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Session 3: Virtual Classrooms for Online Education – Specifications

Course Title: XML for Java Developers  
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I. Full Storyboard Illustrating the Use of the Integrated Virtual Environment

This storyboard details the intended use of the virtual "offline" chat room environment in the scope of the XML for Java Developers class. For illustration purposes, an online student by the name of "Joe" will peruse the framework.

I.1. Step 1: LearningSpace Course Catalog Review

Joe accesses the LearningSpace course catalog to review the online classes currently offered. Joe selects the "XML for Java Developers" course taught by Jean-Claude Franchetti.

I.2. Step 2: Course Schedule Review

Jean-Claude has developed a complete course schedule within the LearningSpace environment. Joe reviews the schedule to understand which material will be covered online as the course progresses.

I.3. Step 3: Getting Familiar with LearningSpace

Joe enters the MediaCenter and accesses Help available within LearningSpace to familiarize himself with the hybrid LearningSpace/virtual classroom environment. No course material is available as the online class has not yet started. Joe understands at this point that all course collateral (i.e., presentations, documents, images/animations, and digitized video/audio files) will be available from the LearningSpace MediaCenter. Joe will also be able to access traditional LearningSpace views to access entries by title, writer, keyword, and type. Additionally, Joe is able to follow a "live link" to an external "welcome" page. The "welcome" page details course conventions, "live" office hours, policies on assignment submission dates, and any other information important for Joe to know before proceeding. The welcome page has an embedded Virtual classroom viewer applet, and includes links to download multimedia browser's plugins or helper applications that may be required to present the course material in an integrated fashion. Multimedia elements supported include GIFs, MIDI files, WAV files, MPEG, and AVI files. "Live" office hours are listed as online events that will be moderated by Jean-Claude in his virtual office. "Live" media elements, such as streaming audio, video, interactive, and multimedia controls are supported as part of course material presentations, or "live" office hours. The course home page provides instructions to install software capable of generating and serving live media such as Microsoft's NetShow, Progressive Networks' Real Audio, and Active X multimedia controls.

As Joe enters the welcome page, he is prompted to enter his name/id. Once Joe enters that information, an "avatar" (i.e., an icon representing Joe) is created and dropped in the virtual classroom. Joe can navigate through various rooms to become familiar with the virtual classroom environment. No virtual professor or students are present in the virtual classroom as the online class has not yet started.
I.4. Step 4: Home Page and Virtual Chat Room Creation

Joe uses the LearningSpace profiling capabilities to create his own webpage. He is also given the ability to create a virtual online or offline chat room for himself and include it as an applet on his web page. Joe will be able to use the environment to socialize with other students or anybody else aware of the location of the page he just created on the web.

I.5. Step 5: Attending an Integrated Multimedia Presentation

The online course has now officially started. Joe enters the MediaCenter again, and finds various multimedia components relating to the XML topics listed for that week in the schedule. Joe follows the "live link" to the external "welcome" page, and enters the virtual classroom to access the online material available for that week. By default, Joe will access the material available for the current week, but he will also be able to backtrack to material previously covered. New material may be added on a daily basis. Joe can click on different links listed on a blackboard within the virtual classroom. The links list various integrated multimedia presentations that Joe can attend at that time. Links are available for course material presentations, homework specifications, homework solutions, and Q&As. As he selects a given collateral, Joe is taken through an integrated multimedia presentation within the virtual classroom viewer. The presentation includes synchronized slide shows, audio/video, and images/animations. Material presentation may include a simulated dialog between the virtual professor, and the virtual students who are present in the classroom.

I.6. Step 6: Asking Questions in the Virtual Classroom

As Joe views the integrated presentations within the virtual classroom, he may ask questions, which will be answered by the professor on a deferred basis. The questions and related answers will be added as part of Q&A links on the virtual classroom blackboard. Joe will be able to review the answers to his questions as part of a later session. Jean-Claude will integrate students’ questions received within the past few days and post answers as a Q&A link in the virtual classroom.

I.7. Step 7: Attending "Live" Office Hours

Joe wishes to attend "live" office hours. At a given time each week, Jean-Claude will monitor an online event within a virtual conference room where all students can come and ask questions. Students can be invited on the stage to ask their questions. A list of questions may be preloaded within the conference room and answered prior to the interactive discussion between Jean-Claude and his students. A log of the interactive session is kept and made available as a Q&A for the given week in the virtual classroom. As Jean-Claude answers questions, he can lead the students through a slide show, and use audio/video and images/animations to support his answers. Note that the traditional LearningSpace threaded bulletin board may also be used to support offline discussions. The LearningSpace CourseRoom may optionally be integrated with the virtual offline
chat room capability so that Q&As resulting from the use of the LearningSpace environment will show in the virtual classroom. Similarly Q&As initiated in the virtual environment may optionally be reflected within the LearningSpace CourseRoom.

I.8. Step 8: Using the Virtual Classroom Homework Support Framework

The integrated virtual environment supports the presentation (i.e., explanations) of homework, projects, and quiz material in much the same way as a regular course material presentation. Quizzes will be administered via the LearningSpace environment. The virtual classroom framework uses a server-side XML processing engine to parse through the integrated presentation scripts that are being fed into the virtual classroom support engine. The same server-side XML processing engine will be available for students to test their XML Web development homework and projects. Students will learn how to develop client and server-side XML web sites, and will make use of various XML markup languages as part of the process. As a result, the XML for Web developer class will greatly benefit from the new existing framework, as it will be used not only to support the coursework presentation but also to facilitate the testing of students' homework solutions in a working XML environment.

I.9. Step 9: Attendance Monitoring

To monitor students' attendance and progress, Jean-Claude uses a combination of LearningSpace's assessment manager, and the monitoring capabilities provided by the virtual environment. Jean-Claude also uses the overall LearningSpace administration capabilities to plan the course implementation, prepare the course, start and deliver the course, and close/archive the course. The course preparation, and delivery portion make extensive use of the virtual classroom environment.
II. Storyboard Detailing the Subset of Capabilities Included in the Sample Demonstration Software

The simplified storyboard set forth in this section illustrates a scaled down demonstration of the virtual "offline" chat room environment in the scope of the XML for Java Developers class. For illustration purposes, an online student by the name of "Joe" peruses the framework. To simplify the demonstration and focus on the proposed online education framework enhancements, we skip the steps that Joe would normally go through to access the virtual environment via the LearningSpace portal.

II.1. Demonstration Step 1: Integrated multimedia presentation

Joe enters the class "welcome" page via Internet Explorer. The virtual classroom viewer applet is embedded on the welcome page. As Joe accesses the welcome page, he sees his avatar enter the virtual classroom. The virtual classroom blackboard features hot spots identifying the online material available for that week.

Joe starts ThePalace's client software and clicks on a link listed on the board located within the virtual classroom. This link is attached to a multimedia presentation that Joe can attend at this time. As Joe double clicks on the blackboard link, he is taken through an integrated multimedia presentation within the virtual classroom viewer. The presentation includes a synchronized slide show with an audio track and a video presentation related to the XML topic of the week (i.e., "Document Type Definitions"). To interrelate the various multimedia components of the presentation, a simulated dialog between the virtual professor and his virtual students is taking place concurrently in the virtual classroom.

II.2. Demonstration Step 2: Partial demonstration of deferred chat capability

As Joe views the integrated presentation within the virtual classroom, he asks questions that show up as speech bubbles coming out of his avatar. In the production environment, these questions would be answered by the professor on a deferred basis, and added as part of Q&A links on the virtual classroom blackboard. Joe would then be able to review the answers to his questions as part of a later session. This deferred chat capability is not fully illustrated as part of our simple demonstration.

II.3. Demonstration Step 3: Demonstration of "live" virtual office hours

Joe wishes to attend "live" office hours. The professor moderates his office hours in a virtual conference room where other students can join as well. Joe is invited on the stage to ask his questions. A log of the session is kept. As the professor answers Joe's questions, he leads Joe through a slideshow to support his answers.
III. Illustration of the Full and Demonstration Storyboards Steps

The following diagram illustrates the steps described in the full system storyboard (i.e., section I), and the sample demonstration scenario (i.e., section II).
IV. Support System Implementation

The virtual environment system is implemented as a set of plug-ins for ThePalace User and Server software. We chose that particular two-dimensional environment for its overall performance, and quality. The client plug-in was designed specifically to support an "offline" classroom environment that integrates various course multimedia components residing either in the Virtual Environment Server or the LearningSpace server (or both). The client plug-in also support Q&A capabilities that enable students to ask questions while attending a particular offline session. Students can then view the instructor's replies as part of a later Q&A review after the instructor has had a chance to post replies to the last batch of student's questions. The client plug-in installed on each student workstation collects the questions and sends them to a Palace Server plug-in, which is also designed specifically for the Integrated Virtual Classroom environment. The server plug-in packages all questions and sends them via email to the instructor and TA. Once the instructor and TA have organized their replies to all questions, they email them to the Palace Server plug-in. The server plug-in packages these answers as a XML/SMIL Q&A that gets posted as a link on the virtual classroom's blackboard. The online chat capabilities of ThePalace provide full support for the instructor "live" office hours. The project testing environment is a separate XML server environment targeted initially to the XML courses. Finally, the system uses monitoring capabilities provided as part of ThePalace user software, PalacePresents, and ThePalace server.

In the next subsections, we detail the support system architecture, summarize the features of the Integrated Virtual Environment, and explain how the demonstration software is currently implemented.

IV.1. Complete Support System Architecture

The diagram below illustrates the overall support system architecture. The demonstration scenario uses the Virtual Environment Administration's Palace Server, the Student environment, and a combined environment for the Professor and TA. All software components demonstrated are running on the same machine for the demonstration.
IV.2. Key features of the Integrated Virtual environment

The Integrated Virtual Environment provides an integrated view of all the multimedia components provided to support offline sessions in the virtual classroom. The online support material is integrated in LearningSpace, and replicated in the Virtual Environment. This makes it possible to keep using LearningSpace's MediaCenter to access individual multimedia components.

The Integrated Virtual Environment provides new offline/online semi-interactive web chat features. As a future extension of the proposed environment, the LearningSpace's...
collaborative learning features (i.e., its multithreaded bulletin board) could be integrated with the new semi-interactive web chat features via a Palace server plug-in.

The Integrated Virtual Environment uses the XML SMIL markup language to specify the integrated multimedia scripts that support the various sessions, Q&As, and homework related material. The text collateral may also be specified using an XML markup language to support improved search capabilities, and a faster retrieval capability. XML Search capabilities require an XML search engine, which allows searching for data matching specific markups, and pointing to exact topics via XML Linking Language pointers. Another benefit of using XML to specify the actual collateral content is the associated support for multiple style sheets allowing presentation of the same material to various output devices (e.g., audio/voice instead of text).

The Integrated Virtual Environment provides novel support for XML assignments and projects giving students the ability to test their projects using an XML infrastructure provided by the instructor. Access to the homework support environment is enabled via a separate server, and via an external link added to the LearningSpace MediaCenter. The testing environment will be specific to the XML pilot courses, but the concept could easily be extended to support other online courses. LearningSpace does not currently provide a project testing capability.

The Integrated Virtual Environment monitors students' presence in the virtual classroom, their use of the offline/online chat capability, and the project testing framework. These new monitoring capabilities complement the ones provided as part of LearningSpace.

IV.3 Implementation of Sample Demonstration Software for the Virtual "Offline" Chat Room Environment

The demo software uses The Palace's viewer, client, server, and PalacePresents Moderator. The Palace's viewer and client software products are used by Joe, while The Palace's server and PalacePresents Moderator products are used to support the online XML class in the demonstration. By skipping the interface to LearningSpace, the demonstration scenario bypasses the need for an administrator. The demonstration scenario illustrates the professor's "live" office hours, and the related role of the TA as a moderator. The demonstration scenario uses a simplified interface to the Virtual Environment administration framework, and uses a Palace Client custom plug-in to emulate classroom avatars. These avatars are used to present XML multimedia course material in an integrated fashion. The course material presentation agenda is encoded in XML/SMIL and converted on the fly to drive the Palace Client virtual classroom interface. The demonstration scenario uses a simplified XML server to generate the XML course scripts.

To support Step 1 of the demonstration, a Palace User Software plug-in was developed to monitor Joe's requests for viewing class material within the virtual classroom. When Joe clicks the link corresponding to the XML DTD online presentation, The Palace User Software plug-in loads in an XML document that details the synchronization of various multimedia components. The XML document is parsed on the server and an XSL style
sheet is used to generate a stream of corresponding lptscrae commands that are fed into ThePalace's server. Lptscrae is a proprietary scripting language used to control ThePalace's server. A client plug-in control stream is also generated from the original XML document, and sent to the client plug-in to drive the virtual classroom presentation on the students' machines.

To support Step 2 of the demonstration, Joe uses the virtual chat capabilities provided by ThePalace's User Software. As the ThePalace's User Software allows logging of the chat sessions, the content of the sessions can easily be translated into an email sent to the professor. Once the professor responds to Joe's questions, an XML Q&A document is generated, and a corresponding Q&A "link" is then posted on the virtual classroom blackboard. To simplify the initial presentation, the professor's deferred reply, and Q&A generation is not demonstrated. The corresponding software will be implemented within the ThePalace's client plug-in, which is currently used to support Step 1 of the demonstration scenario.

To support Step 3, PalacePresents Moderator capabilities are used to gather statistics related to the system's interaction with Joe.

An alternative to using ThePalace's software could be provided by Netscape's Community System, and Microsoft's Commercial Internet System. These later solutions would be much more costly, and would not provide measurable benefits. This is especially true since GIFs, MIDI files, WAV files, MPEG, AVI files, Microsoft's Netshow videos, Progressive Networks' RealAudio audio files, and Shockwave movies are already supported by ThePalace's software for multimedia presentations. Also, assuming a maximum of 8 concurrent students in the virtual classroom, ThePalace's base server software is be free of charge. The eight concurrent students limitation seems acceptable, as students are not usually reviewing a session at the same time, and the size of an online class is usually limited to a few teens of students. Using a two-dimensional tool such as ThePalace leads to reasonable demands on network resources, and limited content development. Most of the network overhead is introduced by avatars, movement, and graphical messaging, as well as multiple downloads of the initial graphics which each new user must have to view the different virtual rooms. ThePalace's software currently utilizes caching on both the server and client to minimize the load on network resources. Administration features also allow you to keep the size of the cache files manageable.

As a result, we suggest extension to ThePalace software to support the proposed virtual classroom capabilities. Clearly, a more powerful alternative would be to use 3D VRML-based environments such as the ones provided by Integrated Data Systems' V-Realm 3D Media Server, Black Sun's CyberHub, and Worlds Inc.'s Active WordServer. However, current versions of specialized VRML servers come bundled with a significant amount of overhead, and their prices are currently very high. Similarly, we could think of implementing "live" office hours in a 3D environment or using streaming audio/video capabilities. Again, these approaches would require costly hardware, and would introduce a significant overhead.
V. Software Requirements

V.1. Third Party Software Checklist

V.1.1. ThePalace Viewer

Systems' requirements for The Palace Viewer are as follows:

*Minimum recommended system*

- Pentium Processor
- 16 MB RAM
- Windows 95
- 28.8 modem

*Disk Space*

The Palace Viewer requires 0.5 MB of disk space after download.

*Browser*

You need Internet Explorer 4.0.1, or Netscape 4.0.5 or better.

V.1.2. ThePalace User Software

Systems' requirements for The Palace User Software are as follows:

*Windows*

- 486+ processor
- Windows 95/98/NT
- 16Mb of RAM
- 16bit High color
- 800x600+ support
- 28.8kbps connection to the Internet
- Mouse

*Macintosh*

- System 7.4+
- 16Mb of RAM
- 28.8kbps connection to the Internet
- Thousands of Colors
- 800x600+ support
- Mouse
V.1.3. The Palace Server Software

Systems' requirements for The Palace Server software are as follows:

Windows

- Pentium processor
- Windows 95/98/NT
- 32MB RAM and 30 MB of disk space
- 64 MB RAM and 60 MB of disk space are recommended for installations handling over 100 Palace users and a high volume of Internet service traffic.
- 16bit High color
- 800x600+ support
- 28.8kbps (or greater) connection to the Internet
- Bandwidth requirements range from 2.5 to 4.2 kbps per simultaneously connected users. Example: a T1 line can support between 350 and 600 users dependent upon the exchange of multimedia components.
- Front ends may be installed across multiple physical servers
- Mouse

Macintosh

- System 7.4+
- 16Mb of RAM
- 28.8kbps connection to the Internet
- Thousands of Colors
- 800x600+ support
- Mouse

UNIX

The UNIX Palace Server runs on the following UNIX platforms:

- Alpha processor running Digital Unix v4.0A or later.
- Intel processor running Linux kernel 2.0.36 or later.
- SPARC processor running Solaris 2.5.1 or later.
- Recommended RAM and disk space is a minimum of 64 megs of RAM on your UNIX server and 2 gigs or more of drive space total. The server itself can run in as few as 12 megs of free RAM and 20 megs of drive space. The server doesn't take up that much drive space, but some additional space will be required for property file growth and server logs.

V.1.4. The Palace Presents
The following are the specific requirements for The Palace Presents, a feature of ThePalace Server:

- Requires the 32-bit Palace for Windows, version 3.0 or better; Mac 1.6 or InstantPalace 1.5.
- Requires a 486 PC or better with at least 8 MB of RAM; the Windows NT version 4.0 or newer or the Windows 95 operating system; and, a 256-color display.
- A minimum screen resolution of 800x600 is required.
- Requires Palace Server Operator access to The Palace hosting the event.

V.1.5. ThePalace Presents Moderator

Systems' requirements for The Palace Presents Moderator are as follows:

- A Pentium or higher processor or equivalent
- Windows 95/98/NT 4.0 or higher operating system
- The latest ThePalace User Software 3.4.2 for Windows
- The Palace Server

V.2. Custom Software Checklist

The custom software implemented for the Virtual Classroom Environment includes a custom plug-in for the Palace User software, and a custom plug-in for the Palace server software. The special support provided by these two plug-ins is described in section IV. The special homework support framework provided for the pilot XML courses requires a custom XML server provided by the instructor.

V.2.1. Custom Palace User Software Plug-in

The custom Palace User software plug-in requires 0.5 MB of additional disk space on the machines running ThePalace User software (i.e., the students', professor's, and TA's machines).

V.2.2. Custom Palace Server Plug-in

The custom Palace server plug-in requires 0.5 MB of additional disk space on the machine running ThePalace Server software (i.e., the Virtual Environment Administration server).

V.2.3. Custom XML Homework Support Software

The custom XML homework support software requires 50 MB of additional disk space on the machine running ThePalace Server software (i.e., the Virtual Environment Administration server).

V.3. Software Requirements per Type User
This subsection provides a software and capabilities checklist for the different users of the Virtual Classroom Environment. The disk space and machine requirements for ThePalace software and plug-ins was specified in the last two sections of this chapter.

V.3.1. Students' Software Requirements

- Browser (IE, Netscape, AOL 4.0)
- ThePalace Viewer
- ThePalace User Software with custom plug-in
- Audio/Video support (i.e., plugins, RealAudio/NetShow/Shockwave software)
- Email/FTP
- Disk space requirements for copies of XML course collateral will be no more than 1 MB for each session. Students should not keep local copies of collateral as the material will be updated very frequently.

V.3.2. Professor's Software Requirements

- Browser (IE, Netscape, AOL 4.0)
- ThePalace Viewer
- ThePalace User Software with custom plug-in
- ThePalace Presents Moderator
- Audio/Video support (i.e., plugins, RealAudio/NetShow/Shockwave software)
- Email/FTP
- XML course development support software (editor, parser, etc.)
- Disk space required for XML special software is approximately 5 MB
- Disk space required to develop XML material is approximately 20 MB

V.3.3. TA's Software Requirements

- Same as professor's

V.3.4. LearningSpace Administrator's Software Requirements

- LearningSpace Server
- Web Server
- Database Server
- Email Server / FTP
- Disk space required for XML course material is approximately 150 MB

V.3.5. Virtual Environment Administrator's Software Requirements

- ThePalace Server (either NT, Windows, or Unix)
- Custom Palace Server plug-in
- Web Server
• Database Server
• Email Server / FTP
• XML custom homework support software
• Disk space required for XML course material is approximately 200 MB
VI. Course collateral for "XML for Java Programmers" online pilot course

The "XML for Java Developer" course will inherit some of the material put together for G22_3033_002. Material for both of these classes is currently available on the web at http://www.nyu.edu/classes/jcf/g22.3033-002. In general, the online class material will includes the following multimedia components.

(a) Offline chat presentations. During these presentations, a virtual professor will address virtual students in the virtual classroom via on screen callouts or using a digitized voice. The virtual professor initiates the presentation of various multimedia components (i.e., see items (b), (c), and (d) below) to support full continuity in the material presentation, and relieve students from having to locate the various components on their own.

(b) Synchronized PowerPoint slide shows/audio tracks covering weekly topics.

(c) Synchronized images/audio tracks covering homework specs explanations, homework solutions, and describing the use of certain software tools (i.e., XML editors, XML parsers, etc.).

(d) Videos covering live presentations, and case studies.

(e) Applets to support interactive presentations, quizzes, and examinations.

(f) Quizzes, examinations, and other online handouts.

(g) XML support software & tools database (e.g., XML editors, XML parsers).

(g) XML project support server (i.e., server-side XML, and relevant XML applications)