Introduction to Machine Learning
NPFL 054

http://ufal.mff.cuni.cz/course/npfl054

Barbora Hladká **Martin Holub**

{Hladka | Holub}@ufal.mff.cuni.cz

Charles University,
Faculty of Mathematics and Physics,
Institute of Formal and Applied Linguistics

Demo 1
Verb Patterns Classification

Purpose of the demo task
= to show several things related to gold standard data for a supervised machine learning task, especially

- Manual annotation and basic data analysis
- Gold Standard data distribution
- Inter-annotator agreement
- Confusion matrices
- Error analysis

Verb Patterns Classification – task description

Verb Patterns Classification is a kind of *lexical disambiguation* of verbs. The task is similar to the traditional *word sense disambiguation* (WSD). The two tasks differ in how the semantic categories are defined (word senses vs. patterns of typical verb usage).

Let's focus on two English verbs, namely *cry* and *enlarge*.

CRY -- dictionary definitions

cry ◆◆◆◆◇

1 cry; cries; crying; cried
When you cry, tears come from your eyes, usually because you are unhappy or hurt.
I hung up the phone and started to cry.
Please don't cry.
He cried with anger and frustration.
...a crying baby.
VB

2 cry; cries; crying; cried
If you cry something, you shout it or say it loudly.
`Nancy Drew,' she cried, `you're under arrest!'.
I cried: `It's wonderful news!'
VB

5 cry; cries
You can refer to a public protest about something or appeal for something as a cry of some kind. (JOURNALISM)
There have been cries of outrage about this expenditure.
Many other countries have turned a deaf ear to their cries for help.
N-COUNT: usu N of/for n

ENLARGE -- dictionary definitions

enlarge ◆◆◇◇◇ enlarge; enlarges; enlarging; enlarged

1 When you enlarge something or when it enlarges, it becomes bigger.
...the plan to enlarge Ewood Park into a 30,000 all-seater stadium...
The glands in the neck may enlarge.
V-ERG

@ enlarged
The UN secretary-general yesterday recommended an enlarged peacekeeping force.
ADJ-GRADED

2 To enlarge a photograph means to develop a bigger print of it.
...newly-weds wishing to enlarge snaps of their big day.
VB

3 If you enlarge on something that has been mentioned, you give more details about it. (FORMAL)
He didn't enlarge on the form that the interim government and assembly would take.
I wish to enlarge upon a statement made by Gary Docking.
VB
= expand

CRY -- Pattern definitions

Pattern 1 **[Human] cry [no object]**

Explanation [[Human]] weeps
usually because [[Human]] is unhappy or in pain

Example *His advice to stressful women was: ` If you **cry**, do n't cry alone.*

Pattern 4 **[Human] cry [THAT-CL|WH-CL|QUOTE] ({out})**

Explanation [[Human]] shouts ([QUOTE]) loudly
typically, in order to attract attention

Example *You can hear them screaming and banging their heads, **crying** that they want to go home.*

Pattern 7 **[Entity | State] cry [{out}] [{for} Action] [no object]**

Explanation [[Entity | State]] requires [[Action]] to be taken urgently

Example *Identifying areas which **cry** out for improvement or even simply areas of muddle and misunderstanding, is by no means negative -- rather a spur to action.*

ENLARGE -- Pattern definitions

Pattern 1 **[[Human]^[Eventuality]] enlarge [Entity]**

Explanation [[Human | Eventuality]] causes [[Entity]] to grow or become larger

Example *These were not large powers, but later changes were to **enlarge** them.*

Pattern 2 **[Entity] enlarge [no object]**

Explanation [[Entity]] grows or becomes larger

Example *As infants grow, their bodies not only **enlarge** but change both in shape and colour.*

Pattern 3 **[[Human]^[Document]] enlarge [{on | upon} Anything = Topic] [no object]**

Explanation [[Human]] speaks or writes at length on [[Anything = Topic]] or [[Document]] contains long-winsed comments on [[Topic]]}

Example *Let me **enlarge** on this a little.*

Pattern 4 **enlarged**

Explanation now larger than before,without any deliberate causer or causer irrelevant

Example *The fluid filled spaces or ventricles appear to be **enlarged**, and the blood flow to the front of the brain is reduced.*

Verb Patterns Classification – annotation description

You will classify *cry* and *enlarge* manually.

- You will be given 10+10 sentences with the given verbs
- For each sentence you will assign a pattern that fits best the given sentence
  - there are 3 predefined patterns for the verb *cry*
  - there are 4 predefined patterns for the verb *enlarge*
  - if you think that no pattern matches the sentence, choose "u"
  - if you think that the given word is not a verb, choose "x"
- Use the forms posted at `https://ufal.mff.cuni.cz/courses/npfl054/demo`

Gold Standard data – distributions

Gold standard data sets are posted on the course web page (DEMO).

CRY – 250 instances in the GS set

class	1	4	7	u	x
frequency	131	59	13	33	14

ENLARGE – 300 instances in the GS set

class	1	2	3	4	u
frequency	230	21	20	26	3

Automatic classifier

Automatic classifier is a function that assigns certain output class to each input instance.

Output class is a discrete (possibly categorical) value.

In the demo task: Pattern tags are categorical output values, sentences containing the verbs in question are input instances.

Classifier accuracy is often *estimated* using a test data sample as a percentage of correctly classified instances in the sample. This estimate is called *sample accuracy*.

Automatic predictions made by automatic classifier (our best model F1) are posted on the course web page (DEMO).

- NOTE that it is the same GS set, and it was also used as training data (!).
- Thus, you can compute only the training error, not the test error.

Manual annotation

Annotated data – a subset of the GS

– the same data set annotated by each group

2014 – 2 groups

- **A** (5 Czech)
- **B** (2 Czech, 3 foreign)

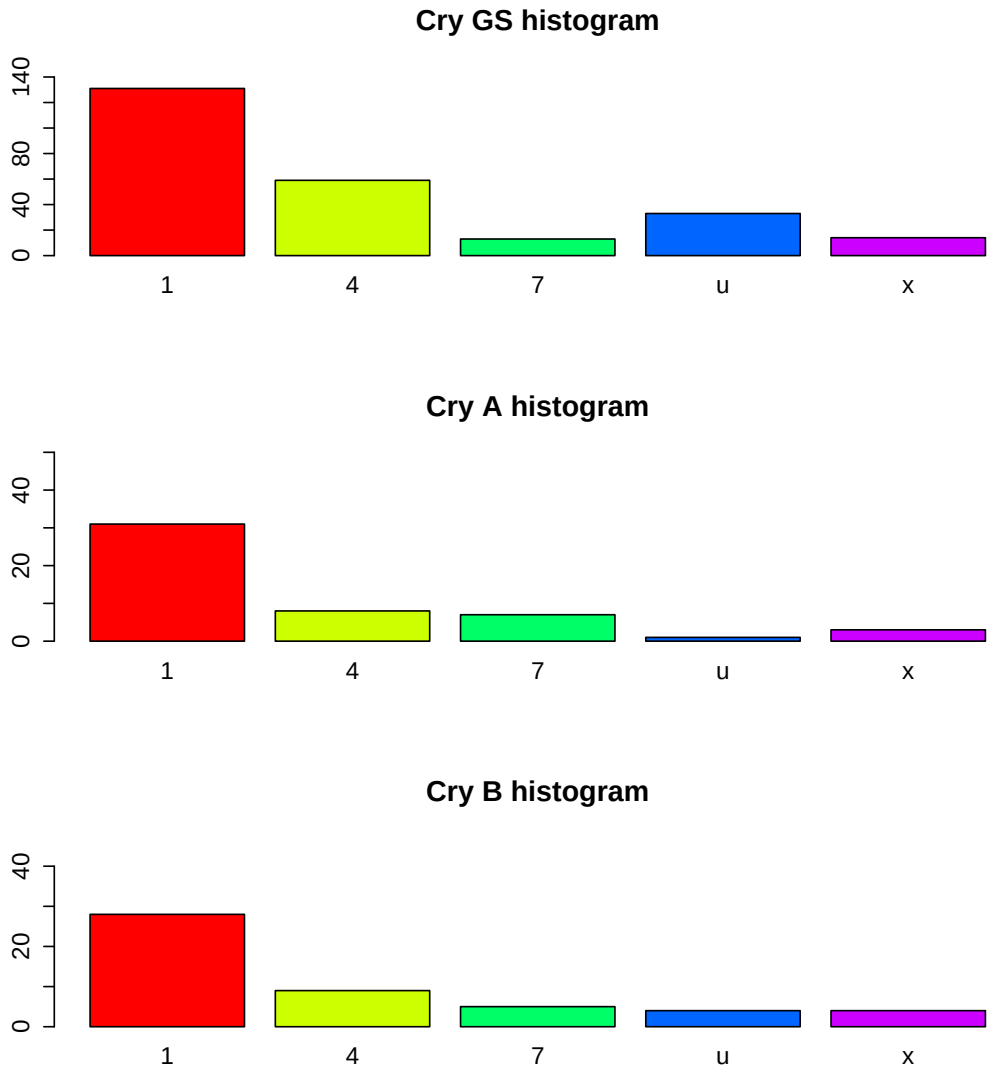
2015 – 4 groups

- **A** (6 Czech)
- **B** (6 Czech)
- **C** (6 Czech)
- **D** (6 Czech)

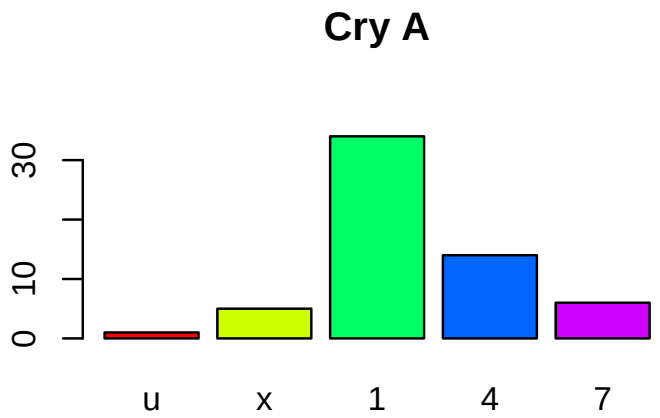
Now we can analyse/compare

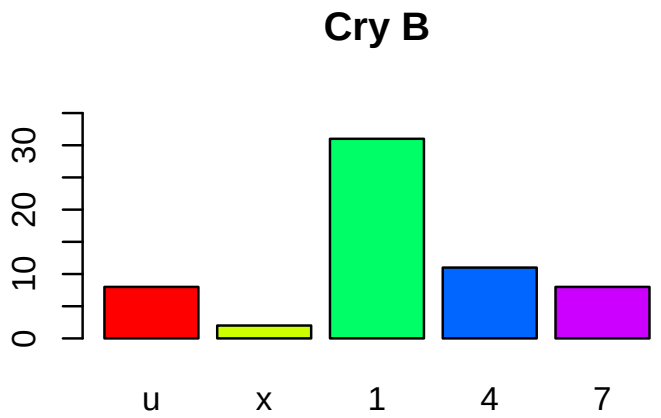
- which group is closer to the Gold Standard
- inter-annotator agreement between groups
- error types
  - – made by people
  - – made by automatic classifier

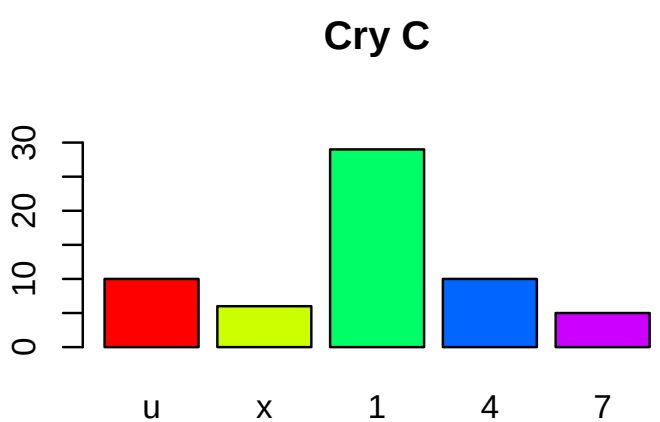
A, B and GS distributions - CRY (2014)

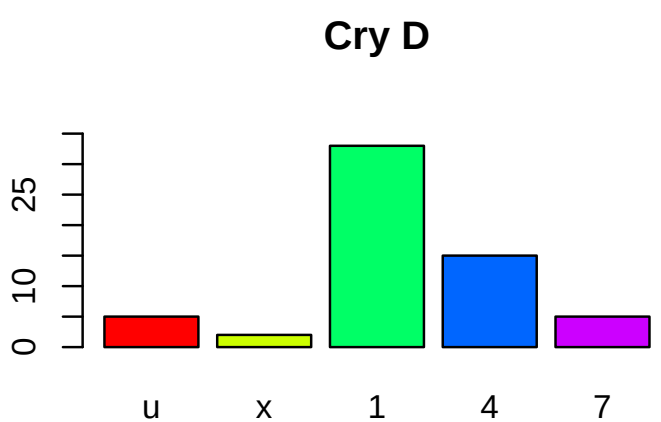


A, B, C, D distributions - CRY (2015)

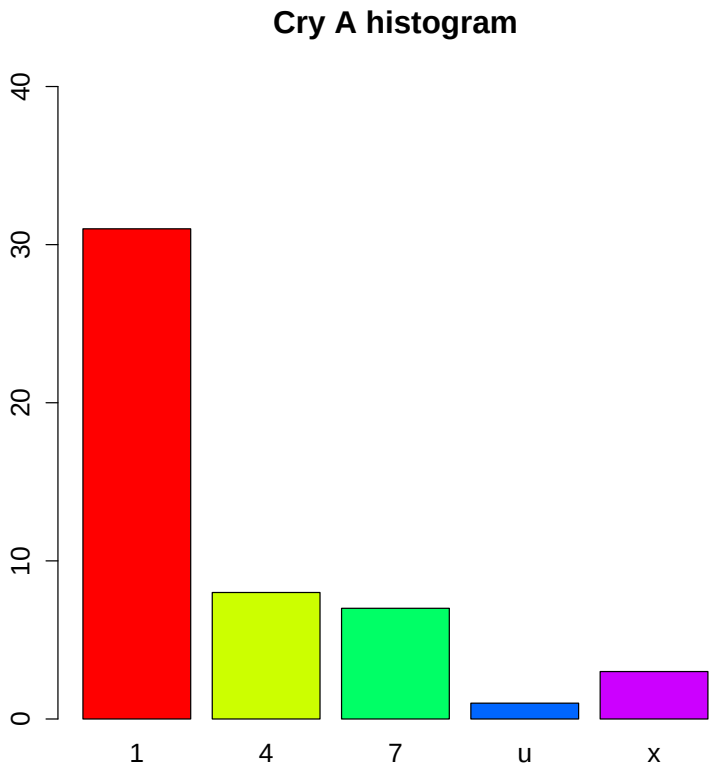








A vs GS - confusion matrix - CRY (2014)



		GS				
		1	**4**	**7**	**u**	**x**
	1	27	2	0	2	0
	4	1	6	0	0	1
A	**7**	0	1	2	3	1
	u	1	0	0	0	0
	x	2	0	0	1	0

Number of agreements: 35 (70 %)
Number of disagreements: 15 (30 %)

A, B, C, D vs GS - confusion matrix - CRY (2015)

A \ GS	u	x	1	4	7
u	0	0	1	0	0
x	0	2	2	1	0
1	2	0	29	3	0
4	1	0	5	8	0
7	3	0	1	0	2

Agreement: 41 (68 %)
Disagreement: 19 (32 %)

C \ GS	u	x	1	4	7
u	3	0	5	2	0
x	1	1	2	2	0
1	1	0	28	0	0
4	1	0	3	6	0
7	0	1	0	2	2

Agreement: 40 (67 %)
Disagreement: 20 (33 %)

B \ GS	u	x	1	4	7
u	2	1	3	2	0
x	0	0	2	0	0
1	0	0	30	1	0
4	2	0	3	6	0
7	2	1	0	3	2

Agreement: 40 (67 %)
Disagreement: 20 (33 %)

D \ GS	u	x	1	4	7
u	2	0	2	1	0
x	1	0	1	0	0
1	1	1	31	0	0
4	0	1	4	10	0
7	2	0	0	1	2

Agreement: 45 (75 %)
Disagreement: 15 (25 %)

A, B, C, D vs GS - confusion m. - ENLARGE (2015)

A \ GS	u	1	2	3	4
u	0	4	0	0	0
1	0	26	0	0	0
2	1	4	7	0	1
3	0	1	0	0	1
4	0	9	1	0	5

Agreement: 38 (63 %)
Disagreement: 22 (37 %)

C \ GS	u	1	2	3	4
u	0	5	2	0	1
1	1	18	0	0	0
2	0	6	6	0	2
3	0	4	0	0	0
4	0	11	0	0	4

Agreement: 28 (47 %)
Disagreement: 32 (53 %)

B \ GS	u	1	2	3	4
u	0	5	0	0	0
1	1	18	1	0	1
2	0	6	7	0	2
3	0	2	0	0	1
4	0	13	0	0	3

Agreement: 28 (47 %)
Disagreement: 32 (53 %)

D \ GS	u	1	2	3	4
u	0	4	0	0	0
1	1	25	2	0	1
2	0	3	6	0	1
3	0	2	0	0	0
4	0	10	0	0	5

Agreement: 36 (60 %)
Disagreement: 24 (40 %)

Practical exercises in R

- Download two files with annotated data cry-A.csv and cry-C.csv.
  - `https://ufal.mff.cuni.cz/courses/npfl054/demo`
- Run R and read the data using `read.csv()`.
  - Hint: see the posted Tutorial, Part I.
  - ... and create objects `cry.A` and `cry.C`.
- Make the confusion matrix between groups A and C.
  - Hint: use `table(cry.A$class, cry.C$class)`
- Compute simple agreement (in percentage) between A and C.
  - Hint: use `diag()` and `sum()`

Summary of Lab #1
Homework

- Go through the posted Tutorial
  ... and get familiar with all details in Parts I and II
- Get familiar with the `data.table` package
  – just to understand Part II
- Do exercise B) in Part III