

Grounding Antonym Adjective Pairs through Interaction

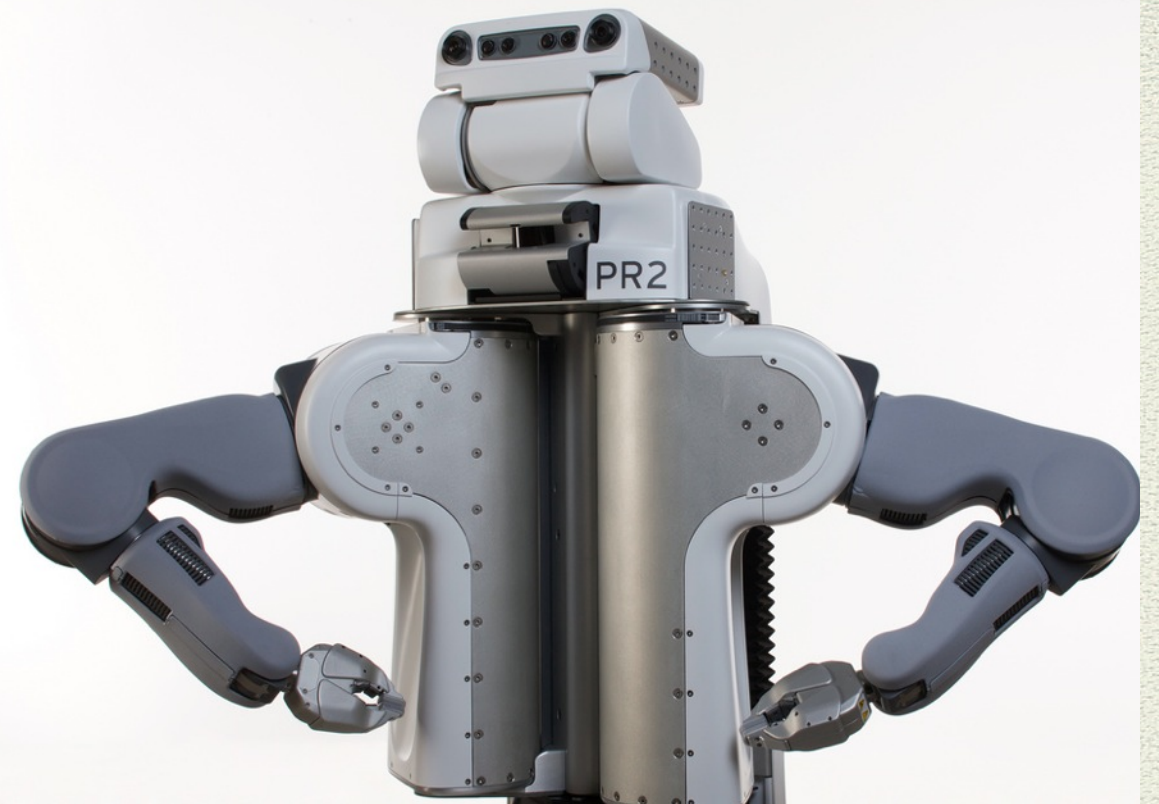
Maxwell Forbes

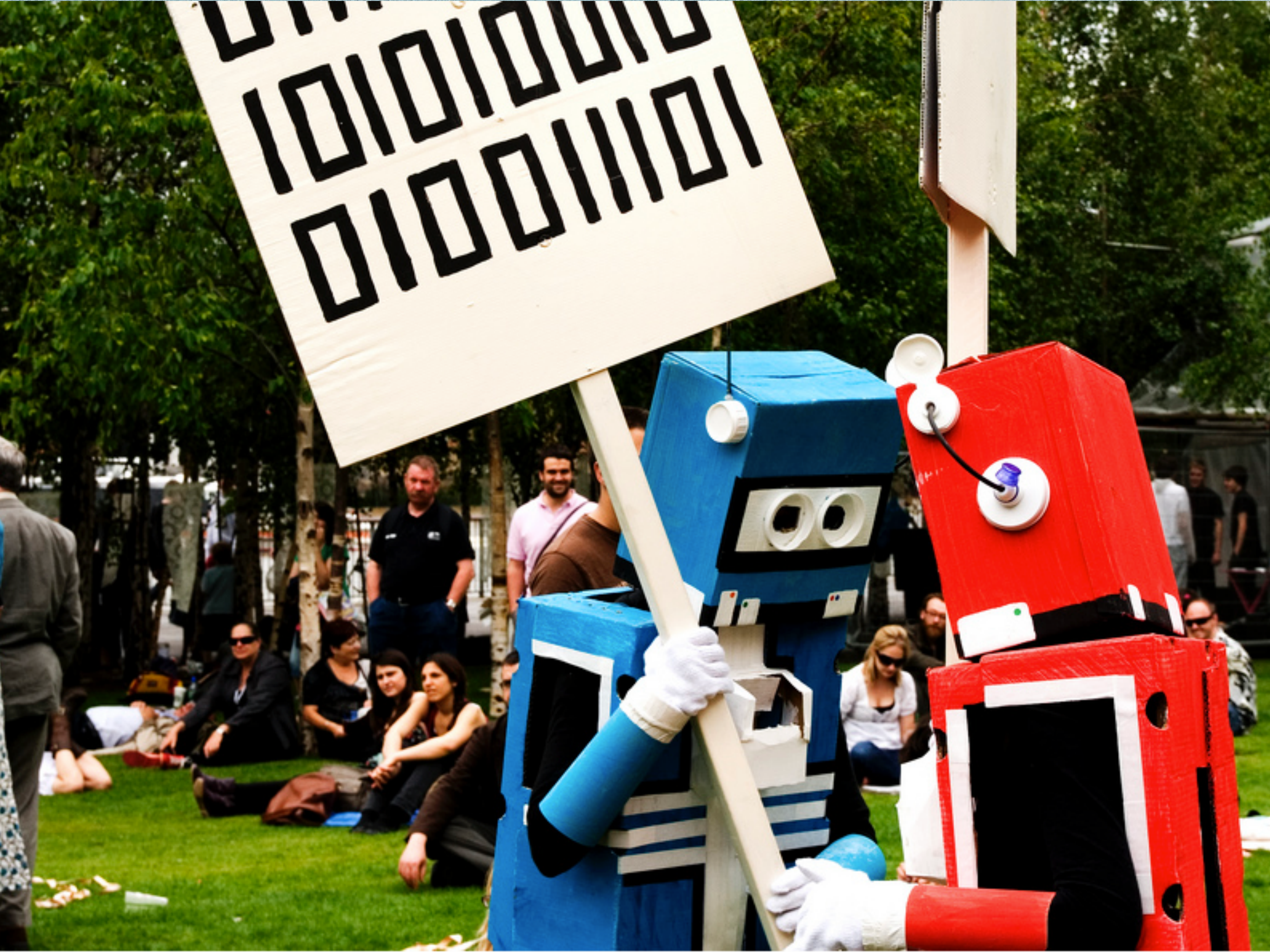
Michael Jae-Yoon Chung

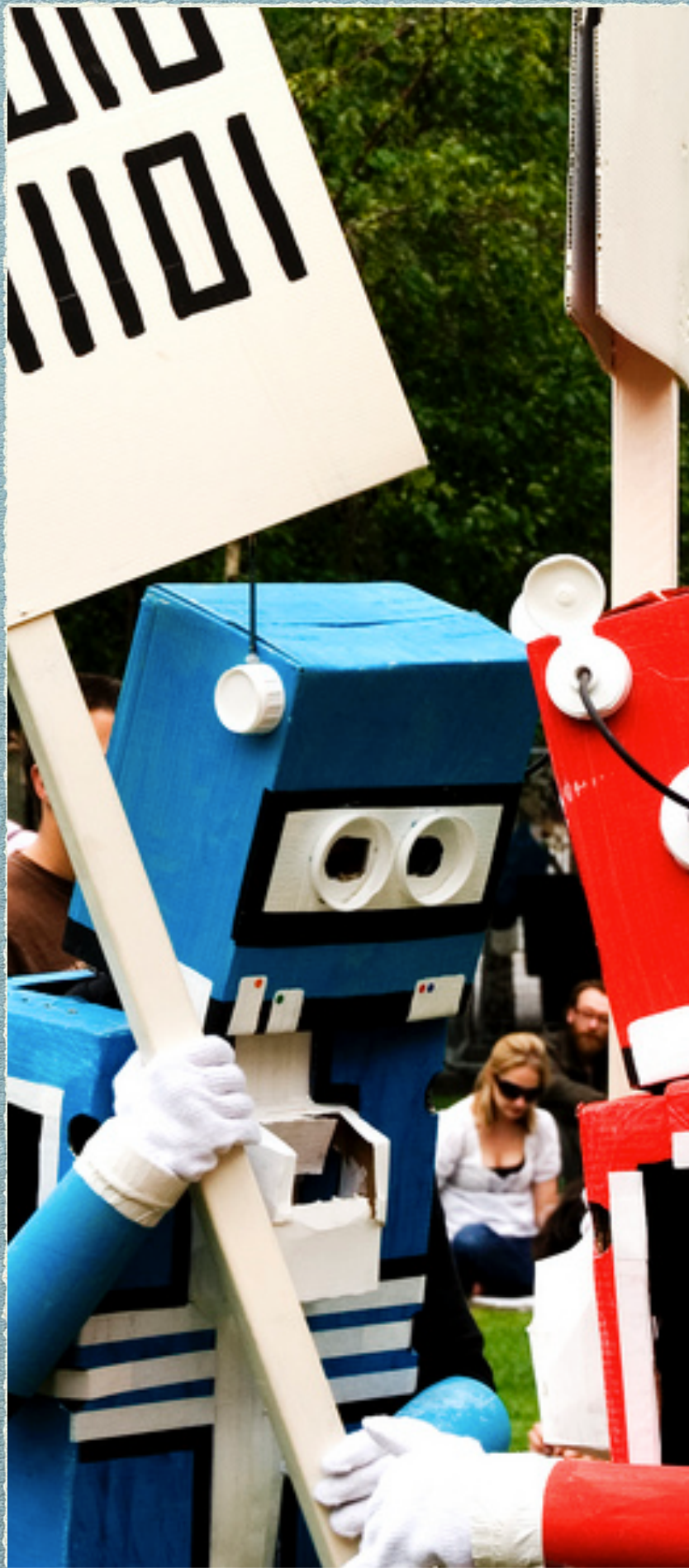
Maya Cakmak

Luke Zettlemoyer

Rajesh P. N. Rao







*facial expression
and gesture
recognition*

*natural language
generation*



*symbol
grounding*

*semantic language
analysis*

speech recognition



Symbol Grounding

“mailbox”



[NOUNS]

“mailbox”



“mailbox” →

|

?





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+

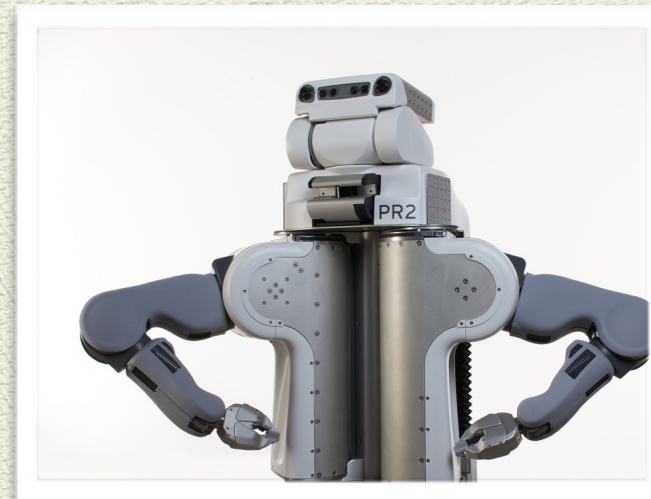


+



0.95

“mailbox”



0.14



0.52



[ADJECTIVES]



“heavy”



compared to what?



“heavy”

|



?



“heavy”
|

sensor_1: x
 $5 < x < 10$

sensor_2: $f1, f2$
 $f1 + f2 > 4$

•

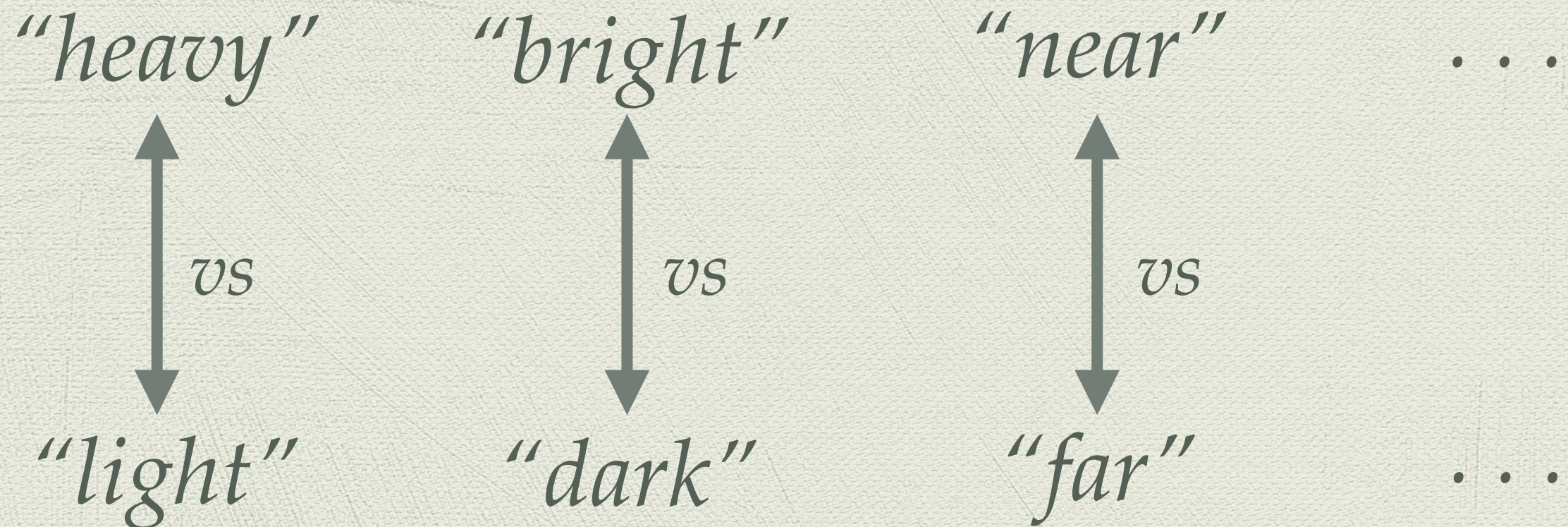
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Our Problem

Grounding **Antonym** Adjective Pairs



Why should we care?

Specificity

*“Bring me the **heavier** mug.”*

*“What’s the **brightest** room
in my house?”*

Feedback

“Please pick up that plate.”

*“It is **too far**
away.”*

Related Work

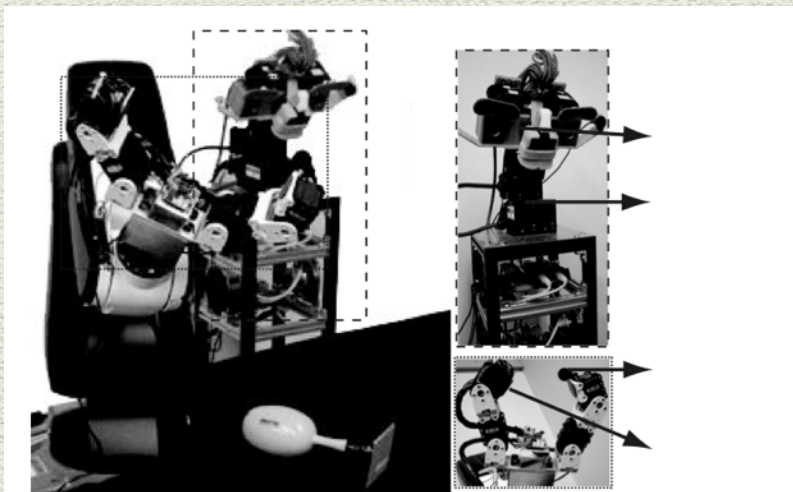


Fig. 3. The robot platform used in the experiments.

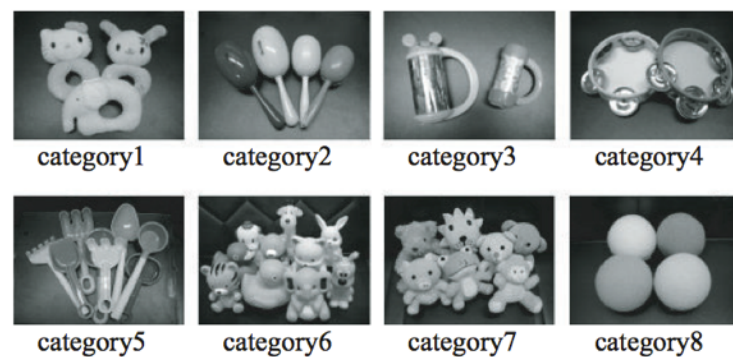
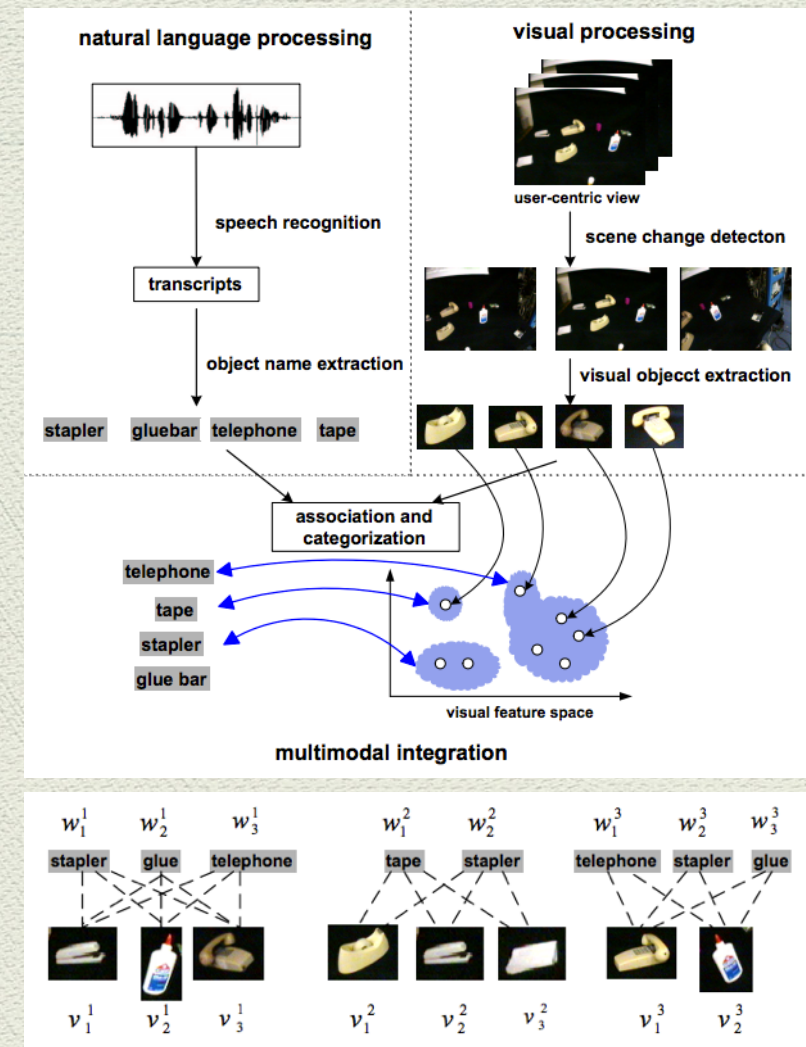


Fig. 4. Eight categories consisting of forty toys.

*Grounding of Word Meanings in
Multimodal Concepts Using LDA*
Nakamura et al. 2009



*On the Integration of Grounding
Language and Learning Objects*
Yu et al. 2004

Our Goals

Interactive



Space Between Adjectives

“heavy” \longrightarrow $S_I = 0.5,$
 $f_I > 4,$
...

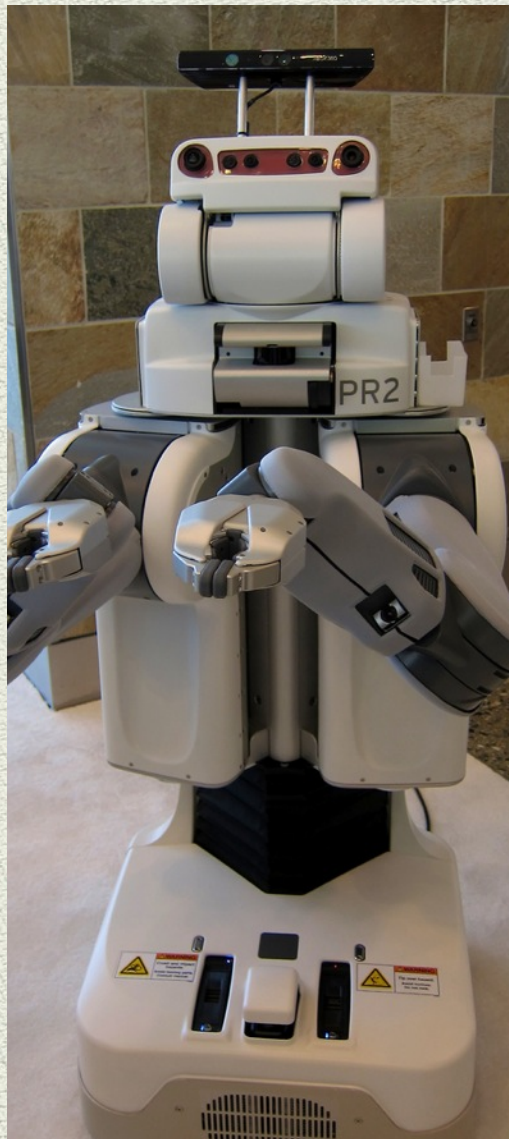


“light” \longrightarrow $S_I > 0.5,$
 $f_I = ?,$
...

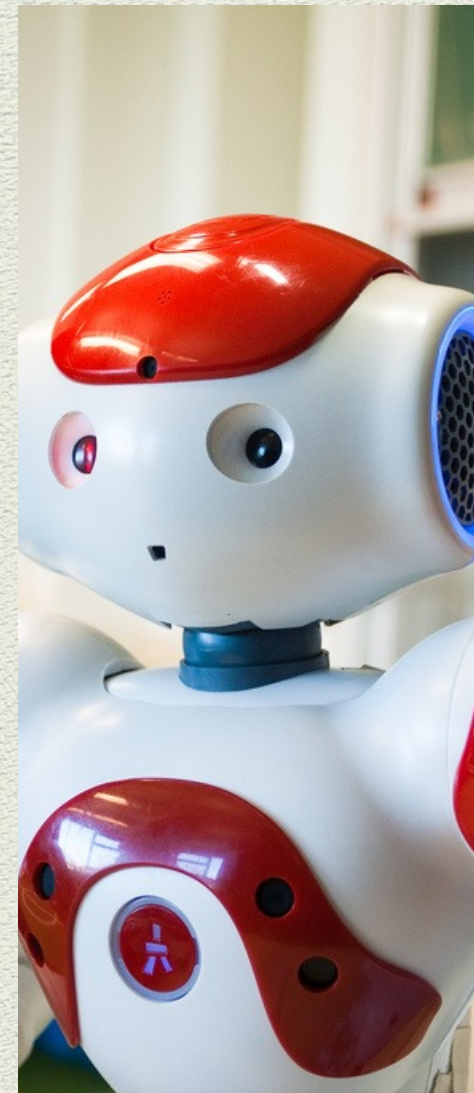
Why Interactive?



vs

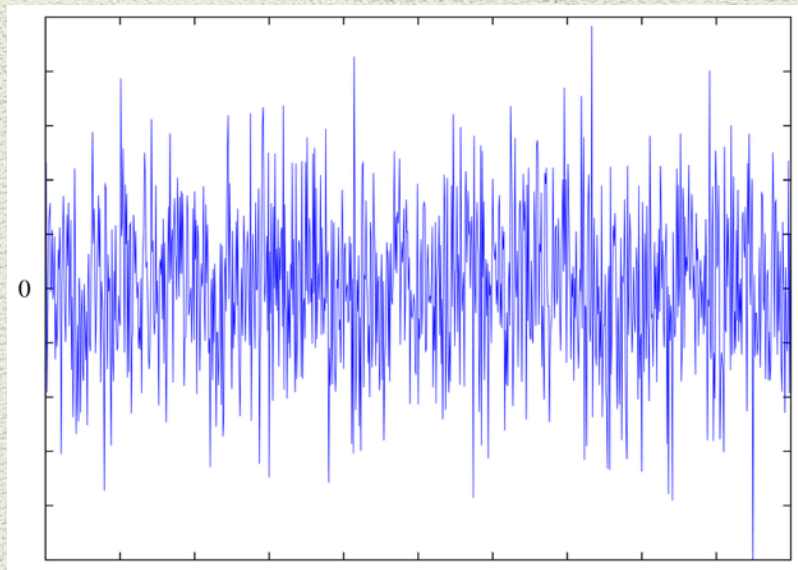


vs



vs ...

Why Space Between Adjectives?



Approach

my sensor features are: [

$f_1 = 0.54627,$

$f_2 = 0.75788,$

\dots

]



heavy
vs
light



“heavy”

my sensor features are: [

$f_1 = 0.54627,$

$f_2 = 0.75788,$

\dots

]



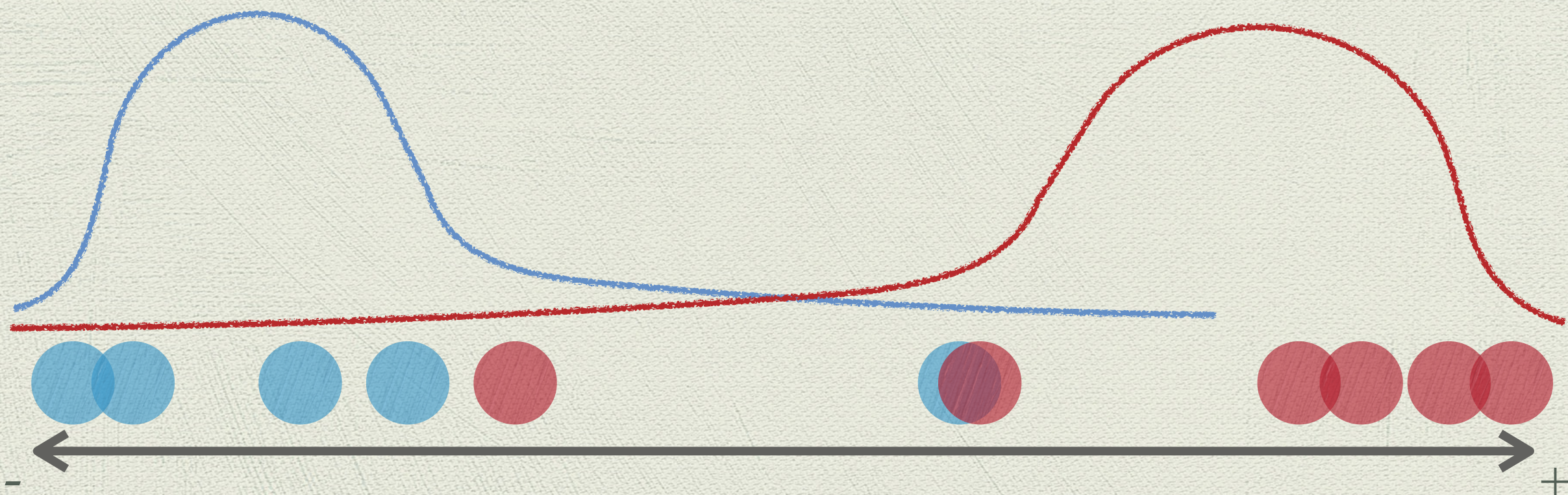
bright
vs
dark



“dark”

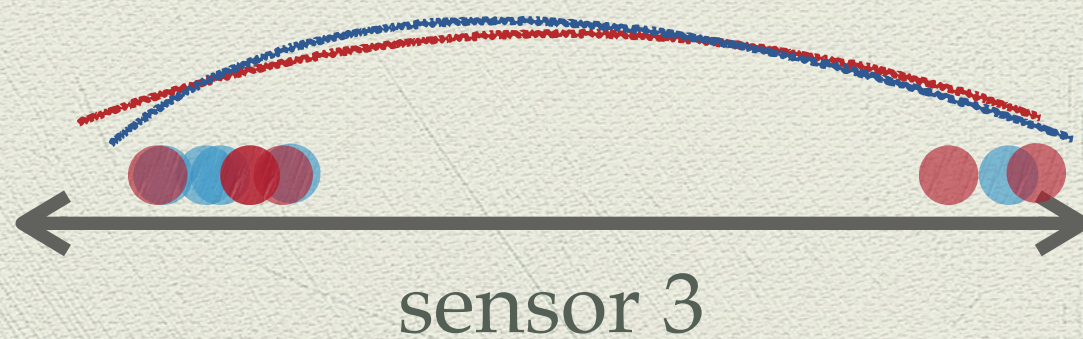
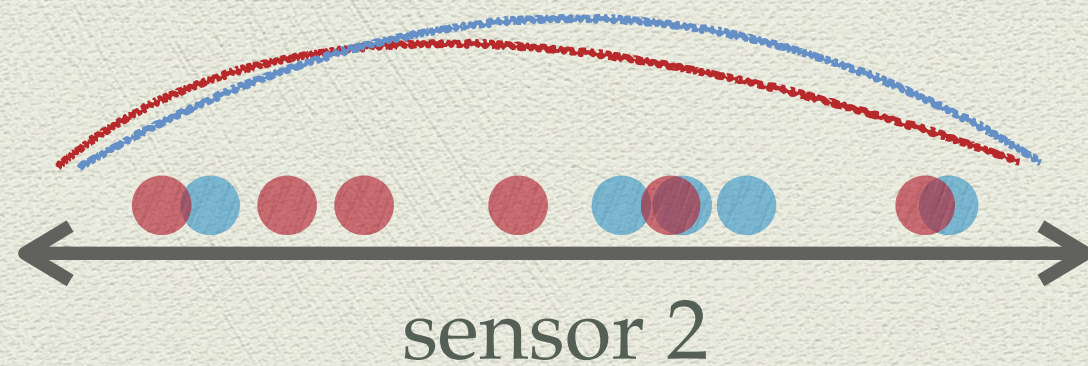
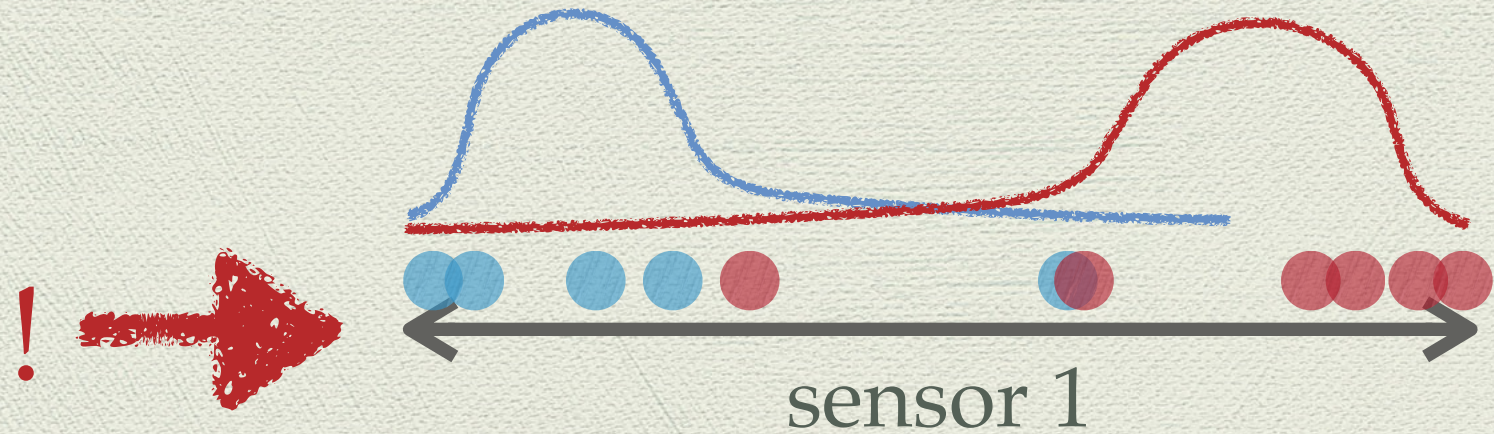
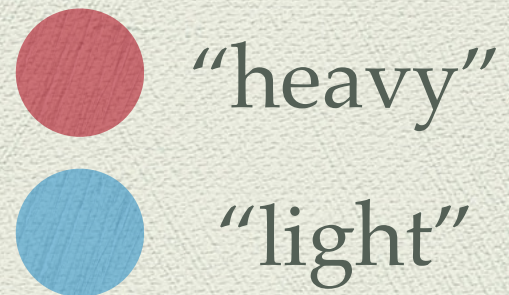
Inside a Classifier

- “heavy”
- “light”

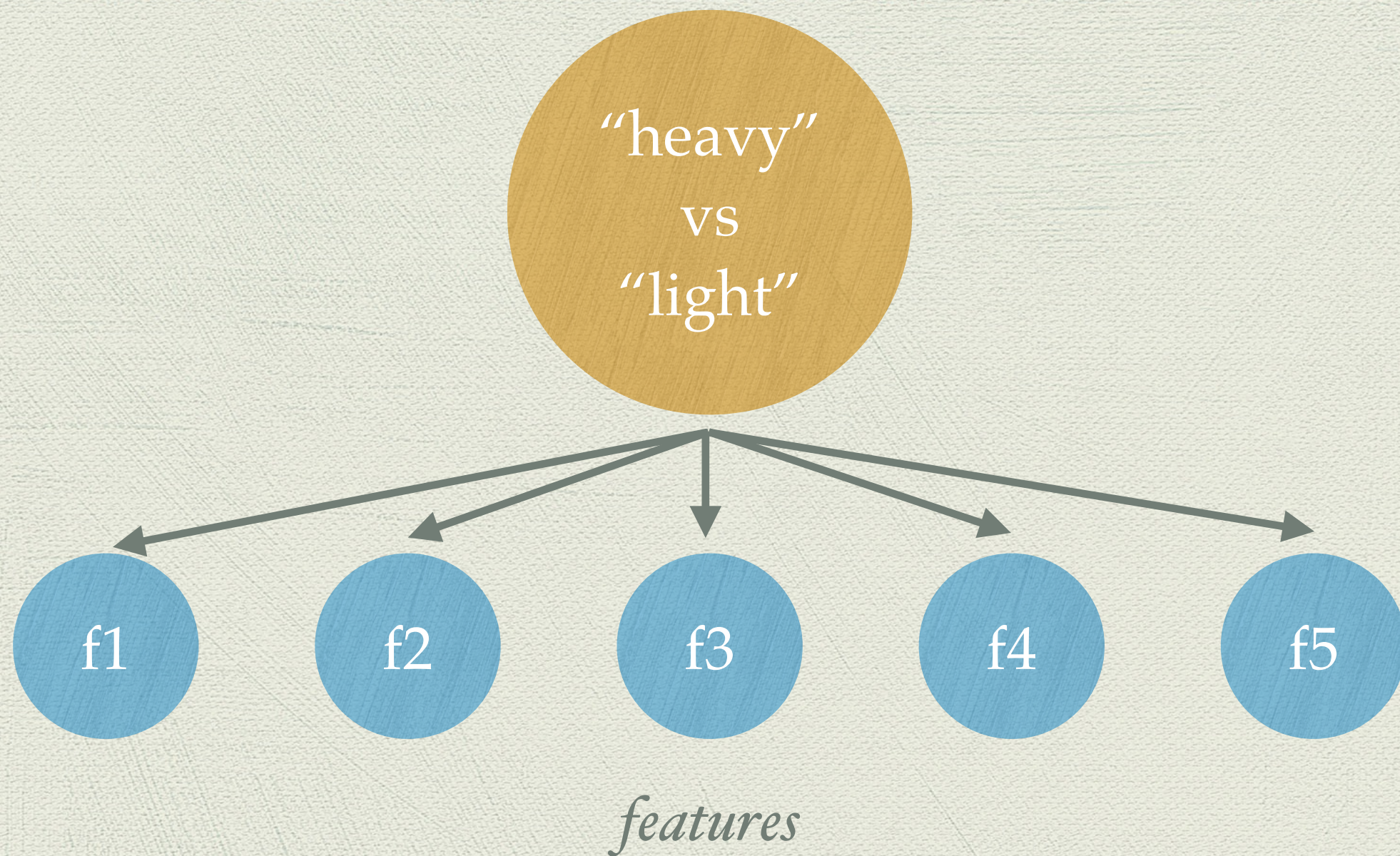


(some sensor)

More Sensors

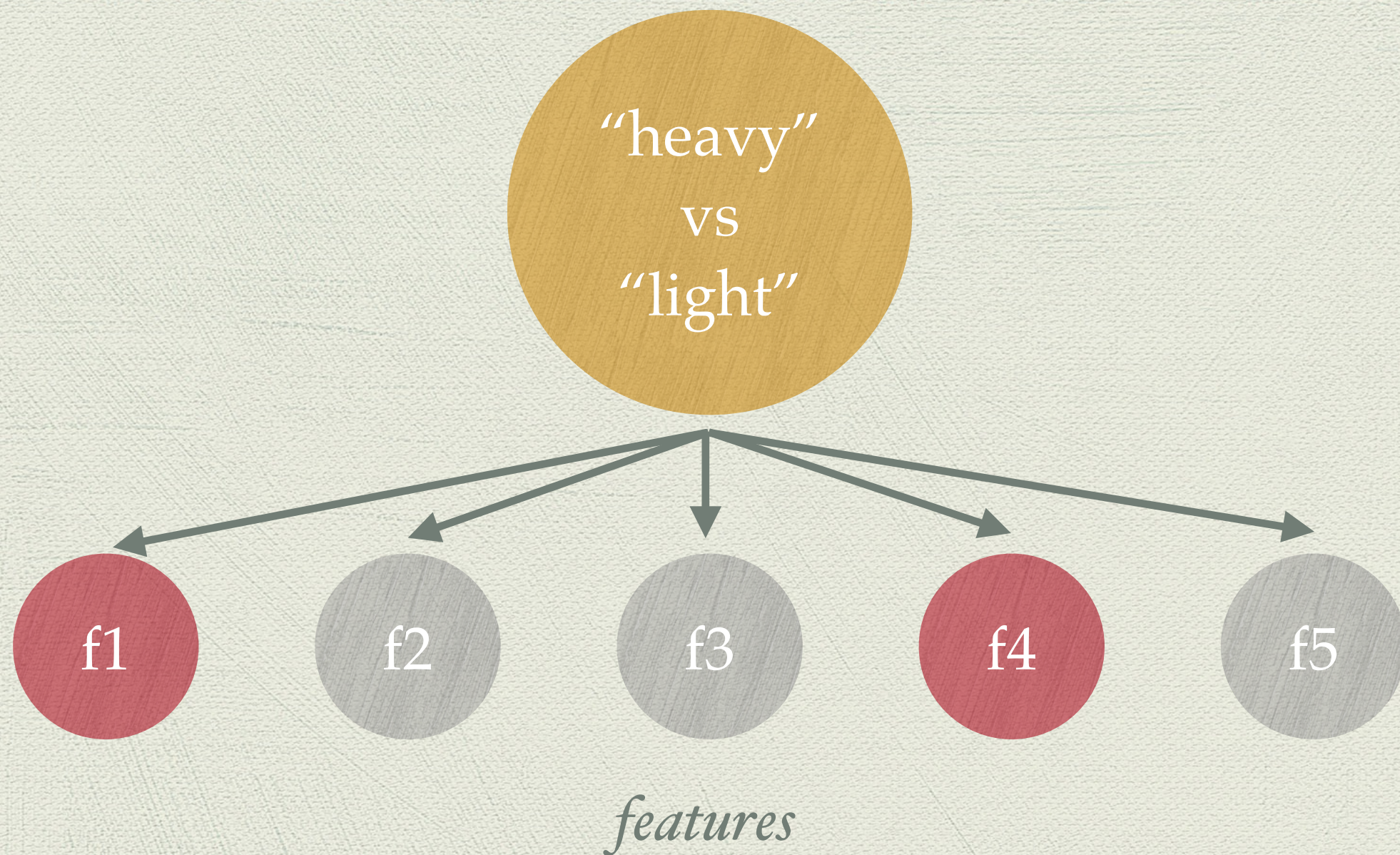


Naïve Bayes

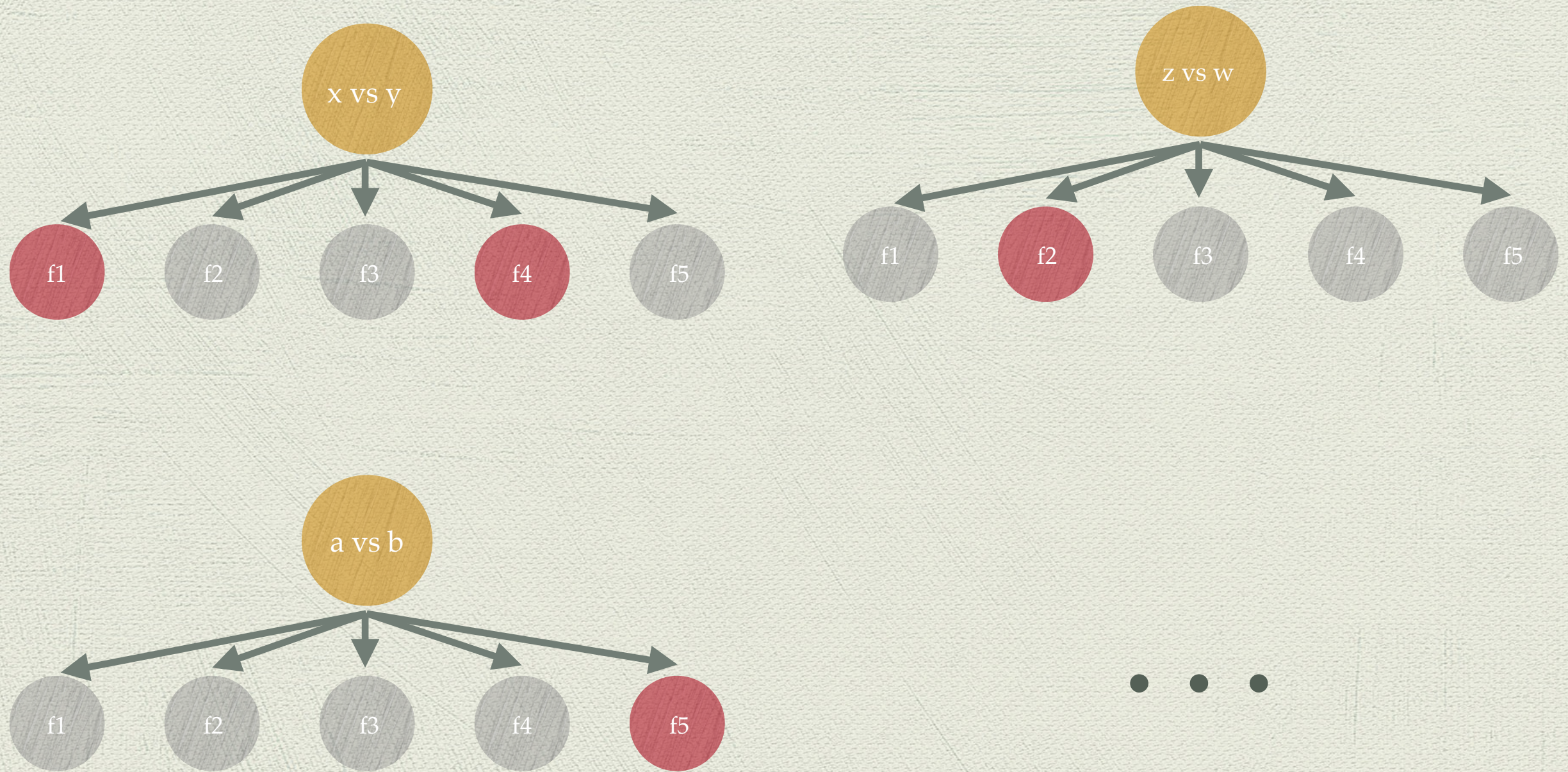


Gaussian naïve Bayes from scikit-learn

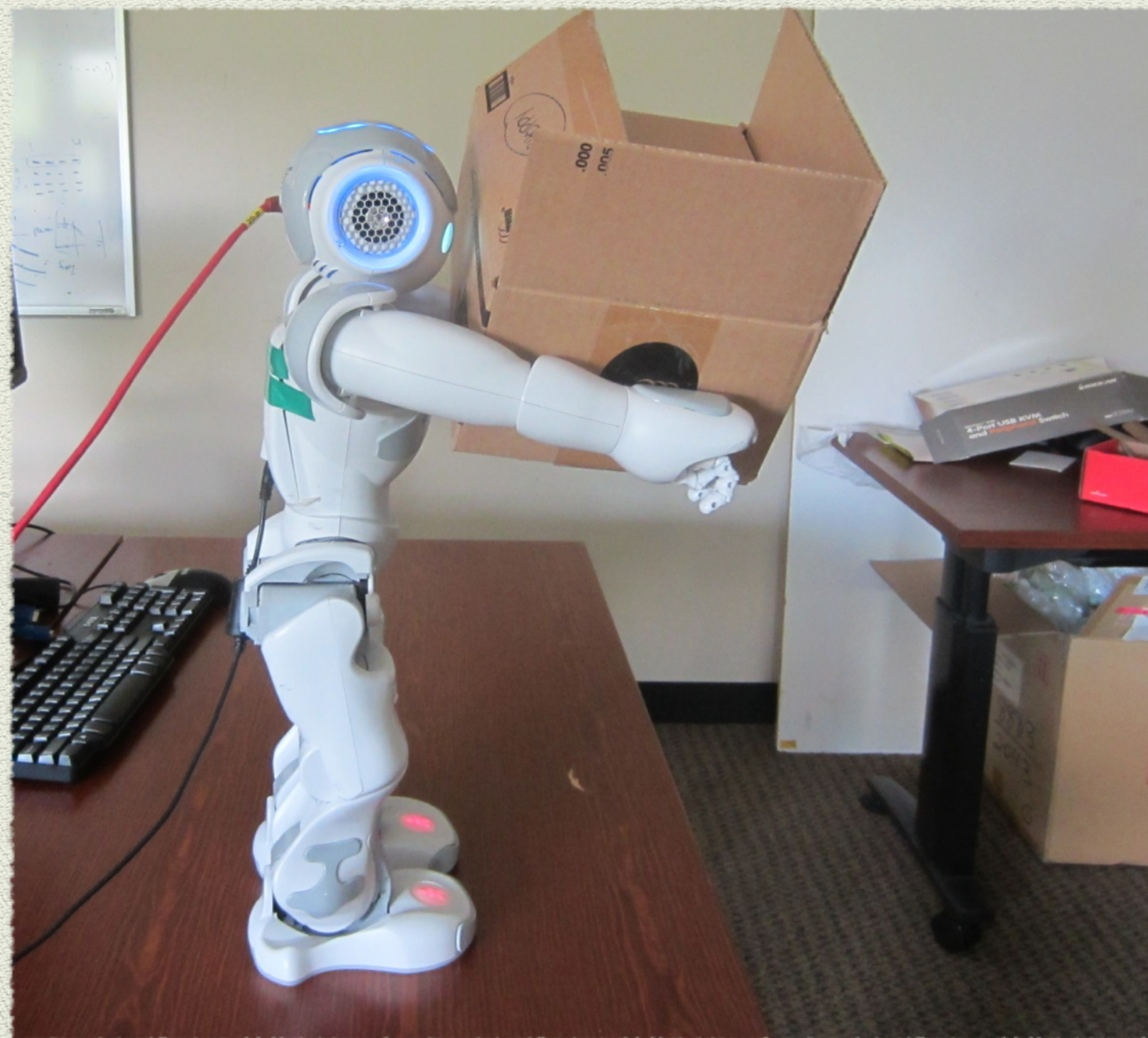
“Relevant” features



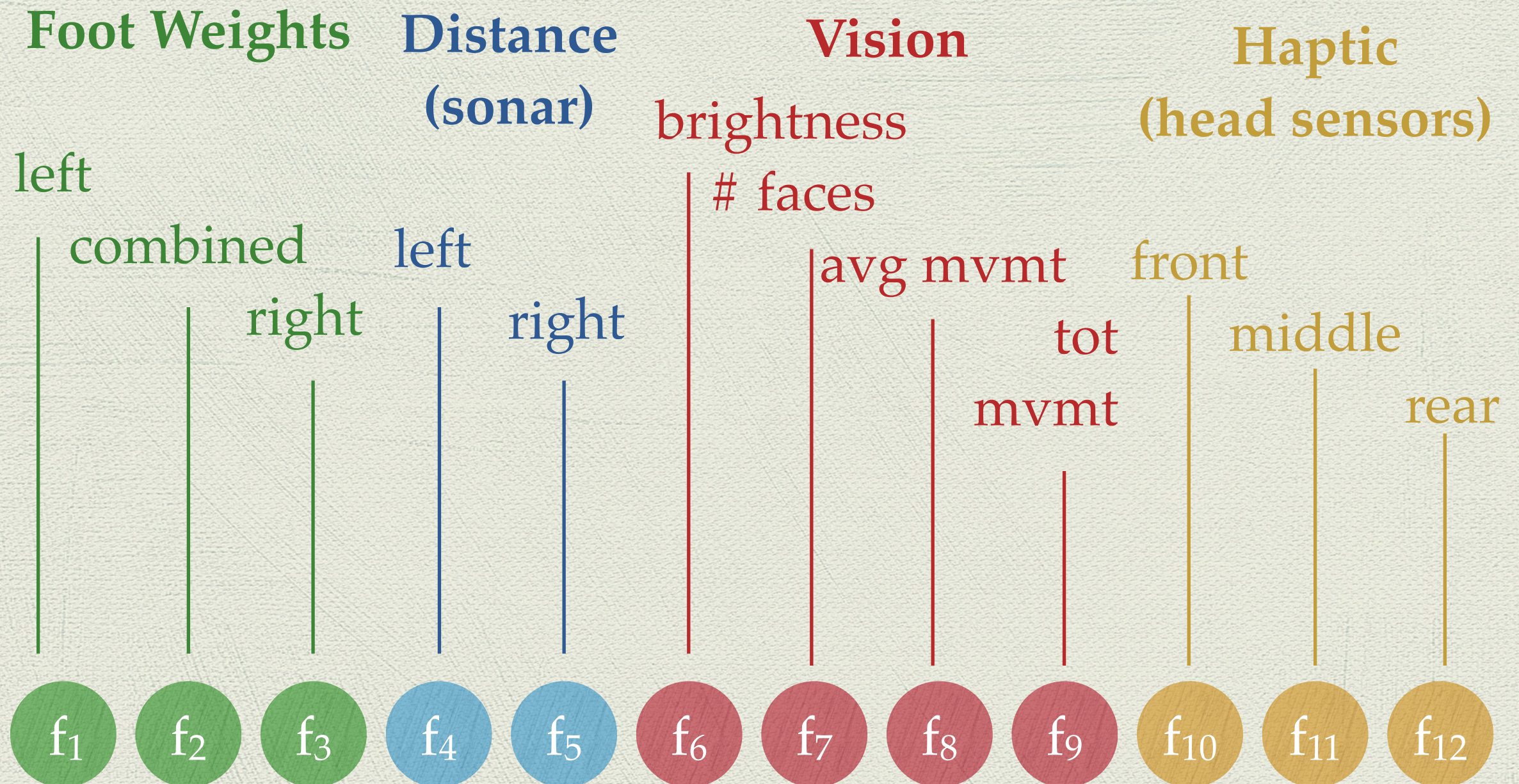
Many Classifiers



Implementation

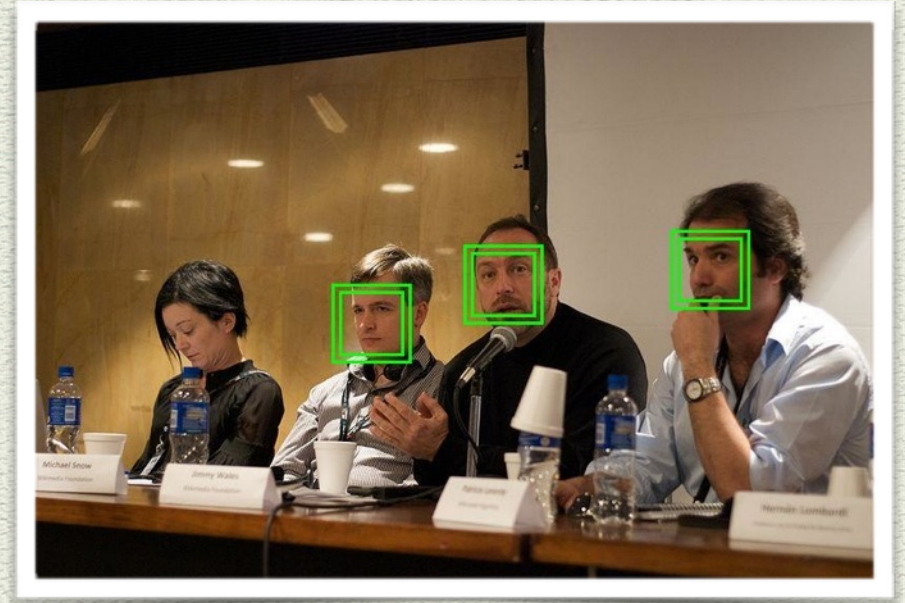


Modalities and Features

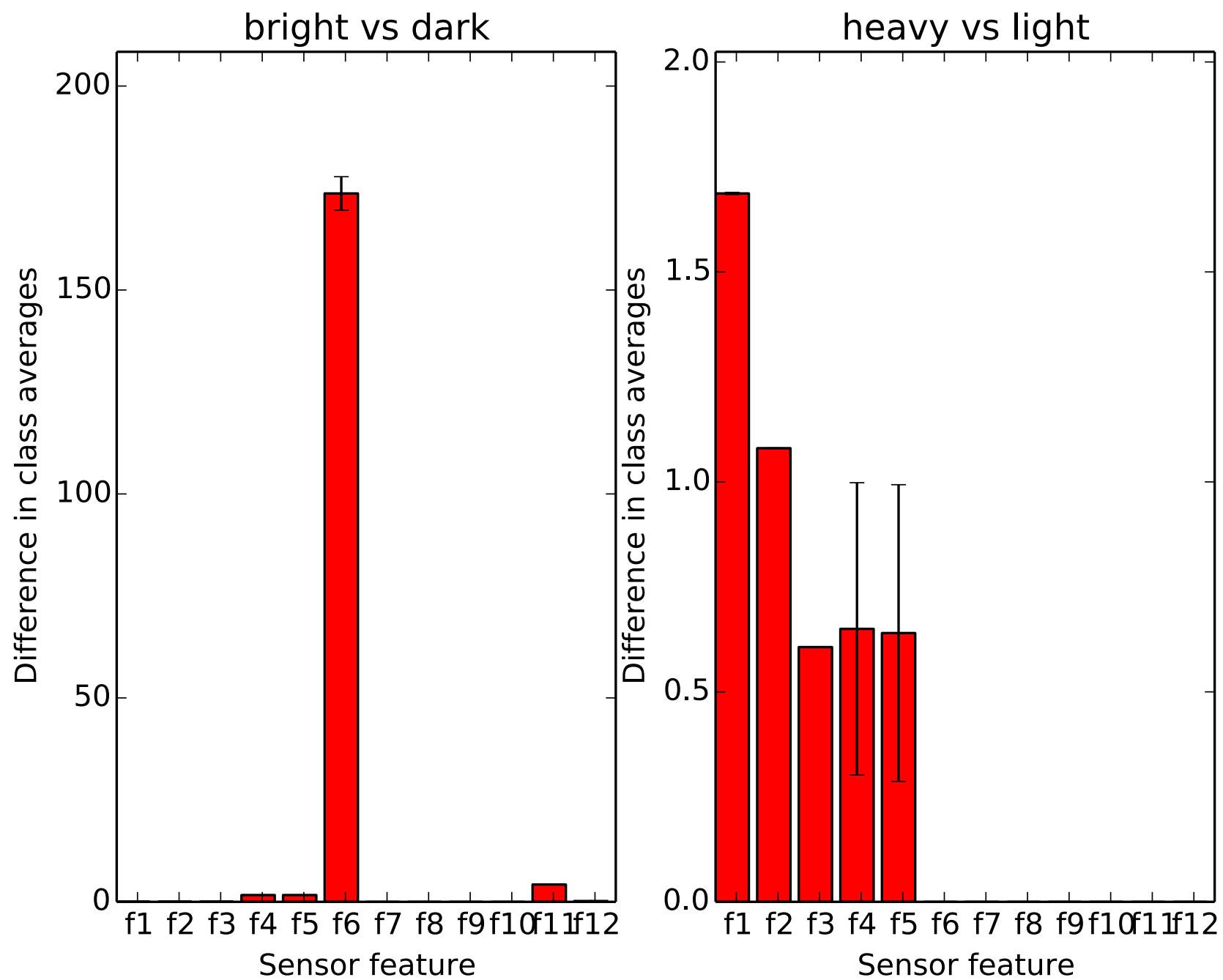


Antonym Adjective Pairs Grounded

1. “heavy” *vs* “light”
2. “bright” *vs* “dark”
3. “crowded” *vs* “lonely”
4. “near” *vs* “far”
5. “fast” *vs* “slow”
6. “uncovered” *vs* “touching”

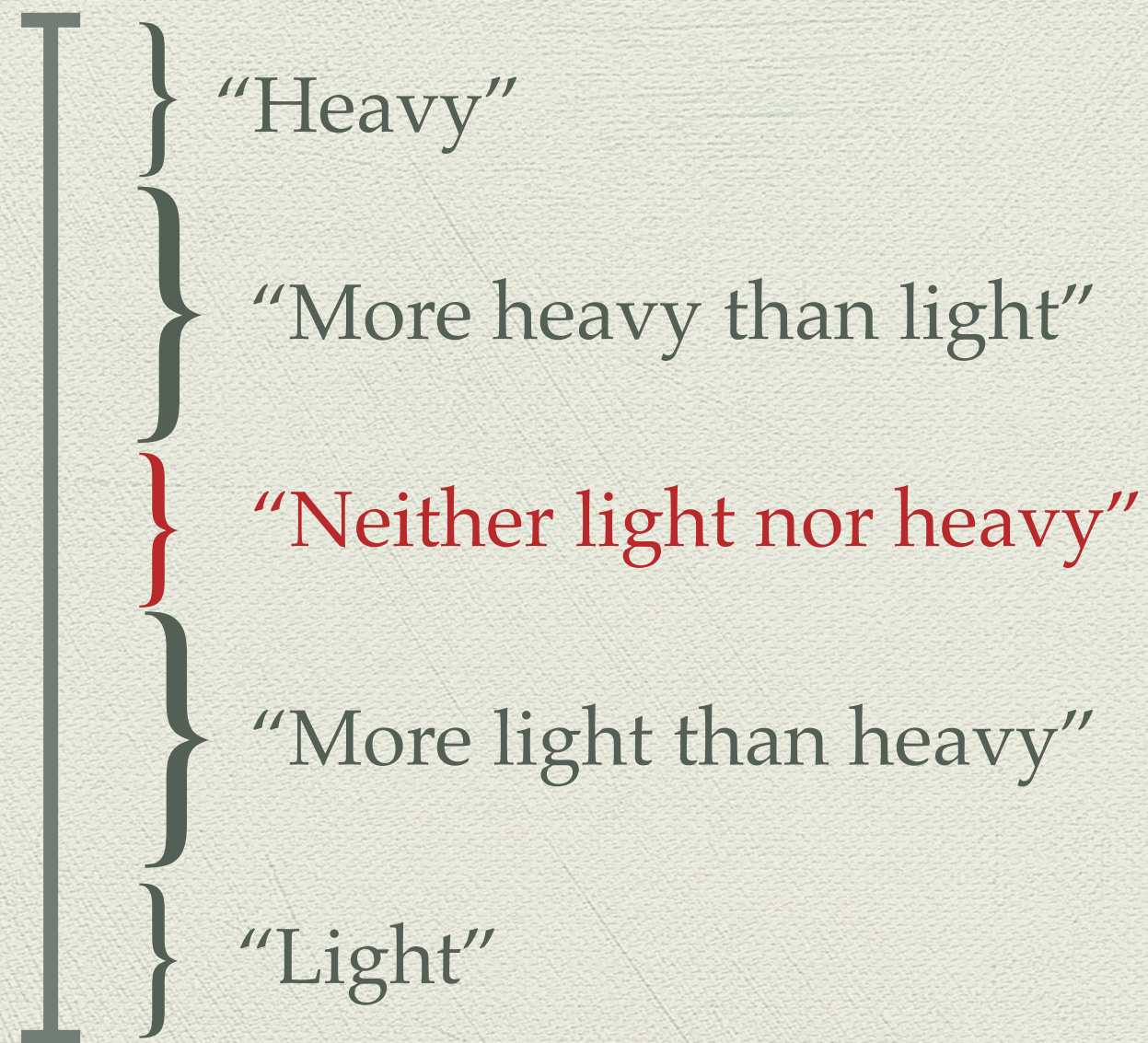


Preliminary Data



Between the Adjectives

$$p(\text{heavy}) = 1.0$$



$$p(\text{light}) = 1.0$$

Challenges: NAO Sensors

USING GAUSSIAN NAIVE BAYES

Limitations

Ambiguous words

“light”

VS

“bright”

Non-informative phrases

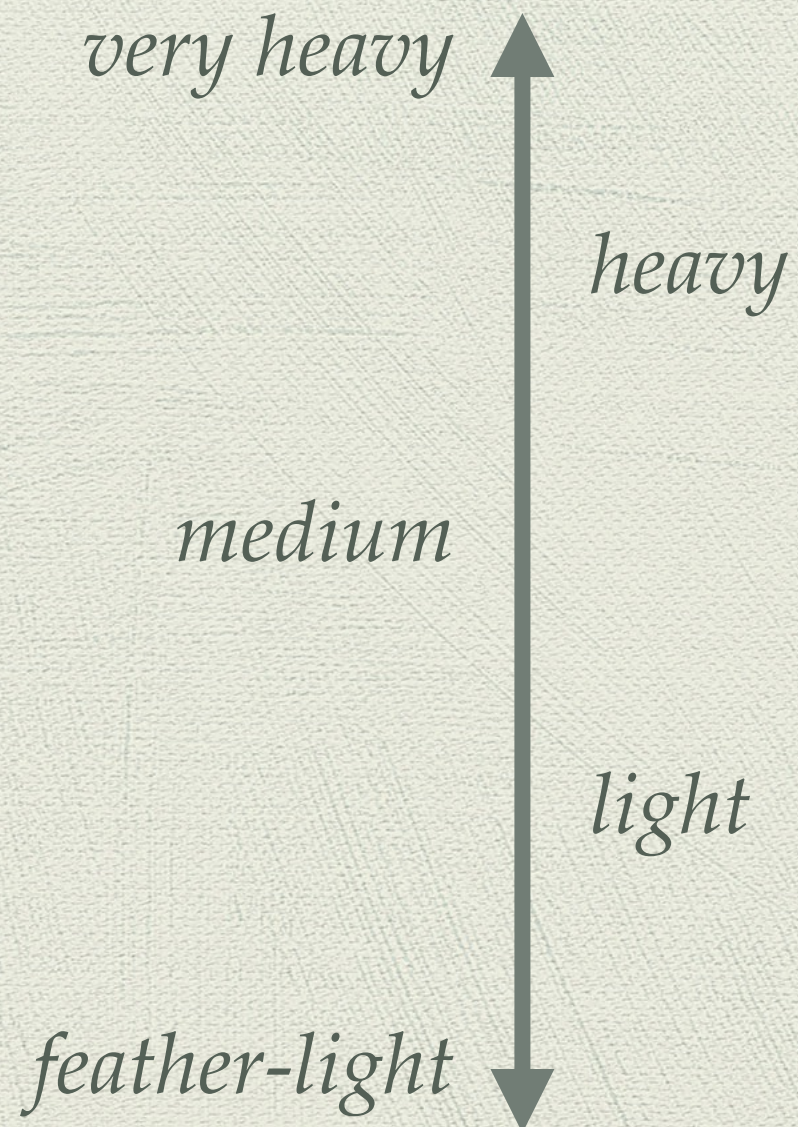
“medium”

“moderate”

“sort of x ”

Future Work

Beyond pairs



Systematic evaluation

- *user studies: accuracy and robustness*

Natural Language Patterns

- *meaning of “very”*

Thank you