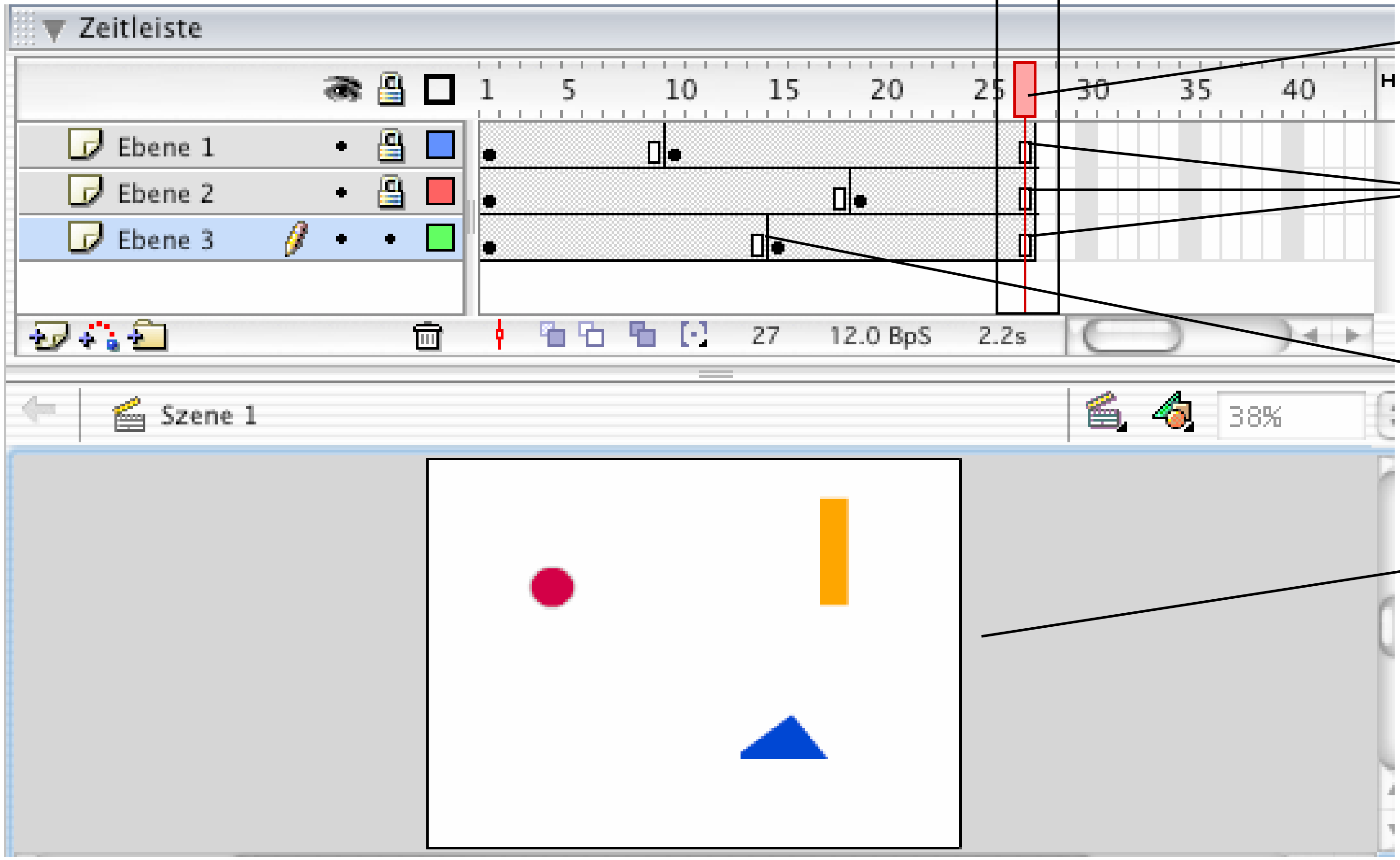
Timeline and Stage



current picture consists of 3 layers

Playback head

3 layers in parallel

Frame change

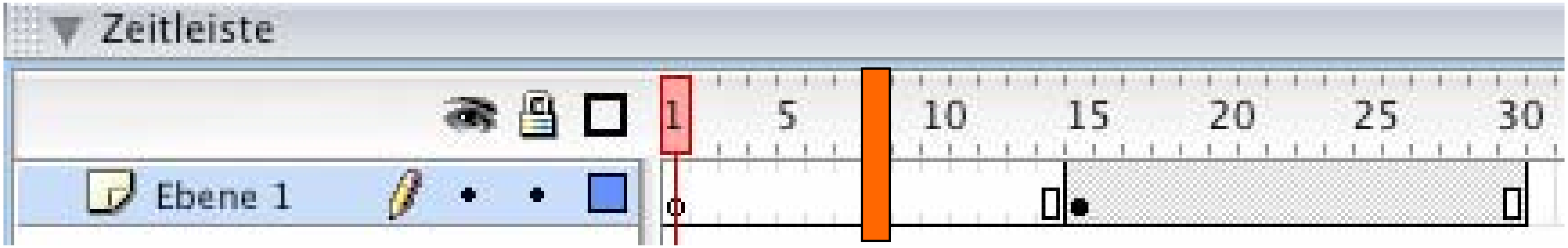
Stage shows current frame

3 dimensions (2 plane dimensions plus time) mapped to 2D screen:

– 2D-frame (stage), no time
– time plus layers, no frame content

} combined

Timeline Symbols



Frame no. 8

- The timeline contains of *frames* (Bilder)
- *Key frames (Schlüsselbilder)* are defined explicitly (drawn by hand)
  - Representation in Flash:
    hollow dot = empty key frame
    black dot = key frame with content
- Default treatment of frame sequences: repeat last frame
  - Grey bar: Sequence of identical frames
  - Square: Last frame of a sequence
  - Changes in key frame affect all subsequent frames till next key frame!

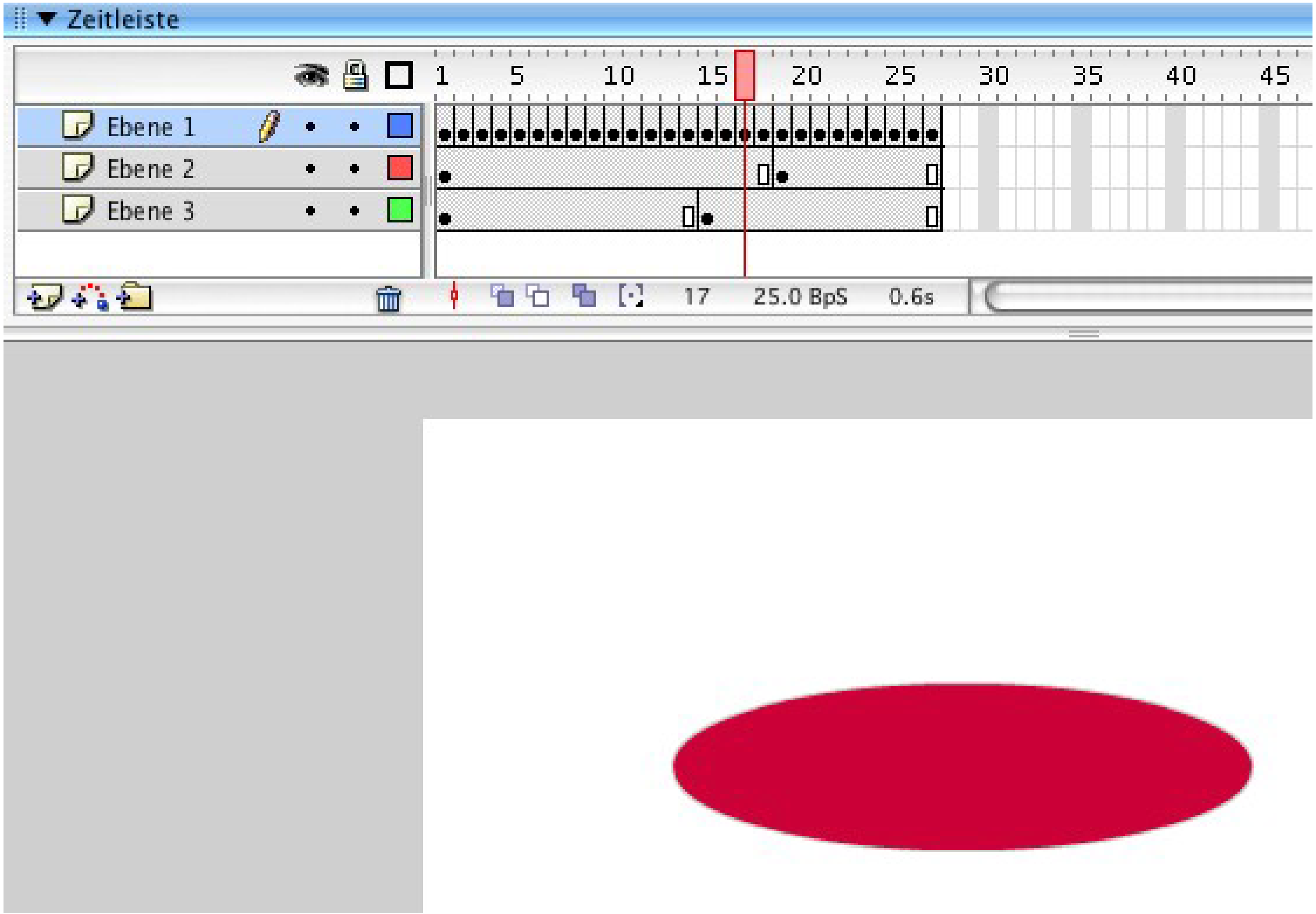
Animation: Change of Pictures over Time

- The suggestion of continuous change or movement:
  - Created by small changes from picture to picture
  - At least 12 frames per second, better more (25 and more)

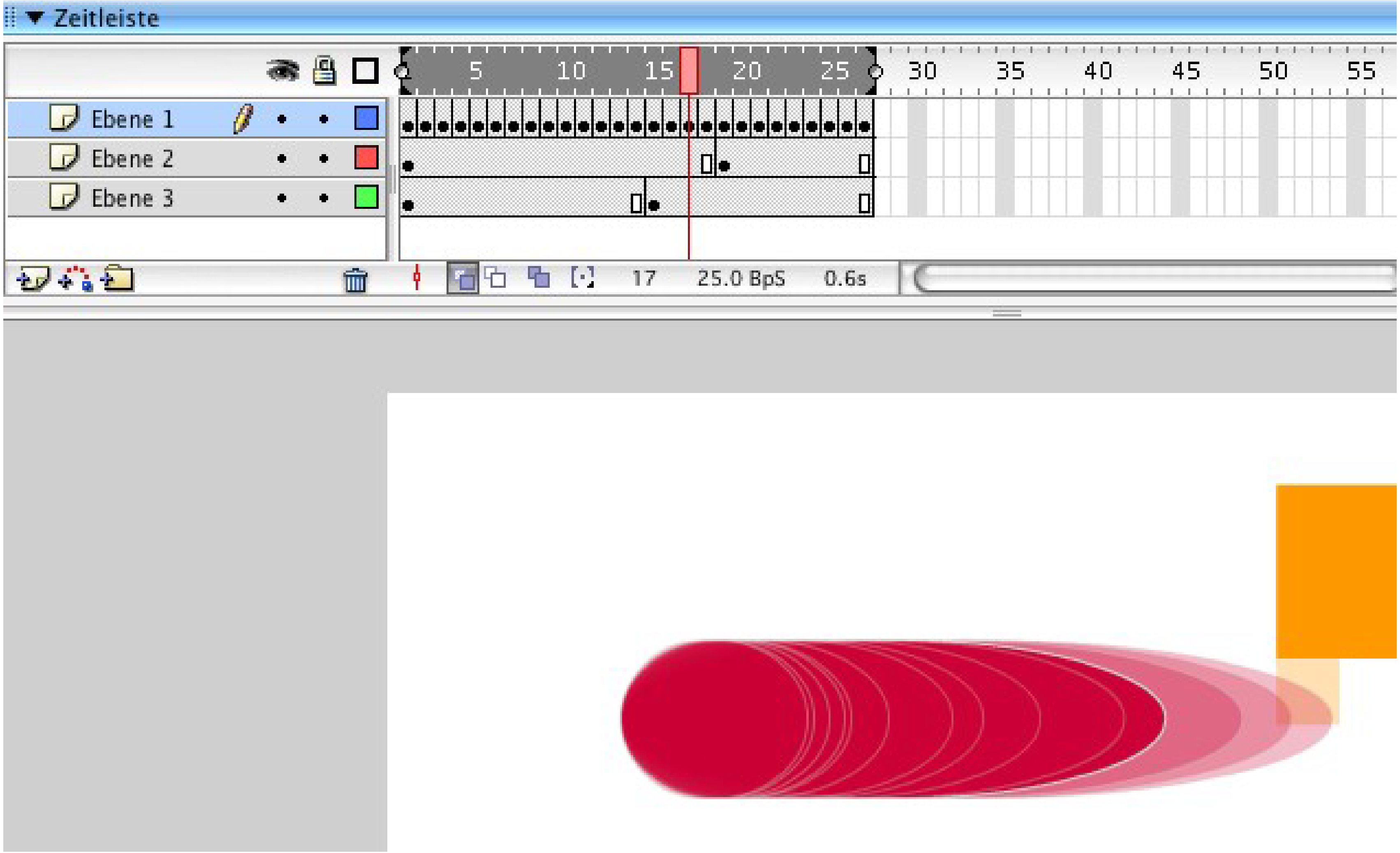
- Single picture animation:
  - One graphic picture (drawn by hand) per frame
  - In Flash: Sequence of key frames

- Interpolation *(tweening):*
  - Sequence of frames defined by first and last frame
  - “In-between frames” generates automatically (interpolated)
  - “Tweening” possible with respect to several properties
    - » Size, location, orientation, colour of individual object *(motion tweening)*
    - » Shape of object *(shape/form tweening)*

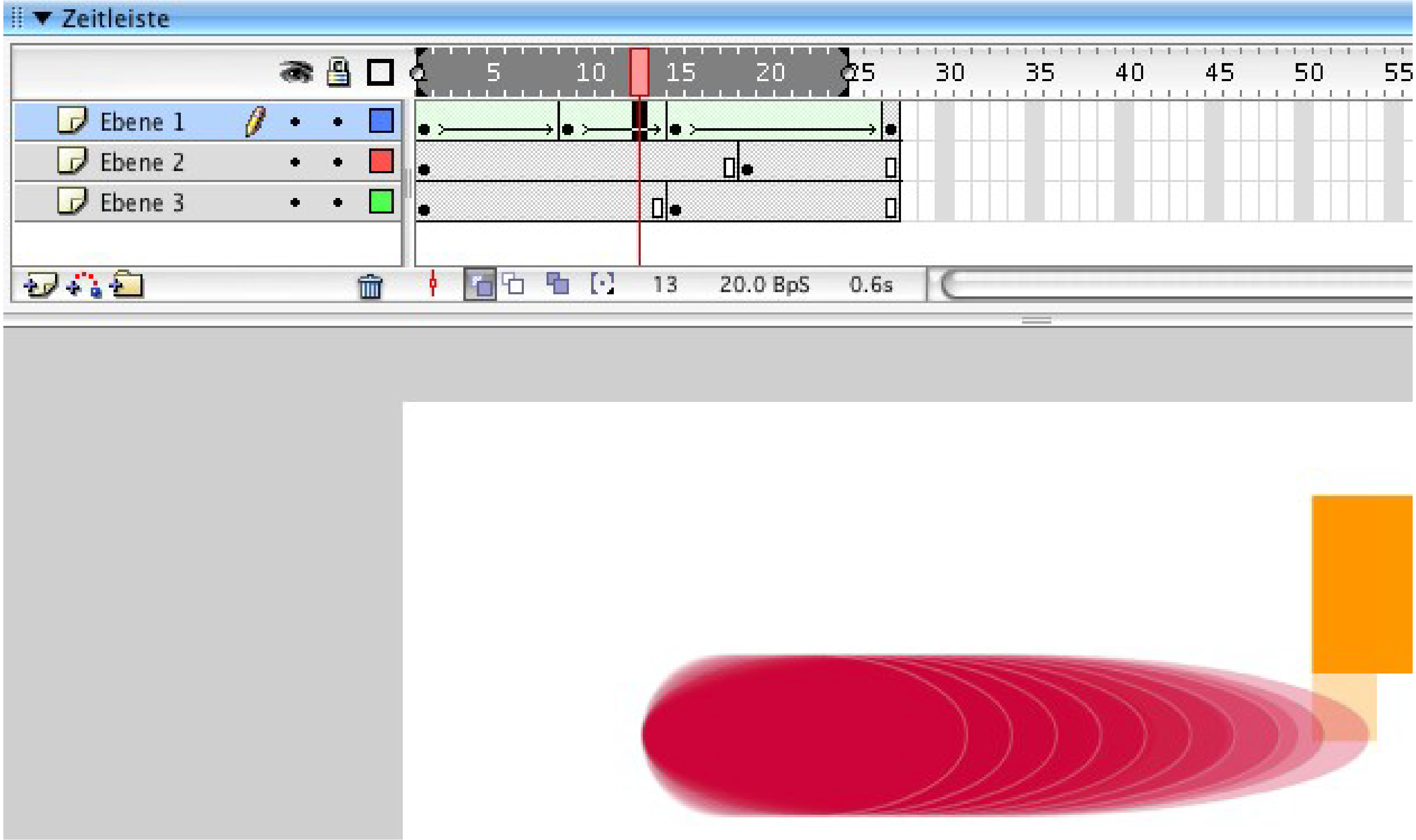
Keyframe Animation



Visualization of Animation with “Onion Skins”



Interpolation with Shape Tween

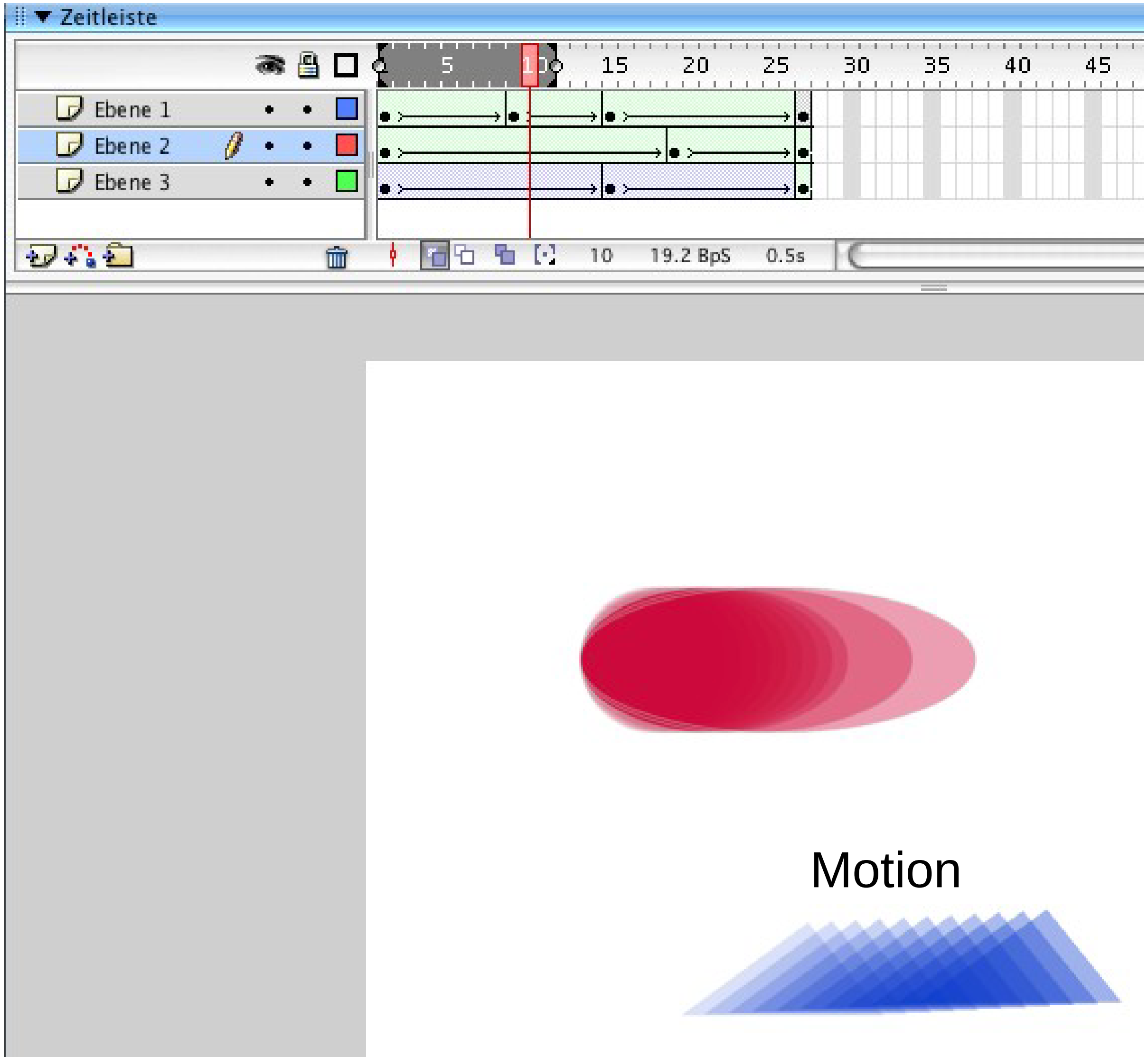


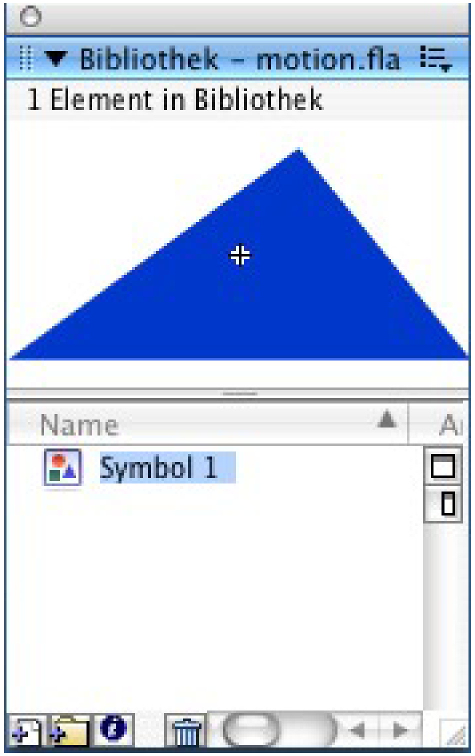
Only a few frames are drawn by hand, intermediate frames are interpolated

Symbols and Instances

- *Symbol*: Reusable element in a Flash animation
  - Contained in Library
  - Examples: Graphics, Buttons, MovieClips, Sounds
- Dragging a symbol onto stage creates an *instance* of the symbol
  - Helpful for reduction of memory requirements
  - Essential for tracking objects in complex animation sequences
- Motion tween:
  - Only applicable to symbols
  - Imported graphics needs to be converted to a symbol before being used in motion tweens
- Strict distinction in Flash:
  - Shape tweens: Applicable only to simple graphical objects
  - Motion tweens: Applicable only to instances of symbols (or groups)

Motion Tween



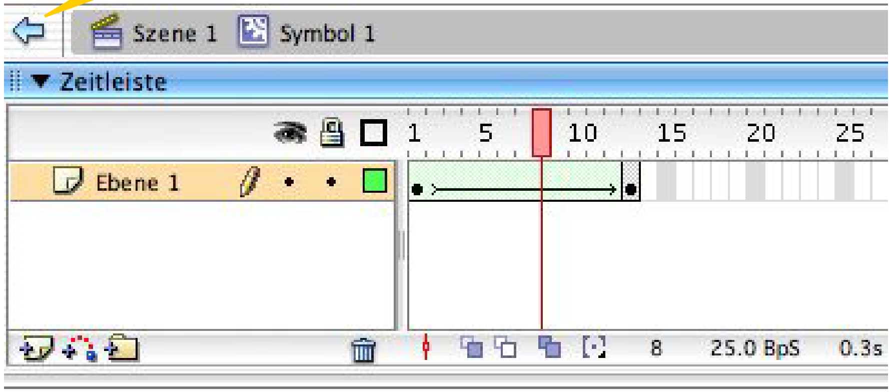


Motion

“slow down” and
“speed up” adjustable
through object inspector

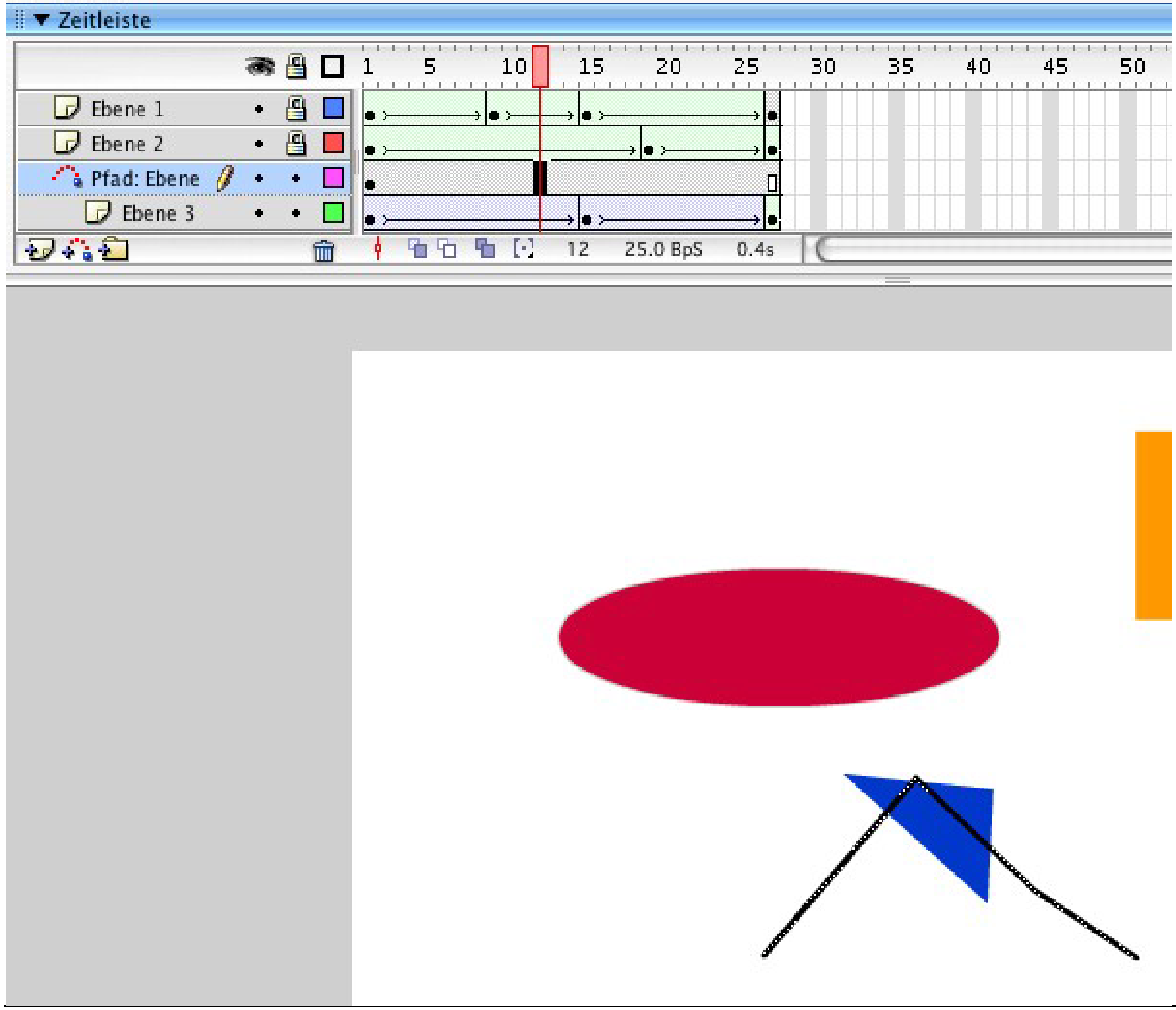
Hierarchical Timelines

- Each object can bring its own timeline
  - Instances of library symbols bring a copy of the timeline defined for the symbol
- Main timeline may be structured hierarchically into a tree of timelines
- Each instance of a symbol can move individually through its timeline
  - ActionScript code (see next lecture) can be added to navigate within timeline



Nested timeline !

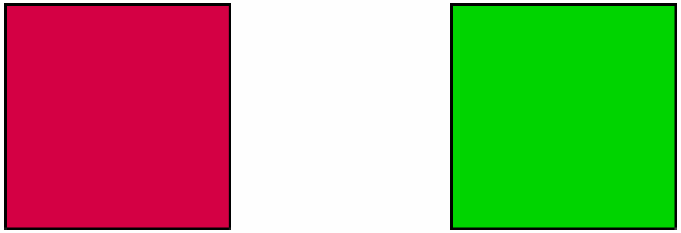
Motion Path



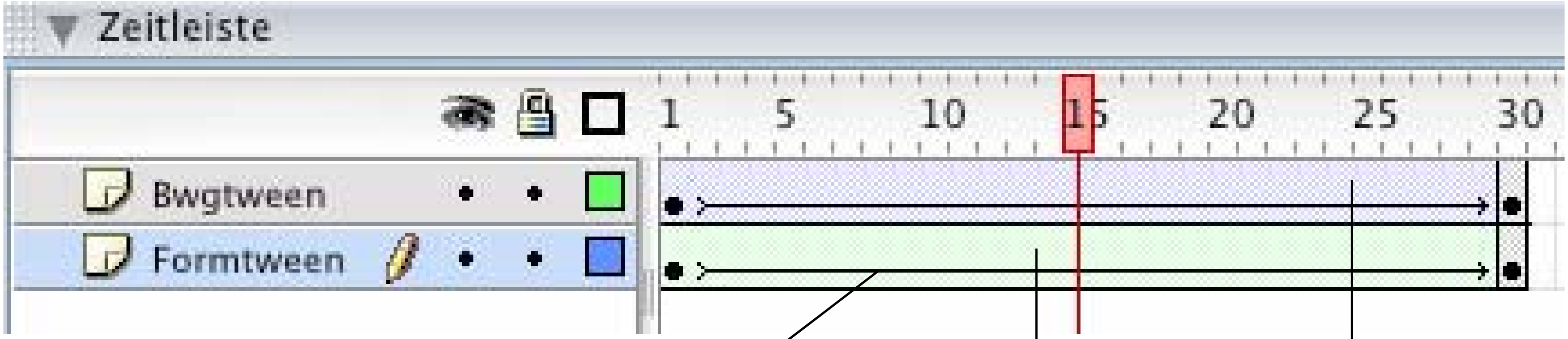
- Motion of objects can be carried along specific lines
- Prerequisites:
  - Path layer inserted above motion tween
  - Respective attribute set in motion tween parameters (object inspector)

Animation of Colours

- The same graphical object can be represented with various colour variants
  - Fill colours, line colours
  - Transparency (alpha)
  - Brightness (luma)
- Flash:
  - Colour changes possible in motion tweens and shape tweens
- Example:
  - Change colour of a square from red to green with interpolation



Representation of "Tweens" in Flash



Tween (interpolating animation)

motion tween

shape tween

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SWF

- The Macromedia Flash file format (SWF) (pronounced “swiff”) delivers vector graphics and animation over the Internet to the Macromedia Flash Player.
  - Pure delivery format
- Design goals:
  - On-screen display
    - Designed for rendering
  - Extensibility
    - Tagged format
  - Network delivery
    - Compact binary format
  - Simplicity
  - Scalability regarding power of hardware
  - Scriptability
    - Stack machine code compatible to “ActionScript” language

Structure of a SWF File

- Tagged structure of objects
- Two categories of tags:
  - Definitions of content (shapes, bitmaps, sounds and so on):
    - Each definition tag assigns a unique *character id*
    - Definitions stored in *dictionary*
  - Control:
    - Control the flow of the movie (timelines, actions)
    - Create and manipulate instances of characters
- Built-in features (selection):
  - Layered display
  - Shapes, fill, line, edges, gradients, shape morphing
  - Bitmaps
  - Fonts and text
  - Buttons
  - Sound, video

Example SWF (1)

- Tools for viewing SWF in readable form

  E.g. *KineticFusion*: Conversion to XML-based language RVML (proprietary) (Rich Vector Markup Language)

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<!-- <!DOCTYPE Movie SYSTEM 'dtd/RVML.dtd'> -->
<Movie version='6' width='550' height='400' rate='12'
   backgroundColor='white' compressed='Yes'
   xmlns='http://www.kineticfusion.org/RVML/1.0'>
   <Definitions>
      <Shape id='Main.Shape_1' bounds='bounds(197.0, 263.3, 298.95, 310.45)'>
         <FillStyles />
         <LineStyles>
            <LineStyle index='1' width='1.0' color='rgb(208,208,208)' />
            <LineStyle index='2' width='1.0' color='rgb(208,208,208)' />
         </LineStyles>
         <Edges>
            <Move x='197.5' y='309.95' />
            <SetStyle line='2' />
            <Line x='298.45' y='309.95' />
            <Line x='260.95' y='263.8' />
            <SetStyle line='1' />
            <Line x='197.5' y='309.95' />
            <ColorFill color='rgb(0,51,204)' />
            <SetStyle line='0' mainFill='0' rightFill='0' />
            <Move x='298.45' y='309.95' />
            <SetStyle mainFill='1' />
            <Line x='260.95' y='263.8' />
            <Line x='197.5' y='309.95' />
            <Line x='298.45' y='309.95' />
         </Edges>
      </Shape>
...
```

Example SWF (2)

```
  <Timeline frameCount='27'>
    <Frame frameNo='1'>
      <Place name='Main.Shape_1' depth='2' />
      <Place name='Main.Shape_2' depth='3'>
        <Transform scaleX='2.5459' scaleY='0.724'
           translateX='-626.35' translateY='11.5' />
      </Place>
      <Place name='Main.Shape_3' depth='4' />
    </Frame>
    <EmptyFrame blankFrames='8' />
    <Frame frameNo='10'>
      <Replace name='Main.Shape_4' depth='4' />
    </Frame>
    <EmptyFrame blankFrames='4' />
    <Frame frameNo='15'>
      <Remove name='Main.Shape_1' depth='2' />
      <Place name='Main.Shape_5' depth='1' />
    </Frame>
    <EmptyFrame blankFrames='3' />
    <Frame frameNo='19'>
      <Remove name='Main.Shape_2' depth='3' />
      <Place name='Main.Shape_2' depth='2' />
    </Frame>
    <EmptyFrame blankFrames='8' />
  </Timeline>
</Movie>
```