



Evaluation of Mathematics, ICT and Technology (EVALMIT) 2023-2024

Self-assessment for research groups

Date of dispatch: 19 September 2023

Deadline for submission: 31 January 2024

Institution (name and short name): University of Oslo (UiO)

Administrative unit (name and short name): Department of Informatics (IFI)

Research group (name and short name): Language Technology Group (LTG)

Date: 31.1.2024

Contact person: Lilja Øvrelid

Contact details (email): liljao@ifi.uio.no

Content

Introduction	3
1. Strategy and organisation	5
1.1 Research group's organisation	5
1.2 Research group's strategy	6
1.3 Relevance to the institutions	8
1.4 Research group's resources	9
1.5 Research group's infrastructures	10
1.6 Research group's cooperations	11
2. Research quality	12
2.1 Research group's scientific quality	12
2.2 Research group's societal contribution	23
3. Challenges and opportunities	25

1. Organisation and strategy

1.1 Research group's organisation

With a staff of more than 400, The UiO Department of Informatics (IFI) is a “powerhouse” for informatics training and research in Northern Europe. It is the largest such unit in Norway and the one with the strongest international rankings. Around a comprehensive core in computer science, IFI interprets informatics in substantial breadth: from microelectronics or signal processing, to participatory design or digital innovation. In 2023, IFI hosts five BSc and eight MSc study programmes, with close to 2500 students. The department is organised in four thematic sections, each of which comprising 2–5 research groups. **LTG** is one of five research groups in the Machine Learning Section (MLS) at IFI and has as its main research focus Natural Language Processing (NLP), i.e. the automated processing of language data, primarily textual data. The research group was established in the 1980s in the Linguistics Department and moved to the Department of Informatics in 2006. In 2020, it became part of the newly formed Machine Learning Section (MLS). The group has had a revolving group leadership over the years and view this role as a shared responsibility among the permanent staff. The group is currently managed by Professor Lilja Øvrelid and consists of members in both junior and more senior research positions, see below. LTG has seen a growth in size during the years 2012–2022, from 11 members in 2012 to 16 members in 2022 (15 members in practice since Professor Stephan Oepen is not formally associated with the group during his appointment as head of department) and 19 members as of December 2023. The growth in size is largely a result of increased external funding and an increased demand for expertise within the area of machine learning and artificial intelligence in society at large, resulting in a new permanent position in the group. The group has a growing portfolio of externally funded projects (currently both RCN and EU-funded), a diverse set of collaborators from both academia and industry and regularly contributes to dissemination and the public debate concerning AI. The group is furthermore single handedly responsible for BSc and MSc-level study programs in Language Technology (currently the only CS programs with a NLP specialisation in Norway), thus contributing to the education of future NLP developers and researchers in the country. The group has well-functioning group dynamics, with bi-weekly group meetings and research seminars, in addition to joint lunches and social activities.

LTG members in 2022 were (15 members, organised by type of role):

- Professor: Jan Tore Lønning, Erik Velldal, Lilja Øvrelid (group leader)
- Associate Professor: Andrey Kutuzov
- Adjunct staff: Pierre Lison, Aleksander Øhrn
- Researcher: Ali Mohammad Hussiny
- PhD fellow: Maja Buljan, Lucas Charpentier, Anthi Papadopoulou, Vinit Ravishankar, Egil Rønningstad, David Samuel, Sondre Wold, Hailing You

LTG members in December 2023 are (19 members, organised by type of role):

- Professor: Erik Velldal, Lilja Øvrelid
- Associate Professor: Andrey Kutuzov, Yves Scherrer
- Adjunct staff: Pierre Lison, Aleksander Øhrn
- Researcher: Ali Mohammad Hussiny, Petter Mæhlum, Étienne Simon
- Postdoctoral fellow: Nikoly Arefev, Vladislav Mikhailov
- PhD fellow: Maja Buljan, Lucas Charpentier, Mariia Fedorova, Helene Bøsei Olsen, Egil Rønningstad, David Samuel, Sondre Wold, Hailing You

Table 1. List of number of personnel by categories

	Position by category	No. of researcher per category	Share of women per category (%)	No. of researchers who are part of multiple (other) research groups at the admin unit	No. of temporary positions
No. of Personnel by position	Professor (1013)	3	33.333%	-	-
	Associate Professor (1011)	1	0%	-	-
	Doctoral Research fellow (1017)	8	37.5%	1	8
	Researcher (1108)	1	0%	-	1
	Adjunct associate professor (1011)	1	0%	-	1
	Adjunct professor (1013)	1	0%	-	1

1.2 Research group's strategy

a) The research group's main goals, objectives and strategies to obtain these (e.g. funding, plans for recruitment, internationalisation etc. within the period 2012-2022.

The group has worked strategically in the period following the last evaluation and the main strategic goals of the group in the period 2012-2022 can be summarised as follows:

- increased research focus on development of tools and resources for **Norwegian NLP**
- group growth in **size** (stabilising at around 15-20 members)
- increased **research output (publications)**
- increased **external funding**
- increased **internal collaboration**, becoming a less fractionated group

Below we describe these goals in some more detail and discuss how we have addressed each of these.

Norwegian NLP: At the outset of this period (2012-2022), LTG research was mostly focused on processing of English text. While this can be seen as an advantage when it comes to international publishing and visibility, group members found there to be a lack of Norwegian NLP tools and saw the need for the group to contribute to the furthering of Norwegian NLP. During this period, the group has participated in a number of projects aimed at creating manually annotated datasets and

ML-trained tools for processing of Norwegian text.

Group size: In the previous self-evaluation round LTG stated a strategic goal of stabilising group size at around 15-20 members. In 2012, the group counted 11 members and in 2022, LTG counted 15 members. Currently, as of 2023, LTG has 19 members, following an intense period of hiring. The group has recently been joined by a new associate professor, as well as two postdoctoral fellows, a researcher and two PhD fellows.

Publications: It has been a pronounced strategic goal to increase the research output of the group in terms of international scientific publications, in particular an increased number of conference proceedings publications (which is the main channel of publication within the field of NLP).

External funding: It has been a pronounced goal of the research group to increase the amount of external funding, in order to enable growth in group size. In this respect, the group has been successful and currently has a rich project portfolio with funding from both the Research Council of Norway (RCN) and EU (Horizon Europe).

Internal collaboration: While the group's research focus still spans several topics, there are currently a number of cross-cutting activities in the group that involve members of both junior and senior staff and that cuts across e.g. externally funded projects. Examples of such focal areas are i) resource creation/data annotation, ii) structured prediction for information extraction (where methods from syntactic and semantic parsing have been applied to other tasks such as negation detection, sentiment analysis and event extraction) and iii) training and evaluation of large-scale language models. The former has also involved a large number of master students hired as annotators and has contributed positively to their integration (and in some cases subsequent hiring) in the group.

b) The benchmark of the research group.

Benchmark 1: external funding

In line with the strategic goals of the group (as described above), the group has obtained an increased level of external funding during the period 2012-2022. In 2012, the group had only one externally funded project WeSearch (with a total budget of NOK 11M and income of NOK 2,7M for 2012). In 2022, the group has an external income of around 5.2M. In 2023, the portfolio was extended with funding for a large infrastructure project (Peace Science Infrastructure) which involves two new positions to the group, the EU project HPLT (with a postdoc position) as well as the recently started Center of Excellence, Integreat, where LTG Professor Øvrelid is a co-director and which will fund several new positions in the coming years. This means that the external income is expected to near double in the current year.

Benchmark 2: research output in terms of publications

As mentioned above, the group has had as a goal to increase the research output of the group in terms of scientific, international publications. If we compare the average number of publications by group members for the 5-year periods 2012-2016 and 2018-2022, we find a clear increase: from an average number of yearly publications of 10 in 2012-2016 to 25 in 2018-2022.

c) The research group's contribution to education (master's degree and/or PhD).

LTG currently coordinates dedicated study programs in Language Technology both at the BSc and MSc level. This means that the group singlehandedly runs one of the department's five study programs at the bachelor and master level. The BSc-level program constitutes the only study program in Norway with a specialisation in NLP/language technology and admits 60 students every year.

As an integral part of these study programs, LTG offers courses in NLP at all levels:

- *IN1140 Introduction to Language Technology* (BSc course, given in Norwegian)
- *IN2110: Language Technology Methods* (BSc course, given in Norwegian)
- *IN4080: Natural Language Processing* (MSc course, given in English)
- *IN5550: Neural Methods in NLP* (MSc course, given in English)

LTG adjunct professor, Aleksander Øhrn, gives the course *IN3120 Search Technology*, a course which recruits students from several of the study programs at the department.

In addition, the group has contributed significantly to the development and teaching of the course *IN3050: Introduction to Artificial Intelligence and Machine Learning* together with researchers from the Robotics and Intelligent Systems (ROBIN) group. This course was given for the first time in the spring of 2020 and has been very popular, attracting several hundred students. Finally, from the inception of the class in 2008 and up until 2022, the group was also responsible for teaching *IN2040: Functional programming* (previously *IN2810*) – a foundational BSc-level programming course that attracted a large body of students across all study programs (the responsibility for the course has since been handed over to another research group in the department).

Members of the group further supervise master students from our own study program as well as from the data science master program offered at the Maths department. In our own study program, we admit around 10 students yearly and during the period 2018-2022, an average of 6 master students have graduated yearly from the study program. During this same period a total of 6 PhD candidates have successfully defended their theses. The growth in group size, however, is expected to produce an increased number of PhD candidates in the coming years, with a total of 6 PhD students expected to graduate in the period 2024-2025.

d) The support provided by the host institution to the research group.

The group has adequate administrative support both for research activities (primarily for project budgeting, but also PhD administration) and teaching-related matters (study administration, admissions, hiring of TAs, exams).

1.3 Relevance to the institutions

The role of the research group within the organisation.

Based on the previous evaluation of the department, there was a strategic ambition to strengthen the department's research and teaching in machine learning (ML). The department's strategic action plan for the period 2019-2021 states that Machine Learning and AI are prioritized subject areas at the department. This prioritisation was initiated with the establishment of a ML section that includes a diverse set of research groups (including LTG) that share the central development and use of ML methods in their research. Our group member Professor Stephan Oepen took on the role of leading the section (with Øvrelid as group leader) and went on to become head of department in 2020. As mentioned already, LTG conducts research on neural ML in all their activities, hence is thematically focused on this area.

As mentioned above, LTG is responsible for dedicated study programs in Language Technology both at the bachelor and master level, hence has central contributions to the teaching and education offered by the department. As a response to the increasing importance of our field of research in society, LTG will contribute to the establishment of a bachelor program in ML and AI at the department and LTG-members Professor Emeritus Jan Tore Lønning and Professor Erik Velldal have had a central role in the working group aimed at assessing and formulating a proposal for a new BSc program in AI and ML at the department.

Group members have further contributed to strategic work at the department during the period 2012-2022. Øvrelid was appointed the leader of the working group on research strategy which provided input to the department strategy document for the current period. LTG have also contributed to the interdisciplinary dScience centre, a focal initiative at the faculty level aimed at uniting various data science initiatives at the faculty where LTG member Velldal is a member of the scientific advisory committee.

1.4 Research group's resources

The funding portfolio of the research group in the last five years (2018-2022).

During the period 2018-2022, the group has been successful in attracting a number of research projects. The main funding source for these projects have been the Research Council of Norway, where the group has obtained funding for both individual researcher projects coordinated by LTG (e.g. the SANT project through the ICTPLUS call), but have also been members of a number of different projects and centres coordinated by other partners, e.g. RCN Lighthouse project (BigMed), Nordic E-Infrastructure (NeIC) and EOSC-Nordic which funded the Nordic Language Processing Laboratory (NLPL), as well as partnering in three Centers for Research-Driven Innovation (SFIs): the SIRIUS centre, coordinated by the ASR and PSY groups in the department, as well as the MediaFutures (coordinated by University of Bergen) and NorwAI (coordinated by NTNU), both starting in 2020, where group members participate in leading roles. The group has also acquired research funding from the [Teksthuben small research projects program](#). In 2022, the group joined a large EU Horizon-funded HPLT project ("[High-performance language technologies](#)"),

which involves five European universities: University of Oslo, University of Edinburgh, Charles University Prague, University of Turku and University of Helsinki, as well as two HPC operators and one startup. Participation in this project allowed to hire a new postdoctoral fellow, Nikolay Arefev.

Table 2. Sources of R&D funding for the research group in the period 2018-2022.

	2018 (kNOK)	2019(kNOK)	2020 (kNOK)	2021(kNOK)	2022(kNOK)
Basic funding	4554	4518	4550	3247	4672
Funding from industry and other private sector sources					
Commissioned research for public sector					
Research Council of Norway	2730	5564	4266	3669	4654
Grant funding from other national sources			500	500	456
International funding e.g. NIH, NSF, EU framework programmes	450	550	700	500	250
Other					

1.5 Research group's infrastructures

a) National infrastructures that the research group manages or co-manages.

The group manages communication and collaboration infrastructure (mailing lists, wiki pages, web services, etc) for the Nordic Language Processing Laboratory (NLPL). This includes the NLPL virtual laboratory, a comprehensive collection of discipline-specific data and software that is maintained automatically and uniformly on multiple national and European superclusters.

b) The most important research infrastructures used by the group.

The most important research infrastructure in modern NLP is computational resources, most often in the form of GPU accelerators. The group successfully uses the Norwegian high-performance computing clusters operated by Sigma2 (in particular, Fox and Saga). In 2022, the group in addition got access (one of the first in Norway) to the pan-European supercomputer LUMI.

1.6 Research group's cooperations

Table 3. The current interactions of the research group with other disciplines, non-academic stakeholders and the potential importance of these for the research (e.g. informing research questions, access to competence, data and infrastructure, broadening the perspectives, short/long-term relations).

Interdisciplinary (within and beyond the group)	LTG has a long tradition for interdisciplinary collaboration. Interdisciplinarity at the intersection of computer science and linguistics has traditionally been at the core of research in NLP and the group has maintained a close collaboration with researchers in the Department of Linguistics over the years, as witnessed by the topical research area SynSem-collaboration and a joint stay at Center for Advanced Study in 2017/18 led by group member Oepen and Haug (Dept. of Linguistics). The link to linguistics has arguably been weakened somewhat in the past year with the increased focus on machine learning in the field. Another field which traditionally has had close ties to NLP is that of logic and knowledge representation. Through the SIRIUS center, coordinated by the ASR group at the department, LTG participated in research aimed at knowledge-informed NLP. LTG has also in recent years had several collaborative efforts with researchers from the social sciences and the humanities. We have submitted joint grant proposals with researchers from the Institute for Social Research (ISF); we have had several co-publications with researchers from the Department of Political Science at UiO; and we are a core partner in the newly established RCN-funded infrastructure project PSI coordinated by PRIO (Peace Research Institute Oslo). Finally, several researchers from LTG have also been part of the so-called Teksthub initiative at UiO, directed at facilitating knowledge-sharing and collaboration between different fields of study based on text-as-data, such as language technology, digital humanities, computational social science, etc. A recent development has been the interdisciplinary collaboration with statisticians, logicians and philosophers from UiO and ML researchers from University of Tromsø, which has resulted in a successfully funded Center of Excellence in Knowledge-Driven Machine learning (SFF; Integreat) which had its kick-off in November 2023 and marks a 10-year research endeavour where LTG-leader Øvrelid is a co-director and group members Kutuzov and Velldal are work package leaders. LTG has long and strong ties with Sigma2 which maintains high-performance computing and large-scale data storage facilities. In particular, this ensures the group's access to LUMI, the most powerful European supercomputer.
Collaboration with other research sectors e.g. higher education, research institutes, health trusts and	NLP has several application areas in other research sectors. Through the RCN Lighthouse project BigMed, LTG researchers collaborated with clinicians from Oslo University Hospital and the AHUS hospital, developing NLP tools for analysis of clinical text.

industry.	In a recently RCN-funded Innovation in Public Sector project (FHI-SA), LTG researchers collaborate closely with health service researchers to analyse patient feedback using sentiment analysis. LTG's adjunct associate professor, Pierre Lison, works as a senior researcher at the Norwegian Computing Center (NR) and collaborates with LTG in the NR-led RCN project CLEANUP.
Transdisciplinary (including non-academic stakeholders) <i>Transdisciplinary research involves the integration of knowledge from different science disciplines and (non-academic) stakeholder communities with the aim to help address complex societal challenges.</i>	Some of the most important collaborators for LTG are partners from the media sector. Some concrete examples include; the SANT project, where NRK, Schibsted, and Aller Media have contributed with data in terms of published reviews which have been used as source texts for the annotation efforts on sentiment analysis; the SFI MediaFutures, where Schibsted, Amedia and TV2 are close collaborators in the work package on Language Technology lead by LTG; and in the SFI NorwAI, where the media monitoring company Retriever has been our closest collaborator, focusing on entity-level sentiment analysis. Beyond media partner collaborations, sentiment analysis is also the focus of a joint RCN-funded project led by FHI/NIPH (the Norwegian Institute for Public Health). Through the aforementioned CLEANUP project LTG are part of a project involving non-academic stakeholders such as Norwegian Welfare and Labour Organization (NAV). In recent years, LTG has had a close collaboration with the Language Bank (Språkbanken) at the National Library (NB), collaborating in several data annotation projects (e.g. the NorNE and NARC datasets). The AI Lab at NB have in recent years become close collaborators in the training and evaluation of large language models and have in particular shared data for the training of such models.

2. Research quality

2.1 Research group's scientific quality

The research profile of the group and the activities that contribute to the research group's scientific quality.

The research focus of LTG, along with the entire field of NLP, has undergone major shifts in research methodology during the period 2012-2022. With a strong tradition of grammar-based parsing in the group, an initial stage during this period saw an increased focus on data-driven approaches to syntactic and semantic parsing. Starting from around 2014, the field of NLP has undergone a further dramatic shift in its re-orientation towards neural machine learning, to the current state where neural approaches are completely dominant in the field. The group made an effort through joint reading groups, seminars and the development of a new course in neural NLP to learn and adopt these new approaches in research and teaching. This re-orientation has been successful but is still an on-going effort with the rapid developments of the field resulting from widespread adoption of generative language models. LTG is currently the largest and most prominent research group within the sub-field of NLP in Norway and central research topics in the group include syntactic and semantic parsing, lexical, diachronic semantics, resource creation

and annotation, sentiment analysis and event extraction. LTG have been the main contributors to the release of a number of manually annotated datasets for training of machine learning models, such as the Norwegian UD treebanks, the NorNE dataset for named entity recognition and the NoReC family of resources. These datasets have directly enabled the support of the Norwegian language in widely used international toolkits for text analysis such as spaCy (<https://spacy.io/>) and Stanza (<https://stanfordnlp.github.io/stanza/>). LTG has contributed in recent years to the release of Norwegian language models, making them openly available for research and innovation. The NorBERT family of language models are currently the top performing language model in an independent benchmark (ScandEval), which compared Scandinavian LMs as well as multilingual models.

Engaging with the wider research community of NLP internationally, LTG has contributed to the organisation of several research competitions (so-called “shared tasks”) in recent years with a set of international collaborators, where teams from all over the world engage in a friendly competition to solve a specific task and thereby furthering the state-of-the-art for this task. LTG-organised shared tasks in recent years include the 2018 ERE shared task on Extrinsic Parser Evaluation (17 teams), the 2019 and 2020 MRP CoNLL shared tasks (26 teams in total) and the 2022 *SEM shared task on Structured Sentiment Analysis (SSA, which attracted 32 teams internationally).

A link to the research group's publication list at the research group's website:

<https://www.mn.uio.no/ifi/english/about/strategy/evalmit/ltg.html>

*It is important to note that the publication tradition in the field of NLP is conference publication and **not** journal publications. There are a small number of journals where researchers publish (Computational Linguistics, Natural Language Engineering, Language Resources and Evaluation), however, the main bulk of publications happen in conference proceedings allowing for a faster turn-around than journals. The top-tier conference proceedings, such as the *CL conferences (ACL, EACL and NAACL), EMNLP are highly competitive with acceptance rates around 20% and also foster a large range of more specialised workshops, e.g. CoNLL, SemEval, etc that are typically co-located with the conferences. Other conferences, like Coling, have a slightly higher acceptance rate (around 25-35%), whereas others are more accepting, with acceptance rates around 50-60% (LREC, Nodalida, the Nordic NLP conference).*

Table 4. List of projects

Project 1: <i>WeSearch: Language Technology for the Web 2011-2015</i>	Project owner(s) (project leaders organisation)	Stephan Oepen, LTG/IFI at UiO
	Total budget and share allocated to research group	NOK 11M, LTG share was 11M
	Objectives and outcomes (planned or actual) and link to website	The objective of the WeSearch project is to prepare general purpose <i>semantic parsing</i> technology: automated large-scale analysis of user-generated Web content (UGC), mapping from human language to formal representations of meaning. Technology will be developed for English, but the research will result in techniques and representations that are directly applicable to other human languages.
Project 2: <i>CLARINO: Common Language Resources and Technology Infrastructure Norway (2012-2017)</i>	Project owner(s) (project leaders organisation)	University of Bergen
	Total budget and share allocated to research group	NOK 25M, LTG share was 3,4M
	Objectives and outcomes (planned or actual) and link to website	CLARINO aimed at establishing an integrated and interoperable research infrastructure of language resources and technologies. It was part of the pan-European ESFRI initiative CLARIN, which provided novel, stable, and extendable infrastructures for eHumanities.
Project 3:	Project owner(s) (project leaders organisation)	Erik Velldal, LTG/IFI at UiO.

<i>SANT: Sentiment Analysis for Norwegian Text 2017–2024</i>	Total budget and share allocated to research group	11.3M, of which RCN-funding comprises 10.1M, all which is allocated to the research group.
	Objectives and outcomes (planned or actual) and link to website	The aim is to enable so-called opinion mining or sentiment analysis for Norwegian, by creating high-quality and large-scale annotated data for training and testing, and also providing machine-learned models for the task (both code and pre-trained models), with all resources made publicly available. Project website: https://www.mn.uio.no/ifi/english/research/projects/sant/index.html
Project 4: <i>HPLT: High-Performance Language Technologies (2022-2025)</i>	Project owner(s) (project leaders organisation)	Charles University in Prague
	Total budget and share allocated to research group	Total budget is € 3.9M, LTG at the UiO share is € 700K
	Objectives and outcomes (planned or actual) and link to website	HPLT is aiming at combining large quantities of data, dozens of languages and high-performance computing to build powerful, efficient and open language and translation models for European languages. https://hplt-project.org
Project 5: <i>BigMed: Precision Medicine Implementation</i>	Project owner(s) (project leaders organisation)	Oslo University Hospital
	Total budget and share allocated to research group	NOK 60M, LTG share was around 3M
	Objectives and outcomes (planned or actual) and link to website	The project goal was to address barriers to clinical implementation of precision medicine and pave the way for big data analytics. https://bigmed.no/

Project 6: <i>CLEANUP: Machine Learning for the Anonymisation of Unstructured Personal Data (2020 – 2024)</i>	Project owner(s) (project leaders organisation)	National Computing Center (NR)
	Total budget and share allocated to research group	NOK 19.5M, LTG share is 3.7M
	Objectives and outcomes (planned or actual) and link to website	The goal of CLEANUP is to develop new machine learning methods to automatically anonymise (or at least strongly de-identify) <i>text documents</i> containing personal data, such as electronic health records, court rulings or chat-based interactions with customers. https://cleanup.nr.no/
Project 7: <i>Media Futures Center for Research-Driven Innovation (2020-2028)</i>	Project owner(s) (project leaders organisation)	University of Bergen
	Total budget and share allocated to research group	NOK 270M; LTG share is NOK10M (excluding in-kind)
	Objectives and outcomes (planned or actual) and link to website	The main objective of the centre is the development of responsible media technology, in particular leveraging AI technology, for the media sector. https://mediafutures.no/
Project 8: <i>NorwAI/Project period (2020 - 2028)</i>	Project owner(s) (project leaders organisation)	Norwegian University of Science and Technology (NTNU)
	Total budget and share allocated to research group	NOK 261; LTG share is 4.8M (excluding in-kind)

	Objectives and outcomes (planned or actual) and link to website	The goal of NorwAI is to develop cutting-edge theories, methods and technology for efficient, effective and responsible exploitation of data-driven AI in innovative industrial solutions. https://www.ntnu.edu/norwai
Project 9: <i>FHI-SA: Strengthening the patient voice/(2022-2025)</i>	Project owner(s) (project leaders organisation)	Institute of Public Health
	Total budget and share allocated to research group	NOK 13.9M; LTG share is NOK 4.6M (excluding in-kind)
	Objectives and outcomes (planned or actual) and link to website	This project will develop and evaluate machine learning tools for automatic analyses of free-text comments from patients.

Table 5. Research group's contribution to publications from the last 5 years (2018-2022)

Publication 1: Diachronic word embeddings and semantic shifts: a survey . In <i>Proceedings of the 27th International Conference on Computational Linguistics</i> , pages 1384–1397, Santa Fe, New Mexico, USA.	Authors	Andrey Kutuzov, Lilja Øvrelid, Terrence Szymanski, and Erik Velldal.
	Short description	The paper surveys the state of academic research related to diachronic word embeddings and semantic shifts detection. It has since become a standard reference in the field of semantic change detection, with more than 340 citations.
	Research group's contribution	Practically the whole paper is written by the LTG members, with a minor input from Terrence Szymanski.

Association for Computational Linguistics. 2018.		
Publication 2: The Talk of Norway: a richly annotated corpus of the Norwegian parliament, 1998–2016 . In <i>Journal of Language Resources and Evaluation</i> . No 52. 2018.	Authors	Emanuele Lapponi, Martin G. Søyland, Erik Velldal and Stephan Oepen.
	Short description	The paper presents the Talk of Norway (ToN) data set, a collection of Norwegian Parliament speeches from 1998 to 2016 and text classification experiments, in collaboration with a researcher from political science. Cited 52 times.
	Research group's contribution	LTG members were responsible for data pre-processing, machine learning experiments and analysis of results.
Publication 3: Evaluation of domain-specific word embeddings using knowledge resources . In	Authors	Farhad Nooralahzadeh, Lilja Øvrelid and Jan Tore Lønning
	Short description	In this work we evaluate domain-specific embedding models induced from textual resources in the Oil and Gas domain. We conduct intrinsic and extrinsic evaluations of both general and domain-specific embeddings and we observe that constructing domain-specific word embeddings is worthwhile even with a considerably smaller corpus size.
	Research group's contribution	LTG members were responsible for the whole paper.
Publication 4: MRP 2020: The Second Shared Task on Cross-Framework and Cross-	Authors	Stephan Oepen, Omri Abend, Lasha Abzianidze, Johan Bos, Jan Hajic, Daniel Hershcovich, Bin Li, Tim O’Gorman, Nianwen Xue, and Daniel Zeman
	Short description	Paper describing the second iteration of the international shared task at the Conference for Natural Language Learning (CoNLL) dedicated to meaning representation across five diverse

Lingual Meaning Representation Parsing . In <i>Proceedings of the CoNLL 2020 Shared Task: Cross-Framework Meaning Representation Parsing</i> . Association for Computational Linguistics. 2020.		semantic frameworks. Establishes a standard inventory of datasets, evaluation metrics and approaches to this task. Cited 62 times.
	Research group's contribution	LTG group member (at the time, currently head of department) Stephan Oepen initiated and led the shared task in close collaboration with colleagues from a diverse set of international research institutions in Israel, Netherlands, Czech Republic, Denmark, China and USA.
Publication 5: UiO-UvA at SemEval-2020 Task 1: Contextualised Embeddings for Lexical Semantic Change Detection . In <i>Proceedings of the Fourteenth Workshop on Semantic Evaluation</i> , pages 126–134, Barcelona (online). International Committee for Computational Linguistics. 2020.	Authors	Andrey Kutuzov and Mario Giulianelli.
	Short description	The paper describes the application of contextualised word embeddings to lexical semantic change detection in the SemEval-2020 Shared Task 1. It became one of the first publications using pre-trained language models for this task, and was cited more than 45 times.
	Research group's contribution	Andrey Kutuzov conducted the part of the experiments related to ELMo language models and was responsible for approximately half of the paper text.
Publication 6:	Authors	Lilja Øvrelid, Petter Mæhlum, Jeremy Barnes and Erik Velldal

A Fine-Grained Sentiment Dataset for Norwegian. In <i>Proceedings of the twelfth Language Resources and Evaluation Conference. European Language Resources Association. 2020.</i>	Short description	This paper presents the first manually annotated dataset of fine-grained sentiment analysis for Norwegian. This dataset becomes one of the datasets in the 2022 shared task on structured sentiment analysis (cf. Publication 10). The paper is cited 47 times.
	Research group's contribution	Members of the research group are responsible for the whole paper. The annotation effort it describes involved a number of master student from the study program in Language Technology, where one (co-author Mæhlum) took a leading role in the annotation effort and was subsequently hired as a researcher in the group in 2022.
Publication 7: Large-Scale Contextualised Language Modelling for Norwegian. In <i>Proceedings of the 23rd Nordic Conference on Computational Linguistics (NoDaLiDa)</i> , pages 30–40, Reykjavik, Iceland (Online). Linköping University Electronic Press, Sweden. 2021.	Authors	Andrey Kutuzov, Jeremy Barnes, Erik Velldal, Lilja Øvrelid, and Stephan Oepen
	Short description	The paper introduces the first ever large-scale monolingual language models for Norwegian, based on ELMo and BERT architectures. The presented models are still actively used by the research community and the industry; the paper was cited 45 times.
	Research group's contribution	The whole paper is written by LTG members.
Publication 8: Structured sentiment analysis as dependency graph parsing. In <i>Proceedings of the 59th Annual Meeting of the</i>	Authors	Jeremy Barnes, Robin Kurtz, Stephan Oepen and Erik Velldal.
	Short description	The paper proposes a novel formulation of the task of fine-grained sentiment analysis as dependency graph parsing (dubbed ‘Structured Sentiment Analysis’), hence uniting two different research strands in LTG: graph-based parsing and sentiment analysis. The paper is cited 54 times.

<i>Association for Computational Linguistics and the 11th International Joint Conference on Natural Language Processing. 2021.</i>	Research group's contribution	LTG members were responsible for data preparation, modelling, experiments and analysis, joined by Kurtz from Sweden, who contributed with an adaptation of his graph-based parser originally developed for meaning representation parsing.
Publication 9: Improving sentiment analysis with multi-task learning of negation . In <i>Journal of Natural Language Engineering. 2021.</i>	Authors	Jeremy Barnes, Erik Velldal and Lilja Øvrelid
	Short description	The paper presents a multi-task approach with a cascading neural architecture with selective sharing of LSTM layers, and shows that explicitly training the model with negation as an auxiliary task helps improve the main task of sentiment analysis. The paper unites two research directions at LTG: negation analysis and sentiment analysis. The paper is cited 41 times.
	Research group's contribution	The whole paper is written by LTG members.
Publication 10: The Text Anonymization Benchmark (TAB): A Dedicated Corpus and Evaluation Framework for Text Anonymization In <i>Journal of Computational Linguistics 48(4). 2022.</i>	Authors	Ildikó Pilán, Pierre Lison, Lilja Øvrelid, Anthi Papadopoulou, David Sánchez, Montserrat Batet
	Short description	The paper presents a novel benchmark and associated evaluation metrics for assessing the performance of text anonymization methods. It is a central result from the CLEANUP project, coordinated by adjunct associate professor Lison.
	Research group's contribution	LTG members were responsible for co-leading the annotation effort, formulating novel evaluation metrics and the neural modelling of the anonymization task.

2.2 Research group's societal contribution

Describe the societal impact of the group's research. Consider contribution to education, economic, societal and cultural development in Norway and internationally.

With the recent development in the field of ML and AI and the widespread adoption of Large Language Models, the group has experienced a massive external interest from the media and society at large. LTG has worked extensively on developing NLP resources for Norwegian – in terms of both datasets and models – which are now put widely to use across all sectors (public/private, research/industry).

The group has contributed to the public debate through several op-eds and interviews with the media and a large number of popular science podcasts and talks in various settings. Øvrelid is a member of the Norwegian AI Research Consortium's policy board, which has as its aim to advice policy making regarding AI and AI regulation.

In 2022, Andrey Kutuzov received the [Norwegian Artificial Intelligence Research Consortium \(NORA\) award as a Distinguished Early Career Researcher](#).

As a central principle in LTG's research is open science and open source.

The group maintains a large and widely used repository of static vector semantic models ([NLPL vector repository](#)). It also actively published pre-trained and fine-tuned language models in [its repositories on HuggingFace Model Hub](#) (de-facto professional standard).

All datasets and pipelines produced by the group are openly released [via Github repositories](#).

UiO has been a member of the Scholar At Risk arrangement since 2001 and LTG currently hosts a SAR-scholar, Mohammad Ali Hussiny, for a two year period, providing mentorship and further education in NLP.

As also mentioned in section 1.2, LTG runs its own study program at both the BSc- and MSc-level, which represent an important contribution to developing national competence in machine learning and language technology. Furthermore, through the NLPL initiative, LTG organises an annual winter school on neural NLP, gathering hundreds of participants from the Nordics and Europe at large for several years in row, with international scholars giving talks on cutting-edge topics in the field, contributing to education and community building.

Table 7. The research group's societal contribution, including user-oriented publications, products (including patents, software or process innovations

No.	Name of publication/product	Date of publication/product	Link to the document
1	LTG github repository of shared resources and tools		https://github.com/ltgoslo
2	LTG huggingface repository of openly shared large language models and datasets		https://huggingface.co/ltg
3	NLPL word embeddings repository		http://vectors.nlpl.eu/repository/
4	Norwegian Universal Dependencies treebanks - LTG members contributed the Norwegian UD treebanks		https://universaldependencies.org/no/index.html
5	Jan Tore Lønning. Interview in VG. Title "Testet chatbot på universitetseksamen"	26/1/2023	https://www.vg.no/nyheter/innenriks/i/gEz75A/testet-chatbot-paa-universitetseksamen-a-besvarelse
6	Erik Velldal. Interview in Morgenbladet (nr. 13, vol. 204). Title: "Språkmaskiner som kan sluke sivilisasjonen: Hva har vi sluppet løs?"	31/3/2023	https://www.morgenbladet.no/aktuelt/2023/03/31/sprak-maskiner-som-kan-sluke-sivilisasjonen-hva-har-vi-sluppet-los
7	Andrey Kutuzov and Stephan Oepen: Interview in Titan: "Da forskerne skulle finne data til språkmodellen, fant de mest porno"	17/4/2023	https://www.titan.uio.no/teknologi/2023/-nar-forskerne-skulle-finne-data-til-sprakmodellen.html
8	Lilja Øvrelid. Interview in TV2. Title: "Advarer om kunstig intelligens. Mye skjer bak lukkede dører".	15/7/2023	https://www.tv2.no/nyheter/innenriks/mye-skjer-bak-lukkede-dorer/15893202/
9	Pierre Lison and Samia Touileb. op-ed piece in Morgenbladet, Title: "Chat GPT"	July 2023	https://www.morgenbladet.no/ideer/debatt/2023/07/14/chat-gpt-og-akademisk-redelighet/

	egner seg dårlig til eksamenssensuren".		
10	Lilja Øvrelid: episode of NORA podcast "NORA forklarer kunstig intelligens". Title: "Lilja Øvrelid forklarer kunstig intelligens innen språkteknologi"		https://podcasts.apple.com/no/podcast/episode-4-lilja-%C3%B8vrelid-forklarer-kunstig-intelligens/id1545373373?i=1000515095967

3. Challenges and opportunities

Over the past years (2018-2023), LTG has seen a growth, and almost doubling, in group size. There is currently no reason why this development should recede and we expect to maintain the current size or even increase further over the next few years. It will therefore be a priority to work towards maintaining a well-functioning group dynamics, enabling collaboration and avoiding project silos within the group. A focus should be on joint academic and social events and sharing of research results. LTG has been successful in acquiring research funding and in 2028 we aim to maintain a steady level of external funding, while working towards selectively acquiring a research portfolio that enables synergies within the group and strengthening the possibilities for collaboration across different externally funded projects. Growth, however, does not come without challenges. A major challenge in these years is founded in the fact that the relevant academic research communities in Norway have not been scaled to meet the increased demands for AI competence / development / research. LTG currently has to turn down a lot of requests for collaborations, funding proposals, outreach activities, etc., simply because we are way beyond capacity. If we had more base funding for permanent positions (associate professorships and above, i.e. permanent positions with competitive salaries) we would be able take much better advantage of the current possibilities for funding and opportunities for collaborations.

LTG takes part in a newly started centre of excellence (SFF; Integreat) and making the most of this opportunity for basic research while balancing the integrity and well-functioning dynamics of the group will be a priority in the years to come. Publication in top-tier NLP venues (such as *CL conferences), balanced with more specialised venues (e.g. interdisciplinary workshops), will be important in cementing the group's position as the leading NLP community in Norway and a central research community in a European and international context.

In response to the development in the field and in particular, the dominance of large tech corporations, LTG will maintain and strengthen the current focus on open, freely available open source technology and making this technology accessible to the wider public. A key focus area will be continued development of resources for evaluating large-scale language models. A challenge that will most likely become even more pressing in the years to come with widespread deployment of these language models is that of the field's carbon footprint. LTG will strive to increasingly address this rising concern through improved reporting including measures of carbon intensity and further focus on smaller, more knowledge-efficient models. When it comes to teaching, the next few years will see a large change in the teaching activities in the group. The BSc program in Language Technology will be replaced by a more general BSc program in AI, where LTG are already involved in the formulation and planning. In 2028 this program will have started and NLP should be clearly present in the new courses offered within this program, providing a basis for further specialisation in our MSc program and the education of NLP researchers and practitioners for the future.