Bloat-Ectomy:
A Method for the Identification and Removal of Duplicate Text in the Bloated Notes of Electronic Health Records and Other Documents

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The authors are part of a team that is using the text notes in electronic healthcare records (EHRs).

DATA

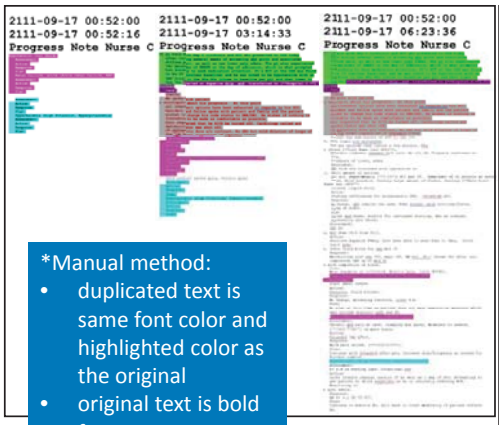
"Multiparameter Intelligent Monitoring in Intensive Care (MIMIC III)"
MIT database of 60,000 Beth Israel Deaconess Hospital admissions with critical care, 2001-2012
http://mimic.physionet.org/about/mimic/

Privacy protection method:

- Preserved:
  - Text notes
  - Timelines for each patient
- Not preserved:
  - Calendar time
  - Ability to simulate real time analysis
  - Proper names

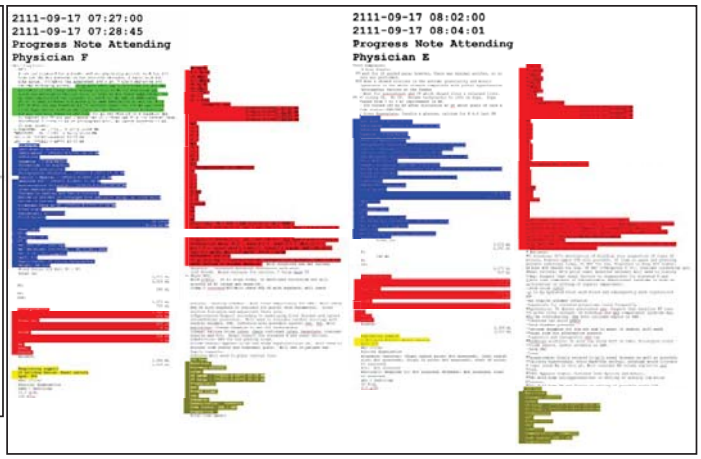
Bloat-Ectomy: Example notes from one admission show duplications*

Progressively longer nurse's notes over 1 shift

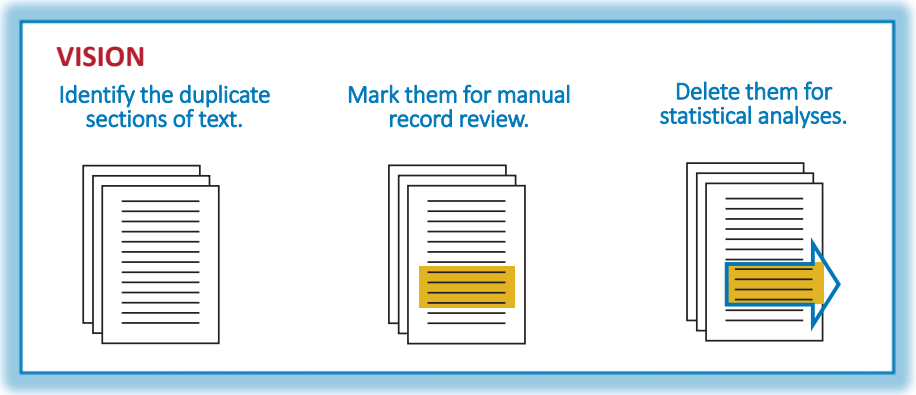


*Manual method:
- duplicated text is same font color and highlighted color as the original
- original text is bold font.

Example of 2 physicians' notes from same time period



Bloat-Ectomy



Bloat-Ectomy: Our needs

LITERATURE re "NOTE BLOAT"

Current methods don't meet our need for:

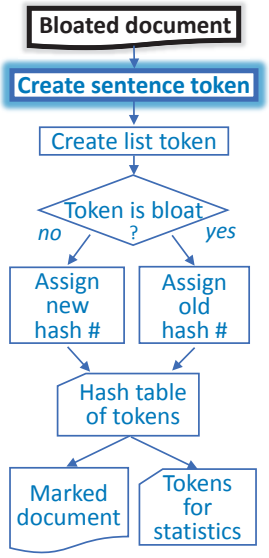
- Exact detection of all pasted material
- Sentence-level (minimal level of meaning) algorithm
- Eliminate less, rather than more, text
- Simple implementation

METHOD

- The LZW compression algorithm* works by hashing ***words*** by assigning sequential numeric addresses to them.
- We are using ***sentences.***

*Welch modification of compression technique developed by Lempel and Ziv, https://ieeexplore.ieee.org/document/1659158?arnumber=1659158&tag=1 (1984); suggested by Walter Bright WalterBright.com.

Bloat-Ectomy: Create sentence tokens



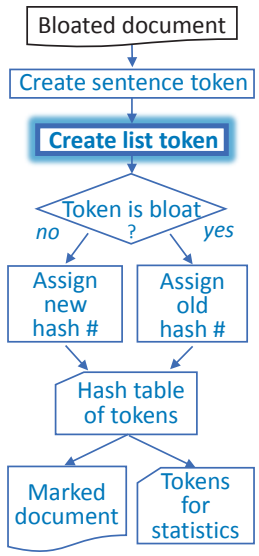

```
No CP. Became tachycardic to 160s
on dopa. No CP.
```

A sentence is:

- Any character(s) + a period
- followed by 1 of:
  - a space
  - a tab
  - a newline character (\n)

Token #	Token
1	No CP.
2	Became tachycardic to 160s on dopa.
3	No CP.

Bloat-Ectomy: Create list tokens

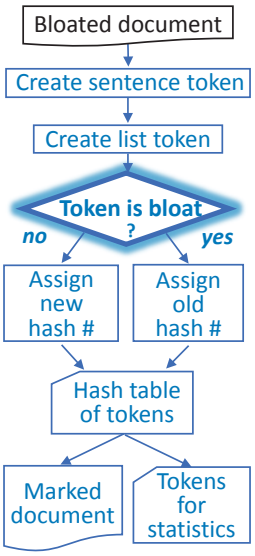



```
Tmax: 36.6
C (97.8
HR: 100 (97 - 166) bpm
Tmax: 36.6
C (97.8
```

List of $\mathcal{X}$ (5 in this example) items defined by newline characters.

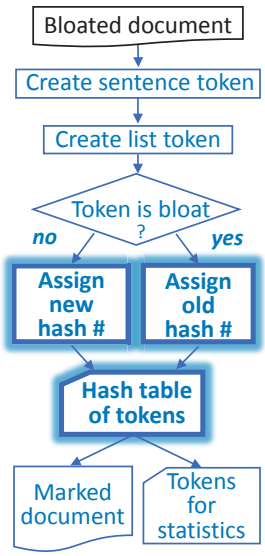
Token #	Token
4	Tmax: 36.6
5	C (97.8
6	HR: 100 (97 - 166) bpm
7	Tmax: 36.6
8	C (97.8

Bloat-Ectomy: Identify bloat



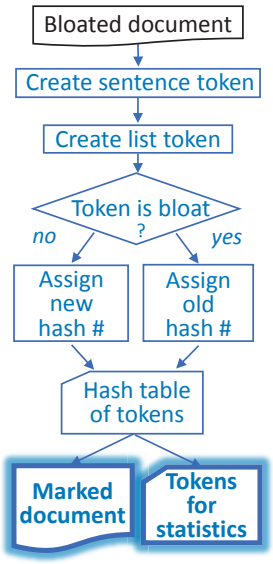
Token #	Token	Bloat ?
1	No CP.	no
2	Became tachycardic to 160s on dopa.	no
3	No CP.	yes
4	Tmax: 36.6	no
5	C (97.8	no
6	HR: 100 (97 - 166) bpm	no
7	Tmax: 36.6	yes
8	C (97.8	yes

Bloat-Ectomy: Add assigned hash numbers to hash table



Token #	Token	Bloat ?	Hash #
1	No CP.	no	1
2	Became tachycardic to 160s on dopa.	no	2
3	No CP.	yes	1
4	Tmax: 36.6	no	3
5	C (97.8	no	4
6	HR: 100 (97 - 166) bpm	no	5
7	Tmax: 36.6	yes	3
8	C (97.8	yes	4

Bloat-Ectomy: Produce outputs



Marked document for manual review

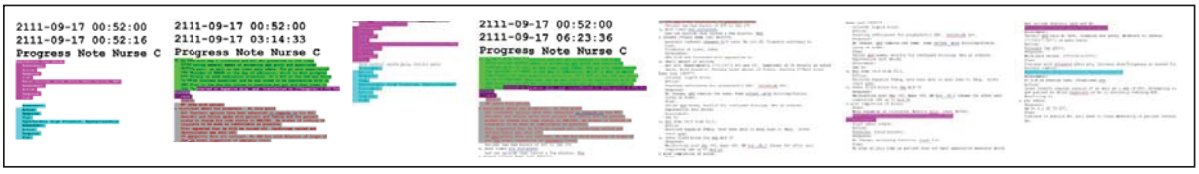
```
No CP.
Became tachycardic to 160s on dopa.
No CP.
Tmax: 36.6
C (97.8
HR: 100 (97 - 166) bpm
Tmax: 36.6
C (97.8
```

Deduplicated tokens for statistics

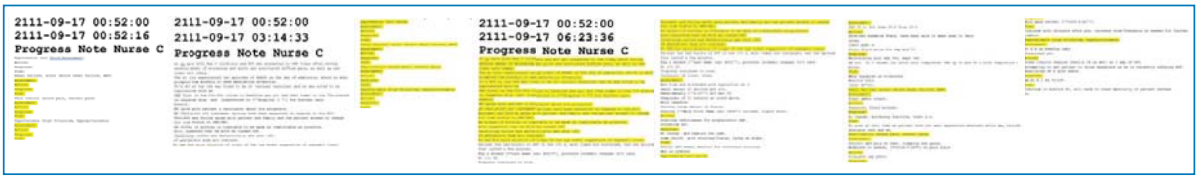
```
No CP.
Became tachycardic to 160s on dopa.
Tmax: 36.6
C (97.8
HR: 100 (97 - 166) bpm
```

Bloat-Ectomy: Results for real example notes Nurse's notes

Manual



Bloat-ectomy



Bloat-Ectomy: Results for real example notes Physicians' notes

Bloat-Ectomy: Flexibility

Adaptation to other texts can be user-made and will depend on the characteristics of the text and the analysis purpose(s).

Token definition options:

- Sentence demarcation (default is period)
- List demarcations: symbols that start a new token in a list (i.e. bullet point, star)

What to do with identified bloat:

- Mark for review.
- Delete for statistical analysis.

Output Formats:

- Word: mark bloat (bold, italics, highlight) and output as docx for a word processor.
- HTML option: highlighted bloat in printout.
- Text: output as a string or token strings to be ingested into a database (i.e., PostgreSQL)

Bloat-Ectomy: Conclusions

Bloat-ectomy:

- **Works**
- **Customizable**