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Roadmap for European MT Research

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1 Overview

The fast and unexpected success of Neural Machine Translation (NMT) started in research in 2014/2015 and has significantly disrupted the field in 2016, which can be seen, e.g., in the WMT challenges where, already in 2016, half of the winning systems were based on neural technologies. The trend towards neural MT systems is also evidenced by a rapid uptake of research into neural approaches by big industrial players, MT service providers, LSPs, and other stakeholders.

Due to the neural disruption, the plan of continuing the "MT Research Roadmap" activity that had been started with the META-NET Strategic Research Agenda for Multilingual Europe 2020 (prepated in 2011/2012 and published in January 2013) and that had been continued in the QTLaunchPad and QTLeap projects has been put on hold for a while. It was clear to the community that first toolkits were needed that are now existing such as Nematus, NeuralMonkey, or OpenNMT. The collaboration among projects within the Cracking the Language Barrier initiative (including QT21, HimL, and MMT) has supported exchange and communication in this phase of rapid learning, change and development.

At META-FORUM 2017, a panel discussion moderated by Josef van Genabith (DFKI) was convened at a time where a sufficient amount of insights into NMT and the opportunities and scientific challenges had been gathered to take up the roadmapping activity again. The panel assembled some of the best and most cited European MT researchers and also tightened the collaboration between QT21 and CRACKER in terms of forecasting and planning next steps and future developments. The panelists whose contributions have been worked into the roadmap were:

- Bill Byrne (University of Cambridge, UK)
- Tony O'Dowd (KantanMT, Ireland)
- Marcello Federico (Fondazione Bruno Kessler, Italy)
- Hermann Ney (RWTH Aachen University, Germany)
- Lucia Specia (University of Sheffield, UK)
- Andrejs Vasiļjevs (Tilde, Latvia)
- Alex Waibel (Carnegie Mellon University, USA; Karlsruhe Institute of Technology, Germany

The roadmap presented below is a completely revised version of the previous roadmap which was prepared before the breakthrough of neural MT. The roadmap was shared with those bodies that have previously worked on the roadmap, most importantly the:

- SRIA Version 1.0 Editorial Team,
- the META-NET Executive Board and
- Cracking the Language Barrier federation.

Comments gathered from these stakeholders were included in the version of the roadmap presented in this deliverable.

2 Roadmap

Roadmap for European Machine Translation Research

Research Priority	Phase 1: 2018-2019	Phase 2: 2020-2024	Phase 3: 2025-2030
Immediate affordable translation for any needed application	Further exploration and finetuning of Neural MT: increasing the sensibility towards low data resources; improving robustness towards noisy data; finding models that combine the advantages of character-based processing dealing with data sparseness with the advantages of phrase-based models that behave more like translation memories. Fully incremental and interactive NMT. Experiments with heavily under-resourced and non-EU languages.	Use novel evaluation methods to explore if a plateau has been reached and, if yes, see how it can be overcome; integration of external knowledge sources, e.g., knowledge graphs, rules, syntax, semantics; first applications of document-level MT; robust and portable dialogue translation including grounding through back translation. Connecting all EU languages together (all translation directions!).	Full deployment of MT systems in wide-ranging applications requiring HQMT, such as technology export, government and public information systems, private services, medical applications etc., full integration of novel translation workflows where appropriate; application- and user-based evaluation driven engagement of core and supplemental technologies; connecting all EU languages with other key languages important for EU-external business and policy.
Evaluation methodology supporting (N)MT in research and production	Automatic MT evaluation/estimation methods that can naturally exploit the capabilities of neural word, sentence and paragraph representations such as paraphrases etc.; neural similarity measures for automatic MT evaluation; Explore novel (non-automatic) ways of assessing the subtleties of NMT; incorporate feedback from research systems, develop datasets for new metrics, best practices, and industry benchmarks; automatic prediction of errors (MQM); automatic reference-free evaluation using analytic test suites for major languages;	Create large-scale evaluation infrastructure, structured to areas, applications, and languages. Implement reporting functionality in industry standard (MQM/DQF?) in all toolkits.	Quality checking is a commodity; standards have been worked out for both methodologies and for certain application areas.
Quality data for NMT research	Develop methods for collection and cleansing (e.g., filtering quality data) using crawling and incldluding tools like grammars, RBMT where applicable for the creation of synthetic data.	Going beyond the sentence boundary. Learning beyond parallel data; environments for collecting and including user feedback (corrections); training against novel quality metrics by reinforcement learning.	Modalities – Fusion of networks (model exchange rather than raw data exchange)
Understanding Neural Networks	Augmenting neural approaches with explainability; machine teaching: from chance to systematic training; user control over the system; more systematic and comprehensive exploration of learning model, architecture, objective functions, hyper-parameter space for NMT (sequence to sequence, convolutional, capsule, attention, GAN, reinforcement learning etc.); how can we improve the structures? Getting insights from multilingual MT.	Making use of representations; Incremental learning; Self-learning; How can we further reduce the error rate? Start exploration of neural interlingua.	Neural interlingua (hidden representation) to handle all languages with the same underlying technology in one elegant model
Going beyond Neural MT	Exploring hybrid forms of neural and count-based (SMT) methods	Learning from developments in other areas such as speech recognition, vision, knowledge processing, big data and general computing	Integration with other NLP services such as summarisation, argument extraction, language simplification, etc.
Translation platform offering human and MT as service	Guided by industry: Develop pilot platforms for the deployment of both human and machine translation services including invoicing for paid services (guided by industry). The services should include general domain and specialised tasks and in addition language checking, quality control, etc. Quality upscale models should permit instant quality upgrade if the delivered quality does not meet expectations.	Consolidating the results from competition based Phase 1 with the goal to integrate the best approaches into one platform. Setting up trusted service centers (“brokers”) that fulfill highest standards (privacy, trust, confidentiality and security of source data and translations). Liaise/fuse translation platform with other existing LT service and resource platforms.	Deployment of HQMT services in the “Cloud”; targeted and tailored APIs; adaptation tools. Attract a community of hundreds of contributors of language resources and language technology tools (from all EU Member States and Associated Countries) to adopt and support a single platform for sharing, maintaining and making use of language resources and tools.
Prototypes and applications for corporate and public use	Adopting NMT for the translator workbench (tag support, terminology). Roll out MT w/o post-editing in targeted (narrow) domains, show feasibility (entertainmen industry, public services, media, ...). Find use cases for startups; Optimise models for tasks like post-editing, outbound/gisting, etc. (which was achieved in the past using specific metrics)	First applications with full MT workflow integrated (esp. in public services), collecting feedback for instant improvement; improving Accuracy over Fluency (use case-based); using interactive NMT; develop sustainable ways of financing and maintaining software packages and services in cooperation with industry.	Full prototypes in many areas, using the cloud services, added languages (export-oriented). Automatic detection, switch of domain, terminology, style, etc.

Delivering multi-media content in any language (captioning, subtitling, dubbing)	Multi-media system prototypes, combining language, speech, image and video analysis; employing novel techniques (multi modal NMT, cross-fertilisation across media types); targeted evaluation metrics for QA; aimed at EU languages with sufficient resources; data collection effort to support multi-media analysis.	Prototype applications in selected domains, such as public service (parliament recordings, sports events, legal proceedings) and other applications (TV archives, movies, online services at content providers); continued effort at multimedia analysis, adding languages if resources permit (incl. non-EU delivery).	Deployment of large-scale applications for multi-media content delivery, public and/or private, in many domains; development of online services for captioning, subtitling, dubbing, including on-demand translation; Semi-automated multi-lingual audio-description using image recognition and MT techniques.
Cross-lingual knowledge management and linked open data	Publication of multilingual language resources as linked open data as well as linking of resources across languages; develop ontology translation components that can localise ontologies and linked datasets to different languages.	Develop an ecosystem of NLP tools and services that leverage the existing multilingual resources on linked open data; develop new generation of MT technology that can profit from semantic data and linked open data and methods that allow querying the data in different languages.	Using linked data for ad-hoc generation of specialised MT engines in almost unlimited domains. Developing general-purpose knowledge graphs.
Avantgarde functionalities	Consecutive interpretation and translation built on insights and results of previous projects such as TC-STAR and EU-BRIDGE.	Synchronous interpretation and translation	Translingual collaborative spaces

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