

Einführung in eXtensible 3D (X3D)

Von

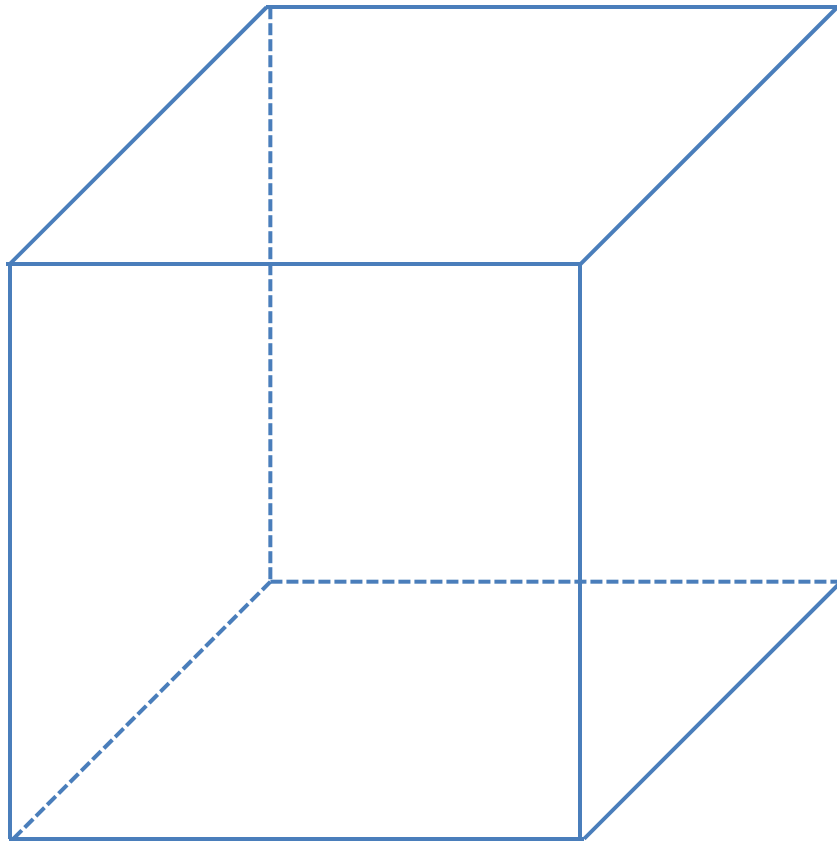
Jan-Martin Kirves

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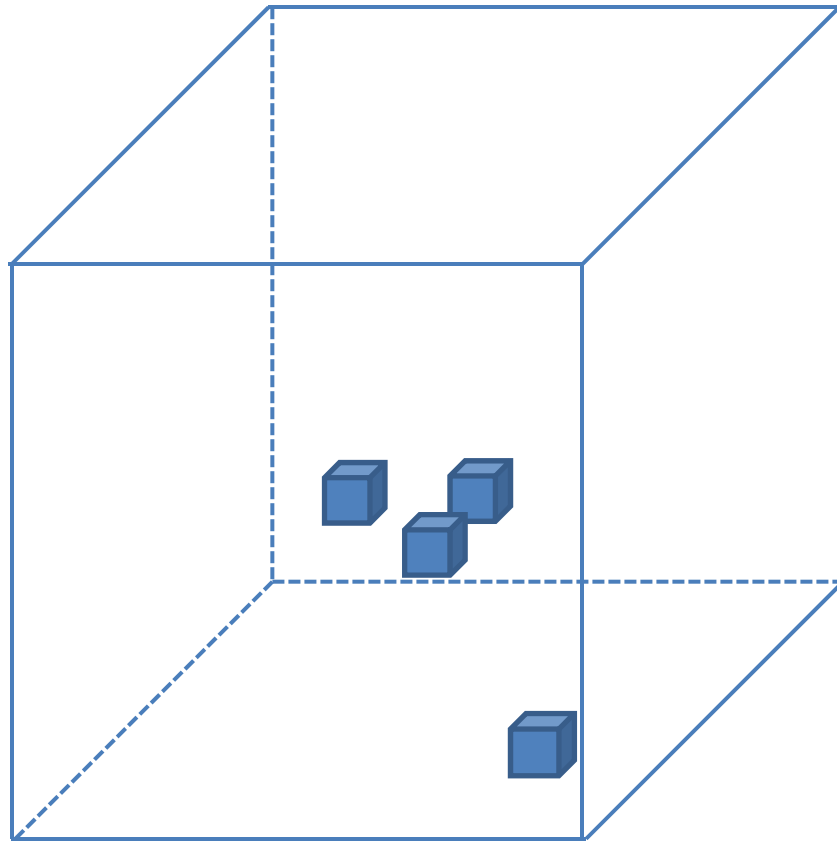
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- Was ist X3D
- Tools
 - Blender
 - VTK
 - Sonstige Tools
 - X3DOM
- X3D Einführung
 - Grundaufbau und HTML Einbindung
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 - Komplexe Geometrie und Texturen
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- X3DOM und JavaScript
- X3D und XSLT
- X3D und Xpath
- VTK Viewer
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- Links und Quellen

3D Darstellung im Allgemeinen

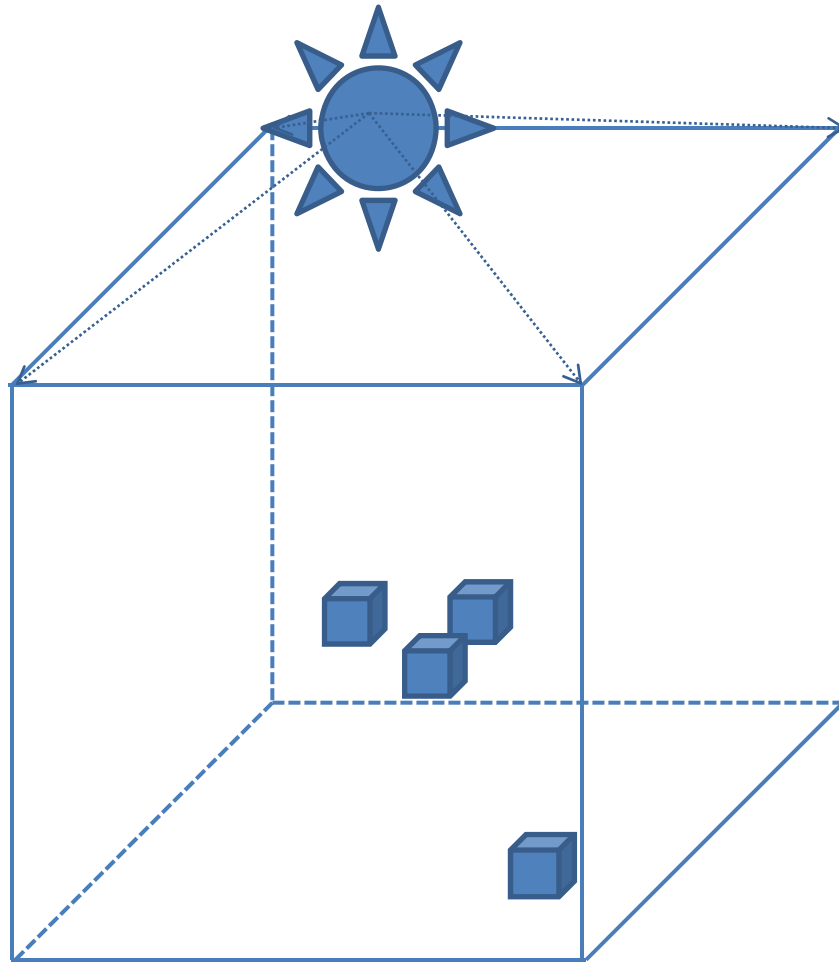
3D Darstellung im Allgemeinen



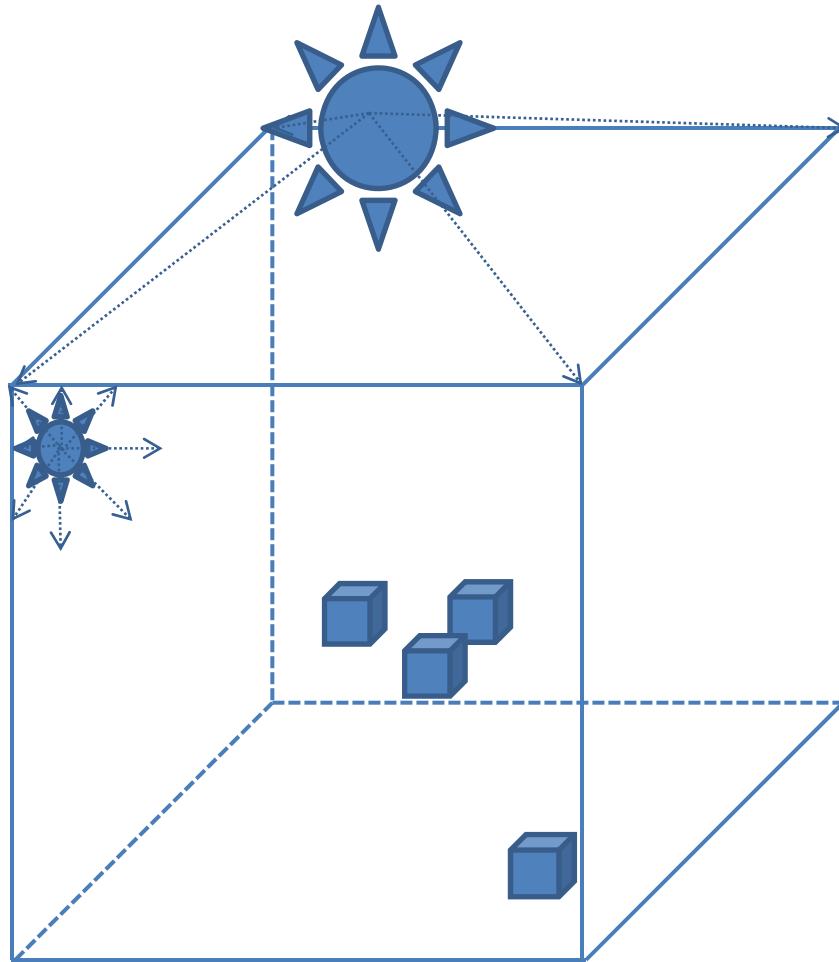
3D Darstellung im Allgemeinen



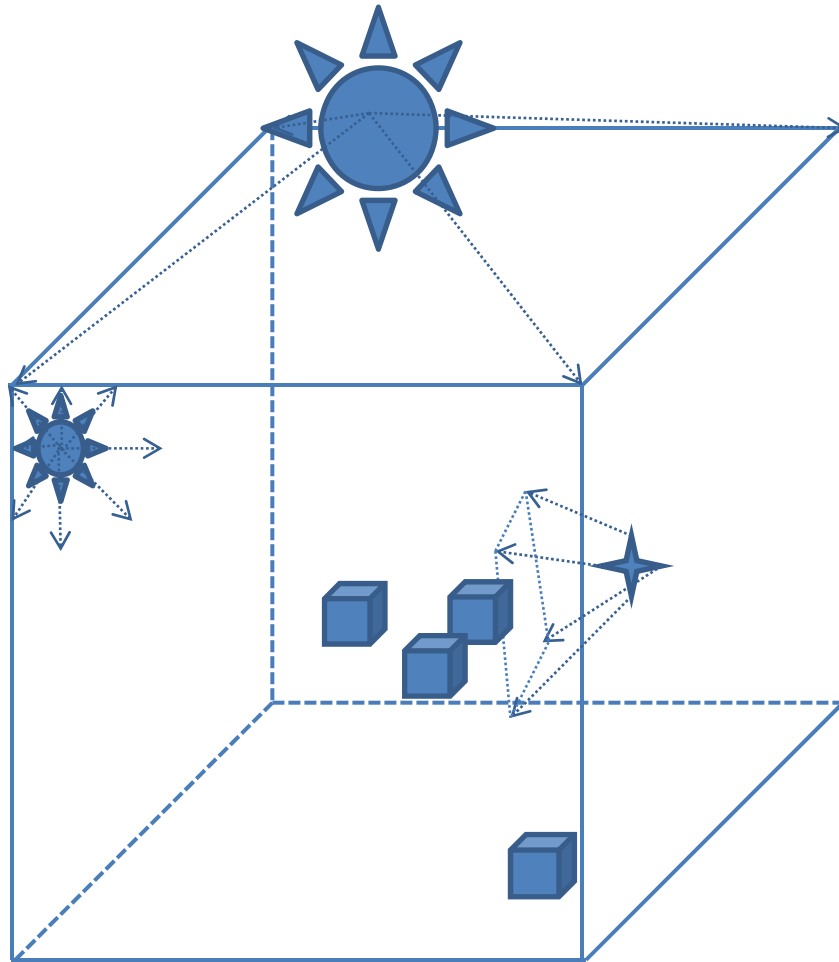
3D Darstellung im Allgemeinen



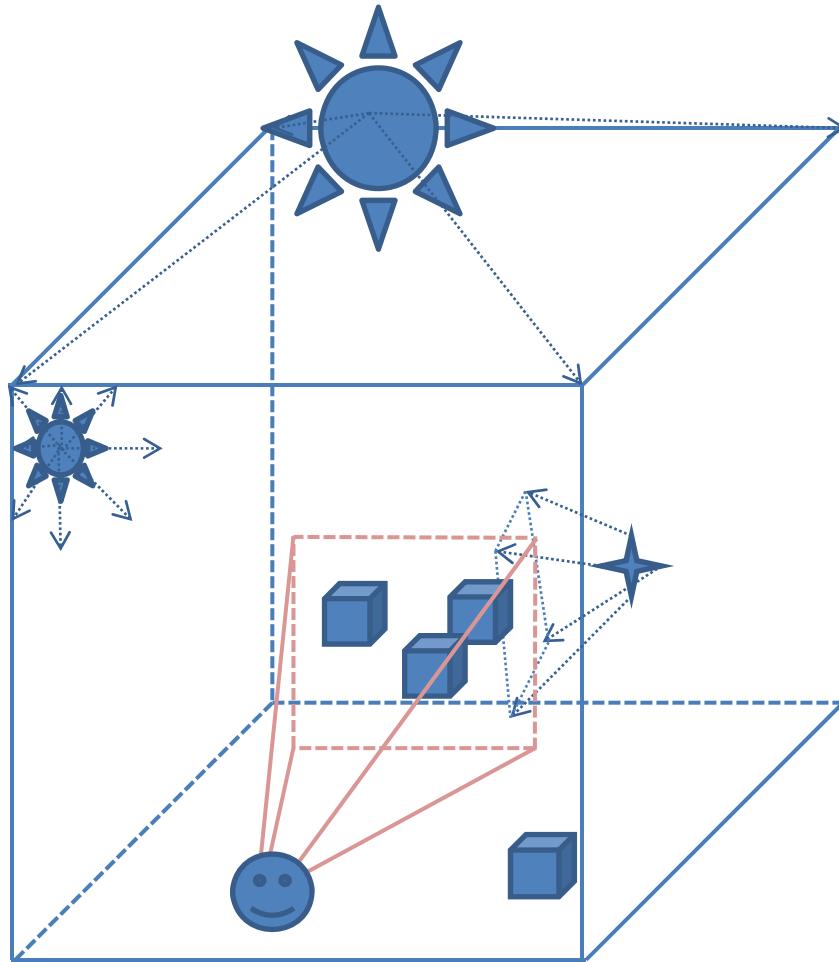
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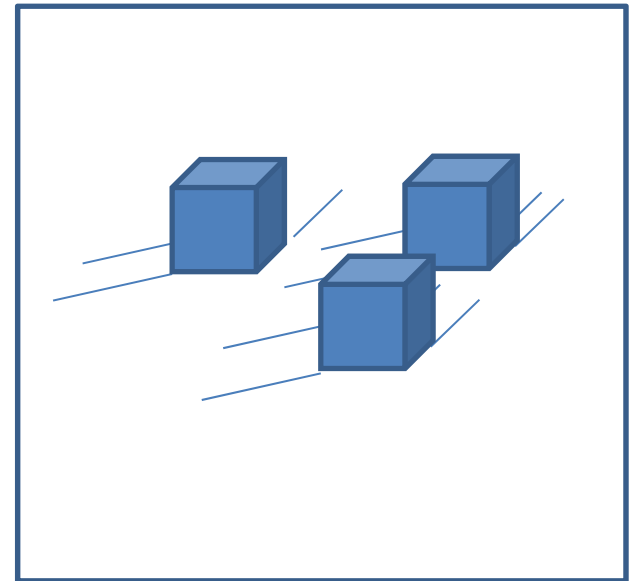
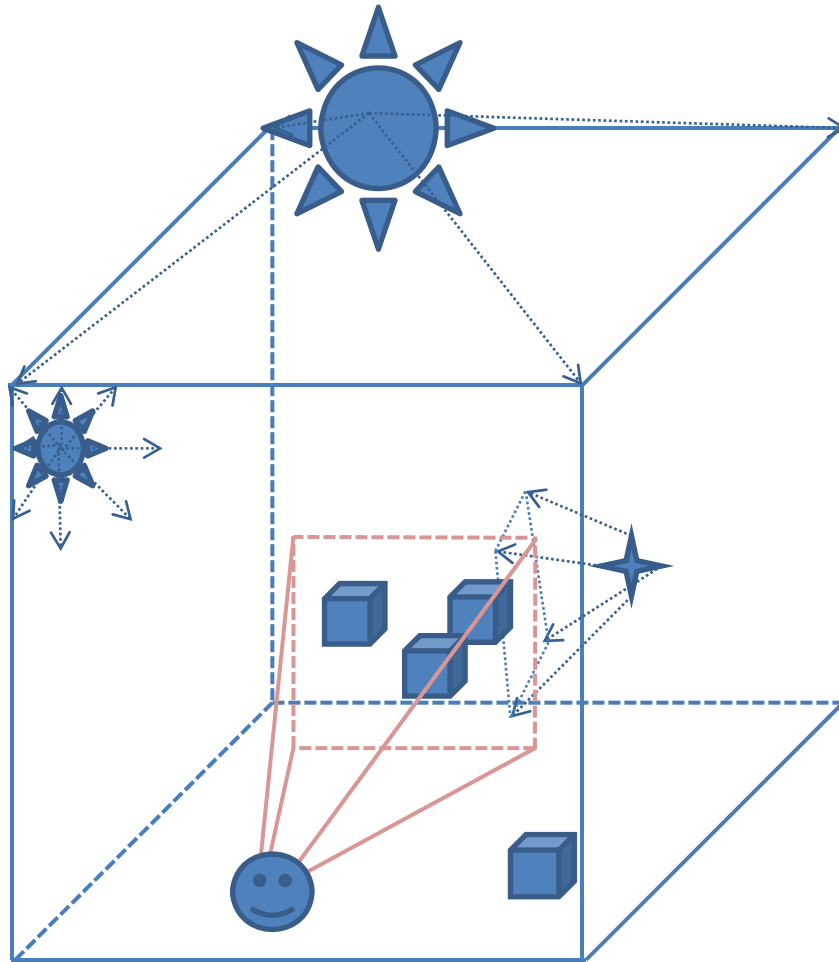
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- Beschreibungssprache für 3D Modelle

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- Weiterentwicklung von VRML

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- Beschreibungssprache für 3D Modelle
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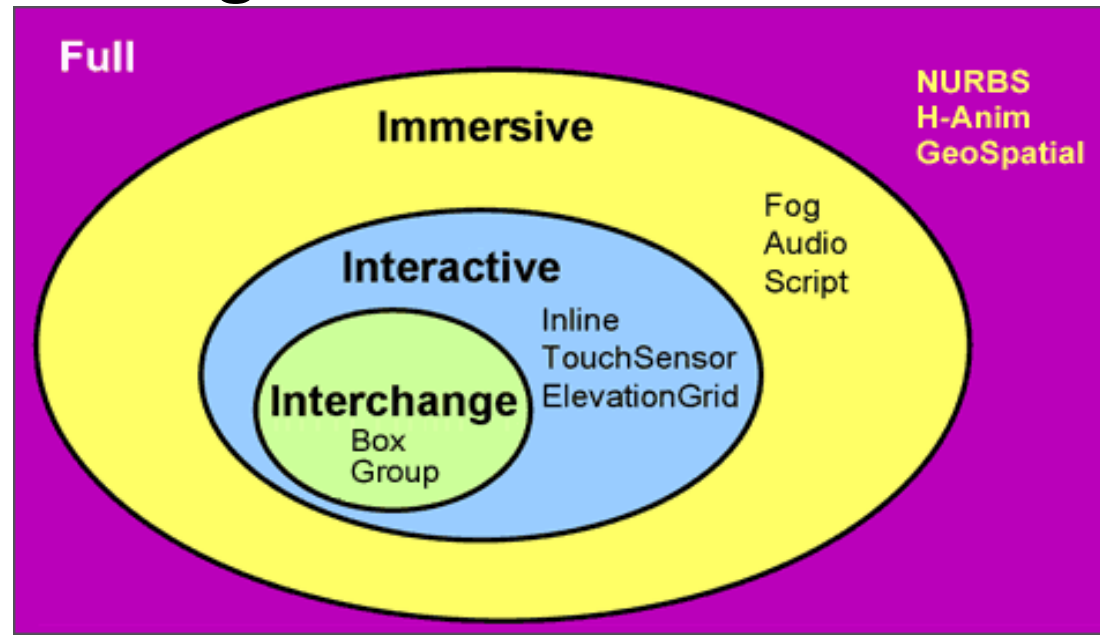
- Beschreibungssprache für 3D Modelle
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- 3D Content Beschreibung und Austausch

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- Beschreibungssprache für 3D Modelle
- Weiterentwicklung von VRML
- Offener ISO-Standard seit 2004
- 3D Content Beschreibung und Austausch
- Human-readable

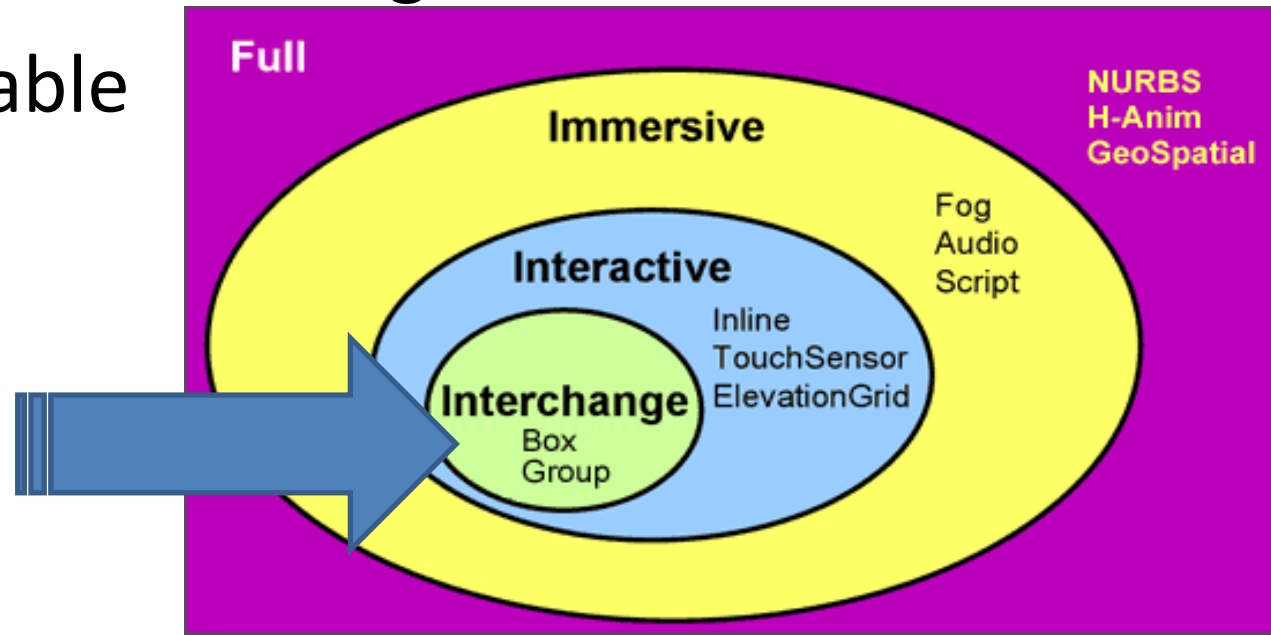
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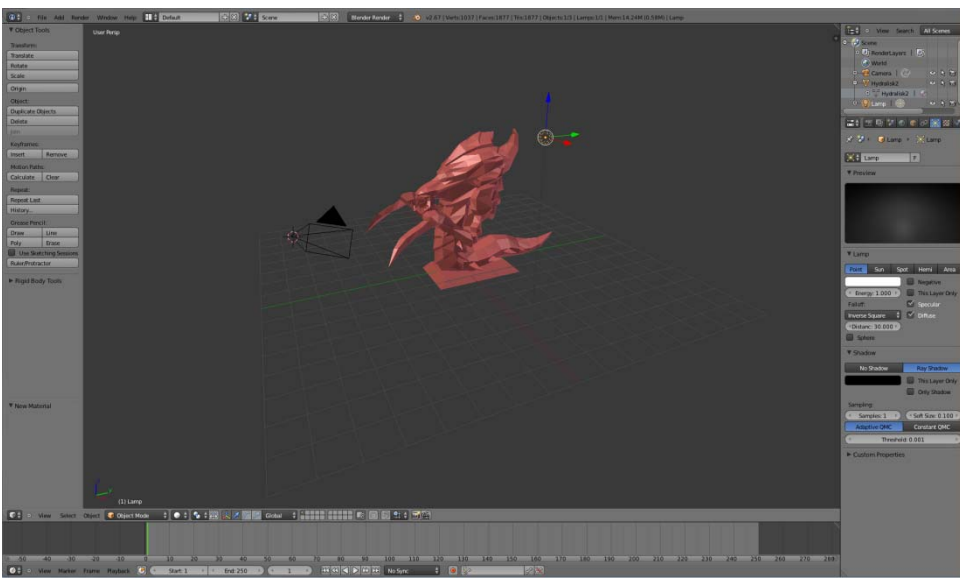
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Blender

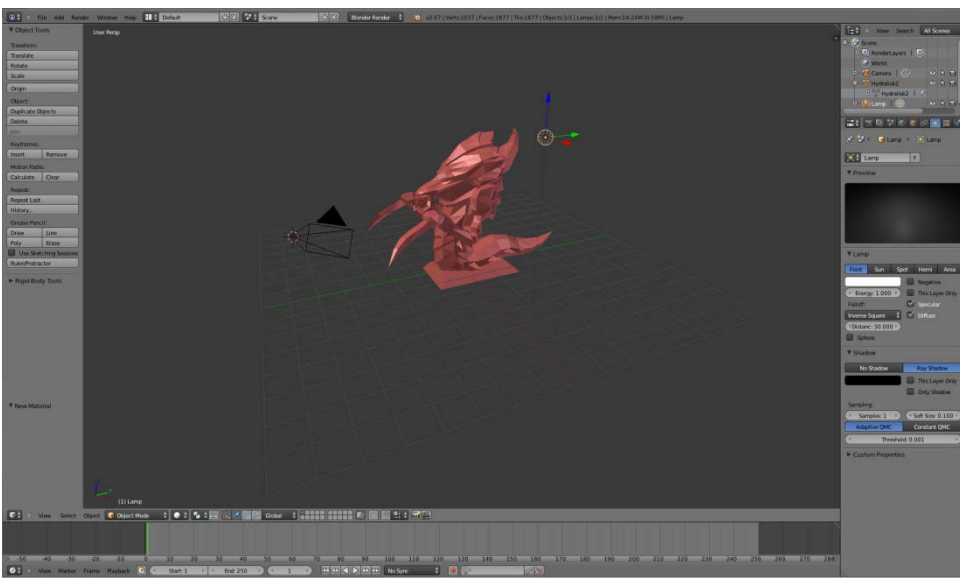
Blender

- Äußerst mächtiges 3D Modellierungswerkzeug



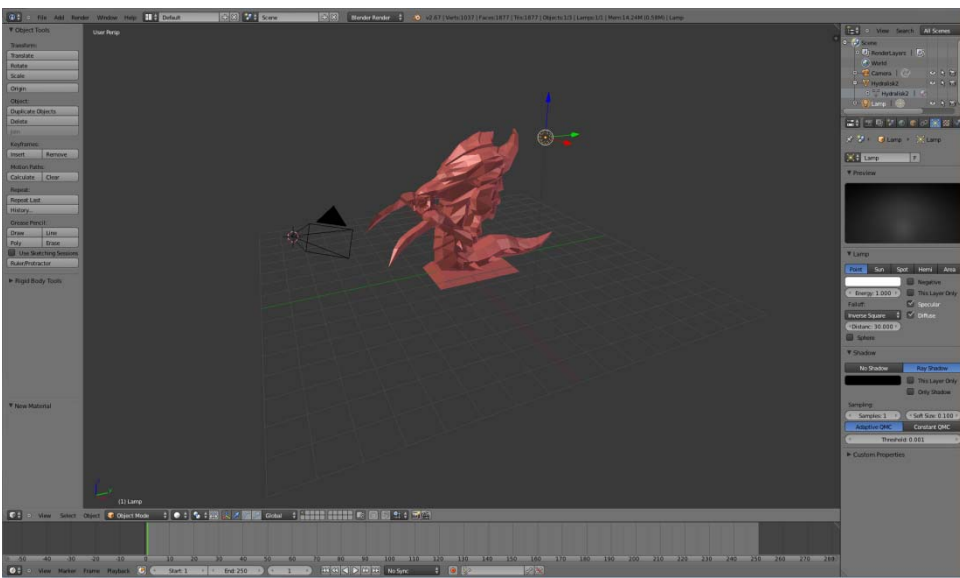
Blender

- Äußerst mächtiges 3D Modellierungswerkzeug
- Frei verfügbar

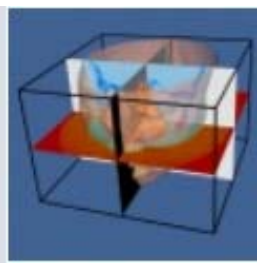
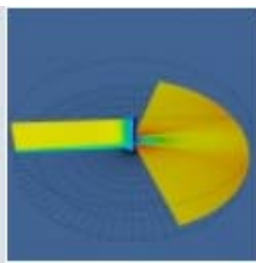
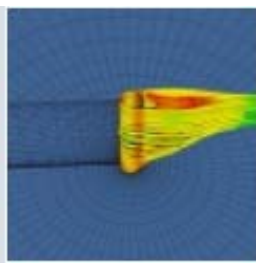
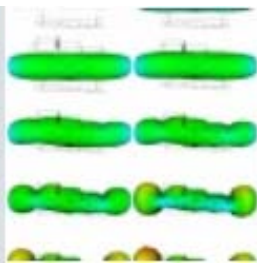
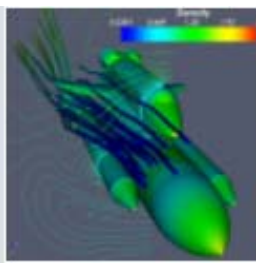
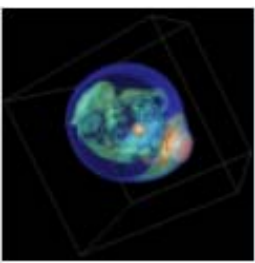


Blender

- Äußerst mächtiges 3D Modellierungswerkzeug
- Frei verfügbar
- Nativer X3D Im-/Export

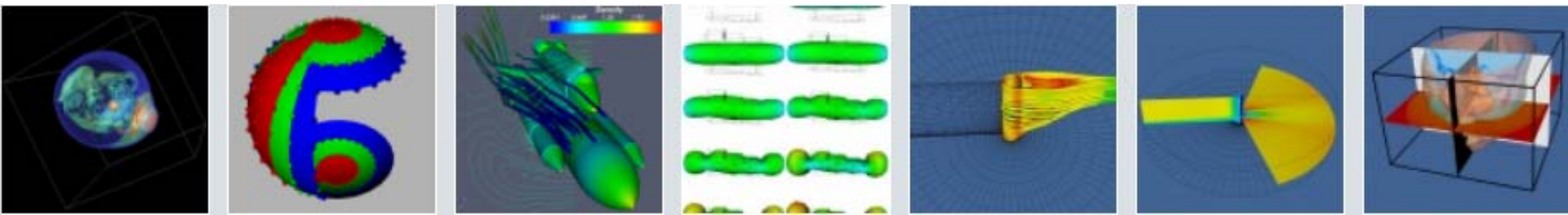


VTK



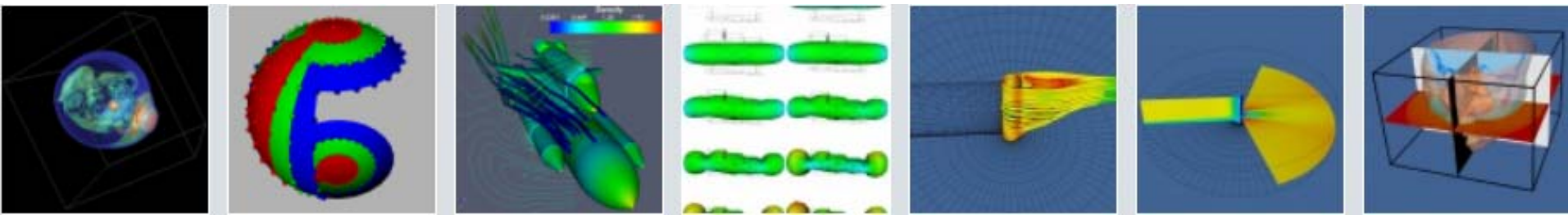
VTK

- Opensource C++ toolkit



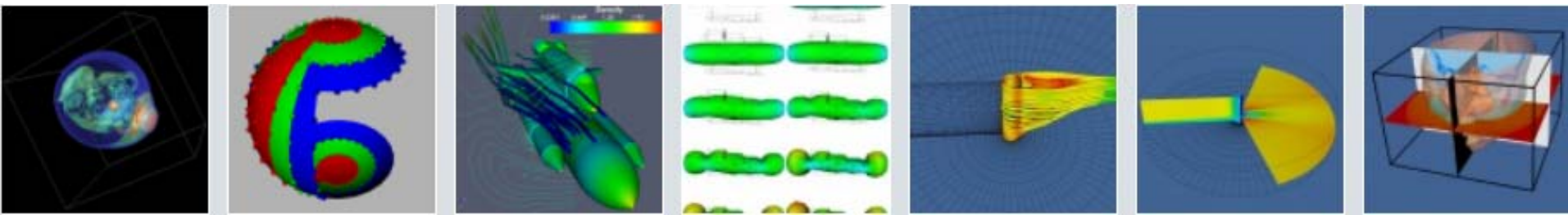
VTK

- Opensource C++ toolkit
- Nutzt intern OpenGL



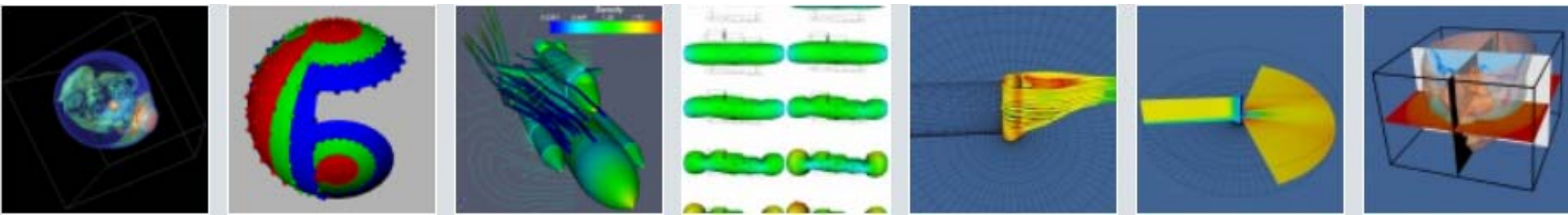
VTK

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- Nutzt intern OpenGL
- Sehr viele Algorithmen vorhanden



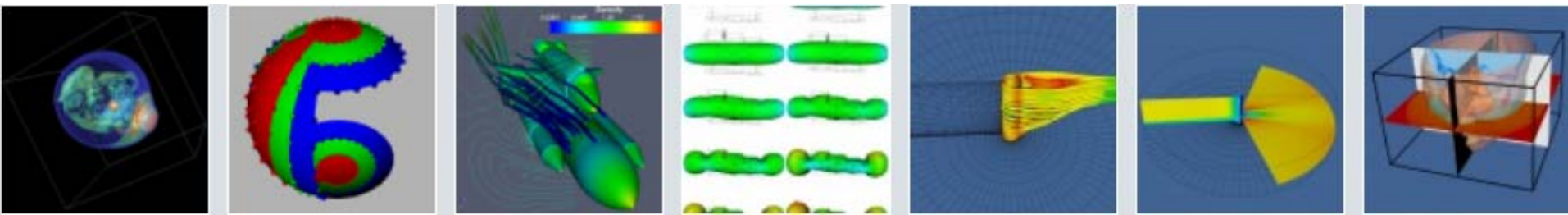
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- Nutzt intern OpenGL
- Sehr viele Algorithmen vorhanden
- Wrapping für Java, Python und Tcl vorhanden



VTK

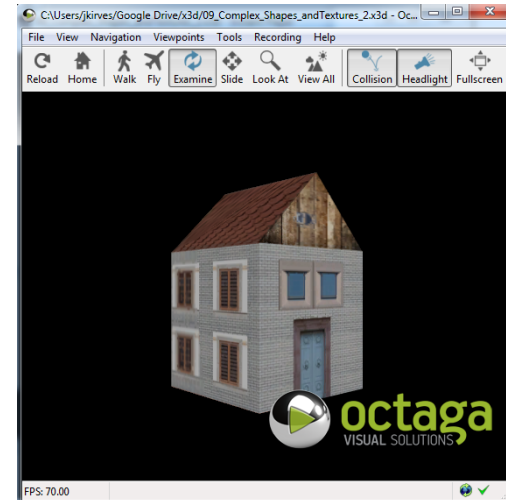
- Opensource C++ toolkit
- Nutzt intern OpenGL
- Sehr viele Algorithmen vorhanden
- Wrapping für Java, Python und Tcl vorhanden
- Export Modul nach X3D



Sonstige Tools

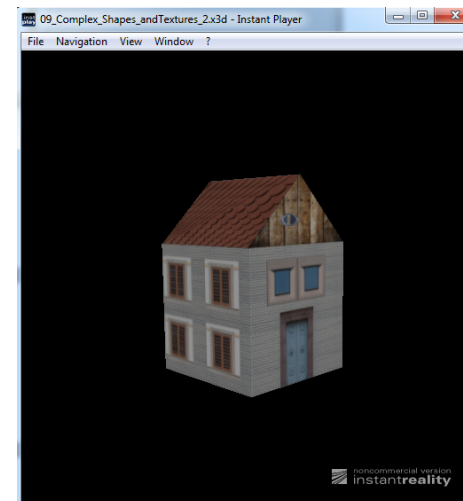
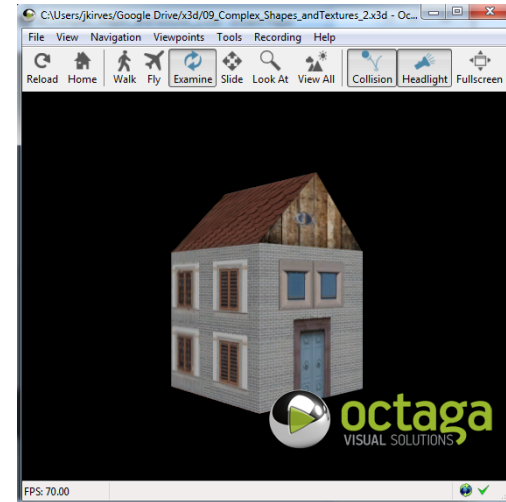
Sonstige Tools

- Octaga Player
 - Plugin für Browser
 - Kommerziell
 - Freie Version verfügbar



Sonstige Tools

- Octaga Player
 - Plugin für Browser
 - Kommerziell
 - Freie Version verfügbar
- Instantreality, Instant Player
 - Stand alone player
 - Frei verfügbar, vom Fraunhofer Institut




x3dom



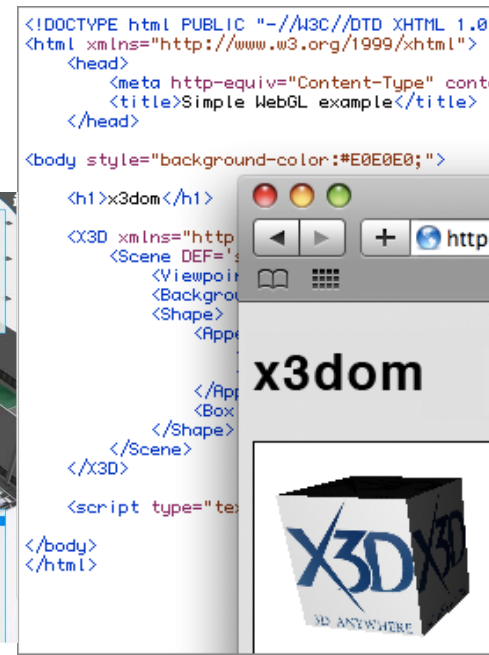
```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <meta http-equiv="Content-Type" cont
    <title>Simple WebGL example</title>
  </head>
  <body style="background-color:#E0E0E0;">
    <h1>x3dom</h1>
    <X3D xmlns="http
      <Scene DEF='s
        <Viewpoi
        <Backgro
        <Shape>
        <App
      </App
        <Box
      </Shape>
    </Scene>
  </X3D>
  <script type="tes
</body>
</html>
```

x3dom



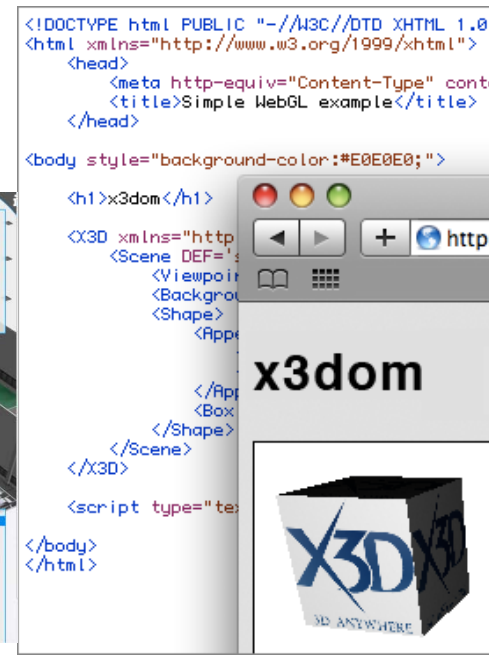
x3dom

- Opensource Framework für Webbrowser



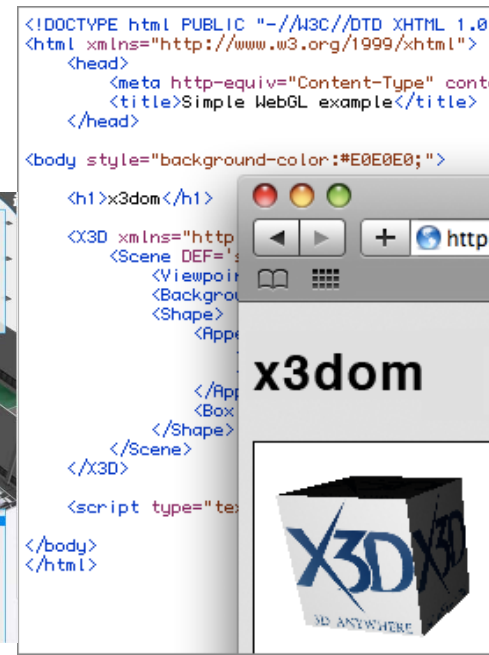
x3dom

- Opensource Framework für Webbrowser
- JavaScript und Flash Support



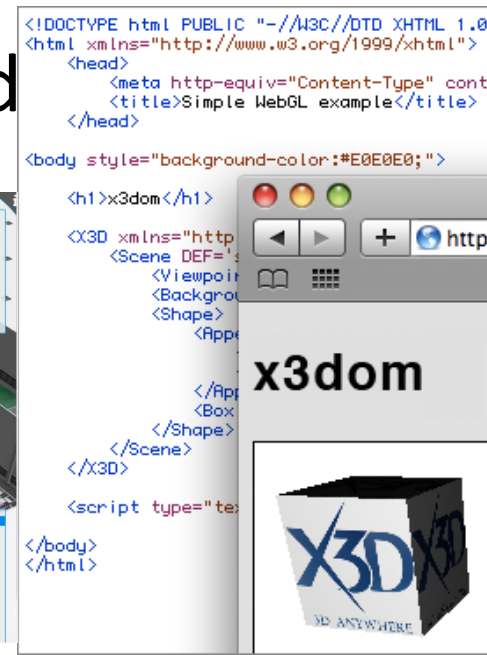
x3dom

- Opensource Framework für Webbrowser
- JavaScript und Flash Support
- Erlaubt das Einbinden von X3D Inhalten in jeden HTML5 DOM



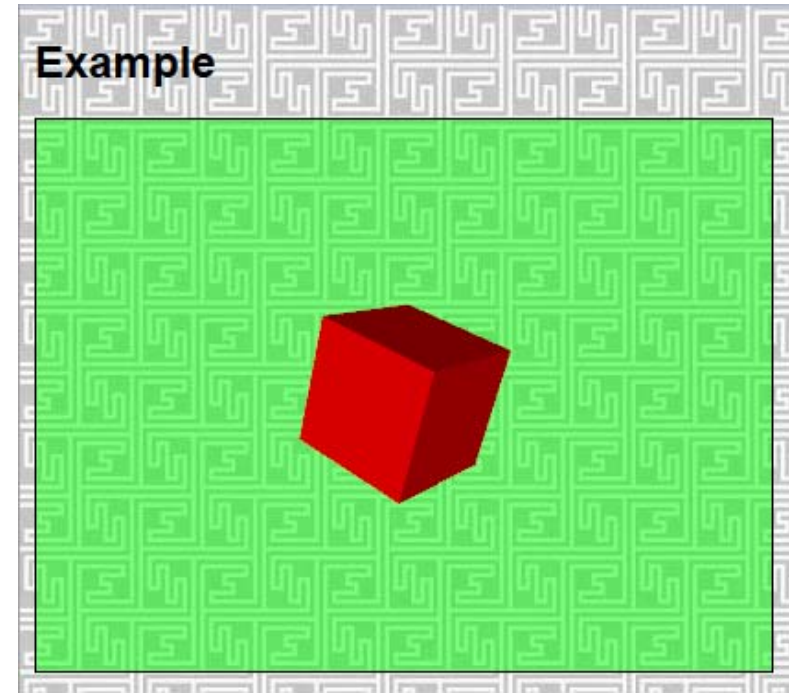
x3dom

- Opensource Framework für Webbrowser
- JavaScript und Flash Support
- Erlaubt das Einbinden von X3D Inhalten in jeden HTML5 DOM
- Nur Zwei Dateien notwendig für X3D im Browser



Grundaufbau und HTML Einbindung

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <title>X3D Examples</title>
    <link rel="stylesheet" type="text/css" href="x3dom.css" />
    <script type="text/javascript" src="x3dom.js"></script>
  </head>
  <body style="background-color:#E0E0E0; background-image:url(background.png);">
    <h1>Example</h1>
    <X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
      <scene>
        <Background DEF="bgnd" transparency="0.5" skyColor="0 1 0"/>
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <box></box>
        </shape>
      </scene>
    </X3D>
  </body>
</html>
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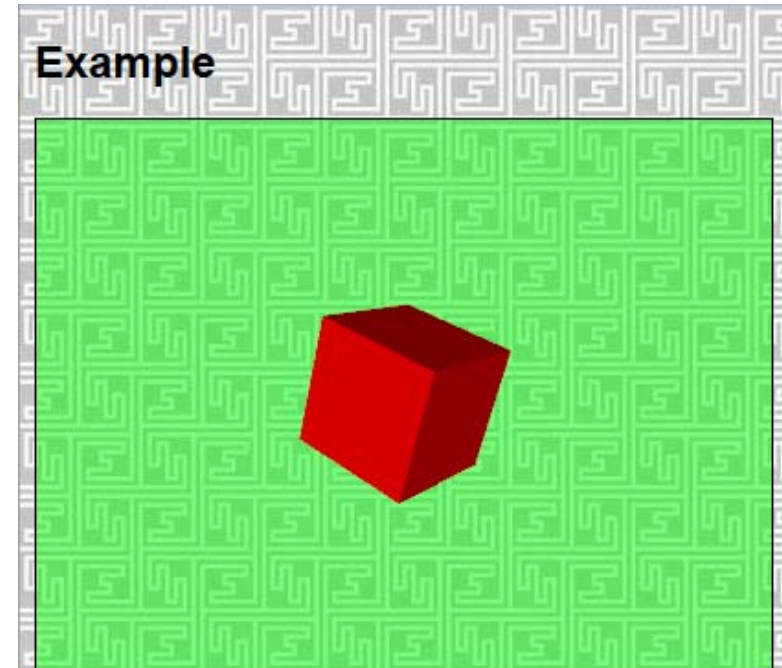
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Wichtig:

Um alle Features verfügbar zu haben:

- xhtml als Dateiformat nutzen
- X3d-namespace als xmlns verwenden



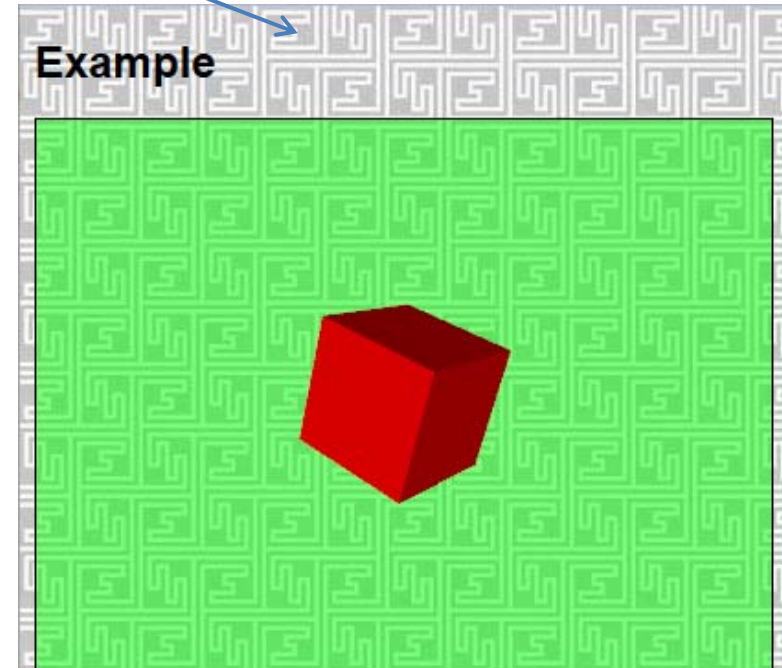
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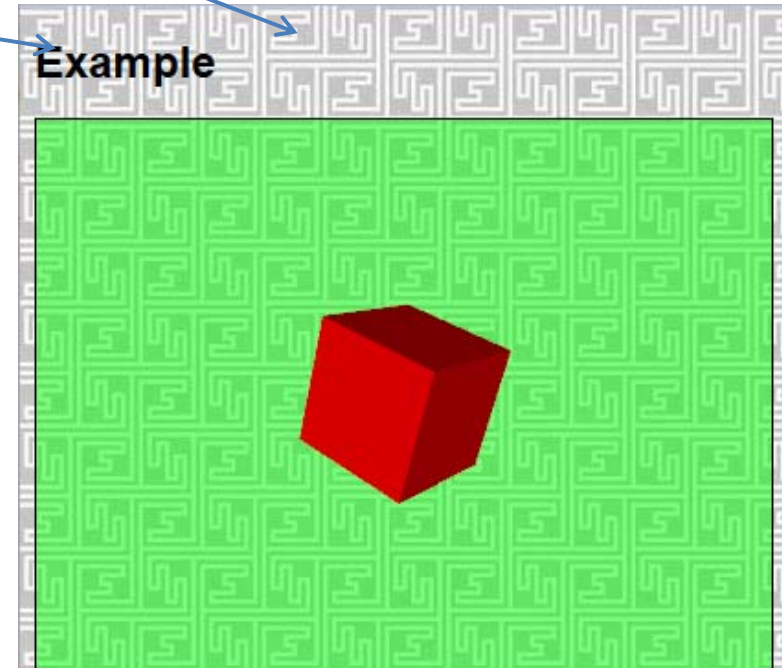
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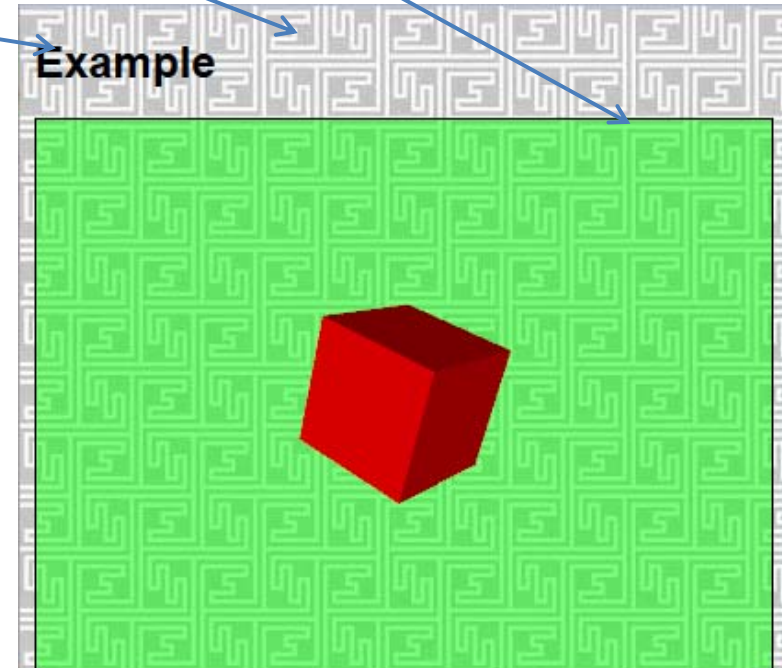
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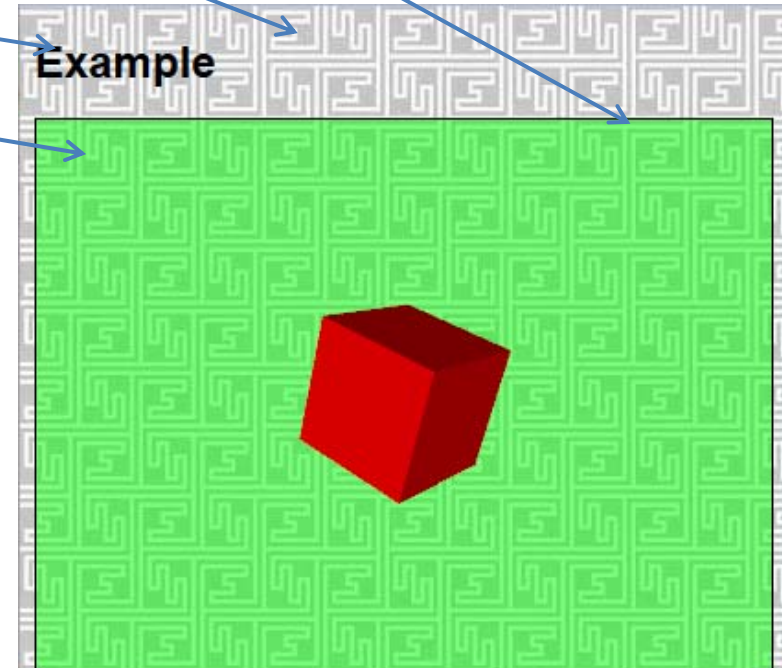
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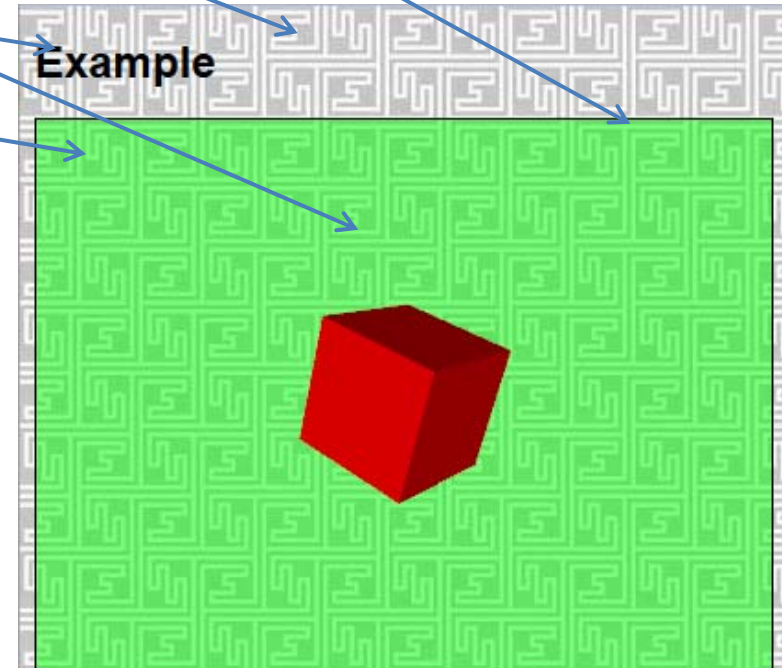
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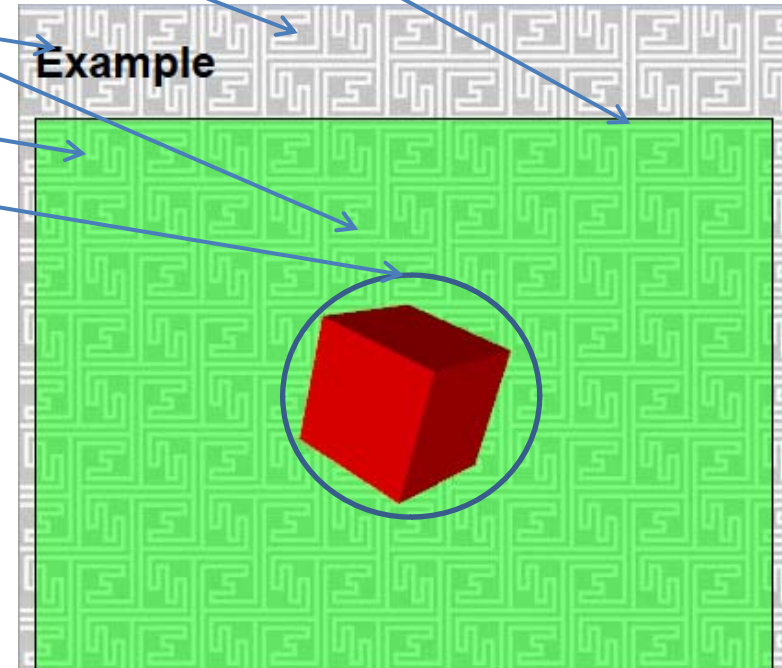
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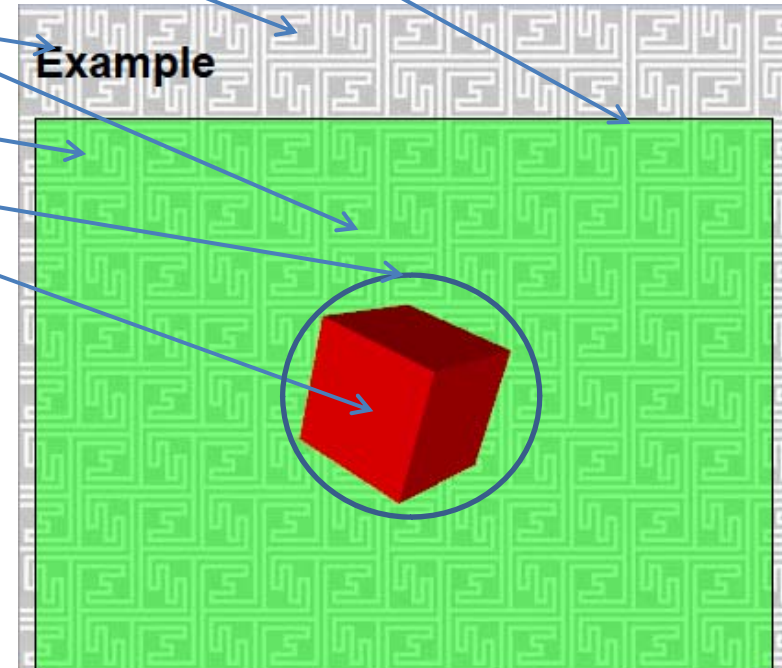
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</html>
```



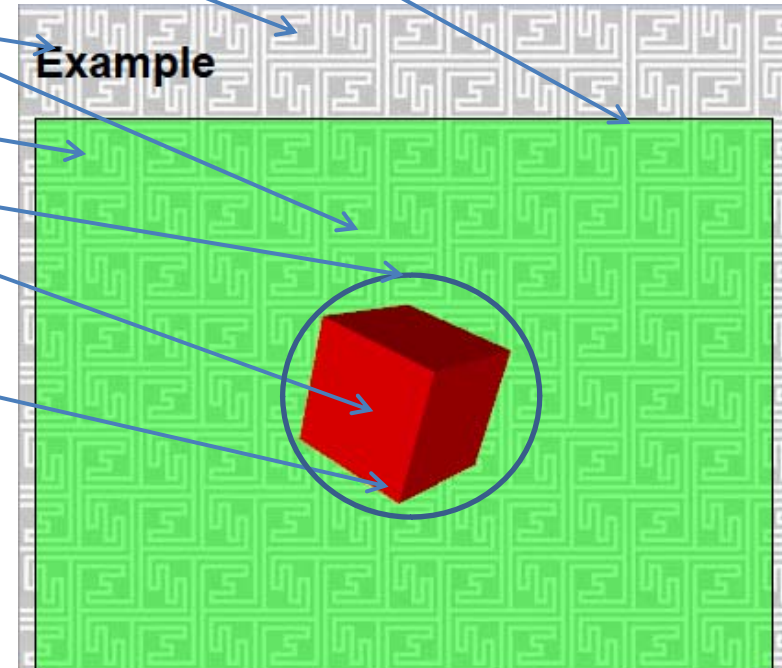
Wichtig:

Um alle Features verfügbar zu haben:

- xhtml als Dateiformat nutzen
- X3d-namespace als xmlns verwenden

Grundaufbau und HTML Einbindung

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <title>X3D Examples</title>
    <link rel="stylesheet" type="text/css" href="x3dom.css" />
    <script type="text/javascript" src="x3dom.js"></script>
  </head>
  <body style="background-color:#E0E0E0; background-image:url(background.png);">
    <h1>Example</h1>
    <X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
      <scene>
        <Background DEF="bgnd" transparency="0.5" skyColor="0 1 0"/>
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <box></box>
        </shape>
      </scene>
    </X3D>
  </body>
</html>
```



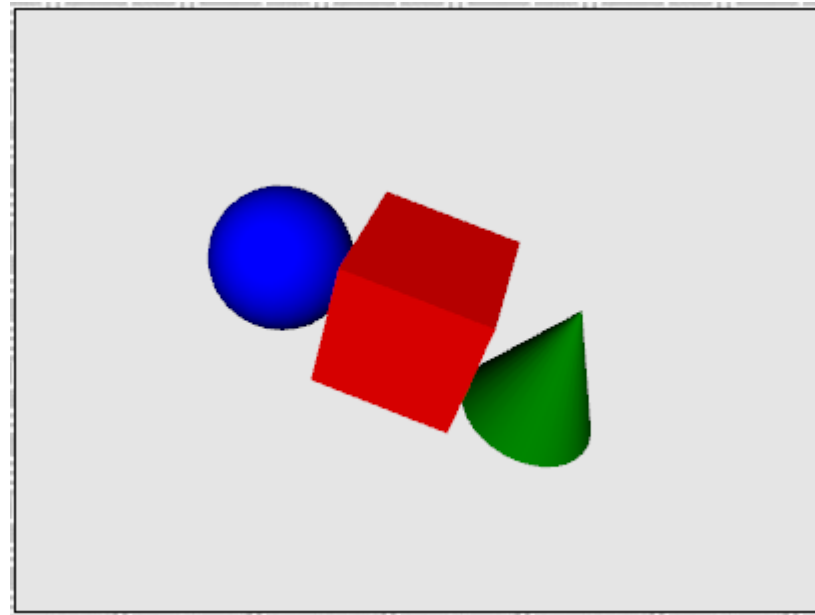
Wichtig:

Um alle Features verfügbar zu haben:

- xhtml als Dateiformat nutzen
- X3d-namespace als xmlns verwenden

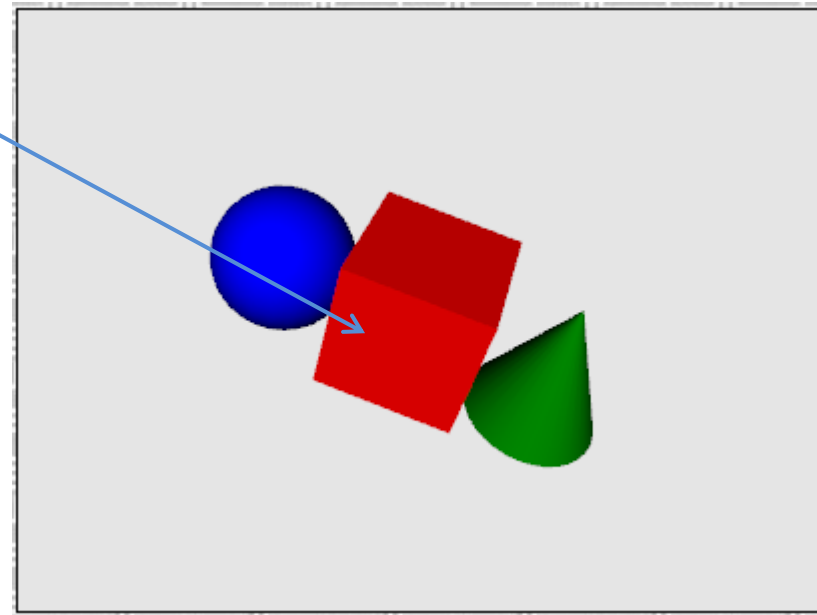
Einfache Formen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <shape>
      <appearance>
        <material diffuseColor='red'></material>
      </appearance>
      <box></box>
    </shape>
    <transform translation="-2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='blue'></material>
        </appearance>
        <sphere></sphere>
      </shape>
    </transform>
    <transform translation="2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



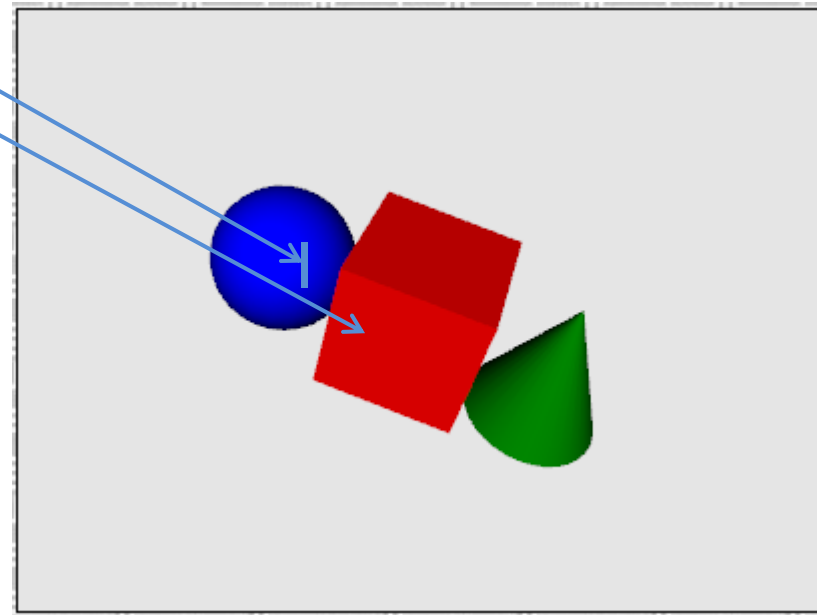
Einfache Formen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
    <transform translation=" 2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



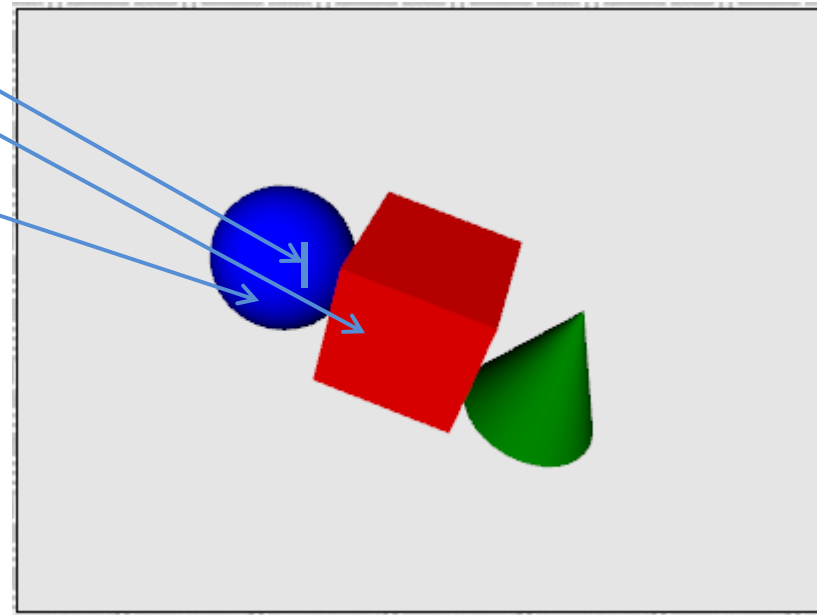
Einfache Formen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <shape>
      <appearance>
        <material diffuseColor='red'></material>
      </appearance>
      <box></box>
    </shape>
    <transform translation="-2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='blue'></material>
        </appearance>
        <sphere></sphere>
      </shape>
    </transform>
    <transform translation=" 2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



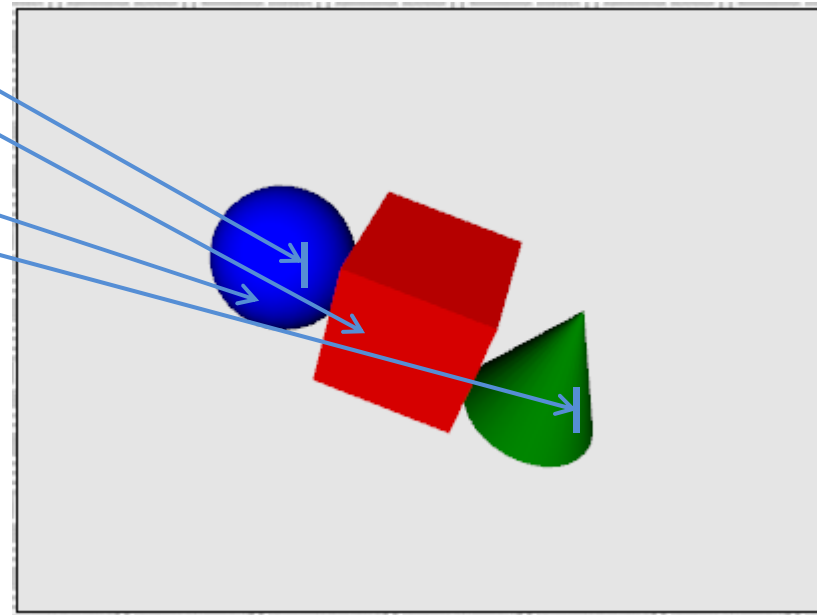
Einfache Formen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
    <transform translation=" 2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



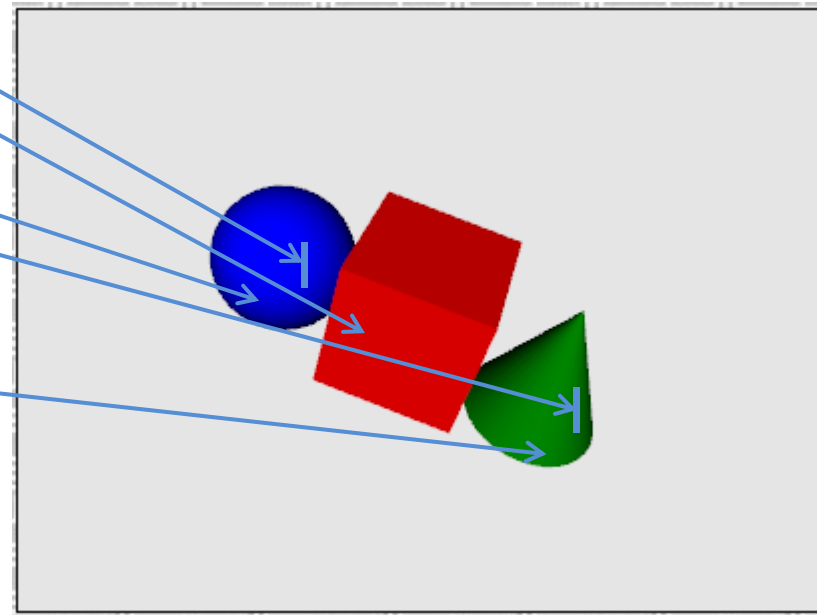
Einfache Formen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
    <transform translation=" 2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



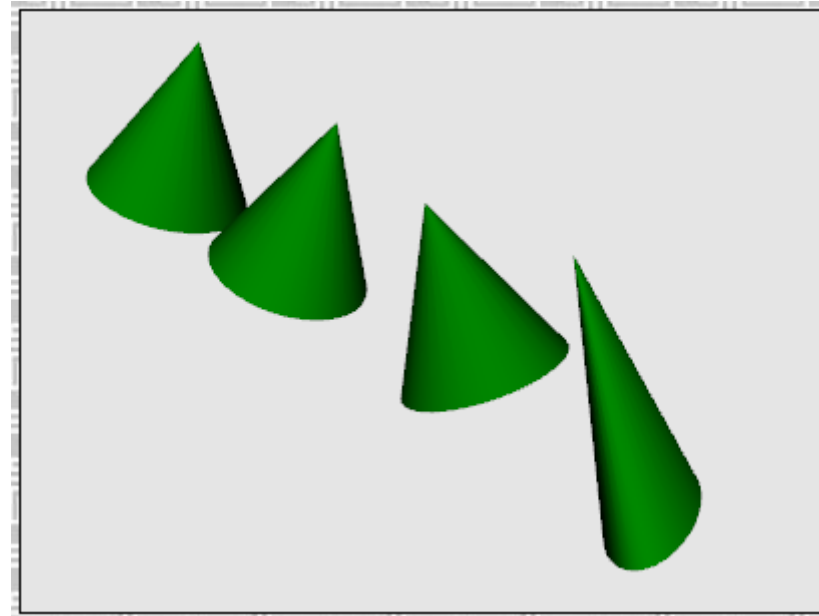
Einfache Formen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
    <transform translation=" 2 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



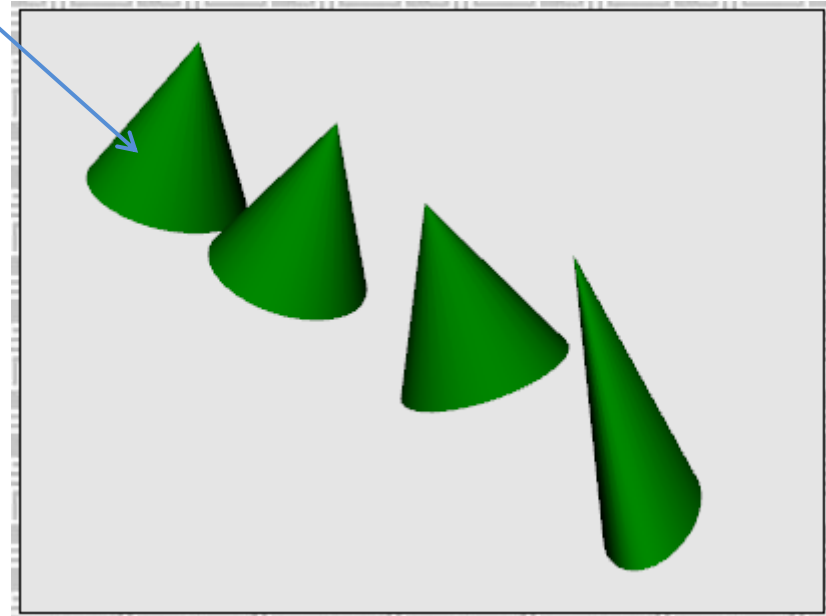
Transform

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0" rotation=" 0 0 1 0.785">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 6 0 0" rotation=" 0 0 1 0.785" scale="0.5 1.5 1">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



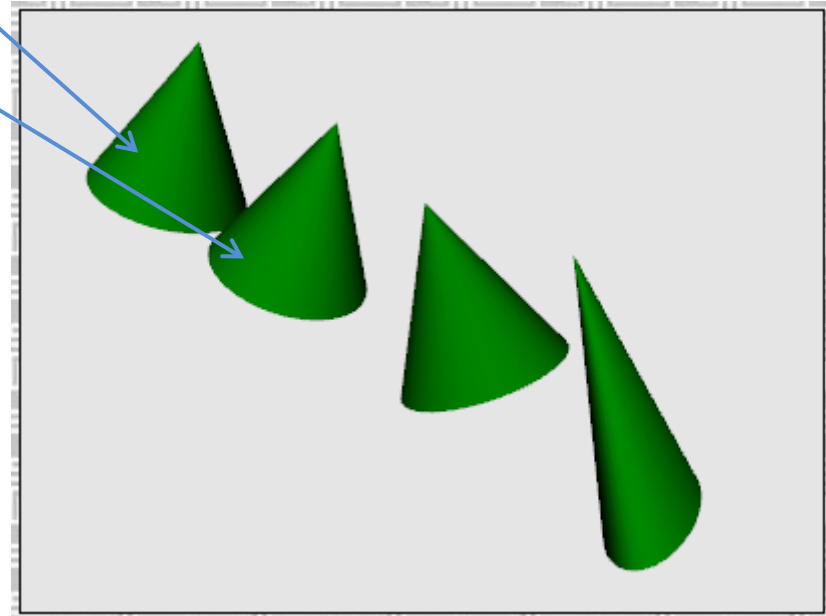
Transform

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="4 0 0" rotation="0 0 1 0.785">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="6 0 0" rotation="0 0 1 0.785" scale="0.5 1.5 1">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



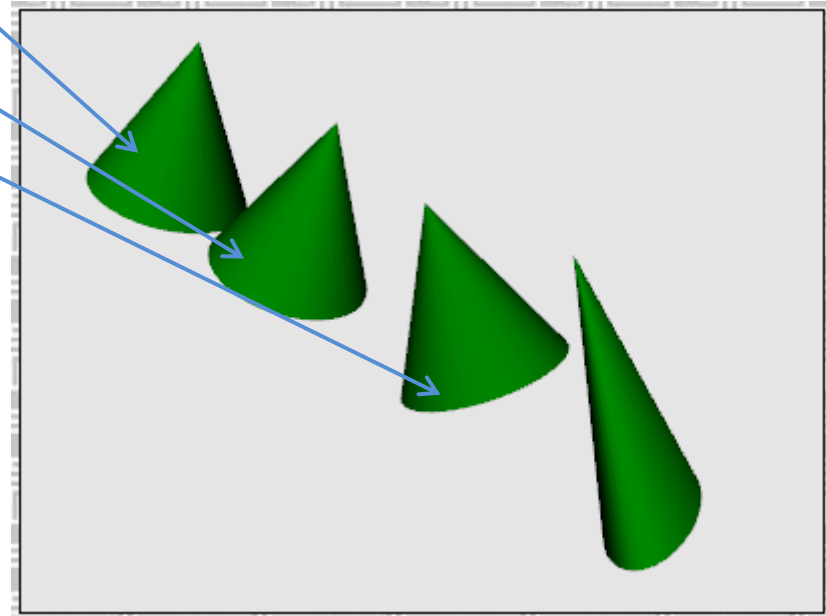
Transform

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="4 0 0" rotation="0 0 1 0.785">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="6 0 0" rotation="0 0 1 0.785" scale="0.5 1.5 1">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



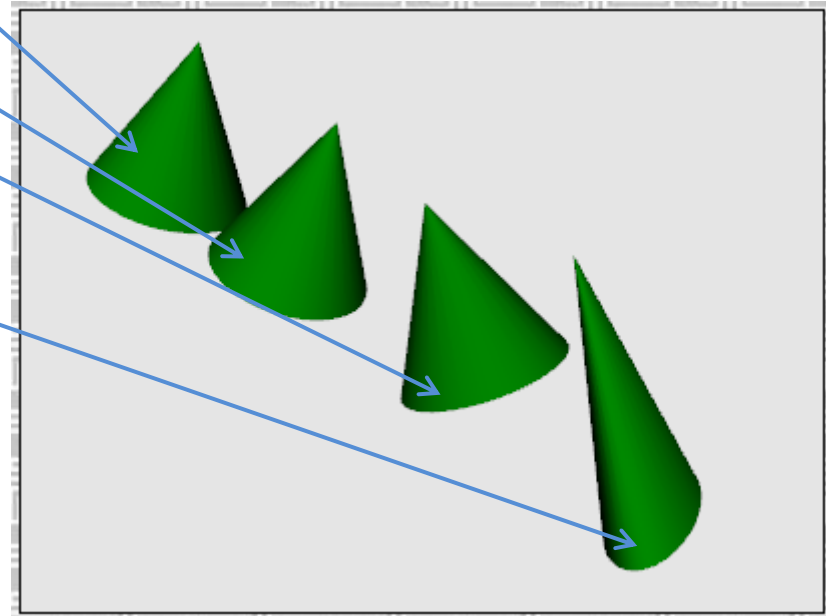
Transform

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="4 0 0" rotation="0 0 1 0.785">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="6 0 0" rotation="0 0 1 0.785" scale="0.5 1.5 1">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



Transform

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="2 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="4 0 0" rotation="0 0 1 0.785">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation="6 0 0" rotation="0 0 1 0.785" scale="0.5 1.5 1">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
  </scene>
</X3D>
```



Transform

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>
```

```
<transform translation="0 0 0">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='green'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
<transform translation="2 0 0">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='green'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
<transform translation="4 0 0" rotation="0 0 1 0.785">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='green'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
<transform translation="6 0 0" rotation="0 0 1 0.785" scale="0.5 1.5 1">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='green'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

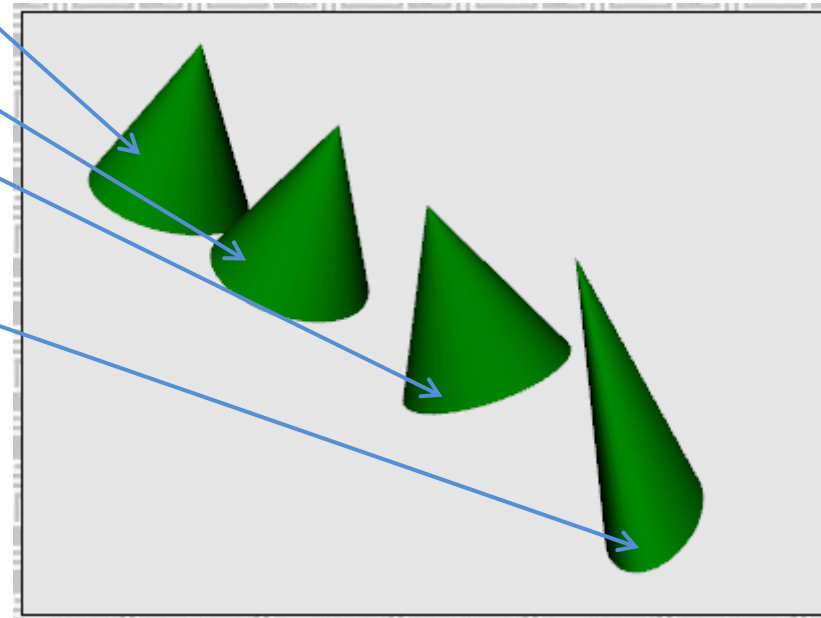
```
</scene>
```

```
</X3D>
```

Wichtig:

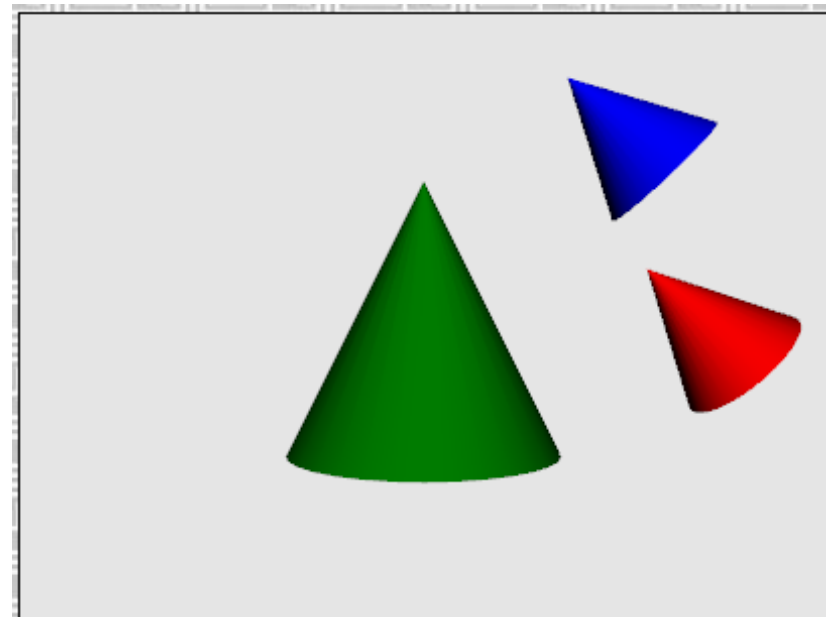
Reihenfolge ist immer:

Translation -> Rotation -> Skalierung



Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 2 0 0">
      <transform rotation=" 0 0 1 0.785">
        <transform scale="0.5 0.5 0.5">
          <shape>
            <appearance>
              <material diffuseColor='red'></material>
            </appearance>
            <cone></cone>
          </shape>
        </transform>
      </transform>
    </transform>
    <transform rotation=" 0 0 1 0.785">
      <transform translation=" 2 0 0">
        <transform scale="0.5 0.5 0.5">
          <shape>
            <appearance>
              <material diffuseColor='blue'></material>
            </appearance>
            <cone></cone>
          </shape>
        </transform>
      </transform>
    </transform>
  </scene>
</X3D>
```

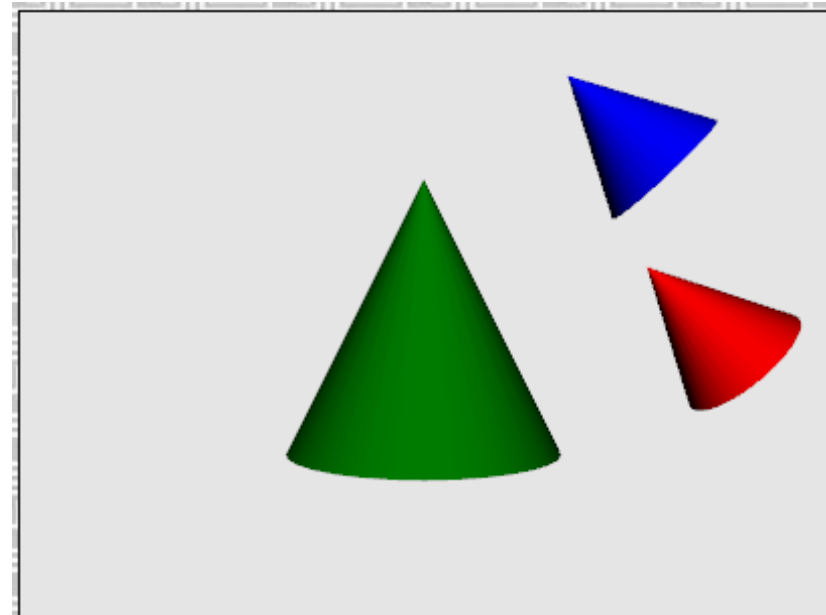


Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>  
  <transform translation=" 0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='green'></material>  
      </appearance>  
      <cone></cone>  
    </shape>  
  </transform>  
  <transform translation=" 2 0 0">  
    <transform rotation=" 0 0 1 0.785">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
  <transform rotation=" 0 0 1 0.785">  
    <transform translation=" 2 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
</scene>  
</X3D>
```

Wichtig:
Reihenfolge ist immer:
Außen -> Innen

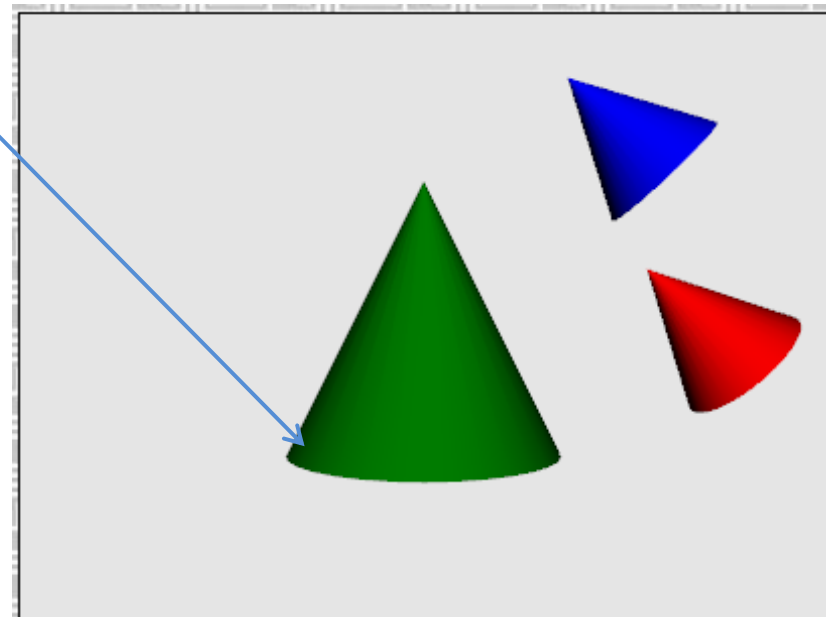


Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>  
  <transform translation="0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='green'></material>  
      </appearance>  
      <cone></cone>  
    </shape>  
  </transform>  
  <transform translation="2 0 0">  
    <transform rotation="0 0 1 0.785">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
  <transform rotation="0 0 1 0.785">  
    <transform translation="2 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
</scene>  
</X3D>
```

Wichtig:
Reihenfolge ist immer:
Außen -> Innen

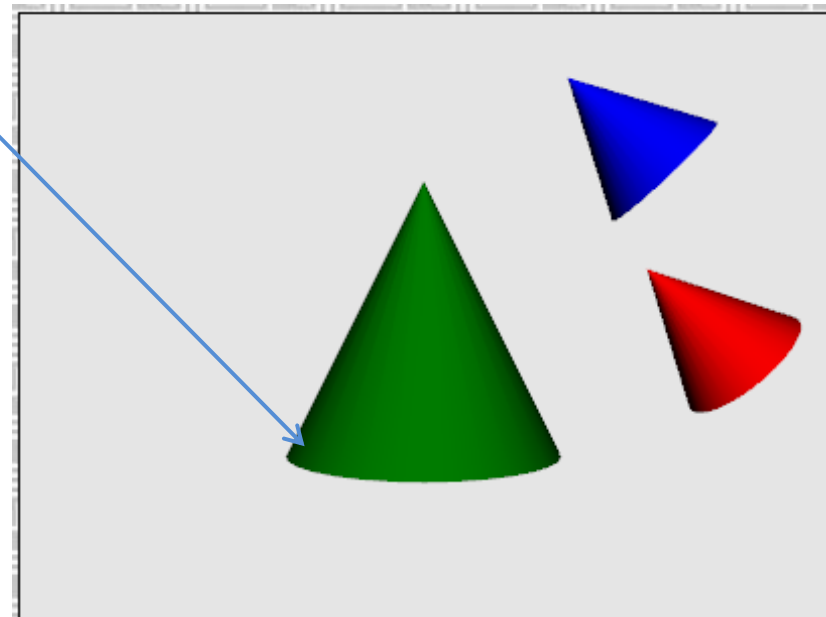


Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>  
  <transform translation=" 0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='green'></material>  
      </appearance>  
      <cone></cone>  
    </shape>  
  </transform>  
  <transform translation=" 2 0 0">  
    <transform rotation=" 0 0 1 0.785">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
  <transform rotation=" 0 0 1 0.785">  
    <transform translation=" 2 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
</scene>  
</X3D>
```

Wichtig:
Reihenfolge ist immer:
Außen -> Innen

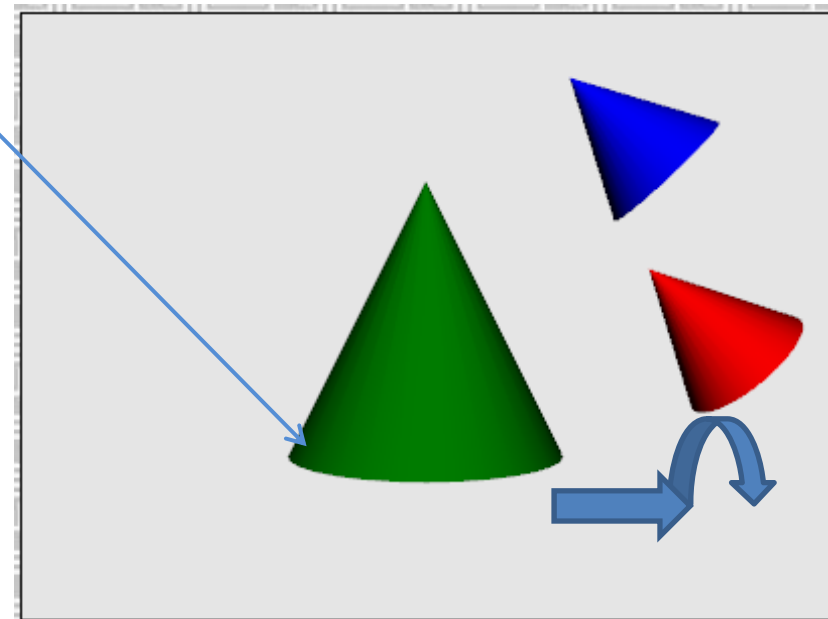


Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>  
  <transform translation=" 0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='green'></material>  
      </appearance>  
      <cone></cone>  
    </shape>  
  </transform>  
  <transform translation=" 2 0 0">  
    <transform rotation=" 0 0 1 0.785">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
  <transform rotation=" 0 0 1 0.785">  
    <transform translation=" 2 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
</scene>  
</X3D>
```

Wichtig:
Reihenfolge ist immer:
Außen -> Innen

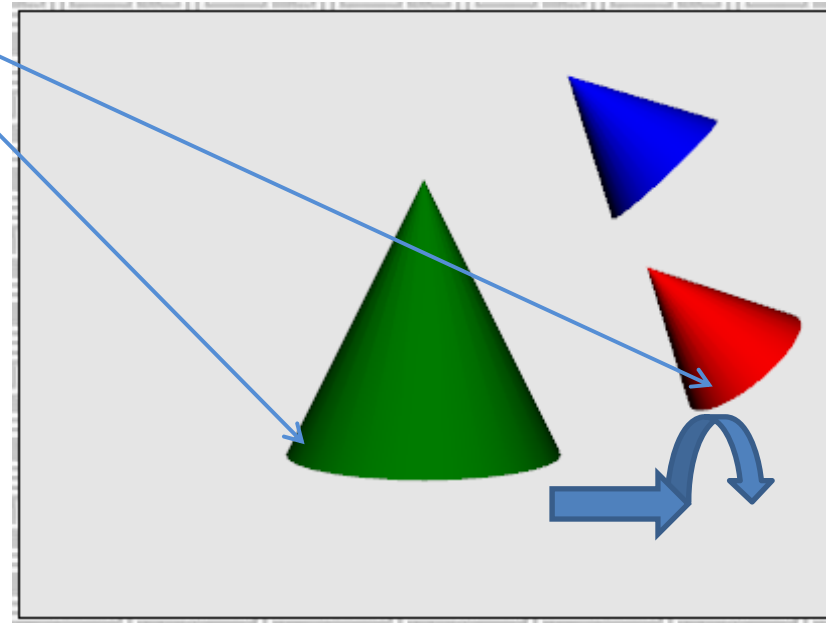


Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>  
  <transform translation="0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='green'></material>  
      </appearance>  
      <cone></cone>  
    </shape>  
  </transform>  
  <transform translation="2 0 0">  
    <transform rotation="0 0 1 0.785">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
  <transform rotation="0 0 1 0.785">  
    <transform translation="2 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
</scene>  
</X3D>
```

Wichtig:
Reihenfolge ist immer:
Außen -> Innen



Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>
```

```
<transform translation=" 0 0 0">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='green'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
<transform translation=" 2 0 0">
```

```
<transform rotation=" 0 0 1 0.785">
```

```
<transform scale="0.5 0.5 0.5">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='red'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
</transform>
```

```
</transform>
```

```
<transform rotation=" 0 0 1 0.785">
```

```
<transform translation=" 2 0 0">
```

```
<transform scale="0.5 0.5 0.5">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='blue'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
</transform>
```

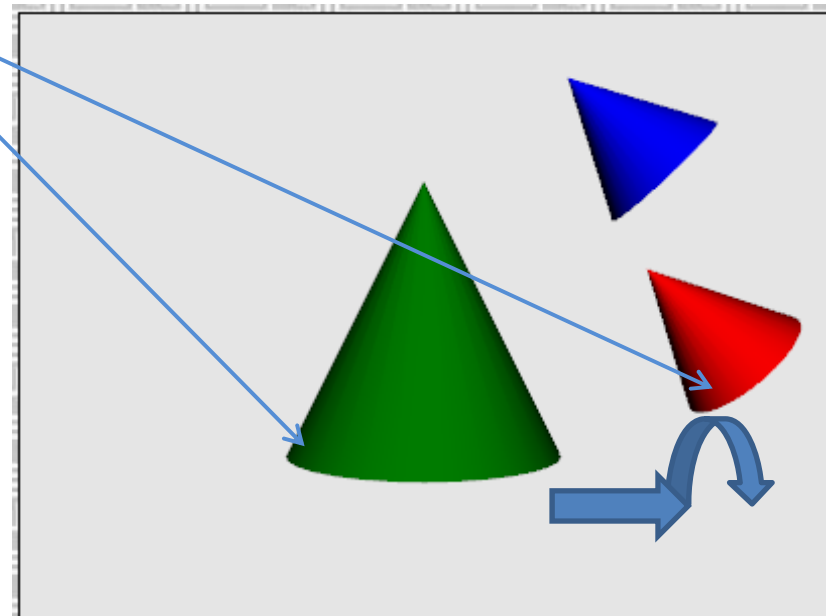
```
</transform>
```

```
</scene>
```

```
</X3D>
```

Wichtig:

Reihenfolge ist immer:
Außen -> Innen



Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

```
<scene>
```

```
<transform translation=" 0 0 0">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='green'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
<transform translation=" 2 0 0">
```

```
<transform rotation=" 0 0 1 0.785">
```

```
<transform scale="0.5 0.5 0.5">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='red'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
</transform>
```

```
</transform>
```

```
<transform rotation=" 0 0 1 0.785">
```

```
<transform translation=" 2 0 0">
```

```
<transform scale="0.5 0.5 0.5">
```

```
<shape>
```

```
<appearance>
```

```
<material diffuseColor='blue'></material>
```

```
</appearance>
```

```
<cone></cone>
```

```
</shape>
```

```
</transform>
```

```
</transform>
```

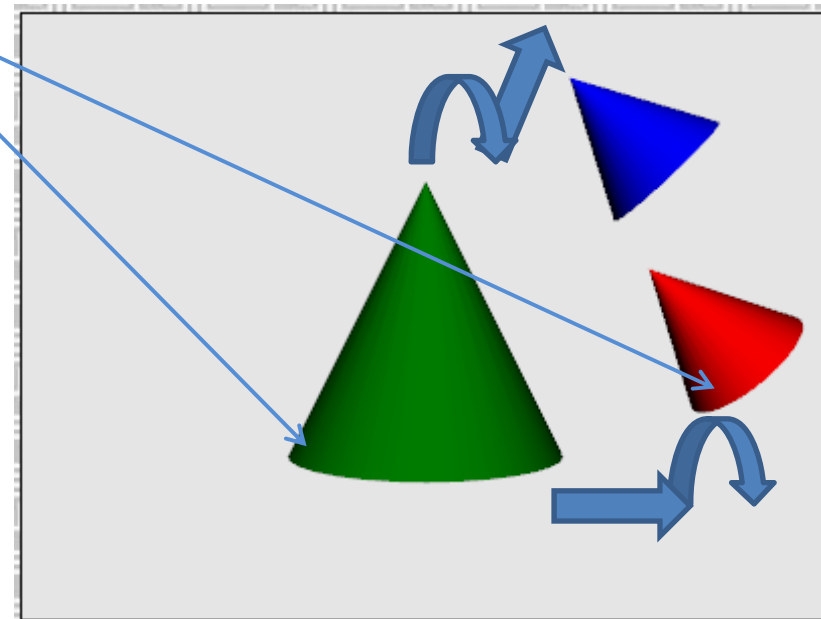
```
</transform>
```

```
</scene>
```

```
</X3D>
```

Wichtig:

Reihenfolge ist immer:
Außen -> Innen

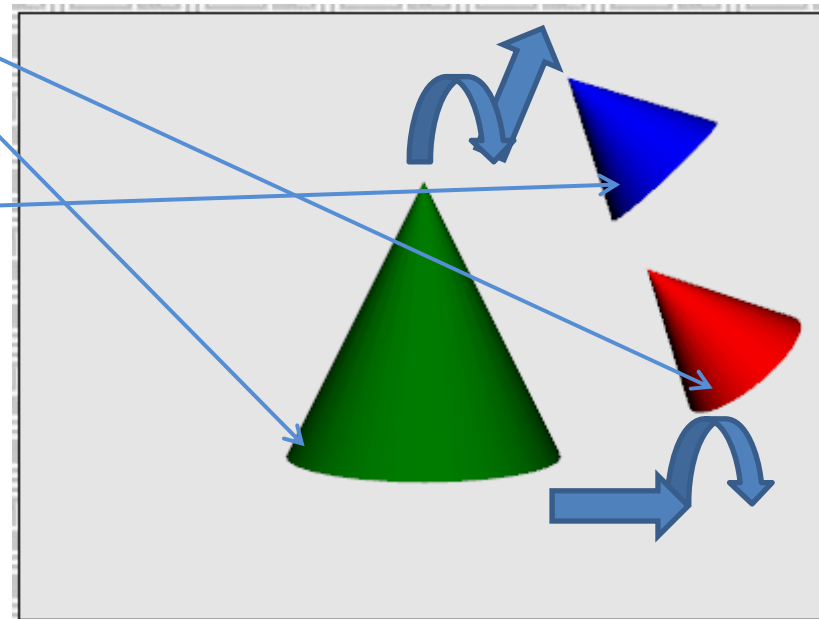


Transform Reihenfolge 1/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
```

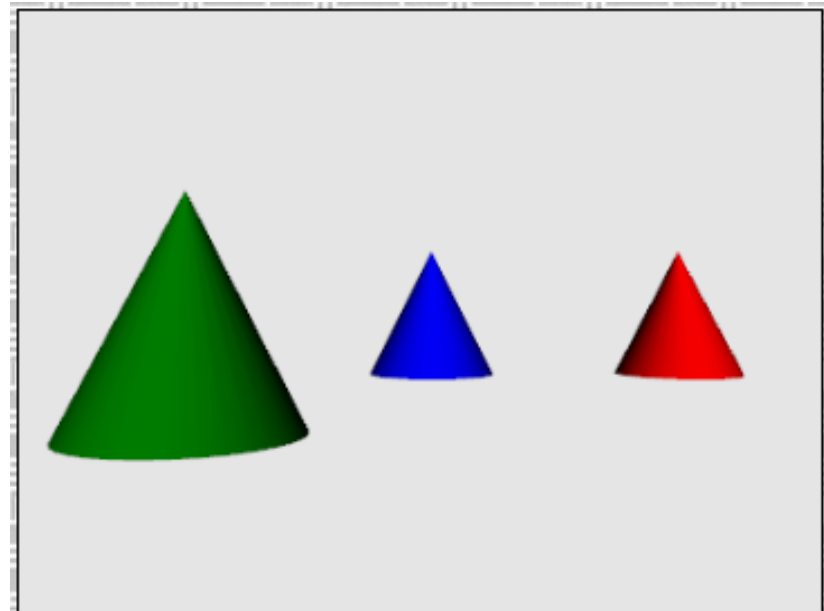
```
<scene>  
  <transform translation=" 0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='green'></material>  
      </appearance>  
      <cone></cone>  
    </shape>  
  </transform>  
  <transform translation=" 2 0 0">  
    <transform rotation=" 0 0 1 0.785">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
  <transform rotation=" 0 0 1 0.785">  
    <transform translation=" 2 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </transform>  
</scene>  
</X3D>
```

Wichtig:
Reihenfolge ist immer:
Außen -> Innen



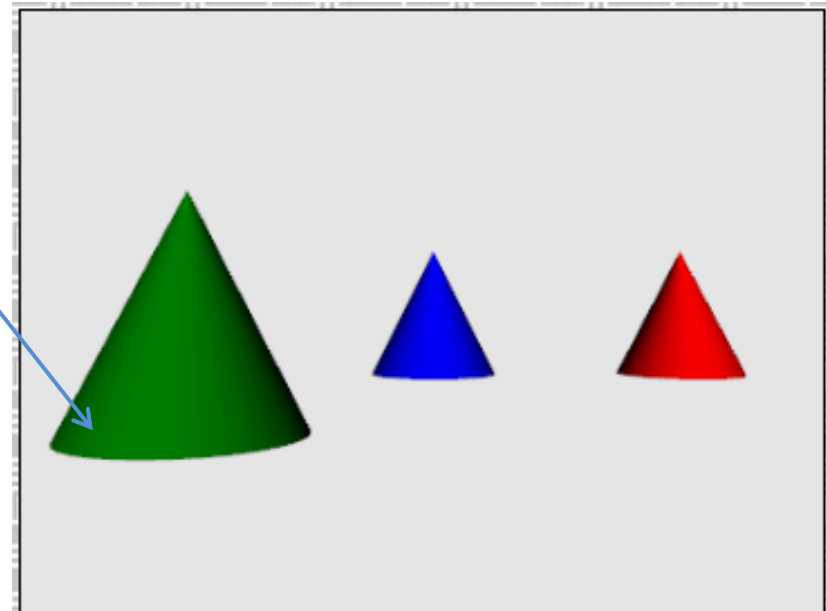
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0">
      <transform scale="0.5 0.5 0.5">
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
    <transform scale="0.5 0.5 0.5">
      <transform translation=" 4 0 0">
        <shape>
          <appearance>
            <material diffuseColor='blue'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
  </scene>
</X3D>
```



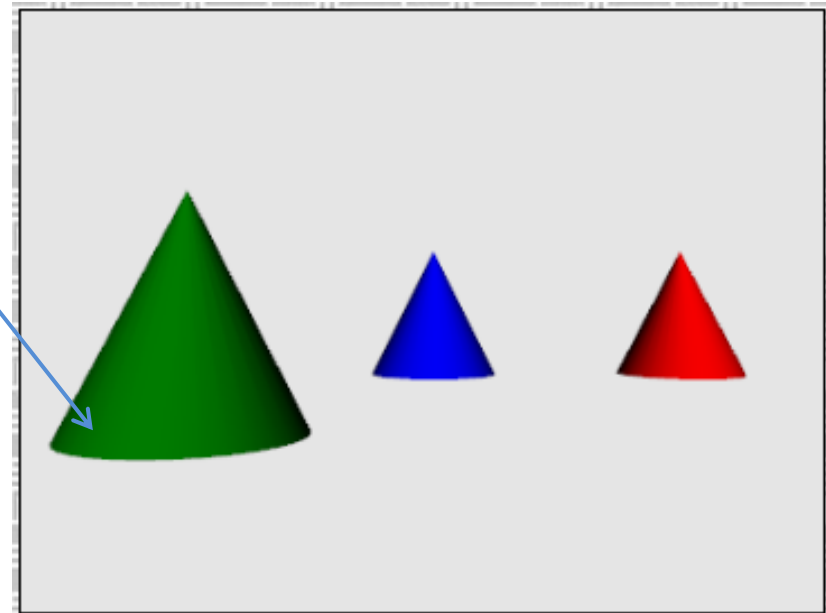
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0">
      <transform scale="0.5 0.5 0.5">
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
    <transform scale="0.5 0.5 0.5">
      <transform translation=" 4 0 0">
        <shape>
          <appearance>
            <material diffuseColor='blue'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
  </scene>
</X3D>
```



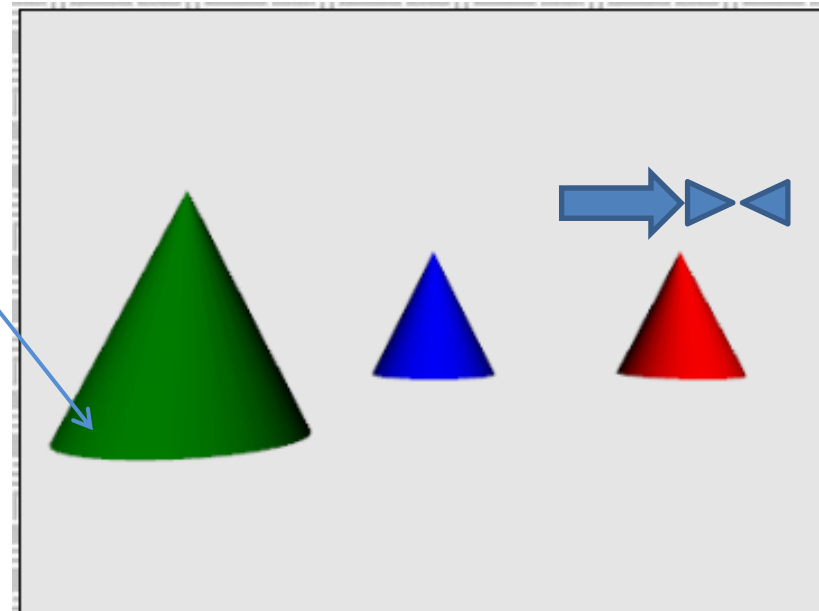
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0">
      <transform scale="0.5 0.5 0.5">
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
    <transform scale="0.5 0.5 0.5">
      <transform translation=" 4 0 0">
        <shape>
          <appearance>
            <material diffuseColor='blue'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
  </scene>
</X3D>
```



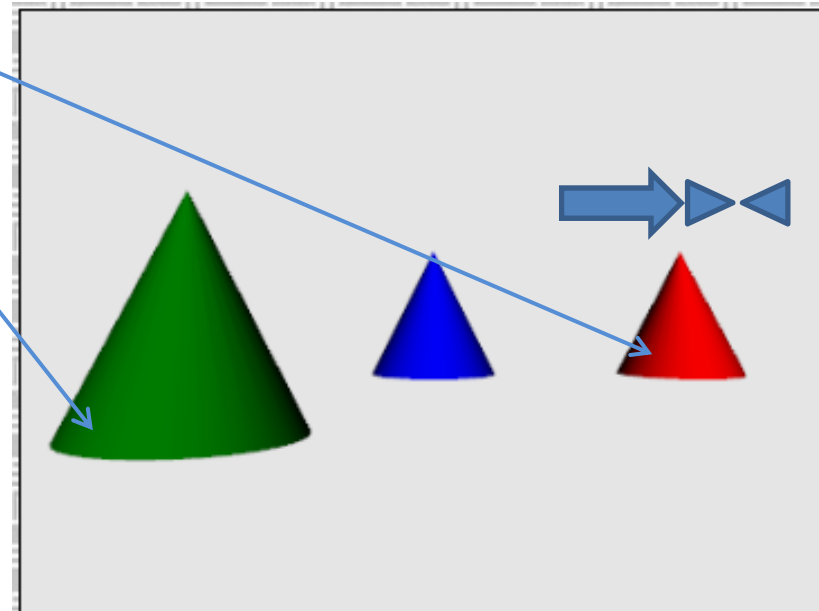
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0">
      <transform scale="0.5 0.5 0.5">
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
    <transform scale="0.5 0.5 0.5">
      <transform translation=" 4 0 0">
        <shape>
          <appearance>
            <material diffuseColor='blue'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
  </scene>
</X3D>
```



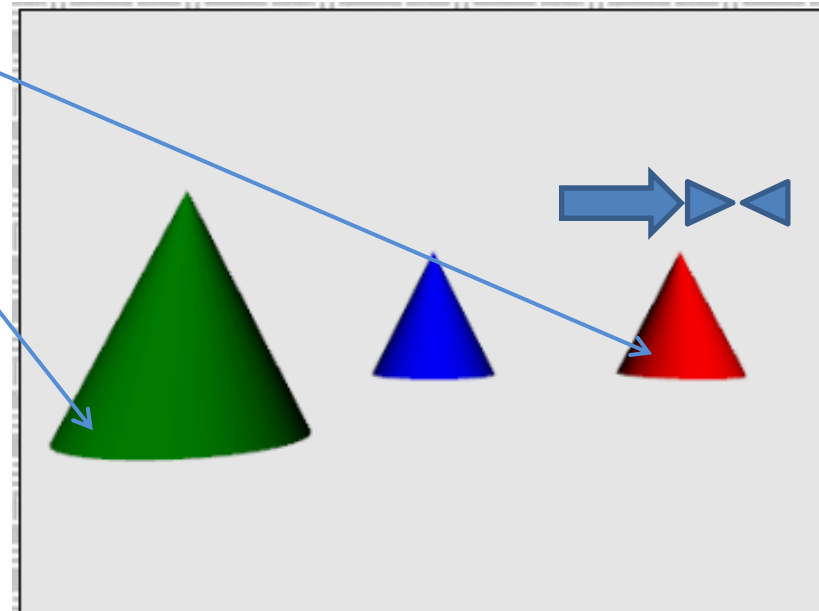
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0">
      <transform scale="0.5 0.5 0.5">
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
    <transform scale="0.5 0.5 0.5">
      <transform translation=" 4 0 0">
        <shape>
          <appearance>
            <material diffuseColor='blue'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
  </scene>
</X3D>
```



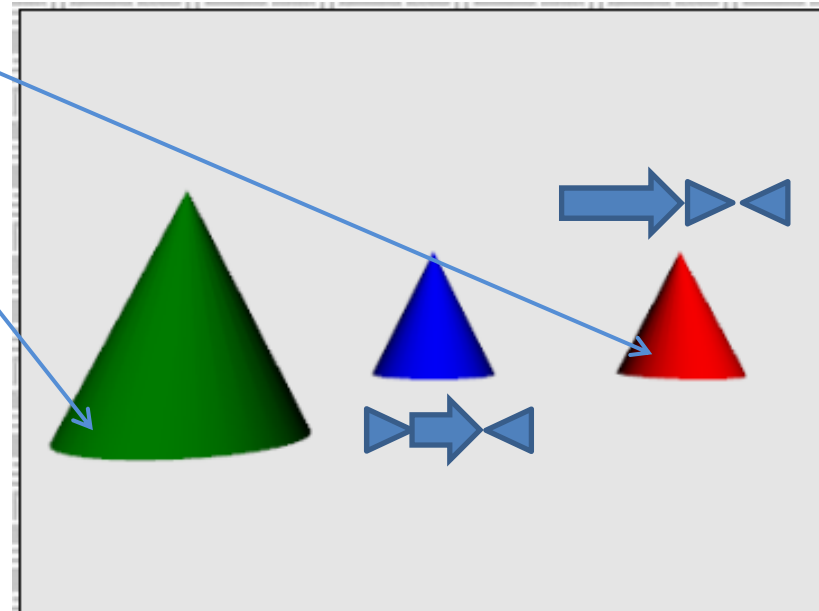
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='green'></material>
        </appearance>
        <cone></cone>
      </shape>
    </transform>
    <transform translation=" 4 0 0">
      <transform scale="0.5 0.5 0.5">
        <shape>
          <appearance>
            <material diffuseColor='red'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
    <transform scale="0.5 0.5 0.5">
      <transform translation=" 4 0 0">
        <shape>
          <appearance>
            <material diffuseColor='blue'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </transform>
  </scene>
</X3D>
```



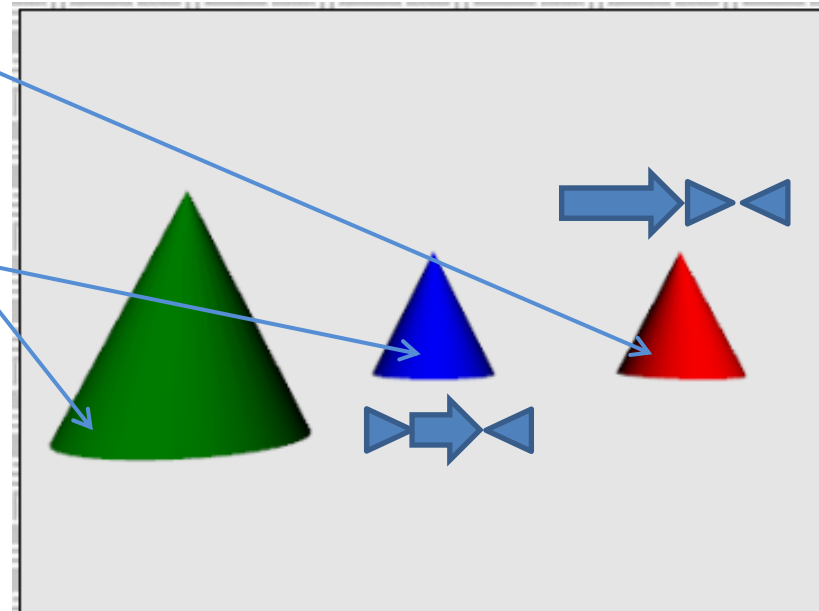
Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
    <transform translation=" 4 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
    <transform scale="0.5 0.5 0.5">  
      <transform translation=" 4 0 0">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </scene>  
</X3D>
```



Transform Reihenfolge 2/2

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
    <transform translation=" 4 0 0">  
      <transform scale="0.5 0.5 0.5">  
        <shape>  
          <appearance>  
            <material diffuseColor='red'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
    <transform scale="0.5 0.5 0.5">  
      <transform translation=" 4 0 0">  
        <shape>  
          <appearance>  
            <material diffuseColor='blue'></material>  
          </appearance>  
          <cone></cone>  
        </shape>  
      </transform>  
    </transform>  
  </scene>  
</X3D>
```



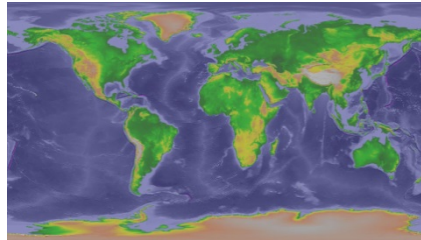
Einfache Formen und Texturen

Einfache Formen und Texturen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation=" 0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
          <ImageTexture url="Earth-640x360.png"/>
        </appearance>
      <box></box>
    </shape>
  </transform>
</scene>
</X3D>
```

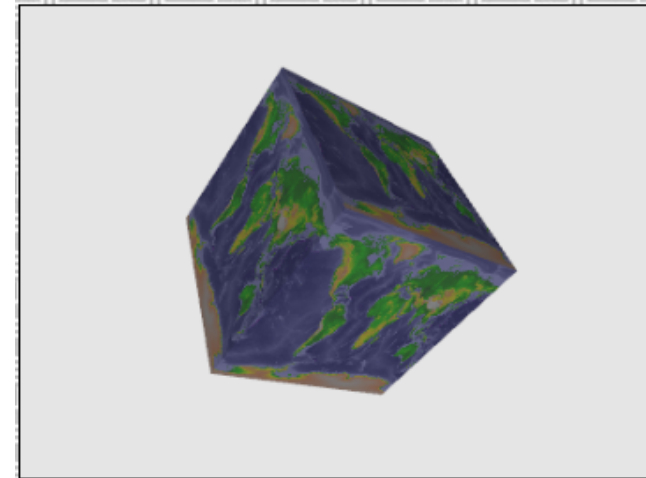
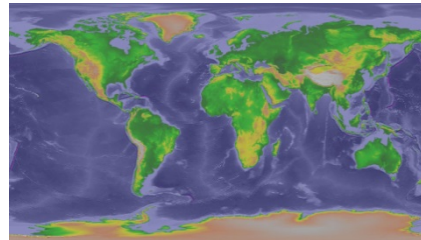
Einfache Formen und Texturen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
      <box></box>  
    </shape>  
  </transform>  
</scene>  
</X3D>
```



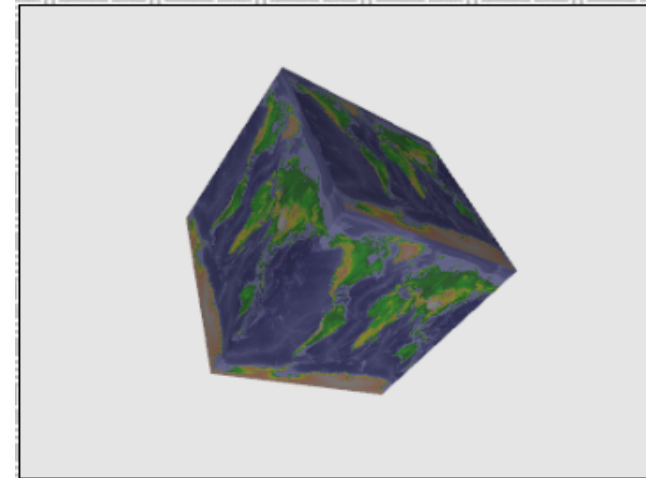
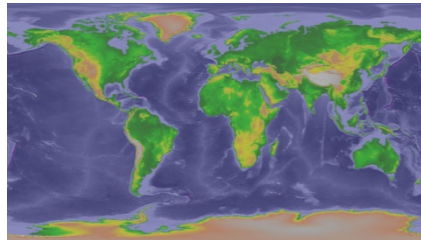
Einfache Formen und Texturen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <box></box>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



Einfache Formen und Texturen

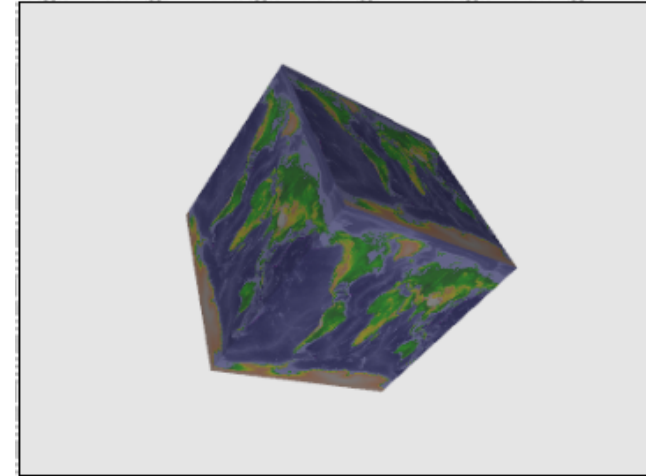
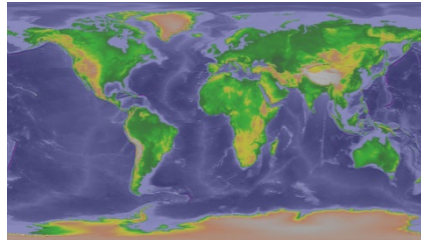
```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <box></box>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



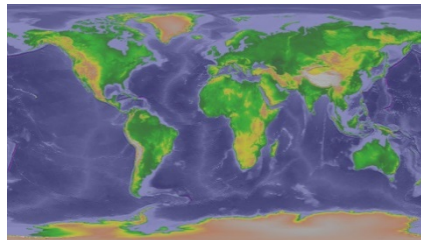
```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```


Einfache Formen und Texturen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <box></box>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```

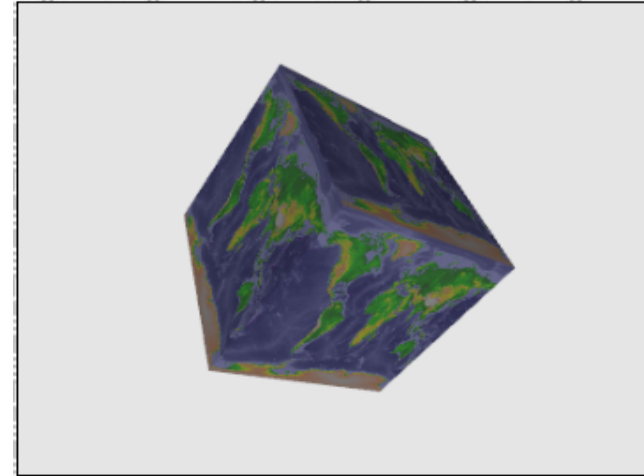
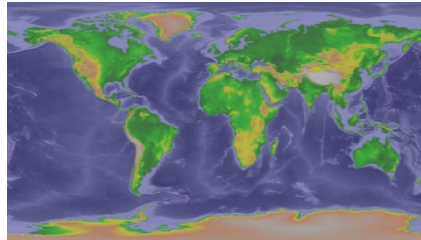


```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```

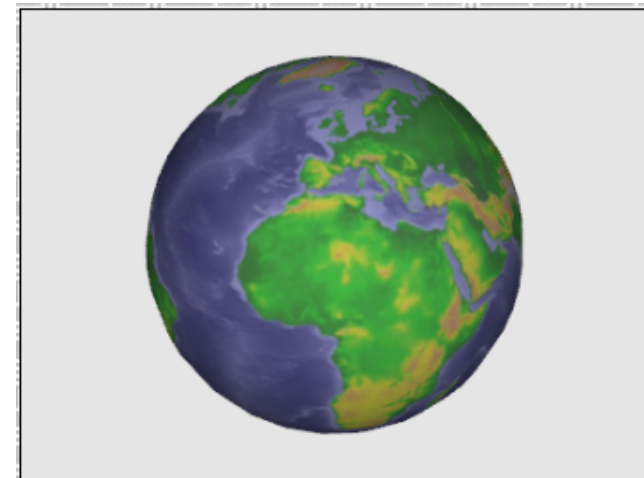
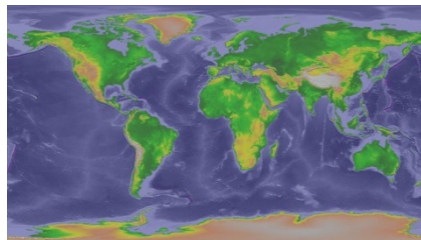


Einfache Formen und Texturen

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <box></box>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <transform translation=" 0 0 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='red'></material>  
          <ImageTexture url="Earth-640x360.png"/>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```

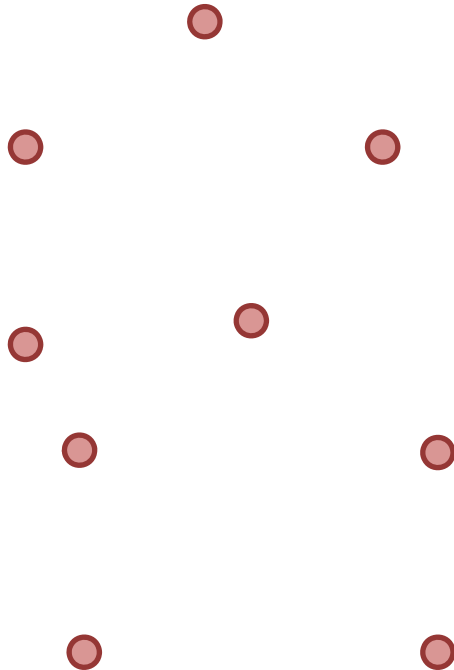


Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0'>
          </IndexedFaceSet>
        </shape>
      </transform>
    </scene>
  </X3D>
```

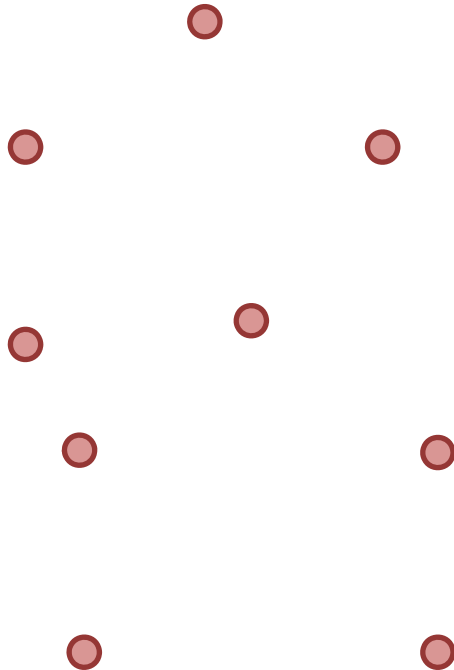
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0'/>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



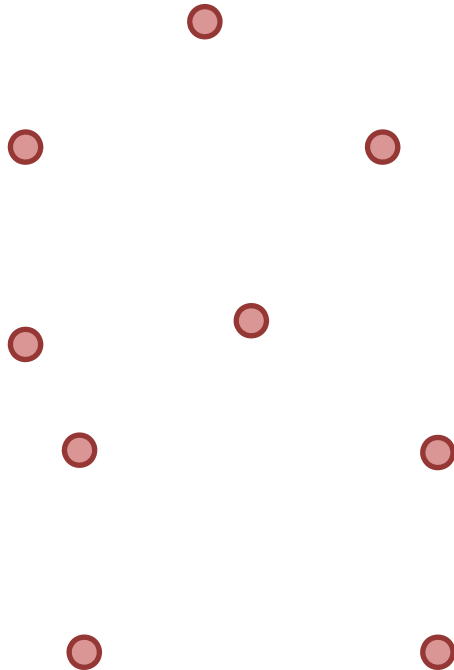
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0'>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



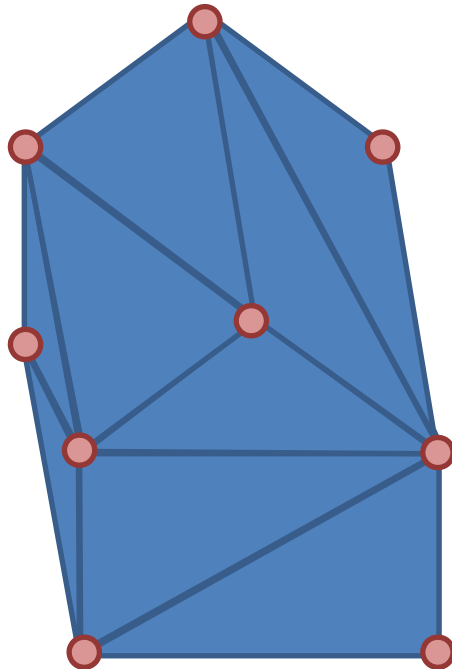
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0' />
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



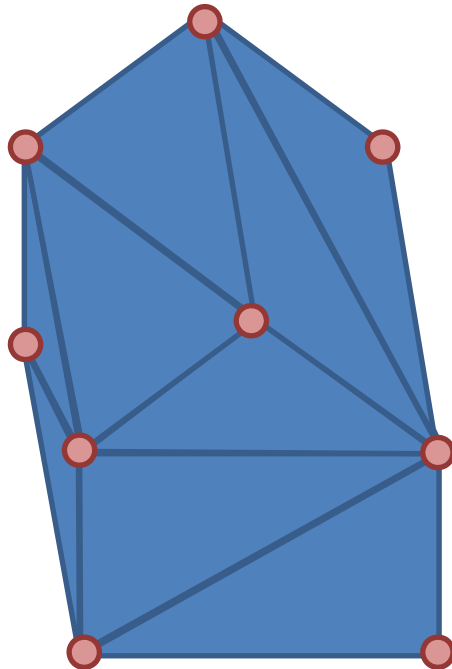
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coord' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0'>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



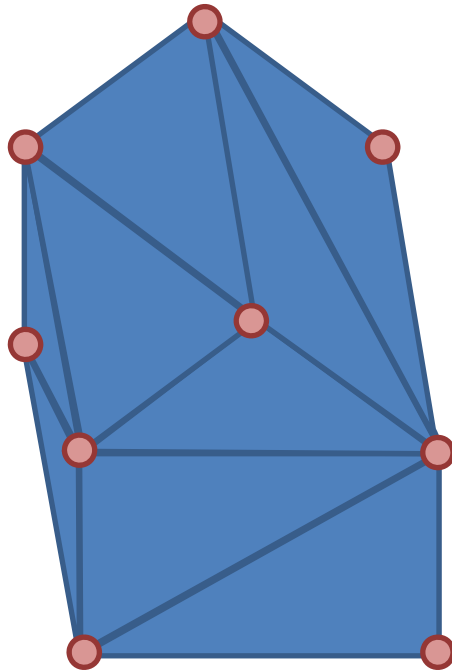
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coord' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0' />
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



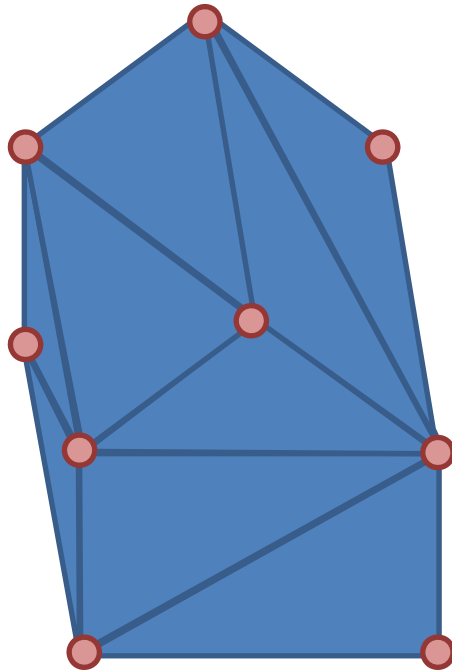
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coord' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0' />
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



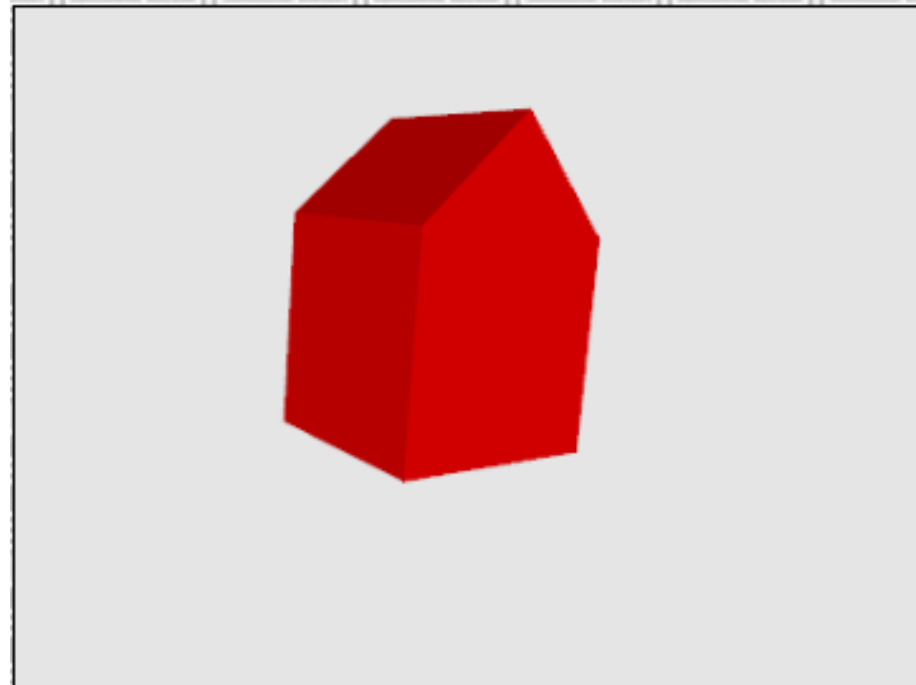
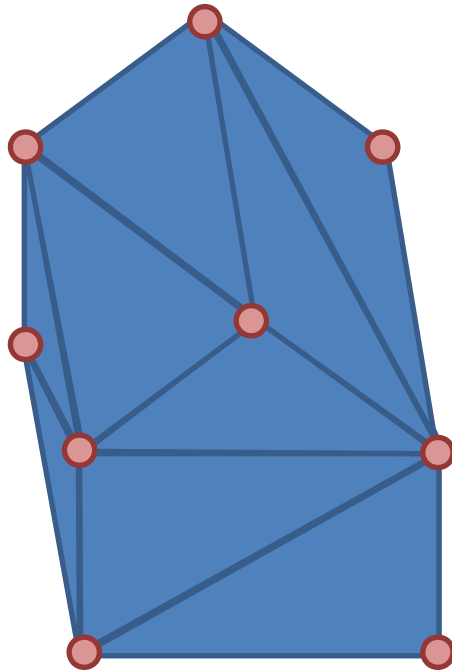
Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coord' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1 5 0 0 5 1 5 1 0 0 0 0 1 0 0 5 1 5 0' />
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



Komplexe Geometrie

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0 5 1.5 0 0 5 1.5 1 0 0 0 0 1 0 0 5 1.5 0'>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



Komplexe Geometrie und Texturen 1/3

Straight forward approach

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
          <ImageTexture repeatS="false" url="hausTex2-sml.png"/>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -1 5 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 0 1 0.5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0'>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```

Komplexe Geometrie und Texturen 1/3

Straight forward approach

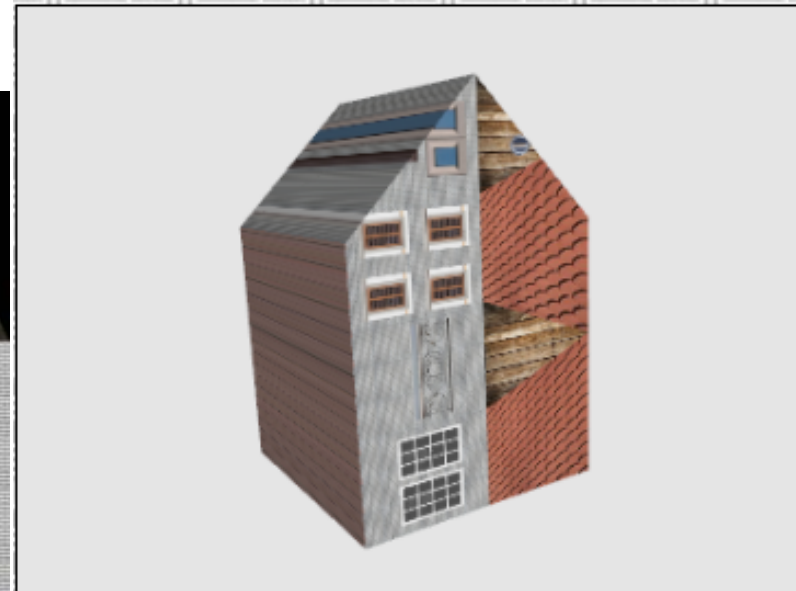
```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
          <ImageTexture repeatS="false" url="hausTex2-sml.png"/>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -15 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 0 1 0.5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0'>
          </Coordinate>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



Komplexe Geometrie und Texturen 1/3

Straight forward approach

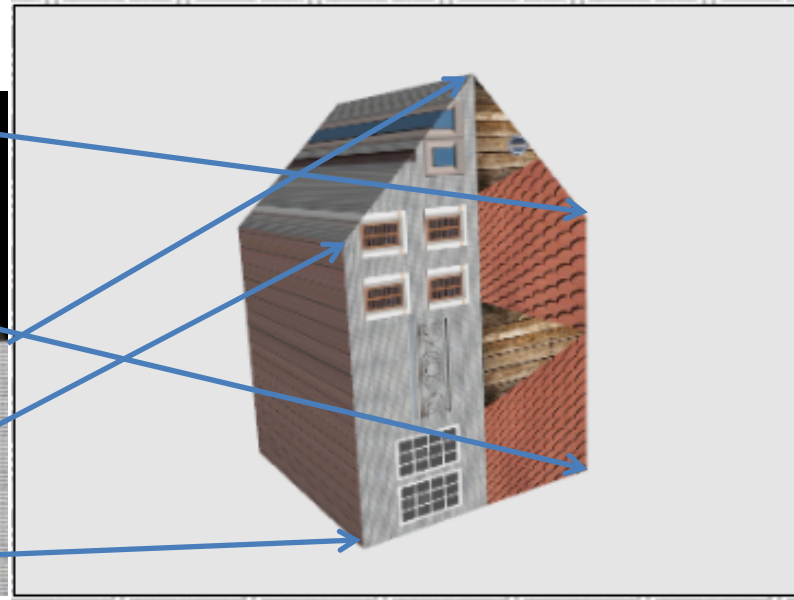
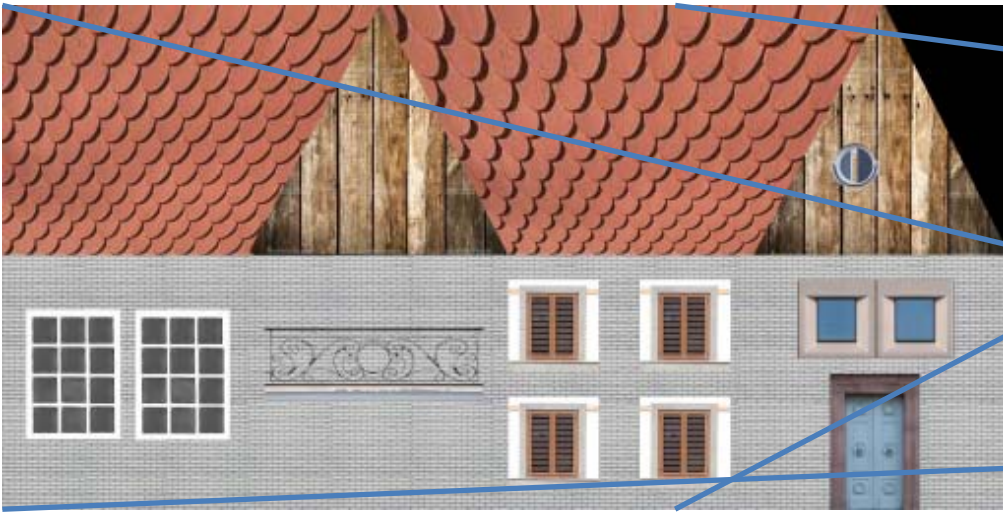
```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
          <ImageTexture repeatS="false" url="hausTex2-sml.png"/>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -15 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 0 1 0.5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0'>
          </Coordinate>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



Komplexe Geometrie und Texturen 1/3

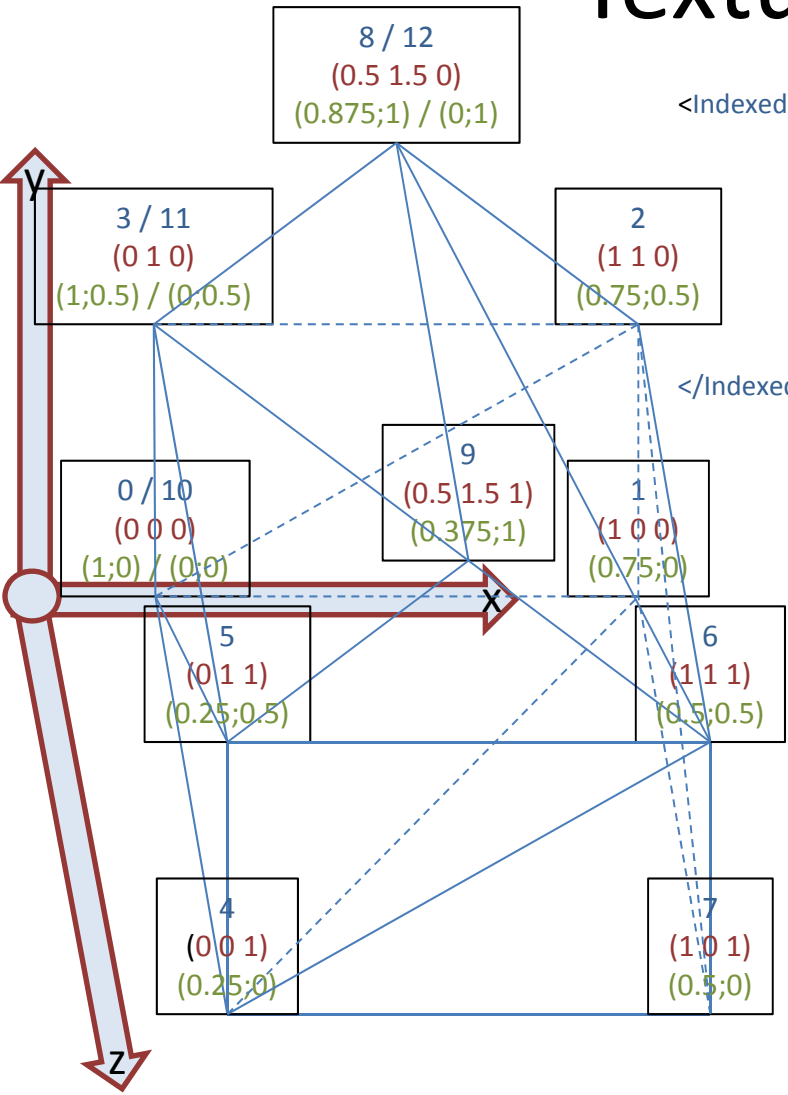
Straight forward approach

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<scene>  
  <transform translation="0 0 0">  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
        <ImageTexture repeatS="false" url="hausTex2-sml.png"/>  
      </appearance>  
      <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -15 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1  
        11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>  
        <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 0 1 0 5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0'>  
        </Coordinate>  
      </IndexedFaceSet>  
    </shape>  
  </transform>  
</scene>  
</X3D>
```



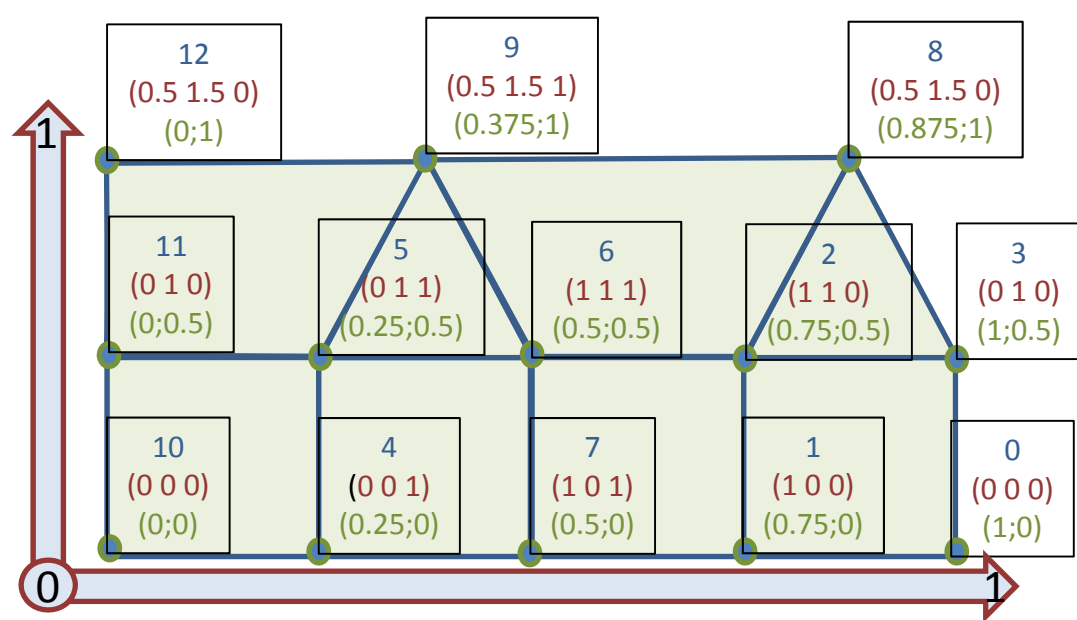
Komplexe Geometrie und Texturen 2/3

Texture Mapping



```

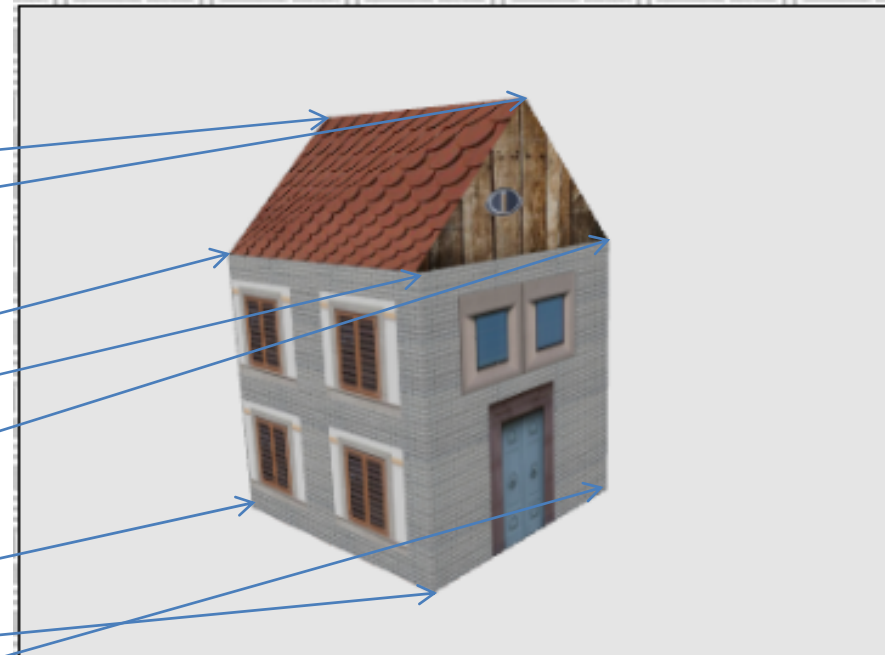
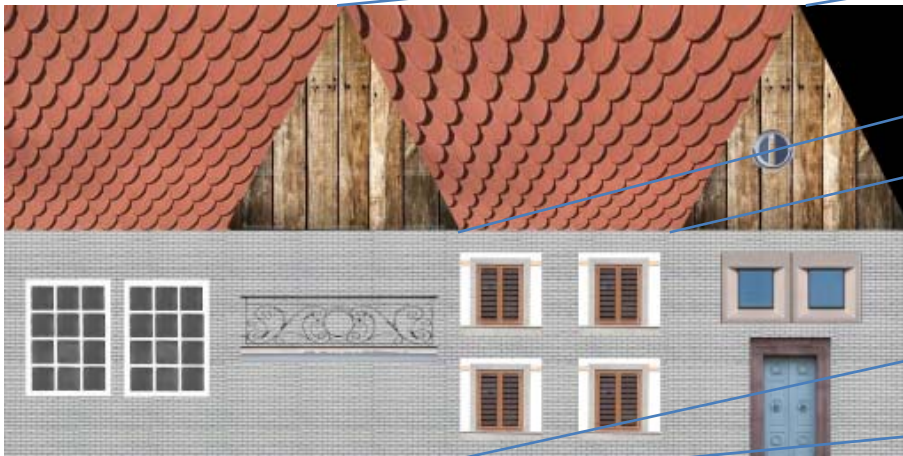
<IndexedFaceSet DEF='haus-idx' coordIndex=' 0 2 1-1 2 0 3-1 10 5 11-1 5 10 4-1 4 6 5-1
6 4 7-1 7 2 6-1 2 7 1-1 2 3 8-1 11 9 12-1
9 11 5-1 5 6 9-1 6 8 9-1 8 6 2-1 0 1 4-1 1 7 4-1'>
<Coordinate DEF='haus-coordR' point=' 0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1
0.5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0' />
<TextureCoordinate DEF='haus-TEXCOORD' point='1 0 0.75 0 0.75 0.5 1 0.5 0.25 0
0.25 0.5 0.5 0.5 0.5 0 0.875 1
0.375 1 0 0 0 0.5 0 1' />
</IndexedFaceSet>
    
```



Komplexe Geometrie und Texturen 3/3

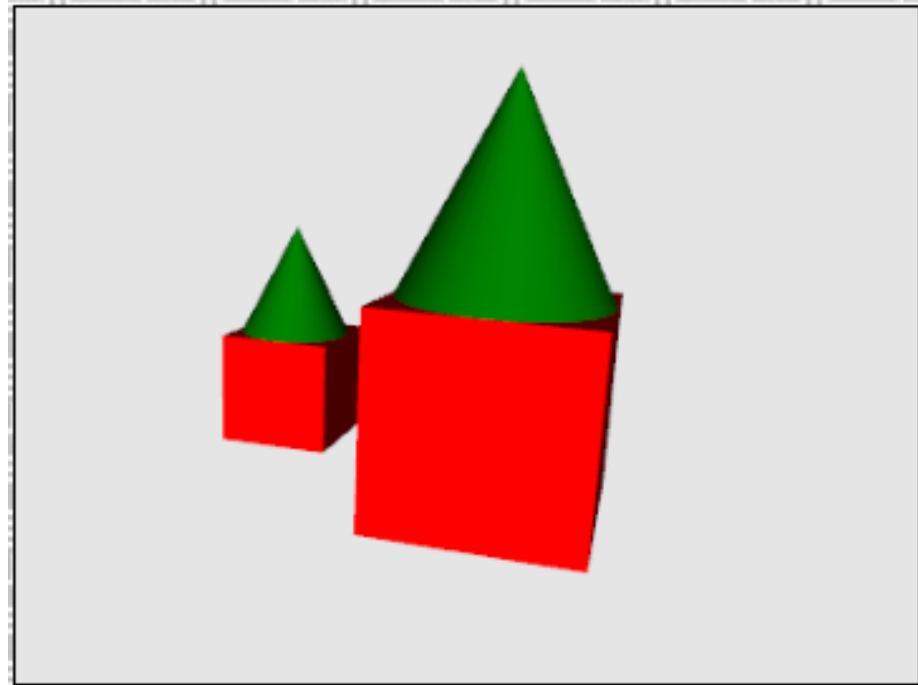
Ergebnis

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <transform translation="0 0 0">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
          <ImageTexture repeatS="false" url="hausTex2-sml.png"/>
        </appearance>
        <IndexedFaceSet DEF='haus-idx' coordIndex='0 2 1 -1 2 0 3 -1 10 5 11 -15 10 4 -1 4 6 5 -1 6 4 7 -1 7 2 6 -1 2 7 1 -1 2 3 8 -1
          11 9 12 -1 9 11 5 -1 5 6 9 -1 6 8 9 -1 8 6 2 -1 0 1 4 -1 1 7 4 -1'>
          <Coordinate DEF='haus-coordR' point='0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 0.5 1.5 0 0.5 1.5 1 0 0 0 0 1 0 0.5 1.5 0'>
          <TextureCoordinate DEF='haus-TEXCOORD' point='1 0 0 0.75 0 0.75 0.5 1 0.5 0.25 0 0.25 0.5 0.5 0.5 0.5 0 0.875 1 0 0.375 1 0 0 0
            0.5 0 1'>
        </IndexedFaceSet>
      </shape>
    </transform>
  </scene>
</X3D>
```



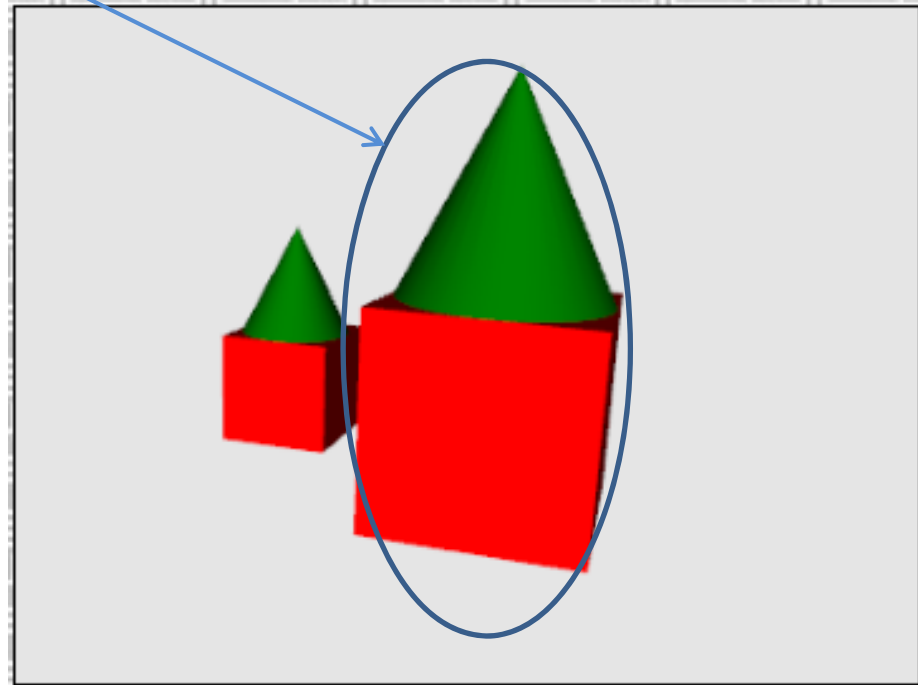
Group, DEF und USE

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <group DEF="g1">
      <shape>
        <appearance>
          <material diffuseColor='red'></material>
        </appearance>
        <box></box>
      </shape>
      <transform translation=" 0 2 0">
        <shape>
          <appearance>
            <material diffuseColor='green'></material>
          </appearance>
          <cone></cone>
        </shape>
      </transform>
    </group>
    <Transform translation= " -2 0 0" scale="0.5 0.5 0.5">
      <Shape USE="g1"/>
    </Transform>
  </scene>
</X3D>
```



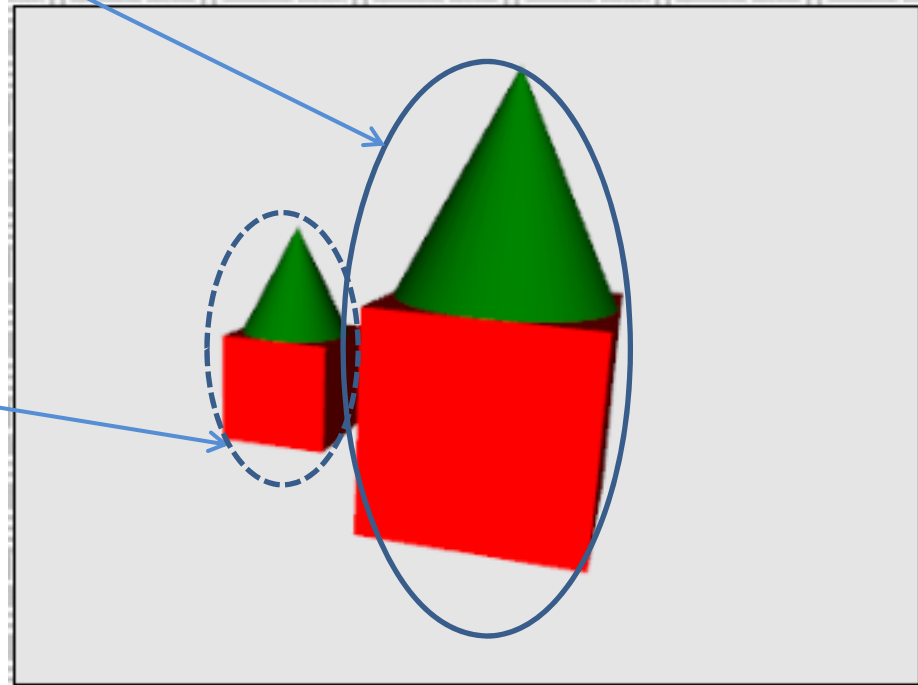
Group, DEF und USE

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<scene>  
  <group DEF="g1">  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation=" 0 2 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </group>  
  <Transform translation=" -2 0 0" scale="0.5 0.5 0.5">  
    <Shape USE="g1"/>  
  </Transform>  
</scene>  
</X3D>
```



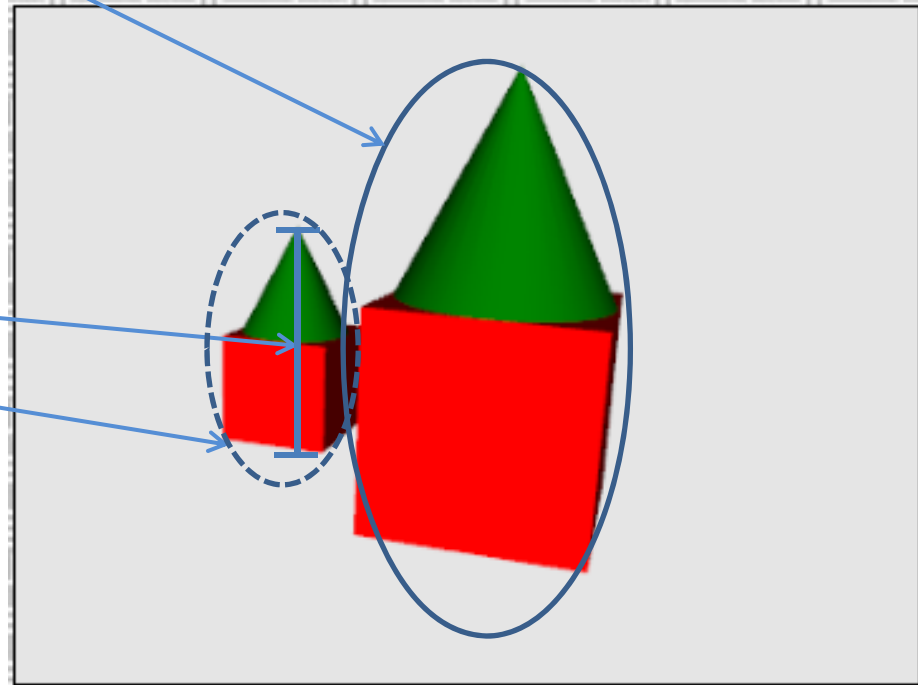
Group, DEF und USE

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<scene>  
  <group DEF="g1">  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation=" 0 2 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </group>  
  <Transform translation= " -2 0 0" scale="0.5 0.5 0.5">  
    <Shape USE="g1"/>  
  </Transform>  
</scene>  
</X3D>
```



Group, DEF und USE

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<scene>  
  <group DEF="g1">  
    <shape>  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation=" 0 2 0">  
      <shape>  
        <appearance>  
          <material diffuseColor='green'></material>  
        </appearance>  
        <cone></cone>  
      </shape>  
    </transform>  
  </group>  
  <Transform translation=" -2 0 0" scale="0.5 0.5 0.5">  
    <Shape USE="g1"/>  
  </Transform>  
</scene>  
</X3D>
```

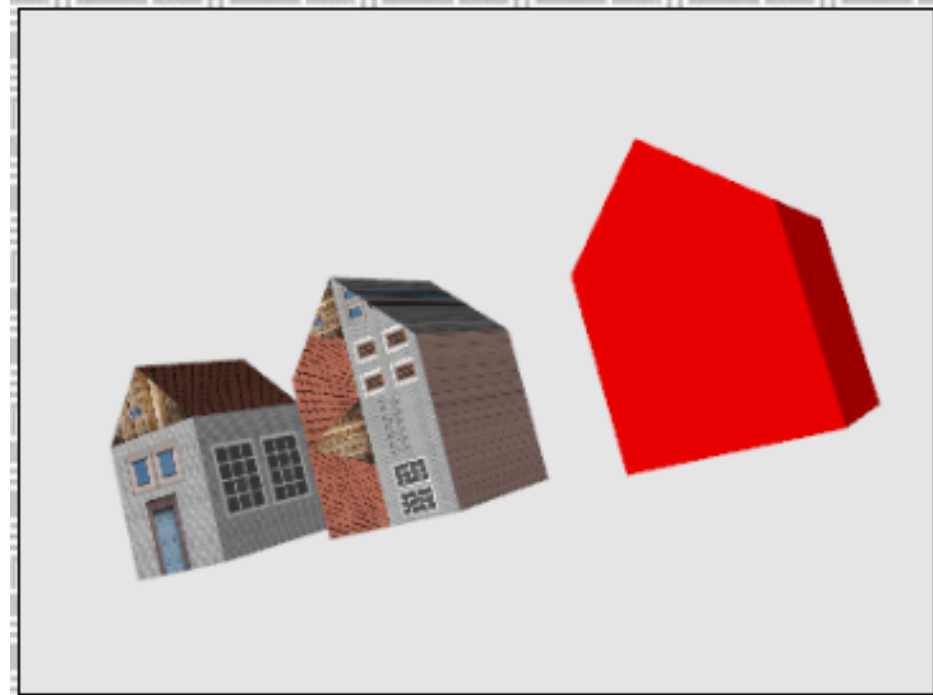


Inline

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <Background DEF="bgnd" transparency="0.0" skyColor="0.9 0.9 0.9"/>
    <transform translation="-2 0 0">
      <Inline url="07_Complex_Geometry.x3d" />
    </transform>
    <transform translation="0 0 0">
      <Inline url="09_Complex_Shapes_andTextures_1.x3d" />
    </transform>
    <transform translation="2 0 0">
      <Inline url="09_Complex_Shapes_andTextures_2.x3d" />
    </transform>
  </Scene>
</X3D>
```

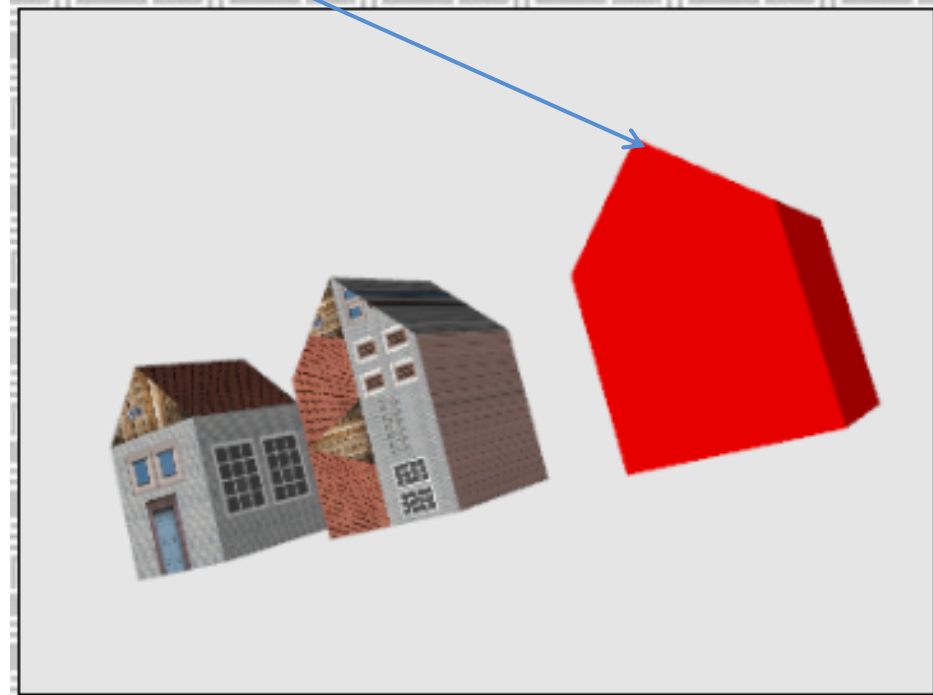
Inline

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <Background DEF="bgnd" transparency="0.0" skyColor="0.9 0.9 0.9"/>
    <transform translation="-2 0 0">
      <Inline url="07_Complex_Geometry.x3d" />
    </transform>
    <transform translation="0 0 0">
      <Inline url="09_Complex_Shapes_andTextures_1.x3d" />
    </transform>
    <transform translation="2 0 0">
      <Inline url="09_Complex_Shapes_andTextures_2.x3d" />
    </transform>
  </Scene>
</X3D>
```



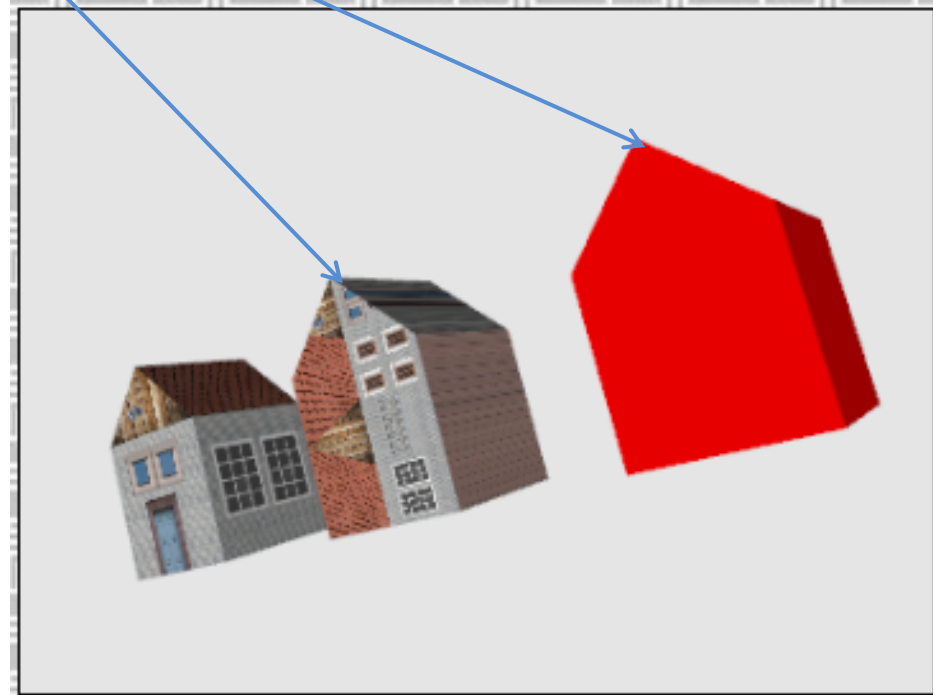
Inline

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<Scene>  
  <Background DEF="bgnd" transparency="0.0" skyColor="0.9 0.9 0.9"/>  
  <transform translation="-2 0 0">  
    <Inline url="07_Complex_Geometry.x3d" />  
  </transform>  
  <transform translation="0 0 0">  
    <Inline url="09_Complex_Shapes_andTextures_1.x3d" />  
  </transform>  
  <transform translation="2 0 0">  
    <Inline url="09_Complex_Shapes_andTextures_2.x3d" />  
  </transform>  
</Scene>  
</X3D>
```



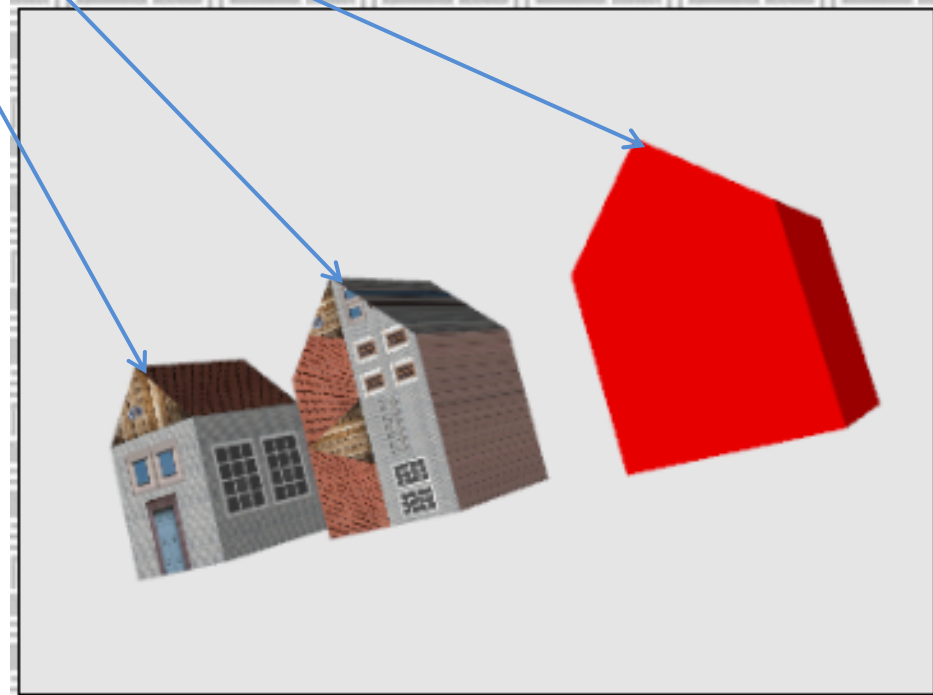
Inline

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<Scene>  
  <Background DEF="bgnd" transparency="0.0" skyColor="0.9 0.9 0.9"/>  
  <transform translation="-2 0 0">  
    <Inline url="07_Complex_Geometry.x3d" />  
  </transform>  
  <transform translation="0 0 0">  
    <Inline url="09_Complex_Shapes_andTextures_1.x3d" />  
  </transform>  
  <transform translation="2 0 0">  
    <Inline url="09_Complex_Shapes_andTextures_2.x3d" />  
  </transform>  
</Scene>  
</X3D>
```



Inline

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
<Scene>  
  <Background DEF="bgnd" transparency="0.0" skyColor="0.9 0.9 0.9"/>  
  <transform translation="-2 0 0">  
    <Inline url="07_Complex_Geometry.x3d" />  
  </transform>  
  <transform translation="0 0 0">  
    <Inline url="09_Complex_Shapes_andTextures_1.x3d" />  
  </transform>  
  <transform translation="2 0 0">  
    <Inline url="09_Complex_Shapes_andTextures_2.x3d" />  
  </transform>  
</Scene>  
</X3D>
```

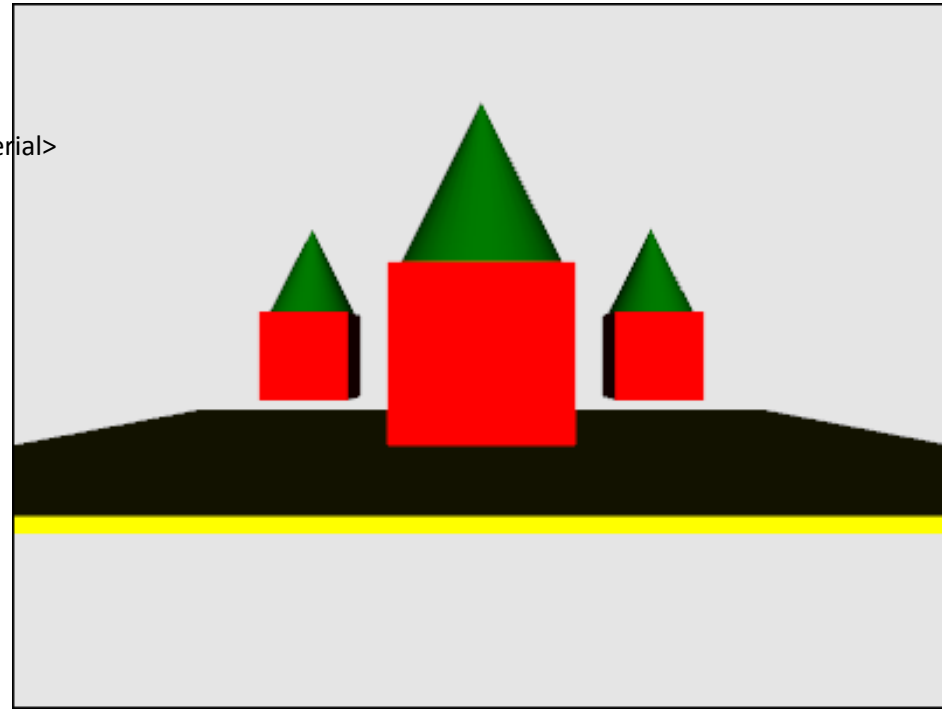


Beleuchtung

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <NavigationInfo headlight='false' />
    <PointLight DEF='Lamp1' color='1 1 1' location='4 2 0' shadowIntensity='0.7' intensity='0.9' radius='20' ambientIntensity='0.5' global='true' />
    <SpotLight DEF='Lamp3' color='1 1 1' location='0 0.75 4' direction='0 0 -1' shadowIntensity='0.7' intensity='0.9' radius='20'
      beamWidth='0.1' cutOffAngle='0.2' global='true' />
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
    <Group DEF="g1" render="true">
      <Shape>
        <Appearance>
          <Material diffuseColor='red' specularColor="0.5 0.5 0.5"></Material>
        </Appearance>
        <Box solid="true"></Box>
      </Shape>
      .
      .
      .
    </Group>
  </Scene>
</X3D>
```

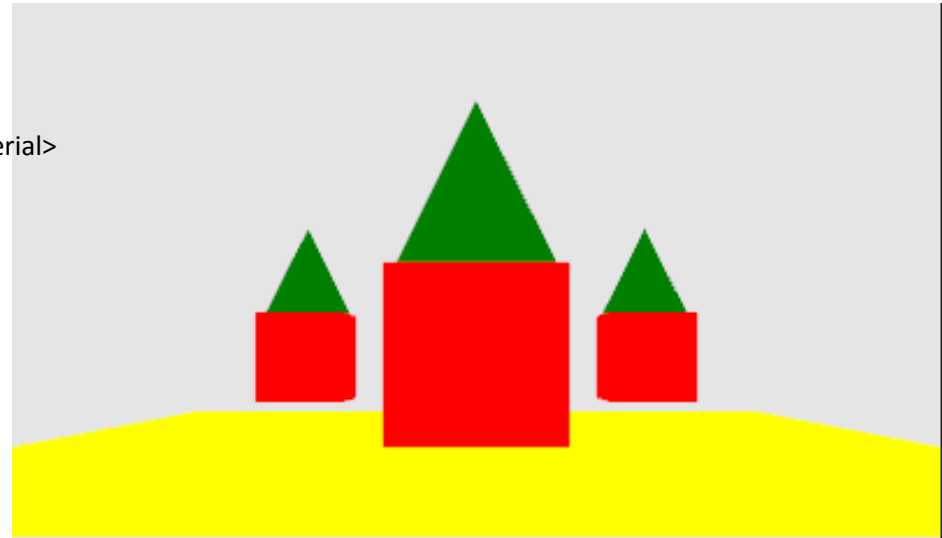
Beleuchtung

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <NavigationInfo headlight='false'/>
    <PointLight DEF='Lamp1' color='1 1 1' location='4 2 0' shadowIntensity='0.7' intensity='0.9' radius='20' ambientIntensity='0.5' global='true'/>
    <SpotLight DEF='Lamp3' color='1 1 1' location='0 0.75 4' direction='0 0 -1' shadowIntensity='0.7' intensity='0.9' radius='20'
      beamWidth='0.1' cutOffAngle='0.2' global='true'/>
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"/></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"/></Box>
      </Shape>
    </Transform>
    <Group DEF="g1" render="true">
      <Shape>
        <Appearance>
          <Material diffuseColor='red' specularColor="0.5 0.5 0.5"/></Material>
        </Appearance>
        <Box solid="true"/></Box>
      </Shape>
      .
      .
      .
    </Group>
  </Scene>
</X3D>
```



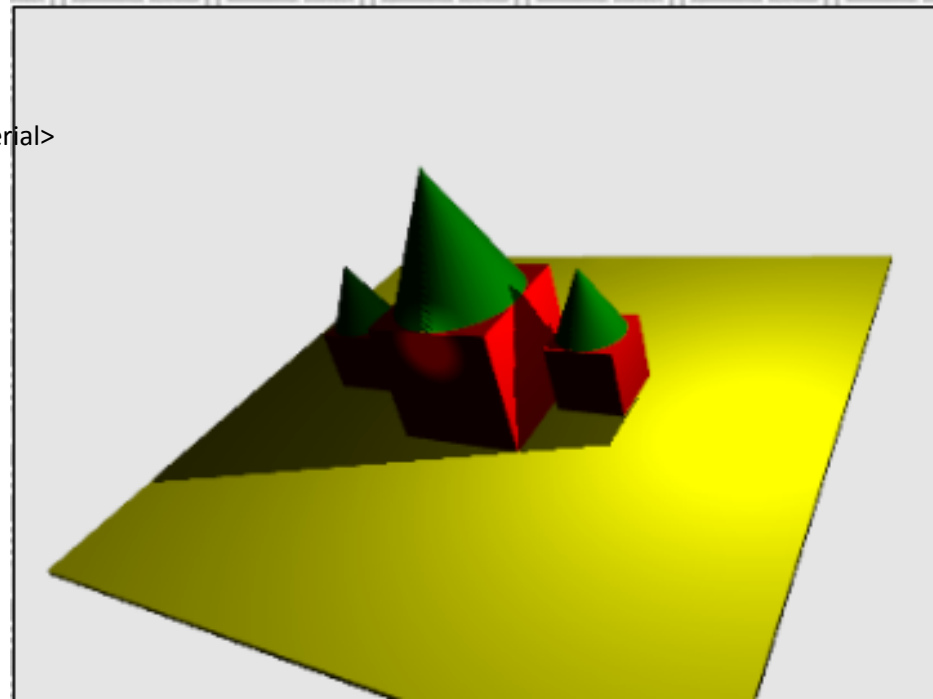
Beleuchtung

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <NavigationInfo headlight='false'/>
    <PointLight DEF='Lamp1' color='1 1 1' location='4 2 0' shadowIntensity='0.7' intensity='0.9' radius='20' ambientIntensity='0.5' global='true'/>
    <SpotLight DEF='Lamp3' color='1 1 1' location='0 0.75 4' direction='0 0 -1' shadowIntensity='0.7' intensity='0.9' radius='20'
      beamWidth='0.1' cutOffAngle='0.2' global='true'/>
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
    <Group DEF="g1" render="true">
      <Shape>
        <Appearance>
          <Material diffuseColor='red' specularColor="0.5 0.5 0.5"></Material>
        </Appearance>
        <Box solid="true"></Box>
      </Shape>
      .
      .
      .
    </Group>
  </Scene>
</X3D>
```



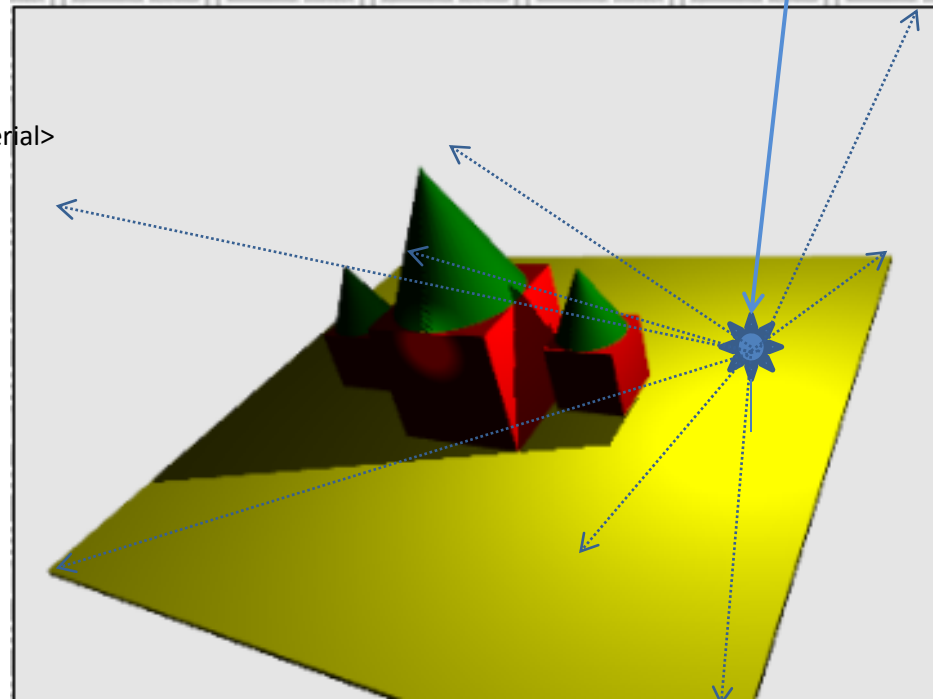
Beleuchtung

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <NavigationInfo headlight='false'/>
    <PointLight DEF='Lamp1' color='1 1 1' location='4 2 0' shadowIntensity='0.7' intensity='0.9' radius='20' ambientIntensity='0.5' global='true'/>
    <SpotLight DEF='Lamp3' color='1 1 1' location='0 0.75 4' direction='0 0 -1' shadowIntensity='0.7' intensity='0.9' radius='20'
      beamWidth='0.1' cutOffAngle='0.2' global='true'/>
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
    <Group DEF="g1" render="true">
      <Shape>
        <Appearance>
          <Material diffuseColor='red' specularColor="0.5 0.5 0.5"></Material>
        </Appearance>
        <Box solid="true"></Box>
      </Shape>
      .
      .
      .
    </Group>
  </Scene>
</X3D>
```



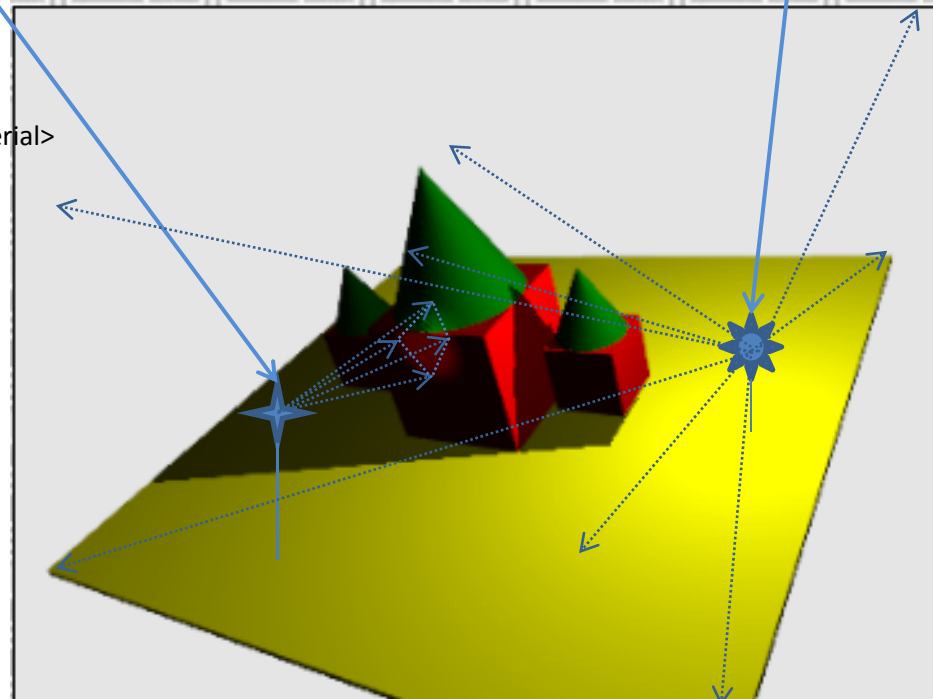
Beleuchtung

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <NavigationInfo headlight='false' />
    <PointLight DEF='Lamp1' color='1 1 1' location='4 2 0' shadowIntensity='0.7' intensity='0.9' radius='20' ambientIntensity='0.5' global='true' />
    <SpotLight DEF='Lamp3' color='1 1 1' location='0 0.75 4' direction='0 0 -1' shadowIntensity='0.7' intensity='0.9' radius='20'
      beamWidth='0.1' cutOffAngle='0.2' global='true' />
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
    <Group DEF="g1" render="true">
      <Shape>
        <Appearance>
          <Material diffuseColor='red' specularColor="0.5 0.5 0.5"></Material>
        </Appearance>
        <Box solid="true"></Box>
      </Shape>
      .
      .
      .
    </Group>
  </Scene>
</X3D>
```



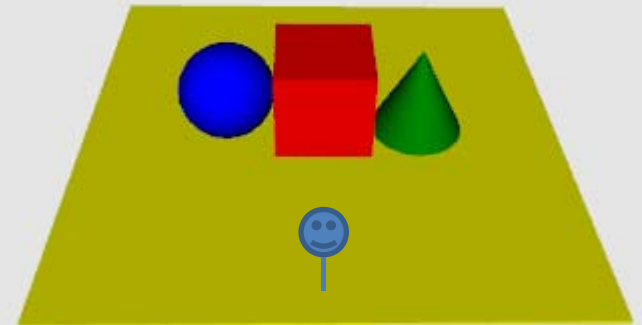
Beleuchtung

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <Scene>
    <NavigationInfo headlight='false'/>
    <PointLight DEF='Lamp1' color='1 1 1' location='4 2 0' shadowIntensity='0.7' intensity='0.9' radius='20' ambientIntensity='0.5' global='true'/>
    <SpotLight DEF='Lamp3' color='1 1 1' location='0 0.75 4' direction='0 0 -1' shadowIntensity='0.7' intensity='0.9' radius='20'
      beamWidth='0.1' cutOffAngle='0.2' global='true'/>
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
    <Group DEF="g1" render="true">
      <Shape>
        <Appearance>
          <Material diffuseColor='red' specularColor="0.5 0.5 0.5"></Material>
        </Appearance>
        <Box solid="true"></Box>
      </Shape>
      .
      .
      .
    </Group>
  </Scene>
</X3D>
```



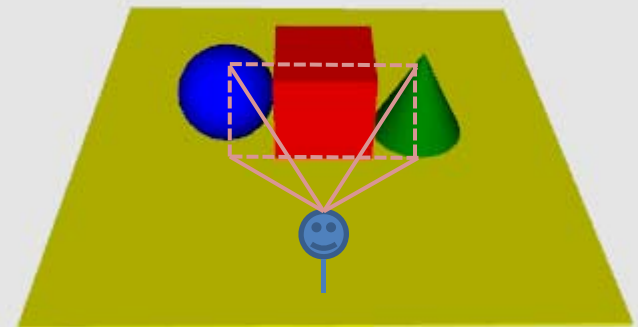
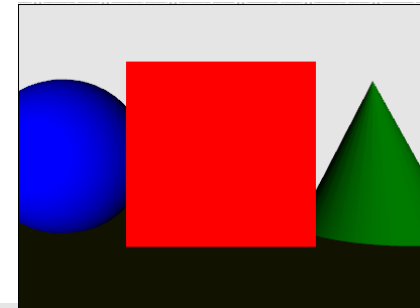
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



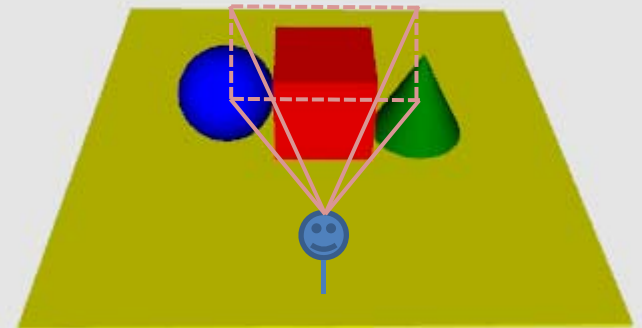
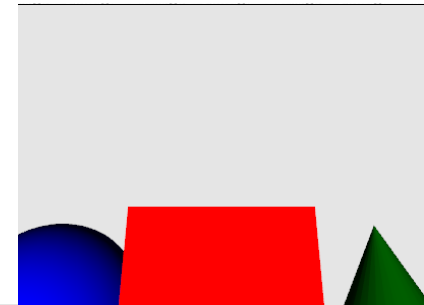
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation="0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation="1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation="0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation="0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation="0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation="0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation="0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation="0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



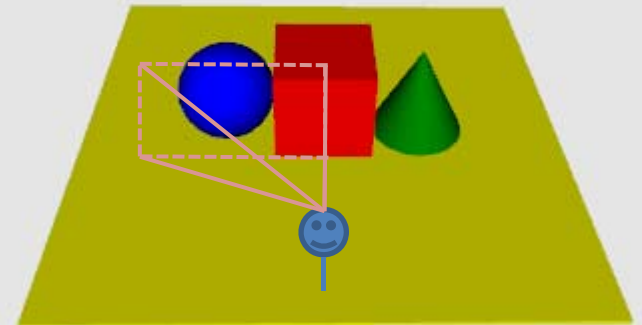
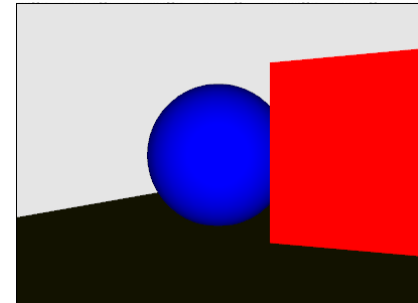
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation="0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation="1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation="0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation="0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation="0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation="0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation="0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation="0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation="0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



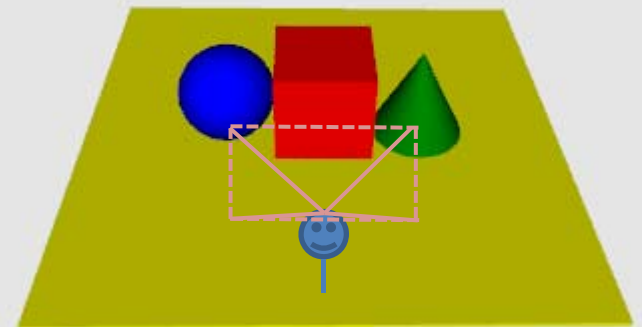
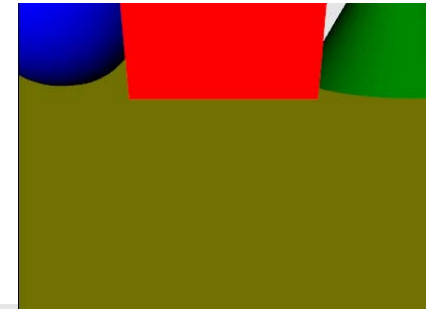
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



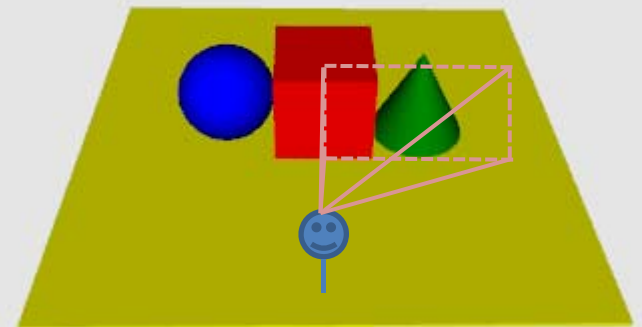
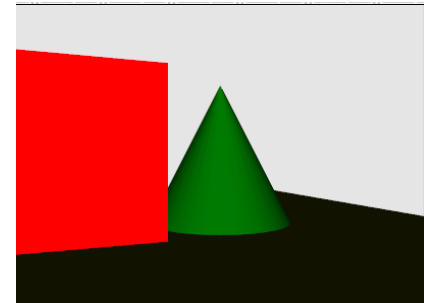
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" "ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



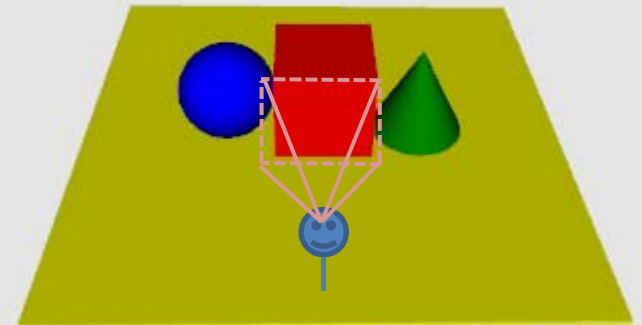
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type="" EXAMINE" "ANY"" transitionType="" ANIMATE"" transitionTime='1.0' speed="3" avatarSize="0.1 0.1 1"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



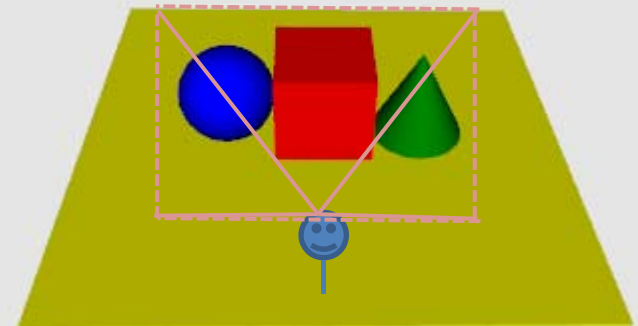
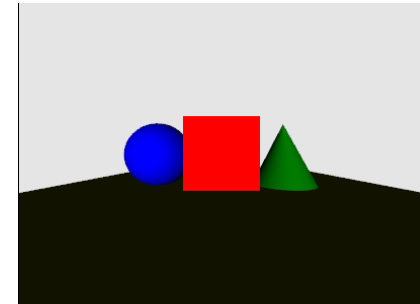
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1' />
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38" />
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38" />
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38" />
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38" />
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



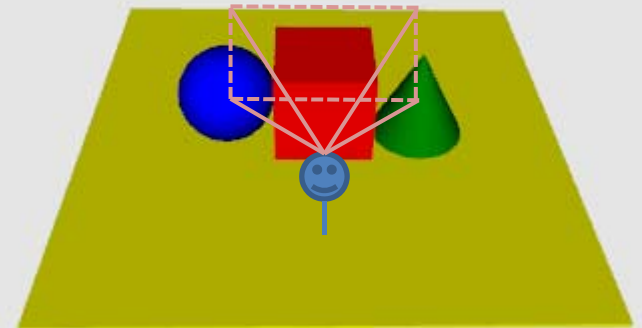
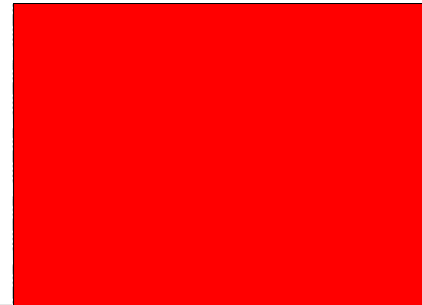
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



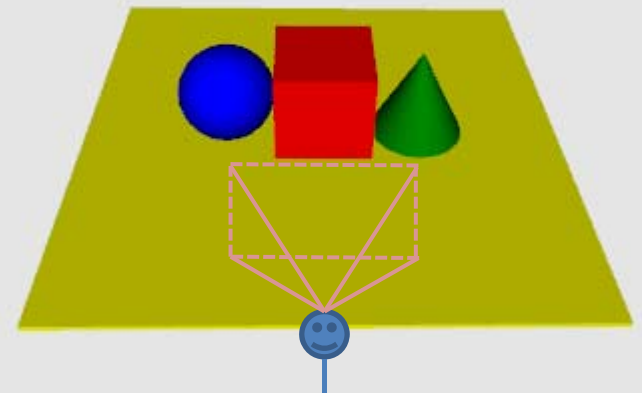
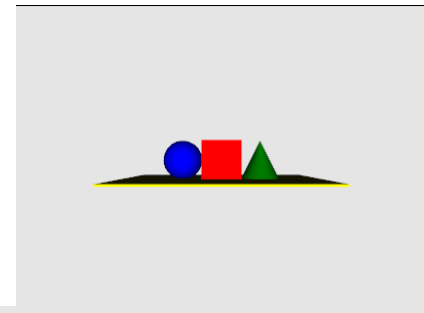
Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type="" EXAMINE" "ANY"" transitionType="" ANIMATE"" transitionTime='1.0' speed="3" avatarSize="0.1 0.1 1"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```



Viewpoint

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <NavigationInfo DEF='CatStyle' type=""EXAMINE"" ANY"" transitionType=""ANIMATE"" transitionTime='1.0' speed='3' avatarSize='0.1 0.1 1'"/>
    <Viewpoint DEF='str' position="0 0 5" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='u22' position="0 0 5" fieldOfView='0.76' orientation=" 1 0 0 0.38"/>
    <Viewpoint DEF='l22' position="0 0 5" fieldOfView='0.76' orientation=" 0 1 0 0.38"/>
    <Viewpoint DEF='d22' position="0 0 5" fieldOfView='0.76' orientation="-1 0 0 0.38"/>
    <Viewpoint DEF='r22' position="0 0 5" fieldOfView='0.76' orientation=" 0 -1 0 0.38"/>
    <Viewpoint DEF='fov22' position="0 0 5" fieldOfView='0.38' orientation=" 0 0 1 0" />
    <Viewpoint DEF='fov90' position="0 0 5" fieldOfView='1.56' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos2' position="0 0 2" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Viewpoint DEF='pos20' position="0 0 20" fieldOfView='0.76' orientation=" 0 0 1 0" />
    <Inline url="02_Simple_Shapes.x3d" />
    <Transform translation=" 0 -1 0" >
      <Shape DEF="Floor" >
        <Appearance>
          <Material DEF="FloorMat" diffuseColor='yellow' specularColor="0 0 0"></Material>
        </Appearance>
        <Box solid="true" size="10 0.1 10"></Box>
      </Shape>
    </Transform>
  </scene>
</X3D>
```

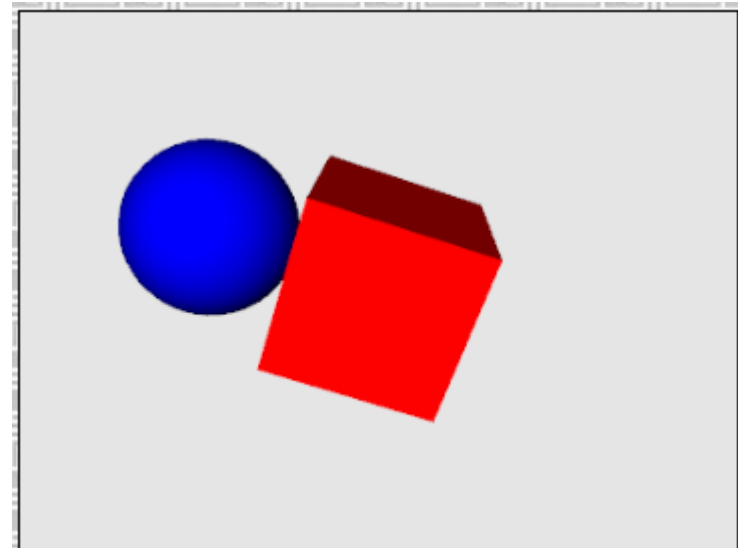


X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <shape onclick="alert('Box was clicked.');">
      <appearance>
        <material diffuseColor='red'></material>
      </appearance>
      <box></box>
    </shape>
    <transform translation="-2 0 0">
      <shape onclick="alert('Sphere was clicked.');">
        <appearance>
          <material diffuseColor='blue'></material>
        </appearance>
        <sphere></sphere>
      </shape>
    </transform>
  </scene>
</X3D>
```

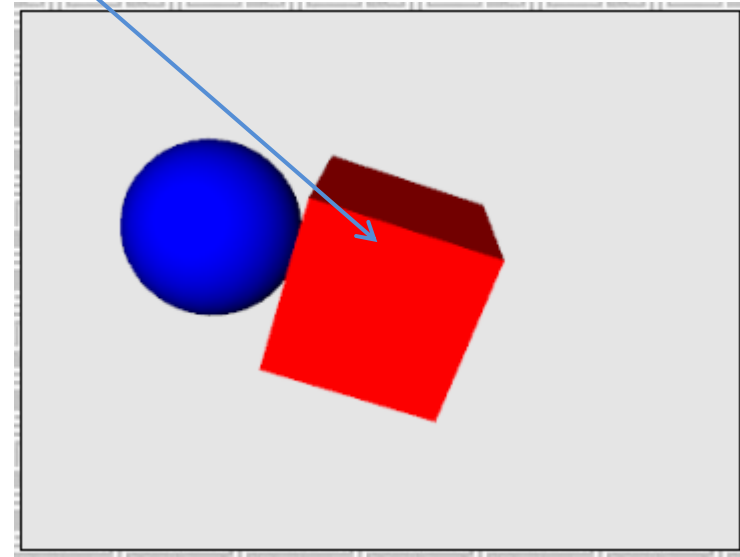
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <shape onclick="alert('Box was clicked.');">
      <appearance>
        <material diffuseColor='red'></material>
      </appearance>
      <box></box>
    </shape>
    <transform translation="-2 0 0">
      <shape onclick="alert('Sphere was clicked.');">
        <appearance>
          <material diffuseColor='blue'></material>
        </appearance>
        <sphere></sphere>
      </shape>
    </transform>
  </scene>
</X3D>
```



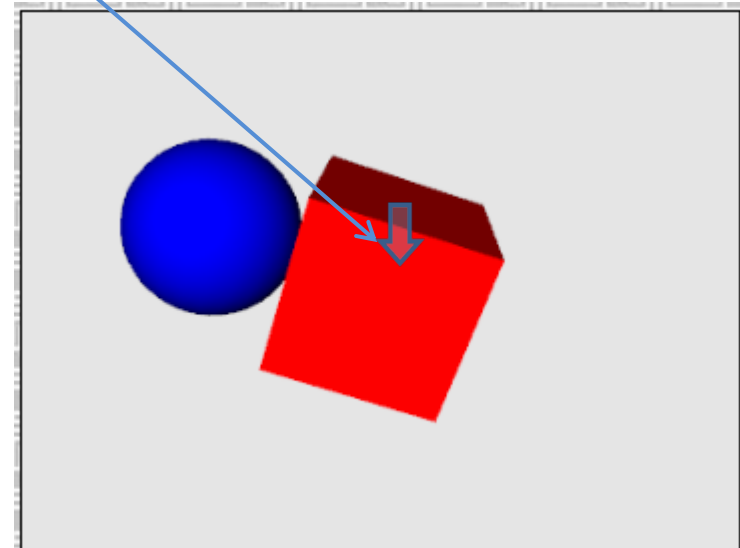
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape onclick="alert('Box was clicked.');">  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape onclick="alert('Sphere was clicked.');">  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



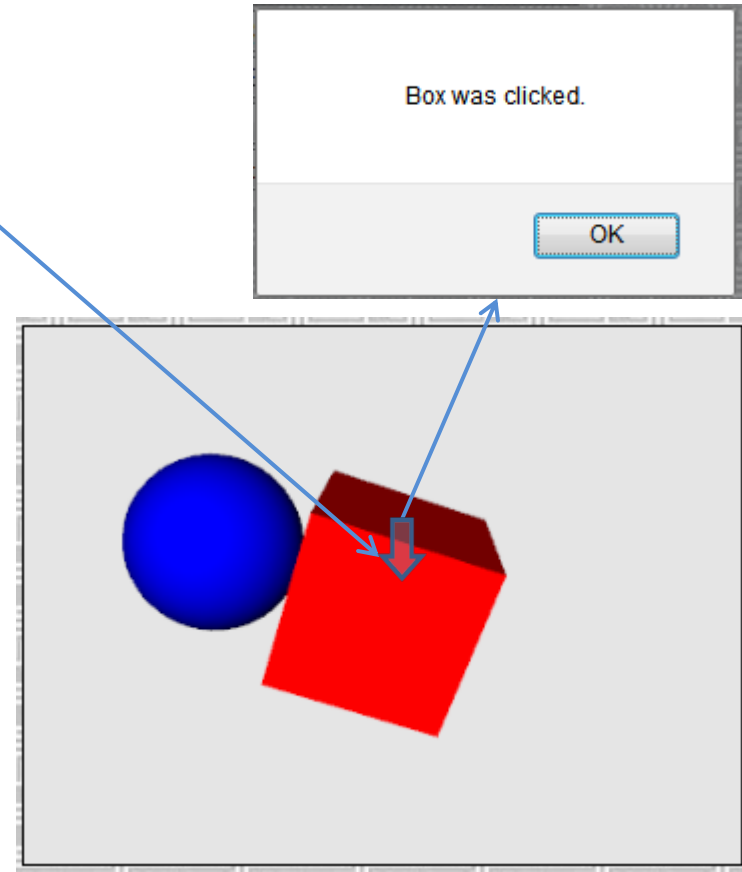
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape onclick="alert('Box was clicked.');">  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape onclick="alert('Sphere was clicked.');">  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



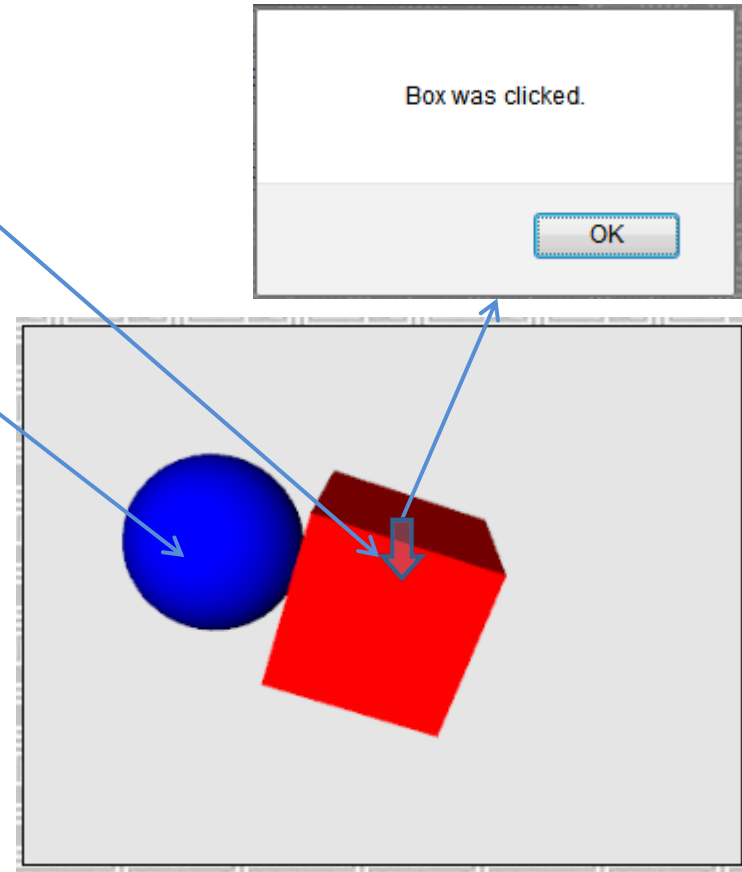
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">
  <scene>
    <shape onclick="alert('Box was clicked.');">
      <appearance>
        <material diffuseColor='red'></material>
      </appearance>
      <box></box>
    </shape>
    <transform translation="-2 0 0">
      <shape onclick="alert('Sphere was clicked.');">
        <appearance>
          <material diffuseColor='blue'></material>
        </appearance>
        <sphere></sphere>
      </shape>
    </transform>
  </scene>
</X3D>
```



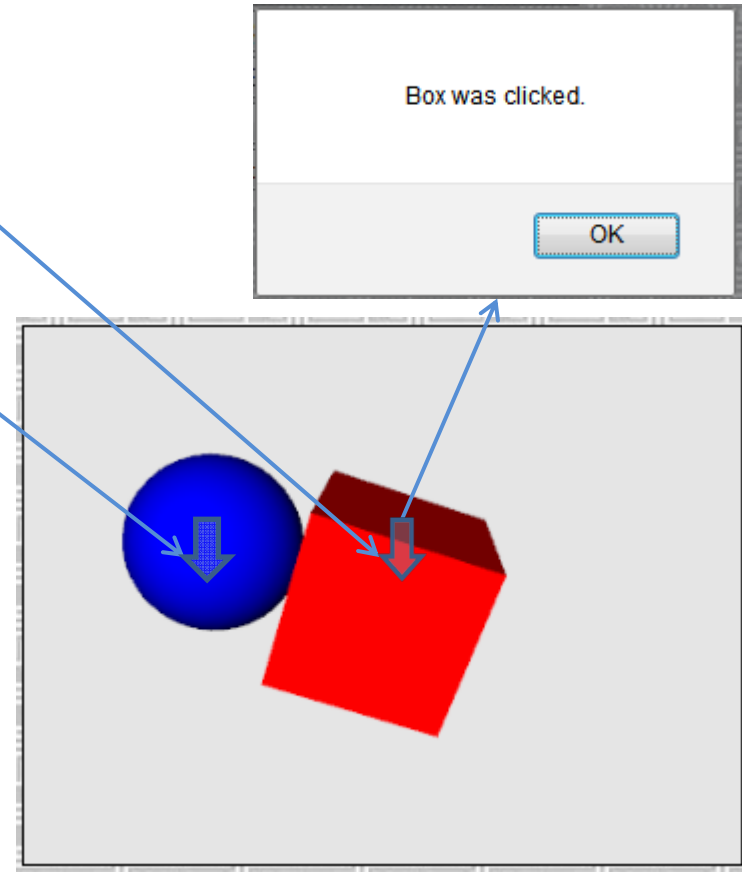
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape onclick="alert('Box was clicked.');">  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape onclick="alert('Sphere was clicked.');">  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



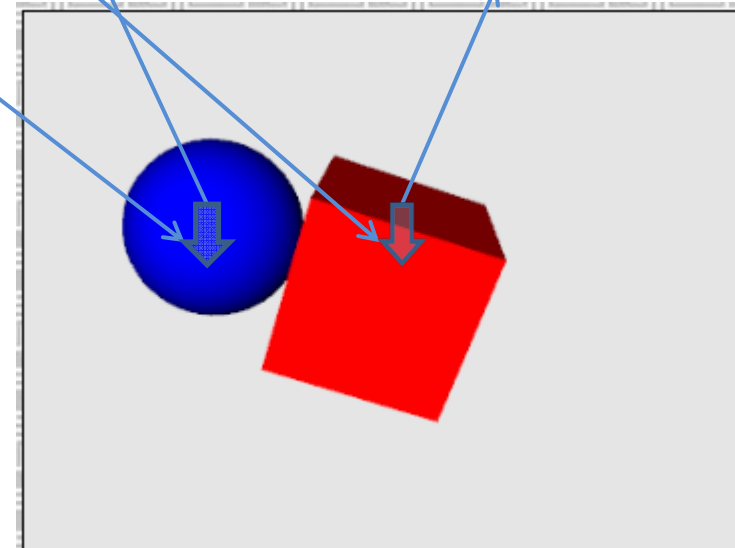
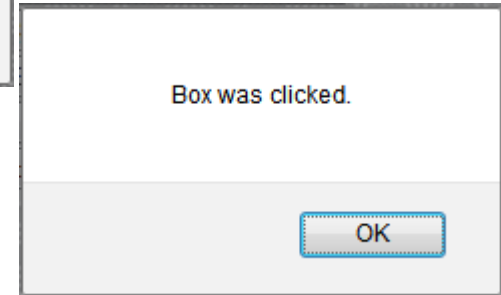
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape onclick="alert('Box was clicked.');">  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape onclick="alert('Sphere was clicked.');">  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



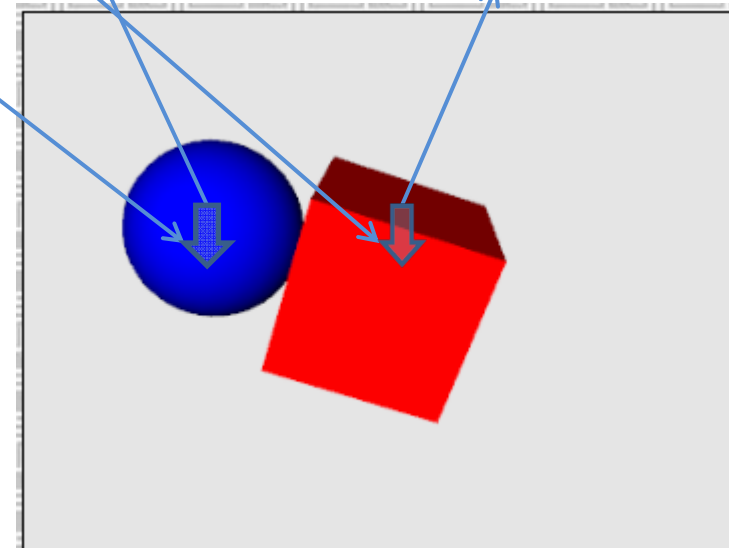
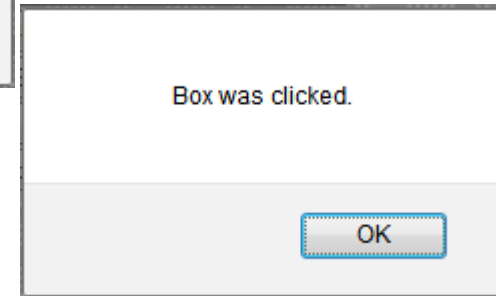
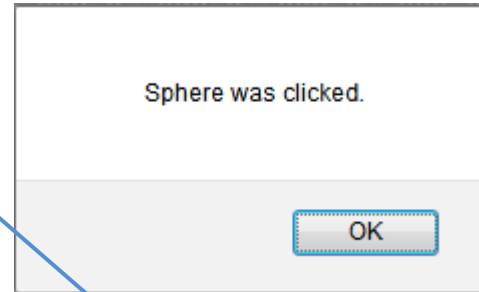
X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape onclick="alert('Box was clicked.');">  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape onclick="alert('Sphere was clicked.');">  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



X3DOM und JavaScript

```
<X3D xmlns="http://www.web3d.org/specifications/x3d-namespace" width="400px" height="300px">  
  <scene>  
    <shape onclick="alert('Box was clicked.');">  
      <appearance>  
        <material diffuseColor='red'></material>  
      </appearance>  
      <box></box>  
    </shape>  
    <transform translation="-2 0 0">  
      <shape onclick="alert('Sphere was clicked.');">  
        <appearance>  
          <material diffuseColor='blue'></material>  
        </appearance>  
        <sphere></sphere>  
      </shape>  
    </transform>  
  </scene>  
</X3D>
```



Wichtig:

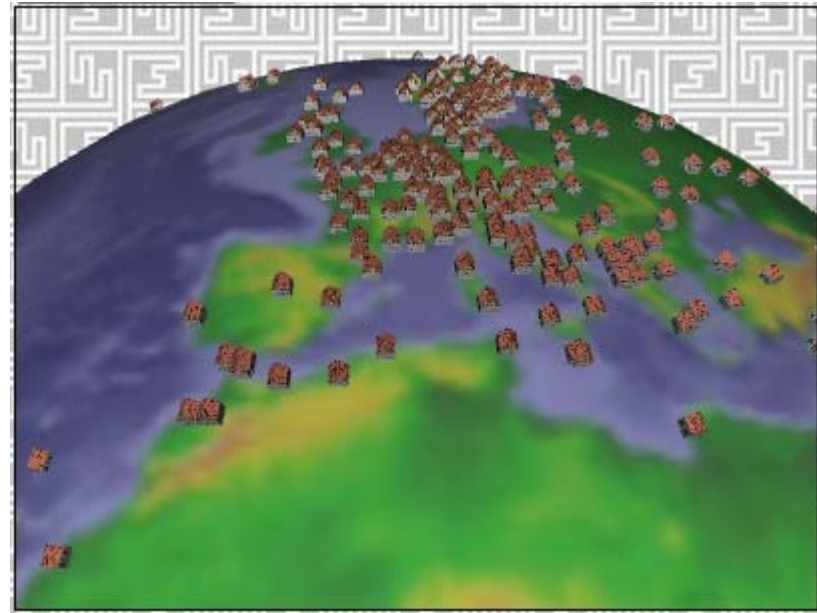
- Shape Objekt für OnClick Events nutzen
- Keine Differenzierung bei USE Referenzen

XSLT und X3D



XSLT und X3D

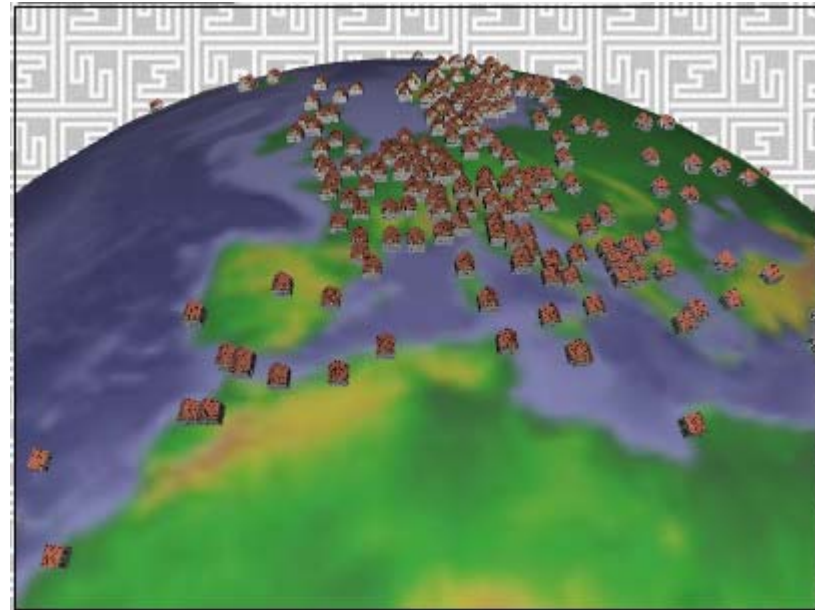
- XSLT Präambel



XSLT und X3D

- XSLT Präambel

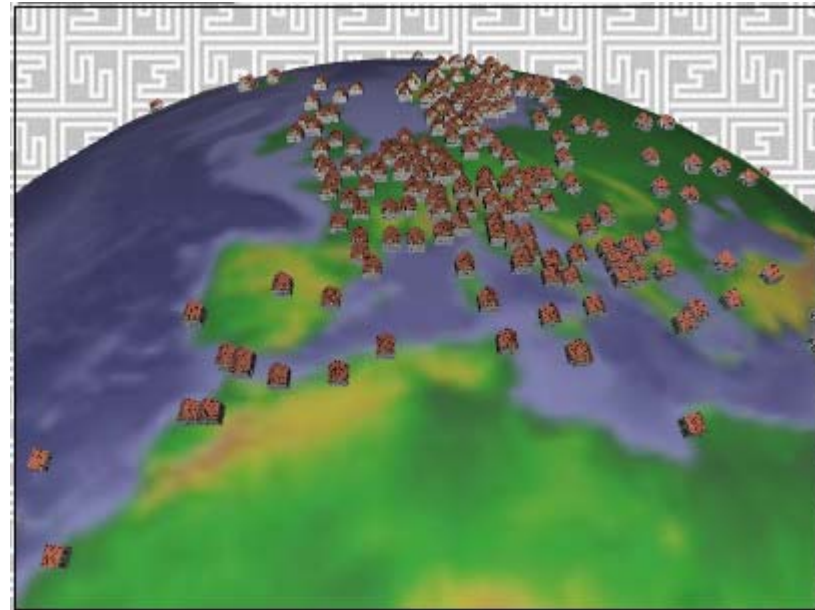
```
<xsl:stylesheet
  version="1.1"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  xmlns:h="http://www.w3.org/1999/xhtml"
  xmlns:d="http://www.web3d.org/specifications/x3d-namespace"
  xmlns="http://www.web3d.org/specifications/x3d-namespace"
  exclude-result-prefixes="html"
>
<xsl:output
  media-type="application/xhtml+xml"
  method="xml"
  indent="yes"
  doctype-system="http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
  doctype-public="-//W3C//DTD XHTML 1.0 Strict//EN"/>
```



XSLT und X3D

- XSLT Präambel

```
<xsl:stylesheet
  version="1.1"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  xmlns:h="http://www.w3.org/1999/xhtml"
  xmlns:d="http://www.web3d.org/specifications/x3d-namespace"
  xmlns="http://www.web3d.org/specifications/x3d-namespace"
  exclude-result-prefixes="html"
>
<xsl:output
  media-type="application/xhtml+xml"
  method="xml"
  indent="yes"
  doctype-system="http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
  doctype-public="-//W3C//DTD XHTML 1.0 Strict//EN"/>
```



- Nutzung von Namespaces wichtig

XSLT und X3D

- XSLT Präambel

```
<xsl:stylesheet
  version="1.1"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  xmlns:h="http://www.w3.org/1999/xhtml"
  xmlns:d="http://www.web3d.org/specifications/x3d-namespace"
  xmlns="http://www.web3d.org/specifications/x3d-namespace"
  exclude-result-prefixes="html"
>
<xsl:output
  media-type="application/xhtml+xml"
  method="xml"
  indent="yes"
  doctype-system="http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
  doctype-public="-//W3C//DTD XHTML 1.0 Strict//EN"/>
```



- Nutzung von Namespaces wichtig
- X3d-namespace muss default sein

X3D und Xpath

X3D und Xpath

- Xpath Evaluierung des JavaScript DOM kann direkt genutzt werden

X3D und Xpath

- Xpath Evaluierung des JavaScript DOM kann direkt genutzt werden

```
<h:script type="text/javascript">  
<![CDATA[
```

```
]]>  
</h:script>
```

X3D und Xpath

- Xpath Evaluierung des JavaScript DOM kann direkt genutzt werden

```
<h:script type="text/javascript">  
<![CDATA[
```

```
function xpath( exp ){  
  var evaluator = new XPathEvaluator();  
  var resultxp = evaluator.evaluate(exp, document.documentElement, resolver, 7, null);  
  for(var i=0; i<resultxp.snapshotLength; i++){  
    var currentNodeValue = resultxp.snapshotItem(i);  
    //DO SOMETHING....  
  }  
}  
]]>  
</h:script>
```

X3D und Xpath

- Xpath Evaluierung des JavaScript DOM kann direkt genutzt werden
- Ein Namespace Resolver muss implementiert werden

```
<h:script type="text/javascript">  
<![CDATA[
```

```
function xpath( exp ){  
  var evaluator = new XPathEvaluator();  
  var resultxp = evaluator.evaluate(exp, document.documentElement, resolver, 7, null);  
  for(var i=0; i<resultxp.snapshotLength; i++){  
    var currentNodeValue = resultxp.snapshotItem(i);  
    //DO SOMETHING....  
  }  
}  
]]>  
</h:script>
```

X3D und Xpath

- Xpath Evaluierung des JavaScript DOM kann direkt genutzt werden
- Ein Namespace Resolver muss implementiert werden

```
<h:script type="text/javascript">
<![CDATA[
function resolver(prefix){
  switch(prefix){
    case "h": return "http://www.w3.org/1999/xhtml";
    case "x": return "http://www.web3d.org/specifications/x3d-namespace";
    default: return "http://www.web3d.org/specifications/x3d-namespace";
  }
}
function xpath( exp ){
  var evaluator = new XPathEvaluator();
  var resultxp = evaluator.evaluate(exp, document.documentElement, resolver, 7, null);
  for(var i=0; i<resultxp.snapshotLength; i++){
    var currentNodeValue = resultxp.snapshotItem(i);
    //DO SOMETHING....
  }
}
]]>
</h:script>
```

Mondial X3D

My X3DOM world

This is my first html page with some 3d objects.

evaluate XPath //d.group[@DEF='Germany']



Mondial X3D

- Erzeugt mit XSLT

My X3DOM world

This is my first html page with some 3d objects.

evaluate XPath `//d:group[@DEF='Germany']`



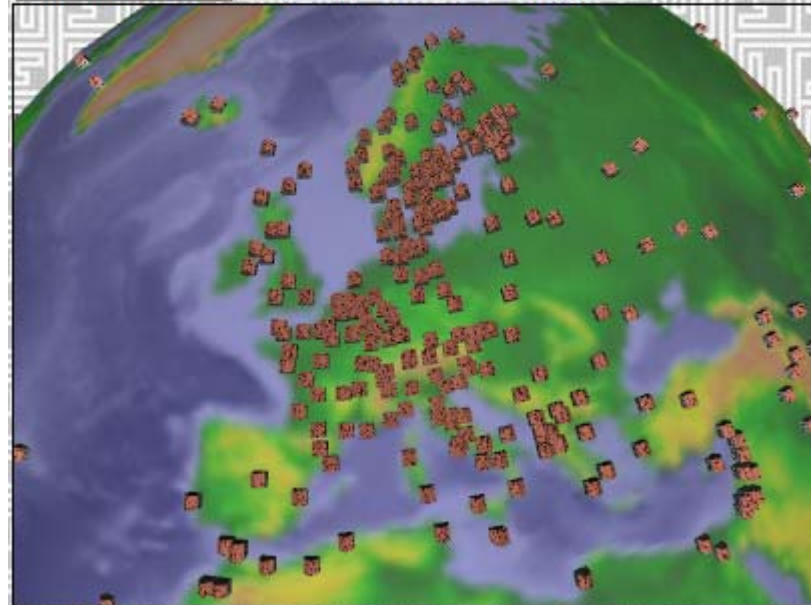
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes

My X3DOM world

This is my first html page with some 3d objects.

evaluate XPath `//d:group[@DEF='Germany']`



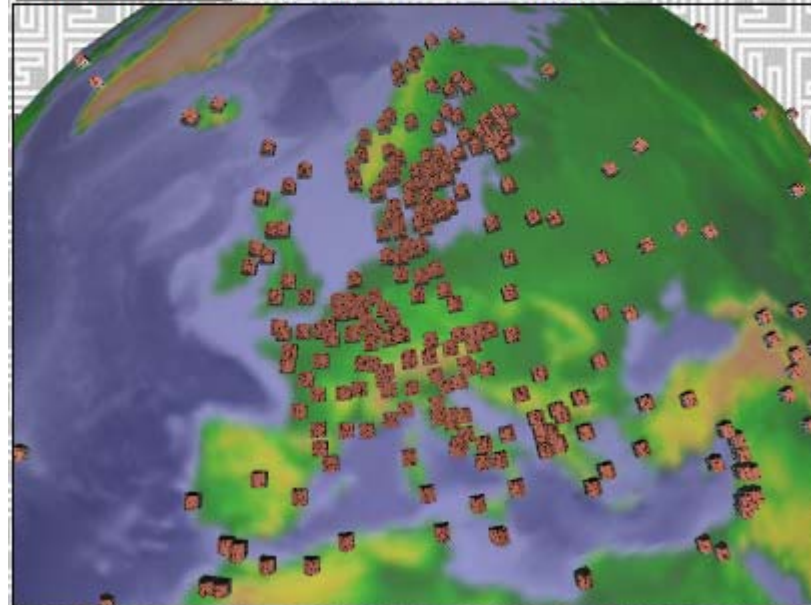
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen

My X3DOM world

This is my first html page with some 3d objects.

evaluate XPath `//d:group[@DEF='Germany']`



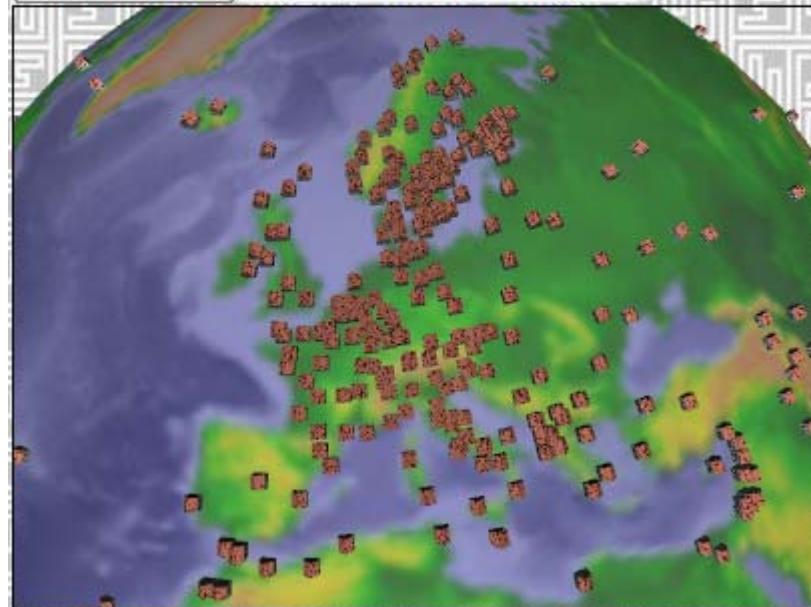
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen

My X3DOM world

This is my first html page with some 3d objects.

evaluate XPath `//d:group[@DEF='Germany']`



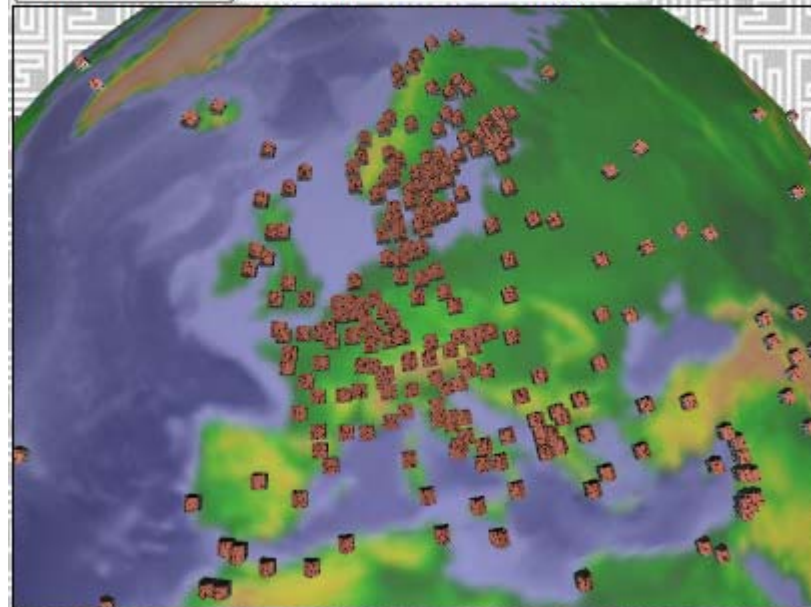
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen
- JavaScript Events

My X3DOM world

This is my first html page with some 3d objects.

evaluate XPath `//d:group[@DEF='Germany']`



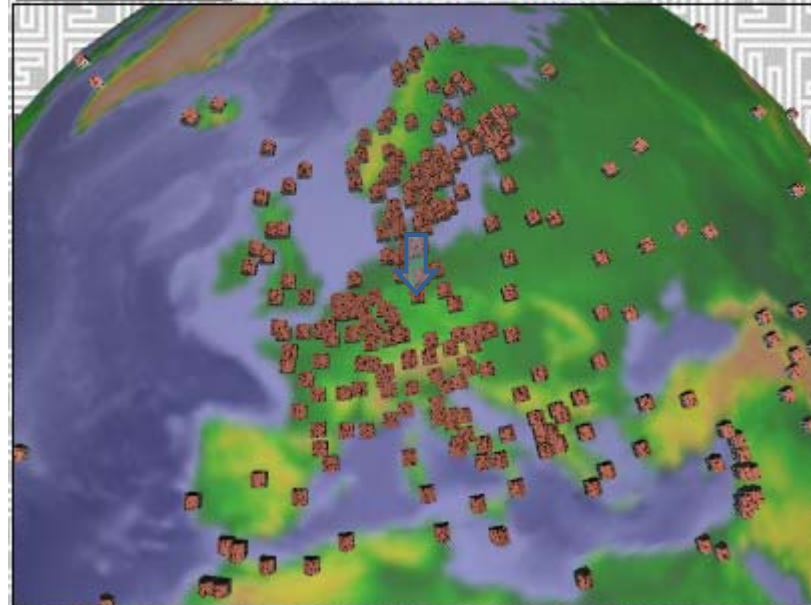
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen
- JavaScript Events

My X3DOM world

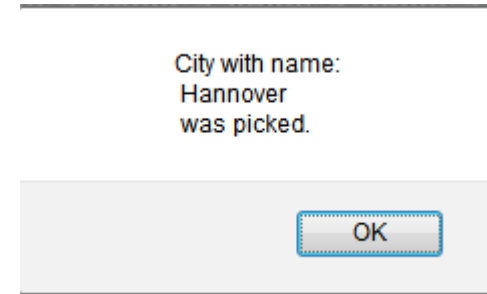
This is my first html page with some 3d objects.

evaluate xPath `//d:group[@DEF='Germany']`



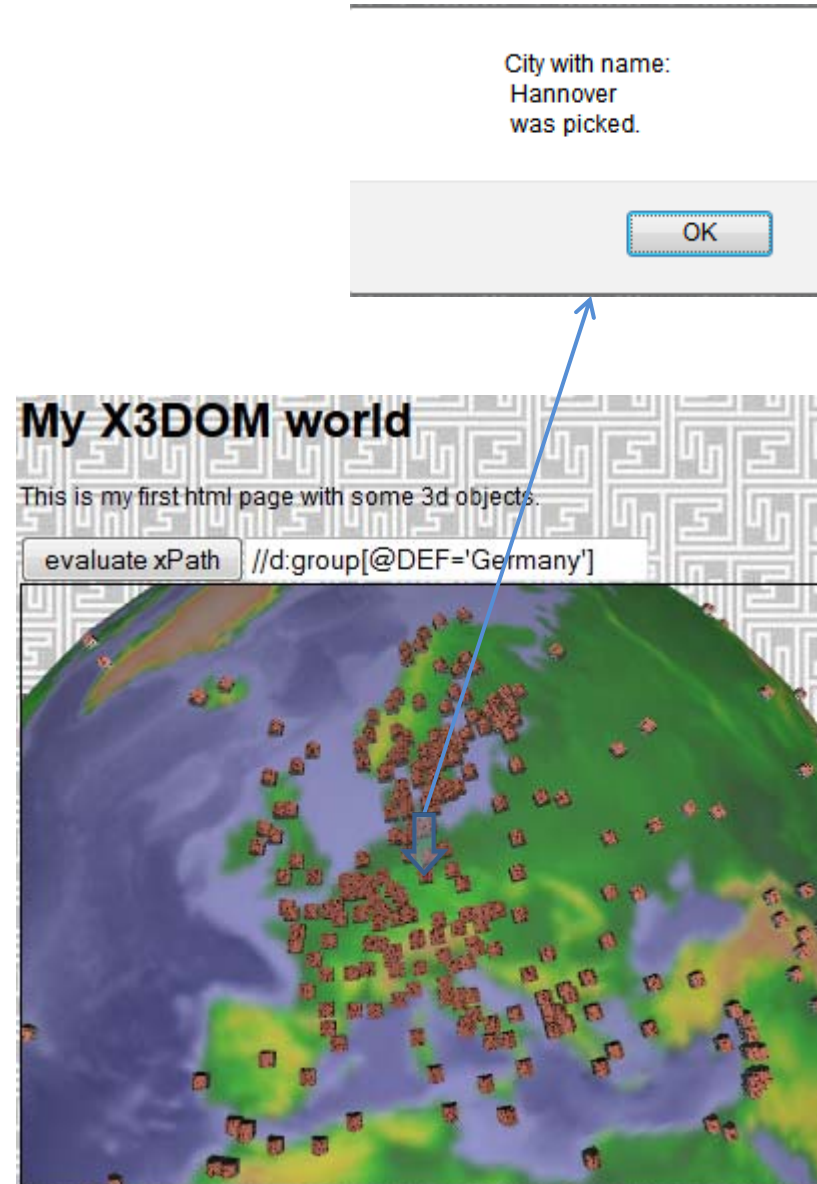
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen
- JavaScript Events



Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen
- JavaScript Events
- XPath Selektion zum verbergen von Ländern



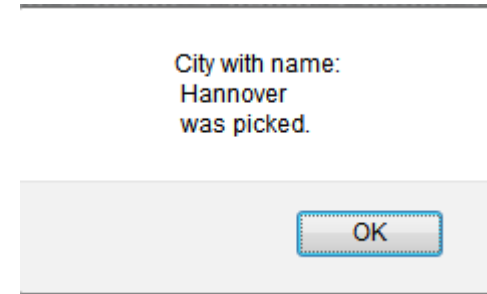
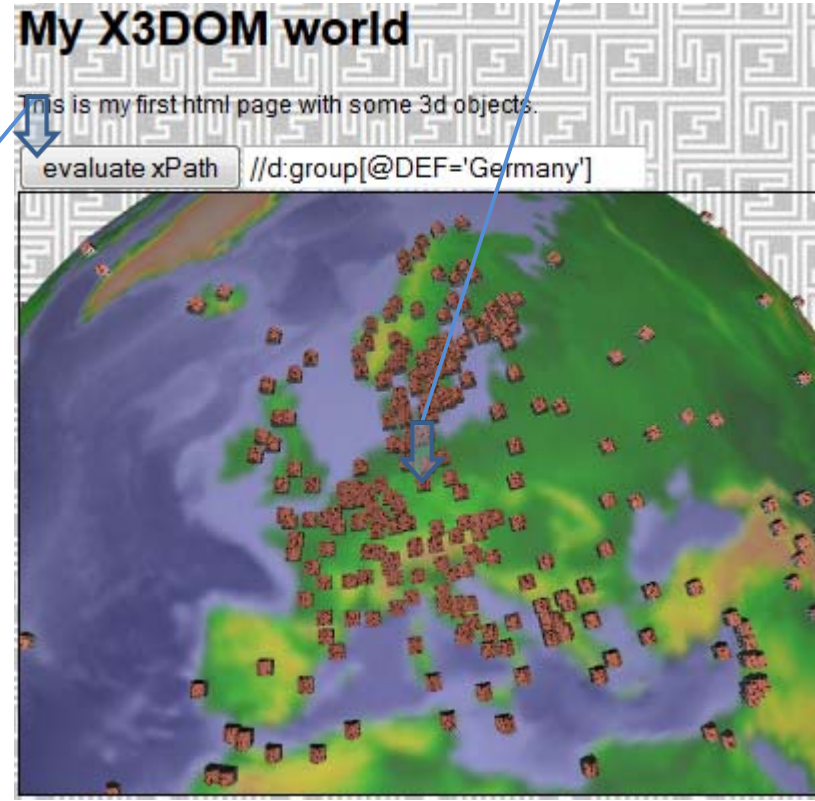
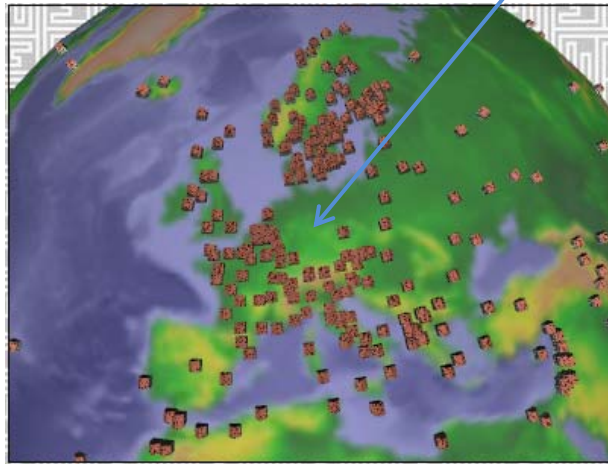
Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen
- JavaScript Events
- XPath Selektion zum verbergen von Ländern

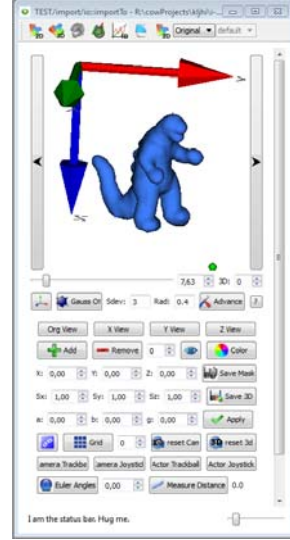
The screenshot shows a 3D application titled "My X3DOM world" with a background of a maze. The text "This is my first html page with some 3d objects." is visible. Below it is a console with the command `evaluate XPath //d:group[@DEF='Germany']`. A blue arrow points from the console to a dialog box that says "City with name: Hannover was picked." and has an "OK" button.

Mondial X3D

- Erzeugt mit XSLT
- Einfache Shapes
- Komplexe Formen
- Texturen
- JavaScript Events
- XPath Selektion zum verbergen von Ländern

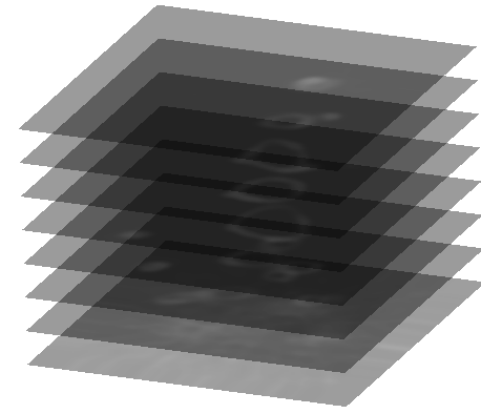
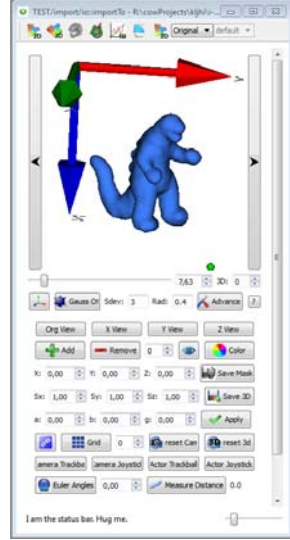


VTK Viewer



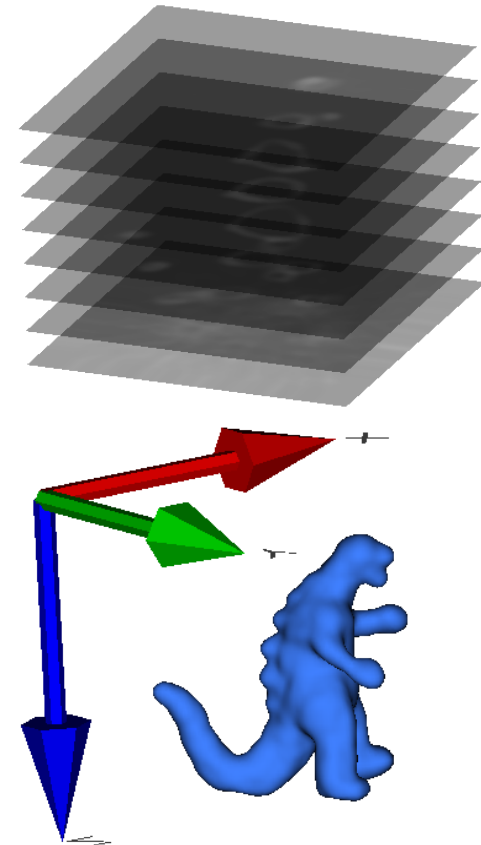
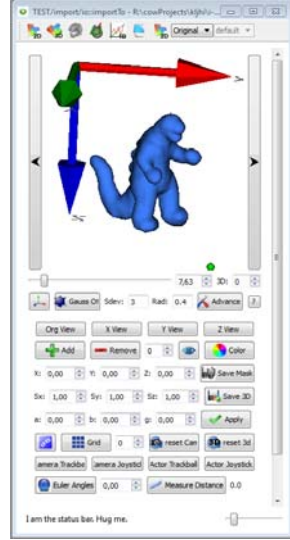
VTK Viewer

- Visualisierung von 3D Volumen Daten



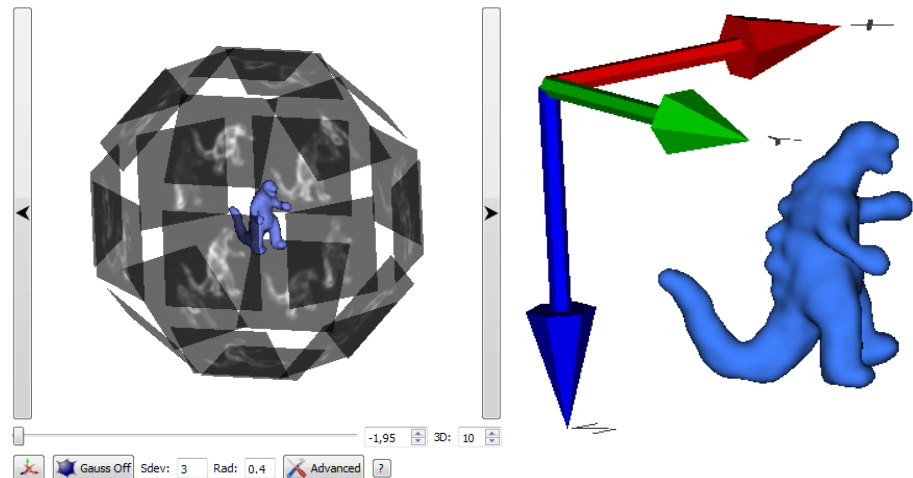
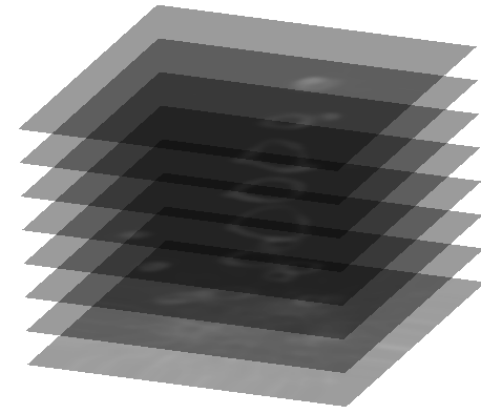
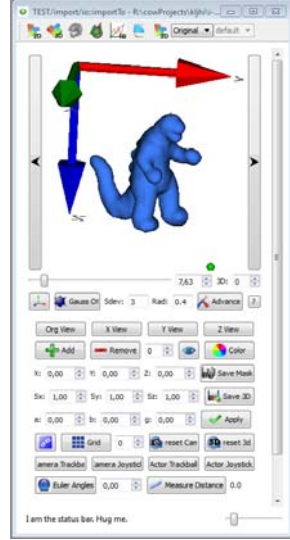
VTK Viewer

- Visualisierung von 3D Volumen Daten
- Marching Cube Algorithmus
Isosurface (Gittermodell)



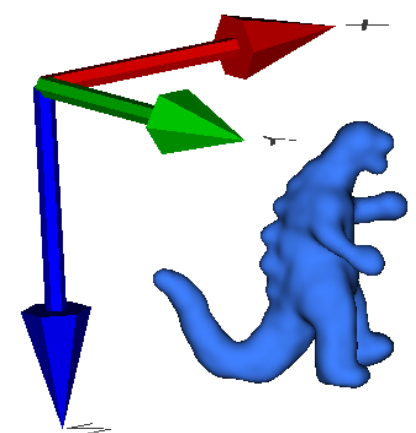
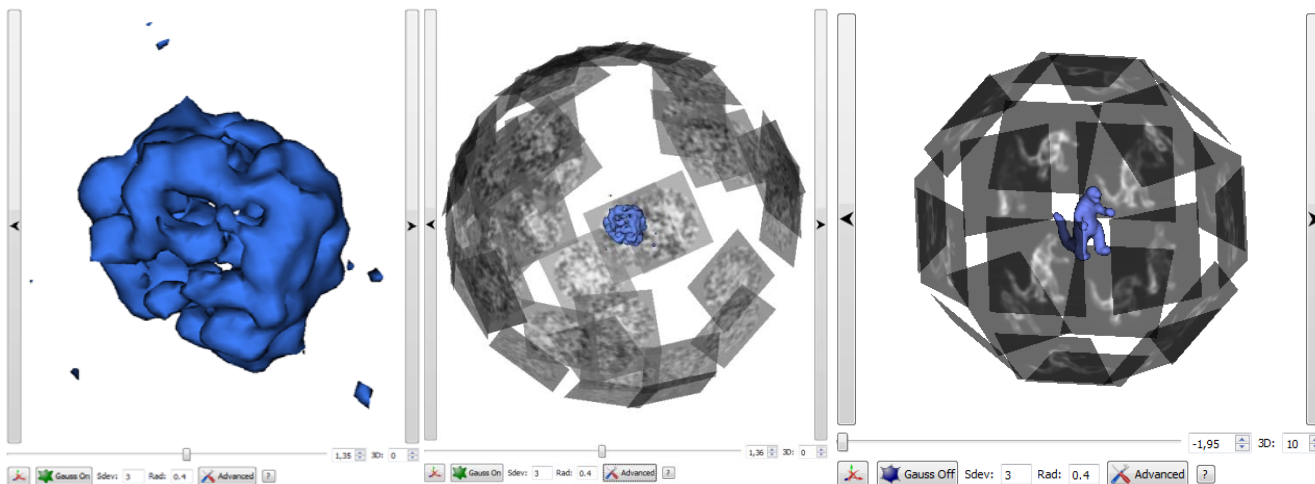
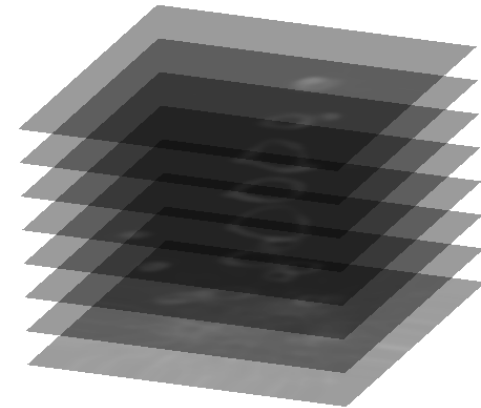
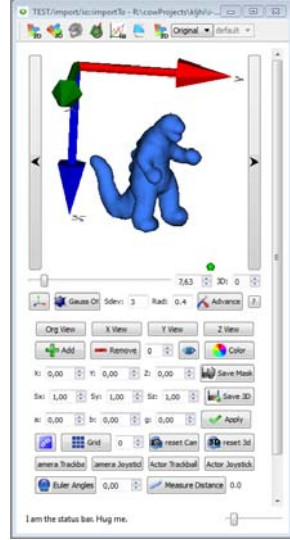
VTK Viewer

- Visualisierung von 3D Volumen Daten
- Marching Cube Algorithmus
Isosurface (Gittermodell)
- 3D Volumen wird aus Projektions-
Bildern gewonnen



VTK Viewer

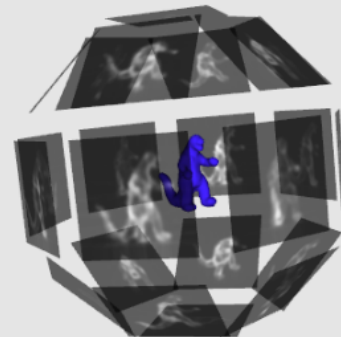
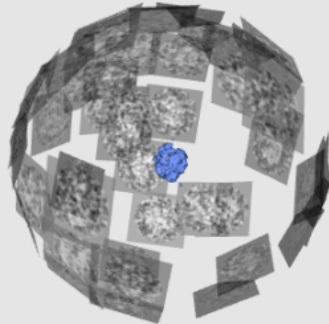
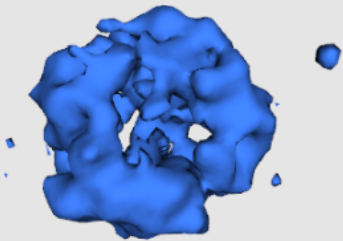
- Visualisierung von 3D Volumen Daten
- Marching Cube Algorithmus
Isosurface (Gittermodell)
- 3D Volumen wird aus Projektions-
Bildern gewonnen



VTK Export nach X3D

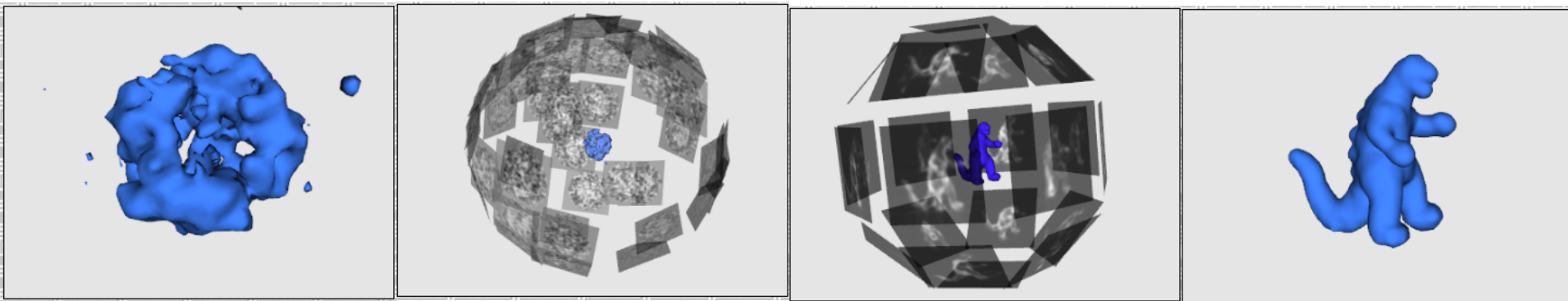
VTK Export nach X3D

- VTK bietet ein Exportmodul



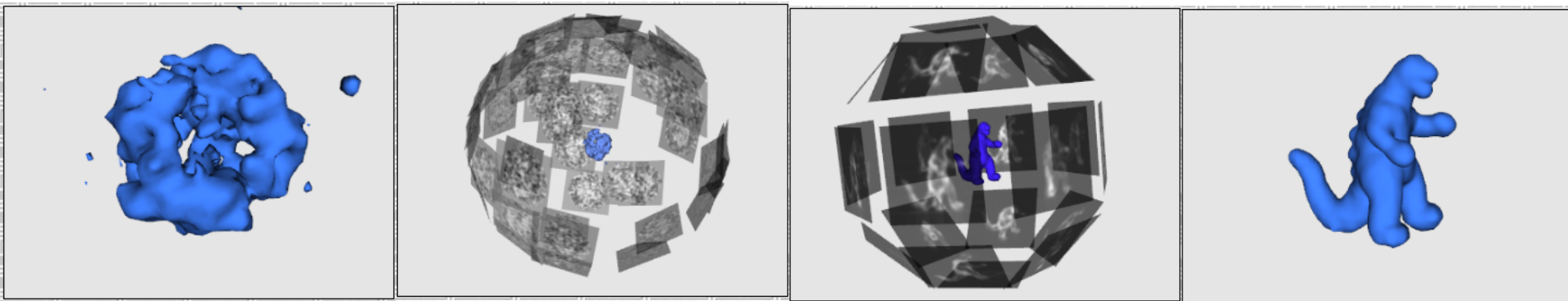
VTK Export nach X3D

- VTK bietet ein Exportmodul
- Texturkoordinaten werden invertiert



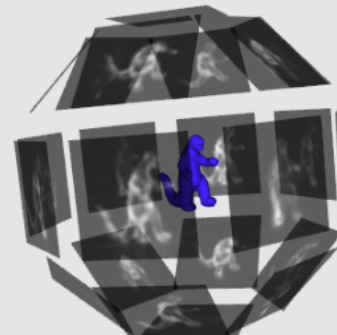
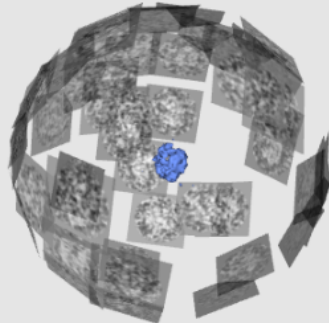
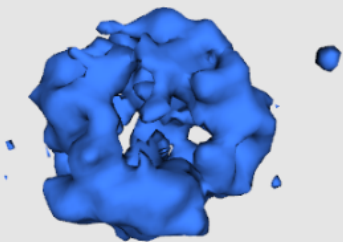
VTK Export nach X3D

- VTK bietet ein Exportmodul
- Texturkoordinaten werden invertiert
- Rotation werden invertiert



VTK Export nach X3D

- VTK bietet ein Exportmodul
- Texturkoordinaten werden invertiert
- Rotation werden invertiert
- => Leichte Modifikation notwendig



Links und Quellen

- <http://www.blender.org/>
Blender Homepage
- <http://www.vtk.org/>
VTK Homepage
- <http://www.web3d.org/x3d/content/X3dTooltips.html>
Kommentierte DTD zu X3D
- <http://x3dgraphics.com/>
Hilfreiche Beispiele zu X3D
- <http://www.x3dom.org/>
x3dom Homepage. Mit vielen Beispielen und Erklärungen

Antonia Kirves

Geboren 10.06.2013



Vielen Dank für die Aufmerksamkeit

