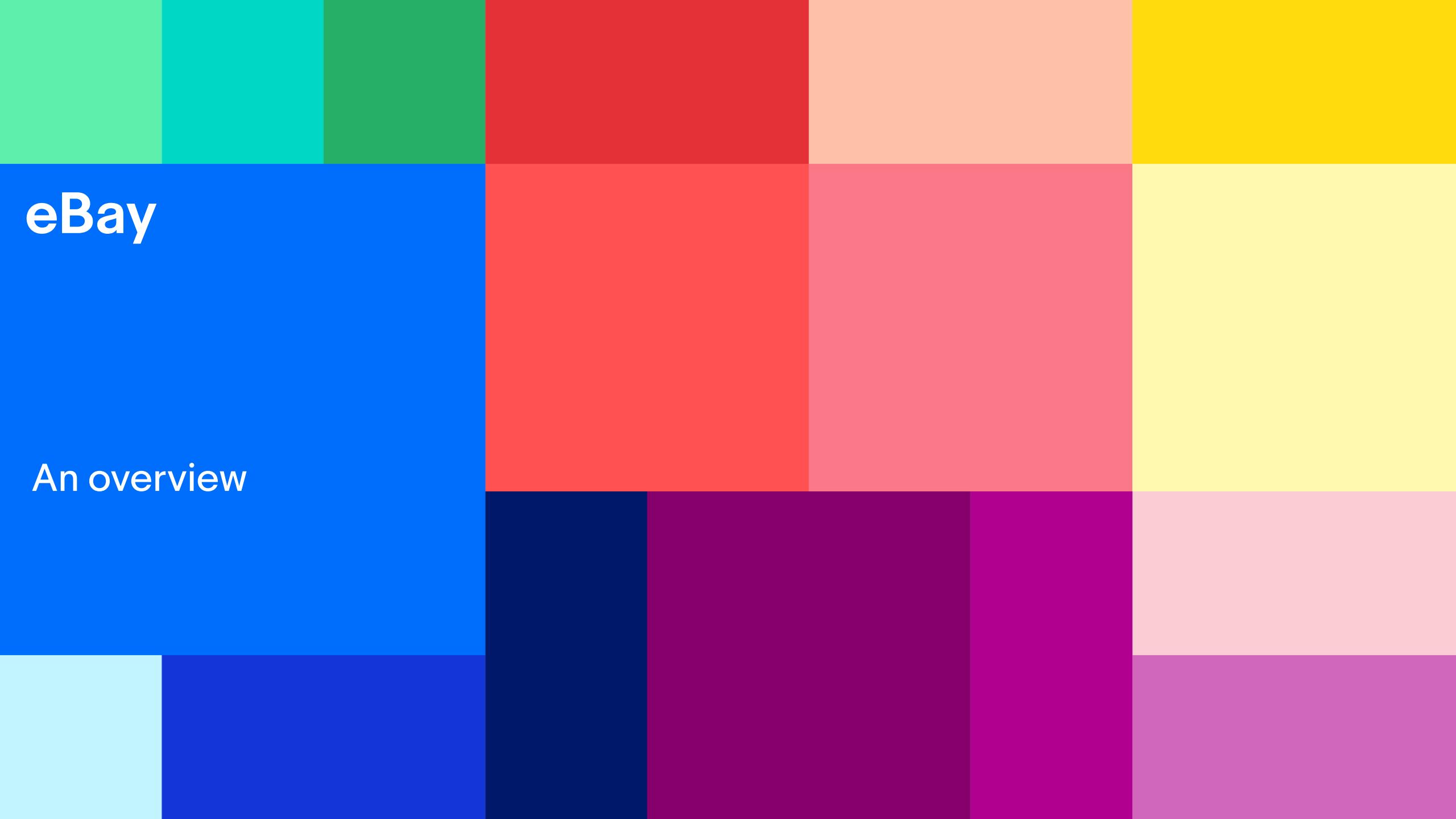


Neural MT in e-Commerce: Advances and Challenges

Shahram Khadivi

March 2nd, 2018



eBay

An overview

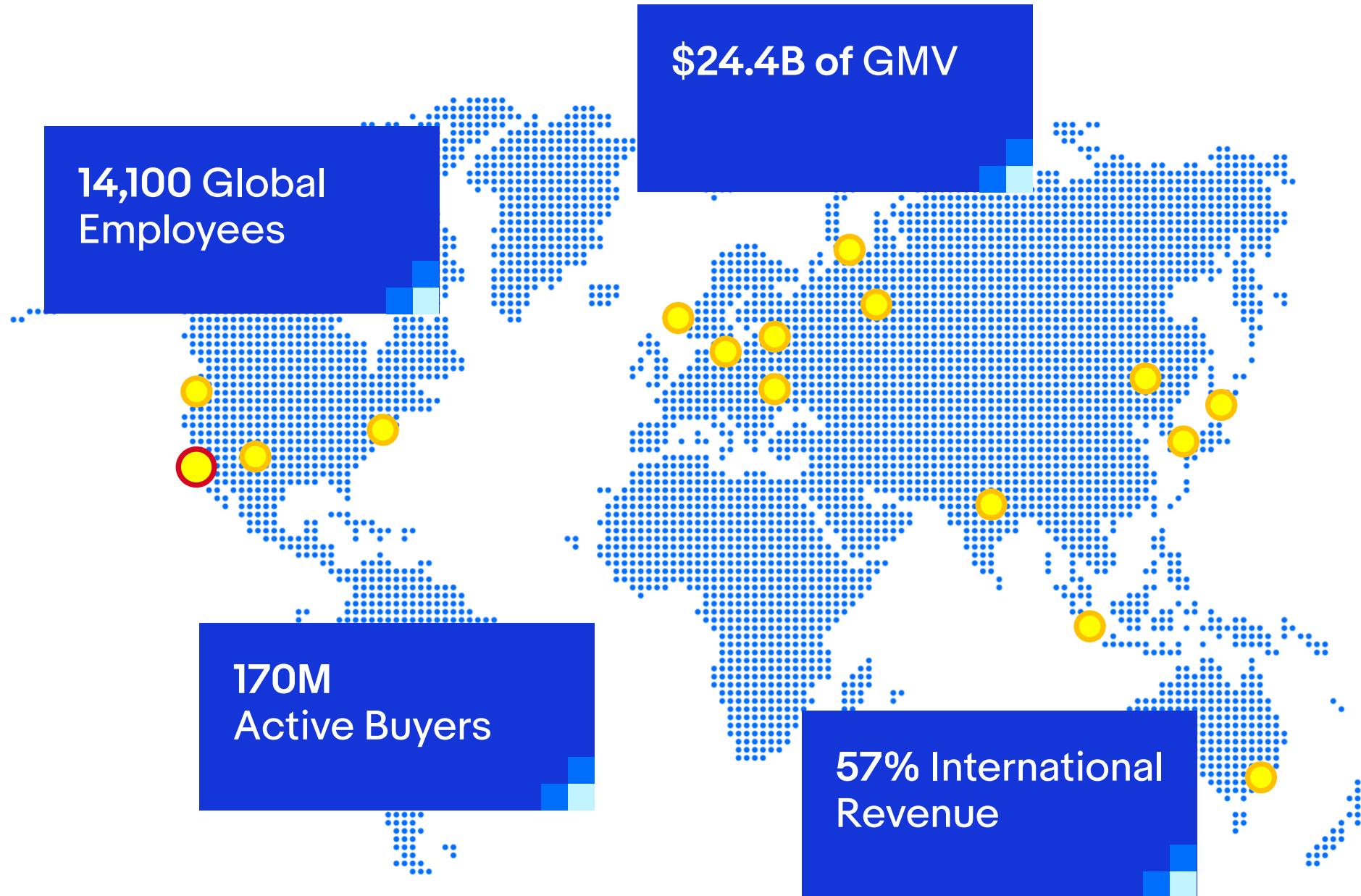
eBay Today

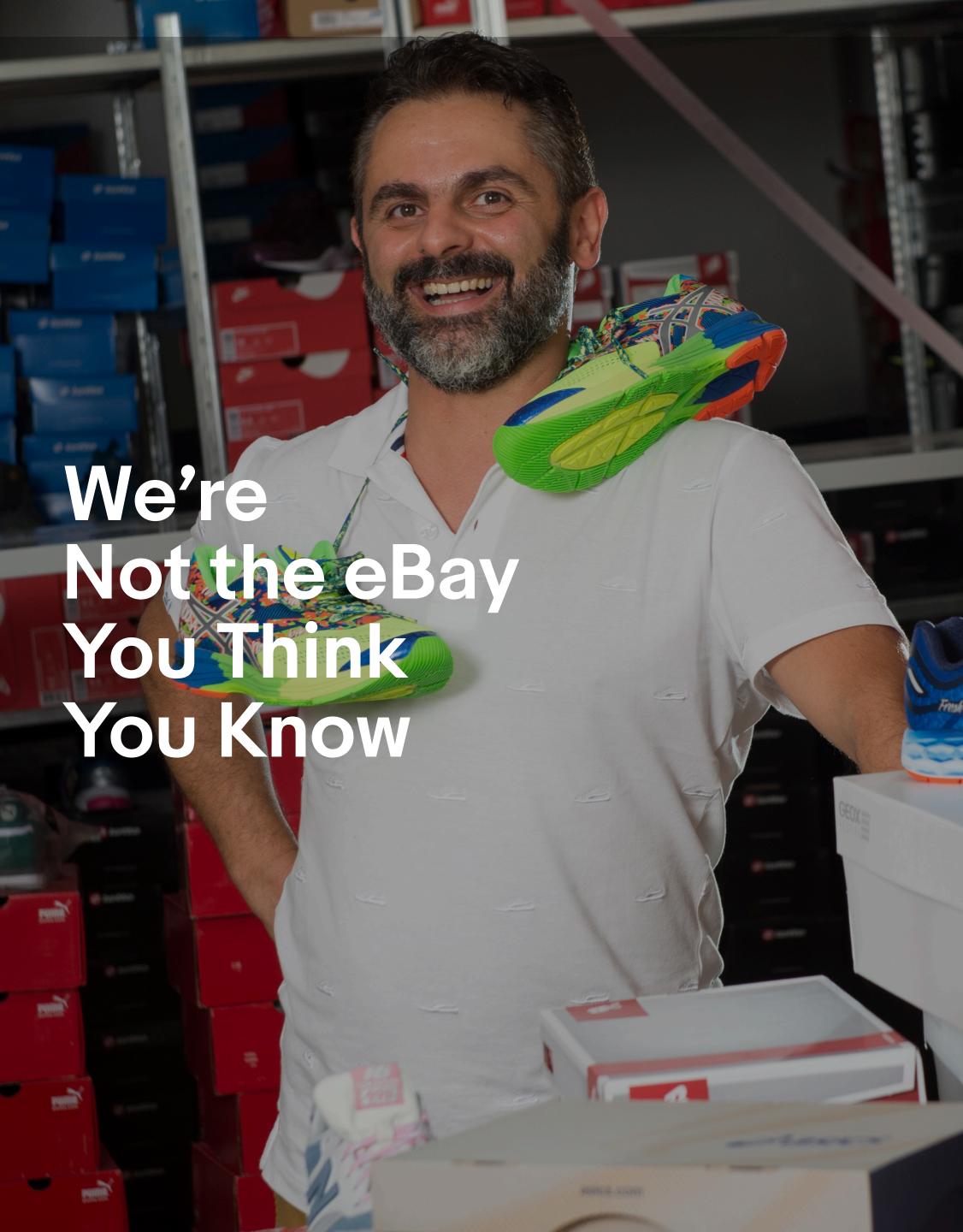
ebay

StubHub

ebay
classifieds
group

Q4 2017 numbers





We're
Not the eBay
You Think
You Know

81%

of items sold are new
and unused

70%

of items sold on eBay
ship for free*

Q4 2017

*Applies to US, UK, DE

~2/3

of eBay packages in the
U.S. are delivered within
three business days or
less

1.1B

live listings

170M

active buyers



190

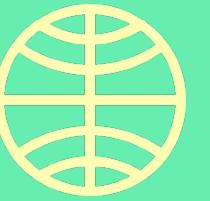
Markets



Q4 2017

57%

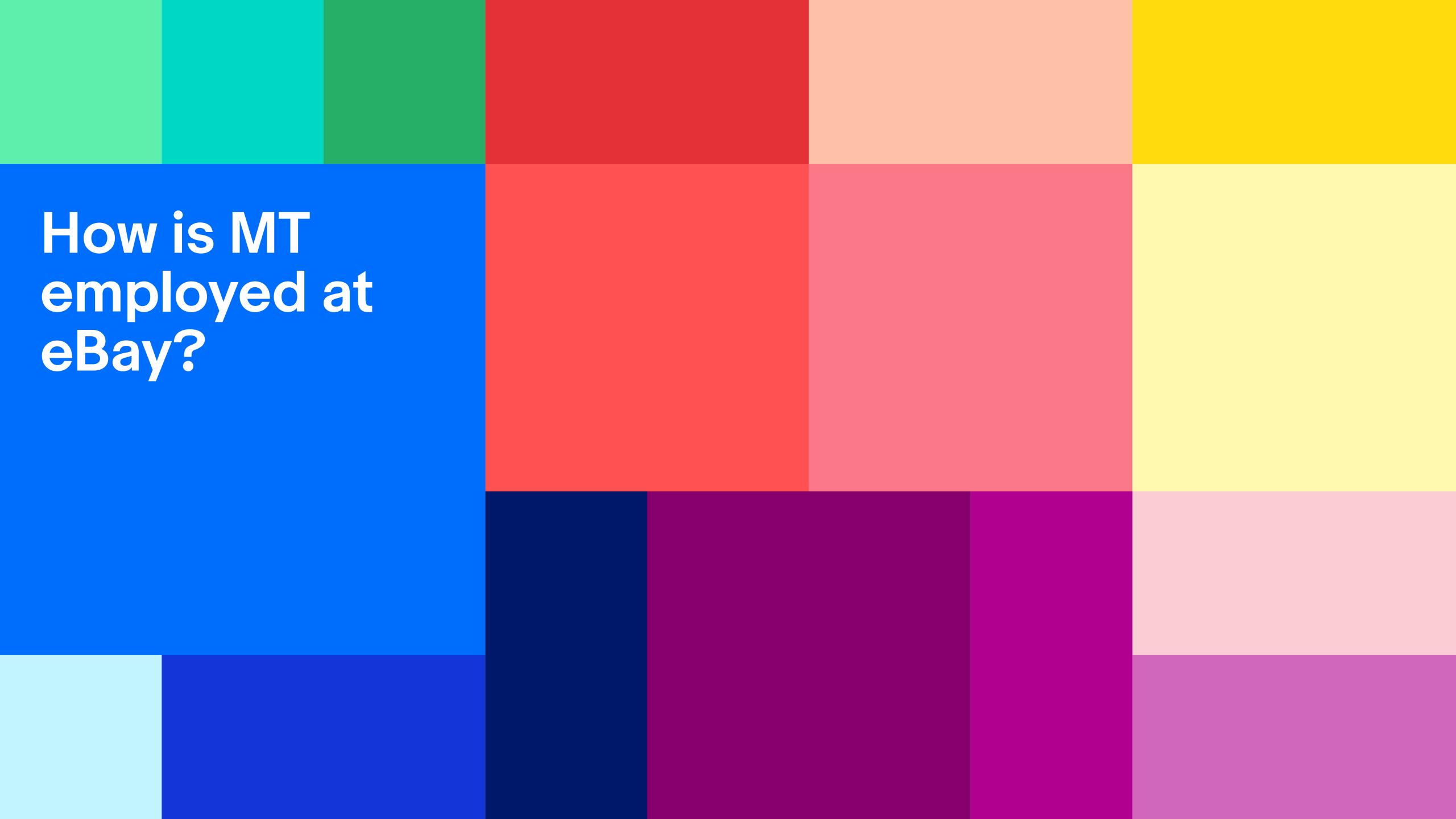
of business is
international



8B+

Translations per day &
20+ translation directions





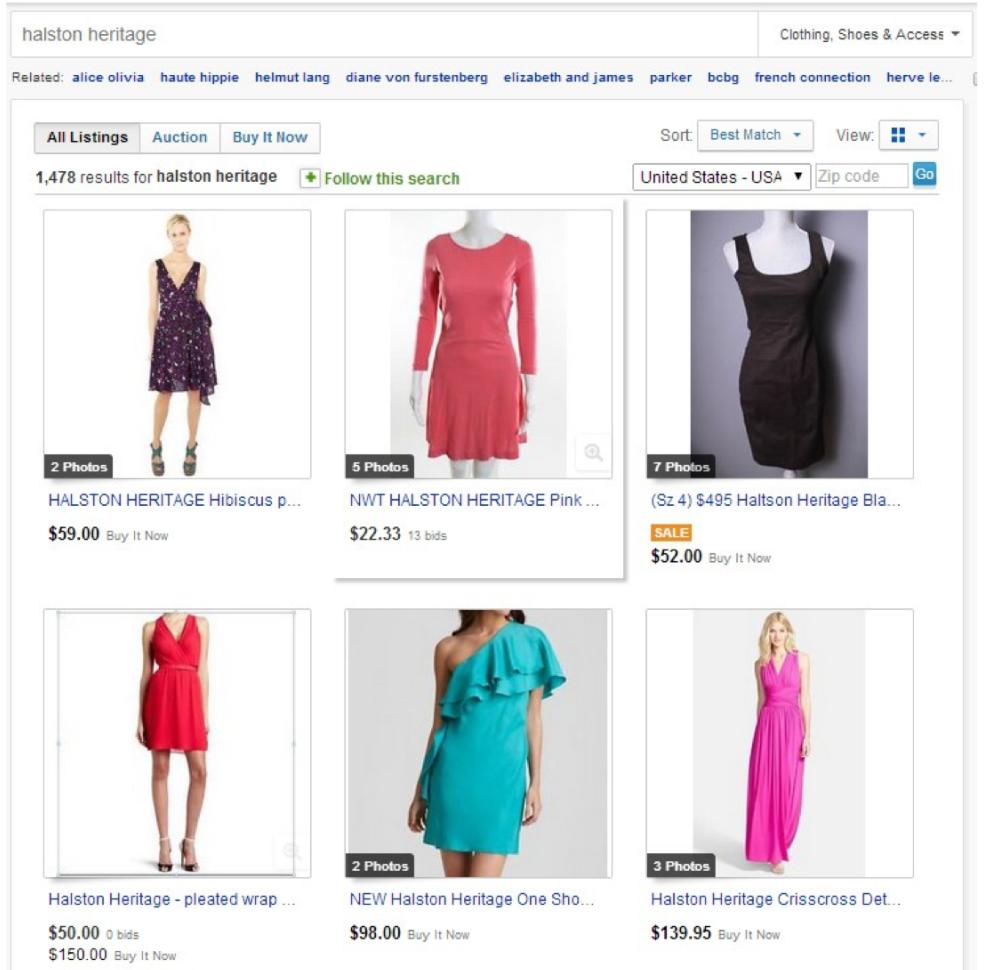
How is MT employed at eBay?

Static content

The screenshot shows the eBay Fashion homepage. At the top, there's a search bar with "Search..." and a dropdown menu for "Clothing, Shoes & Access". Below the header, the word "FASHION" is prominently displayed. To the left, a sidebar lists "Sales & Events" (Sales & Events, Fashion Daily Deals), "Featured Shops" (Designer Collective, Watch Shop, Handbag Shop, Wedding Boutique, Collectible Sneakers, Engagement Ring Boutique, Sandal Shop, Athletic Shop), "Shop By Department" (Women, Men, Kids & Baby, Shoes, Handbags & Accessories, Jewelry & Watches, Health & Beauty), and "Everyday Savings" (Outlet - up to 60% off). The main content area features a large banner for "INTRODUCING DESIGNER COLLECTIVE" with a "SHOP NOW" button. Below the banner, a man and a woman walk away from the camera on a rooftop with power lines in the background. At the bottom, there are three smaller images: a quilted handbag, two watches (one Michael Kors, one Nixon), and a diamond ring.

...is translated by the
localization team

Dynamic content



The data flow is huge and continuous

...requires machine translation

In Australia, a car/truck part is purchased every

4
seconds

In the US, a smartphone is purchased every

5
seconds

In the US, a watch is purchased every

5
seconds

In the UK, a makeup product is purchased every

2
seconds

Translation flow

- 1 The user issues a query in the foreign language

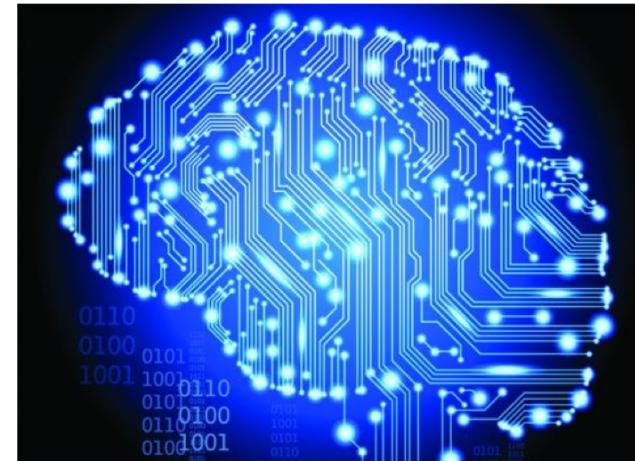
A screenshot of a search interface. On the left is a white input field containing the text "lunettes de soleil homme". To the right of the input field is a solid blue rectangular button with the word "Rechercher" written in white capital letters.

Translation flow

2 The engine translates the foreign query into English

QT: query translation

lunettes de soleil homme



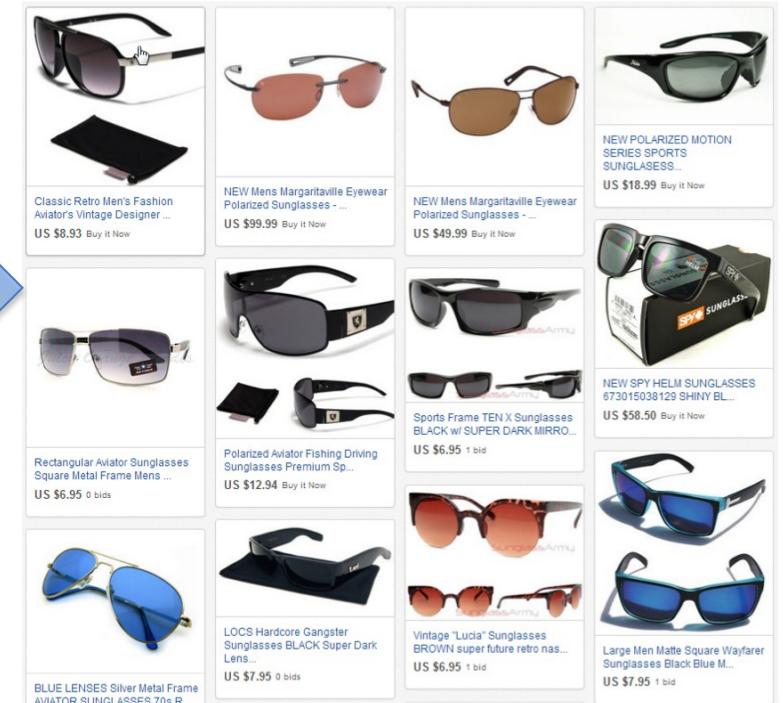
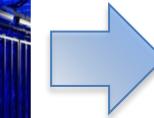
men's sunglasses

Translation flow

3

The translated query is issued against the eBay English search engine to retrieve English inventory

men's sunglasses

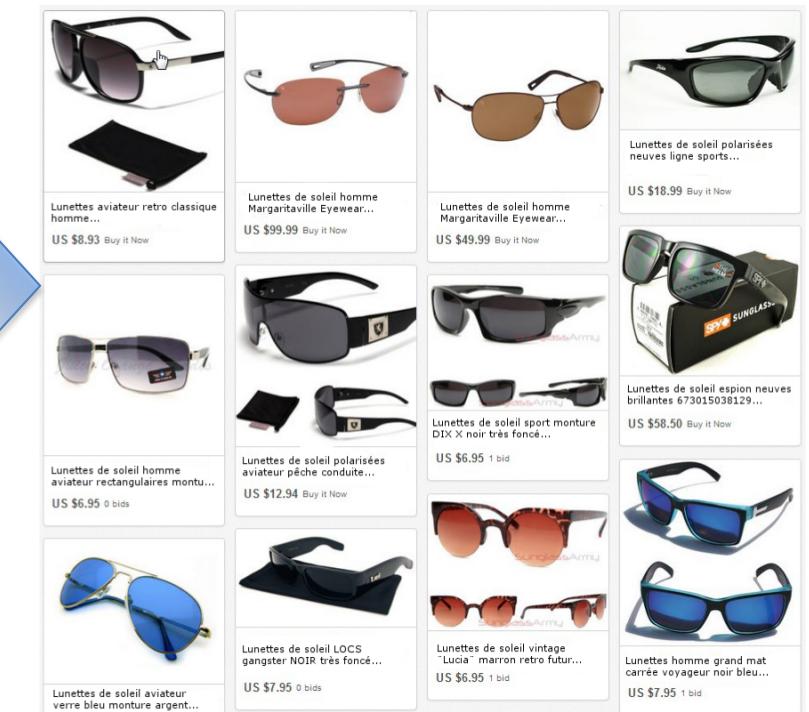
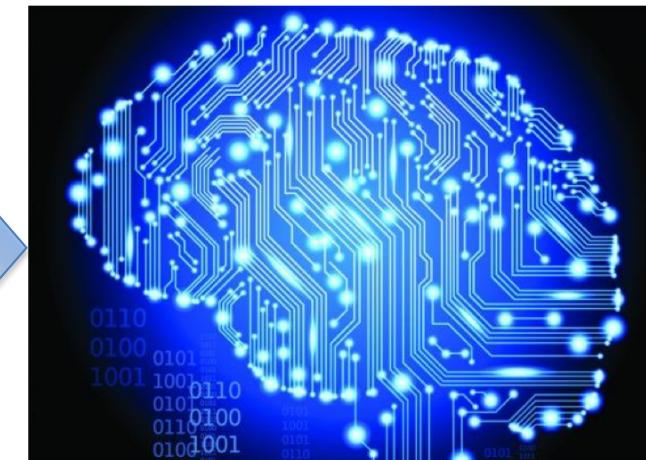
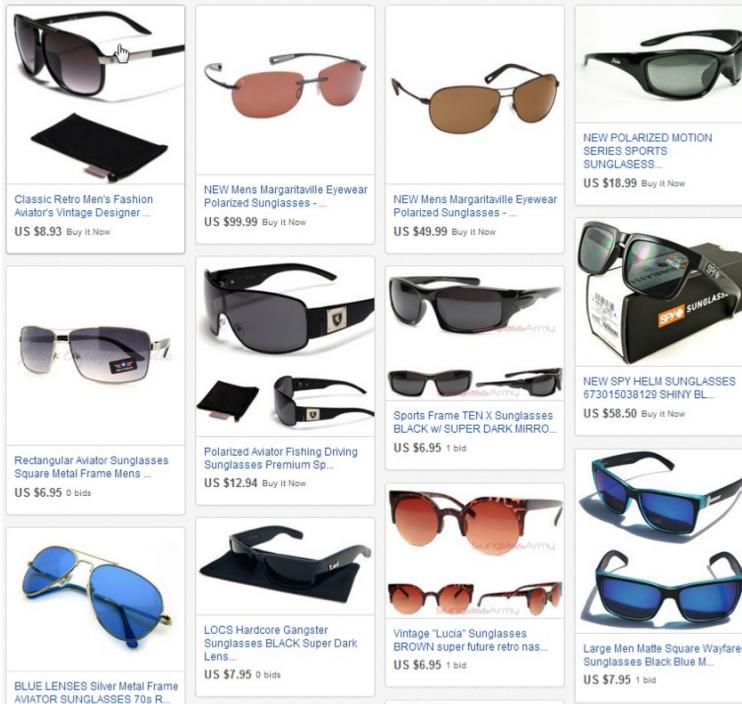


Translation flow

4

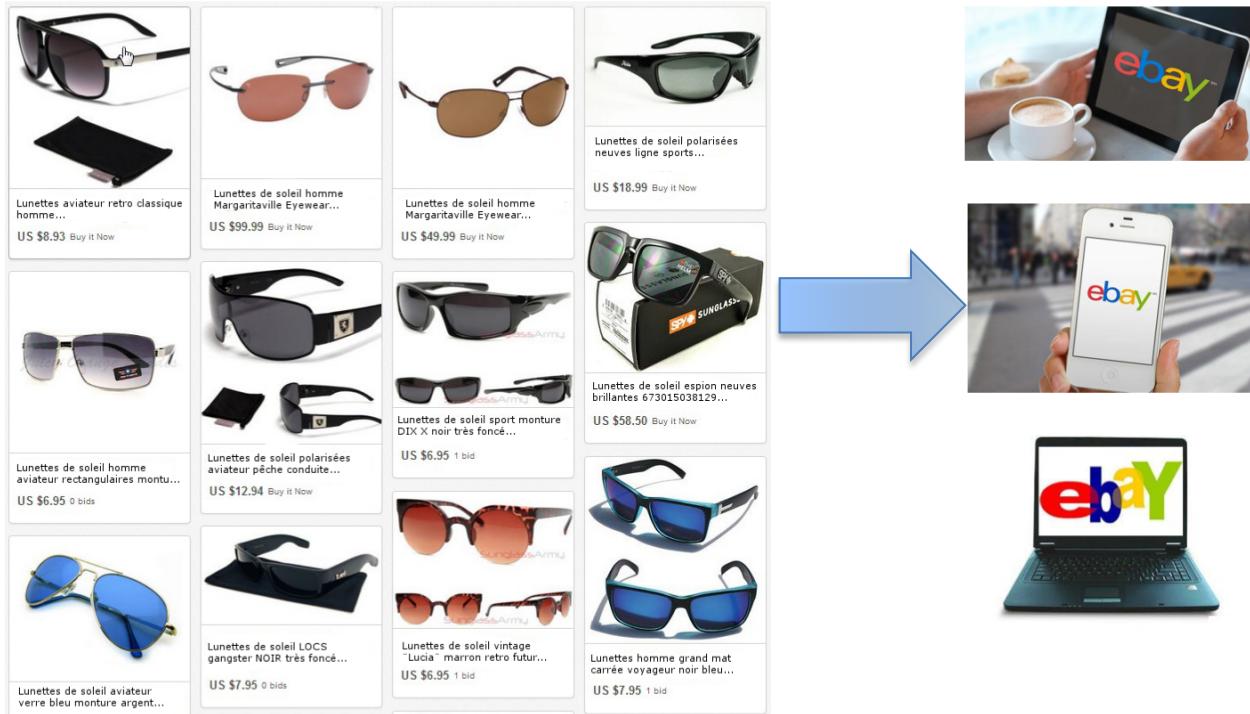
The engine translates the English inventory into the foreign language

ITT: item title translation, DT: description translation (on-demand)



Translation flow

5 The translated inventory is served to the user



Other use-cases:

- User queries
- Titles
- Item specifics
- Description
- Product reviews
- user-to-user communication
- customer service communication
- site localization (with post-editing)
- ...

The screenshot shows an eBay listing for an Apple Watch Series 2 42mm Aluminum Case Black Sport Band (MP062LL/A). The item is listed as used with 199 product ratings. The current bid is \$222.50 with 2 bids. Shipping is \$20.82 via International Priority Shipping to Germany. Payment options include PayPal, VISA, and American Express. The item specifics table includes details like Condition (Used), Compatible Operating System (iOS - Apple), Case Size (42mm), Band Material (Fluoroelastomer), and Band Color (Black). The detailed item info section provides a product description and key features table.

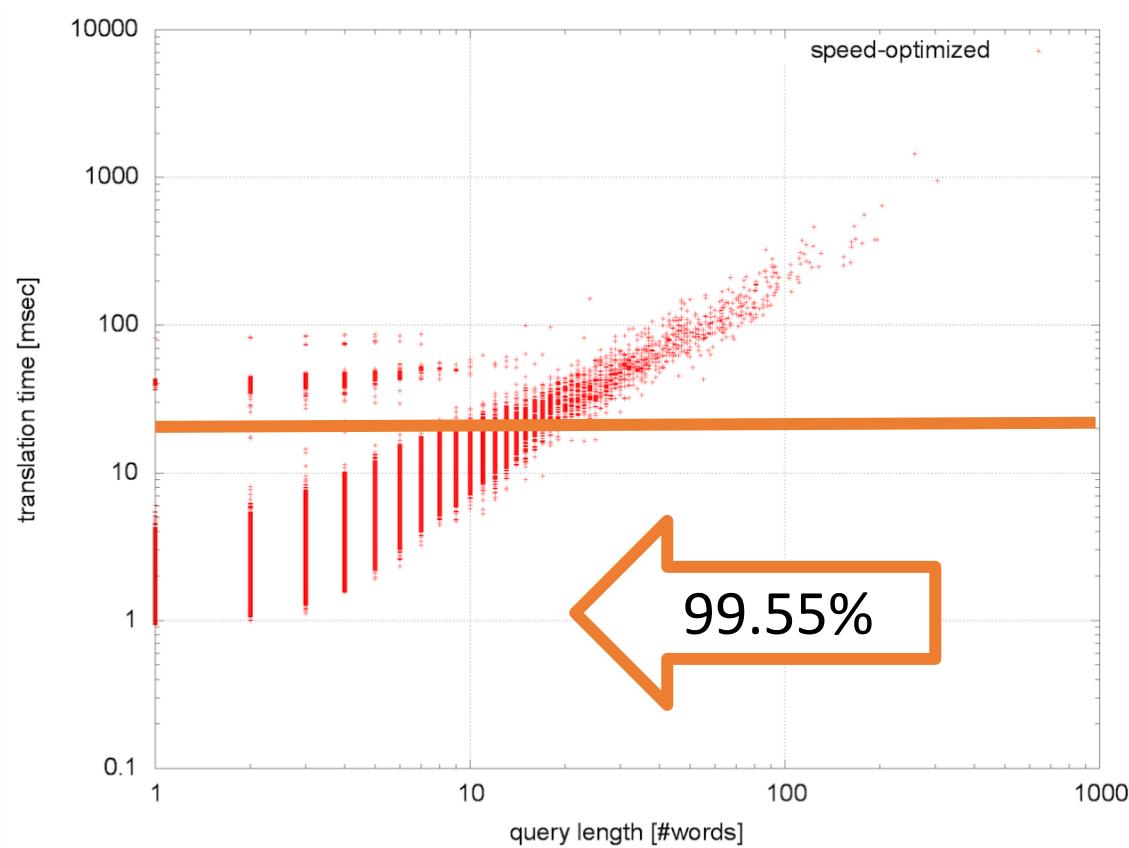
apple watch series 2. the condition is 9/10 used for 2 months. comes with clean cloud, USB charger no wall charger. comes with Milanese Loop Band and original black sport band too.

MT Challenges at eBay?

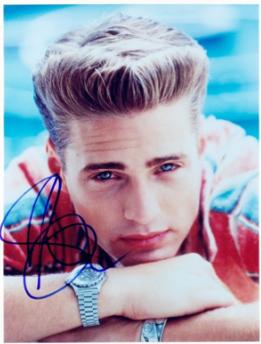


MT is mission-critical

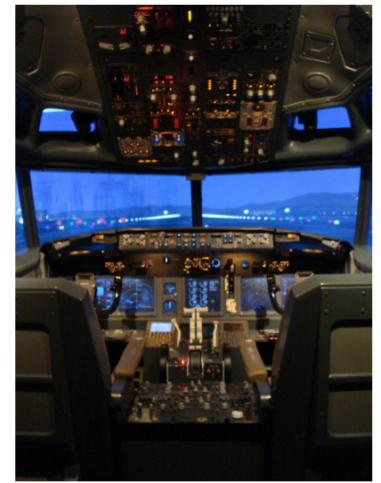
- System must be tuned for maximum throughput



Very diverse data



\$4,000,000



\$79,000

A tiny sample from 15,000 categories



A wide range of inputs

- The translation engine must accommodate a wide range of input like
 - Foreign queries: requires translation
 - English queries: don't try to translate!
 - Ambiguous queries (no article): “figure” (English or French?), “time” (English or Portuguese?)
 - Limited context, ambiguities in different product categories
 - New products with new vocabulary every day
 - Noisy, non-grammatical user input
 - Misspelled queries e.g. 334 likely spelling variants of “Samsung” in 10M queries

```
samsung samsug samsumg samung amsung samnsung smsung samsuns samaung sumsung smasung samsng samsing samusng sammlung ssamsung samdung  
samusung sasmung sasung samsugh samsung samsum samsuung samsubg samsnug samsungg samsunf ssmsung samsunh samasung samnsug damsung  
sampsung sanmsung samssung sammsung samsund saamsung aamsung samsyng samsungs samsong samsungg samsang samsungh samsunga sqmsung  
sambung hamsun sasmsung samsumng samsaung samsunv samsunsg samnung salmsung samsunt samnsun sammung asmsung samsjng samunsg samsung  
samsunge salsung samyoung samusug samsui samsnung sampung samgun samesung samcung isamsung gamsung zamsung xsamsung samxung samsungy  
samsungfg samsung sameung üsamsung szmsung swmsung smausng samumg samsusng samsunug samsunb samsoung samsitung samsdung samiang asamsung  
sumsumg sumsong somsung smasun smamsung samzung samusun samsungù samsungo samsungf samsums samsujg samsuhg samsin samshng sampsun  
saksung saamsug rsamsung lsamsung eamsung xamsung ...
```

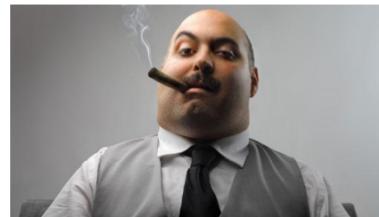
Brand preservation



HUGO
HUGO BOSS

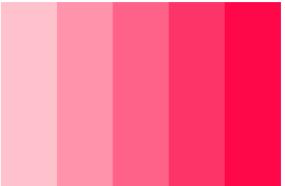


VS.



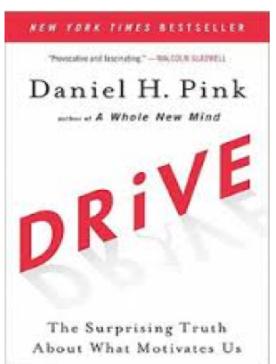
Polysemous words are more frequent and diverse

“pink”



PINK

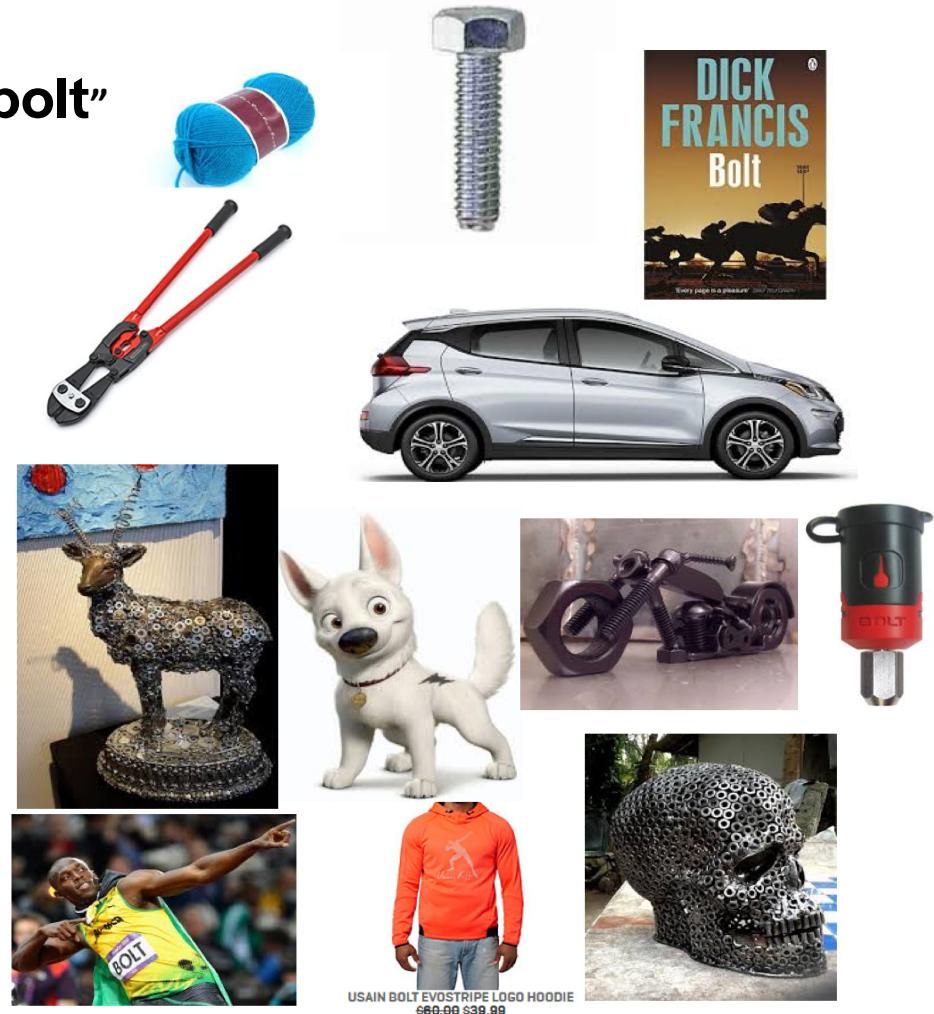
VICTORIA'S SECRET



More Examples:

ball: sports or formal dances?

“bolt”



skin: human skin or mobile phone case?

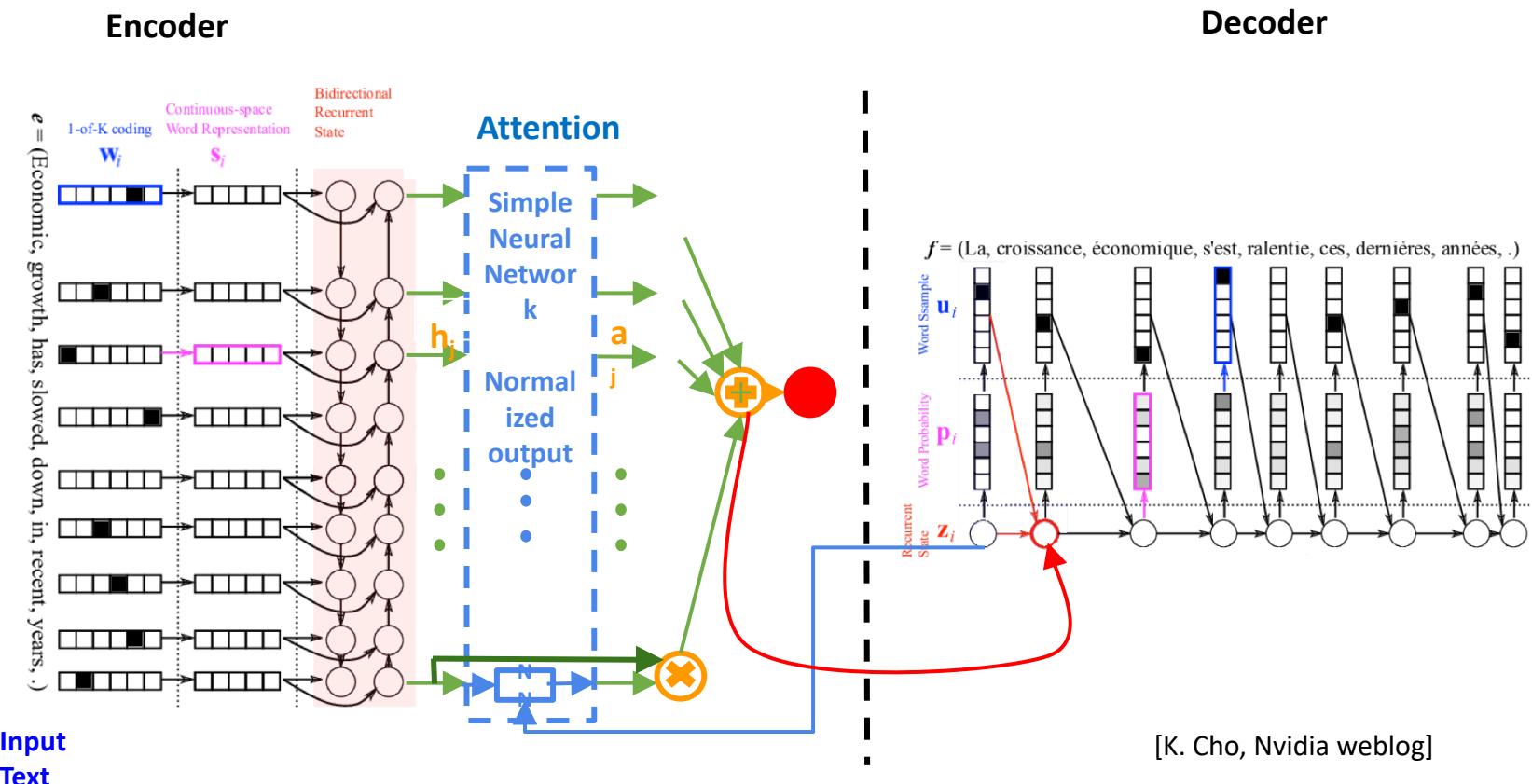
mixer: kitchen or recording studio?

Other Challenges

- **Find the right word order in spite of the lack of syntax**
- **Lack of in-domain parallel data**
- **Low correlation of MT measures like BLEU with the final goal of selling the product**
- **Morphological agreement**

eBay Neural MT

Attention-based Architecture



eBay Neural MT

Features

General:

- Built with Tensorflow 1.x
- Minimum risk training ([Shen, 2015](#))
- Bayesian dropout ([Gal, 2015](#))
- Multi-encoder, Multi-source
- Back-translation
- Byte pair encoding
- Placeholders

Advanced:

- Copying mechanism
- Dual-learning
- Bandit and Counterfactual learning

e-Bay specific:

- Guided alignment
- Domain adaptation: instance weighting, and domain (product category) embedding
- Hybrid NMT

Why NMT?

- Attention-based NMT often outperforms SMT
- NMT produces fluent translations
- Integrated training

Why phrases?

- Capture idioms
- Good local reordering
- Handling of the rare words
- Count-based
- Text override

Why integrate phrases into beam search for NMT?

- Combine count-based and neural models
- NMT can control reordering
- Search space not limited by phrase table
- Keep the current PBMT pipeline in production unchanged

Hybrid NMT

Hybrid Approach

Soft integration of
PBMT into NMT

Hybrid model:

- Model combination of NMT with PBMT
- Search over words and phrases in a hybrid beam search
- NMT training is not modified
- Integrate phrase-based models directly in search

→ Target sentence can be composed of word-based NMT and phrase-based translations

Hybrid Approach

Soft integration of
PBMT into NMT

Hybrid model:

- Model combination of NMT with PBMT
- Search over words and phrases in a hybrid beam search.
- NMT training is not modified
- Integrate phrase-based models directly in search

General Process:

- Start with standard NMT beam search
 - Generate target sentence word-by-word left to right
 - Fixed amount of candidates at each time step
- Suggest phrase translations based on current attention
 - Hard coverage on PBT
 - Score phrase translations using NMT model

→ Target sentence can be composed of word-based NMT and phrase-based translations

$$\hat{e}_1^I = \operatorname{argmax}_{I, e_1^I} \left\{ \sum_{m=1}^M \lambda_m h_m(f_1^J, e_1^I) \right\}$$

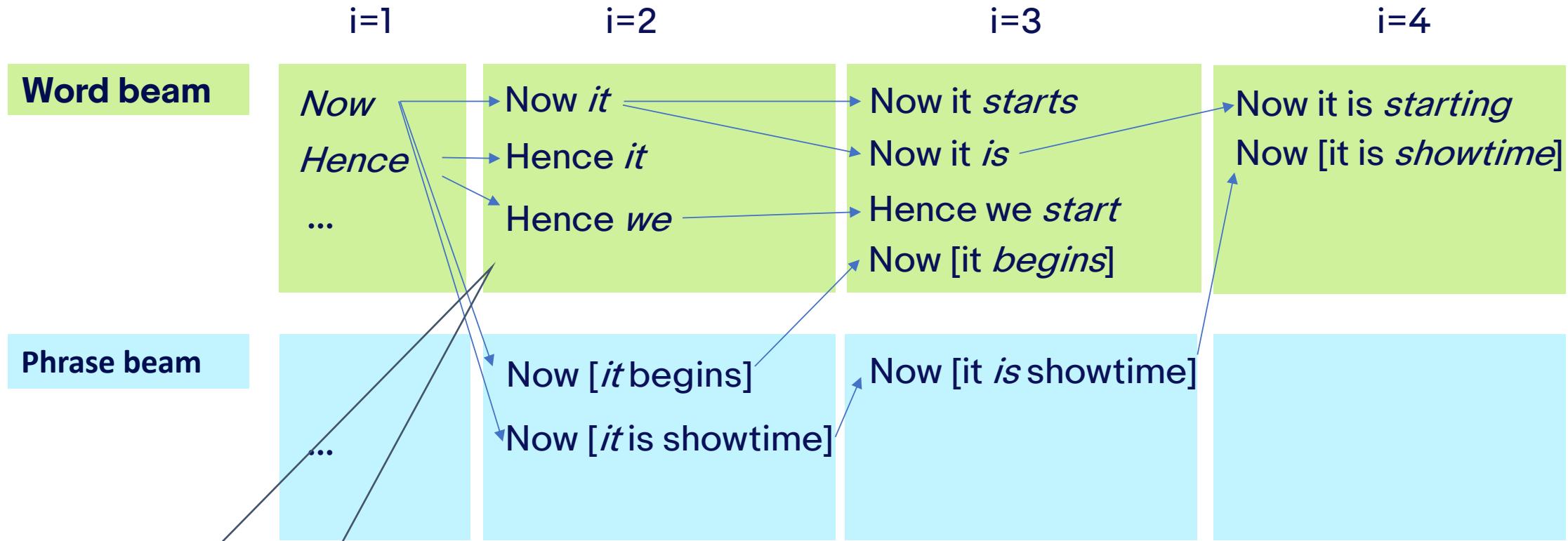
- Possible features:
 - NMT models
 - Language models
 - Word penalty, phrase penalties
 - Phrase scores
 - Word lexica
 - Coverage penalties
 - ...

Hybrid Search

Source sentence:

Jetzt geht es los

Attention:

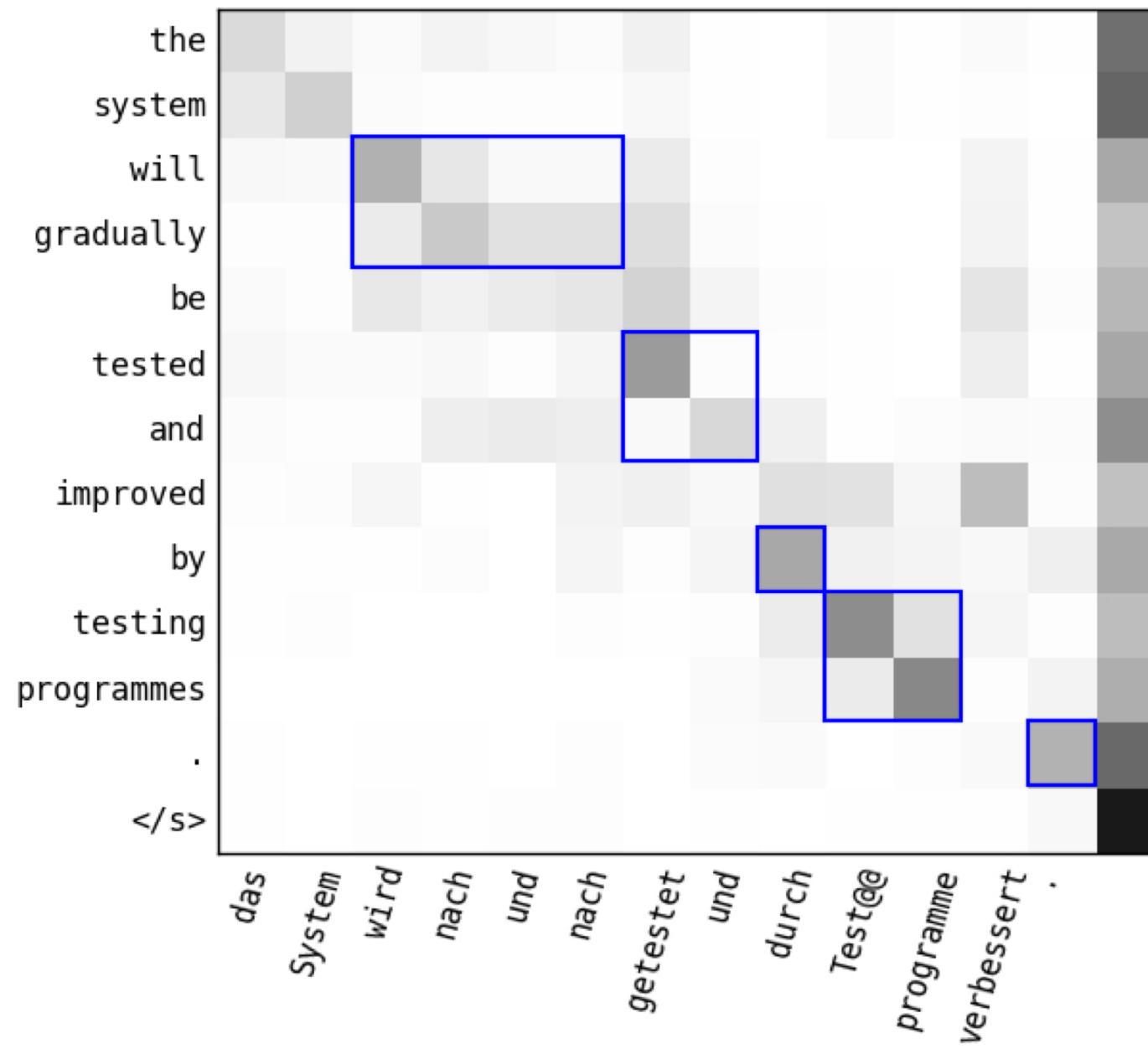


Matching phrases:

geht es los -> it begins
geht es los -> it is showtime

De→En

Real Example



De → En

- How to choose between phrase-based and word-based translations
- Evaluate different SMT features
 - Including target n-gram language model trained on additional monolingual data
- Organize hypotheses according to coverage
 - Pruning, rest-score estimation
 - How to combine soft and hard coverages
- How to reliably fix errors by “manual override” phrase pairs

Experimental Studies

Dahlmann, L., Matusov, E., Petrushkov, P., & Khadivi, S. (2017). Neural machine translation leveraging phrase-based models in a hybrid search. *arXiv preprint arXiv:1708.03271*.

e-Commerce Data set

En→Ru

Training set:

- Sentence pairs: 2.9M
- Running words: 46M/45M
- Vocabularies: 300K/700K

Development set:

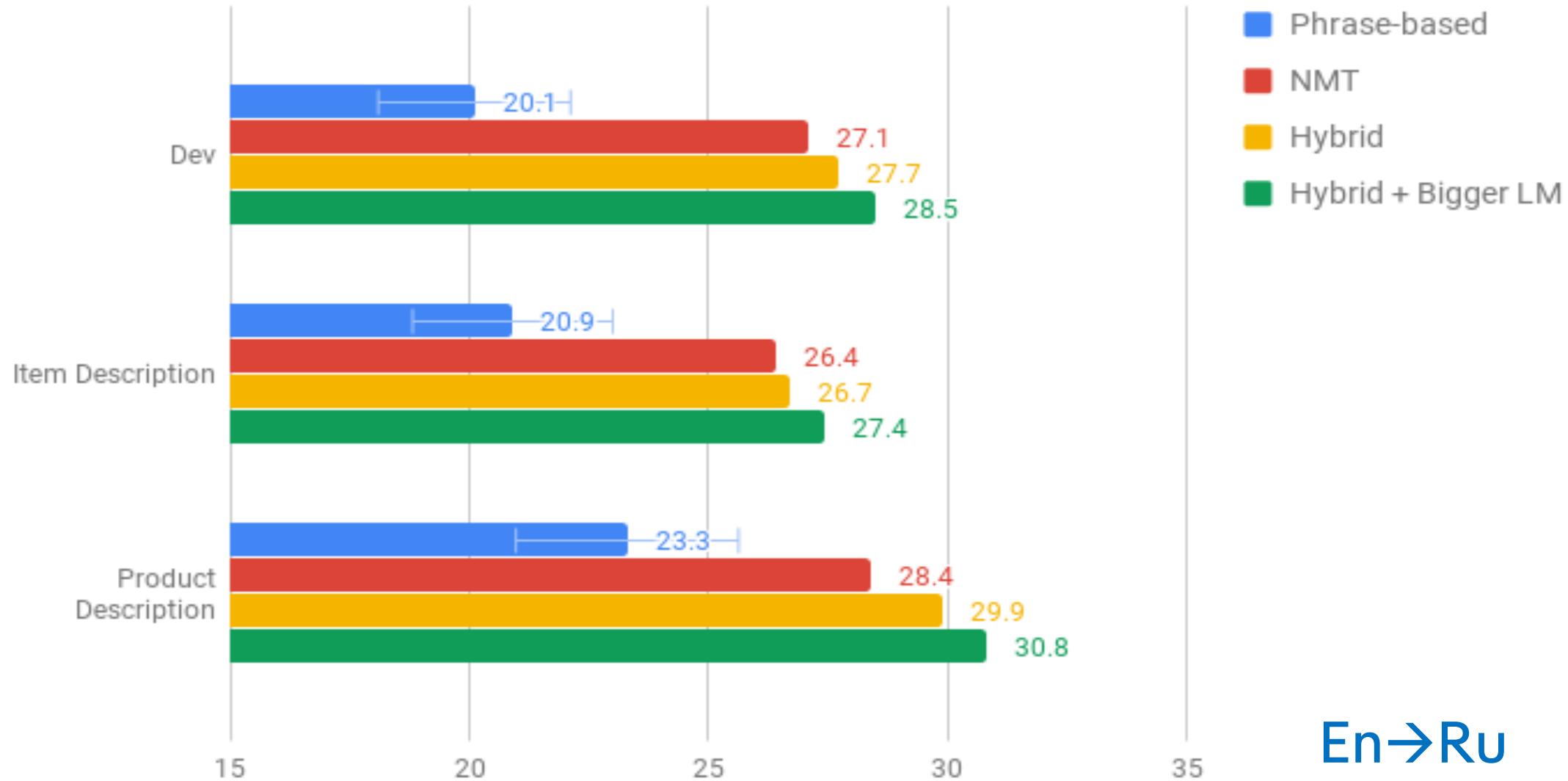
- 950 sentences

Test sets:

- Item Description: 683 sentences
- Product Description: 368 sentences

Hybrid NMT outperforms strong NMT baseline

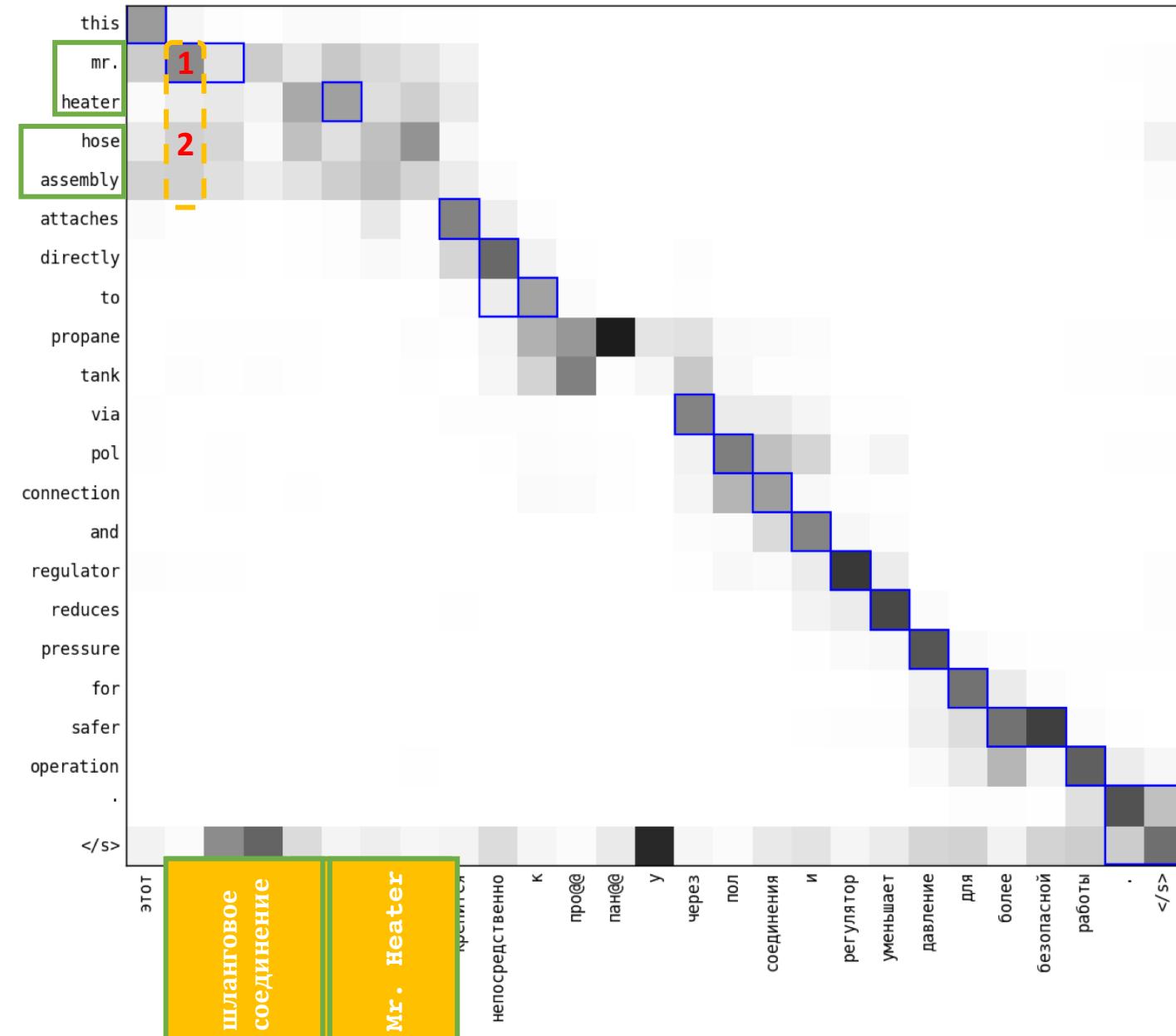
En-Ru e-commerce product/item translation (BLEU [%])



En→Ru

Override for fixing errors

En→Ru



German-English translation examples with hybrid NMT

Source	" aber es ist kein Fa@@ ss ohne Boden " , sagte Kon@@ rad .
Reference	" but it is not a bottomless pit , " says Konrad .
NMT	" but it is not without soil , " Konrad said .
Hybrid	" but it is not a bottomless pit , " said Konrad .
Source	Sie präsentiert ganz deutlich die kleinen Momente von Män@@ ner@@ freund@@ schaften .
Reference	it highlighted the little moments of male friendship .
NMT	it clearly presents the small moments of men friendly .
Hybrid	it clearly presents the small moments of male friendship .

De→En

Summary

- Neural MT is also the state-of-the-art for almost all e-commerce tasks
- eBay's NMT outperforms phrase-based production system on descriptive contents and titles
- Hybrid approach (NMT search + phrases) combines the best of both worlds
- Hybrid approach provides more control over translation output
- Hybrid approach facilitates to productionize the NMT models

Current & Future Works

Better use of comparable corpora

Using more monolingual data

- Source monolingual data:
 - Semi-supervised learning
 - Bandit Learning (RL)
Learns to translate by optimizing a reward
 - Counterfactual learning:
Learning from logged data
- Target monolingual data:
 - Back-translation
 - Continuous back-translation
- Using both source and target monolingual data:
 - Dual Learning (BT+RL)

Texto original

Game Nerd Computer Geek Beach Towel | Wellcoda

Valorar la traducción ★ ★ ★ ☆ ☆

Juego Nerd De Computadora Geek Toalla de playa | wellcoda - [ver título original](#)

Añadir

Estado: Nuevo

Size: - Seleccionar -

Cantidad: 1 Más de 10 disponibles

GBP 13,99 Aproximadamente 15,65 EUR

¡Cómpralo ya!

Añadir a la cesta

• Añadir a lista de seguimiento
★ Añadir a colección

4 en seguimiento

Estado - nuevo

Usuario con experiencia

Plazo de devolución: 60 día(s)

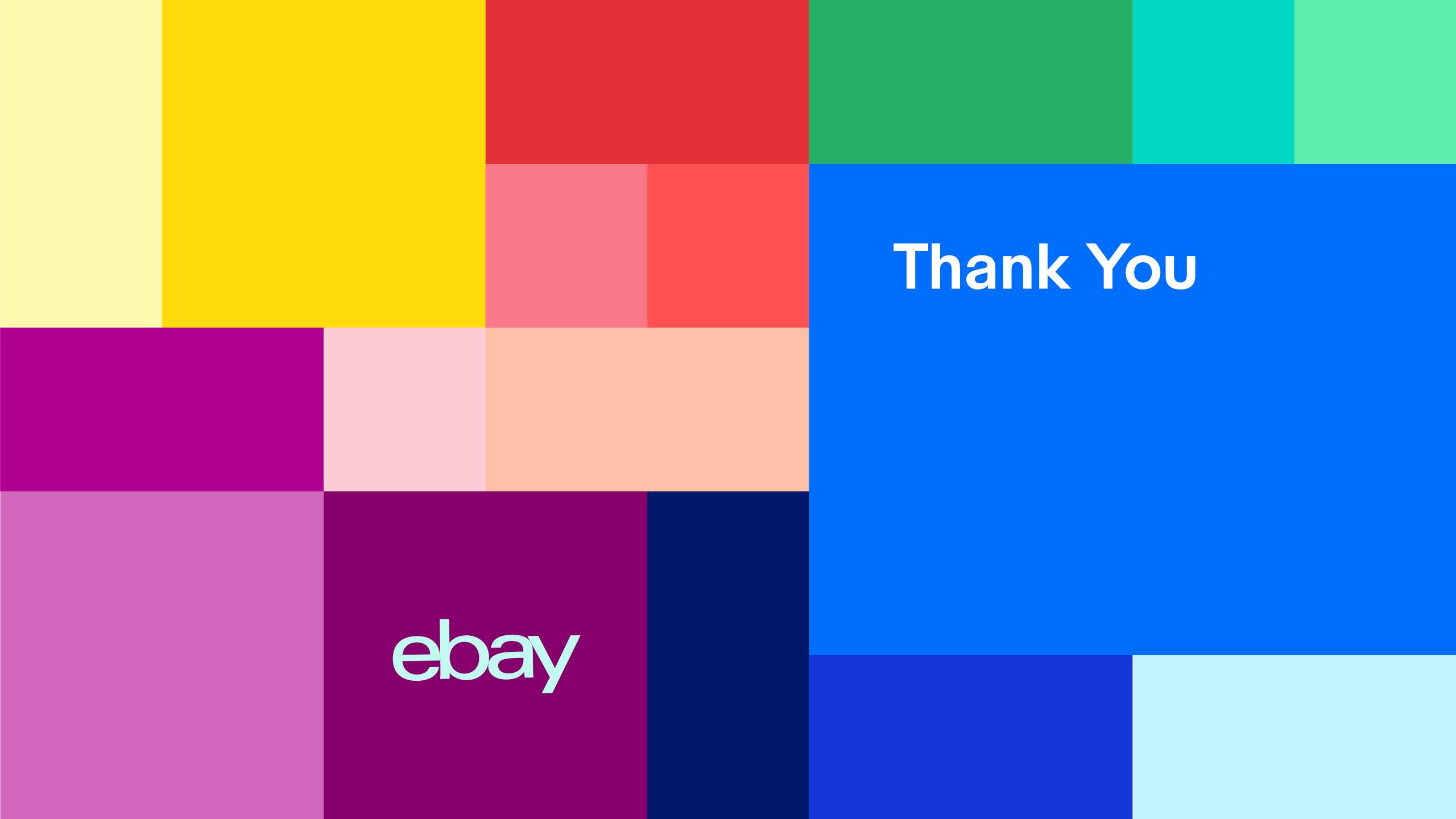
99,7% Votos positivos

✓ Recibe constantemente valoraciones altas de los compradores

✓ Envía los artículos con rapidez

✓ Tiene un historial de servicio excelente

Guarda este vendedor



Thank You

ebay

Backup Slides

Related works

1. The AMU-UEDIN Submission to the WMT16 News Translation Task: Attention-based NMT Models as Feature Functions in Phrase-based SMT [Junczys-Dowmunt & Dwojak+ 16] (WMT 2016)
2. Improved Neural Machine Translation with SMT Features [He & He+ 16] (AAAI 2016)
3. Neural Machine Translation with External Phrase Memory [Tang & Meng+ 16]