

X3D Graphics for Web Authors

Getting Started

*A journey of a thousand miles
begins with a single step.*

Chinese proverb

Contents

Goals, motivation and student background

Software support

- X3D Examples
- X3D-Edit authoring tool and Hello World example

X3D for Web Authors

- book organization and use

Summary and References

Goals

This work presents Extensible 3D (X3D) Graphics, the open, royalty-free, international standard for 3D graphics on the Web

Book and slideset goals include

- Show Web authors experienced with HTML and XML how to build and connect X3D models
- Teach students principles of Web-capable 3D graphics
- Serve as a ready-reference book for X3D experts

Explain broad principles and specific details of X3D for anyone learning how to build 3D models

Motivation 1

Over 30 years of steady growth and innovation have made 3D graphics an exciting field

Key professional organization is SIGGRAPH for computer graphics and interactive techniques

- Includes technical experts and artists alike
- <http://www.siggraph.org>

Nevertheless, few people actually build 3D models themselves

- Usually requires advanced programming skills
- Costly proprietary tools and approaches compete

Motivation 2

Rather than creating another expensive technical niche, X3D is designed for Web interoperability

- Support capabilities common to most (or all) tools
- Provide import/export publishing compatibility for many other formats
- Align 3D with [Architecture of the World Wide Web](#)

This approach works well for simple 3D models, scaling up to large-scale virtual environments

- Ultimate X3D success means that 3D graphics becomes a “first-class citizen” for Web multimedia

Student background

Provide introductory course in to 3D graphics achievable at undergraduate level

- Course successfully taught first as VRML, then X3D

The following are all helpful but not required

- XML authoring background
- Programming skills
- Modeling-tool experience

Lots of free resources are available

- Can be self-taught with dedicated effort
- Support and feedback from online community

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X3D Examples

Software support

Software support for X3D authoring

Lots of free plugins, tools and resources provided

- X3D Examples Help at

<http://www.web3d.org/x3d/content/examples/help.html>

Best first step is to install an X3D plugin into your default Web browser

- Letting you easily view any X3D scene

Set up to author X3D scenes using plain-text editor, or else by using an X3D-aware authoring tool

- X3D-Edit provided free for any use
- Other tools listed on Help page above

X3D Examples

Numerous (thousands) of X3D examples are available online

- <http://x3dgraphics.com/examples/help.html#Examples>

Can browse all examples in *X3D for Web Authors*

- <http://x3dgraphics.com/examples> summary
- <http://x3dgraphics.com/examples/X3dForWebAuthors> archive
- <http://x3dgraphics.com/X3dExamplesX3dForWebAuthors.zip>

Recommended approach:

- Browse examples online
- Download and edit on local system

X3D Examples Archives

X3D for Web Authors

- Textbook on how to design and build X3D scenes

Basic

- Diverse scenes illustrating various X3D capabilities

Conformance NIST

- Strictly defined test examples for correct operation

VRML 2.0 Sourcebook

- Textbook on VRML97, examples converted to X3D

Savage

- Open-source military models and tools

X3D Examples download panel, X3D-Edit

Download Example Archives

☒ **X3D for Web Authors Examples**
A wide variety of basic examples are provided that show how to design and build X3D scenes. These are explained in the book X3D for Web Authors.

☐ **Basic Examples**
The Basic Examples archive provide provides numerous scenes illustrating a broad variety of X3D capabilities.

☐ **ConformanceNIST Test Suite Examples**
The ConformanceNIST Test Suite Examples were authored by National Institute of Standards and Technology (NIST) to provide a complete test set for the Virtual Reality Modeling Language (VRML97). They were automatically converted into X3D and provide approximate coverage for the X3D Immersive Profile.

☐ **VRML 2.0 Sourcebook X3D Examples**
The VRML 2.0 Sourcebook is an outstanding textbook covering the Virtual Reality Modeling Language (VRML) 97. These were the first examples converted into X3D.

☐ **Savage X3D Examples**
NPS Scenario Authoring and Visualization for Advanced Graphical Environments (SAVAGE) library is an open-source set of X3D models and prototype tools used for defense simulation.

Local download directory: ... C:\

Start downloads **Cancel downloads**

Close **Help**

X3D-Edit authoring tool

Software support

X3D-Edit

Available free for any use

- <https://savage.nps.edu/X3D-Edit>
- Written using Java, XML and X3D
- Windows, MacOSX, Linux, Solaris operating systems

Standalone application with automatic updates
available once installed

Also available for Netbeans as plugin module

- Open integrated development environment (IDE),
primarily (but not exclusively) for Java
- <http://www.netbeans.org>

X3D-Edit features


X3D-Edit features include direct editing of X3D scenes using the XML (.x3d) encoding, embedded visualization of scenes using the Xj3D viewer, XML validation against X3D DTDs and Schemas, drag-and-drop palette for X3D nodes, popup panels for node editing, and extensive help resources.

Planned features include ClassicVRML and X3D compressed binary encoding support, encryption and digital-signature authentication using XML Security standards.

Palette

- Information
- Geometry -- Primitives
 - Shape
 - Box
 - Cone
 - Cylinder
 - Sphere
- Text
 - Font Style
- Grouping
- Viewing and Navigation
- Appearance, Material and Textures
- Geometry -- Points, Lines and Polygons
- Event Animation and Interpolation
- User Interactivity
- Event Utilities and Scripting
- Geometry 2D
- Lighting and Environment
- Environment Sensor and Sound
- Geometry -- Triangles and Quadrilaterals
 - Normal
 - TriangleSet
 - TriangleFanSet
 - TriangleStripSet

X3D Viewer



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HelloWorld.x3d - Navigator

- version="1.0" encoding="UTF-8"
- PUBLIC "ISO//Web3D//DTD X3D 3...."
- X3D xmlns:xsd="http://www.w3.org/2001/XMLSchema-instance" xsd:noNamespaceSch
- head
- Scene
 - Group
 - Viewpoint position="0 -1 7", centerOfRot...
 - Transform rotation="0 1 0 3"
 - Shape
 - Sphere

Filters: [] []

Output

```
https://x3d.svn.sourceforge.net/svnroot/x3d x'>ML check x'
Checking file: C:/www.web3d.org/x3d/content/examples/HelloWorld.x3d...
XML validation finished.
```

newPage/Vih/X3dObject.html **HelloWorld.x3d**

```

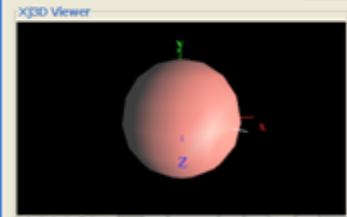
1 <?xml version="1.0" encoding="UTF-8"?>
2 <!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.2//EN" "http://www.web3d.org/specifications/x3d-3.2.dtd">
3 <X3D profile='Immersive' version='3.2' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSch
4
5   <head>
6     <meta content='HelloWorld.x3d' name='title'/>
7     <meta content='Simple X3D example' name='description'/>
8     <meta content='3D October 2000' name='created'/>
9     <meta content='2 December 2007' name='modified'/>
10    <meta content='Don Brutzman' name='creator'/>
11    <meta content='http://www.web3d.org/x3d/content/examples/HelloWorld.x3d' name='identifier'/>
12    <meta content='X3D-Edit 3.2, https://savage.nps.edu/X3D-Edit' name='generator'/>
13    <meta content='license.html' name='license'/>
14  </head>
15  <Scene>
16    <!-- Example scene to illustrate X3D tags and attributes. -->
17    <Group>
18      <Viewpoint description='Hello world!' position='0 -1 7' centerOfRotation='0 -1 0'/>
19      <Transform rotation='0 1 0 3'>
20        <Shape>
21          <Sphere/>
22          <Appearance>
23            <Material>
24              <ImageTexture/>
25            </Appearance>
26          </Shape>
27        </Transform>
28      <Transform translation='0 0 0'>
29        <Shape>
30          <Text string='Hello world!'>
31            <FontStyle size='24'>
32              <Appearance>
33                <Material definition='default'>
34              </Appearance>
35            </Material definition='default'>
36          </Text>
37        </Shape>
38      </Transform>
39    </Group>
40  </Scene>
41 </X3D>

```

Edit Material

DEF: [] USE: [] containerField: []

X3D Viewer



55.55

Material Fields

difuseColor	1.0	0.452381	0.40339
emissiveColor	0.0	0.0	0.0
specularColor	0.686486	0.396903	0.419275
transparency	0.0		
ambientIntensity	0.24		
shininess	0.9		

Universal Media (overwrites Material Fields)

theme: ArtDeco []

Geometry

Sphere [] axes [] light vector []

Light

on []

color: 1.0 1.0 1.0

direction: -0.707 0.0 -0.707

intensity: 1

ambientIntensity: 1

Material Fields

```

.x3dv | ecmascript SA | Java SA | x3d
[Material DEF="ArtDeco03"
  difuseColor="1.0 0.452381 0.40339"
  emissiveColor="0.0 0.0 0.0"
  specularColor="0.686486 0.396903 0.419275"
  transparency="0.0"
  ambientIntensity="0.24"
  shininess="0.9"
  containerField="material"
]

```

OK Cancel Help

X3D-Edit download and installation

Options on X3D-Edit home page

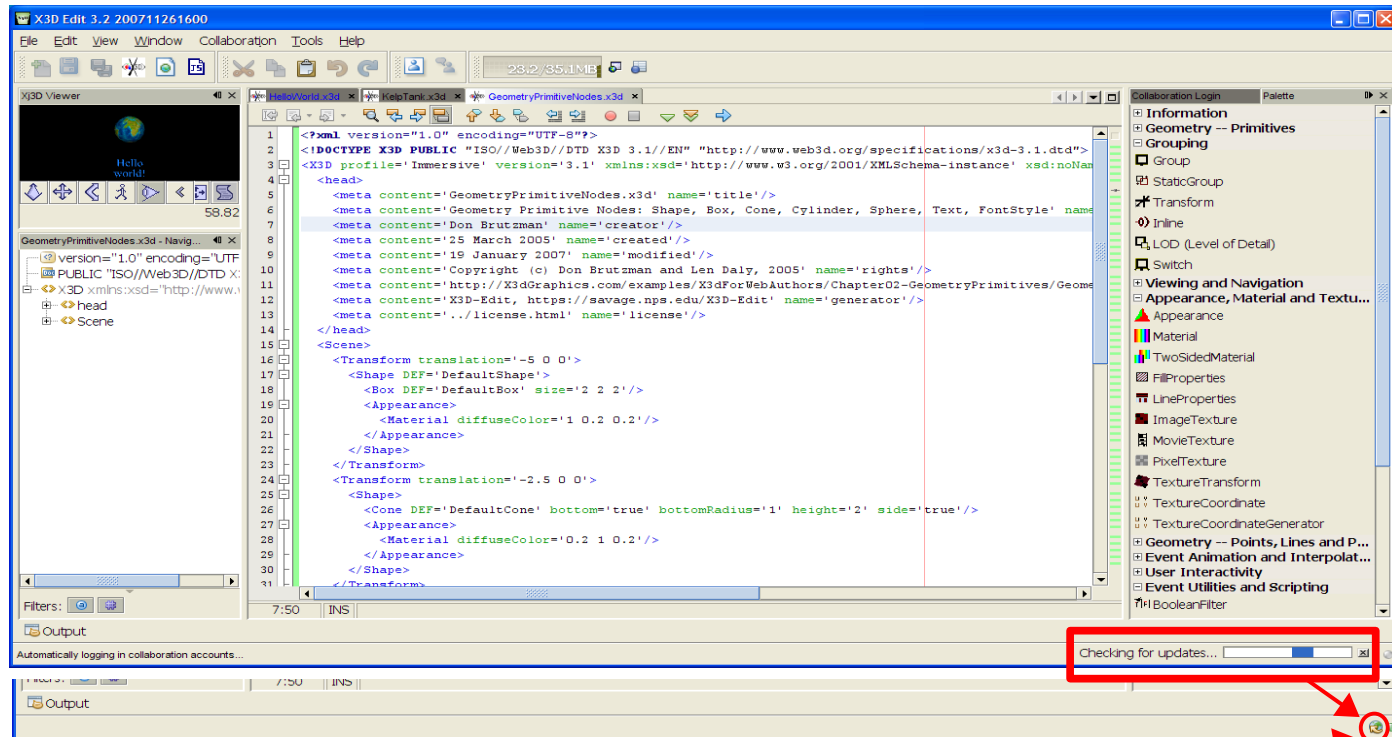
- <https://savage.nps.edu/X3D-Edit/#Downloads>

Standalone executable application:

- Download and extract X3D-Edit3.2.zip
- <https://savage.nps.edu/X3D-Edit/X3D-Edit3.2.zip>
- Launch *runX3dEditWin.bat* on a Windows machine
- Launch *runX3dEditMac.sh.command* on a Mac
- Working test reports for Linux...
- That's all there is to it!

X3D-Edit updates

Icon in lower-left corner of screen indicates when updates are available for automatic installation



Plugin available: click

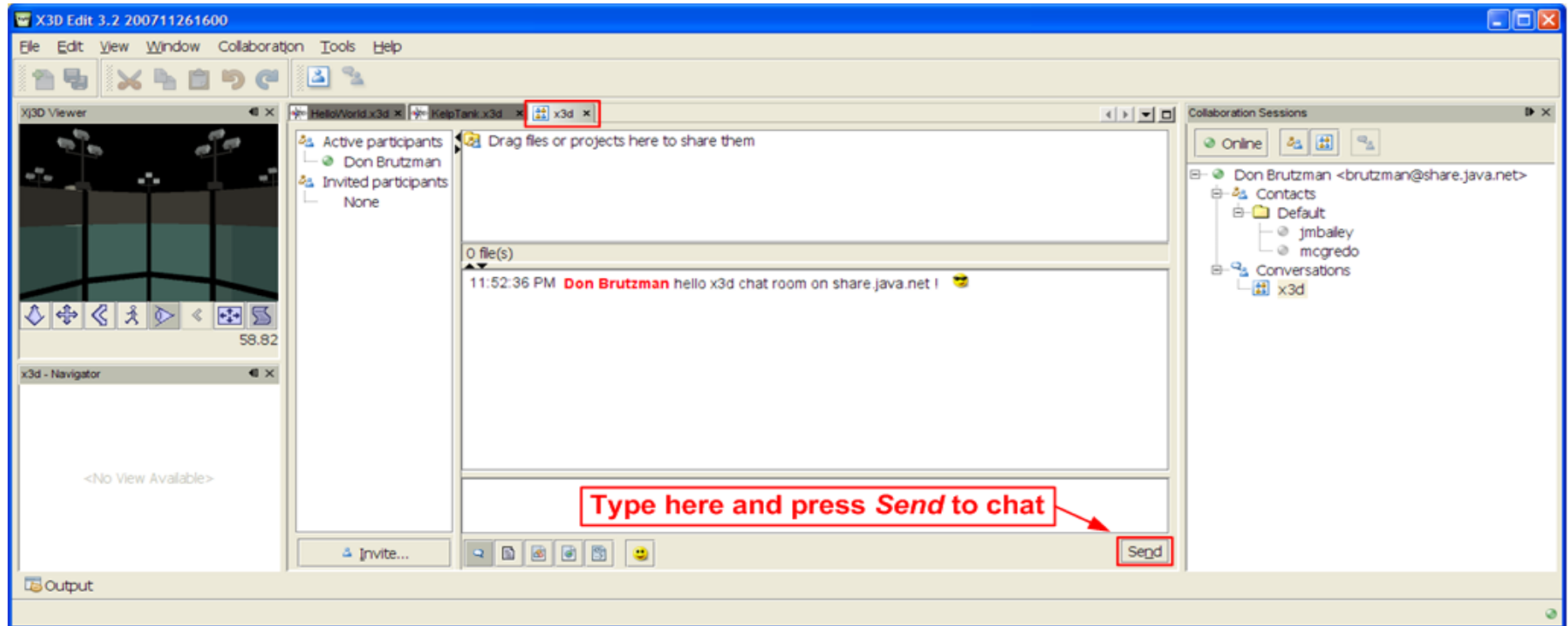
X3D-Edit collaboration chat 1

Chat-based collaboration for text messaging or simultaneous file sharing is now available as an integrated capability in X3D-Edit.

Currently the installation procedure is performed by end users. Directions and screen snapshots are available at

- <https://savage.nps.edu/X3D-Edit/XmppChatCollaborationModule.html>

X3D-Edit collaboration chat 2



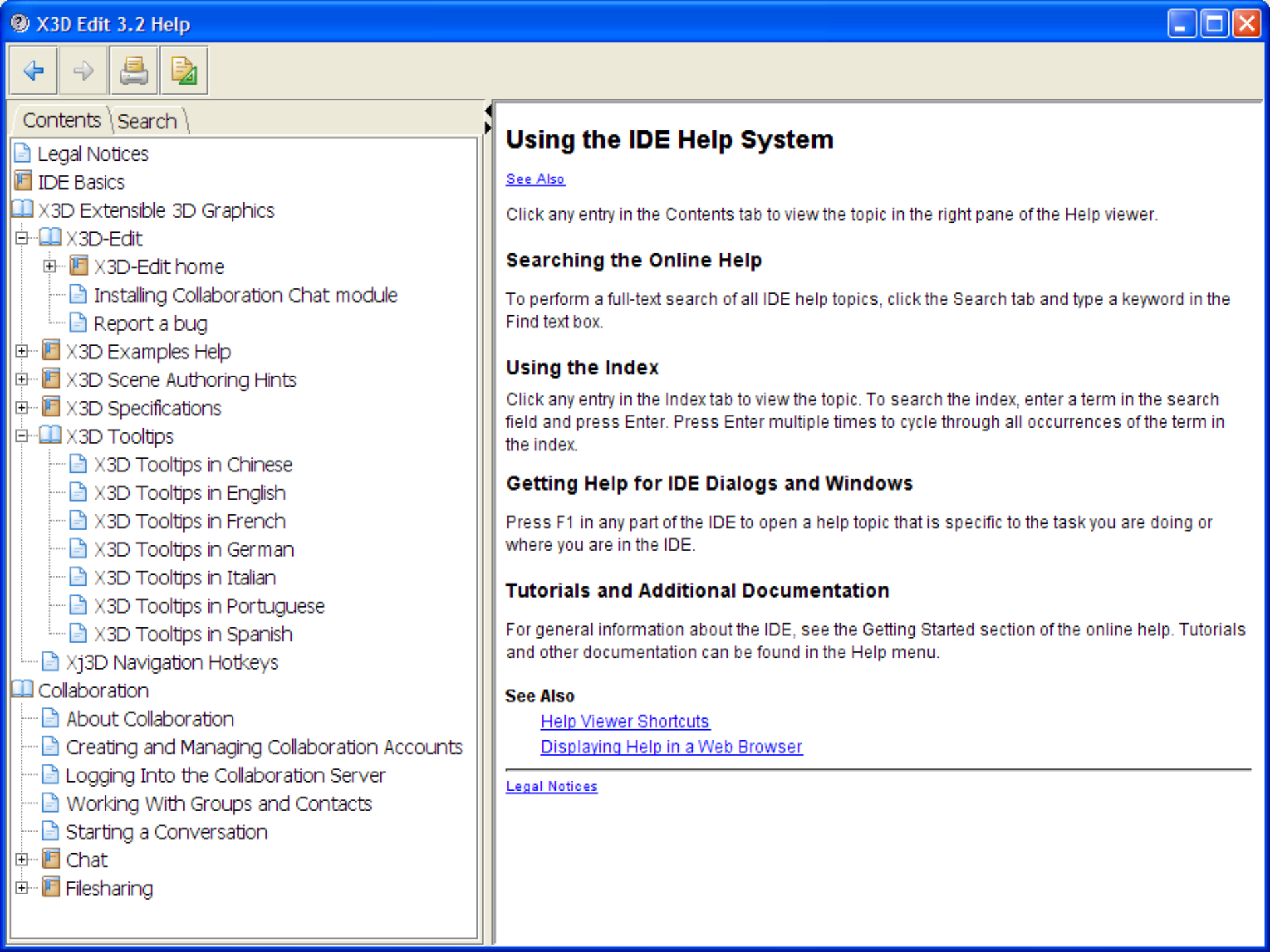
XMPP JID for the chat channel is <xmpp://x3d@muc.share.java.net>
Subscription directions are provided on the installation page

X3D-Edit built using Netbeans

X3D-Edit 3.2 is written in Java using the **Netbeans** platform, and so is portable across major desktop and laptop operating systems (Windows MacOSX Linux Solaris)

- <http://www.netbeans.org>

Lots of help and documentation are provided, both online and within X3D-Edit help system



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- Legal Notices
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- X3D Extensible 3D Graphics
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- X3D Specifications
- X3D Tooltips
 - X3D Tooltips in Chinese
 - X3D Tooltips in English
 - X3D Tooltips in French
 - X3D Tooltips in German
 - X3D Tooltips in Italian
 - X3D Tooltips in Portuguese
 - X3D Tooltips in Spanish
- Xj3D Navigation Hotkeys
- Collaboration
 - About Collaboration
 - Creating and Managing Collaboration Accounts
 - Logging Into the Collaboration Server
 - Working With Groups and Contacts
 - Starting a Conversation
- Chat
- Filesharing

Using the IDE Help System

[See Also](#)

Click any entry in the Contents tab to view the topic in the right pane of the Help viewer.

Searching the Online Help

To perform a full-text search of all IDE help topics, click the Search tab and type a keyword in the Find text box.

Using the Index

Click any entry in the Index tab to view the topic. To search the index, enter a term in the search field and press Enter. Press Enter multiple times to cycle through all occurrences of the term in the index.

Getting Help for IDE Dialogs and Windows

Press F1 in any part of the IDE to open a help topic that is specific to the task you are doing or where you are in the IDE.

Tutorials and Additional Documentation

For general information about the IDE, see the Getting Started section of the online help. Tutorials and other documentation can be found in the Help menu.

See Also

- [Help Viewer Shortcuts](#)
- [Displaying Help in a Web Browser](#)

[Legal Notices](#)

Highlights of NetBeans IDE 6.0 Keyboard Shortcuts & Code Templates

Finding, Searching, and Replacing

Ctrl-F3	Search word at insert point
F3/Shift-F3	Find next/previous in file
Ctrl-F/H	Find/Replace in file
Alt-F7	Find usages
Ctrl-Shift-P	Find/replace in projects
Alt-Shift-U	Find usages results
Alt-Shift-H	Turn off search result highlights
Ctrl-R	Rename
Ctrl-U, then U	Convert selection to uppercase
Ctrl-U, then L	Convert selection to lowercase
Ctrl-U, then S	Toggle case of selection
Alt-Shift-V	Paste formatted

Navigating through Source Code

Ctrl-O/Alt-Shift-O	Go to type/file
Ctrl-Shift-T	Go to JUnit test
Alt-O	Go to source
Ctrl-B	Go to declaration
Ctrl-G	Go to line
Ctrl-Shift-M	Toggle add/remove bookmark
Ctrl-Shift-Period/Comma	Next/previous bookmark
Ctrl-Period/Comma	Next/previous usage/compile error
Ctrl-Shift-1/2/3	Select in Projects/Files/Favorites
Ctrl-[Move caret to matching bracket
Ctrl-K/Ctrl-Shift-K	Next/previous word match
Alt-Left/Alt-Right/Ctrl-Q	Go backward/forward/to last edit

Coding in Java

Alt-Insert	Generate code
Ctrl-Shift-I	Fix all class imports
Alt-Shift-I	Fix selected class's import
Alt-Shift-F	Format selection
Alt-Shift Left/Right/Up/Down	Shift lines left/right/up/down
Ctrl-Shift-Up/D	Copy lines up/down
Ctrl/Alt-F12	Inspect members/hierarchy
Ctrl-/	Add/remove comment lines
Ctrl-E	Delete current line

Coding in C/C++

Alt-Shift-C	Go to declaration
Ctrl-F9	Evaluate expression

Coding in Ruby

Ctrl-Shift-A	Jump Rails action > view
Alt-Shift-Period/Comma	Select Next/Previous element
Ctrl-Shift-Space	Show documentation
Ctrl-Shift-T	Jump from test file to file

SOA

Tab-Shift-Arrows	Move through elements
Alt-Shift-F	Advanced search
Alt/Shift-Enter	Expand/collapse elements
Ctrl-Shift-9	Show BPEL Mapper

UML

Alt-Shift-A/O	Insert attribute/operation into selected element
Ctrl-Shift-F	Fit diagram into window
F8	Toggle Overview window
Ctrl-Shift-5	Select active UML diagram

Compiling, Testing, and Running

F9	Compile package/ file
F11	Build main project
Shift-F11	Clean & build main project
Ctrl-Q	Set request parameters
Ctrl-Shift-U	Create JUnit test
Ctrl-F6/Alt-F6	Run JUnit test on file/project
F6/Shift-F6	Run main project/file

Opening and Toggling between Views

Ctrl-Tab (Ctrl-`)	Toggle between open documents
Shift-Escape	Maximize window (toggle)
Ctrl-F4/Ctrl-W	Close currently selected window
Ctrl-Shift-F4	Close all windows
Shift-F10	Open contextual menu
Alt-Shift-D	Undock window

Debugging

Ctrl-F5	Start debugging main project
Ctrl-Shift-F5	Start debugging current file
Ctrl-Shift-F6	Start debugging test for file (JUnit)
Shift-F5/F5	Stop/Continue debugging session
F4	Run to cursor location in file
F7/F8	Step into/over
Ctrl-F7	Step out
Ctrl-Alt-Up	Go to called method
Ctrl-Alt-Down	Go to calling method
Ctrl-F9	Evaluate expression
Ctrl-F8	Toggle breakpoint
Ctrl-Shift-F8	New breakpoint
Ctrl-Shift-F7	New watch

Hello World example

Hello World example

Hello World programs are simple examples of a computer language to illustrate their structure

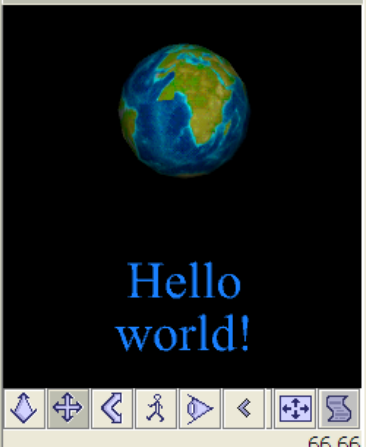
- HelloWorld.x3d actually has a small world in it!
- Found in local-directory archive download at *www.web3d.org/x3d/content/examples*

X3D-Edit display includes color-coded text, node palette, validation, XML tree, Xj3D rendering

- Pretty-print HTML version is another useful output

Studying and modifying HelloWorld.x3d is an excellent way to learn a lot about X3D graphics

X3D Viewer



66.66

HelloWorld.x3d - Navigator

- version="1.0" encoding="UTF-8"
- PUBLIC "ISO//Web3D//DTD X3D
- X3D xmlns:xsd="http://www.w3.
- head
- Scene
 - Group
 - Viewpoint position="0 -1 0"
 - Transform rotation="0 1 0 3"
 - Shape
 - Sphere
 - Appearance
 - Material diffuse
 - ImageTexture
 - Transform translation="0 -2 0"
 - Shape
 - Text solid="false"
 - FontStyle just
 - Appearance
 - Material diffuse

Palettes

- Information
 - Meta
 - Geometry -- Primitives
 - Grouping
 - Group
 - StaticGroup
 - Transform
 - Inline
 - LOD (Level of Detail)
 - Switch
 - Viewing and Navigation
 - Appearance, Material and Textures
 - Appearance
 - Material
 - TwoSidedMaterial
 - FillProperties
 - LineProperties
 - ImageTexture
 - MovieTexture
 - PixelTexture
 - TextureTransform
 - TextureCoordinate
 - TextureCoordinateGenerator
 - Geometry -- Points, Lines and Pol...
 - Event Animation and Interpolation
 - User Interactivity
 - Event Utilities and Scripting
 - Geometry 2D
 - Lighting and Environment
 - Environment Sensor and Sound
 - Geometry -- Triangles and Quadril...

XML Editor

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd" [
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'>
  <head>
    <meta content='HelloWorld.x3d' name='title' />
    <meta content='Simple X3D example' name='description' />
    <meta content='30 October 2000' name='created' />
    <meta content='20 December 2007' name='modified' />
    <meta content='Don Brutzman' name='creator' />
    <meta content='http://www.web3d.org/x3d/content/examples/HelloWorld.x3d' name='identifier' />
    <meta content='X3D-Edit 3.2, https://savage.nps.edu/X3D-Edit' name='generator' />
    <meta content='license.html' name='license' />
  </head>
  <Scene>
    <!-- Example scene to illustrate X3D tags and attributes. -->
    <Group>
      <Viewpoint centerOfRotation='0 -1 0' description='Hello world!' position='0 -1 7' />
      <Transform rotation='0 1 0 3'>
        <Shape>
          <Sphere />
          <Appearance>
            <Material diffuseColor='0 0.5 1' />
            <ImageTexture url='earth-topo.png' "earth-topo.jpg" "earth-topo-small.gif" />
          </Appearance>
        </Shape>
      </Transform>
      <Transform translation='0 -2 0'>
        <Shape>
          <Text solid='false' string='Hello world!' />
          <FontStyle justify='MIDDLE' "MIDDLE" />
        </Shape>
        <Appearance>
          <Material diffuseColor='0.1 0.5 1' />
        </Appearance>
      </Transform>
    </Group>
  </Scene>
</X3D>
```

29:55 INS

Output - XML check

```
XML validation started.
Checking file: /C:/www.web3d.org/x3d/content/examples/HelloWorld.x3d...
XML validation finished.
```

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">

<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation='http://www.web3d.org/specifications/x3d-3.1.xsd'>
  <head>
    <meta name='title' content='HelloWorld.x3d' />
    <meta name='description' content='Simple X3D example' />
    <meta name='created' content='30 October 2000' />
    <meta name='modified' content='2 December 2007' />
    <meta name='creator' content='Don Brutzman' />
    <meta name='identifier' content='http://www.web3d.org/x3d/content/examples/HelloWorld.x3d' />
    <meta name='generator' content='X3D-Edit 3.2, https://savage.nps.edu/X3D-Edit/' />
    <meta name='license' content='license.html' />
  </head>
  <!--
  -->
  <Scene>
    <!-- Example scene to illustrate X3D tags and attributes. -->
    <Group>
      <Viewpoint description='Hello world!' position='0 -1 7' centerOfRotation='0 -1 0' />
      <Transform rotation='0 1 0 3'>
        <Shape>
          <Sphere />
          <Appearance>
            <Material diffuseColor='0 0.5 1' />
            <ImageTexture
              url='earth-topo.png' earth-topo-small.gif "http://www.web3d.org/x3d/content/examples/Basic/earth-topo.png"
              "http://www.web3d.org/x3d/content/examples/Basic/earth-topo-small.gif" />
            </ImageTexture>
          </Appearance>
        </Shape>
      </Transform>
      <Transform translation='0 -2 0'>
        <Shape>
          <Text string='Hello "world!"' solid='false'>
            <FontStyle justify='MIDDLE' MIDDLE' />
          </Text>
          <Appearance>
            <Material diffuseColor='0.1 0.5 1' />
          </Appearance>
        </Shape>
      </Transform>
    </Group>
  </Scene>
</X3D>
```

Book organization

Book organization

Chapter 1 provides a thorough technical background study of how X3D works.

Subsequent chapters covers specific X3D nodes, grouped by similar functionality

- Chapters 2-6 for scene-graph fundamentals
- Chapters 7-9 for event animation and scripting
- Chapters 10-14 can be read in any order

Example scenes are provided in every chapter to enable direct learning, by changing examples and creating new scenes

Chapter descriptions

1. **Technical Overview.** General introduction of the fundamentals of 3D, including scene graphs, events, node reuse, file structure and encodings, components and profiles, and conformance.
2. **Geometry Nodes, Part 1: Primitives.** The basic primitive shapes.
 - Box, Sphere, Cylinder, Cone, and Text.
3. **Grouping Nodes.** Collecting and positioning objects in the 3D world.
 - Inline, LOD, Group and StaticGroup, Switch, Transform, and Anchor.

Chapter descriptions

4. Viewing and Navigation. How to view and navigate in the 3D world

- Viewpoint and NavigationInfo.

5. Appearance, Material, and Textures.
Adding colors, shininess, and transparency

- Material and TwoSidedMaterial,
or by adding image-file textures
- PixelTexture, ImageTexture, MovieTexture,
TextureTransform, TextureCoordinate, and
TextureCoordinateGenerator.

Chapter descriptions

6. **Geometry Nodes, Part 2: Points, Lines, and Polygons.** Geometric creations that are more advanced than the basic shapes.
- Coordinate, Color, PointSet, LineSet, Extrusion
IndexedLineSet, IndexedFaceSet, ElevationGrid.
7. **Event Animation and Interpolation.** Making objects move, twist, wiggle, and shake.
- TimeSensor and interpolation nodes:
ScalarInterpolator, PositionInterpolator,
PositionInterpolator2D, ColorInterpolator,
OrientationInterpolator, CoordinateInterpolator.

Chapter descriptions

8. User Interactivity Nodes. Allowing users to interact with the world by connecting

- TouchSensor, PlaneSensor, CylinderSensor, SphereSensor, KeySensor, and StringSensor nodes.

9. Event Utilities and Scripting. Event type conversion and improved animation using the event-utility nodes

- BooleanFilter, BooleanSequencer, BooleanToggle, BooleanTrigger, IntegerSequencer, IntegerTrigger
- author-programmable Script node.

Chapter descriptions

10. **Geometry Nodes, Part 3: Geometry2D**

Nodes. Flat geometry is helpful for building 2D shapes that face the viewer. Planar nodes include

- Polypoint2D, Rectangle2D, TriangleSet2D, Polyline2D, Circle2D, Arc2D, ArcClose2D, Disk2D.

11. **Lighting and Environment Nodes.** Achieve lighting and scene background effects using

- DirectionalLight, PointLight, SpotLight, Background, TextureBackground, Fog, and Sound.

Chapter descriptions

12. **Environment Sensor and Sound Nodes.**

User activity in the environment can be detected and processed by using

- LoadSensor, Collision, Billboard, ProximitySensor, and VisibilitySensor

13. **Geometry Nodes, Part 4: Triangles and Quadrilaterals.** Fundamental low-level geometry creation using triangles:

- TriangleSet, TriangleStripSet, TriangleFanSet, IndexedTriangleSet, IndexedTriangleStripSet, and IndexedTriangleFanSet.

Chapter descriptions

14. Creating Prototype Nodes. Probably the most powerful extension feature in X3D is the ability to define new reusable nodes, known as prototypes. Prototype declarations are combinations of already-existing nodes and (optionally) other prototypes. Prototype instances can then be used like any other X3D node. External prototype declarations allow authors to collect reusable prototype definitions together in a single file that can be accessed by other scenes.

How to use the book

How to use the book, 1

Hands-on, eyes-on approach

- Learning is best accomplished by building and modifying scenes, using a text editor or an authoring tool that is X3D capable
- Modify and refresh frequently, you won't break it!
- X3D-Edit is provided free for your use
<https://savage.nps.edu/X3D-Edit>

Web authors and X3D students

- Chapter 1 section 1 only, then start with Chapter 2 and proceed in order
- Review chapter 1 periodically later, when you want

How to use the book, 2

Experienced 3D programmers

- Read Chapter 1 first to figure out how X3D is both similar to (and different from) the technologies which you already understand
- Skim chapters 2-6 scene graph fundamentals, then study chapters 2-9 animation, use others as needed

Experienced X3D authors

- Study Chapter 1 descriptions of XML + ClassicVRML encodings, which are functionally equivalent
- Remainder of book in any order, can use it as a ready-reference manual

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Summary

Summary

Reading this “Getting Started” slideset prepares you to work examples in *X3D for Web Authors*

Topics include

- Goals, Motivation and Student background
- X3D-Edit Authoring Tool and Hello World example
- *X3D for Web Authors*: book organization and use
- It is important to get your system fully set up to view and edit X3D example scenes
- Can skip Chapter 1, Technical Introduction
 - Start right in working examples in Chapter 2

References 1

X3D: Extensible 3D Graphics for Web Authors
by Don Brutzman and Leonard Daly, Morgan
Kaufmann Publishers, April 2007, 468 pages.

- Chapter 3, Grouping Nodes
- <http://x3dGraphics.com>
- <http://x3dgraphics.com/examples/X3dForWebAuthors>

X3D Examples Help

- <http://www.web3d.org/x3d/content/examples/help.html>

References 2

X3D-Edit Authoring Tool

- <https://savage.nps.edu/X3D-Edit>

X3D Scene Authoring Hints

- <http://x3dgraphics.com/examples/X3dSceneAuthoringHints.html>

X3D Graphics Specification

- <http://www.web3d.org/x3d/specifications>
- Also available as help pages within X3D-Edit

References 3

Netbeans

- <http://www.netbeans.org>

Netbeans IDE Field Guide, second edition,
Patrick Keegan, Ludovic Champenois,
Gregory Crawley, Charlie Hunt,
Christopher Webster, Prentice Hall, 2006.

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X3D Graphics for Web Authors

Getting Started

*A journey of a thousand miles
begins with a single step.*

Chinese proverb



Contents

Goals, motivation and student background

Software support

- X3D Examples
- X3D-Edit authoring tool and Hello World example

X3D for Web Authors

- book organization and use

Summary and References



Goals

This work presents Extensible 3D (X3D) Graphics, the open, royalty-free, international standard for 3D graphics on the Web

Book and slideset goals include

- Show Web authors experienced with HTML and XML how to build and connect X3D models
- Teach students principles of Web-capable 3D graphics
- Serve as a ready-reference book for X3D experts

Explain broad principles and specific details of X3D for anyone learning how to build 3D models



Excerpted and adapted from Chapter 1, *X3D Graphics for Web Authors*
<http://x3dGraphics.com>

Motivation 1

Over 30 years of steady growth and innovation have made 3D graphics an exciting field

Key professional organization is SIGGRAPH for computer graphics and interactive techniques

- Includes technical experts and artists alike
- <http://www.siggraph.org>

Nevertheless, few people actually build 3D models themselves

- Usually requires advanced programming skills
- Costly proprietary tools and approaches compete

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Association for Computing Machinery (ACM) at <http://www.acm.org>

is the parent organization of the

Special Interest Group on Graphics (SIGGRAPH) <http://www.siggraph.org>

Motivation 2

Rather than creating another expensive technical niche, X3D is designed for Web interoperability

- Support capabilities common to most (or all) tools
- Provide import/export publishing compatibility for many other formats
- Align 3D with *Architecture of the World Wide Web*

This approach works well for simple 3D models, scaling up to large-scale virtual environments

- Ultimate X3D success means that 3D graphics becomes a “first-class citizen” for Web multimedia



Students (and experts) working in 3D graphics usually get “locked into” one authoring tool or software package. This means they are often learning methods techniques that are peculiar to the tool interface, rather than 'nondenominational' 3D graphics knowledge that is more general, more portable, and suitable for Web export.

We hope that the book and associated materials changes this long-running situation.

The *Architecture of the World Wide Web* is a World Wide Web Consortium (W3C) Recommendation, administered by the W3C Technical Architecture Group (TAG) and online at <http://www.w3.org/TR/webarch>

Student background

Provide introductory course in to 3D graphics
achievable at undergraduate level

- Course successfully taught first as VRML, then X3D

The following are all helpful but not required

- XML authoring background
- Programming skills
- Modeling-tool experience

Lots of free resources are available

- Can be self-taught with dedicated effort
- Support and feedback from online community



We are working to make X3D learnable and usable by any Web author.

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X3D Examples

Software support



Software support for X3D authoring

Lots of free plugins, tools and resources provided

- X3D Examples Help at

<http://www.web3d.org/x3d/content/examples/help.html>

Best first step is to install an X3D plugin into your default Web browser

- Letting you easily view any X3D scene

Set up to author X3D scenes using plain-text editor, or else by using an X3D-aware authoring tool

- X3D-Edit provided free for any use
- Other tools listed on Help page above



Get ready, get set...

X3D Examples

Numerous (thousands) of X3D examples are available online

- <http://x3dgraphics.com/examples/help.html#Examples>

Can browse all examples in *X3D for Web Authors*

- <http://x3dgraphics.com/examples> summary
- <http://x3dgraphics.com/examples/X3dForWebAuthors> archive
- <http://x3dgraphics.com/X3dExamplesX3dForWebAuthors.zip>

Recommended approach:

- Browse examples online
- Download and edit on local system



... go!

X3D Examples Archives

X3D for Web Authors

- Textbook on how to design and build X3D scenes

Basic

- Diverse scenes illustrating various X3D capabilities

Conformance NIST

- Strictly defined test examples for correct operation

VRML 2.0 Sourcebook

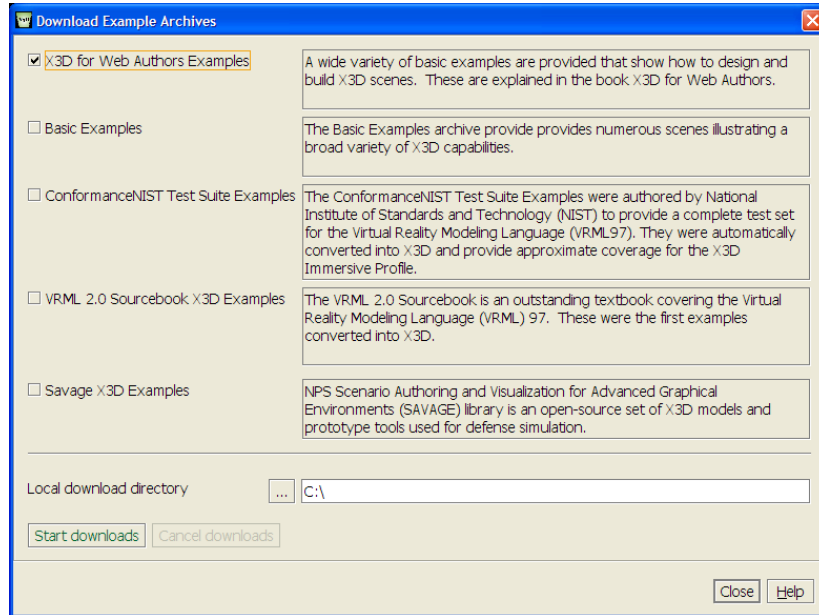
- Textbook on VRML97, examples converted to X3D

Savage

- Open-source military models and tools



X3D Examples download panel, X3D-Edit



X3D-Edit includes this download panel. Select the top-level *Examples* menu, then *Download X3D Example Archives*.

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X3D-Edit authoring tool

Software support



Acknowledgements at <https://savage.nps.edu/X3D-Edit/#Acknowledgements>

X3D-Edit

Available free for any use

- <https://savage.nps.edu/X3D-Edit>
- Written using Java, XML and X3D
- Windows, MacOSX, Linux, Solaris operating systems

Standalone application with automatic updates
available once installed

Also available for Netbeans as plugin module

- Open integrated development environment (IDE),
primarily (but not exclusively) for Java
- <http://www.netbeans.org>



The X3D-Edit 3.2 Authoring Tool for Extensible 3D (X3D) Graphics supports the creation, checking, display and publication of X3D scenes.

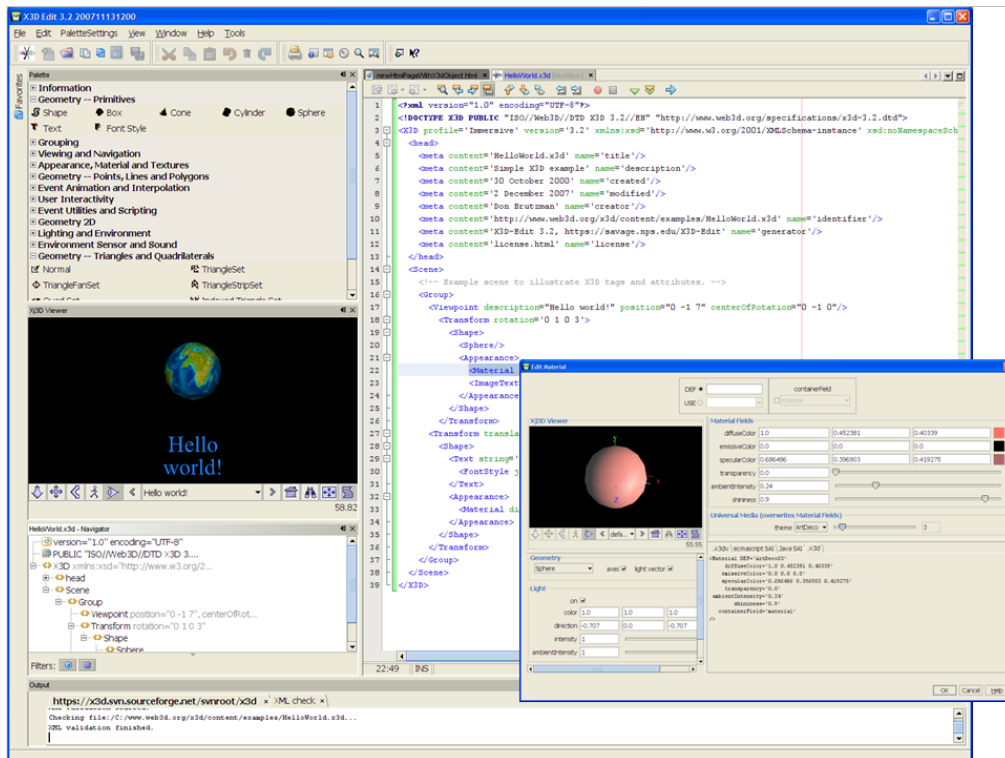
It is written in open-source Java and XML using the Netbeans platform, making it suitable both as a standalone application and as a plugin module for the Netbeans integrated development environment (IDE).

X3D-Edit features

X3D-Edit features include direct editing of X3D scenes using the XML (.x3d) encoding, embedded visualization of scenes using the Xj3D viewer, XML validation against X3D DTDs and Schemas, drag-and-drop palette for X3D nodes, popup panels for node editing, and extensive help resources.

Planned features include ClassicVRML and X3D compressed binary encoding support, encryption and digital-signature authentication using XML Security standards.





- As the name implies, X3D-Edit is primarily oriented towards editing X3D text. Additional features include:
- Popup editors for each node
 - Palette for dragging/dropping new nodes
 - Xj3D scene visualization
 - XML tree view
 - Automatic code completion and element matching
 - Validation and error checking
 - Help system including multilingual tooltips, X3D specifications, examples help and X3D Scene Authoring Hints
 - Automatic updates

<https://savage.nps.edu/X3D-Edit>

X3D-Edit download and installation

Options on X3D-Edit home page

- <https://savage.nps.edu/X3D-Edit/#Downloads>

Standalone executable application:

- Download and extract X3D-Edit3.2.zip
- <https://savage.nps.edu/X3D-Edit/X3D-Edit3.2.zip>
- Launch *runX3dEditWin.bat* on a Windows machine
- Launch *runX3dEditMac.sh.command* on a Mac
- Working test reports for Linux...
- That's all there is to it!

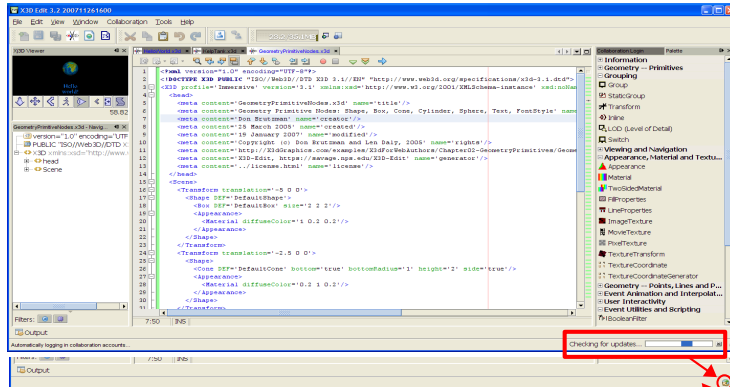


Further customization for Linux is welcome, expert help is invited

Work in progress: Java WebStart version

X3D-Edit updates

Icon in lower-left corner of screen indicates when updates are available for automatic installation

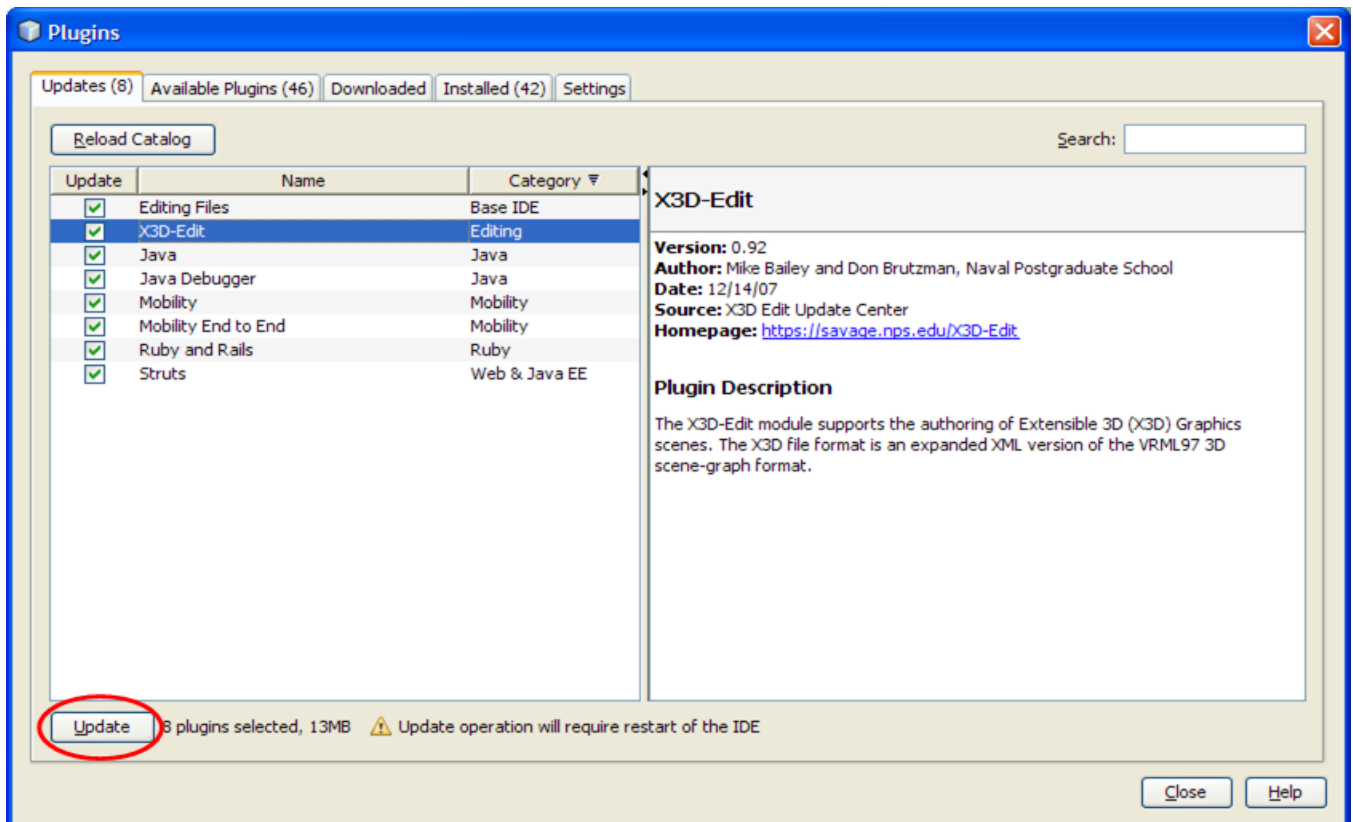


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Plugin available: click



It is also possible to manually trigger an X3D-Edit update, if one is available.
From top menu, select *Tools > Plugins > Updates* and then click the Update button.



X3D-Edit collaboration chat 1

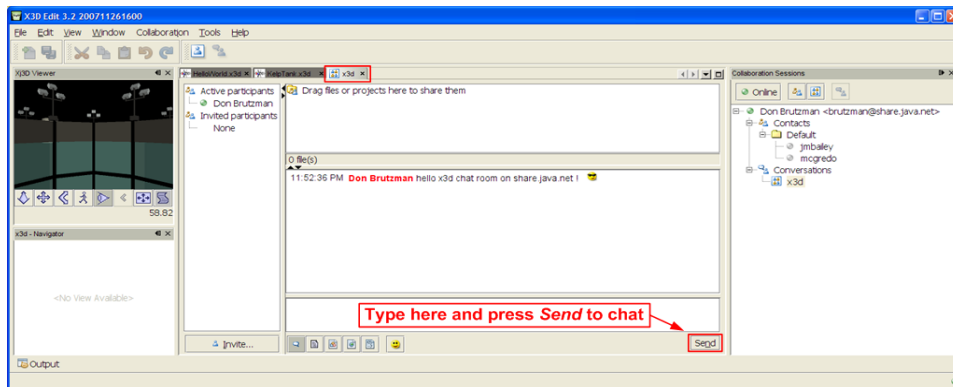
Chat-based collaboration for text messaging or simultaneous file sharing is now available as an integrated capability in X3D-Edit.

Currently the installation procedure is performed by end users. Directions and screen snapshots are available at

- <https://savage.nps.edu/X3D-Edit/XmppChatCollaborationModule.html>



X3D-Edit collaboration chat 2



XMPP JID for the chat channel is <xmpp://x3d@muc.share.java.net>

Subscription directions are provided on the installation page

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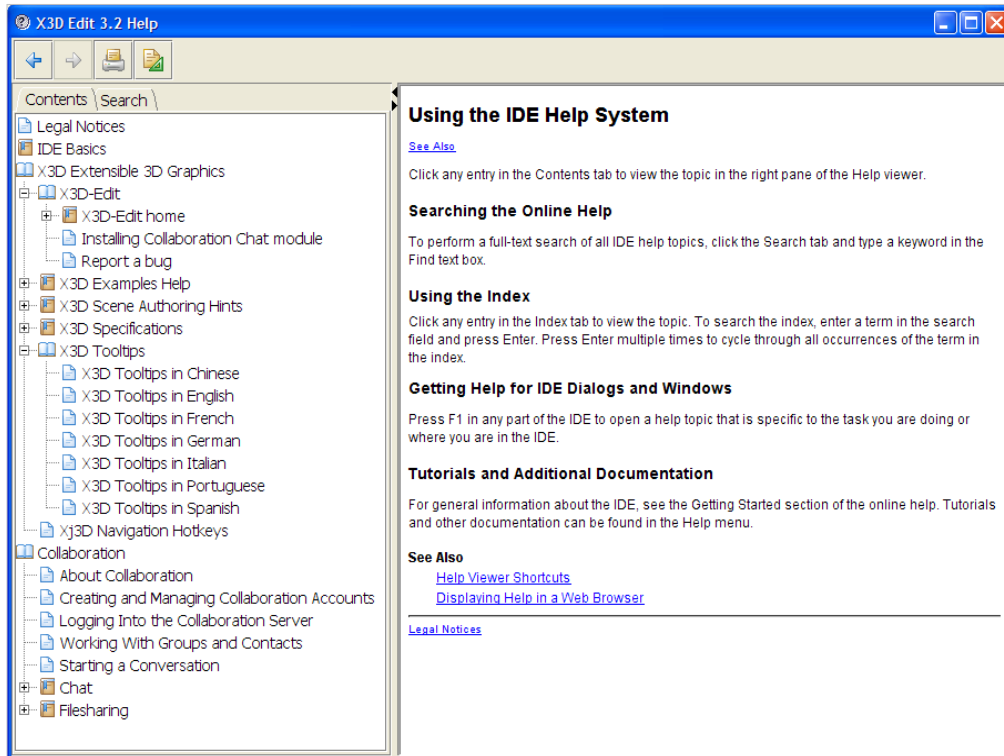
X3D-Edit built using Netbeans

X3D-Edit 3.2 is written in Java using the [Netbeans](#) platform, and so is portable across major desktop and laptop operating systems (Windows MacOSX Linux Solaris)

- <http://www.netbeans.org>

Lots of help and documentation are provided, both online and within X3D-Edit help system





F1 or the Help menu launches the JavaHelp system.

Highlights of NetBeans IDE 6.0 Keyboard Shortcuts & Code Templates

Finding, Searching, and Replacing

Ctrl-F3	Search word at insert point
F3/Shift-F3	Find next/previous in file
Ctrl-F/H	Find/Replace in file
Alt-F7	Find usages
Ctrl-Shift-P	Find/replace in projects
Alt-Shift-U	Find usages results
Alt-Shift-H	Turn off search result highlights
Ctrl-R	Rename
Ctrl-U, then U	Convert selection to uppercase
Ctrl-U, then L	Convert selection to lowercase
Ctrl-U, then S	Toggle case of selection
Alt-Shift-V	Paste formatted

Navigating through Source Code

Ctrl-O/Alt-Shift-O	Go to type/file
Ctrl-Shift-T	Go to JUnit test
Alt-O	Go to source
Ctrl-B	Go to declaration
Ctrl-G	Go to line
Ctrl-Shift-M	Toggle add/remove bookmark
Ctrl-Shift-Period/Comma	Next/previous bookmark
Ctrl-Period/Comma	Next/previous usage/compile error
Ctrl-Shift-1/2/3	Select in Projects/Files/Favorites
Ctrl-[Move caret to matching bracket
Ctrl-K/Ctrl-Shift-K	Next/previous word match
Alt-Left/Alt-Right/Ctrl-Q	Go backward/forward/to last edit

Coding in Java

Alt-Insert	Generate code
Ctrl-Shift-I	Fix all class imports
Alt-Shift-I	Fix selected class's import
Alt-Shift-F	Format selection
Alt-Shift Left/Right/Up/Down	Shift lines left/right/up/down
Ctrl-Shift-Up/D	Copy lines up/down
Ctrl/Alt-F12	Inspect members/hierarchy
Ctrl-/	Add/remove comment lines
Ctrl-E	Delete current line

Coding in C/C++

Alt-Shift-C	Go to declaration
Ctrl-F9	Evaluate expression

Coding in Ruby

Ctrl-Shift-A	Jump Rails action > view
Alt-Shift-Period/Comma	Select Next/Previous element
Ctrl-Shift-Space	Show documentation
Ctrl-Shift-T	Jump from test file to file

SOA

Tab-Shift-Arrows	Move through elements
Alt-Shift-F	Advanced search
Alt/Shift-Enter	Expand/collapse elements
Ctrl-Shift-9	Show BPEL Mapper

UML

Alt-Shift-A/O	Insert attribute/operation into selected element
Ctrl-Shift-F	Fit diagram into window
F8	Toggle Overview window
Ctrl-Shift-5	Select active UML diagram

Compiling, Testing, and Running

F9	Compile package/ file
F11	Build main project
Shift-F11	Clean & build main project
Ctrl-Q	Set request parameters
Ctrl-Shift-U	Create JUnit test
Ctrl-F6/Alt-F6	Run JUnit test on file/project
F6/Shift-F6	Run main project/file

Opening and Toggling between Views

Ctrl-Tab (Ctrl-`)	Toggle between open documents
Shift-Escape	Maximize window (toggle)
Ctrl-F4/Ctrl-W	Close currently selected window
Ctrl-Shift-F4	Close all windows
Shift-F10	Open contextual menu
Alt-Shift-D	Undock window

Debugging

Ctrl-F5	Start debugging main project
Ctrl-Shift-F5	Start debugging current file
Ctrl-Shift-F6	Start debugging test for file (JUnit)
Shift-F5/F5	Stop/Continue debugging session
F4	Run to cursor location in file
F7/F8	Step into/over
Ctrl-F7	Step out
Ctrl-Alt-Up	Go to called method
Ctrl-Alt-Down	Go to calling method
Ctrl-F9	Evaluate expression
Ctrl-F8	Toggle breakpoint
Ctrl-Shift-F8	New breakpoint
Ctrl-Shift-F7	New watch

Available via the top Help menu, and also online at <http://wiki.netbeans.org/wiki/view/KeymapProfileFor60>

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Hello World example



Hello World example

Hello World programs are simple examples of a computer language to illustrate their structure

- HelloWorld.x3d actually has a small world in it!
- Found in local-directory archive download at *www.web3d.org/x3d/content/examples*

X3D-Edit display includes color-coded text, node palette, validation, XML tree, Xj3D rendering

- Pretty-print HTML version is another useful output

Studying and modifying HelloWorld.x3d is an excellent way to learn a lot about X3D graphics

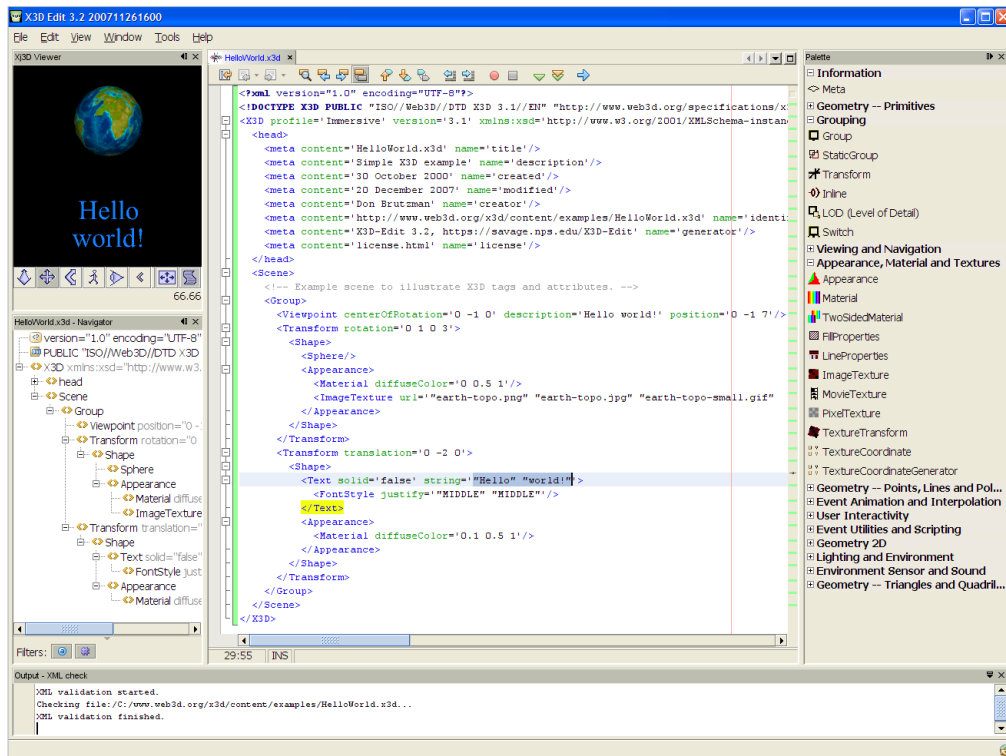


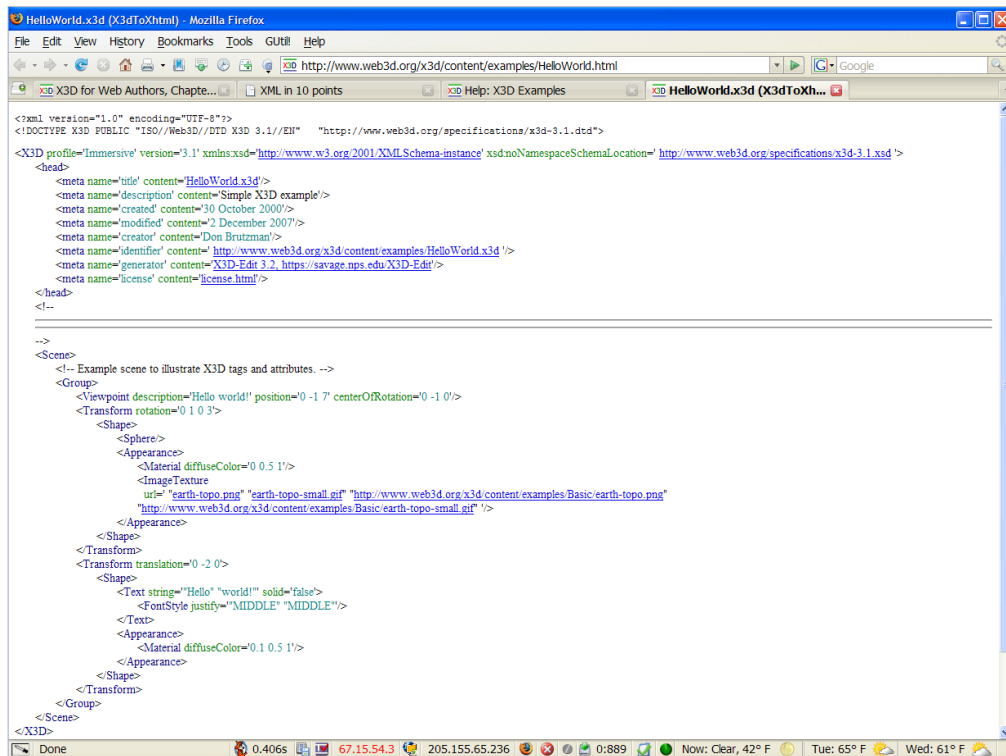
<http://x3dgraphics.com/examples/HelloWorld.x3d>

<http://www.web3d.org/x3d/content/examples/HelloWorld.x3d>

master in version control:

http://x3d.svn.sourceforge.net/viewvc/*checkout*/x3d/www.web3d.org/x3d/content/examples/HelloWorld.x3d





Pretty-printed HTML output using X3dToXhtml.xslt stylesheet

<http://www.web3d.org/x3d/content/examples/HelloWorld.html>

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Book organization



Book organization

Chapter 1 provides a thorough technical background study of how X3D works.

Subsequent chapters covers specific X3D nodes, grouped by similar functionality

- Chapters 2-6 for scene-graph fundamentals
- Chapters 7-9 for event animation and scripting
- Chapters 10-14 can be read in any order

Example scenes are provided in every chapter to enable direct learning, by changing examples and creating new scenes



Chapter descriptions

1. **Technical Overview.** General introduction of the fundamentals of 3D, including scene graphs, events, node reuse, file structure and encodings, components and profiles, and conformance.
2. **Geometry Nodes, Part 1: Primitives.** The basic primitive shapes.
 - Box, Sphere, Cylinder, Cone, and Text.
3. **Grouping Nodes.** Collecting and positioning objects in the 3D world.
 - Inline, LOD, Group and StaticGroup, Switch, Transform, and Anchor.



Chapter descriptions

4. **Viewing and Navigation.** How to view and navigate in the 3D world
 - Viewpoint and NavigationInfo.
5. **Appearance, Material, and Textures.** Adding colors, shininess, and transparency
 - Material and TwoSidedMaterial, or by adding image-file textures
 - PixelTexture, ImageTexture, MovieTexture, TextureTransform, TextureCoordinate, and TextureCoordinateGenerator.



Chapter descriptions

6. **Geometry Nodes, Part 2: Points, Lines, and Polygons.** Geometric creations that are more advanced than the basic shapes.
 - Coordinate, Color, PointSet, LineSet, Extrusion IndexedLineSet, IndexedFaceSet, ElevationGrid.
7. **Event Animation and Interpolation.** Making objects move, twist, wiggle, and shake.
 - TimeSensor and interpolation nodes: ScalarInterpolator, PositionInterpolator, PositionInterpolator2D, ColorInterpolator, OrientationInterpolator, CoordinateInterpolator.



Chapter descriptions

8. **User Interactivity Nodes.** Allowing users to interact with the world by connecting
 - TouchSensor, PlaneSensor, CylinderSensor, SphereSensor, KeySensor, and StringSensor nodes.
9. **Event Utilities and Scripting.** Event type conversion and improved animation using the event-utility nodes
 - BooleanFilter, BooleanSequencer, BooleanToggle, BooleanTrigger, IntegerSequencer, IntegerTrigger
 - author-programmable Script node.

Chapter descriptions

10. **Geometry Nodes, Part 3: Geometry2D**

Nodes. Flat geometry is helpful for building 2D shapes that face the viewer. Planar nodes include

- Polypoint2D, Rectangle2D, TriangleSet2D, Polyline2D, Circle2D, Arc2D, ArcClose2D, Disk2D.

11. **Lighting and Environment Nodes.** Achieve lighting and scene background effects using

- DirectionalLight, PointLight, SpotLight, Background, TextureBackground, Fog, and Sound.



Chapter descriptions

12. **Environment Sensor and Sound Nodes.**

User activity in the environment can be detected and processed by using

- LoadSensor, Collision, Billboard, ProximitySensor, and VisibilitySensor

13. **Geometry Nodes, Part 4: Triangles and Quadrilaterals.** Fundamental low-level geometry creation using triangles:

- TriangleSet, TriangleStripSet, TriangleFanSet, IndexedTriangleSet, IndexedTriangleStripSet, and IndexedTriangleFanSet.



Chapter descriptions

14. **Creating Prototype Nodes.** Probably the most powerful extension feature in X3D is the ability to define new reusable nodes, known as prototypes. Prototype declarations are combinations of already-existing nodes and (optionally) other prototypes. Prototype instances can then be used like any other X3D node. External prototype declarations allow authors to collect reusable prototype definitions together in a single file that can be accessed by other scenes.



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How to use the book



How to use the book, 1

Hands-on, eyes-on approach

- Learning is best accomplished by building and modifying scenes, using a text editor or an authoring tool that is X3D capable
- Modify and refresh frequently, you won't break it!
- X3D-Edit is provided free for your use
<https://savage.nps.edu/X3D-Edit>

Web authors and X3D students

- Chapter 1 section 1 only, then start with Chapter 2 and proceed in order
- Review chapter 1 periodically later, when you want



Note that url for the X3D-Edit home page starts with **https** not **http**

How to use the book, 2

Experienced 3D programmers

- Read Chapter 1 first to figure out how X3D is both similar to (and different from) the technologies which you already understand
- Skim chapters 2-6 scene graph fundamentals, then study chapters 2-9 animation, use others as needed

Experienced X3D authors

- Study Chapter 1 descriptions of XML + ClassicVRML encodings, which are functionally equivalent
- Remainder of book in any order, can use it as a ready-reference manual



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Summary



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Reading this "Getting Started" slideset prepares you to work examples in *X3D for Web Authors*

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- Goals, Motivation and Student background
- X3D-Edit Authoring Tool and Hello World example
- *X3D for Web Authors*: book organization and use
- It is important to get your system fully set up to view and edit X3D example scenes
- Can skip Chapter 1, Technical Introduction
 - Start right in working examples in Chapter 2

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Students should have an [X3D plugin](#) installed in their [Web browser](#) by now, along with [X3D-Edit](#) or another editor.

References 1

X3D: Extensible 3D Graphics for Web Authors
by Don Brutzman and Leonard Daly, Morgan
Kaufmann Publishers, April 2007, 468 pages.

- Chapter 3, Grouping Nodes
- <http://x3dGraphics.com>
- <http://x3dgraphics.com/examples/X3dForWebAuthors>

X3D Examples Help

- <http://www.web3d.org/x3d/content/examples/help.html>



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X3D Graphics Specification

- <http://www.web3d.org/x3d/specifications>
- Also available as help pages within X3D-Edit



References 3

Netbeans

- <http://www.netbeans.org>

Netbeans IDE Field Guide, second edition,
Patrick Keegan, Ludovic Champenois,
Gregory Crawley, Charlie Hunt,
Christopher Webster, Prentice Hall, 2006.



Netbeans IDE Field Guide website online at
<http://www.netbeans.org/kb/articles/NBFieldGuide.html>

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