



# TRS1000 Teaching Resource System

## Lecture Notes

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# Preface

The Teaching Resource System is a framework for creating teaching resources where the same source file is used to generate various resources. This includes lecture notes and lecture slides.

This document represents the lecture slides for the fictitious course TRS1000 *Teaching Resource System* which aims to describe the Teaching Resource System. Currently there is only one topic. This topic is an overview of the system which also corresponds to one set of topic slides and one chapter in the lecture notes.

The overview topic also corresponds to a paper presented at ICECE'2007 in Brazil which describes the Teaching Resource System. The actual slides used at the conference have been created using the system and is itself an example of its use.

More details on the actual use of the system will be included at a later date. These will form extra topics which correspond to extra chapters in the lecture notes.

Further information regarding the lecture notes can be found on the web site for the Teaching Resource System:

- TRS1000 *Teaching Resource System* Web Site  
(<http://www.cel.usyd.edu.au/~pstepien/TRS1000>)

The actual code for the Teaching Resource System will be made available in future for others to use. The delay in its release was due to a change of employment by the author.

Comments and feedback on these lecture notes and in the Teaching Resource System in general are most welcome.



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## Chapter 1

# The Generation of Different Teaching Resources Using a Single Source of Information

### Abstract

A number of different teaching resources are used when presenting a course of study. These include slides used in lectures, lecture notes, tutorial exercises and laboratory exercises. These resources, along with other information, such as announcements, are also usually made available online via a course web site. Traditionally, these different resources were generated using different software packages. As there is duplication of information, such as between the lecture slides and lecture notes, ensuring that information is consistent between resources becomes time consuming. To overcome this problem, a system for generating different resources from a single source of information has been developed. This ensures that there is no duplication of information and that related information are kept together, such as tutorial exercises and the worked solutions to the exercises. The system described actually provides a complete package for managing all teaching related activities, including grading.

### 1.1 Introduction

Presenting a course of study at a University requires a number of different teaching resources. For example, material in lectures is typically presented using a projector connected to a computer running a presentation package such as Microsoft PowerPoint. This material is usually complemented with a set of lecture notes that provides more information than contained in the lecture slides. The lecture notes are typically written using a word processor such as Microsoft Word. Since the lecture slides and lecture notes are created separately, there is the possibility for inconsistencies between the two. Also, as the course content changes, both have to be updated separately.

To overcome the problem just described, it would be beneficial for the information used in the lecture slides and the lecture notes to be generated from the same source of information. This would guarantee consistency between the lecture slides and lecture notes and would also allow for information to be updated easily when required. This same source file could then be used to generate other resources, such as notes to help the lecturer present the material and online resources that students can view with an Internet browser.

Further to the benefit of consistency between various resources, it also provides a systematic way of describing course content. This leads to a hierarchy of information. For example, each key point on a lecture slide maps to a certain passage of text in the lecture notes. This ensures that all the key points in a topic are covered and that a detailed description is available for students in the lecture notes.

A system for generating teaching resources using the methodology just described, where a single source of information is used to generate various teaching resources, has been developed and made available on the author's web site [1] for others to use. It has not been given a name but will be referred to as the Teaching Resource System as it actually provides a complete system for teaching, including grading and assessment. It has been an ongoing effort over the last four years, with the system used to support a number of courses lectured by the author. It runs under the Linux [2] operating system and uses publicly available software packages that normally are provided with Linux distributions. All source files are plain text, which allows for ease of editing and a compact form for archiving material used in a course of study.

As a background to current practices for generating teaching resources, some document preparation tools will first be

described. These will also include the tools that are used as the basis for the Teaching Resource System. Then, the Teaching Resource System will be described. To support the description, a practical application will be provided. This is for the course of study that was the initial motivation for the system. Finally, as this is an ongoing project, some of the future plans will be covered. This includes the modification of the system to improve current functionality as well as the incorporation of new features.

## 1.2 Document Preparation Tools

The two main tools required for presenting a course of study are a presentation package and a word processor. Commonly used packages are Microsoft PowerPoint and Microsoft Word respectively. Lecture slides are created using PowerPoint and other material, such as lecture notes, tutorial exercises, laboratory procedures and examination papers, are created using Word.

These two tools do have some versatility as they can be used to generate a number of different resources each. For example, both have the capability of generating online versions. Also, PowerPoint has the ability to include notes to help with the presentation of a lecture. However, this versatility is limited and also requires manual intervention when the presentation is updated.

There are other document preparation packages which are in the public domain. One package in particular is LaTeX [3] [4]. It provides for even greater versatility as it runs under the Linux operating system. The Linux environment also includes a vast array of software, some of which are used as part of the Teaching Resource System. The main benefit of using LaTeX is that documents are described using plain text files. The source files contain directives to indicate features of the documents such as section headings and lists. The source files can also be easily manipulated using programs such as Perl [5] and Sed [6]. This allows for source files to be modified depending on the use of the resultant document. Source files are compiled to produce documents in the Portable Document Format (PDF). This allows for easy viewing of documents, as readers are available for a vast range of platforms.

## 1.3 The Teaching Resource System

The basis of the Teaching Resource System is the LaTeX document preparation system. It is used in conjunction with other software that is normally included with most Linux distributions.

A summary of all the software that is used in the Teaching Resource System is shown in Table 1.1.

<i>Tool</i>	<i>Use</i>
LaTeX	Document preparation (PDF)
LaTeX2HTML	Online resources (HTML)
Perl	Programming language
Sed	Stream editor
GNU Make	Coordinate compilation
GNU Emacs	Editing the source files

Table 1.1: Software used for the Teaching Resource System

The framework for all the teaching resources are provided as part of the system leaving the lecturer to focus only on the course content rather than how each resource is generated.

Documents made using LaTeX are described using plain text source files that can be created using any plain text editor. The GNU Emacs [7] editor, usually included in Linux distributions, was used as it has the added benefit of allowing information about the file to be included into the file itself when it is saved. This is used to keep track of document revisions.

The LaTeX source files are compiled using different directives to generate different documents. The source files can also be modified before being compiled using Perl or other software available under Linux to add or remove certain sections as required. Compilation is coordinated using GNU Make [8].

Generally, each source file is used to generate a number of different documents, including an online version using LaTeX2HTML. The benefit of having an online version in HyperText Markup Language (HTML) is that it allows for easy viewing of information rather than having to download a possibly large PDF file.

The course web site is used to provide an entry point for all the resources. For simplicity and ease of navigation, it contains only two levels, although there may be links to other documents that have two levels in themselves, such as the lecture slides.

In this same system, student assessment is also included. The results for assessment during the semester are stored in a plain text file and then accessed using a Perl script to generate a LaTeX source file that is then compiled to provide a summary of student results.

Colour is used in documents for figures and also for headings and other areas to make them easier to read and to highlight certain information. Most students have access to colour printers at home and some also read documents directly on their own computers. The only problem with coloured documents occurs when printing to a monochrome printer or photocopying documents for distribution as coloured portions can become too light to read. To overcome this problem, colour documents can be converted automatically into monochrome documents by setting colours either to white or to black.

## 1.4 Practical Application

The teaching resources used for a course depend on the structure of the course. Some resources, however, are generally common to all courses. These include resources that are used in lectures and resources used in practical components, such as tutorials and laboratory exercises. Other resources not specifically used for teaching, but required for assessing the performance of students, are quizzes and examinations.

To show the utility and convenience of the Teaching Resource System, a practical application of its use for ELEC4605 Computer Engineering is provided. The system was initially developed for this course and has been incrementally improved over the years.

This course consists of lectures divided into approximate weekly topics. Students undertake tutorial exercises during the first half of the semester and complete a laboratory project in the second half of the semester. There are two examinations, one in the middle of the semester and a final one at the end of the semester.

A list of the source information used to generate most the teaching resources is shown in Table 1.2. Note that the actual source files required depend on the requirements of a course.

<i>Resource Source</i>	<i>Number of Source Files</i>
Course Information	One only
Lecture	One for each topic
Tutorial	One for each tutorial session
Laboratory	One for each laboratory session
Examination	One for mid-semester and one for final
Assessment	One for each form of assessment
Web Site	One only
Other	One for each additional resource

Table 1.2: Source Files for ELEC4605

The details of the various resources generated from the source files are covered in turn.

### 1.4.1 Course Information

This is a document that is handed out to students at the start of the semester outlining the details of the course, including the assessment requirements. The source file is compiled to a PDF document as well as in HTML form for direct online viewing on the course web site.

This is one of the simplest examples of the system where a single source is used to generate two resources, both of which contain the same information. It will be shown that in most cases, a single source file is used to generate resources that contain different information.

As this document is handed out to students, a monochrome version is also created which is used for photocopying. As mentioned previously, the process for creating a monochrome version is automatic.

### 1.4.2 Lecture

The lecture resources represent the best example of the usefulness of the teaching resource system. A single source file is used to generate three different resources as summarised in Table 1.3.

Resource	Description
Lecture Notes	Detailed description of material presented in lectures
Lecture Slides	The slides presented in lectures
Lecture Slide Notes	Notes to help the lecturer present the material

Table 1.3: Resources used for lectures

An example of the three lecture resources generated is shown in Figure 1.1. The lecture slides are also made available in HTML form on the course web site.

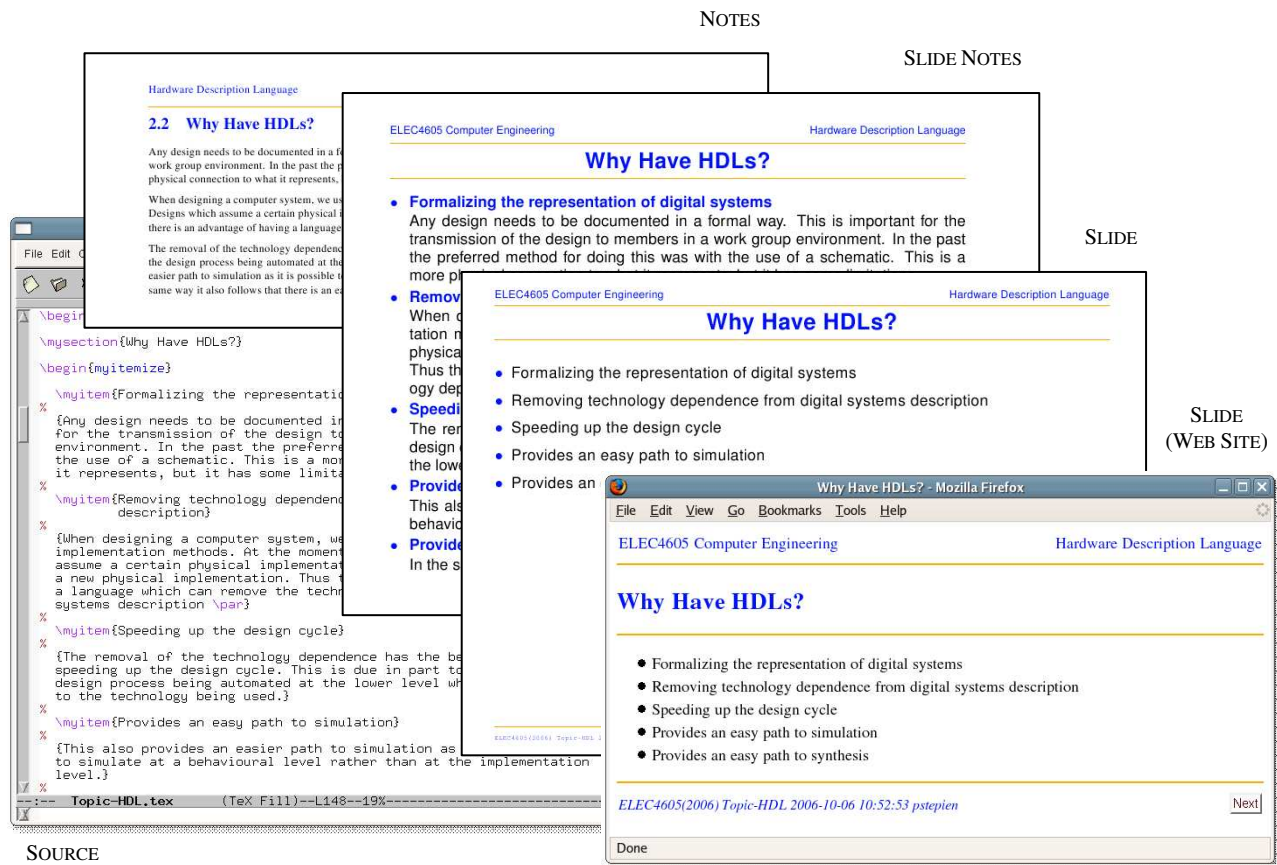


Figure 1.1: Lecture resources generated from a single source file

This example shows how parts of the source file contribute to create the various resources. In this case, the source file has a number of key points along with a detailed description of the key points. The lecture notes only contain the detailed description, which requires it to be written so that it is self-contained and makes sense without the key points. This makes the lecture notes read like a textbook. The lecture slide contains only key points. This is used as a starting point for expansion during the lecture. The lecturer also has a set of slide notes that include both the key points and the detailed description. An online version of the lecture slides is generated for inclusion on the course web site. It provides a convenient way to directly view the information on a slide without having to use a PDF browser. This can be especially useful if using a mobile device with limited processing power and screen size, such as a pocket computer.

The various parts of the source are used by default in different resources. For example, the lecture slide notes use all of the source information whereas the lecture slides use only the key points and the lecture notes use only the detailed description. It is also possible to add directives to include certain information into a particular resource. For example, it is possible to include a diagram into the lecture slide notes for the lecturer to draw on the board to help explain some the material being presented.

As can be seen from this example, all of the information for the various resources are contained in the same source file and kept together. The key points are next to the detailed description. This association of information is one of the main benefits of writing lecture material using this system.

### 1.4.3 Tutorial and Laboratory

A single source file is used for each tutorial and laboratory session to generate three different resources. These are summarised in Table 1.4.

<i>Resource</i>	<i>Description</i>
Work Sheet	Instructions and questions for students to complete
Solutions	Solutions for students to check their own work
Tutor Notes	Detailed solutions and instructions for tutors

Table 1.4: Resources used for tutorials and laboratory exercises

The source file is structured in a similar way to that shown for the lecture resources only that there are three different sets of information that are associated together. The tutor notes contain the questions and the solutions as well as extra information to help tutors answer student questions. Students receive only the work sheet and solutions. An online version is also provided for the work sheet and solutions to allow for direct viewing without using a PDF browser.

### 1.4.4 Examination

A single source file is used to generate three different resources used for examinations. These are summarised in Table 1.5. As examination papers are generally not made available online, there is no path for generating an online version. The examination papers are formatted differently from other documents and use a larger font type to make them easier to read.

<i>Resource</i>	<i>Description</i>
Questions	The examination paper
Solutions	Solutions to the examination questions
Extracts	Parts of the examination paper such as the title page

Table 1.5: Resources used for examinations

The source file contains both the questions and the solutions. The solutions document contains the questions along with the solutions in a boxed area following the question.

Parts of the examination paper can be extracted for inclusion on the course web site as a PDF file. This is used for the title page, which contains instructions for the examination and for pages containing reference material.

### 1.4.5 Assessment

Information regarding the performance of each student must be maintained to provide a final grade at the end of the semester. The Teaching Resource System has been extended to include this capability. This makes the system a totally unified platform to aid teaching throughout the semester.

Student details are contained in a plain text file as an array of Perl records. Information is extracted using a Perl script to generate LaTeX source for compilation. This allows for the creation of student roles and marking sheets used for assessment in tutorial and laboratory sessions and also for marking examinations. It is also used to provide student results on the course web site.

There is a limitation in storing student information in this form, as it can be difficult to update the details of a particular student. A search for the student name or student identification number is required first. This limitation can be overcome if the information to be entered is already sorted in the same order as the student records in the file. In another course which had weekly quizzes that were multiple-choice, a different system for entering the marks was developed. This allowed for the partial student identification number to be entered along with the choices selected by the student. These are then automatically marked. Combining both data entry and marking proved to be a substantial saving in time.

## 1.4.6 Web Site

The web site is used to provide an entry point for all the resources students use in the course. For simplicity and ease of navigation, it contains only two levels, although there may be links to other documents that have two levels in themselves, such as the lecture slides.

The layout of the web site pages is similar to the various documents, thus giving a unified image for all the resources. It has been designed so that if one of the web site pages is printed, it will look similar to the equivalent PDF document.

The complete top level of the web site is also available as a PDF document. This provides a convenient way of packaging all the information on the web site and also allows for ease of printing, which can prove problematic for some web sites. Documents are also provided in various formats where two or four pages appear on a sheet of paper in an effort to save paper. Students are also encouraged to print on both sides of the page.

Most of the resources generated for a course of study are made available on the course web site. This includes the documents generated from the sources files listed in Table 1.2, except for the lecture slide notes, tutor notes and examination papers. Certain resources are also made available for direct online viewing in HTML.

## 1.5 Future Development

The Teaching Resource System is being developed on a continuous basis. At the beginning of each semester, new features are added and existing features are updated. To make the system available for others to use, it has been packaged so that it can be easily downloaded and adapted for any course of study.

There are a number of aims for future development. The main aim is to make the source of all documents as simple as possible to write by reducing the number of formatting directives and to make them consistent between different document types. This will include the addition of new commands that may require source files to be processed first using a Perl script to convert the source file into a form suitable for LaTeX. Note that even though LaTeX is the tool used to generate the resultant documents, the principles of the Teaching Resource System can be applied to other similar tools.

To keep track of documents, version control information is included at the bottom of every page. The Emacs text editor automatically adds the version information to source files. Although a document version may be identified, there is no easy way of recreating previous versions of a document. To overcome this problem, a versioning system, such as the Concurrent Versions System (CVS) [9] that is available under most distributions of Linux, will be incorporated. This will also be the basis for an improved backup and archiving system.

The deployment of the course web site is currently done manually. As the resources are compiled on the same file system as the web server, the web site files are simply copied to the appropriate location. This will be updated to use another method that does not assume that the web server uses the same file system as that where the resources are compiled. This could be implemented using the File Transfer Protocol (FTP) to transfer the web site files.

In an attempt to keep the system as simple as possible and to have all source files as text, the student records are stored as an array of Perl records. The main drawback is the difficulty in updating information as a student record has to be located first using a search operation before entering data into the correct field. This may be modified to include the use of publicly available database program.

## 1.6 Conclusion

Generating teaching resources using a single source of information guarantees that there is consistency between resources. As information is entered only once, it is also quick and convenient to add or modify teaching material. The main benefit of this approach is that it allows for the creation of teaching resources in a systematic manner. For example, all key points on a lecture slide map directly to expanded information in the lecture notes.

The Teaching Resource System described provides a complete solution for generating all teaching resources and also for recording student assessment.

## 1.7 Acknowledgment

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# Bibliography

- [1] Stepien, P., *Peter Stepien Web Site*, (<http://www.cel.usyd.edu.au/~pstepien>).
- [2] Siever, E., Weber, A., Figgins, S., Love, R., Robbins, A., *Linux in a Nutshell*, OReilly, Fifth Edition, 2005.
- [3] Lamport, L., *LaTeX: A Document Preparation System*, Addison Wesley, Second Edition, 1994.
- [4] Mittlebach, F., Goossens, M., Braams, J., Carlisle, D., Rowley, C., *The LaTeX Companion*, Addison Wesley, Second Edition, 2004.
- [5] Wall, L., Christiansen, T., Orwant, J., *Programming Perl*, OReilly, Third Edition, 2000.
- [6] Dougherty, D., Robbins, A., *sed & awk*, OReilly, Second Edition, 1997.
- [7] Cameron, D., Elliott, J., Loy, M., Raymond, E., Rosenblatt, B., *Learning GNU Emacs*, OReilly, Third Edition, 2004.
- [8] Mecklenburg, R., *Managing Projects with GNU Make*, OReilly, Third Edition, 2004.
- [9] Vesperman, J., *Essential CVS*, OReilly, Second Edition, 2006.