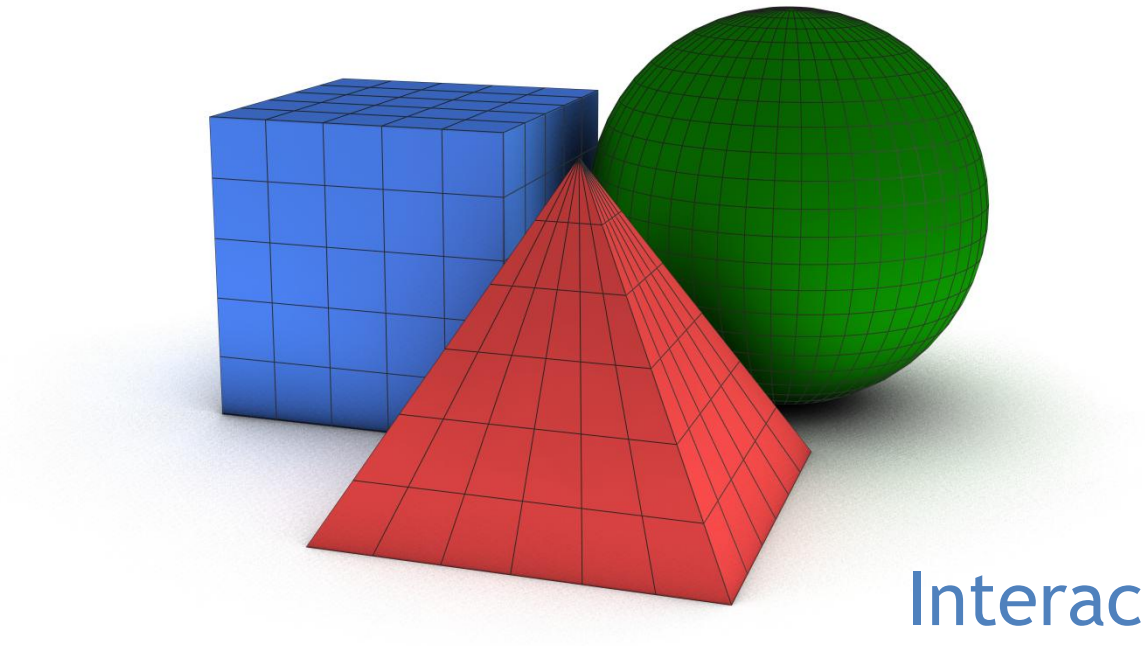
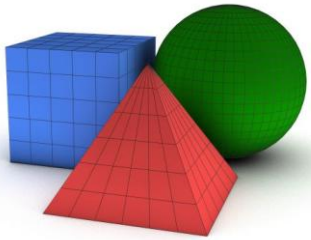


Declarative Integration of Interactive 3D Graphics into the World-Wide Web

Principles, Current Approaches, and Research Agenda

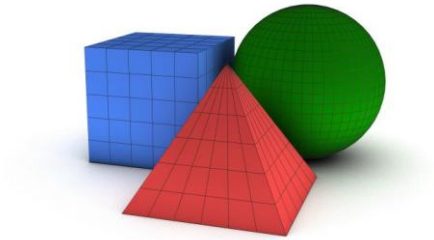
Jacek Jankowski, Sandy Ressler, Kristian Sons, Yvonne Jung, Johannes Behr, and Philipp Slusallek

Introduction

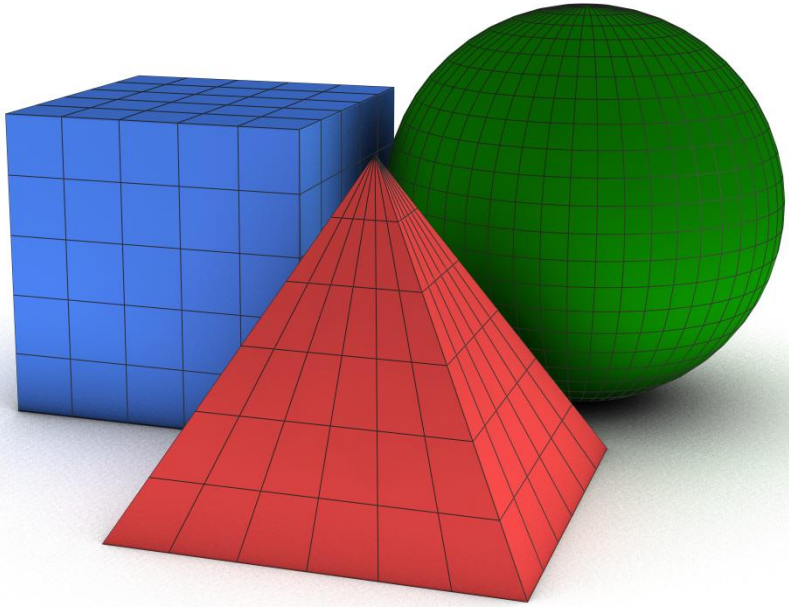


	2D (Final HTML5 spec)	3D (No W3C spec yet)
Declarative Scene graph Part of HTML document DOM Integration CSS/ Events	SVG	dec3D
Imperative Procedural API Drawing context Flexible	<canvas>	WebGL

Outline

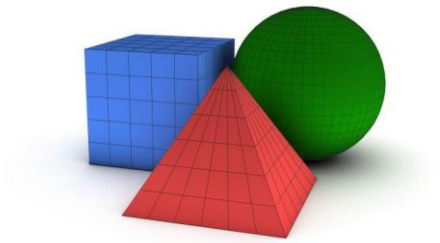


- Declarative 3D Principles
- Declarative 3D Frameworks
  - Evaluation Platforms: X3DOM and XML3D
  - Declarative 3D Essentials
  - Level of Integration and Polyfill Approach
- Declarative 3D Agenda
- Conclusions

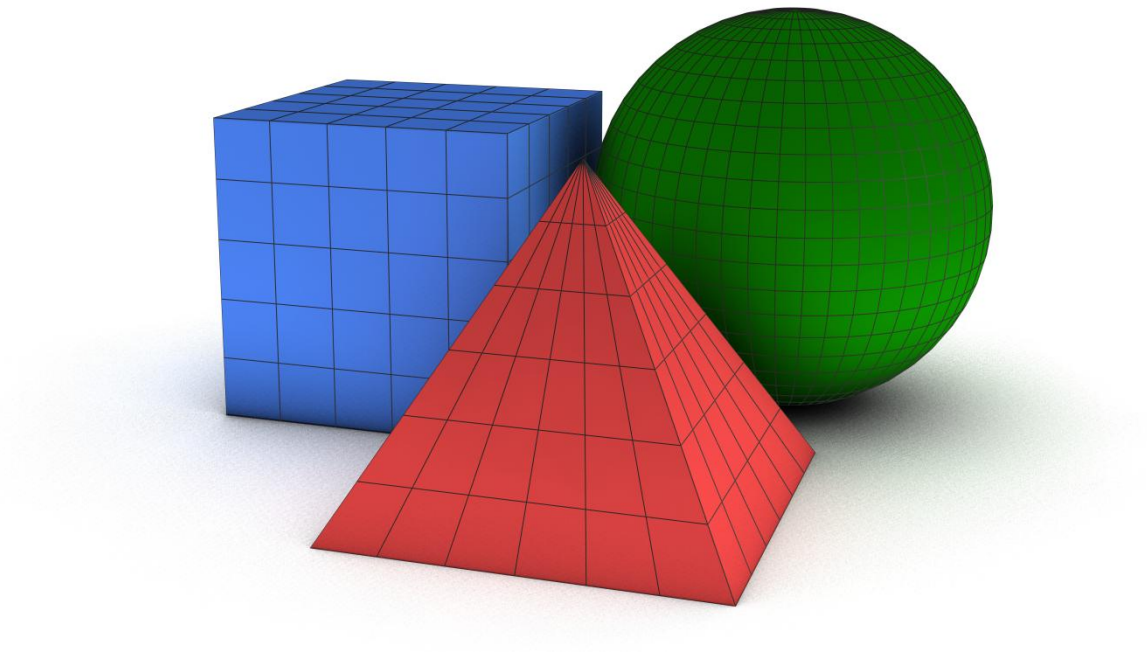


Principles of Declarative 3D

Declarative 3D Principles

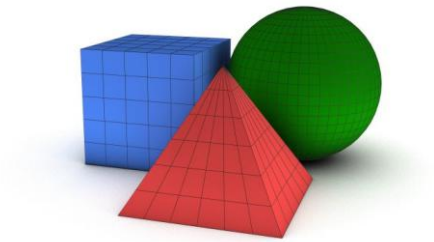


- Following the Established Principles of the Web
  - Separation of structure from content
  - Separation of content from style
  - Use of the Document Object Model (DOM)
- 3D Content Creation and Reuse
- Platform Independence
- Efficiency and Scalability
- Security and Digital Rights Management
- Accessibility and Usability
- Leveraging Web Development Infrastructure



Declarative 3D Frameworks

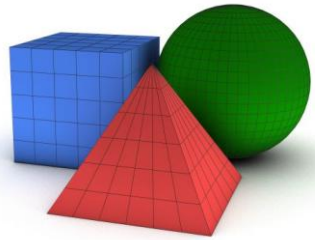
X3DOM: History

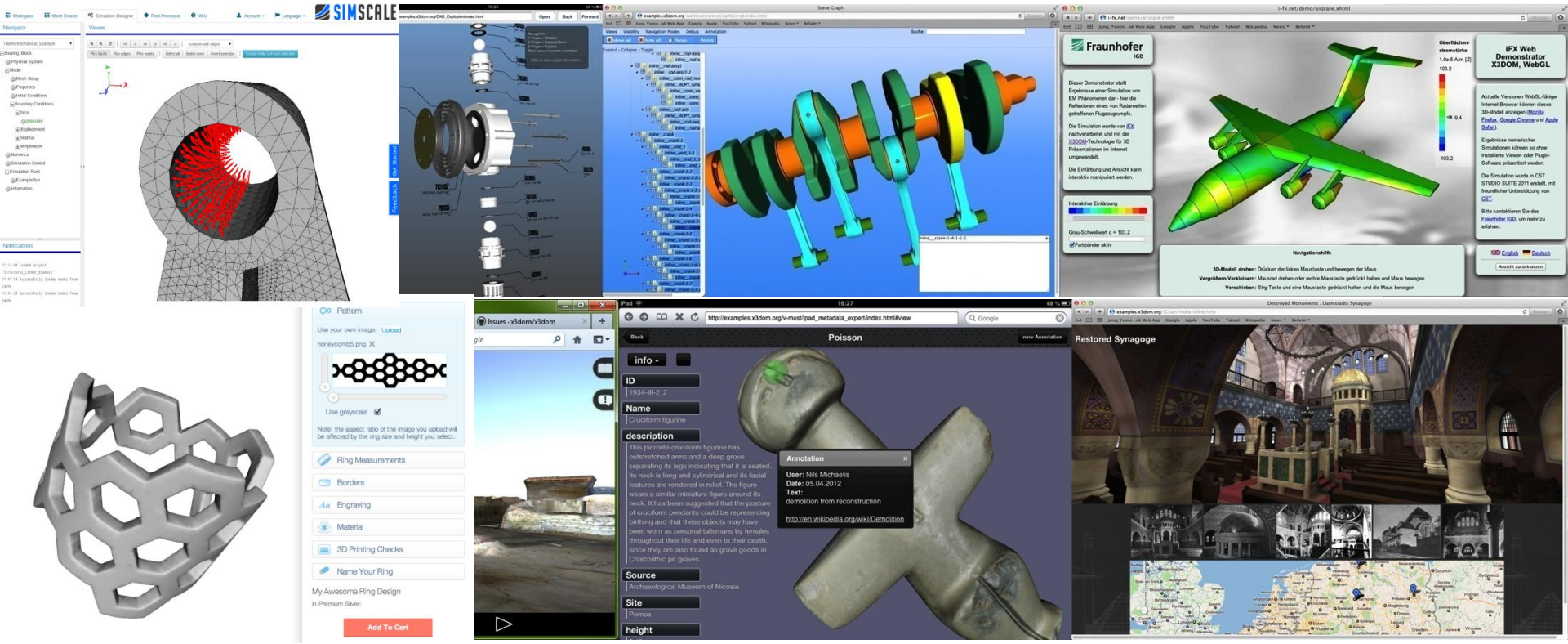


- **2004: X3D: ISO Standard; Plugin integration model**
- **2007: HTML5** Spec:: http://www.w3.org/TR/2009/WD-html5-20090212/no.html#declarative-3d-scenes

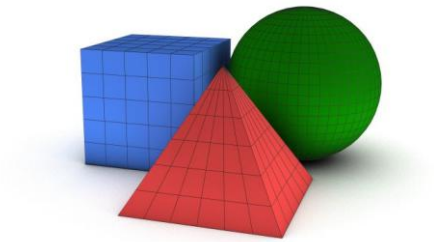
  *13.2 **Declarative** 3D scenes*
  *Embedding 3D imagery into XHTML documents is the domain of X3D, or technologies based on **X3D** that are namespace aware.*
- **2008**: First experiment by Philip Taylor, W3C: http://philip.html5.org
  X3D in DOM, no DOM manipulation (Canvas3D for rendering)
- **2009:** x3dom by Fraunhofer IGD, Based on code of Taylor:
  Full DOM integration. Maps to **Native**, **X3D-Plugin, WebGL or Flash**
  Utilizes **HTML/JS/CSS** for **scripting** and **interaction**
  HTML-Profile: **Reduced complexity** and **implementation effort**
- **2011**: **W3C Declarative 3D Community Group**
- **2012**: **Component-Plugins**: Volume, GEO, CAD, Geo2D, …

X3DOM: Showcases

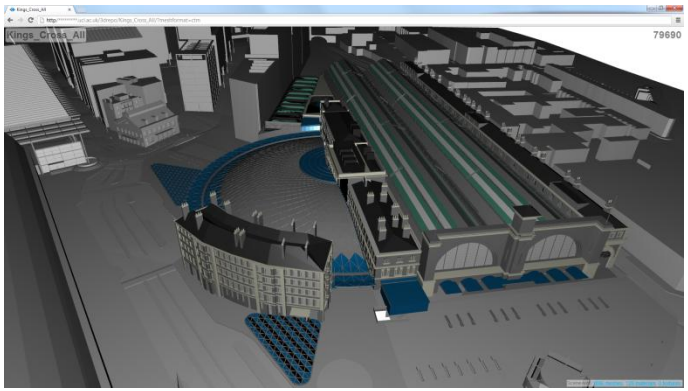




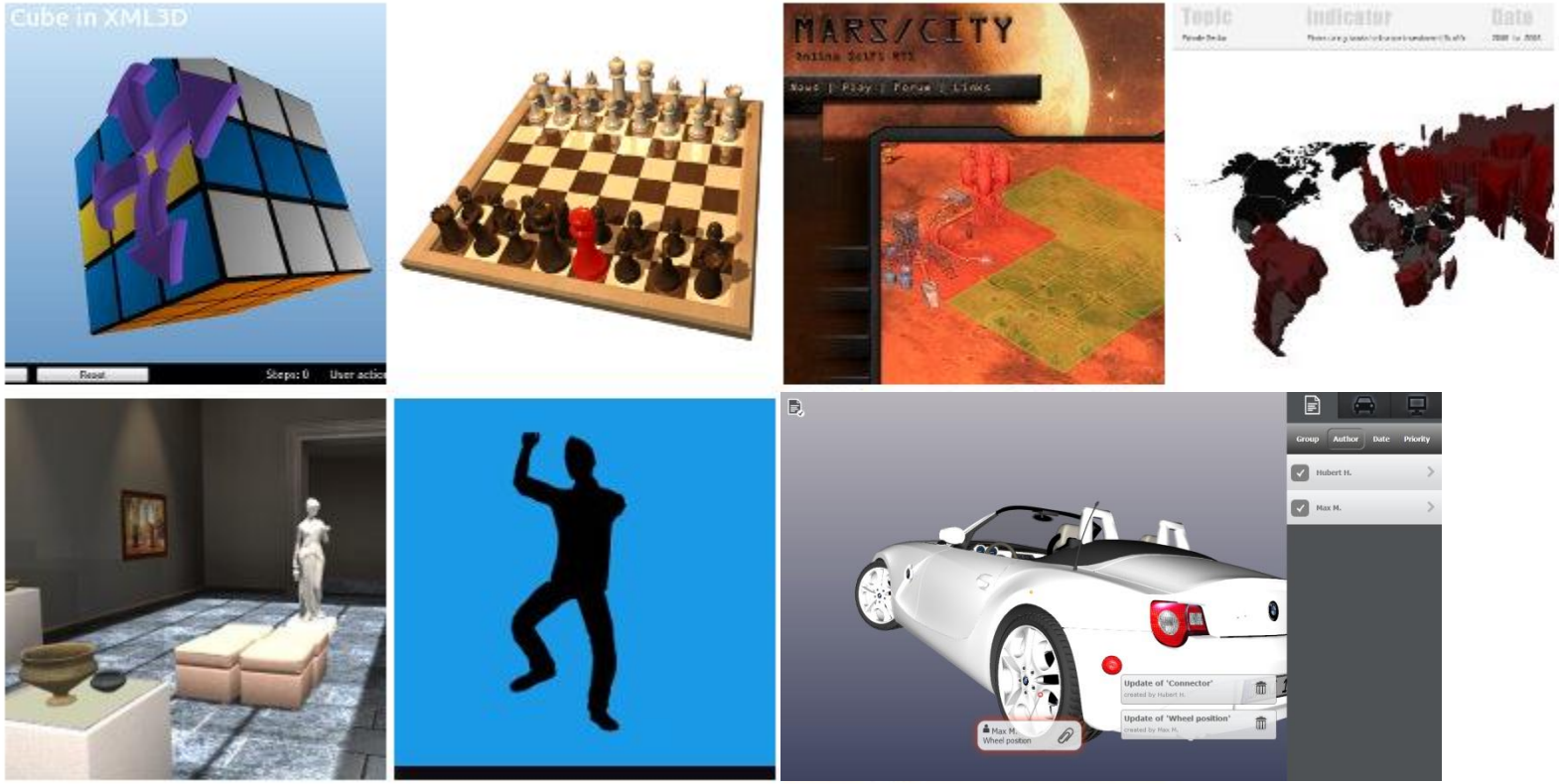
XML3D



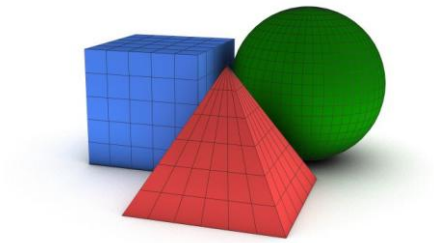
- Designed from scratch
  - Granular data compositing
  - Data structures aligned with VBOs
  - Consistent resource handling, XML3DRepo
    - [Doboš, Web3D2013]
- Integrated dataflow concept (Xflow)
  - Skeleton animation, Image Processing, Augmented Reality
    - [Klein, Web3D2013]
  - Can be mapped to HW (GPU, River Trail, WebCL?)
- Available on Github:
  - https://github.com/xml3d/xml3d.js



XML3D


Cube in XML3D
Reset
Steps: 0
MARS/CITY
Topic
Indicator
Date
Group
Author
Date
Priority
Hubert H.
Max M.
Update of 'Connector'
Update of 'Wheel position'

Declarative 3D Essentials

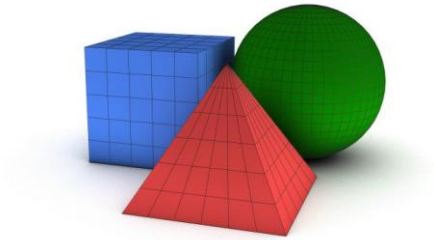


- Extracted 15 essentials for HTML/DOM-based 3D graphics
- For instance:
  - Use CSS 3D Transforms for transformations

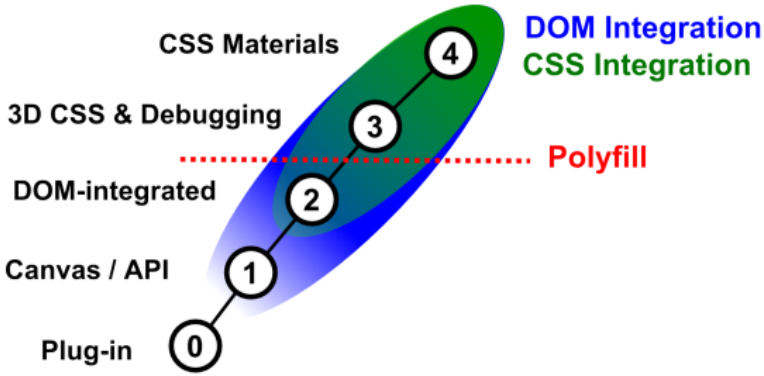
```
<div>
   <dec3d style="border: 1px solid black;">
     <div style="transform: scale3d(2, 2, 2);">
        ...
     </div>
   </dec3d>
</div>
```

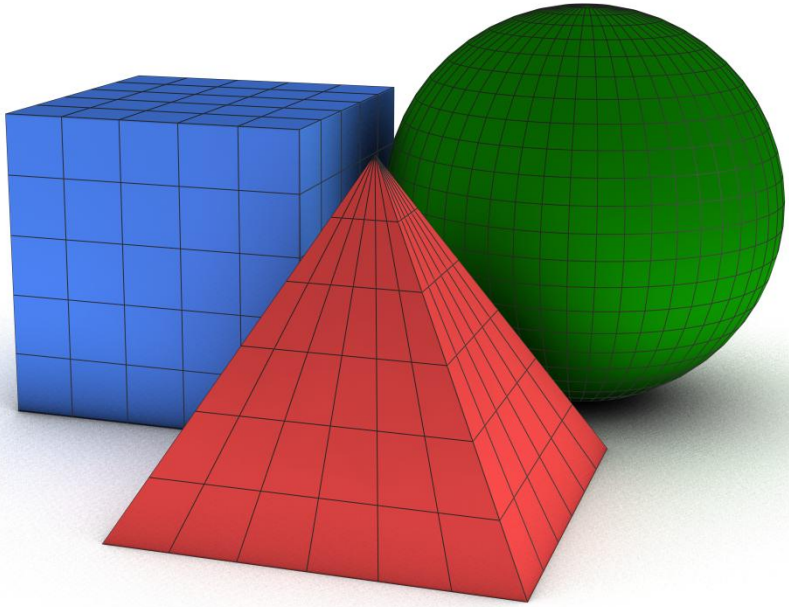
- How tight can we integrate 3D with web technology?

Level of Integration (LOI)



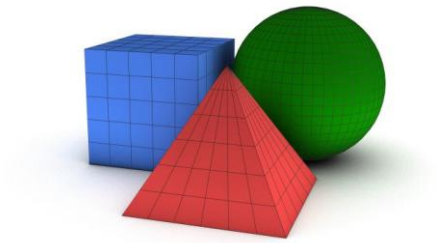
- LOI 0: Classical integration using plug-ins
- LOI 1: Dedicated element in the DOM + API (WebGL)
- LOI 2: Scene description integrated in the DOM
- LOI 3 and LOI 4: Tight integration with CSS





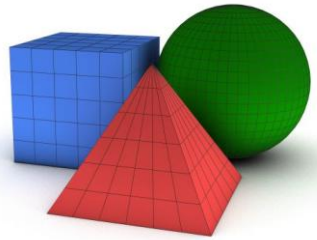
Demo

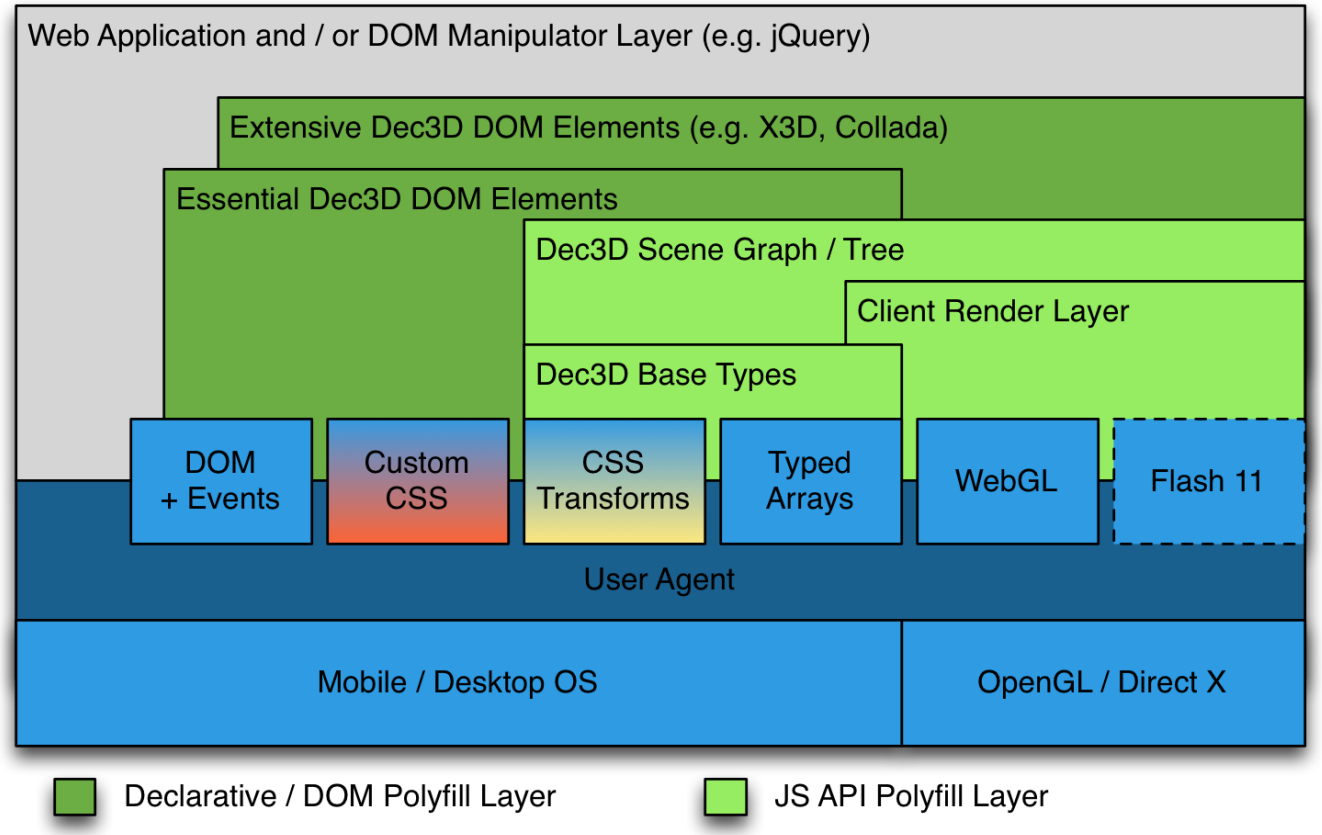
Polyfill Approach

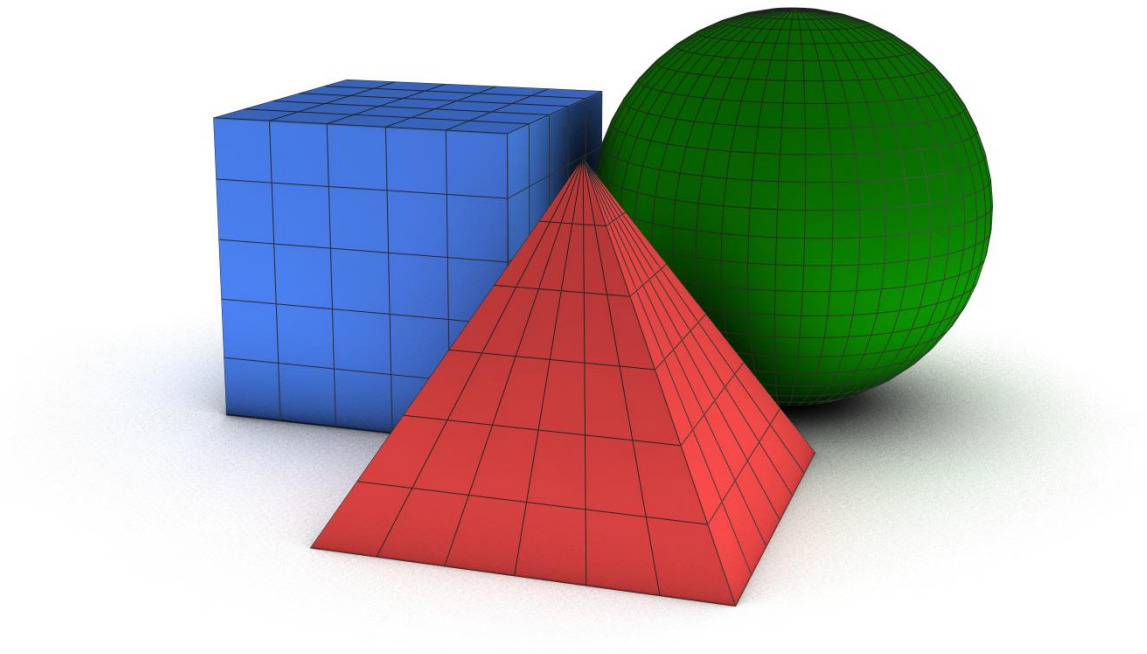


- What is Polyfill?
- UA requirements:
  - DOM: Polyfill Layer must be able to access and monitor changes in related DOM elements
  - Events: The UA must support registration, firing, and extending UI events
  - CSS: Supporting scene management though custom CSS properties
  - CSS 3D Transforms: Extending for optimal performance
  - TypedArrays: ...
  - ...

Proposed Declarative 3D Polyfill Runtime Architecture

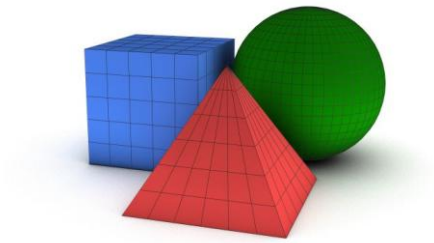




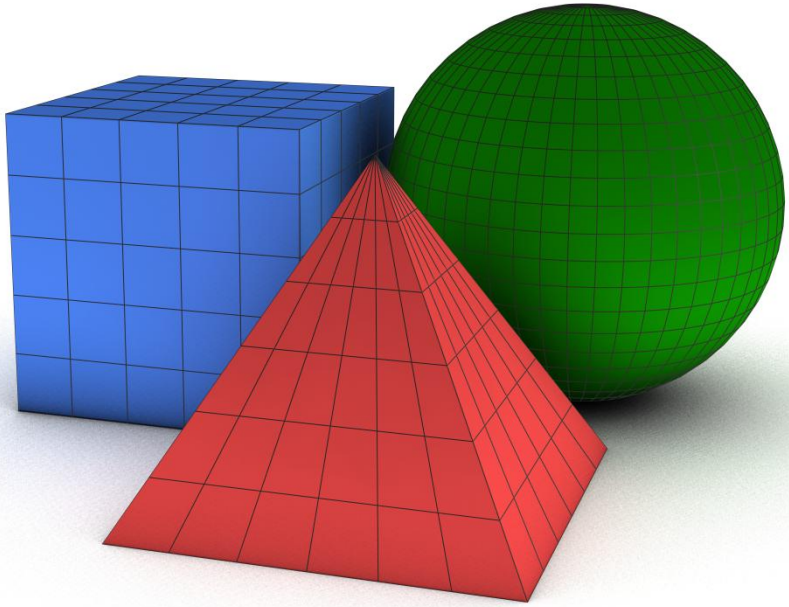


Declarative 3D Agenda

Declarative 3D Agenda

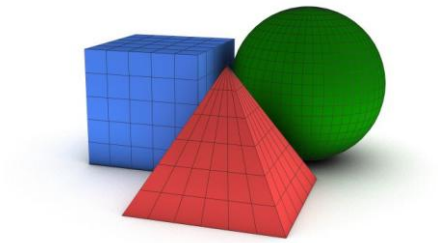


- Encourage Participation
- Clear Definition of Use Cases and Requirements
- Clear Technical Specification
- Outreach and Exemplar Applications
- W3C Working Group Proposal



Conclusions

Conclusions



- Declarative vs. Imperative
- Need more participation from the Web3D community
- Ultimate goal: 3D for everyone and everywhere

Join us now!

Visit: http://declarative3d.org/