New directions in document formatting : Superglue

Frank Mittelbach Chris Rowley

June 2003

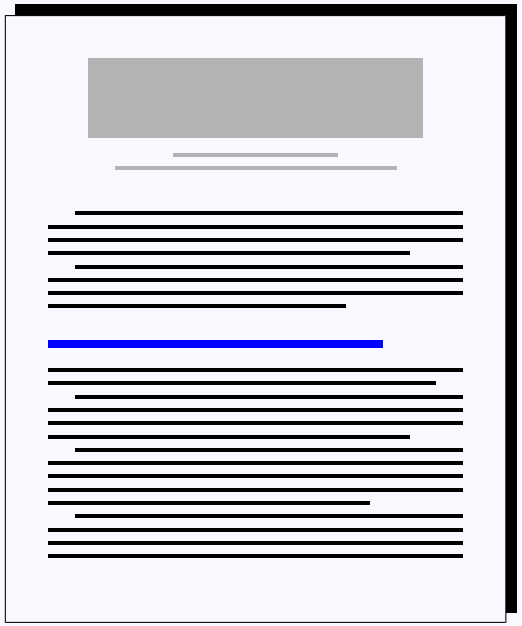
Abstract

We shall describe a detailed proposal for a useful and practical extension of TEX's glue model to support more general and more typical (in quality typography) design specifications for the distribution of white space. Extending TEXto use this 'superglue' will not necessitate any change in the subsystem for finding and optimising break-points since these processes only use the glue-stretch-ratio (via the badness) for the aggregation of all the glue within a box. We provide a simple means to calculate the badness of a box containing 'superglue' and this has the bonus of leading naturally to a straightforward method of replacing TEX's hard-wired calculation of the 'badness of the glue stretch' by a specifiable calculation. Our model was developed primarily to better support page layout specification but it also has potential applications paragraph building.

Contents

Some problems with normal glue

A typical page produced by LaTeX



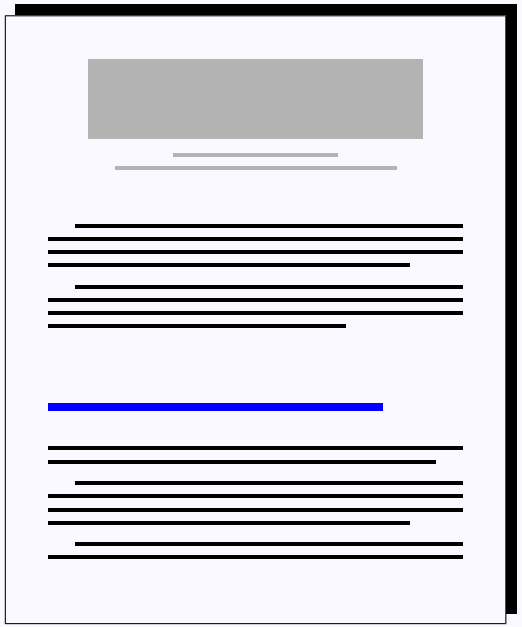
. . . but remove a few lines at the bottom we get . . .

Another typical page

Problems

- Space above heading grows faster than space below figure
- Space below heading grows too far
- Space between paragraphs grows as well

A better solution



Features

- Space below figure larger than space above heading
- Space below heading does not grow without limit
- Spaces between paragraphs do not grow
- Space above figure grows only if a lot of space is needed

TEX's glue and badness

- Glue has three components: natural length, stretch and shrink.
- Badness of a set box depends on:
  - piecewise sum of each component over all glue in the box
  - difference between: 'natural length of contents' and 'prescribed length of box'
- For stretch, the badness b of a box
  - 'needing' S units of space
  - 'having' $P(>0)$ units of stretch

  is:

$$b = 100 \left(\frac{S}{P} \right)^3$$

- The stretch defines only the 'badness scale': badness 100
- The shrink defines both:
  - a maximum
  - its badness: 100

Superglue

Adding priority levels to glue

- Superglue defined by
  - natural space n
  - extra space in *priority levels*
    $e = e_1 + e_2 + \cdots + e_c$
  - stretch space p
  - Each e_i can be zero.

  [similarly for shrink, with $p = 0$]

Where did normal glue go to?

- Normal glue with `plus` part q becomes superglue:

$$e_1 = e_2 = \ldots = e_c = \frac{q}{c} \quad p = q$$

And what about badness?

- The badness of a set box with superglue depends on:
  - component-wise sum over all superglue in the box of
    - extra space
    - stretch space
  - difference between: 'natural length of contents' and 'prescribed length of box'
- Thus 'total extra and stretch space ' in a box is the component-wise sum over all superglue.

[Thus we can restrict ourselves to a single superglue N, E, P.]

Frank's Fabulous Formula for Superbadness

For stretch, the badness b of a box

- 'needing' S units of space
- 'having' E units of extra space
- 'having' P units of stretch space

is:

$$b = \begin{cases} 0 & S = 0 \\ 100\left(\frac{S}{E}\right)^3 & 0 < S \leq E \\ 100\left(1 + \frac{S-E}{P}\right)^3 & 0 \leq E < S \text{ and } P > 0 \\ \infty & E < S > 0 \text{ and } P = 0 \end{cases}$$

Notes

- Here $E \geq 0$ and $P \geq 0$; but probably not essential.
- The 'extra space' is all allocated to 'badness < 100'.
- $b(E) = 100$; also not essential.
- Not used: distribution of 'extra space' to priority levels.

In Which Chris has a Convexity Crisis

Graph of badness as a function of the ‘stretch ratio’: no longer a simple cubic.

[wonderful graph]

Extra space distribution

Assumptions

Assuming a box requires $0 \leq S$ units of extra space and contains a Total Superglue of $E = E_1 + \cdots + E_c$ and P.
Then the following algorithm is used to distributed the space:

Algorithm

- If $S \geq E$ then use e on each individual superglue in the box completely and use $\frac{S-E}{P}$ as the stretch factor to be multiplied by p for each individual superglue.
- Otherwise $0 \leq S < E$.
  Set $i \leftarrow 1$.
  While $S > 0$ do:
  - If $S \geq E_i$ then use all of e_i for each individual superglue.
    Set $S \leftarrow S - E_i$ and $i \leftarrow i + 1$ and recurse.
  - Otherwise $S < E_i$.
    In that case use $\frac{S}{E}$ as the stretch factor to be multiplied by e_i for each individual superglue.
    Set $S \leftarrow 0$.

Implementation [maybe:-)] Please!!

Further extensions

- Discrete superglue
- . . .