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C O U R S E N O T E S



Introduction to VRML

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Introduction to VRML 97

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Abstract

VRML (the Virtual Reality Modeling Language) has emerged as the de facto standard for describing 3-D shapes and scenery on the World Wide Web. VRML's technology has very broad applicability, including web-based entertainment, distributed visualization, 3-D user interfaces to remote web resources, 3-D collaborative environments, interactive simulations for education, virtual museums, virtual retail spaces, and more. VRML is a key technology shaping the future of the web.

Participants in this course will learn how to use VRML 97 (a.k.a. *ISO VRML*, *VRML 2.0*, and *Moving Worlds*) to author their own 3-D virtual worlds on the World Wide Web. Participants will learn VRML concepts and terminology, and be introduced to VRML's text format syntax. Participants also will learn tips and techniques for increasing performance and realism. The course includes numerous VRML examples and information on where to find out more about VRML features and use.

Lecturer biographies

- **David R. Nadeau**

Mr. Nadeau is a principal scientist at the San Diego Supercomputer Center (SDSC), specializes in scientific visualization and virtual reality. He is an author of technical papers on graphics and VRML, a co-author of two books on VRML (*The VRML Sourcebook*, and *The VRML 2.0 Sourcebook*), and authors the bi-monthly *VRML Technique* column for NetscapeWorld magazine. He has taught VRML courses at conferences including SIGGRAPH 96, WebNet 96, and VRML 97, and is the creator of *The VRML Repository*, a principal Web site for information on VRML software and documentation. Mr. Nadeau co-chaired *VRML 95*, the first conference on VRML, and the *VRML Behavior Workshop*, the first workshop on behavior support for VRML. He is SDSC's representative in the *VRML Consortium*.

- **John L. Moreland**

Mr. Moreland is a senior programmer/analyst at SDSC and specializes in scientific visualization and virtual reality. He is the author of papers on VRML, and a co-author of two books on VRML (*The VRML Sourcebook*, and *The VRML 2.0 Sourcebook*). He was the principal developer of a large VRML scientific visualization environment demonstrated in the CAVE at Supercomputing '95. He has taught courses in VRML at conferences worldwide including Internet World Asia 96, SIGGRAPH 96, Web Developers 97, and Internet World Asia 97. Mr. Moreland co-chaired *VRML 95*, the first conference on VRML, and the *VRML Behavior Workshop*, the first workshop on behavior support for VRML.

- **Michael M. Heck**

Mr. Heck is the Vice President for Research and Development at Template Graphics Software (TGS), one of the first vendors to produce a cross-platform VRML browser. He has been involved with 3-D graphics and SIGGRAPH since 1980. He has been a speaker at previous SIGGRAPH courses, including courses on PHIGS (1986), PEX (1993), OpenInventor (1995), and VRML (1996). He was a co-author for the first book on 3-D programming with PHIGS. Both Mr. Heck and TGS are focused upon making VRML and 3-D graphics a pervasive technology by providing tools for both programmers and end users on a wide range of platforms and environments.

Preface

Welcome to the SIGGRAPH 97 *Introduction to VRML 97* course notes! These course notes have been written to give you a quick, practical, example-driven overview of *VRML 97*, the Web's Virtual Reality Modeling Language. To do this, we've included over 500 pages of course material with nearly 200 images and over 100 VRML examples!

To use these course notes you will need an HTML Web browser with support for viewing VRML worlds. An up to date list of available VRML browsing and authoring software is available at:

The VRML Repository
(<http://www.sdsc.edu/vrml>)

What's included in these notes

These course notes primarily contain three types of information:

1. General information, such as this preface
2. Course slides and examples
3. Article reprints from NetscapeWorld magazine

The course slides are arranged as a sequence of 400+ hyper-linked pages containing VRML syntax notes, VRML usage comments, or images of sample VRML worlds. Clicking on a sample world's image, or the file name underneath it, loads the VRML world into your browser for you to examine yourself.

You can view the text for any of the VRML worlds using a text editor and see how we created a particular effect. In most cases, the VRML files contain extensive comments providing information about the techniques the file illustrates.

The course notes provide a necessarily terse overview of VRML. A more detailed introduction to the basic features of VRML is provided in four article reprints courtesy NetscapeWorld magazine. The articles do not cover all of VRML. We recommend that you invest in one of the VRML books on the market to get thorough coverage of the language. Two of this course's lecturers are co-authors of one such VRML book, *The VRML 2.0 Sourcebook*. Several other good VRML books are on the market as well.

A word about VRML versions

VRML has evolved through several versions of the language, starting way back in late 1994. These course notes cover *VRML 97*, the latest version of the language. To provide context, the following table provides a quick overview of these VRML versions and the names they have become known by.

Version	Released	Comments
VRML 1.0	May 1995	<p>Begun in late 1994, the first version of VRML was largely based upon the <i>Open Inventor</i> file format developed by Silicon Graphics Inc. The VRML 1.0 specification was completed in May 1995 and included support for shape building, lighting, and texturing.</p> <p>VRML 1.0 browser plug-ins became widely available by late 1995, though few ever supported the full range of features defined by the VRML 1.0 specification.</p>
VRML 1.0c	January 1996	<p>As vendors began producing VRML 1.0 browsers, a number of ambiguities in the VRML 1.0 specification surfaced. These problems were corrected in a new VRML 1.0c (clarified) specification released in January 1996. No new features were added to the language in VRML 1.0c.</p>
VRML 1.1	canceled	<p>In late 1995, discussion began on extensions to the VRML 1.0 specification. These extensions were intended to address language features that made browser implementation difficult or inefficient. The extended language was tentatively dubbed VRML 1.1. These enhancements were later dropped in favor of forging ahead on VRML 2.0 instead.</p> <p>No VRML 1.1 browsers exist.</p>
Moving Worlds	January 1996	<p>VRML 1.0 included features for building static, unchanging worlds suitable for architectural walk-throughs and some scientific visualization applications. To extend the language to support animation and interaction, the VRML architecture group made a call for proposals for a language redesign. Silicon Graphics, Netscape, and others worked together to create the <i>Moving Worlds</i> proposal, submitted in January 1996. That proposal was later accepted and became the starting point for developing VRML 2.0. The final VRML 2.0 language specification is still sometimes referred to as the <i>Moving Worlds</i> specification, though it differs significantly from the original <i>Moving Worlds</i> proposal.</p>
VRML 2.0	August 1996	<p>After seven months of intense effort by the VRML community, the <i>Moving Worlds</i> proposal evolved to become the final VRML 2.0 specification, released in August 1996. The new specification redesigned the VRML syntax and added an extensive set of new features for shape building, animation, interaction, sound, fog, backgrounds, and language extensions.</p> <p>Beta versions of VRML 2.0 browser plug-ins have been available since</p>

late 1997. However, as of this writing (May 1997) there are still no fully-compliant, complete VRML 2.0 browsers available on the market.

VRML 97 September 1997 In early 1997, efforts got under way to present the VRML 2.0 specification to the International Standards Organization (ISO) which oversees most of the major language specifications in use in the computing community. The ISO version of VRML 2.0 was reviewed and the specification significantly rewritten to clarify issues. A few minor changes to the language were also made. The final ISO VRML was dubbed *VRML 97*. The VRML 97 specification features finalized in March 1997, while the specification's text finalized in September 1997.

One beta version of a VRML 97 browser plug-in is available as of this writing: Silicon Graphics Cosmo Player for SGI platforms. More VRML 97 compliant browsers are expected within the next few months.

VRML 1.0 and VRML 2.0 differ radically in syntax and features. A VRML 1.0 browser cannot display VRML 2.0 worlds. Most VRML 2.0 browsers, however, can display VRML 1.0 worlds.

VRML 97 differs in a few minor ways from VRML 2.0. In most cases, a VRML 2.0 browser will be able to correctly display VRML 97 files. However, for 100% accuracy, you should have a VRML 97 compliant browser for viewing the VRML files contained within these course notes.

How we created these course notes

These course notes were developed primarily on Silicon Graphics High Impact UNIX workstations. HTML and VRML text was hand-authored using a text editor. A Perl program script was used to process raw course notes text to produce the 400+ individual HTML files, one per course slide.

HTML text was displayed using Netscape Navigator 3.01 on Silicon Graphics and PC systems. Colors were checked for viewability in 24-bit, 16-bit, and 8-bit display modes on a PC. Text sizes were chosen for viewability at a normal 12 point font on-screen, and at an 18 point font for presentation during the SIGGRAPH 97 course. The large text, white-on-black colors, and terse language are used to insure that slides are readable when displayed for a large course audience at the SIGGRAPH 97 conference.

VRML worlds were displayed on Silicon Graphics systems using the Silicon Graphics Cosmo Player 1.02 beta 2 VRML 97 compliant browser for Netscape Navigator. The same worlds were displayed on PC systems using three different VRML 2.0 compliant browsers for Netscape Navigator: Silicon Graphics Cosmo Player 1.0 beta 3a, Intervista WorldView 2.0, and Newfire Torch alpha 3.

Texture images were created using Adobe PhotoShop 4.0 on a PC with help from KAI's PowerTools 3.0 from MetaTools. Image processing was also performed using the Image Tools suite of applications for UNIX workstations from the San Diego Supercomputer Center.

PDF course notes for printing by SIGGRAPH 97 were created by dumping individual course slides to PostScript on a Silicon Graphics workstation. The PostScript was transferred to a PC where it was converted to PDF and assembled into a single PDF file using Adobe's Distiller and Exchange.

Use of these course notes

We are often asked if there are any restrictions on use of these course notes. The answer is:

These course notes are copyright (c) 1997 by David R. Nadeau, John L. Moreland, and Michael M. Heck. Users and possessors of these course notes are hereby granted a nonexclusive, royalty-free copyright and design patent license to use this material in individual applications. License is not granted for commercial resale, in whole or in part, without prior written permission from the authors. This material is provided "AS IS" without express or implied warranty of any kind.

You are free to use these course notes in whole or in part to help you teach your own VRML courses. You may translate these notes into other languages and you may post copies of these notes on your own Web site, as long as the above copyright notice is included as well. You may not, however, sell these course notes for profit or include them on a CD-ROM or other media product without our written permission.

If you use these course notes, we ask that you:

1. Give us credit for the original material
2. Tell us since we like hearing about the use of our material!

If you find bugs in the notes, please tell us. We have worked hard to try and make the notes bug-free, but if something slipped by, we'd like to fix it before others are confused by our mistake.

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