

**UiO : Department of Informatics**  
University of Oslo

# uioexam — a $\text{\LaTeX}$ document class for UiO exam problems

Program source code and documentation

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1st July 2015





**E**XAM PROBLEMS at the University of Oslo must be typeset according to very rigid specifications; two examples are shown in Figures 1 and 2 on pages 2 and 3. The L<sup>A</sup>T<sub>E</sub>X document class `uioexam` has been written to implement these rules. It is based on the standard `article` style with the following main modifications:

- The top half of the front page contains a table with the most important information regarding the exam.
- The page header gives the exam subject and the date, and the footer contains a reference to the following page to make sure that no pages are missing.

## Program documentation system

This program was documented using the `web0` package which is based on Donald Knuth's ideas of *literate programming*. For more information on the `web0` implementation, see <http://dag.at.ifi.uio.no/public/doc/web0.pdf>.

# 1 User guide for the `uioexam` document class

The `uioexam` document class is used for typesetting exam problems at the University of Oslo. Two simple examples are shown in Figures 1 and 2 on the following pages. (Both examples are two pages long to demonstrate the special page headers and footers.)

## 1.1 Document class parameters

The `uioexam` class accepts these parameters:

**11pt** selects 11 pt type size.<sup>1</sup>

**12pt** chooses 12 pt type size; this is the default.

**american** or **USenglish** is used when the exam text is written in American English; this is the default.

**del** is used for constituent<sup>2</sup> exams which will be marked as "Constituent exam" or "Deleksamen" (depending on the language). This option may be used in combination with the **ny** and **utsatt** options.

**english** or **UKenglish** is used for British English.

**exercise** will call the individual questions (created using the `\oppgave` command) for "Exercises" (see Section 2.3.2.1 on page 9). (This option should only be used for English text.)

**norsk** is for exams written in Norwegian "Bokmål".

**number** will print a small box for the candidate's number; see an example in the top right-hand corner in Figure 2 on page 3.

**ny** is for new<sup>3</sup> exams, and it may be used in combination with the **del** and **utsatt** options.

**nyorsk** is for writing exams in Norwegian "Nynorsk".

<sup>1</sup> 10 pt type size is not allowed; it is too small for this kind of document.

<sup>2</sup> A *constituent exam* is an exam which is taken during the term and contributes a certain percentage to the final grade.

<sup>3</sup> A *new exam* may be taken if you fail the ordinary exam.

# UNIVERSITETET I OSLO

Det matematisk-naturvitenskapelige fakultet

Eksamensdato: INF2100 – Programmeringslaboratorium  
med kompilatorkonstruksjon  
Eksamensdag: 17. oktober 2008  
Tid for eksamen: 9.00–12.00  
Oppgavesettet er på 2 sider.  
Vedlegg: Ingen  
Tillatte hjelpeemner: Alle

Kontroller at oppgavesettet er komplett før  
du begynner å besvare spørsmålene.

## Innhold

- |  |        |
|--|--------|
| 1 <b>Oversettelse</b> (vekt 40%)       | side 1 |
| 2 <b>Programmering</b> (vekt 50%)      | side 2 |
| 3 <b>Hva kan du ellers?</b> (vekt 10%) | side 2 |

### Oppgave 1 Oversettelse (vekt 40%)

Her er et C-program. Oversett det til Java. (Dette er det første av  
3 problemer på 2 sider.)

```
/* Program 'gcd'  
-----  
A function to compute the greatest common divisor.  
*/  
  
int LF; /* Line feed */  
  
int gcd (int a, int b)  
{ /* Computes the gcd of a and b. */  
  
    while (a != b) {  
        if (a < b) {  
            b = b-a;  
        } else {  
            a = a-b;  
        }  
    }  
    return a;  
}
```

(Fortsettes på side 2.)

Eksamens i INF2100, 17. oktober 2008

Side 2

```
int main ()  
{  
    int v1, v2, res;  
  
    v1 = getint(); v2 = getint();  
    res = gcd(v1,v2);  
    LF = 10;  
    putint(res); putchar(LF);  
}
```

### Oppgave 2 Programmering (vekt 50%)

Skriv parse-metoden til ifUnit.

### 2a Forklaring (vekt 10%)

Vis hvorledes synkroniseringen med skanneren skjer.

### Oppgave 3 Hva kan du ellers? (vekt 10%)

Skriv om noe du tror du kan.

---

```
1 \documentclass[norsk]{uioexam}  
2 \usepackage[utf8]{inputenc}  
3 \usepackage[T1]{fontenc}  
4 \usepackage[babel, textcomp, fancyvrb]  
5 \usepackage[newcent] %% Lettere å lese enn «Computer Modern»  
6  
7 \dato{17.-oktober 2008}  
8 \emne{INF2100}{Programmeringslaboratorium\\  
9     med kompilatorkonstruksjon}  
10 \tid{9.00}{12.00}  
11  
12 \begin{document}  
13 \tableofcontents  
14  
15 \oppgabe[40\%]{Oversettelse}  
16 Her er et C-program. Oversett det til Java. (Dette er det  
17 første av \Nproblems~problemer på \Npages~sider.)  
18 \VerbatimInput[fontsize=\small]{gcd.rusc}  
19  
20 \oppgabe[50\%]{Programmering}  
21 Skriv \texttt{parse}-metoden til \texttt{ifUnit}.  
22  
23 \deloppgabe[10\%]{Forklaring}  
24 Vis hvorledes synkroniseringen med skanneren skjer.  
25  
26 \oppgabe[10\%]{Hva kan du ellers?}  
27 Skriv om noe du tror du kan.  
28 \end{document}
```

---

Figure 1: Norwegian exam demo

<p style="text-align: center;"><b>UNIVERSITY OF OSLO</b> Faculty of mathematics and natural sciences</p> <p style="text-align: right;">Candidate no.</p> <p>Deferred constituent exam in: INF2270 – Computer Architecture          Day of examination: 17th October 2008          Examination hours: 14:30 – 17:30          This problem set consists of 2 pages.          Appendices: The x86 instruction set table                           The gas assembly manual          Permitted aids: A calculator                           Any written or printed material</p> <p style="text-align: center;">Please make sure that your copy of the problem set is complete before you attempt to answer anything.</p> <p><b>Contents</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">1 Translation (weight 75%)</td> <td style="width: 30%; text-align: right;">page 1</td> </tr> <tr> <td>2 Multiple choice (weight 25%)</td> <td style="text-align: right;">page 2</td> </tr> </table> <p><b>Problem 1 Translation (weight 75%)</b></p> <p>Translate this C program into x86 assembly language:</p> <pre>#include &lt;stdio.h&gt;  void rle (char *to, char *from) {     char *t = to, *f = from;      while (*f) {         char c = *(f++);         int n = 1;          while (n&lt;9 &amp;&amp; *f==c) {             ++n; ++f;         }         if (n == 1) {             *(t++) = c;         } else {             *(t++) = '#'; *(t++) = '0'+n; *(t++) = c;         }     }     *t = 0; }</pre> <p>(Continued on page 2.)</p>	1 Translation (weight 75%)	page 1	2 Multiple choice (weight 25%)	page 2	<p style="text-align: center;">Exam in INF2270, 17th October 2008</p> <p style="text-align: right;">Page 2</p> <pre>int main (void) {     char s[200];      rle(s, "Abba spiller musikk");     printf("Svarer er: %s.\n", s);     return 0; }</pre> <p><b>Problem 2 Multiple choice (weight 25%)</b></p> <p>Which of these are legal instruction names in x86 assembly code?</p> <p><input type="checkbox"/> AddL  <input type="checkbox"/> ModB  <input type="checkbox"/> JumpEqual</p>
1 Translation (weight 75%)	page 1				
2 Multiple choice (weight 25%)	page 2				

---

```

1 \documentclass[UKenglish,number,utsatt,del]{uioexam}
2 \usepackage[utf8]{inputenc}
3 \usepackage[T1]{fontenc}
4 \usepackage{babel, textcomp, fancyvrb}
5 \usepackage{mathpazo} %% Easier to read than "Computer Modern"
6
7 \dato{17th October 2008}
8 \emne{INF2270}{Computer Architecture}
9 \tid{14:30}{17:30}
10 \hjelpeMidler{A calculator\\ Any written or printed material}
11 \vedlegg{The x86 instruction set table\\
12     The \texttt{gas} assembly manual}
13
14 \begin{document}
15 \tableofcontents
16
17 \oppgave[75\%]{Translation}
18 Translate this C program into x86 assembly language:
19 \VerbatimInput[fontsize=\small]{rle.c}
20
21 \oppgave[25\%]{Multiple choice}
22 Which of these are legal instruction names in x86 assembly code?
23 \begin{choiceList}[]
24 \choice AddL \choice ModB \choice JumpEqual
25 \end{choiceList}
26 \end{document}

```

---

Figure 2: English exam demo

**plainsub** Normally, subproblems (started by a `\deloppgave` command) will be numbered “1a”, “1b”, etc. Using the `plainsub` option will result in just “a”, “b”, etc.

**problem** will call the individual questions (created using the `\oppgave` command; see Section 2.3.2.1 on page 9) for “Problems”; this is the default. (This option should only be used for English text.)

**utsatt** is used for deferred<sup>4</sup> exams. This option may be used in combination with the `del` option already mentioned.

## 1.2 Exam information

Formal information about the exam is supplied by special commands,<sup>5</sup> usually placed just before `\begin{document}`.

`\dato{date}` provides the exam date.

`\emne{code}{name}` specifies the course; the first parameter gives the code (as in “INF1000”) and the second one the full name.

`\hjelpeidler{text}` is used to provide information on which aids are allowed during the exam; the default is “Any”.

`\tid{start time}{end time}` give the time for the exam.

`\vedlegg{text}` tells which appendices are supplied with the exam text; the default is “None”.

If a *name* or a *text* is too long, you may add `\s` to split the lines.

## 1.3 The problems

Each new problem should be started with an `\oppgave{...}`. The parameter should be a suitable problem title.

Exam writers are requested by the faculty to assign weights to the individual problems; this is easily accomplished using an option to `\oppgave`, as in

```
\oppgave[20\%]{Translation}
```

### 1.3.1 Subproblems

A problem may be split into several parts using the `\deloppgave` command. Parameter and option are as for `\oppgave`.

## 1.4 Useful declarations

### 1.4.1 List of problems

The command `\tableofcontents` will print a list of all the problems. This is requested by the faculty.

### 1.4.2 How many problems are there?

The command `\Nproblems` will tell how many problems there are in the set.

---

<sup>4</sup>A deferred exam is an exam you take when you were ill during the standard exam.

<sup>5</sup>The names of these commands reveal the Norwegian origin in this document class.

### **1.4.3 How many pages in the problem set?**

The command `\Npages` returns the number of pages in the problem set.<sup>6</sup>

### **1.4.4 Multiple choice lists**

The environment `\begin{choicelist}... \end{choicelist}` is used for a list of alternatives from which the candidate shall make his or her selection. Each alternative is indicated by a `\choice`;<sup>7</sup> for an example, see line 24 in Figure 2 on page 3.

Normally, the choices are labeled “a”, “b”, etc. If you want a different label (or no labels at all), just add an option to the `\begin{choicelist}... \end{choicelist}` environment (as has been done in Figure 2; see line 23).

---

<sup>6</sup>The result from `\Npages` may be wrong if there is floating material (`\begin{figure}... \end{figure}` or `\begin{table}... \end{table}`) at the end of the document; try to avoid this.

<sup>7</sup>For historical reasons, the command `\item` may also be used; it has exactly the same effect as `\choice` in this context.

## 2 Standard L<sup>A</sup>T<sub>E</sub>X 2 $\varepsilon$ document class definitions

All L<sup>A</sup>T<sub>E</sub>X 2 $\varepsilon$  class definitions consist of a standard part followed by code specific to that class.

The class should also specify which version of L<sup>A</sup>T<sub>E</sub>X 2 $\varepsilon$  it needs. Since `uioexam` uses the `\MakeLowercase` command, it requires a version from June 1995 or more recent.

#1 `{uioexam}`  $\equiv$

1 `\NeedsTeXFormat{LaTeX2e}[1995/06/01]`  
2 `{standard LaTeX specifications #2(p.6)}`  
3 `{uioexam definitions #8(p.10)}`  
(This code is not used.)

Note that all internal names have the prefix “`exam@`” to avoid confusion with names in other packages and any user-defined names.

### 2.1 Identification

All L<sup>A</sup>T<sub>E</sub>X 2 $\varepsilon$  document classes should state their name and version number.

#2 `{standard LaTeX specifications}`  $\equiv$

4 `\ProvidesClass{uioexam}[2015/06/01 v 3.12 UiO document class]`  
(This code is extended in #2<sub>a</sub>(p.6). It is used in #1(p.6).)

### 2.2 Initial code

This Section contains code that must be defined before the class options are processed.

#2<sub>a</sub> `{standard LaTeX specifications #2(p.6)}` + $\equiv$

5 `{initial code #3(p.6)}`  
(This code is extended in #2<sub>b</sub>(p.8).)

#### 2.2.1 Adaption to various languages

This class presently handles the following four languages: American English (option `USenglish` or `american`), British English (option `UKenglish` or just `english`), Norwegian “Bokmål” (option `norsk`), and Norwegian “Nynorsk” (option `nyorsk`).

**2.2.1.1 English text** The macro `\exam@english` defines<sup>8</sup> the English words; they are identical for American and British English.

#3 `{initial code}`  $\equiv$

6 `\newcommand{\exam@english}{`  
7 `\def \exam@aidstext {Permitted aids}`  
8 `\def \exam@any {Any}`  
9 `\def \exam@candidate {Candidate no}`  
10 `\def \exam@caution {Please make sure that your copy of the`  
11 `\exam@exercise\ set is\\`  
12 `complete before you attempt to answer anything}`  
13 `\def \exam@consists {This \exam@exercise\ set consists of}`  
14 `\def \exam@contents {\exam@Exercise s}`  
15 `\def \exam@continued {Continued on page}`  
16 `\def \exam@day {Day of examination}`  
17 `\def \exam@encltext {Appendices}`  
18 `\def \exam@examin {Exam in}`  
19 `\def \exam@examinD {Constituent exam in}`

<sup>8</sup>The individual word commands are defined using `\def` rather than `\newcommand` as they may be redefined. Using `\renewcommand` will not work either, as the commands are not defined the first time `\exam@english` is called. (I could have used a `\providecommand` followed by a `\renewcommand`, but that seems a little excessive.)

```

20  \def \exam@examinDN {New constituent exam in}
21  \def \exam@examinDNU{New and deferred constituent exam in}
22  \def \exam@examinDU {Deferred constituent exam in}
23  \def \exam@examinN  {New exam in}
24  \def \exam@examinNU {New and deferred exam in}
25  \def \exam@examinU  {Deferred exam in}
26  \def \exam@faculty  {Faculty of mathematics and natural sciences}
27  \def \exam@hours   {Examination hours}
28  \def \exam@none    {None}
29  \def \exam@page    {Page}
30  \def \exam@pages   {pages}
31  \def \exam@sectionname {\exam@Exercise}
32  \def \exam@univ   {UNIVERSITY OF OSLO}
33  \def \exam@weight  {weight}}

```

(This code is extended in #3<sub>a</sub> (p.7). It is used in #2<sub>a</sub> (p.6).)

As is common in nearly all L<sup>A</sup>T<sub>E</sub>X document classes, American English is the default language.

#3<sub>a</sub> {initial code #3(p.6)} +≡  
 34 \exam@english  
 (This code is extended in #3<sub>b</sub> (p.7).)

**2.2.1.2 Text in “Bokmål”** Here are the same words in Norwegian “Bokmål”.

#3<sub>b</sub> {initial code #3(p.6)} +≡  
 35 \newcommand{\exam@norwegian}{  
 36 \def \exam@aidstext {Tillatte hjelpe midler}  
 37 \def \exam@any {Alle}  
 38 \def \exam@candidate {Kandidatnr}  
 39 \def \exam@caution {Kontroller at oppgavesettet er komplett f\o r\\  
 40 du begynner \aa\ besvare sp\o rsm\aa\ lene}  
 41 \def \exam@consists {Oppgavesettet er p\aa}\br/>
 42 \def \exam@contents {Oppgaveoversikt}  
 43 \def \exam@continued {Fortsettes p\aa\ side}  
 44 \def \exam@day {Eksamensdag}  
 45 \def \exam@encltext {Vedlegg}  
 46 \def \exam@examin {Eksamens i}  
 47 \def \exam@examinD {Deleksamen i}  
 48 \def \exam@examinDN {Ny deleksamen i}  
 49 \def \exam@examinDNU{Ny og utsatt deleksamen i}  
 50 \def \exam@examinDU {Utsatt deleksamen i}  
 51 \def \exam@examinN {Ny eksamen i}  
 52 \def \exam@examinNU {Ny og utsatt eksamen i}  
 53 \def \exam@examinU {Utsatt eksamen i}  
 54 \def \exam@faculty {Det matematisk-naturvitenskapelige fakultet}  
 55 \def \exam@hours {Tid for eksamen}  
 56 \def \exam@none {Ingen}  
 57 \def \exam@page {Side}  
 58 \def \exam@pages {sider}  
 59 \def \exam@sectionname {Oppgave}  
 60 \def \exam@univ {UNIVERSITETET I OSLO}  
 61 \def \exam@weight {vekt}}

(This code is extended in #3<sub>c</sub> (p.7).)

**2.2.1.3 Text in “Nynorsk”** And, finally, here are the words in Norwegian “Nynorsk”. Most words are the same as for “Bokmål”.

#3<sub>c</sub> {initial code #3(p.6)} +≡  
 62 \newcommand{\exam@nynorsk}{\exam@norwegian  
 63 \def \exam@aidstext {Tillatne hjelpe middel}  
 64 \def \exam@caution {Kontroller at opp\aa\ vesettet er komplett f\o r\\  
 65 du tek til \aa\ svare p\aa\ sp\o rsm\aa\ la}}

```

66  \def \exam@consists {Oppg\aa vesettet er p\aa}
67  \def \exam@contents {Oversikt over oppg\aa vene}
68  \def \exam@continued {Framhald p\aa\ side}
69  \def \exam@examinDNU{Ny og utsett deleksamen i}
70  \def \exam@examinDU {Utsett deleksamen i}
71  \def \exam@examinNU {Ny og utsett eksamen i}
72  \def \exam@examinU {Utsett eksamen i}
73  \def \exam@faculty {Det matematisk-naturvitenskaplege fakultet}
74  \def \exam@none {Ingen}
75  \def \exam@sectionname {Oppg\aa ve}

```

(This code is extended in #3<sub>d</sub> (p.10).)

## 2.3 Options

This part of the code defines the document class options.

```
#2b <standard LaTeX specifications #2(p.6) +≡
76  <option declarations #4(p.8)⟩
77  <option initiations #5(p.8)⟩

```

(This code is extended in #2<sub>c</sub> (p.10).)

### 2.3.1 Type size options

Exam problems should not be set in 10 pt type, but 11 pt and 12 pt are acceptable.

```
#4 <option declarations⟩ ≡
78  \DeclareOption{10pt}{\ClassWarningNoLine{uioexam}{Do not
79      use type size '10pt'}%
80      \def \exam@size {11pt}}
81  \DeclareOption{11pt}{\def \exam@size{11pt}}
82  \DeclareOption{12pt}{\def \exam@size{12pt}}

```

(This code is extended in #4<sub>a</sub> (p.8). It is used in #2<sub>b</sub> (p.8).)

12 pt type is the default.

```
#5 <option initiations⟩ ≡
83  \def \exam@size {12pt}

```

(This code is extended in #5<sub>a</sub> (p.9). It is used in #2<sub>b</sub> (p.8).)

### 2.3.2 Language options

As mentioned previously, the uioexam class can presently handle English (American and British) and Norwegian (“Bokmål” and “Nynorsk”).

```
#4a <option declarations #4(p.8) +≡
84  \DeclareOption{american}{\exam@english
85      \PassOptionsToPackage{american}{babel}}
86  \DeclareOption{english}{\exam@english
87      \PassOptionsToPackage{english}{babel}}
88  \DeclareOption{norsk}{\exam@norwegian
89      \PassOptionsToPackage{norsk}{babel}}
90  \DeclareOption{nynorsk}{\exam@nynorsk
91      \PassOptionsToPackage{nynorsk}{babel}}
92  \DeclareOption{UKenglish}{\exam@english
93      \PassOptionsToPackage{UKenglish}{babel}}
94  \DeclareOption{USenglish}{\exam@english
95      \PassOptionsToPackage{USenglish}{babel}}

```

(This code is extended in #4<sub>b</sub> (p.9).)

**2.3.2.1 “Exercise” or “problem”?** When writing English, some authors like to call the exam questions “problems” while others prefer “exercises”. The two options `exercise` and `problem` let the user decide.

#4<sub>b</sub> *(option declarations #4(p.8)) +≡*

```

96  \DeclareOption{exercise}{
97    \def \exam@exercise {exercise}
98    \def \exam@Exercise {Exercise}}
99  \DeclareOption{problem}{
100   \def \exam@exercise {problem}
101   \def \exam@Exercise {Problem}}

```

(This code is extended in #4<sub>c</sub> (p.9).)

The word “problem” is the default.

#5<sub>a</sub> *(option initiations #5(p.8)) +≡*

```

102 \ExecuteOptions{problem}

```

(This code is extended in #5<sub>b</sub> (p.9).)

### 2.3.3 Kinds of exams

In addition to ordinary exams, there are deferred, new and constituent ones. The choice is remembered as a letter code which will be used in accessing the correct text macros. The width of the information table is also increased when the title is changed.

#4<sub>c</sub> *(option declarations #4(p.8)) +≡*

```

103 \DeclareOption{del}{\def \exam@del{D}\addtolength{\exam@width}{4mm}}
104 \DeclareOption{ny}{\def \exam@ny{N}\addtolength{\exam@width}{4mm}}
105 \DeclareOption{utsatt}{\def \exam@utsatt{U}\addtolength{\exam@width}{4mm}}

```

(This code is extended in #4<sub>d</sub> (p.9).)

The default is to have an ordinary exam.

#5<sub>b</sub> *(option initiations #5(p.8)) +≡*

```

106 \def \exam@del{}
107 \def \exam@ny{}
108 \def \exam@utsatt{}
109 \newlength{\exam@width} \setlength{\exam@width}{0cm}

```

(This code is extended in #5<sub>c</sub> (p.10).)

### 2.3.4 Section number appearance

Should section numbers appear as “1b” or just “b”. The former is the default:

#4<sub>d</sub> *(option declarations #4(p.8)) +≡*

```

110 \AtBeginDocument{%
111   \renewcommand{\thesubsection}{\arabic{section}\alph{subsection}}}

```

(This code is extended in #4<sub>e</sub> (p.9).)

The option `plainsub` selects the latter alternative:

#4<sub>e</sub> *(option declarations #4(p.8)) +≡*

```

112 \DeclareOption{plainsub}{\AtBeginDocument{%
113   \renewcommand{\thesubsection}{\alph{subsection}}}}

```

(This code is extended in #4<sub>f</sub> (p.9).)

### 2.3.5 Additional options

If the problem set is to be handed in, it should contain a square for the student’s number.

#4<sub>f</sub> *(option declarations #4(p.8)) +≡*

```

114 \DeclareOption{number}{\setboolean{exam@number}{true}}

```

(This code is extended in #4<sub>g</sub> (p.10).)

The Boolean variable must be declared:

#4g  $\langle \text{option declarations } \#4_{(\text{p.8})} \rangle + \equiv$   
115    \newboolean{exam@number}  
(This code is extended in #4h (p.10).)

Any other option is sent to the `article` class.

#4h  $\langle \text{option declarations } \#4_{(\text{p.8})} \rangle + \equiv$   
116    \DeclareOption\*{\PassOptionsToClass{\CurrentOption}{article}}

### 2.3.6 Option initiation

After all options have been defined, they may be processed.

#5c  $\langle \text{option initiations } \#5_{(\text{p.8})} \rangle + \equiv$   
117    \ProcessOptions \relax

## 2.4 Package and class loading

The `uioexam` class is built on top of a base document class and various packages.

#2c  $\langle \text{standard LaTeX specifications } \#2_{(\text{p.6})} \rangle + \equiv$   
118    \load packages #6\_{(\text{p.10})}  
119    \load base document class #7\_{(\text{p.10})}

### 2.4.1 The `calc` package

When calculating page numbers, the `calc` package will be helpful.

#6  $\langle \text{load packages} \rangle \equiv$   
120    \RequirePackage{calc}  
(This code is extended in #6a (p.15). It is used in #2c (p.10).)

### 2.4.2 The `ifthen` package

Since the `uioexam` class does some testing, the `ifthen` package is useful.

#3d  $\langle \text{initial code } \#3_{(\text{p.6})} \rangle + \equiv$   
121    \RequirePackage{ifthen}

### 2.4.3 The base document class

As mentioned, `uioexam` is an extension of the standard `article` document class. The option “`a4paper`” and the specified type size are standard.

#7  $\langle \text{load base document class} \rangle \equiv$   
122    \LoadClass[a4paper,\exam@size]{article}  
(This code is used in #2c (p.10).)

## 3 Code specific to `uioexam`

### 3.1 Page size and layout

The text area of exam papers should be somewhat taller than the standard A4 page layout. The width is not extended as that would impede readability.

#8  $\langle \text{uioexam definitions} \rangle \equiv$   
123    \addtolength{\topmargin}{-1.7cm}

```
124 \addtolength{\textheight}{3cm}
(This code is extended in #8a (p.11). It is used in #1 (p.6).)
```

We can relax the rather strict limits that the standard L<sup>A</sup>T<sub>E</sub>X document classes set when breaking paragraphs into lines.

```
#8a {uioexam definitions #8(p.10)} +≡
125 \tolerance=6000 \hbadness=\tolerance \pretolerance=3000
(This code is extended in #8b (p.11).)
```

## 3.2 Page styles

uioexam defines two new page styles:

**examfirst** is used for the front page. It contains the table with all the exam information.

**exammain** is used for all the other pages. It contains a header and — except for the final page — a footer.

```
#8b {uioexam definitions #8(p.10)} +≡
126 {define page styles #9(p.11)}
127 \pagestyle{exammain}\thispagestyle{examfirst}
(This code is extended in #8c (p.12).)
```

The page styles are defined using three macros: `\exam@info`, `\exam@head`, and `\exam@foot`.

```
#9 {define page styles} ≡
128 \newcommand{\ps@examfirst}{%
129   \def\@evenhead{\exam@info}\def\@oddhead{\exam@info}%
130   \def\@evenfoot{\exam@foot}\def\@oddfoot{\exam@foot}}
131 \newcommand{\ps@exammain}{%
132   \def\@evenhead{\exam@head}\def\@oddhead{\exam@head}%
133   \def\@evenfoot{\exam@foot}\def\@oddfoot{\exam@foot}}
(This code is extended in #9a (p.11). It is used in #8b (p.11).)
```

### 3.2.1 The macro `\exam@head`

This macro defines the header to use on every page but the first. In a slanted font, it gives the exam code and the date to the left and the page number to the right.

```
#9a {define page styles #9(p.11)} +≡
134 \newcommand{\exam@head}{\normalfont\slshape
135   \exam@examin\exam@id, \exam@date \hfill \exam@page\ \thepage}
(This code is extended in #9b (p.12).)
```

### 3.2.2 The macro `\exam@foot`

This macro defines the footer to use on every page. It gives, in a slanted font, a continuation message referring to the following page number.<sup>9</sup> On the last page, however, the footer should be empty.<sup>10</sup>

---

<sup>9</sup>Try doing that automatically in FrameMaker or Word! ☺

<sup>10</sup>Ideally, one should design a special page style for the last page and specify something like

```
\AtEndDocument{\thispagestyle{examlast}}
```

This will not work, however, if there is little text on the last page; then L<sup>A</sup>T<sub>E</sub>X will apply that page style to the last page but one. The reason for this behavior is that L<sup>A</sup>T<sub>E</sub>X reads ahead before deciding where to break the page.

```
#9b  {define page styles #9(p.11)} +≡
136  \newcommand{\exam@foot}{\ifthenelse{\thepage=\Npages}
137  {}%
138  {{\normalfont\slshape \setcounter{exam@temp}{\thepage + 1}%
139  (\exam@continued\ \arabic{exam@temp}. )\hfill}}}
140  (This code is extended in #9c(p.12).)
```

The counter used to compute the number of the following page must be declared.

```
#8c  {uioexam definitions #8(p.10)} +≡
140  \newcounter{exam@temp}
141  (This code is extended in #8d(p.12).)
```

### 3.2.3 The macro \exam@info

This macro defines the page information table which is implemented as a page header used on the front page. It contains a centered box with no height and depth; the L<sup>A</sup>T<sub>E</sub>X command \raisebox was used to achieve this effect.

```
#9c  {define page styles #9(p.11)} +≡
141  \newcommand{\exam@info}{%
142  \raisebox{0pt}[0pt][0pt]{\begin{minipage}[t]{\textwidth}%
143  {\exam@info: select font #10(p.12)}%
144  {\exam@info: print number box #11(p.12)}%
145  {\exam@info: name of university #12(p.13)}%
146  {\exam@info: main information table #13(p.13)}%
147  {\exam@info: caution #15(p.13)}%
148  \end{minipage}}}
```

**3.2.3.1 Fonts used in the page information table** As mentioned in the introduction, the exam paper layout is based on preprinted sheets distributed in ancient times. I don't recognize the font used there, but Computer Modern Sans at 14 pt looks sufficiently similar.

```
#10  {\exam@info: select font} ≡
149  \normalfont
150  \fontfamily{cmss}\fontsize{14.4}{14pt}\selectfont
151  (This code is used in #9c(p.12).)
```

**3.2.3.2 The candidate's number** If the author has specified it, a box for the candidate's number is added in the top right-hand corner.

```
#11  {\exam@info: print number box} ≡
151  \ifthenelse{\boolean{exam@number}}{\exam@printnumberbox}{}
152  (This code is used in #9c(p.12).)
```

The box should occupy no vertical space so as not to influence the placing of the other front page elements.

```
#8d  {uioexam definitions #8(p.10)} +≡
152  \newcommand{\exam@printnumberbox}{%
153  \raisebox{0pt}[0pt][0pt]{\rlap{\makebox[\textwidth-5mm][r]{}}
154  \begin{tabular}{c}\fbox{\rule{0cm}{1cm}\rule{1.6cm}{0cm}}\\
155  \scriptsize \exam@candidate\\
156  \end{tabular}}}
157  (This code is extended in #8e(p.13).)
```

**3.2.3.3 The name of the University and the Faculty** First comes a centered<sup>11</sup> line with the University's name followed by another line with the name of the Faculty. These are in a bigger font than the other text in the exam information table.

#12  $\langle \text{\exam@info: name of university} \rangle \equiv$

```

157  {\centering
158   \fontsize{25}{25pt}\bfseries \exam@univ\\[4mm]
159   \fontsize{20.7}{20pt}\mdseries \exam@faculty
160   \par}
161 \vspace{8mm}

```

(This code is used in #9<sub>c</sub> (p.12).)

**3.2.3.4 The main exam information** Now comes the table with the main information concerning the exam. The table has two columns, but the entry stating the number of pages spans both columns.

#13  $\langle \text{\exam@info: main information table} \rangle \equiv$

```

162  \langle \text{\exam@info: define time line #14(p.13)} \rangle
163  {\renewcommand{\arraystretch}{1.6}%
164   \leavevmode\hspace*{-\exam@width}\begin{tabular}{@{}ll@{}}
165   \csname exam@examin\endcsname\exam@del\exam@ny\exam@utsatt\endcsname:&
166   \exam@breakable{\exam@id~\exam@dash~\exam@title}\\\
167   \exam@day:& \exam@date \exam@timeline
168   \multicolumn{2}{@{}l@{}}{\exam@consists\ Npages\ \exam@pages.}\\\
169   \exam@encltext:& \exam@breakable{\exam@encl}\\\
170   \exam@aids:& \exam@breakable{\exam@aids}\\\
171 \end{tabular}\hspace*{-\exam@width}\par
172 \vspace{8mm}

```

(This code is used in #9<sub>c</sub> (p.12).)

(Note the redefinition of `\arraystretch` to increase vertical spacing.)

Note that some entries contain a small table with only one column. The reason for this is that the text can be quite long, and we want to handle `\s` gracefully.

#8<sub>e</sub>  $\langle \text{uoexam definitions #8(p.10)} \rangle + \equiv$

```

173  \newcommand{\exam@breakable}[1]{%
174   \renewcommand{\arraystretch}{1.1}%
175   \begin{tabular}[t]{@{}l@{}}
176   #1\\
177 \end{tabular}}

```

(This code is extended in #8<sub>f</sub> (p.14).)

The line with the exam times must be given special treatment as it may be omitted.<sup>12</sup>

#14  $\langle \text{\exam@info: define time line} \rangle \equiv$

```

178  \ifthenelse{\equal{\exam@timea}{}}{%
179   \def \exam@timeline{\\"{}}
180   \def \exam@timeline{\\"{}exam@hours:\\
181   \exam@timea\,\text{--}\,\exam@timeb\\\"{}}

```

(This code is used in #13 (p.13).)

**3.2.3.5 A word of caution** After the exam information table comes a mandatory caution to the students.

#15  $\langle \text{\exam@info: caution} \rangle \equiv$

```

182  {\centering
183   \exam@caution.

```

---

<sup>11</sup>I use the `\centering` command rather than the `\begin{center}... \end{center}` environment as the latter — for some reason I do not yet understand — produces a warning about a missing `\item`.

<sup>12</sup>Note the trick of appending the macro `\exam@timeline` to the previous line; this is necessary as the the TeX table parser will otherwise start a new line and run into trouble when there is none.

```
184     \par}
  (This code is used in #9c (p.12).)
```

Since the front page header now occupies quite a lot of space, we must compensate at the document start.<sup>13</sup>

```
#8f  {uioexam definitions #8(p.10)} +≡
185  \AtBeginDocument{\vspace*{7.5cm}}
  (This code is extended in #8g (p.14).)
```

### 3.3 Section headings

The section headings look slightly different from the standard ones:<sup>14</sup>

- The `\section` heading starts with the word “Oppgave” (or “Oppgåve”, “Exercise” or “Problem”; see Section 2.2.1 on page 6).
- The `\subsection` heading contains no such specification.

This is implemented by redefining the standard hook `\@seccntformat` to include the `\exam@xxxname` and `\exam@xxxspace`.<sup>15</sup>

```
#8g  {uioexam definitions #8(p.10)} +≡
186  \renewcommand{\@seccntformat}[1]{%
187    \csname exam@#1name\endcsname\csname exam@#1space\endcsname
188    \csname the#1\endcsname \hspace*{1em}}
189  \newcommand{\exam@sectionspace}{~}
  (This code is extended in #8h (p.14).)
```

#### 3.3.1 A notation with weights

The exam problems should be weighted so the students will know which are the most important ones. To facilitate this, alternative<sup>16</sup> versions of `\section` and `\subsection` are provided:

`\oppgive[w]{...}` is used to indicate that the next problem has the specified weight.

`\deloppgive[w]{...}` is used to indicate that the sub-problem has the given weight.

```
#8h  {uioexam definitions #8(p.10)} +≡
190  \newcommand{\oppgive}[2][]{%
191    \ifthenelse{\equal{#1}{}}{%
192      \section{#2}%
193      \section{#2\hspace{0.8em}\mdseries (\exam@weight~#1)}}{%
194    \newcommand{\deloppgive}[2][]{%
```

<sup>13</sup>Why not drop the elaborate page style of the front page and let `\AtBeginDocument` generate the exam information table? Unfortunately, this is expressly forbidden in L<sup>A</sup>T<sub>E</sub>X 2<sub>E</sub>:

“The `\AtBeginDocument` hook should not be used for code that does any typesetting since the typeset result would be unpredictable.”[2, Section 4.7]

However, just inserting vertical space seems to work ok.

<sup>14</sup>I assume that levels below `\subsection` are not used in an exam problem.

<sup>15</sup>This redefinition works even when `\exam@xxxname` and `\exam@xxxspace` are undefined because the T<sub>E</sub>X specification states that

... the “expansion of the entire `\csname... \endcsname` text will be a single control sequence token, defined to be like `\relax` if its meaning is currently undefined.[1, p 213]

<sup>16</sup>I decided to keep the original versions of `\section` and `\subsection` unmodified, as some authors might want to employ some variants that are not supported by `\oppgive` and `\deloppgive`, like `\section*{...}` or `\section[short text]{...}`.

```

195     \ifthenelse{\equal{#1}{}}{%
196         {\subsubsection{#2}}{%
197             {\subsubsection{#2\hspace{0.8em}\mdseries (\exam@weight~#1)}}}%

```

(This code is extended in #8<sub>i</sub> (p.15).)

### 3.4 List of choices

When using multiple choice exams, a list of alternatives in which the candidate may tick off the answer, is useful. The `choicelist` environment is implemented as a specialization of `list`:

```

#8i {uioexam definitions #8(p.10)} +≡
198   \newcommand{\choicelist}[1][\alph{exam@choice}]{%
199       \list{\addtocounter{exam@choice}{1}\ding{111}%
200           #1}%
201       {\setcounter{exam@choice}{0}%
202           \setlength{\itemsep}{0pt}\setlength{\parsep}{0pt}}}
203   \let \endchoicelist = \endlist
204   \let \choice = \item

```

(This code is extended in #8<sub>j</sub> (p.15).)

(Note that each choice may be started with either `\item` or `\choice`.)

A suitable square for marking can be found in *Zapf Dingbat*:

```

#6a {load packages #6(p.10)} +≡
205   \RequirePackage{pifont}

```

(This code is extended in #6<sub>b</sub> (p.15).)

The choice counter must be defined:

```

#6b {load packages #6(p.10)} +≡
206   \newcounter{exam@choice}

```

### 3.5 Table of contents

The table of contents is typeset somewhat differently from the standard article style. For instance, there is no vertical space between the sections, and it is not necessary to test `\secnumdepth`. This code is copied from the L<sup>A</sup>T<sub>E</sub>X 2 $\varepsilon$  source and slightly modified.

```

#8j {uioexam definitions #8(p.10)} +≡
207   \renewcommand{\l@section}[2]{%
208       \addpenalty@\secpenalty
209       \vspace{0.0em \@plus\p@}%
210       \setlength{\tempdima}{1.5em}%
211       \begingroup
212           \renewcommand{\@pnumwidth}{5em}
213           \parindent = \z@
214           \rightskip = \pnumwidth
215           \parfillskip = -\pnumwidth
216           \leavevmode \bfseries
217           \advance\leftskip\tempdima
218           \hskip -\leftskip
219           #1\nobreak\hfil
220           \nobreak\hb@xt@\pnumwidth{\hss \normalfont
221               \MakeLowercase{\exam@page} #2}\par
222       \endgroup }

```

(This code is extended in #8<sub>k</sub> (p.16).)

### 3.5.1 Modifications to \tableofcontents

As this command now produces a list of problems, the title should be different.

```
#8k {uioexam definitions #8(p.10)} +≡  
223  \AtBeginDocument{\def \contentsname{\exam@contents}}  
224  \setcounter{tocdepth}{1}  
(This code is extended in #8l(p.16).)
```

## 3.6 User interface

The user interface consists of five commands giving the the required exam info:

\dato gives the exam date.

\emne tells the subject. It has two parameters: the former tells the code (i.e., “IN 142”) and the latter the full title of the course (i.e., “Operativsystemer”).

\hjelpeidler names the permitted aids (if any).

\tid gives the exam hours. It has two parameters: the time the examination starts, and when it ends. Specify “\tid{}{}” if you want to omit this information.

\vedlegg lists any additional material (if there is any).

(The command names are in Norwegian and mean “date”, “subject”, “aids”, “time”, and “appendices”, respectively.)

For example, the problem set shown in Figure 1 on page 2 used the following commands to generate the required exam information:

```
\dato{17.~oktober 2008}  
\emne{INF2100}{Programmeringslaboratorium\\  
med kompilatorkonstruksjon}  
\tid{9.00}{12.00}
```

All the commands just save their data in a macro for later user; see Section 3.2.3 on page 12.

```
#8l {uioexam definitions #8(p.10)} +≡  
225  \newcommand{\dato}[1]{\def \exam@date {\#1}}  
226  \newcommand{\emne}[2]{\def \exam@id {\#1}\def \exam@title {\#2}}  
227  \newcommand{\hjelpeidler}[1]{\def \exam@aids{\#1}}  
228  \newcommand{\tid}[2]{\def \exam@timea{\#1}\def \exam@timeb {\#2}}  
229  \newcommand{\vedlegg}[1]{\def \exam@encl{\#1}}  
(This code is extended in #8m(p.16).)
```

The default values for two commands are just a lot a question marks that the user is bound to notice.

```
#8m {uioexam definitions #8(p.10)} +≡  
230  \dato{???. ???. ????} \emne{IN ???}{????}  
(This code is extended in #8n(p.16).)
```

The other three commands, however, have sensible defaults.

```
#8n {uioexam definitions #8(p.10)} +≡  
231  \hjelpeidler{\exam@any} \tid{}{} \vedlegg{\exam@none}  
(This code is extended in #8o(p.17).)
```

## 3.7 Additional definitions

The uioexam package defines a few new commands that are useful when writing exam questions.

### 3.7.1 How many problems are there?

We can use the cross reference mechanism of L<sup>A</sup>T<sub>E</sub>X to determine how many problems there are in the set. First, we add a label at the end of the document:<sup>17</sup>

#8<sub>o</sub> {*uioexam definitions #8(p.10)*} +≡  
232    \AtEndDocument{\label{::SLUTT::}}  
(This code is extended in #8<sub>p</sub>(p.17).)

Then, we can use a special version of \ref to find the last section number:

#8<sub>p</sub> {*uioexam definitions #8(p.10)*} +≡  
233    \newcommand{\Nproblems}{\exam@get@number{\exam@ref{::SLUTT::}}}  
(This code is extended in #8<sub>q</sub>(p.17).)

Note that we must remove any suffix attached to the number (as in “4b”). Since we don’t know whether there is such a suffix, a somewhat tricky solution is necessary.

#8<sub>q</sub> {*uioexam definitions #8(p.10)*} +≡  
234    \newcommand{\exam@get@number}[1]{%  
235     \setcounter{exam@temp}{0} %  
236     \setbox0=\hbox{\global\advance\c@exam@temp#1}%  
237     \arabic{exam@temp}}  
(This code is extended in #8<sub>r</sub>(p.17).)

**3.7.1.1 A variant of \ref** The standard \ref command produces a combination of tokens and typesetting commands rather than just tokens. Since we want to use these tokens, we need a token-producing version of \ref for internal use. It is called \exam@ref.

#8<sub>r</sub> {*uioexam definitions #8(p.10)*} +≡  
238    \newcommand{\exam@ref}[1]{\@ifundefined{r@#1}{0}{%  
239     {\expandafter\expandafter\expandafter \@car\csname r@#1\endcsname  
240       \@nil}}}  
(This code is extended in #8<sub>s</sub>(p.17).)

Note that \exam@ref will return “0” if the label has not been defined; no warning will be given.

### 3.7.2 How many pages are there?

Using the same technique as described above, we can easily find how many pages there are in the problem set:

#8<sub>s</sub> {*uioexam definitions #8(p.10)*} +≡  
241    \newcommand{\Npages}{\exam@pageref{::SLUTT::}}  
(This code is extended in #8<sub>t</sub>(p.17).)

**3.7.2.1 A variant of \pageref** This token-producing version of \pageref is similar to \exam@ref above.

#8<sub>t</sub> {*uioexam definitions #8(p.10)*} +≡  
242    \newcommand{\exam@pageref}[1]{\@ifundefined{r@#1}{0}{%  
243     {\expandafter\expandafter\expandafter \@cdr\csname r@#1\endcsname  
244       \@nil}}}  
(This code is extended in #8<sub>u</sub>(p.18).)

---

<sup>17</sup>This method of identifying the final page is not without flaws. If the exam set has floating figures or tables, they may produce pages after the labeled page. I see no easy way around this problem; fortunately, however, it does not occur very frequently.

### 3.7.3 Additional commands

To typeset a European dash of  $\frac{3}{4}$ em length without loading the `textcomp`<sup>18</sup> package, this command might be used:

```
#8u  {uioexam definitions #8(p.10)} +≡  
245  \newcommand{\exam@dash}{\mbox{--\hspace*{-0.25em}--}}
```

---

<sup>18</sup>The reason we don't want to load packages unnecessarily, is that the user might want to load them with different options.

## References

- [1] Donald E. Knuth. *The T<sub>E</sub>Xbook*. Addison-Wesley, 1984.
- [2] *L<sup>A</sup>T<sub>E</sub>X 2 $\varepsilon$  for class and package writers*. Included in the L<sup>A</sup>T<sub>E</sub>X distribution. 1995.

## Meta symbols

{\exam@info: caution #15} .....	page	13
{\exam@info: define time line #14} .....	page	13
{\exam@info: main information table #13} .....	page	13
{\exam@info: name of university #12} .....	page	13
{\exam@info: print number box #11} .....	page	12
{\exam@info: select font #10} .....	page	12
{\define page styles #9} .....	page	11
{\initial code #3} .....	page	6
{\load base document class #7} .....	page	10
{\load packages #6} .....	page	10
{\option declarations #4} .....	page	8
{\option initiations #5} .....	page	8
{\standard LaTeX specifications #2} .....	page	6
{\uioexam #1} .....	page	6 *
{\uioexam definitions #8} .....	page	10

(Symbols marked with \* are not used.)