X3D Graphics for Web Authors

Getting Started with X3D

A journey of a thousand miles
begins with a single step.
Chinese proverb

web|3D CONSORTIUM

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

X3D Examples

Software support

Software support for X3D authoring

Lots of free plugins, tools and resources provided

- X3D Resources at

http://www.web3d.org/x3d/content/examples/X3dResources.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 X3D Resources page above

X3D Examples

Numerous (thousands) of X3D examples are available online

- http://x3dgraphics.com/examples/X3dResources.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 242 models

- Textbook on how to design and build X3D scenes

Basic 637 models

- Diverse scenes illustrating various X3D capabilities

Conformance NIST 732 models

- Strictly defined test examples for correct operation

VRML 2.0 Sourcebook 269 models

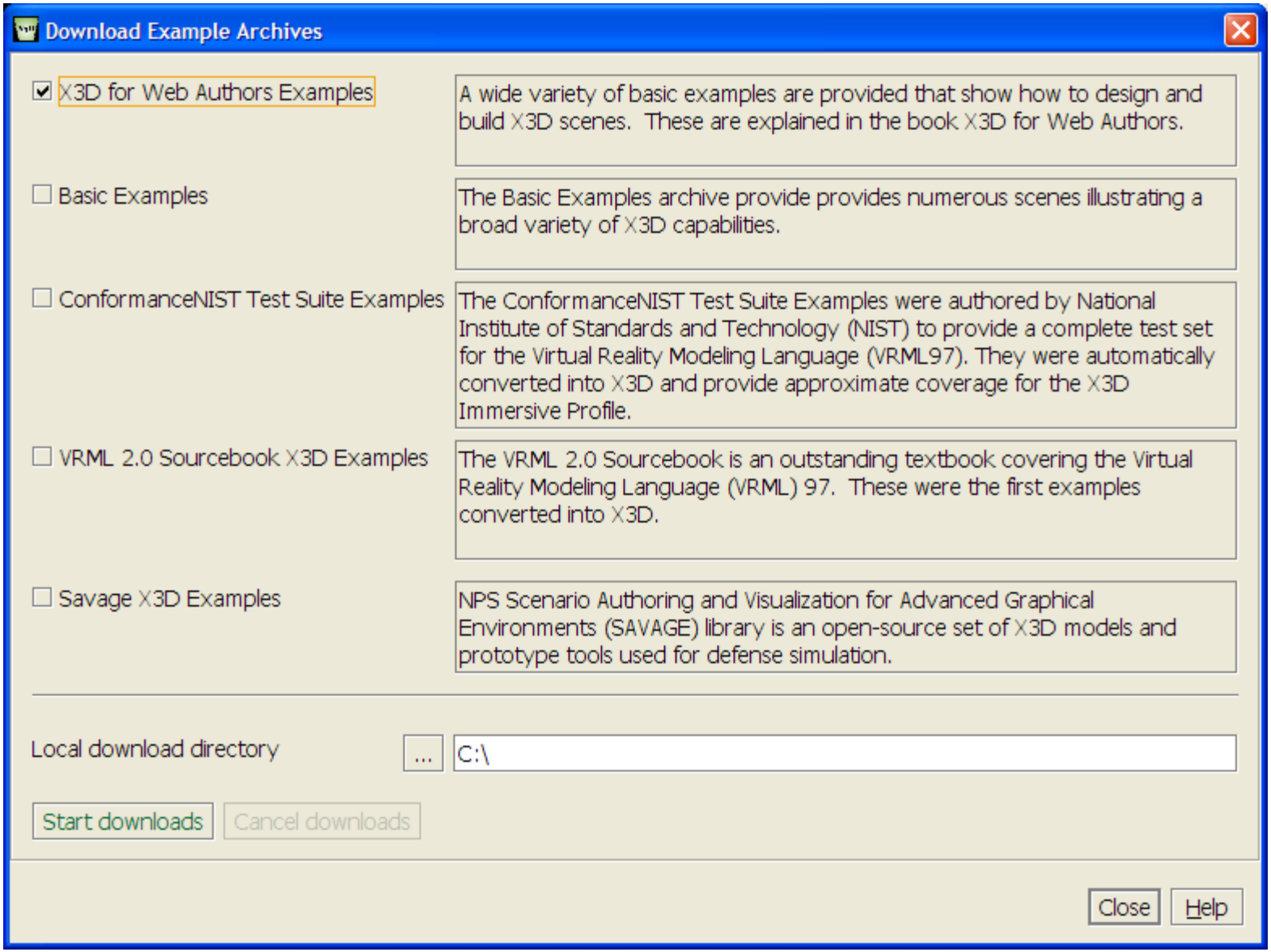
- Textbook on VRML97, examples converted to X3D

Savage 1134 models

- Open-source military models and tools

3000+ models available

X3D Examples download panel, X3D-Edit



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.

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

X3D-Edit Authoring Tool for Extensible 3D (X3D) Graphics

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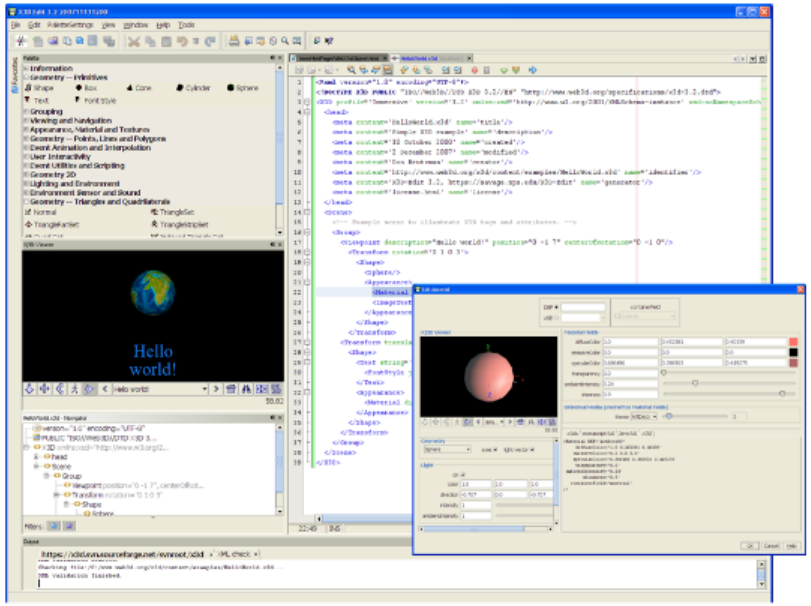
Open Standards for Real-Time 3D Communication

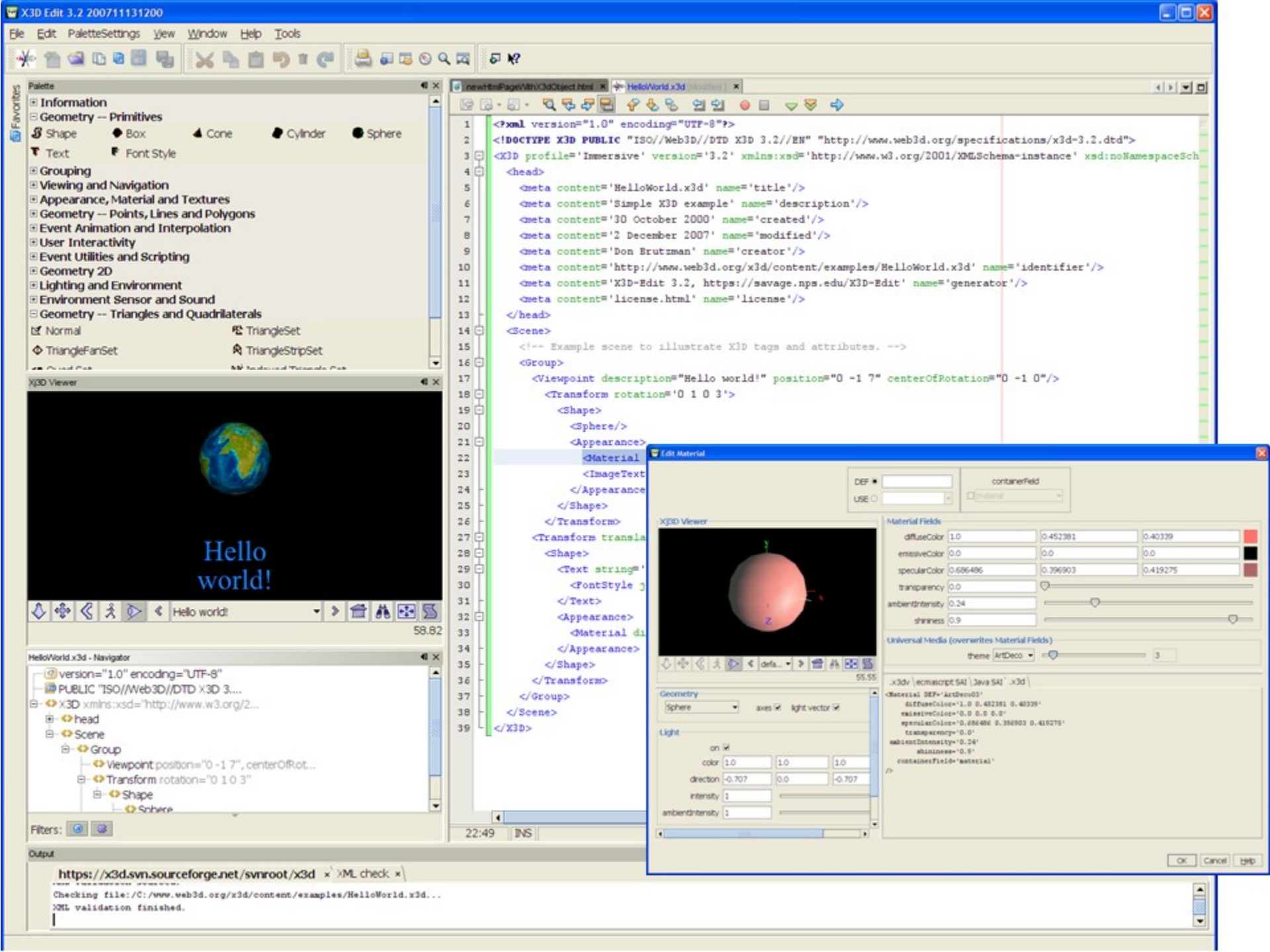
X3D-Edit is an Extensible 3D (X3D) Graphics authoring tool for simple error-free editing, authoring and validation of X3D scenes.



Overview

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 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, and additional X3D scene authoring support.


X3D Edit 3.2 200711131200
File Edit PaletteSettings View Window Help Tools
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
Hello world!
Hello world!
58.82
HelloWorld.x3d - Navigator
version="1.0" encoding="UTF-8"
PUBLIC "ISO//Web3D//DTD X3D 3....
X3D xmlns:xsd="http://www.w3.org/2...
head
Scene
Group
Viewpoint position="0 -1 7", centerOfRot...
Transform rotation="0 1 0 3"
Shape
Sphere
Filters:
newHtmlPageWithX3dObject.html
HelloWorld.x3d
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.2//EN" "http://www.web3d.org/specifications/x3d-3.2.dtd">
<X3D profile='Immersive' version='3.2' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSch
<head>
<meta content='HelloWorld.x3d' name='title'/>
<meta content='Simple X3D example' name='description'/>
<meta content='30 October 2000' name='created'/>
<meta content='2 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 description="Hello world!" position="0 -1 7" centerOfRotation="0 -1 0"/>
<Transform rotation='0 1 0 3'>
<Shape>
<Sphere/>
<Appearance>
<Material
<ImageText
</Appearance
</Shape>
</Transform>
<Transform transla
<Shape>
<Text string='
<FontStyle
</Text>
<Appearance>
<Material di
</Appearance>
</Shape>
</Transform>
</Group>
</Scene>
</X3D>
22:49 INS
Edit Material
DEF
USE
containerField
X3D Viewer
Material Fields
diffuseColor 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
OK Cancel Help
Output
https://x3d.svn.sourceforge.net/svnroot/x3d
XML check
Checking file:/C:/www.web3d.org/x3d/content/examples/HelloWorld.x3d...
XML validation finished.

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
- Successful test reports received for Linux...
- That's all there is to it!

X3D-Edit built using Netbeans

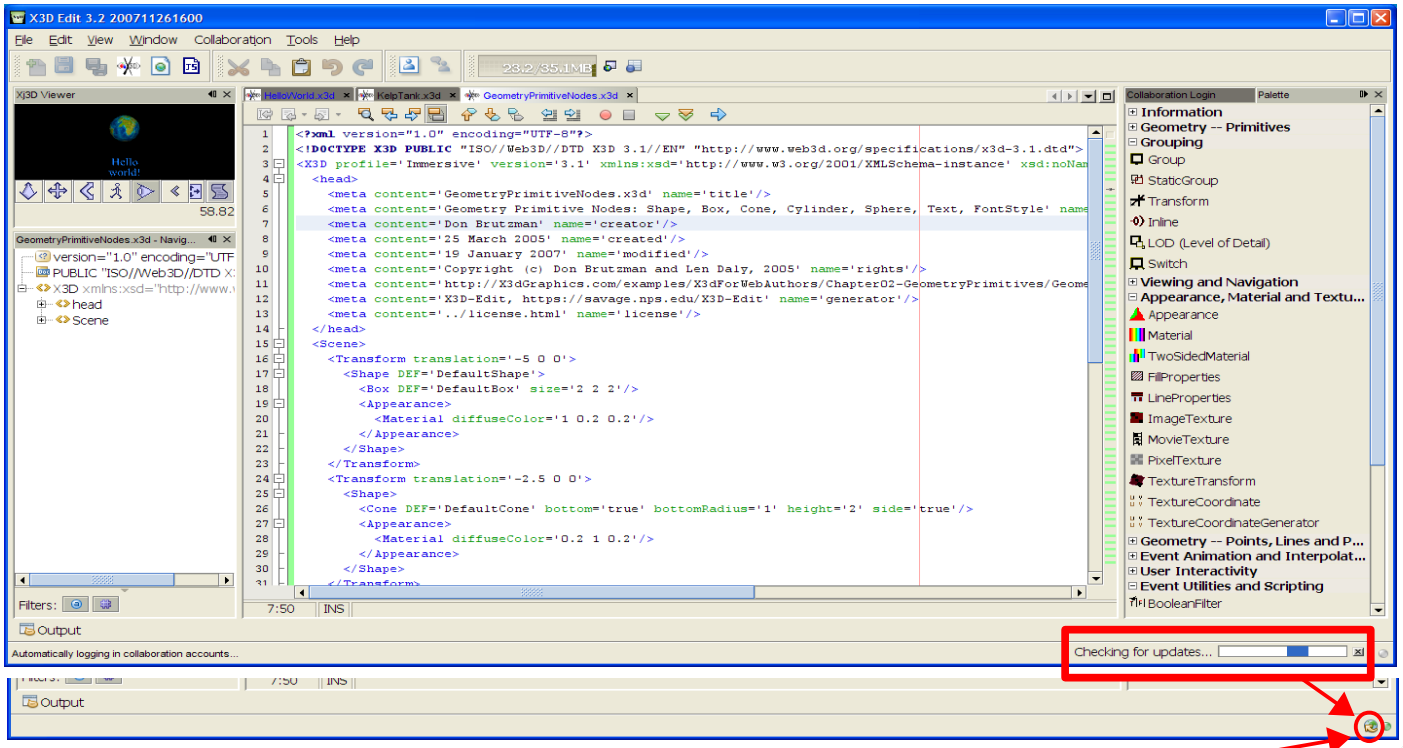
X3D-Edit 3.2 is written in Java using the Netbeans platform, and so is portable across major desktop and laptop operating systems (Windows MacOSX Linux Solaris)

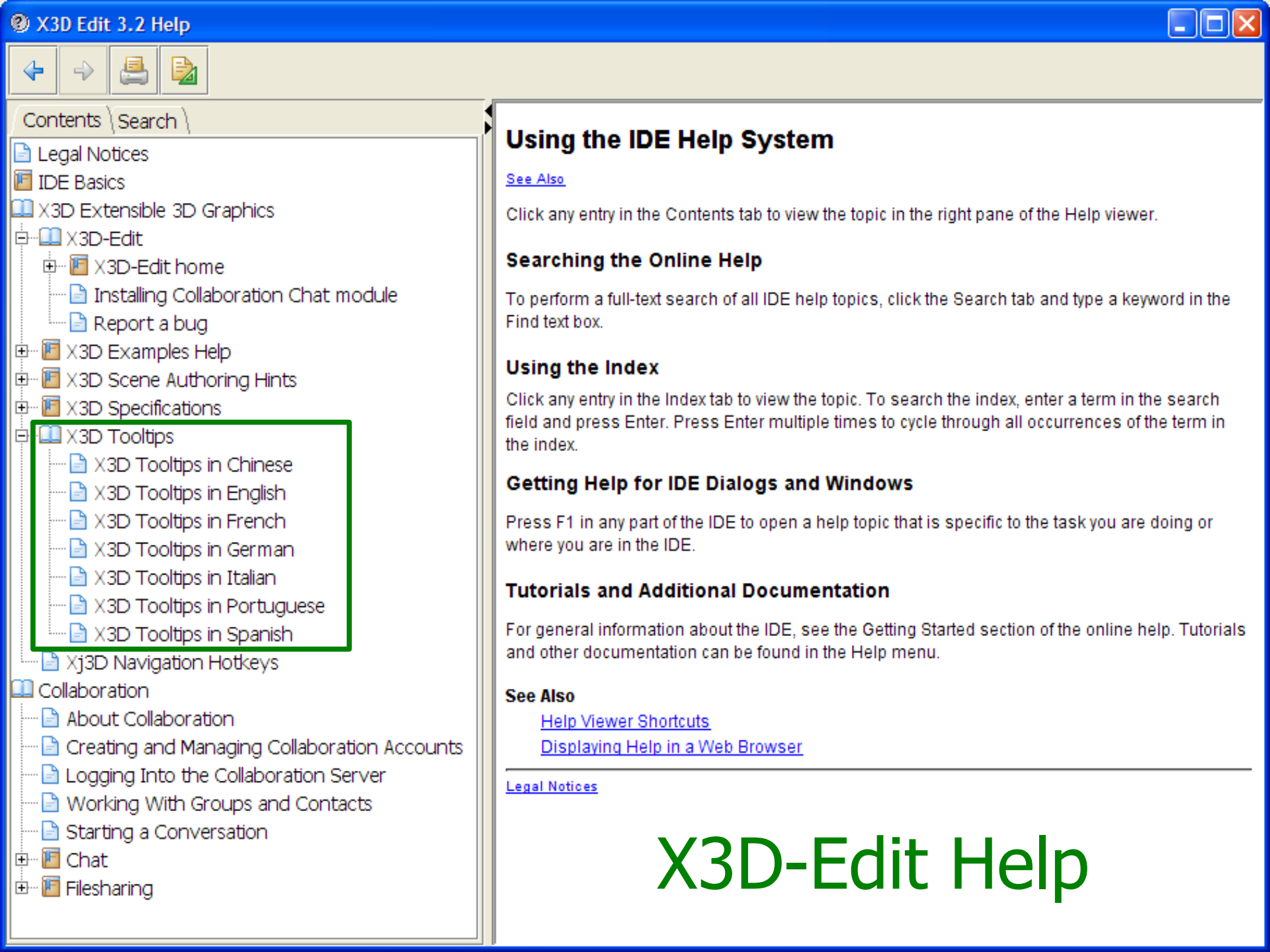
- http://www.netbeans.org

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

X3D-Edit updates

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

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Contents
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X3D-Edit
X3D-Edit home
Installing Collaboration Chat module
Report a bug
X3D Examples Help
X3D Scene Authoring Hints
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
X3D-Edit Help

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

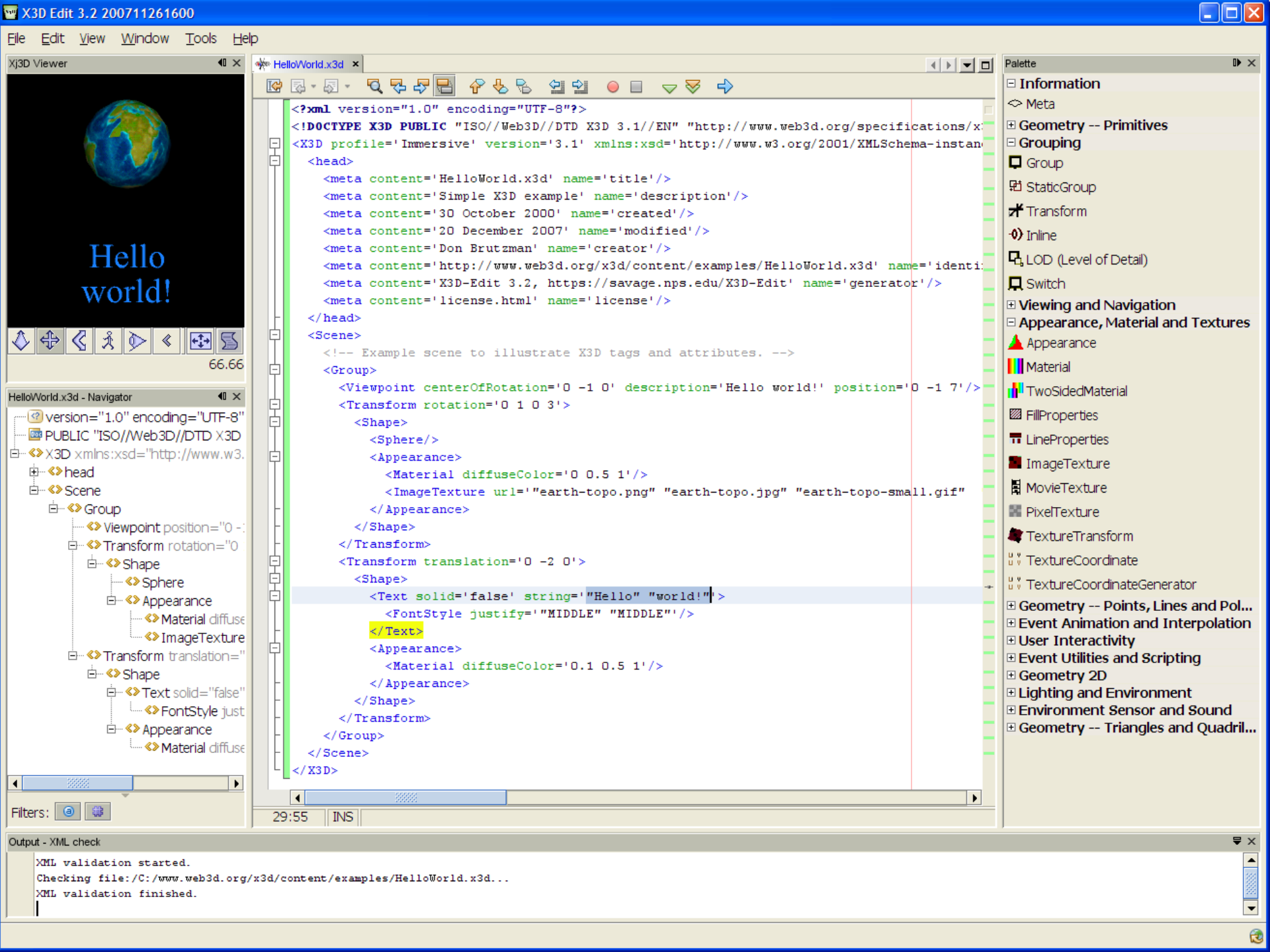
Hello World programs are simple examples of a computer language to illustrate their structure

- 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 Edit 3.2 200711261600
File Edit View Window Tools Help
Xj3D Viewer
Hello world!
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 -
Transform rotation="0
Shape
Sphere
Appearance
Material diffuse
ImageTexture
Transform translation="
Shape
Text solid="false"
FontStyle just
Appearance
Material diffuse
Filters:
HelloWorld.x3d
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instan
<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='identi
<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"'/>
</Text>
<Appearance>
<Material diffuseColor='0.1 0.5 1'/>
</Appearance>
</Shape>
</Transform>
</Group>
</Scene>
</X3D>
29:55
INS
Palette
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...
Output - XML check
XML validation started.
Checking file:/C:/www.web3d.org/x3d/content/examples/HelloWorld.x3d...
XML validation finished.

Suggested exercise

Recreate the HelloWorld.x3d scene with X3D-Edit

- Create a new X3D scene, Save As using a new filename of your choosing
- Iconize the <head> element by clicking margin '+'
- Drag and drop nodes to build the scene
- Edit by typing, and by using node editors
- Make sure you maintain valid XML as you go
- Save, view, repeat as necessary

This matches how we build many X3D scenes

X3D for Web Authors, Chapter 01 - Technical Overview: Hello World

Simple X3D example

launch: X3D | X3DV | X3DB
links: VRML97 | XHTML | C14N

```
<?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='10 July 2006'/>
    <meta name='creator' content='Don Brutzman'/>
    <meta name='identifier' content=' http://www.web3d.org/x3d/content/examples/Basic/HelloWorld.x3d '/>
    <meta name='generator' content='X3D-Edit, https://savage.nps.edu/X3D-Edit'/>
    <meta name='license' content='license.html'/>
  </head>
  <!--
```

Index for Viewpoint image: Viewpoint 1

```
  -->
  <Scene>
    <!-- Example scene to illustrate X3D tags and attributes. -->
    <Group>
      <Viewpoint description='hello, world!' position='0 -1 7'/>
      <Transform>
        <Transform rotation='0 1 0 3'>
          <Shape>
            <Sphere/>
            <Appearance>
              <ImageTexture
               url=' "earth-topo.png" "earth-topo-small.gif" "/www.web3d.org/x3d/content/examples/earth-topo.png" "/www.web3d.org/x3d/content/examples/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" '/>
            </Appearance>
          </Shape>
        </Transform>
      </Transform>
      <Transform translation='0 -2 0'>
        <Shape>
          <Text string='"Hello" "world!"' solid='true'>
            <FontStyle justify='"MIDDLE" "MIDDLE"'/>
          </Text>
          <Appearance>
            <Material diffuseColor='0.1 0.5 1'/>
          </Appearance>
```

HelloWorld.x3d (X3dToXhtml) - Mozilla Firefox

File Edit View History Bookmarks Tools GUtil! Help

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

X3D for Web Authors, Chapte... | XML in 10 points | Help: X3D Examples | HelloWorld.x3d (X3dToXh...

```
<?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" '/>
                    </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>
```

Done 0.406s 67.15.54.3 205.155.65.236 0:889 Now: Clear, 42° F Tue: 65° F Wed: 61° F

Other features

Viewing alternatives for X3D

Default built-in viewer is open-source Xj3D

- High performance, implemented using Java OpenGL

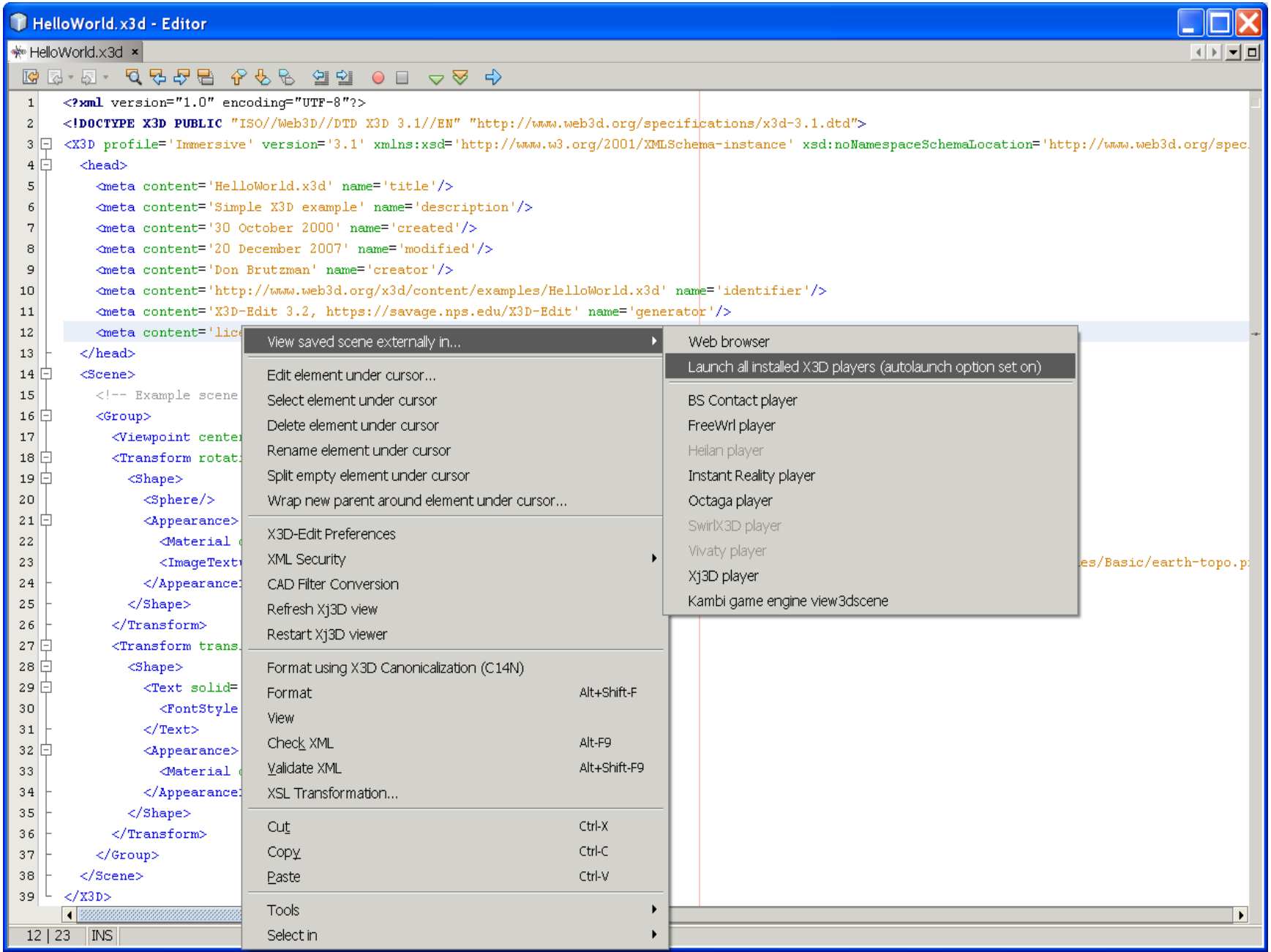
Can launch current scene into web browser

- Displays using any of your installed plugins
- "Launch all viewers" simplifies comparison testing

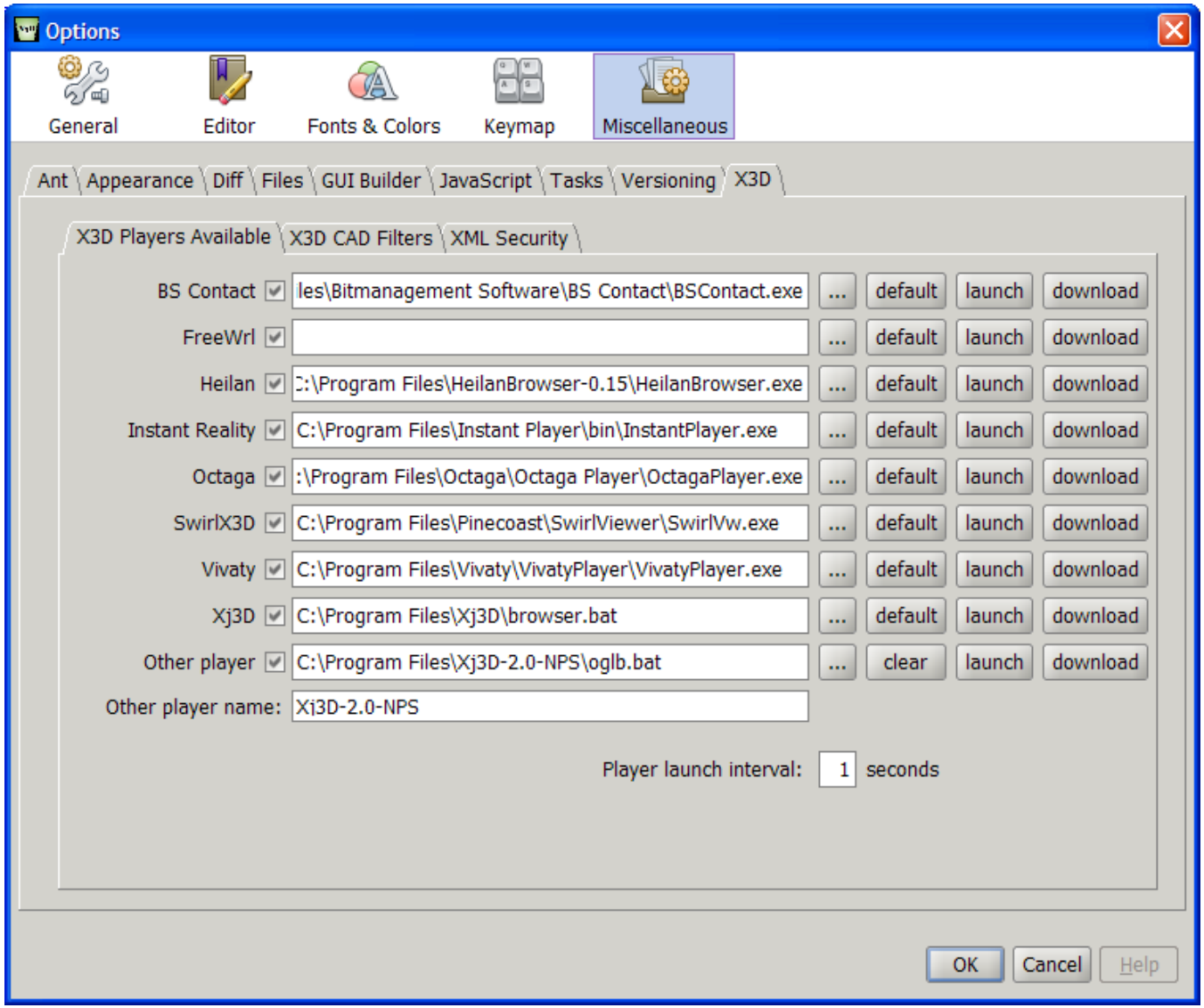
Can also launch into standalone applications

- Configuration panel simplifies download, install

Right-click to launch external viewer



Download, configure viewers:
Tools, Options, Miscellaneous, X3D, Players



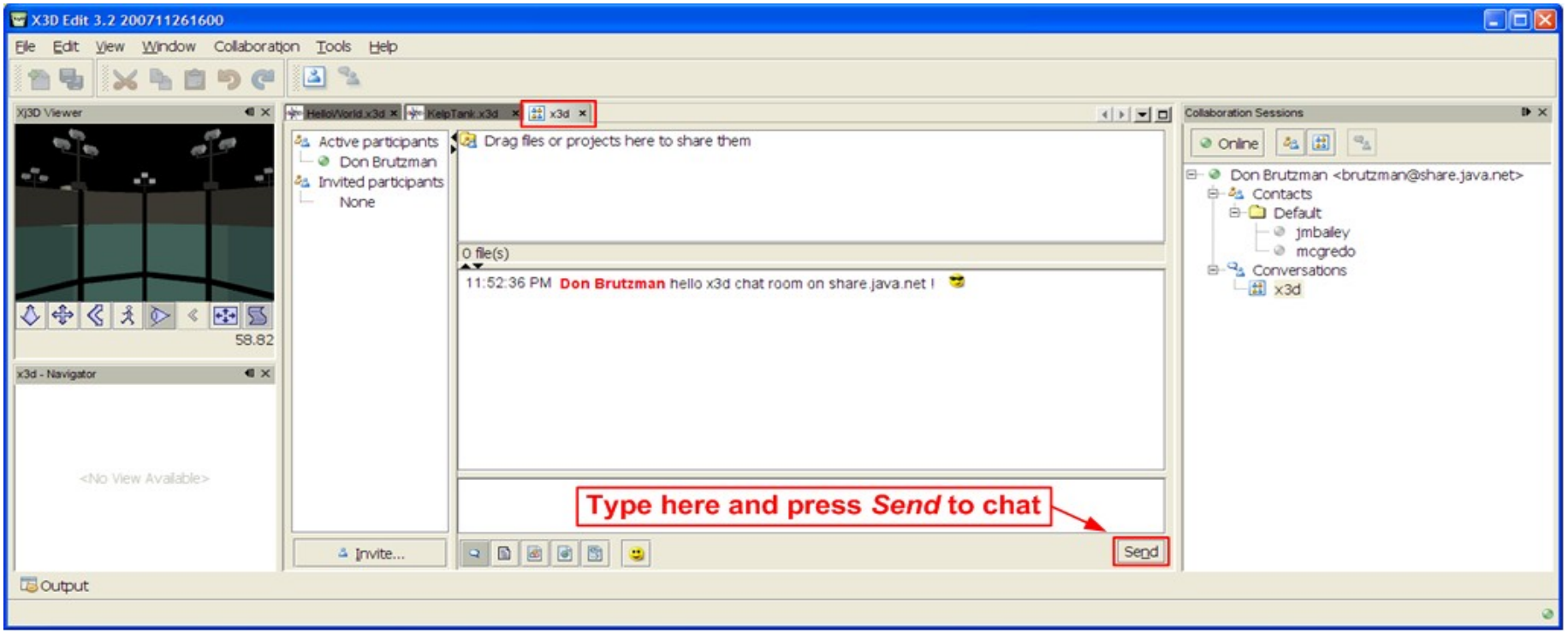
X3D-Edit collaboration chat 1

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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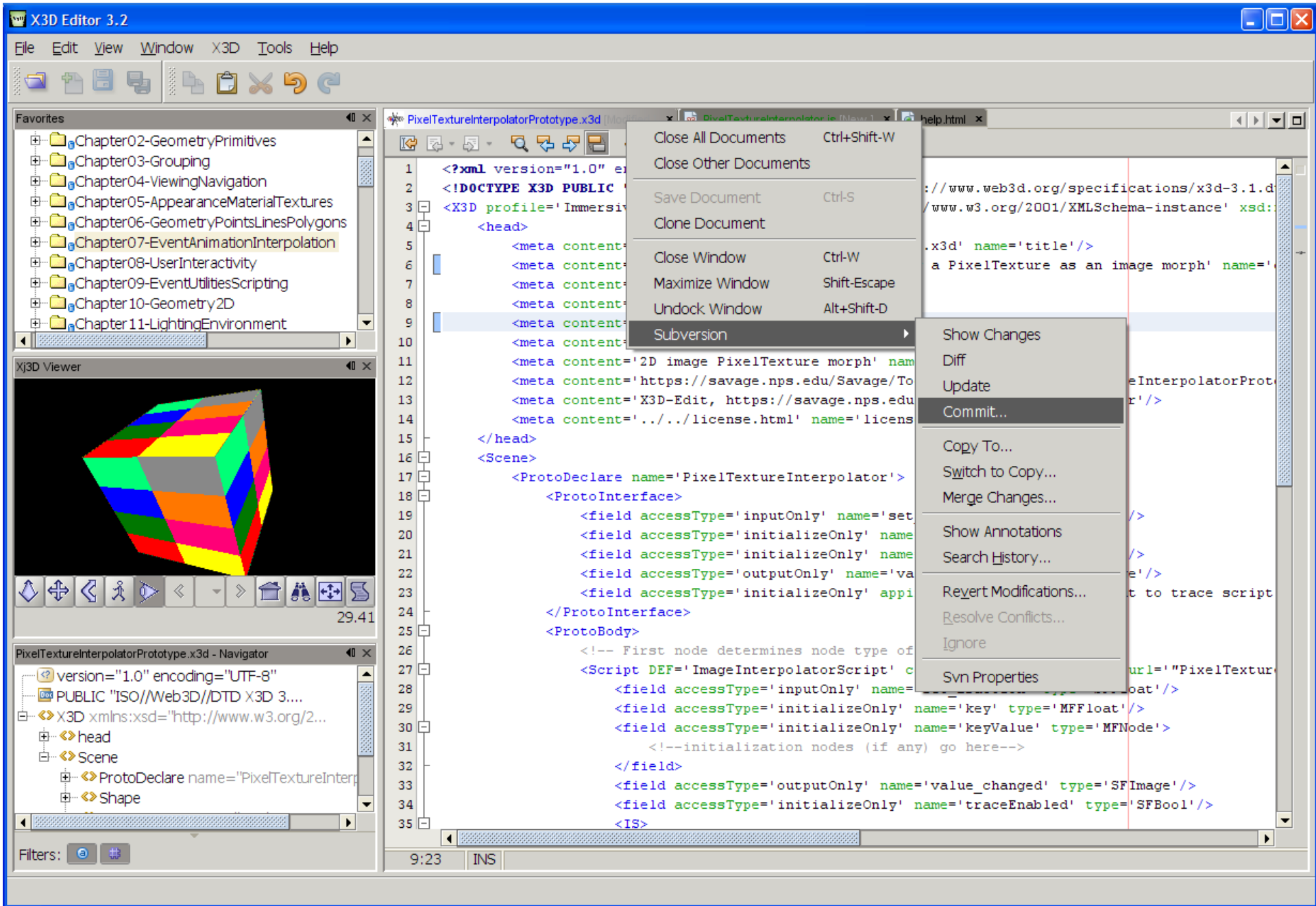
Version control support included

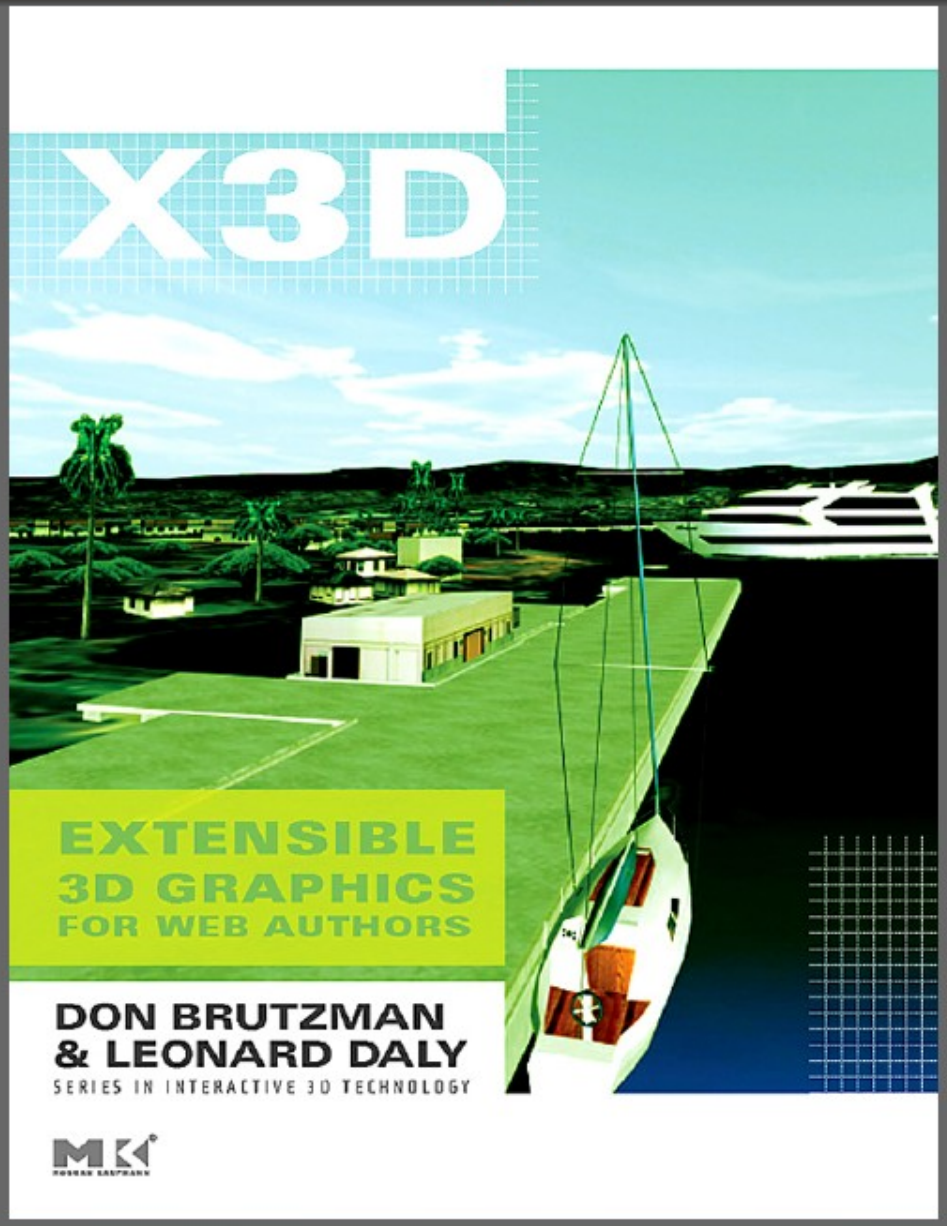


X3D for Web Authors

http://x3dGraphics.com

Bookmarks

Options



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

Summary

Summary

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

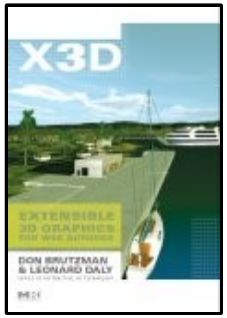
Topics include

- 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.



- http://x3dGraphics.com
- http://x3dgraphics.com/examples/X3dForWebAuthors

X3D Resources

- http://www.web3d.org/x3d/content/examples/X3dResources.html

References 2

X3D-Edit Authoring Tool

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

X3D Scene Authoring Hints

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

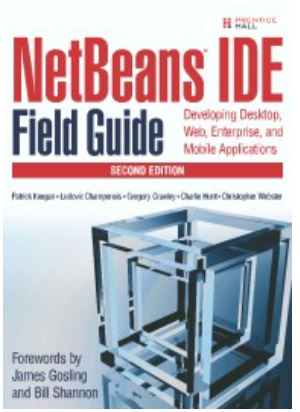
X3D Graphics Specification

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

References 3

Netbeans

- http://www.netbeans.org
- http://plugins.netbeans.org/PluginPortal

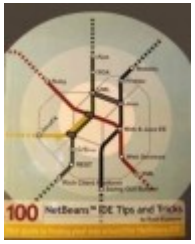


Netbeans IDE Field Guide, second edition, Patrick Keegan, Ludovic Champenois, Gregory Crawley, Charlie Hunt, Christopher Webster, Prentice Hall, 2006.

- http://www.netbeans.org/kb/articles/NBFieldGuide.html

References 4

Netbeans Tips and Tricks, Ruth Kusterer, Prentice Hall, November 2008.



- "Your Guide to Finding Your Way Around the NetBeans IDE"
- http://www.netbeans.org/kb/articles/netbeans-tips-and-tricks-book.html

Contact

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Monterey California 93943-5000 USA
1.831.656.2149 voice
1.831.656.7599 fax

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CGEMS, SIGGRAPH, Eurographics

The Computer Graphics Educational Materials Source(CGEMS) site is designed for educators

- to provide a source of refereed high-quality content
- as a service to the Computer Graphics community
- freely available, directly prepared for classroom use
- http://cgems.inesc.pt

X3D for Web Authors recognized by CGEMS! ☺

- Book materials: X3D-Edit tool, examples, slidesets
- Received jury award for Best Submission 2008

CGEMS supported by SIGGRAPH, Eurographics

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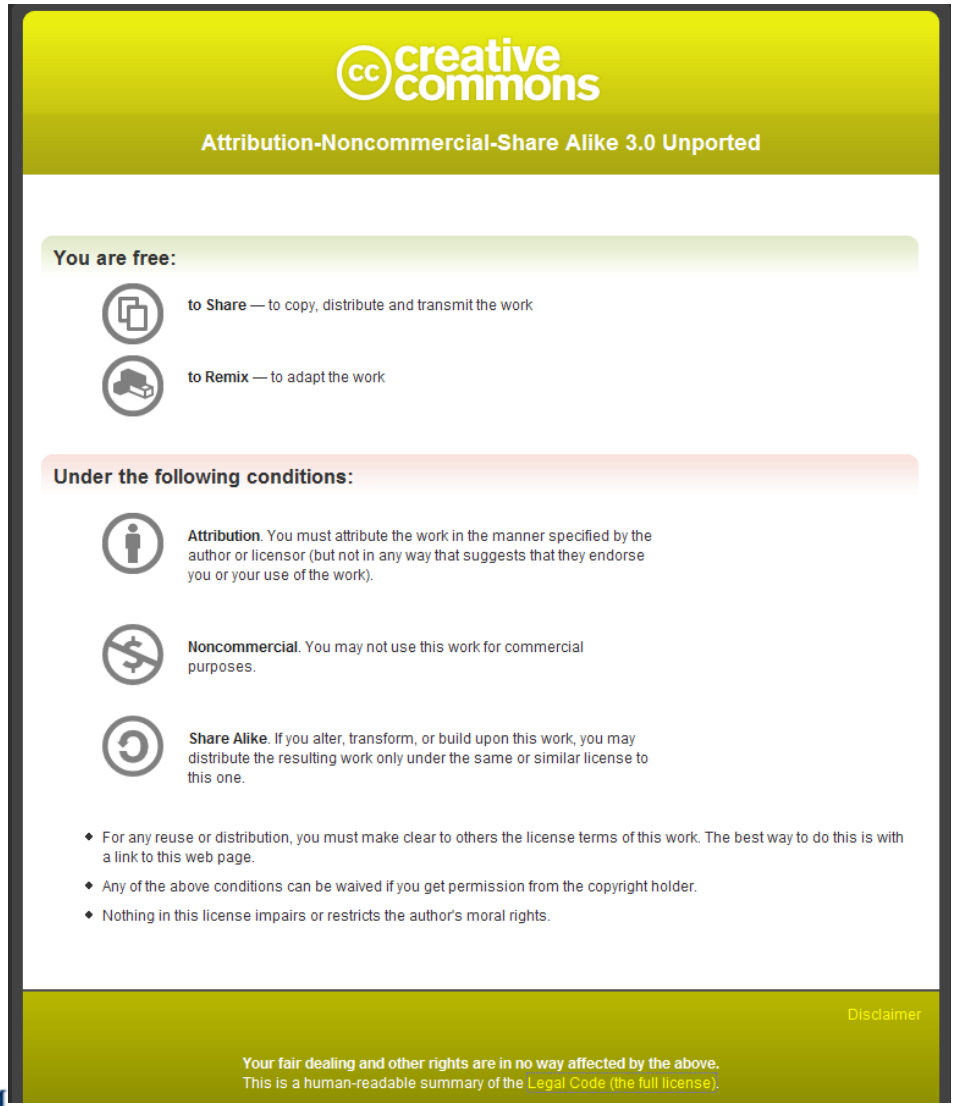

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Open-source license
for X3D-Edit software and X3D example scenes

http://www.web3d.org/x3d/content/examples/license.html

X3D Graphics for Web Authors

Getting Started with X3D

A journey of a thousand miles
begins with a single step.
Chinese proverb

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1

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

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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

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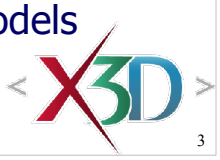

3

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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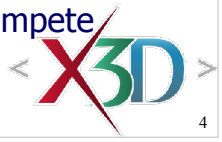

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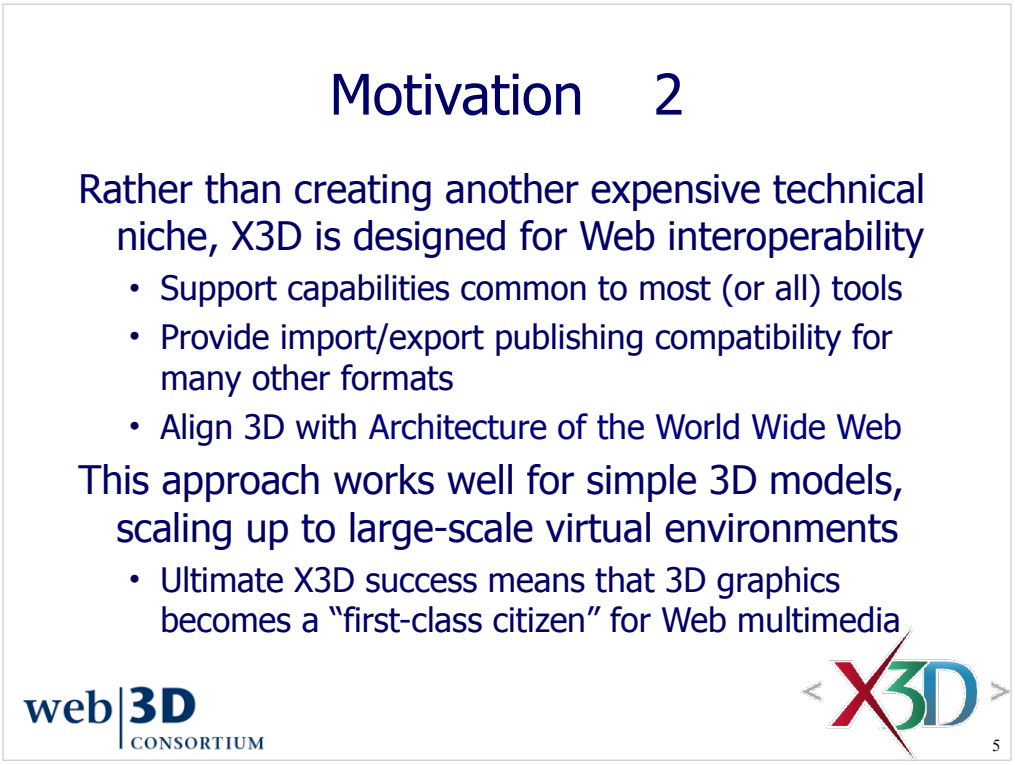
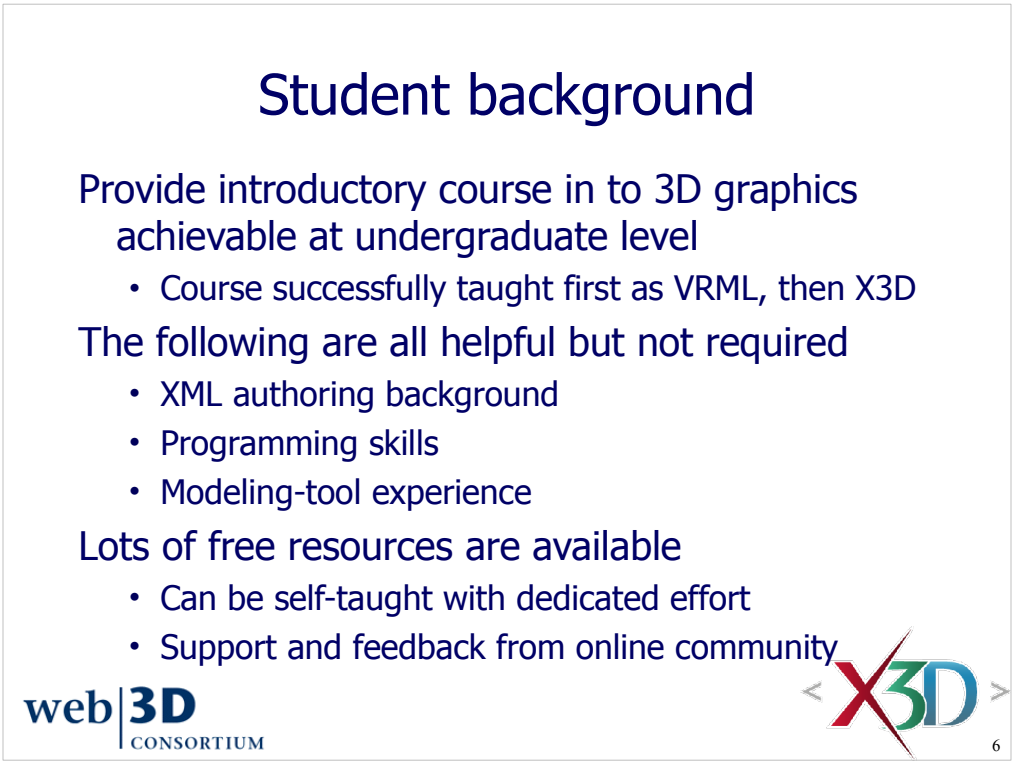
Association for Computing Machinery (ACM) at http://www.acm.org
is the parent organization of the
Special Interest Group on Graphics (SIGGRAPH) http://www.siggraph.org



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



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

X3D Examples

Software support

back to Table of Contents

Software support for X3D authoring

Lots of free plugins, tools and resources provided
- X3D Resources at

http://www.web3d.org/x3d/content/examples/X3dResources.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 X3D Resources page above

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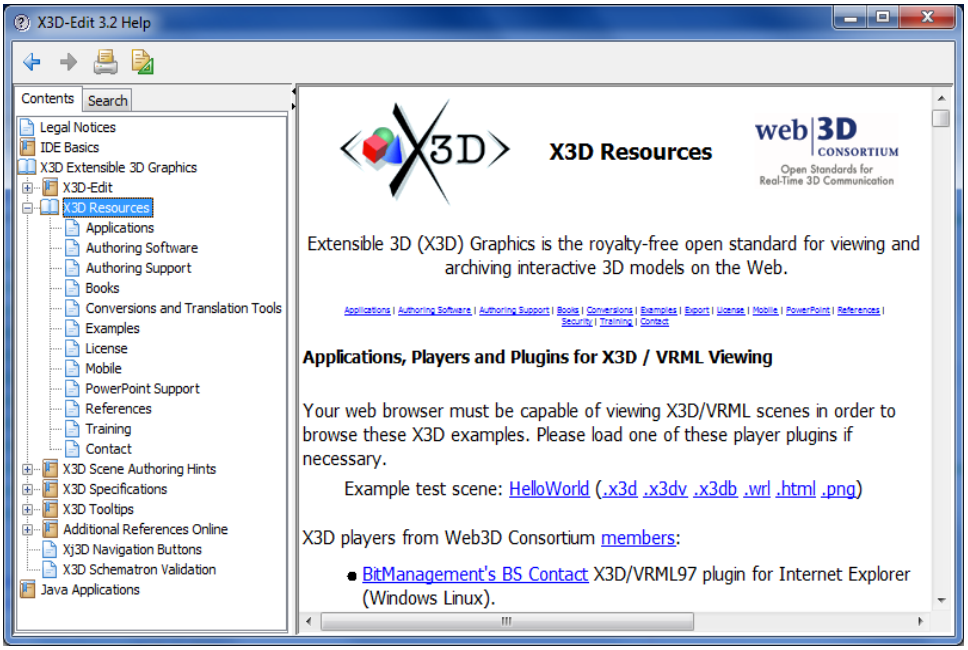
There are several ways to get to the X3D Resources page

- Online
- An earlier version of the X3D Resources (formerly called X3D Help page) is also provided as Appendix B in X3D for Web Authors book
- Also bundled with each of the X3D Examples archives
- Sakai course website for enrolled NPS students
- Bundled with X3D-Edit help system:



... go!

X3D Examples

Numerous (thousands) of X3D examples are available online

- http://x3dgraphics.com/examples/X3dResources.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

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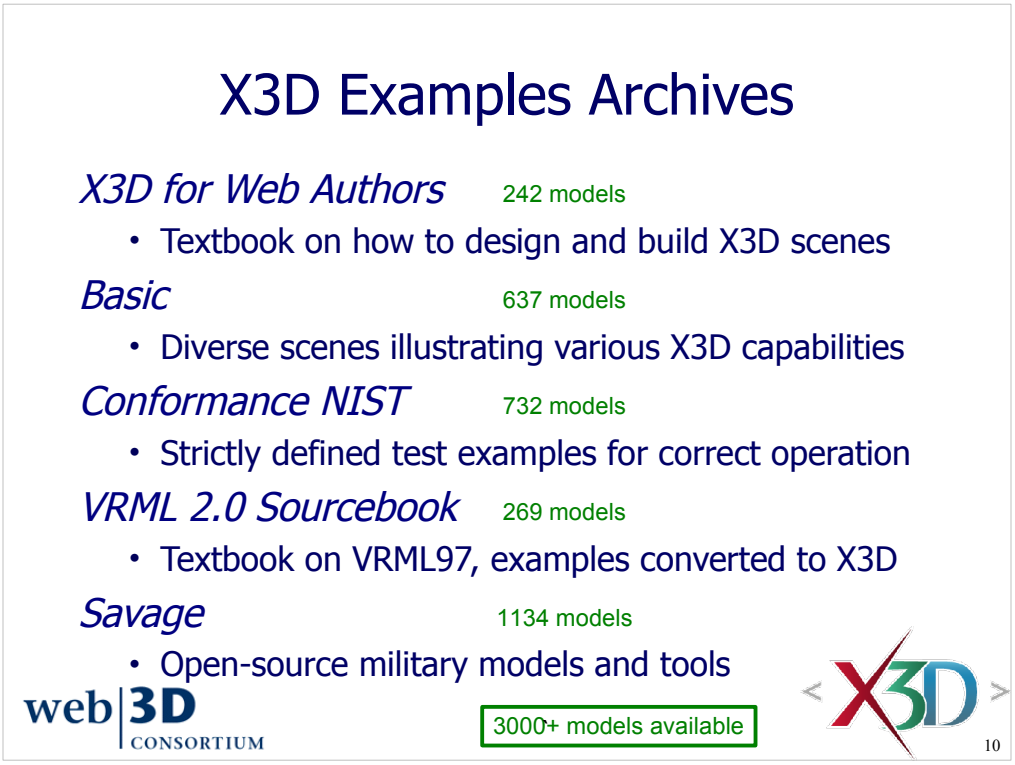
... go!



Model archives, .zip distributions and version control inspection are available at

- http://x3dgraphics.com/examples/X3dResources.html#Examples

NPS students from USA and other government agencies can also use the restricted-access SavageDefense archive.

- NPS SavageDefense library is an open-source set of models used for defense simulation. Access is restricted to NPS partners working on government-sponsored projects. Bug reports are tracked privately.
- Online at https://savagedefense.nps.navy.mil/SavageDefense
- Compressed archive (~450 MB) at X3dExamplesSavageDefense.zip
- Subversion master source is retrievable via subversion check out:

```
svn co https://savagedefense.nps.navy.mil/svn/nps/SavageDefense SavageDefense
```

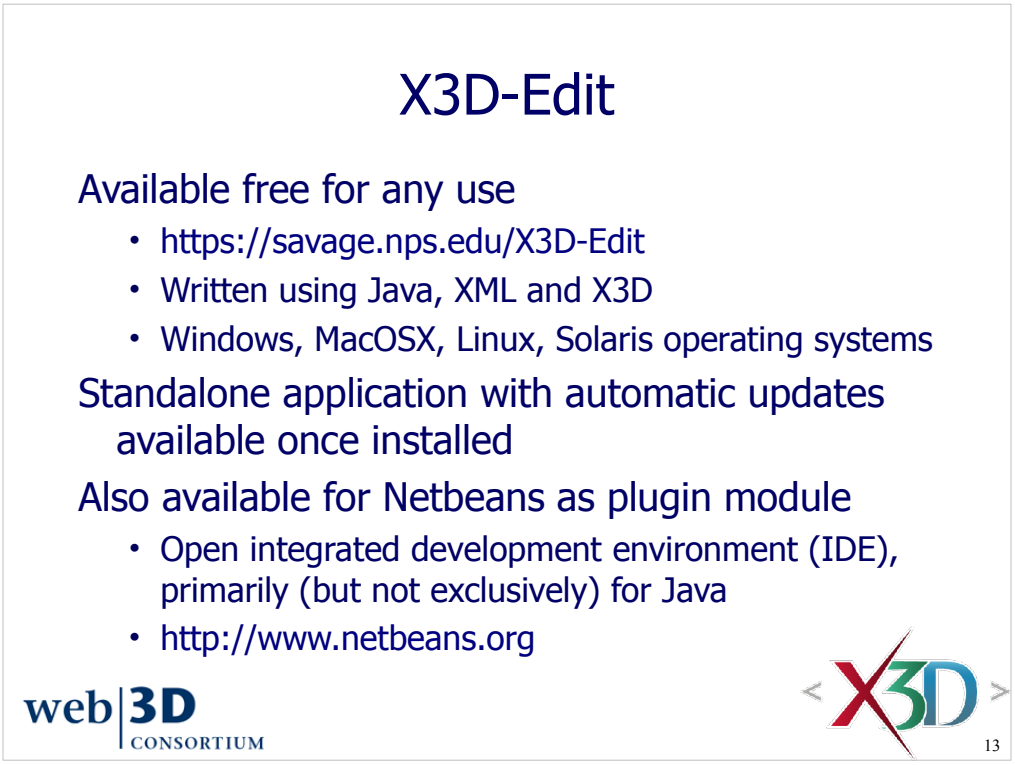
X3D Examples download panel, X3D-Edit

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

All .zip distributions remain available at

- http://x3dgraphics.com/examples/X3dResources.html#Examples

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



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

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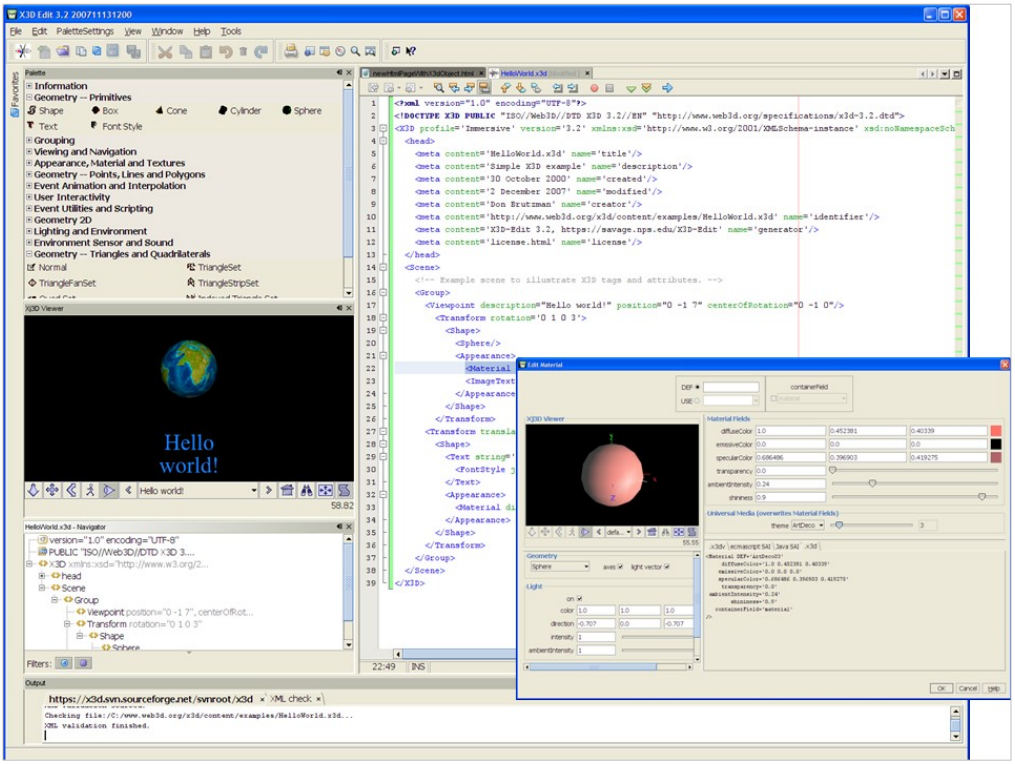
X3D-Edit home page is online at https://savage.nps.edu/X3D-Edit



As the name implies, X3D-Edit is primarily oriented towards editing X3D text. Additional features include:

- Pop-up 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
- Successful test reports received for Linux...
- That's all there is to it!

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Further customization for Linux is welcome, expert help is invited

Work in progress: Java WebStart version

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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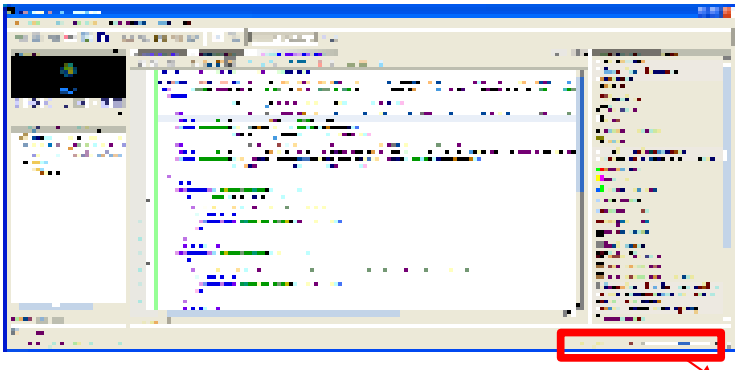
X3D-Edit updates

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



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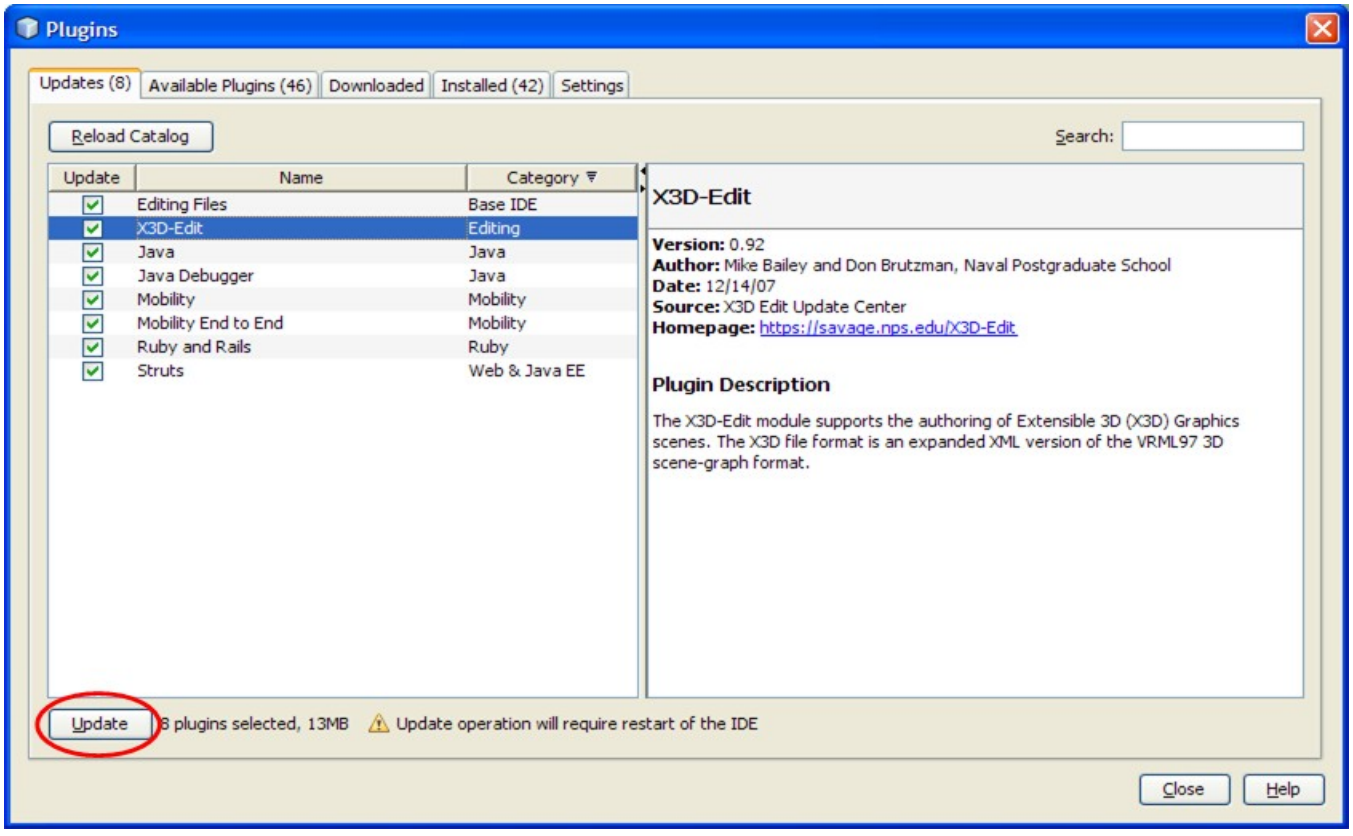
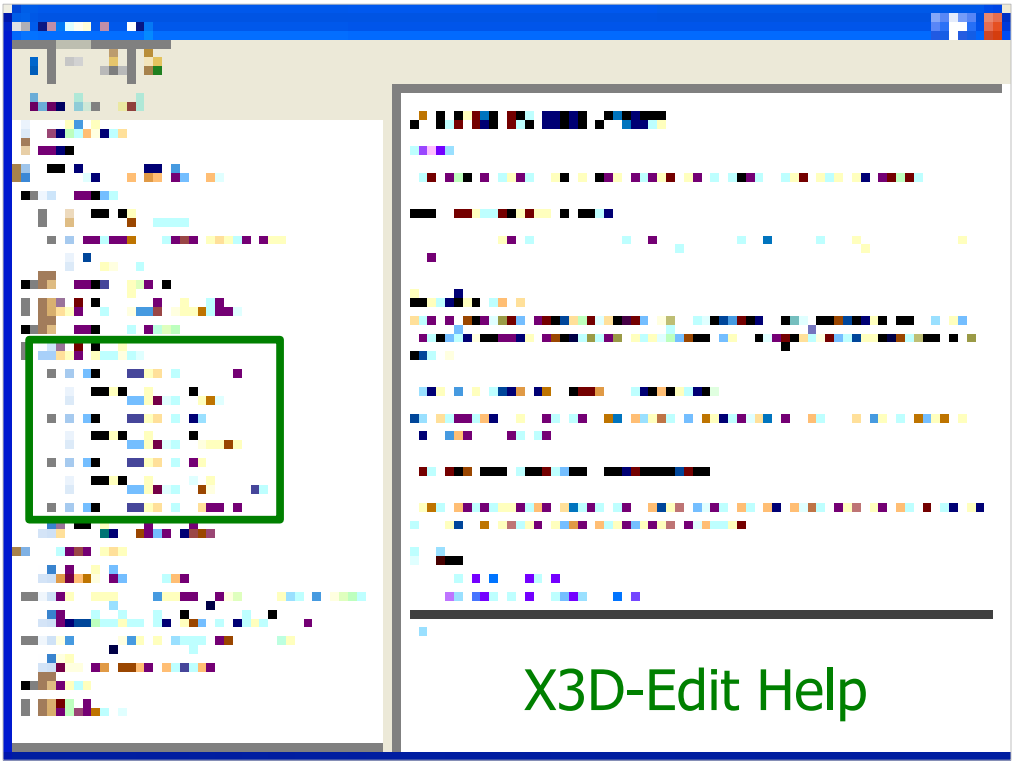
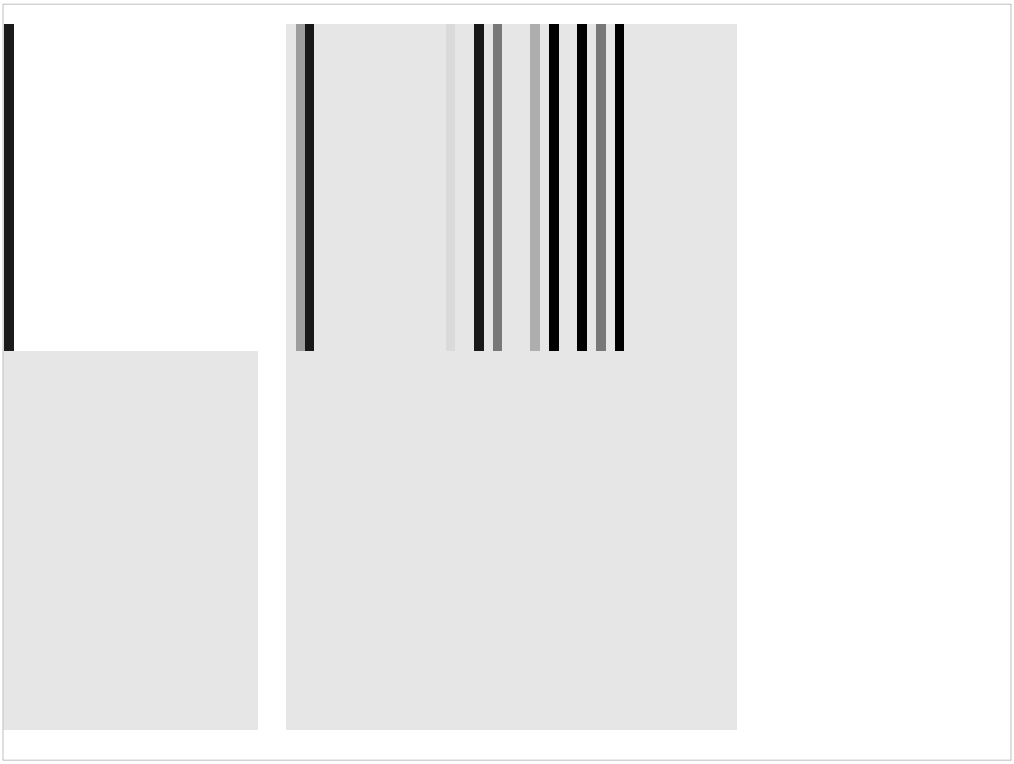
It is also possible to manually trigger an X3D-Edit update, if one is available.

From top menu, select *Tools* > *Plugins* > *Updates* and then click the Update button.





F1 or the Help menu launches the JavaHelp system.



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

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

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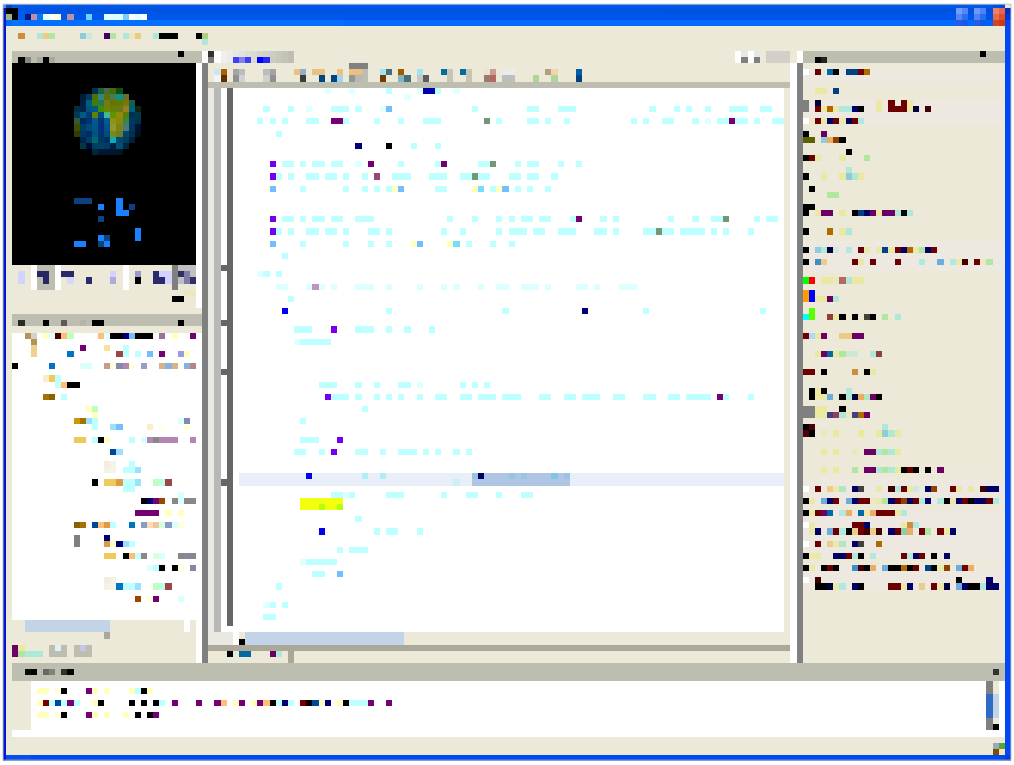
http://x3dgraphics.com/examples/HelloWorld.x3d

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



Suggested exercise

Recreate the HelloWorld.x3d scene with X3D-Edit

- Create a new X3D scene, Save As using a new filename of your choosing
- Iconize the <head> element by clicking margin '+'
- Drag and drop nodes to build the scene
- Edit by typing, and by using node editors
- Make sure you maintain valid XML as you go
- Save, view, repeat as necessary

This matches how we build many X3D scenes

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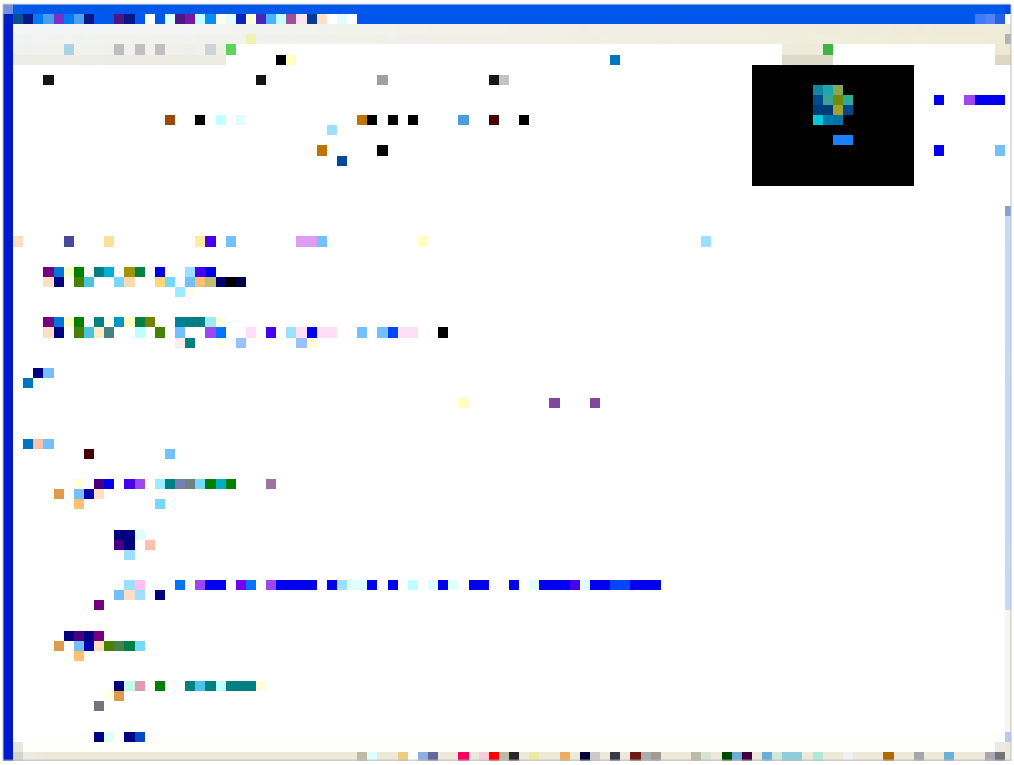

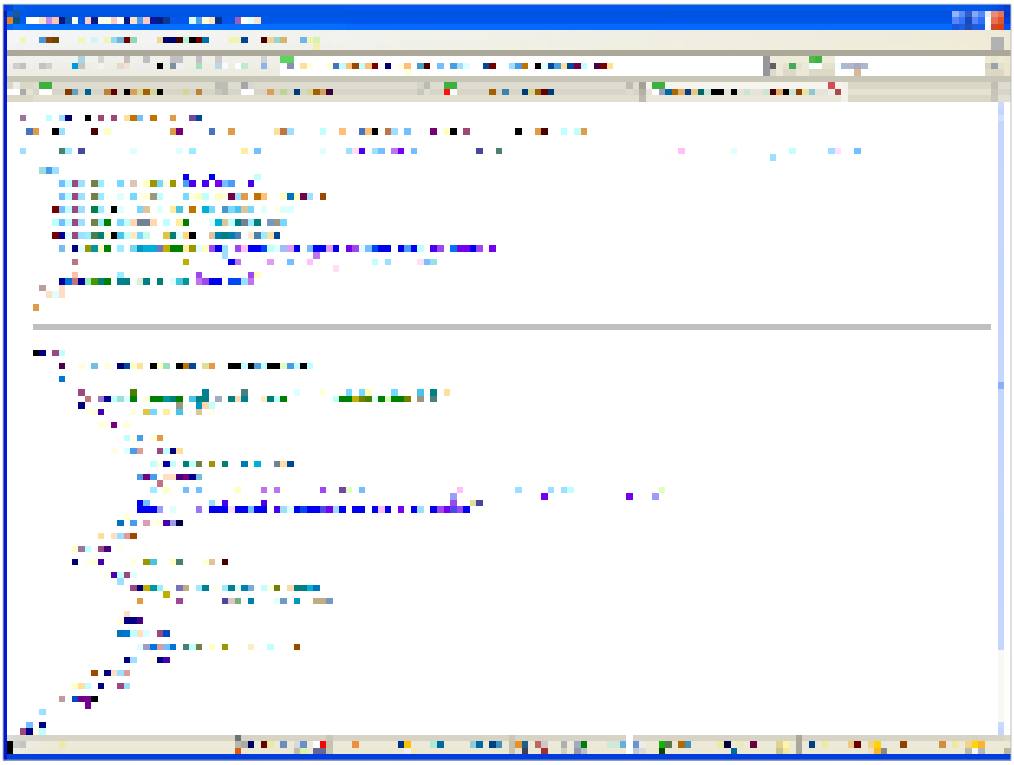

Pretty-printed HTML output using X3dToXhtml.xslt stylesheet

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

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Other features

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Viewing alternatives for X3D

Default built-in viewer is open-source Xj3D

- High performance, implemented using Java OpenGL

Can launch current scene into web browser

- Displays using any of your installed plugins
- "Launch all viewers" simplifies comparison testing

Can also launch into standalone applications

- Configuration panel simplifies download, install

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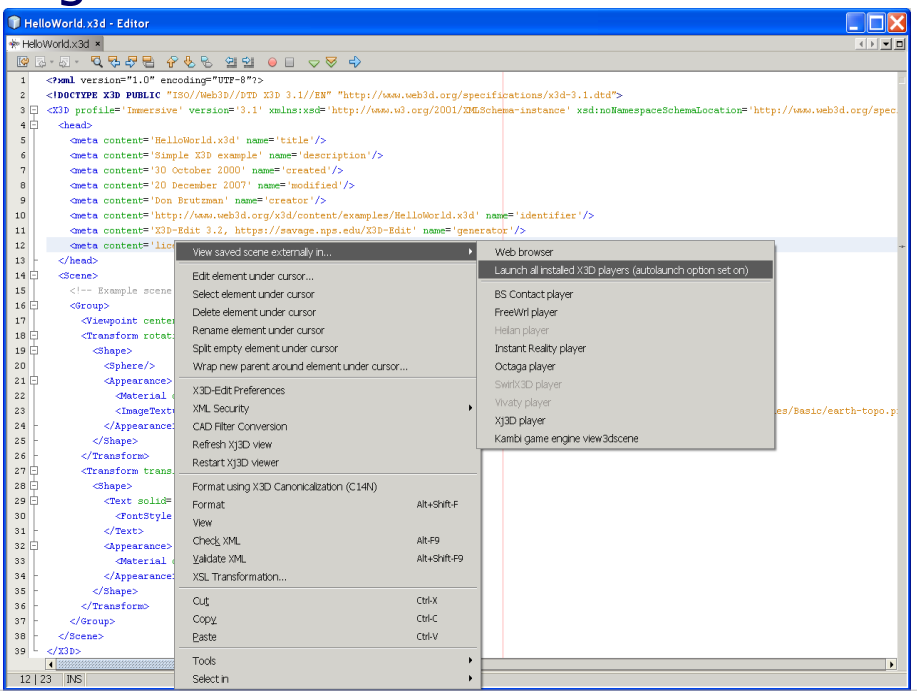
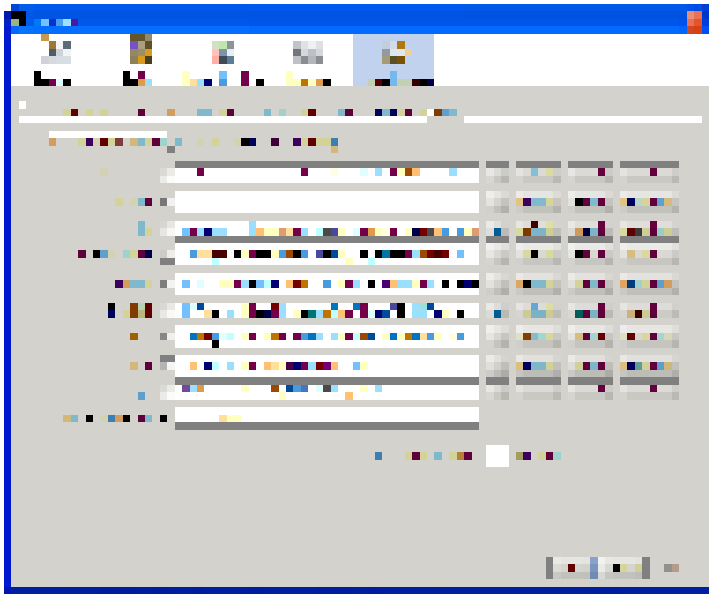
http://www.xj3d.org

http://www.web3d.org/x3d/content/examples/X3dResources.html#Applications

Right-click to launch external viewer



Download, configure viewers:
Tools, Options, Miscellaneous, X3D, Players



X3D-Edit menu selections: *Tools, Options, Miscellaneous, X3D, Players*

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

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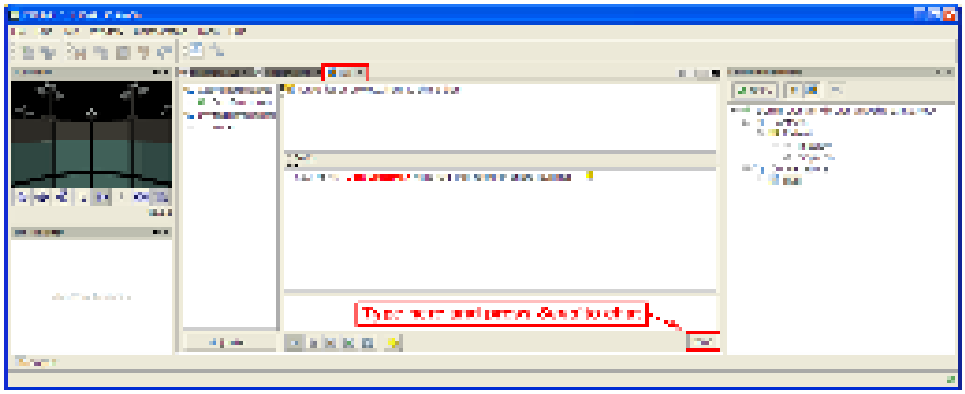
X3D-Edit collaboration chat 2



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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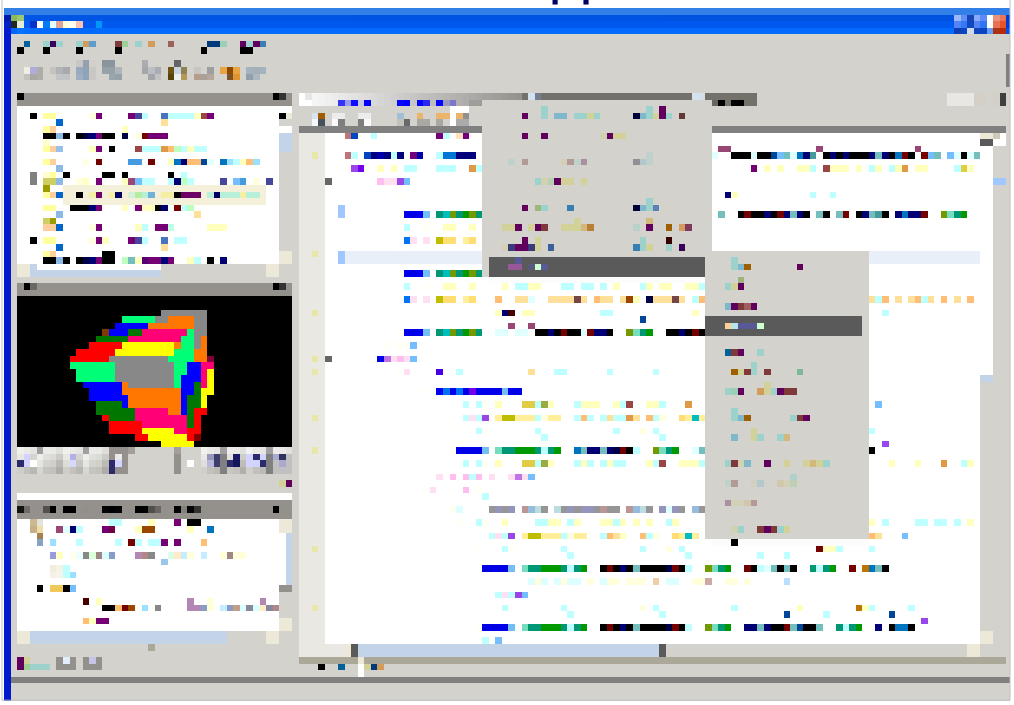
Version control support included

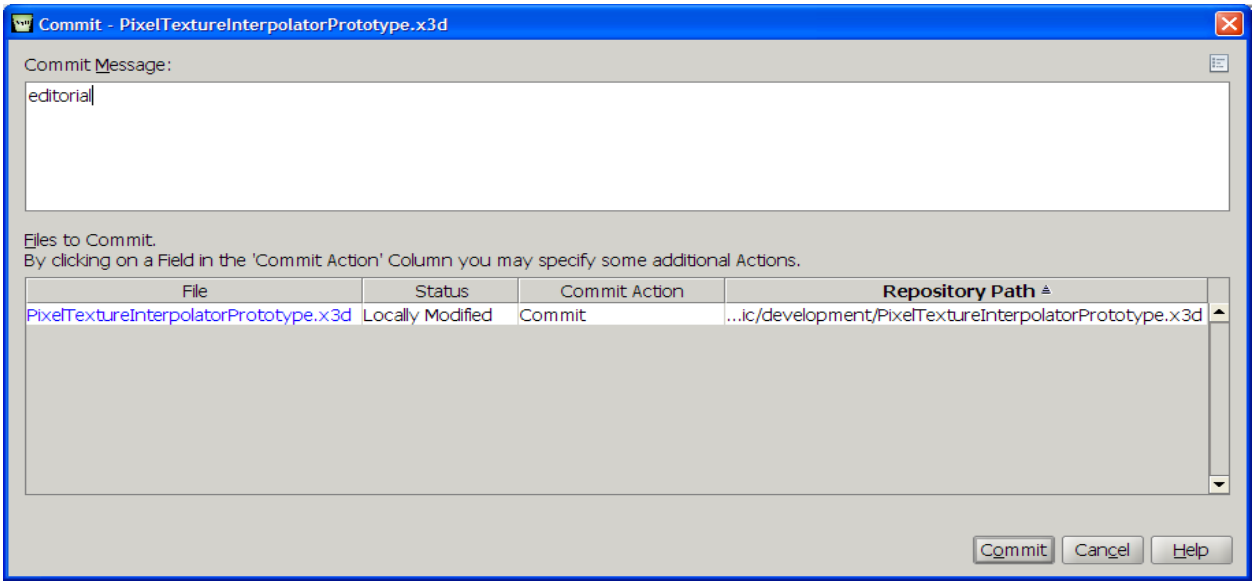


Version control allows multiple authors to share updates and work together.
Prerequisite: you must have the Collabnet subversion client installed.

If the file being edited is under version control, the Netbeans platform detects that and offers Subversion or CVS version control (as appropriate) without further setup.

Developers can work with X3D-Edit directly to update, diff (difference compare) and commit any file changes. X3D-Edit 3.2 subversion master source is at

http://x3d.svn.sourceforge.net/viewvc/x3d/www.web3d.org/x3d/tools/X3dEdit3.2



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X3D for Web Authors

http://x3dGraphics.com

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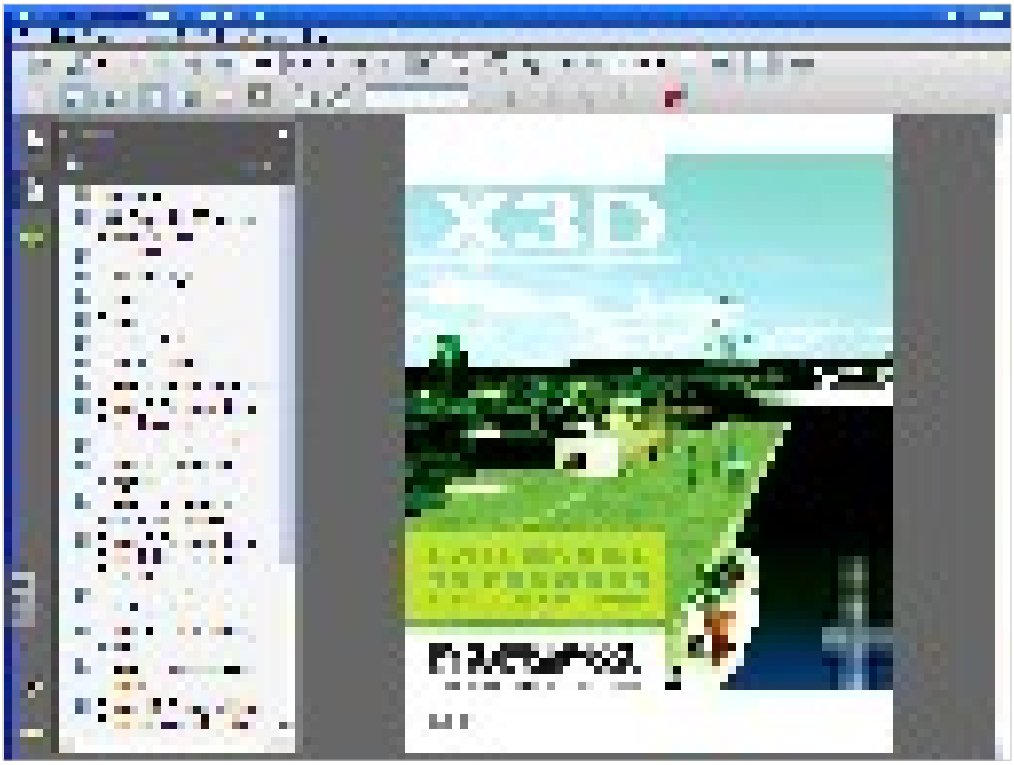
X3D

Book organization

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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

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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.

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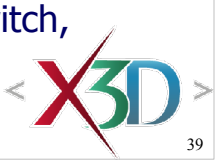

Chapter descriptions

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.

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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.

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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.

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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.

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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.

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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

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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

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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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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

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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.

- http://x3dGraphics.com
- http://x3dgraphics.com/examples/X3dForWebAuthors

X3D Resources

- http://www.web3d.org/x3d/content/examples/X3dResources.html

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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

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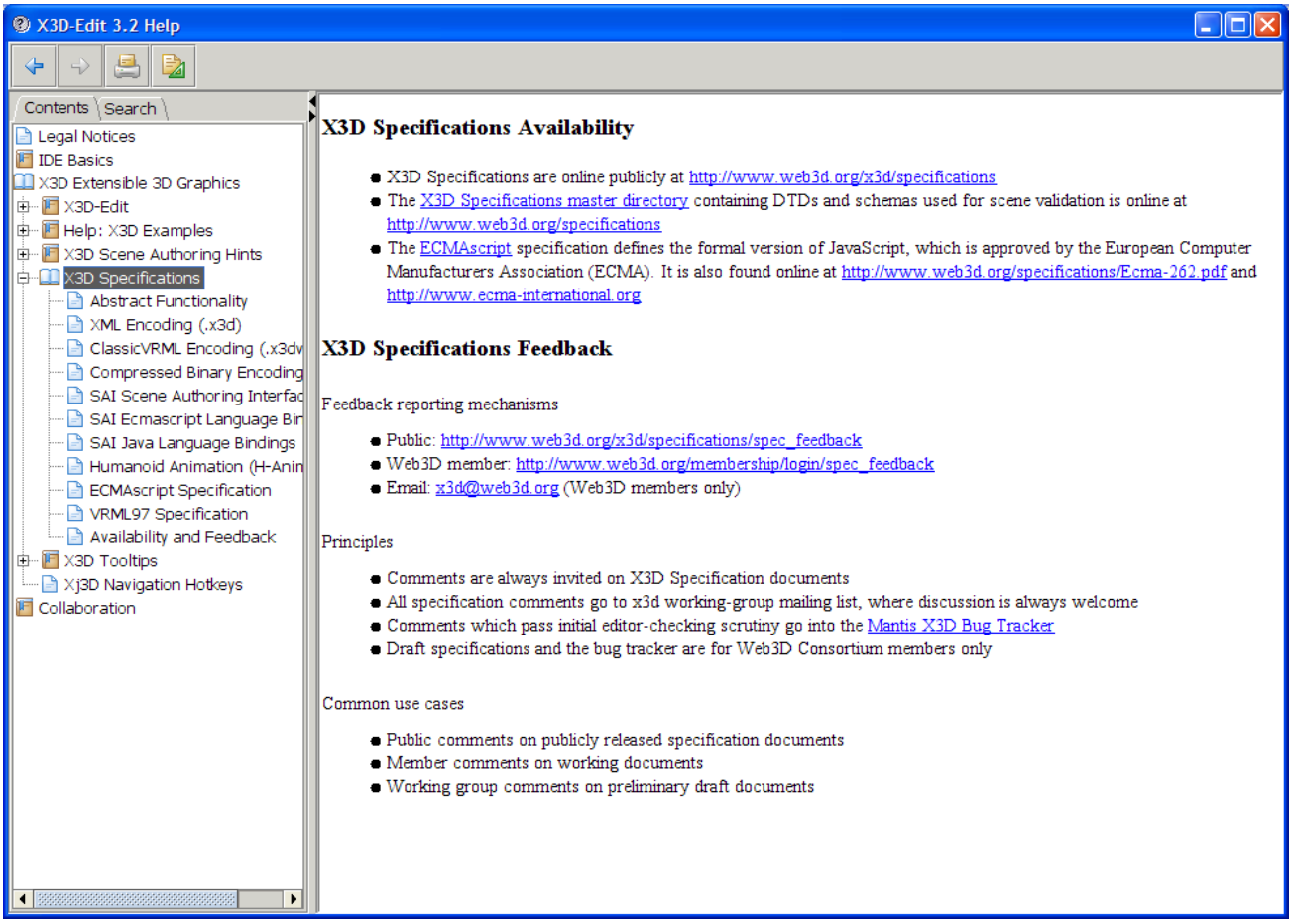

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- http://www.netbeans.org
- http://plugins.netbeans.org/PluginPortal

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

- http://www.netbeans.org/kb/articles/NBFieldGuide.html

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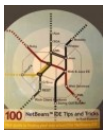

- "Your Guide to Finding Your Way Around the NetBeans IDE"
- http://www.netbeans.org/kb/articles/netbeans-tips-and-tricks-book.html

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

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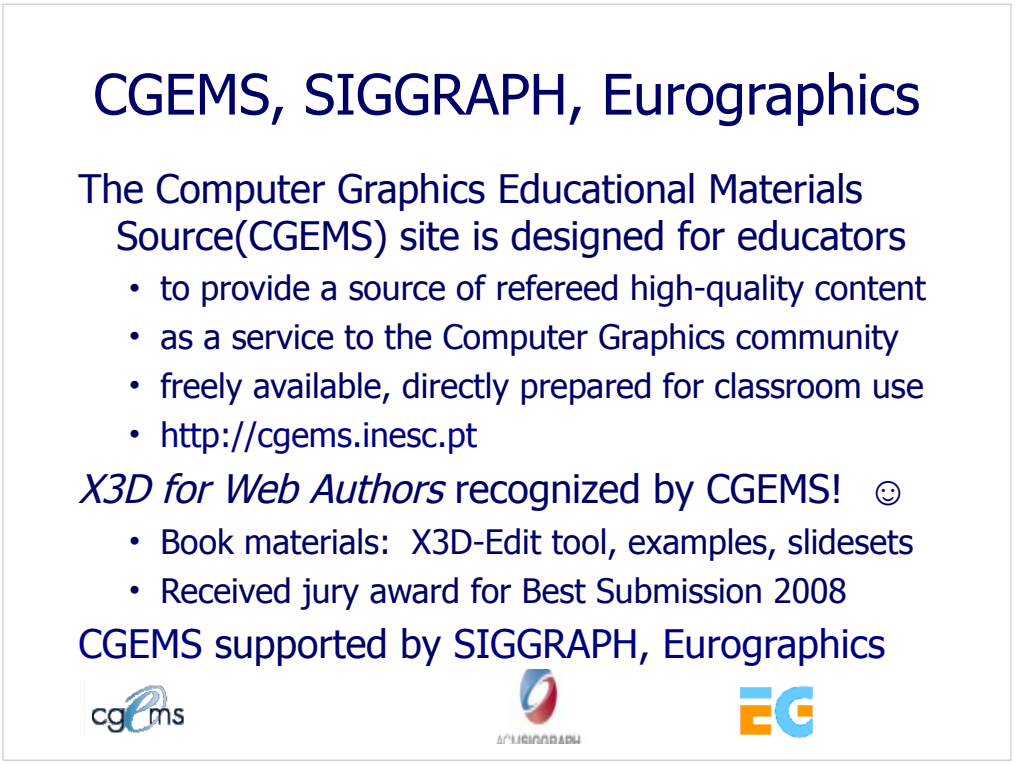

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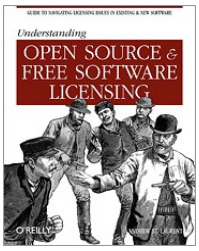
Good references on open source:



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