



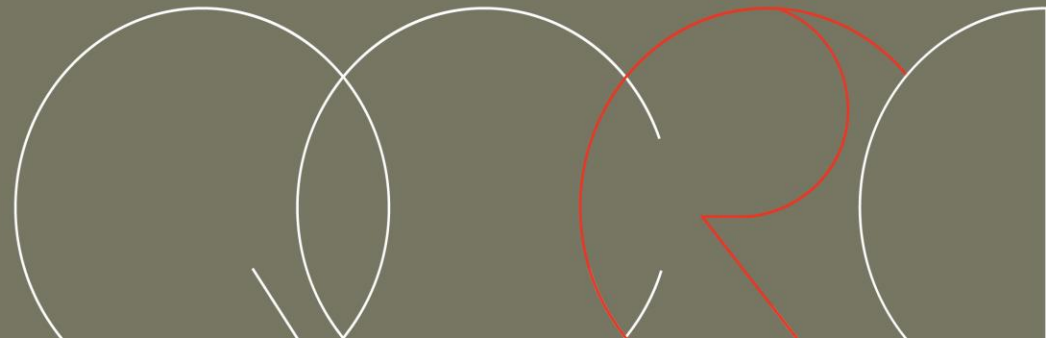
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Machine Translation – Winds of Change

Stephan Vogel
Research Director
Arabic Language Technologies

InterACT 25
August 14, 2016
Baden-Baden, Germany



Wind of Change – This one for Alex



The future's in the air
I can feel it everywhere
Blowing with the wind of change

Wind of Change – A rock ballade by the Scorpions 1990
Celebrating the political changes of the times



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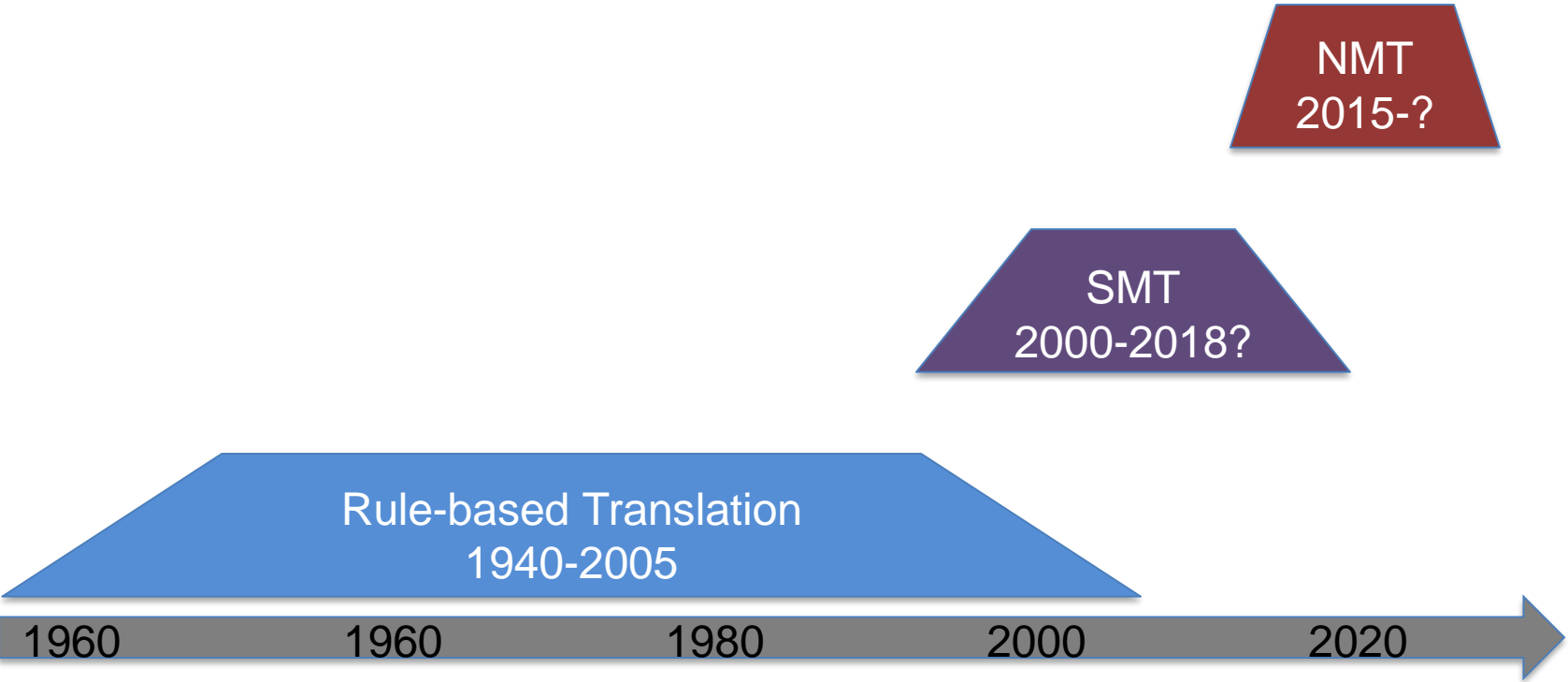
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Wind of Change = Paradigm Shift

- Paradigm Shift:
Term introduced by Thomas Kuhn in his famous book “The Structure of Scientific Revolutions” (1962) to describe progress in science
- Paradigm: what the members of a certain scientific community have in common, that is to say, the whole of techniques, practices, patents, and values shared by the members of the community.
- We could also say: Which papers are accepted at conferences
 - Look at recent NAACL and upcoming ACL and you see a paradigm shift happening
- Example: Ptolemaic to Copernican model of the universe



Paradigm Shifts in Machine Translation



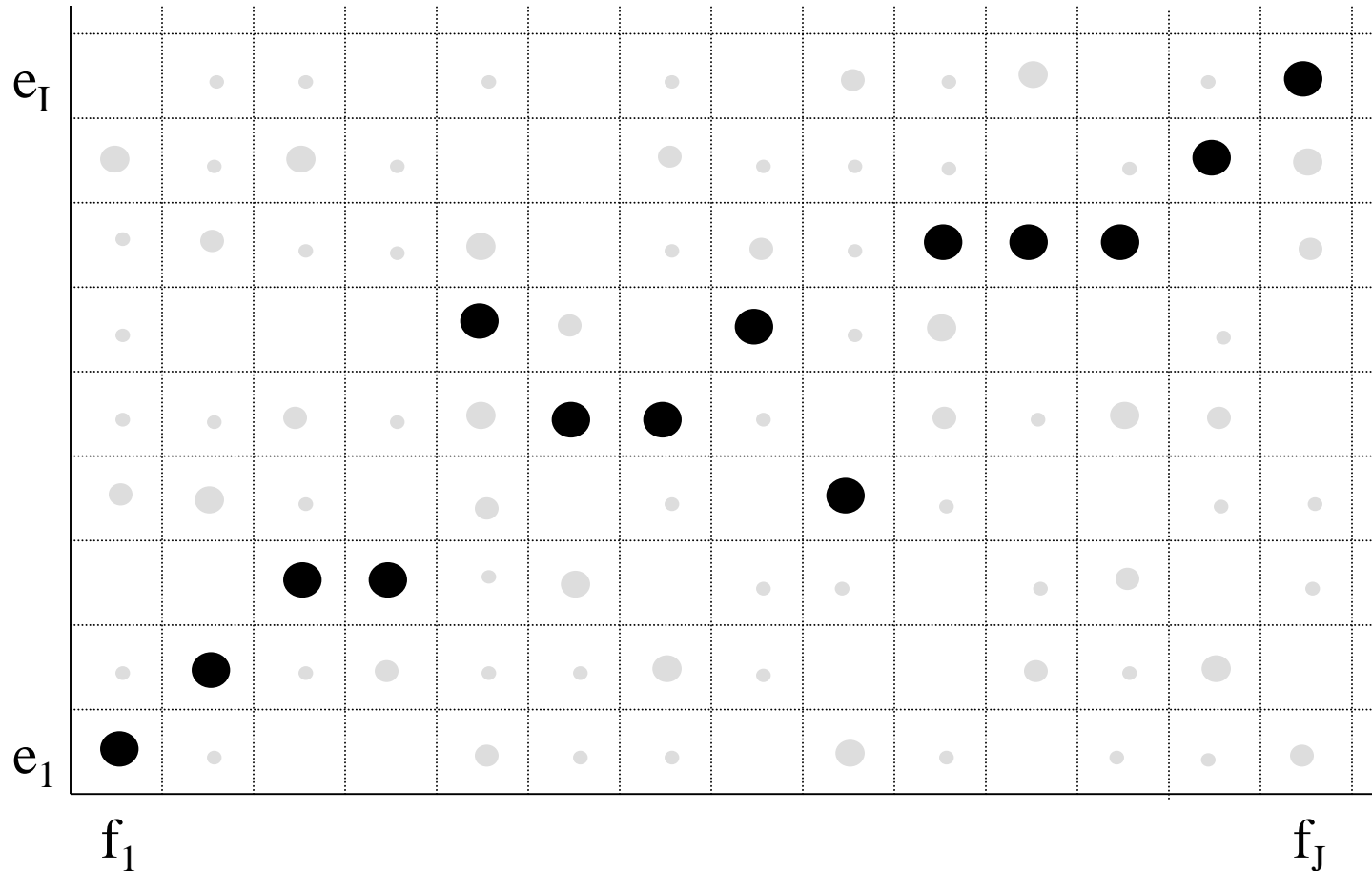
The Old Paradigm: Statistical MT

- Train word alignment
- Extract phrase pairs (or sub-tree to sub-tree pairs)
- Learn word or phrase reordering patterns
- Train n-gram language model for target language
- Use inventory of these translation pairs, reordering patterns, and language model to translate new sentences



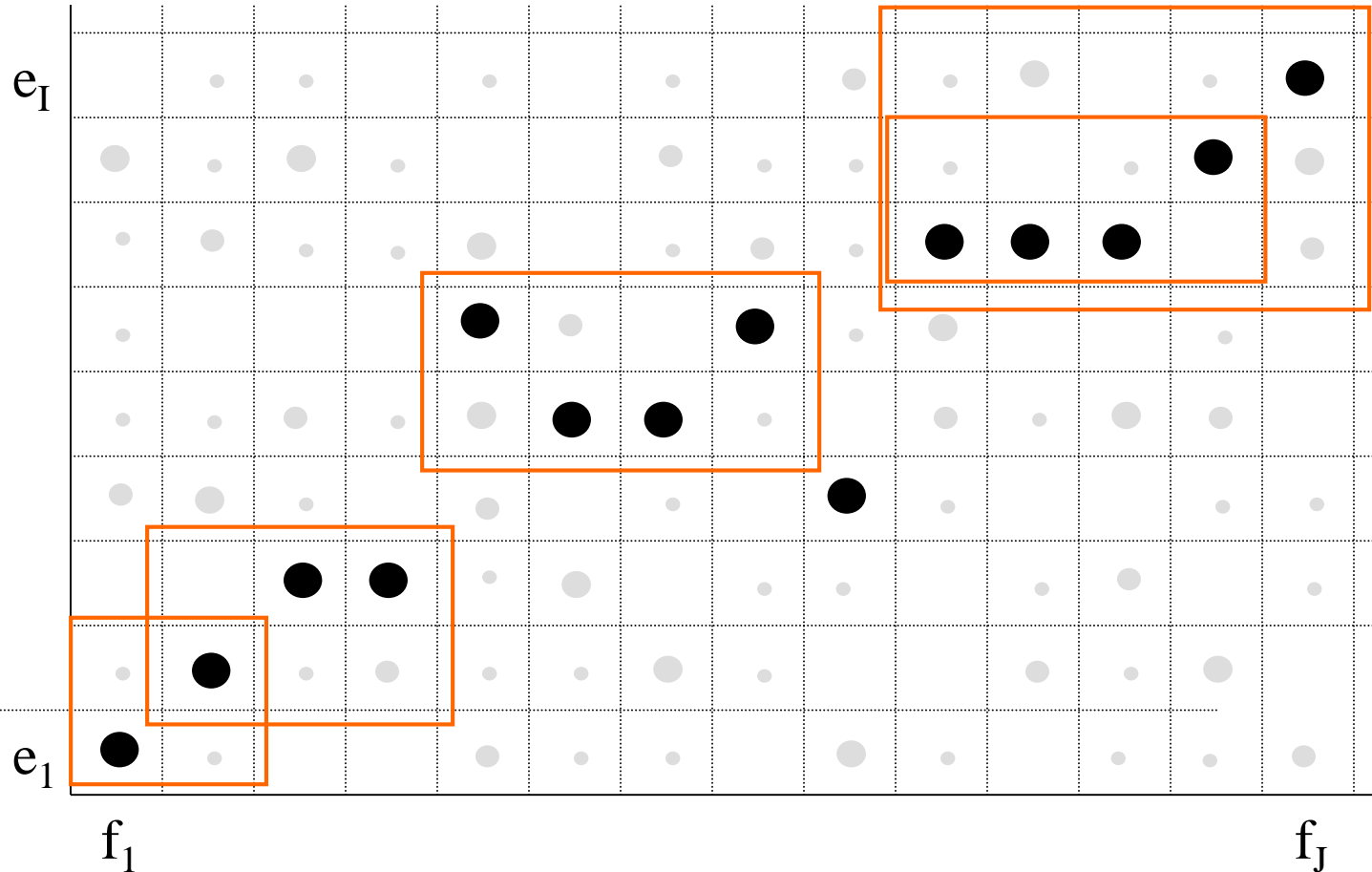
Word Alignment

- Calculate Viterbi path (i.e. path with highest probability)

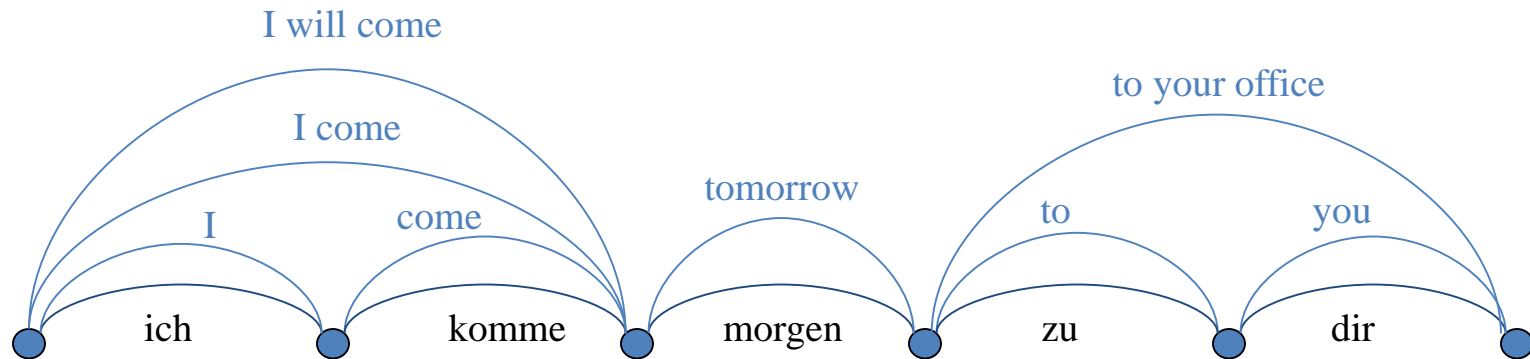


Extract Phrase Pairs

- Read off source phrase – target phrase pairs



Decode New Sentences



h: c=11000, t=I will come

h: c=11011, t=I will come to your office

h: c=11111, t=I will come to your office tomorrow

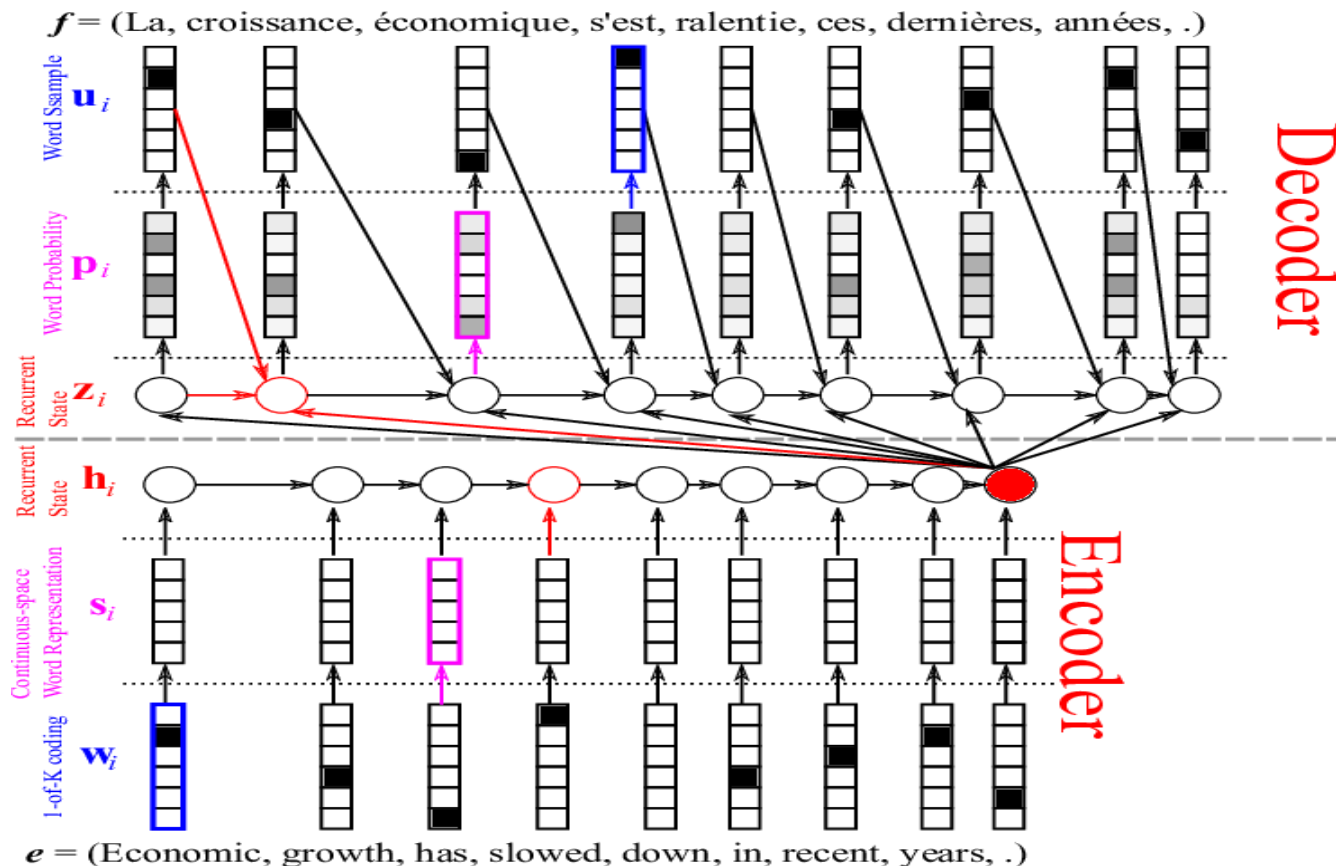


The Old Paradigm: Statistical MT

- Data-Driven:
 - More data -> better translations
 - Low resource scenarios – oh well!
- Serious Problem: Each word is an island
 - Related words (e.g. red, green, blue, ...) are not related in the MT system
 - Worse: different word forms (e.g. table, tables) are complete strangers in SMT
- Some repair mechanisms
 - Factored models
 - Word class models
 - AMR Abstract meaning representation



The New Paradigm: Neural MT



From Kyunghyun Cho: <https://devblogs.nvidia.com/parallelforall/introduction-neural-machine-translation-gpus-part-2/>



The New Paradigm: Neural MT

- Map words into vector space: Embeddings
 - Related words hopefully close in that space
- Process sequence of words and build representation of entire sentence (Encoder)
- Generate sequence of words starting from this representation, also using previously generated words (Decoder)
- NMT is data-driven as SMT
 - Currently no indication that it will solve the low-resource MT problem



Back to the Future: A Few Observations



- Back to the 1990s – word for word translation
 - Right now NMT operates on word level, or sub-word level
 - Can we capture the benefits of phrase-based translation?
 - Can we incorporate syntactic structure?



- No explicit modeling of word alignment
 - Attention mechanism introduced to recover some of the power of the word alignment models
- No specific modeling of word reordering
 - Such models helped a lot in SMT

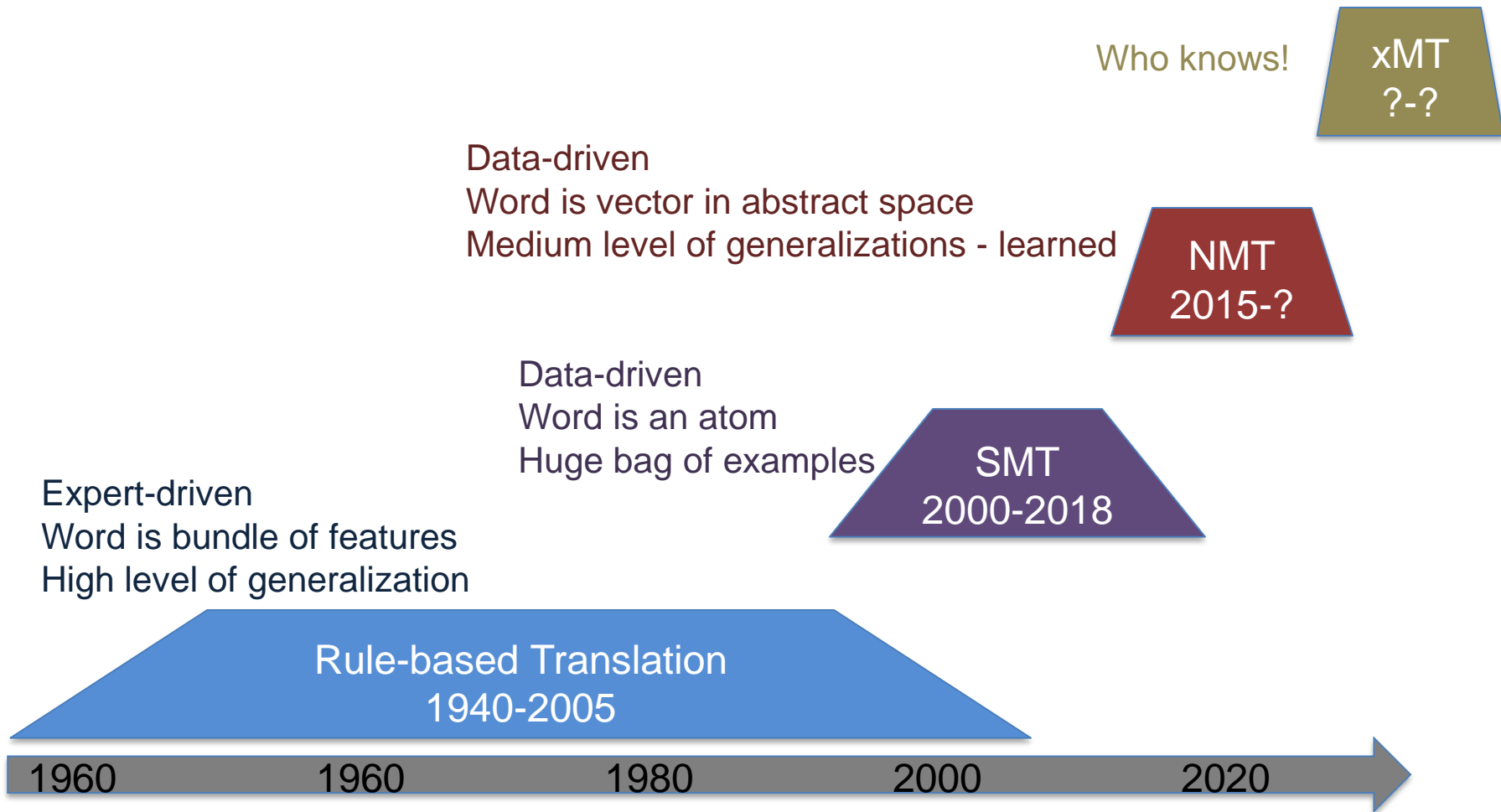


Déjà Vu – Neural Language Processing

- Neural Network based machine learning is not new
 - Created a lot of hype 30 years ago!
 - Rumelhart, D.E., J.L. McClelland and the PDP Research Group (1986). *Parallel Distributed Processing (vols 1 & 2)*
 - Nice simulators: Rochester, Stuttgart
 - Special hardware
- Applications in natural language processing
 - Parsing Complex Sentences with Structured Connectionist Networks
Jain, Neural Computing, 1991
- Applications in speech recognition
 - Phoneme Recognition Using Time-Delay Neural Networks
Waibel, Hanazawa, Hinton, Shikano, Lang
IEEE Transactions on Acoustics, Speech, and Signal Processing, 1989
- Applications in machine translation
 - Machine Translation using Neural Networks and Finite-State Models
Castaño, Casacuberta, Vidal, TMI 1997



Paradigm Shifts in Machine Translation



More Wind of Change – MT Business

- Translation has grown to a 40 billion USD industry
 - Yearly grows: 7%
- Machine translation is taking an increasing share
 - Yearly growth 20-25% pa *
- Observations:
 - Companies are embracing MT
 - Governments are adopting MT (e.g. European Parliament)
 - Translators are (often unhappily) accepting the reality of MT
 - Translation memory providers provide MT APIs
- MT is not so much replacing human translation, but covering before uncovered territory

* [http://www.researchandmarkets.com/reports/3138713/globalmachinetranslation market20152019](http://www.researchandmarkets.com/reports/3138713/globalmachinetranslation%20market20152019)



MT for Web, Social Media, Online Shopping



143 Billion words a day across
100 language combinations



Would need 200,000
translators



facebook

2 billion text translations on
a daily basis



Microsoft
Translator

??? Billion words a day

- 1) <https://www.quora.com/How-many-words-are-translated-every-day-by-Google-translate>
- 2) <http://wersm.com/facebook-translates-billions-of-posts-every-day/>
- 3) Hassan Sawaf: Personal communication



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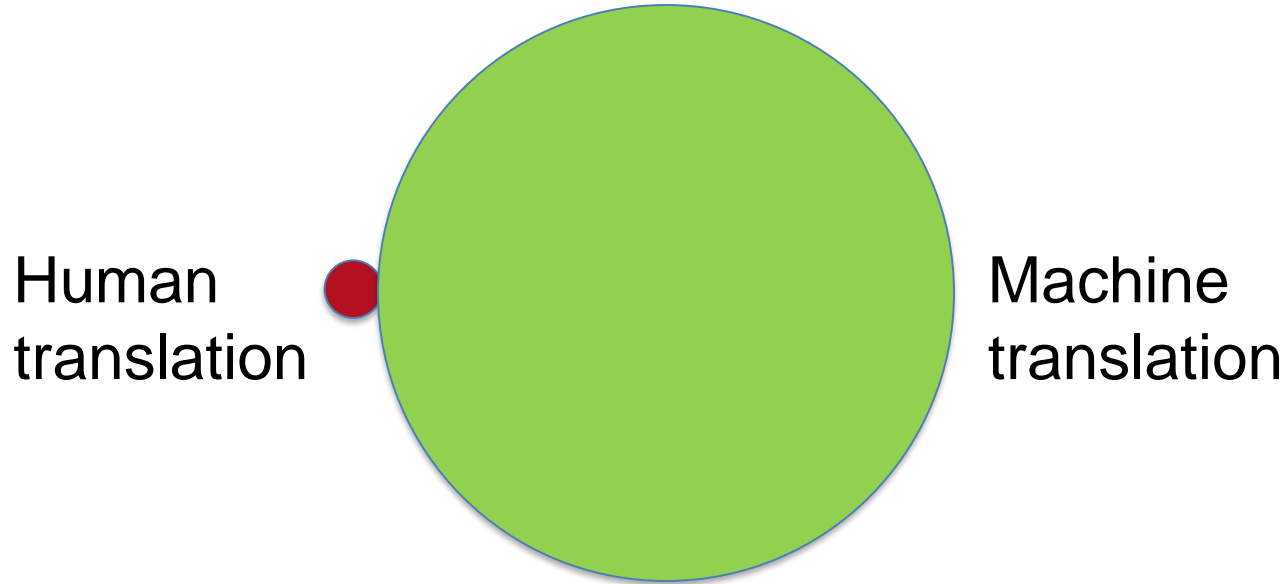


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MT for Web, Social Media, Online Shopping



100 times more content translated by machines than by humans!



Wind of Change - MT Startups

Disruption In Progress: 10 Years and 190 Translation Startups

by [Gino Diño](#) on October 6, 2015



The translation, localization, and language tech start-up scene is huge. In the past decade alone, 190 translation, language tech, and localization startups were founded, according to [Crunchbase's data](#).

<https://slator.com/features/disruption-in-progress-10-years-and-190-translation-startups/>



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Wind of Change - MT Startups

10 Years of Translation Startups
2005 - 2015

SLATOR
Language Industry Intelligence

			2015
	- GlobeChat - Localizer - Applanga - fluently	- Fanyitong - Skuuper - DailyTranslate Ltd	
2014	- SeekPanda - Elymentz - Keego - Reach7 - Up & Buzz - Agile	- HIZLIÇEVIRI - Minimal Technologies - Translation.io - WordWorks Media - KL Translations Ltd - MotaWord	
	- DROTR - Droid Translator - Jargon - Unbabel - RixTrans Translation agency - KAWO - Ricksher - TRAN.SL	- Spanglator - TurboTranslations - myKnowtions - Auctionory - Autotiming - Lingout - AmigoCAT	2013
		- IW Interpreters Worldwide - Zaznu - LocPlanet - SmartLation - TransElated - Go4Translations - Speakrs - TalkPal	
2012	- Finecevir - POEditor - Lingohub - Flitto - Lingvus - Softlation	- Videum - Elio Motors - Webflakes - World News Translate - VODU - CloudMenu	
	- Duolingo - Transfluent - TextMaster - ANECSYS - Verbalizeit - Bravolol - greatcontent.com - Lingo365 Translation Services	- Easyling - SpeechTrans - Nativy Translations - Tradixo - Marco Polo Project - FIT Digital - Copypanthers - Frenchwide	2011
		- Translation Cloud - Localizeyourapps - Mustaqil.com - Pharmacad Services - ChineseTrans - Filip - phriseup - Talks Hub	

2010	- Viki - AppFusions - Babelverse - Cloudwords - Rev - ProPRcopy - Memsorce	- lingoking GmbH - Endless - Dakwak - TripleCurve - OneSky - Applingua - Lexifone	- Tolab - Phocabulary - TuDocumentLegal - Tolg.com - VEROLING - Wordchuck - Translation Services 24	- Threeplicate - Tweetlator - RockCat Studio - Alconost Nitro - Diction - Owl Commerce - YLT - Translations
	- Transifex - Servio - twago.com - Jibbig - Quest Visual - CommBridge - SayHi	- Webali - Contentor - WritePath - eType - Veritas Language - World Renders - hyperlingo	- Socialbel - MendWord - Translations - GTranslate - Get Localization - TranslationsPal - Synble - Looah LLC	- Asia Translate - World Language Communications - TRANSLLOOPA - Yaraku, Inc. - Caterpi.com - Twibberish
2008	- Gengo - One Hour Translation - tolingo - Machine Zone, Inc. - Intelatext		- Crowdin - Wordbee - Localize-Translate - Technovate - Translations - ConveyThis	- GATIM Language Services - English Profi - H&S Translation Services - Applied Asian Languages - Linguistix
	- SpeakLike - Dotsub - bab.la - Alfabetic - Asia Online	- Translation Services USA - Supertext AG - Three Innovators - Day Translations, Inc. - Cultures Connection	- CNX Translation - One Stop Shop Translations - ZipDX - ProDialect Language Solutions - Somya Translators	2007
2006		- Lingotek - All Voices International - Global Lingo - Eiphnh Consulting Solutions - Translation Agency - Mazas-Pasaulis	- Lingtastic - JR Language Translation Services - tauyou - Homeworker24 GmbH - Wapa Translation	
	- Across Systems - In Every Language - Lingo	- Backstage Media - database convert - Megatranslations	- QuicCONSULT - Information & Consultancy Services	2005

**Source: Crunchbase*



Wind of Change - MT Startups

Some examples close to home:

- Mobile Technologies - acquired by Facebook

- Alex Waibel (KIT, CMU)
- Famous for Jibbigo



- Safaba – acquired by Amazon

- Alon Lavie (CMU)



- Apptek - MT section acquired by eBay

- Longwinded story. The short: Hassan Sawaf brings technology from RWTH to Apptek



- Unbabel: MT plus crowd-sourced postediting

- Former LTI PhD student: Vasco



- Lilt: interactive MT

- Out of Stanford: Spence Greene, John de Niro



Summary: MT and Winds of Change

- Another paradigm shift in MT research and development:
From SMT to NMT
- Machine translation is taking an increasing share in the translation industry

MT 20% growth versus HT 7% growth

- MT has become an everyday reality in the Web, in social media, etc
100 times more words by machine than by translators



Winds of Change - Exiting Times for MT Researchers



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Congratulations to InterACT & Alex



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