CS 240 – Data Structures and Data Management

Module 10: Compression - Enriched

T. Biedl É. Schost O. Veksler

Based on lecture notes by many previous cs240 instructors

David R. Cheriton School of Computer Science, University of Waterloo

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Outline

1. Compression
   - Arithmetic compression

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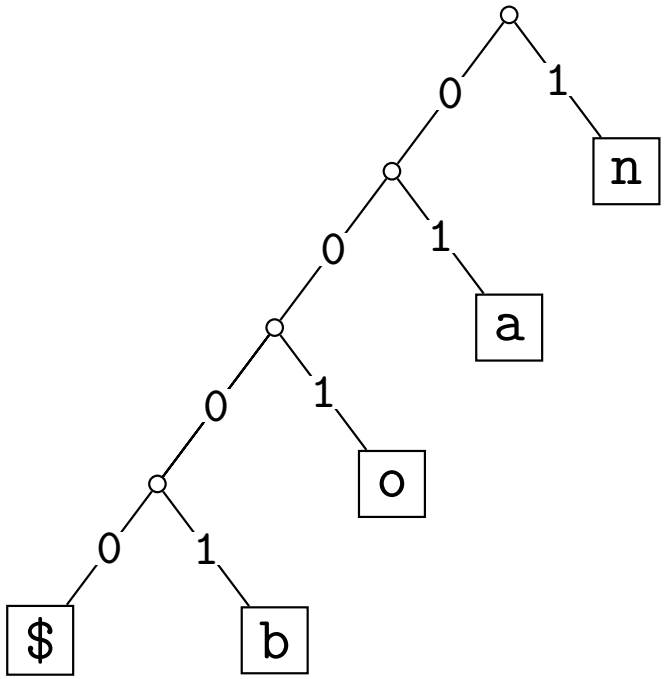
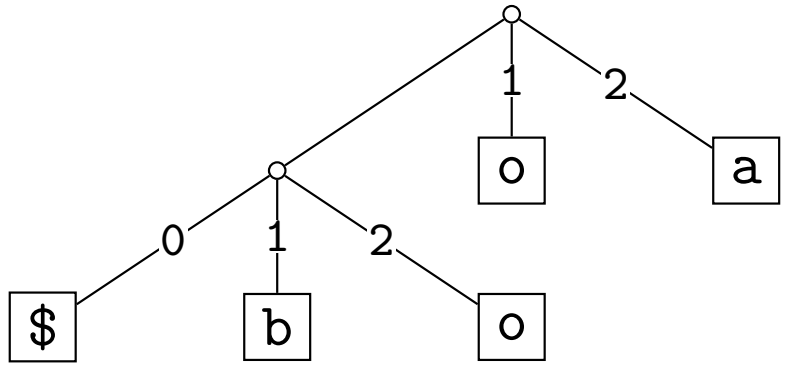
Huffman with a different base

Example text: `nobanana$`, $\Sigma_S = \{\$, b, o, a, n\}$

Character frequencies: `$` : 1, `b` : 1, `o` : 1, `a` : 3, `n` : 3

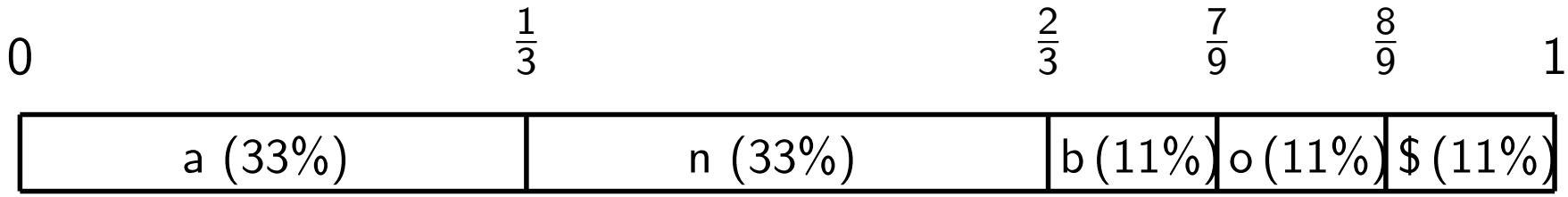




$$\left(\underbrace{10010001011011010000}_{20 \text{ bits}}\right) \text{vs.} (202011212100)_3 = \left(\underbrace{11000001111110010110}_{19 \text{ bits}}\right)$$

Arithmetic compression

Subdivide $[0, 1]$ by frequencies of letters.



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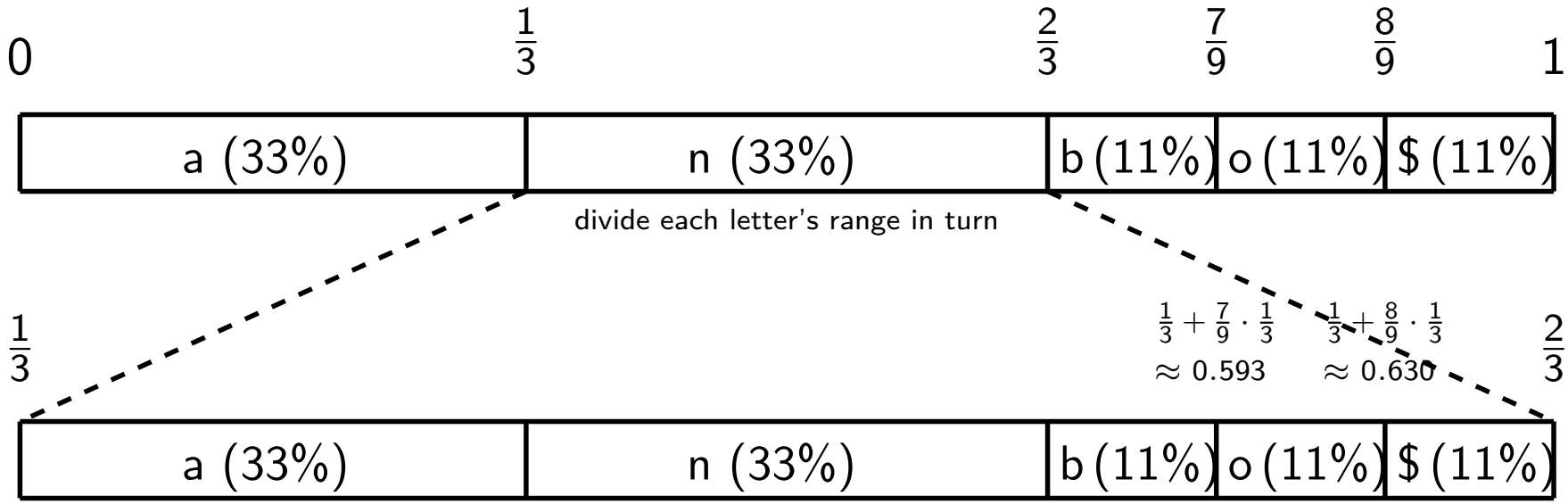

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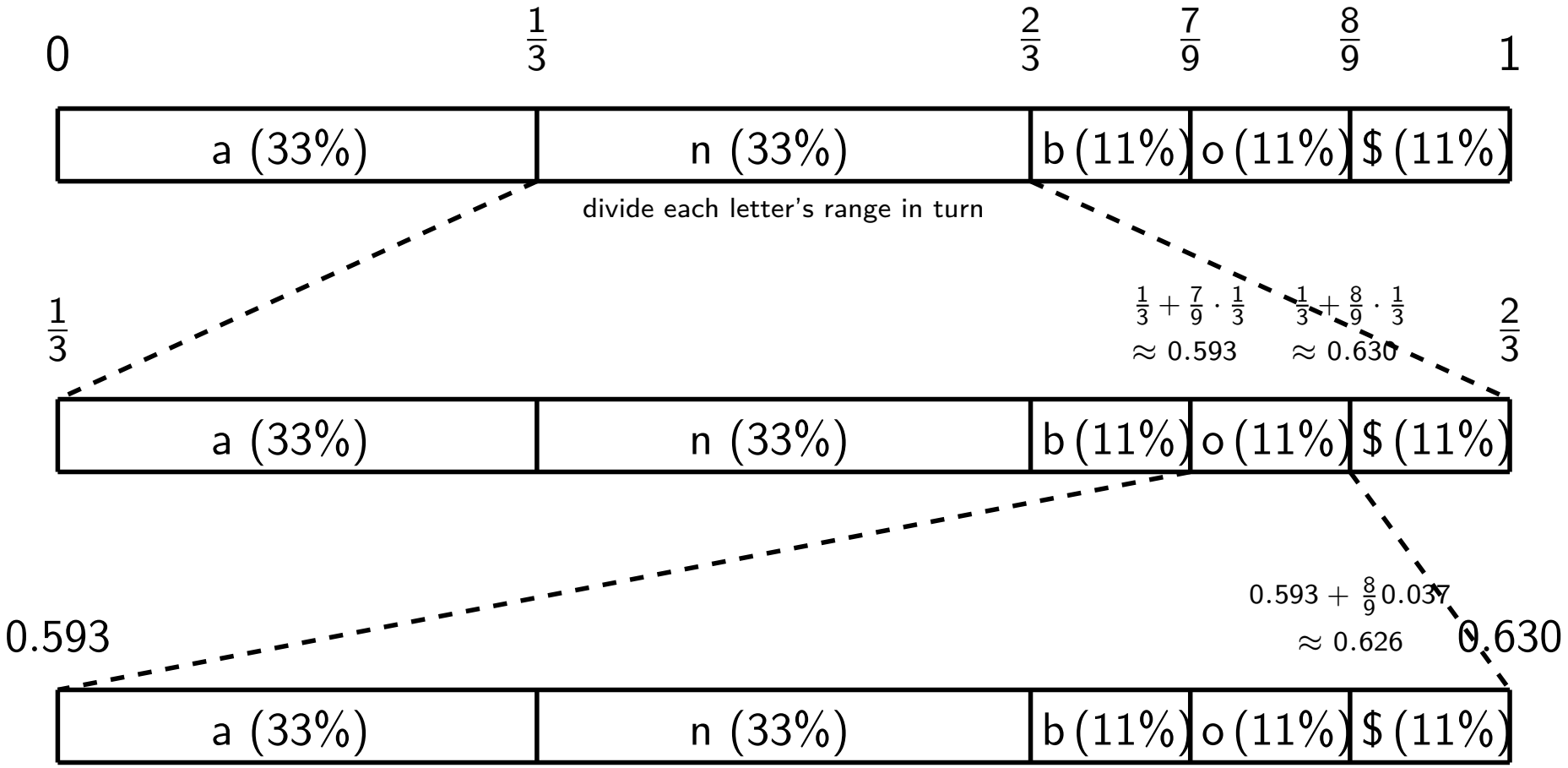

Arithmetic compression

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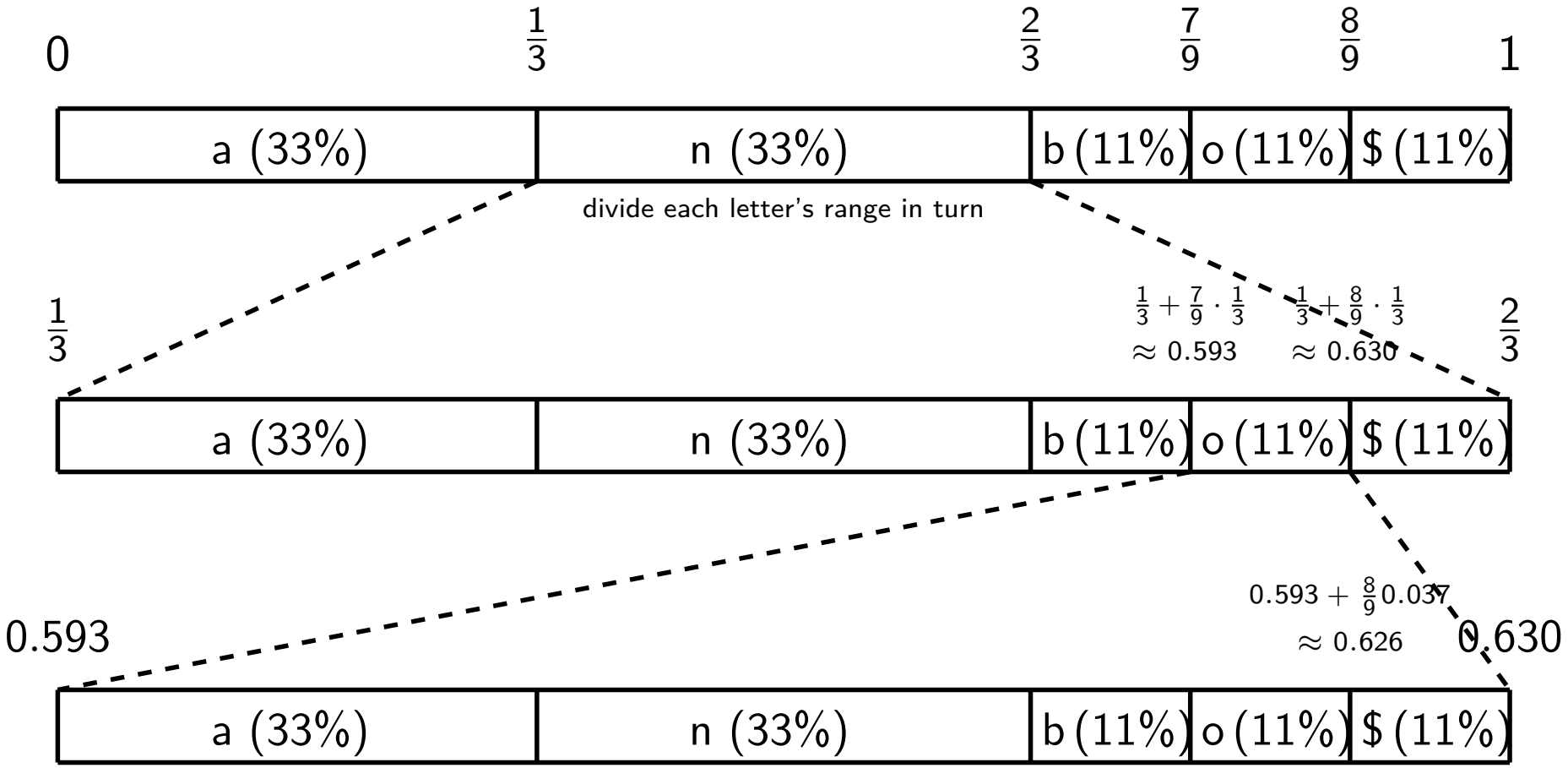

Any number in interval $(0.626, 0.63)$ represents 'no$'.

Arithmetic compression code

ArithmeticEncoding(f, S)
f: frequencies of Σ_S, S: text to encode (ends with \$)

1. $I \leftarrow [0,1]$ // interval
2. **for** $i = 0 \ldots |S| - 1$
3. subdivide I relative to frequencies f
4. $I \leftarrow$ interval that corresponds to $S[i]$
5. $C \leftarrow$ number in I that needs few bits
6. **return** C (or its binary encoding)

ArithmeticDecoding(f, C)
f: frequencies of Σ_S, C: number to decode

1. $S \leftarrow$ empty string, $I \leftarrow [0,1]$
2. **repeat**
3. subdivide I relative to frequencies f
4. S.*append*(character whose interval contains C)
5. **until** $c =$ \$
6. **return** S