

# The l3pdfoutline module

## Commands for PDF bookmarks

### L<sup>A</sup>T<sub>E</sub>X PDF management bundle

The L<sup>A</sup>T<sub>E</sub>X Project\*

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## 1 l3pdfoutline documentation

### 1.1 Introduction

This module contains a number of commands to create the PDF outline, also called bookmarks.

*Attention:* There can be only one outline in a PDF and the commands of this module should not be mixed with other code that creates outline items, this would mess up the tree!

A reference implementation that shows the use of the command is in `latex-lab-bookmark.dtx`, a package that can replace the package `bookmark`.

The outline is a tree build with a set of objects. The root is the *outline dictionary* which is referenced from the catalog with the `/Outline` key. The other objects are called *outline items*.

The dictionaries of the *outline items* contain keys which can be divided into three classes:

**“Management”** The connection between the root, the items and their children are described with keys `/Parent`, `/Next`, `/Prev`, `/First`, `/Last`. The `/Count` key describes how many subitems are visible (open).

**“Attributes”** The `/Title` key contains the text shown in the bookmarks, `/C` sets its color, the flag `/F` sets the font type (italic and/or bold). There is a `/SE` key which can reference a structure, but its function is unclear (the note in the reference says, that it is not meant for navigation, but does not say what it is for).

**“Action”** The action that should be executed can be set either with an `/A` or a `/Dest` key. L<sup>A</sup>T<sub>E</sub>X typically uses only the first option and adds an action, e.g., for a simple link to a destination something like `<< /S /GoTo /D (section.1) /SD 19 0 R >>` (the `SD` key is used when there are structures).

While in most cases the outline is used with a `GoTo` action and more or less mirrors the table of contents, other actions are possible too, an outline item can, e.g., open

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\*E-mail: [latex-team@latex-project.org](mailto:latex-team@latex-project.org)

an external url or another file. The PDF reference lists in total 17 different, theoretically usable actions<sup>1</sup>: GoTo, GoToR, GoToE, GoToDp (PDF 2.0), Launch, Thread, URI, Sound, Movie, Hide, Named, SetOCGState, Rendition, Trans, GoTo3DView, JavaScript, RichMediaExecute.

An action dictionary typically looks like this:

```
/A << /Type /Action %optional
  /S ... % type name, e.g. /URI or /GoTo
  /Next ... % optional, next action
  ... % more keys
>>
```

The `/Next` key allows to chain actions. The value can be a reference to a single action, or an array of actions. It depends on the action type which other keys should be used.

From all these action types the `bookmark` package supports `GoTo` (through the `dest` and `page` keys), `GoToR` (through the `gotor` key together with the `dest` and `page` keys), `Named` (through the `named` key) and `URI` (through the `uri` key). These standard types looks like this:

**GoTo link to a named destination** e.g. `/S /GoTo /D (section.1) /SD 19 0 R`, this can be handled with `\pdfoutline_goto:nnn`.

**GoTo link to a page** `/S /GoTo /D [5 0 R /FitH 0]`

**Named** e.g. `/S/Named/N/FirstPage`, values are `FirstPage`, `NextPage`, `PrevPage`, `LastPage`.

**URI** e.g. `/S/URI/URI(https://blub.de)`

**GoToR** `/S/GoToR/F(blub.pdf)/D[0/Fit], /S/GoToR/F(blub.pdf)/D[3/FitH 0], /S/GoToR/F(blub.pdf)/D(duck)`

All other actions (and also chained actions) are not directly supported by `bookmark` but can be implemented by using the `rawaction` key.

Theoretically all needed objects described above could be created manually, but getting all the management keys right wouldn't be trivial. For `/Count` e.g. one would have to track recursively the number of visible subitems. Luckily all backends have dedicated primitives or `\special`'s to create outline items which take care of the management keys. Not quite so lucky is that the backends use different methods to decide if an outline item is a sibling or a child or some great-uncle of the previous item.

The `(x)dvipdfmx` backend has the easiest implementation: The general syntax is `\special{pdf:out [-]number << attr>>}` where the parameter *number* is an integer representing the level of the outline entry. The first item has to start with the level 1 and one can't skip levels, so one can't simply use a fixed number for the various headings; instead one has to keep track of which level has been used previously. This is a bit awkward, nevertheless with this backend it is possible to build the outline directly while compiling the document and one doesn't have to use the `aux` or to delay code until the end of the document.

When using `pdfTeX`, `luaTeX` or the `dvips` backend, a count must be given in the primitive which describes the number of direct children of the outline. The backend then

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<sup>1</sup>Sound and Movie are deprecated in PDF 2.0

collects (recursively) following items until all children are found and then goes up a level again. To get this number the code has to obviously look ahead to count all subsections below the current section. `hyperref` solved this problem by writing everything into the `.out` file and to process it at begin of the next compilation to get the correct count. The `bookmark` package writes the content and attributes (hex encoded) into the `.aux`-file. Additionally it keeps track of the number of children during the compilation and stores it for every bookmark in a command. When the `.aux` file is read in again at the end of the document, it decodes content and attributes again and writes out all the outline objects. In this way it can produce the outline tree for pdfTeX and luaTeX directly in the first compilation. With the dvips backend it creates a `.ps` file which is then read in at the next compilation.

The new implementation in this module doesn't use external files but keeps all bookmarks in memory and outputs them at the end of the document (for the dvi based engines in the shipout/lastpage hook, this can require a second compilation if the page numbers change).

## 1.2 The commands

### 1.3 Creating an outline item

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<code>\pdfoutline_action:nnn</code>	<code>\pdfoutline_action:nnn{&lt;level&gt;}{&lt;action&gt;}{&lt;title&gt;}</code>
<code>\pdfoutline_action:(neo nee)</code>	

---

This creates an outline item. `<level>` is an integer expression and sets the (relative) level: A positive number creates a child of the current outline item, 0 creates a sibling, and negative numbers go back. `<action>` should be a list of dictionary keys and its values that can be used within the `/A` key, e.g. the output from `\pdfdict_use:n`<sup>23</sup>. `<title>` is the title, it should be correctly escaped and encoded for use as a literal string (but without the outer parentheses), such a representation can for example be created with `\pdfstringdef` or with a combination of `\pdf_purify:nN` and `\pdf_string_from_unicode:nnN` from the `l3pdfptools` module. The command can be used for general outline item, for the special case of a GoTo link to a named destination see the following command.

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<code>\pdfoutline_goto:nnn</code>	<code>\pdfoutline_goto:nnn{&lt;level&gt;}{&lt;destination&gt;}{&lt;title&gt;}</code>
<code>\pdfoutline_goto:(neo nee)</code>	

---

This creates an outline which creates a link to a named destination. While such a GoTo link can also be created with `\pdfoutline_action:nnn` the use of this command is recommended as it will also create a reference to a structure destination if tagging is activated. `<level>` is an integer expression and sets the (relative) level: A positive number creates a child of the current outline, 0 creates a sibling, and negative numbers go back. `<destination>` is a destination name. `<title>` is the title, it should be correctly escaped and encoded for a use as a literal string (but without the outer parentheses), such a representation can for example be created with `\pdfstringdef` with a combination of `\pdf_purify:nN` and `\pdf_string_from_unicode:nnN` from the `l3pdfptools` module.

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<code>\l_pdfoutline_active_bool</code>	This boolean decides if bookmarks are shown at all.
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<sup>2</sup>It can not be an object reference as this doesn't work with most backends.

<sup>3</sup>This is not completely accurate: the dvips backend expects in some cases special names, e.g. a color must be given with `/Color` and not `/C`. Complex actions must therefore be tested and if needed one must add backend abstractions.

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`\l_pdfoutline_open_bool` This boolean decides if bookmarks are shown “open”, so show their children or not.

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`\l_pdfoutline_open_int` With this integer you can set the number of visible levels. Bookmarks with a level above the value of this integer are always closed. So if it is set to 1, everything is closed and so only the top level bookmarks are shown if its value is 2, the first level will show its children, etc. By default this integer is set to `\c_max_int` and so everything is open.

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`\l_pdfoutline_F_bitset` This bitset is used to set the flag for the font in bookmarks. It knows the two values *italic* and **bold**, so after

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`\bitset_set_true:Nn \l_pdfoutline_F_bitset {italic}`

italic will be enabled.

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`\l_pdfoutline_color_tl`  
`\l_pdfoutline_color_model_tl`

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`\l_pdfoutline_color_tl` can be empty or hold a color expression to set the color of the outline(s). It then should have either the format `[model]{value}` or be a color expression. For examples: `[rgb]{1,0,.5}` or `red!50!blue`. `\l_pdfoutline_color_model_tl` should be `rgb` or `cmyk`. The first is the normal one, the option to use also `cmyk` is only offered for the case that some PDF/A validator complains.

## 1.4 References

A user package that uses these commands to create a tree must be able to retrieve parents and level data.

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`\pdfoutline_id_ref_last:`    `★ \pdfoutline_id_ref_last:`  
`\pdfoutline_level_ref_last:` `★ \pdfoutline_level_ref_last:`

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These expandable functions give back the id and the level of the last bookmark created.

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`\pdfoutline_parent_ref:n ★ \pdfoutline_parent_ref:n{⟨id⟩}`

---

This retrieves the parent of the bookmark with id `⟨id⟩`. If the bookmark is at the root level the value is 1.

## 2 l3pdfoutline implementation

### 2.1 Package declaration

```

1 <@@=pdfoutline>
2 <*header>
3 \ProvidesExplPackage{l3pdfoutline}{2026-05-26}{0.97c}
4   {PDF outlines}
5 </header>

6 <*package>
```

## 2.2 Public variables

`\l_pdfoutline_active_bool` The state of the first boolean decides if a bookmark is created at all, this allows to disable  
`\l_pdfoutline_open_bool` bookmarks fully or in parts. The second boolean decides if a bookmark is open (so shows  
its children) or not.

```

7 \bool_new:N \l_pdfoutline_active_bool
8 \bool_set_true:N \l_pdfoutline_active_bool
9 \bool_new:N \l_pdfoutline_open_bool
10 \bool_set_true:N \l_pdfoutline_open_bool

```

*(End of definition for \l\_pdfoutline\_active\_bool and \l\_pdfoutline\_open\_bool. These variables are documented on page 3.)*

`\l_pdfoutline_open_int` This is the level up to which a bookmark is opened. By default the maximum integer  
value is used and everything is open.

```

11 \int_new:N \l_pdfoutline_open_int
12 \int_set:Nn \l_pdfoutline_open_int { \c_max_int }

```

*(End of definition for \l\_pdfoutline\_open\_int. This variable is documented on page 4.)*

`\l_pdfoutline_F_bitset` Outlines have a /F flag, we provide a public bitset for it.

```

13 \bitset_new:Nn \l_pdfoutline_F_bitset
14 {
15     Italic      = 1,
16     italic      = 1,
17     Bold        = 2,
18     bold        = 2
19 }

```

*(End of definition for \l\_pdfoutline\_F\_bitset. This variable is documented on page 4.)*

`\l_pdfoutline_color_tl` The variable for the color expression.

`\l_pdfoutline_color_model_tl`

```

20 \tl_new:N \l_pdfoutline_color_tl
21 \tl_new:N \l_pdfoutline_color_model_tl
22 \tl_set:Nn \l_pdfoutline_color_model_tl {rgb}

```

*(End of definition for \l\_pdfoutline\_color\_tl and \l\_pdfoutline\_color\_model\_tl. These variables are documented on page 4.)*

## 2.3 Data structure for the Count

`\l__pdfoutline_tmpa_tl`

```

23 \tl_new:N \l__pdfoutline_tmpa_tl

```

*(End of definition for \l\_\_pdfoutline\_tmpa\_tl.)*

`\g__pdfoutline_id_int` This integer is used to track the bookmarks. id 1 is the root, the first “real” bookmark  
has id 2.

```

24 \int_new:N \g__pdfoutline_id_int
25 \int_gincr:N \g__pdfoutline_id_int

```

*(End of definition for \g\_\_pdfoutline\_id\_int.)*

`\g__pdfoutline_current_parent_id_tl` This holds the id of the current parent so that we do not have to retrieve it all the time.

```

26 \tl_new:N \g__pdfoutline_current_parent_id_tl
27 \tl_gset:Nn \g__pdfoutline_current_parent_id_tl {1}

```

(End of definition for `\g__pdfoutline_current_parent_id_tl`.)

`\g__pdfoutline_current_level_int` This holds the (relative) level. It starts at 1 as dvipdfmx counts this way.

```
28 \int_new:N \g__pdfoutline_current_level_int
29 \int_gincr:N \g__pdfoutline_current_level_int
```

(End of definition for `\g__pdfoutline_current_level_int`.)

We do not assume that we will ever have more than 2000 bookmarks, but we set a block size so that we can make the range dynamic if needed like in the object code.

`\c__pdfoutline_block_size_int` Sets the block size used for managing outlines.

```
30 \int_const:Nn \c__pdfoutline_block_size_int { 2000 }
```

(End of definition for `\c__pdfoutline_block_size_int`.)

For some backends we must know for every outline the numbers of direct children, and we must know the id of the parent to be able to go up the tree again. For this we use two intarray variables.

`\g__pdfoutline_kid_count_intarray` The first contains for every id the number of (direct) kids. The second contains the id of the parent.  
`\g__pdfoutline_parent_id_intarray`

```
31 \intarray_new:Nn \g__pdfoutline_kid_count_intarray { \c__pdfoutline_block_size_int }
32 \intarray_new:Nn \g__pdfoutline_parent_id_intarray { \c__pdfoutline_block_size_int }
33 \intarray_gset:Nnn \g__pdfoutline_parent_id_intarray {1}{1}
```

(End of definition for `\g__pdfoutline_kid_count_intarray` and `\g__pdfoutline_parent_id_intarray`.)

Unlike bookmark we do not use an external file but keep all content in memory in one large tl var.

`\g__pdfoutline_collect_build_tl`

```
34 \tl_new:N \g__pdfoutline_collect_build_tl
```

(End of definition for `\g__pdfoutline_collect_build_tl`.)

The main commands

`\pdfoutline_action:nnn`

```
35 \cs_new_protected:Npn \pdfoutline_action:nnn #1 #2 #3
36 % #1 level, #2 action, #3 title
37 {
38   \bool_if:NT \l_pdfoutline_active_bool
39   {
40     \int_compare:nNnTF {\g__pdfoutline_id_int}={1}
41     {
42       \tl_build_gbegin:N \g__pdfoutline_collect_build_tl
43       \__pdfoutline_item:nnnn {0}{#2}{#3}{action}
44       \tl_gput_right:Nn \g__kernel_pdfmanagement_end_run_code_tl
45       {
46         \tl_build_gend:N \g__pdfoutline_collect_build_tl
47         \tl_use:N \g__pdfoutline_collect_build_tl
48       }
49     }
50     {
51       \__pdfoutline_item:nnnn {#1}{#2}{#3}{action}
```

```

52     }
53     \cs_gset_protected:Npn \pdfoutline_action:nnn ##1 ##2 ##3
54     {
55         \bool_if:NT \l_pdfoutline_active_bool
56         {\__pdfoutline_item:nnnn {##1}{##2}{##3}{action}}
57     }
58 }
59 }
60 \cs_generate_variant:Nn \pdfoutline_action:nnn {nee}

```

(End of definition for \pdfoutline\_action:nnn. This function is documented on page 3.)

**\pdfoutline\_goto:nnn**

```

61 \cs_new_protected:Npn \pdfoutline_goto:nnn #1 #2 #3
62 % #1 level, #2 destination, #3 title
63 {
64     \bool_if:NT \l_pdfoutline_active_bool
65     {
66         \int_compare:nNnTF {\g__pdfoutline_id_int}={1}
67         {
68             \tl_build_gbegin:N \g__pdfoutline_collect_build_tl
69             \__pdfoutline_item:nnnn {0}{#2}{#3}{goto}
70             \tl_gput_right:Nn \g__kernel_pdfmanagement_end_run_code_tl
71             {
72                 \tl_build_gend:N \g__pdfoutline_collect_build_tl
73                 \tl_use:N \g__pdfoutline_collect_build_tl
74             }
75         }
76         {
77             \__pdfoutline_item:nnnn {#1}{#2}{#3}{goto}
78         }
79     }
80     \cs_gset_protected:Npn \pdfoutline_goto:nnn ##1 ##2 ##3
81     {
82         \bool_if:NT \l_pdfoutline_active_bool
83         {\__pdfoutline_item:nnnn {##1}{##2}{##3}{goto}}
84     }
85 }
86 \cs_generate_variant:Nn \pdfoutline_goto:nnn {nee}

```

(End of definition for \pdfoutline\_goto:nnn. This function is documented on page 3.)

**\\_\_pdfoutline\_item:nnnn**

```

87 \cs_new_protected:Npn \__pdfoutline_item:nnnn #1 #2 #3 #4
88 % #1 level, #2 action, #3 title, #4 keyword action or goto
89 {
90     \int_gincr:N \g__pdfoutline_id_int

```

Follow up bookmarks. At first siblings. The parent doesn't change.

```

91     \int_compare:nNnTF {#1}={0}
92     {
93         \intarray_gset:Nnn
94         \g__pdfoutline_parent_id_intarray
95         { \g__pdfoutline_id_int }
96         { \g__pdfoutline_current_parent_id_tl }

```

```

97         \intarray_gset:Nnn
98         \g__pdfoutline_kid_count_intarray
99         { \g__pdfoutline_current_parent_id_tl }
100        { \intarray_item:Nn \g__pdfoutline_kid_count_intarray { \g__pdfoutline_current_pare
101      }
102    {

```

The first child of the previous bookmark

```

103        \int_compare:nNnTF {#1} > {0}
104      {
105        \int_gincr:N \g__pdfoutline_current_level_int
106        \tl_gset:Ne \g__pdfoutline_current_parent_id_tl
107        { \int_eval:n { \g__pdfoutline_id_int -1 } }
108        \intarray_gset:Nnn
109        \g__pdfoutline_parent_id_intarray
110        { \g__pdfoutline_id_int }
111        { \g__pdfoutline_current_parent_id_tl }
112        \intarray_gset:Nnn
113        \g__pdfoutline_kid_count_intarray
114        { \g__pdfoutline_current_parent_id_tl }
115        { 1 }
116      }

```

The most complicated case: going up the hierarchy. The root level is 1, so we can go up at most current level minus 1 steps. If we are already at the root level, the current parent is 1.

```

117      {
118        \int_compare:nNnTF { \g__pdfoutline_current_level_int } = {1}
119        {
120          \tl_gset:Ne \g__pdfoutline_current_parent_id_tl {1}
121        }
122        {
123          \int_step_inline:nn
124          { \int_min:nn { \int_abs:n {#1} } { \g__pdfoutline_current_level_int -
125      1 } }
126          {

```

Get recursively the parent of the current parent and decrease the level.

```

126          \tl_gset:Ne \g__pdfoutline_current_parent_id_tl
127          { \intarray_item:Nn \g__pdfoutline_parent_id_intarray { \g__pdfoutline_
128          \int_gdecr:N \g__pdfoutline_current_level_int
129        }
130      }

```

Store the parent and increase the kid count of the finally found parent (if this is the root level, the id is 1)

```

131        \intarray_gset:Nnn
132        \g__pdfoutline_parent_id_intarray
133        { \g__pdfoutline_id_int }
134        { \g__pdfoutline_current_parent_id_tl }
135        \intarray_gset:Nnn
136        \g__pdfoutline_kid_count_intarray
137        { \g__pdfoutline_current_parent_id_tl }
138        {

```



```

139             \intarray_item:Nn
140             \g__pdfoutline_kid_count_intarray
141             { \g__pdfoutline_current_parent_id_tl } + 1
142         }
143     }
144 }

```

Now we store the collected data into the tl var.

```

145 \__pdfoutline_store:nnn {#2}{#3}{#4}
146 }

```

*(End of definition for \\_\_pdfoutline\_item:nnnn.)*

`\__pdfoutline_color_export:nnN` This exports space separated values from a color expression or a [model]{values} expression. It is used in the next command.

```

147 \cs_new_protected:Npn \__pdfoutline_color_export_aux:wnnN [#1] #2 #3 #4
148 {
149     \color_export:nnnN {#1}{#2}{ space-sep-#3 }#4
150 }
151 \cs_new_protected:Npn \__pdfoutline_color_export:nnN #1 #2 #3 %#1 color, #2 target model, #3
152 {
153     \tl_if_blank:nTF { #1 }
154     { \tl_clear:N #3 }
155     {
156         \tl_if_head_eq_charcode:nNTF {#1} [ %]
157         {
158             \__pdfoutline_color_export_aux:wnnN #1 { #2 } #3
159         }
160         {
161             \color_export:nnN { #1 } { space-sep-#2 } #3
162         }
163     }
164 }
165 \cs_generate_variant:Nn \__pdfoutline_color_export:nnN {ee}

```

*(End of definition for \\_\_pdfoutline\_color\_export:nnN.)*

`\__pdfoutline_store:nnn` This command stores the data into the tl var. The backends have different requirements regarding the handling, so we keep arguments separate and generic to stay flexible.

```

166 \cs_new_protected:Npn \__pdfoutline_store:nnn #1 #2 #3
167 % #1: action or destination, #2: title, #3: keyword action or goto
168 {
169     \int_compare:nNnF { \g__pdfoutline_current_level_int } < { \l_pdfoutline_open_int }
170     { \bool_set_false:N \l_pdfoutline_open_bool }
171     \__pdfoutline_color_export:eeN {\l_pdfoutline_color_tl}{\l_pdfoutline_color_model_tl}\l_
172     \tl_build_gput_right:Ne \g__pdfoutline_collect_build_tl
173     {
174         \exp_not:N \use:c { __pdf_backend_#3:nnnnnnn }
175         % #1 level, #2 kid count, #3 open? #4 color, #5 flag, #6 action/destination, #7 title
176         {
177             \int_use:N \g__pdfoutline_current_level_int
178         }
179         {
180             \exp_not:N \intarray_item:Nn
181             \exp_not:N \g__pdfoutline_kid_count_intarray

```

```

182         { \int_use:N \g__pdfoutline_id_int }
183     }
184     {
185         \bool_if:NTF\l_pdfoutline_open_bool {\exp_not:N \c_true_bool }{\exp_not:N \c_false_bool }
186     }
187     {
188         \l__pdfoutline_tmpa_tl
189     }
190     {
191         \bitset_to_arabic:N \l_pdfoutline_F_bitset
192     }
193     {
194         \exp_not:n {#1} % action/destination, or expand??
195     }
196     {
197         \exp_not:n {#2} % title, or expand??
198     }
199 }
200 }

```

(End of definition for \\_\_pdfoutline\_store:nnn.)

## 2.4 References

`\pdfoutline_id_ref_last:`

```
201 \cs_new:Npn \pdfoutline_id_ref_last: {\int_use:N \g__pdfoutline_id_int}
```

(End of definition for \pdfoutline\_id\_ref\_last:. This function is documented on page 4.)

`\pdfoutline_level_ref_last:`

```
202 \cs_new:Npn \pdfoutline_level_ref_last: {\int_use:N \g__pdfoutline_current_level_int}
```

(End of definition for \pdfoutline\_level\_ref\_last:. This function is documented on page 4.)

`\pdfoutline_parent_ref:n`

```
203 \cs_new:Npn \pdfoutline_parent_ref:n #1 { \intarray_item:Nn \g__pdfoutline_parent_id_intarray{#1}
```

```
204 \endcsname}
```

(End of definition for \pdfoutline\_parent\_ref:n. This function is documented on page 4.)

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