Machine Translation Research in META-NET

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Outline

- **Pillar I in META-NET**
  - …the research element of META-NET
- **Semantics in Machine Translation**
  - Semantic features in statistical MT
  - (Semantic) Tree-based translation
- **Hybrid MT systems**
  - Rule-based and statistical
- **Context in MT**
  - „Extra-linguistic“ features
- **More data for MT**
  - Parallel data for under-resources langauges
- **Related projects & the Future**

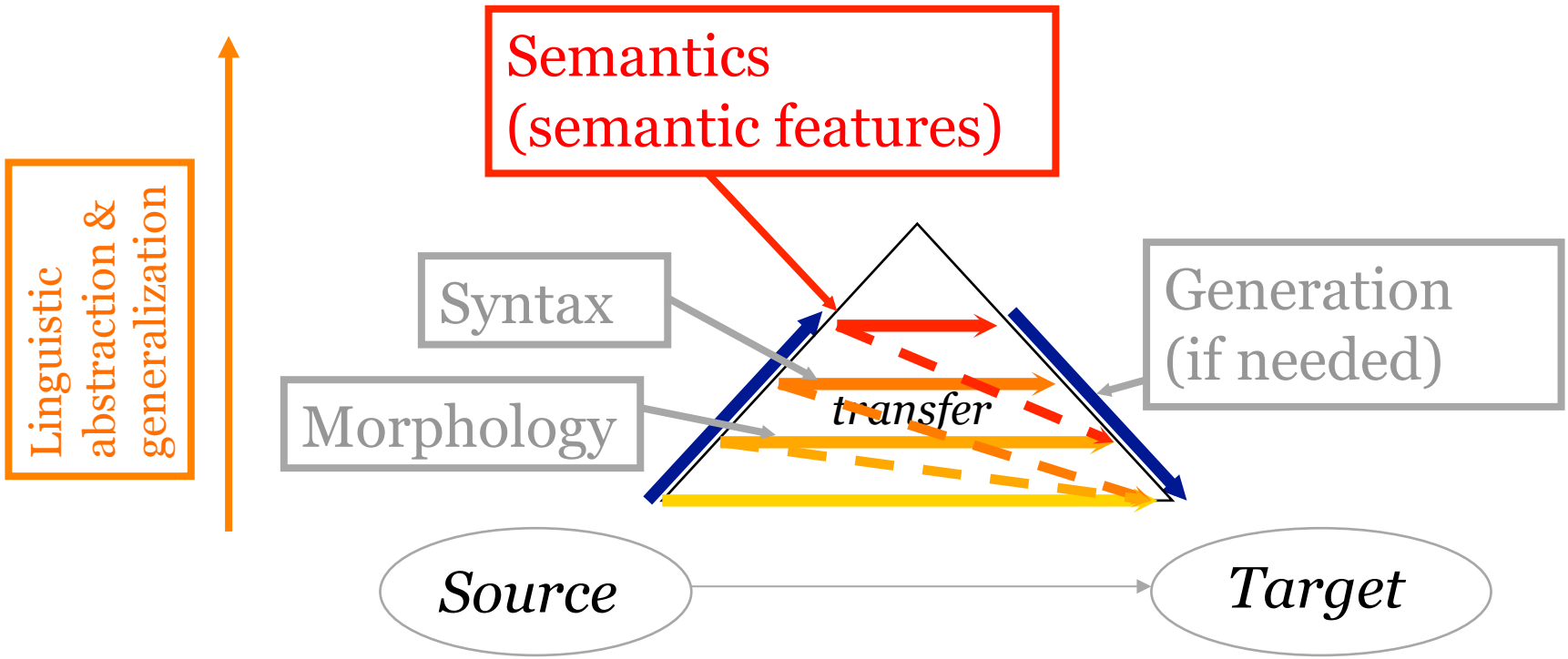
Semantics in Machine Translation

Semantics in Machine Translation

- **What is semantics, anyway?**
  - For now: anything beyond and outside morphology and syntax
    - Semantic Roles (words vs. predicates)
    - Lexical Semantics (WSD), MWE
    - Named Entities
    - Co-reference (pronominal, bridging anaphora)
    - Textual Entailment
    - Discourse Structure
    - Information Structure … + any combination of the above
- **New metrics**
  - BLEU, METEOR, NIST etc. biased towards (good) local n-grams
  - Metrics sensitive to semantics?
- **Tools and Resources**
  - Semantically annotated parallel corpora; metrics tools, analysis tools

Semantics in Machine Translation

- **Analysis – transfer [– generation]**



Semantics in Machine Translation

- **Case Study 1**
  - Cross-lingual Textual Entailment for Adequacy Evaluation

    Y. Mehad, M. Negri, M. Federico: *Towards cross-lingual textual entailment*, NAACL 2010
- **Case Study 2**
  - Combined Syntax and Semantics for MT Transfer

    D. Mareček, M. Popel, Z. Žabokrtský: *Maximum Entropy Translation Model in Dependency-Based MT Framework*, WMT / ACL 2010
- **Case Study 3**
  - Anaphora Resolution for translation of pronouns

    C. Hardmeier, M. Federico: *Modeling Pronominal Anaphora in Statistical MT*, IWSLT 2010.
- **Case Studies → Selected Challenges**
  - Evaluation of impact of individual additions
    - Evaluation data with/without phenomenon under study
    - Automatic vs. human evaluation

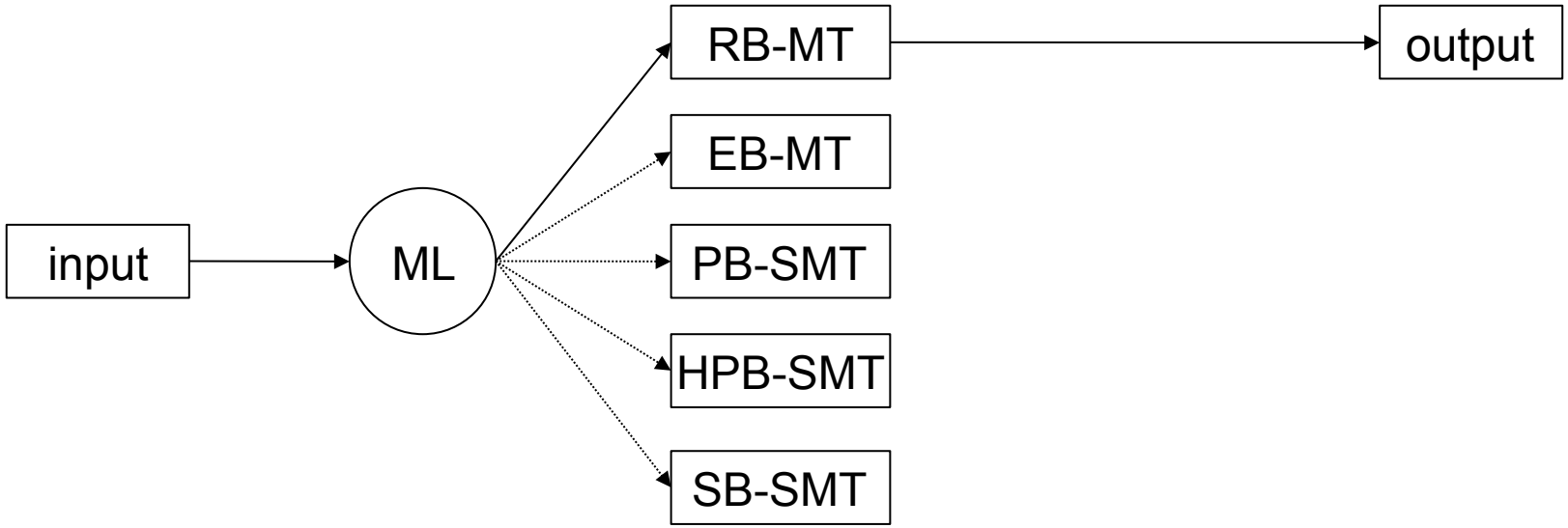
Hybrid MT Systems

Machine Translation Paradigms

- RB-MT – Rule-Based Machine translation
- EB-MT – Example-Based Machine Translation
- SMT – Statistical Machine Translation
- PB-SMT – Phrase-Based Statistical Machine Translation
- HPB-SMT – Hierachical Phrase-Based Statistical Machine Translation
- SB-SMT – Syntax-Based Statistical Machine Translation
- …
- **Observation:** Different systems have different strengths (e.g., easy training of SMT vs. good grammar of RB-MT)
- **Hypothesis:** Hybrid systems can combine best of all

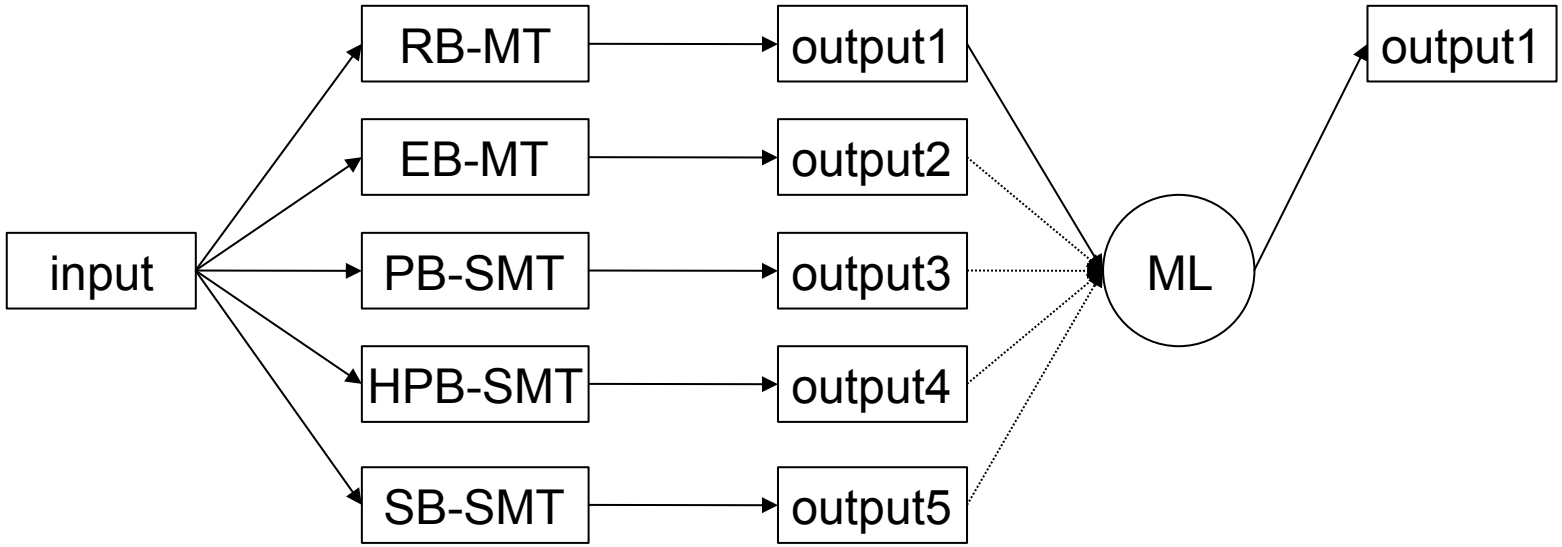
Hybrid MT: Pre-Translation System Selection

- **Multiple MT engines/systems available**
- **Machine learning techniques**
  - decide which system is best to translate the input sentence



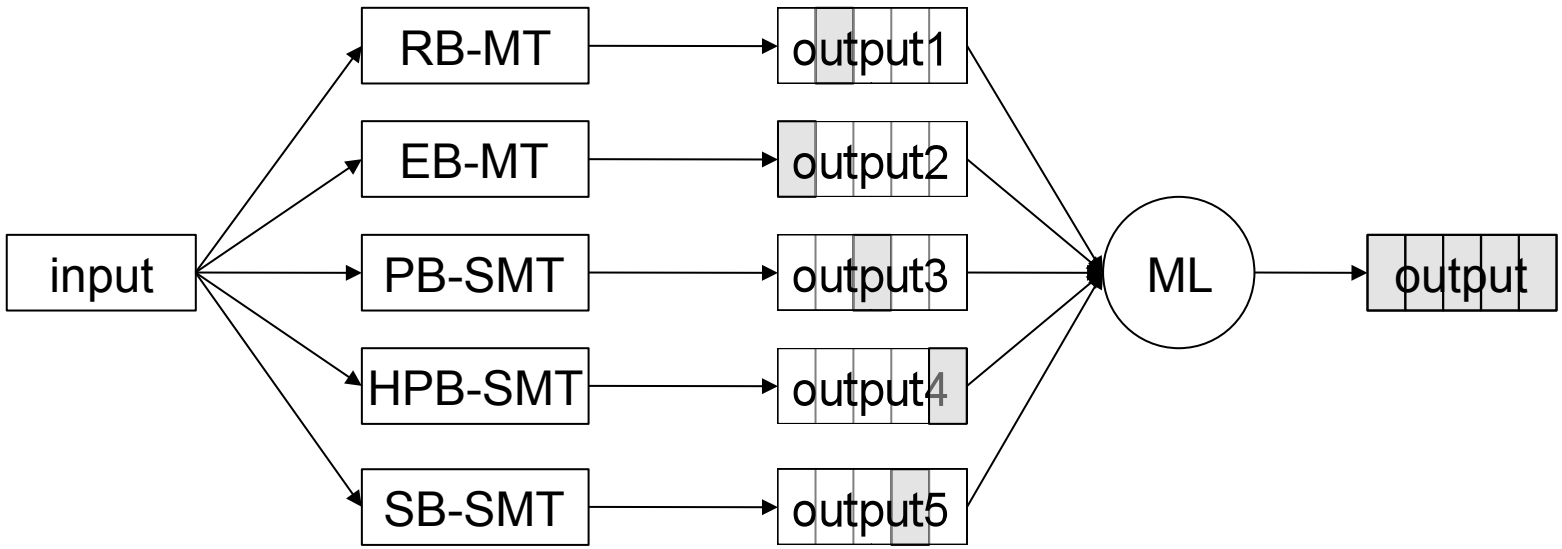
Hybrid MT: Pre-Translation System Selection

- **Multiple MT engines/systems available**
- **All systems translate**
  - Analysis of ouptuts → select translation



Hybrid MT: Pre-Translation System Selection

- **Multiple MT engines/systems available**
- **All systems translate**
  - Translation compiled from analyzed pieces

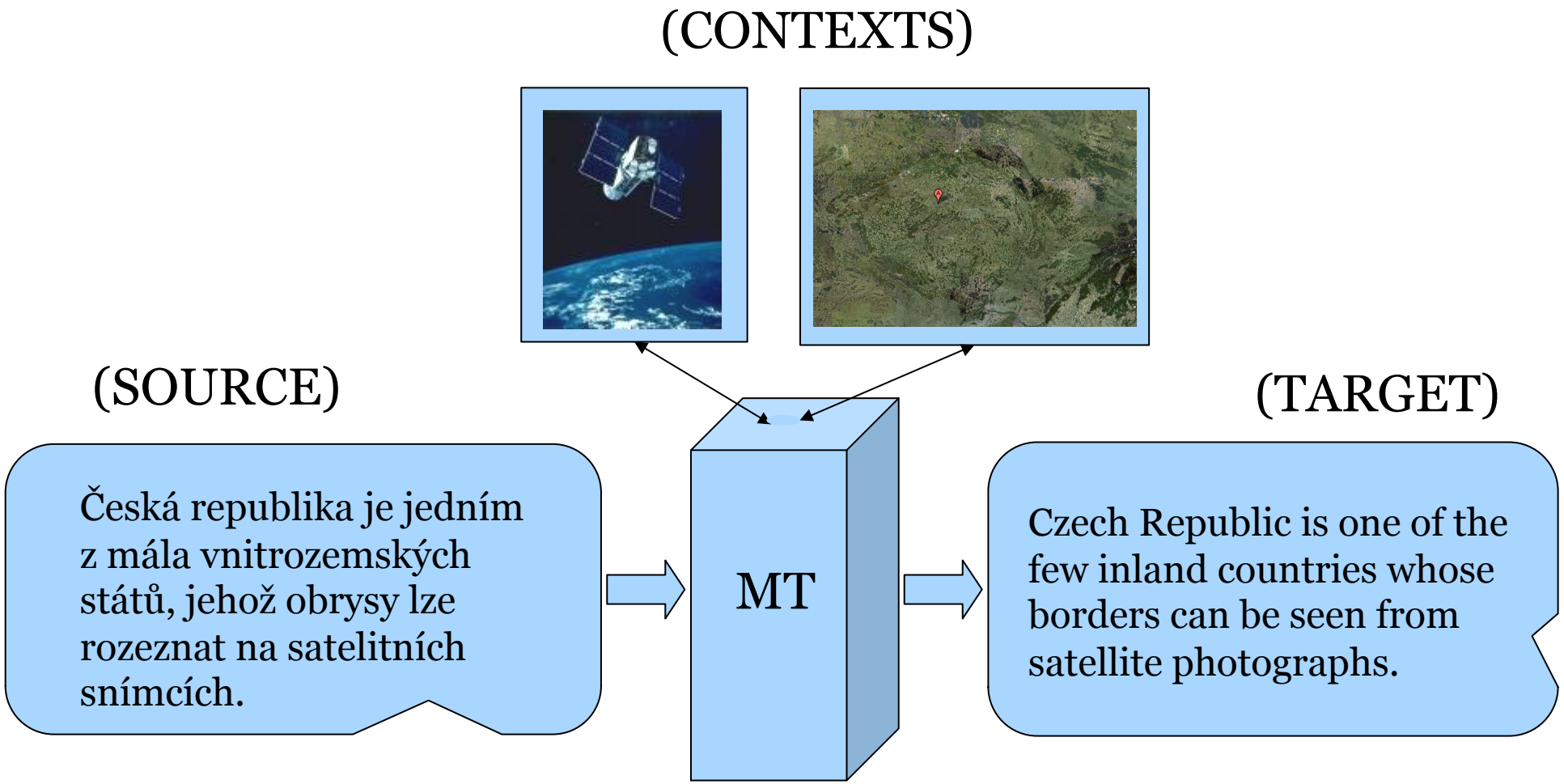


The META-NET Hybrid System Approach

- Based on system combination
- Multiple systems based on different paradigms used to produce annotated n-best outputs:
  - **Matrex (example based):** all language pairs ↔ English
  - **Moses (phrase based):** all language pairs ↔ English
  - **Metis (rule based):** Spanish → English, German → English
  - **Apertium (rule based):** Spanish ↔ English
  - **Lucy (rule based):** Spanish, German ↔ English
  - **Joshua (hierarchical phrase based):** all language pairs ↔ English
  - **TectoMT (deep syntax based):** Czech ↔ English
- **Annotation:** words, phrases, subtrees, chunks scored by different models (depending on the system)
- **Decoding:** machine learning techniques used to recombine those to get better output

Context in Machine Translation

Increase MT quality and services in multimodal context



Context in Machine Translation

- **Domain adapted language and translation models**
  - Method
    - Large corpus divided in predefined domains
    - Train translation and language models on each domain
    - Train additional language models on the predefined domains
    - Train a classifier to classify incoming documents to a domain
    - Decode using respective translation and language models
    - Evaluate results and revise method if necessary
  - Resources
    - JRC-Acquis & Eurovoc
    - Europarl
  - Innovation
    - Design, implement and fine-tune classification algorithms
    - Explore ways to effectively combine language and translation models

Context in Machine Translation

- **Context in statistical morphology learning**
  - *O. Kohonen, S. Virpioja, L. Leppänen and K. Lagus (2010): Semisupervised Extensions to Morfessor Baseline*
- **Multimodal context in translation**
  - Research questions:
    - Which kind of multimodal contextual information can be used to advance MT quality? How to better access multimodal information?
    - In which MT applications multimodal information is useful?
  - Current target: enhancing language and translation models with visual and textual context data and ontological knowledge
    - Use cases: translation of figure captions, translation of subtitles, MT in extended reality applications, robotics applications

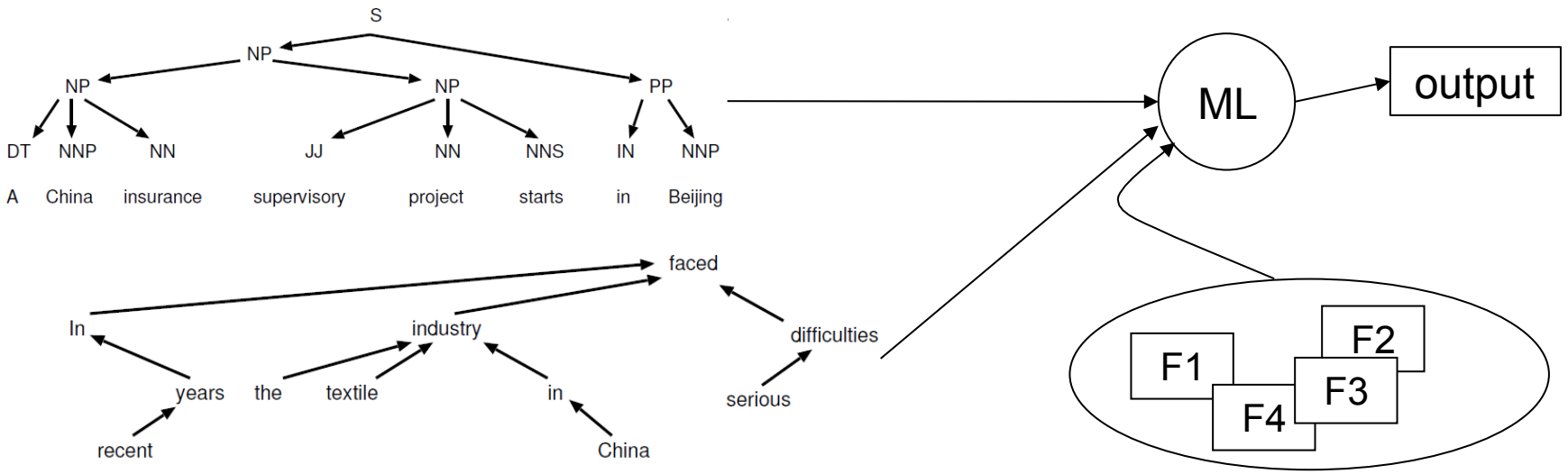
Context in Machine Translation: 2011 Challenge

- **Data**
  - JRC Acquis corpus, 22 European languages
  - Translations by the state-of-the-art statistical systems
- **Tasks**
  - To choose to the best translation from a set candidate translations by multiple systems (reranking task)
  - Context is given by the source sentence, larger linguistic context and the domain of the text
- **Goals**
  - To discover the set of best context features, find representation
  - To foster collaboration between MT and Machine Learning (ML) researchers; infuse MT research with advances from the ML field
- **Future Challenge: 2013**
  - Using visual context (images)

Data and Machine Learning for MT

Data and Advanced Machine Learning in MT

- **"There is no data like more data"**
  - Data crawling, cleanup, deduplication, …
  - Available through META-SHARE
- **Advanced Machine Learning Experiments**
  - Combining several previously described approaches



Related Projects

EU 7th FP Machine Translation (selected projects)

- **EuromatrixPlus**
  - Machine Translation in general – now 8 selected languages (Czech, English, French, Spanish, German, Italian, Slovak, Bulgarian)
- **FAUST**
  - Improving fluency, incorporating user feedback (fast)
  - French, English, Czech, Spanish
- **ACCURAT**
  - Using comparable corpora, esp. for low-resource languages
  - Estonian, Croatian, ...
- **LetsMT! (PSP)**
  - Building of data resources (low-resourced languages)
  - For business and research
- **Panacea**
  - Building Resources & Language Tools
  - Tools + Resources → Automatically analyzed corpora
- **Khresmoi (IP)**
  - Medical information retrieval for patients and practitioners
  - Cross-language (English, German, Czech, French) ← MT

The Future

The Future

- **Resources, resources, resources**
  - … and their availabilty (META-SHARE)
- **Novel, high-risk research**
  - Linguistics
    - Unclear “which linguistics”, but some
  - Language Understanding
    - Context, domain knowledge (ontologies?), other modalitites
  - … but SMT is here to stay (in some form)
    - … even though we might not recognize the current “kitchen-sink” paradigm a few years from now
  - New algorithms
    - Neural networks (finally?), Genetic algorithms, Brain research, …
  - Better [automatic] evaluation to guide progress
- **Commercial Applications**
  - Post-editing (CAT) tools with integrated (S)MT, novel features, ergonomics
  - Multilingual information access, information extraction, summarization, sentiment

Q/A

Thank you very much.

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