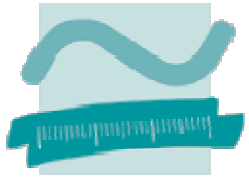
Teaching Computer Graphics and Multimedia with Quest3D

Heinrich P. Godbersen



Technische Fachhochschule Berlin

Quest3D Conference, Aachen Sept. 2007

www.godbersen.eu

1 Introduction

Setting:

- 9000 students, 100 graduate annually in “Medieninformatik”
- Study of computer science, with focus on multimedia
- Java is first programing language

2 Visual Programing / Data Flow Languages

3 Computer Graphics

4 Multimedia Projects

- Diploma Thesis
- Spin-Offs

5 Research: Low Cost Virtual Environment

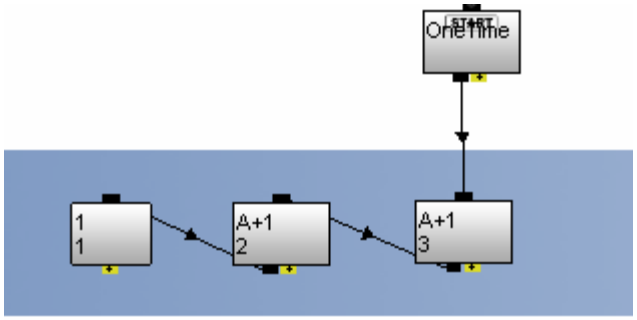
6 Results

2 Visual Programing and Dataflow Languages

Students relate Quest3D concepts to their own programing language experiences

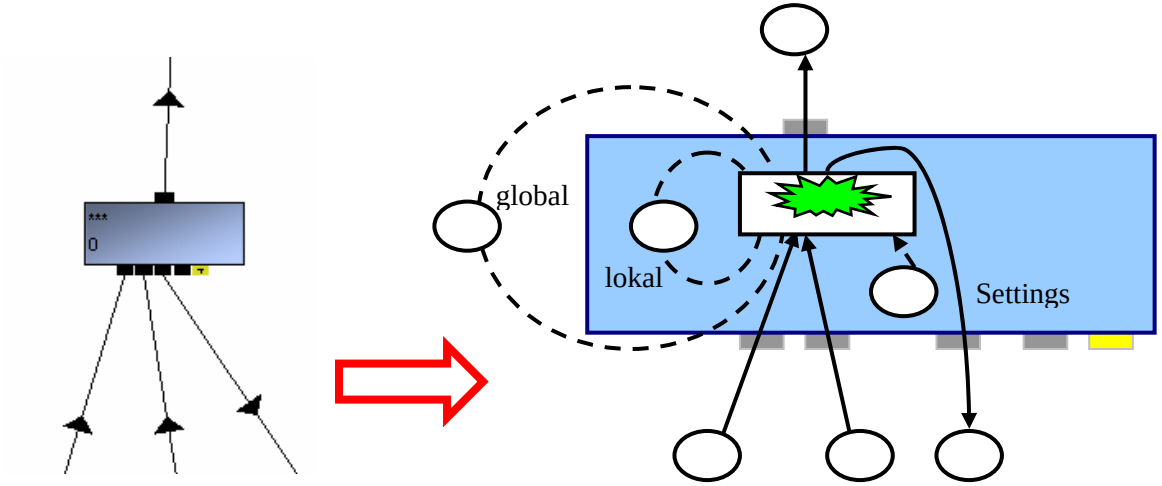
I relate to my research work on visual programing (1980 +)

integrated into scene graph



Mix of Control- and Dataflow. Use CallOnGetChild to focus on data flow

Petri Net / Function Net



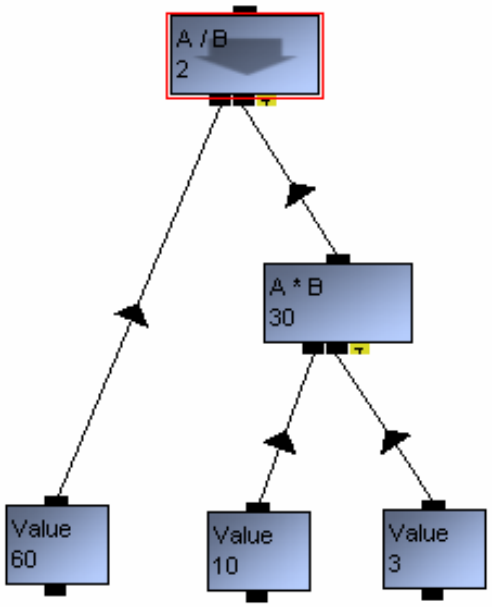
individual Operation

Channel	Refinement as a Petri Net

Tree traversal

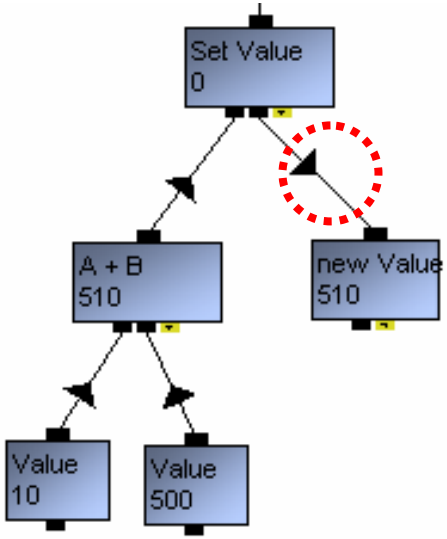
Postorder (Nachordnung)

2 = 60 / (10 *3)



a) Inorder (Inordnung)

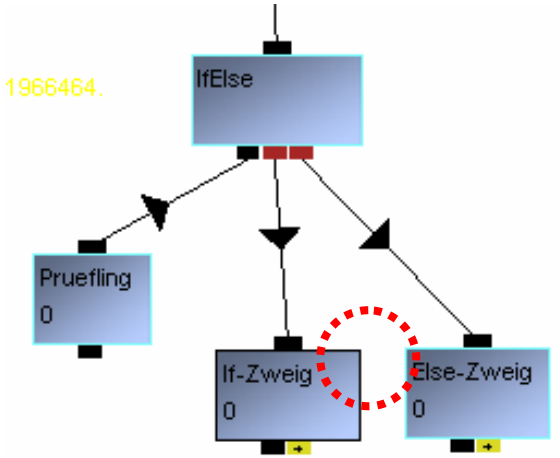
“Set Value“ liest Ergebnis des linken Unterbaums und schreibt in den rechten.



„Schreiben“ erkennbar an der Pfeil-richtung nach unten.

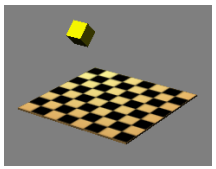
b) conditional branch

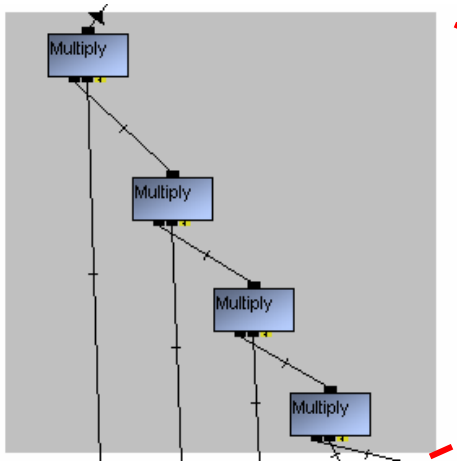
Nur der rechte Teilbaum wird hier nach der „if“- Prüfung weiter traversiert.

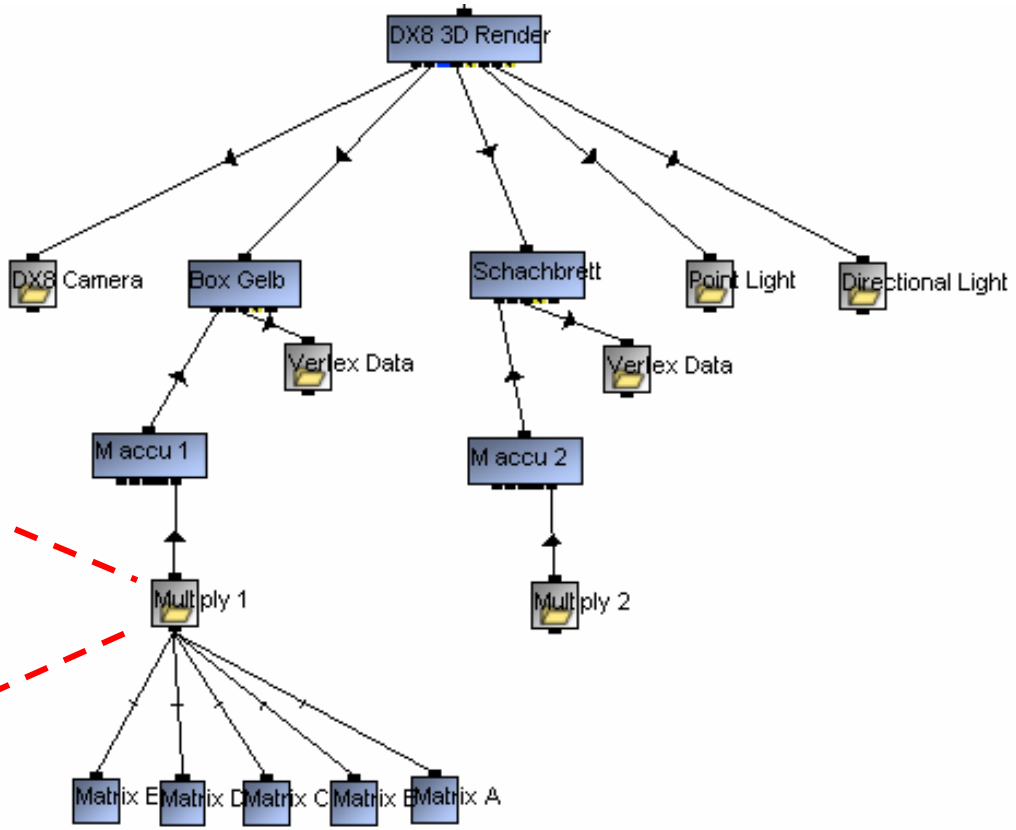


Aktive Channels sind an der hell-blauen Umrandung zu erkennen.

Hierarchy 1 (folder)

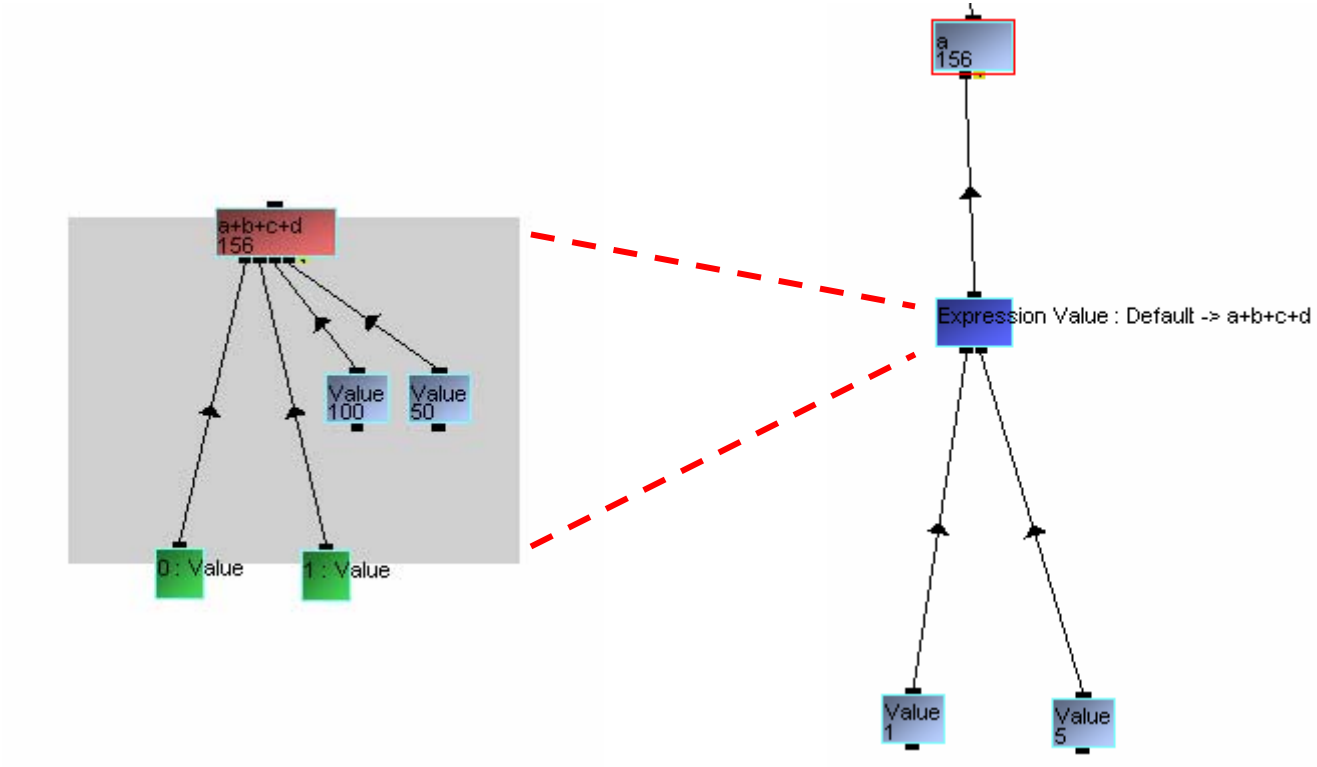




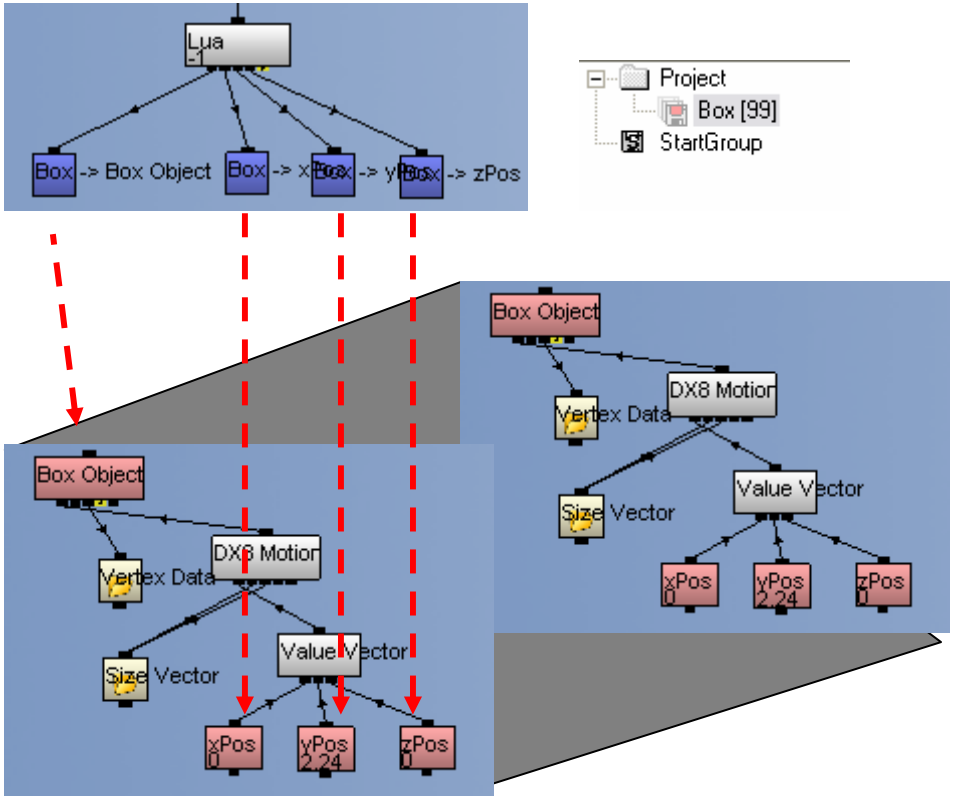


Drachen_accu.cgr

Hierarchy 2 (parameter channel)

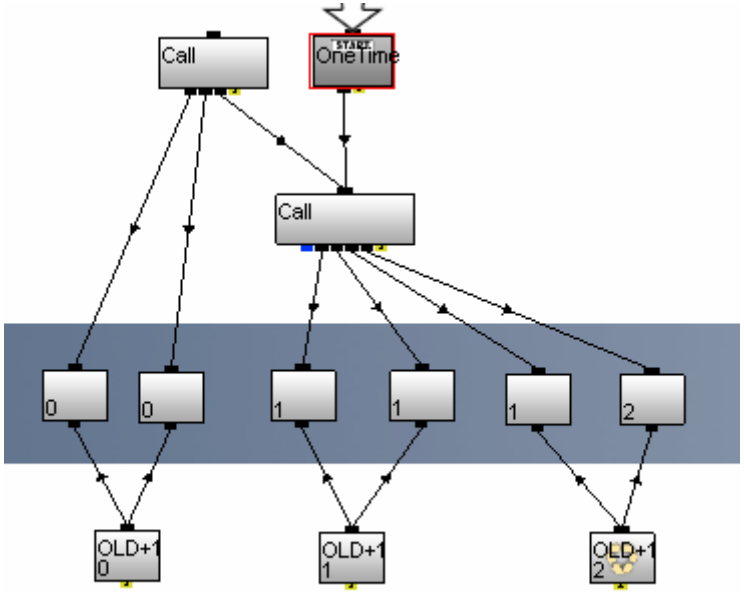


Hierarchy 3 (Lua + groups)



Result:

Evaluation



no call one call two calls

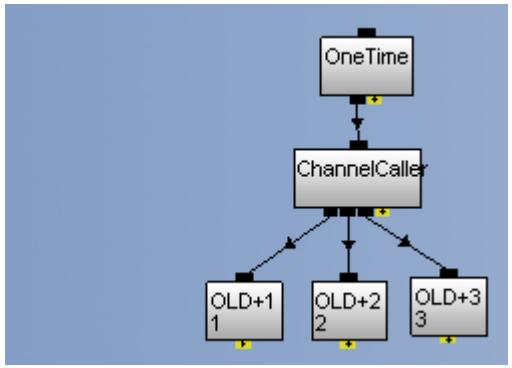
not in active tree

standard (evaluate one per frame)

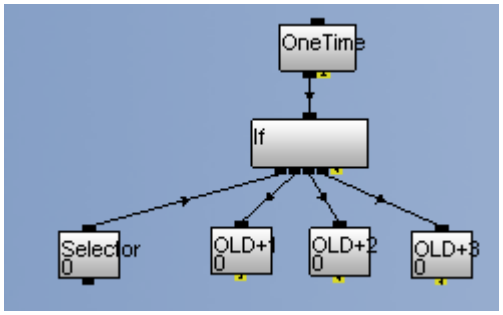
continous (evaluate new for each parent)

Control Flow

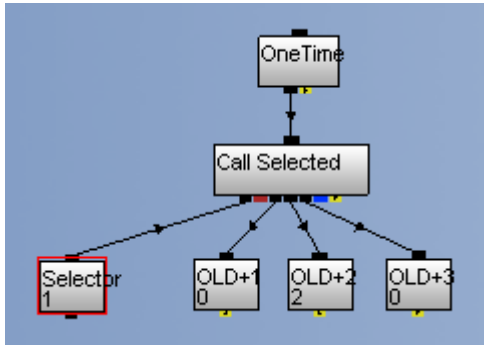
Sequence



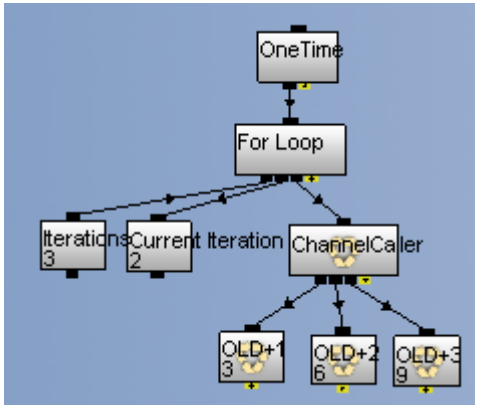
If



Choice



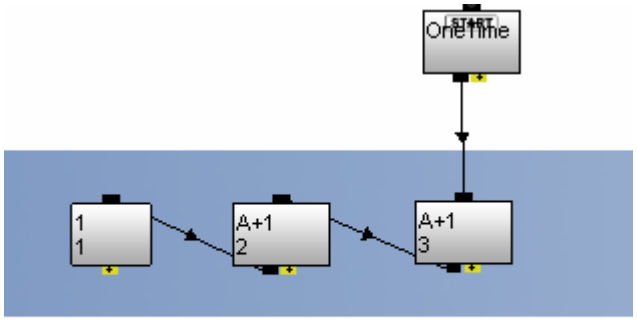
For

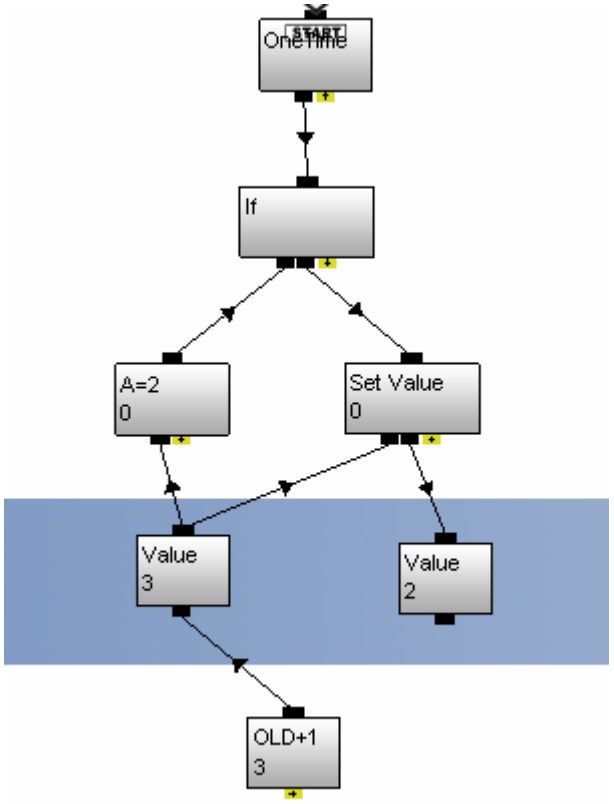


While

intrinsic

Data Flow





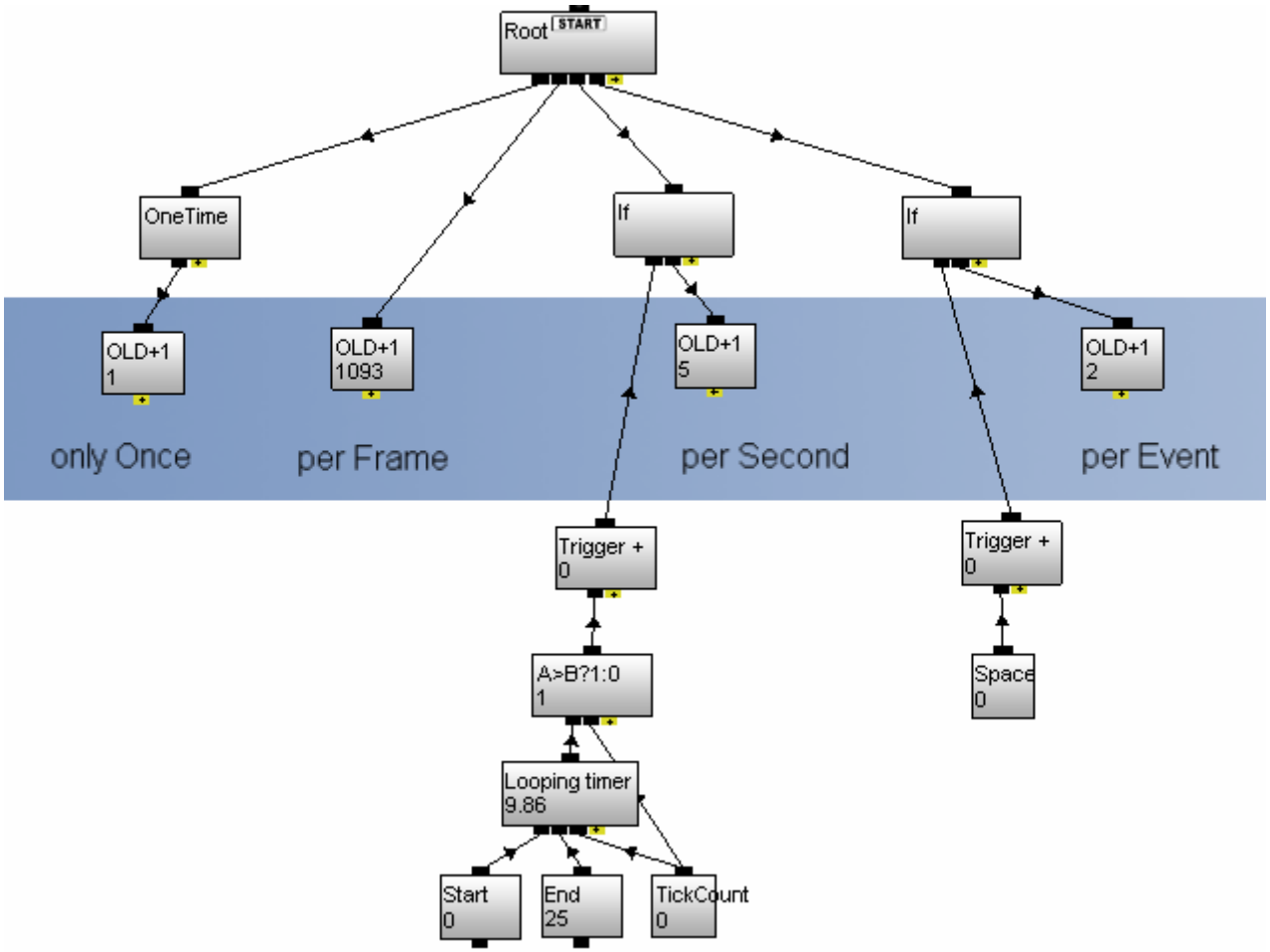
Data flow

+ Complex results available as union members

Set* Operators:

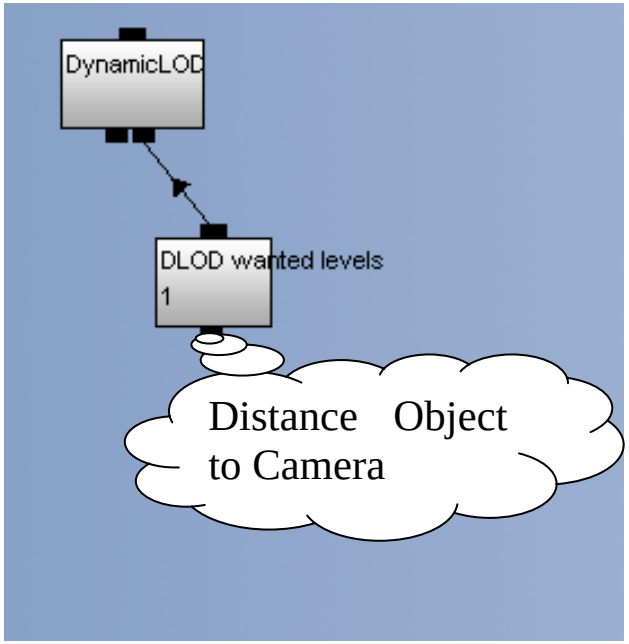
Storage of intermediate results

Time

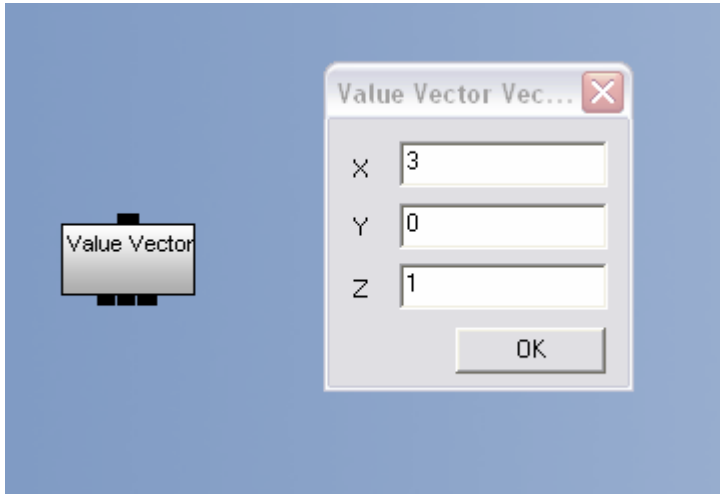


+ phyisics time
+ (video refresh rate)

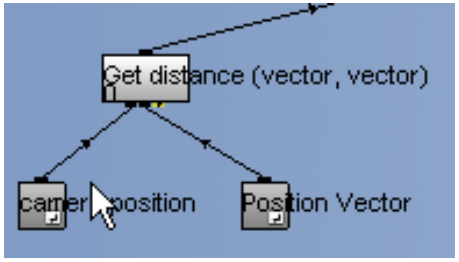
Environment,



internal Storage



instead of:



3 Computer Graphics Course

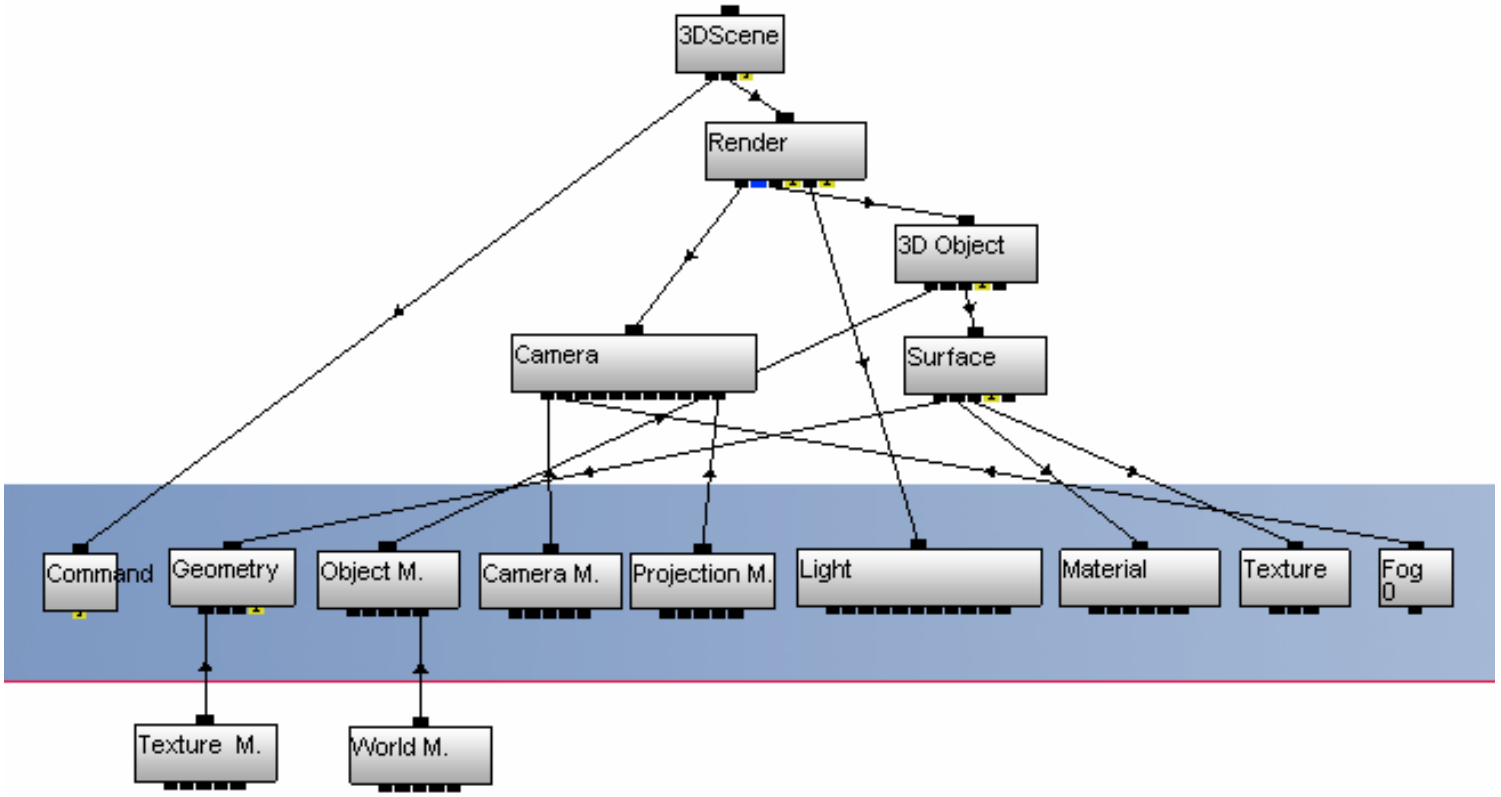
mandatory course

some of our students prefer to do design work or create geometry (3D artist)

Focus on concepts

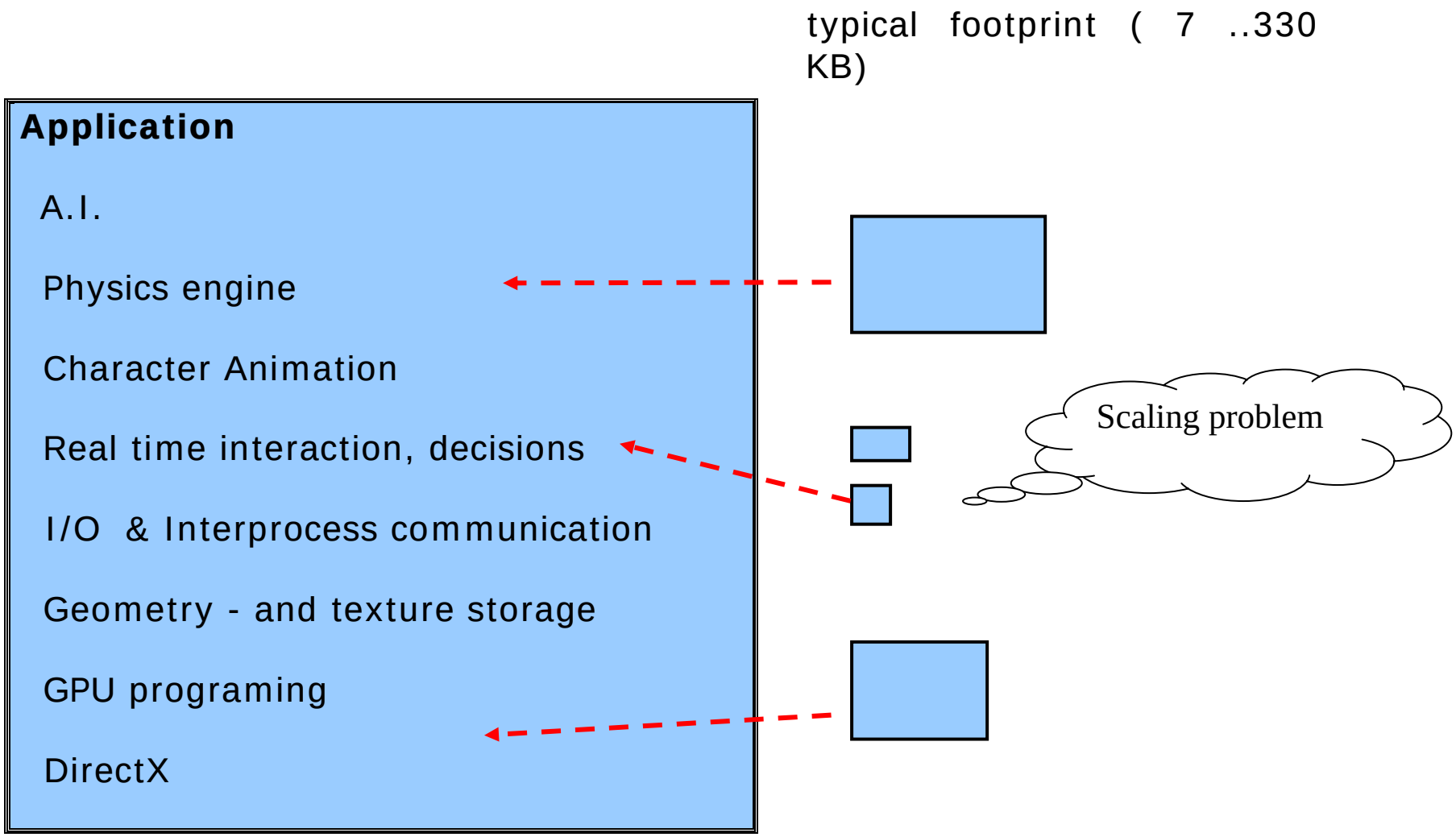
- Vector algebra, transformation, accumulation, different 3D spaces, projection
- parametric curves
- State graphs
- Geometry
- Interpolation
- Pipelines (transformation, rendering)
- Lighting, Shading, multi stage
- Antialiasing
- Culling
- Maps in all varieties

DirectX Pipeline



- Transformation Pipeline
- Render Pipeline

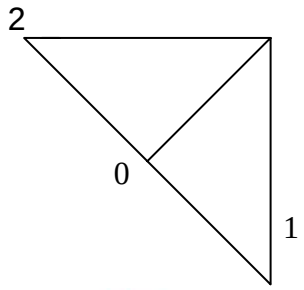
Problem domains vs typical channel footprint

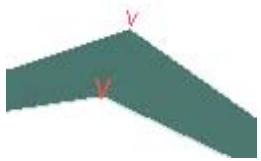


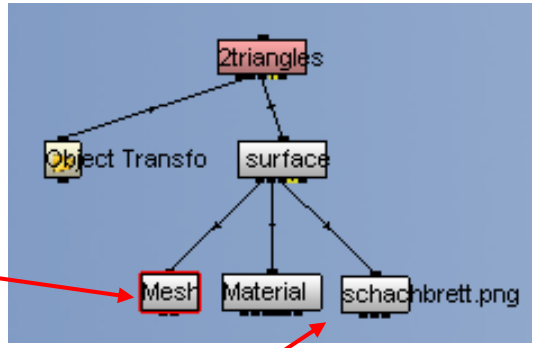
X-File 1 Mesh, Vertex normal, Material, Texture koordinates

```
xof 0303txt 0032

Mesh {
 4; 0.0;  0.0;  0.0;, // 0
    5.0; -5.0; -5.0;, // 1
   -5.0;  0.0;  5.0;, // 2
    5.0;  0.0;  5.0;; // 3
 2; 3;2,3,0;,
    3;1,0,3;;

MeshNormals {
  3; 0.00; 1.00;  0.00;, // 0
     0.20; 0.91; -0.21;, ... // 1+
  2; 3;0,0,0;, //Kante
     3;2,2,2;; }

MeshTextureCoords {
  4;
  0.5; 0.5;, ... // 0
  1.0; 0.0;;     // 3 }

MeshMaterialList {
  1;   2;   0,   0;
  Material {   0.2; 0.5; 0.4; 1.0;;  ...
   TextureFilename {
"schachbrett.png";}
}}}
```

(a) Mesh

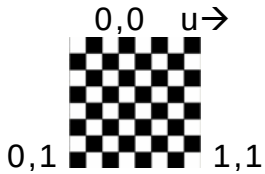






(b) Material & Texture

Texture space

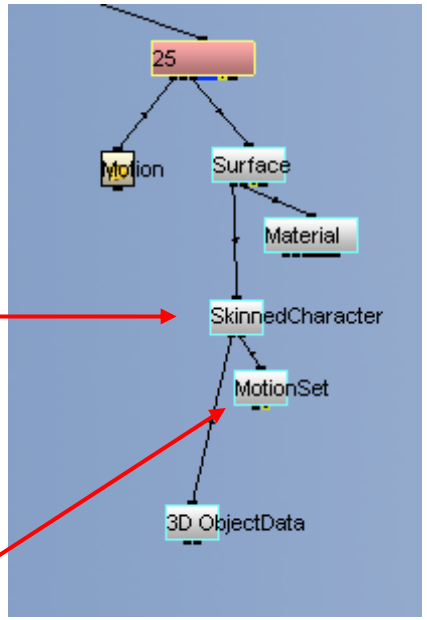


Result

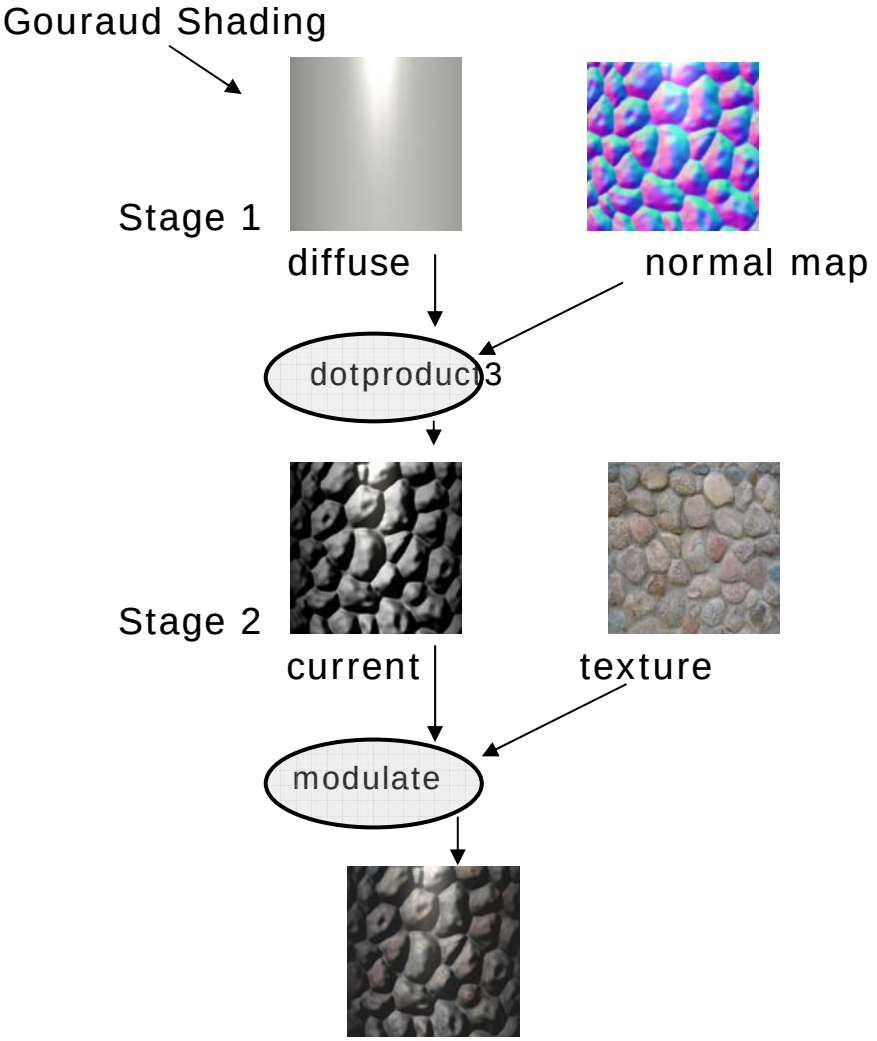
X-File 2

Hierarchie, Animation & Skinning

```
...
Frame Bip01_Spine1 {
  FrameTransformMatrix {
     0.99, -0.01, -0.10,  0.00,
     0.01,  0.99, -0.04,  0.00,
     0.10,  0.04,  0.99,  0.00,
     4.76, -0.00, -0.00,  1.00;;    }

Frame Bip01_Spine2 {
     FrameTransformMatrix {  ... }

     Frame Bip01_Spine3 {
      FrameTransformMatrix { ... }
...
}}} ...

Animation Anim-Bip01_Spine1 {
  { Bip01_Spine1 }

  AnimationKey {0;                          // Rotation
280; 0; 4; -0.9982, -0.0218, 0.0535, -0.0080;;,
     1; 4; -0.9980, -0.0234, 0.0566, -0.0068;;,
.... }}

SkinWeights { "Bip01_R_Finger01";
62; 136,     1370,   1371,    ....
     0.3,     0.2,    0.14,
 .... }
```



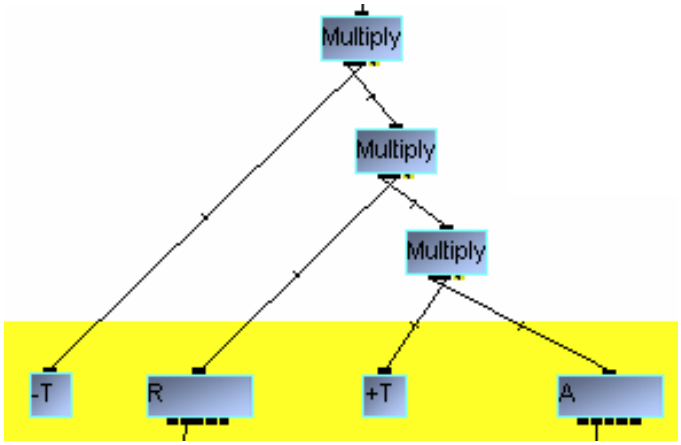
Render Pipeline



Normal Mapping

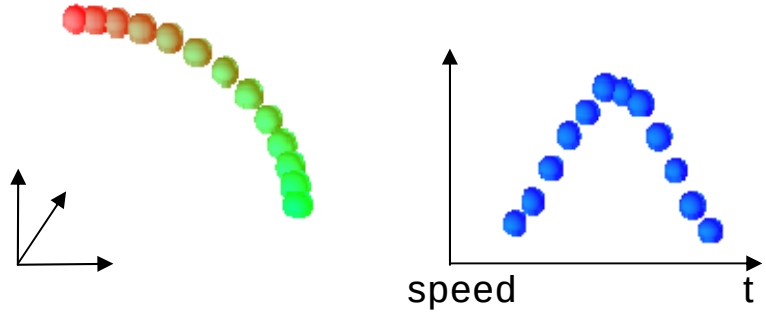
Feldsteine-dot3.cgr, blech-max8.x

Explain CG Concepts 1

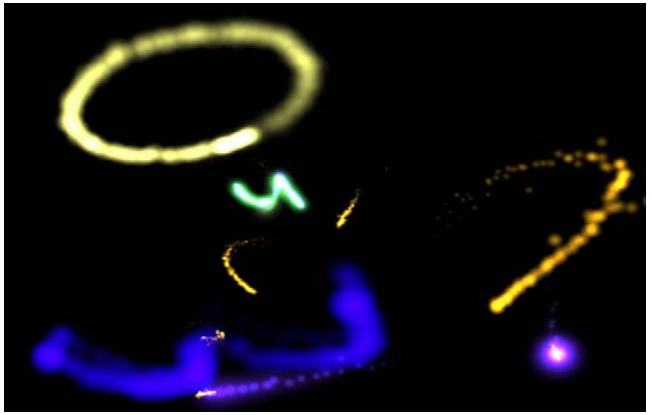


Transformation M = -T * R * T * A

Aliasing, MipMaps

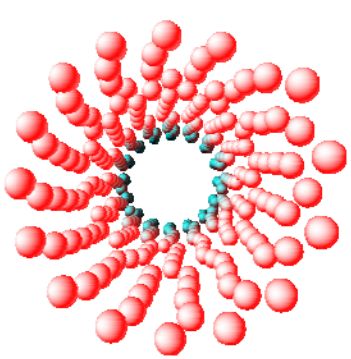


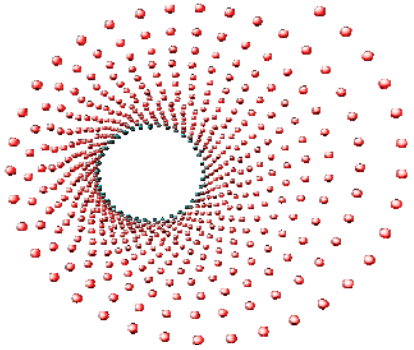
interpolation



parametric curves (via 2 envelopes)

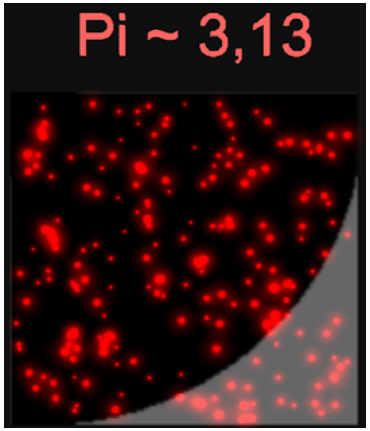
Explain CG Concepts 2





FPS, Jitter

Time Warp



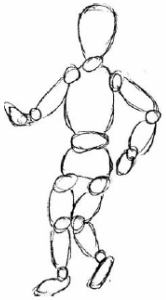
Monte Carlo

4 Multimedia Projekts

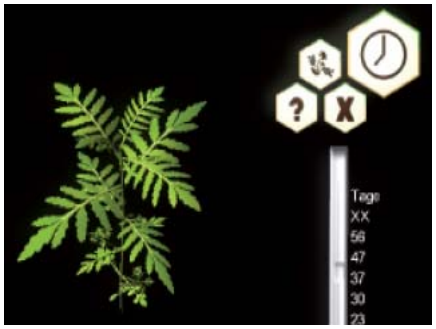
4.1 Course Multimedia Project

Focus on experimental projects, low cost, distributed, design

Quest3D, Max/Msp/Jitter, vvvv,EyesWeb, Reactor, ...



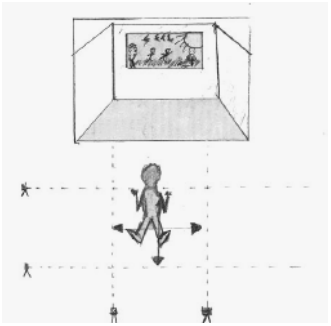
Lass d. Puppen tanzen



Die Studentenblume

Parallelwelten

Zak McKracken



IMAG

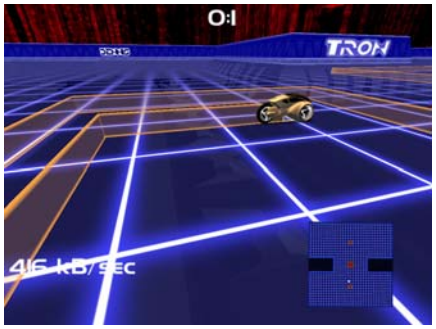
Secret of X3

On Air

BMX Action

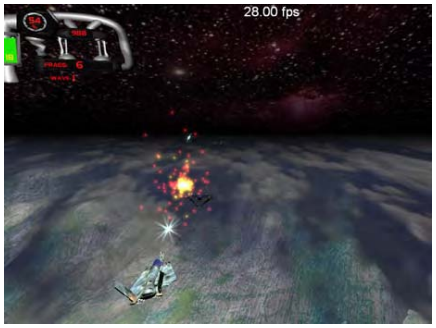
movin'movie

Virtual Visitors



Tron- The Game

Tom!



C.O.R.E.

Duo 3000

Sk8ball

Schülerlabor

QuestLab

Chronosphere

Virtuelle Galerie

4.2 Diploma Thesis

Gericke, Ines: Virtuelle, interaktive 3D-Visualisierung des antiken Hauses „Casa della Venere“.

Hampel, Stefan: Channel Programmierung im Autorensystem Quest3D zur Erstellung einer Trackingapplikation.

Zart, David: Ansteuerung einer Hydraulikplattform.

Ebert-Razmdjou, Astrid: Wahrnehmung und Visualisierung mittels 2D und 3D Animation.

Seim, Oliver: Optimierung der Ladezeiten des Helmholtz- Schülercampus.

Lehmann, Jan-F.; Ringel, Oliver: Erweiterbarkeit der Quest3D- Autorenumgebung am Beispiel einer datenbankbasierten Anwendung zur Verwaltung und Präsentation von Inhalten.

4.3 Spin-Offs

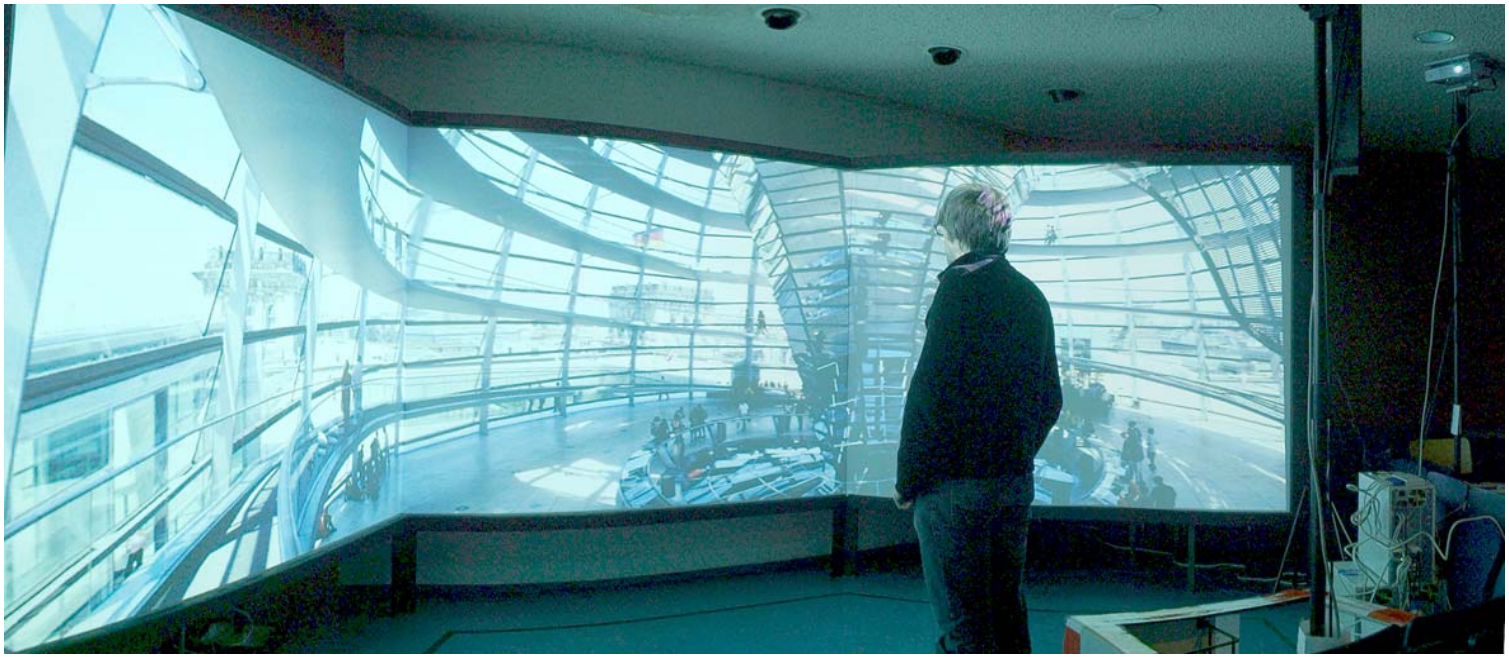
Schuelerlabor	www.helmholtz-campus.de/
Sportshuttle	www.sportshuttle.de
Flight Wienna	www.tiscmedia.at

5 Research Low Cost Virtual Environment

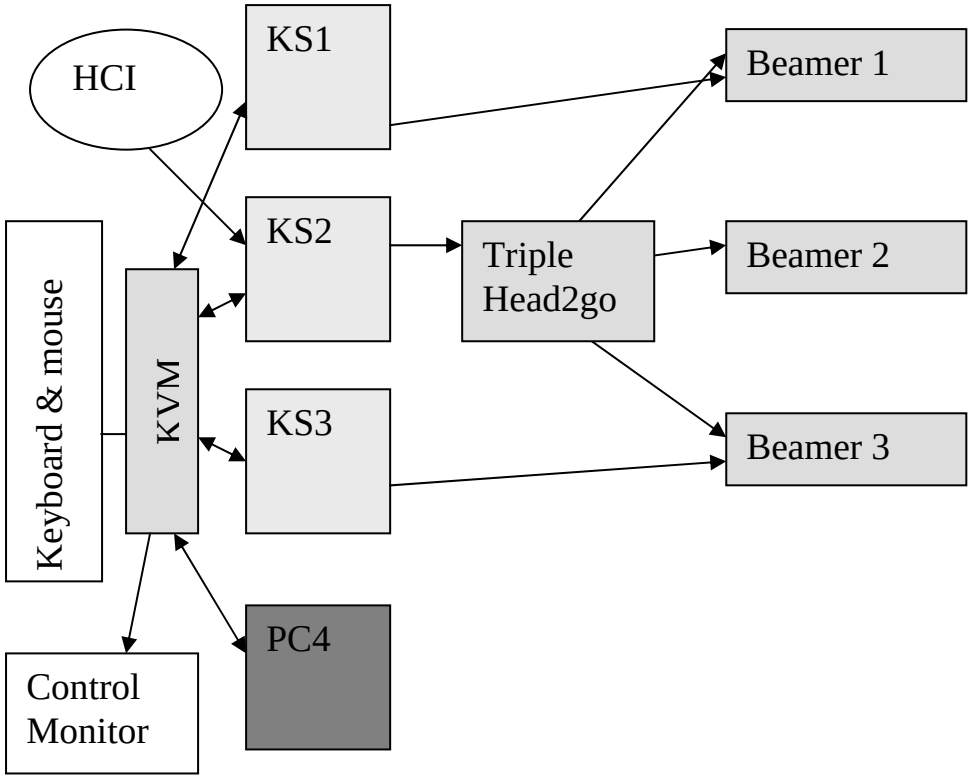
Heinrich Godbersen, Stefan Hampel, Oliver Heinrich, Monika Kothe, Jens Pieper

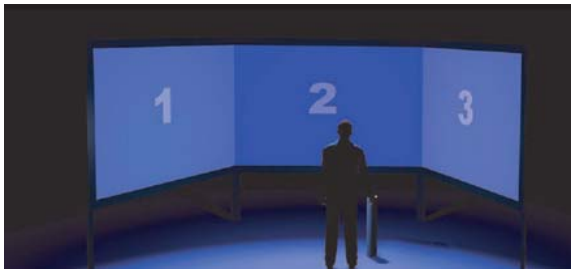
Our interests:

Multiscreen, HCI, distributed systems, comodity hardware, software reuse ...



System Architecture

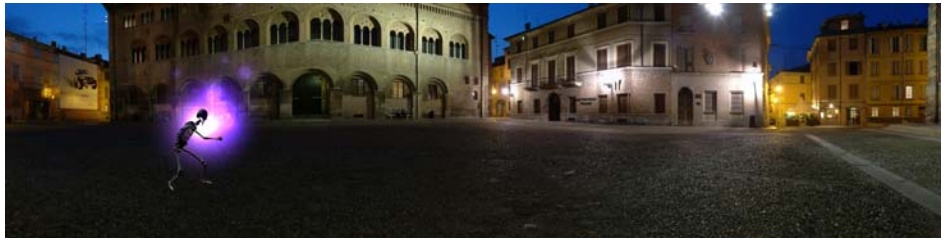




Quest3D, Girder, IRremote, ZoomPlayer, ..

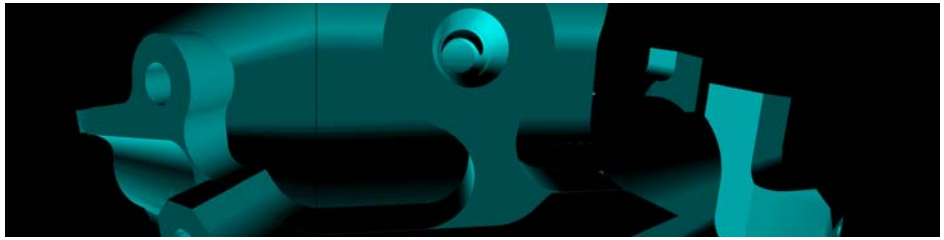
Multiscreen Examples

Cubic panorama

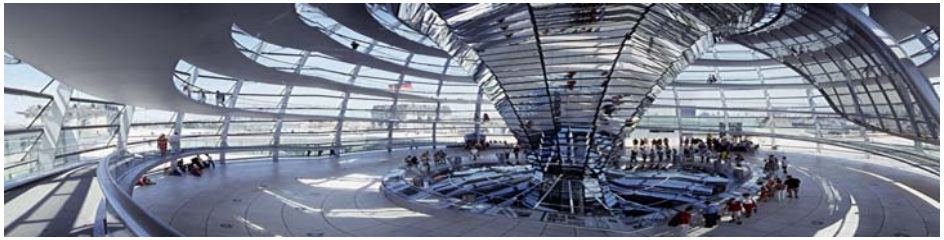


3D animation inside cubic panorama

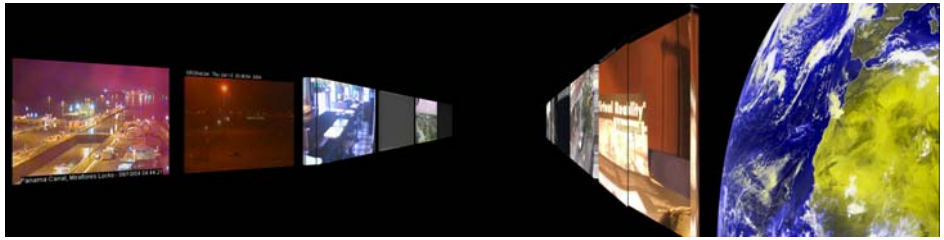
Ocean



Fly through



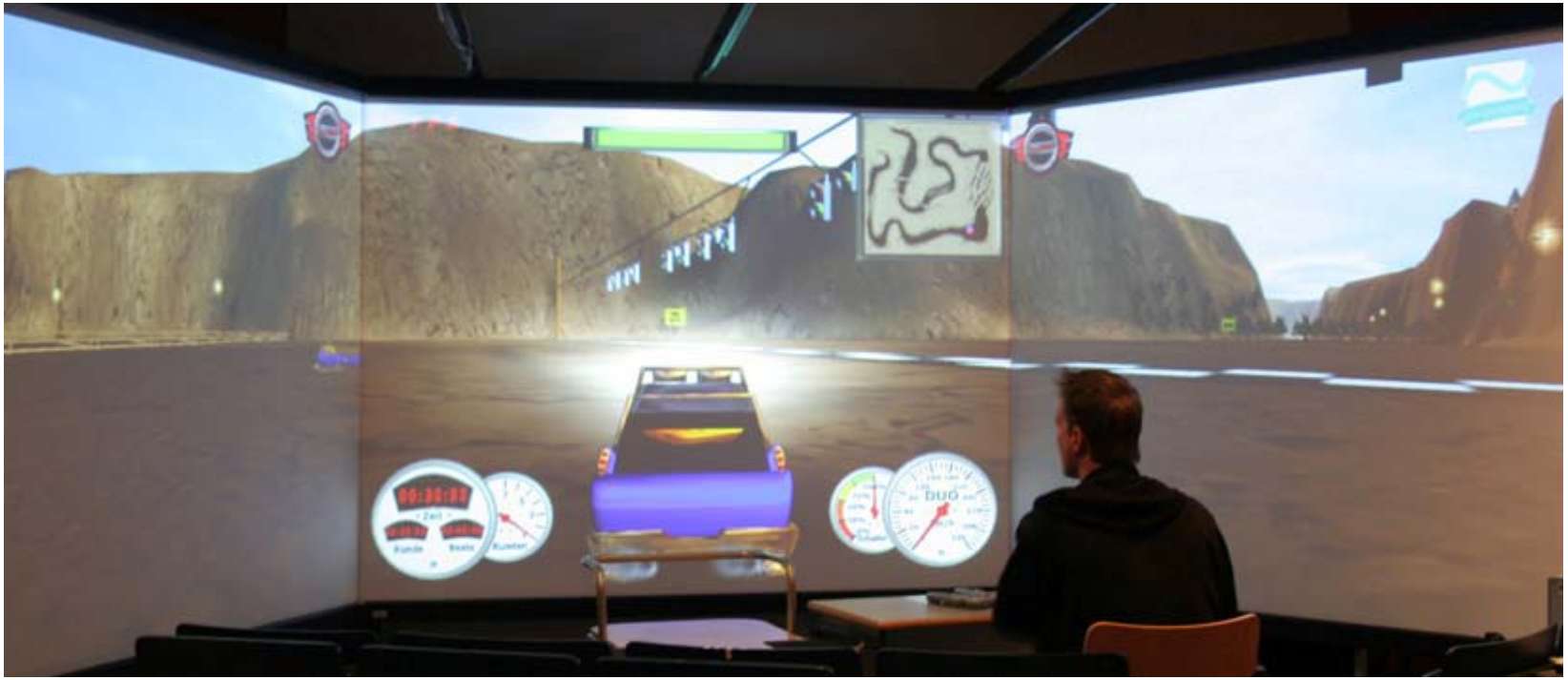
Cylinder panorama



Webcam galery

Assets: www.Quest3D.com, www.fullscreenqtvr.com, www.360-berlin.de

“Duo 3000” Multiscreen /Multiplayer Game



Lange Nacht der Wissenschaften, Berlin 2005 +

“Flight Wienna”

Lange Nacht der Wissenschaften, Berlin 2007

in cooperation with Stefan Hampel + www.tiscmedia.at

6 Results

Acceptance by students (200 +)

10 % hook into, very good results

40 % OK, but loose interest

50 % stay away (why another programing language?)

Student report

- fast results for a large variety of topics
- steep initial learning curve, but does not scale
- good for teaching concepts
- Current documentation not sufficient
- Sometimes frustrating (is it me or a bug?)
- programing logic cumbersome (more familar in standard languages)
- overwelmed by channel variety (no interest in depreciated)

Undo, loose shortcuts, backward compatibility, documentation, ...

My opinion

- general acceptance of visual programing is still low
- students underestimate productivity gains
- Good way to teach concepts
- Excellent coverage of DirectX
- encourages lasy documentation
- often not perceived as an production tool
- aestetics missing in demos
- Text book missing

- Templates may be a solution, but not appropiate in our setting

There is no free breakfast ...

My personal whish list

- Focus on new channels, hide old ones
- Its frustrating to learn later, that a particular usage is discouraged (Socket, ..)
- Provide annotated workable examples covering all channels
- Naming: LOD variants on diferent places in Alphabet (not template)
- Templates needed for HCI (logic, visualization), e.g. Radio Button. Slider, ...
- Allow users to grasp complexity of a channel
- Provide very slow visual evaluation with feedback
- leave the looks of dungeons behind
- focus on quality insurance

Literature

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[Go04] Godbersen, H.P.; Pieper, J.: **Erschwingliche Visualisierung.** TFH-Presse Nr. 1/04, April 2004, S. 7 http://www.tfh-berlin.de/~godberse/nocms/god/Go04.pdf

[Th07] Thadeusz, F.: **Sturzflug für jedermann.** Der Spiegel, 27/2007 S. 151

[Go07] Godbersen, H.P.: **Eine Low-Cost Lösung für interaktive, immersive 3D-Echtzeitanwendungen**. Zur Veröffentlichung angenommen.

godbersen.eu