



The stony
road to
complex page
layout

Frank
Mittelbach

The Ask

Some History

T_EX's Model

User Wishlist

Balancing & Floats

Columns

Column dependency

Rules & Backgrounds

At the border

Wishlist summary

Typesetting
Challenges

Balancing

Right to left

Spaces & penalties

Summary

The stony road to complex page layout (and its road blocks)

フランク ミッテルバッハ

2013-10-23



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The old road



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Translated ...

When typesetting complex layouts



is not fully up to the task

(unless we restrict the scenario)



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Instead



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is



needed?



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For:

- multiple columns
- text balancing
- float positioning
- grid typesetting
- ... and much more



Conflicting goals

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- Varying the number of columns on a page
- Balancing
- Automatic float placement
- Grid typesetting
- Do everything automatically



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- Varying the number of columns on a page
 - what happens with footnotes?
 - what happens with floats?
- Balancing
- Automatic float placement
- Grid typesetting
- Do everything automatically



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Summary

- Varying the number of columns on a page
 - what happens with footnotes?
 - what happens with floats?
- Balancing
 - but have explicit columns breaks obeyed
 - but change typesetting based on columns
- Automatic float placement

- Grid typesetting

- Do everything automatically



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Summary

- Varying the number of columns on a page
 - what happens with footnotes?
 - what happens with floats?
- Balancing
 - but have explicit columns breaks obeyed
 - but change typesetting based on columns
- Automatic float placement
 - into and across columns
 - maintaining relationships to call-outs
 - and produce pleasing (and compact) layout
- Grid typesetting
- Do everything automatically



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 - but change typesetting based on columns
- Automatic float placement
 - into and across columns
 - maintaining relationships to call-outs
 - and produce pleasing (and compact) layout
- Grid typesetting
 - **but use elements of varying and unknown heights**
- Do everything automatically



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 - what happens with floats?
- Balancing
 - but have explicit columns breaks obeyed
 - but change typesetting based on columns
- Automatic float placement
 - into and across columns
 - maintaining relationships to call-outs
 - and produce pleasing (and compact) layout
- Grid typesetting
 - but use elements of varying and unknown heights
- Do everything automatically
 - but guess exceptions (without them being marked up)



Moving on . . .

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Brief history on multi-column attempts in \LaTeX

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Summary

1982 \TeX book describes code for index balancing

1988 `multicol` version 1.0a

1993 balancing by Patrick Daly

1999 `ltxgrid` by Arthur Ogawa

1999-2000 Prototype of `xor`

2007 `flowfram` by Nicola Talbot

2011 `adjmulticol` by Boris Veytsman



Brief history on multi-column attempts in \LaTeX

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Summary

- 1982 \TeX book describes code for index balancing
— specific use case only
- 1988 `multicol` version 1.0a — multiple columns,
restriction on floats and footnotes
- 1993 balancing by Patrick Daly
— manual adjustment needed
- 1999 `ltxgrid` by Arthur Ogawa
— two-column, potential loss of material
- 1999-2000 Prototype of `xor` — general float handling, balancing,
grids, but no production version
- 2007 `flowfram` by Nicola Talbot — general text blocks,
no balancing, limited float support
- 2011 `adjmulticol` by Boris Veytsman
— fixing some `multicol` limitations



Brief history on multi-column attempts in L^AT_EX

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Summary

Or in summary:

- 30 years have passed since T_EX82
- Only a handful attempts
- No general solution

Why?



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Summary

We probably don't have the extra computer resources for 100 people to typeset 40 or 50 page documents during the daytime.

Donald Knuth, Stanford 1981

<http://www.youtube.com/playlist?list=PL0AB2986EB62BB5FE>



The T_EX model

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Summary

T_EX was designed for documents with

- a single column
- left-to-right typesetting
- display mathematics (irregular baselines)
- offering paragraph optimization



The T_EX model

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Summary

T_EX was designed for documents with

- a single column
- left-to-right typesetting
- display mathematics (irregular baselines)
- offering paragraph optimization

The processing/typesetting is

- **unidirectional: paragraph → galley → page**
- **with some limited multi-stream functionality (e.g., footnotes)**



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- display mathematics (irregular baselines)
- offering paragraph optimization

The processing/typesetting is

- unidirectional: paragraph → galley → page
- with some limited multi-stream functionality (e.g., footnotes)

Paragraph shapes are

- **specified by lines — not by vertical relationships**



The T&E X model

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- Processing freezes the horizontal width
 - with no way to recover parts of an already typeset paragraph
 - instead, unset paragraph material needs to be kept
 - issues with reprocessing on macro level



The T_EX model

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Summary

- Processing freezes the horizontal width
 - with no way to recover parts of an already typeset paragraph
 - instead, unset paragraph material needs to be kept
 - issues with reprocessing on macro level
- Size changes need to be modeled as paragraph shapes
 - **conceptually wrong**
 - **precompiled paragraph shapes will give “incorrect results” if lines contain large objects**



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- Size changes need to be modeled as paragraph shapes
 - conceptually wrong
 - precompiled paragraph shapes will give “incorrect results” if lines contain large objects
- No builtin concept for grids
 - the glue concept is effectively an orthogonal approach



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 - instead, unset paragraph material needs to be kept
 - issues with reprocessing on macro level
- Size changes need to be modeled as paragraph shapes
 - conceptually wrong
 - precompiled paragraph shapes will give “incorrect results” if lines contain large objects
- No builtin concept for grids
 - the glue concept is effectively an orthogonal approach
- Relationship between different streams is only maintained rudimentarily
 - **loss of relationships inside the OR**



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From the user wishlist . . .

Balancing or not . . .

- How do I fill the first column first?
- How do I avoid stretching in the last column?
- How do I prevent balancing of short texts?

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Summary

- How do I fill the first column first?
 - realized early on as `multicols*` environment
- How do I avoid stretching in the last column?
 - parameters, e.g., `\finalcolumnbadness` introduced
- How do I prevent balancing of short texts?
 - tricky, what are good options?



From the user wishlist . . .

Balancing or not . . .

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Summary

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 - realized early on as `multicols*` environment
- How do I avoid stretching in the last column?
 - parameters, e.g., `\finalcolumnbadness` introduced
- How do I prevent balancing of short texts?
 - tricky, what are good options?

*Short text fragments
do not balance nicely.*

*How should this ma-
terial be distributed*

over the columns?

. . . or . . .

*Short text fragments
do not balance nicely.
How should this ma-*

*terial be distributed
over the columns?*

- manual solution with `unbalance`
- parameter for minimal number of lines (to be added)



From the user wishlist . . .

Floats

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Summary

- Can I have my floats automatically placed with multicols?
- Can I have floats that span some of the columns?
- Why are full width floats never placed on the current page?



From the user wishlist . . .

Floats

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Summary

- Can I have my floats automatically placed with multicols?
 - not with the current approach used;
 - balancing will throw off all placement calculations
- Can I have floats that span some of the columns?
 - not with the current approach used;
 - solutions could be (fairly easily) provided if
 - balancing is restricted
 - floats are manually placed by the user
- Why are full width floats never placed on the current page?
 - to avoid backtracking and recalculations;
 - these days this could be improved



Side note

Float placement costs

$$\text{bruteforce}(a, n) = (a + 1)^n \quad \text{for } a \text{ areas and } n \text{ floats} \quad (1)$$

$$\text{trials}(a, n) = \binom{n + a}{a} = \frac{(n + a)!}{n!a!} \quad (2)$$

with $a \geq c(c + 1)$ for c columns on a page.

An additional float waiting increases the trials by $\frac{n+a+1}{n+1}$

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Side note

Float placement costs

$$\text{bruteforce}(a, n) = (a + 1)^n \quad \text{for } a \text{ areas and } n \text{ floats} \quad (1)$$

$$\text{trials}(a, n) = \binom{n+a}{a} = \frac{(n+a)!}{n!a!} \quad (2)$$

with $a \geq c(c+1)$ for c columns on a page.

An additional float waiting increases the trials by $\frac{n+a+1}{n+1}$

- $\text{trials}(8, 12) = 125.970$ $\text{trials}(10, 12) = 646.646$
- $\text{trials}(6, 24) = 593.775$ $\text{trials}(8, 24) = 10.518.299$
- $\text{trials}(3, 24) = 2.300$

This is the search space for one page, no global optimization!

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- Can I have columns of different width?
- Can I have different number of columns per page?
- Can I have arbitrarily shaped columns?

1. One two three four. 2. One two three four.
three four. 3. One two three four.4. 15. One two
One two three four. 5. One two three four.16.
three four. 6. One two three four. One two three
Red blue green yellow. 7. four. 17. One
One two three four. 8. One two two three four.
three four. 9. One two three 18. One two three
four.10. One two three four. four. Red blue green
11. One two three four. yellow. 19. One two
12. One two three four. three four. 20. One two
Red blue green yellow. three four. 21. One two three
low. 13. One two four.22. One two three four.
three four. 23. One two three four. 24. One



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Summary

- Can I have columns of different width?
— not if the column content is automatically determined
- Can I have different number of columns per page?
— only if the page break is manually chosen
- Can I have arbitrarily shaped columns?

1. One two three four. 2. One two three four.
three four. 3. One two three four.4. One two
three four. 5. One two three four.16. One two
three four. 6. One two three four. One two three
Red blue green yellow. 7. four. 17. One
One two three four. 8. One two two three four.
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12. One two three four. three four. 20. One two
Red blue green yellow. three four. 21. One two three
low. 13. One two four.22. One two three four.
three four. 23. One two three four. 24. One

— not really in any generality



Reiterate ...

Paragraph breaking

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Summary

The situation:

- Paragraphs are broken into lines as a whole
- Formatted material cannot be reformatted (in general)



Reiterate . . .

Paragraph breaking

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Summary

The situation:

- Paragraphs are broken into lines as a whole
- Formatted material cannot be reformatted (in general)

The consequences:

- For reformatting unformatted (macro level) material needs to be captured and used
- Any shape requirement (e.g., variation on horizontal width a page boundary) has to be anticipated beforehand and translated into a suitable `\parshape`
- However, T_EX is not able to account for vertical variation, except by trial and error



From the user wishlist . . .

Columns (cont.)

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Summary

- Can I force `multicols` to skip to the next column if there are only a few lines left?
- Can I have (fixed) content at the top of each column?
- Can I have variable content added the top of each column, e.g., a continuation line in an index?
- Can I get my table broken across several columns/pages (with table headers repeated)?



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Summary

- Can I force `multicols` to skip to the next column if there are only a few lines left?
 - yes, using the `\vfilneg` approach
- Can I have (fixed) content at the top of each column?
 - yes, fairly easily (no user interface provided)
- Can I have variable content added the top of each column, e.g., a continuation line in an index?
 - yes, implemented for the *L^AT_EX Companion* index
- Can I get my table broken across several columns/pages (with table headers repeated)?
 - partly; without table headers `multicols` and `longtable` could be easily married
 - hard, with table headings or balancing requirements



From the user wishlist . . .

Act depending on current column

- Can I find out if some environment is typeset fully within a single column?
- Can I switch the line-numbering if the column changes?
- Can I produce pull-quotes sticking into the margin on outside columns?
- Can I force `multicols` to start the next column *only* if in the first column, but not if in the second column?

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From the user wishlist . . .

Act depending on current column

- Can I find out if some environment is typeset fully within a single column?
- Can I switch the line-numbering if the column changes?
- Can I produce pull-quotes sticking into the margin on outside columns?
- Can I force `multicols` to start the next column *only* if in the first column, but not if in the second column?

— yes to all; it is possible to gather the necessary information with a two-pass algorithm and use it to provide typesetting variations

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- Can I find out if some environment is typeset fully within a single column?
- Can I switch the line-numbering if the column changes?
- Can I produce pull-quotes sticking into the margin on outside columns?
- Can I force `multicols` to start the next column *only* if in the first column, but not if in the second column?
 - yes to all; it is possible to gather the necessary information with a two-pass algorithm and use it to provide typesetting variations
 - if the typesetting significantly changes the column structure, more passes may be necessary
 - worst case scenario may be an impossible document, i.e., a document that alternates between two or more states



From the user wishlist . . .

Rules

- Can I have the column rules colored?
- Can I have rules at the outside of multicolrs?
- Can I have a rule just between the 4th and 5th column?
- Can I (arbitrarily) customize the column rules?

tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel,

lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetur adipiscing elit. In hac habitasse platea dictumst.



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Summary

- Can I have the column rules colored?
— yes, through `\columnseprulecolor`
- Can I have rules at the outside of multicols?
- Can I have a rule just between the 4th and 5th column?
- Can I (arbitrarily) customize the column rules?

tellus sit amet tortor gravida
placemat. Integer sapien est, ia-
culis in, pretium quis, viverra ac,
munc. Praesent eget sem vel leo
ultrices bibendum. Aenean fau-
cibus. Morbi dolor nulla, male-
stada eu, pulvinar at, mollis ac,
nulla. Curabitur auctor semper
nulla. Donec varius orci eget
risus. Duis nibh mi, congue eu,
accumsan eleifend, sagittis quis,
diam. Duis eget orci sit amet orci
dignissim rutrum.

Nam dui ligula, fringilla a,
eismod sodales, sollicitudin vel.

lacinia nulla vitae enim. Pel-
lentesque tincidunt purus vel
magna. Integer non enim. Prae-
sent euismod nunc eu purus.
Donec bibendum quam in tel-
lus. Nullam cursus pulvinar lec-
tus. Donec et mi. Nam vulpu-
tate metus eu enim. Vestibulum
pellentesque felis eu massa.

Quisque ullamcorper placerat
ipsum. Cras nibh. Morbi vel
justo vitae lacus tincidunt ultri-
ces. Lorem ipsum dolor sit amet,
consectetur adipiscing elit. In
hac habitasse platea dictumst.

— yes, all this could be easily implemented

— only question: what is an adequate user interface?



From the user wishlist . . .

Shades and backgrounds

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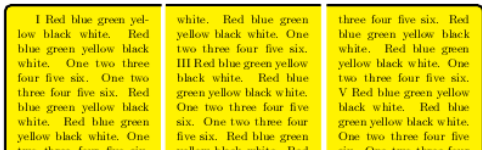
Spaces & penalties

Summary

- Can I color the background behind a multicols environment?



- Can I add borders?





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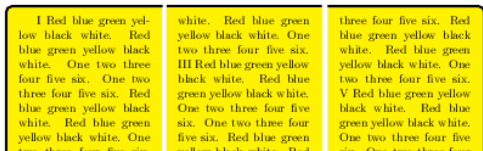
Spaces & penalties

Summary

- Can I color the background behind a multicols environment?



- Can I add borders?



- yes to both; column boxes and positions are known, so it is easy to add background material
- no official interface though



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Summary

- Why is there no one-column multicol environment?
- How do I change the margins for a multicol environment?
- How can I interrupt multicol with single column material?
- How can I avoid the indentation after a multicol environment?



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Summary

- Why is there no one-column multicol environment?
 - simply because I didn't foresee the need (and it was simpler)
 - provided by `adjmulticol`
- How do I change the margins for a multicol environment?
 - provided by `adjmulticol`
- How can I interrupt multicol with single column material?
 - by stopping and restarting
- How can I avoid the indentation after a multicol environment?
 - manually, using `\noindent`



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Unresolvable wishes

- combination of conflicting requirements



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Unresolvable wishes

- combination of conflicting requirements

Hard problems

- touching T_EX processing / model limitations
 - may limit the applicable scenarios
 - may result in fragile “hacks”
- combination of requirements with layout interdependencies
 - multi-pass algorithms required
 - may result in impossible documents
- huge search space
 - no efficient algorithms
 - may result in sub-optimal solutions



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Unresolvable wishes

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Hard problems

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 - may limit the applicable scenarios
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Summary

Unresolvable wishes

- combination of conflicting requirements

Hard problems

- touching T_EX processing / model limitations
 - may limit the applicable scenarios
 - may result in fragile “hacks”
- combination of requirements with layout interdependencies
 - multi-pass algorithms required
 - may result in impossible documents
- **huge search space**
 - **no efficient algorithms**
 - **may result in sub-optimal solutions**



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Unresolvable wishes

- combination of conflicting requirements

Hard problems

- touching T_EX processing / model limitations
 - may limit the applicable scenarios
 - may result in fragile “hacks”
- combination of requirements with layout interdependencies
 - multi-pass algorithms required
 - may result in impossible documents
- huge search space
 - no efficient algorithms
 - may result in sub-optimal solutions

Soft problems

- missing (or bad) user interfaces



Moving on . . .

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Balancing considered harmful

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The steps of the algorithm:

- Find a good starting column height
- Trial-cut all material into columns of that height



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Summary

The steps of the algorithm:

- Find a good starting column height
- Trial-cut all material into columns of that height
- We fail the trial if
 - the badness of any column is higher than `columnbadness`
 - the last column is larger than first
 - a forced break ends up in the last column
 - previous trial height $<$ natural height of first column $<$ trial height



Sample typesetting challenges

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Summary

The steps of the algorithm:

- Find a good starting column height
- Trial-cut all material into columns of that height
- We fail the trial if
 - the badness of any column is higher than `columnbadness`
 - the last column is larger than first
 - a forced break ends up in the last column
 - previous trial height $<$ natural height of first column $<$ trial height
- If the trial failed retry with a (slightly) larger column size



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Summary

The steps of the algorithm:

- Find a good starting column height
- Trial-cut all material into columns of that height
- We fail the trial if
 - the badness of any column is higher than `columnbadness`
 - the last column is larger than first
 - a forced break ends up in the last column
 - previous trial height $<$ natural height of first column $<$ trial height
- If the trial failed retry with a (slightly) larger column size
- If the trial succeeded and the final column has a high badness ($>$ `finalcolumnbadness`) set the column at its natural height and not stretched out



Balancing considered harmful

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- Enlarging the column size may result in overflowing the available space
- The final result often shows compressed columns



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- Enlarging the column size may result in overflowing the available space
 - resolved by introducing `\maxbalancingoverflow`
- The final result often shows compressed columns



Balancing considered harmful

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- Enlarging the column size may result in overflowing the available space
 - resolved by introducing `\maxbalancingoverflow`
- The final result often shows compressed columns

① text 1

② text 2

③ text 3

④ text 4

⑤ text 5



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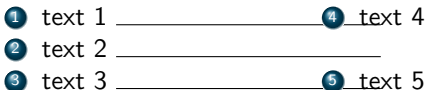
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Summary

- Enlarging the column size may result in overflowing the available space

— resolved by introducing `\maxbalancingoverflow`

- The final result often shows compressed columns





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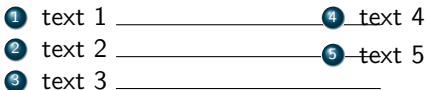
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Summary

- Enlarging the column size may result in overflowing the available space
— resolved by introducing `\maxbalancingoverflow`

- The final result often shows compressed columns



- no (good) general solution possible
- only alternative is to inspect the state of **each** column and use this to fail a trial
- danger: adequate solutions are dropped



Sample typesetting challenges

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```
\documentclass{article}

\usepackage[landscape,lines=30]{geometry}

\usepackage{multicol}

\usepackage{ptext} \usepackage{xepersian}

\begin{document}
\tableofcontents
\begin{multicols}{4}
\section{بخش اول} \ptext[1-2] بخش اول \footnote{\ptext[3]}
\section{بخش اول} \ptext[4]
\end{multicols}
\end{document}
```

Should be as easy as that ... and the task for `multicol` is simple, isn't it?



Typesetting right to left

The result (wrong!)

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یک اندر دگر بسته شد بجنبید چون کار پیوسته شد چو دریا و چون کوه و چون دشت و راع زمین شد به کردار روشن چراغ بیالید کوه آنها بردمید سر رستنی سوی بالا کشید زمین را بلندی نبد جایگاه یکی مرکزی تیره بود و سیاه خور و خواب و آرام جوید

همی وزان زندگی کام جوید همی نه گویا زبان و نه جویا خرد ز خاک و ز خاشاک تن پرورد ندانند بد و نیک فرجام کار نخواهد ازو بندگی کردگار چو دانا توانا بد و دادگر از ایرا نکرد آییچ پنهان هنر چنینست فرجام کار جهان ندانند کسی آشکار و نهان.

سود ازین پس بگو کافرینش چه بود تویی کرده کردگار جهان ببینی همی آشکار و نهان به گفتار دانندگان راه جوی به گیتی بهوی و به هر کس بگوی ز هر دانشی چون سخن بشنوی از آموختن یک زمان نغوی چو دیدار یابی به شاخ سخن بدانی که دانش نیاید به بن.

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۲ بخش اول

در بخشش و دادن آمد پدید و بخشید دانا چنان چون سزید فلکها

کسی کو خرد را ندارد ز پیش دلش گردد از کرده خویش ریش هشیوار دیوانه خواند ورا همان خویش بیگانه داند ورا ازویی به هر دو سرای ارجمند گسسته خرد پای دارد بپند خرد چشم جانست چون بنگری تو بی چشم شادان جهان نسپری نخست آفرینش خرد را شناس نگاهبان جانست و آن سه پاس سه پاس تو چشم است و گوش و زبان کزین سه رسد نیک و بد بی گمان خرد را و جان را که یارد ستود و گر من ستایم که یارد شوند حکیمها چو کس نیست گفتن چه

کنون ای خردمند وصف خرد بدین جایگه گفتن اندر خورد کنون تا چه داری بیار از خرد که گوش نیوشنده زو بر خورد خرد بهتر از هر چه ایزد بداد ستایش خرد را به از راه داد خرد رهنمای و خرد دلگشای خرد دست گیرد به هر دو سرای ازو شادمانی وزویت غمیست وزویت فزونی وزویت کمیست خرد تیره و مرد روشن روان نباشد همی شادمان یک زمان چه گفت آن خردمند مرد خرد که دانا ز گفتار از برخورد.

از آغاز باید که دانی درست سرمایه گوهرا ن از نخست که یزدان ز ناچیز چیز آفرید بدان تا توانایی آرد پدید سرمایه گوهرا ن این چهار بر آورده بی ربح و بی روزگار یکی آتشی بر شده ناپناک میان آب و باد از بر تیره خاک نخستین که آتش به جنبش دمید ز گرمیش پس خشکی آمد پدید وزان پس ز آرام سردی نمود ز سردی همان باز نری فزود چو این چار گوهر به جای آمدند ز بهر سنجی سرای آمدند گهرها یکی اندر دگر ساخته ز هرگونه گردن برافراخته پدید آمد این گنبد تیزرو شگفتی نماینده نوبه او ابره و دو هفت شد کند خدای گرفتند هر یک سزاوار جای.

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Frank Mittelbach

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Typesetting right to left

Corrected result

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۱ بخش اول

کنون ای خردمند وصف خرد بدین جایگه گفتن اندر خورد کنون تا چه داری بیار از خرد که گوش نیوشنده زو بر خورد خرد بهتر از هر چه ایزد بداد ستایش خرد را به از راه داد خرد رهنمای و خرد دلگشای خرد دست گیرد به هر دو سرای ازو شادمانی وزویت گمبست وزویت فزونی وزویت کمبست خرد تیره و مرد روشن روان نباشد همی شادمان یک زمان چه گفت آن خردمند مرد خرد که دانا ز گفتار از بر خورد.

کسی کو خرد را ندارد ز پیش دلش گردد از کرده خویش ریش هشیوار دیوانه خواند ورا همان خویش بیگانه داند ورا ازوی به هر دو سرای ارجمند گسسته خرد پای دارد ببند خرد چشم جانست چون بنگری تو بی چشم شادان جهان نسپری نخست آفرینش خرد را شناس نگهبان جانست و آن سه پاس سه پاس تو چشم است و گوش و زبان کزین سه رسد نیک و بد بی گمان خرد را و جان را که یارد ستود و کر من ستایم که یارد شنود حکیمان چو کس نیست گفتن چه

۲ بخش اول

سود ازین پس بگو کافرینش چه بود تویی کرده کردگار جهان ببینی همی آشکار و نهان به گفتار داندگان راه جوی به گیتی بپوی و به هر کس بگوی ز هردانشی چون سخن بشنوی از آموختن یک زمان نغوی چو دیدار یابی به شاخ سخن بدانی که دانش نباید به بن.

بخش اول

در بخشش و دادن آمد بدیدر ببخشید دانا چنان چون سزید فلکها

یک اندر دگر بسته شد بجنبید چون کار پیوسته شد چو دریا و چون کوه و چون دشت و راغ زمین شد به کردار روشن چراغ بیالید کوه آبها بر دمید سر رستنی سوی بالا کشید زمین را بلندی بند جایگاه یکی مرکزی تیره بود و سیاه خور و خواب و آرام جوید همی وزان زندگی کام جوید همی نه گویا زبان و نه جویا خرد ز خاک و ز خاشاک تن پرورد ندادند بد و نیک فرجام کار نخواهد ازو بندگی کردگار چو دانا توانا بد و دادگر از ایرا نکرد ایچ پنهان هنر چنبست فرجام کار جهان نداند کسی آشکار و نهان.

از آغاز باید که دانی درست سرمایه گوهرا از نخست که یزدان ز ناچیز چیز آفرید بدان تا توانایی آرد بدید سرمایه گوهرا این چهار بر آورده بی رح و بی روزگار یکی آتشی بر شد تا بناک میان آب و باد از بر تیره خاک نخستین که آتش به جنبش دمید ز گرمیش پس خشکی آمد بدید وزان پس ز آرام سردی نمود ز سردی همان باز تری فرود چو این چار گوهر به جای آمدند ز بهر سببجی سرای آمدند گهرها یک اندر دگر ساخته ز هرگونه گردن برافراخته بدید آمد این گنبد نیز زو شگفتی نمابنده نوبه او بره و دو هفت شد کدخدای گرفتند هر یک سزاوار جای.

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Frank Mittelbach

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Sample typesetting challenges

Space and penalty sequences

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```
\begin{multicols}{2}
  \begin{itemize}
    \item \verb=\addpenalty= and \verb=\addvspace=
          logic in \LaTeX{} has a flaw
    \item \texttt{multicol} makes this apparent
  \end{itemize}
  \begin{itemize}
    \item \verb=\addpenalty= and \verb=\addvspace=
          logic in \LaTeX{} has a flaw
    \item \texttt{multicol} makes this apparent
  \end{itemize}
\end{multicols}
```



Space and penalty sequences

... and the result

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- `\addpenalty` and `\addvspace` logic in \LaTeX has a flaw
- `multicol` makes this apparent
- `\addpenalty` and `\addvspace` logic in \LaTeX has a flaw
- `multicol` makes this apparent

You see the issue?



Space and penalty sequences

... and the result

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Summary

- `\addpenalty` and `\addvspace` logic in \LaTeX has a flaw

- `multicol` makes this apparent
-

- `\addpenalty` and `\addvspace` logic in \LaTeX has a flaw

- `multicol` makes this apparent

You see the issue?

Right ... the columns don't line up



Space and penalty sequences

So what's the problem?

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```
... \penalty -51 % 1st \addpenalty
... \glue 8.0 plus 2.0 minus 4.0 % 1st \addvspace
... \glue -8.0 plus -2.0 minus -4.0 % 2nd \addpenalty
... \penalty -51 % dito
... \glue 8.0 plus 2.0 minus 4.0 % dito
... \glue(\parskip) 0.0 plus 1.0 % start of \item
... \hbox(6.83331+0.0)x345.0, glue set 323.88889fil
```




Space and penalty sequences

So what's the problem?

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```
... \penalty -51 % 1st \addpenalty
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... \penalty -51 % dito
... \glue 8.0 plus 2.0 minus 4.0 % dito
... \glue(\parskip) 0.0 plus 1.0 % start of \item
... \hbox(6.83331+0.0)x345.0, glue set 323.88889fil
```

- L^AT_EX generates a sequence of `\addpenalty` and `\addvspace` calls
- The break is taken at the second penalty
- This leaves a zero space at the bottom of the column/page making the baseline shift downwards as `\prevdepth` is getting ignored



Moving on . . .

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- If we take off the shoes, i.e., restrict the use case scenarios somewhat, then a lot can be achieved already within the limitations of T_EX (or LuaT_EX)



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Summary

- If we take off the shoes, i.e., restrict the use case scenarios somewhat, then a lot can be achieved already within the limitations of T_EX (or LuaT_EX)
- Good automatic float placement is still a largely unresolved research area
 - Not an engine question at this point!



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Summary

- If we take off the shoes, i.e., restrict the use case scenarios somewhat, then a lot can be achieved already within the limitations of T_EX (or LuaT_EX)
- Good automatic float placement is still a largely unresolved research area
 - Not an engine question at this point!
- The paragraph shape model is defective
 - A typesetting engine needs to enable reformatting
 - Paragraph breaking algorithms should work on physical shape specifications not on line counts



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Summary

- If we take off the shoes, i.e., restrict the use case scenarios somewhat, then a lot can be achieved already within the limitations of T_EX (or LuaT_EX)
- Good automatic float placement is still a largely unresolved research area
 - Not an engine question at this point!
- The paragraph shape model is defective
 - A typesetting engine needs to enable reformatting
 - Paragraph breaking algorithms should work on physical shape specifications not on line counts
- Multi-directional typesetting may need a better model
 - T_EX's model is clearly defective, but LuaT_EX's (Omega) model may need revisiting as well → looking forward to John's talk



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So is waiting necessary?



Thank you

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Or can it be helped a little?