EXAM 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 4 and 5. The \LaTeX{} document class \texttt{uioexam} has been written to implement these rules. It is based on the standard \texttt{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 \texttt{web0} package which is based on Donald Knuth’s ideas of literate programming. For more information on the \texttt{web0} implementation, see http://dag.at.ifi.uio.no/public/doc/web0.pdf.

1 User guide for the \texttt{uioexam} document class

The \texttt{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 \texttt{uioexam} class accepts these parameters:

\texttt{11pt} selects 11 pt type size.\(^1\)

\texttt{12pt} chooses 12 pt type size; this is the default.

\texttt{american} or \texttt{USenglish} is used when the exam text is written in American English; this is the default.

\texttt{del} is used for constituent\(^2\) exams which will be marked as “Constituent exam” or “Deleksamen” (depending on the language). This option may be used in combination with the \texttt{ny} and \texttt{utsatt} options.

\texttt{english} or \texttt{UKenglish} is used for British English.

\(^1\)10 pt type size is not allowed; it is too small for this kind of document.

\(^2\)A \textit{constituent exam} (“deleksamen” in Norwegian) is an exam which is taken during the term and contributes a certain percentage to the final grade.
**Oversettelse (40%)**

Here is a C program. Translate it to Java. (This is the first of 3 problems on 2 sides.)

```c
/* Program 'gcd' */
int gcd (int a, int b)
{
    while (a != b) {
        if (a < b) {
            b = b - a;
        } else {
            a = a - b;
        }
    }
    return a;
}
```

**Programmering (50%)**

Write the `parse` method of `ifUnit`.

**Forklaring (10%)**

Describe how the synchronization with the scanner works.

**Hva kan du ellers? (10%)**

Write something you think you can.

1. Nothing? (5%) You must be able to write something.
2. Are you completely sure?

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**Figure 1: Norwegian exam demo**
Problem 1 Translation (weight 75%)

Translate this C program into x86 assembly language:

```c
#include <stdio.h>
void rle (char *to, char *from)
{
    char *t = to, *f = from;
    while (*f) {
        char c = *(f++);
        int n = 1;
        while (n<9 && *f==c) {
            ++n; ++f;
        }
        if (n == 1) {
            *(t++) = c;
        } else {
            *(t++) = '#'; *(t++) = '0'+n; *(t++) = c;
        }
    }
    *t = 0;
}
```

(Continued on page 2.)

```c
int main (void)
{
    char s[200];
rle(s, "Abbba spiller musikk");
    printf("Svaret er: %s.\n", s);
    return 0;
}
```

a Proof of correctness (weight 10%)

Give a proof that your program is correct.

Problem 2 Multiple choice (weight 25%)

Which of these are legal instruction names in x86 assembly code?

- AddL
- ModB
- JumpEqual

a Other instructions (weight 5%) Which other instructions do you know?

b Assembly directives (weight 3%) Which assembly directives do you know?

\documentclass[UKenglish,number,utsatt,del,plainsub]{uioexam}
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
\usepackage{babel,textcomp,fancyvrb}
\usepackage{mathpazo} %% Easier to read than "Computer Modern"
\dato{17th October 2008}
\emne{INF2270}{Computer Architecture}
\tid{14:30}{17:30}
\hjelpemidler{A calculator\ Any written or printed material}
\vedlegg{The x86 instruction set table\ The \texttt{gas} assembly manual}
\begin{document}
\tableofcontents
\oppgave[75\%]{Translation}

Translate this C program into x86 assembly language:
\VerbatimInput[fontsize=\small]{rle.c}
\deloppgave[10\%]{Proof of correctness}

Give a proof that your program is correct.
\oppgave[25\%]{Multiple choice}

Which of these are legal instruction names in x86 assembly code?
\begin{choicelist}
\choice AddL
\choice ModB
\choice JumpEqual
\end{choicelist}
\litendeloppgave[5\%]{Other instructions} Which other instructions do you know?
\litendeloppgave[3\%]{Assembly directives} Which assembly directives do you know?
\end{document}
exercise will call the individual questions (created using the \oppgave command) for “Exercises” (see Section 2.3.2.1 on page 11). (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 the previous page.

ny is for new exams, and it may be used in combination with the del and utsatt options.

nynorsk is for writing exams in Norwegian “Nynorsk”.

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 11) for “Problems”; this is the default. (This option should only be used for English text.)

utsatt is used for deferred 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, 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.

\hjelpemidler\{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\}

\footnote{A new exam may be taken if you fail the ordinary exam.}

\footnote{A deferred exam ("utsatt eksamen" in Norwegian) is an exam you take when you were ill during the standard exam.}

\footnote{The names of these commands reveal the Norwegian origin in this document class.}
1.3.1 Subproblems

A problem may be split into several parts using the `\deloppgave` or `\litendeloppgave` commands; `\deloppgave` forces a line break after the title while `\litendeloppgave` does not. 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.

1.4.3 How many pages in the problem set?

The command `\Npages` returns the number of pages in the problem set.\(^6\)

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`;\(^7\) for an example, see line 24 in Figure 2 on page 5.

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).

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\(^6\)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.

\(^7\)For historical reasons, the command `\item` may also be used; it has exactly the same effect as `\choice` in this context.