

The L^AT_EX3 kernel: design-level coffins*

The L^AT_EX3 Project[†]

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Abstract

A L^AT_EX3 ‘coffin’ is a design-level method for typesetting boxed material. The structure of coffins contains not only the boxed material itself but also information about the size of the box and potential alignment positions. This structure makes it possible to build complex layouts rapidly by assembling coffins. This module contains the design-level code to implement this scheme.

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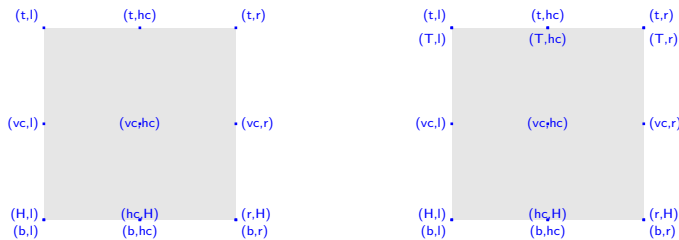


Figure 1: Standard coffin handles: left, horizontal coffin; right, vertical coffin

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1 Introduction: the coffin concept

In $\text{\LaTeX}3$ terminology, a ‘coffin’ is a box containing typeset material. Along with the box itself, the coffin structure includes information on the size and shape of the box, which makes it possible to align two or more coffins easily. This is achieved by providing a series of ‘poles’ for each coffin. These are horizontal and vertical lines through the coffin at defined positions, for example the top or horizontal centre. The points where these poles intersect are called ‘handles’. Two coffins can then be aligned by describing the relationship between a handle on one coffin with a handle on the second. In words, an example might then read

Align the top-left handle of coffin A with the bottom-right handle of coffin B.

The locations of coffin handles are much easier to understand visually. Figure 1 shows the standard handle positions for a coffin typeset in horizontal mode (left) and in vertical mode (right). Notice that the later case results in a greater number of handles being available. As illustrated, each handle results from the intersection of two poles. For example, the centre of the coffin is marked ‘(hc,vc)’, *i.e.* it is the point of intersection of the horizontal centre pole with the vertical centre pole. New handles are generated automatically when poles are added to a coffin: handles are ‘dynamic’ entities.

2 Creating and setting coffins

Before any alignment can take place, coffins must be created and their contents must be created. All coffin operations are local to the current \TeX group with the exception of coffin creation. Coffins are also ‘colour safe’: in contrast to the code-level \box_... functions there is no need to add additional grouping to coffins when dealing with colour.

`\NewCoffin` \NewCoffin \langle coffin \rangle

Before a \langle coffin \rangle can be used, it must be allocated using \NewCoffin . The name of the

$\langle coffin \rangle$ should be a control sequence (starting with the escape character, usually \backslash), for example

```
 $\backslash$ NewCoffin $\backslash$ MyCoffin
```

Coffins are allocated globally, and an error will be raised if the name of the $\langle coffin \rangle$ is not globally-unique.

```
 $\backslash$ SetHorizontalCoffin  $\backslash$ SetHorizontalCoffin  $\langle coffin \rangle$   $\{ \langle material \rangle \}$ 
```

Typesets the $\langle material \rangle$ in horizontal mode, storing the result in the $\langle coffin \rangle$. The standard poles for the $\langle coffin \rangle$ are then set up based on the size of the typeset material.

```
 $\backslash$ SetVerticalCoffin  $\backslash$ SetVerticalCoffin  $\langle coffin \rangle$   $\{ \langle width \rangle \}$   $\{ \langle material \rangle \}$ 
```

Typesets the $\langle material \rangle$ in vertical mode constrained to the given $\langle width \rangle$ and stores the result in the $\langle coffin \rangle$. The standard poles for the $\langle coffin \rangle$ are then set up based on the size of the typeset material.

3 Controlling coffin poles

A number of standard poles are automatically generated when the coffin is set or an alignment takes place. The standard poles for all coffins are:

- l a pole running along the left-hand edge of the bounding box of the coffin;
- hc a pole running vertically through the centre of the coffin half-way between the left- and right-hand edges of the bounding box (*i.e* the ‘horizontal centre’);
- r a pole running along the right-hand edge of the bounding box of the coffin;
- b a pole running along the bottom edge of the bounding box of the coffin;
- vc a pole running horizontally through the centre of the coffin half-way between the bottom and top edges of the bounding box (*i.e* the ‘vertical centre’);
- t a pole running along the top edge of the bounding box of the coffin;
- H a pole running along the baseline of the typeset material contained in the coffin.

In addition, coffins containing vertical-mode material also feature poles which reflect the richer nature of these systems:

- B a pole running along the baseline of the material at the bottom of the coffin.

T a pole running along the baseline of the material at the top of the coffin.

`\SetHorizontalPole` `\SetHorizontalPole <coffin> {<pole>} {<offset>}`

Sets the *<pole>* to run horizontally through the *<coffin>*. The *<pole>* will be located at the *<offset>* from the bottom edge of the bounding box of the *<coffin>*. The *<offset>* should be given as a dimension expression; this may include the terms `\TotalHeight`, `\Height`, `\Depth` and `\Width`, which will evaluate to the appropriate dimensions of the *<coffin>*. For example, to create a pole running horizontally through the coffin at one third of the distance from the base of the coffin to the top, the appropriate instruction would be

```
\SetHorizontalPole \MyCoffin {height/3} {\TotalHeight/3}
```

Note that poles which run *horizontally* are described in terms of their *vertical* location in the coffin. Also notice that the total height of the coffin is described by the sum of `\Height` and `\Depth`: these are both measured from the horizontal baseline of the material in the coffin.

`\SetVerticalPole` `\SetVerticalPole <coffin> {<pole>} {<offset>}`

Sets the *<pole>* to run vertically through the *<coffin>*. The *<pole>* will be located at the *<offset>* from the left-hand edge of the bounding box of the *<coffin>*. The *<offset>* should be given as a dimension expression; this may include the terms `\TotalHeight`, `\Height`, `\Depth` and `\Width`, which will evaluate to the appropriate dimensions of the *<coffin>*. For example, to create a pole running vertically through the coffin at one third of the distance from the left-hand edge, the appropriate instruction would be

```
\SetVerticalPole \MyCoffin {width/3} {\Width/3}
```

Note that poles which run *vertically* are described in terms of their *horizontal* location in the coffin.

`\TotalHeight` `\TotalHeight`

Within the *<offset>* argument of `\SetHorizontalPole` and `\SetVerticalPole`, `\TotalHeight` will give the distance from the base to the top of the bounding box of the relevant coffin.

`\Height` `\Height`

Within the *<offset>* argument of `\SetHorizontalPole` and `\SetVerticalPole`, `\Height` will give the distance from the baseline to the top of the bounding box of the relevant coffin.

`\Depth` `\Depth`

Within the *<offset>* argument of `\SetHorizontalPole` and `\SetVerticalPole`, `\Depth`

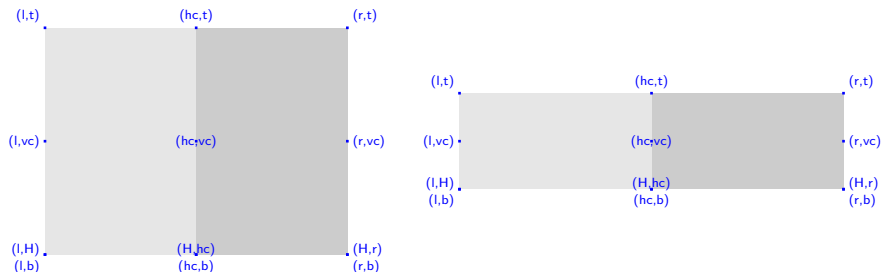


Figure 3: Coffin resizing: left, resized to exactly 4 cm by 6 cm; right, scaled a factors of 2 and 0.5 in x and y , respectively (example coffin as in Figure 2).

`\ResizeCoffin` and `\ScaleCoffin` can be used interchangeably: whether scale factors or absolute values are the best form for the resizing will depend upon the context (Figure 3).

6 Joining coffins

The key operation for coffins is joining coffins to each other. This is always carried out such that the first coffin is the ‘parent’, and is updated by the alignment. The second ‘child’ coffin is not altered by the alignment process.

```

\JoinCoffins *
  <coffin1> [ <coffin1-pole1> , <coffin1-pole2> ]
  <coffin2> [ <coffin2-pole1> , <coffin2-pole2> ]
  ( <x-offset> , <y-offset> )

```

Joining of two coffins is carried out by the `\JoinCoffins` function, which takes two mandatory arguments: the ‘parent’ `<coffin1>` and the ‘child’ `<coffin2>`. All of the other arguments shown are optional.

The standard `\JoinCoffins` functions joins `<coffin2>` to `<coffin1>` such that the bounding box of `<coffin1>` after the process will expand. The new bounding box will be the smallest rectangle covering the bounding boxes of the two input coffins. When the starred variant of `\JoinCoffins` is used, the bounding box of `<coffin1>` is not altered, *i.e.* `<coffin2>` may protrude outside of the bounding box of the updated `<coffin1>`. The difference between the two forms of alignment is best illustrated using a visual example. In Figure 4, the two processes are contrasted. In both cases, the small red coffin has been aligned with the large grey coffin. In the left-hand illustration, the `\JoinCoffins` function was used, resulting in an expanded bounding box. In contrast, on the right `\AttachCoffin` was used, meaning that the bounding box does not include the area of the smaller coffin.

The alignment is carried out by first calculating `<handle1>`, the point of intersection of `<coffin1-pole1>` and `<coffin1-pole2>`, and `<handle2>`, the point of intersection of `<coffin2-pole1>` and `<coffin2-pole2>`. If the two `<poles>` are not specified, `\JoinCoffins` will use the default value `(H,1)`, *i.e.* the reference point used by `TEX` for the underlying box. Once the two `<handles>` have been located, `<coffin2>` is then attached to



Figure 4: Contrast between `\JoinCoffins` (left) and `\JoinCoffins*` (right); the bounding box of the coffin is show in black.

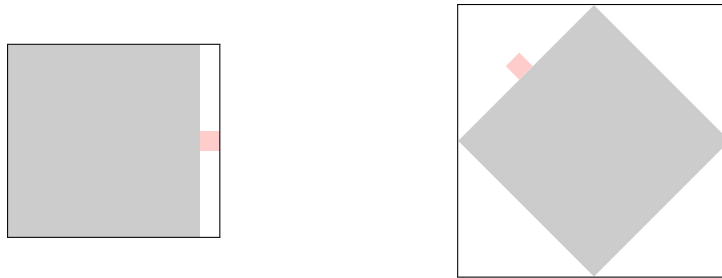


Figure 5: The effect of rotation of a joined coffin: the black line shows the coffin bounding box.

$\langle coffin1 \rangle$ such that the relationship between $\langle handle1 \rangle$ and $\langle handle2 \rangle$ is described by the $\langle x-offset \rangle$ and $\langle y-offset \rangle$. This $\langle offset \rangle$ is an optional argument, and if it is not given then $(0\text{ pt}, 0\text{ pt})$ is used.

Notice that when `\JoinCoffins` is used the new bounding box is the smallest rectangle containing the bounding boxes of the two input coffins. As a result, it will include additional white space unless one coffin entirely overlaps the other (Figure 5, left). Rotation of coffins will take account of the extent of the material after rotation when re-calculating the bounding box. This means that no *unnecessary* white space will be added on rotation (Figure 5, right).

As part of the joining procedure, the poles of the two input coffins are preserved within the structure of the updated coffin. In this way it is possible to carry out complex alignment procedures. The poles of a coffin after alignment may therefore be divided into three groups:

1. The ‘native’ poles of the updated coffin, such as `l`, `r`, `hc`, *etc.*
2. Poles derived from $\langle coffin1 \rangle$, such as $\langle coffin1 \rangle$ -`l`, $\langle coffin1 \rangle$ -`r`, $\langle coffin1 \rangle$ -`hc`, *etc.*
3. Poles derived from $\langle coffin2 \rangle$, such as $\langle coffin2 \rangle$ -`l`, $\langle coffin2 \rangle$ -`r`, $\langle coffin2 \rangle$ -`hc`, *etc.*



Figure 6: Aligning coffins using poles from previous operations.

Applying this ability allows a series of joining operations to take place, as illustrated in Figure 6. In this example, the scheme used for alignment was as follows:

```

\SetHorizontalCoffin\OutputCoffin{}
\SetHorizontalCoffin\RedCoffin
  {\color{red!20!white}\rule{0.2 in}{0.2 in}}
\JoinCoffins\OutputCoffin[vc,hc]\RedCoffin[vc,hc]
\SetHorizontalCoffin\BlueCoffin
  {\color{blue!20!white}\rule{0.2 in}{0.2 in}}
\JoinCoffins\OutputCoffin[\RedCoffin-vc,\RedCoffin-hc]
  \BlueCoffin[b,l]
\SetHorizontalCoffin\GreenCoffin
  {\color{green!20!white}\rule{0.2 in}{0.2 in}}
\JoinCoffins\OutputCoffin[\BlueCoffin-vc,\BlueCoffin-hc]
  \GreenCoffin[b,l]
\SetHorizontalCoffin\YellowCoffin
  {\color{yellow!20!white}\rule{0.2 in}{0.2 in}}
\JoinCoffins\OutputCoffin[\GreenCoffin-vc,\GreenCoffin-hc]
  \YellowCoffin[b,l]
\SetHorizontalCoffin \OrangeCoffin
  {\color{orange!20!white}\rule{0.2 in}{0.2 in}}
\JoinCoffins\OutputCoffin[\BlueCoffin-t,\BlueCoffin-l]
  \OrangeCoffin[b,r]
\TypesetCoffin\OutputCoffin

```

This process begins by setting up `\OutputCoffin` to hold the joined output. Each join then takes place placing the new addition relative to the previous one. As each coffin joined has a unique name it is possible to align relative to each one of the component parts of the assembly. This is illustrated by the addition of the final `\OrangeCoffin` based on the earlier placement of the `\BlueCoffin`.

7 Typesetting coffins

```

\TypesetCoffin
  <coffin> [ <pole1> , <pole2> ]
  ( <x-offset> , <y-offset> )

```

Typesetting is carried out by first calculating *<handle>*, the point of intersection of *<pole1>* and *<pole2>*. This is an optional argument, and if not given then (H, 1), the \TeX reference point of the underlying box, is used. The coffin is then typeset such that the

relationship between the current reference point in the document and the $\langle handle \rangle$ is described by the $\langle x\text{-offset} \rangle$ and $\langle y\text{-offset} \rangle$. This $\langle offset \rangle$ is optional, and if not given (0 pt, 0 pt) is used. Typesetting a coffin is therefore analogous to carrying out an alignment where the ‘parent’ coffin is the current insertion point.

8 Diagnostic functions

Diagnostic data for following the coffin-building process is available both graphically and at the terminal. This reflects the fact that coffins are visual constructs.

```
\DisplayCoffinHandles \DisplayCoffinHandles  $\langle coffin \rangle$  { $\langle colour \rangle$ }
```

This function first calculates the intersections between all of the $\langle poles \rangle$ of the $\langle coffin \rangle$ to give a set of $\langle handles \rangle$. It then prints the $\langle coffin \rangle$ at the current location in the source, with the position of the $\langle handles \rangle$ marked on the coffin. The $\langle handles \rangle$ will be labelled as part of this process: the locations of the $\langle handles \rangle$ and the labels are both printed in the $\langle colour \rangle$ specified.

```
\MarkCoffinHandle \MarkCoffinHandle  $\langle coffin \rangle$ 
[  $\langle pole1 \rangle$  ,  $\langle pole2 \rangle$  ] { $\langle colour \rangle$ }
```

This function first calculates the $\langle handle \rangle$ for the $\langle coffin \rangle$ as defined by the intersection of $\langle pole1 \rangle$ and $\langle pole2 \rangle$. It then marks the position of the $\langle handle \rangle$ on the $\langle coffin \rangle$. The $\langle handle \rangle$ will be labelled as part of this process: the location of the $\langle handle \rangle$ and the label are both printed in the $\langle colour \rangle$ specified. If no $\langle poles \rangle$ are give, the default (H,1) is used.

```
\ShowCoffinStructure \ShowCoffinStructure  $\langle coffin \rangle$ 
```

This function shows the structural information about the $\langle coffin \rangle$ in the terminal. The width, height and depth of the typeset material are given, along with the location of all of the poles of the coffin. For example, for the rotated coffin in Figure 2, the output of $\backslash\text{ShowCoffinStructure}$ is:

```
Size of coffin \ExampleCoffin:
> ht = 102.2052pt
> dp = 0.0pt
> wd = 102.2052pt

Poles of coffin \ExampleCoffin:
> b => {51.1026pt}{0.0pt}{707.10678pt}{707.10678pt}
> t => {0.0pt}{51.1026pt}{707.10678pt}{707.10678pt}
> vc => {25.5513pt}{25.5513pt}{707.10678pt}{707.10678pt}
> r => {102.2052pt}{51.1026pt}{-707.10678pt}{707.10678pt}
> hc => {76.6539pt}{25.5513pt}{-707.10678pt}{707.10678pt}
```

```

> T => {51.1026pt}{0.0pt}{707.10678pt}{707.10678pt}
> H => {51.1026pt}{0.0pt}{707.10678pt}{707.10678pt}
> B => {51.1026pt}{0.0pt}{707.10678pt}{707.10678pt}
> l => {51.1026pt}{0.0pt}{-707.10678pt}{707.10678pt}.
\coffin_show_structure:N ...N \l_coffin_show_toks

```

Notice that the poles of a coffin are defined by four values: the x and y co-ordinates of a point that the pole passes through and the x - and y -components of a vector denoting the direction of the pole. It is the ratio between the later, rather than the absolute values, which determines the direction of the pole.

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