Multimedia-Programmierung
Übung 8

Ludwig-Maximilians-Universität München

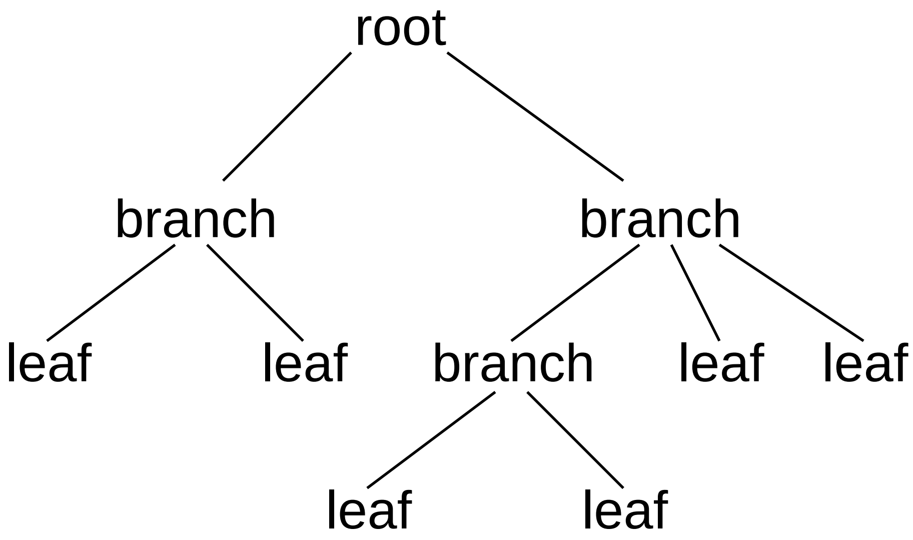
Sommersemester 2009

Today

- Scene Graph and Layouts
- Interaction
- Animations
- Effects

JavaFX Scene Graph 1

- Scene graph is a tree data structure consisting of **nodes**
- Nodes can be the root, branches or leafs
- Branches have zero or more children, while leafs have no children



root

branch branch

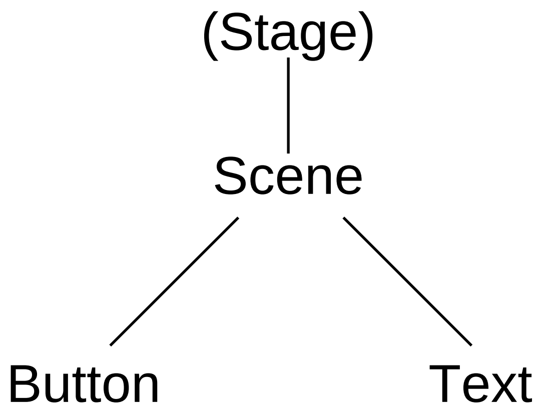
leaf leaf branch leaf leaf

leaf leaf

JavaFX Scene Graph 2

- Nodes can be UI components, text, images …
- Nodes can be transformed, animated or applied with effects

```
var counter = 0;
Stage {
    title: "My first App"
    width: 250
    height: 200

    scene: Scene {
        content: [
            Button {
                text: "press me"
                layoutX: 80, layoutY: 100
                action: function() { counter++; }
            }
           Text {
                font : Font { size: 24 }
                x: 100, y: 80
                content: counter
            }
        ]
    }
}
```



(Stage)

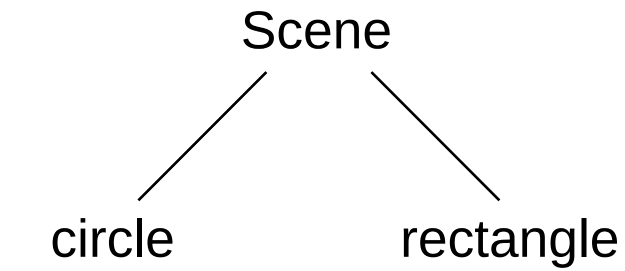
Scene

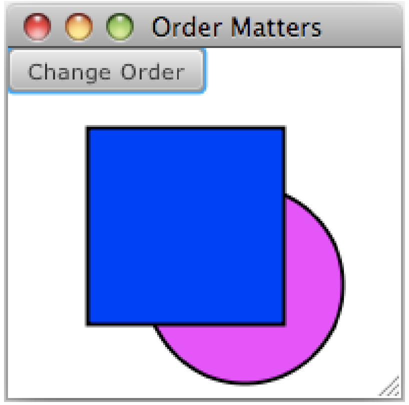
Button

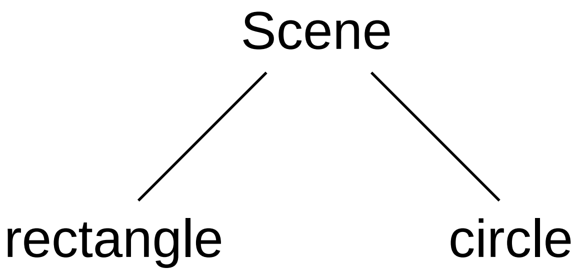
Text

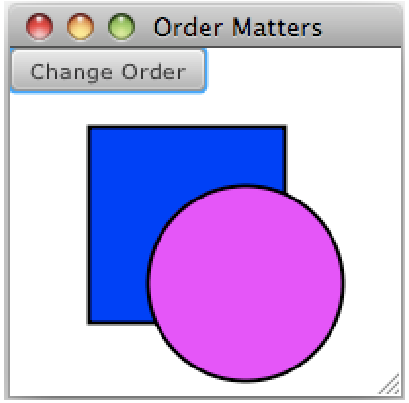
Order Matters

- Nodes are painted in their order
- Later nodes are painted on top of previous nodes



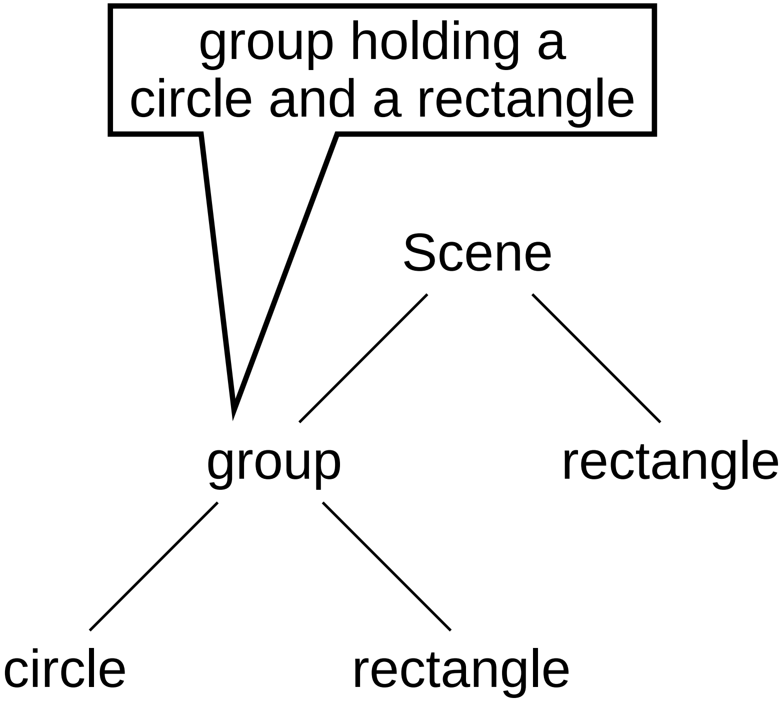






Grouping Nodes

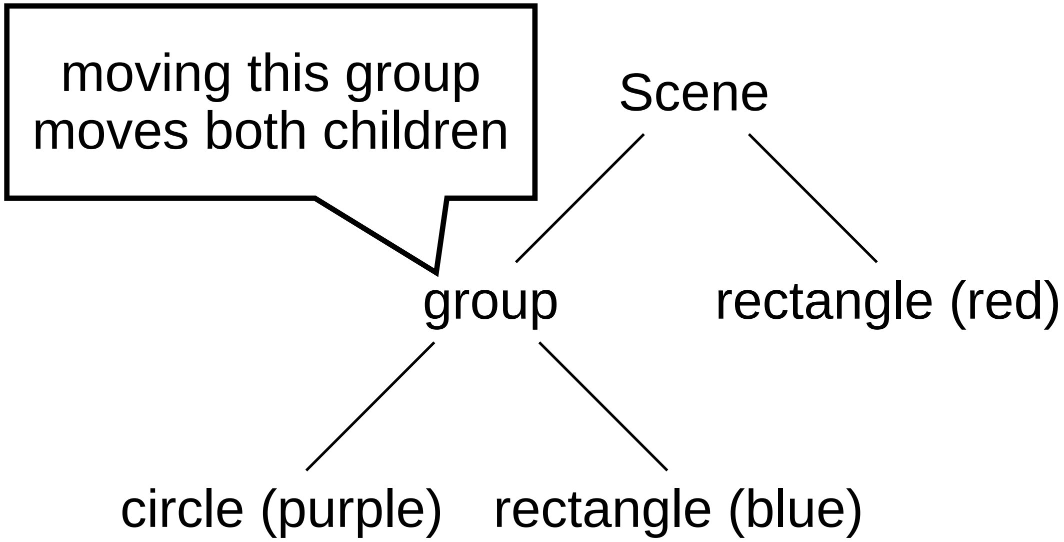
- Nodes can be grouped together (javafx.scene.Group)
- Groups enable the manipulation of several nodes at the same time



```
Stage {
   title: "My first Group", width: 200, height: 200
   scene: Scene {
      content: [
         Group {
            content: [
                 Circle {
                      centerX: 120, centerY: 120, radius: 20
                      fill: Color.MAGENTA, stroke: Color.BLACK
                      strokeWidth: 2
                  }
                  Rectangle {
                       x: 50, y: 40, width: 50, height: 50, fill: Color.BLUE
                       stroke: Color.BLACK, strokeWidth: 2
                  }
            ]
         }
         Rectangle {
             x: 10, y: 30, width: 50, height: 50, fill: Color.RED
             stroke: Color.BLACK, strokeWidth: 2
         } ]}}
```

Changing Nodes

- Changes on a node (e.g. transformations) affect the node's children in the same way



moving this group moves both children

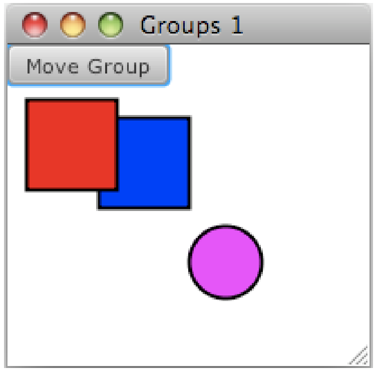
Scene

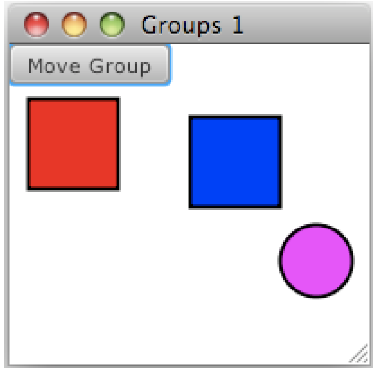
group

rectangle (red)

circle (purple)

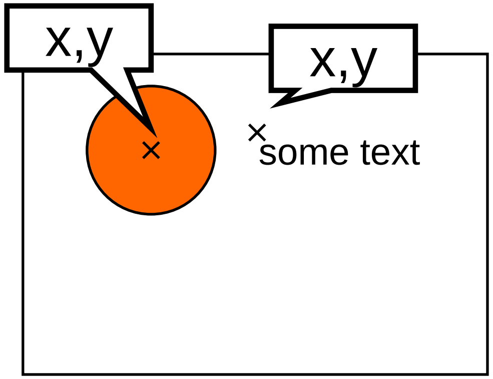
rectangle (blue)



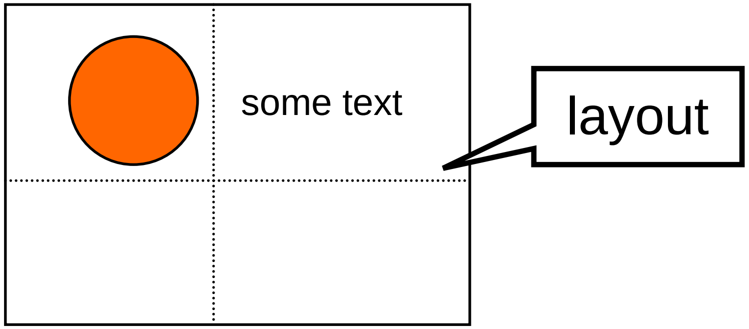


Layout Nodes

- Till now: layouts defined by absolute coordinates

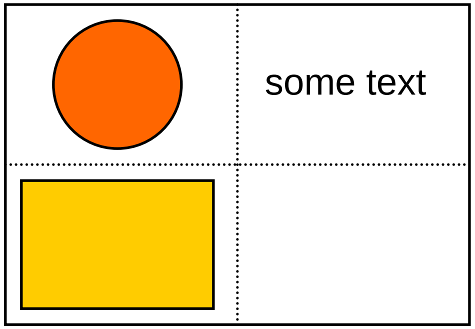


- Now: layout nodes support relative layouts (javafx.scene.layout)



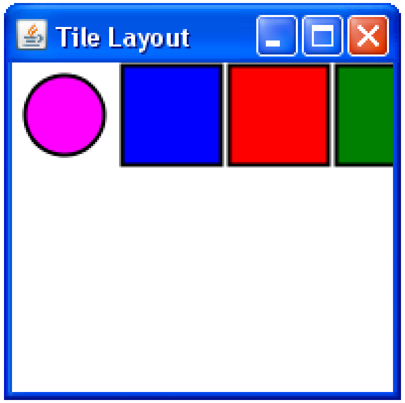
Tile Layout

- Nodes are laid out in tiles
- Tiles are of equal size (by default the size of the largest node)
- Nodes can be ordered horizontally or vertically
- The layout will automatically wrap its content when the width or height of the Tile layout is reached (has to be specified manually)



Tile Layout
Examples 1

- Horizontal tile layout, no width, no column count



```
Stage {
    title: "Tile Layout", width: 200, height: 200
    scene: Scene {
        content: [
            Tile {
                content: [
                      Circle {
                            ...
                       }
                       Rectangle {
                             ...
                       }
                       Rectangle {
                             ...
                       }
                       Rectangle {
                             ...
                       }
                ]
            }
]}}
```

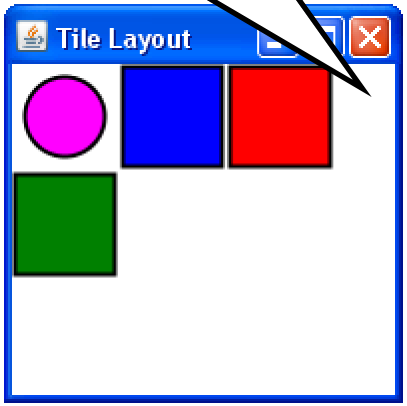
tile without
any parameters

Tile Layout

Examples 2

- Horizontal tile layout, with width, no column count

nodes are wrapped at 200



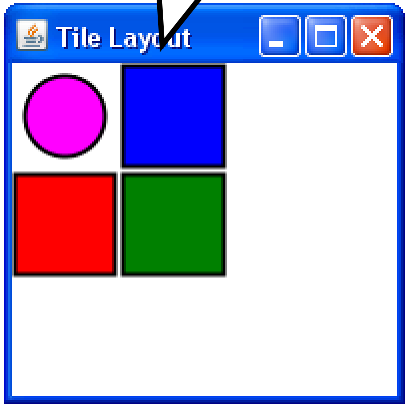
```
Stage {
    title: "Tile Layout", width: 200, height: 200
    scene: Scene {
        content: [
            Tile {
                width: 200
                content: [
                      Circle {
                           …
                       }
                       Rectangle {
                            …
                       }
                       Rectangle {
                            …
                       }
                       Rectangle {
                            …
                       }
                ]
            }
]}}
```

tile with a fixed width

Tile Layout
Examples 3

- Horizontal tile layout, no width, two columns

nodes are arranged in two columns horizontally

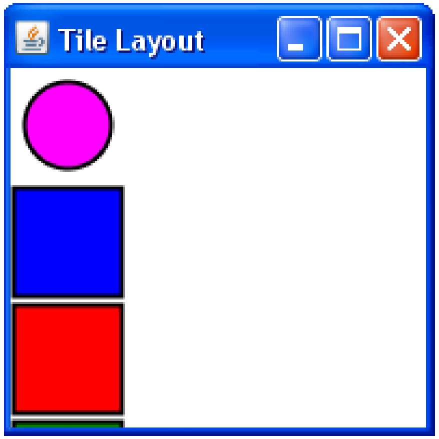


```
Stage {
    title: "Tile Layout", width: 200, height: 200
    scene: Scene {
        content: [
            Tile {
                columns: 2
                content: [
                      Circle {
                            …
                       }
                       Rectangle {
                             …
                       }
                       Rectangle {
                             …
                       }
                       Rectangle {
                             …
                       }
                ]
            }
]}}
```

layout with two columns

Tile Layout
Examples 4

- Vertical tile layout, no height, no column count



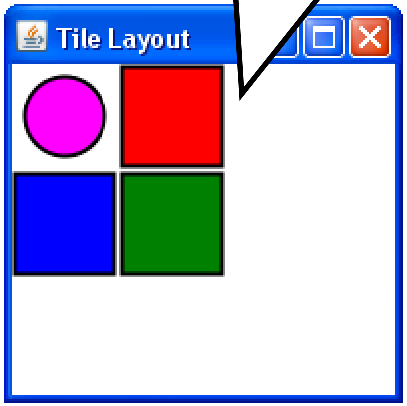
```
Stage {
    title: "Tile Layout", width: 200, height: 200
    scene: Scene {
        content: [
            Tile {
                vertical: true
                content: [
                      Circle {
                            …
                        }
                       Rectangle {
                             …
                        }
                       Rectangle {
                             …
                        }
                       Rectangle {
                             …
                        }
                 ]
             }
]}}
```

vertical layout

Tile Layout
Examples 5

- Vertical tile layout, no width, two rows

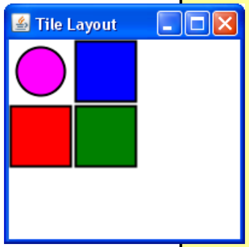
nodes are arranged in two row vertically



```
Stage {
    title: "Tile Layout", width: 200, height: 200
    scene: Scene {
        content: [
            Tile {
                vertical: true
                rows: 2
                content: [
                     Circle {
                          ...
                      }
                     Rectangle {
                          ...
                      }
                     Rectangle {
                          ...
                      }
                     Rectangle {
                          ...
                      }
                ]
            }
]}}
```

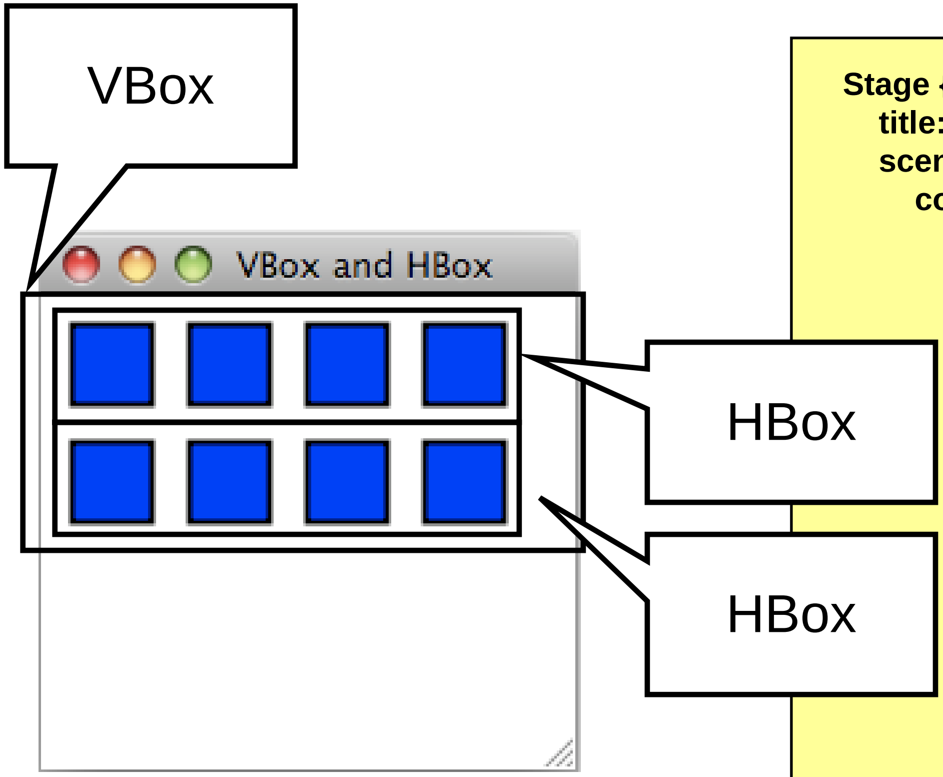
vertical layout with two rows

compare to two columns horizontally



VBox and HBox Layouts

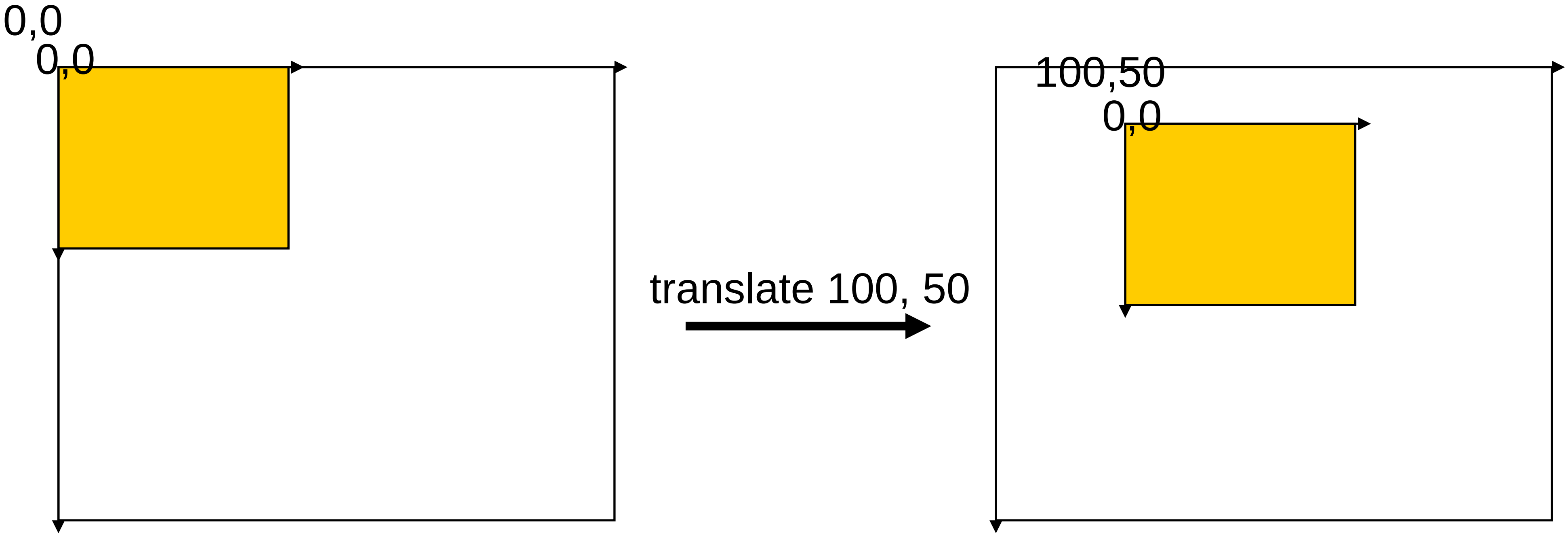
- Nodes are laid out horizontally (HBox) or vertically (VBox)



```
Stage {
  title: "VBox and HBox“, width: 200, height: 200
  scene: Scene {
    content: [
      VBox {
        layoutX: 10, layoutY: 10, spacing: 10
        content: [
          for(i in [0..1])
            HBox {
              spacing: 10
              content:
                for(j in [0..3])
                  Rectangle {
                    width: 30, height: 30, fill: Color.BLUE
                    stroke: Color.BLACK, strokeWidth: 2
                  }
            }

        ]
      }
    ]
  }
}
```

Transformations

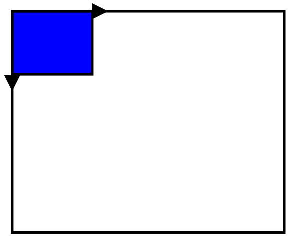
- Nodes can be transformed (rotation, translation, scaling, skew)
- Transforming a node does not change its size, height, width, x, y, etc. but its coordinate system



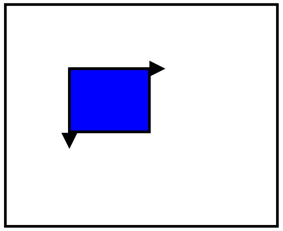
Transformations

the transform variable

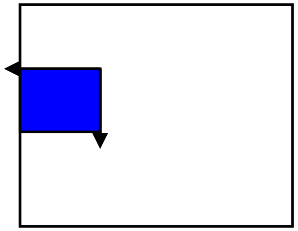
- Transformations are applied in order of their appearance within the transform sequence



1. translate(100,100)



2. rotate(90,20,30)



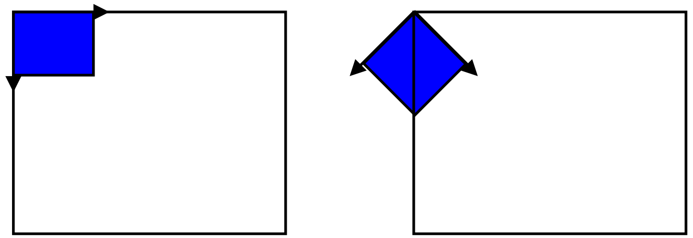
```
Stage {
    title : "Transformations"
    scene: Scene {
        width: 400
        height: 400
        content: [
            Rectangle {
                x: 0, y: 0
                width: 100, height: 100
                fill: Color.BLUE
                stroke: Color.BLACK
                transforms: [
                    Transform.translate(100,100),
                    Transform.rotate(90, 20, 30)
                ]
            }
        ]
    }
}
```

sequence of transformations

Transformations

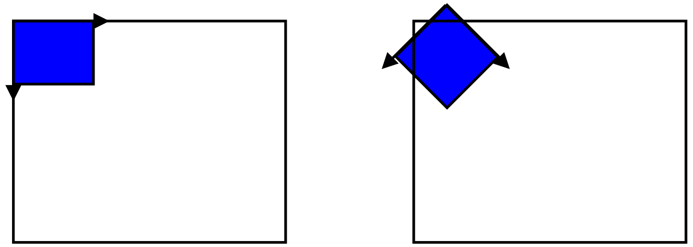
some examples 1

- Transform.rotate(angle,x,y) rotates clockwise around a pivot point



```
...
transforms: [
    Transform.rotate(45, 0, 0)
]
...
```

rotate 45° clockwise
around 0,0



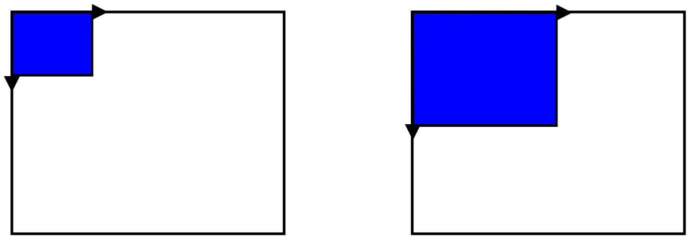
```
...
transforms: [
    Transform.rotate(45, 50, 50)
]
...
```

around the center
(if rectangle is 100x100px)

Transformations

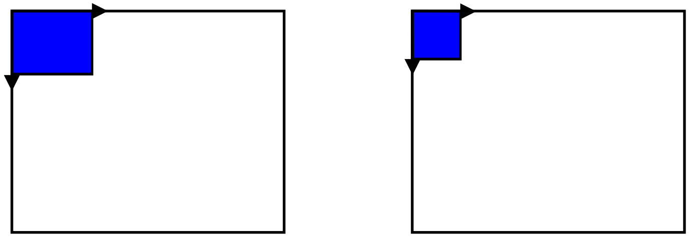
some examples 2

- Transform.scale(xfactor,yfactor) scales the node’s axes



```
...
transforms: [
    Transform.scale(2.0, 2.0)
]
...
```

scale 200%

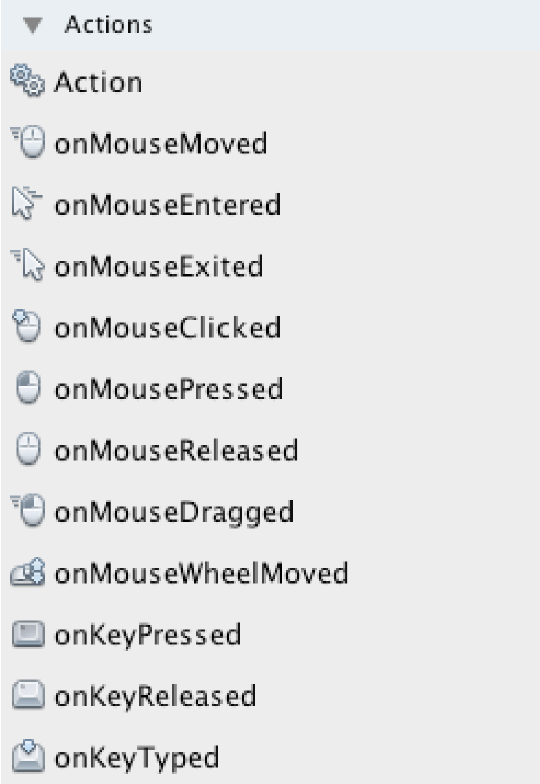


```
...
transforms: [
    Transform.scale(0.50, 0.50)
]
...
```

scale 50%

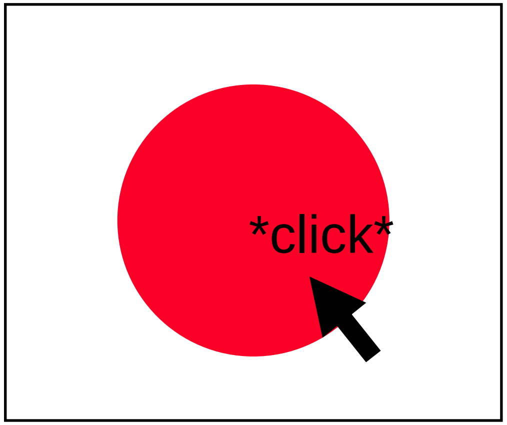
Interaction with Nodes

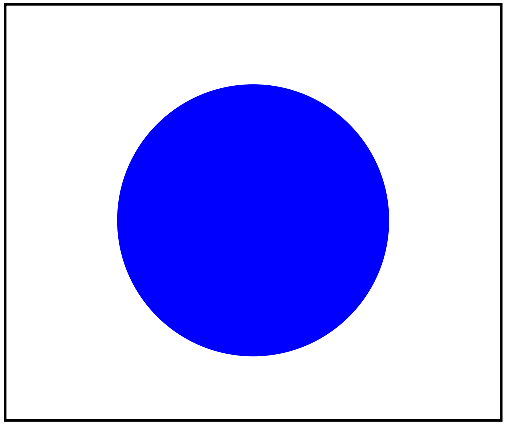
- Nodes can receive mouse and keyboard events
- Depending on the node, different events might be available
- Instance variables map to event related functions
- Events include (but are not limited to):
  - onKeyPressed
  - onKeyReleased
  - onMouseClicked
  - onMouseDragged
  - onMouseMoved
  - onMouseReleased
  - onMouseWheelMoved
  - etc.



Interaction with Nodes

example1: clicking a node





```
Stage {
    title : "Clicking a Node"
    scene: Scene {
        width: 400
        height: 400
        content: [
            Circle {
                centerX: 100, centerY: 100
                radius: 40
                fill: Color.RED
                onMouseClicked: function( e: MouseEvent ):Void {
                    (e.node as Circle).fill = Color.BLUE; // type casting
                }
            }
        ]
    }
}
```

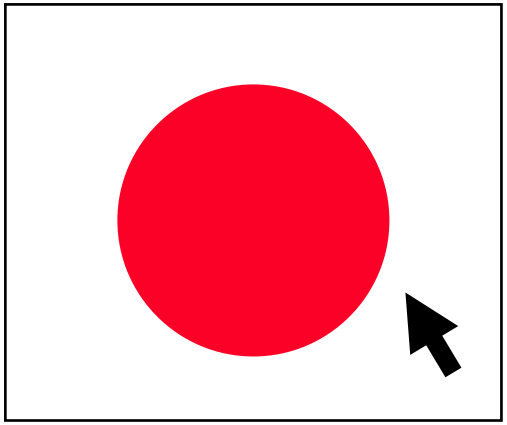
function assigned to instance variable onMouseClicked

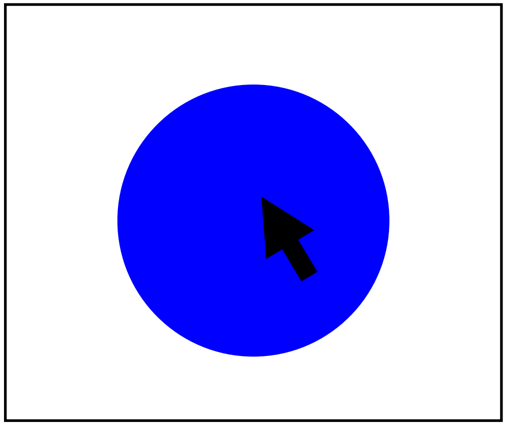
JavaFX type casting: (object as object)

Interaction with Nodes

example2: entering an Element

Attention: Desktop Profile only!





```
Stage {
    title : "Hovering a Node"
    scene: Scene {
        width: 200
        height: 200
        content: [
            Circle {
                centerX: 100, centerY: 100
                radius: 40
                fill: Color.RED
                onMouseEntered: function( e: MouseEvent ):Void {
                    (e.node as Circle).fill = Color.BLUE;
                }

                onMouseExited: function( e: MouseEvent ):Void {
                    (e.node as Circle).fill = Color.RED;
                }
            }
        ]
    }
}
```

Interaction with Nodes

example3: simple node dragging

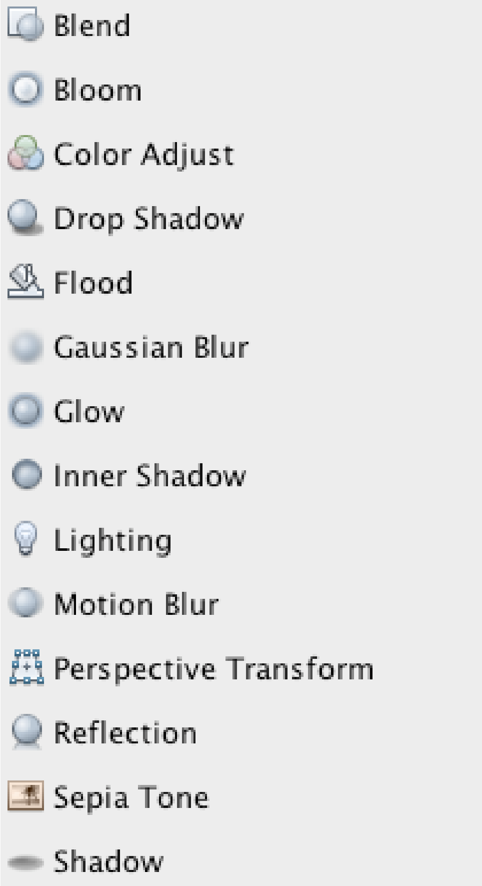
```
var xOffset:Number = 0;
var yOffset:Number = 0;
Stage {
    title : "Dragging a Node"
    scene: Scene {
        width: 200
        height: 200
        content: [
            Circle {
                centerX: 100, centerY: 100
                radius: 40
                fill: Color.RED
                onMousePressed: function( e: MouseEvent ):Void {
                    def cur_circle = (e.node as Circle);
                    xOffset = e.sceneX - cur_circle.centerX;
                    yOffset = e.sceneY - cur_circle.centerY;
                }

                onMouseDragged: function( e: MouseEvent ):Void {
                   def cur_circle = (e.node as Circle);
                   cur_circle.centerX = e.sceneX - xOffset;
                   cur_circle.centerY = e.sceneY - yOffset;
                }
            }
        ]
    }
}
```

when the circle is pressed, calculate the offset

while dragging the circle, recalculate its center

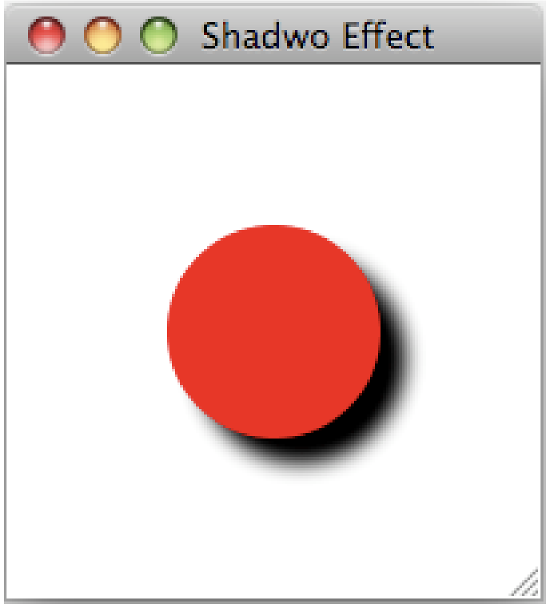
Effects

- Attention: desktop profile only
- Effects are applied to nodes using the effect variable
- Effects include:
  - Blend
  - Bloom
  - Shadow
  - Glow
  - Gaussian Blur
  - Reflection
  - Etc.



Effects

example1: shadow

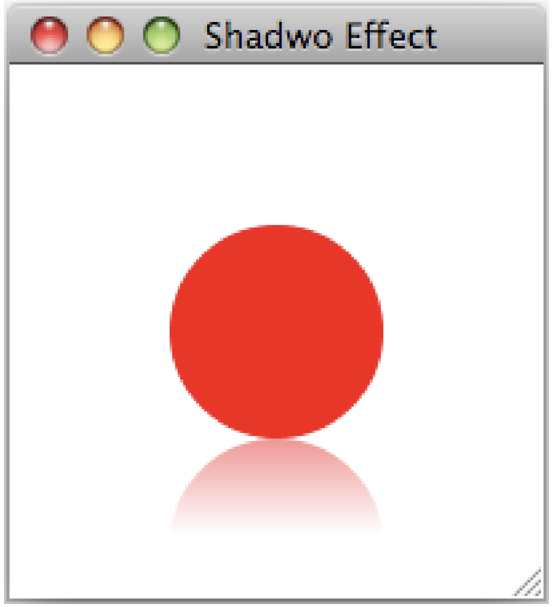


```
Stage {
    title : "Shadow Effect"
    scene: Scene {
        width: 400
        height: 400
        content: [
            Circle {
                centerX: 100, centerY: 100
                radius: 40
                fill: Color.RED
                effect: DropShadow {
                        offsetX: 10
                        offsetY: 10
                        color: Color.BLACK
                        radius: 10
                    }

            }
        ]
    }
}
```

adding the DrowpShadow effect to the Circle node.

Effects

example2: Reflection

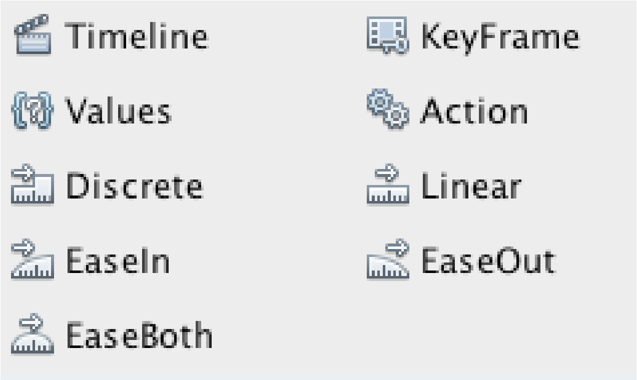


```
Stage {
    title : "Shadow Effect"
    scene: Scene {
       width: 400
       height: 400
       content: [
          Circle {
             centerX: 100, centerY: 100
             radius: 40
             fill: Color.RED
             effect: Reflection {
                   fraction: 0.45
                   topOffset: 0.0
                   topOpacity: 0.5
                   bottomOpacity: 0.0
                }
          }
       ]
    }
 }
```

adding the Reflection effect to the Circle node.

Animation

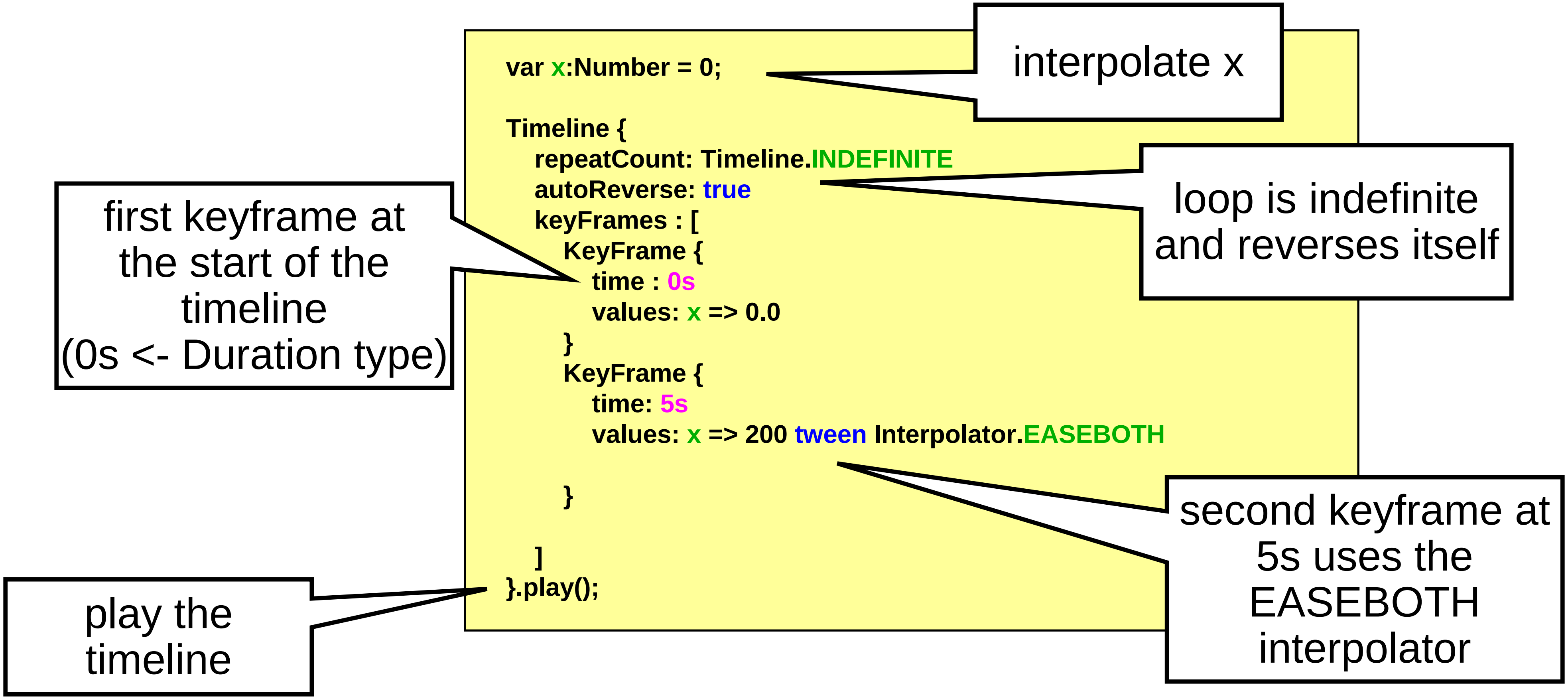
- JavaFX support the keyframe concept
- That is, animations are defined by so called keyframes
- Other values are interpolated



Animation

creating a timeline

- To animate an object, a Timeline is needed
- Within the Timeline, Keyframes are defined



```
var x:Number = 0;

Timeline {
    repeatCount: Timeline.INDEFINITE
    autoReverse: true
    keyFrames : [
        KeyFrame {
            time : 0s
            values: x => 0.0
        }
        KeyFrame {
            time: 5s
            values: x => 200 tween Interpolator.EASEBOTH

        }

    ]
}.play();
```

interpolate x

loop is indefinite
and reverses itself

first keyframe at
the start of the
timeline
(0s <- Duration type)

second keyframe at
5s uses the
EASEBOTH
interpolator

play the
timeline

Animation

binding to the animated value

- The interpolated variable can be used like any other variable

```
Stage {
    title : "First Animation"
    scene: Scene {
        width: 200
        height: 200
        content: [
            Circle {
                centerX: bind x
                centerY: 100
                radius: 40
                fill: Color.RED
            }
        ]
    }
}
```

bind to the interpolated variable

Animation

Interpolators

- Discrete: no interpolation, value “jumps” directly to the keyframe value
- Linear: linear interpolation
- EaseIn: interpolated values smaller at the beginning then linear
- EaseOut: smaller in the end
- EaseBoth: EaseIn + EaseOut

Useful Links

- JavaFX Language References
  http://openjfx.java.sun.com/current-build/doc/reference/JavaFXReference.html
- JavaFX Getting Started
  http://java.sun.com/javafx/1/tutorials/core/getStarted/
- The JavaFX UI Tutorial
  http://java.sun.com/javafx/1/tutorials/ui/index.html
- JavaFX API
  http://java.sun.com/javafx/1.2/docs/api/