REPRESENTING MODALITY: A COMPLEX TASK

Approaches, Annotation Systems and Applications

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Introduction

Modality: a general framework

- Definition:

"Modality might be construed broadly to include several types of attitudes that a speaker might have toward an event or state"

Baker et al, 2010

Factivity
Did the event happen?

Evidentiality
Is the information reliable?

Sentiment
How does the speaker feel?

Example: different modalities

- GM will lay off workers
- A spokesman for GM said GM will lay off workers
- The politician claimed that GM will lay off workers
- GM may lay off workers
- Some wish GM would lay off workers
- Will GM lay off workers?
- Many wonder whether GM will lay off workers

Approaches: an overview

Linguistic approach: Palmer, 2001

Propositional modality
Truth-value or factual status

Epistemic:
Express judgment

Evidential:
Indicate evidence

Example:
'Charlie must be at home now'

Event modality
Events that have not happened yet

Deontic:
External impositions

Dynamic:
Internal willingness

Example
'Charlie must come in now'

Linguistic approach: Palmer, 2001

+ Further categories:

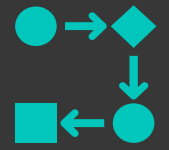
- Future
- Negative
- Interrogative
- Imperative-Jussive

- Presupposed
- Conditional
- Purposive

- Resultative
- Wishes
- Fears

Modality
Status of the proposition

Tense
Time



Aspect
Internal temporal constituency

Philosophy approach: Von Fintel, 2006

Definition:

"a category of linguistic meaning having to do with the expression of possibility and necessity"

Modal triggers

Modal auxiliaries
Charlie might be home

Adverbs
Perhaps Charlie is home

Adjectives
It is necessary that Charlie is home

Semimodal verbs
Charlie has to be home

Nouns
There is a possibility that Charlie is home

Conditionals
If it is evening, then Charlie is home

Philosophy approach: Von Fintel, 2006

Modality types: premises

Epistemic: what is known

'It has to be cold' (there are people wearing winter coats)

Deontic: set of laws/moral principles

'Students have to book a seat' (library regulation)

Bouletic: desires

'I have to pass this exam' (student who wants good grades)

Circumstantial: set of circumstances

'You have to call the doctor' (you are currently sick)

Teleological: a goal + means to reach it

'To go to work without getting wet, you have to drive your car'

! Same trigger can express different modalities !

Logic approach: Portner, 2009

Idea: classify modality based on its level

Sub-sentential

Constituents smaller than a clause

Modal adjectives, nouns, attitude expressions, infinitives, negative polarity, verbal mood

Sentential

The whole clause

Modal auxiliaries and adverbs, conditional sentences

Discourse

Set of clauses

'I might go to the library. I should return this book' (if I go to the library, then I should return the book)

Modality and Negation

Interaction with Negation

 Not thoroughly studied, but gives rise to curious phenomena

 English verb may + negation

- 'He may not have any cake' (deontic, "not allowed") → modality scope of negation
- 'He may not be home' (epistemic, "possible that not") → negation scope of modality

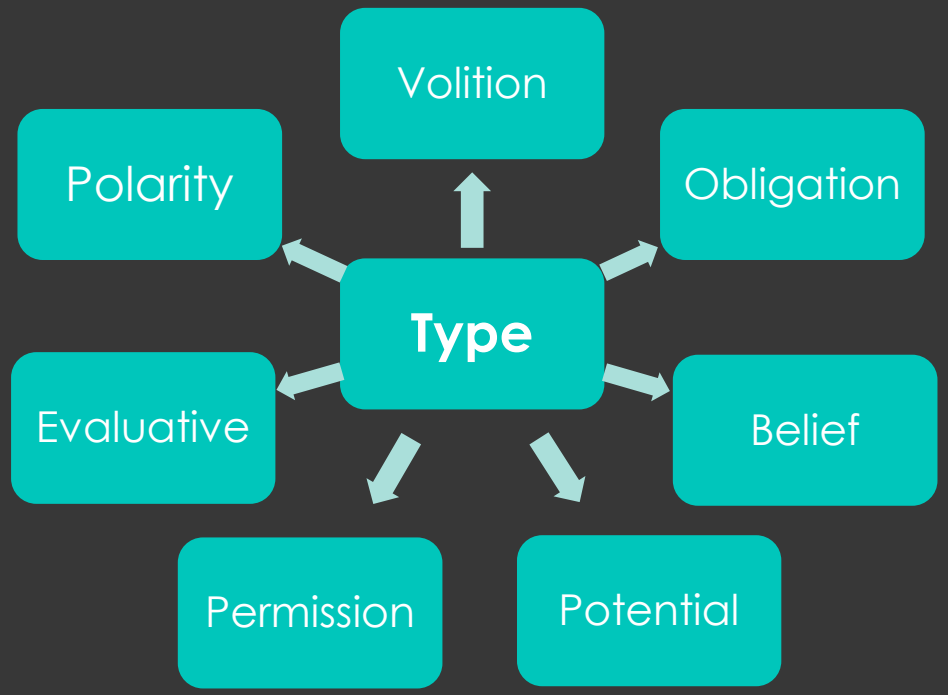
 English must vs German müssen

- 'He must not stay home' ("obligatory that not") → negation scope of modality
- 'Er muss nicht zuhause bleiben' ("He doesn't have to stay home.") → modality scope of negation

Annotating Modality

OntoSem project (Nirenburg and Raskin, 2004)

- General purpose lexical-semantic analyser
- Encodes modality information



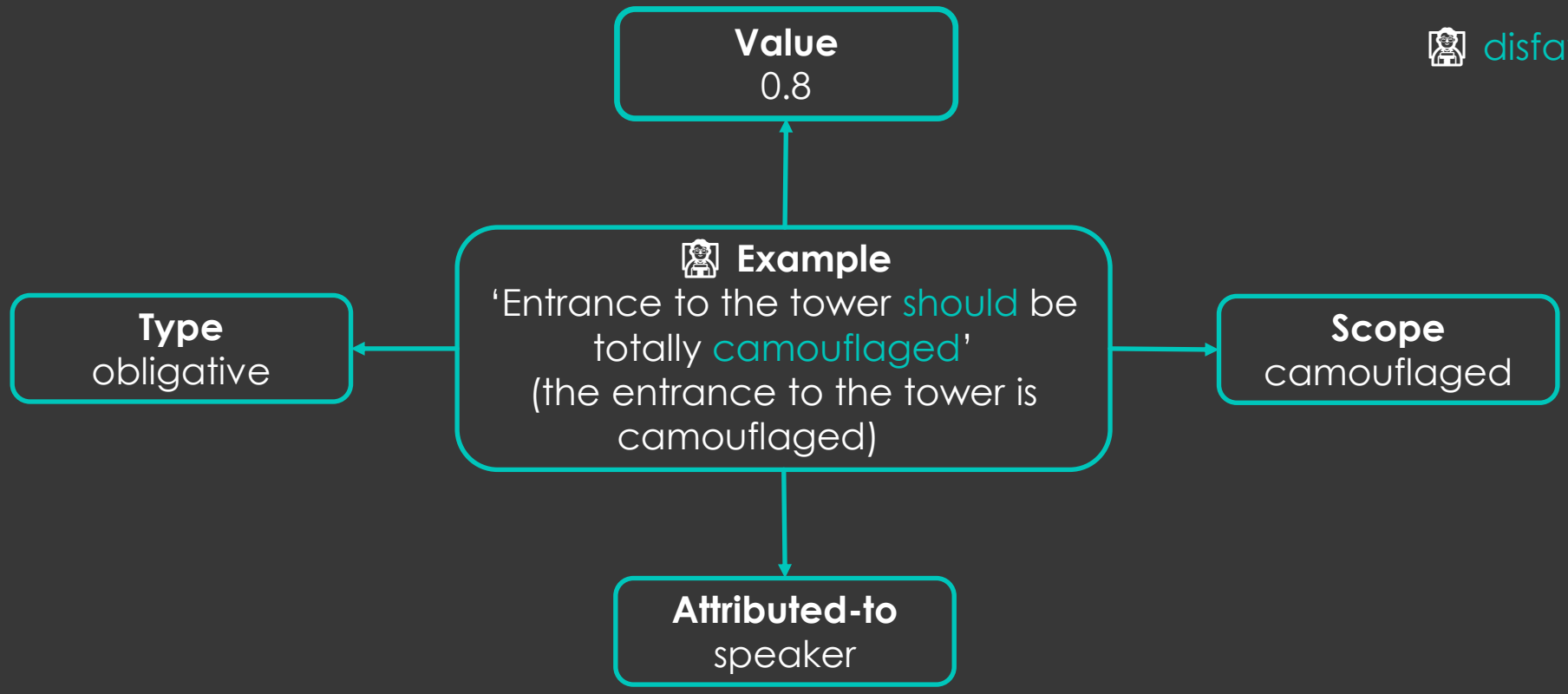
Value → Between 0 and 1

Scope → Predicate affected

Attributed-to → Default: speaker

OntoSem project (Nirenburg and Raskin, 2004)

! Value attribution arbitrary but useful for relative comparisons
disfavour lower than adore (evaluative scale)



Modality Lexicon (Baker et. Al, 2010)

Focus on factivity
P = proposition, H = holder

Requirement
Does H require P?

Success
Does H succeed in P?

Ability
Can H do P?

Belief
With what strength does H believe P?)

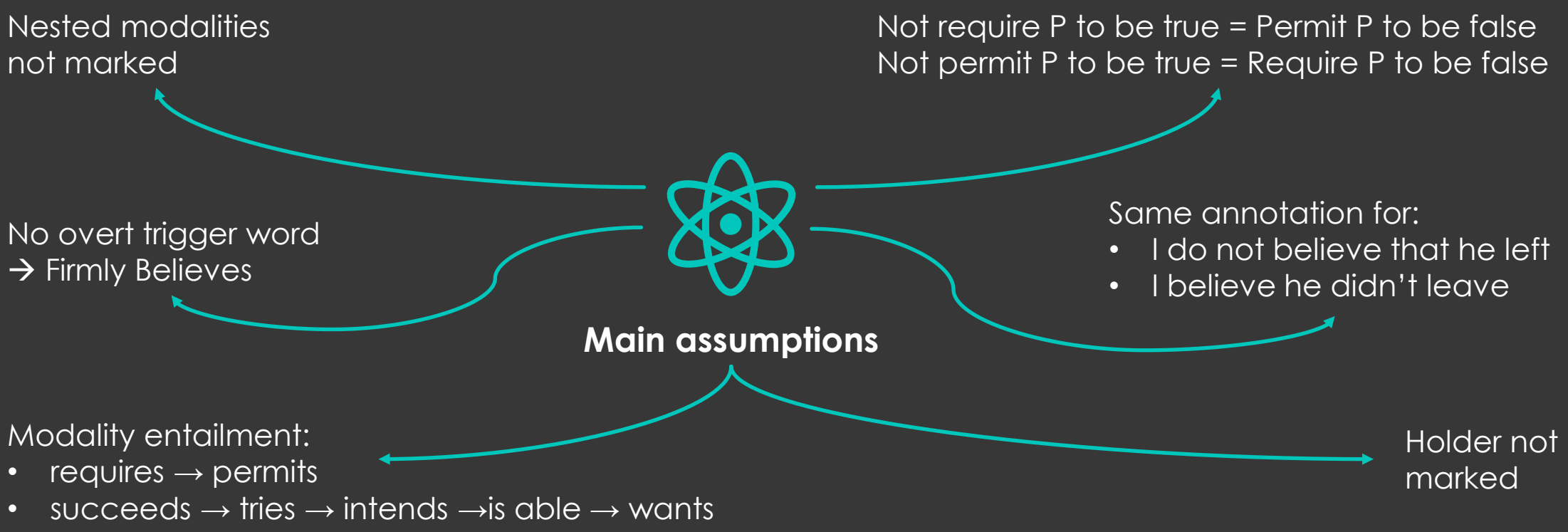
Permission
Does H allow P?

Effort
Does H try to do P?

Intention
Does H intend P?

Want
Does H want P?

Modality Lexicon (Baker et. Al, 2010)



Modality Lexicon (Baker et. Al, 2010)

Lexicon entry

- **String**: one or more words
- **Part of speech**: for each word in the string, to avoid irrelevant homophones
- **Modality**: one of the modalities above
- **Trigger (head word)**: primary phrasal constituent in case of multiword strings
- **Subcategorization codes**: one or more, structural relationship of targets to triggers for verb types

Modality Lexicon (Baker et. Al, 2010)

Example entry

String: Need
Pos: VB
Modality: Require
Trigger: Need
Subcat: **V3-passive-basic** – The government is needed to buy tents.
Subcat: **V3-I3-basic** – The government will need to work continuously for at least a year. We will need them to work continuously.
Subcat: **T1-monotransitive-for-V3-verbs** – We need a Sir Sayyed again to maintain this sentiment.
Subcat: **T1-passive-for-V3-verb** – Tents are needed.
Subcat: **Modal-auxiliary-basic** – He need not go.

Example sentence tag

Input: Americans should know that we can not hand over Dr. Khan to them.

Output: Americans <TrigRequire should> <TargRequire know> that we <TrigAble can> <TrigNegation not> <TargNOTAble hand> over Dr. Khan to them.

Related Tasks

Modality-related tasks

Speculated Sentences Detection

💡 Where is uncertainty expressed in the text?

🐵 'The drug could potentially reduce symptoms'

Scope Resolution

💡 Which words are affected by the modality?

🐵 'I might call you tomorrow' → scope can be whole sentence or only the verb 'call'

Speculated Events Detection

💡 What events are uncertain?

🐵 'The launch might be delayed' → the event is the launch

Modality-related tasks

Modality Tagging

💡 Which modality is expressed by the words?

🤦 'Are allowed to enter' → permission
🤦 'Should consider' → suggestion.

Belief categorization

💡 Which level of belief does the speaker express?

🤦 'I believe the results are accurate' → personal belief
🤦 'The results are confirmed' → certainty

Contradiction and Contrast Processing

💡 Are contrasting modalities expressed?

🤦 'He claimed to be at work, but his colleague said he was absent'

Applications

Modality applications

Sentiment Analysis

💡 Identify sentiment behind text, strength, scope

🤖 'I absolutely love the new features of this app, but the customer service can be unhelpful': positive towards features, negative towards service

Textual Entailment

💡 Recognize if truth of a fragment follows from another one

🤖 'John must submit the report by Friday' entails 'John is required to submit the report this week'

Machine Translation

💡 Preserve nuances of modality when translating

🤖 Translation of 'You shouldn't park here' must convey prohibition accurately

Modality applications

Text mining

💡 Extract information and patterns from text

👩 Mining customer feedback to identify common issues

Structure Identification in Scientific Papers

💡 Analyse and summarize sections of scientific text

👩 'This study aims to prove' → introduction
👩 'The data confirms' → results

Trustworthiness Detection

💡 Evaluate reliability of information through modality triggers

👩 Reliability of rumour in social media

Symbolic Representation

Review

Rule-based systems with different strategies of identification

Dependency parsing
Look at relationship between elements

Modality word is the head

POS tags
Identify patterns and disambiguate

' The medicines were in strong need' → POS: noun, no modality

Trigger words
List of words that signal modality

'need', 'must', 'should'

Regular expressions
Identify patterns associated with modality statements

Logical languages
Use formal logic constructs to represent modalities

Modal Logic

🏛 Classical

- **Necessity** operator: □

   ‘It is necessary that John cooks’
  → □ Cooks(John)

- **Possibility** operator: ◇

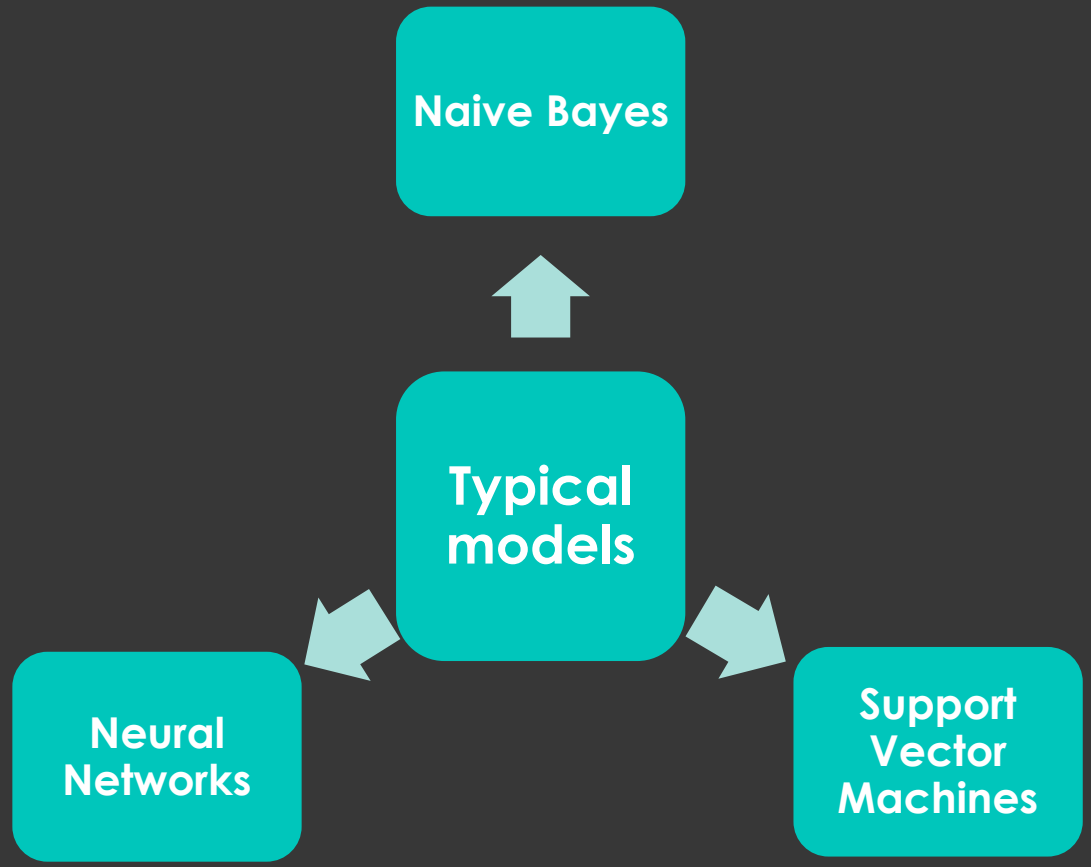
   ‘It is possible that John cooks’
  → ◇ Cooks(John)

🧬 Evolution

- Obligation
- Permission
- Belief
- Temporal dimension

Statistical Representation

Review



! Heavy **dataset dependence**

Feature engineering is fundamental

Feature engineering for modality

Sentiment Scores

Reflect sentiment through quantitative measures (positive, negative, neutral)

Classify overall mood

Affective Lexicons

Collection of words associated with emotions and strength (strength, polarity)

Identify specific moods

Psycholinguistic features

Features derived from psychological research on language processing (concreteness, valence, arousal, …)

Predict further emotional impact

Syntactic Features

Capture structure of sentence and grammatical relations (POS tags, phrase structure, grammatical relations, …)

Indicate modality, negation, …

Feature engineering for modality

Semantic Features

💡 Capture meaning through semantic features (role labelling, word-sense disambiguation, …)

🛠 Understand context impact on mood

Pragmatic Features

💡 Consider context of communication (intent, politeness, formality, …)

🛠 Understand degree of belief and mood

N-grams and Collocations

💡 Capture sequences of N words and their frequency of co-occurrence

🛠 Detect idioms and fixed phrases

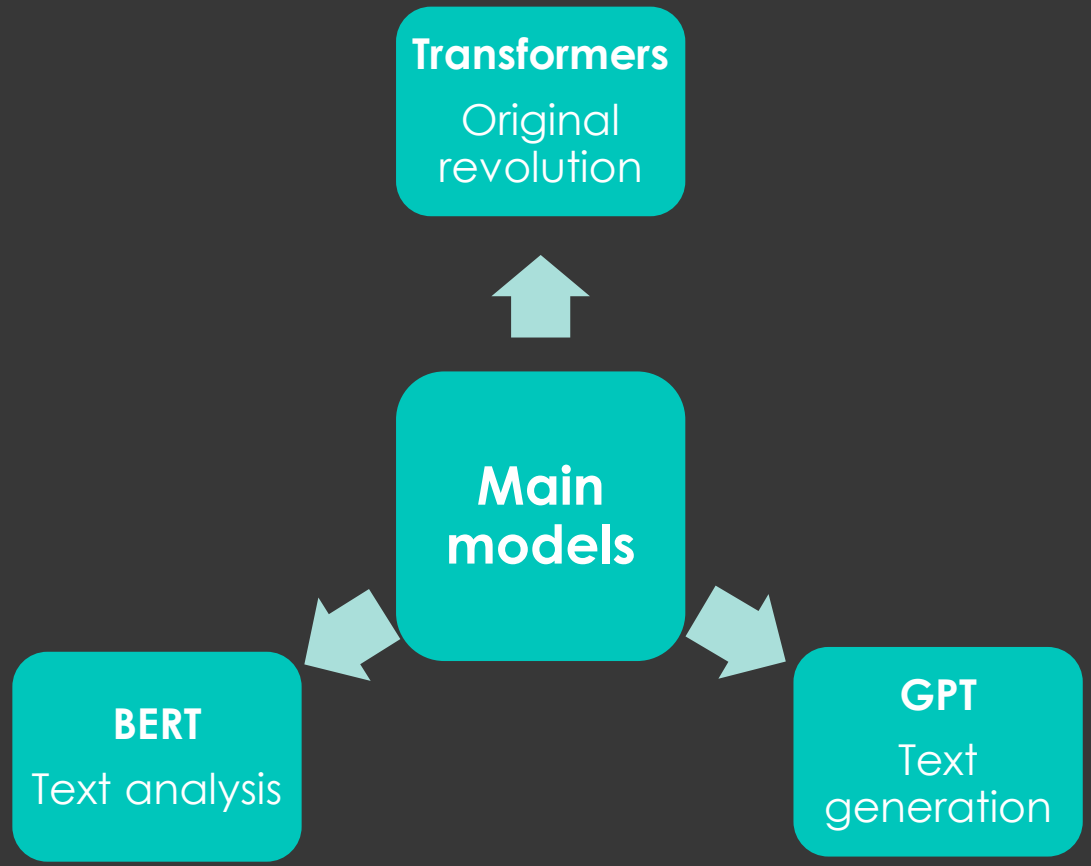
Negation and Intensifiers

💡 Words modifying intensity of emotion or reversing polarity

🛠 Critical for accurate mood detection

LLMs Representation

Review



Word Representation

High-dimensional, contextualized vectors

Main Features

- Attention mechanism
- Positional Encoding
- Large Datasets
- Fine-Tuning

Ethics and Society implications

Bias and Fairness

⚠ Systematic errors that create unfair outcomes

🤖 Misinterpreting expressions of emotions in a certain language, leading to incorrect assessments of mood

- Discrimination
- Diversifying training data

Emotional Manipulation

⚠ Systems may use mood detection to influence users' behaviour

🤖 A music streaming service plays music according to mood to maximize the users' time on the app

- User manipulation
- Establishing ethical guidelines

Mental Health

⚠ Systems may obtain information regarding the mental state of a user

🤖 An app that can alert a specialist in case it detects an unstable mental state in the user

- Misinterpretation
- Ensure that these systems are always carefully monitored by humans

Ethics and Society implications

Accountability and Transparency

⚠ Systems are not clear in explaining their decision and are not responsible for their mistakes

🤦 A candidate can be rejected based on a wrong mood detection
🟤 Mistrust and harm
🟤 Strict regulations on such systems

Surveillance and Monitoring

⚠ LLMs can facilitate the systematic observation of individuals

🤦 Monitoring employee communications leading to punishment
🟤 Fear and self-censorship
🟤 Strict regulations on surveillance

Long-Term Societal Effects

⚠ Widespread use of systems may have lasting effects on society

🤦 People altering their online behaviour to conform to norms
🟤 Homogenization of individual expression
🟤 Public discourse, ethical use, regulations

Conclusion

Conclusion

LLMs have changed everything. Compared to previous methodologies, they have been capable of representing modality like never before

Benchmarks confirm that there still a lot to do

The future of AI is a mystery, and nobody really knows what will happen in the long and short term

References

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THANK YOU FOR YOUR ATTENTION!

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