# Stream Mining

## One-Hot Encoding and DGIM

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# One-Hot Encoding

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- **categorical** features common

$$x \in \{\text{red}, \text{green}, \text{blue}\}$$

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# One-Hot Encoding

- **categorical** features common
- need for numbers in algorithms
- naïve approach: number serially
  - meaningless numerical calculations
- **one-hot encoding**
  - one binary feature for each possible value

$$x \in \{\text{red}, \text{green}, \text{blue}\} \longrightarrow x \in \{1, 2, 3\} \quad ✗$$

$$x \in \{\text{red}, \text{green}, \text{blue}\} \longrightarrow (x_{\text{red}}, x_{\text{green}}, x_{\text{blue}}) \in \{0, 1\}^3 \quad ✓$$

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sizes: 8 4 4 2 1 1

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    - powers of two
  - include all ones; end with ones
- **estimation**: half the size of the oldest bucket + sum of sizes of all other buckets
  - error rate: $\pm 50\%$
- needs only $\mathcal{O}((\log_2 N)^2)$ **bits**

$$
\begin{array}{ccccccccc}
\text{sizes: } 8 & 4 & & 4 & 2 & & 1 & 1 & \\
\boxed{\ldots 1\ 0\ 1} & \boxed{1\ 0\ 1\ 1\ 0\ 0\ 0\ 1} & 0 & \boxed{1\ 1\ 1\ 0\ 1} & \boxed{1\ 0\ 0\ 1} & 0 & \boxed{1} & \boxed{1} & 0
\end{array}
$$

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```
p,x,s,n,t,p,f,c,n,k,e,e,s,s,w,w,p,w,o,p,k,s,u
e,x,s,y,t,a,f,c,b,k,e,c,s,s,w,w,p,w,o,p,n,n,g
e,b,s,w,t,l,f,c,b,n,e,c,s,s,w,w,p,w,o,p,n,n,m
...
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Are there simple rules to determine edibility?

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...
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Are there simple rules to determine edibility? **Yes!** (e.g. odour)

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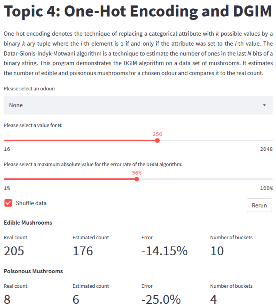

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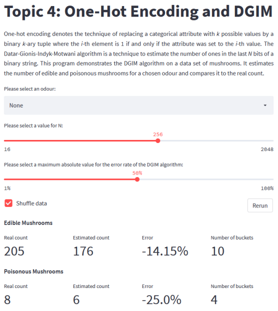

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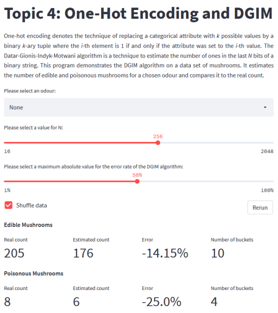

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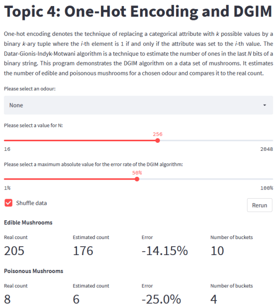

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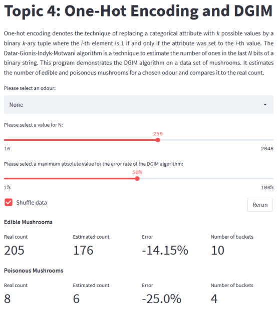

Please select an odour:

None

Please select a value for N:

256

16 2048

Please select a maximum absolute value for the error rate of the DGIM algorithm:

50%

1% 100%

Shuffle data

Rerun

**Edible Mushrooms**

| Real count | Estimated count | Error | Number of buckets |
|---|---|---|---|
| 214 | 208 | -2.8% | 10 |

**Poisonous Mushrooms**

| Real count | Estimated count | Error | Number of buckets |
|---|---|---|---|
| 11 | 12 | 9.09% | 6 |

Please select an odour:

None

Please select a value for N:

2048

16 2048

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50%

1% 100%

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Rerun

**Edible Mushrooms**

| Real count | Estimated count | Error | Number of buckets |
|---|---|---|---|
| 1675 | 1872 | 11.76% | 15 |

**Poisonous Mushrooms**

| Real count | Estimated count | Error | Number of buckets |
|---|---|---|---|
| 67 | 72 | 7.46% | 9 |

Please select an odour:

None

Please select a value for N:

2048

16 2048

Please select a maximum absolute value for the error rate of the DGIM algorithm:

1%

1% 100%

Shuffle data

Rerun

**Edible Mushrooms**

| Real count | Estimated count | Error | Number of buckets |
|---|---|---|---|
| 1678 | 1672 | -0.36% | 410 |

**Poisonous Mushrooms**

| Real count | Estimated count | Error | Number of buckets |
|---|---|---|---|
| 68 | 68 | 0.0% | 68 |

# References

- Project code: `https://github.com/s9770652/DS1-DGIM`
- Mushroom data set: `https://archive-beta.ics.uci.edu/ml/datasets/mushroom`
- *Streamlit*: `https://streamlit.io/`
- Python package *dgim*: `https://pypi.org/project/dgim/`
- Description of one-hot encoding: `https://sherbold.github.io/intro-to-data-science/04_Data-Analysis-Overview.html#Features`
- Description of the DGIM algorithm (Section 4.6): `http://infolab.stanford.edu/~ullman/mmds/ch4.pdf`