Natural Language Processing
Text classification

Sofia Serrano
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Credit to Yulia Tsvetkov and Noah Smith for slides

Announcements

https://courses.cs.washington.edu/courses/cse447/23wi/

- Academic Integrity Form is due this Friday
- Quiz 1: **next** Wednesday (1/18)
  - 5 multiple-choice questions
  - Released on Canvas once lecture ends on 1/18, open for 12 hours
  - 10-min time limit once you start the quiz
  - Materials from weeks 1 and 2 (up through the end of class this Friday)
    - Introduction to NLP, introduction to text classification
    - Instructions for HW 1

Is this spam?

from: **ECRES 2022 <2022@ecres.net>** via amazonses.com

reply-to: 2022@ecres.net

to: yuliats@cs.washington.edu

date: Feb 22, 2022, 7:21 AM

subject: The Best Renewable Energy Conference (Last chance !)

signed-by: amazonses.com

security: Standard encryption (TLS) Learn more

Dear Colleague,

Account: yuliats@cs.washington.edu

Good news: Due to many requests, the submission deadline has been extended to 10 March 2022 (It is firm date).

We would like to invite you to submit a paper to 10. European Conference on Renewable Energy Systems (ECRES). **ECRES 2022 will be held hybrid mode, the participants can present their papers physically or online.** The event is going to be organized in Istanbul/Turkey under the technical sponsorship of Istanbul Medeniyet University and many international institutions. The conference is highly international with the participants from all continents and more than 40 countries.

The submission deadline and special and regular issue journals can be seen in ecres.net

There will be keynote speakers who will address specific topics of energy as you would see at ecres.net/keynotes.html

CLICK FOR PAPER SUBMISSION

All accepted papers will be published in a special Conference Proceedings under a specific ISBN. Besides, the extended versions will be delivered to reputable journals **indexed in SCI, E-SCI, SCOPUS, and EBSCO.** You can check our previous journal publications from ecres.net . **Please note that the official journal of the event, Journal of Energy Systems (dergipark.org.tr/jes) is also indexed in SCOPUS.**

Spam classification

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spam

Invitation to present at the February 2022 Wikimedia Research Showcase

Emily Lescak <elescak@wikimedia.org> Tue, Nov 23, 2021, 11:00 AM
to yuliats@cs.washington.edu

Hi Yulia,

My name is Emily Lescak and I am a member of the Research team at the Wikimedia Foundation. On beh te you to present your research on social biases on Wikipedia at our Research Showcase in February 2022. This topic fits into our theme for this showcase, which is gaps and biases on Wikipedia.

The Wikimedia Research Showcase is a monthly, public lecture series where Foundation, acad hare recent work related to Wikipedia, Wikimedia, peer production, and open-source software. We focus on topics and projects that we think our audience— a global community of academic researchers, Wikip oundation staff—would find interesting and relevant to their work.

Research Showcase presentations are generally 20 minutes long, with an additiona ypically invite two presenters to every showcase. Most presenters choose to use slides to present their work.

The February showcase takes place on the 16th at 9:15AM Pacific / 17:15 UTC. Prese ive on YouTube and also archived for later viewing on the Wikimedia Foundation's YouTube channel

If this date does not work for you, but you are still interested in giving a showcase presen ow and we can discuss other options.

I hope to get a chance to see your work presented at the Research Showcase!

Sincerely,

Emily

not spam

Language ID

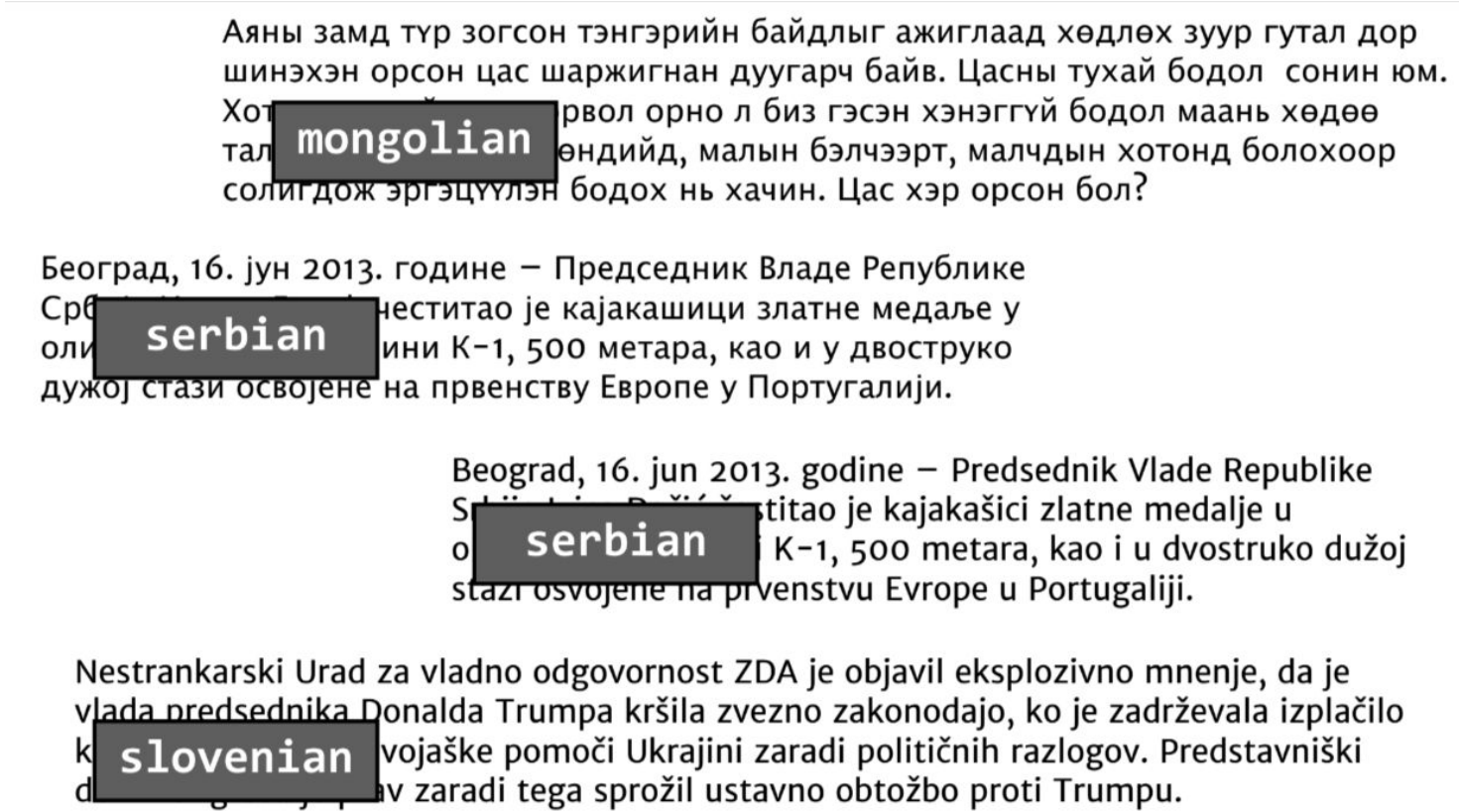
Аяны замд түр зогсон тэнгэрийн байдлыг ажиглаад хөдлөх зуур гутал дор шинэхэн орсон цас шаржигнан дуугарч байв. Цасны тухай бодол сонин юм. Хот хүрээ тийш цас орвол орно л биз гэсэн хэнэггүй бодол маань хөдөө талд, говийн ээрэм хөндийд, малын бэлчээрт, малчдын хотонд болохоор солигдож эргэцүүлэн бодох нь хачин. Цас хэр орсон бол?

Београд, 16. јун 2013. године – Председник Владе Републике Србије Ивица Дачић честитао је кајакашици златне медаље у олимпијској дисциплини К-1, 500 метара, као и у двоструко дужој стази освојене на првенству Европе у Португалији.

Beograd, 16. jun 2013. godine – Predsednik Vlade Republike Srbije Ivica Dačić čestitao je kajakašici zlatne medalje u olimpijskoj disciplini K-1, 500 metara, kao i u dvostruko dužoj stazi osvojene na prvenstvu Evrope u Portugaliji.

Nestrankarski Urad za vladno odgovornost ZDA je objavil eksplozivno mnenje, da je vlada predsednika Donalda Trumpa kršila zvezno zakonodajo, ko je zadrževala izplačilo kongresno potrjene vojaške pomoči Ukrajini zaradi političnih razlogov. Predstavniški dom kongresa je prav zaradi tega sprožil ustavno obtožbo proti Trumpu.

Language ID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Хот рвол орно л биз гэсэн хэнэггүй бодол маань хөдөө
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mongolian
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slovenian

Sentiment analysis

By **John Neal**

This review is from: Accoutrements Horse Head Mask (Toy)

When I turned State's Witness, they didn't have enough money to put me in the Witness Protection Program, so they bought me this mask and gave me a list of suggested places to move. Since then I've lived my life in peace and safety knowing that my old identity is forever obscured by this life-saving item.

By **Christine E. Torok**

Verified Purchase (What's this?)

First of all, for taste I would rate these a 5. So good. Soft, true-to-taste fruit flavors like the sugar variety...I was a happy camper.

BUT (or should I say BUTT), not long after eating about 20 of these all hell broke loose. I had a gastrointestinal experience like nothing I've ever imagined. Cramps, sweating, bloating beyond my worst nightmare. I've had food poisoning from some bad shellfish and that was almost like a skip in the park compared to what was going on inside

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Topic classification

MEDLINE Article

Syntactic frame and verb bias in aphasia: Plausibility judgments of undergoer-subject sentences

?

MeSH Subject Category Hierarchy

- Antagonists and Inhibitors
- Blood Supply
- Chemistry
- Drug Therapy
- Embryology
- Epidemiology
- …

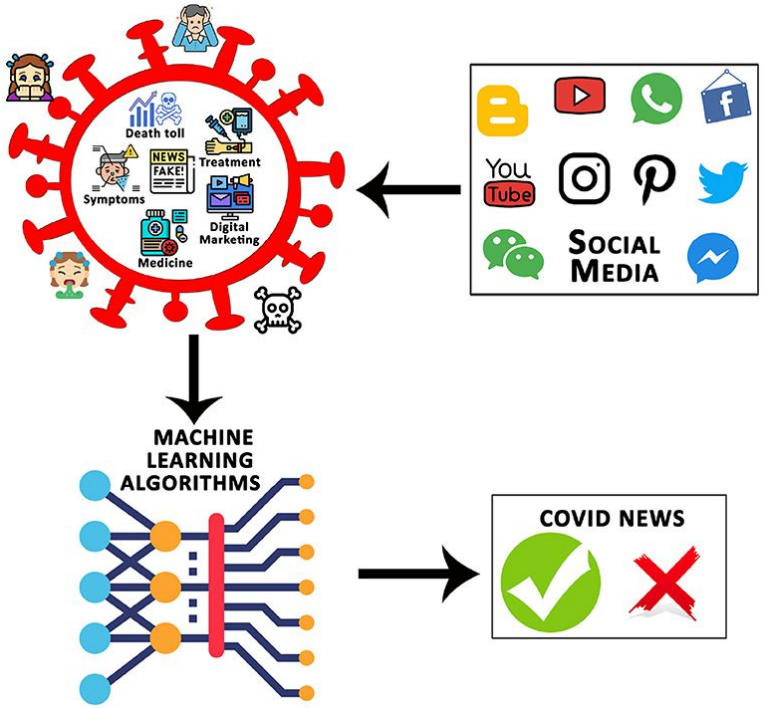
Authorship attribution: is the author male or female?

By 1925 Vietnam was divided into three parts under French colonial rule. The southern region embracing Saigon and the Mekong delta was the colony Cochin-China; the central area with its imperial capital at Hue was the protectorate of Annam.

Clara never failed to be astonished by the extraordinary felicity of her own name. She found it hard to trust herself to the mercy of fate, which had managed over the years to convert her greatest shame into one of the greatest assets...

S. Argamon, M. Koppel, J. Fine, A. R. Shimoni, 2003. “Gender, Genre, and Writing Style in Formal Written Texts,” Text, volume 23, number 3, pp. 321–346

Fact verification: trustworthy or fake?



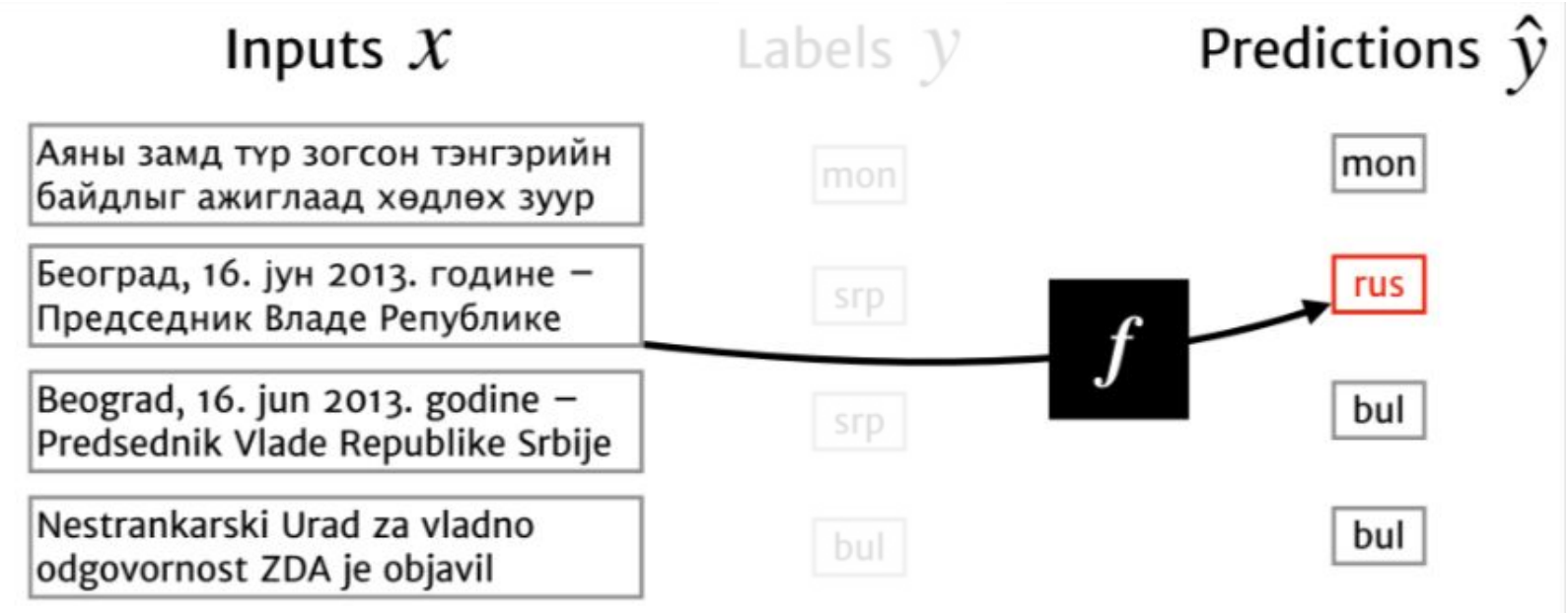
Detecting COVID-19-Related Fake News Using Feature Extraction

Suleman Khan, Saqib Hakak, N. Deepa, B. Prabadevi, Kapal Dev and Silvia Trelova

Text classification

- We might want to categorize the content of the text:
  - Spam detection (binary classification: spam/not spam)
  - Sentiment analysis (binary or multiway)
    - movie, restaurant, product reviews (pos/neg, or 1-5 stars)
    - political argument (pro/con, or pro/con/neutral)
    - Topic classification (multiway: sport/finance/travel/etc)
  - Language identification (multiway: languages, language families)
  - …
- Or we might want to categorize the author of the text (authorship attribution)
  - Human- or machine generated?
  - Native language identification (e.g., to tailor language tutoring)
  - Diagnosis of disease (psychiatric or cognitive impairments)
  - Identification of gender, dialect, educational background, political orientation (e.g., in forensics [legal matters], advertising/marketing, campaigning, disinformation)
  - …

Text classification



Goal: create a function f that makes a prediction $\hat{y}$ given an input x

Over the next couple of days, we'll investigate:

1. How do we "digest" text into a form usable by a function?

   (Keywords for this section: features, feature extraction,

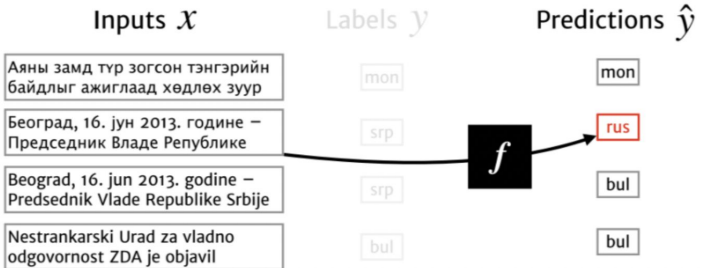
   feature selection, representations)

2. What kinds of strategies might we use to create our function *f*?

   (Keyword for this section: models)

3. How do we evaluate our function *f*?

   (Keyword for this section: … evaluation)



How do we “digest” text into a form usable by a function?

Classification: features (measurements)

- Perform measurements and obtain features

4.2, 212, 3.4, 1332

diameter, weight, softness, color

5.2, 315, 5.7, 4567

diameter, weight, softness, color

Text classification – feature extraction

What can we measure over text? Consider this movie review:

I love this movie! It's sweet, but with satirical humor. The dialogue is great, and the adventure scenes are fun… It manages to be whimsical and romantic while laughing at the conventions of the fairy tale genre. I would recommend it just to about anyone. I've seen it several times, and I'm always happy to see it again whenever I have a friend who hasn't seen it before.

Text classification – feature extraction

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(almost) the entire lexicon

word	count	relative frequency
love	10	0.0007
great	…	
recommend		
laugh		
happy		
…		
several		
boring		
…		

Types of textual features

- Words
  - content words, stop-words
  - punctuation? tokenization? lemmatization? lowercase?
- Word sequences
  - bigrams, trigrams, n-grams
- Grammatical structure, sentence parse tree
- Words' part-of-speech
- Word vectors
- …

Possible representations for text

- Bag-of-Words (BOW)
  - Easy, no effort required
  - Variable size, ignores sentential structure

- Hand-crafted features
  - Full control, can use NLP pipeline, class-specific features
  - Over-specific, incomplete, makes use of NLP pipeline

- Learned feature representations
  - Can learn to contain all relevant information
  - Needs to be learned

Bag-of-Words (BOW)

- Given a document d (e.g., a movie review) – how to represent d ?

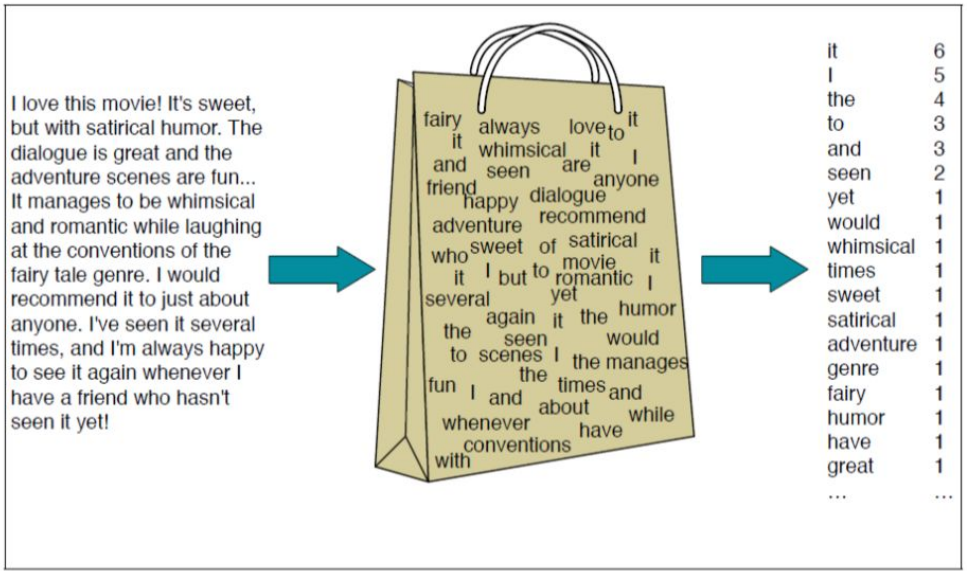
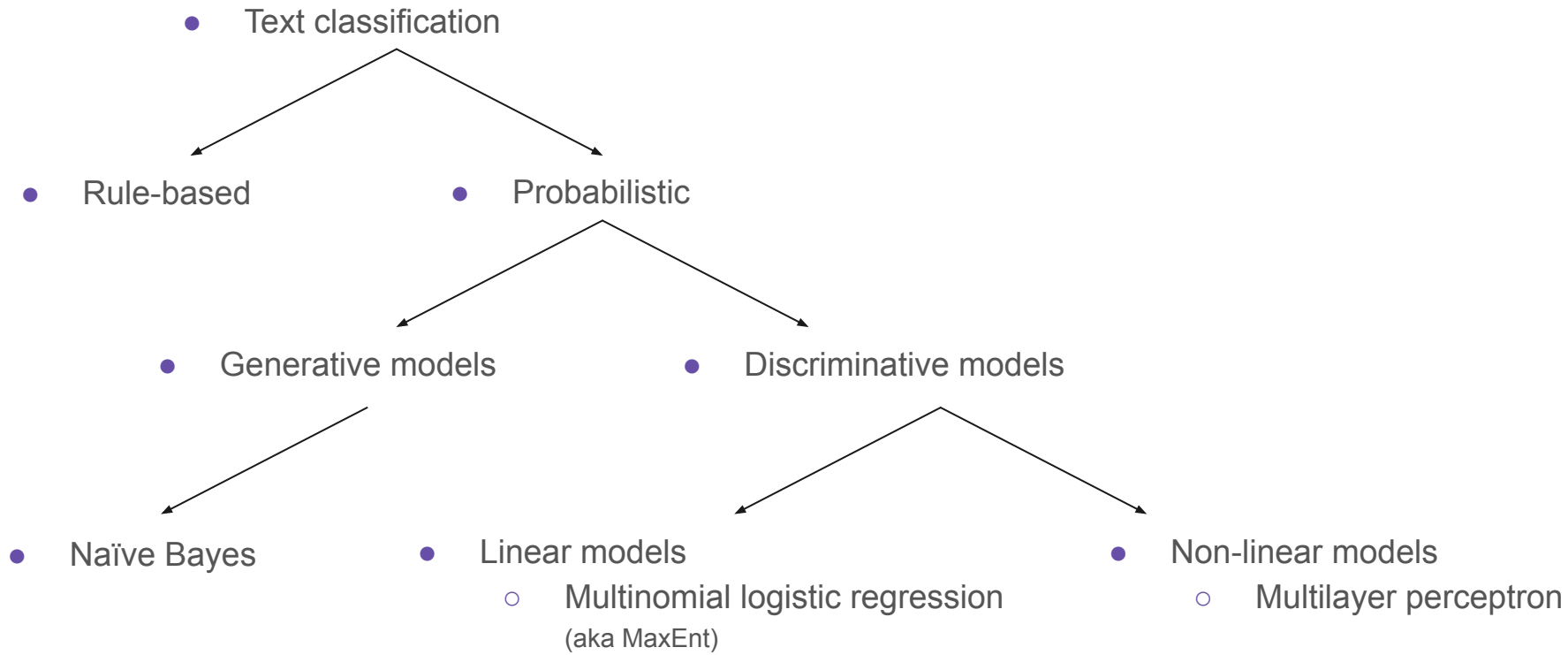


Figure from J&M 3rd ed. draft, sec 7.1

What kinds of strategies might we use to create our function *f*?

We'll consider alternative models for classification



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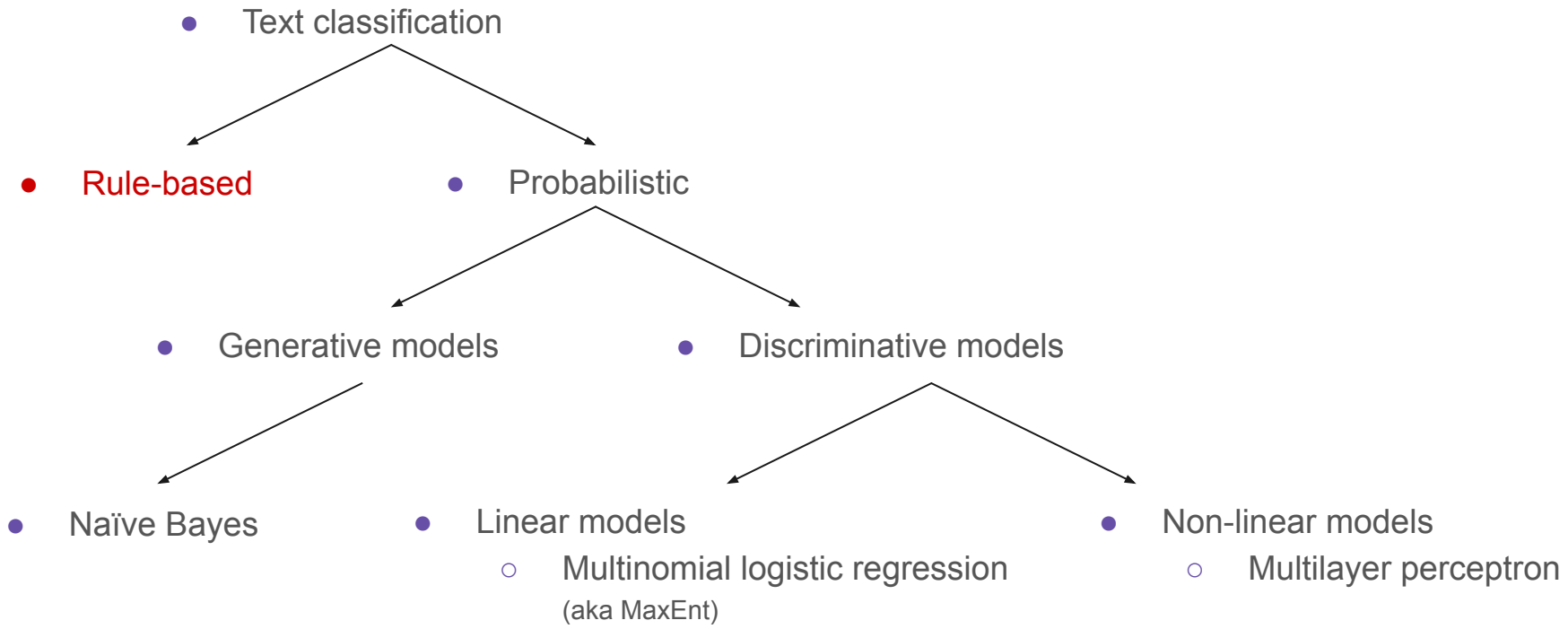

Rule-based classifier

```
def classify_sentiment(document):
  for word in document:
    if word in {“good”, “wonderful”, “excellent”}:
      return 5
    if word in {“bad”, “awful”, “terrible”}:
      return 1
```

Rule-based classification: challenges

Sentiment: Half submarine flick, half ghost story, all in one a criminally neglected film.

Rule-based classification: challenges

Sentiment: Half submarine flick, half ghost story, all in one a criminally neglected film.

⟶ hard to identify a priori which words are informative (and what information they carry!)

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Sentiment: It's not life-affirming, it's vulgar, it's mean, but I liked it.

Rule-based classification: challenges

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Sentiment: It's not life-affirming, it's vulgar, it's mean, but I liked it.

⟶word order matters, but hard to encode in rules!

Rule-based classification: challenges

Sentiment: Half submarine flick, half ghost story, all in one a criminally neglected film.

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Sentiment: It's not life-affirming, it's vulgar, it's mean, but I liked it.

⟶word order matters, but hard to encode in rules!

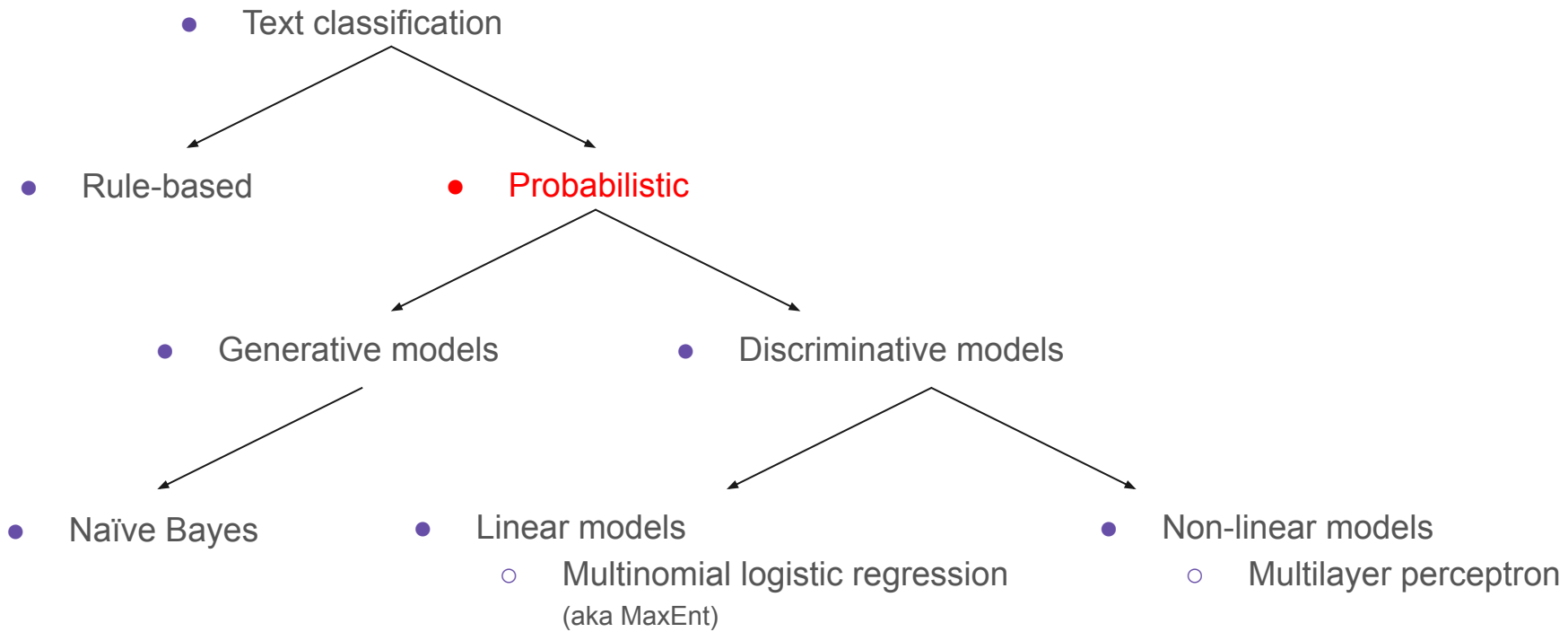
Language ID: All falter, stricken in kind. "LINGERIE SALE"

⟶simple features can be misleading!

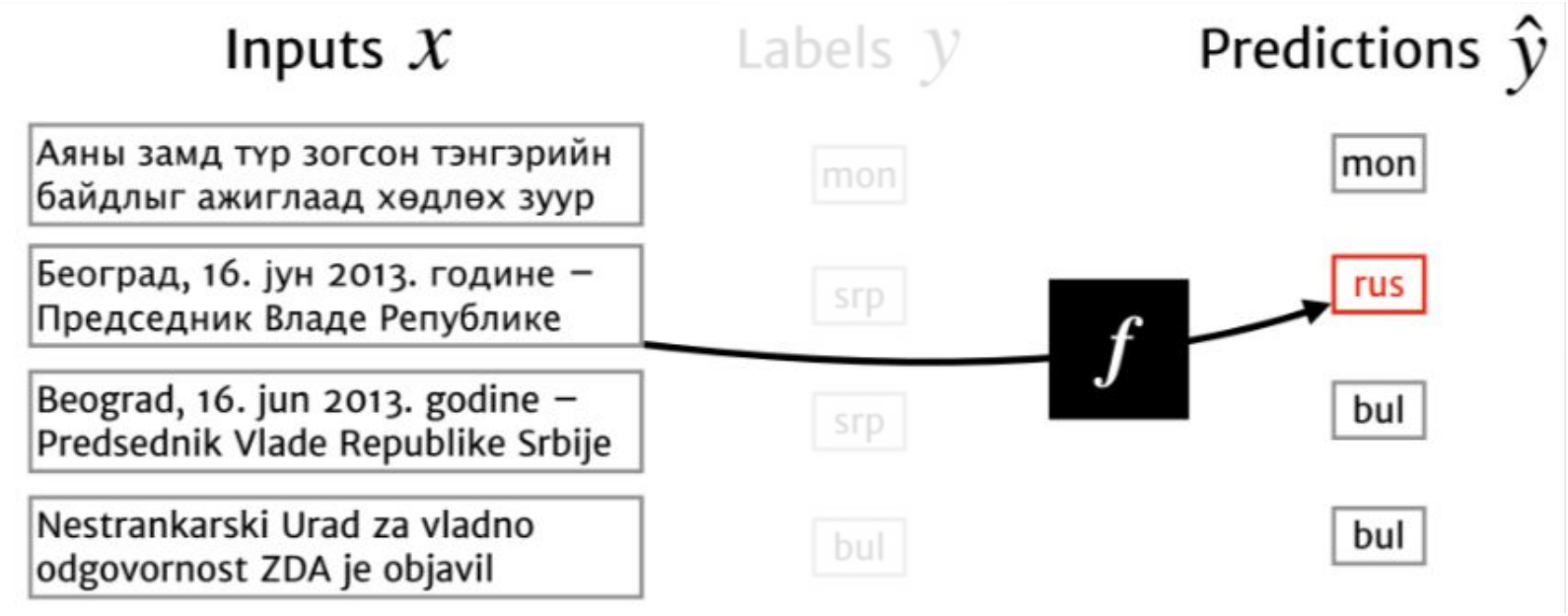
Rule-based classification

But don’t forget: if you don’t have access to data, speaker intuition and a bit of coding get you pretty far!

We'll consider alternative models for classification



Learning-based classification



pick the function f that does “best” on training data

Goal: ~~create a function f that makes a prediction $\hat{y}$ given an input x~~

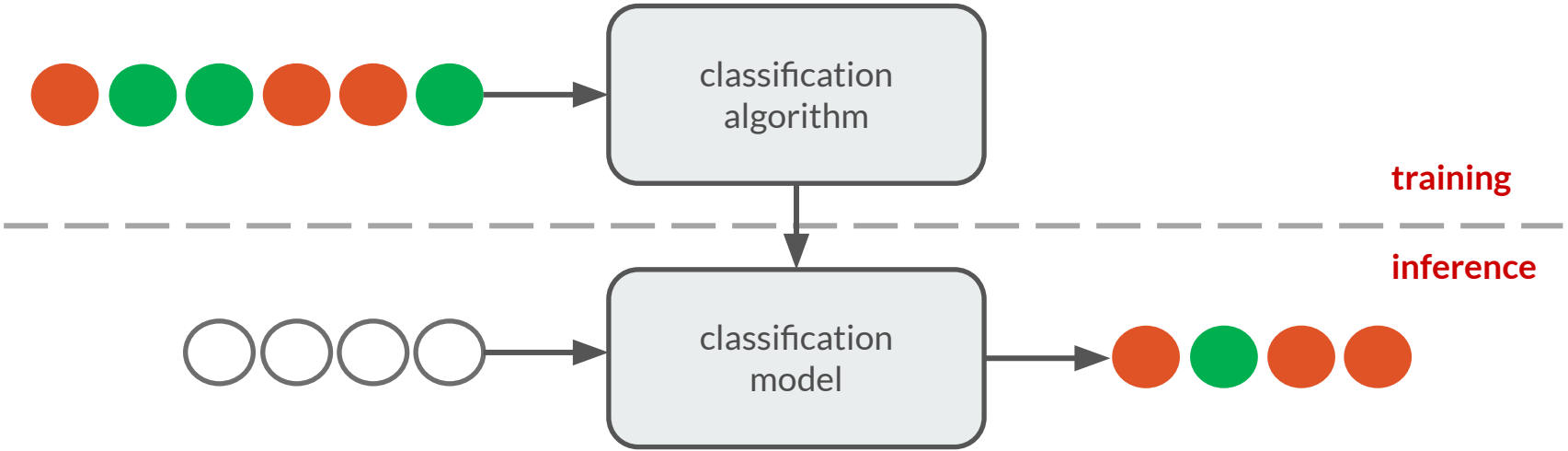
Classification: learning from data

- Supervised
  - labeled examples
    - Binary (true, false)
    - Multi-class classification (politics, sports, gossip)
    - Multi-label classification (#party #FRIDAY #fail)
- Unsupervised
  - no labeled examples
- Semi-supervised
  - labeled examples + non-labeled examples
- Weakly supervised
  - heuristically-labeled examples

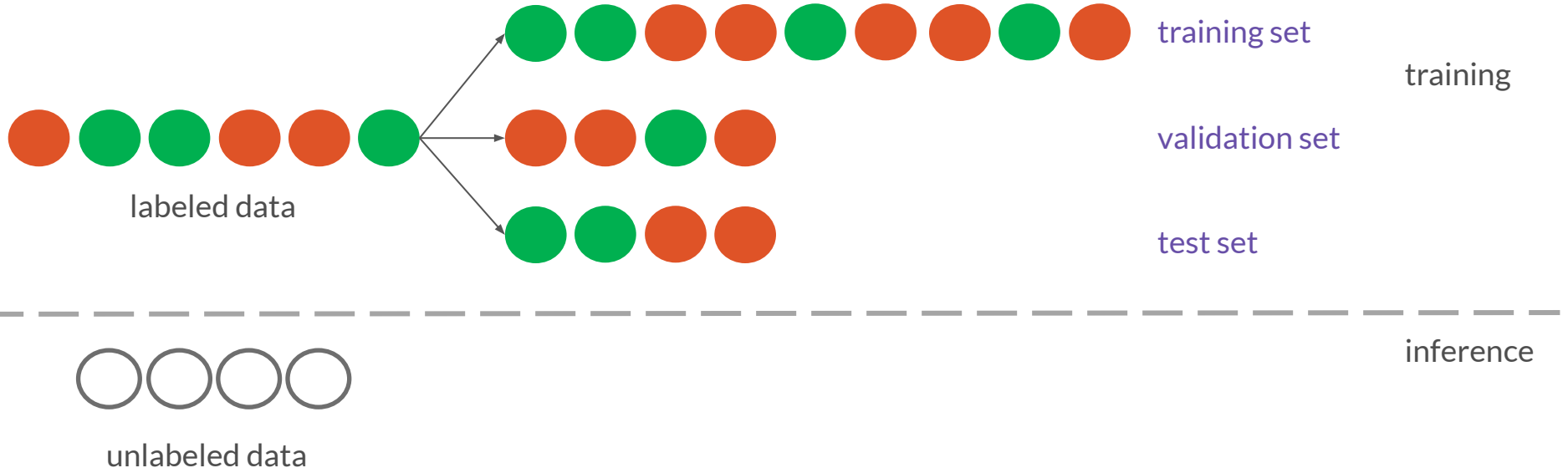
Where do datasets come from?

Human institutions	Noisy labels	Expert annotation	Crowd workers
Government proceedings	Domain names	Treebanks	Question answering
Product reviews	Link text	Biomedical corpora	Image captions

Supervised classification



Training, validation, and test sets



Supervised classification: formal setting

- Learn a classification model from labeled data on
  - properties ("features") and their importance ("weights")
- X: set of attributes or features $\{x_1, x_2, \ldots, x_n\}$
  - e.g. fruit measurements, or word counts extracted from an input documents
- y: a "class" label from the label set $Y = \{y_1, y_2, \ldots, y_k\}$
  - e.g., fruit type, or spam/not spam, positive/negative/neutral

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- Given data samples $\{x_1, x_2, \ldots, x_n\}$ and corresponding labels $Y = \{y_1, y_2, \ldots, y_k\}$
- We train a function $f: x \in X \rightarrow y \in Y$ (the model)

Supervised classification: formal setting

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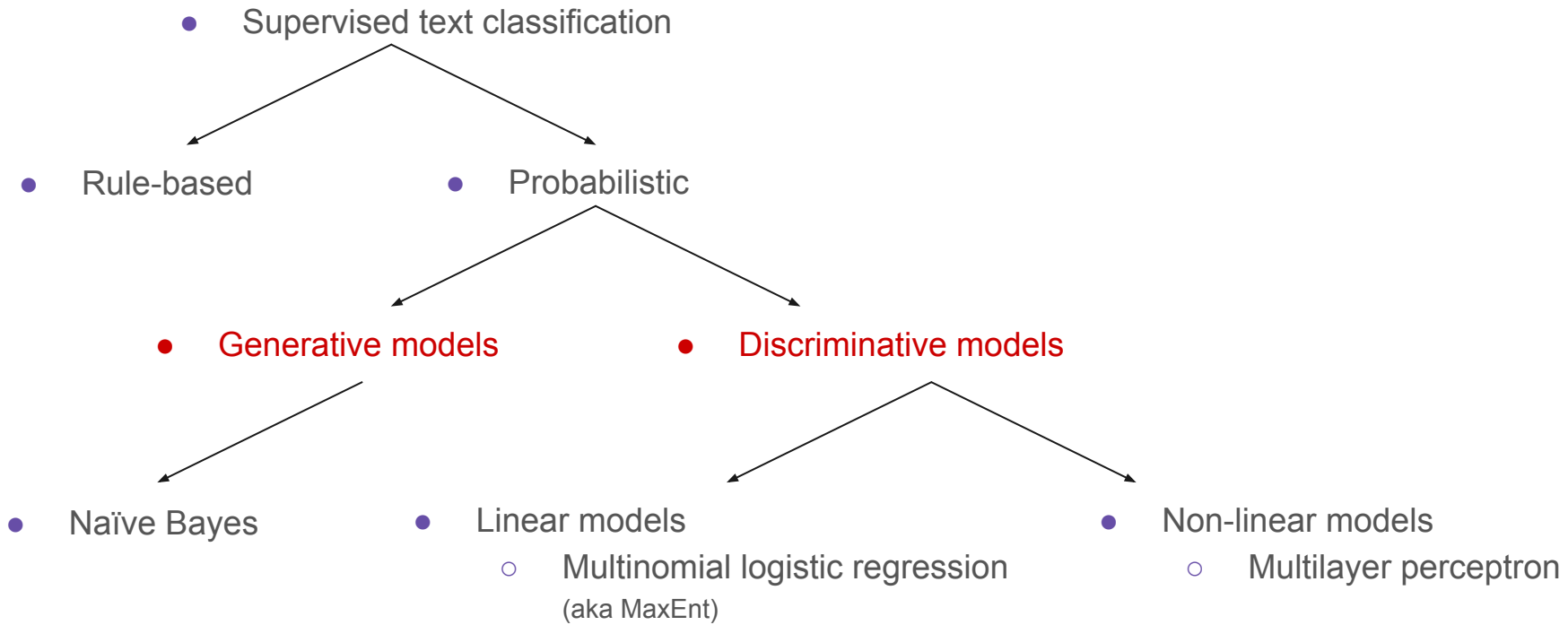
- At inference time, apply the model on new instances to predict the label

We'll consider alternative models for classification



Generative and discriminative models

- Generative model: a model that calculates the probability of the input data itself

$$P(X, Y)$$

joint

- Discriminative model: a model that calculates the probability of a latent trait given the data

$$P(Y \mid X)$$

conditional

Generative and discriminative models

- Generative text classification: Learn a model of the joint P(X, y), and find

$$\hat{y} = \underset{\tilde{y}}{\operatorname{argmax}}\ P(X, \tilde{y})$$

- Discriminative text classification: Learn a model of the conditional P(y | X), and find

$$\hat{y} = \underset{\tilde{y}}{\operatorname{argmax}}\ P(\tilde{y}|X)$$

We'll consider alternative models for classification