How to use the style file

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1 Introduction

Authors are invited to use standard LaTeX and the class file

```
irmaart.cls
```

This file is essentially 'article.cls', slightly changed, loading amsmath, amssymb, latexsym and with amsthm.sty included. It sets the page size to

```
\textheight 195mm
\textwidth  125mm
```

Several other packages are also included, namely url, ulem, makeidx. For drawing automata, the packages are gastex and vaucanson. These have to be included if required. The TeX source file should begin with

```
\documentclass{irmaart}
\input{ha.sty}
```

Conventions that are special to the Handbook are summarized in the file `ha.sty`. Personal macros should be defined via `\newcommand` instead of `\def` to avoid non-traceable redefinitions. Also, you should avoid one-letter lower case newly defined commands like

```
\newcommand\e{\varepsilon}
```

since this may interfere with conversion of your article to Times fonts in the integration process. However, predefined macros for $\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}$, and $\mathbb{C}$ are given in ha.sty: they are `$\N, \Z, \Q, \R$, and $\C$`. See the source file for the composition of the title. Classification and keywords are mandatory.

2 Some rules for displayed formulas, theorems and enumerations

In order to achieve a uniform appearance of all the contributions, we encourage you to observe the following rules when preparing your article.

2.1 Text style

In order to emphasize a word in a sentence, use `\emph{this}` or equivalently `\textit{this}`: you will get *this* and *this* respectively. However, *this* is slanted, and different. So avoid use of `\textsl{this}`.

2.2 Displayed formulas

If you have displayed formulas consisting of more than one line you should use

```
\begin{align}...\end{align}
```

instead of

```
\begin{eqnarray}...\end{eqnarray}
```

(respectively the starred forms) since the former yields a better spacing. Compare:

$$A = f(x_i) = F'(x) \tag{2.1}$$
$$B = g(x_i) = G'(x) \tag{2.2}$$

$$A \quad = \quad f(x_i) = F'(x) \tag{2.3}$$
$$B \quad = \quad g(x_i) = G'(x) \tag{2.4}$$

In case you do not want the numbering for every line, type `\nonumber` at the end of the line where you do not want a number.

$$\begin{aligned} A &= f(x_i) = F'(x) \\ B &= g(x_i) = G'(x) \end{aligned} \tag{2.5}$$

If you want a number for the complete block, this works:

```
\begin{equation}\begin{split}...\end{split}\end{equation}
```

$$\begin{aligned} A &= f(x_i) = F'(x) \\ B &= g(x_i) = G'(x) \end{aligned} \tag{2.6}$$

Numbering of equations is done in per section basis, in the form (2.1), (2.2),....

Unnumbered, displayed equations should be enclosed in the environment

```
\begin{displaymath}
  A=B
\end{displaymath}
```

and not in

```
$$A=B$$
```

because the first is conformant to LaTeX and the second only to TeX.

If the equation finishes a sentence, the final dot should be added to the equation, separated by a small space obtained with `\,`. The same holds for commas. Thus,

$$A = B\,, \tag{2.7}$$ AA:eq:A

where

$$C = D\,. \tag{2.8}$$ AA:eq:B

obtained with

```
\begin{equation}
  \label{AA:eq:A}
  A=B\,,
\end{equation}
where
\begin{equation}
  \label{AA:eq:B}
  C=D\,.
\end{equation}
```

2.3 Theorems and alike

For theorems, lemmas, definitions, etc. use the standard syntax.

`\begin{theorem}...\end{theorem}`

Put optional arguments into square brackets ("Main theorem" in the example below).

Theorem 2.1 (Main theorem). *If a knot K has Seifert form V_K and its Alexander polynomial is not* 1*, then there is an infinite family $\{K_i\}$ of non-concordant knots such that each K_i has Seifert form V_K.*

AA:st0 **Proposition 2.2** (Möbius inversion formula). *Let α, β be two functions from $\mathbb{N} \setminus 0$ into $\mathbb{N}$. Then*

$$\alpha(n) = \sum_{d|n} \beta(d) \qquad (n \geqslant 1) \tag{2.9}$$

AA:eq0.3.3

if and only if

$$\beta(n) = \sum_{d|n} \mu(d)\alpha(n/d) \qquad (n \geqslant 1)\,. \tag{2.10}$$

AA:eq0.3.4

The following theorem-like environments are available:

(1) theorem
(2) proposition
(3) lemma
(4) corollary
(5) conjecture

For definitions, remarks, examples etc, the text appears not italicized.

Definition 2.1. A *preference order* (or *preference relation*) on $\mathcal{X}$ is a binary relation $\succ$ with the following properties.

(i) *Asymmetry:* If $x \succ y$, then $y \not\succ x$.
(ii) *Negative transitivity*: If $x \succ y$ and $z \in \mathcal{X}$, then either $x \succ z$ or $z \succ y$ or both must hold.

The following environments of this kind are available:

(1) definition
(2) remark
(3) example

Enumerations of statements, like theorems, lemmas etc. are numbered together, definitions are numbered separately, and there is a counter for examples. Numbering is done per section.

For a proof, use

`\begin{proof}...\end{proof}`

An end-of-proof sign □ is set automatically.

Proof. This finishes the proof of the corollary. □

2.4 Operator names

There are several TEX-commands setting things automatically upright like $\det, \sin, \ldots$. If you need operators not predefined, simply define for instance

```
\newcommand{\Hom}{\operatorname{Hom}}
\newcommand{\Ker}{\operatorname{Ker}}
\newcommand{\Card}{\operatorname{Card}}
```

and then use `\Hom, \Ker` to obtain

$$\varphi \in \operatorname{Hom}(G/H) \Longrightarrow \operatorname{Ker}(\varphi) \neq \{0\}\,.$$

and similarly

$$n = \operatorname{Card}(X)\,.$$

It is important to distiguish between baseline dots and centered dots. The first is used in an enumeration, and preceded and followed usually by a colon, like in $a_1, \ldots, a_n$, the second one stands for a repetition of an operation, and is preceded and followed by the operation symbol, like in the sum $a_1 + \cdots + a_n$ or in the product $a_1 \cdots a_n$. Fortunately, `amsmath` takes care of this, except for implicite product where `\cdots` should be used, see the Latex Companion, 2nd edition, page 569 for details.

2.5 Enumerations and conditions

Conditions are numbered (i), (ii), etc. Properties are numbered (1), (2), etc. Three environments are available for uniform presentation of enumerations. These are labeled

```
conditions  conditionsiii conditionsabc
```

and are used in a straighforward manner. See the source of this file. Theorem 2.3 is typed with `\item[\textup{(i)}]` in the `\itemize` environment, while Theorem 2.4 uses the environment `conditionsiii`. The enumeration in the definition is done with `enumerate`.

Definition 2.2. A *preference order* (or *preference relation*) on $\mathcal{X}$ is a binary relation $\succ$ with the following properties.

(i) *Asymmetry:* If $x \succ y$, then $y \not\succ x$.
(ii) *Negative transitivity*: If $x \succ y$ and $z \in \mathcal{X}$, then either $x \succ z$ or $z \succ y$ or both must hold.

AA:st1 **Theorem 2.3.** *Let $X \subset A^*$. The following conditions are equivalent.*

(i) *The set X is recognized by a finite automaton.*
(ii) *The minimal automaton $\mathcal{A}(X)$ is finite.*
(iii) *The family of sets $u^{-1}X$, for $u \in A^*$, is finite.*
(iv) *The syntactic monoid $\mathcal{M}(X)$ is finite.*
(v) *The set X is recognizable.*

AA:st2 **Theorem 2.4.** *Let $X \subset A^*$. The following conditions are equivalent.*

(i) *The set X is recognized by a finite automaton.*

(ii) *The minimal automaton $\mathcal{A}(X)$ is finite.*
(iii) *The family of sets $u^{-1}X$, for $u \in A^*$, is finite.*
(iv) *The syntactic monoid $\mathcal{M}(X)$ is finite.*
(v) *The set X is recognizable.*

Proof. ...
(ii) $\Leftrightarrow$ (iii) is clear.
...
(iv) $\Rightarrow$ (v) is clear.
(v) $\Rightarrow$ (i). Let $\varphi : A^* \to M$ be a morphism onto a finite monoid M, and suppose that φ recognizes X. Let $\mathcal{A} = (M, 1, \varphi(X))$ be the deterministic automaton with transition function defined by $m \cdot a = m\varphi(a)$. Then $1 \cdot w \in \varphi(X)$ if and only if $\varphi(w) \in \varphi(X)$, thus if and only if $w \in X$. Consequently $L(\mathcal{A}) = X$. □

Example 2.1. The following conditions are equivalent.
(i) X is finite.
(ii) The lengths of the words in X is bounded.

Example 2.2. The following statement hold.
(1) X admits an enumeration.
(2) The generation series of X is algebraic.

2.6 Misc

When sets are defined by acondition, the vertical bar is typed as `\mid`:

$$\mathbb{R}_+ = \{x \in \mathbb{R} \mid x \geqslant 0\}\,.$$

This has to be distinguished from the vertical bar | used for the absolute value.

When a construct is defined by data enclosed in angular brackets, use `\langle` and `\rangle`, as in $M = \langle S \rangle$ and do not type $M =< S >$. The first is obtained by typing `M=\langle S\rangle`, the second is `M = < S >`.

2.7 Url

For urls, it is a good idea to use the command `\url` which takes care of hyphenation. For instance, the url `http://www.liafa.jussieu.fr/~jep/Semigroups2.0/semigroups2.html` was written in the source as

```
\url{http://www.liafa.jussieu.fr/~jep/Semigroups2.0/semigroups2.html}
```

2.8 Cooperative work

For cooperative work, there exist simple tricks that permit to exchange versions of the text between authors. One may use the commands

- `\sout{Striked text}` as in ~~Striked text~~
- `\xout{Hatched text}` as in ~~Hatched text~~
- `\uwave{Wavelet underlined text}` as in Wavelet underlined text

These can be used together with color, like in

```
\Red{\xout{This is a long hatched text}}
```

to give ~~This is a long hatched text~~.

Other help consists in numbering lines. This helps for commenting on typos and similar local changes. The package `\lineno` is used in this file to do this, see the source.

2.9 Cross references between contributions

It is important to avoid repetitions of labels in the chapters composing the book. For instance, several authors may call a figure `fig:automaton`. Therefore, every contribution should choose a short signature, like the sequence of the first letters of the names of the authors, and should start every label with this signature. For this file, the signature is AA, and for instance the figure below rendered in gastex is labeled `AA:fig:gastex`.

Also, every contribution should start with a first line containing a label like `\label{chapterXYZ}`, where XYZ is the signature.

The package `\showkeys` helps to find the labels and the references that are used in a paper.

Also the `\hyperref` package makes navigation easier. Observe that the options used in this example file also add, to the entry of the bibliography, a reference to the pagewhere it was cited.

3 Drawing automata

There are two packages for drawing automata that have been chosen, and one of them should be used in the Handbook. These are Gastex and Vaucanson. Both are available at the CTAN site.

For the *Vaucanson* package, the homepage is `http://igm.univ-mlv.fr/~lombardy/Vaucanson-G/` Here is the example of the homepage.

```
\begin{figure}[Hbt]
  \centering
  \begin{VCPicture}{(0,-2)(6,2)}
    % states
    \State[p]{(0,0)}{A} \State{(3,0)}{B} \State[r]{(6,0)}{C}
    % initial--final
    \Initial{A} \Final{C}
    % transitions
    \EdgeL{A}{B}{a} \ArcL{B}{C}{b} \ArcL{C}{B}{b} \LoopN{A}{a}
    \LoopS{C}{d}
    %
  \end{VCPicture}
```

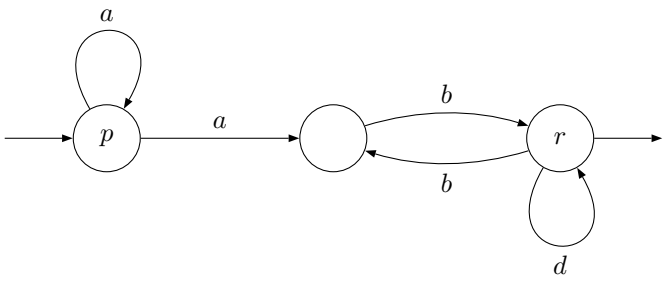

Figure 1. Vaucanson rendering of the sample automaton. `AA:fig:vaucanson`

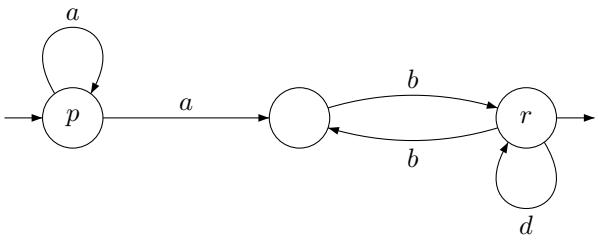

Figure 2. Gastex rendering of the sample automaton. `AA:fig:gastex`

```
  \caption{Vaucanson rendering of the sample automaton.}
  \label{AA:fig:vaucanson}
\end{figure}
```

The result is rendered in Figure 1.

For the *Gastex* package, the homepage is `http://www.lsv.ens-cachan.fr/~gastin/gastex/gastex.html`. The same automaton writes as follows.

```
\begin{figure}[Hbt]
  \centering
  \begin{picture}(60,30)(0,-15)
    % \put(0,-15){\framebox(60,30){}}
    % states
    \node[Nmarks=i](A)(0,0){$p$}\node(B)(30,0){}\node[Nmarks=f](C)(60,0){$r$}
    % edges
    \drawedge(A,B){$a$}\drawedge[curvedepth=3](B,C){$b$}
    \drawedge[curvedepth=3](C,B){$b$}
    % loops
    \drawloop[loopangle=-90](C){$d$}
    \drawloop(A){$a$}
  \end{picture}
  \caption{Gastex rendering of the sample automaton.}
  \label{AA:fig:gastex}
\end{figure}
```

The result is rendered in Figure 2.

4 Notations for "Handbook on Automata"

It is a good idea to have common notations for the basic objects considered in the handbook.

4.1 Alphabets,..., transducers

- Alphabets are denoted A, B, etc.
- Letters or symbols are written a, b, c, or 0, 1, etc.
- Words are denoted by w, x, y, z, u, v.
- The empty words is denoted 1 or ε (`\varepsilon`).
- Languages (that is sets of words) may be denoted by X, Y, Z, K, L, etc.
- Morphisms (homomorphisms) or functions are denoted f, g, h or α, β, etc.
- Automata, machines, transducers are denoted by $\mathcal{A}$, $\mathcal{M}$, $\mathcal{T}$.
- Algebras may also be denoted by $\mathfrak{A}$.

An *automaton* over an alphabet A is a tuple $\mathcal{A} = (Q, I, E, T)$ where E is a subset of $Q \times A \times Q$, or also $\mathcal{A} = (Q, I, T)$ when the set of edges is understood. For an edge $e = (p, a, q)$, the state p is the starting state, q is the ending state of e, and a is the label carried by the edge. This extends to paths in a straightforward manner. A *transducer* over A and B is a tuple $\mathcal{T} = (Q, I, E, T)$ where E is a finite subset of $Q \times A^* \times B^* \times Q$.

An automaton is *deterministic* if there is only one initial state, and if for each state p and each letter a, there is at most one edge starting in p and carrying the label a. For a deterministic automaton, one defines the *next-state function* or *transition function*, denoted by a dot, as follows:

$$p \cdot a = \begin{cases} q & \text{if there is an edge } (p, a, q) \text{ in the automaton} \\ \bot & \text{otherwise}\,. \end{cases}$$

Here $\bot$ stands for "undefined". Reserve the δ-notation for nondeterministic automata.

4.2 General stylistic recommendations

- Use a spellchecker.
- Emphasise abbreviations like e.g., or i.e., that is write a comma and a space after them: *e.g.*, *i.e.*, . It is bretter not to use them, and to replace them by *that is*.
- Emphasise Latin expressions like *a priori*, *etc.* Moreover, after etc use only one single dot.
- Use the word "non" always followed by a hyphen "-" or concatenated to the following word, "non" followed by a space does not exist in English. Thus, nonnegative, nondecreasing *etc* is ok.
- Avoid abbreviations like iff, resp., s.t.... Use plain expressions.
- Use always ℓ instead of l, never use l as an index or in a formula.

Use the following notions:

- x is *positive* if $x > 0$, x is negative if $x < 0$, x is nonnegative if $x \geqslant 0$ and x is nonpositive if $x \leqslant 0$.

- Similarly, if $x < y$ implies $f(x) < f(y)$ for all x, y, then write f is *increasing*, if $x < y$ implies $f(x) \leqslant f(y)$ for all x, y, then f is *nondecreasing*. The same applies to *decreasing* and *nonincreasing*.

5 Index

The bibliography will be on a per chapter basis, and the index will be common to the volume. So it is important to have entries to the index that are meaningful, rather too long than too short. At usual, an entry to the index is declared by `\index{term}`.

For composed terms, such as *pushdown automaton*, add both entries `automaton!pushdown` and `pushdown!automaton` to the index, assuming that there will be another entry for *automaton*, and another entry for *pushdown*, like `pushdown!storage`.

The stylefile contains the package `makeidx`, so it suffices to type the command `makeindex nameoffile` to compute the index.

6 Bibliography

For the bibliography, the use of Bibtex is mandatory. Again, intial capitals should not be used in book titles, thus write

The design and analysis of algorithms

instead of

The Design and Analysis of Algorithms as the title of the book of Aho et al.

The official abbreviations for the journals are given in the file `serials.pdf` which will be sent to the authors. Moreover, it is recommended to use the abbreviations contained in the file `abbrevs`. This file contains the standard spelling for the conferences, series, journals, publishers. This will permit a unified presentation. In order to avoid duplication of the entries, the labels for the entries in the bibliography should be composed of the names of the authors, separated by the "&" sign, followed by a semicolon ":" which itself is followed by the year (four digits). For instance

```
\cite{Allouche&Shallit:2003}
\cite{Almeida&Zeitoun:2008}
\cite{Aho&Hopcrof&tUllman:1974}
\cite{Bassino&David&Nicaud:2009}
```

to cite [2, 3, 4] and [1]. If there are several papers of the same author for the same year, use small letters do distinguish them, for instance `Erdos:1941a`, `Erdos:1941b`, `Erdos:1941c`, `Erdos:1941d`, `Erdos:1941e` and so on.

When a paper appeared in a conference, the appropriate entry type in the bib file is `@inproceedings`. Also, the use of the abbreviations contained in the file `abbrevs.bib` is recommended to make the presentation uniform.

The bibliography is typeset in smallfonts. Thus the whole bib section writes as

```
\bibliographystyle{abbrv}
```

```
\addcontentsline{toc}{section}{References}
\begin{footnotesize}
  \bibliography{abbrevs,irma.bib}
\end{footnotesize}
```

References

[1] A. Aho, J. E. Hopcroft, and J. D. Ullman. *The design and analysis of computer algorithms*. Addison-Wesley, 1974. 10

[2] J.-P. Allouche and J. Shallit. *Automatic sequences*. Cambridge University Press, 2003. 10

[3] J. Almeida and M. Zeitoun. Description and analysis of a bottom-up DFA minimization algorithm. *Inform. Process. Lett.*, 107(2):52–59, 2008. 10

[4] F. Bassino, J. David, and C. Nicaud. On the average complexity of Moore's state minimization algorithm. In S. Albers and J.-Y. Marion, editors, *STACS 2009, Proc. 26th Symp. Theoretical Aspects of Comp. Sci.*, volume 09001 of *Dagstuhl Seminar Proceedings*, pages 123–134, 2009. 10

Abstract. This style file fixes a number of conventions to get a uniform presentation of the contributions, and also contains examples for particular constructs. For example, one convention is that there are no initial capitals in the title of the chapter.
The abstract of each contributed chapter will eventually be removed from the paper and included in the web page of the handbook, so it should be informative, and it should be repeated, in some form, in the introduction.
The abstract is placed after the end of the paper *strcto sensu*, and it is not counted in the page limit of the contribution.
For those authors who started using the previously recommended style file, we apologize for the additional work.

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