Fake News Detection

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Introduction

- What is Fake news?
- Why Study Fake News?
- Why is Fake News attracting more public attention recently?

What Is Fake News?

Definition of fake news

*Fake news is **intentionally** and verifiably **false** news published by a **news** outlet.*

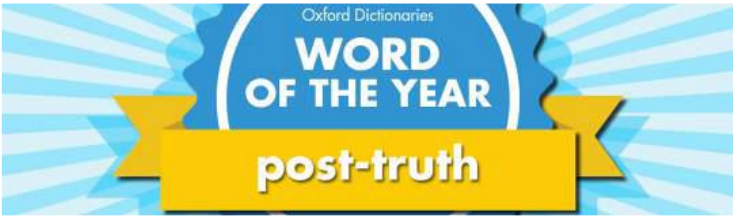
- ***Intention***: **Bad**
- ***Authenticity***: **False**
- ***News or not?*** **News**

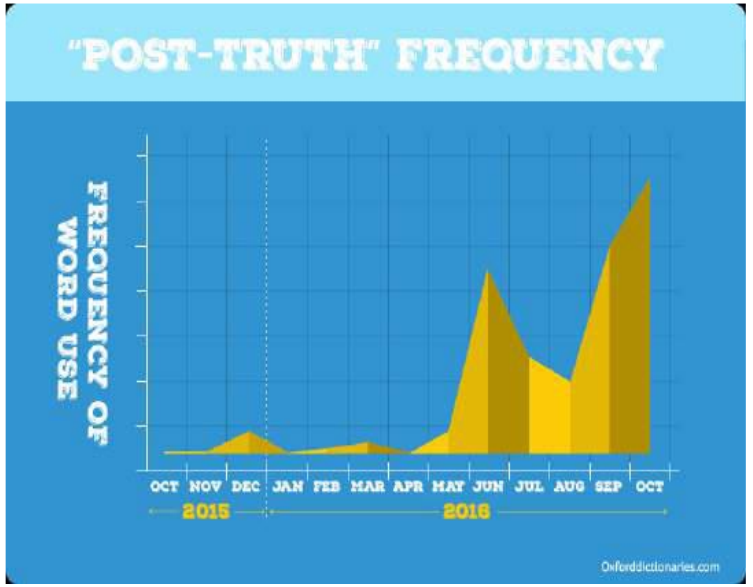
What Is Fake News?

Related concepts

	Authenticity	Intention	News?
Fake news	False	Bad	Yes
False news	False	Unknown	Yes
Satire news	Unknown	Not bad	Yes
Disinformation	False	Bad	Unknown
Misinformation	False	Unknown	Unknown
Rumor	Unknown	Unknown	Unknown

Why Study Fake News?





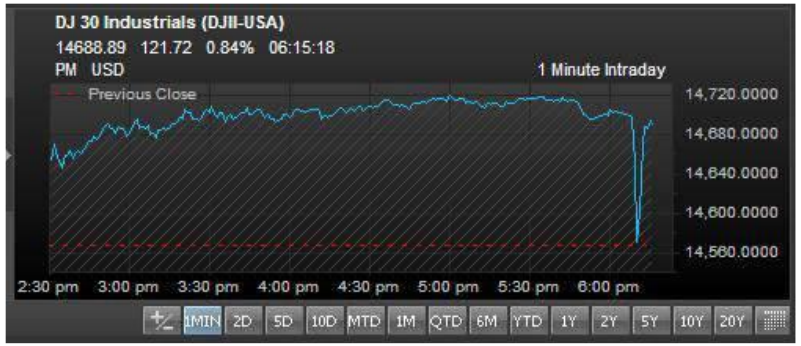
Fake news is now viewed as one of the greatest threats to **democracy**, **justice**, **public trust**, **freedom of expression**, **journalism** and **economy**.

Political Aspects: May have had an impact on

- 2016 U.S. presidential election
  - # Shares, reactions, and comments on Facebook.1
  - 8,711,000 for top 20 frequently-discussed **FAKE** election stories.
  - 7,367,000 for top 20 frequently-discussed **TRUE** election stories.

Why Study Fake News?

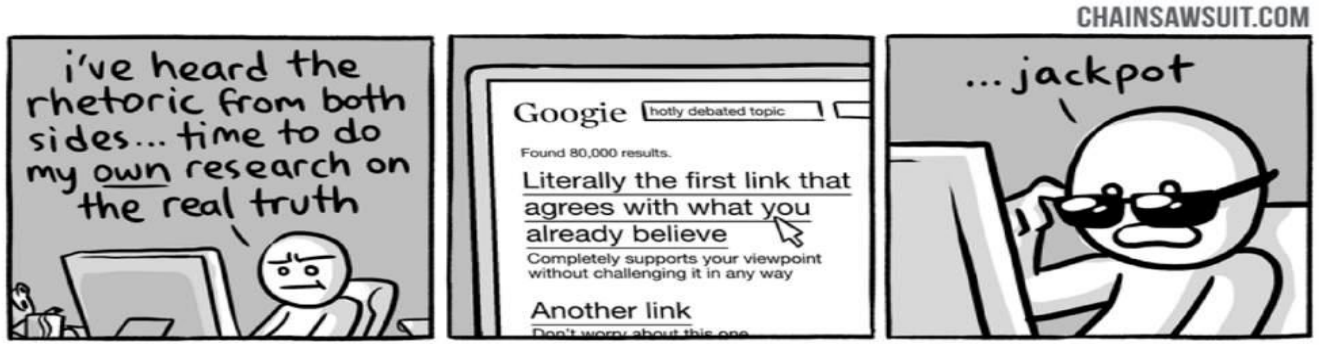
- **Economic** Aspects:
  - "Barack Obama was injured in an explosion" wiped out $130 billion in stock value.
  - Dozens of "well-known" teenagers in Veles,Macedonia
    - Penny-per-click advertising
    - During U.S. 2016 presidential Elections
    - Earning at least $60,000 in six months
    - Far outstripping their parents' income
    - Average annual wage in town: $4,800



Why Study Fake News?

Social/Psychological Aspects:

- Humans have been proven to be irrational/vulnerable when differentiating between truth/false news
  - Typical accuracy in the range of 55-58%
- For fake news, it is relatively easier to obtain public trust
- **Validity Effect:** individuals tend to trust fake news after repeated exposures
- **Confirmation Bias:** individuals tend to believe fake news when it confirms their pre-existing knowledge
- **Peer Pressure/Bandwagon Effect**



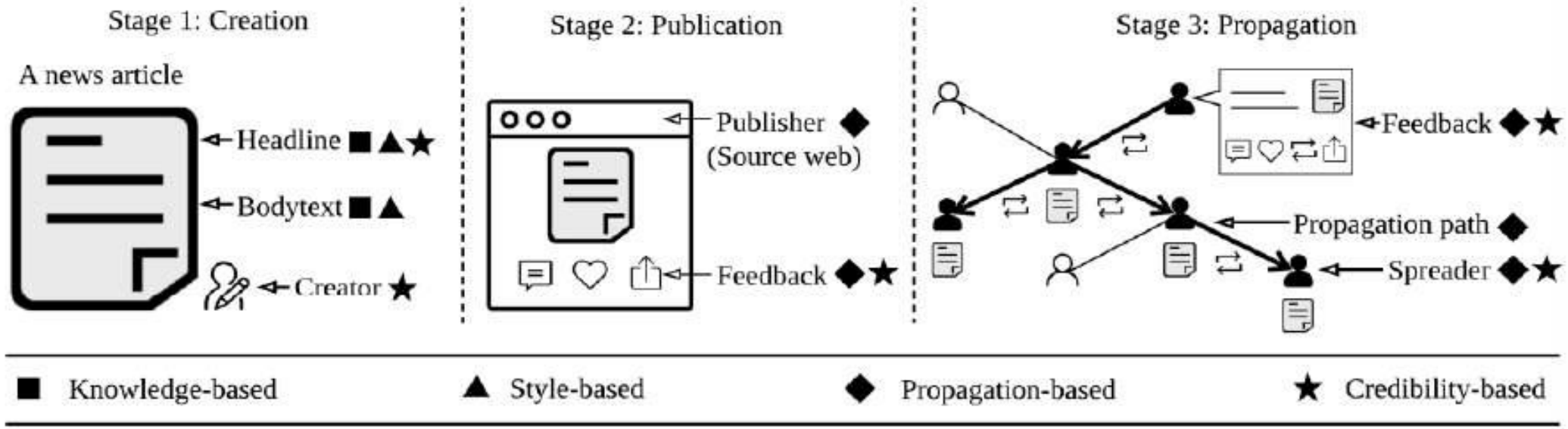
Why is Fake News attracting more public attention recently?

Fake news can now be created and *published faster* and *cheaper*

- The rise of Social Media and its popularity also plays an important role
  - As of Aug. 2017, 67% of Americans *get* their news from social media.
- Social media accelerates *dissemination* of fake news.
  - It breaks the physical distance barrier among individuals.
  - It provides rich platforms to share, forward, vote, and review

Fake News Detection

- Knowledge-based Fake News Detection
- Style-based Fake News Detection
- Propagation-based Fake News Detection
- Credibility-based Fake News Detection
- Fake News Datasets


Stage 1: Creation
A news article
Headline
Bodytext
Creator
Stage 2: Publication
Publisher
(Source web)
Feedback
Stage 3: Propagation
Feedback
Propagation path
Spreader
Knowledge-based
Style-based
Propagation-based
Credibility-based

Knowledge-based Fake News Detection

Overview

Knowledge-based fake news detection aims to assess **news authenticity** by comparing the **knowledge** extracted from to-be-verified **news content** with known facts (i.e., true knowledge).

It is also known as **fact-checking**.

- *Manual Fact-checking* – providing ground truth.
- *Automatic Fact-checking* – a better choice for scalability.

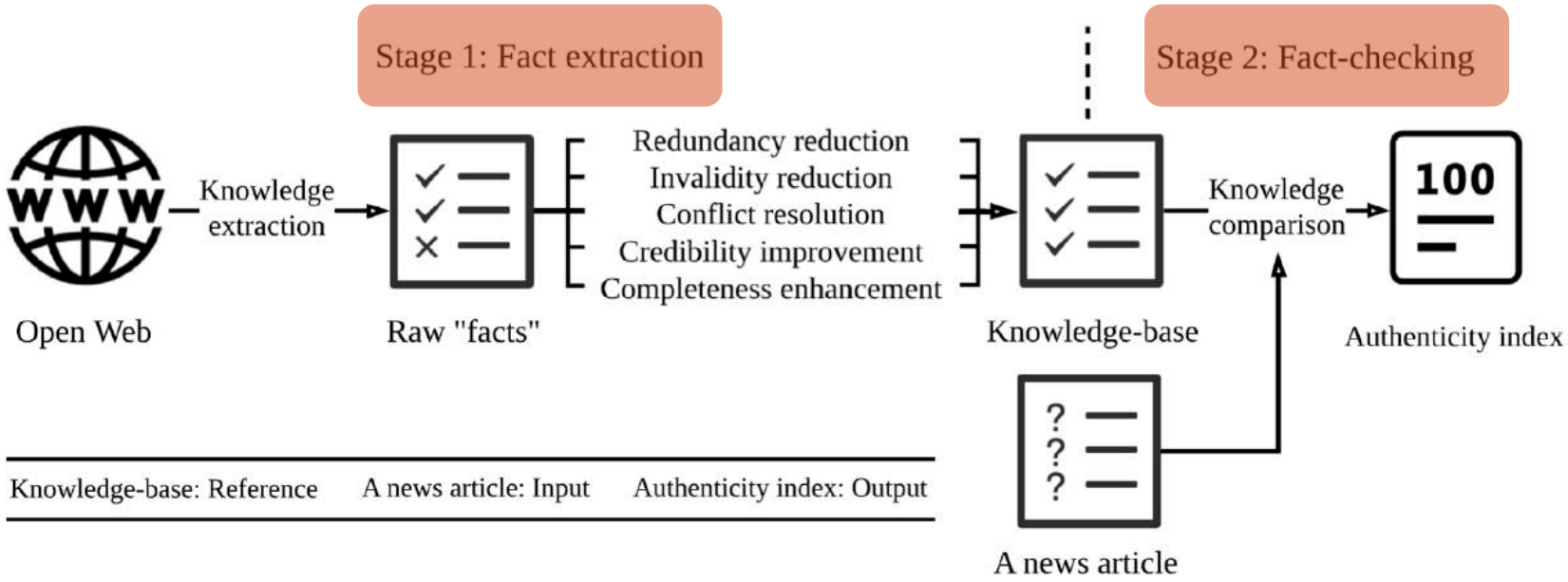
Manual Fact-checking

Classification and comparison

	Expert-based manual fact-checking	Crowed-based manual fact-checkin
Fact-checker(s)	One or several domain-expert(s)	A large population of regular individuals
Easy to manage?	Yes	No
Credibility	High	Comparatively low
Scalability	Poor	Comparatively high

Automatic Fact-checking

- How to represent “**knowledge**”?
- How to obtain **the known facts** (i.e., ground truth)?
- How to **compare** the knowledge extracted with known facts?

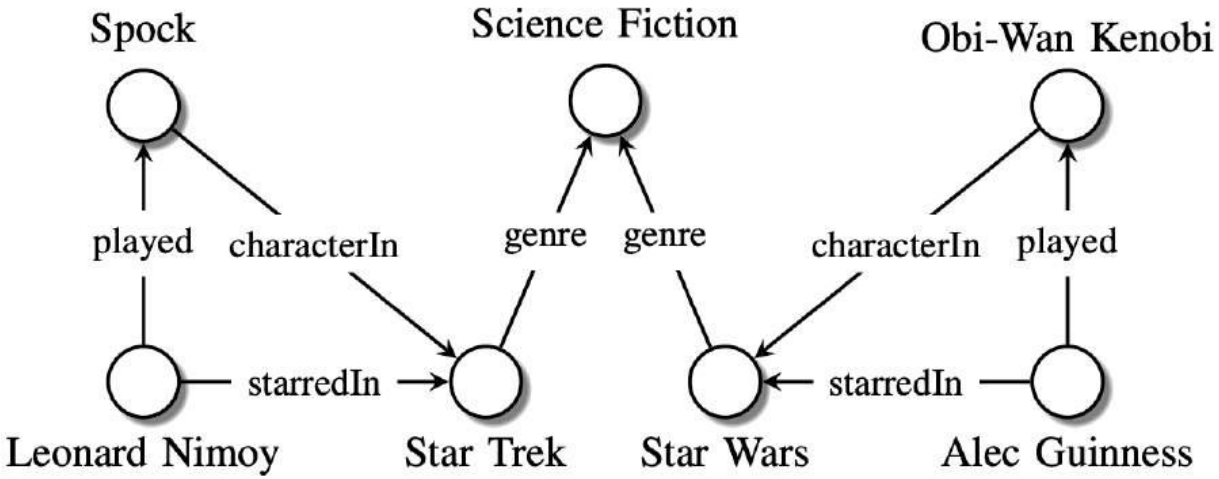


Knowledge Representation

Knowledge is represented as **a set of (Subject, Predicate, Object) (SPO) triples** extracted from the given information. For example,

"*Leonard Nimoy was an actor who played the character Spock in the science-fiction movie Star Trek*"

subject	*predicate*	*object*
(LeonardNimoy,	*profession,*	*Actor)*
(LeonardNimoy,	*starredIn,*	*StarTrek)*
(LeonardNimoy,	*played,*	*Spock)*
(Spock,	*characterIn,*	*StarTrek)*
(StarTrek,	*genre,*	*ScienceFiction)*



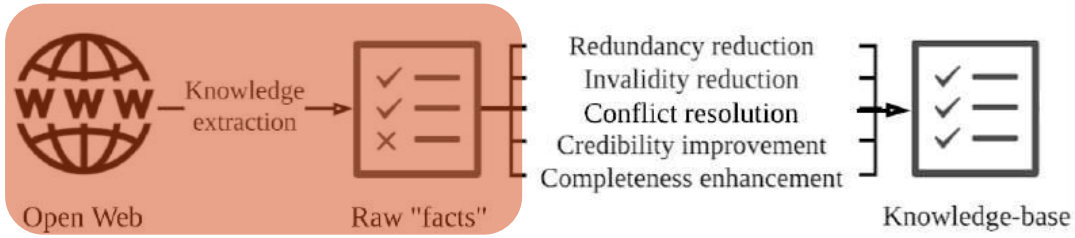
Stage 1. Fact Extraction

Constructing knowledge graph to obtain the known facts

Types of Web content that contain relational information and can be utilized for knowledge extraction by different extractors: **text, tabular data, structured pages** and **human annotations.**

Source(s):

- Single-source knowledge extraction
  - Rely on one comparatively reliable source (e.g., Wiki)
  - Efficient ⬆, Knowledge completeness ⬇
- Open-source knowledge extraction
  - Fuse knowledge from distinct knowledge
  - Efficient ⬇, Knowledge completeness ⬆



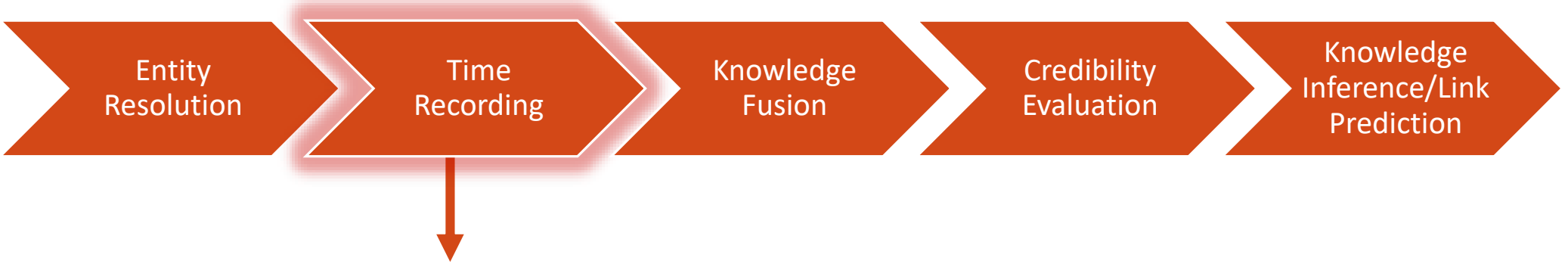
Use to reduce redundancy

- To identify mentions that refer to the same real-world entity, e.g.,

(DonaldJohnTrump,profession, President) & *(DonaldTrump, profession, President)*

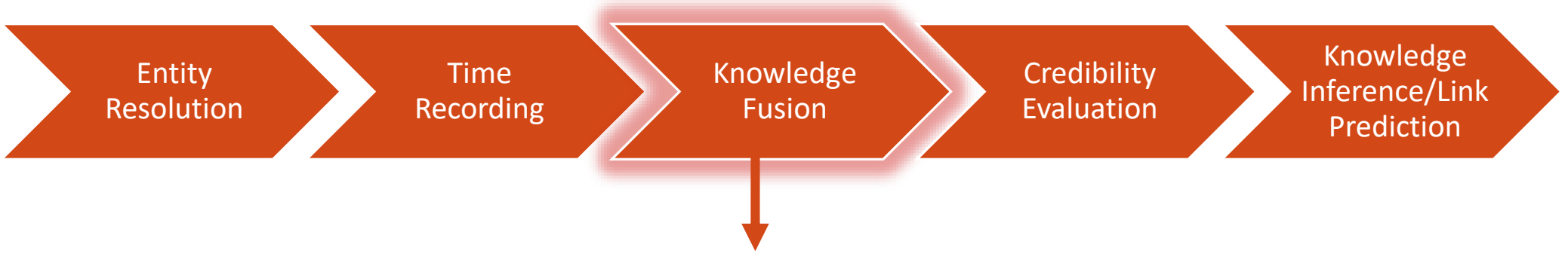
should be a redundant pair.

- Current techniques are often distance- or dependence-based.
- Often expensive (requires pairwise distance) computation
- Blocking/Indexing can be used to deal with complexity



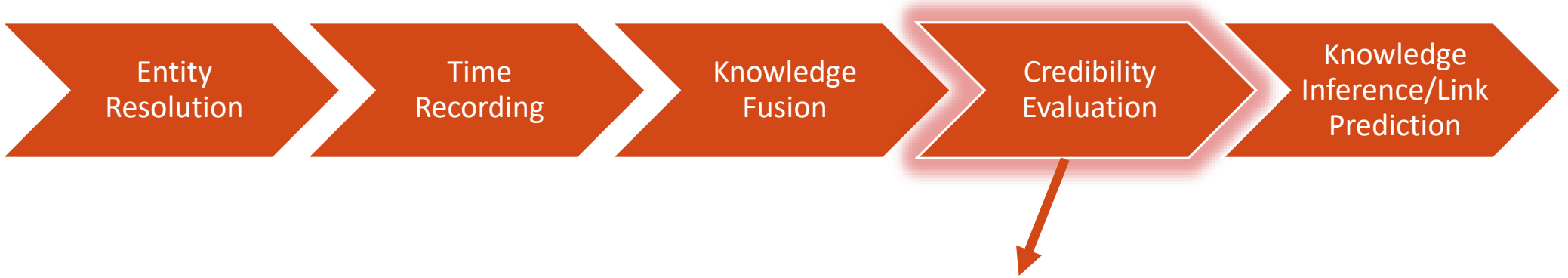
Use to remove outdated knowledge

- E.g., *(Britain, joinIn, EuropeanUnion)* has been outdated.
- Use Compound Value Type (CVT): facts having beginning and end dates



Use to handle conflicts (often in open-source knowledgeextraction)

- E.g., *(DonaldTrump, bornIn, NewYorkCity)* & *(DonaldTrump, bornIn, LosAngeles)* are a conflicting pair.
- Fix by having support values for facts (e.g., website credibility), or using ensemble methods
- Often correlated to (Credibility Evaluation Stage).



Use to improve the credibility of knowledge

- E.g., The knowledge extracted from The Onion.
- Often focus on analyzing the source website(s).

Use to infer new facts based on known ones

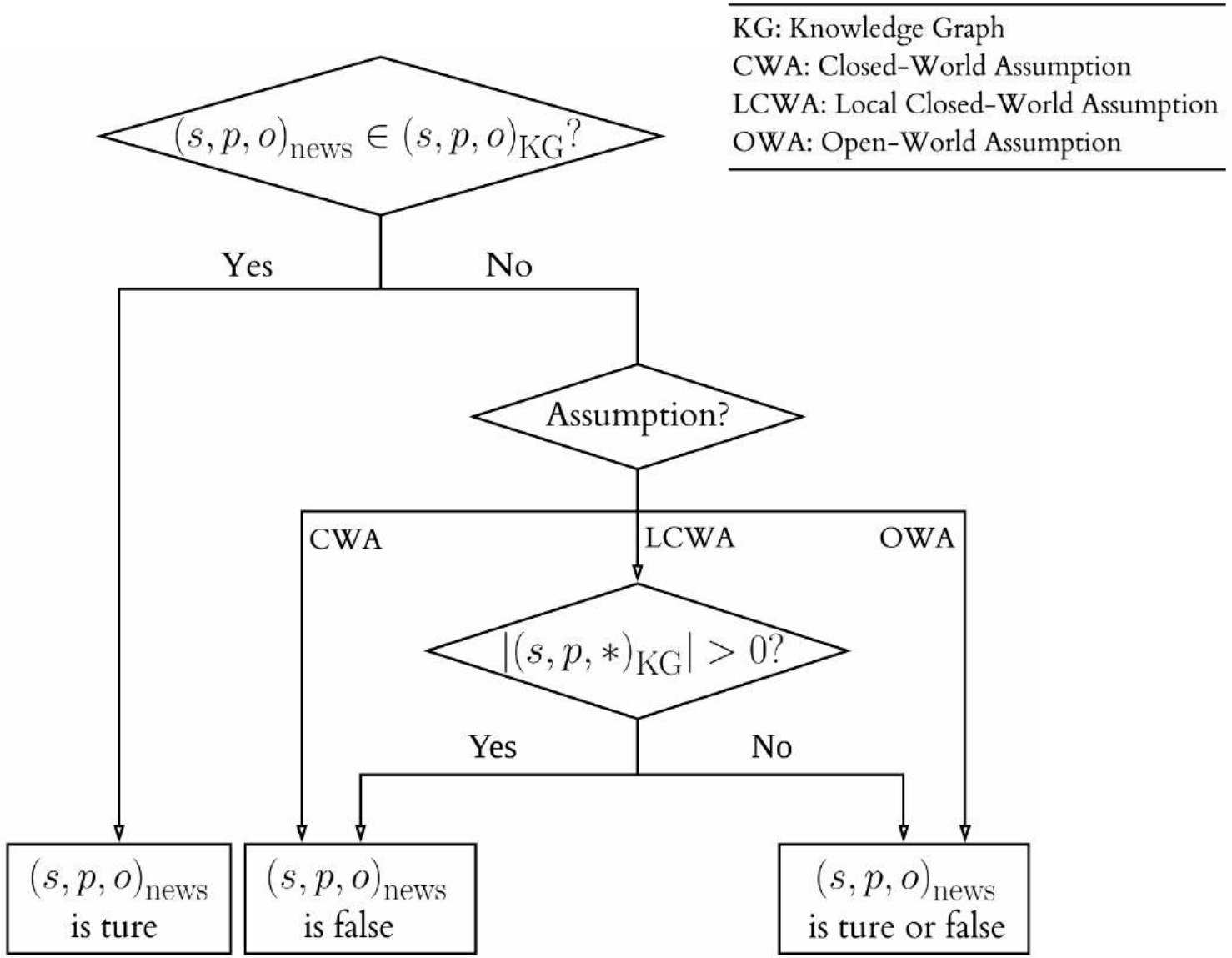
• Knowledge extracted from online resources, particularly, using a single source, are far from complete.

machine learning

- **Latent Feature Models,** e.g., **RESCAL**
- **Graph Feature Models**, e.g., **PRA**
- **Markov Random Field (MRF) Models**

Stage 2. Fact-checking

Comparing knowledge between news articles and knowledge graphs



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- Credibility-based Fake News Detection
- Fake News Datasets & Tools

Style-based Fake News Detection

Overview

Style-based fake news detection aims to assess news intention, i.e., is there an intention to mislead the public or not?

Fake news style:

A set of quantifiable characteristics (e.g., machine learning features) that can well represent fake news and differentiate fake news from truth.

Deception Analysis and detection

Deception Analysis and detection aims to investigate style of deceptive content across various types of information, e.g., online communications, reviews, statements and fake news.

Deception studies

- Deception style theories
  - Why content style can help investigate deceptions
- Style-based features and patterns
  - Can(well) represent and capture deception
- Deception detection strategies
  - How style can be utilized to detect fake news and other types of deceptive information.

Style-based fake news detection

A common strategy for style-based deception detection is to utilize a feature vector representing the content style of the given information within a machine learning framework to predict whether the information is deceptive (i.e., A classification problem) or how deceptive it is (a regression problem).

Training data

- A set of feature vectors with their corresponding labels: fake vs. normal

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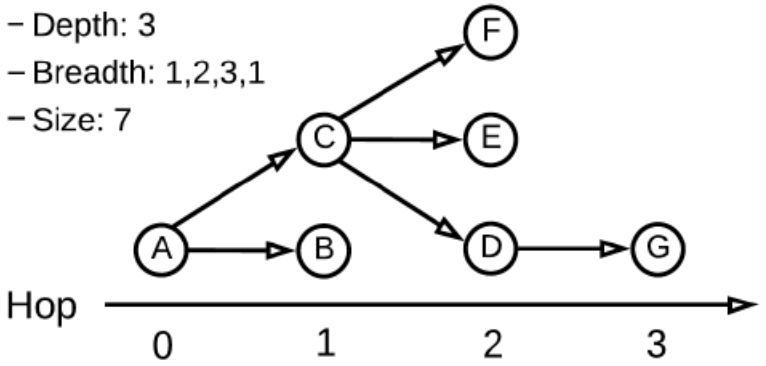
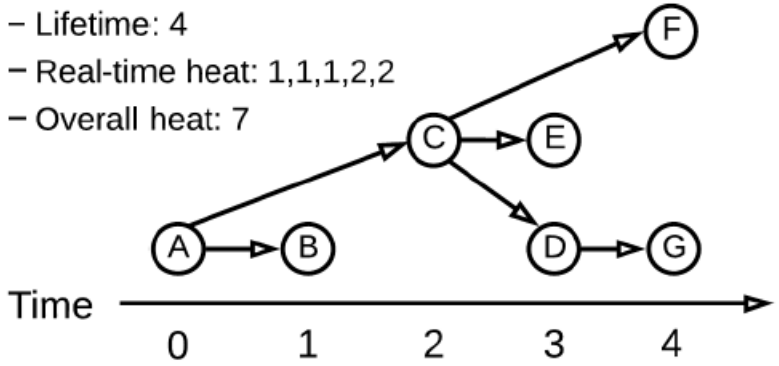
Propagation-based Fake News Detection

Studying fake news from a propagation-based perspective, related to the dissemination of fake news, e.g., How it propagates and users spreading it?

Formal representation of fake news propagation

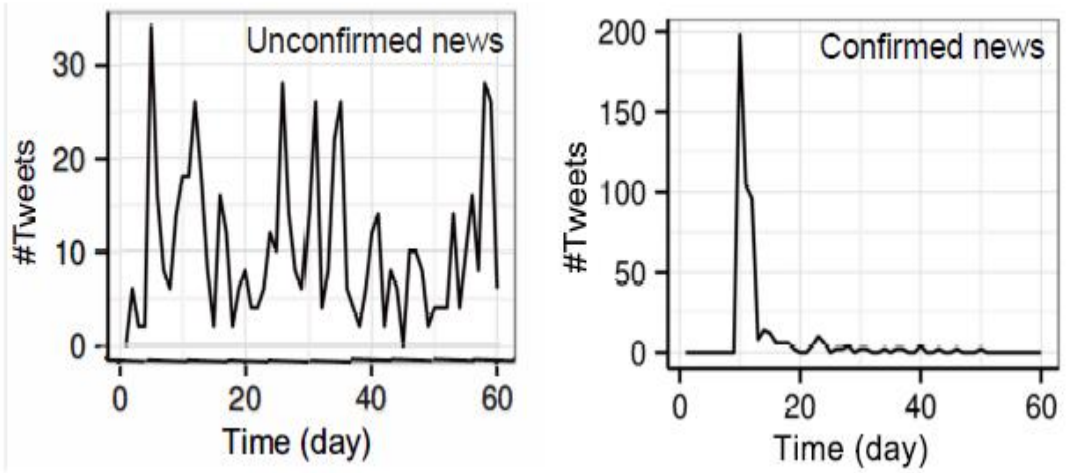
- Fake news cascade
  - A fake news cascade is a tree or tree-like structure that represents the propagation of a certain fake news article on a social network of users





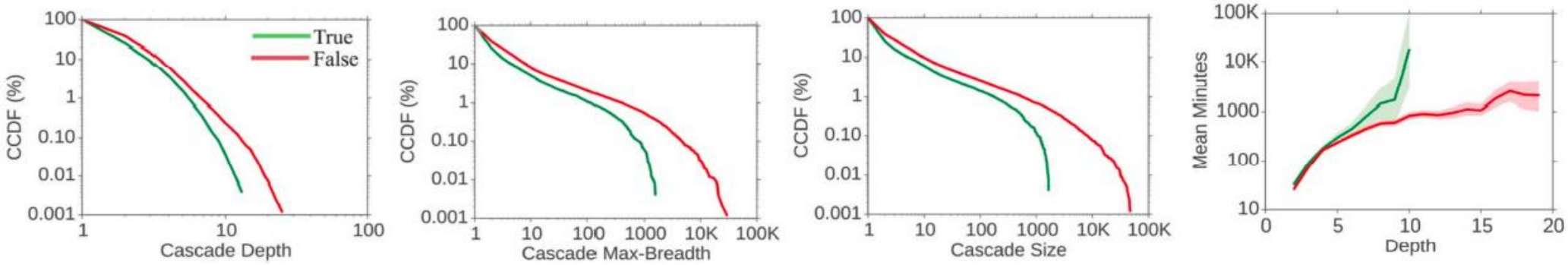
- Empirical patterns - a qualitative analysis
- Mathematical models - a quantitative analysis

Empirical patterns



Unconfirmed news often gets renoticed.

Empirical patterns



False news spreads farther, faster, and more widely than true news

Political false news spreads farther, faster, and more widely than false news

Mathematical models

A Modified Epidemic Diffusion Model

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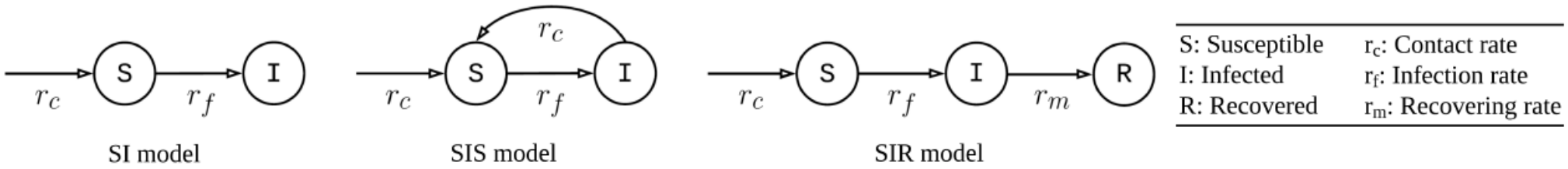

spreads online.

S (Susceptible, refers to those who are potential candidates, but are not yet infected with the disease)
I (Infected, refers to those who have been infected with the disease)
R (Recovered, refers to those who were infected with the disease but have recovered)

Modified Epidemic model

Step 1: Specifying States And Transition Rates

Step 2: Model Construction

Step 3: Identifying Transition Rates

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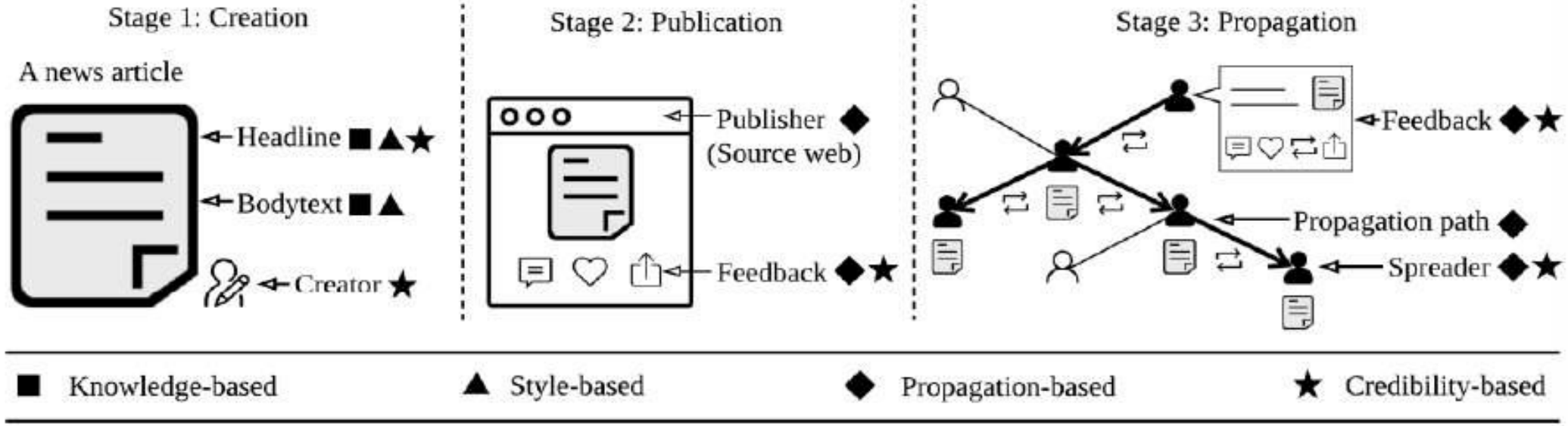
Credibility-based Fake News Detection

Studying fake news based on news-related and social-related

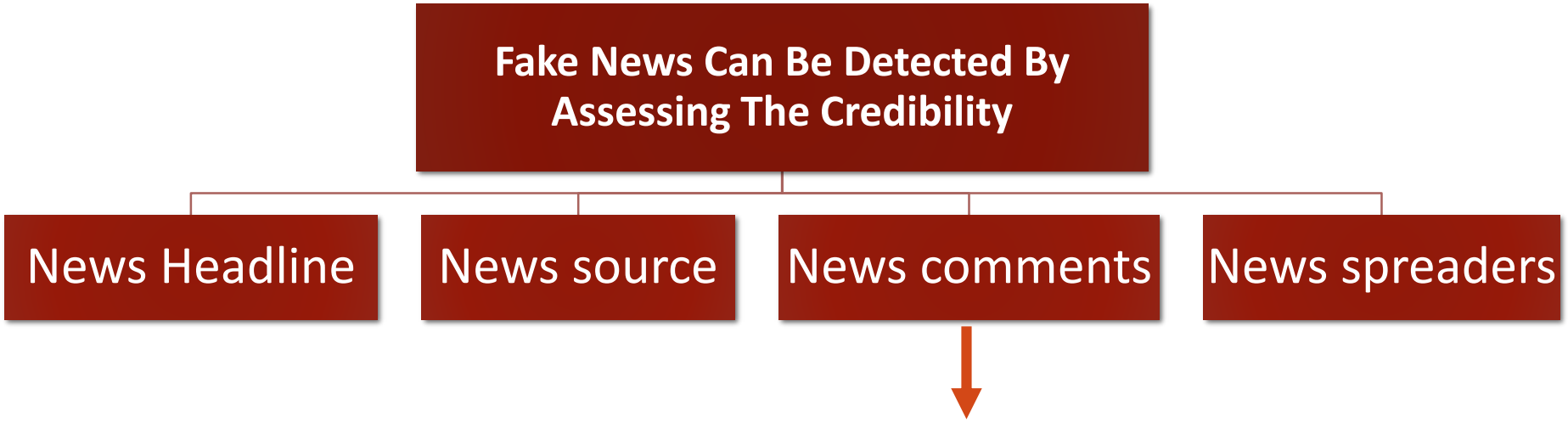
- News-related such as:
  - Headline
  - body-text
  - Creator
  - publisher
- Social-related such as:
  - comments
  - propagation paths
  - spreaders



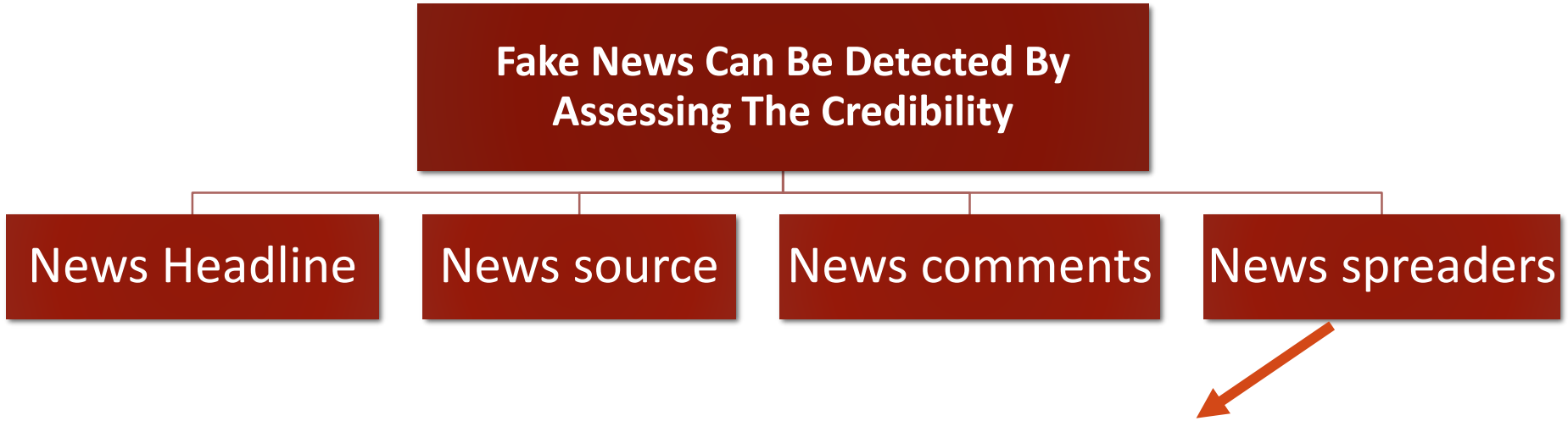
Credibility-based Fake News Detection

- **Clickbaits**
  - 23 things parents should never apologize for
  - Reduce attention and deep read

- **Web credibility analysis techniques**
  - PageRang Algorithm
  - HITS Algorithm
- Web Spam
- Set of content and link features within machine learning framework and inference in multi-layer probabilistic model



- User comments on news websites and social media carry invaluable information
- Classified into
  - content-based model
  - behavior-based model
  - graph(network)-based models



- Are able to engage in fake news dissemination in multiple ways such as sharing, forwarding, liking and reviewing.
- Malicious users, with low credibility
  - Bot
  - Troll
  - Cyborg
- Naive users, with relatively high credibility

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Fake News Datasets

Dataset	Include
BuzzFeed News	Complete sample of news published in Facebook from 9 news agencies over a week close to the 2016 U.S. Election from September 19 to 23 and September 26 and 27.
LIAR	12,836 human-labeled short statements, which are sampled from various contexts, such as news releases, TV or radio interviews, campaign speeches.
CREDBANK	60 million tweets that cover 96 days starting from october 2015


Thank
you

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