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Converting the Mathematical Encyclopaedia for use in Microsoft Windows

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Contents

1 Introduction

The Mathematical Encyclopaedia is a hypertext reference book on mathematics, intended for use by both high school and first to second year undergraduate university students. It is a part of HypeMAT, a package for computer-aided mathematics education, developed at the Institute of Mathematics at the Helsinki University of Technology. The text in the Encyclopaedia has been formatted using the LaTeX document preparation system [B:Lam94, B:GMS94, B:Knu90], and the hypertext properties have been implemented using tools created in the HyperTeX project [I:HTFAQ, I:Lanl, I:NYJM]. The Encyclopaedia is distributed as a DVI file with the hypertext properties stored as special codes normally ignored by non-hypertext-capable DVI viewers and drivers. The hypertext properties become available when the DVI file is read using a viewer with hypertext capabilities, such as Xhdvi, which is the one chosen for use in HypeMAT.

Hypertext capable DVI viewers are, however, available only on Unix and NeXT platforms. Because MS-Windows is by far the most popular operating system among potential users of HypeMAT and the Encyclopaedia, it would be useful to find a way to read the Encyclopaedia on this platform, too. [I:MS]

Writing an entire hypertext-capable DVI viewer could well be wasteful and inefficient if other solutions were available. A more appropriate approach would be to convert the Encyclopaedia into another format, platform independent if possible, that could be read by applications available on the MS-Windows platform. Investigating these possibilities was the objective of this study. Two alternatives appeared promising: one based on the IBM Techexplorer program, and the other on Adobe's Portable Document Format (PDF).

IBM Techexplorer is a WWW browser plug-in program that accepts raw TeX or LaTeX code as its input. It formats the text and displays it in the browser's window. Hypertext links and labels can be included by adding Techexplorer's proprietary commands. The program is in its development stage and only available for use on a relatively limited range of platforms and with one particular WWW browser.

Since Techexplorer supports only a fairly limited set of LaTeX features, some editing will be necessary in order to view the Encyclopaedia with Techexplorer.

The Portable Document Format is designed, as the name suggests, to be a platform-independent way of representing formatted documents. Readers are available free of charge for all of the most widely used operating systems — MS-Windows, Unix/X-windows, Macintosh and NeXT — and the format is relatively well known.

The conversion into PDF is done in three steps. First, the LaTeX file is run to produce a DVI file, just as when Xhdvi was used to view the DVI file. Subsequently, the DVI file is turned into a PostScript file, which is finally converted into PDF using Adobe's Acrobat Distiller software. The hypertext information is preserved in the intermediate stages in forms that are normally ignored by conventional drivers and viewers without hypertext capabilities.

A sample of the over 400 page Encyclopaedia was selected and converted both for Techexplorer and into PDF. The conversions were done in such a way that the "variable costs" were kept low, *i.e.* converting the entire Encyclopaedia later could be done with little extra work. In the course of the study, the procedure for conversion into PDF turned out to be so automatic and independent of the content of the document that the whole Encyclopaedia was converted.

2 Starting point

2.1 HypeMAT

The HypeMAT package for computer-aided mathematics education currently consists of two major components: the Mathematical Encyclopaedia and the Problem Collection [B:Jok95]. The Encyclopaedia can be read with the Xhdvi program on a computer running a Unix operating system. The same holds for the Problem Collection, which is implemented using MetaCard software [I:MC]. Both of these programs, Xhdvi and MetaCard, are distributed free of charge. In addition, if Mathematica [B:Wol91, I:Wol] has been purchased, it can be used as a tool when solving the problems. HypeMAT has been developed by Simo K. Kivelä[2], Riikka Nurmiainen[3], Anna Loimulahti, and Markko Jantunen[4].

The HypeMAT package is distributed as an easy-to-install version including executables for Linux, a freely distributed Unix implementation. Linux has been chosen because the majority of the potential users of HypeMAT, namely most high schools, have PC computers with MS-Windows operating systems, and if they must install a new operating system to be able to use HypeMAT, they would probably rather choose a freely distributed one. [B:Doc96, B:WeK96, I:LDP]

Although Linux is available free of charge, the need to install and administer an additional operating system may be a serious obstacle to to the use of HypeMAT. Since MetaCard and Mathematica are available for use on a variety of platforms, including MS-Windows, finding a way to read the Encyclopaedia in a MS-Windows environment could greatly increase the ease of both installation and use of the whole HypeMAT package.

2.2 Representing Hypertext in TeX and LaTeX

In the HyperTeX project, a standard for representing hypertext in DVI (Device Independent) files was created, using TeX's `\special` commands. In general, the arguments of these commands are included verbatim in the DVI file, allowing features not covered by the DVI format to be realised. These features are, by definition, device dependent, and it is up to the designer of the particular DVI viewer or driver to decide how to handle them. [I:HTFAQ, I:Lanl, I:NYJM]

According to the HyperTeX convention, hypertext information is coded using basic HTML (Hypertext Markup Language) tags [I:HTML]. A label is assigned to the current location within the document by inserting a

```
\special{<a name="label">}
```

command. A link to a specific location, defined by a URL (Universal Resource Locator), is implemented by inserting a

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[4]Helsinki University of Technology, Computing Centre, P.O.Box 1100, FIN-02015 HUT, Finland, <URL http://www.hut.fi/~markko/>

```
\special{<a href="URL">}
```

command before the element — usually a section of text — constituting the link, and a

```
\special{</a>}
```

command after it. If the link refers to a location within the same document, defined as *label*, its URL can be given in the simple, relative form `#`*label*.

Of course, in order to turn these embedded special commands into hypertext links, a DVI viewer capable of processing them correctly is needed, too. Two such viewers have been developed in the HyperTeX project: one called Xhdvi, for Unix platforms,[5] the other HyperTeXview, for the NeXT platform.[6]

Unfortunately, the progress of the HyperTeX project has slowed down significantly after many people involved in it changed jobs. Since May of 1996, nothing has been reported on the mailing list `hypertex-announce@aps.org` [I:HypM]. Development of the Xhdvi viewer stopped after version 0.8a, which was released on the 22nd of May, 1995. There is apparently little hope that a hypertext-capable DVI viewer will be available on the MS-Windows platform in the near future. Therefore, if TEX based hypertext documents are to be viewed on the MS-Windows platform, other solutions need to be found.[7]

2.3 Structure of the Encyclopaedia

The Encyclopaedia consists of 88 *articles*, each of which is subdivided into one or more *modules*, which are each a couple of screenfuls of text. Articles are stored in separate LATEX `.tex` files.

The LATEX files are processed by running LATEX on the file `ens.tex`. This file simply loads the required packages and inputs the files that contain the articles. The packages are (more or less) standard LATEX packages except for `ens.sty`, which defines the special commands used throughout the articles for formatting the text and adding hypertext information. These commands include the following:

- `\htmladdname{`*key*`}`: Defines a hypertext label, *i.e.* names the location so that it can be referenced; similar to HTML's `<A NAME=`*key*`>`.
- `\htmladdsmashlink{`*text*`}{`*key*`}`: Typesets *text*, adding a link to location *key* defined by `\htmladdname`, corresponding to HTML's `<A HREF=`*key*`>`*text*`</A>`. In other words, defines *text* as a hypertext anchor for the link to *key*.
- `\linkkialleviivaus{`*text*`}{`*key*`}`: Typesets *text* underlined, adding a link to the location with the label *key*. Uses `\htmladdshashlink`.

[5] Xhdvi, written by Arthur P. Smith, is based on the widely used Xdvi viewer by Paul Vojta. [I:Xdvi]

[6] HyperTeXview is written by Dmitri Linde (`dmitri@physics.stanford.edu`) and significantly extended by Mark D. Doyle (`<URL http://nqcd.lanl.gov/people/doyle/doyle.html>`, `doyle@aps.org`).

[7] More information concerning HyperTeX can be found on the HyperTeX WWW pages [I:NYJM, I:Lanl]. The computer `snorri.chem.washington.edu`, mentioned in many of the documents, does not run a Xhdvi ftp server anymore. However, Xhdvi and other software and macro packages are available from the Comprehensive TEX Archive Network (CTAN, see for instance `<URL http://www.tex.ac.uk/tex-archive/>` or, in Finland, `<URL http://ftp.funet.fi/pub/TeX/CTAN/>`).

- `\LINK`, `\HLINK`, `\KLINK`, `\KHLINK` (with various arguments): Typeset some text, add a framed box containing some other text into the right hand side margin and create a link from the framed box to a hypertext label defined by `\htmladdname`. The different variants are for single- and multiline boxes and for different processing of keys. Most of the Encyclopaedia's links are made using these commands.

- `\Sivunumerot{`*page*`}{`*total*`}`: Sets the page number to *page* and the total number of pages to *total*. They are stored in the variables `sivuno` and `sivujenlkm` for later use.

- `\perusreunapalikat`: Adds elements that are repeated at the beginning and end of every module. These include page numbers and arrow buttons that can be used to move to the next or previous page within the article, or to the table of contents, index, or instructions of use.

- `\EsiTiedot{`*prerequisites*`}`, `\KatsoMyos{`*see-also*`}`: Defines the prerequisites for reading the module and the modules "see also" references, respectively. They are saved into LaTeX's variables `\EsiTiedNimi` and `\KatsoMNimi`.

- `\Artikkeli{`*articlename*`}`, `\Moduli{`*modulename*`}`: Mark the beginning of an article and a module, respectively. The names *articlename* and *modulename* are stored in LaTeX's `ArtNimi` and `ModuliNimi` variables for later use. They are also defined as hypertext labels for the beginning of the article or module.

  At the beginning of each module, a new page is started, and the names of the article and module, the prerequisites, and the "see also" references are printed at the top of the page, together with other repeated elements, produced by the command `\perusreunapalikat`. In addition, a hypertext label of the form *articlename*`:`*page* is created.

- `\Kuva[`*filename*`]{`*explanation*`}`: Inputs the file *filename*`.tex` that is supposed to contain a picture in some form, most often a EPS (Encapsulated PostScript) file included using the psfig package [I:Psf] and optionally enhanced with some LaTeX elements using the `picture` environment. The strigs *explanation* and *filename* are written to a file that will provide a list of figures. If the *filename* argument is missing, a remark about this is printed instead.

  When the article files are processed by LaTeX, the pictures are not embedded into the resulting DVI file, but only the names of the files that containt the pictures.

- `\Animaatio`: Future expansion for including animations.

Most of the hypertext links are in the middle of the text. They are designed to provide further information and answers to questions that arise when reading the Encyclopaedia. They are implemented by adding a `\LINK` command or one of its variants to appropriate words in the text. As a result, these words are printed as they are, but a framed box is created in the margin. This box contains the title of the related part of text, as defined by the `\Artikkeli` and `\Moduli` commands, and has a link to it. This way of having the links in the margin is advantageous compared to having the word underlined in the middle of the text, as in, for instance, most WWW pages, because it does interrupt reading the text.

Underlined words are, however, used as anchors for some hypertext links; namely the prerequisites and "see also" references at the beginning of each module. This is reasonable, because here the only function of the text is to serve as anchors for the links.

2.4 Requirements for the Conversion

In the field of typesetting and formatting text that includes mathematical notation, TeX is, together with its extension LaTeX, one of the very best programs. Therefore, a TeX based system should probably be used for formatting of the Encyclopaedia on-screen, although several other solutions have been proposed, based *i.a.* on HTML and Mathematica. [B:Ste96, I:Bum, I:Pol, I:WolHM]

The users of the current Unix and Xhdvi based versions of HypeMAT should preferable not be left without support. A back conversion from the new format — which is to be chosen according to the knowledge acquired in this study — into the current one may not be possible. Therefore, the conversion should be made into an automated process, allowing the Encyclopaedia to be developed further in the current format and converted into the new format, as needed.

2.5 Sample for conversion

Following these guidelines, a sample of the Encyclopaedia was selected, consisting of five articles, 18 modules in all. The articles were chosen in such a way that many of the hypertext links would refer to within the sample, and that it would contain pictures. The chosen articles were the ones in the files `vektori.tex`, `vektalg.tex`, `piste.tex`, `suora.tex`, and `taso.tex`.

This sample was converted both for IBM Techexplorer and into PDF.

3 IBM Techexplorer

3.1 The Techexplorer Program

3.1.1 Plug-in for TeX and LaTeX Files

IBM Techexplorer is a WWW browser plug-in program developed by IBM, used to display TeX and LaTeX documents on the Web [I:TE]. When the browser, with Techexplorer installed, receives a document whose type is `application/x-tex`, `application/x-latex`, or `application/x-tech-explorer`, it launches Techexplorer, which processes the document. The output of Techexplorer is displayed in the browser's window.

The version of Techexplorer used in this study was 1.2; first the beta version, then the officially released one. At least at this stage, Techexplorer is only available for the Windows 95 and Windows NT operating systems, and it can only be plugged into either Netscape Navigator version 2.01 or higher or Microsoft Internet Explorer version 3.0 or hihger. [I:MS, I:NS]

Techexplorer does not distinguish between TeX and LaTeX documents. This may seem quite astounding for TeX and LaTeX users, since the structures of TeX and LaTeX documents are quite different. However, treating them equally eliminates the ambiguity caused by the fact that servers sending files to the WWW usually indentify the file's content type simply from the file name extension, which is `.tex` for both TeX and LaTeX documents. Because of this, in the rest of this section, the word TeX should be understood to refer to both plain TeX and LaTeX.

TeX is a relatively large electronic typesetting system. It provides ways of using variables, defining subprograms (or macros), including files and ready-made macro packages, switching fonts and using control structures. Processing a TeX file is, therefore, much like compiling a program, and it often requires access to many auxiliary files that may be set up in various directories.

Techexplorer's promise of doing all this in a easy-to-install, automatically running WWW browser plug-in sounds ambitious. It is no surprise that the features supported are quite limited, and that the result displayed differs from that produced by a full-scale TeX system. For a list of supported commands, see [I:TEUG].

3.1.2 File Access

Accessing files is, evidently, one of the fields in which problems can be expected to be run into, when using Techexplorer. TeX documents often refer to external files, like macro packages, pictures or simply text files with more TeX code to be included in the document.

Techexplorer supports the `\input{`*filename*`}` command for including external files. It asks for *filename*`.tex` from the server, and — supposing the file is found in the same directory as the file containing the `\input` command, and it has appropriate permissions — inserts it into the current position.

Unfortunately, there are other file access commands, too, like `\usepackage`, and determining in which directories the files are searched for, is not always that simple. In a conventional, single-site TeX system, files are usually searched for in many directories, and different types of files are searched in different sets of directories. These directories differ from installation to installation, and they may depend on earlier commands in the TeX file, either implicitly (for instance, after loading a package that specifies which file should be used for a certain purpose) or explicitly (if the path names are generated by commands in the TeX file).

When the files are processed by Techexplorer, inputting files is distributed between the client side (Techexplorer) and the server side, which causes difficulties. Techexplorer generates the file and path name, converts it to an URL and asks for it. Since the server is assumed to be a normal HTTP server, with no special TeX capabilities, it can do no more than search for the file in the directory specified in the URL. Because there is no "standard TeX installation", but available packages and their locations vary from system to system, Techexplorer cannot know which directory holds the files.

It is, therefore, understandable that `\input` has been chosen to be the only supported command for reading in auxiliary files, because it is normally used only for reading files from the same directory as the master file, or files with explicit path names.[8]

3.1.3 Fonts and Pictures

Because of TeX's background as a typesetting system, and not a word processing program, great attention is paid to fonts. In a typical TeX installation, hundreds if not thousands of different

[8]In addition, Techexplorer provides a variant `\inputonce` which causes the file to be read in only if it has not been read in at an earlier stage of processing the document. This can be useful for suppressing transfer of input files that only contain macro definitions, if they are mentioned more than once in the master TeX file and files read in by other `\input` commands.

combinations of sizes, shapes, weights, widths, and families are available, each with unique character shape and spacing. Special symbols needed in mathematical formulae and conventions used when typesetting them are built-in. The accurate control thus achieved enables high quality output.

In the MS-Windows environment, different font techniques are normally used. The default fonts used in TEX, called Computer Modern fonts [B:Knu86a], are consequently not available in Windows, and neither in Techexplorer. Therefore, other methods for displaying the formulae have been chosen:

1. The Monotype Math fonts shipped with Lotus WordPro and Lotus SmartSuite. IBM claims this set to be 100% complete for the "basic TeX and LaTeX" symbols.
2. The Lucida Bright Math fonts that are part of the Microsoft TrueType Font Pack (This set is 90% complete).
3. The WordPerfect Math and IconicSymbols fonts (90% complete).
4. The standard Microsoft Windows Symbol and WingDings fonts (70% complete).

The first three alternatives rely on fonts possibly installed on the computer together with other software; the fonts are not distributed with Techexplorer. The fourth alternative uses fonts included in the normal Windows installation, so they should always be available. Alternatives 3 and 4 were tested.

Pictures in BMP, DIB, GIF, JPG, and PCX formats can be included, using the proprietary `\includegraphics` command. All of these are bitmap formats, which display in the same size regardless of the size of the font chosen for the surrounding text.

3.2 Conversion for Techexplorer

3.2.1 `ens.tex`

When the sample was converted for Techexplorer, its main structure was not changed. Also Techexplorer accesses Encyclopaedia through the master file `ens.tex` that was cleaned up a bit. For the original and converted `ens.tex` files, see sections B.1.1 and B.2.1.

References to unneeded packages were removed, and the `\write` commands, used for creating lists of figures and references, were removed. The `\include` and `\includeonly` commands were changed to `\input` commands, and `\usepackage{ens}` was changed to `\input{ens-sty}`.

3.2.2 `ens.sty`

Because the style file `ens.sty` is an essential part of the structure of the Encyclopaedia, but Techexplorer does not support loading macro packages using the `\usepackage` command, the style file `ens.sty` was renamed to to `ens-sty.tex` so that it can be read in using the `\input` command. The contents of the file was changed substantially.

The original `ens.sty` file begins by loading certain packages and setting the paper size and margins. These commands were removed, because functionality provided by the packages was not used in the sample, and paper size is an irrelevant concept in Techexplorer.

The command `\textsc`, which is used in LaTeX to typeset text in SMALL CAPS, is not supported by Techexplorer. Because it is used in the Encyclopaedia's articles, it is defined in the Techexplorer version to be identical to `\textsl` and thus cause the text to be displayed *slanted*.

The next change was to remove some `\newtoks`, `\newcount`, and `\newcounter` commands, because they are not supported by Techexplorer, and as hypertext links are implemented differently in Techexplorer, they are not needed, either.

Definitions of the commands `\Sivunumerot`, `\Avain`, `\SivunLoppu`, and `\Animaatio` (see section 2.3 for descriptions of the commands) were changed to empty, as these commands turned out to be unnecessary with Techexplorer: `\Avain` was only used for generating the list of references, and `\Animaatio` is a future expansion for including animations. `\Sivunumerot` and `\SivunLoppu` are used to divide the Encyclopaedia into pages, but with Techexplorer, the entire Encyclopaedia can be displayed as one, very long page, and page breaks are not needed. For the same reason, the commands `\perusreunapalikat` and and `\nuolilinkit`, the latter being a subroutine used by the former, were removed.

In the definition of the image inclusion command `\Kuva`, a special problem was caused by optional arguments, Techexplorer not supporting them. Originally, `\Kuva` took two arguments, one of which was optional. When both arguments are present, the command was in the form

`\Kuva[`*file*`]{`*description*`}`

where *file* is the name of the image file to be included and *description* is a short descriptive text that is only written to an auxiliary list of figures. For Techexplorer, this command had to be defined as only having mandatory arguments, so in the form above, the first argument would be "`[`", the second one "*file*", the third one "`]`", and the fourth one "*description*". Fortunately, the command was never used in the articles with only one argument.

As Techexplorer only supports graphics in bitmap formats, and if the images were converted into bitmaps, the relative size of the images would be very much dependent on the resolution of the surrounding text, this command was chosen to be changed to only display the text "*(Kuva)*" (meaning "picture"). This was done by defining:

```
\newcommand{\Kuva}[4]{\emph{(Kuva)}}
```

In the future, if later versions of Techexplorer support PostScript graphics or another vector graphics format that the images can be converted to, they can be included by defining:

```
\newcommand{\Kuva}[4]{\includegraphics{#2}}
```

Hypertext commands were changed, most obviously, too. The low-level `\htmladdnormallink`, `\htmladdsmashlink`, and `\htmladdname` were changed to use Techexplorer's internal `\labelLink` and `\label` commands. The higher-level commands `\linkkialleviivaus`, `\linkkilaatikko`, `\korkealinkkilaatikko`, and `\LINK` together with its variants, were all made to simply display the text and produce a link to the specified location, the `\marginpar` command being unsupported by Techexplorer. For `\linkkialleviivaus`, this was done because Techexplorer displays links in colour, and underlining was thus not necessary to show the existence of a link — as it is in the original black-and-white form of the Encyclopaedia — and unnecessary underlining is considered bad typographical style.

The commands `\Artikkeli`, `\Moduli`, `\EsiTiedot`, and `\KatsoMyos` were significantly simplified. Suppressing page breaks took away the need of tracking page numbers within an article, which was fortunate, Techexplorer not supporting counters. The names of articles, modules, prerequisites, and "see also" references were no longer needed to be repeated at the beginning of each page, so they were changed to be displayed when the respective commands were executed. This was necessary, because using Techexplorer, they could not be stored in variables. Defining the article and module names as hypertext labels and creating links to the prerequisites and "see also" references were done right away.

3.2.3 Further Work to Be Done

The main structure of the Encyclopaedia was converted for reading with Techexplorer, as described above. However, because of Techexplorer's limited support for TEX commands, several individual commands used in the article files should be either changed or redefined, for instance in `ens-sty.tex`. The result of one of these soorly supported commands, appearing in the sample, is shown in figure . Here, the LATEX code:

```
  \V{a}\times\V{b} =
  \begin{array}[t]{cccccc}
    & a_x b_x \V{i}\times\V{i} &+& a_x b_y \V{i}\times\V{j}
  &+& a_x b_z \V{i}\times\V{k}\\
   +& a_y b_x \V{j}\times\V{i} &+& a_y b_y \V{j}\times\V{j}
  &+& a_y b_z \V{j}\times\V{k}\\
   +& a_z b_x \V{k}\times\V{i} &+& a_z b_y \V{k}\times\V{j}
  &+& a_z b_z \V{k}\times\V{k}
\end{array}
```

should produce the following output:

$$\mathbf{a}\times\mathbf{b} = \begin{array}[t]{cccccc} & a_x b_x \mathbf{i}\times\mathbf{i} &+& a_x b_y \mathbf{i}\times\mathbf{j} &+& a_x b_z \mathbf{i}\times\mathbf{k}\\ +& a_y b_x \mathbf{j}\times\mathbf{i} &+& a_y b_y \mathbf{j}\times\mathbf{j} &+& a_y b_z \mathbf{j}\times\mathbf{k}\\ +& a_z b_x \mathbf{k}\times\mathbf{i} &+& a_z b_y \mathbf{k}\times\mathbf{j} &+& a_z b_z \mathbf{k}\times\mathbf{k} \end{array}$$

However, as Techexplorer does not support the optional argument `[t]` in `\begin{array}`, it takes "`[`" for the mandatory argument, in this case `{cccccc}`, that specifies the alignment of the columns in the array, does not understand it, and replaces it with the default alignment: centering for all columns. Consequently, "`t]{cccccc}`", interpreted as being part of the array's contents, is displayed in the leftmost cell in the first row of the array, and the array is not top-aligned with $\mathbf{a}\times\mathbf{b}$, as it should.

Taking care of all these unsupported commands will have to be done by hand, separately for each individual anomaly.

4 PDF

The Portable Document Format (PDF) is a format designed for viewing documents on different platforms. It has been developed as a proprietary standard by Adobe Systems, Incorporated, but has gained some wider popularity, too. [I:Ad]

4.1 Background in PostScript

PDF is based on the PostScript page description language, which was also developed by Adobe, and has subsequently become a *de facto* standard. [B:Ado85, B:Ado90b]

PostScript was designed as a device and resolution independent page description language for driving printers. A PostScript file is processed by a PostScript interpreter as a program that first defines appropriate subprograms, and then tells the printer what to do to produce the output. For viewing PostScript files on-screen, emulator programs have been written. PostScript is quite often chosen as the format for distributing documents in electronic format. NeXT computers even use a hardware PostScript processor for displaying graphics.

Viewing documents on-screen is, however, somewhat different from printing them. Because a PostScript file only tells how to print the whole document, in order to display a particular page, the PostScript file must be, in general, processed in its entirety, and the desired page must be captured from the output. The reader of a document will most often want to change pages and move up and down on one page in a nonlinear order, so to avoid processing the PostScript file again and again, information about the output pages must be stored in some form. The reader may also want to look at other sections of the document, referred to by the text, which is something where hypertext links would very useful.

The Portable Document Format provides solutions to these problems. It has more structure, allowing pages to be handled individually, and supports hypertext references both to within the document and to arbitrary external URL's. Other new features in PDF, compared to PostScript, include attaching notes to a formatted PDF document, and allowing or denying different types of access to a document — reading, printing, changing, etc. PDF files are, therefore, quite suitable for on-screen viewing, and provide a possible solution for viewing the Encyclopaedia on a MS-Windows computer.

The increased amount of structure in PDF documents is also used in Adobe's PostScript Extreme architecture (formerly known as Supra), which uses parallel Raster image processors (RIP's) to increase printing speed. In high-speed printing, ripping is generally the most time-consuming phase. Using several parallel RIP units can cut down this time substantially, because the job can be divided into independent subtasks. [B:HCO96, I:AdExt, I:AdEPDF, I:AdSWP]

PDF uses syntax and commands similar to PostScript, and the underlying imaging model is the same in both languages.

Because of PDF's similarities with PostScript, an obvious method of producing a PDF file, in addition to creating one directly, is conversion from an existing PostScript file. This can be done using Adobe's Distiller program, which is part of the commercial Acrobat software package. The newest versions of a freely distributed program, Ghostscript, also allow creating PDF files, but only using a very limited set of fonts. [I:GS]

In many environments, including the one that was used for writing the Encyclopaedia, printing a TeX document is done using PostScript. Therefore, it seemed to be a natural way to proceed to first print the Encyclopaedia into a PostScript file and then turn the PostScript file into PDF, using Distiller. Ghostscript could not be used, because of the special fonts needed in the Encyclopaedia's mathematical formulae.

4.2 Fonts

In the system that was used, fonts are normally handled as follows, when printing a TeX document. The DVI driver Dvips determines the resolution of the printer to be used and creates appropriate bitmaps for the fonts used in the document, using Metafont[B:Knu79, B:Knu86b]. These bitmap fonts, known as PostScript type 3 fonts, are included into the PostScript file.

This is appropriate, if the PostScript file is only going to be printed on the printer. However, if the file is going to be printed using a different resolution, the result achieved by using these bitmap fonts is not optimal. If the file is converted into PDF for on-screen viewing at varying resolutions, bitmap fonts normally give still much worse results. This is due to the fact that screen resolutions are lower than printer resolutions, and moreover, they are not multiples of 300 dpi, which is the resolution often used by printers.

To avoid these problems, PostScript type 1 fonts, which are vector fonts, must be used [B:Ado90a]. For distributing the Encyclopaedia to be possible without copyright problems, public domain fonts would be desirable.

Basic type 1 fonts are available free of charge, including Times, Helvetica, Courier and Symbol, but such normal text fonts are not sufficient for typesetting mathematical formulae. For this reason, TeX uses its own fonts, called Computer Modern fonts [B:Knu86a], whose format is not compatible with PostScript. Fortunately, several PostScript type 1 renditions of Computer Modern fonts have been developed. Commercial solutions are available from Blue Sky Research [I:BS] and Y&Y, Inc. [I:YaY], but there are public domain fonts, too, created by Basil K. Malysev [I:Bak, I:Par]. Malysev's fonts, called BaKoMa and Paradissa, were chosen for the work in this study.

Another problem was, however, caused by combining mathematical formulae and the letters Ä and Ö used in Finnish. On the computer system that was used, Computer Modern (CM) fonts are not used for typesetting text containing Ä and Ö, but DC fonts, which are extensions of CM. Unfortunately, the BaKoMa and Paradissa collections do not cover DC fonts. This problem was avoided by choosing Times to be used for normal text (including Ä and Ö characters) and Computer Modern for mathematical formulae.

4.3 Conversion into PDF

4.3.1 Conversion of `ens.tex` and `ens.sty`

Turning the Encyclopaedia into a PDF file could be done with quite little changes to the files `ens.sty` and `ens.tex`.

The font used for normal text was changed to Times simply by inserting "`\usepackage{times}`" at the beginning of the file `ens.tex`.

The hypertext commands defined in `ens.sty` were changed to use the commands defined in

Michael Mehlich's[9] hyper package [I:Hyp]. The reason for this was not that the original, explicitly written commands would have caused any particular problems, but simply that it seemed reasonable to move to use supported macro packages, which might already have dealt with some problems potentially coming up in the future. Versions 2.8 and 3.0a were used; defining hypertext labels with the earlier version's `\blindhyperanchor` command resulted in a DVI file that could not be properly processed by Dvips. The hyperref package written by Sebastian Rahtz[10] and Yannis Haralambous could have been tried instead of hyper [I:HypR].

These changes affected the lowest-level commands `\htmladdnormallink`, `\htmladdsmashlink`, and `\htmladdname`, which were altered to use the `\hyperreference` and `\blindhyperanchor` commands. Because the special character "#" preceding the hypertext labels was not needed in the definitions of the hypertext commands any more, the definition of the command `\risuaita`, previously used for this purpose, was removed. Also, the hyper package was loaded at the beginning of `ens.sty` using the `\RequirePackage` command.

Because the table of contents, index, and instructions of use were not part of the sample chosen for the conversion, the commands that create links to them were removed from the definition of the command `\perusreunapalikat` that is used to add the elements that are repeated at the top of each page.

References to articles outside the sample were manually removed from the text. For the prerequisites and "see also" references, they were removed by simply redefining the `\ETKM` command, used to format these references and create links for them. This way, the labels of the these references are simply typeset after each reference. That the hypertext links work correctly can be seen from the links in the text.

The files converted for PDF can be seen in appendix B.3.

4.3.2 Processing the Files

The file `ens.tex` shown in Appendix B.3 was processed, as usual, with the command "`latex ens`".

For turning the resulting DVI file into PostScript, a newer version of Dvips, 5.62, was compiled, because the version 5.58f normally used on the system does not offer the option of embedding hypertext information [I:Dvips, I:DvipsH, I:DvipsP]. Because of problems with configuring the complex directory structure of the font files normally used on the system, symbolic links to necessary font files were created all in only a few directories. The BaKoMa fonts were installed into the same directory as the Dvips program.

The DVI file was converted into PostScript with the command:

```
dvips -z -O 0in,-0.0022mm
```

The `-z` option tells Dvips to include the hypertext information in a form recognized by Distiller. This option was undocumented, but could, fortunately, very easily be determined from the source code.

For some reason, the hypertext anchors appeared, by default, about an inch too low on a 15"

[9] E-mail `mehlich@informatik.uni-muenchen.de`

[10] E-mail `s.rahtz@elsevier.co.uk`

the screen. The option `-O` was used to fix this problem by moving the origin on the page. The real reason of the problem was not investigated, as a new version of Dvips will most probably be professionally installed in the near future.

Because the page size in the DVI file was taller than the default A4, the page size should have been changed at this stage, too. However, this was not done, because in the future, the Encyclopaedia will be changed to use A4 size pages, which will also allow it to be printed on paper, if needed, with the hypertext links replaced by page number references.

The resulting PostScript file `ens.ps`, with all fonts now embedded in type 1 format, was converted into PDF using Distiller for Windows.

5 Conclusions

As the World Wide Web is a hypertext media growing very quickly in popularity, it would in some sense be the ideal way of distributing the Encyclopaedia, if only a successful way of embedding mathematical formulae into Web documents was found. Most Finnish high schools already have or are going to get an Internet connection in the near future, too.

Techexplorer brings one answer to the obvious need of representing mathematical formulae on the Web. Unfortunately, the implementation is not very successful in the sense that TEX or LATEX documents must be edited substantially, if they are to be displayed correctly using Techexplorer, as the study showed for the Encyclopaedia.

The overall appearance of the output is not as neat as it is when formatted with TEX. The output quality is, of course, partly a matter of taste, but at least the spacing of characters was clearly more uneven when displayed by Techexplorer than when typeset with TEX. A sample of the Encyclopaedia can be seen as originally typeset by TEX (figure), as displayed by Techexplorer using Windows and WordPerfect fonts (figure 2), and as displayed and printed by Adobe Acrobat Reader (figures 3 and 4). Version 1.2 of Techexplorer does not support printing.

Breaking lines with Scandinavian characters does not work in Techexplorer, as can be seen in the word "päde", at the end the fifth visible line in figure 2 (a).

During the time that Techexplorer waits for the article files and receives them, the window in which the the text is displayed responds very slowly to any user input, including scrolling. Even with the relatively small sample of six articles, this hinders reading the text. With the full 88 articles and pictures, using the Encyclopaedia will probably be still much slower. Depending on the way Techexplorer stores and caches large documents, this delay may occur either only when bringing up the Encyclopaedia, or every time that the user wants to jump to another location.

A solution might be to divide the text into separate files that are not all read at the same time. This would require changing the `\labelLink` commands to `\docLink` commands, which refer to hypertext labels in other files, and managing names of the article files. Depending on the caching techniques used in the browsers and available to the plug-in, jumping between files may require loading the file unnecessarily again and again, causing unwanted delays.

Splitting the longer articles into shorter pages, to make a large proportion fit onto the screen at one time and to make them load more quickly, would also require major changes. The current process of dividing articles into modules is based on the entire article being processed at once. Also, TEX uses variables when defining hypertext labels for subsequent modules, and

Techexplorer does not support the use of variables.

The Techexplorer program is only available for Windows 95 and Windows NT platforms, and it can only be plugged into Netscape and Internet Explorer WWW browsers. Although this would be a sensible solution for most high schools, Unix systems are in wider use in universities, which form another group of potential users. The platform-independent philosophy behind the Portable Document Format, also working in practice, makes PDF a more flexible choice, with respect to different audiences.

Pictures play quite an important in the Encyclopaedia, too, and they are all in vector graphics form, namely PostScript. Since PDF is based on PostScript, it can handle PostScript graphics very well, which makes the situation about optimal for PDF. Techexplorer, on the contrary, only supports bitmap image formats, which is undesirable, because the relative sizes of bitmap pictures would vary according to the size selected for the surrounding text.

The current versions of Techexplorer still lack some obvious features, like printing. Before Techexplorer can be expected to be considered as a useful solution for viewing the Encyclopaedia, some work is still required. Unfortunately, there is no guarantee that this work will be carried out. If it is, more and more features will become available as the the program is developed further, but old ones may cease to function in the way that they used to. Updating the Encyclopaedia to take advantage of the new features and to work after possible changes to old ones will require some efforts, perhaps at several stages when new versions of Techexplorer become available. Techexplorer's end user licenses also terminate at specific dates, and if IBM discontinues the development of the program, it may become impossible to distribute readers for the Encyclopaedia, and all the work spent adapting the Encyclopaedia for Techexplorer will be wasted.

For these reasons, developing the Encyclopaedia to be displayed using Techexplorer is not advisable. Conversion into PDF, on the contrary, appears to be a very suitable solution.

In the Portable Document Format file, the typesetting has been taken care by TeX. Therefore, the text quality is as good as can be achieved using TeX. Using different fonts for the body text and for mathematical formulae can be disturbing, though. If desired, commercial type 1 renditions of Computer Modern fonts, supporting the Ä and Ö characters [I:YaY] or commercial type 1 fonts including sufficient mathematical characters[11] could be purchased, provided that the licenses allow distributing the fonts also in type 1 form; some licenses require that when products where the fonts have been used are distributed, only bitmap versions of the fonts be included. The possibility of distributing type 1 fonts may change, if the Encyclopaedia will some day be made into a commercial product.

[11] An example of a set of type 1 fonts equipped with mathematical symbols is LucidaBright combined with LucidaNewMath, available from Y&Y[I:YaY].

A Sample of the Encyclopaedia in the Different Formats

⇐ ⇒

Sisällys

Hakemisto

Ohjeet

Vektorialgebra **3/4**

ESITIEDOT: vektori

KATSO MYÖS: determinantti

Vektoritulo

Vektoritulo eli *ristitulo* voidaan määritellä vain avaruuden vektoreille. Sitä merkitään $\mathbf{a} \times \mathbf{b}$ ja se määritellään seuraavilla ehdoilla: vektori

- Ristitulovektorin pituus on $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}| \sin \vartheta$, missä ϑ on vektoreiden $\mathbf{a}$ ja $\mathbf{b}$ välinen kulma ($0 \leq \vartheta \leq \pi$). pituus
- Ristitulovektorin suunta määräytyy siten, että se on kohtisuorassa vektoreita $\mathbf{a}$ ja $\mathbf{b}$ vastaan; kahdesta mahdollisuudesta valitaan se, joka tekee vektorikolmikosta $\mathbf{a}$, $\mathbf{b}$, $\mathbf{a} \times \mathbf{b}$ oikeakätisen (so. kyseiset kolme vektoria suhtautuvat toisiinsa kuten oikean käden peukalo, etusormi ja keskisormi suorakulmaisiksi ojennettuina).
- Jos jompikumpi vektoreista $\mathbf{a}$ ja $\mathbf{b}$ on nollavektori, myös niiden ristitulo on nollavektori. nollavektori

Geometrisilla tarkasteluilla on mahdollista osoittaa, että ristitulo noudattaa osittelulakeja, so.

$$\mathbf{a} \times (\mathbf{b} + \mathbf{c}) = \mathbf{a} \times \mathbf{b} + \mathbf{a} \times \mathbf{c} \qquad (\mathbf{a} + \mathbf{b}) \times \mathbf{c} = \mathbf{a} \times \mathbf{c} + \mathbf{b} \times \mathbf{c}.$$

Skalaariset kertoimet voidaan myös kerätä yhteen:

$$(\lambda \mathbf{a}) \times (\mu \mathbf{b}) = \lambda\mu(\mathbf{a} \times \mathbf{b}).$$

Vaihdannainen tai liitännäinen ei vektoritulo sen sijaan ole. Tekijöiden järjestystä vaihdettaessa muuttuu merkki: $\mathbf{a} \times \mathbf{b} = -\mathbf{b} \times \mathbf{a}$. Esimerkiksi on $(\mathbf{i} \times \mathbf{j}) \times \mathbf{j} = \mathbf{k} \times \mathbf{j} = -\mathbf{i}$ ja $\mathbf{i} \times (\mathbf{j} \times \mathbf{j}) = \mathbf{i} \times \mathbf{o} = \mathbf{o}$ eikä liitännäisyys siis päde.

Vektorin vektoritulo itsensä kanssa on nollavektori: $\mathbf{a} \times \mathbf{a} = \mathbf{o}$. Tällöin nimittäin vektoreiden välinen kulma on $\vartheta = 0$, jolloin tulovektorin pituus on $= 0$.

Kantavektoreiden vektoritulot ovat kantavektori

$$\begin{aligned}
&\mathbf{i} \times \mathbf{i} = \mathbf{j} \times \mathbf{j} = \mathbf{k} \times \mathbf{k} = \mathbf{o}, \\
&\mathbf{i} \times \mathbf{j} = \mathbf{k},\ \mathbf{j} \times \mathbf{k} = \mathbf{i},\ \mathbf{k} \times \mathbf{i} = \mathbf{j} \quad \text{ja} \\
&\mathbf{j} \times \mathbf{i} = -\mathbf{k},\ \mathbf{k} \times \mathbf{j} = -\mathbf{i},\ \mathbf{i} \times \mathbf{k} = -\mathbf{j}.
\end{aligned}$$

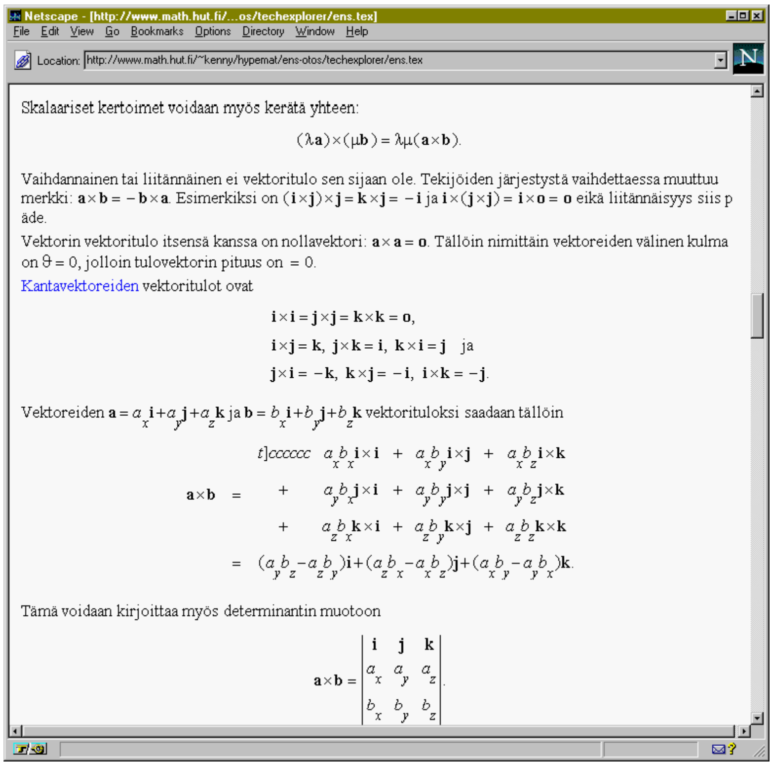
Vektoreiden $\mathbf{a} = a_x\mathbf{i} + a_y\mathbf{j} + a_z\mathbf{k}$ ja $\mathbf{b} = b_x\mathbf{i} + b_y\mathbf{j} + b_z\mathbf{k}$ vektorituloksi saadaan tällöin

$$\begin{aligned}
\mathbf{a} \times \mathbf{b} &= \quad a_xb_x\mathbf{i} \times \mathbf{i} + a_xb_y\mathbf{i} \times \mathbf{j} + a_xb_z\mathbf{i} \times \mathbf{k} \\
&\quad + a_yb_x\mathbf{j} \times \mathbf{i} + a_yb_y\mathbf{j} \times \mathbf{j} + a_yb_z\mathbf{j} \times \mathbf{k} \\
&\quad + a_zb_x\mathbf{k} \times \mathbf{i} + a_zb_y\mathbf{k} \times \mathbf{j} + a_zb_z\mathbf{k} \times \mathbf{k} \\
&= (a_yb_z - a_zb_y)\mathbf{i} + (a_zb_x - a_xb_z)\mathbf{j} + (a_xb_y - a_yb_x)\mathbf{k}.
\end{aligned}$$

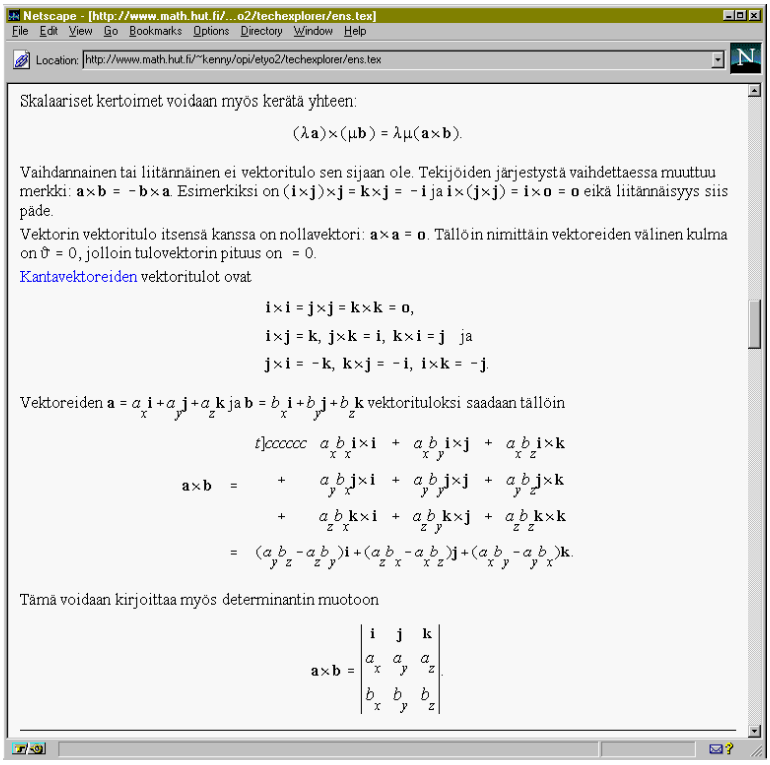
Tämä voidaan kirjoittaa myös determinantin muotoon

$$\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}.$$

Figure 1: Original sample typeset by LaTeX.

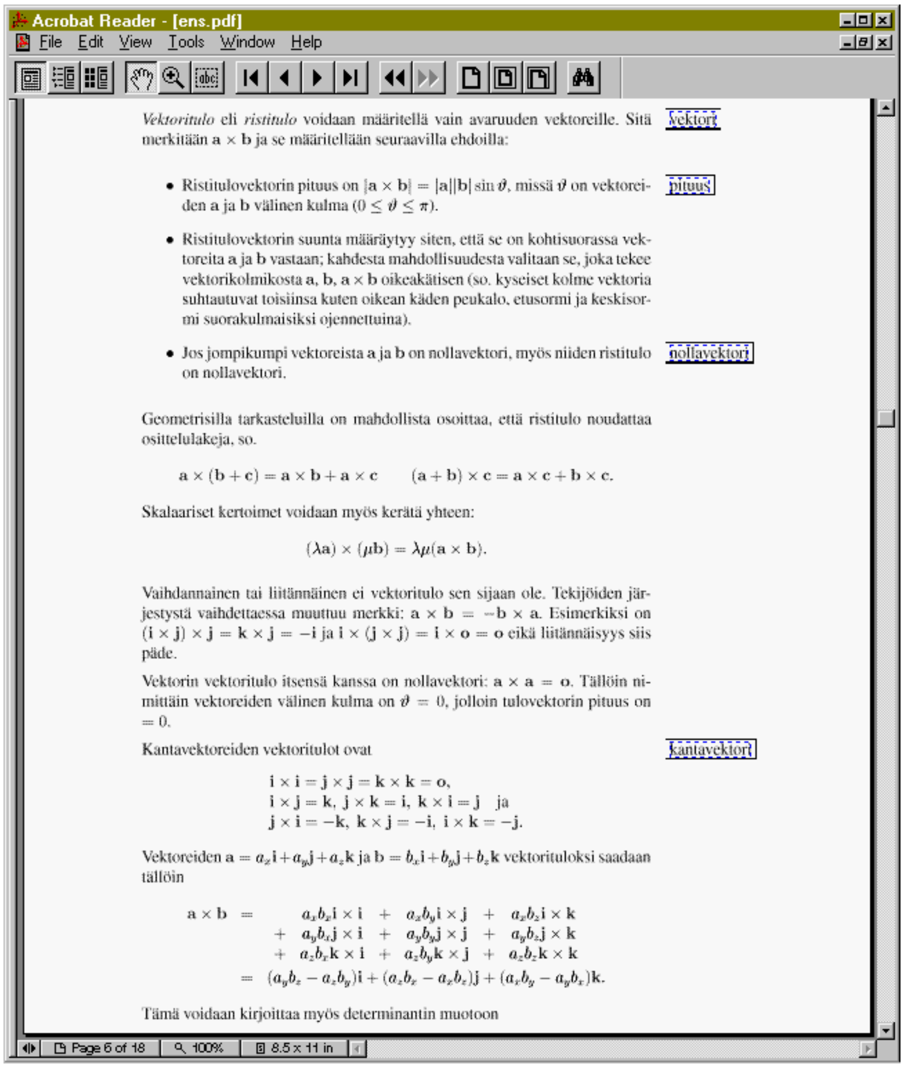


(a)



(b)

Figure 2: Sample displayed by Techexplorer, using standard Windows fonts (a), and WordPerfect fonts (b).



Vektoritulo eli *ristitulo* voidaan määritellä vain avaruuden vektoreille. Sitä merkitään $\mathbf{a} \times \mathbf{b}$ ja se määritellään seuraavilla ehdoilla: vektorit

- Ristitulovektorin pituus on $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}| \sin\vartheta$, missä ϑ on vektoreiden $\mathbf{a}$ ja $\mathbf{b}$ välinen kulma ($0 \leq \vartheta \leq \pi$). pituus
- Ristitulovektorin suunta määräytyy siten, että se on kohtisuorassa vektoreita $\mathbf{a}$ ja $\mathbf{b}$ vastaan; kahdesta mahdollisuudesta valitaan se, joka tekee vektorikolmikosta $\mathbf{a}$, $\mathbf{b}$, $\mathbf{a} \times \mathbf{b}$ oikeakätisen (so. kyseiset kolme vektoria suhtautuvat toisiinsa kuten oikean käden peukalo, etusormi ja keskisormi suorakulmaisiksi ojennettuina).
- Jos jompikumpi vektoreista $\mathbf{a}$ ja $\mathbf{b}$ on nollavektori, myös niiden ristitulo on nollavektori. nollavektori

Geometrisilla tarkasteluilla on mahdollista osoittaa, että ristitulo noudattaa osittelulakeja, so.

$$\mathbf{a} \times (\mathbf{b} + \mathbf{c}) = \mathbf{a} \times \mathbf{b} + \mathbf{a} \times \mathbf{c} \qquad (\mathbf{a} + \mathbf{b}) \times \mathbf{c} = \mathbf{a} \times \mathbf{c} + \mathbf{b} \times \mathbf{c}.$$

Skalaariset kertoimet voidaan myös kerätä yhteen:

$$(\lambda\mathbf{a}) \times (\mu\mathbf{b}) = \lambda\mu(\mathbf{a} \times \mathbf{b}).$$

Vaihdannainen tai liitännäinen ei vektoritulo sen sijaan ole. Tekijöiden järjestystä vaihdettaessa muuttuu merkki: $\mathbf{a} \times \mathbf{b} = -\mathbf{b} \times \mathbf{a}$. Esimerkiksi on $(\mathbf{i} \times \mathbf{j}) \times \mathbf{j} = \mathbf{k} \times \mathbf{j} = -\mathbf{i}$ ja $\mathbf{i} \times (\mathbf{j} \times \mathbf{j}) = \mathbf{i} \times \mathbf{o} = \mathbf{o}$ eikä liitännäisyys siis päde.

Vektorin vektoritulo itsensä kanssa on nollavektori: $\mathbf{a} \times \mathbf{a} = \mathbf{o}$. Tällöin nimittäin vektoreiden välinen kulma on $\vartheta = 0$, jolloin tulovektorin pituus on $= 0$.

Kantavektoreiden vektoritulot ovat kantavektori

$$\begin{array}{l} \mathbf{i} \times \mathbf{i} = \mathbf{j} \times \mathbf{j} = \mathbf{k} \times \mathbf{k} = \mathbf{o}, \\ \mathbf{i} \times \mathbf{j} = \mathbf{k},\ \mathbf{j} \times \mathbf{k} = \mathbf{i},\ \mathbf{k} \times \mathbf{i} = \mathbf{j} \quad \text{ja} \\ \mathbf{j} \times \mathbf{i} = -\mathbf{k},\ \mathbf{k} \times \mathbf{j} = -\mathbf{i},\ \mathbf{i} \times \mathbf{k} = -\mathbf{j}. \end{array}$$

Vektoreiden $\mathbf{a} = a_x\mathbf{i} + a_y\mathbf{j} + a_z\mathbf{k}$ ja $\mathbf{b} = b_x\mathbf{i} + b_y\mathbf{j} + b_z\mathbf{k}$ vektorituloksi saadaan tällöin

$$\begin{aligned} \mathbf{a} \times \mathbf{b} = &\quad a_x b_x \mathbf{i} \times \mathbf{i} + a_x b_y \mathbf{i} \times \mathbf{j} + a_x b_z \mathbf{i} \times \mathbf{k} \\ &+ a_y b_x \mathbf{j} \times \mathbf{i} + a_y b_y \mathbf{j} \times \mathbf{j} + a_y b_z \mathbf{j} \times \mathbf{k} \\ &+ a_z b_x \mathbf{k} \times \mathbf{i} + a_z b_y \mathbf{k} \times \mathbf{j} + a_z b_z \mathbf{k} \times \mathbf{k} \\ = &\ (a_y b_z - a_z b_y)\mathbf{i} + (a_z b_x - a_x b_z)\mathbf{j} + (a_x b_y - a_y b_x)\mathbf{k}. \end{aligned}$$

Tämä voidaan kirjoittaa myös determinantin muotoon

Figure 3: Sample in PDF displayed by Adobe Acrobat Reader.

$\boxed{\Leftarrow}$ $\boxed{\Rightarrow}$

Vektorialgebra **3/4**

ESITIEDOT: vektoriVektori

KATSO MYÖS: determinanttiDeterminantti

Vektoritulo

Vektoritulo eli *ristitulo* voidaan määritellä vain avaruuden vektoreille. Sitä merkitään $\mathbf{a} \times \mathbf{b}$ ja se määritellään seuraavilla ehdoilla: vektori

- Ristitulovektorin pituus on $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}| \sin \vartheta$, missä ϑ on vektoreiden $\mathbf{a}$ ja $\mathbf{b}$ välinen kulma ($0 \leq \vartheta \leq \pi$). pituus
- Ristitulovektorin suunta määräytyy siten, että se on kohtisuorassa vektoreita $\mathbf{a}$ ja $\mathbf{b}$ vastaan; kahdesta mahdollisuudesta valitaan se, joka tekee vektorikolmikosta $\mathbf{a}$, $\mathbf{b}$, $\mathbf{a} \times \mathbf{b}$ oikeakätisen (so. kyseiset kolme vektoria suhtautuvat toisiinsa kuten oikean käden peukalo, etusormi ja keskisormi suorakulmaisiksi ojennettuina).
- Jos jompikumpi vektoreista $\mathbf{a}$ ja $\mathbf{b}$ on nollavektori, myös niiden ristitulo on nollavektori. nollavektori

Geometrisilla tarkasteluilla on mahdollista osoittaa, että ristitulo noudattaa osittelulakeja, so.

$$\mathbf{a} \times (\mathbf{b} + \mathbf{c}) = \mathbf{a} \times \mathbf{b} + \mathbf{a} \times \mathbf{c} \qquad (\mathbf{a} + \mathbf{b}) \times \mathbf{c} = \mathbf{a} \times \mathbf{c} + \mathbf{b} \times \mathbf{c}.$$

Skalaariset kertoimet voidaan myös kerätä yhteen:

$$(\lambda \mathbf{a}) \times (\mu \mathbf{b}) = \lambda \mu (\mathbf{a} \times \mathbf{b}).$$

Vaihdannainen tai liitännäinen ei vektoritulo sen sijaan ole. Tekijöiden järjestystä vaihdettaessa muuttuu merkki: $\mathbf{a} \times \mathbf{b} = -\mathbf{b} \times \mathbf{a}$. Esimerkiksi on $(\mathbf{i} \times \mathbf{j}) \times \mathbf{j} = \mathbf{k} \times \mathbf{j} = -\mathbf{i}$ ja $\mathbf{i} \times (\mathbf{j} \times \mathbf{j}) = \mathbf{i} \times \mathbf{o} = \mathbf{o}$ eikä liitännäisyys siis päde.

Vektorin vektoritulo itsensä kanssa on nollavektori: $\mathbf{a} \times \mathbf{a} = \mathbf{o}$. Tällöin nimittäin vektoreiden välinen kulma on $\vartheta = 0$, jolloin tulovektorin pituus on $= 0$.

Kantavektoreiden vektoritulot ovat kantavektori

$$\begin{aligned} &\mathbf{i} \times \mathbf{i} = \mathbf{j} \times \mathbf{j} = \mathbf{k} \times \mathbf{k} = \mathbf{o}, \\ &\mathbf{i} \times \mathbf{j} = \mathbf{k},\ \mathbf{j} \times \mathbf{k} = \mathbf{i},\ \mathbf{k} \times \mathbf{i} = \mathbf{j} \quad \text{ja} \\ &\mathbf{j} \times \mathbf{i} = -\mathbf{k},\ \mathbf{k} \times \mathbf{j} = -\mathbf{i},\ \mathbf{i} \times \mathbf{k} = -\mathbf{j}. \end{aligned}$$

Vektoreiden $\mathbf{a} = a_x\mathbf{i} + a_y\mathbf{j} + a_z\mathbf{k}$ ja $\mathbf{b} = b_x\mathbf{i} + b_y\mathbf{j} + b_z\mathbf{k}$ vektorituloksi saadaan tällöin

$$\begin{aligned} \mathbf{a} \times \mathbf{b} = {} & a_x b_x \mathbf{i} \times \mathbf{i} + a_x b_y \mathbf{i} \times \mathbf{j} + a_x b_z \mathbf{i} \times \mathbf{k} \\ & + a_y b_x \mathbf{j} \times \mathbf{i} + a_y b_y \mathbf{j} \times \mathbf{j} + a_y b_z \mathbf{j} \times \mathbf{k} \\ & + a_z b_x \mathbf{k} \times \mathbf{i} + a_z b_y \mathbf{k} \times \mathbf{j} + a_z b_z \mathbf{k} \times \mathbf{k} \\ = {} & (a_y b_z - a_z b_y)\mathbf{i} + (a_z b_x - a_x b_z)\mathbf{j} + (a_x b_y - a_y b_x)\mathbf{k}. \end{aligned}$$

Tämä voidaan kirjoittaa myös determinantin muotoon

$$\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}.$$

Figure 4: Sample in PDF printed by Adobe Acrobat Reader.

B Files Converted for Techexplorer and PDF

The files are also available electronically at `<URL http://www.math.hut.fi/~kenny/opi/etyo2>`.

B.1 Original files

B.1.1 Original ens.tex

```
% Hypermediatietosanakirja matematiikasta
% SKK, 27.10.1994
% LaTeX2e

\documentclass[12pt]{article}
\usepackage[finnish]{babel}
\usepackage{t1enc}
\usepackage{psfig}
\pssilent                             % Ei turhia ilmoituksia kuvista
\usepackage{ens}

\immediate\openout14=viitt
\immediate\openout15=kuvat

\write14{\protect \documentclass{article}}
\write14{\protect \usepackage[finnish]{babel}}
\write14{\protect \usepackage{t1enc}}
\write14{\protect \usepackage{layout}}
\write14{\protect \usepackage{amstex}}
\write14{\protect \begin{document}}
\write14{Viitelista \protect \today \protect
   \vspace{1cm} ^^J}

\write15{\protect \documentclass{article}}
\write15{\protect \usepackage[finnish]{babel}}
\write15{\protect \usepackage{t1enc}}
\write15{\protect \usepackage{layout}}
\write15{\protect \usepackage{amstex}}
\write15{\protect \begin{document}}
\write15{Kuva- ja animaatiolista \protect \today \protect
   \vspace{1cm} ^^J}

\includeonly{vektori,vektalg,piste,suora,taso}

\begin{document}


% Title page, instructions, table of contents

\include{otsikko}     \include{ohjeet}      \include{sisall}
```

```
% Articles

\include{reaalilv}    \include{pii}         \include{neper}
\include{summtulo}    \include{keskiarv}    \include{murtolv}
\include{alkutekj}    \include{lukujarj}    \include{kompllv}
\include{potenssi}    \include{juuri}       \include{polynomi}
\include{polytekj}    \include{yhtalo}      \include{poly-yht}
\include{juuriyht}    \include{itsaryht}    \include{transyht}
\include{yhtryhma}    \include{epayht}      \include{funktio}
\include{realfkt}     \include{rational}    \include{ekspfkt}
\include{logfkt}      \include{trigfkt}     \include{trigkvat}
\include{arcusfkt}    \include{hypfkt}      \include{areafkt}
\include{lukujono}    \include{lukjonra}    \include{sarjat}
\include{funkra}      \include{jatkuv}      \include{derivaat}
\include{derivsnt}    \include{alkfnder}    \include{maxmin}
\include{kaannep}     \include{nopkiih}     \include{newton}
\include{diffyht}     \include{intfkt}      \include{maarint}
\include{inttekn}     \include{alatilav}    \include{massakp}
\include{hitmom}      \include{geometr}     \include{koord}
\include{vektori}     \include{vektalg}     \include{determ}
\include{piste}       \include{suora}       \include{taso}
\include{geomprob}    \include{syntgeom}    \include{analgeom}
\include{vektgeom}    \include{alggeom}     \include{kulma}
\include{kolmio}      \include{pythagor}    \include{monikulm}
\include{monitaho}    \include{tangnorm}    \include{kayra}
\include{pinta}       \include{ympyra}      \include{pallo}
\include{karlier}     \include{2astkayr}    \include{2astpint}
\include{geomkuv}     \include{avkaavat}    \include{joukot}
\include{logiikka}    \include{induktio}    \include{lukumaar}
\include{binomkrt}    \include{todnakl}     \include{jakauma}
\include{tilasto}     \include{matmerk}     \include{matemat}
\include{matemaat}


% Index

\include{hakem}


\write14{\protect \end{document} ^^J}
\write15{\protect \end{document} ^^J}

\closeout14
\closeout15

\end{document}
```

B.1.2 Original ens.sty

```
% Tyylitiedosto hypermediatietosanakirjaa varten
%
% Tulostetaan dvi-tiedoston ohella tiedostot, joissa on 1) kuva-
% ja animaatioluettelo sekä 2) avainsanaluettelo; tiedostot on
% avattava päätiedostossa (ens.tex tms.). Avainsanaluettelossa
% esitetään artikkelin nimi, esitieto- ja katso myös -kentät,
% modulin nimi, modulin avainsanat.
%
% SKK, 25.2.1995
% LaTeX2e

\RequirePackage{amsmath}
\RequirePackage{amsfonts}
\RequirePackage{amssymb}
\RequirePackage{ifthen}
\RequirePackage{vmargin}
\RequirePackage{multicol}

\setpapersize{A4}
%\setmargins{30mm}{14mm}{130mm}{1200mm}{12pt}{9mm}{0pt}{5mm} % for printing
\setmargins{30mm}{7mm}{130mm}{1200mm}{12pt}{9mm}{0pt}{5mm}   % xhdvi
%          left  top  width  height head  hsep foot fskip

\setlength{\parskip}{\medskipamount}
\setlength{\parindent}{0pt}
\setlength{\emergencystretch}{10pt}

\pagestyle{empty}

\newcommand{\ETKM}[2]{\linkkialleviivaus{\mbox{#1}}{#2}}
\newcommand{\BD}{\begin{displaymath}}
\newcommand{\ED}{\end{displaymath}}

\newcommand{\xhdvi}{\texttt{xhdvi}}
\newcommand{\gs}{\texttt{ghostscript}}
\newcommand{\HypeMAT}{\texttt{HypeMAT}}

\newtoks\ArtNimi
\newtoks\EsiTiedNimi
\newtoks\KatsoMNimi
\newtoks\ModuliNimi
\newcount\ArtAlku

\newcounter{sivuno}
\newcounter{sivujenlkm}
\newcounter{tmpsivuno}   % Käytetään nuolia tehdessä

\newcommand{\Sivunumerot}[2]{\setcounter{sivuno}{#1}
```

```
\setcounter{sivujenlkm}{#2}}

% Apumerkkijonoja:
%   risuaitaa ei voi käyttää makroissa kuin muodossa ##, joka tuplaantuu
%     myös dvi-tiedostoon
%   Merkkijonoa "> ei voi käyttää makroissa, koska se on lyhenne
%     ranskalaiselle  lainausmerkille  >>
\edef\risuaita{\string#}
\edef\suurempikuin{\string>}

% HTML-makrot
\newcommand{\htmladdnormallink}[2]%
  {\special{html:<a href="#2"\suurempikuin}#1\special{html:</a>}}
\newcommand{\htmladdsmashlink}[2]%
  {\special{html:<a href="#2"\suurempikuin}\protect\smash[b]{#1}%
  \special{html:</a>}}
\newcommand{\htmladdname}[1]%
  {\special{html:<a name="#1"\suurempikuin}\special{html:</a>}}

% Yksiriviset linkit
\newcommand{\linkkialleviivaus}[2]{\underline{\htmladdsmashlink{#1}{#2}}}
\newcommand{\linkkilaatikko}[2]{\fbox{\htmladdsmashlink{#1}{#2}}}
\newcommand{\LINK}[3]{#1\marginpar{\linkkilaatikko{#2}{\risuaita #3}}}
\newcommand{\HLINK}[3]{#1\marginpar{\linkkilaatikko{#2}{\risuaita #2}}}

% Kaksiriviset linkit
\newcommand{\korkealinkkilaatikko}[4]%
  {\fbox{\parbox[t]{#3}{\htmladdsmashlink{#1}{#4}%
  \newline\htmladdsmashlink{#2}{#4}}}}
\newcommand{\KLINK}[6]%
  {#1\marginpar{\korkealinkkilaatikko{#4}{#5}{#6}{\risuaita #3}}}
\newcommand{\KHLINK}[6]%
  {#1\marginpar{\korkealinkkilaatikko{#4}{#5}{#6}{\risuaita #2}}}

% Korttien selailuun tarvittavat nuolet
\newcommand{\nuolilinkit}[1]{%
\setcounter{tmpsivuno}{\value{sivuno}}%
\marginpar{\mbox{%
\addtocounter{tmpsivuno}{-1}%
\ifthenelse{\equal{#1}{r}}{%
%\phantom{\fbox{$\Leftarrow$}}~%
\makebox[0pt][l]{}\hspace{2em}%
}{%
\makebox[0pt][l]{%
\linkkilaatikko{$\Leftarrow$}{\risuaita \the\ArtNimi :\arabic{tmpsivuno}}}%
\hspace{2em}}%
\addtocounter{tmpsivuno}{2}%
\ifthenelse{\equal{#1}{l}}{%
\phantom{\fbox{$\Rightarrow$}}%
}{%
```

```
\linkkilaatikko{$\Rightarrow$}{\risuaita \the\ArtNimi :\arabic{tmpsivuno}}}}}}

% Peruskama, joka tulee joka sivulle: Nuolet, Sisällys, Hakemisto, Ohjeet
\newcommand{\perusreunapalikat}{%
\ifthenelse{\value{sivuno} = 1}{%
  \ifthenelse{\value{sivujenlkm} > 1}{%
    \nuolilinkit{r}}%
                {\marginpar{\phantom{roskaa}}}}{%
  \ifthenelse{\value{sivuno} < \value{sivujenlkm}}{%
    \nuolilinkit{lr}%
    }{%
    \nuolilinkit{l}}}%
\marginpar{\linkkilaatikko{Sisällys}{\risuaita Sisällys}}%
\marginpar{\linkkilaatikko{Hakemisto}{\risuaita Hakemisto}}%
\marginpar{\linkkilaatikko{Ohjeet}{\risuaita Ohjeet}}%
\marginpar{\phantom{roskaa}}%
}

\newcommand{\Artikkeli}[1]{\ArtNimi={#1} \ArtAlku=1
\write14{\textbf{#1} ^^J}
\write15{\textbf{#1} ^^J}}

\newcommand{\EsiTiedot}[1]{\EsiTiedNimi={#1}
\write14{\quad \textsl{Esitiedot: #1} ^^J}}

\newcommand{\KatsoMyos}[1]{\KatsoMNimi={#1}
\write14{\quad \textsl{Katso myös: #1} ^^J}}

\newcommand{\Moduli}[1]{\ModuliNimi={#1} \newpage
\mbox{}\perusreunapalikat\\[7mm]
% \ifodd\ArtAlku \pagenumbering{arabic} \ArtAlku=0 \fi
{\raggedright
\textbf{\the\ArtNimi} \hfill
%\perusreunapalikat
\ifthenelse{\value{sivuno} = 1}{\htmladdname{\the\ArtNimi}}{}
\htmladdname{\the\ArtNimi :\arabic{sivuno}}
\htmladdname{\the\ModuliNimi}
\textbf{\arabic{sivuno}/\arabic{sivujenlkm}} \newline
\textsc{Esitiedot:} \the\EsiTiedNimi \newline
\textsc{Katso myös:} \the\KatsoMNimi

\vspace{3mm} \hrule \vspace{3mm} \textbf{#1}
\write14{\quad \textbf{#1} \quad \thepage ^^J}
\write15{\quad \textbf{#1} \quad \thepage ^^J}}}

\newcommand{\Avain}[1]{\write14{\quad\quad #1 ^^J}}

\newcommand{\SivunLoppu}{\mbox{}\perusreunapalikat}

% Makron \Kuva syntaksi on seuraava: \Kuva[tiedosto]{selitysteksti}
```

```
% Parametri [tiedosto] voi puuttua.
% Toiminta: Jos parametri [tiedosto] puuttuu, kirjoitetaan kuvan pai-
% kalle tekstiin laatikkoon suljettu selitysteksti ja kuvaluetteloon
% selitysteksti sekä maininta, että tiedostoa ei ole. Jos parametri
% tiedosto on annettu, luetaan tiedosto.tex sisään ja kuvaluetteloon
% kirjoitetaan selitysteksti sekä tiedostonimi.

\newcommand{\Kuva}[2][EI]{\def\1{#1} \def\2{EI}
\ifx\1\2 \raisebox{0pt}[22mm][22mm]{\textsc{Kuva.} #2} \else \input{#1} \fi
\write15{\quad\quad \textit{Kuva:} #2 / tiedosto #1 ^^J}}

%\newcommand{\Animaatio}[1]{\fbox{\textsc{Animaatio.} #1}
%\write15{\quad\quad \textit{Animaatio:} #1 ^^J}}
\newcommand{\Animaatio}[1]{}

\newcommand{\V}[1]{{\bf #1}}
\newcommand\vs{\ {\widehat =}\ }
\newcommand\stackupsdown[2]{\mathrel{\mathop{#1}\limits_{#2}}}
\newcommand{\D}{\mathop{\mathgroup\symoperators D}\nolimits}
\newcommand{\arccot}{\mathop{\mathgroup\symoperators arccot}\nolimits}
\newcommand{\arsinh}{\mathop{\mathgroup\symoperators arsinh}\nolimits}
\newcommand{\arcosh}{\mathop{\mathgroup\symoperators arcosh}\nolimits}
\newcommand{\artanh}{\mathop{\mathgroup\symoperators artanh}\nolimits}
\newcommand{\arcoth}{\mathop{\mathgroup\symoperators arcoth}\nolimits}

\newcommand{\N}{\mathbb N}
\newcommand{\Z}{\mathbb Z}
\newcommand{\Q}{\mathbb Q}
\newcommand{\R}{\mathbb R}
\newcommand{\C}{\mathbb C}
```

B.2 Files Converted for Techexplorer

B.2.1 `ens.tex` Converted for Techexplorer

```
% Hypermediatietosanakirja matematiikasta
% SKK, 27.10.1994
% LaTeX2e
% Conversion for Techexplorer: Kenny 26.3.1997

\documentclass[12pt]{article}
\usepackage[finnish]{babel}
\usepackage{t1enc}

\begin{document}

\input{ens-sty}

\input{vektori}
\input{vektalg}
\input{piste}
\input{suora}
\input{taso}

\end{document}
```

B.2.2 `ens.sty` Converted for Techexplorer

Because Techexplorer does not know how to ask for macro packages with a `.sty` extension, `ens.sty` was renamed to `ens-sty.tex` and, of course, modified to comply with Techexplorer's requirements.

```
% Tyylitiedosto hypermediatietosanakirjaa varten
%
% Tulostetaan dvi-tiedoston ohella tiedostot, joissa on 1) kuva-
% ja animaatioluettelo sekä 2) avainsanaluettelo; tiedostot on
% avattava päätiedostossa (ens.tex tms.). Avainsanaluettelossa
% esitetään artikkelin nimi, esitieto- ja katso myös -kentät,
% modulin nimi, modulin avainsanat.
%
% SKK, 25.2.1995
% LaTeX2e
% Conversion for Techexplorer: Kenny 26.3.1997

% RequirePackage commands removed
% paper size and margin setting commands removed

\renewcommand{\textsc}[1]{\textsl{#1}}
```

```
\setlength{\parskip}{\medskipamount}
\setlength{\parindent}{0pt}
\setlength{\emergencystretch}{10pt}

\pagestyle{empty}

\newcommand{\ETKM}[2]{\linkkialleviivaus{\mbox{#1}}{#2}}
\newcommand{\BD}{\begin{displaymath}}
\newcommand{\ED}{\end{displaymath}}

\newcommand{\xhdvi}{\texttt{xhdvi}}
\newcommand{\gs}{\texttt{ghostscript}}
\newcommand{\HypeMAT}{\texttt{HypeMAT}}

% toks and counter declarations and auxiliary string removed

\newcommand{\Sivunumerot}[2]{}

% HTML-makrot
\newcommand{\htmladdnormallink}[2]{\labelLink{#2}{#1}}
\newcommand{\htmladdsmashlink}[2]{\labelLink{#2}{\protect\smash{#1}}}
\newcommand{\htmladdname}[1]{\label{#1}}

% Yksiriviset linkit
\newcommand{\linkkialleviivaus}[2]{\htmladdsmashlink{#1}{#2}}
\newcommand{\linkkilaatikko}[2]{\fbox{\htmladdsmashlink{#1}{#2}}}
\newcommand{\LINK}[3]{\htmladdnormallink{#1}{#3}}
\newcommand{\HLINK}[3]{\htmladdnormallink{#1}{#2}}

% Kaksiriviset linkit
\newcommand{\KLINK}[6]{\LINK{#1}{#3}}
\newcommand{\KHLINK}[6]{\HLINK{#1}{#2}}

% Lots of stuff removed for techexplorer

\newcommand{\Artikkeli}[1]{%
\hrule\hrule
\textbf{#1}
\htmladdname{#1}
}

\newcommand{\EsiTiedot}[1]{\textsc{Esitiedot:} #1}

\newcommand{\KatsoMyos}[1]{\textsc{Katso myös:} #1}

\newcommand{\Moduli}[1]{%
\htmladdname{#1}
\par\hrule
}
```

```
\newcommand{\Avain}[1]{}

\newcommand{\SivunLoppu}{}

% Makron \Kuva syntaksi on seuraava: \Kuva[tiedosto]{selitysteksti}
% Parametri [tiedosto] voi puuttua.
% Toiminta: Jos parametri [tiedosto] puuttuu, kirjoitetaan kuvan pai-
% kalle tekstiin laatikkoon suljettu selitysteksti ja kuvaluetteloon
% selitysteksti sekä maininta, että tiedostoa ei ole. Jos parametri
% tiedosto on annettu, luetaan tiedosto.tex sisään ja kuvaluetteloon
% kirjoitetaan selitysteksti sekä tiedostonimi.

\newcommand{\Kuva}[4]{}

\newcommand{\Animaatio}[1]{}

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% The following unchanged for techexplorer
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

\newcommand{\V}[1]{{\bf #1}}
\newcommand\vs{\ {\widehat =}\ }
\newcommand\stackupsdown[2]{\mathrel{\mathop{#1}\limits_{#2}}}
\newcommand{\D}{\mathop{\mathgroup\symoperators D}\nolimits}
\newcommand{\arccot}{\mathop{\mathgroup\symoperators arccot}\nolimits}
\newcommand{\arsinh}{\mathop{\mathgroup\symoperators arsinh}\nolimits}
\newcommand{\arcosh}{\mathop{\mathgroup\symoperators arcosh}\nolimits}
\newcommand{\artanh}{\mathop{\mathgroup\symoperators artanh}\nolimits}
\newcommand{\arcoth}{\mathop{\mathgroup\symoperators arcoth}\nolimits}

\newcommand{\N}{\mathbb N}
\newcommand{\Z}{\mathbb Z}
\newcommand{\Q}{\mathbb Q}
\newcommand{\R}{\mathbb R}
\newcommand{\C}{\mathbb C}
```

B.3 Files Converted for PDF

B.3.1 `ens.tex` Converted for PDF

The only change was adding the line

```
\usepackage{times}
```

after line 11:

```
\pssilent                              % Ei turhia ilmoituksia kuvista
```

B.3.2 `ens.sty` Converted for PDF

Only the following changes were made:

1. The line

   ```
   \RequirePackage{hyper}
   ```

   was added after the other `\RequirePackage` commands.

2. The line

   ```
   \edef\risuaita{\string#}
   ```

   was removed.

3. The low-level HTML commands on the lines

   ```
   \newcommand{\htmladdnormallink}[2]
     {\special{html:<a href="#2"\suurempikuin}#1\special{html:</a>}}
   \newcommand{\htmladdsmashlink}[2]
     {\special{html:<a href="#2"\suurempikuin}\protect\smash[b]{#1}%
     \special{html:</a>}}
   \newcommand{\htmladdname}[1]
     {\special{html:<a name="#1"\suurempikuin}\special{html:</a>}}
   ```

   were changed to use commands defined in the `hyper` package. The new forms are:

   ```
   \newcommand{\htmladdnormallink}[2]{\hyperreference{#2}{#1}}
   \newcommand{\htmladdsmashlink}[2]{\hyperreference{#2}%
     {\protect\smash[b]{#1}}}
   \newcommand{\htmladdname}[1]{\blindhyperanchor{#1}}
   ```

4. The lines

   ```
   \marginpar{\linkkilaatikko{Sisällys}{\risuaita Sisällys}}%
   \marginpar{\linkkilaatikko{Hakemisto}{\risuaita Hakemisto}}%
   \marginpar{\linkkilaatikko{Ohjeet}{\risuaita Ohjeet}}%
   ```

   at the end of the definition of `\perusreunapalikat` were removed.

5. The line

   ```
   \newcommand{\ETKM}[2]{\linkkialleviivaus{\mbox{#1}}{#2}}
   ```

   was changed to:

   ```
   \newcommand{\ETKM}{}
   ```

After the conversion, the file is as follows:

```
% Tyylitiedosto hypermediatietosanakirjaa varten
%
% Tulostetaan dvi-tiedoston ohella tiedostot, joissa on 1) kuva-
% ja animaatioluettelo sekä 2) avainsanaluettelo; tiedostot on
% avattava päätiedostossa (ens.tex tms.). Avainsanaluettelossa
% esitetään artikkelin nimi, esitieto- ja katso myös -kentät,
% modulin nimi, modulin avainsanat.
%
% SKK, 25.2.1995
% LaTeX2e
% Modified for PDF by Kenrick Bingham

\RequirePackage{amsmath}
\RequirePackage{amsfonts}
\RequirePackage{amssymb}
\RequirePackage{ifthen}
\RequirePackage{vmargin}
\RequirePackage{multicol}
\RequirePackage{hyper}                                          % Added for PDF

\setpapersize{A4}
%\setmargins{30mm}{14mm}{130mm}{1200mm}{12pt}{9mm}{0pt}{5mm} % for printing
\setmargins{30mm}{7mm}{130mm}{1200mm}{12pt}{9mm}{0pt}{5mm}   % xhdvi
%          left  top  width  height head  hsep foot fskip

\setlength{\parskip}{\medskipamount}
\setlength{\parindent}{0pt}
\setlength{\emergencystretch}{10pt}

\pagestyle{empty}

\newcommand{\ETKM}{}                                            % Changed for PDF
\newcommand{\BD}{\begin{displaymath}}
\newcommand{\ED}{\end{displaymath}}

\newcommand{\xhdvi}{\texttt{xhdvi}}
\newcommand{\gs}{\texttt{ghostscript}}
\newcommand{\HypeMAT}{\texttt{HypeMAT}}

\newtoks\ArtNimi
\newtoks\EsiTiedNimi
\newtoks\KatsoMNimi
\newtoks\ModuliNimi
\newcount\ArtAlku

\newcounter{sivuno}
\newcounter{sivujenlkm}
\newcounter{tmpsivuno}   % Käytetään nuolia tehdessä

\newcommand{\Sivunumerot}[2]{\setcounter{sivuno}{#1}
```

```
\setcounter{sivujenlkm}{#2}}

% Apumerkkijonoja:
%   risuaitaa ei voi käyttää makroissa kuin muodossa ##, joka tuplaantuu
%     myös dvi-tiedostoon
%   Merkkijonoa "> ei voi käyttää makroissa, koska se on lyhenne
%     ranskalaiselle  lainausmerkille  >>
%\edef\risuaita{\string#}                                  % removed for PDF
\edef\risuaita{}
\edef\suurempikuin{\string>}

% HTML-makrot                                              % changed for PDF
\newcommand{\htmladdnormallink}[2]{\hyperreference{#2}{#1}}
\newcommand{\htmladdsmashlink}[2]{\hyperreference{#2}{\protect\smash[b]{#1}}}
\newcommand{\htmladdname}[1]{\blindhyperanchor{#1}}

% Yksiriviset linkit
\newcommand{\linkkialleviivaus}[2]{\underline{\htmladdsmashlink{#1}{#2}}}
\newcommand{\linkkilaatikko}[2]{\fbox{\htmladdsmashlink{#1}{#2}}}
\newcommand{\LINK}[3]{#1\marginpar{\linkkilaatikko{#2}{\risuaita #3}}}
\newcommand{\HLINK}[3]{#1\marginpar{\linkkilaatikko{#2}{\risuaita #2}}}

% Kaksiriviset linkit
\newcommand{\korkealinkkilaatikko}[4]%
  {\fbox{\parbox[t]{#3}{\htmladdsmashlink{#1}{#4}%
  \newline\htmladdsmashlink{#2}{#4}}}}
\newcommand{\KLINK}[6]%
  {#1\marginpar{\korkealinkkilaatikko{#4}{#5}{#6}{\risuaita #3}}}
\newcommand{\KHLINK}[6]%
  {#1\marginpar{\korkealinkkilaatikko{#4}{#5}{#6}{\risuaita #2}}}

% Korttien selailuun tarvittavat nuolet
\newcommand{\nuolilinkit}[1]{%
\setcounter{tmpsivuno}{\value{sivuno}}%
\marginpar{\mbox{%
\addtocounter{tmpsivuno}{-1}%
\ifthenelse{\equal{#1}{r}}{%
%\phantom{\fbox{$\Leftarrow$}}~%
\makebox[0pt][l]{}\hspace{2em}%
}{%
\makebox[0pt][l]{%
\linkkilaatikko{$\Leftarrow$}{\risuaita \the\ArtNimi :\arabic{tmpsivuno}}}%
\hspace{2em}}%
\addtocounter{tmpsivuno}{2}%
\ifthenelse{\equal{#1}{l}}{%
\phantom{\fbox{$\Rightarrow$}}%
}{%
\linkkilaatikko{$\Rightarrow$}{\risuaita \the\ArtNimi :\arabic{tmpsivuno}}}}}}

% Peruskama, joka tulee joka sivulle: Nuolet, Sisällys, Hakemisto, Ohjeet
```

```
\newcommand{\perusreunapalikat}{%
\ifthenelse{\value{sivuno} = 1}{%
\ifthenelse{\value{sivujenlkm} > 1}{%
\nuolilinkit{r}}%
        {\marginpar{\phantom{roskaa}}}}{%
\ifthenelse{\value{sivuno} < \value{sivujenlkm}}{%
\nuolilinkit{lr}%
}{%
\nuolilinkit{l}}}%
%\marginpar{\linkkilaatikko{Sisällys}{\risuaita Sisällys}}%       % removed
%\marginpar{\linkkilaatikko{Hakemisto}{\risuaita Hakemisto}}%     % for
%\marginpar{\linkkilaatikko{Ohjeet}{\risuaita Ohjeet}}%           % PDF
\marginpar{\phantom{roskaa}}%
}

\newcommand{\Artikkeli}[1]{\ArtNimi={#1} \ArtAlku=1
\write14{\textbf{#1} ^^J}
\write15{\textbf{#1} ^^J}}

\newcommand{\EsiTiedot}[1]{\EsiTiedNimi={#1}
\write14{\quad \textsl{Esitiedot: #1} ^^J}}

\newcommand{\KatsoMyos}[1]{\KatsoMNimi={#1}
\write14{\quad \textsl{Katso myös: #1} ^^J}}

\newcommand{\Moduli}[1]{\ModuliNimi={#1} \newpage
\mbox{}\perusreunapalikat\\[7mm]
% \ifodd\ArtAlku \pagenumbering{arabic} \ArtAlku=0 \fi
{\raggedright
\textbf{\the\ArtNimi} \hfill
%\perusreunapalikat
\ifthenelse{\value{sivuno} = 1}{\htmladdname{\the\ArtNimi}}{}
\htmladdname{\the\ArtNimi :\arabic{sivuno}}
\htmladdname{\the\ModuliNimi}
\textbf{\arabic{sivuno}/\arabic{sivujenlkm}} \newline
\textsc{Esitiedot:} \the\EsiTiedNimi \newline
\textsc{Katso myös:} \the\KatsoMNimi

\vspace{3mm} \hrule \vspace{3mm} \textbf{#1}
\write14{\quad \textbf{#1} \quad \thepage ^^J}
\write15{\quad \textbf{#1} \quad \thepage ^^J}}}

\newcommand{\Avain}[1]{\write14{\quad\quad #1 ^^J}}

\newcommand{\SivunLoppu}{\mbox{}\perusreunapalikat}

% Makron \Kuva syntaksi on seuraava: \Kuva[tiedosto]{selitysteksti}
% Parametri [tiedosto] voi puuttua.
% Toiminta: Jos parametri [tiedosto] puuttuu, kirjoitetaan kuvan pai-
% kalle tekstiin laatikkoon suljettu selitysteksti ja kuvaluetteloon
```

```
% selitysteksti sekä maininta, että tiedostoa ei ole. Jos parametri
% tiedosto on annettu, luetaan tiedosto.tex sisään ja kuvaluetteloon
% kirjoitetaan selitysteksti sekä tiedostonimi.

\newcommand{\Kuva}[2][EI]{\def\1{#1} \def\2{EI}
\ifx\1\2 \raisebox{0pt}[22mm][22mm]{\textsc{Kuva.} #2} \else \input{#1} \fi
\write15{\quad\quad \textit{Kuva:} #2 / tiedosto #1 ^^J}}

%\newcommand{\Animaatio}[1]{\fbox{\textsc{Animaatio.} #1}
%\write15{\quad\quad \textit{Animaatio:} #1 ^^J}}
\newcommand{\Animaatio}[1]{}

\newcommand{\V}[1]{{\bf #1}}
\newcommand\vs{\ {\widehat =}\ }
\newcommand\stackupsdown[2]{\mathrel{\mathop{#1}\limits_{#2}}}
\newcommand{\D}{\mathop{\mathgroup\symoperators D}\nolimits}
\newcommand{\arccot}{\mathop{\mathgroup\symoperators arccot}\nolimits}
\newcommand{\arsinh}{\mathop{\mathgroup\symoperators arsinh}\nolimits}
\newcommand{\arcosh}{\mathop{\mathgroup\symoperators arcosh}\nolimits}
\newcommand{\artanh}{\mathop{\mathgroup\symoperators artanh}\nolimits}
\newcommand{\arcoth}{\mathop{\mathgroup\symoperators arcoth}\nolimits}

\newcommand{\N}{\mathbb N}
\newcommand{\Z}{\mathbb Z}
\newcommand{\Q}{\mathbb Q}
\newcommand{\R}{\mathbb R}
\newcommand{\C}{\mathbb C}
```

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