The PracTEX Journal, 2006, No. 4
Article revision 2006/11/14

Homework Assignments in CONTEXT

Aditya Mahajan

Email adityam@umich.edu

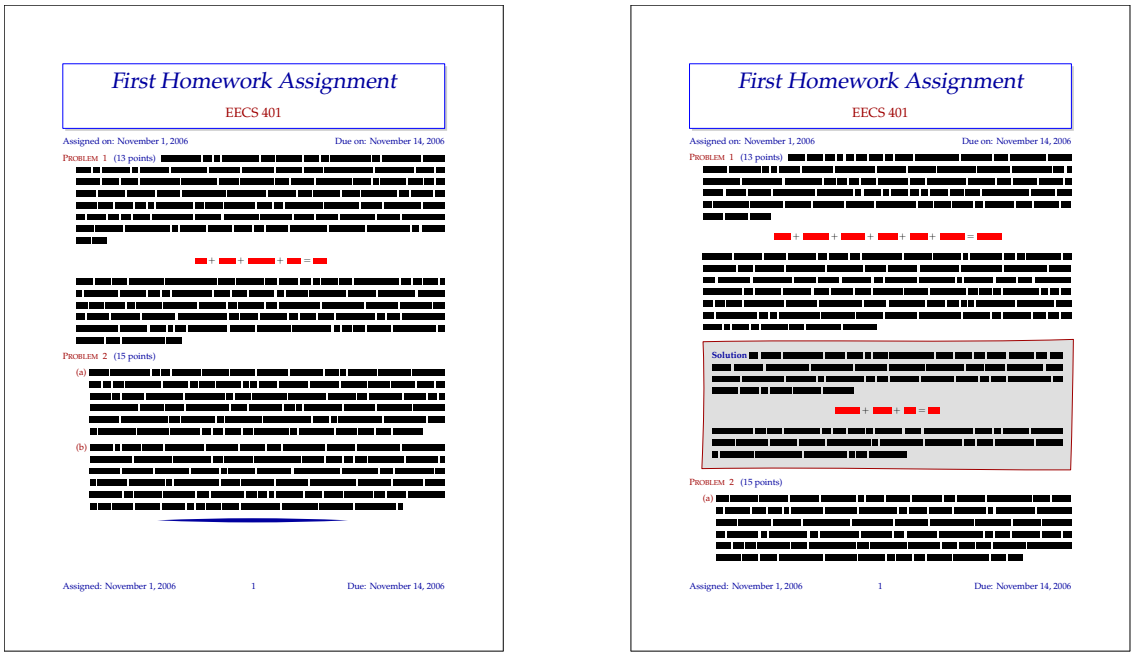
Abstract This article shows how to create a CONTEXT environment file to typeset homework assignments and their solutions. The same source file can be used to generate two versions: without and with the solutions.

1 Introduction

As a teaching assistant for a course, part of my responsibilities was to create homework assignments and their solutions. In the past, I had used Philip Hirschhorn's `exam.cls` (CTAN:macros/latex/contrib/exam/exam.cls) to prepare homework assignments in LATEX. The `exam` class is feature rich and well documented, but the resultant look was a bit formal for my taste. Modifying the look and feel of the output was difficult as I did not understand low level LATEX constructs. CONTEXT, with its ease of configuration, was an appealing alternative and I decided to give it a try for this project. CONTEXT does not come with any pre–built module for typesetting homework assignments, but rolling out one on my own was easy. I wanted a visual output that looked different from traditional TEX documents. I ended up with a result shown in Figure 1. This article explains my setup.

2 Directory Structure

CONTEXT provides a project–environment–product–component structure for organizing large projects which is ideal for preparing homework assignments. A project consists of one or more products that share a common environment. Each product consists of several components. All the layout and macro definitions for the project go in an environment file. Thus preparing homework assignments can be considered a project; each



Problem set Solutions

Figure 1: Sample assignment and solution

course a product; and each homework assignment a component. A PDF file for a particular assignment can be generated by compiling a component; a PDF file for all assignments (which is useful for students who want to archive the course material) can be generated by compiling the product file. While compiling a component, CONTEXT searches the parent directory for project, product and environment files. This feature allowed me to use a directory structure shown in Figure 2 (the course was called EECS 401). This structure ensures that all the files related to a particular course are in one directory. In the future, if I have to create assignments for a different course, I can create a new directory parallel to `EECS401` and define it as a new product. This structure is also portable as I can copy the `assignments` directory to a different computer and everything will work there.

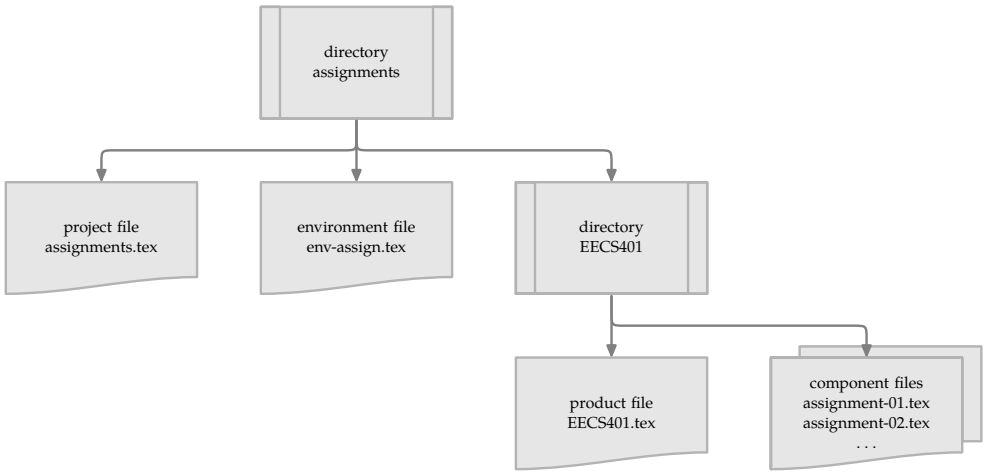


Figure 2: The project structure

3 The Work Flow

An assignment has a title —containing assignment name, course name, assigned date and due date— and a set of problems with solutions. I defined three main macros: `\assignment`, `\startproblem` and `\startsolution`. The `\assignment` macro collects the information needed for the title of the assignment, and prints the title in a fancy layout. This macro looks as follows, with the typeset title shown on the right.

```
\assignment[
     title=First Homework Assignment,
    course=EECS 401,
  assigned={d=1,m=11,y=2006},
       due={d=14,m=11,y=2006}]
```

First Homework Assignment

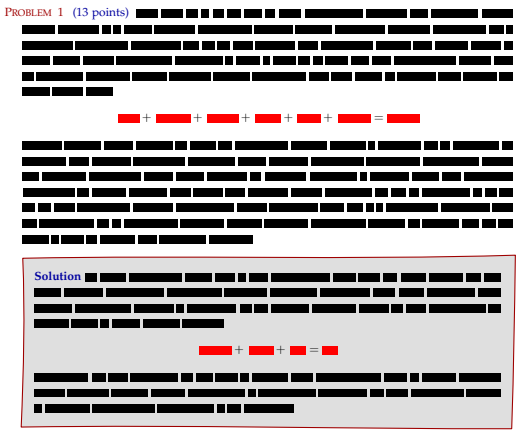
EECS 401

Assigned on: November 1, 2006 Due on: November 14, 2006

The environments `\startproblem` and `\startsolution` are for creating problems and solutions. The solution is only typeset in `solution` mode, which can be set by

passing `--mode=solution` to `texexec`, or by saying `\enablemode[solution]` at the beginning of the file. I prefer the `solution` environment to be nested inside the `problem` environment as shown below.

```
\startproblem[reference tag]{points}
  problem statement
   ..........
   ..........
  \startsolution
    solution
    ..........
    ..........
  \stopsolution
\stopproblem
```



The title information, problems and solutions for a single assignment are entered in a component file (`assignment-01.tex`). One also needs to do some initializations in a component file to specify the project and the product to which that component belongs. Thus a component file looks like

```
\startcomponent  assignment-01
\project         assignments
\product         EECS401

 \assignment[
      title=First Homework Assignment,
     course=EECS 401,
   assigned={d=1,m=11,y=2006},
        due={d=14,m=11,y=2006}]

\startproblem[reference tag]{points}
  problem statement
  \startsolution
```

```
    solution
  \stopsolution
\stopproblem
% Other problems
\stopcomponent
```

The layout and formatting of the problems and the solutions are taken care by the environment file `env-assign.tex`. The details are given in `env-assign.pdf`.[1] I will elaborate on the main macros `\startproblem` and `\startsolution`.

The macro `\startproblem` needs to have a tag for referencing[2] and the number of points for the problem. Both these parameters should be optional, and it should be possible to distinguish between them when only one argument is present. One way to implement such a macro is using parameter assignment, like `\startproblem[tag=..., points=...]`. This is too verbose, so I came up with an alternative solution —provide the second optional argument in curly brackets! So the macro `\startproblem` can have four forms:

1. `\startproblem[tag]{points}` where `tag` is a tag for referring the problem and `points` denotes the number of points for the problem.
2. `\startproblem[tag]` where only a tag for referring the problem is defined, and no points are declared.
3. `\startproblem{points}` where only the number of points are declared, and no tag for referring is defined.
4. `\startproblem` where there is neither tag for referring, nor points are defined.

Notice that I want two optional arguments here, one inside square brackets, and the other inside curly brackets. I define this macro as follows: First define an enumeration[3] `PROBLEM` that takes care of numbering and referring of problems.

---

1. This file was typeset from the source file using `texexec --module --mode=color env-assign.tex`. This gives a nicely typeset PDF of the source code and the comments. Lines starting with `%D` are typeset using ConTeXt, and code lines are pretty printed in color (note the `--mode=color` in the command).
2. A tag for referencing is a label in LaTeX parlance. In all ConTeXt environments, the label is passed as an optional argument to the macro.
3. Enumerations in ConTeXt are different from enumerate environment in LaTeX. One can think of them as being equivalent to `theorem` environment in LaTeX.

```
\defineenumeration
  [PROBLEM]
  [     text={\labeltext{problem}},
    location=hanging,
   headstyle=\sc,
   headcolor=colorone,
      before={\resetnumber[formula]\page[desirable]},
       after=\blank,
  ]
```

This does most of the book–keeping, and is hidden from the user. All enumerations accept an optional argument, in square brackets, as a tag for referring. The main macro `\startproblem` is defined as

```
\def\startproblem%
  {\dosingleempty\dostartproblem}

\def\dostartproblem[#1]%
  {\startPROBLEM[#1]\dosinglegroupempty\dodostartproblem}

\def\dodostartproblem#1%
  {\iffirstargument
  % Check if #1 = 1, use point, else use points
    \bgroup \colortwo (#1 \dopoints{#1}) \egroup
   \fi}
```

This definition takes care of the two different optional arguments. To understand what is happening here, let's break it down in pieces.

```
\def\startproblem%
  {\dosingleempty\dostartproblem}
```

The macro `\dosingleempty` is CONTEXT's way of doing optional arguments —it checks for an optional argument in square brackets. If you want two or more optional arguments (all in square brackets), you can use `\dodoubleempty`, `\dotripleempty`, etc. The conditionals `\iffirstargument`, `\ifsecondargument`, etc., check which arguments were present. These macros are very robust and form a foundation for the entire CONTEXT

macro package. See the wiki[4] for more details. The macro \dostartproblem is defined as

```
\def\dostartproblem[#1]%
  {\startPROBLEM[#1]\dosinglegroupempty\dodostartproblem}
```

It passes the optional argument to \startPROBLEM which uses it as a tag for referring. \dosinglegroupempty is a ConTeXt macro that checks for an optional argument in curly brackets. This is the *group* analogue of \dosingleempty. It checks for a left brace, so \startproblem 2 is not the same as \startproblem{2}. In the first case \dosinglegroupempty does not *see* the optional arguments, while in the second it does. The macro \dodostartproblem is defined as

```
\def\dodostartproblem#1%
  {\iffirstargument
  % Check if #1 = 1, use point, else use points
    \bgroup \colortwo (#1 \dopoints{#1}) \egroup
   \fi}
```

The conditional \iffirstargument is set to true by \dosinglegroupempty when the optional argument is present. If the optional argument is present, it is printed followed by *point* or *points* as appropriate.

The macro \startsolution should hide its contents in a normal run, and print its contents in `solution` mode. I first define \startsolution as a local buffer (which collects its contents and does nothing with them).

```
\definebuffer[solution]
\setupbuffer[solution][local=yes]
```

When solution mode is enabled, I redefine \startsolution as an enumeration without a number.[5]

```
\defineenumeration
    [solution]
```

4. http://wiki.contextgarden.net/Inside_ConTeXt
5. Even though I do not want numbered solutions, I use (rather abuse) an enumeration since it is easy to change its look.

```
[      text=\labeltext{solution},
     number=no,
  headstyle=bold,
  headcolor=colortwo,
   location=serried,
      width=fit,
     before=\startsolutionbackground,
      after=\stopsolutionbackground
]
```

A frame which can break across pages is placed around the solutions. The options `before=...` and `after=...` to `\defineenumeration` call the textbackground macros, which draw the frame using METAPOST. To read more about textbackgrounds, read the *details* manual;[6] to read more about integrating METAPOST to draw backgrounds in CONTEXT, read the MetaFun manual.[7]

To generate the homework and its solutions change directory to `EECS401` and

1. run:

   ```
   texmfstart texexec --result=assignment-01-p.pdf assignment-01
   ```

   to generate `assignment-01-p.pdf` that only contains the problems.
2. run (in one line):

   ```
   texmfstart texexec --mode=solution
                      --result=assignment-01-s.pdf assignment-01
   ```

   to generate `assignment-01-s.pdf` that contains problems and their solutions.

Notice the `--result=...` option to `texexec` renames the output PDF files, which makes it easier to maintain two different PDF outputs. `texexec` has other useful features, which are described in the `texexec` manual.[8] The attached zip file `assignments.tar.gz`

6. http://www.pragma-ade.com/general/manuals/details.pdf
7. http://www.pragma-ade.com/general/manuals/metafun-p.pdf
8. http://www.pragma-ade.com/general/manuals/mtexexec.pdf. This manual is a bit out of date, CONTEXT recently moved to a RUBY `texexec` while the manual describes the options for the old PERL `texexec`. However, most of the options explained in the manual are still valid as the user–interface has not changed much.

contains the whole setup, including a sample assignment `assignment-01.tex`. The typeset problem set and solution of this sample are available as `assignment-01-p.pdf` and `assignment-01-s.pdf`.

4 A Note about up to date CONTEXT

The example `assignments/EECS401/assignment-01.tex` provided with this article uses a macro `\sometxt` which has been recently (in July 2006) added to CONTEXT. If that does not work in your system, you need to update your CONTEXT distribution by running

```
texmfstart ctxtools --update
```

In case you cannot update your distribution, you can replace `\sometxt{...}` with `textext"..."`.[9] `\sometxt` really speeds up METAPOST processing by avoiding separate TEX runs to typeset text. CONTEXT is developed at an fast pace and I would recommend updating periodically to avail new features.

5 Conclusion

The whole experience of getting homeworks assignments the way I wanted them turned out to be much easier than expected. CONTEXT is a coherent set of macros, with comprehensive manuals, exhaustive explanations in the source, and a very helpful mailing list.[10] With a little playing around, you can easily get a look *that you want.*

9. The regular expression `s/\\sometxt{\(\{-\}\)}/textext"\1"` can be used in Vim.
10. http://wiki.contextgarden.net/ConTeXt_Mailing_Lists