

INTRODUCTION TO JAVA 3D

1. What is Java 3D?

- Java 3D is an interactive 3D graphics API for building applications and applets in Java.
 - A means for developing and presenting 3D content.
 - Designed for “*Write once, run anywhere*”.

2. What does Java 3D do?

- Provide a vendor-neutral, platform-independent API within Java
 - Java3D exists as part of the *Java Media APIs*.
 - Integrates with other Java APIs: image processing, fonts, 2D drawing, user interfaces, etc.

- Enable high level application development
 - Authors focus upon content, not rendering
 - Java 3D handles optimal rendering
- And achieve high performance
 - Draw via OpenGL/Direct3D
 - Uses 3D graphics hardware acceleration where available

3. What do I need to use Java 3D?

- Software:
 - Java 2 platform
 - Java 3D 1.3
- Hardware: a 3D graphics accelerator

BUILDING 3D CONTENT

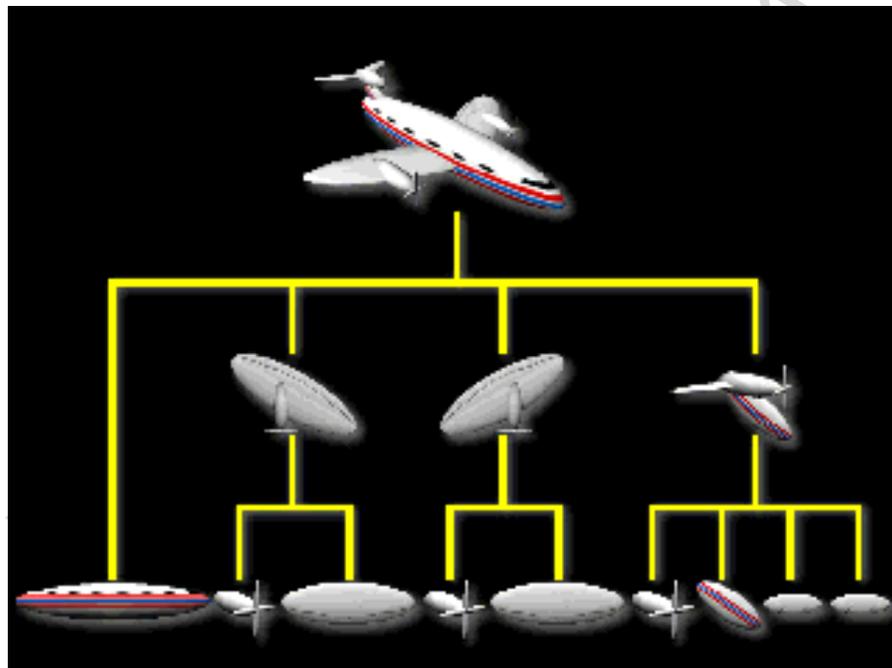
1. A *virtual universe* holds everything.

- A universe describes everything that we see and do within a particular world.
- A virtual universe is a collection of scene graphs.
- Typically there is one virtual universe per application.

2. Scene graphs

- A *scene graph* is a hierarchical tree that describes objects and their relationship to each other.
 - “Children” are shapes, lights, sounds, etc.
 - “Parents” are groups of children and other parents

- Airplane: a scene graph example

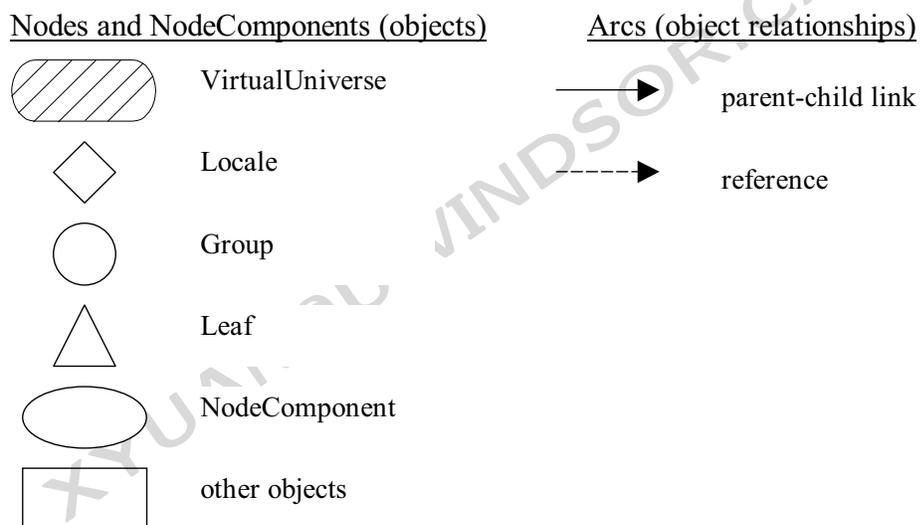


- A *node* is an item in a scene graph.
 - *Leaf nodes* are the nodes with no children.
 - Shapes, lights, sounds, etc.
 - Animation behaviors
 - *Group nodes* are the nodes with children.
 - Transforms, switches, etc.
- A *node component* is a bundle of attributes for a node.
 - Geometry of a shape
 - Color of a shape
 - Sound data to play
- Scene graphs are built from components including:
 - Shapes (geometry and appearance)
 - Groups and transforms

- Lights
 - Fog and backgrounds
 - Sounds and sound environments (reverb)
 - Behaviors
 - View platforms (viewpoints)
3. A *locale* is a position in the virtual universe at which to put scene graphs.
- A locale positions branches of scene graph in the virtual universe.
 - Typically there is one locale per virtual universe.
 - A *branch graph* is a scene graph that forms a tree branch in the a locale of the virtual universe.

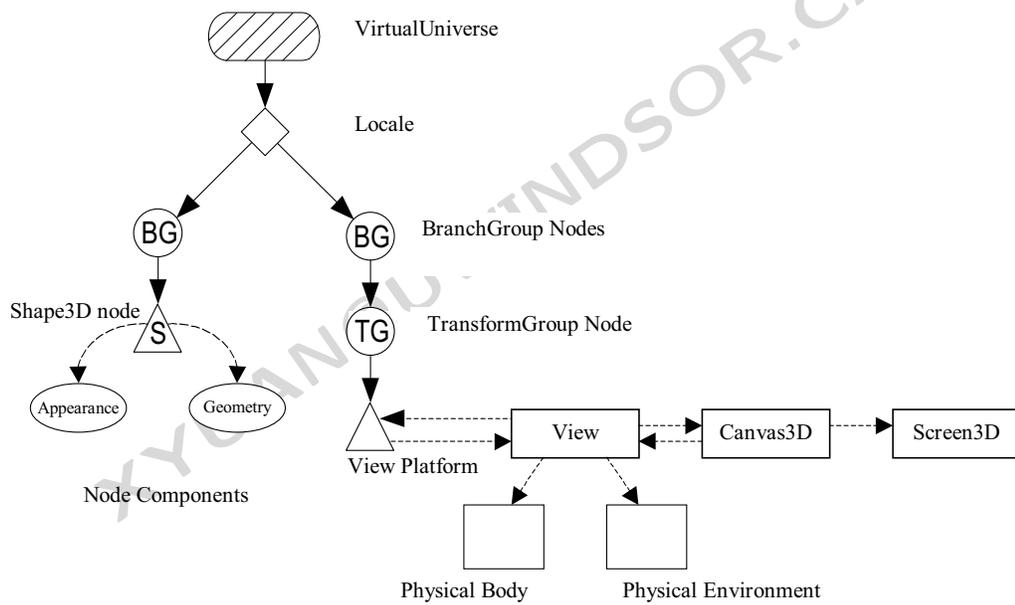
- Typically there are several branch graphs per locale.
- Scene graphs are typically divided into two types of branch graphs:
 - *Content branch*: shapes, lights, and other content
 - Typically multiple content branches per locale
 - *View branch*: viewing information
 - Typically one view branch per virtual universe
- This division is optional:
 - Content and viewing information can be interleaved in the same branch (and sometimes should be)

4. Symbols representing objects in scene graphs

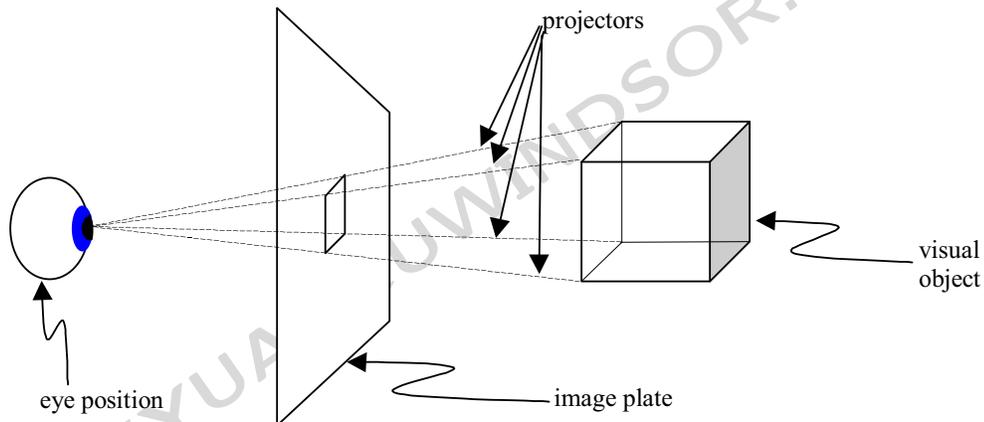


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5. Virtual universe: a scene graph with symbols



6. Image plane and eye position in a virtual universe



- An image plane is the conceptual rectangle where the content of a virtual universe is projected to form the rendered image.
- Canvas3D provides an image in a window on your computer display.
 - In the real world, the devices that a canvas paints on to can be different.
 - a set of 3D shutter glasses
 - a CAVE environment, or
 - a flat monitor.
 - A graphics configuration is extracted from a system and then passed to the canvas with necessary options.

7. A complete view and camera representation needs to model many of the same characteristics in the 3D world.



- The `PhysicalBody` class models the body of a user, and represents how he/she is looking at the virtual world.
 - Eye position relative to the center of the head is mainly used when making stereo projections for HMDs and similar devices.
 - Ear position relative to the center of the head is used to control the projection of 3D sound.
 - Eye height from the ground is used for automatic terrain following as the rendering should match the reality to prevent motion sickness and similar physiological problems.
 - Eye position relative to the screen is used for more control over the stereo projection.

- Head Tracking transform is used to control and scaling or offset calculations that need to be done.
- The `PhysicalEnvironment` class models the computer environment that the user's body sits in. It manage and installs the various devices available on your computer.
 - Audio device is installed most of the time.
 - There are also specialized devices, such as the classical Mattel PowerGlove.

8. Recipe for writing Java 3D programs

1. Create a `Canvas3D` object
2. Create a `VirtualUniverse` object
3. Create a `Locale` object, attaching it to the `VirtualUniverse` object
4. Construct a view branch graph
 - a. Create a `View` object
 - b. Create a `ViewPlatform` object
 - c. Create a `PhysicalBody` object
 - d. Create a `PhysicalEnvironment` object
 - e. Attach `ViewPlatform`, `PhysicalBody`, `PhysicalEnvironment`, and `Canvas3D` objects to `View` object
5. Construct content branch graph(s)
6. Compile branch graph(s)
7. Insert subgraphs into the `Locale`

9. An overview of the Java 3D API class hierarchy

