Learning Meters of Arabic and English poems

With Recurrent Neural Networks

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Introduction

Hello, Arabic

ودعْ عنك آراءَ الرجالِ وقولَهم فقولُ رسولِ الله أزكى وأشرحُ

But ... What is poetry?

General Definition:

- **Poetry** is a piece of writing or speaking, which **MUST** follow specific **Patterns**.

Example, *English verse*:

That **time** of **year** thou **mayst** in **me** be**hold**

To detect poems' meters, we need to learn those **Patterns**.

Arabic Prosody العَرُوض

- **Foot** التفعيلة: is a sequence of vowels and consonants.

Feet	Scansion
فَعُولُنْ	0/0//
فَاعِلُنْ	0//0/
مُسْتَفْعِلُنْ	0//0/0/
مَفاعِيلُنْ	0/0/0//
مَفْعُولاَت	0//0///
فَاعِلاَتُنْ	0/0//0/
مُفَاعَلَتُنْ	0///0//
مُتَفَاعِلُنْ	0//0///

Arabic Prosody العَرُوض

Arabic Patterns/Meters بحور الشعر:

- **Meter** البحر: is a sequence of feet.

Meter Name	**Meter** *feet combination*
al-Wafeer	مُفَاعَلَتُن مُفَاعَلَتُن فَعُولُن
al-Taweel	فَعُوْلُنْ مَفَاْعِيْلُنْ فَعُوْلُنْ مَفَاْعِلُنْ
⋮	⋮
al-Moktadib	مَفْعُوْلاتُ مُسْتَفْعِلُنْ مُسْتَفْعِلُن
al-Modar'e	مَفَاْعِيْلُنْ فَاْعِلاتُنْ مَفَاْعِيْلُنْ

Arabic Prosody, example!

From بحر الوافر:

ويسْأل فىْ الْحوادْث ذوْ صوابِ

ويسأل فل	حوادث ذو	صوابن
0///0//	0///0//	0/0//
مفاْعلتنْ	مفاْعلتنْ	فعوْلنْ

English Prosody

English Meters Building Blocks:

- Syllables: /ˈwɔːtə/ = /ˈwɔː/ + /tə(r)/.
  - **stressed** + unstressed.
- Foot: is a combination of stressed and unstressed syllables.

Feet	Stresses Combination
Iamb	×/
Trochee	/×
Dactyl	/××
Anapest	××/
Pyrrhic	××
Amphibrach	×/×
Spondee	//

Meter: is repeating a foot n times; where $n \in [1, 8]$.

English Patterns

Iambic pentameter verse:

$$\underbrace{\text{That } \textbf{time}}_{\text{Iambic Foot}} \overbrace{\text{of } \textbf{year}}^{\text{2nd}} \overbrace{\text{thou } \textbf{mayst}}^{\text{3rd}} \overbrace{\text{in } \textbf{me}}^{\text{4th}} \overbrace{\text{be}\textbf{hold}.}^{\text{5th}}$$

Literature Review

Detecting Arabic poems' Meters

Abuata and Al-Omari:

- Five-step Algorithm
  1. Getting the input, carrying full diacritics.
  2. Metrical scansion rules are applied to the Arud writing. 0/0/..
  3. Grouping zero and ones to feet تفعيلات.
  4. A class is assigned to the input.
- **Results**: 82.2% of 417 verses.

Alnagdawi et al, similar approach; Context-Free Grammar; 75% correctly classed from 128.

example!

ويسْأل فىْ الْحوادْث ذوْ صوابٍ

ويسأل فل	حوادث ذو	صوابن
0///0//	0///0//	0/0//
مفاْعلتنْ	مفاْعلتنْ	فعوْلنْ

Abuata and Al-Omari && Alnagdawi et al; Problems

Issues;

- A huge constrain. Diacritics are a must.
- Converting the text into pronounced text is probabilistic.
  - اثبات الحروف المحذوفة خطاً
  - التصرف فى التقاء الساكنين

Tanasescu et al.

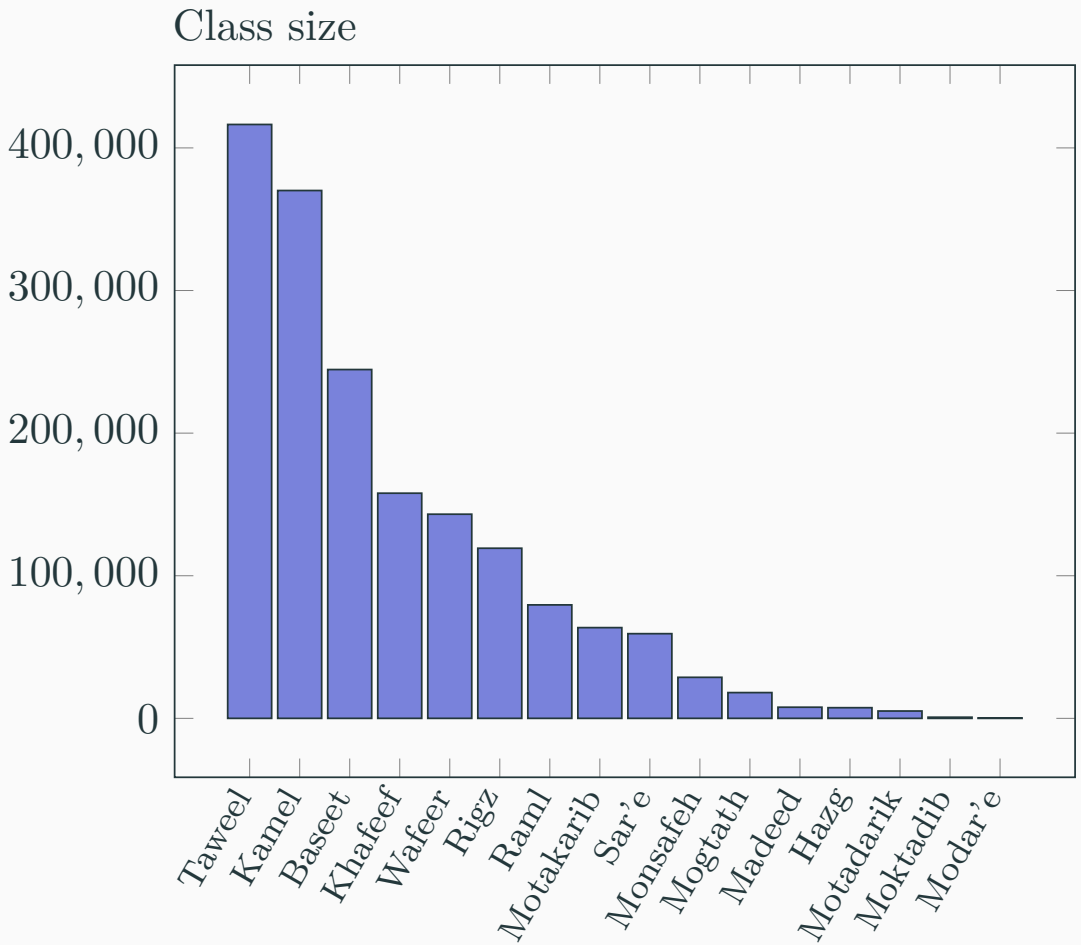
Binary Classification; Metric or Free-Verse:

- verses are represented as vectors of statistical features.

Datasets

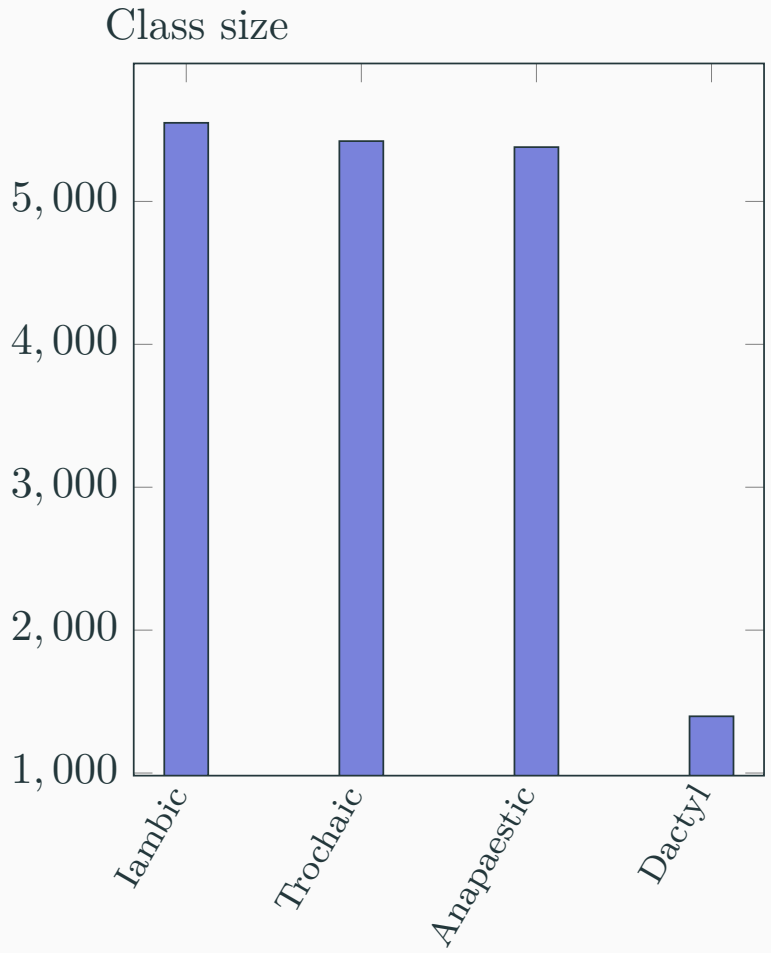
Datasets

Arabic Dataset:



Datasets

English Dataset:

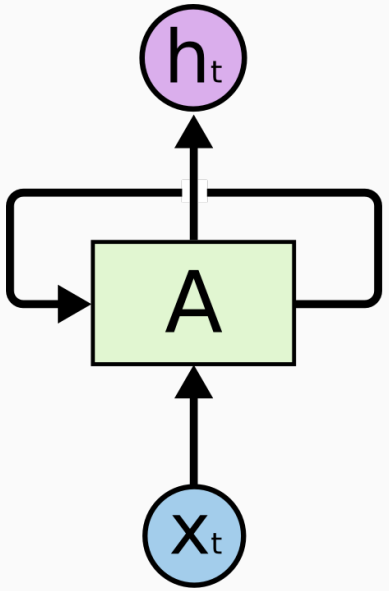


Methodology

Which Network!

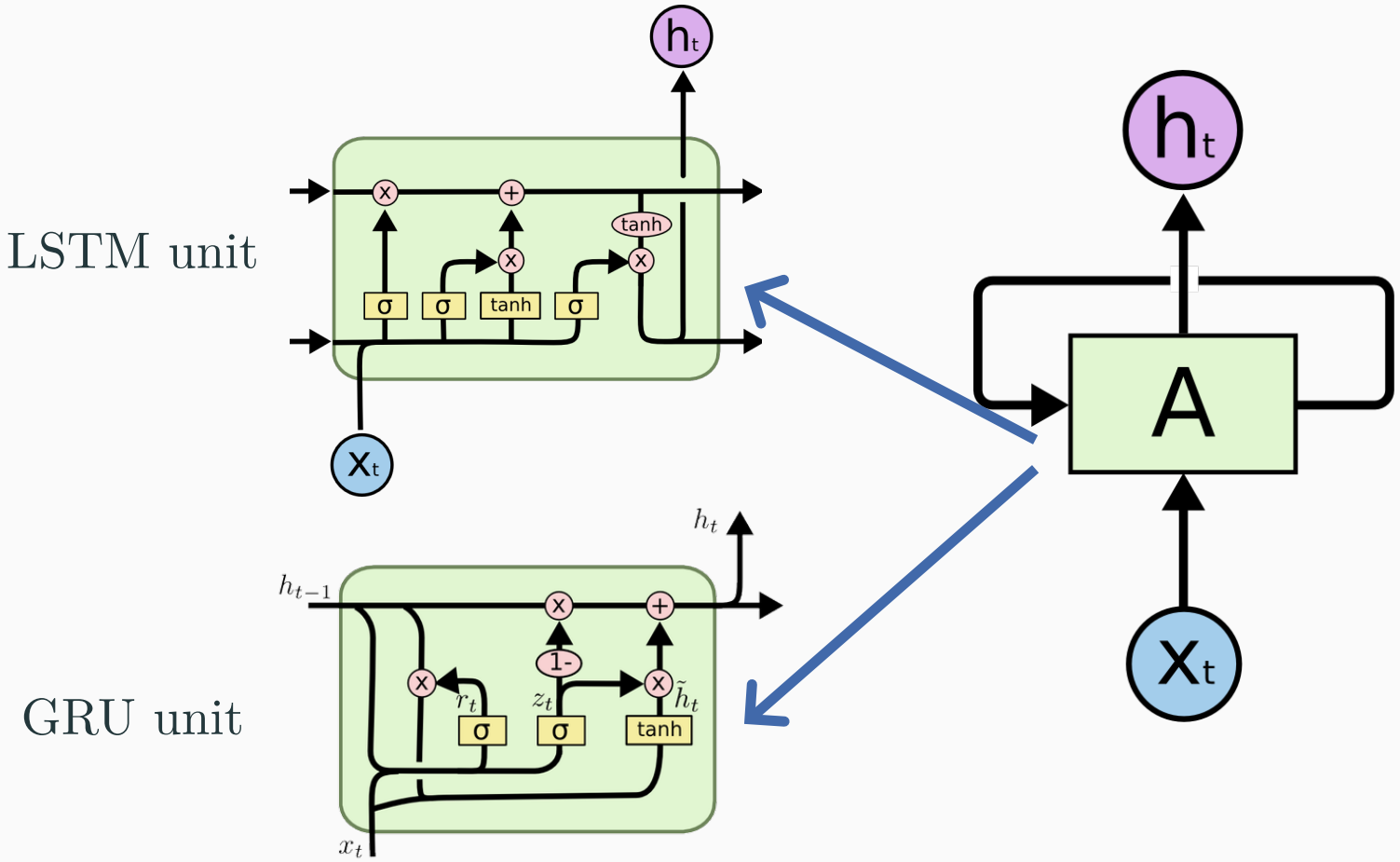
– **Pattern**: is a sequance of characters.

- Unlike feedforward neural networks, RNNs can use their internal state (memory) to process sequences of inputs.



Rolled Rnn unit

RNN, Architectures



- Two variants of unidirectional *recurrent units*.

RNN, Architectures

Bi-direction unit.

Data Representation

An Issue:

- Diacritics are standalone characters!
  - `len` مرحبا ≠ `len` مَرْحَبَاً
  - We have represented the letter and its diacritic as a one character.

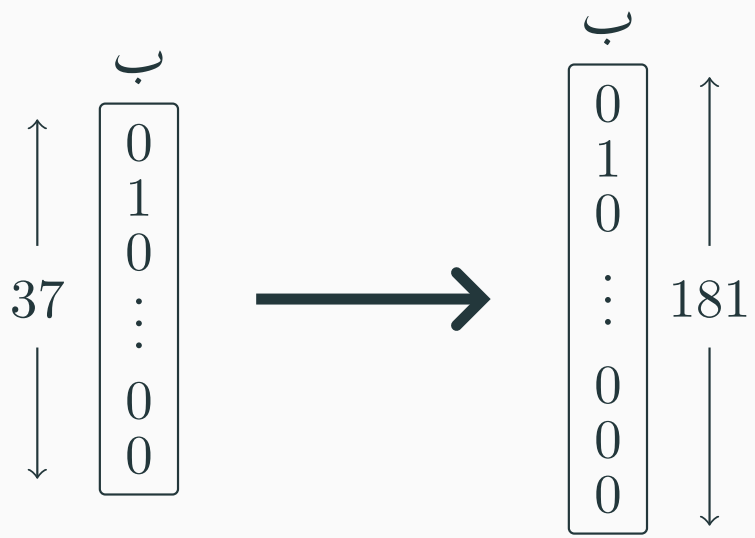
Benefits:

1. Verse's length is fixed, regardless the diacritic states.
2. Saving more space, by shorten the length of full diacritic verses.
3. Models can be tested on both diacritic or non-diacritic data.

Encoding Techniques

1. One-Hot
2. Binary
3. Two-Hot (new technique)

One-Hot

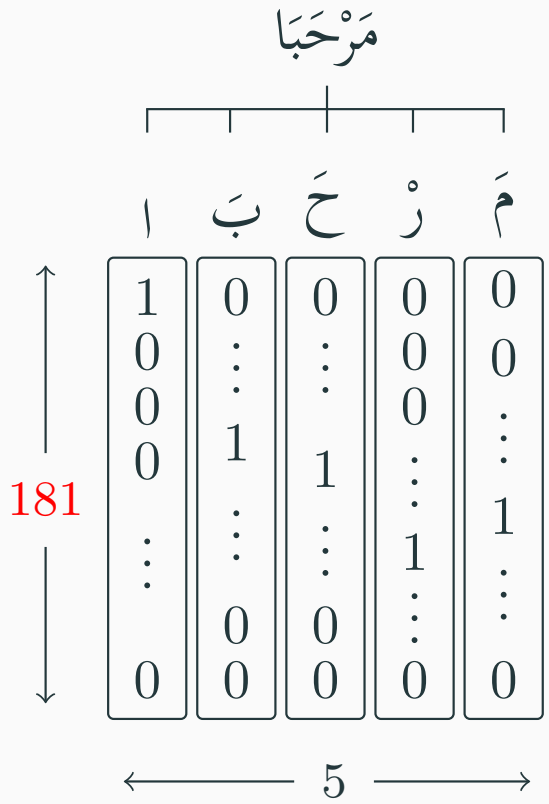


One-Hot Vector: from 37×1 to 181×1

181 is the number of all combination between letters and diacritics.

$181 = 36 + 36 \times 4 + 1$

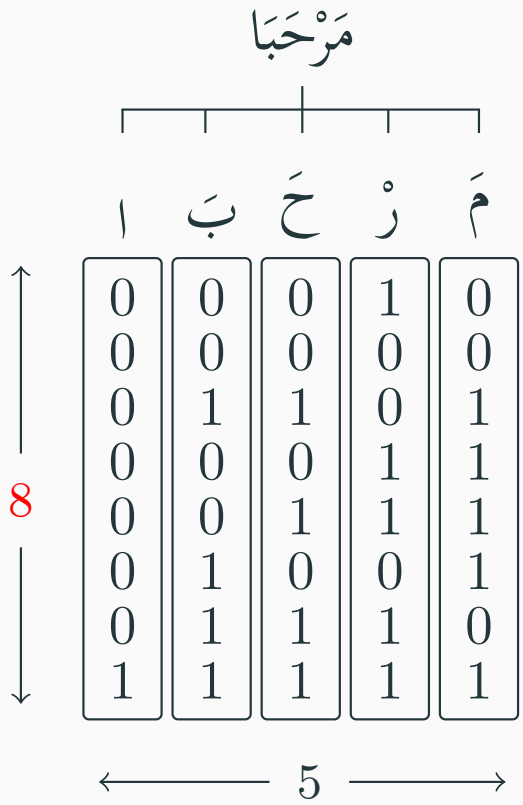
One-Hot, example



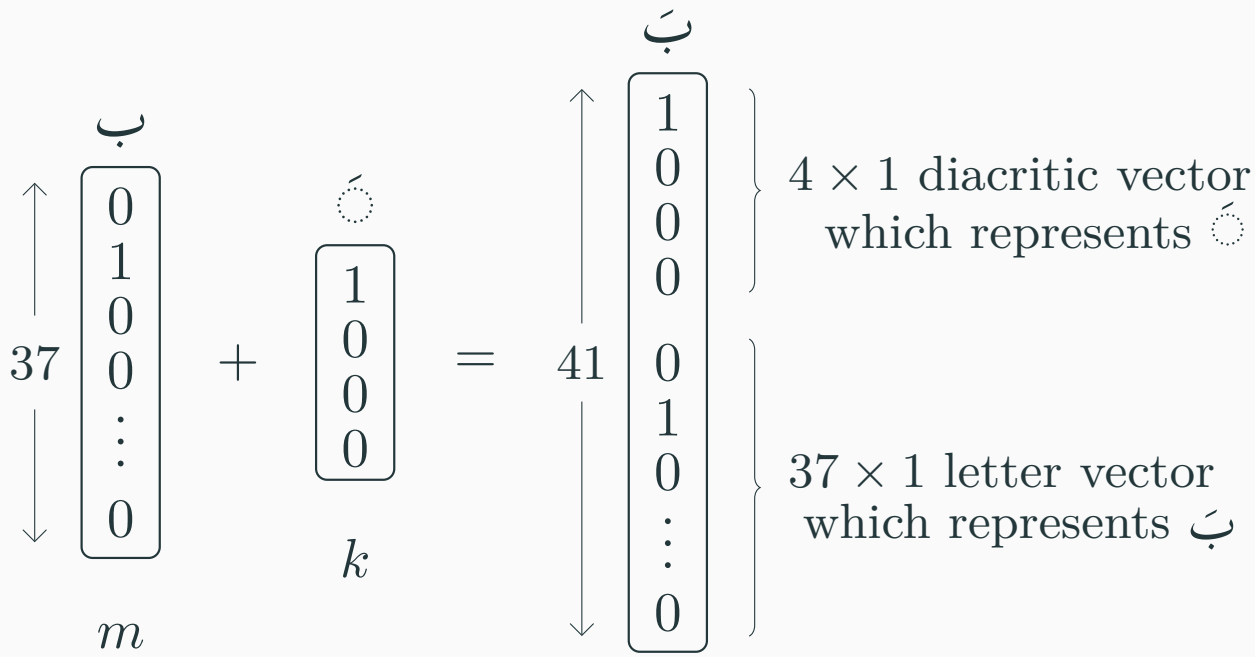
Binary

Let n be the vector length.

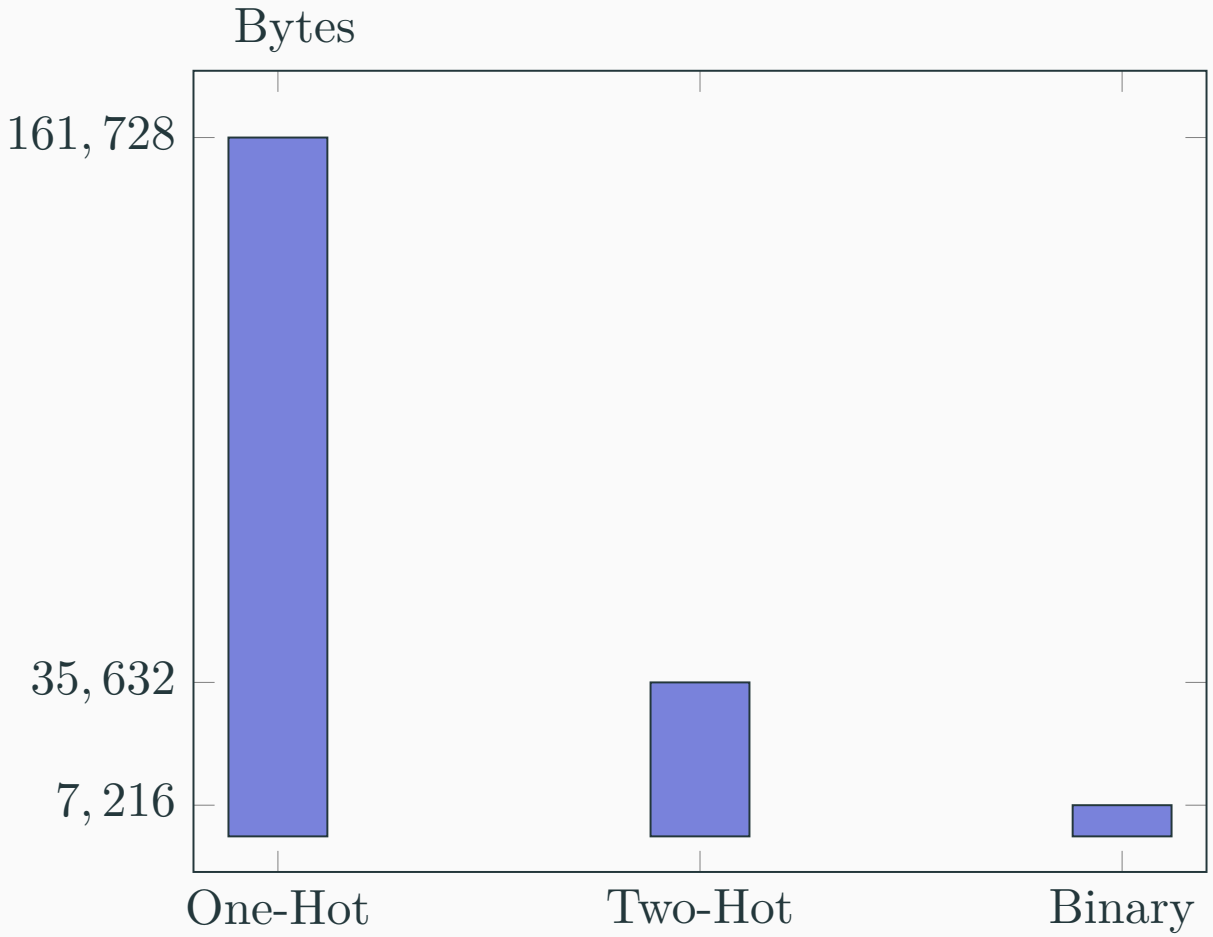
$n = \lceil \log_2 l \rceil \; l \in \{181, 28\}$



Two-Hot


ب
37
0
1
0
0
⋮
0
m
+
ً
1
0
0
0
k
=
بَ
41
1
0
0
0
0
1
0
⋮
0
4 × 1 diacritic vector
which represents ً
37 × 1 letter vector
which represents بَ

Space Comparison



Results