Concepts

Shape and geometry

Shape nodes can contain a single geometry node

- For example, one of the five geometry primitive nodes
- Alternatively contains a more-advanced geometry node
  - Chapter 2: Geometric primitives
  - Chapter 6: Points Lines and Polygon nodes
  - Chapter 10: Geometry2D nodes
  - Chapter 13: Triangle nodes

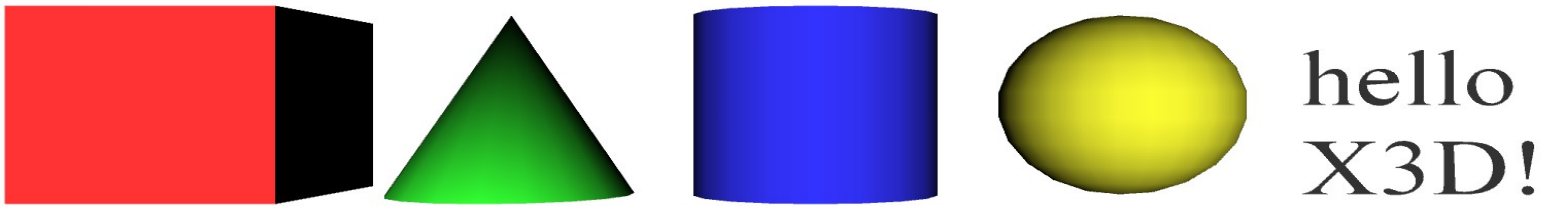
Shape nodes can also contain an Appearance node

- Which in turn contains a Material node for coloring
- Covered in Chapter 3

Why is this pattern fundamental?

- Common design pattern throughout X3D:
  - Shape
    - GeometryNode
    - Appearance
      - Material (optional) for colors
      - ImageTexture (optional) for wrapping an image file
- Top three priorities in graphics design: *performance performance performance!!!*
- This pattern is repeated in order to directly represent geometry and appearance together for maximum graphics-card performance

Geometry Primitives



Primitives are simple geometric constructs

Shape, geometry, Appearance, Material pattern

Browsers decide implementation details, including tessellation (polygon count) and thus quality

Common field: *solid*

In 3D graphics, all triangles have 2 sides

- Graphics term: backface culling only draws front sides

The *solid* field defines whether a geometry node has an inside or not, with a default value of true

- *solid*='true' means do not render (draw) the inside
- *solid*='false' means render both inside and outside

This approach reduces the number of polygons needing to be drawn, thus improving performance

Confusing if user gets lost inside invisible geometry

- Hint: set *solid*='false' to draw both sides

X3D Nodes and Examples

Shape parent with geometry child

```
<Shape>
    <Box size='1 2 3'/>
    <Appearance>
        <Material/>
    </Appearance>
</Shape>
```

Shape must be parent node, can only hold one geometry node

Appearance and Material nodes define colors, transparency, etc.

```
<Shape>
    <Sphere radius='1'/>
    <Appearance>
        <Material/>
    </Appearance>
</Shape>
```

Primitives have simple dimensions

- Typical volume ~1 m radius

All units are in meters

Note parent-child relationships

Box node

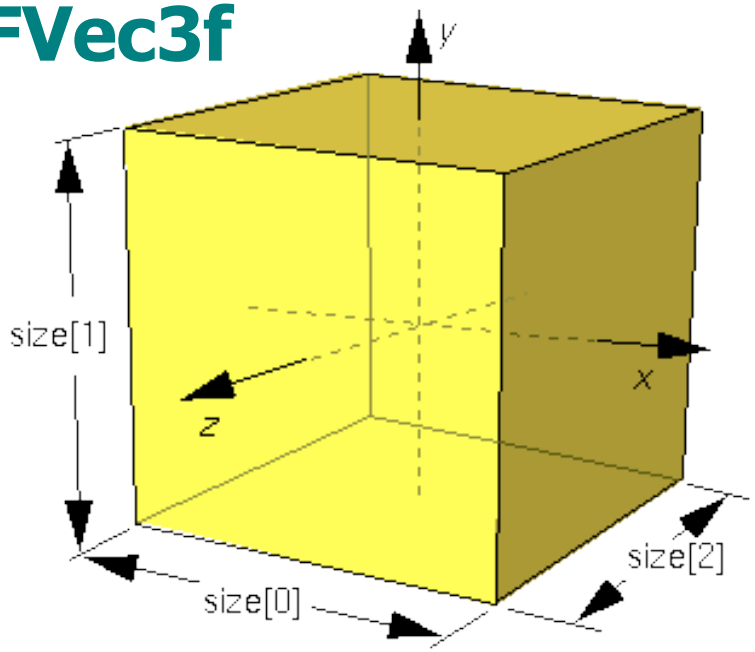
Six-sided rectangular parallelepiped

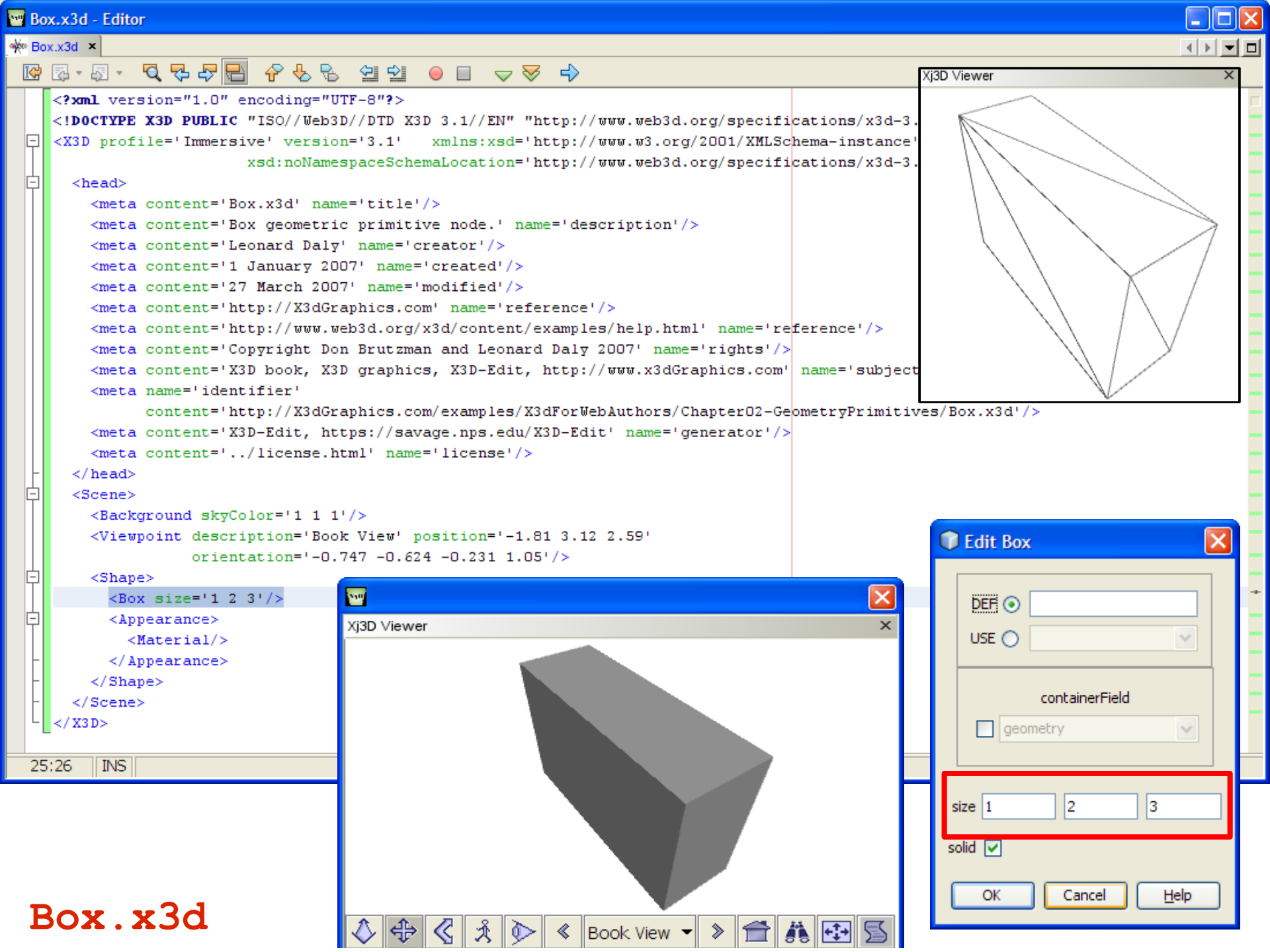
- meaning: not necessarily a cube, but it can be
- Three non-zero non-negative *size* dimensions for x y z

Centered at local origin

size field has X3D data type **SFVec3f**

- **SF Vec** = Single-field vector
- array length of 0 or 1 only
- **3f** = 3 floating-point values
- Default *size*='2 2 2'




Box.x3d - Editor
Box.x3d
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
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<meta content='Box geometric primitive node.' name='description'/>
<meta content='Leonard Daly' name='creator'/>
<meta content='1 January 2007' name='created'/>
<meta content='27 March 2007' name='modified'/>
<meta content='http://X3dGraphics.com' name='reference'/>
<meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
<meta content='Copyright Don Brutzman and Leonard Daly 2007' name='rights'/>
<meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subject
<meta name='identifier'
content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter02-GeometryPrimitives/Box.x3d'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
</head>
<Scene>
<Background skyColor='1 1 1'/>
<Viewpoint description='Book View' position='-1.81 3.12 2.59'
orientation='-0.747 -0.624 -0.231 1.05'/>
<Shape>
<Box size='1 2 3'/>
<Appearance>
<Material/>
</Appearance>
</Shape>
</Scene>
</X3D>
25:26
INS
Xj3D Viewer
Book View
Xj3D Viewer
Edit Box
DEF
USE
containerField
geometry
size
1
2
3
solid
OK
Cancel
Help
Box.x3d

X3D Tooltips - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.web3d.org/x3d/content/X3dTooltips.html#Box

X3D Tooltips

Box	**Box is a geometry node.** **Hint: insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
size	**[size accessType initializeOnly, type SFVec3f CDATA "2 2 2"]** size x y z in meters. **Warning:** simple-geometry dimensions cannot be changed after initial creation, use Transform scale instead.
solid	**[solid accessType initializeOnly, type SFBool (true|false) "true"]** Setting solid true means draw only one side of polygons (backface culling on), setting solid false means draw both sides of polygons (backface culling off). **Warning:** default value true can completely hide geometry if viewed from wrong side! **Warning:** solid false not supported in VRML97.
containerField	**[containerField: NMTOKEN "geometry"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

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Cone node

Circular *bottomRadius*

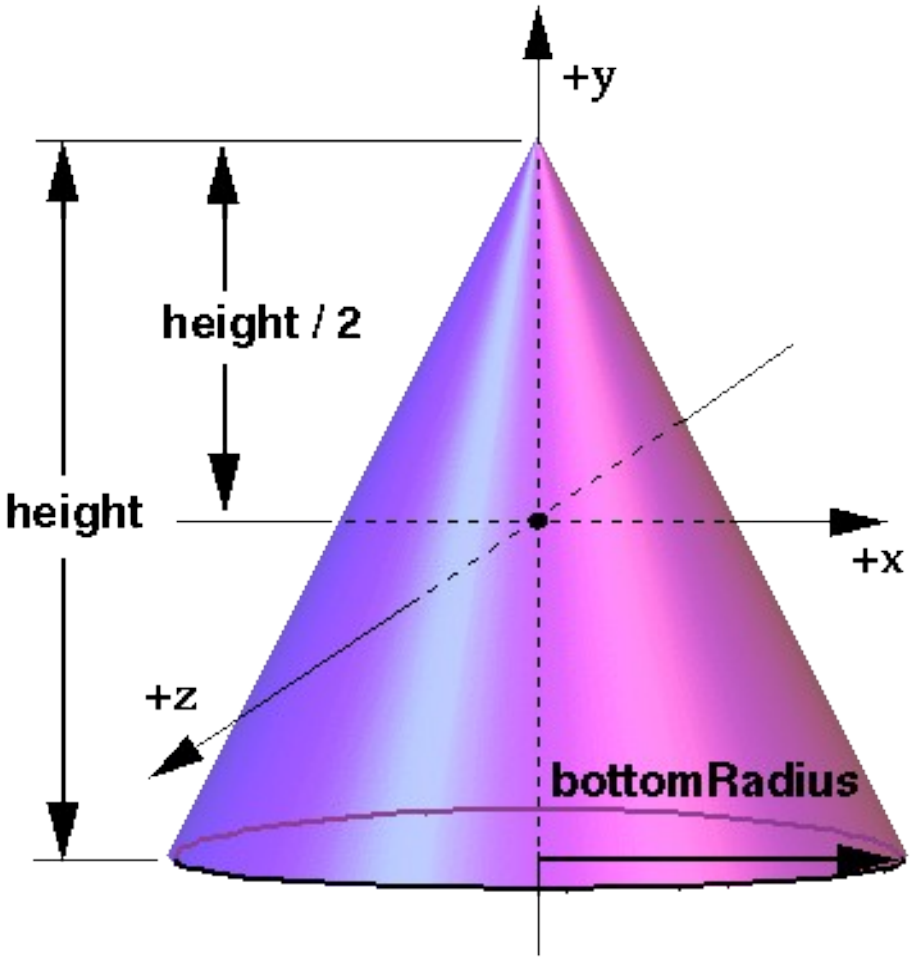
non-zero non-negative *height* above bottom

Centered at local origin

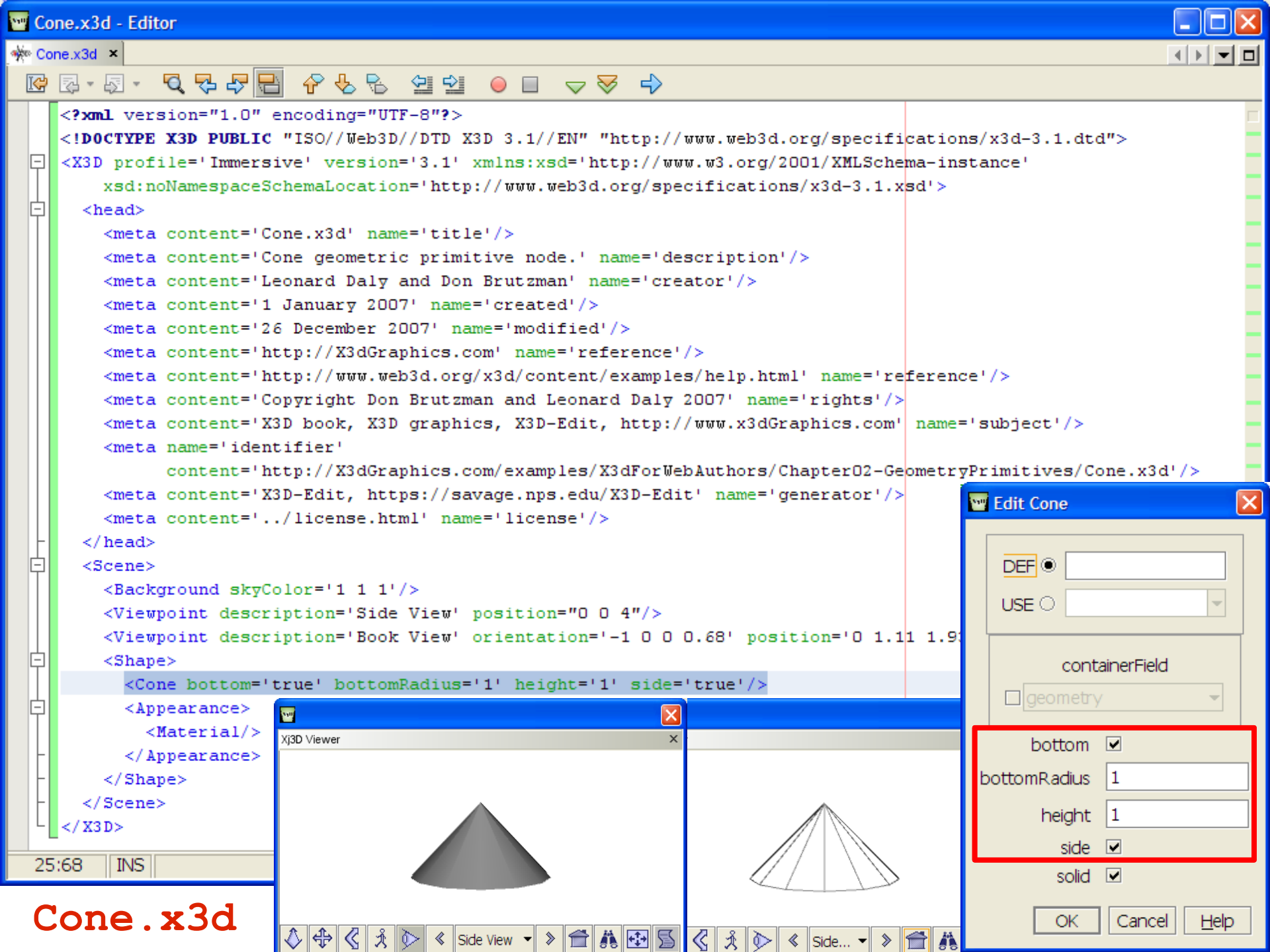
Can hide different parts

- *side*='false'
- *bottom*='false'

Default *height*='2' *bottomRadius*='1'



Set *side*='false' (for bottom only) to define flat circle


Cone.x3d - Editor
Cone.x3d
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<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'>
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<meta content='Cone geometric primitive node.' name='description'/>
<meta content='Leonard Daly and Don Brutzman' name='creator'/>
<meta content='1 January 2007' name='created'/>
<meta content='26 December 2007' name='modified'/>
<meta content='http://X3dGraphics.com' name='reference'/>
<meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
<meta content='Copyright Don Brutzman and Leonard Daly 2007' name='rights'/>
<meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subject'/>
<meta name='identifier'
content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter02-GeometryPrimitives/Cone.x3d'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
</head>
<Scene>
<Background skyColor='1 1 1'/>
<Viewpoint description='Side View' position="0 0 4"/>
<Viewpoint description='Book View' orientation='-1 0 0 0.68' position='0 1.11 1.9
<Shape>
<Cone bottom='true' bottomRadius='1' height='1' side='true'/>
<Appearance>
<Material/>
</Appearance>
</Shape>
</Scene>
</X3D>
25:68
INS
Xj3D Viewer
Side View
Side...
Edit Cone
DEF
USE
containerField
geometry
bottom
bottomRadius
1
height
1
side
solid
OK
Cancel
Help
Cone.x3d

X3D Tooltips - Mozilla Firefox

File Edit View History Bookmarks Tools GUtil! Help

http://www.web3d.org/x3d/content/X3dTooltips.html#Cone

Google

	top help credits
Cone	**Cone is a geometry node.** **Hint: insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
height	**[height: accessType initializeOnly, type SFFloat CDATA "2"]** Size in meters. **Warning:** simple-geometry dimensions cannot be changed after initial creation, use Transform scale instead.
bottomRadius	**[bottomRadius: accessType initializeOnly, type SFFloat CDATA "1"]** Size in meters. **Warning:** simple-geometry dimensions cannot be changed after initial creation, use Transform scale instead.
side	**[side: accessType initializeOnly, type SFBool (true|false) "true"]** Whether to draw sides (other inside faces are not drawn). **Warning:** cannot be changed after initial creation.
bottom	**[bottom: accessType initializeOnly, type SFBool (true|false) "true"]** Whether to draw bottom (other inside faces are not drawn). **Warning:** cannot be changed after initial creation.
solid	**[solid: accessType initializeOnly, type SFBool (true|false) "true"]** Setting solid true means draw only one side of polygons (backface culling on), setting solid false means draw both sides of polygons (backface culling off). **Warning:** default value true can completely hide geometry if viewed from wrong side! **Warning:** solid false not supported in VRML97.
containerField	**[containerField: NMTOKEN "geometry"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.
	top help credits

Cylinder node

Right-angle cylinder with top and bottom caps

Non-zero non-negative *height* above bottom

Circular *radius*

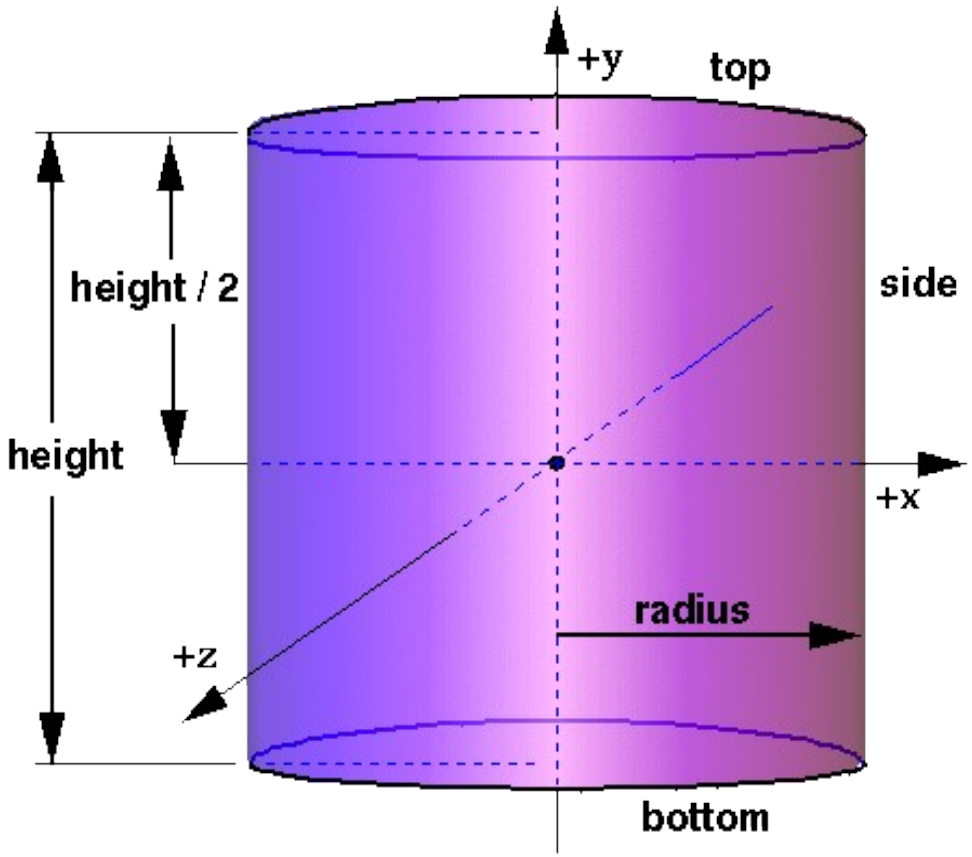
Centered at local origin

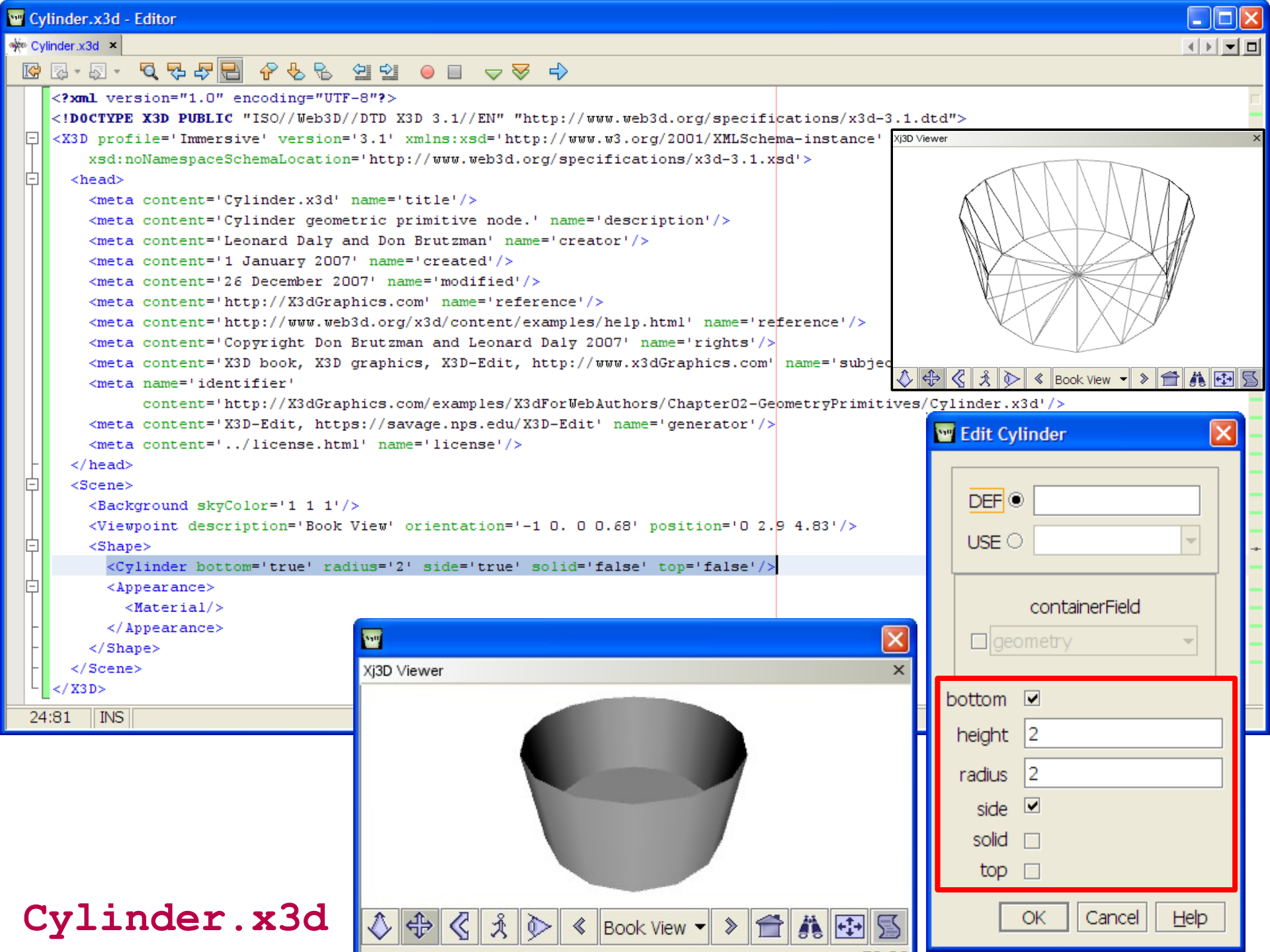
Can hide different parts

- *side*='false'
- *top*='false'
- *bottom*='false'

Default values are

height='2' *radius*='1'




Cylinder.x3d - Editor
Cylinder.x3d
<?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'
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<meta content='Cylinder geometric primitive node.' name='description'/>
<meta content='Leonard Daly and Don Brutzman' name='creator'/>
<meta content='1 January 2007' name='created'/>
<meta content='26 December 2007' name='modified'/>
<meta content='http://X3dGraphics.com' name='reference'/>
<meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
<meta content='Copyright Don Brutzman and Leonard Daly 2007' name='rights'/>
<meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subjec
<meta name='identifier'
content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter02-GeometryPrimitives/Cylinder.x3d'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
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<Viewpoint description='Book View' orientation='-1 0. 0 0.68' position='0 2.9 4.83'/>
<Shape>
<Cylinder bottom='true' radius='2' side='true' solid='false' top='false'/>
<Appearance>
<Material/>
</Appearance>
</Shape>
</Scene>
</X3D>
24:81
INS
Xj3D Viewer
Book View
Edit Cylinder
DEF
USE
containerField
geometry
bottom
height
2
radius
2
side
solid
top
OK
Cancel
Help
Xj3D Viewer
Book View
Cylinder.x3d

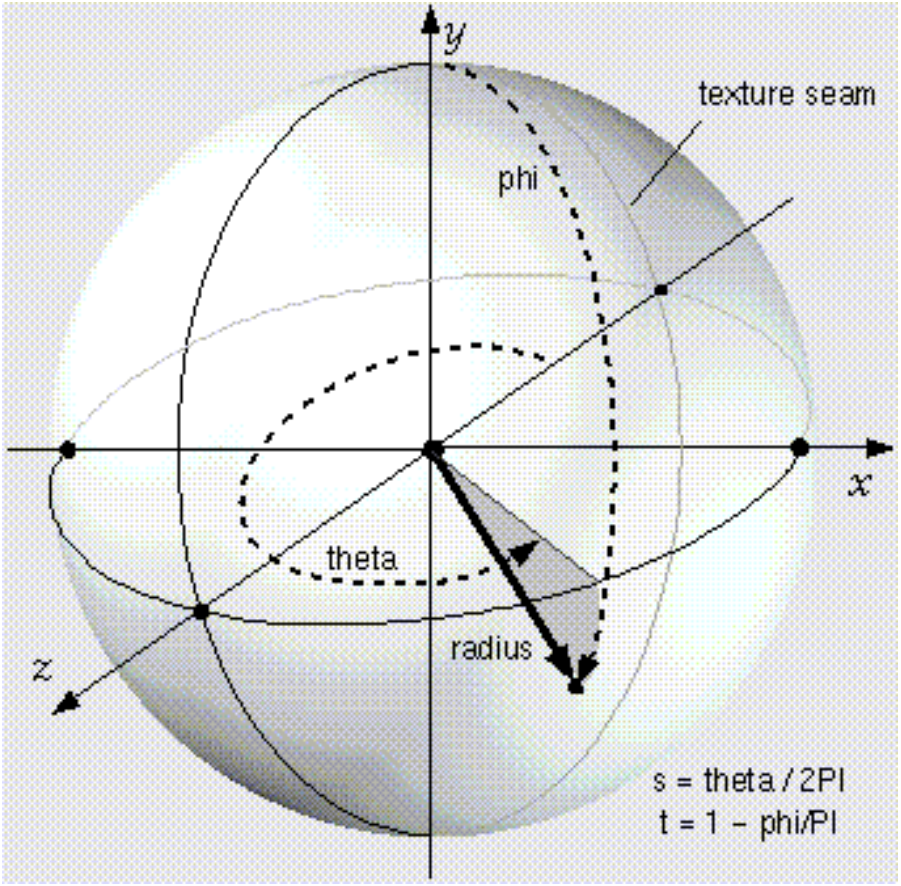
Cylinder	**Cylinder is a geometry node.** **Hint: insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
height	**[height: accessType initializeOnly, type SFFloat CDATA "2"]** Size in meters. **Warning:** simple-geometry dimensions cannot be changed after initial creation, use Transform scale instead.
radius	**[radius: accessType initializeOnly, type SFFloat CDATA "1"]** Size in meters. **Warning:** simple-geometry dimensions cannot be changed after initial creation, use Transform scale instead.
top	**[top: accessType initializeOnly, type SFBool (true|false) "true"]** Whether to draw top (inside faces are never drawn). **Warning:** cannot be changed after initial creation.
side	**[side: accessType initializeOnly, type SFBool (true|false) "true"]** Whether to draw sides (inside faces are never drawn). **Warning:** cannot be changed after initial creation.
bottom	**[bottom: accessType initializeOnly, type SFBool (true|false) "true"]** Whether to draw bottom (inside faces are never drawn). **Warning:** cannot be changed after initial creation.
solid	**[solid: accessType initializeOnly, type SFBool (true|false) "true"]** Setting solid true means draw only one side of polygons (backface culling on), setting solid false means draw both sides of polygons (backface culling off). **Warning:** default value true can completely hide geometry if viewed from wrong side! **Warning:** solid false not supported in VRML97.
containerField	**[containerField: NMTOKEN "geometry"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

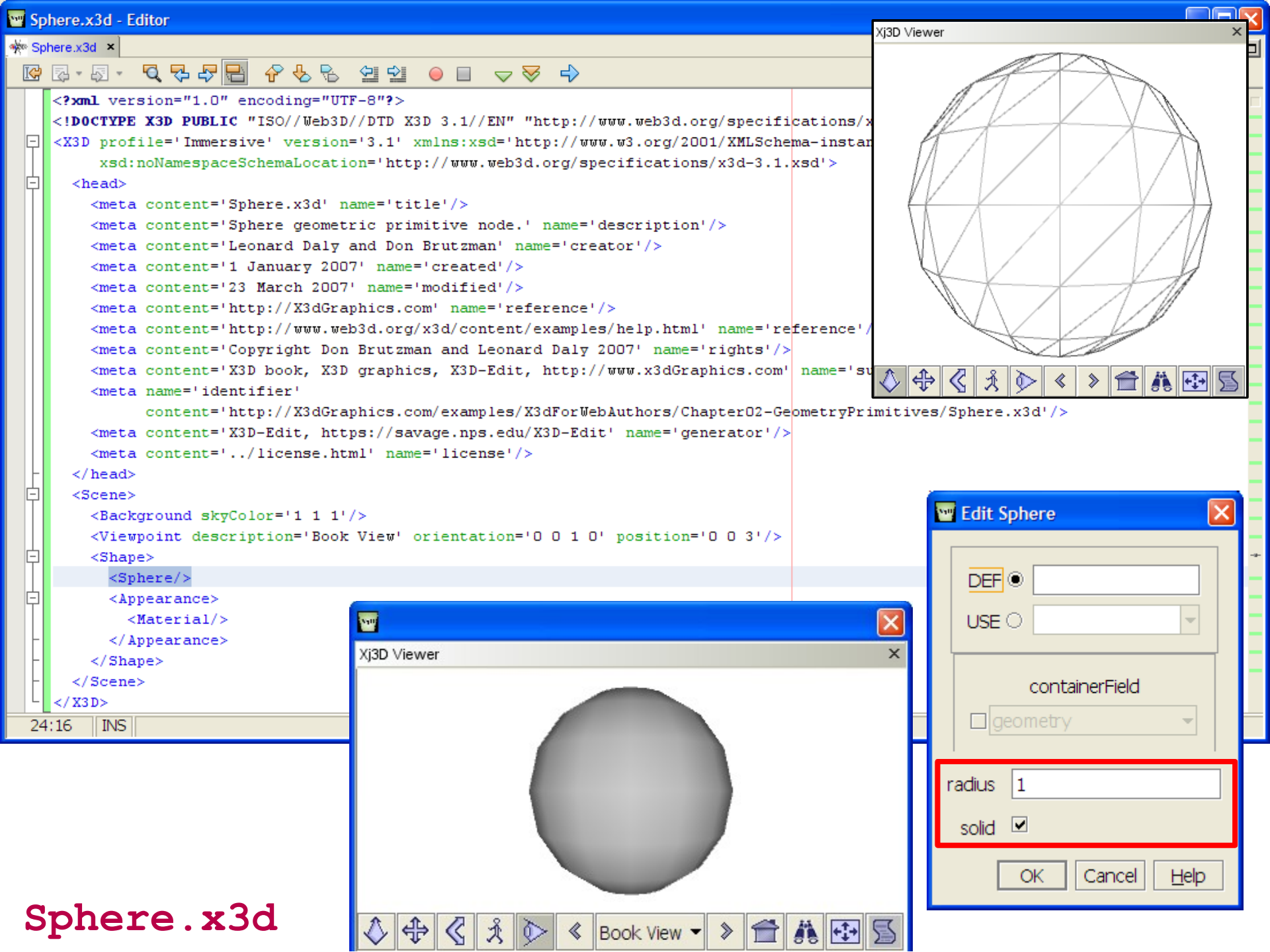
Sphere node

Circular *radius*

Centered at local origin

- phi and theta are implicit
- not defined by author




Sphere.x3d - Editor
Sphere.x3d
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<!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
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<meta content='Sphere geometric primitive node.' name='description'/>
<meta content='Leonard Daly and Don Brutzman' name='creator'/>
<meta content='1 January 2007' name='created'/>
<meta content='23 March 2007' name='modified'/>
<meta content='http://X3dGraphics.com' name='reference'/>
<meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/
<meta content='Copyright Don Brutzman and Leonard Daly 2007' name='rights'/>
<meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='su
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content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter02-GeometryPrimitives/Sphere.x3d'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
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<Sphere/>
<Appearance>
<Material/>
</Appearance>
</Shape>
</Scene>
</X3D>
24:16
INS
Xj3D Viewer
Xj3D Viewer
Book View
Edit Sphere
DEF
USE
containerField
geometry
radius
1
solid
OK
Cancel
Help
Sphere.x3d

X3D Tooltips - Mozilla Firefox

File Edit View History Bookmarks Tools GUtil! Help

http://www.web3d.org/x3d/content/X3dTooltips.html#Sphere

Google

	top help credits
Sphere	**Sphere is a geometry node.** **Hint: insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
radius	**[radius: accessType initializeOnly, type SFFloat CDATA "1"]** Size in meters. **Warning:** simple-geometry dimensions cannot be changed after initial creation, use Transform scale instead.
solid	**[solid: accessType initializeOnly, type SFBool (true|false) "true"]** Setting solid true means draw only one side of polygons (backface culling on), setting solid false means draw both sides of polygons (backface culling off). **Warning:** default value true can completely hide geometry if viewed from wrong side! **Warning:** solid false not supported in VRML97.
containerField	**[containerField: NMTOKEN "geometry"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.
	top help credits

Text node

Produce readable flat, 2D text strings in X3D world

string field is MFString array of "quoted strings"

- Each "quoted string" appears on a separate line

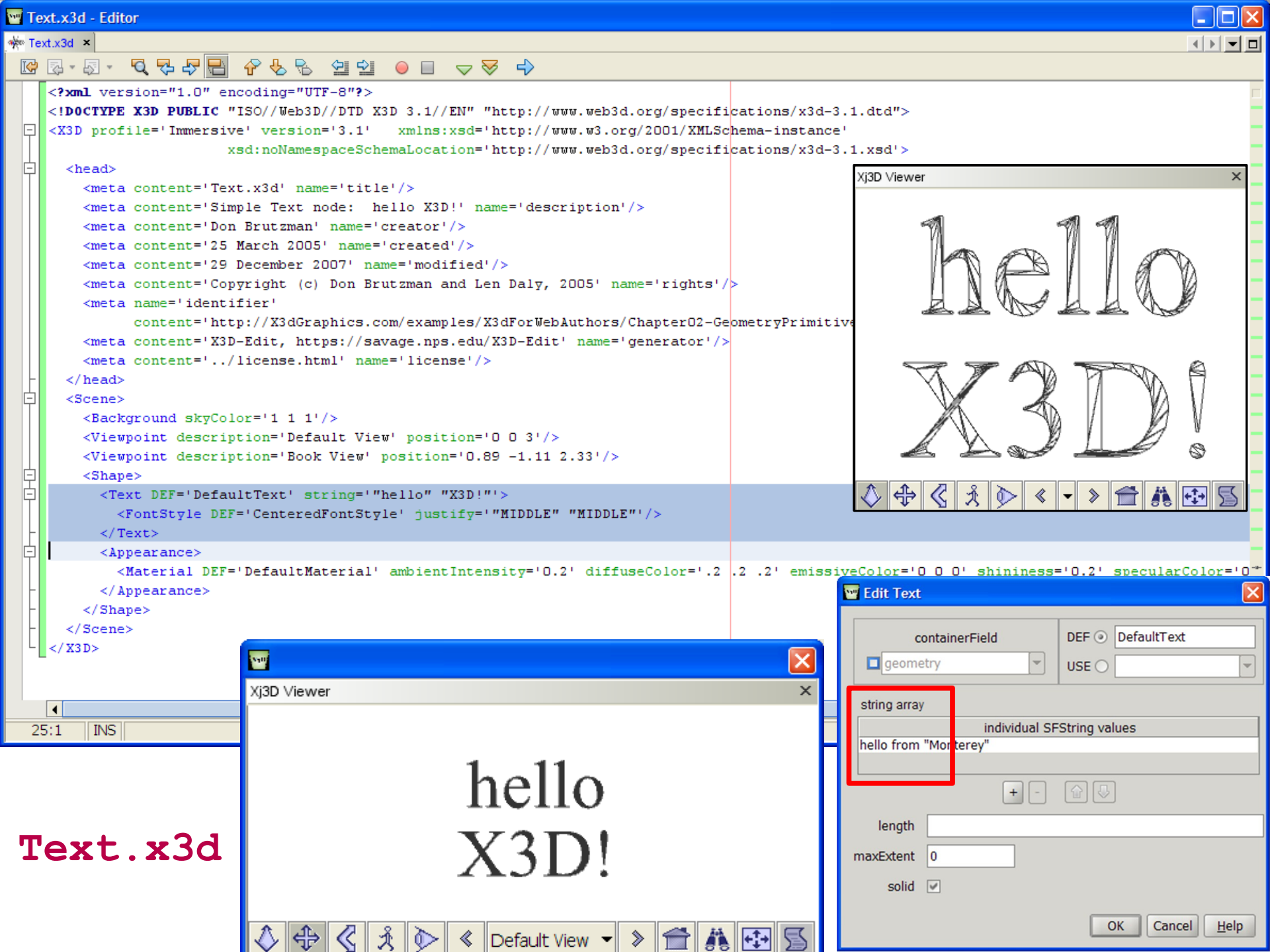
length field is MFFloat array of lengths for each line

- Can shrink or stretch size of each line if needed

maxExtent is maximum length for all substring lines

Note characters have no 3D depth

- Flat when viewed from alongside
- Typically viewable from behind since default is *solid*='false'
- Hint: use Billboard to face user


Text.x3d - Editor
Text.x3d
<?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'
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<meta content='Simple Text node: hello X3D!' name='description'/>
<meta content='Don Brutzman' name='creator'/>
<meta content='25 March 2005' name='created'/>
<meta content='29 December 2007' name='modified'/>
<meta content='Copyright (c) Don Brutzman and Len Daly, 2005' name='rights'/>
<meta name='identifier'
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<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
</head>
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<Viewpoint description='Default View' position='0 0 3'/>
<Viewpoint description='Book View' position='0.89 -1.11 2.33'/>
<Shape>
<Text DEF='DefaultText' string='"hello" "X3D!"'>
<FontStyle DEF='CenteredFontStyle' justify='"MIDDLE" "MIDDLE"'/>
</Text>
<Appearance>
<Material DEF='DefaultMaterial' ambientIntensity='0.2' diffuseColor='.2 .2 .2' emissiveColor='0 0 0' shininess='0.2' specularColor='0
</Appearance>
</Shape>
</Scene>
</X3D>
25:1
INS
Xj3D Viewer
hello
X3D!
Xj3D Viewer
hello
X3D!
Default View
Edit Text
containerField
geometry
DEF
DefaultText
USE
string array
individual SFString values
hello from "Monterey"
length
maxExtent
0
solid
OK
Cancel
Help
Text.x3d

Inserting apostrophes, ampersands, and quotation marks into Text strings

Character entity definitions are XML encodings

- Character entities are also known as *escape characters*
- apostrophe ' is ' & is & " is "
- http://www.w3.org/TR/REC-html40/sgml/entities.html

Precede embedded "quote marks" with backslash \" to differentiate from line-delimiting quote marks

Suggested XML to escape Text node's string field:

- single quote (apostrophe) as XML attribute delimiter
- string=' "Hello from \"Monterey\" " ' or
- string=' "Hello from \"Monterey\" " '
- string=' "A friend's new car" "just arrived" '

Try it yourself

1. Create a new scene by clicking the New X3D Scene button, or else select using menus (*File*, *New X3D*, *New X3D Scene*)
2. Open the palette for *Geometry: Primitives*
3. Drag a new Shape node into the scene graph where XML comment says

```
<!-- Scene graph nodes are added here -->
```

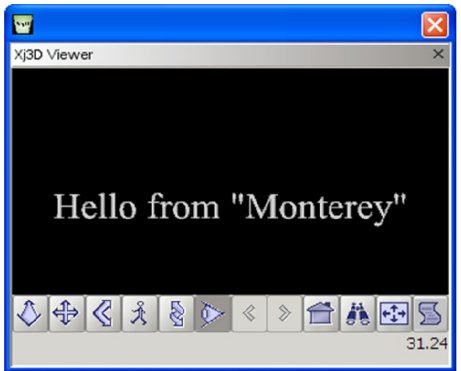
7. Drag a new Text node into the scene graph where the XML comment says

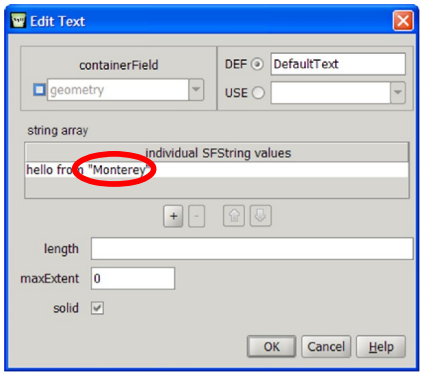
```
<!-- Add a single geometry node here -->
```

9. Right click on the Text node, cut and paste the text into the `string` field. Be sure to include all of the double quotes, don't paste the single quote delimiters.

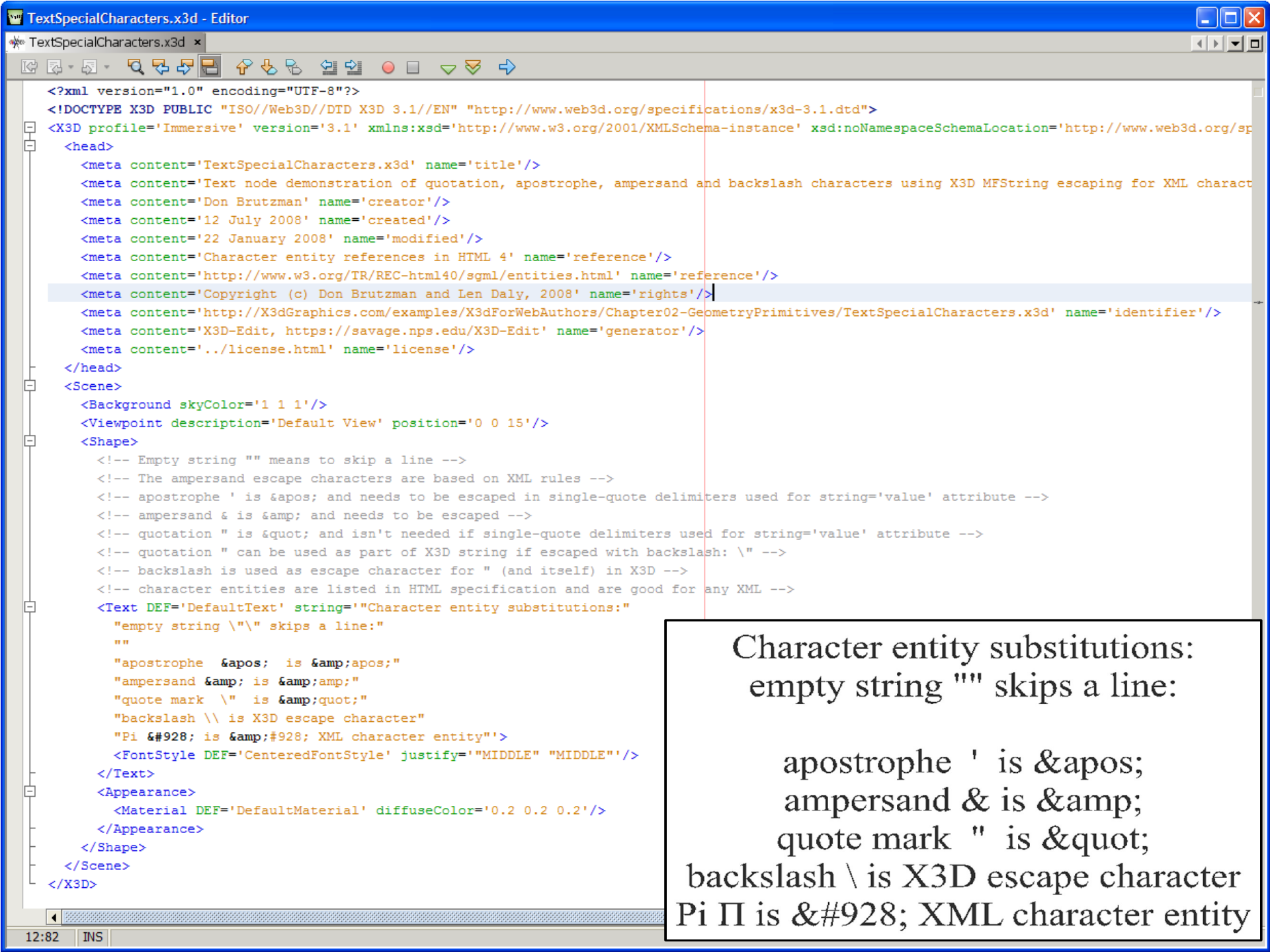
```
<Text string='Hello from \"My Home Town\" ' />
```

11. Right-click the context menu to refresh or redraw in Xj3D:





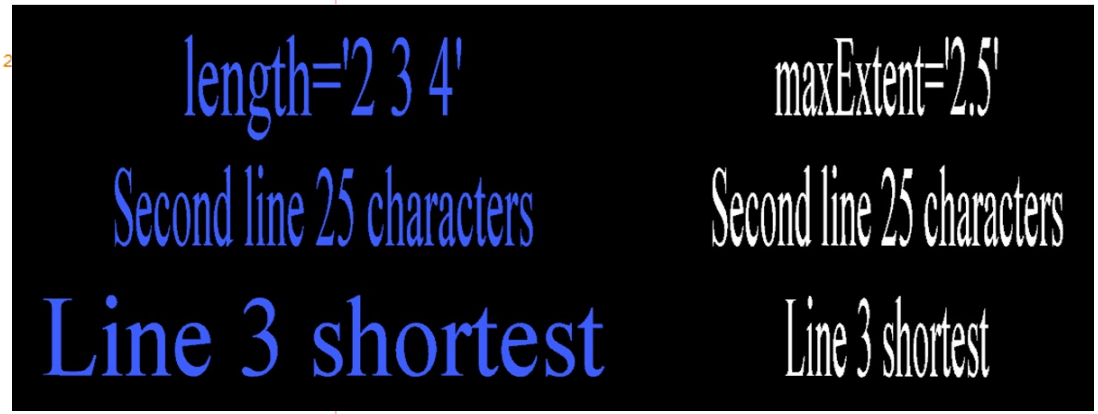
web|3D CONSORTIUM


TextSpecialCharacters.x3d - Editor
TextSpecialCharacters.x3d
<?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/sp
<head>
<meta content='TextSpecialCharacters.x3d' name='title'/>
<meta content='Text node demonstration of quotation, apostrophe, ampersand and backslash characters using X3D MFString escaping for XML charact
<meta content='Don Brutzman' name='creator'/>
<meta content='12 July 2008' name='created'/>
<meta content='22 January 2008' name='modified'/>
<meta content='Character entity references in HTML 4' name='reference'/>
<meta content='http://www.w3.org/TR/REC-html40/sgml/entities.html' name='reference'/>
<meta content='Copyright (c) Don Brutzman and Len Daly, 2008' name='rights'/>
<meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter02-GeometryPrimitives/TextSpecialCharacters.x3d' name='identifier'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
</head>
<Scene>
<Background skyColor='1 1 1'/>
<Viewpoint description='Default View' position='0 0 15'/>
<Shape>
<!-- Empty string "" means to skip a line -->
<!-- The ampersand escape characters are based on XML rules -->
<!-- apostrophe ' is ' and needs to be escaped in single-quote delimiters used for string='value' attribute -->
<!-- ampersand & is & and needs to be escaped -->
<!-- quotation " is " and isn't needed if single-quote delimiters used for string='value' attribute -->
<!-- quotation " can be used as part of X3D string if escaped with backslash: \" -->
<!-- backslash is used as escape character for " (and itself) in X3D -->
<!-- character entities are listed in HTML specification and are good for any XML -->
<Text DEF='DefaultText' string='"Character entity substitutions:"
"empty string \"\" skips a line:"
""
"apostrophe ' is '"
"ampersand & is &"
"quote mark \" is ""
"backslash \\ is X3D escape character"
"Pi Π is Π XML character entity"'>
<FontStyle DEF='CenteredFontStyle' justify='"MIDDLE" "MIDDLE"'/>
</Text>
<Appearance>
<Material DEF='DefaultMaterial' diffuseColor='0.2 0.2 0.2'/>
</Appearance>
</Shape>
</Scene>
</X3D>
12:82
INS
Character entity substitutions:
empty string "" skips a line:
apostrophe ' is '
ampersand & is &
quote mark " is "
backslash \ is X3D escape character
Pi Π is Π XML character entity

TextLengthMaxExtent.x3d - Editor

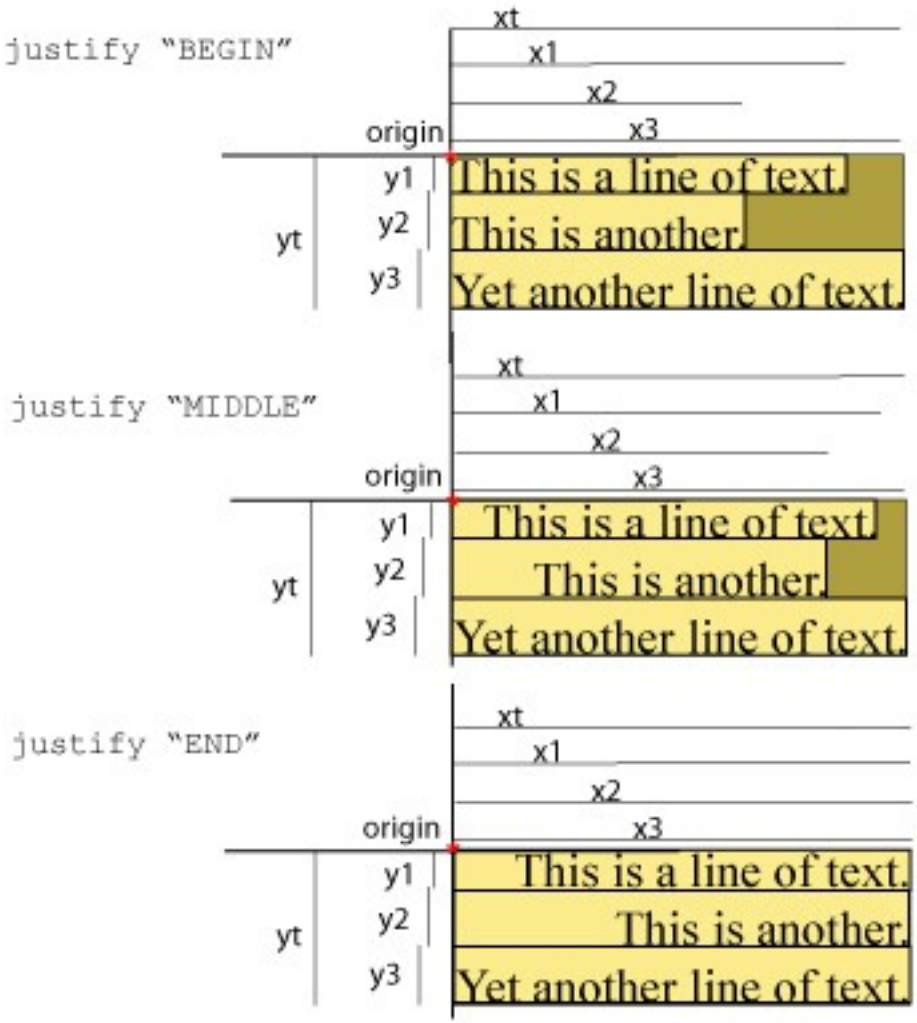
TextLengthMaxExtent.x3d

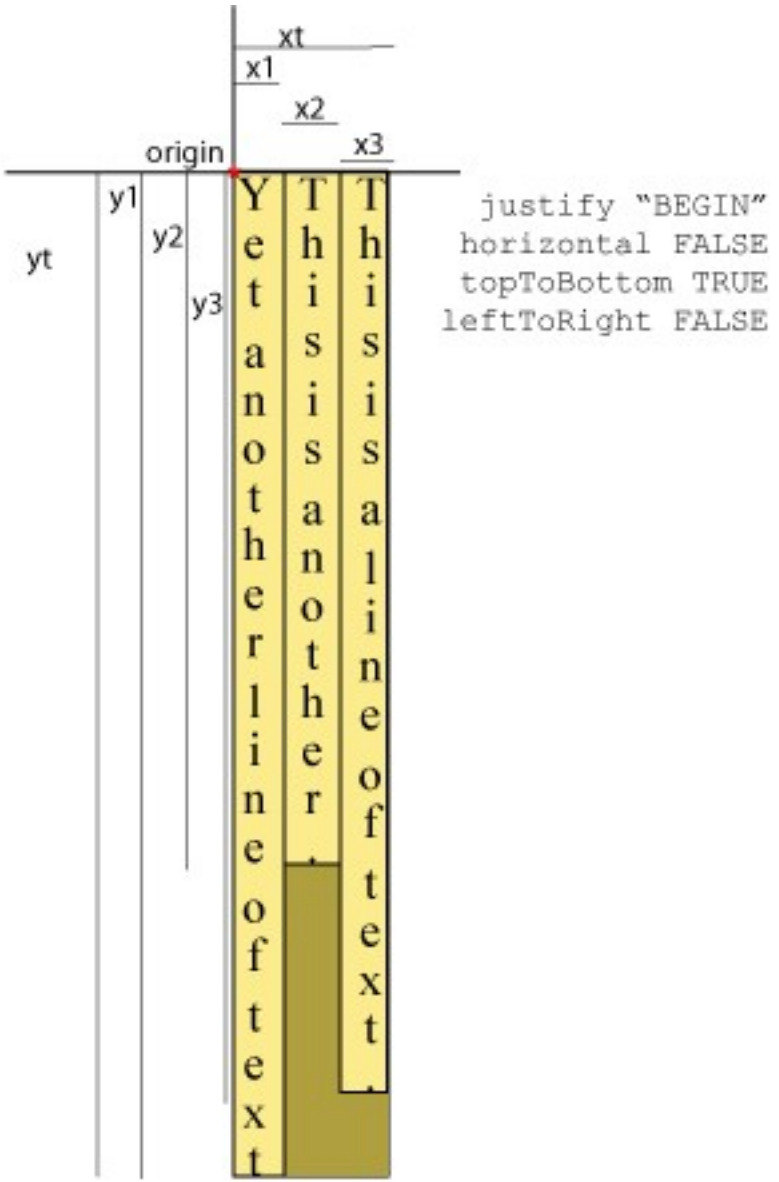
```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation='http://www.web3d.org/s
  <head>
    <meta content='TextLengthMaxExtent.x3d' name='title'/>
    <meta content='Simple Text node, illustrating length array and maxExtent field' name='description'/>
    <meta content='Don Brutzman' name='creator'/>
    <meta content='25 January 2009' name='created'/>
    <meta content='25 January 2009' name='modified'/>
    <meta content='TextLengthMaxExtent.png' name='reference'/>
    <meta content='Copyright (c) Don Brutzman and Len Daly, 2005' name='rights'/>
    <meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter02-GeometryPrimitives/TextLengthMaxExtent.x3d' name='identifier'/>
    <meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
    <meta content='../license.html' name='license'/>
  </head>
  <Scene>
    <Viewpoint description='Default View' position='0 0 6'/>
    <Viewpoint description='Book View' position='0.89 -1.11 2.33'/>
    <Transform translation='-2 0 0'>
      <Shape>
      <Text DEF='DefaultText' length='2 3 4' string='"length=&apos;2 3 4&apos;" "Second line 25 characters" "Line 3 shortest"'>
          <FontStyle DEF='CenteredFontStyle' justify='"MIDDLE" "MIDDLE"' />
        </Text>
        <Appearance>
        <Material DEF='BlueMaterial' diffuseColor='0.2
        </Appearance>
      </Shape>
    </Transform>

    <Transform translation='2 0 0'>
      <Shape>
      <Text maxExtent='2.5' string='"maxExtent=&apos;2.5&apos;" "Second line 25 characters" "Line 3 shortest"'>
          <FontStyle USE='CenteredFontStyle' />
        </Text>
      </Shape>
    </Transform>
  </Scene>
</X3D>
```



1:1 INS

Horizontal or vertical adjustments

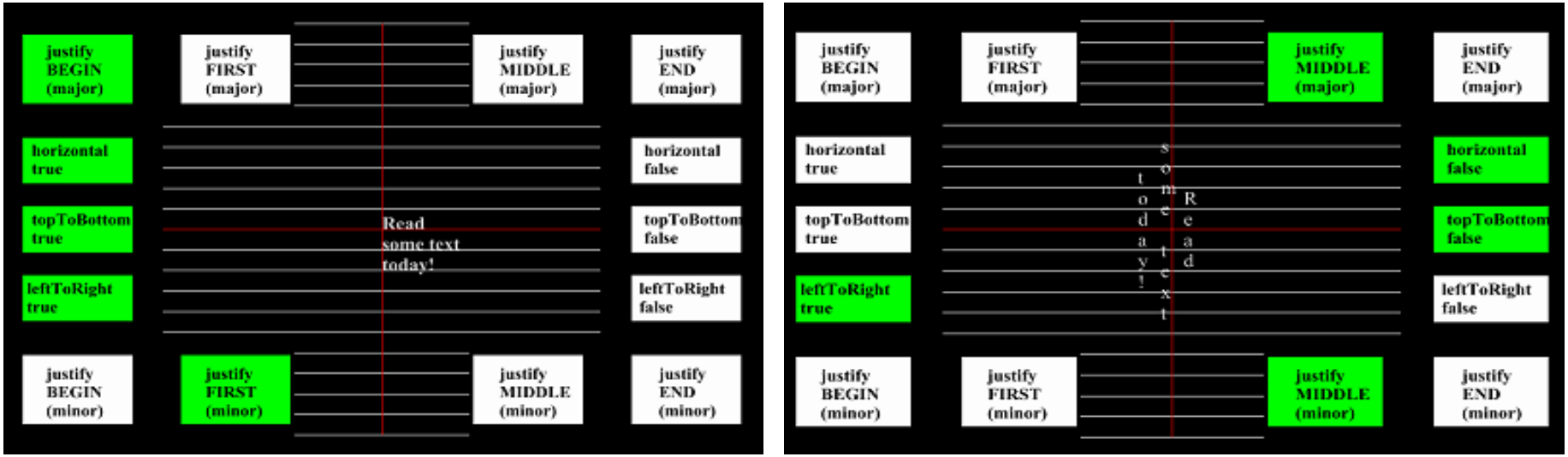




Text	**Text is a geometry node that can contain a FontStyle node.** **Hint: insert a Shape node before adding geometry or Appearance. You can also substitute a type-matched ProtoInstance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
string	**[string: accessType inputOutput, type MFString CDATA #IMPLIED]** Single or multiple string values to present as Text. **Hint:** Strings can have multiple values, so separate each string by quote marks **Hint:** Strings can contain quote marks by first escaping them with a backslash example: "say \"hello\" please" **Hint:** many XML tools substitute XML character references automatically if needed (like & for & or " for ").
length	**[length: accessType inputOutput, type MFFloat CDATA #IMPLIED]** Array of length values for each text string in the local coordinate system. Each string is stretched or compressed to fit.
maxExtent	**[maxExtent: accessType inputOutput, type SFFloat CDATA "0.0"]** Limits/compresses all text strings if max string length is longer than maxExtent, as measured in local coordinate system.
solid	**[solid: accessType initializeOnly, type SFBool (true|false) "true"]** Setting solid true means draw only one side of polygons (backface culling on), setting solid false means draw both sides of polygons (backface culling off). **Warning:** default value true can completely hide geometry if viewed from wrong side! **Warning:** solid false not supported in VRML97.
lineBounds	**[lineBounds: accessType outputOnly, type MFVec2f CDATA #IMPLIED]** Array of 2D bounding box values for each line of text in the local coordinate system.
textBounds	**[textBounds: accessType outputOnly, type SFVec2f CDATA #IMPLIED]** 2D bounding box value for all lines of text in the local coordinate system.
containerField	**[containerField: NMTOKEN "geometry"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

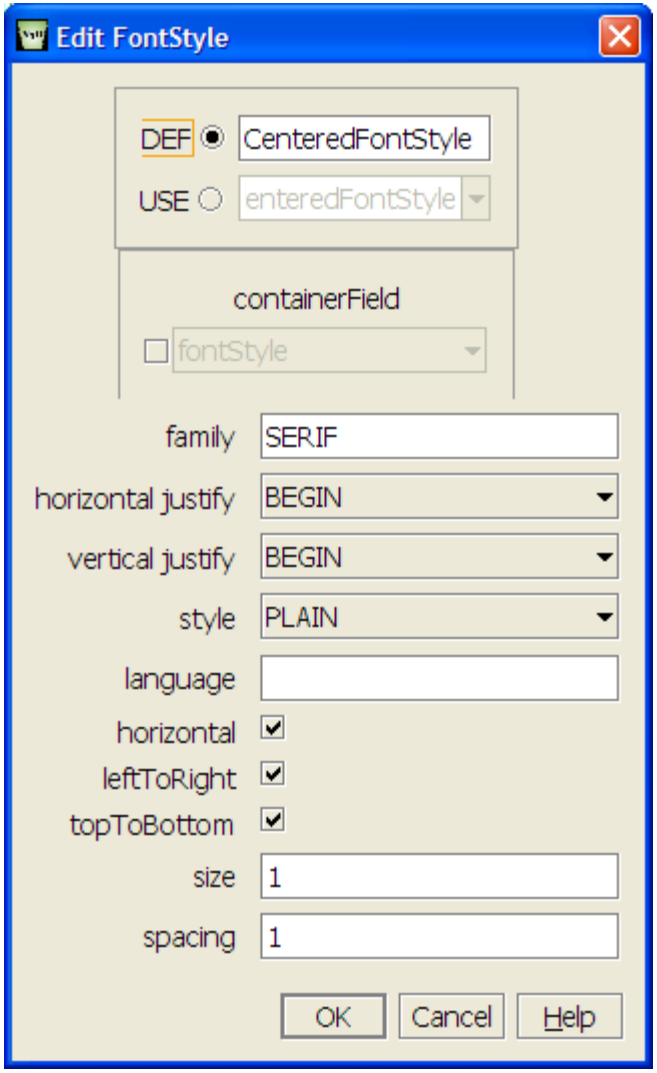
FontStyle node

Defines *size*, font *family*, layout directions and justification, language, and style for Text strings



http://www.web3d.org/x3d/content/examples/ConformanceNist/Appearance/FontStyle/driver.x3d

```
<FontStyle justify=' "MIDDLE" "MIDDLE" '/>
```



- FontStyle is only allowed as child of a Text node
  - FontStyle modifies that parent
- Other supported default font family values are SANS (serif) and TYPEWRITER
  - Additional font families require special browser support
- Other field values support internationalization (I18N) and localization (L10N)
  - DEF, USE for consistent look

FontStyle values, X3D Specification

Table 15.2 — Major Alignment, *horizontal* = TRUE

***justify* Enumerant**	***leftToRight* = TRUE**	***leftToRight* = FALSE**
FIRST	Left edge of each line	Right edge of each line
BEGIN	Left edge of each line	Right edge of each line
MIDDLE	Centred about X-axis	Centred about X-axis
END	Right edge of each line	Left edge of each line

Table 15.3 — Major Alignment, *horizontal* = FALSE

***justify* Enumerant**	***topToBottom* = TRUE**	***topToBottom* = FALSE**
FIRST	Top edge of each line	Bottom edge of each line
BEGIN	Top edge of each line	Bottom edge of each line
MIDDLE	Centred about Y-axis	Centre about Y-axis
END	Bottom edge of each line	Top edge of each line

FontStyle values, X3D Specification

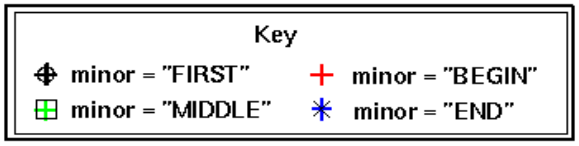
Table 15.4 — Minor Alignment, *horizontal* = TRUE

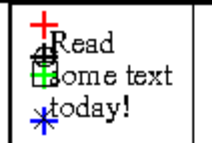
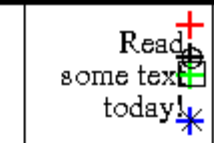
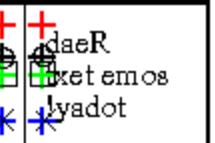
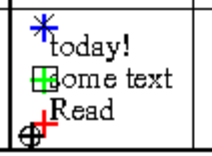
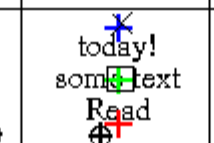
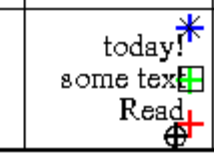
***justify* Enumerant**	***topToBottom* = TRUE**	***topToBottom* = FALSE**
FIRST	Baseline of first line	Baseline of first line
BEGIN	Top edge of first line	Bottom edge of first line
MIDDLE	Centred about Y-axis	Centred about Y-axis
END	Bottom edge of last line	Top edge of last line

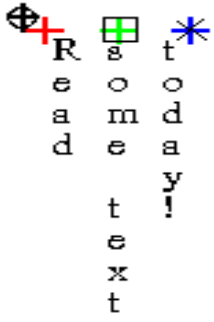
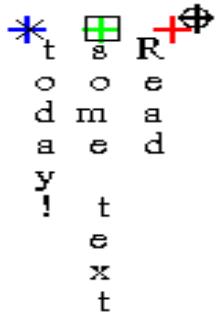
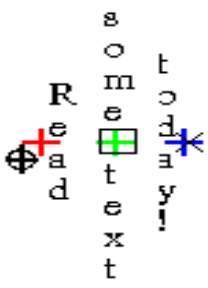
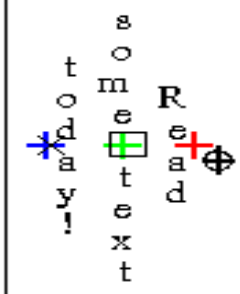
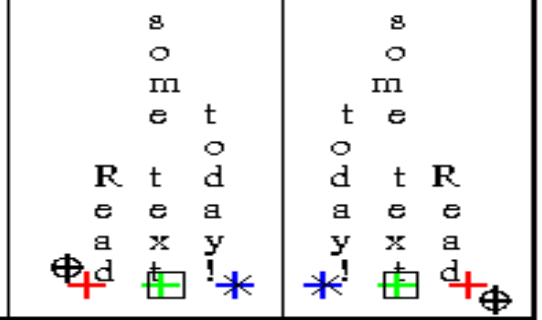
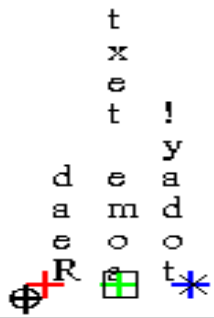
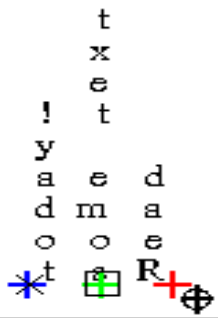
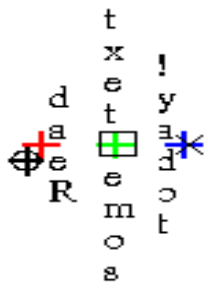
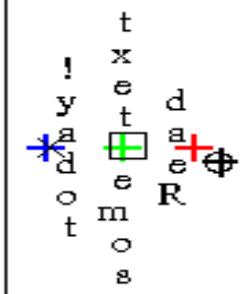
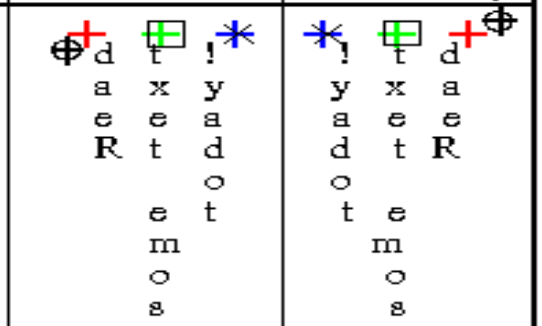
Table 15.5 — Minor Alignment, *horizontal* = FALSE

***justify* Enumerant**	***leftToRight* = TRUE**	***leftToRight* = FALSE**
FIRST	Left edge of first line	Right edge of first line
BEGIN	Left edge of first line	Right edge of first line
MIDDLE	Centred about X-axis	Centred about X-axis
END	Right edge of last line	Left edge of last line

X3D Specification Tables 15.6 and 15.7



topToBottom	major = "BEGIN" or "FIRST"		major = "MIDDLE"		major = "END"	
	leftToRight		leftToRight		leftToRight	
	TRUE	FALSE	TRUE	FALSE	TRUE	FALSE
TRUE						
FALSE						

topToBottom	major ="BEGIN" or "FIRST		major ="MIDDLE"		major ="END"	
	leftToRight		leftToRight		leftToRight	
	TRUE	FALSE	TRUE	FALSE	TRUE	FALSE
TRUE						
FALSE						

Note: In every case, the "FIRST" minor axis marker ⊕ is coincident with the "BEGIN" minor axis marker + (and is offset for presentation purposes only).

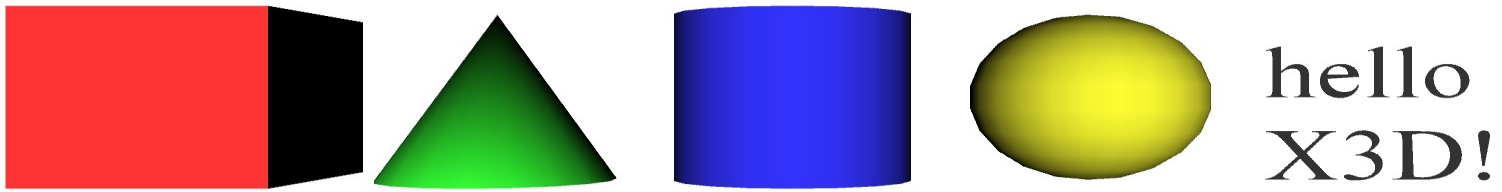
top help credits

FontStyle	**FontStyle defines the size, family, and style used for Text nodes.** **Hint: first add a Text node as parent.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
family	**[family: accessType initializeOnly, type MFString CDATA "SERIF"]** Sequence of font family names in preference order - browsers use first supported family. Supported values include "SERIF" "SANS" "TYPEWRITER". Hint: SERIF and SANS are variable-width fonts (for example, Roman and Arial). Hint: TYPEWRITER is a fixed-width font (for example, Courier). Hint: Strings can have multiple values, so separate "each string" "by" "quote marks".
style	**[style: accessType initializeOnly, type SFString CDATA (PLAIN|BOLD|ITALIC|BOLDITALIC) "PLAIN"]** Pick one of four values for text style.
justify	**[justify: accessType initializeOnly, type MFString CDATA "BEGIN"]** Two string values are provided for major and minor axis alignment, possible values are "FIRST" "BEGIN" "MIDDLE" "END"] Example: "MIDDLE" "MIDDLE". Hint: Strings can have multiple values, so separate "each string" "by" "quote marks".
size	**[size: accessType initializeOnly, type SFFloat CDATA "1.0"]** Nominal height (in local coordinate system) of text glyphs Also sets default spacing between adjacent lines of text.
spacing	**[spacing: accessType initializeOnly, type SFFloat CDATA "1.0"]** Adjustment factor for line spacing between adjacent lines of text.
language	**[language: accessType initializeOnly, type SFString CDATA #IMPLIED]** Language codes consist of a primary code and a (possibly empty) series of subcodes. [language-code = primary-code ("-" subcode)*] Two-letter primary codes are reserved for language abbreviations. [RFC1766, http://www.ietf.org/rfc/rfc1766.txt] Two-letter primary codes include en (English), fr (French), de (German), it (Italian), nl (Dutch), el (Greek), es (Spanish), pt (Portuguese), ar (Arabic), he (Hebrew), ru (Russian), zh (Chinese), ja (Japanese), hi (Hindi), ur (Urdu), and sa (Sanskrit). Any two-letter subcode is understood to be a country code. [ISO3166 or http://www.oasis-open.org/cover/iso639a.html]
horizontal	**[horizontal: accessType initializeOnly, type SFBool (true|false) "true"]** Whether text direction is horizontal (true) or vertical (false).
leftToRight	**[leftToRight: accessType initializeOnly, type SFBool (true|false) "true"]** Whether text direction is left-to-right (true) or right-to-left (false).
topToBottom	**[topToBottom: accessType initializeOnly, type SFBool (true|false) "true"]** Whether text direction is top-to-bottom (true) or bottom-to-top (false).
containerField	**[containerField: NMTOKEN "fontStyle"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

top help credits

Review

Geometry Primitives



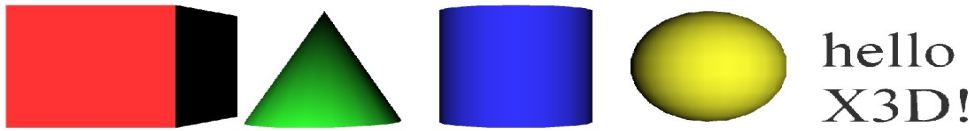
Primitives are simple geometric constructs

Shape, geometry, Appearance, Material pattern

Browsers decide implementation details, including quality of tessellation resolution

C:/My Documents/X3D/X3dBook/chapters/Chapter02-GeometryPrimitives/GeometryPrimitiveNodes.x3d

<?xml version="1.0" encoding="UTF-8"?>
<! DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.0//EN" "http://www.web3d.org/specifications/x3d-3.0.dtd">
X3D: version: 3.0, profile: Immersive, xmlns:xsd: http://www.w3.org/2001/XMLSchema-instance, xsd:noNamespaceSchemaLocation: http://www.web3d.org/specifications/x3d-3.0.xsd
head
meta: name: filename, content: GeometryPrimitiveNodes.x3d
meta: name: description, content: Geometry Primitive Nodes: Shape, Box, Cone, Cylinder, Sphere, Text, FontStyle
meta: name: creator, content: Don Brutzman
meta: name: created, content: 25 March 2005
meta: name: modified, content: 25 March 2005
meta: name: rights, content: Copyright (c) Don Brutzman and Len Daly, 2005
meta: name: identifier, content: GeometryPrimitiveNodes.x3d
meta: name: generator, content: X3D-Edit, http://www.web3d.org/x3d/conte
meta: name: license, content: ../../license.html



Scene
Transform: translation: -5 0 0
Shape: DEF: DefaultShape, bboxCenter: 0 0 0, bboxSize: -1 -1 -1, containerField: children
Box: DEF: DefaultBox, size: 2 2 2, containerField: geometry
Appearance: DEF: DefaultAppearance, containerField: appearance
Material: diffuseColor: 1 0.2 0.2
Transform: translation: -2.5 0 0
Shape
Cone: DEF: DefaultCone, height: 2, bottomRadius: 1, side: true, bottom: true, containerField: geometry
Appearance
Material: diffuseColor: 0.2 1 0.2
Transform: translation: 0 0 0
Shape
Cylinder: DEF: DefaultCylinder, height: 2, radius: 1, top: true, side: true, bottom: true, containerField: geometry
Appearance
Material: diffuseColor: 0.2 0.2 1
Transform: translation: 2.5 0 0
Shape
Sphere: DEF: DefaultSphere, radius: 1, containerField: geometry
Appearance
Material: diffuseColor: 1 1 0.2
Transform: translation: 4 0 0
Shape
Text: DEF: DefaultText, string: "hello" "X3D!", maxExtent: 0.0, containerField: geometry
FontStyle: DEF: DefaultFontStyle, family: "SERIF", style: PLAIN, justify: "BEGIN", size: 1.0, spacing: 1.0, horizontal: true, leftToRight: true, topToBottom: true, containerField: fontStyle
Appearance
Material: DEF: DefaultMaterial, diffuseColor: 0.8 0.8 0.8, emissiveColor: 0 0 0, specularColor: 0 0 0, shininess: 0.2, ambientIntensity: 0.2, transparency: 0, containerField: material

Transform nodes position each Shape so that they do not obscure each other

X3D spec excerpt for Shape node

12.4.5 Shape

```
Shape : X3DShapeNode {
  SFNode  [in,out] appearance NULL      [X3DAppearanceNode]
  SFNode  [in,out] geometry   NULL      [X3DGeometryNode]
  SFNode  [in,out] metadata   NULL      [X3DMetadataObject]
  SFVec3f []       bboxCenter 0 0 0     (-∞,∞)
  SFVec3f []       bboxSize   -1 -1 -1 [0,∞) or -1 -1 -1
}
```

The Shape node has two fields, *appearance* and *geometry,* which are used to create rendered objects in the world. The *appearance* field contains an Appearance node that specifies the visual attributes (e.g., material and texture) to be applied to the geometry. The *geometry* field contains a geometry node. The specified geometry node is rendered with the specified appearance nodes applied. See 12.2 Concepts for more information.

17 Lighting component contains details of the X3D lighting model and the interaction between Appearance nodes and geometry nodes.

If the *geometry* field is `NULL`, the object is not drawn.

The *bboxCenter* and *bboxSize* fields specify a bounding box that encloses the Shape node's geometry. This is a hint that may be used for optimization purposes. The results are undefined if the specified bounding box is smaller than the actual bounding box of the geometry at any time. A default *bboxSize* value, (-1, -1, -1), implies that the bounding box is not specified and, if needed, is calculated by the browser. A description of the *bboxCenter* and *bboxSize* fields is contained in 10.2.2 Bounding boxes.

X3D Specification Diagrams