WEB3D 2020

The 25th International ACM Conference on 3D Web Technology
November 9-13, 2020, Virtual Conference, Seoul, Korea

X3D Version 4 Working Draft

Released and Ready for Review!

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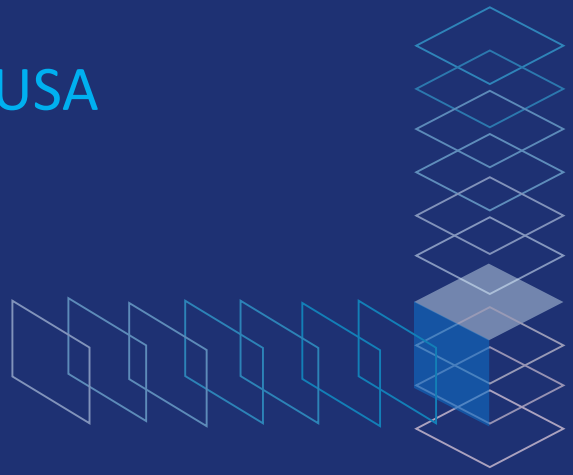

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Web3D 2020 Conference

9-13 November 2020

Don Brutzman

X3D Working Group

Welcome to X3D4!

- Web3D has published updated X3D4 working draft 2 for public review
- Full compatibility demonstrated for full X3D and VRML ecology
- Now is time for earlier adopters to improve codebases, test models
- Successful implementation and evaluation of excellent results
- Review draft available at Web3D 2020 Conference November 2020 as Web3D Consortium members decide on readiness for ISO ratification

- Your questions, comments and improvements are always welcome.
- Execution is a team sport – have fun with X3D4! ☺ ☺ ☺ ☺

X3D4 Changes, Capabilities and Opportunities

- X3D version 4 is a major upgrade to the Extensible 3D (X3D) Graphics International Standard, and the seventh formal ISO revision since VRML97.
- X3D4 supports HTML5 integration, advanced Physically Based Rendering (PBR) with glTF, shadows, high-fidelity audio graphs, Texture Projector nodes, Humanoid Animation (HAnim2) and numerous other improvements.
- Available file encodings include XML ClassicVRML and JSON, and complete open-source programming libraries are available in JavaScript, Java, and Python. Strict validation of models allows exceptionally high levels of Quality Assurance (QA).
- Much execution work is accelerating the implementation and evaluation of X3D4 forward. Much activity is moving ahead with X3D4.
- This tutorial summarizes new capabilities and describes author support in modern browsers, updated tools and a growing set of examples.

X3D Highlights https://www.web3d.org/x3dv4-highlights

- *Major:* HTML5 integration allows X3D on any web page
- *Major:* multiple file formats and programming languages
- *Major:* glTF asset materials, shadows, Physically Based Rendering (PBR) PhysicalMaterial and Non-Photorealistic (NPR) UnlitMaterial nodes
- *Major:* integrate Web Audio API for high-fidelity audio graphs
- *Major:* PointProperties, Texture Projector nodes, navigation improvements
- *Major:* no plugins required, multiple open-source implementations
- *Major:* backwards/forwards compatibility with X3D and VRML
- Numerous and growing set of converters, tools, models, support
- Active working groups & community continue driving forward steadily…
- Here we go! ☺

X3D4 Highlights: Benefits and Opportunities

- Benefits of International Standard with ISO review: rigor, reliable, reuse
- 3D Printing, 3D Scanning, CAD models, general metadata architecture
- Humanoid Animation (HAnim) upgrades: anatomically correct skeleton, motion animation, emerging work on internal organs and medical records
- Partnerships with other Standards Development Organizations (SDOs) including ISO, W3C Khronos, hopefully Open Geospatial Consortium (OGC)
- Semantic Web and structured metadata for querying 3D models
- Influential enabler for emerging new work: Medical representations, cultural and natural heritage, Web3D User Experience (Web3DUX)
- Shared pool of knowledge, forums for tackling tough challenges

X3D Version 4 Strategy: Straight Ahead

2016-2020 Annual Milestones Follow

X3D® Version 4 is a major upgrade to the Extensible 3D (X3D) Graphics International Standard that aligns with the HTML5 Recommendation. This is major work in progress, expected to include several future versions. This effort is driven by the X3D Graphics Working Group with regular community outreach.

X3D is always evolving, and the Web3D Consortium Standards Strategy carefully guides all these improvements. X3D Version 4 enables authors to publish any interactive 3D content anywhere on the Web, without restrictions or plugins.

Next-generation evolution + revolution is combined with archival compatibility of existing legacy content.

- X3D Implementations Status and X3D Version 4.0 Development show specific details and planned evolutionary changes to the baseline X3D architecture.
- Next year: X3D Version 4.1 can add Mixed Augmented Reality (MAR) capabilities and consider improved geometric compression.

W3C Workshop on Web and Virtual Reality

Samsung San Jose, October 19-20, 2016; San Jose, CA, USA

White paper: **X3D Capabilities for Declarative Virtual Reality**

Thank You
Mitch Williams

Web3D 2017, Brisbane Australia: Future of X3D

"**Future of X3D**" presentation and detailed notes from Web3D 2017 Conference, Brisbane Australia, 7 June 2017 (photograph).

Web3D 2018, Poznan Poland: Future of X3Dv4

"**Future of X3D**“ progress presentation from Web3D 2018 Conference, Poznan Poland, 20-22 June 2018. Continued scrutiny and development.

Web3D 2019, Los Angeles: X3Dv4 Working Draft

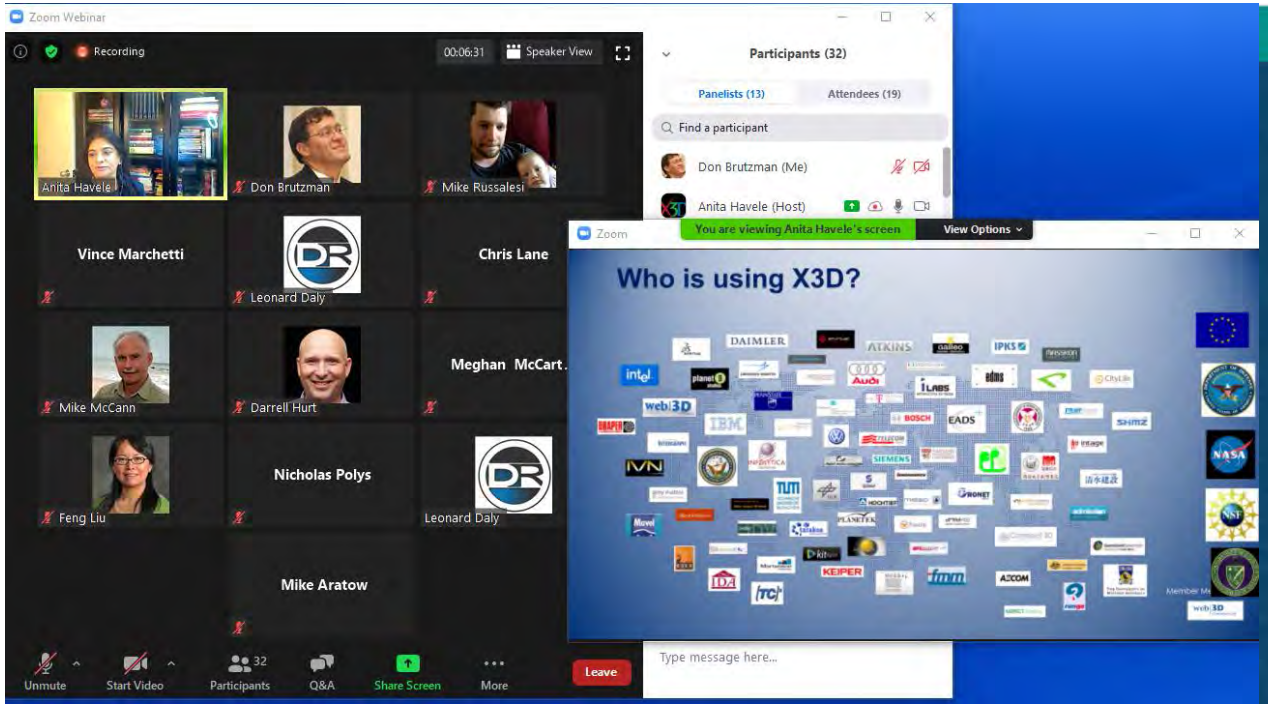
First X3Dv4 Working Draft Specification release, numerous execution discussions in group meetings and technical sessions. Onward we go!

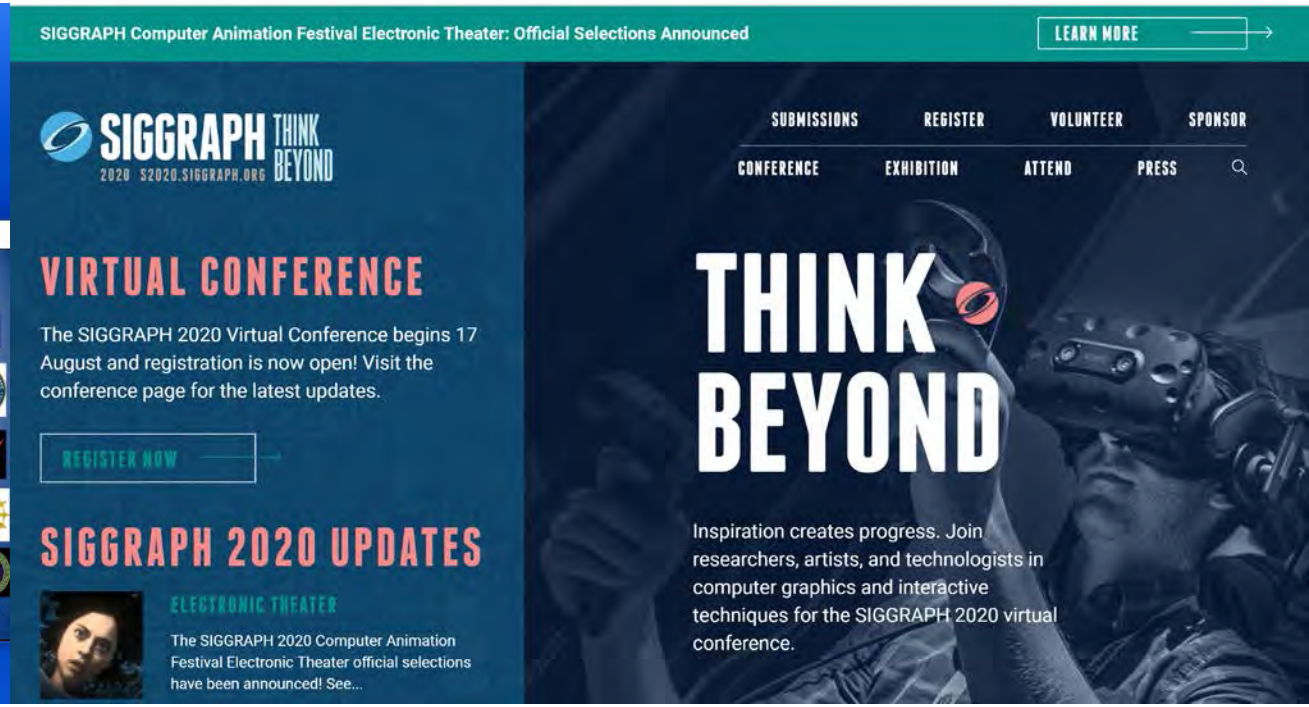
SIGGRAPH 2020, Working Draft 2 Public Release

Second X3Dv4 Working Draft Specification released, now reviewing examples implementations and evaluations. Results matter!

Web3D Webinars
3-6 August 2020

SIGGRAPH
24-28 August 2020





Web3D 2020 Conference – 25th Anniversary Event

Papers, Posters, Tutorials, Workshops and Industrial Use Cases can all inform Web3D Consortium member vote for ISO Committee Draft (CD) submission

https://web3d.siggraph.org

Keeping track of what is happening

Strategy: X3D Version 4

- https://www.web3d.org/x3d4

x3d-public mailing list archives all discussion

- https://www.web3d.org/mailman/listinfo/x3d-public_web3d.org

Twitter announcements

- @Web3DConsortium
- https://twitter.com/Web3Dconsortium

Web3D Standards

- https://www.web3d.org/standards
- https://www.web3d.org/specifications

Weekly Videoconferences
X3D Working Group

X3D4 Working Draft 2 Public Release, August 2020

- Ready for early adopters! X3D4 work is accelerating forward.

X3Dv4 Public Working Draft

https://www.web3d.org/x3dv4-public-working-draft

View Edit Revisions

The Web3D Consortium is happy to release the second public X3Dv4 Working Draft (WD2) Specification.

- Release reviewed satisfactorily by X3D Working Group, 31 July 2020
- Published at web3d.org/specifications/X3Dv4Draft and X3Dv4WorkingDraft.zip (also reviewers .pdf)

Key references:

- X3D4 Overview
- X3D4 Highlights
- X3D4 Strategy
- X3D4 Implementations Status

Final Working Draft 2 Update includes Editors Markup November 2020

Much X3D4 execution work is accelerating forward on implementation and evaluation of example models, to good effect. Have fun with X3Dv4!

X3D4 Assets: Lots!

- X3D Training and Tutorials plus new learning site 3D for the Web
- X3D Draft Specification for early adoption and final review
- X3D Resources available to support both X3D and VRML
- X3D Scene Authoring Hints and X3D Quality Assurance (QA)
- X3D Tooltips and X3D Validator and X3D Regular Expressions (regexes)
- X3D Example Archives: over 4000 models in regular regression testing
- Humanoid Animation (HAnim2) Specification and Examples
- X3DJSAIL Java, X3DPSAIL Python, X3D to JSON, X3D Turtle, X3DJSONLD
- Other programming languages planned
- Twitter announcements and Web3D Videos

Books about X3D and VRML

Books on Extensible 3D (X3D) Graphics

X3D Graphics is the international standard for real-time 3D communication.

1. *X3D for Web Authors* by Don Brutzman and Leonard Daly, Morgan Kaufmann Publishers, Elsevier, April 2007, 468 pages.
   - Free book download in ACM Digital Library is available for ACM and SIGGRAPH members.
   - X3dGraphics.com provides free X3D example scenes and chapter slidesets.
   - Course video lessons for learning X3D (also YouTube course video archive).
   - Online course for enrolled NPS and distance-learning students.
2. *WebGl HOTSHOT* by Mitch Williams, ISBN-13: 9781783280919, 306 pages, 2014. Chapter 1 shows how X3D complements WebGL.
3. *Visualizing Information Using SVG and X3D* by Vladimir Geroimenko and Chaomei Chen, editors, Springer, 2008.
4. *Computer Graphics: From a Small Formula to Cyberworlds* by Alexei Sourin, 3rd edition, Pearson Prentice Hall, Singapore, 385 pages, 2012. Chapter 14 discusses X3D and VRML.
5. *Networked Graphics: Building Networked Games and Virtual Environments* by Anthony Steed and Manuel Fradinho Oliveira, Elsevier, 536 pages, 2009. Chapter 7 discusses X3D, X3D-Edit and DIS.
6. *Interactive 3D Multimedia Content: Models for Creation, Management, Search and Presentation*, edited by Wojciech Cellary and Krzysztof Walczak, Springer London, 302 pages, 2012. Contributed chapters discuss X3D capabilities together with other standards, then describe significant implemented research work regarding 3D/VR/AR systems. Most works provide extensions based on the VRML/X3D standards. Online resource: Chapter 2, Interactive 3D Content Standards.
7. Digital Simulations for Improving Education: Learning Through Artificial Teaching Environments, edited by David Gibson (University of Vermont, USA) and Young Kyun Baek (Korea National University of Education, Korea), IGI Global, 540 pages, April 2009.
8. *Core Web3D* by Aaron E. Walsh and MikaÃ«l Bourges-SÃ©venier, Prentice Hall PTR, Upper Saddle River, New Jersey USA, 1088 pages, 2000. Several chapters discuss developmental versions of X3D.
9. *X3D: Programmierung interaktiver 3D-Anwendungen fÃ¼r das Internet*, Peter Schickel and JÃ¶rg H. Kloss, Addison Wesley, December 2009.
10. *VRML & X3D for virtual reality* by KyungBae Park, KyungIn Kang and SeungWook Kwak, 21 Century, ISBN-10: 8984681903, 422 pages, 2006 (in Korean).
11. *X3D, Who are you? Focus on examples for Web 3D design* by KyungBae Park and SeungWook Kwak, Global, ISBN-13: 9788955024135, 472 pages, 2007 (in Korean).

https://www.web3d.org/x3d/content/examples/X3dResources.html#Books

X3D Extensible 3D Graphics For Web Authors

Buy Book | Read More | Examples | Figures | Tools | Authors

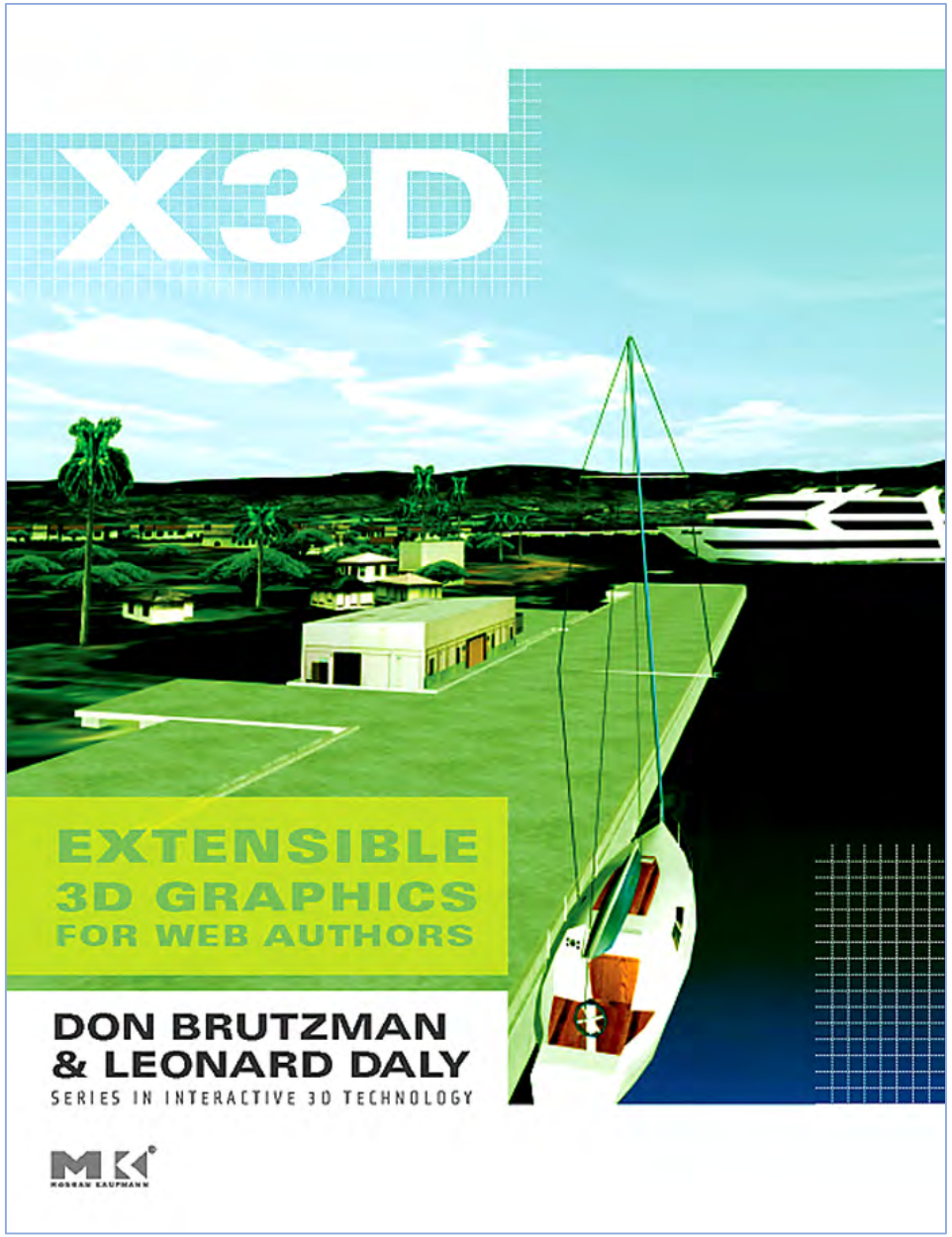
Welcome

Building and interacting with 3D graphics is a "hands on" experience. Throughout this book there are lots of examples to study and modify. Practice helps you learn how X3D works, and assists you in building your own projects.

The book presents the essential ideas needed to understand how an X3D world is constructed. Book chapters build upon each other, progressing from simple ideas to sophisticated concepts.

X3D: Extensible 3D Graphics for Web Authors assumes that you are interested in learning more about 3D graphics. Some experience with other Web technologies (such as HTML or XML) is helpful. No prior programming experience is needed.

Award cgems



http://x3dgraphics.com

YouTube: X3D for Web Authors

https://www.youtube.com/channel/UCSOnGlgAFxkWg8ilg-JEbAQ/playlists

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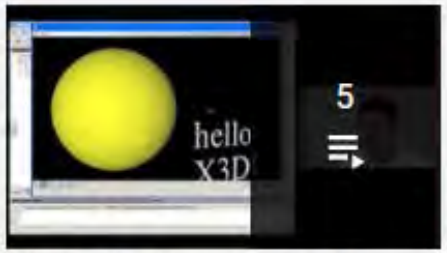
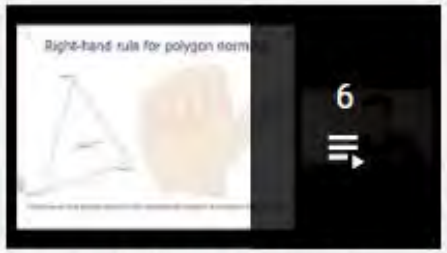


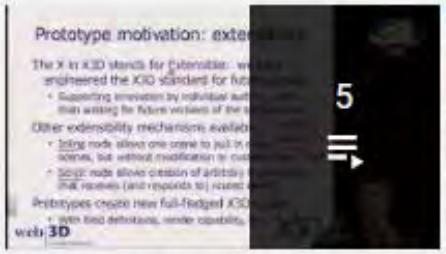
Chapter 2, Geometry Part 1: Primitive Nodes and Text

VIEW FULL PLAYLIST



Chapter 6, Geometry Part 2: Points, Lines, and Polygons

VIEW FULL PLAYLIST

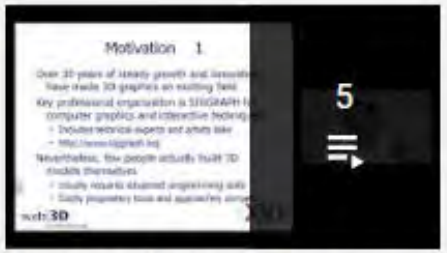


Chapter 14, Creating Prototype Nodes

VIEW FULL PLAYLIST

Chapter 13, Geometry Part 4: Triangles and Quadrilaterals

VIEW FULL PLAYLIST



Chapter 1, Technical Overview

VIEW FULL PLAYLIST

Books on Virtual Reality Modeling Language (VRML) 97

VRML design began in 1994 and the language became a stable International Standard in 1997. Of interest: X3D is a third-generation design that is fully backwards-compatible with the second-generation VRML 97 standard. Thus all design guidelines and technical details in the following textbooks remains relevant.

10. *VRML 2 Sourcebook* by Andrea L. Ames, David R. Nadeau, and John L. Moreland, John Wiley & Sons, 1996. (also see VRML 2 Sourcebook examples in X3D)
11. *Annotated VRML 2.0 Reference Manual* by Rikk Carey and Gavin Bell, Addison Wesley, Boston Massachusetts, 1997.
12. *Late Night VRML 2.0 with Java* by Bernie Roehl, Justin Couch, Cindy Reed-Ballreich, Tim Rohaly and Geoff Brown, Ziff-Davis Press (Macmillan Publishers), 1997.
13. *VRML 2.0 Handbook* by Jed Hartman and Josie Wernecke, Addison Wesley, Boston Massachusetts, 1996. Also see the Tenochtitlan examples.
14. *VRML: Exploring Virtual Worlds on the Internet*, by Walter Goralski, Matthew Poli, and Peter Vogel, Prentice Hall PTR, January 1997.
15. *Das Einsteigerseminar VRML* by Prof. Dr. Rolf Daessler, April 2001, BHV Publishing Group, 498 pages, in German. Available online.
16. 3D User Interfaces with Java 3D by Jon Barrilleaux, Manning Publications, 2000. A guide to computer-human interaction in 3D with direct mappings to VRML.

Training and Tutorials for X3D

The Web3D Conference includes excellent papers, panels and tutorials each year. Offered annually since 1995, the conference is sponsored by ACM SIGGRAPH and the Web3D Consortium.

The X3D for Web Authors textbook includes a comprehensive set of online examples, slidesets and videos. Coverage includes all of VRML and the X3D Immersive Profile. The X3D for Web Authors Course Adoption page lists an introductory tutorial and chapter classes as X3D instruction.

The VRML 2 Sourcebook also includes a comprehensive set of online examples and slidesets. Coverage of the Virtual Reality Modeling Language (VRML) 97 approximately equals the X3D Immersive Profile.

Additional training and tutorial resources include:

- Instant Reality tutorials
- Edutech Wiki X3D tutorials by DKS
- VRML Primer and Tutorial and examples archive by Daniel K. Schneider and Sylvere Martin-Michiellot
- Understanding Scene Graphs by Aaron E. Walsh, *Dr. Dobb's Journal*, 1 July 2002 (covers VRML, X3D, MPEG-4, and Java3D).
- Yumetech X3D extensions documentation.

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https://www.web3d.org/x3d/content/examples/X3dResources.html#Tutorials


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The next-generation VRML
About X3D
Bell X-1 Model from Smithsonian3D

webx3d.org

X3D Resources

Extensible 3D (X3D) Graphics is the royalty-free open standard for publishing, viewing, printing and archiving interactive 3D models on the Web.

Applications | Authoring Tools | Authoring Support | Books | Conformance | Conversions | Examples | Export and Import | Feedback | License | Mobile | Model Search | PowerPoint | Programming Languages | Quality Assurance (QA) | References | Security | Showcase | Training and Tutorials | Videos | VRML and Open Inventor | Wish List | X3D-Edit | X3D Scene Authoring Hints | X3D Tooltips | X3D Validator | Contact

Numerous resources are available to support both X3D Graphics and its compatible predecessor, the Virtual Reality Modeling Language (VRML).

Applications, Players and Plugins for X3D / VRML Viewing

Extensible 3D (X3D) is the third-generation successor to the Virtual Reality Modeling Language (VRML), providing full backwards compatibility and adding functionally equivalent XML and compressed-binary file encodings.

- Player support for X3D components provides a feature comparison of major X3D viewers, for each player and each X3D component.
- A simple example test scene is HelloWorld.x3d provided in a variety of X3D encodings and conversions: (.x3d XML, .x3dv ClassicVRML, .wrl VRML97, .html listing, .html X_ITE, .xhtml X3DOM, .java Java source, .json JavaScript Object Notation, .py Python source (experimental), .ttl Turtle source (experimental) with SPARQL query, .x3db compression, XML canonicalization (C14N), and .png image)
- The HelloWorld.x3d scene is a simple authoring example that illustrates the minimalist X3D Interchange profile. Also available: internationalized Hello World Scenes.
- Please install one of the following X3D players to view X3D/VRML scenes and browse these examples.

https://www.web3d.org/x3d/content/examples/X3dResources.html

X3D Scene Authoring Hints

These hints provide a collection of style guidelines, authoring tips and best practices to improve the quality, consistency and maintainability of Extensible 3D (X3D) Graphics models.

Audio and Sound

- Tool recommendations:
  - Audacity is an excellent open-source audio editing and recording tool (Windows Macintosh Linux).
  - MuseScore is an excellent open-source music-score editing and recording tool that can produce `.midi` and `.wav` files (Windows Macintosh Linux).
  - Video tools can typically play audio files.
- Sound formats:
  - X3D player support for the `.wav` format is required, while `.midi` and `.mp3` support are recommended.
  - Other audio formats are optional, you are welcome to check documentation for browsers of interest.
  - So far, no streaming protocol is required to be supported in X3D players... but none is forbidden, either. Experimentation is good, the "X" in X3D stands for Extensible.
- For reliability an author can use a variety of formats at once, if desired. See URL Links for information how to link multiple formats/versions of an audio file.
- Do not add audio files to open-source archives without proper permissions and Credits.

https://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html

Extensible 3D (X3D) 4.0 Tooltips

web3D CONSORTIUM
Open Standards for Real-Time 3D Communication

X3D Tooltips provide authoring hints for each node and field found in X3D Architecture Specification version 4 draft.

X3D Tooltips provide context-sensitive support for authors and are usable within tools (such as X3D-Edit). Each node's table entry also provides appropriate links to the X3D Abstract Specification, X3D Schema Documentation, X3D DOCTYPE Documentation, X3D JSON Documentation (draft), X3D Regular Expressions (regexes), and X3D Java SAI Library (X3DJSAIL).

AcousticProperties Analyser Anchor Appearance Arc2D ArcClose2D AudioClip AudioDestination Background BallJoint Billboard BiquadFilter BlendedVolumeStyle BooleanFilter BooleanSequencer BooleanToggle BooleanTrigger BoundaryEnhancementVolumeStyle BoundedPhysicsModel Box BufferAudioSource CADAssembly CADFace CADLayer CADPart CartoonVolumeStyle ChannelMerger ChannelSelector ChannelSplitter Circle2D ClipPlane CollidableOffset CollidableShape Collision CollisionCollection CollisionSensor CollisionSpace Color ColorChaser ColorDamper ColorInterpolator ColorRGBA component ComposedCubeMapTexture ComposedShader ComposedTexture3D ComposedVolumeStyle Cone ConeEmitter connect Contact Contour2D ContourPolyline2D Convolver Coordinate CoordinateChaser CoordinateDamper CoordinateDouble CoordinateInterpolator CoordinateInterpolator2D Cylinder CylinderSensor Delay DirectionalLight DISEntityManager DISEntityTypeMapping Disk2D DoubleAxisHingeJoint DynamicsCompressor EaseInEaseOut EdgeEnhancementVolumeStyle ElevationGrid EspduTransform ExplosionEmitter EXPORT ExternProtoDeclare Extrusion field fieldValue FillProperties FloatVertexAttribute Fog FogCoordinate FontStyle ForcePhysicsModel Gain GeneratedCubeMapTexture GeoCoordinate GeoElevationGrid GeoLocation GeoLOD GeoMetadata GeoOrigin GeoPositionInterpolator GeoProximitySensor GeoTouchSensor GeoTransform GeoViewpoint Group HAnimDisplacer HAnimHumanoid HAnimJoint HAnimMotion HAnimSegment HAnimSite head ImageCubeMapTexture ImageTexture ImageTexture3D IMPORT IndexedFaceSet IndexedLineSet IndexedQuadSet IndexedTriangleFanSet IndexedTriangleSet IndexedTriangleStripSet Inline IntegerSequencer IntegerTrigger IS IsoSurfaceVolumeData KeySensor Layer LayerSet Layout LayoutGroup LayoutLayer LinePickSensor LineProperties LineSet ListenerPointSource LoadSensor LocalFog LOD Material Matrix3VertexAttribute Matrix4VertexAttribute meta MetadataBoolean MetadataDouble MetadataFloat MetadataInteger MetadataSet MetadataString MicrophoneSource MotorJoint MovieTexture MultiTexture MultiTextureCoordinate MultiTextureTransform NavigationInfo Normal NormalInterpolator NurbsCurve NurbsCurve2D NurbsOrientationInterpolator NurbsPatchSurface NurbsPositionInterpolator NurbsSet NurbsSurfaceInterpolator NurbsSweptSurface NurbsSwungSurface NurbsTextureCoordinate NurbsTrimmedSurface OpacityMapVolumeStyle OrientationChaser OrientationDamper OrientationInterpolator OrthoViewpoint OscillatorSource PackagedShader ParticleSystem PeriodicWave PhysicalMaterial PickableGroup PixelTexture PixelTexture3D PlaneSensor PointEmitter PointLight PointPickSensor PointProperties PointSet Polyline2D PolylineEmitter Polypoint2D PositionChaser PositionChaser2D PositionDamper PositionDamper2D PositionInterpolator PositionInterpolator2D PrimitivePickSensor ProgramShader ProjectionVolumeStyle ProtoBody ProtoDeclare ProtoInstance ProtoInterface ProximitySensor QuadSet ReceiverPdu Rectangle2D RigidBody RigidBodyCollection ROUTE ScalarChaser ScalarDamper ScalarInterpolator Scene ScreenFontStyle ScreenGroup Script SegmentedVolumeData ShadedVolumeStyle ShaderPart ShaderProgram Shape SignalPdu SilhouetteEnhancementVolumeStyle SingleAxisHingeJoint SliderJoint Sound SpatialSound Sphere SphereSensor SplinePositionInterpolator SplinePositionInterpolator2D SplineScalarInterpolator SpotLight SquadOrientationInterpolator StaticGroup StreamAudioDestination StreamAudioSource StringSensor SurfaceEmitter Switch TexCoordChaser2D TexCoordDamper2D Text TextureBackground TextureCoordinate TextureCoordinate3D TextureCoordinate4D TextureCoordinateGenerator TextureProjector TextureProjectorParallel TextureProperties TextureTransform TextureTransform3D TextureTransformMatrix3D TimeSensor TimeTrigger ToneMappedVolumeStyle TouchSensor Transform TransformSensor TransmitterPdu TriangleFanSet TriangleSet TriangleSet2D TriangleStripSet TwoSidedMaterial unit UniversalJoint UnlitMaterial Viewpoint ViewpointGroup Viewport VisibilitySensor VolumeData VolumeEmitter VolumePickSensor WaveShaper WindPhysicsModel WorldInfo X3D

accessType Definitions *type* Definitions XML data types Range Intervals Field Type Definitions Credits and Translations X3D Resources X3D Scene Authoring Hints

SFBool MFBool SFColor MFColor SFColorRGBA MFColorRGBA SFInt32 MFInt32 SFFloat MFFloat SFDouble MFDouble SFImage MFImage SFNode MFNode SFRotation MFRotation SFString MFString SFTime MFTime SFVec2f MFVec2f SFVec2d MFVec2d SFVec3f MFVec3f SFVec3d MFVec3d SFVec4f MFVec4f SFVec4d MFVec4d MFMatrix3f SFMatrix3d MFMatrix3d SFMatrix4f MFMatrix4f SFMatrix4d MFMatrix4d

https://www.web3d.org/x3d/tooltips/X3dTooltips.html

X3D Validator

The X3D Validator performs comprehensive Quality Assurance (QA) testing to ensure the validity of X3D3 and X3D4 models.

◉ Choose a local .x3d model file

Choose File | No file chosen

○ Enter an online .x3d model url

Hello World .x3d

Validate

X3D model: http://www.web3d.org/x3d/content/examples/HelloWorld.x3d

X3D model file name: **HelloWorld.x3d** (length: 3453 bytes) (revalidation address)

--------- Commence validation checks for **HelloWorld.x3d** ---------
Total file length: 3454 bytes
X3D file length: 3454 bytes

https://savage.nps.edu/X3dValidator

1. Performing XML well-formed check...
XML well-formed check: **pass**.

2. Performing DOCTYPE reference check...
found HTML page wrapping X3D model in original file: false
[X3dDoctypeChecker] success: valid XML declaration found.
[X3dDoctypeChecker] success: final X3D 3.3 DOCTYPE found.
DOCTYPE reference check: **pass**.

3. Performing X3D DTD validation check (X3D DTD documentation) ...
X3D DTD validation check: **pass**.

4. Performing X3D schema validation check (X3D schema documentation) ...
X3D schema validation check: **pass**.

5. Performing X3dToX3dvClassicVrml.xslt X3dToVrml97.xslt conversion check (Quality Assurance (QA) overview) ...
X3dToX3dvClassicVrml.xslt X3dToVrml97.xslt conversion check: **pass**.

6. Performing integer/float data-patterns check...
as part of X3D Regular Expressions (regexes)
integer/float data-patterns check: **pass**.

7. Performing X3D Schematron check...
X3D Schematron check: **pass**.

8. Performing X3D Tidy check (X3D Tidy Scene Cleanup, Corrections and Modifications) ...
X3D Tidy check: **pass**.

9. Performing X3D to XHTML pretty-print listing check (Quality Assurance (QA) overview) ...
Conversion complete, documentation appears below.

Authoring hints: Select url links to check the availability of online addresses. Comments are inserted with local links to document ROUTE connections. Node tooltips are also provided.

X3D Regular Expressions (regexes)

X3D Regular Expressions (regexes) are used to validate the correctness of string and numeric array values in an X3D scene.

Overview

Regular expressions (regexes) define string grammars that efficiently and rigorously define allowable character patterns making up a data value.

Regexes themselves are carefully defined sequences of characters that form a search pattern, mainly used for string pattern matching. For example, this technique allows detection of well-formed (or incorrect) MFVec3f arrays of three-tuple floats in an X3D scene.

X3D regexes are utilized judiciously when the base types of XML Schema are insufficient to capture the necessary richness of X3D content validation. Like all aspects of X3D Schema validation, regex validation is typically high performance and optional for end-user content display.

Note that not all regex languages are completely consistent, thus small (but fundamentally important) variations can occur. This work strictly follows regex syntax for XML Schema, which in turn permits consistent application using other variations of regex languages.

Interestingly, various data validation tools provide expressive power that is able to validate values to different degrees of fidelity.

a. **DOCTYPE (DTD).** DOCTYPE validation can only check that attribute values are strings. In some cases, a strict set of allowed enumeration values is defined (such as legal names for profiles and components).
b. **XML Schema.** Schema validation can check a large set of built-in data types. However, XML Schema validation is typically not able to fully check the correctness of array values. For example, an SFVec3f triplet (3-tuple) or an MFVec3f array can be checked to only contain floating-point values, but cannot be checked to have a multiple of three floats.
c. **Regular expressions (regexes).** Regular expressions can define any regular grammar, and thus have arbitrary expressive power. Although definitions may be tricky to define, character patterns of arbitrary complexity are theoretically achievable.
d. Regexes found on this page are included in the data-type definitions of each X3D XML Schema and X3D Unified Object Model (X3DUOM).

X3D Regular Expressions are an important part of X3D Quality Assurance (QA) to maximize the correctness of X3D scene content.

---

https://www.web3d.org/specifications/X3dRegularExpressions.html

Quality Assurance (QA)

X3D Quality Assurance (QA) identifies errors and warnings in order to make X3D scene content more portable and reliable. Improved Quality Assurance (QA) helps achieve intended results in X3D scenes and metadata.

- X3D Validator provides a server-based suite of tests to help ensure the quality of X3D scenes and metadata. Validation tests include:
  - XML header and DOCTYPE checking for correct document headers
  - Well-formed XML checking for syntactic correctness
  - X3D Specifications: Schema and DOCTYPE Validation checking for valid X3D nodes, fields and values
  - X3D to ClassicVRML conversion checks a variety of legal X3D constructs
  - Regular expression (regex) checking (design discussion) for malformed floating-point numbers and excess leading zeros.
  - X3D Schematron rule checking verifies semantic correctness and completeness, detecting internal-consistency problems to help assure the quality and correctness of X3D scenes
  - X3D Tidy helps authors automatically correct fixable errors in X3D scenes.
  - X3D to XHTML conversion pretty-print listing to check online URL links, document ROUTE connections, and provide node tooltips
  - Support for .html/.xhtml pages containing X3DOM support for X3D models. Errors or warnings are provided as appropriate for experimental attributes and interspersed HTML elements.
  - X3D Validator is written in Java using publicly available source code.
- X3D-Edit authoring tool also provides further tools and tests (individually or in combination) for checking X3D scenes.
  - X3D Canonicalizer (C14N button) applies X3D Canonicalization (C14N) `.xml` to reformat scenes into X3D Canonical Form.
  - Additional test: ExternProtoDeclare field verification checks that field signatures match the original ProtoDeclare definitions, providing author with the option to apply updates.
  - Additional test: url list editor checks for resource availability (green=found, **black=retrieving**, red=unavailable, **orange=filename case mismatch**).
- X3D JSON Schema (documentation) detects type and syntax errors in the experimental X3D JSON Encoding. Currently authored manually by Roy Walmsley. Eventually this tool will be autogenerated for all X3D versions.
- JSONLint validation has been added for all .json versions of scenes in the X3D Examples Archives.
- Altova XMLSpy includes X3D as a native file type with full validation support.
- Running individual X3D players and applications often can reveal errors in the browser console. For example, Xj3D is very strict about playing content with perceived errors.
- Example diff image reveals subtle changes following an Xj3D renderer update. Established capability: offscreen rendering of X3D example scene viewpoints unlock 10,000+ helpful unit tests.
- X3D Regular Expressions (regexes) are used to validate the correctness of string and numeric array values in an X3D scene.

Detailed build logs for the X3D Examples Archives provide comprehensive conversion records of test processes.

https://www.web3d.org/x3d/content/examples/X3dResources.html#QualityAssurance

Examples: Scene Archives for X3D

The X3D Examples Archives demonstrate how X3D nodes and scenes work. Thousands of scenes are provided in all X3D encodings. You can browse them individually online or download fully complete, separately installable .zip archives. Links to thousands of additional X3D example scenes are provided.

A simple example test scene is HelloWorld.x3d provided in a variety of X3D encodings: .x3d XML, .x3dv ClassicVRML, .wrl VRML97, .html listing, .html X_ITE, .xhtml X3DOM, .java Java source, .json JavaScript Object Notation, .py Python source (experimental), .ttl Turtle source (experimental) with SPARQL query, .x3db compression, XML canonicalization (C14N), and .png image

Quick Links	X3D for Web Authors	X3D for Advanced Modeling	Basic	Conformance Nist	Humanoid Animation (HAnim)	VRML 2 Sourcebook	Savage	SavageDefense
Overview, references:	README	README	README	README	README	README	README	README
Archive examples:	Online	Online	Online	Online	Online	Online	Online	Online
Local links (if present):	Local	Local	Local	Local	Local	Local	Local	Local
Java conversions:	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc
3993 total X3D scenes:	268	109	784	761	66	416	1250	405
Catalog metadata XML:	Content catalog	Content catalog	Content catalog	Content catalog	Content catalog	Content catalog	Content catalog	Content catalog
Ant build scripts:	build.xml	build.xml	build.xml	build.xml	build.xml	build.xml	build.xml	build.xml
Quality Assurance (QA) regression testing:	build.log.txt (history)	build.log.txt (history)	build.log.txt (history)	build.log.txt (history)	build.log.txt (history)	build.log.txt (history)	build.log.txt (history)	build.log.txt (history)
Full download:	zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)
Additional details:	see below	see below	see below	see below	see below	see below	see below	see below

Special testing distribution. A comprehensive collection of all JSON example scenes is available at X3dExampleArchivesJsonScenes.zip (MD5 checksum) plus current output from the X3D JSON build process at build.log.json.txt.

Production notes:

- README.txt summarizes archive contents and lists key links.
- Build scripts are written using Ant with build.xml files in each archive's root.
- Please install a player plugin in your Web browser to view X3D/VRML scenes and browse these examples. Alternatively you can view X3DOM versions by selecting the .xhtml links.
- These examples are maintained by the Web3D Consortium and are all protected under an open source license, provided free for any use.
- The Sourceforge X3D Project is the site where master versions of most X3D examples are maintained.
- Quality Assurance (QA) regression testing provides exhaustively thorough validation checks on all X3D example scenes.
- Each example scene is provided using all X3D file encodings.
  - XML `.x3d`, ClassicVRML `.x3dv`, VRML97 `.wrl` and pretty-print HTML `.html` form. Compressed Binary Encoding `.x3db` and X3D Canonicalization (C14N) `.xml` formats were added in 2006.
  - X3DOM `.xhtml` formats were added in 2013.
  - The viewpoint snapshot slidesets (with images taken by Xj3D in offline-rendering mode) were added in 2014.
- Zipped example archives start with the directory structure `www.web3d.org/x3d/content/examples` in order to match the online addresses for most examples, and also to allow side-by-side installation of local archives for easier user access.

https://www.web3d.org/x3d/content/examples/X3dResources.html#Examples

X3D for Advanced Modeling (X3D4AM) Examples Archive

X3D for Advanced Modeling (X3D4AM) is a work in progress for learning advanced Extensible 3D (X3D) Graphics modeling techniques.

Online resources include the X3D-Edit authoring tool, X3D Tooltips, X3D Validator, *X3D for Web Authors* book, and multiple X3D Examples scene archives. Also available: companion examples archive X3D for Web Authors (X3D4WA).

17 Directories, 118 X3D Models

Additive Manufacturing
Animation
Audio Spatial Sound
Buildings
Conversions
Geometric Shapes
Hello World Scenes
Inspiration
Life Sciences
Matlab
San Carlos Cathedral
Scanning
Security
Shay D Pixel
Texture Mapping
User Experience UX
Visualization

17 Directory Summaries	118 X3D Models

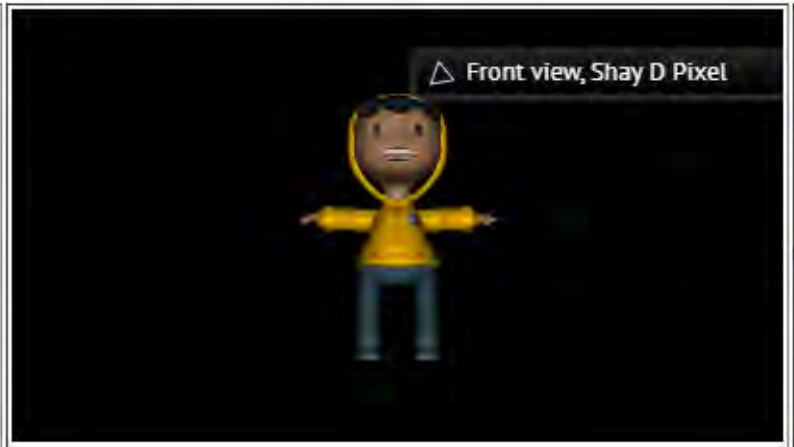
https://x3dgraphics.com/examples/X3dForAdvancedModeling

https://x3dgraphics.com/examples/X3dForAdvancedModeling/ShayDPixel/ShayDPixelVersion2Index.html

Sign in

X3D Example Archives: X3D4AM, X3D for Advanced Modeling, Shay D Pixel, Shay D Pixel Version 2

Shay D Pixel standing in default pose from original real-time model for SIGGRAPH 2017, approximately 1m tall.



X3D model
ClassicVRML
VRML97
Canonical XML
annotated documentation
.py python

X_ITE
X3DOM
.json (check)
.x3db Binary
.java source (Javadoc)
.ttl Turtle (query)

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.3//EN" "https://www.web3d.org/specifications/x3d-3.3.dtd">
<X3D profile='Interchange' version='3.3' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation =' https://www.web3d.org/specifications/x3d-3.3.xsd '>
    <head>
        <meta name='title' content='ShayDPixelVersion2.x3d'/>
        <meta name='description' content='Shay D Pixel standing in default pose from original real-time model for SIGGRAPH 2017, approximately 1m tall.'/>
        <meta name='creator' content='Mario Nagumura'/>
        <meta name='translator' content='Don Brutzman'/>
        <meta name='created' content='6 November 2017'/>
        <meta name='translated' content='6 November 2017'/>
        <meta name='modified' content='28 November 2019'/>
        <meta name='Image' content='images/pixel3D_screenshot01.jpg'/>
        <meta name='Image' content='images/pixel3D_screenshot02.jpg'/>
        <meta name='Image' content='images/pixel3D_screenshot03.jpg'/>
        <meta name='Image' content='images/pixel3D_screenshot04.jpg'/>
        <meta name='TODO' content='investigate Transform nodes for HAnim skeleton'/>
        <meta name='identifier' content=' https://x3dgraphics.com/examples/X3dForAdvancedModeling/ShayDPixel/ShayDPixelVersion2.x3d '/>
        <meta name='generator' content='X3D-Edit 3.3, https://savage.nps.edu/X3D-Edit'/>
        <meta name='generator' content='PolyTrans NuGraf by Okino Computer Graphics https://www.okino.com/nrs/nrs.htm'/>
        <meta name='license' content=' Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) https://creativecommons.org/licenses/by-nc-sa/4.0 '/>
    </head>
```

https://x3dgraphics.com/examples/X3dForAdvancedModeling/ShayDPixel/ShayDPixelVersion2Index.html

```
{ "X3D": {
    "encoding":"UTF-8",
    "@profile":"Interchange",
    "@version":"3.3",
    "@xsd:noNamespaceSchemaLocation":"https://www.web3d.org/specifications/x3d-3.3.xsd",
    "JSON schema":"https://www.web3d.org/specifications/x3d-3.3-JSONSchema.json",
    "head": {
        "meta": [
          {
            "@name":"title",
            "@content":"ShayDPixelVersion2.x3d"
          },
          {
            "@name":"description",
            "@content":"Shay D Pixel standing in default pose from original real-time model for SIGGRAPH 2017, approximately
          },
          {
            "@name":"creator",
            "@content":"Mario Nagumura"
          },
```

JSON JavaScript Object Notation conversion

```
Transform(DEF='Eyes',translation=(0.00042963,55.4652,14.4673),
  children=[
  Transform(translation=(-0.00042963,-55.4652,-14.4673),
    children=[
    Group(DEF='Eyes_geometry',
      children=[
      Shape(
        appearance=Appearance(
          material=Material(DEF='map2',ambientIntensity=1,shininess=1,specularColor=(0.5,0.5,0.5)),
          texture=ImageTexture(DEF='pixed_3D_Default_texture',url=["pixelModel_BaseColor.png","https://x3dgraphics.com
          textureTransform=TextureTransform(),),
        geometry=IndexedFaceSet(coordIndex=[1453,777,776,1452,-1,1452,776,775,1451,-1,1451,775,774,1450,-1,1450,774,77
          coord=Coordinate(point=[(-7.85606,89.4308,11.5314),(-7.80428,89.4076,11.4783),(-7.74223,89.3883,11.435),(-7.
          normal=Normal(vector=[(0.0854615,0.974458,0.207675),(0.0854615,0.974458,0.207675),(0.0854615,0.974457,0.2076
          texCoord=TextureCoordinate(point=[(0.353705,0.987305),(0.354152,0.985998),(0.355505,0.986313),(0.355112,0.98
Transform(DEF='Face',translation=(0.000431061,46.8829,0.466633),
  children=[
  Transform(translation=(-0.000431061,-46.8829,-0.466633),
    children=[
    Group(DEF='Face_geometry',
```

Python x3d.py conversion

https://x3dgraphics.com/examples/X3dForAdvancedModeling/ShayDPixel/ShayDPixelVersion2Index.html

Autoconversion of .x3d XML to X3DJSAIL .java source, also available for Python JSON ClassicVRML VRML97 etc.

Java X3DJSAIL conversion

```
143    /** Create and initialize the X3D model for this object. */
144    public final void initialize()
145    {
146  x3dModel = new X3D().setProfile(X3D.PROFILE_INTERCHANGE).setVersion(X3D.VERSION_3_3)
147  .setHead(new head()
148    .addMeta(new meta().setName(meta.NAME_TITLE      ).setContent("ShayDPixelVersion2.x3d"))
149    .addMeta(new meta().setName(meta.NAME_DESCRIPTION).setContent("Shay D Pixel standing in default pose from original re
150    .addMeta(new meta().setName(meta.NAME_CREATOR    ).setContent("Mario Nagumura"))
151    .addMeta(new meta().setName(meta.NAME_TRANSLATOR ).setContent("Don Brutzman"))
152    .addMeta(new meta().setName(meta.NAME_CREATED    ).setContent("6 November 2017"))
153    .addMeta(new meta().setName(meta.NAME_TRANSLATED ).setContent("6 November 2017"))
154    .addMeta(new meta().setName(meta.NAME_MODIFIED   ).setContent("28 November 2019"))
155    .addMeta(new meta().setName(meta.NAME_IMAGE      ).setContent("images/pixel3D_screenshot01.jpg"))
156    .addMeta(new meta().setName(meta.NAME_IMAGE      ).setContent("images/pixel3D_screenshot02.jpg"))
157    .addMeta(new meta().setName(meta.NAME_IMAGE      ).setContent("images/pixel3D_screenshot03.jpg"))
158    .addMeta(new meta().setName(meta.NAME_IMAGE      ).setContent("images/pixel3D_screenshot04.jpg"))
159    .addMeta(new meta().setName(meta.NAME_TODO       ).setContent("investigate Transform nodes for HAnim skeleton"))
160    .addMeta(new meta().setName(meta.NAME_IDENTIFIER ).setContent("https://x3dgraphics.com/examples/X3dForAdvancedModelin
161    .addMeta(new meta().setName(meta.NAME_GENERATOR  ).setContent("X3D-Edit 3.3, https://savage.nps.edu/X3D-Edit"))
162    .addMeta(new meta().setName(meta.NAME_GENERATOR  ).setContent("PolyTrans NuGraf by Okino Computer Graphics https://ww
163    .addMeta(new meta().setName(meta.NAME_LICENSE    ).setContent("Attribution-NonCommercial-ShareAlike 4.0 International
164  .setScene(new Scene()
165    .addChild(new WorldInfo().setTitle("ShayDPixelVersion2.x3d"))
166    .addChild(new Viewpoint("ViewFromFront").setDescription("Front view, Shay D Pixel").setCenterOfRotation(0.0,0.5,0.0).
167    .addChild(new Viewpoint("ObliqueCamera").setDescription("Oblique view, Shay D Pixel").setCenterOfRotation(0.0,0.5,0.0
168    .addChild(new Viewpoint("ViewFromLeftSide").setDescription("View from left side, Shay D Pixel").setCenterOfRotation(0
169    .addChild(new Viewpoint("ViewFromBack").setDescription("View from back, Shay D Pixel").setCenterOfRotation(0.0,0.5,0.
170    .addChild(new Viewpoint("ViewOverShoulder").setDescription("Over the shoulder view, Shay D Pixel").setCenterOfRotatio
171    .addChild(new Viewpoint("ViewOverHead").setDescription("View from overhead, Shay D Pixel").setCenterOfRotation(0.0,0.
172    .addChild(new Viewpoint("ViewFromRightSide").setDescription("View from right side, Shay D Pixel").setCenterOfRotation
173    .addChild(new Transform("ScaleTolmHeight").setScale(0.00962,0.00962,0.00962).setTranslation(0.0,0.004,0.0)
174      .addChild(new Transform("pixel v2")
```

https://x3dgraphics.com/examples/X3dForAdvancedModeling/ShayDPixel/ShayDPixelVersion2Index.html

X3D for Web Authors (X3D4WA) Examples Archive

X3D for Web Authors is an introductory reference textbook for learning Extensible 3D (X3D) Graphics.

Author support includes the X3D-Edit authoring tool, X3D Tooltips, X3D Validator, complete course slidesets and course video lessons for learning X3D (also YouTube course video archive), plus this open-source scene archive. Supporting textbook in listed ACM Digital Library.
Also available: companion examples archive X3D for Advanced Modeling (X3D4AM).


16 Directories, 267 X3D Models


Chapter 01 Technical Overview
Chapter 02 Geometry Primitives
Chapter 03 Grouping
Chapter 04 Viewing Navigation
Chapter 05 Appearance Material Textures
Chapter 06 Geometry Points Lines Polygons
Chapter 07 Event Animation Interpolation
Chapter 08 User Interactivity
Chapter 09 Event Utilities Scripting
Chapter 10 Geometry 2D
Chapter 11 Lighting Environmental Effects
Chapter 12 Environment Sensor Sound
Chapter 13 Geometry Triangles Quadrilaterals
Chapter 14 Prototypes
Chapter 15 Metadata
Kelp Forest Exhibit

16 Directory Summaries	267 X3D Models

https://x3dgraphics.com/examples/X3dForWebAuthors

VRML 2 Sourcebook, X3D Examples Archive

The *VRML 2 Sourcebook* was written by Andrea L. Ames, David R. Nadeau, and John L. Moreland, published by John Wiley & Sons, 1996. This open-source archive has translated the original examples to create corresponding example scenes using X3D. The original SIGGRAPH 98 course notes with corresponding translated Siggraph 98 Course scenes are also available.

Virtual Reality Modeling Language (VRML97) is the second-generation ISO International Standard that is fully compatible with the third-generation ISO standard, Extensible 3D (X3D) Graphics. VRML97 provides a close match to the X3D Immersive Profile.

31 Directories, 416 X3D Models

Chapter 02 Introduction
Chapter 03 Shapes
Chapter 04 Text
Chapter 05 Positioning Shapes
Chapter 06 Rotating Shapes
Chapter 07 Scaling Shapes
Chapter 08 Animating Position Orientation Scale
Chapter 09 Sensing Viewer
Chapter 10 Materials
Chapter 11 Grouping
Chapter 12 Inline
Chapter 13 Points Lines Faces
Chapter 14 Elevation Grid
Chapter 15 Extrusion
Chapter 16 Color
Chapter 17 Textures
Chapter 18 Texture Mapping
Chapter 19 Normals Shading
Chapter 20 Lighting
Chapter 21 Shiny Materials
Chapter 22 Background
Chapter 23 Fog
Chapter 24 Sound
Chapter 25 Level Of Detail
Chapter 26 Viewpoint
Chapter 27 Sensing Visibility Proximity Collision
Chapter 28 Anchor
Chapter 29 World Info
Chapter 30 Scripts
Chapter 31 Prototypes
Siggraph 98 Course

31 Directory Summaries	416 X3D Models

https://www.web3d.org/x3d/content/examples/Vrml2Sourcebook

ConformanceNist X3D Examples Archive

The ConformanceNist X3D Examples Archive was converted from the original VRML Test Suite (VTS) providing full coverage of the Virtual Reality Modeling Language (VRML97) Specification. It was produced by a team of experts at the U.S. National Institute of Science and Technology (NIST) in 1999.

This open-source archive was designed using an interactive conformance testing methodology that continues to work well today. It provides a huge number of rendering and behavior examples to help verify X3D model and player conformance matching the Immersive Profile of the X3D Architecture ISO Specification.

13 Sections, 66 Directories, 761 Models

https://www.web3d.org/x3d/content/examples/ConformanceNist

H-Anim
HUMANOID ANIMATION

ISO/IEC 19774-1

Part 1: Humanoid animation (HAnim) architecture

H|Anim

This document is ISO/IEC 19774-1:2019, Humanoid animation (HAnim) architecture. The full title of this document is: *Information technology — Computer graphics, image processing and environmental data representation — Part 1: Humanoid animation (HAnim) architecture*.

Humanoid Animation (HAnim2) Specification

HumanoidAnimation X3D Examples Archive

The HumanoidAnimation X3D Examples Archive are being ported from the original X3D Example Archives: Basic, Humanoid Animation.

Current work is upgrading all models to support ISO/IEC 19774-1 Humanoid animation (HAnim) International Specification.

Quality Assurance (QA) efforts are documented with diagnostics, warnings and error messages.

7 Directories, 79 X3D Models

Characters
Polygonal
Templates

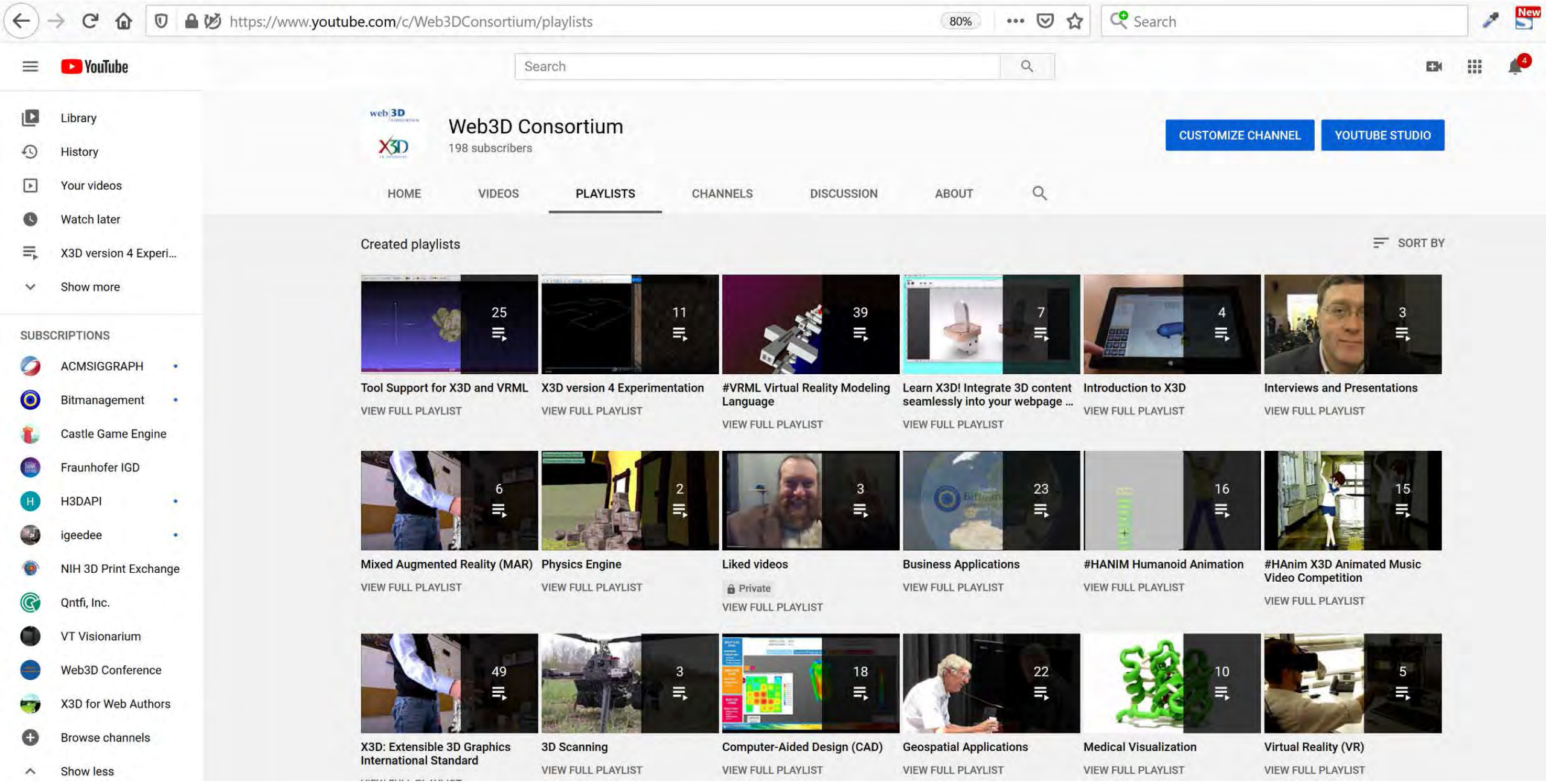
Legacy
Prototypes

Motion Animation
Specifications

7 Directory Summaries	79 X3D Models
Characters HAnim Characters are HAnim2 X3D4 models conforming to version 2 of the Humanoid Animation (HAnim) International Standard, ISO—IEC 14774:2019. TODO: work in progress is converting HAnim1 models to HAnim2, testing X3D Quality Assurance (QA) conformance, and upgrading X3dTidy stylesheet cleanup capabilities. See build.X3dSchematronX3dTidy.log.txt and build.log.txt for current status. X3D Tooltips of interest, in hierarchical order: HAnimHumanoid, HAnimJoint, HAnimSegment, HAnimSite, HAnimDisplacer, HAnimMotion. Humanoid animation (HAnim) version 2 International Standard includes Part 1: architecture and Part 2: motion data animation. X3D Specification section of interest: 26 Humanoid Animation (HAnim) component.	• HAnim Model Foot Left • HAnim Model Foot Right • HAnim Model Hand Left • HAnim Model Hand Right • HAnim Models Hands Feet • Jin LOA 1 • Jin LOA 2 • Jin LOA 3 • Jin LOA 4 • Joe Kick • Korean Character 01 Jin • Korean Character 02 Chul • Korean Character 03 Hyun • Korean Character 04 Young

https://www.web3d.org/x3d/content/examples/HumanoidAnimation

Web3D Consortium YouTube Channel



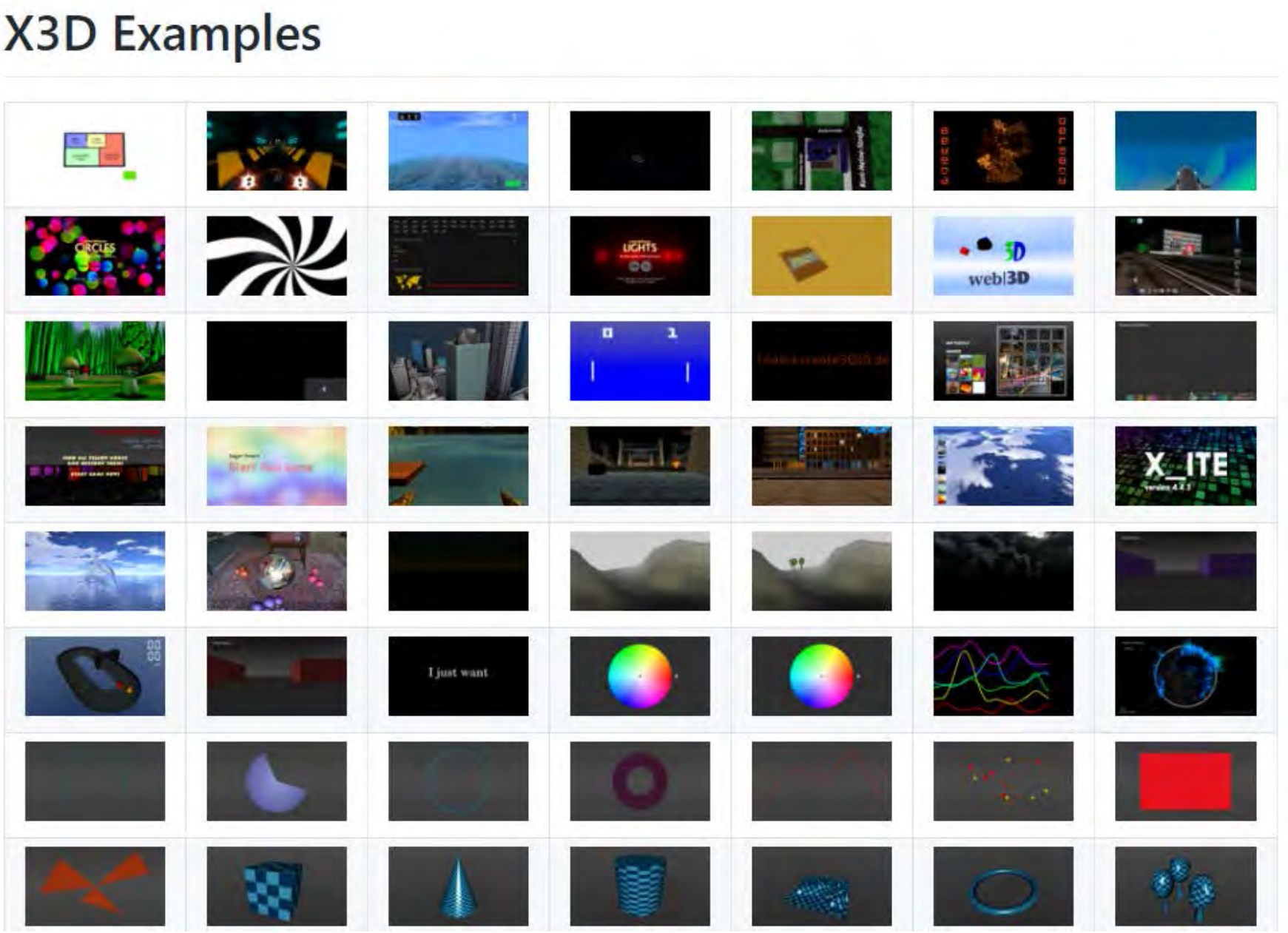
X3D4 Players and Authoring Tools

- X_ITE open-source JavaScript for HTML pages
- X3DOM open-source JavaScript for HTML pages
- Castle Game Engine: view3Dscene open-source Object Pascal
- FreeWrl open-source C

- Titania authoring environment (Linux)
- Others in progress: X3D-Edit v4, White Dune
- Blender export improvements are continuing
- Meshlab export improvements deserve scrutiny

X_ITE

X_ITE is a new 3D JavaScript library entirely written in JavaScript and uses WebGL for 3D rendering. Authors can publish X3D and VRML source online within an HTML5 page with X_ITE that works with Web browsers **without** prior plugin installation. This gives X3D authors the ability to displays content in 3D, using WebGL 3D graphics technology to display X3D content in several different browsers across several different operating systems. Since X3D is backwardly compatible, X_ITE can also be used as a VRML viewer.



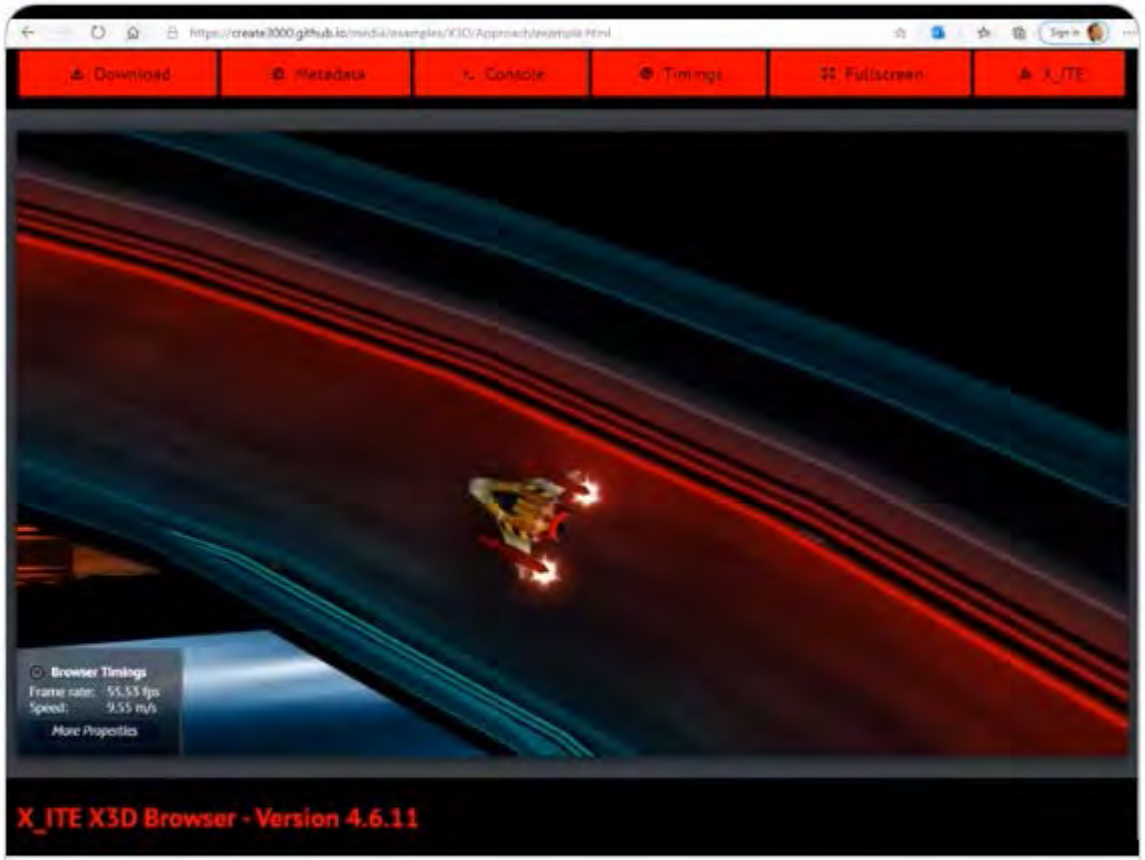
https://github.com/create3000/x_ite/wiki

X_ITE

Web3D Consortium
@Web3DConsortium

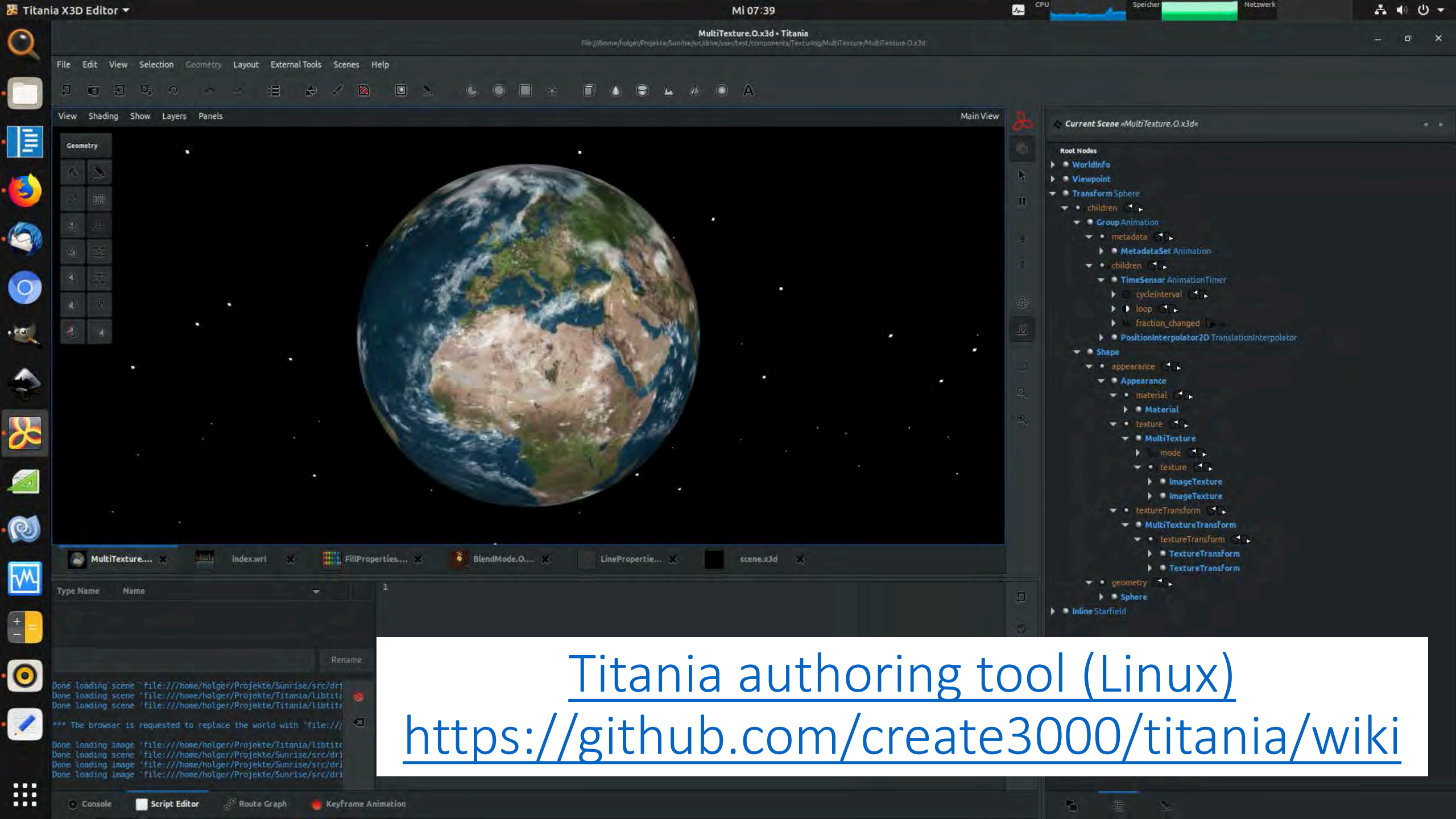
X_ITE #X3D BROWSER: Have you seen this? v4.2.14 open-source JavaScript 6 by CREATE3000 includes advanced rendering, XHTML DOM integration, compatibility with Titania authoring tool. No plugins! create3000.de/x_ite/getting-...

5:23 PM · Dec 29, 2018 · Twitter Web Client



X ITE v4.6.11 Approach Demo
X_ITE is a new 3D JavaScript library entirely written in JavaScript and uses WebGL for 3D rendering. Authors can publish X3D and VRML source online within an...
youtube.com

https://github.com/create3000/x_ite/wiki



Titania authoring tool (Linux)

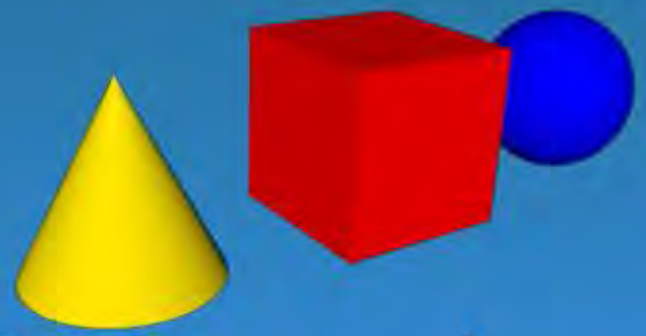
https://github.com/create3000/titania/wiki

x3dom
Instant 3D the HTML way!

News & User's Apps | Get it | See it | Documentation | Get involved | Browser Support | Profile

Fork me on GitHub

Integrate 3D content seamlessly into your webpage - the scene is directly written into the HTML markup. No Plugins needed. Simply include a javascript file. Free for non-commercial and commercial purposes.



Place 3D data anywhere you like

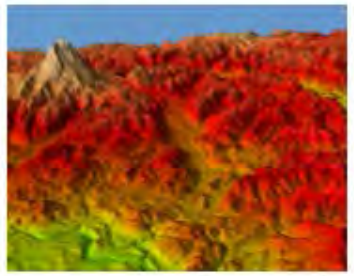
The 3d context can be created without background or borders. Don't believe it? Just try to move the geometric objects next to this text...

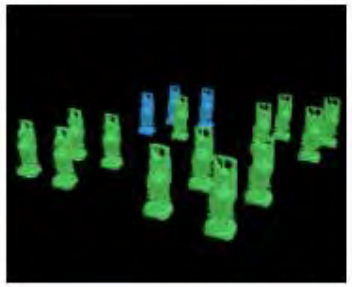
https://www.x3dom.org

x3dom
Instant 3D the HTML way!

News & User's Apps | Get it | See it | Documentation | Get involved | Browser

Featured

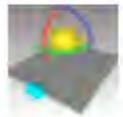




Animation


Animating Objects with Routes
In this tutorial you will learn how to animate your obj...


Using the OnOutputChange Event
In this tutorial you will learn how to use the output g...

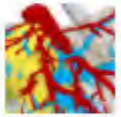

Interactive 3D Transformations
Within this tutorial, you will learn how to create powe...


Picking Objects
This tutorial will show you how to pick objects in X3DO...


Using different Picking Buffer Modes
This tutorial will show you how to pick detailed inform...

Medical Data


NIST: AnthroGloss Human Body data
Two Poses from CAESAR project, two bodies (same subject...


Liver reconstruction
by Steven Birr / UNI Magdeburg. Attention: This example...


VolumeRendering
(MedX3DOM)...


VolumeRendering: Cut through a volume/Clip to a plane
(MedX3DOM)...

x3dom.org/examples

Castle Game Engine

Support the engine on patreon

Download | News | Features | Documentation | Scene Graph (X3D) | view3dscene | Talk with us | Gallery

Castle Game Engine

Cross-platform (desktop, mobile, console) 3D and 2D game engine supporting many asset formats (glTF, X3D, Spine...) and using modern Object Pascal

Download
Version 6.5 (Snapshot)

After downloading, read the "Getting Started" and manual.

Support on Patreon

- Use **any 3D or 2D software** to create your models in various formats: glTF, X3D, VRML, Spine JSON, Collada...
- Develop **cross-platform** applications, for desktop (**Windows, Linux, macOS, FreeBSD...**), mobile (**Android,**

https://castle-engine.io

LATEST NEWS:

Editor improvements: undo, context menu on hierarchy, shell list, clear warnings...

October 24, 2020

"Escape from the Universe" has been released in Japan for Nintendo Switch

October 23, 2020

Various engine improvements: lift lights limit, test simultaneous animations, fix changing TLevel.Player, SaveScreenRgba...

October 22, 2020

Improvements to creatures and items from resource.xml (weapon reloading, automatic pool...), updated resource_animations and fps_game examples

October 20, 2020

Scene graph (X3D)

Contents:

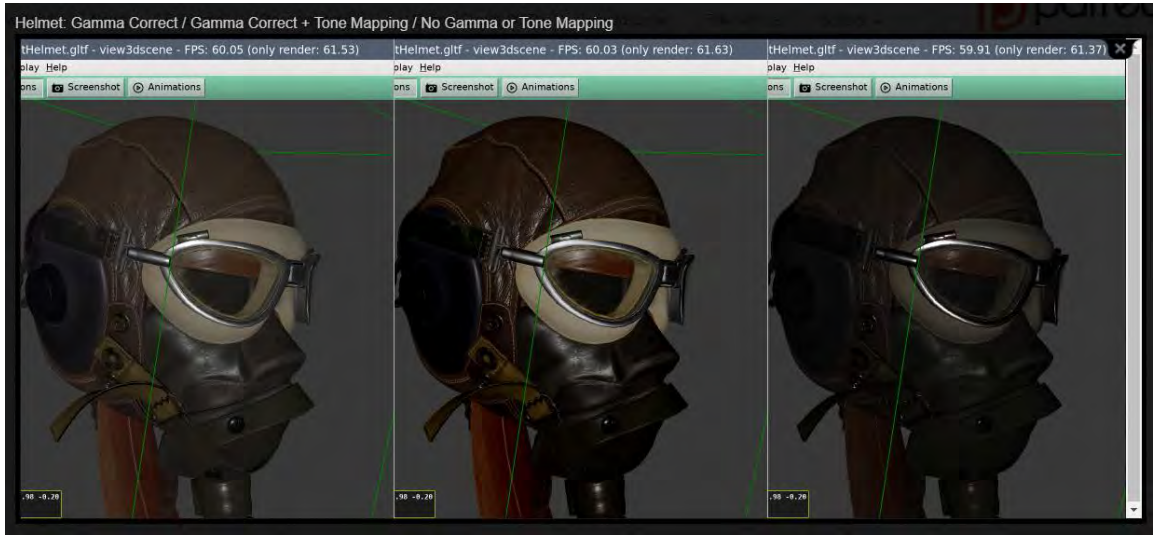
1. What is X3D

X3D (and it's older version, VRML) is a file format for 3D models. Various 3D modeling applications can export to it, for example Blender includes an X3D exporter (see also our Blender exporting notes).

To try it out, just create some X3D models (or download them from the Internet, or grab our demo models) and open them with our view3dscene.

As a 3D file format, X3D is quite unique, as

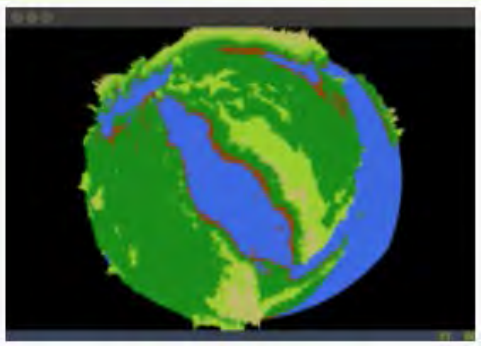
- It's not only a file format. It's actually a very flexible scene graph for 3D applications. Every X3D node corresponds to a Pascal class with appropriate fields, and you can freely create and modify X3D nodes at runtime.
- It's designed to describe *virtual 3D worlds*, not just static scenes. So you can express animations, interactive behaviors (e.g. open the door when user presses a handle), and scripting right inside the X3D file. Many advanced graphic effects are also possible, like mirrors by generated cube map textures, screen effects, shadow maps, shadow volumes, effects using GLSL shaders and much more.

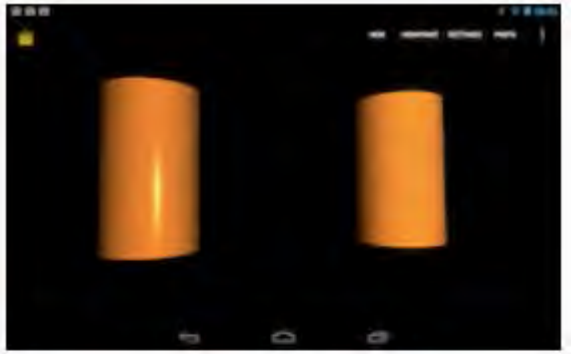


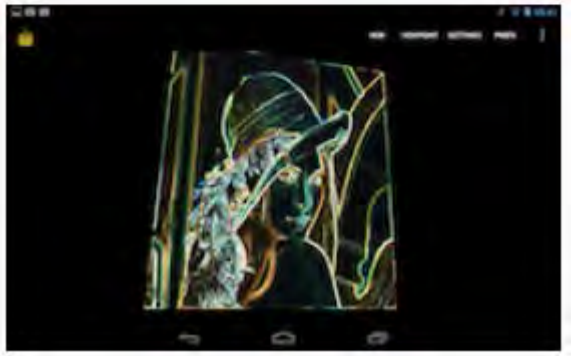
https://castle-engine.io

X3D/VRML

FreeWRL







http://freewrl.sourceforge.net/examples.html

X3D4 Code Libraries and Tools

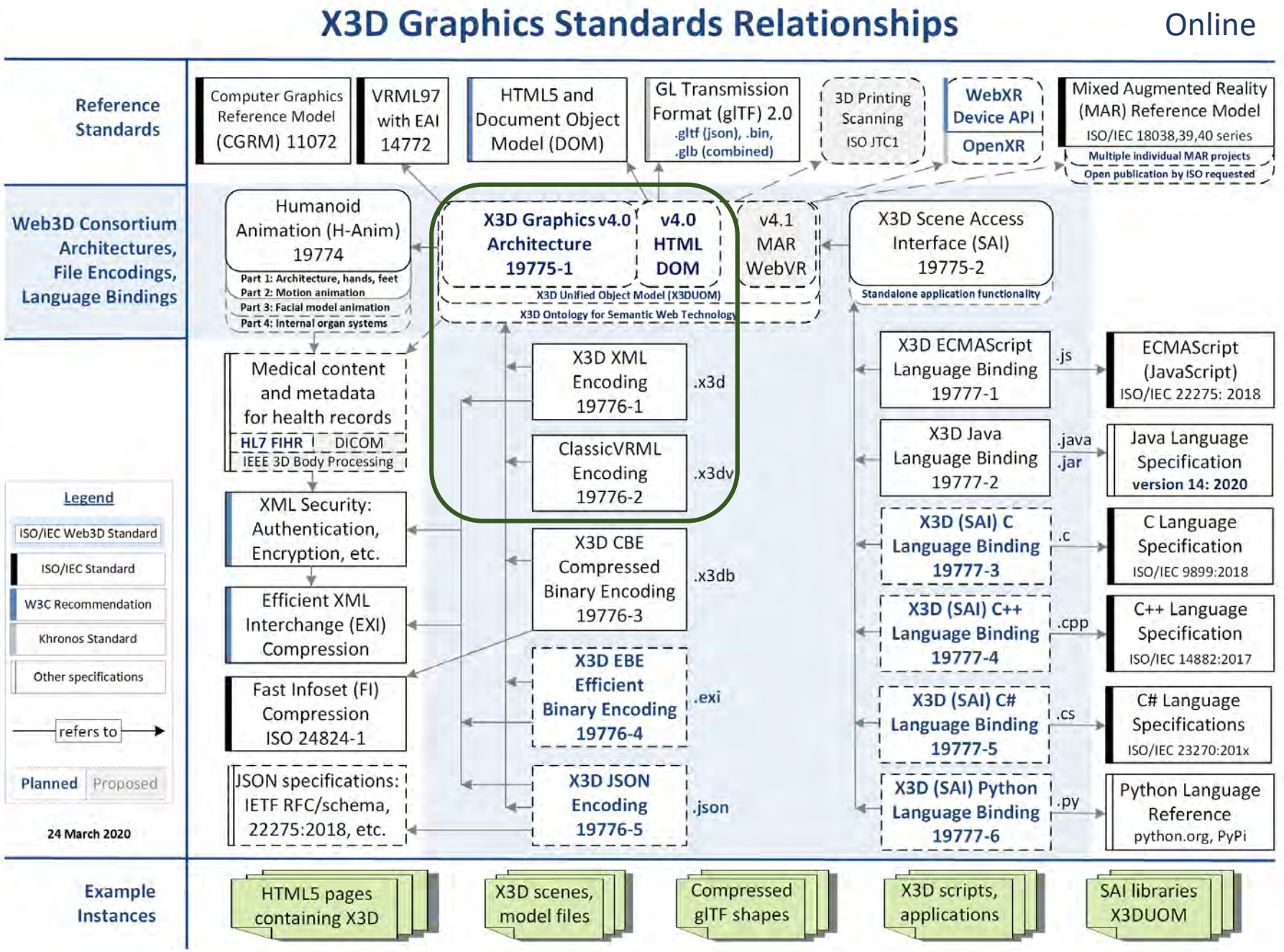
- X3DJSONLD: JavaScript, JSON, Node.js
- X3DJSAIL: Java
- X3DPSAIL: Python
- X3D C++: proposed, under development
- X3D Ontology for Semantic Web
- X3D JavaScript Object Notation (JSON) Encoding

- X3D Quality Assurance (QA): schemas, doctypes, schematron
- X3D Validator: battery of comprehensive tools as online test page, rebuild/redeployment for X3D4 in progress
- Vast suite of XML tools – all still work!

We are here!

Common basis for every kind of X3D model, confirmed by round-trip tests

2021 Updates:
File Encodings
Language Bindings



X3D Java Scene Access Interface Library (X3DJSAIL)

X3D Java Scene Access Interface Library (X3DJSAIL) supports programmers with standards-based X3D Java interfaces and objects, all as open source.

Abstract

X3DJSAIL, the X3D Java Scene Access Interface Library is a set of strongly typed Java application programming interfaces (APIs) providing programmer access to an X3D scene graph. Two integrated Java packages are included that contain X3D SAI interfaces and support the X3D Graphics Standards for Java programmers.

- `org.web3d.x3d.jsail` provides concrete implementation-oriented classes for building X3D scenes using standalone Java objects.
- `org.web3d.x3d.sai` contains standard X3D SAI interfaces to independently compile Script-node source for use in X3D players.

Available products include Javadoc documentation, several thousand self-validating Examples, source code, compiled classes build support, run-time jar archives, and draft specification annexes for node interfaces and abstract-node type interfaces.

Goals include making it easy to create an X3D scene graph using Java, while also making it hard to create an incorrect or invalid X3D model.

This library supports multiple uses:

- Create high-performance standalone Java applications using a Plain Old Java Object (POJO) implementation for X3D.
- Compiling Java source code used in X3D Script nodes.
- Test ongoing development of X3D version 4 (also supporting X3D versions 3.0 through 3.3).
- Future: serve as a design template for planned autogeneration of similar codebases using ECMAScript, C#/C++/C, and Python programming languages.

http://www.web3d.org/specifications/java/X3DJSAIL.html

Python X3D Package x3d.py

X3D Python Scene Access Interface Library (X3DPSAIL)

Installation | Design Features | Development | Examples | Jupyter Notebook | References | TODO | Contact

The x3d.py Python X3D Package supports programmers with Python interfaces and objects for standards-based X3D programming, all as open source.
The presentation Python X3D Package Implementation provides an overview and shows examples.

Installation

Download and install Python on your system.

Python `x3d.py` package installation and update options:

- **`pip install x3d`**
  or
- **`python -m pip install x3d`**

That should be all that is needed for most Python X3D programmers! Here is an example screenshot for PythonX3dSmokeTests.py using IDLE.

Design Features

The current implementation strives to follow first principles of python package design, being as "pythonic" as possible.

https://www.web3d.org/x3d/stylesheets/python/python.html

x3d 0.0.34

```
pip install x3d
```

Latest version

Released: Nov 1, 2020

Package support for Extensible 3D (X3D) Graphics International Standard (IS)

Navigation

- Project description
- Release history
- Download files

Project links

- Homepage

Project description

Python package *x3d*

This project creates the Python X3D Package which is available for import via PyPi.

Web3D Consortium maintains this package under a BSD-style open-source license.

Package installation (choose one)

- *pip install x3d*
- *python -m pip install x3d*

https://pypi.org/project/x3d

X3D to JSON Stylesheet Converter

The X3D to JSON stylesheet converts .x3d XML to .json, supporting the forthcoming JSON Encoding for X3D Graphics.

Overview | Goals | Data Types | Design Patterns | Design Correspondences | Examples | Issues | Options | References | Related Work | Tools | Contact

Status: developmental work is mature and provides full coverage. Design pattern being assessed by X3D community.

Overview

This work supports X3D JSON Encoding efforts by the X3D Working Group. It is summarized in the Web3D 2016 paper "A JSON Encoding for X3D".

The Web3D Consortium standards strategy has the fundamental objective to enable the open publishing of interactive 3D graphics models on the Web, enabling real-time 3D communication. Web3D carefully improves and evolves X3D Graphics and related standards while maintaining long-term archival stability.

JavaScript Object Notation (JSON) is "a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language". (from json.org)

X3D scenes can be encoded in various encoding formats. In order to consistently take advantage of JSON capabilities, the X3D Working Group is preparing a new ISO/IEC 19776-5 specification X3D JSON Encoding.

The X3D JSON Encoding needs to meet multiple interoperability requirements:

- Representing any X3D scene graph found in another encoding (such as .x3d XML, .x3dv ClassicVRML, and .x3db Compressed Binary Encoding, CBE).
- Round-trip conversion capability as primary requirement to show that features in the X3D Abstract Specification can all be represented in an X3D JSON file.
- File extension (.js is also used by Script nodes, .json is common, .x3dj is unused/unambiguous) and MIME type.
- Forward compatibility with the evolving X3D version 4.0 revision.

The X3D abstract specification (ISO/IEC 19775-1) governs X3D semantics and presentation for all scene encodings. Thus no new X3D functionality for graphics rendering or scene interaction are needed for the X3D JSON encoding.

X3D to JSON Stylesheet Converter

X3D Ontology for Semantic Web

The X3D Ontology for Semantic Web provides terms of reference for semantic query of X3D models.

Motivation

Extensible 3D (X3D) Graphics is the royalty-free open standard for publishing, viewing, printing and archiving interactive 3D models on the Web.

The X3D Semantic Web Working Group mission is to publish models to the Web using X3D in order to best gain Web interoperability and enable intelligent 3D applications, feature-based 3D model querying, and reasoning over 3D scenes.

Motivating insights:

> "The answer to your question is the response to the query." Jim Hendler and Dean Allemang
>
> "Trying to use the Semantic Web without SPARQL is like trying to use a relational database without SQL." Tim Berners-Lee
>
> "The proof of the pudding is in the eating." Wiktionary

To learn more about publishing 3D graphics on the Web, please see What is X3D? and X3D Version 4 Overview.

https://www.web3d.org/x3d/content/semantics

Scene Access Interface (SAI) autogeneration, X3D Programming Language binding “wish list”

- Looking to develop best-practice design patterns for

- EcmaScript (JavaScript)
  - X3DJSONLD Codebase by John Carlson

- C, C++, C#
  - Exemplar codebases by Dr. Myeong Won Lee

- Others?

HTML5 and Open Web Architecture

- Harmonization of ID linkages and event models, HTML DOM and X3D
- Composition with Cascading Style Sheets (CSS)
- Compatibility + usage of Scalable Vector Graphics (SVG)
- Accessibility, annotations, internationalization (I18N), etc.
- X3D as presentation layer compatible with Semantic Web
- Linkage of hybrid model data and information

Some aspects are standardization, others can simply align good design.

- *Now active*. **Web3DUX User Experience Working Group** established to share, assess, and promote best practices for X3D + HTML usage.

Rendering progress is significant, what's next?

X3D version 4, HTML5/DOM

- Inline
  - glTF model assets, JSON or binary
  - Optional support **STL, PLY,** others
- Physically Based Materials: glTF
- Advanced lighting, PBR, NPR
- Shadow-capable lights, shapes
- Cloud-based, offline rendering

Next year opportunity…

X3D version 4.1, VR/AR/XR/MAR

- Co-develop 4.1 might easily follow completion of X3D v4.0
- WebXR as baseline capability set
- Composing see-through/360 video, high-definition, green screen, etc.
- Push "settled issues" to X3D v4.0, defer final WebVR support to v4.1
- ***Emerging:*** user health, safety, privacy and personal physical security

X3D Security considerations

- Each section of specification notes relevant security considerations
- Few vulnerabilities noted, please report if known. X3D is quite secure!
- Also listed as hints in X3D Tooltips wherever they occur
- Collected security considerations at X3D Resources: Security

Strong security for scene content available with XML encoding

- XML Encryption (for privacy)
- XML Digital Signature (for authentication, non-repudiability, etc.)
- Example provided online: X3D Security Examples (README)

3D Printing and 3D scanning

- 3D Printing: bits into atoms
- 3D Scanning: atoms into bits

Uh, approximately everything?!

CAD Design Printing Scanning Working Group is building profiles

- Geometry requirements essentially complete
- **Metadata and annotations** getting close scrutiny, building exemplars
- Contributing to multi-standard ISO tech committee, Byoung Nam Lee
- Also STEP Visualization group, Soonhung Han, Christophe Mouton

Simple use case: scan, print, view any object archivally published to X3D.
Share via NIH 3D Print Exchange and possibly NPS X3D Model Exchange

Audio

W3C Audio Working Group

- Web Audio, Web Midi, Web Audio Processing: Use Cases and Requirements
- Web Audio API is now W3C Candidate Recommendation (CR) !

"High-level API or processing and synthesizing audio in Web applications"

High-fidelity audio processing chains, *AcousticProperties* for materials

Excellent support emerging in Web browsers plus additional codebases

Audio graphs, realistic audio rendering with configurable pipeline

Doppler shift for sound from moving objects

Now matching online examples and refining design, more to follow!

White paper achieved: Strategies for Improved Sound Support in X3D

Humanoid Animation (HAnim) + Medical

New HAnim version 2 International Standard (IS) available online
- HAnim Architecture (skeleton, skin, hands and feet, precise naming)
- HAnim Motion Animation (e.g. motion capture, BVH mocap conversion)
- HAnim tool, player, validation and example updates ongoing to match X3D4

Medical Working Group meets regularly with accelerating progress
- Liaisons with DICOM imaging, Health Level 7 (HL7), etc.
- Diverse applications and uses, demonstrate using test cases

- Shared strategy: suitable for archival Electronic Health Records (EHR)
  - Especially cooperative work with HL7 FHIR standard for health care data exchange

- **Metadata and annotations**, security, compression, ontologies, standards
  - Building all the way to X3D Semantic Web ontologies for all models and domains
  - Full package of necessary technical capabilities now available for proof of capability

X3D 4 Summary #1

- First X3Dv4 Public Working Draft specification released for Web3D 2019! Scrutiny, feedback and engagement are welcome.
- Big detailed Big Picture: see X3Dv4 Strategy and X3Dv4 Implementations Status.
- Following the path projected by Web3D 2017's Future of X3D session, building on steady progress at Web3D 2018, daily email posts and weekly meetings, multiple Web3D Consortium working groups and community participants continue to build on the architectural stability of the Extensible 3D (X3D) Graphics International Standard.
- Two open-source implementations (X3DOM and X_ITE) adapt X3D content for HTML5 integration, with excellent results showing compatible event models for user interaction and model animation.
- Considering a 3D Printing and 3D Scanning profile for hardware interoperability.
- Virtual, Augmented and Mixed Reality (VR/AR/MR) can all use X3D and continue being explored to good effect – X3Dv4.1 to follow. Strategic timing is valuable.

X3Dv4 Strategy

X3D® Version 4 (X3Dv4) is a major upgrade to the Extensible 3D (X3D) Graphics International Standard that provides close support for the HTML5 Recommendation. This is major work in progress, expected to include several future versions. This effort is driven by the X3D Graphics Working Group with contributions from other working groups and regular community outreach.

- *Imminent.* X3Dv4 Public Working Draft specification release for Web3D 2019 and SIGGRAPH conferences
- *Current.* X3Dv4 Implementations Status provides summary links tracking active efforts,
- *Recent.* "**X3D Futures: what is happening, how to get involved!**" presentation from Web3D 2018 Conference, Poznan Poland, 22 June 2018.
- *Previous.* "**Future of X3D**" presentation and detailed notes from Web3D 2017 Conference, Brisbane Australia, 7 June 2017 (photograph).

X3D is always evolving, and the Web3D Consortium Standards Strategy carefully guides all these improvements. X3D Version 4 enables authors to publish interactive 3D content anywhere on the Web, without restrictions or plugins. Next-generation evolution + revolution is combined with archival compatibility of existing legacy content. Please see:

- **X3D Version 4.0 Technical Development** shows planned evolutionary changes to the baseline X3D architecture.
- X3D Version 4.1 will add Mixed Augmented Reality (MAR) capabilities for diverse virtual and augmented reality (VR, AR) devices.

Normalizing interaction (event model) semantics with HTML5 can further open up X3D for the vast majority of Web authors. The Web3D Consortium has identified X3DOM and X_ITE as prototypes for the next generation X3D Version 4.0 that support direct integration into HTML5 webpages without requiring the use of any browser plug-in. The Consortium and the X3D community are working closely with open-source exemplars to maintain and expand the X3D standard as it progresses and moves into full browser support. The Consortium also continues to support all existing X3D and VRML content.

Steady progress towards X3D Version 4 continues. We cordially invite you to Join Web3D as we continue to reliably build a stable foundation that establishes 3D graphics as a "first-class citizen" in the World Wide Web.

X3Dv4 Implementations Status

X3Dv4 implementations are under way. X3D® Version 4 (X3Dv4) is a major upgrade to the Extensible 3D (X3D) Graphics International Standard that provides close support for the HTML5 Recommendation.

The X3D Working Group is executing the Web3D Web3D Standards Adoption Process and meeting guidance by Web3D Board of Directors, all to good effect. Web3D Consortium membership has value!

Approach Summary

X3D activity includes over 20 years of progressive evolution that maintains durable stability and backwards compatibility. The best way to introduce new capabilities is to propose them on the x3d-public mailing list so that they can be considered in detail. Then we add an agenda item to the next X3D Working Group teleconference so that the proposed capability can be discussed. Then, away we go:

- ***Specification Prose:*** produce draft X3Dv4 Architecture Specification (github) aligning with W3C HTML5/DOM Recommendations.
- ***Implement Code:*** open-source JavaScript X_ITE and X3DOM players (for HTML5) plus other X3D browsers.
- ***Evaluate Examples:*** using all available X3D implementations and ~3500 models in X3D Example Archives.
- ***Finalize and Review:*** iteratively improve specification, implementations and examples until success thresholds are met.

X3D Node and Statement Inventory Comparison tracks progress of all known X3D players, authoring and validation tools.

Milestones

1. *26-31 July 2019.* Publish draft specification plus examples and implementation updates at Web3D2019/SIGGRAPH 2019 conferences.
2. *16 December 2019.* Working group closes new-technology submissions, finalize all efforts. Prepare ISO NWIP document.
3. *First quarter 2020.* Working Draft submitted to X3D Community, Web3D Consortium members, Web3D Board and ISO.

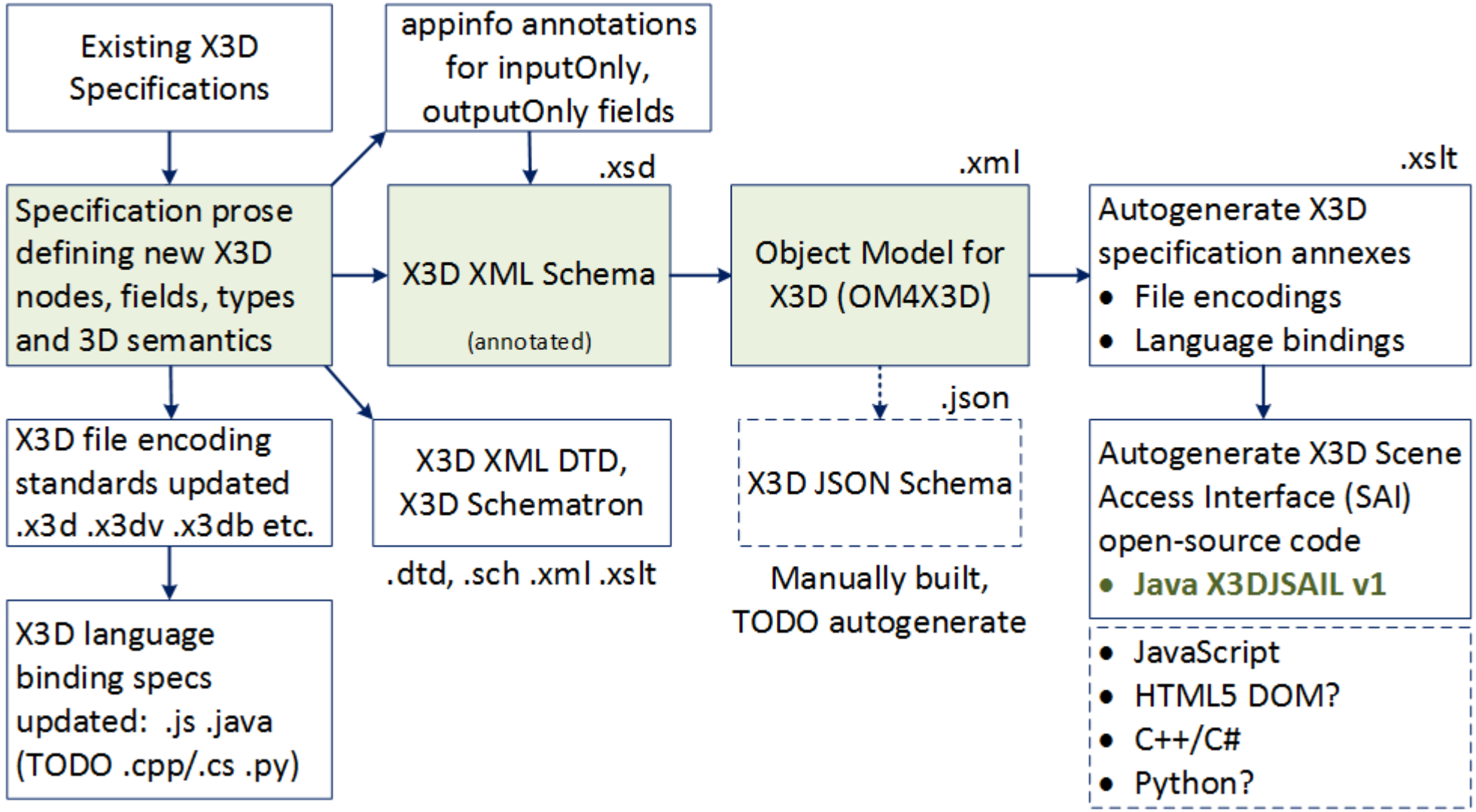
… and now ready

X3Dv4 Summary #2

- Central to these efforts is an X3D Unified Object Model (X3DUOM) that enables consistent implementation and presentation of content across multiple file encodings (XML, ClassicVRML, JSON, binary) as well as multiple programming language bindings (JavaScript, Java and planned adaptations to C/C++/C# and Python).
  - X3D JSON Loader (X3DJSONLD) and X3D JSON Encoding
  - X3D Java Scene Access Interface Library (X3DJSAIL)
  - X3D Python Scene Access Interface Library (X3DPSAIL) (aka x3d python package)

- Second-generation Humanoid Animation (HAnim) has stabilized motion-capture (mocap) outputs for both general-purpose and human-specific (i.e. medical) usage. Medical mappings and deployment efforts continue.

Object Model for X3D: Creation, Autogeneration



X3D Unified Object Model (X3DUOM)

X3D 4 Summary #3

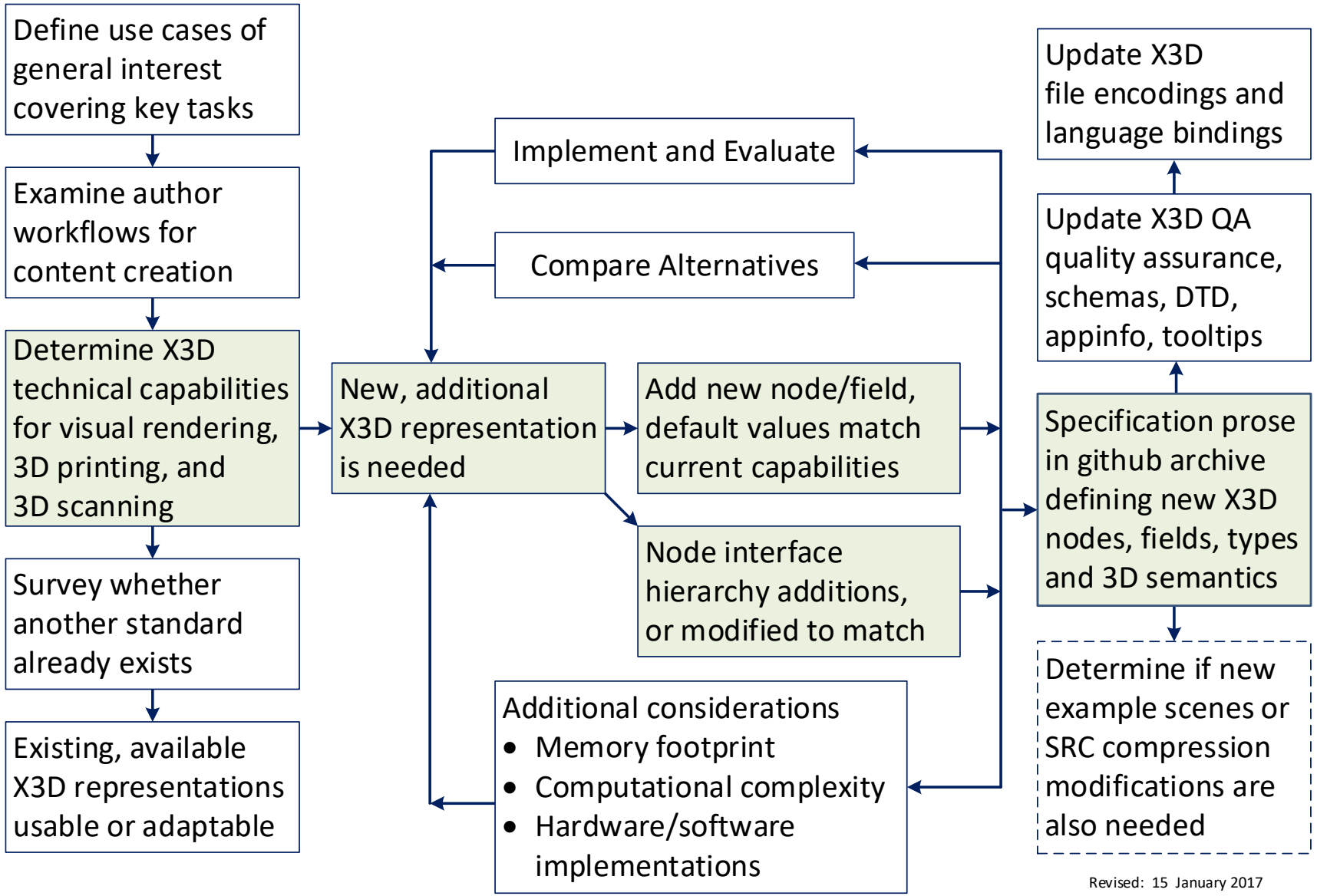
- Over two decades of progress are steadily evolving to finally unlock full promise of Interactive 3D Graphics within the Web architecture.
- X3D Resources, X3D Scene Authoring Hints, X3D Tooltips, import/export support, forwards/backwards version compatibility, X3D Quality Assurance (QA) validation tools, and a large corpus of open-source version-controlled X3D examples are together ensuring that consistent semantics are emerging for 3D on any platform.
- XML compression, encryption and authentication available already.
- This progress report outlines numerous parallel lines of effort, and also points out individual opportunities to utilize and extend X3D consistently across multiple domains.

Specification design process for new capabilities

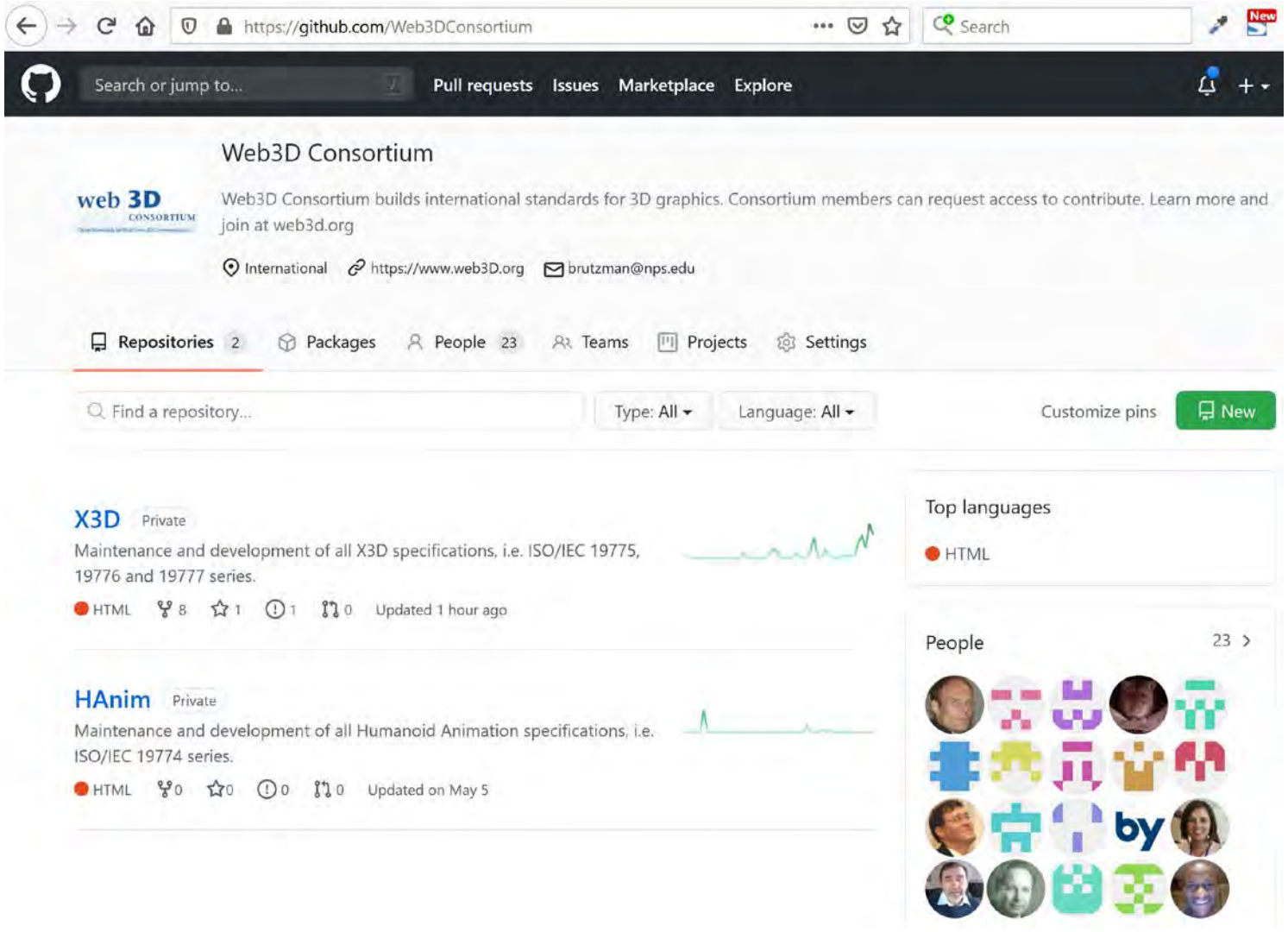
Web3D process helps us *work together* to get a big job done!

Stable playing field permits due diligence and reliability

ISO standard means stable evolution and adoption

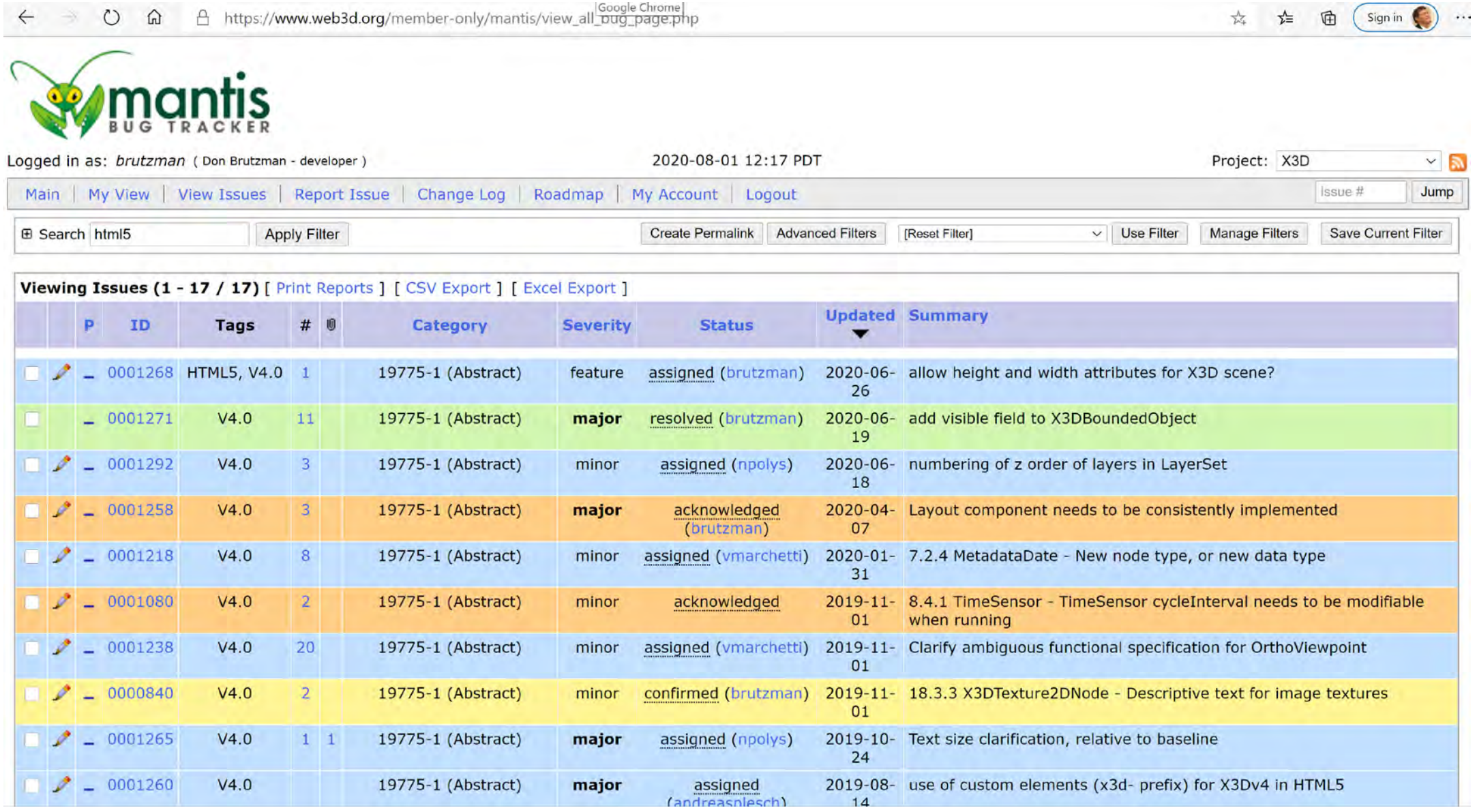


Transparent and accountable: all specifications maintained in github version control for members



Member value: Mantis issue tracker is thorough

https://www.web3d.org/member-only/mantis/view_all_bug_page.php



https://www.web3d.org/member-only/mantis/view_all_bug_page.php

Logged in as: *brutzman* (Don Brutzman - developer) 2020-08-01 12:17 PDT Project: X3D

Main | My View | View Issues | Report Issue | Change Log | Roadmap | My Account | Logout Issue # Jump

Search html5 Apply Filter Create Permalink Advanced Filters [Reset Filter] Use Filter Manage Filters Save Current Filter

Viewing Issues (1 - 17 / 17) [Print Reports] [CSV Export] [Excel Export]

P	ID	Tags	#		Category	Severity	Status	Updated	Summary
_	0001268	HTML5, V4.0	1		19775-1 (Abstract)	feature	assigned (brutzman)	2020-06-26	allow height and width attributes for X3D scene?
_	0001271	V4.0	11		19775-1 (Abstract)	**major**	resolved (brutzman)	2020-06-19	add visible field to X3DBoundedObject
_	0001292	V4.0	3		19775-1 (Abstract)	minor	assigned (npolys)	2020-06-18	numbering of z order of layers in LayerSet
_	0001258	V4.0	3		19775-1 (Abstract)	**major**	acknowledged (brutzman)	2020-04-07	Layout component needs to be consistently implemented
_	0001218	V4.0	8		19775-1 (Abstract)	minor	assigned (vmarchetti)	2020-01-31	7.2.4 MetadataDate - New node type, or new data type
_	0001080	V4.0	2		19775-1 (Abstract)	minor	acknowledged	2019-11-01	8.4.1 TimeSensor - TimeSensor cycleInterval needs to be modifiable when running
_	0001238	V4.0	20		19775-1 (Abstract)	minor	assigned (vmarchetti)	2019-11-01	Clarify ambiguous functional specification for OrthoViewpoint
_	0000840	V4.0	2		19775-1 (Abstract)	minor	confirmed (brutzman)	2019-11-01	18.3.3 X3DTexture2DNode - Descriptive text for image textures
_	0001265	V4.0	1	1	19775-1 (Abstract)	**major**	assigned (npolys)	2019-10-24	Text size clarification, relative to baseline
_	0001260	V4.0			19775-1 (Abstract)	**major**	assigned (andreasplesch)	2019-08-14	use of custom elements (x3d- prefix) for X3Dv4 in HTML5

Future Infrastructure Deployment Goals

- Web3D Conference: publish X3D models for every paper, poster, tutorial
- Wikipedia model publication
- Content production tools: Blender, MeshLab, others
- Collaborative Web and VR Environments
- Your Application Here!

Thanks for many contributions!!

… we continue tuning testing and deploying all of these great new capabilities

Web3D membership has value!

X3Dv4 Draft Specification Implementation Status

Components and Nodes	X3D Specification Paragraphs	Examples	Implementations	Tooltips, links to Validation	Notes
~~Annotation~~	~~42 Annotation component~~	~~TODO~~	~~Xj3D~~ (partial)		Work in progress by Design Printing Scanning and Medical Working Groups
Event model alignment	Modifications to Concepts, 4.4.8 Event model		X_ITE (complete), X3DOM (partial)		X3D Script/ROUTE events via DEF, HTML5/DOM events via id, browsers exchange event changes after render loops
Field name changes	Affects child SF/MFNode field naming for ~10 nodes		X3D-Tidy conversion updates once resolved		See Potential future changes for improved consistency of field names
glTF file loading	Multiple nodes for scene graph integration and advanced rendering		X3DOM, others		glTF closely related to Lighting model, also provides geometric compression.
HAnim v2	26 Humanoid Animation (HAnim) component, updating HAnimHumanoid and adding HAnimMotion node for BVH-style motion animation	TODO update Basic Archives: HAnim	X3DJSAIL Ready for update by other existing applications.	HAnimMotion, HAnimHumanoid	HAnim v2 is undergoing ISO Final Draft International Standard editors review, expected completion 7 August 2019.
Inline	9 Networking component Allow loading other model types, security precautions	TODO	X3DOM		Mantis 744, Mantis 1151, Mantis 1171, Mantis 1257 TODO support STL, PLY?
Lighting model	TODO add new capabilities while retaining optional backwards compatibility with X3Dv3 17 Lighting component	TODO	TODO confirm: Castle Game Engine X3DOM		Satisfactory review by X3D Working Group of Physically Based Rendering (PBR) proposals by Michalis Kamburelis

Bottom lines all around

Our X3D + HTML future now arriving. Take advantage of new capabilities!

- An amazing amount of progress is available for early adopters, now.
- We have a formal path forward, proven process and good procedures.

Web3D membership has value!

- Can accelerate, focus attention, offer help, support for your project of interest
- Web3D needs you to Join Our Team as business, university, agency or individual

Community contributors adding major value too!

- Ask questions, review, contribute code and models

Get involved, share benefits!

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