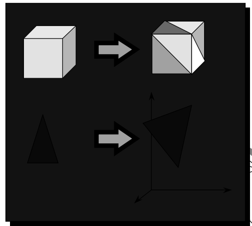
Dreidimensionale, virtuelle Welten im Web

- Grundlagen: 3D Graphik
- VRML
  - Einführung
  - statische Szenen
  - Animationen

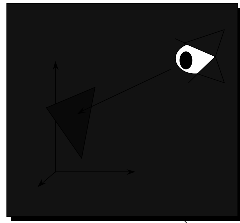
Graphics Pipeline

- Transform



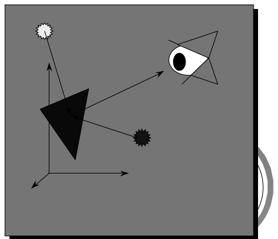
Graphics Pipeline

- Transform
- Backface Cull



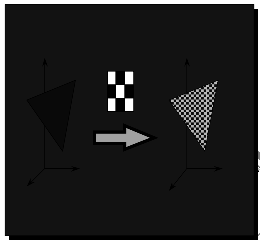
Graphics Pipeline

- Transform
- Backface Cull
- Lighting



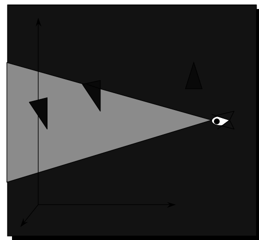
Graphics Pipeline

- Transform
- Backface Cull
- Lighting
- Texture Transform



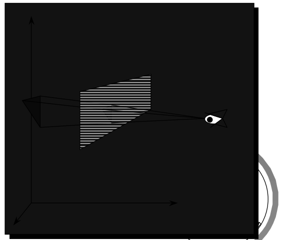
Graphics Pipeline

- Transform
- Backface Cull
- Lighting
- Texture Transform
- View Cull and Clip



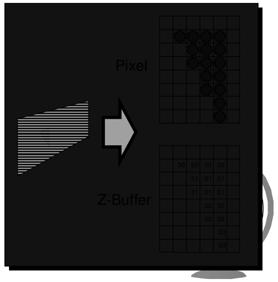
Graphics Pipeline

- ➤ Transform
- ➤ Backface Cull
- ➤ Lighting
- ➤ Texture Transform
- ➤ View Cull and Clip
- ➤ View Project



Graphics Pipeline

- ➤ Transform
- ➤ Backface Cull
- ➤ Lighting
- ➤ Texture Transform
- ➤ View Cull and Clip
- ➤ View Project
- ➤ Rasterize



VRML

Dreidimensionale, virtuelle Welten im Internet

Geschichte von VRML

- 1994/95 VRML 1.0 (Mark Pesce)
  - beruht auf SGI’s Open Inventor
- 1995: erste Browser und PlugIns
- 1996: VRML 2.0
  - beruht auf SGI’s Moving Worlds
- Ende 1997: VRML97 wird ISO-Standard

Virtual Reality

State of the Art:

Virtual Reality = grafische Simulation von dreidimensionalen Räumen mit eingeschränkten Interaktionsmöglichkeiten

Idee von VRML

- Räume sind durch Hyperlinks über das Internet verbunden
- mehrere Benutzer können gleichzeitig in diesen Räumen agieren
- Einbetten anderer Medien
- architekturunabhängig
- erweiterbar
- niedrige Bandbreiten (Modem)

Internet-Metapher

- **WWW: Buch, Querverweise**
  verwobenes Dokument, in dem der Benutzer blättert.
- **VRML: Welt, Cyberspace, “Tunnel”**
  gigantischer Raum (Universum), in dem sich der Benutzer bewegt.

Konzepte von VRML 2.0

- Szenengraph, Knoten
- Prototypen
- Events, Sensoren, Interpolatoren
- Routes
- Script-Knoten

VRML: Beispiel

pfeil.wrl

```
#VRML V2.0 utf8
DEF APP Appearance {
        material Material { diffuseColor 1 0 0 } }
Shape { appearance USE APP
            geometry Cylinder { radius 1 height 5 } }
Anchor { children
  Transform { translation 0 4 0
    children Shape { appearance USE APP
                  geometry Cone { bottomRadius 2
                                   height 3 } } }
  url "anotherWorld.wrl" }
```

Statische Szenen

- Geometrie
- Erscheinungsbild (Oberflächen)
- Transformationen

Geometrische Knoten

- Maße: Meter, Radian
- Geometrische Knoten
  - `Sphere { radius 0.5 }`
  - `Cone { bottomRadius 3 height 5 }`
  - `Cylinder { radius 3  height 5 }`
  - `Box { size 0.5 2 3 }`
  - `Text { string “Beispieltext”`

    ```
            fontstyle FontStyle
              { size 2  family “SANS”
                style “BOLD” } }
    ```

Geometrische Knoten

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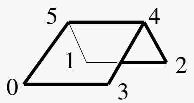
    ```

außerdem: IndexedLineSet
IndexedFaceSet
PointSet

Beispiel zu IndexedFaceSet

WRL Datei




```
IndexedFaceSet { coord Coordinate {
                  point [ -1 0  1,
                          -1 0 -1,
                           1  0 -1,
                           1  0  1,
                           1  1  0,
                          -1  1  0 ]
                  }
                coordIndex [ 0,1,2,3,-1,
                             0,3,4,5,-1,
                             1,2,4,5,-1
                             ]
              }
```

Erscheinungsbild

```
Shape {
  geometry Box { size 1 4 2 }
  appearance Appearance { material  ...
                          texture ...
                        }
}
```

Erscheinungsbild (Appearance)

- Oberflächenfarbe

```
Material
  { diffuseColor  0.2 0.3 0.8
    ambientIntensity 0.2
    emissiveColor   0 0.3 0.1
    shininess 0.8
    transparency 0.8  }
```

Erscheinungsbild (Appearance)

- Oberflächentextur

```
ImageTexture
  { url "stephan.jpg"
    repeatS TRUE
    repeatT TRUE
  }
```

Paket

- außerdem: PixelTexture,
  MovieTexture

Transformationen

```
Transform { children Shape { ... }
            translation 0 1 0
            rotation 0 1 0 1.57
            scale 1 2 1
          }
```

Verschachtelte Transformationen

```
Transform {
  translation 0 1 0
  children
    Transform {
      translation 0 0 1
      children Shape { ... }
    }
}
```

weitere (statische) Knoten

- `LOD`
- `Switch`
- `Anchor`
- Lichtquellen, z.B. `SpotLight`
- `Inline`
- `Background`
- `Viewpoint`

DEF/USE

```
DEF Kugel
 Shape { geometry
          Sphere { radius 3 }
       }
Transform { translation 0 2 0
            children USE Kugel
          }
```

Erweiterbarkeit (Prototypes)

```
PROTO Kugel
      [ field SFColor col 0 0 0.2 ]
{ Shape { geometry Sphere { radius 3 }
   appearance Appearance { material
     Material { diffuseColor IS col }
    }
  }
}

Kugel { col 0 1 0.5 }
```