Bulletin of the **S**ection of **L**ogic

Susan Jones*
John Smith**
Hans Anders

FULL TITLE
FULL SUBTITLE[1]

Abstract

The abstract should briefly summarize the contents of the paper and **should not contain any references**.

If needed, it can be split into several paragraphs.

The abstract should be followed by a list of keywords. The authors **must provide at least 3 keywords** which should be typed in lowercase (except for proper names) and separated with commas.

The authors can **optionally** provide the *Mathematical Subject Classification* codes by using the `msc` environment which has an **optional argument** indicating the year (the default value is `2010`). However, it is **not compulsory**.

Keywords: Keyword 1, keyword 2, keyword 3.

2020 Mathematical Subject Classification: code 1, code 2, code 3.

1. Title part

There are three commands in the preamble the authors are requested to use and fill with arguments:

* *Thanks* note by Susan Jones.

** *Thanks* note by John Smith.

[1] Title *thanks* note.

- `AuthorEmail`
- `Affiliation`
- `Title`.

1.1. AuthorEmail

The `\AuthorEmail` command has the following syntax:

`\AuthorEmail[#1]{#2}[#3]{#4}[#5]`,

where:

`#1` is an optional argument which can contain an author's **ORCID number** in the format: dddd-dddd-dddd-dddd (an author is requested to fill this argument should they have an ORCID number),

`#2` is a mandatory argument which should contain an author's **full name**,

`#3` is an optional argument which can contain an author's name **in an abbreviated form** (in case the full name does not fit within the header),

`#4` is a mandatory argument which should contain an author's **email address**,

`#5` is an optional argument which can contain a thanks footnote text if an author wants to include one.

If a paper is multi-authored, then each author should execute a separate `\AuthorEmail` executed. The order of authors' names will reflect the order in which commands have been executed.

1.2. Affiliation

The `\Affiliation` command has the following syntax:

`\Affiliation{#1}{#2}{#3}{#4}{#5}`,

where:

`#1` is a mandatory argument which should contain a **university's / institution's name**,

`#2` is a mandatory argument which should contain an **institute's / department's / faculty's name**,

`#3` is a mandatory argument which should contain a **work address in the format: postal code, street name and number**,

`#4` is a mandatory argument which should contain the **names of a town and country**,

`#5` is a mandatory argument which should contain the **indices of authors with this affiliation** (e.g., if a given affiliation is assigned to authors 1 and 3, one should put '1,3' as `#5`).

If there are multiple affiliations occurring in the paper, then each of them needs to be included in a separate `\Affiliation` command. In such a case the order in which subsequent `\Affiliation` commands are executed can be arbitrary.

If a given argument is not applicable, leave it empty.

1.3. Title

The `\Title` command has the following syntax:

```
\Title[#1]{#2}[#3],
```

where:

`#1` is an optional argument which can contain the **paper's title in an abbreviated form** if the full title does not fit within the header,

`#2` is a mandatory argument which should contain **paper's title in the full form**. If it needs to be broken into multiple lines, one can do that by inserting the '\\' commands in the appropriate places,

`#3` is an optional argument which can contain a **footnote text** if the author wants to attach one to the title.

2. Extra packages and commands

The authors can define their own commands in the preamble of the document. They can also use additional packages, however since the `BSLstyle`

class automatically loads certain packages, they are asked not to include these packages in the preamble as it can lead to compilation errors. The list of packages pre-loaded by `BSLstyle` is as follows:

- `amsmath`
- `amsfonts`
- `amscd`
- `amssymb`
- `amsthm`
- `caption`
- `etoolbox`
- `cleveref`
- `graphicx`
- `enumitem`
- `url`
- `hyperref`
- `xargs`
- `titling`
- `lineno`
- `aliascnt`
- `datetime`
- `totpages`
- `fancyhdr`
- `footmisc`
- `setspace`
- `textcase`
- `xstring`

3. Maths: Environments and formulas

3.1. Mathematics environments

The authors are requested to use predefined mathematics environments the list of which is presented below:

- `definition` (`\begin{definition}...\end{definition}`)
- `theorem` (`\begin{theorem}...\end{theorem}`)
- `remark` (`\begin{remark}...\end{remark}`)
- `proposition` (`\begin{proposition}...\end{proposition}`)
- `corollary` (`\begin{corollary}...\end{corollary}`)
- `fact` (`\begin{fact}...\end{fact}`)
- `conjecture` (`\begin{conjecture}...\end{conjecture}`)
- `lemma` (`\begin{lemma}...\end{lemma}`)
- `example` (`\begin{example}...\end{example}`)

- `claim` (`\begin{claim}...\end{claim}`)
- `proof` (`\begin{proof}...\end{proof}`).

Each of the above-mentioned environments (except for *proof*) has its unnumbered version which will be yielded if an astherisk is added to the environment command (e.g., `\begin{example*}...\end{example*}`).

In case the author wants to use a mathematics environment which is not listed above, they should define in it in the preamble in a standard `amsthm`-manner and assign to it one of the following theorem styles:

- `definition`
- `plain`
- `remark`.

The anchor for numbering should be `theorem`. For instance:

```
\theoremstyle{definition}
\newtheorem{statement}[theorem]{Statement}
```

If one wants the newly introduced environment to properly cooperate with the `cleveref` package, they should put in the preamble the following lines of code (below the exemplary new environment is `Statement` defined in the `definition` style):

```
\theoremstyle{definition}
\newaliascnt{Statement}{theorem}
\newtheorem{statement}[Statement]{Statement}
\aliascntresetthe{Statement}
\crefname{Statement}{statement}{statements}
```

Below come some examples of usage of mathematical environments.

DEFINITION 3.1 (Strong finite model property [2, Sect. 6.2]). Let Λ be a normal modal logic, M a set of finitely based models such that $\Lambda = \Lambda_{\mathsf{M}}$, and f a function mapping natural numbers to natural numbers. Λ has the

$f(n)$-size model property with respect to M if every Λ-consistent formula ϕ is satisfiable in a model in M containing at most $f(|\phi|)$ states.

Λ has the strong finite model property with respect to M if there is a computable function f such that Λ has the $f(n)$-size model property with respect to M. Λ has the polysize model property with respect to M if there is a polynomial p such that Λ has the $p(n)$-size model property with respect to M.

Λ has the $f(n)$-size model property (respectively, strong finite model property, polysize model property) if there is a set of finitely based models M such that $\Lambda = \Lambda_{\mathsf{M}}$ and Λ has the $f(n)$-size model property (respectively, strong finite model property, polysize model property) with respect to M.

LEMMA 3.2 (Zorn's Maximum Principle [8]). *In a closed set $\mathfrak{A}$ of sets A there exists at least one, A^*, not contained as a proper subset in any other $A \in \mathfrak{A}$.*

THEOREM 3.3 (McKinsey & Tarski [4]). $\mathsf{S4} \vdash \varphi$ *iff* $\mathfrak{A}_X \vDash \varphi$ *for every dense-in-itself metrizable space X.*

CONJECTURE (Goldbach). Every even integer greater than 2 can be expressed as the sum of two prime numbers.

Remark 3.4. Every countable subset of $\mathbb{R}$ has Lebesgue measure 0.

If a list (such as the `itemize` or `enumerate` environment) is placed at the beginning of a mathematical environment such as `definition`, `theorem`, `proof`, it automatically starts in a new line.

FACT 3.5 (Axioms of ZFC [3]).

AXIOM 0. *Set existence.*

$$\exists x(x = x).$$

AXIOM 1. *Extensionality.*

$$\forall x \forall y(\forall z(z \in x \leftrightarrow z \in y) \rightarrow x = y).$$

AXIOM 2. *Foundation.*

$$\forall x[\exists y(y \in x) \rightarrow \exists y(y \in x \wedge \neg \exists z(z \in x \wedge z \in y))].$$

AXIOM 3. *Comprehension scheme.* For each formula ϕ with free variables among $x, z, w_1, \ldots, w_n$,

$$\forall z \forall w_1, \ldots, w_n \exists y \forall x (x \in y \leftrightarrow x \in z \wedge \phi).$$

AXIOM 4. *Pairing.*

$$\forall x \forall y \exists z (x \in z \wedge y \in z).$$

AXIOM 5. *Union.*

$$\forall \mathscr{F} \exists A \forall Y \forall x (x \in Y \wedge Y \in \mathscr{F} \rightarrow x \in A).$$

AXIOM 6. *Replacement Scheme.* For each formula ϕ with free variables among $x, y, A, w_l, \ldots, w_n$,

$$\forall A \forall w_1, \ldots, w_n [\forall x \in A \exists! y \phi \rightarrow \exists Y \forall x \in A \exists y \in Y \phi].$$

On the basis of Axioms 0, 1, 3, 4, 5 and 6, one may define $\subset$ (subset), $\emptyset$ (empty set), S (ordinal successor; $S(x) = x \cup \{x\}$), and the notion of wellordering. The following axioms are then defined.

AXIOM 7. *Infinity.*

$$\exists x (\emptyset \in x \wedge \forall y \in x (S(y) \in x)).$$

AXIOM 8. *Power set.*

$$\forall x \exists y \forall z (z \subset x \rightarrow z \in y).$$

AXIOM 9. *Choice.*

$$\forall A \exists R (R \text{ well orders } A).$$

COROLLARY 3.6 (van Benthem [6]). E is not provably arithmetical in ZF.

PROOF: $ZF + AC \vdash E(\phi^m, \phi^o)$ and $ZF \vdash E(\phi^m, \phi^o) + AC^{u0}$. The latter implies, by Jech's result, that $\sim ZF \vdash E(\phi^m, \phi^o)$. But then E cannot be provably arithmetical in ZF, since $ZF + AC$ is conservative over ZF with respect to arithmetical statements. (If ϕ is arithmetical, i.e., all quantifiers in ϕ are relativized to ω, and $ZF + AC \vdash \phi$, then, since $ZF \vdash (ZF)^L$ and

$ZF \vdash (AC)^L$, $ZF \vdash \phi^L$, where L defines the constructible universe. Now ω is absolute and, therefore, $ZF \vdash \phi$.) □

PROPOSITION 3.7 (Segerberg [5]). Suppose that L is a classical system. Let $\mathscr{C}$ be any class o frames. If every modal axiom of L is valid in $\mathscr{C}$, then L is consistent with respect to $\mathscr{C}$.

PROOF: The proof goes by induction on the length of derivations in L. Every nonmodal axiom is easily seen to be valid in $\mathscr{C}$. The modal axioms are valid in $\mathscr{C}$ by hypothesis.

Suppose A and $A \to B$ are valid in $\mathscr{C}$. Let M be any model on any frame in $\mathscr{C}$. Take any w in M. Then $M, w \models A$ and $M, w \models A \to B$. So, by truth definition, $M, w \models B$. Hence MP preserves validity in $\mathscr{C}$.

Suppose finally that $A \leftrightarrow B$ is valid in $\mathscr{C}$. Let M be any model on any frame in $\mathscr{C}$. Since $A \leftrightarrow B$ is true in M, $\|A\|^M = \|B\|^M$. Then $A \leftrightarrow B$ must hold at every point in M. Hence RE preserves validity in $\mathscr{C}$. □

3.2. Mathematical formulas

Below are some examples of mathematical formulas.

The so-called Dirac delta is a measure $\delta(x) : \mathcal{B}(\mathbb{R}) \longrightarrow \overline{\mathbb{R}}_+$ defined as follows:

$$\delta(A) = \begin{cases} 1, & \text{if } 0 \in A, \\ 0, & \text{if } 0 \notin A. \end{cases} \tag{3.1}$$

If we switch to informal definition, then the formula (3.1) is replaced by:

$$\delta(x) = \begin{cases} +\infty, & \text{if } x = 0, \\ 0, & \text{if } x \neq 0. \end{cases} \tag{3.2}$$

Here is a simple sequent-based proof of the formula $((A \to C) \vee (B \to C)) \to ((A \wedge B) \to C)$:

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{A, B, C \vdash C}\,(\mathsf{Ax})}{A, B, A \to C \vdash C}\,(\mathsf{MP}) \quad \dfrac{\dfrac{}{A, B, C \vdash C}\,(\mathsf{Ax})}{A, B, B \to C \vdash C}\,(\mathsf{MP})}{A, B, (A \to C) \vee (B \to C) \vdash C}\,(\vee \vdash)}{A \wedge B, (A \to C) \vee (B \to C) \vdash C}\,(\wedge \vdash)}{(A \to C) \vee (B \to C) \vdash A \wedge B \to C}\,(\vdash \to)}{\vdash ((A \to C) \vee (B \to C)) \to (A \wedge B \to C)}\,(\vdash \to)$$

And here is a formula that estimates the number of elements of a structure yielded by a genering stream reasoning algorithm for DatalogMTL (see [7]):

$$\left(4 \cdot \left(\frac{w + 2 \cdot step}{\mathsf{gcd}(\mathcal{T}_I \cup \mathsf{N} \cup \{step\})} + 1\right)^2\right) \cdot \mathsf{P} \cdot |\mathcal{O}_I|^{\mathsf{A}} \tag{3.3}$$

4. Sectioning: This is a section header

Here come the contents of the section.

4.1. This is a subsection header

Here come the contents of the subsection.

4.1.1. This is a subsubsection header

Here come the contents of the subsubsection.

This is a paragraph header Here come the contents of the paragraph.

This is a subparagraph header Here come the contents of the subparagraph.

5. Bibliography management

The authors are requested to use BibTeX to process their bibliographies. It involves creating a separate `.bib` file with bibliography entries and putting it in the same folder as the main `.tex` source file.

In order for LaTeX to generate a bibliography which will be formatted in accordance with `BSLbibstyle`, one needs to execute the following sequence of commands:

```
\bibliographystyle{BSLbibstyle}
\bibliography{#1}
```

in the place where the bibliography is to be displayed (`#1` is the name (without the file type extension) of the `.bib` file with bibliography entries). The

authors can use the attached bibliography template (named `biblio.bib`) to create their own bibliography file. More information about bibliography management with BibTeX see [1].

There are three rules the authors are asked to abide by when preparing their `.bib` files:

Rule 1: Always use journal names and names of proceedings series in their **full form**. For instance: `Journal of Logic and Computation` rather than (`J. Logic Comput.`) or `Lecture Notes in Computer Science` rather than `LNCS`.

Rule 2: Whenever for a given publication occurring in the bibliography there exists a DOI number, include it in the bibliography entry in the `.bib` file. Use, however, **plain DOI numbers** rather than full links, so for example `10.2307/2267577` rather than `http://dx.doi.org/10.2307/2267577`.

Rule 3: When providing page numbers of a given bibliography entry use an ndash (i.e., `--`) rather than a hyphen (i.e., `-`) to separate the first page and the last page numbers. For example: `pages = {153--169}` rather than `pages = {153-169}`.

Acknowledgements. Acknowledgements such as funding information or thanks for reviewers' remarks can be put here.

References

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[7] P. A. Walega, M. Kaminski, B. C. Grau, *Reasoning over Streaming Data in Metric Temporal Datalog*, [in:] **The Thirty-Third AAAI Conference on Artificial Intelligence, AAAI 2019, The Thirty-First Innovative Applications of Artificial Intelligence Conference, IAAI 2019, The Ninth AAAI Symposium on Educational Advances in Artificial Intelligence, EAAI 2019, Honolulu, Hawaii, USA, January 27 – February 1, 2019**, AAAI Press (2019), pp. 3092–3099, DOI: https://doi.org/10.1609/aaai.v33i01.33013092.

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Susan Jones

University of California
Department of Philosophy
94720-2390, 314 Moses Hall #2390
Berkeley, California, USA

University of Vienna
Institute of Mathematics
Kurt Gödel Research Center for Mathematical Logic
1090, Augasse 2–6, UZA 1 – Building 2
Vienna, Austria

e-mail: s.jones@univie.ac.at

John Smith

University of California
Department of Philosophy
94720-2390, 314 Moses Hall #2390
Berkeley, California, USA

e-mail: john.smith@berkeley.edu

Hans Anders

University of Amsterdam
Faculty of Science
Institute for Logic, Language and Computation
1098 XG, Science Park 107
Amsterdam, The Netherlands

e-mail: anders@uva.nl