

Machine Translation



Chris Dyer

Language Technologies Institute
Machine Learning Department

MT Marathon 2012
September 3, 2012

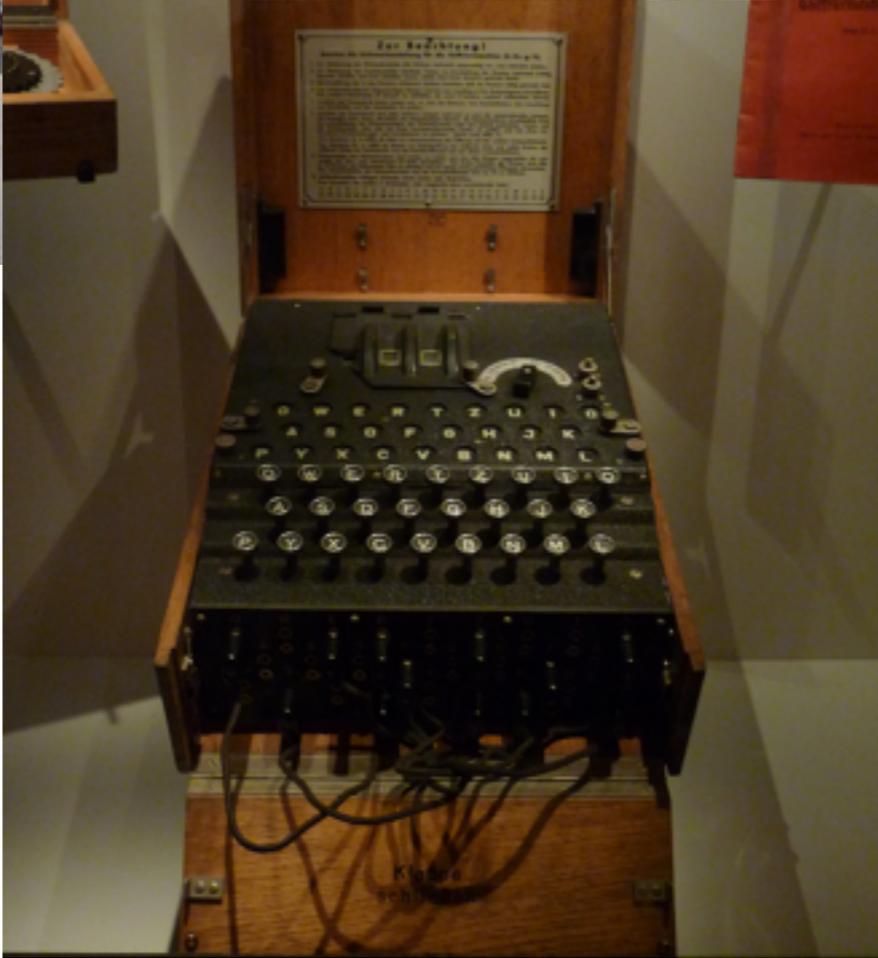
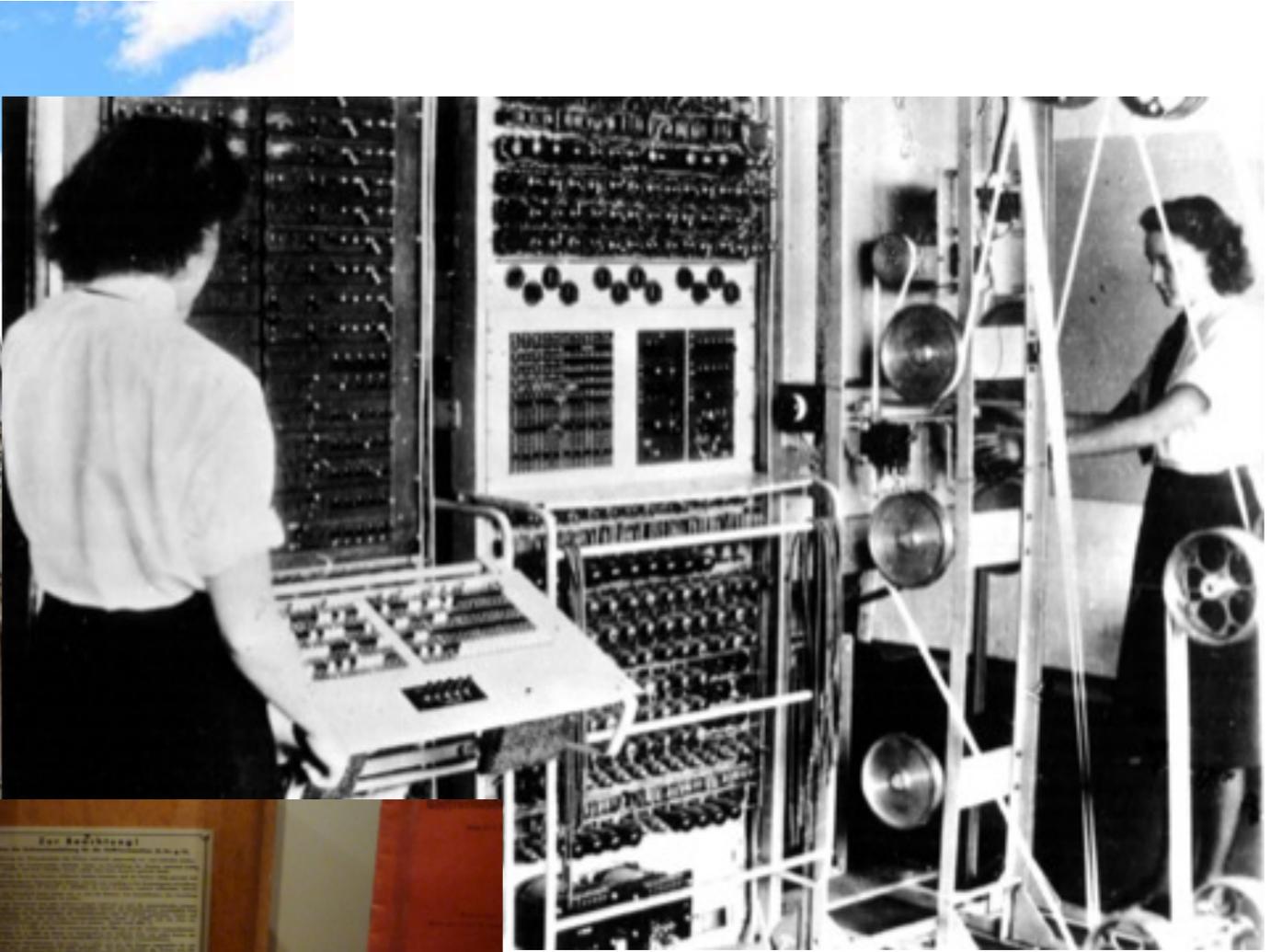


Carnegie Mellon



Overview

- A Brief History of MT
- Modeling: Language & Translation
- Using MT
- Evaluating MT
- Coffee



MT Timeline

- 1940s - WW2 code breaking
- 1947 - Weaver letter outlining translation as a problem in cryptography
- 1954 - Georgetown Experiments showed “promise” of Russian-English MT
- 1966 - ALPAC report shifts funding to basic research in computational linguistics
- 1968 - MT company SYSTRAN founded (still in existence)
- 1970s - advances in formal languages and automata theory; development of *statistical speech recognition* techniques at IBM and Princeton
- 1993 - Weaver’s model of translation prototyped by IBM; **statistical revolution**
- 1999 - Open source reimplementations of IBM models
- 2000s - Major modeling advances, rediscovery of syntax, large scale funding
- 2006 - Open source Moses decoder development begins
- 2006 - Google Translate launches

One naturally wonders if the problem of translation could conceivably be treated as a problem in cryptography. When I look at an article in Russian, I say: *'This is really written in English, but it has been coded in some strange symbols. I will now proceed to decode.'*



Warren Weaver to Norbert Wiener, March, 1947



Claude Shannon. “A Mathematical Theory of
Communication” 1948.

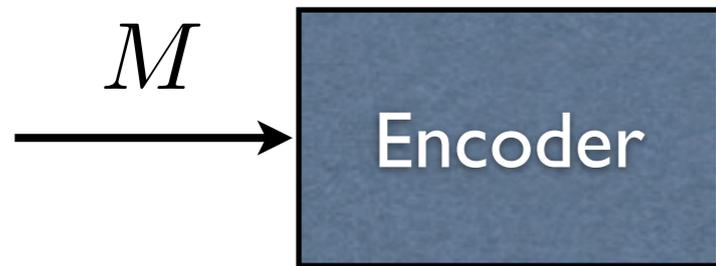
M



Message



Claude Shannon. "A Mathematical Theory of
Communication" 1948.



Message



Claude Shannon. "A Mathematical Theory of Communication" 1948.



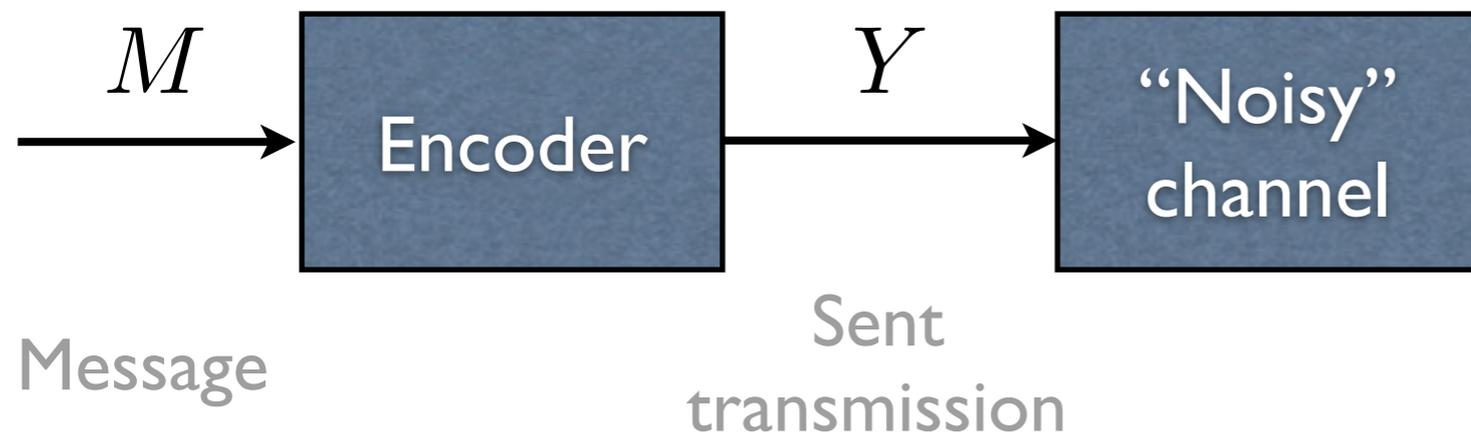
Message

Sent
transmission

$$p(y)$$



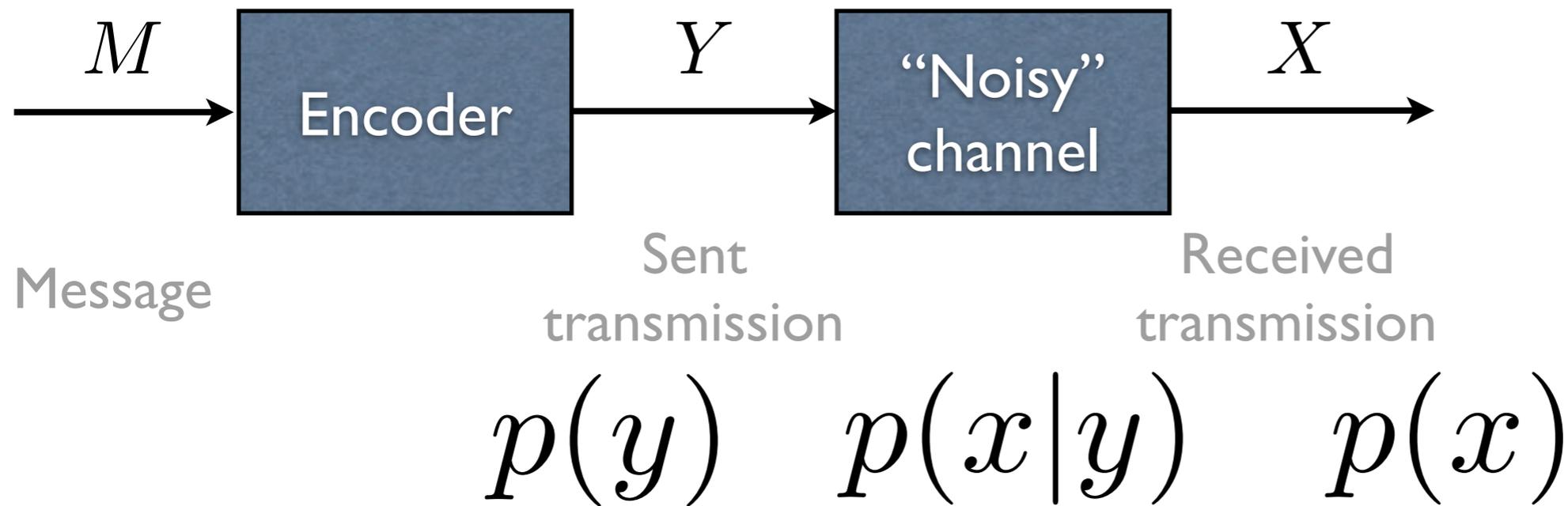
Claude Shannon. "A Mathematical Theory of
Communication" 1948.



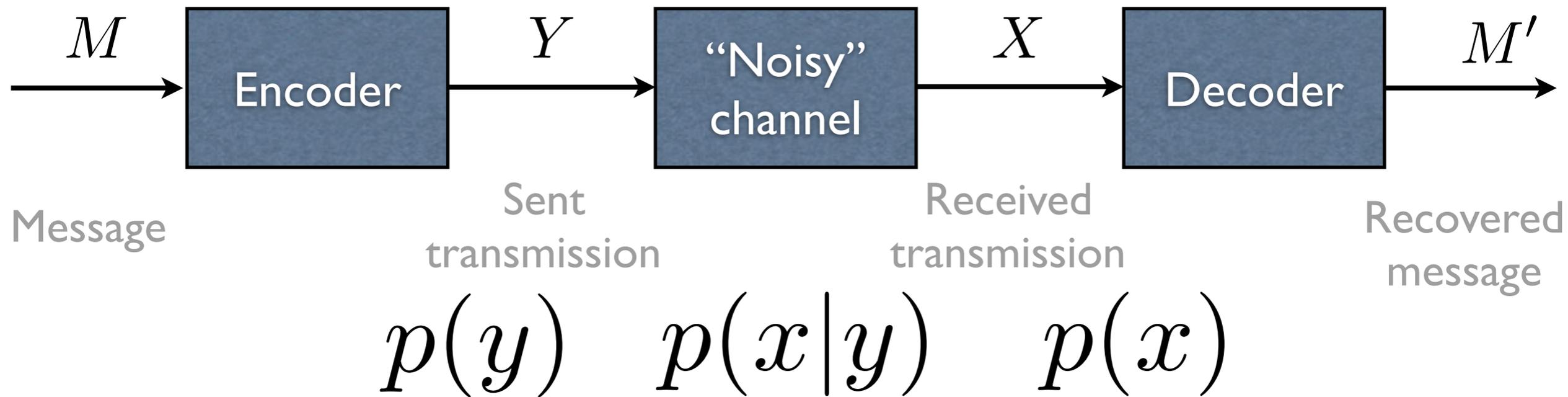
$$p(y) \quad p(x|y)$$



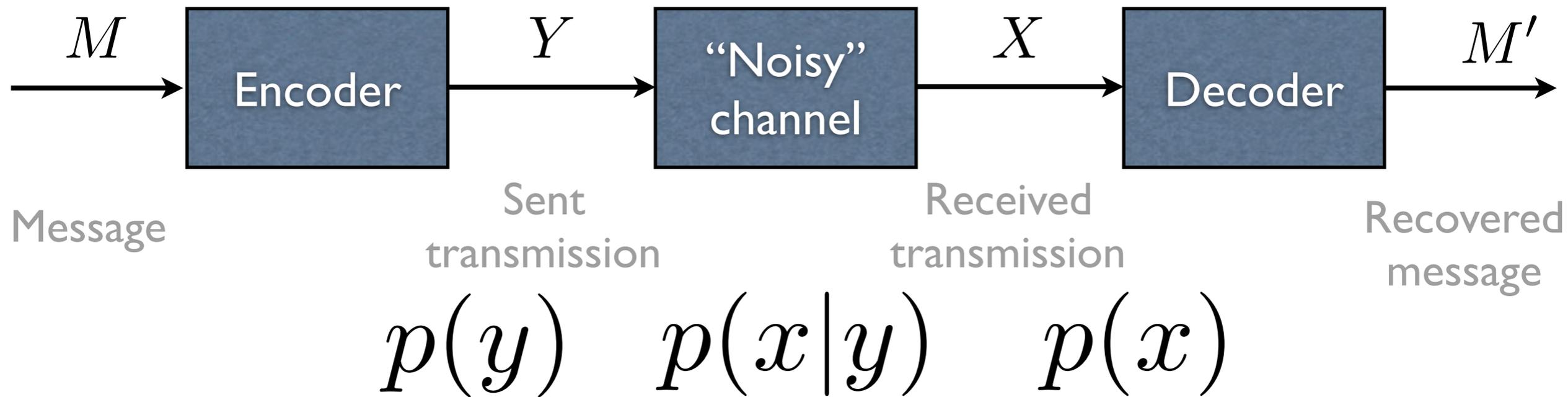
Claude Shannon. "A Mathematical Theory of Communication" 1948.



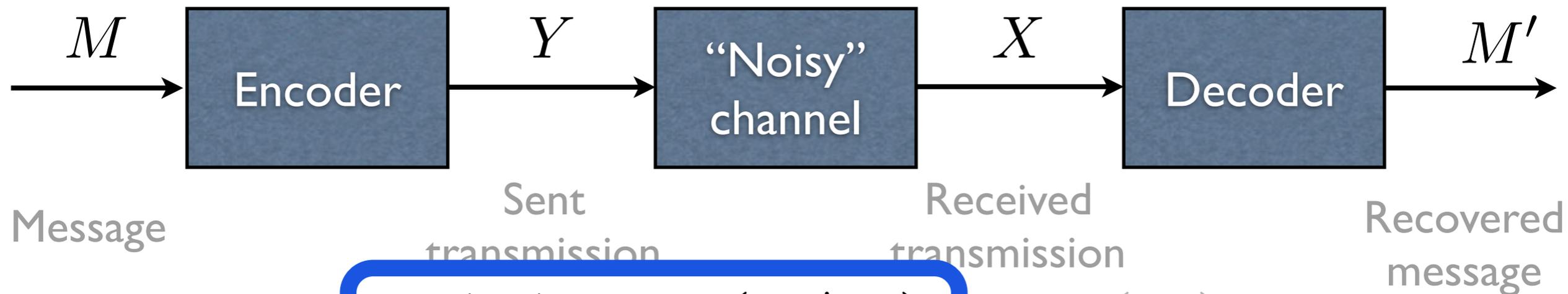
Claude Shannon. “A Mathematical Theory of Communication” 1948.



Claude Shannon. "A Mathematical Theory of Communication" 1948.



Claude Shannon. “A Mathematical Theory of Communication” 1948.



$p(y)$ $p(x|y)$ $p(x)$



Claude Shannon. "A Mathematical Theory of Communication" 1948.



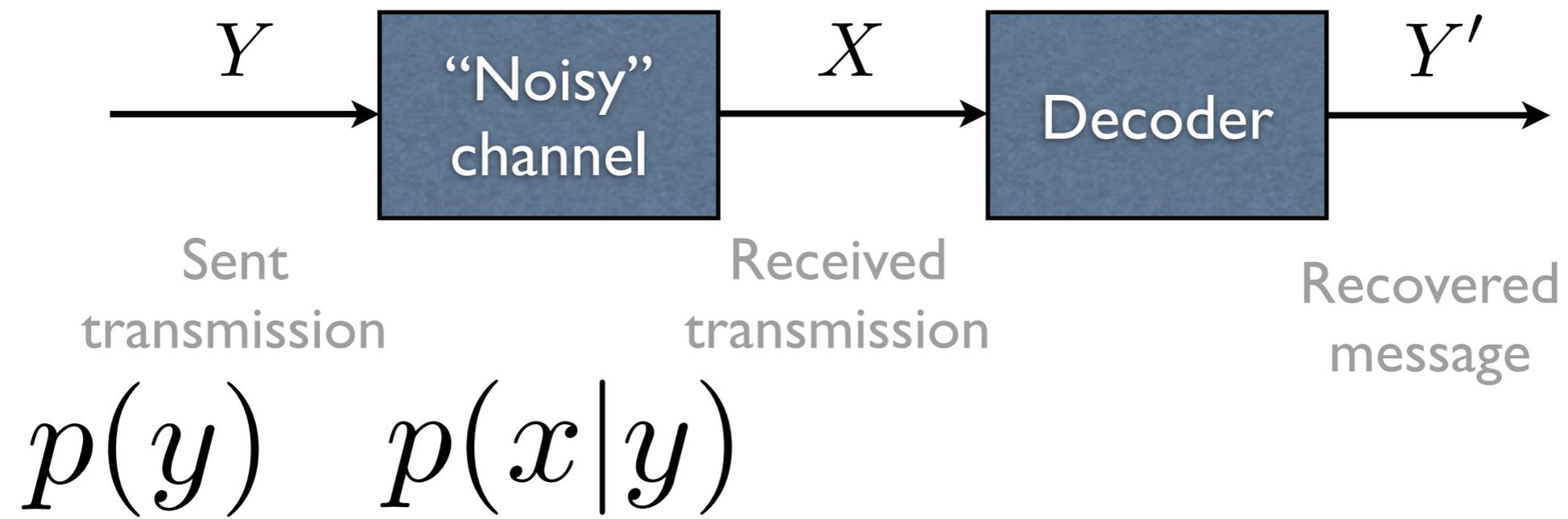
$$p(y) \quad p(x|y)$$

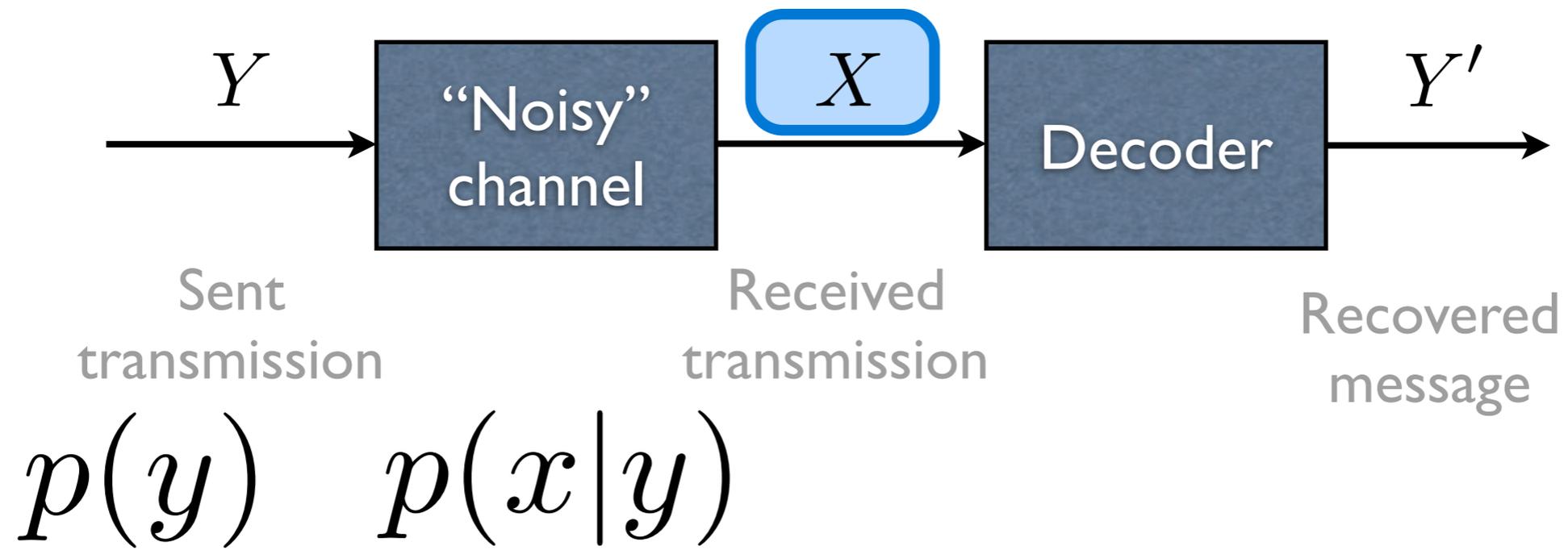
Shannon's theory tells us:

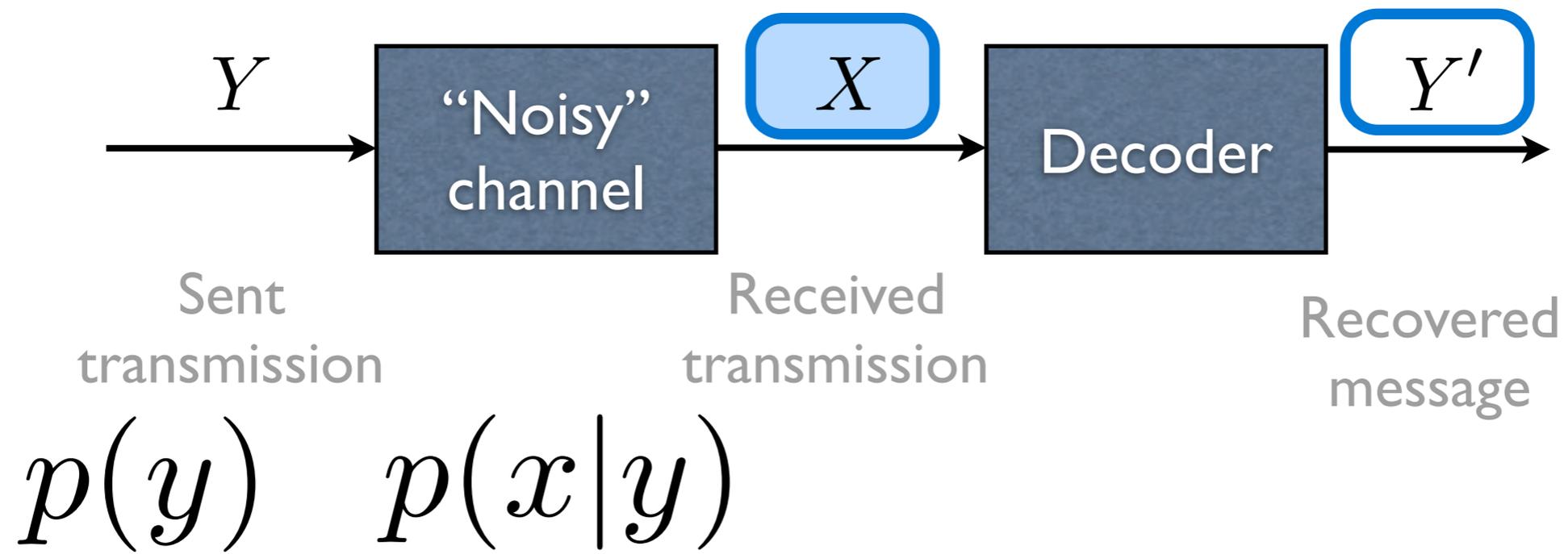
- 1) how much data you can send
- 2) the limits of compression
- 3) why your download is so slow
- 4) how to translate

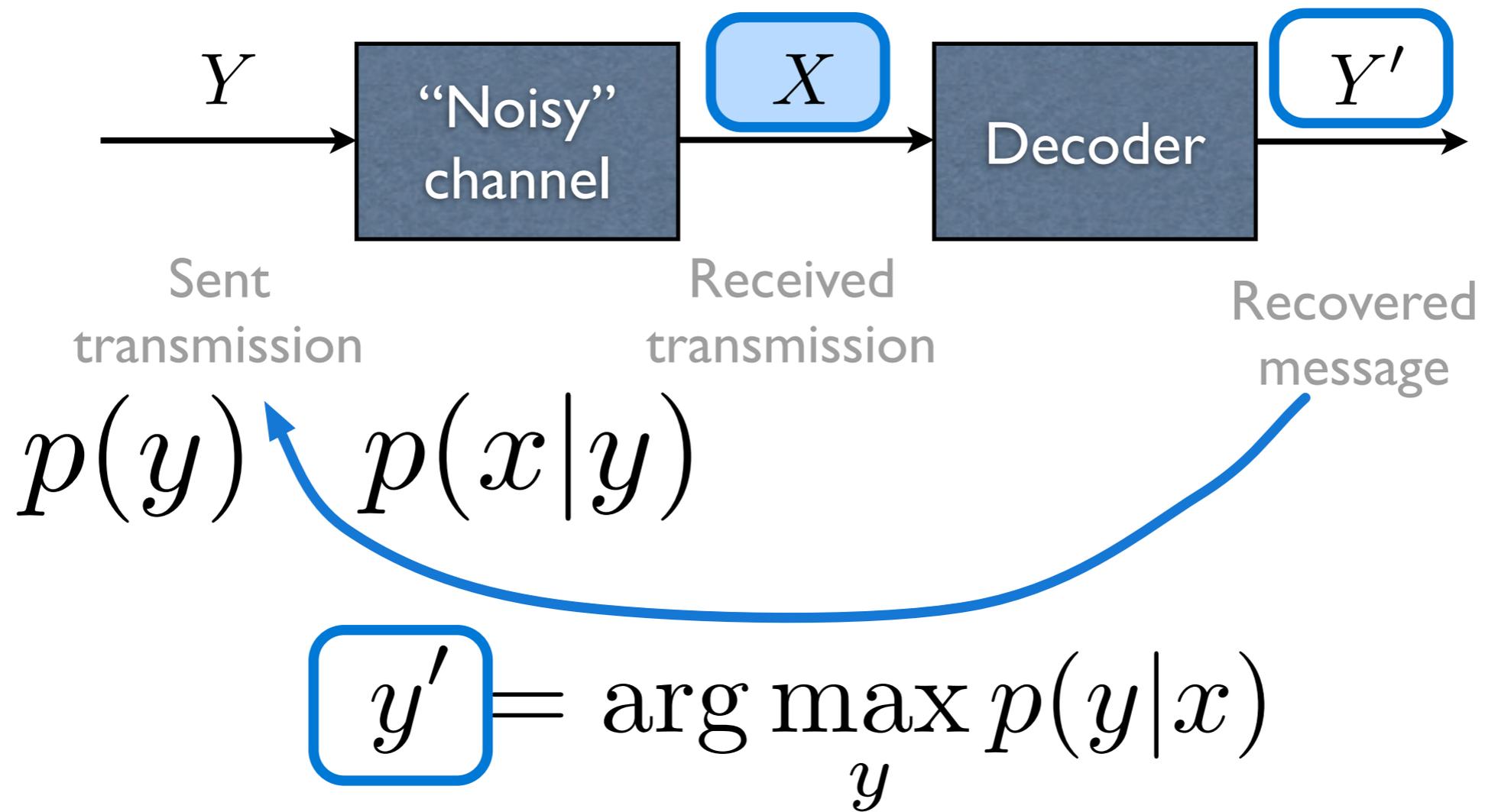


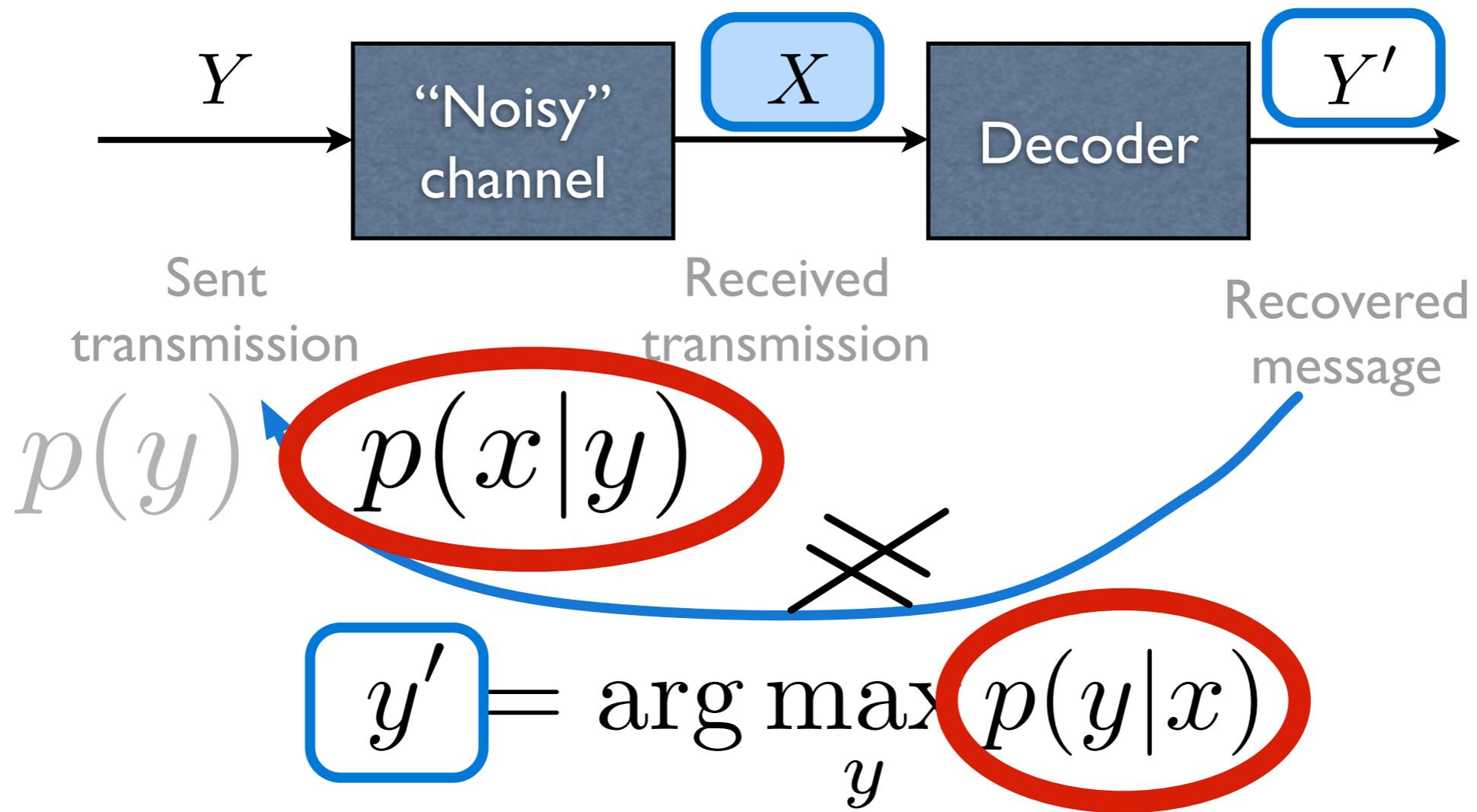
Claude Shannon. "A Mathematical Theory of Communication" 1948.

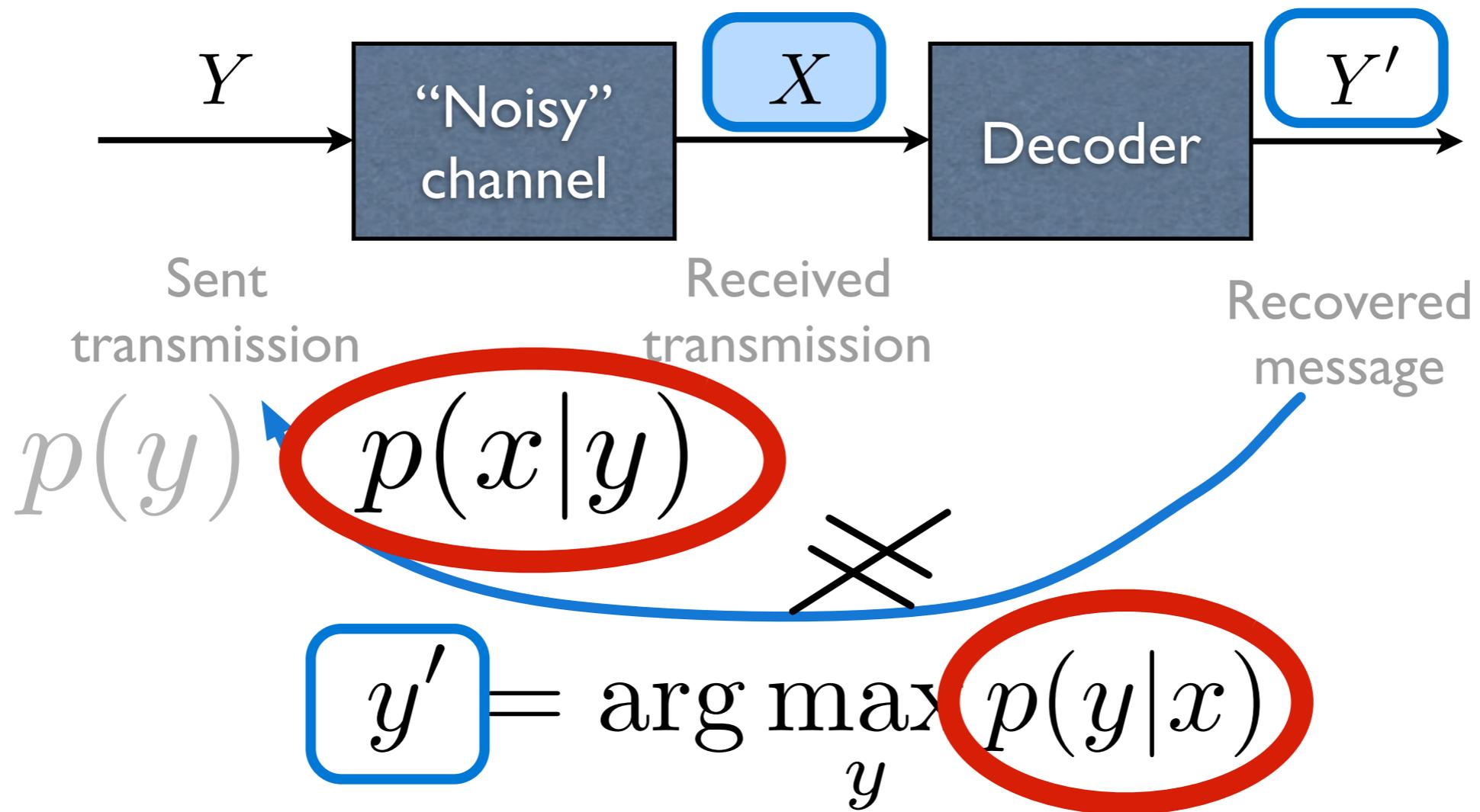




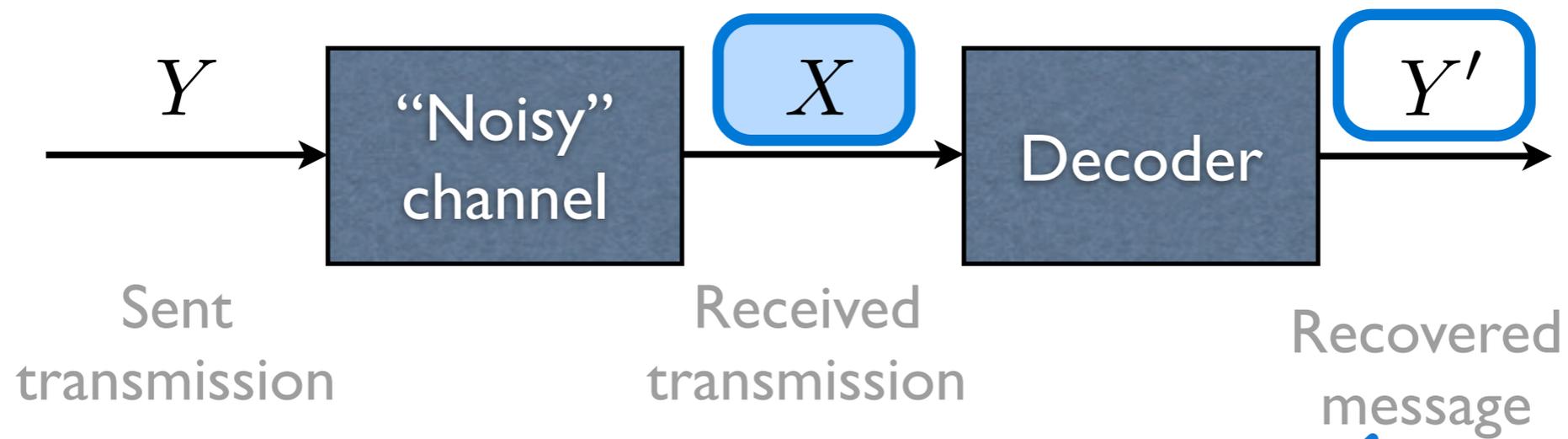






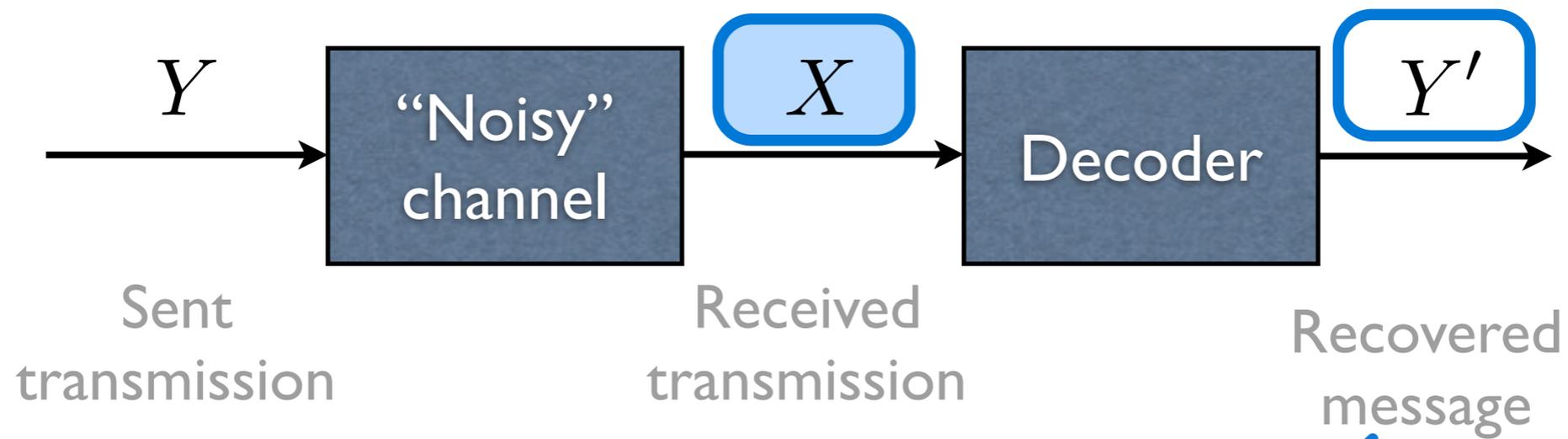


I can help.



$$y' = \arg \max_y p(y|x)$$

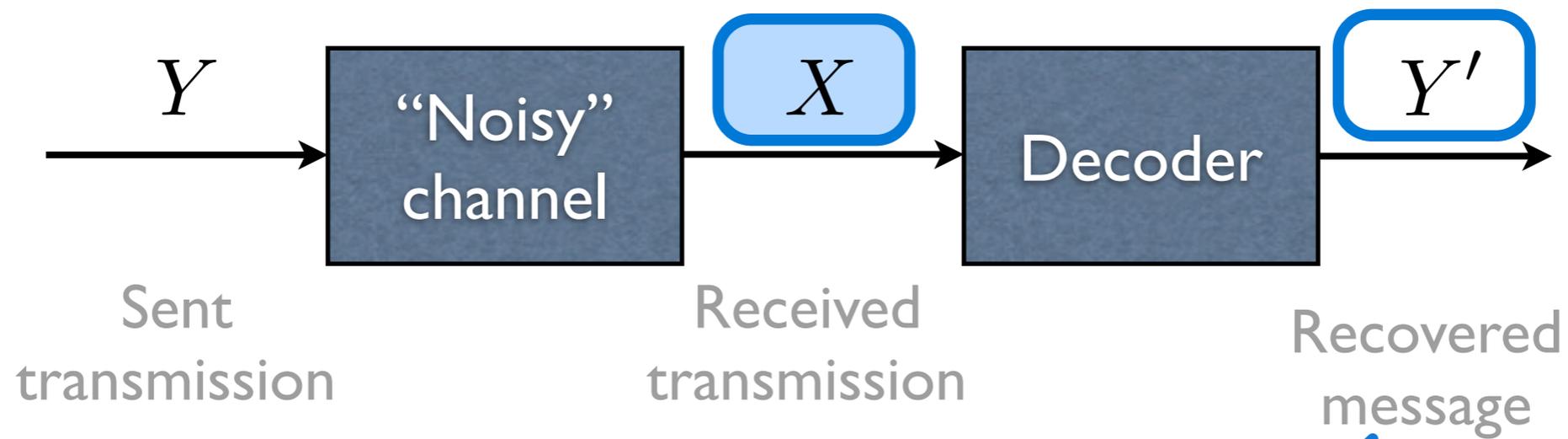
$$= \arg \max_y \frac{p(x|y)p(y)}{p(x)}$$



$$\boxed{y'} = \arg \max_y p(y|x)$$

$$= \arg \max_y \frac{p(x|y)p(y)}{p(x)}$$

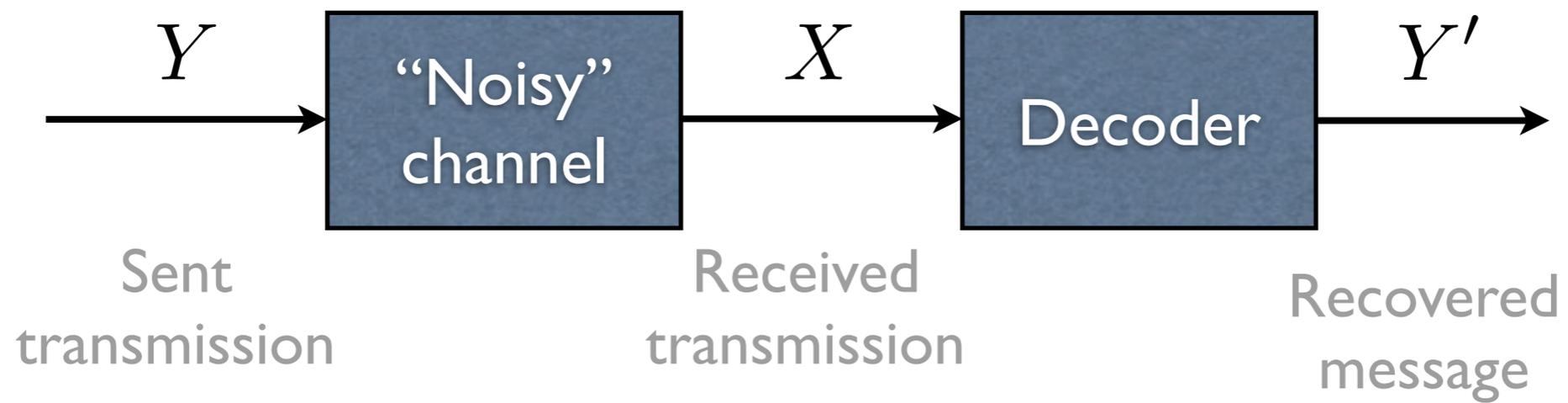
Denominator doesn't depend on y .



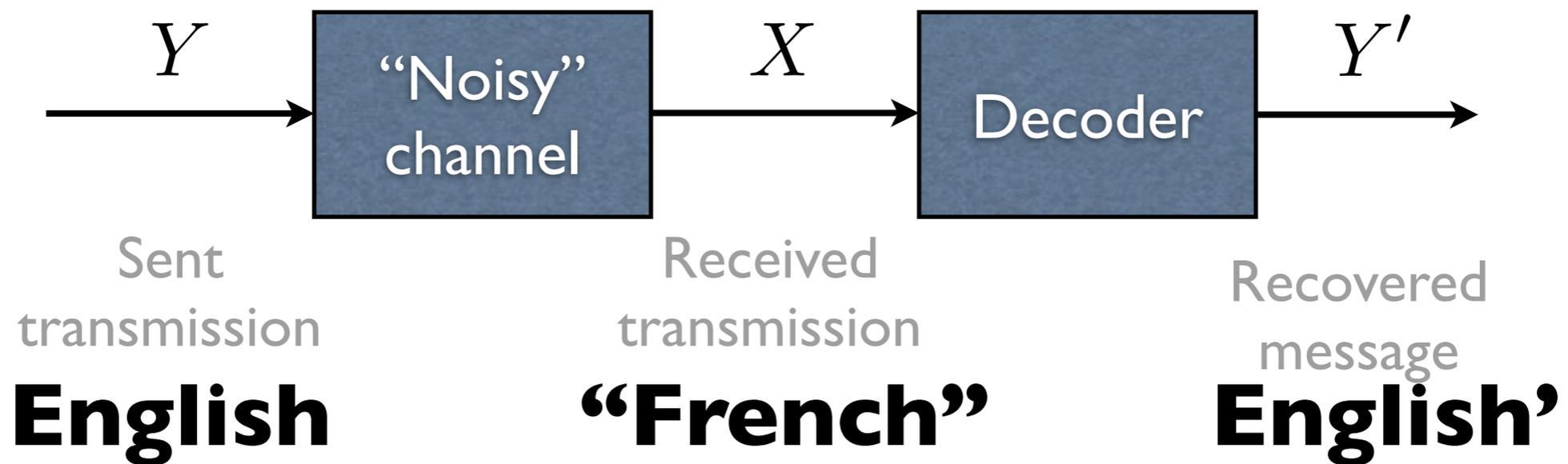
$$\boxed{y'} = \arg \max_y p(y|x)$$

$$= \arg \max_y \frac{p(x|y)p(y)}{p(x)}$$

$$= \arg \max_y p(x|y)p(y)$$

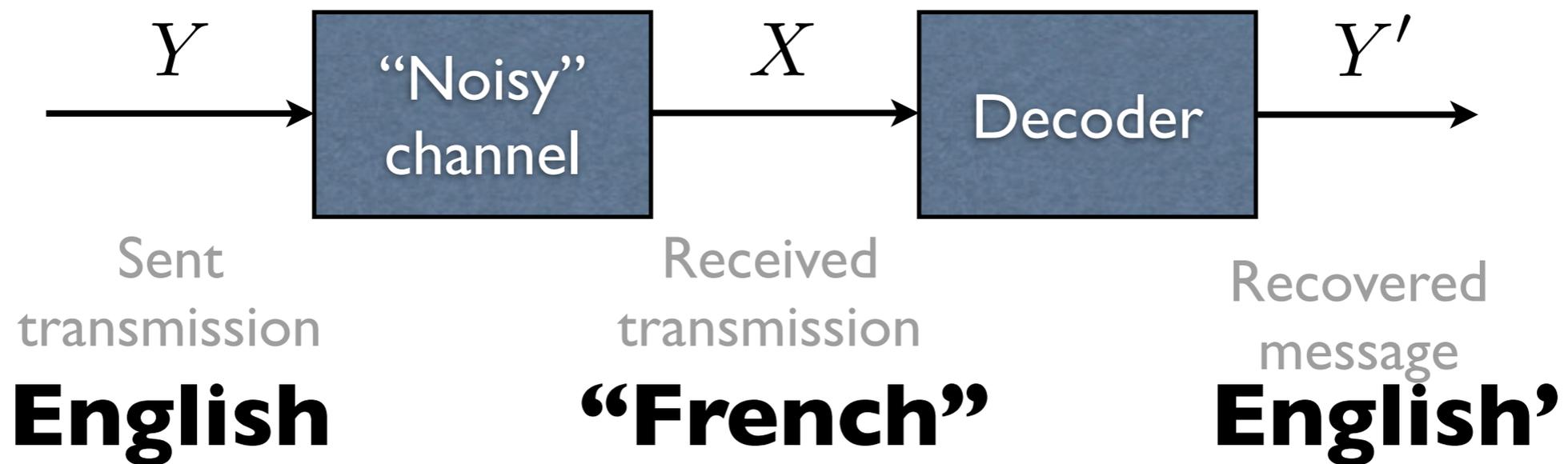


$$y' = \arg \max_y p(x|y)p(y)$$



~~$$y' = \arg \max_y p(x|y)p(y)$$~~

$$e' = \arg \max_e p(\mathbf{f}|\mathbf{e})p(\mathbf{e})$$

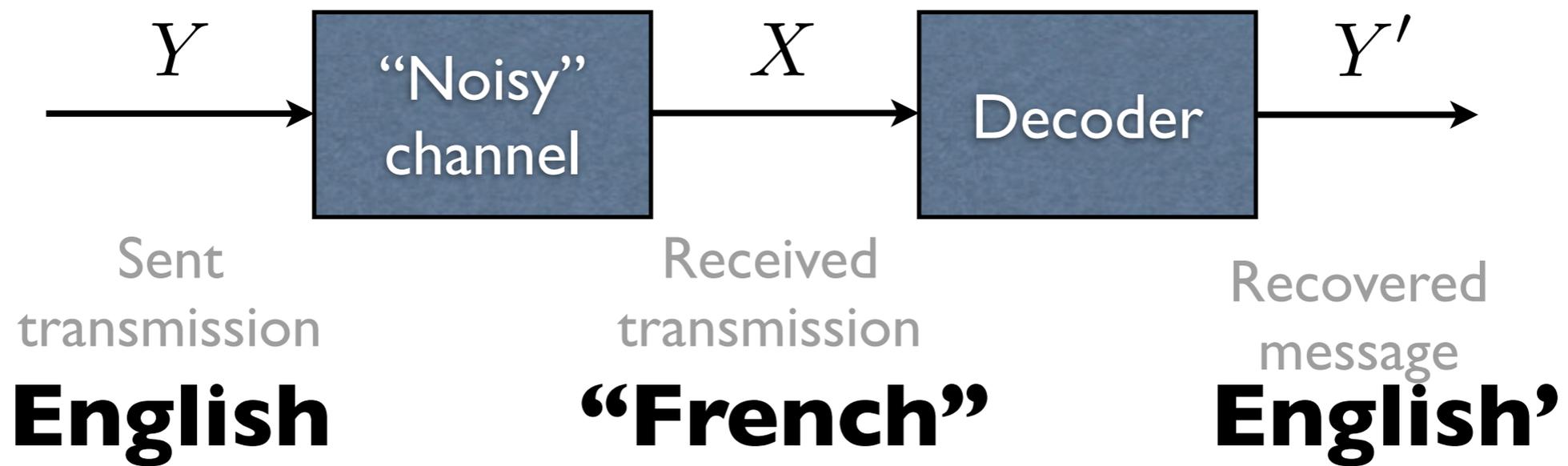


~~$$y' = \arg \max_y p(x|y)p(y)$$~~

$$e' = \arg \max_e p(\mathbf{f}|\mathbf{e})p(\mathbf{e})$$



translation model



~~$$y' = \arg \max_y p(x|y)p(y)$$~~

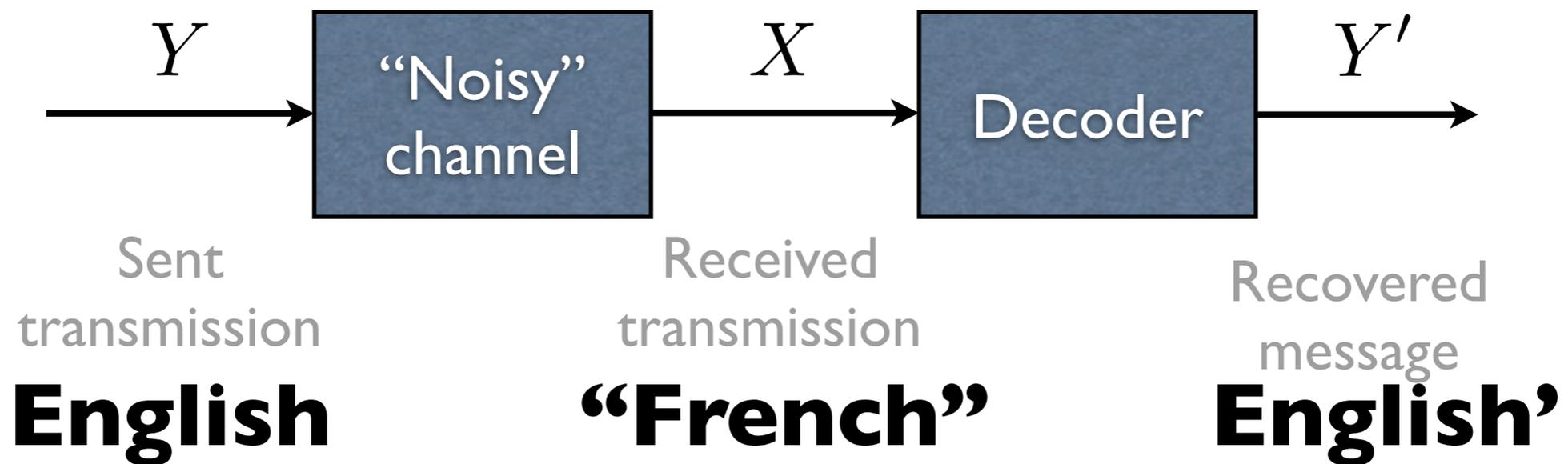
$$e' = \arg \max_e p(\mathbf{f}|\mathbf{e})p(\mathbf{e})$$



translation model



language model



~~$$y' = \arg \max_y p(x|y)p(y)$$~~

$$e' = \arg \max_e p(\mathbf{f}|\mathbf{e})p(\mathbf{e})$$



translation model



language model

Other noisy channel applications: OCR, speech recognition, spelling correction...

Division of labor

- **Translation model**
 - probability of translation *back* into the source
 - ensures **adequacy** of translation
- **Language model**
 - is a translation hypothesis “good” English?
 - ensures **fluency** of translation

The Big Question in MT

The Big Question in MT

- **How do we *design* language and translation models?**

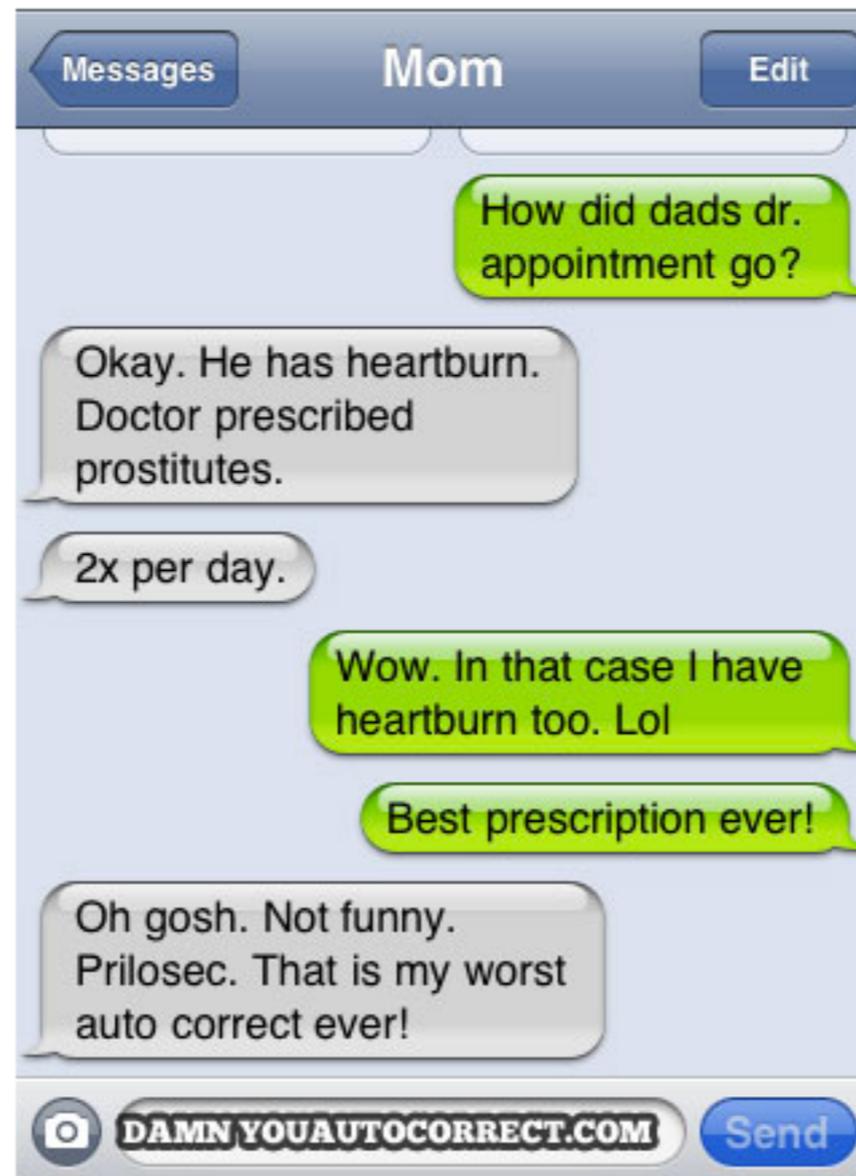
The Big Question in MT

- **How do we *design* language and translation models?**
- Two (usually competing) considerations
 - Is the model **correct**?
 - Is prediction (*inference*) **tractable**?
 - Also: is there data to learn the parameters?

Language Modeling

- Two related, but different questions:
 - Is a string of words grammatical or not?
 - Is a string of grammatical words semantically coherent?
- We usually adopt a statistical approach:
 - What is the **probability** of a sentence in some language?
 - **Modeling challenge:** there are an *infinite number* of grammatical sentences in any language

DAMN YOU, AUTO CORRECT!



DAMN YOU, AUTO CORRECT!



Open Problems

- N -gram models have billions or trillions of parameters
 - Do we really need all of these?
 - If we do, how do we efficiently represent them?
- How do we efficiently reason with LMs?
- Can we come up with a better representation for words?
- Can we leverage *syntactic* information to improve language models?
- LMs were developed for English: ***how should they change when we model different languages?***

English:

I have a bad headache

Chukchi (Siberian language):

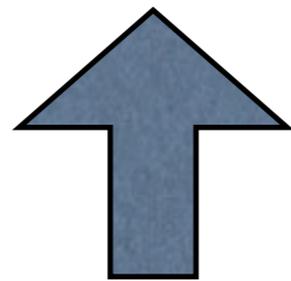
Təmeyŋəlevtpəytərəkən

English:

I have a bad headache

Chukchi (Siberian language):

Təmeyŋəlevtpəytərəkən



Aggultinative and polysynthetic languages have rich word-formation processes.

Translation Modeling

- Modeling task: Is a string of words \mathbf{e} (in the target language) a meaning-preserving translation of a string of words \mathbf{f} (in the source)?
- **Modeling challenges:**
 - There are an infinite number of sentences
 - How do we learn parameters of the models?

In der Innenstadt explodierte eine Autobombe

- **Factor problem into (conditionally) independent parts**

In der Innenstadt explodierte eine Autobombe

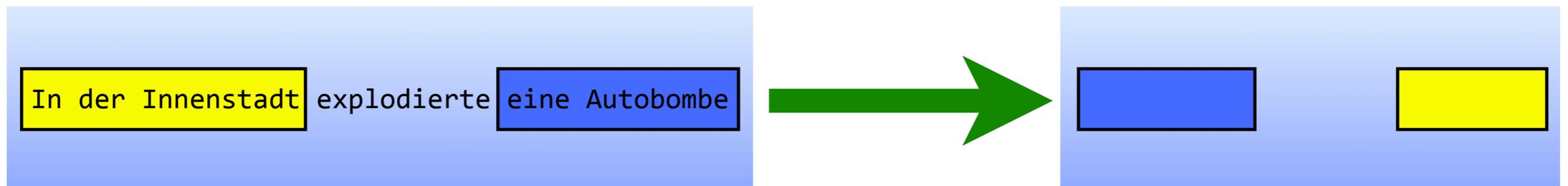
- **Factor problem into (conditionally) independent parts**
 - Permute the source words into the target language order

In der Innenstadt explodierte eine Autobombe

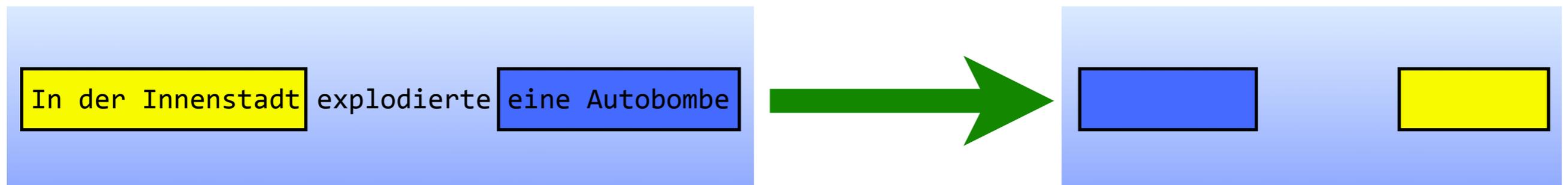
- **Factor problem into (conditionally) independent parts**
 - Permute the source words into the target language order

In der Innenstadt explodierte eine Autobombe

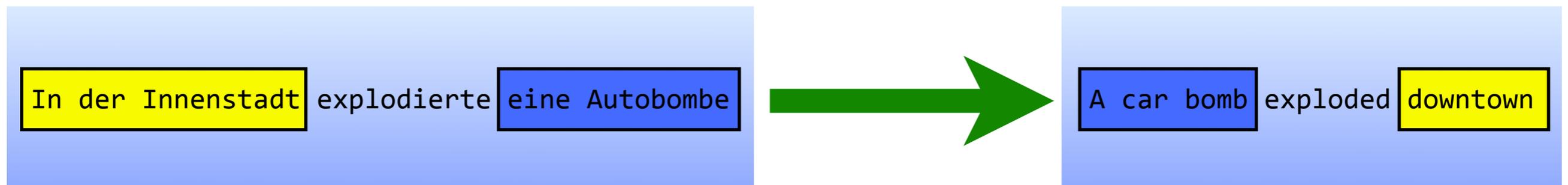
- **Factor problem into (conditionally) independent parts**
 - Permute the source words into the target language order



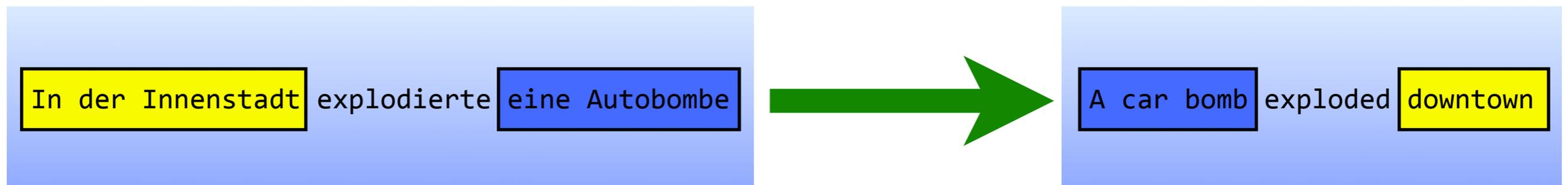
- **Factor problem into (conditionally) independent parts**
 - Permute the source words into the target language order
 - Pick translations for individual words / phrases
 - Probability of particular translations
 - Look at source context
 - Ensure that the output is fluent & idiomatic



- **Factor problem into (conditionally) independent parts**
 - Permute the source words into the target language order
 - Pick translations for individual words / phrases
 - Probability of particular translations
 - Look at source context
 - Ensure that the output is fluent & idiomatic



- **Factor problem into (conditionally) independent parts**
 - Permute the source words into the target language order
 - Pick translations for individual words / phrases
 - Probability of particular translations
 - Look at source context
 - Ensure that the output is fluent & idiomatic
- **Computational challenges**
 - Searching all word permutations is NP-hard
 - Massive numbers of translation alternatives



- **String-to-string translation**

- Became popular in the 1990's with *statistical MT*
- State-of-the-art for many (most?) language pairs
 - Especially: Closely related language pairs
 - Especially: Typologically similar language pairs
 - ~ Google Translate / Bing Translator
- Limitations
 - Independence assumptions are wrong (too strong *and* too weak)
 - No structural information available to improve modeling
- **Models can be learned directly from *parallel data***

In der Innenstadt explodierte eine Autobombe



A car bomb exploded downtown

www.un.org

http://www.un.org/english/

We the peoples

Daily Briefing | Radio, TV, Photo | Documents, Maps | Publications, Stamps, Databases | UN Works | Search

Peace & Security | Economic & Social Development | Human Rights | Humanitarian Affairs | International Law

Welcome to the United Nations

UN Millennium Development Goals

United Nations News Centre

About the United Nations

Main Bodies

Conferences & Events

Member States

General Assembly President

Secretary-General

Situation in Iraq

Mideast Roadmap

Renewing the UN

UN Action against Terrorism

Issues on the UN Agenda

Civil Society / Business

UN Webcast

CyberSchoolBus

5 September 2005 >>

Home | Recent Additions | Employment | UN Procurement | Comments | Q & A | UN System Sites | Index

عربي | 中文 | English | Français | Русский | Español

Copyright, United Nations, 2000-2005 | Use of UN60 Logo | Terms of Use | Privacy Notice | Help [Text version]

Live and On-Demand Webcasts, 24 Hours a Day. Click on UN Webcast

联合国主页

http://www.un.org/chinese/

我们人民

每日简报 | 多媒体 | 文件与地图 | 出版物 | 邮票 | 数据库 | 服务全球 | 网址搜索

和平与安全 | 经济与社会发展 | 人权 | 人道主义事务 | 国际法

欢迎来到联合国

联合国千年发展目标

联合国新闻

联合国概况

联合国主要机关

会议与活动

联合国会员国

联合国大会主席

联合国秘书长

伊拉克局势

中东路线图

更新联合国

反恐怖主义

联合国日常议题

民间团体/商业

联合国网络直播

空中校车

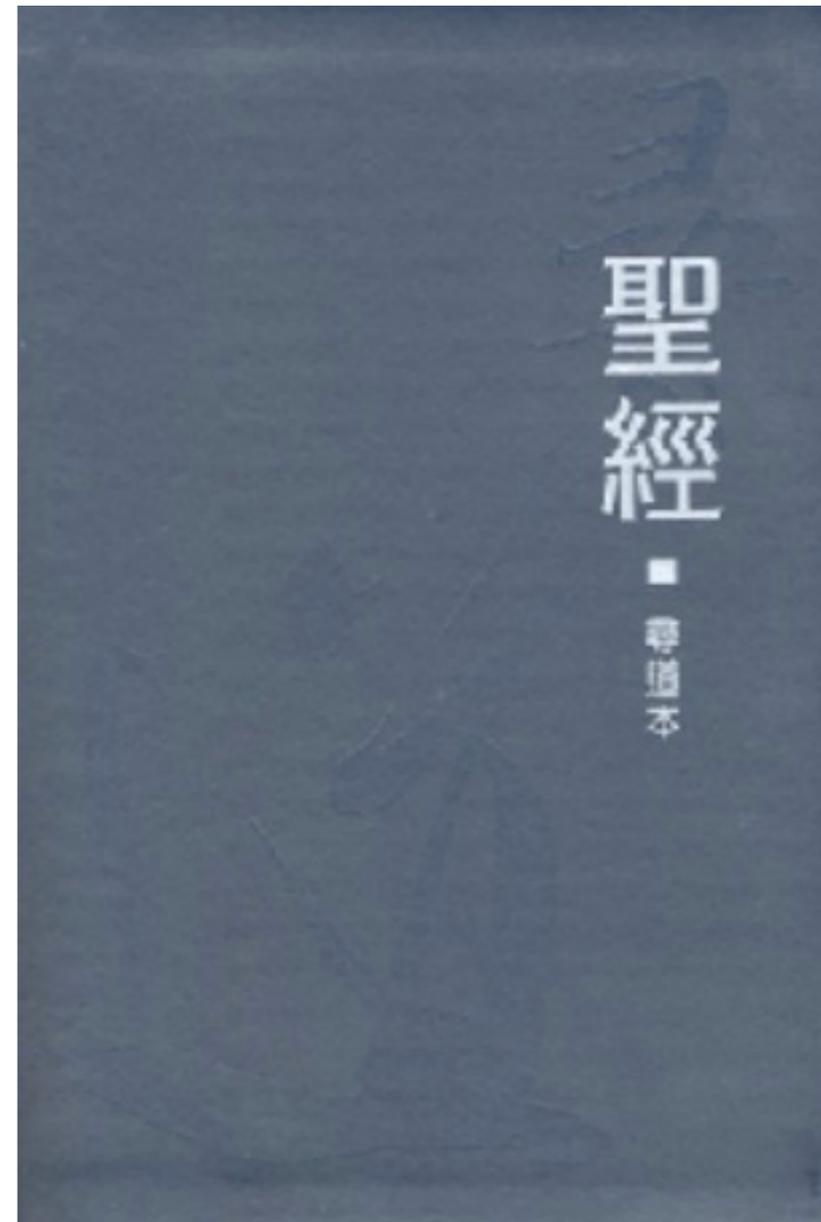
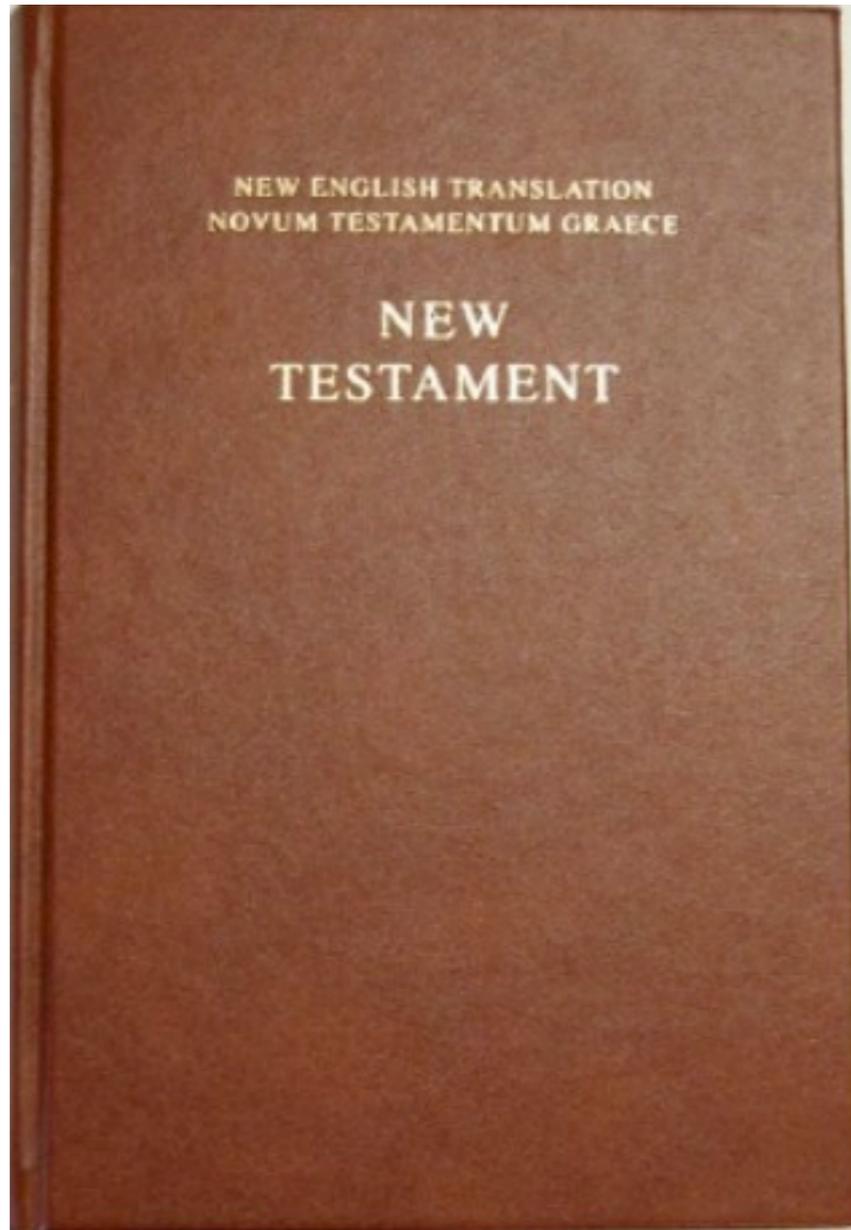
联大第60届会议一般性辩论

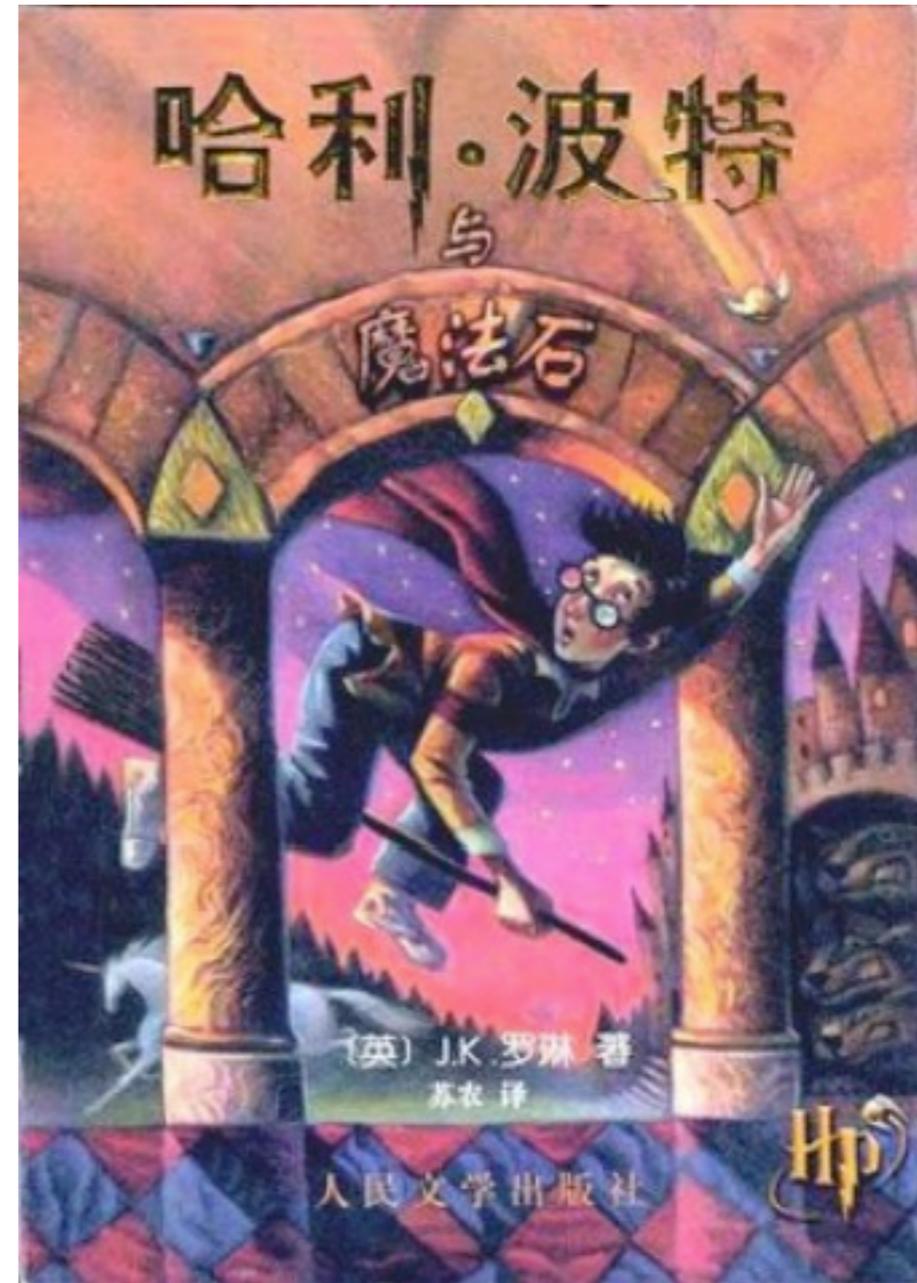
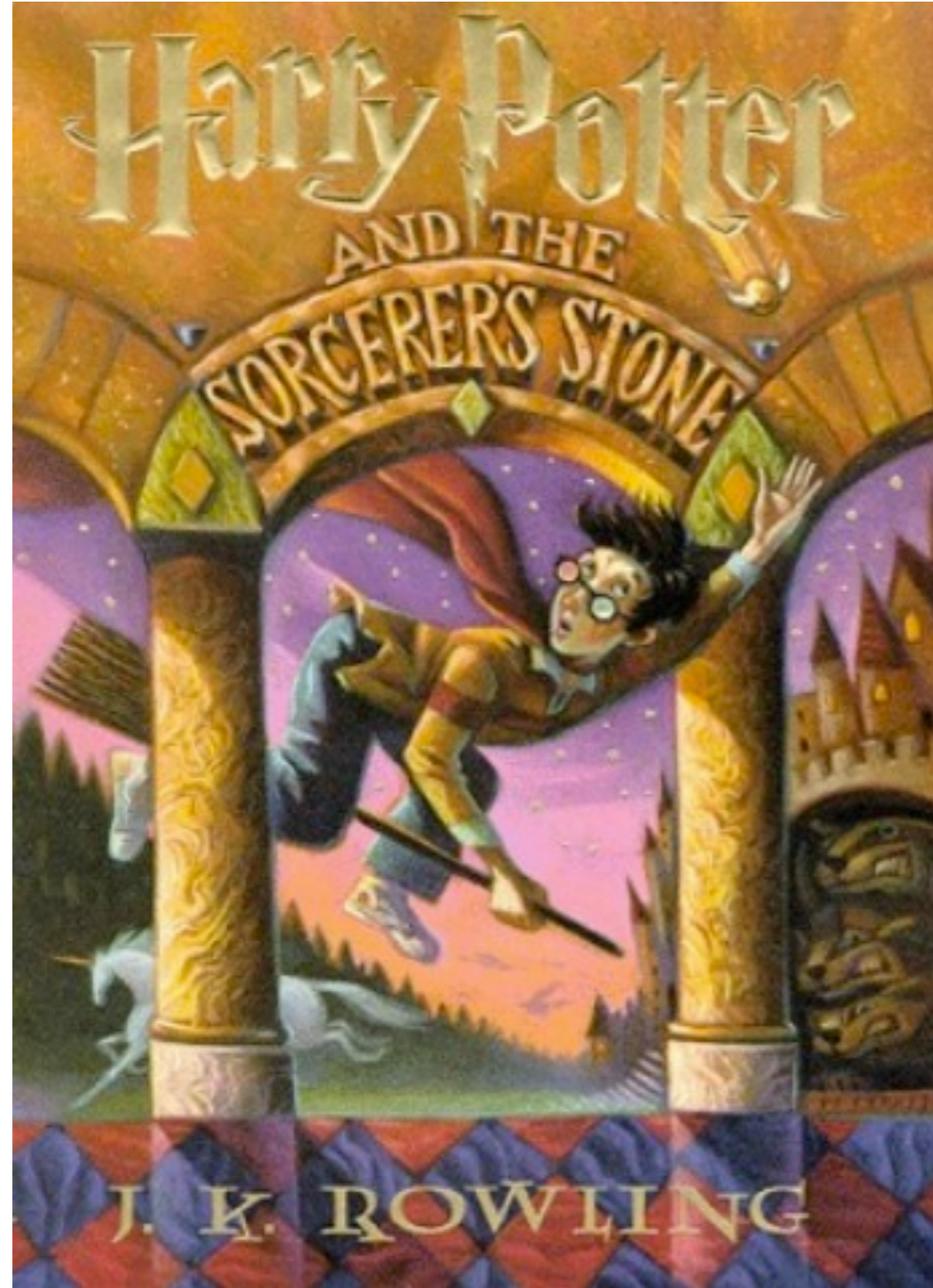
新增内容 | 工作机会 | 联合国采购 | 建议 | 问题与解答 | 其他网址 | 网址索引

عربي | 中文 | English | Français | Русский | Español

联合国2000-2005年版权 | 联合国60周年徽标使用准则 | 使用条件 | 隐私通告 | 帮助 [纯文字版]

联合国网络直播

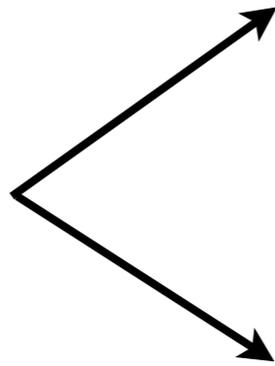




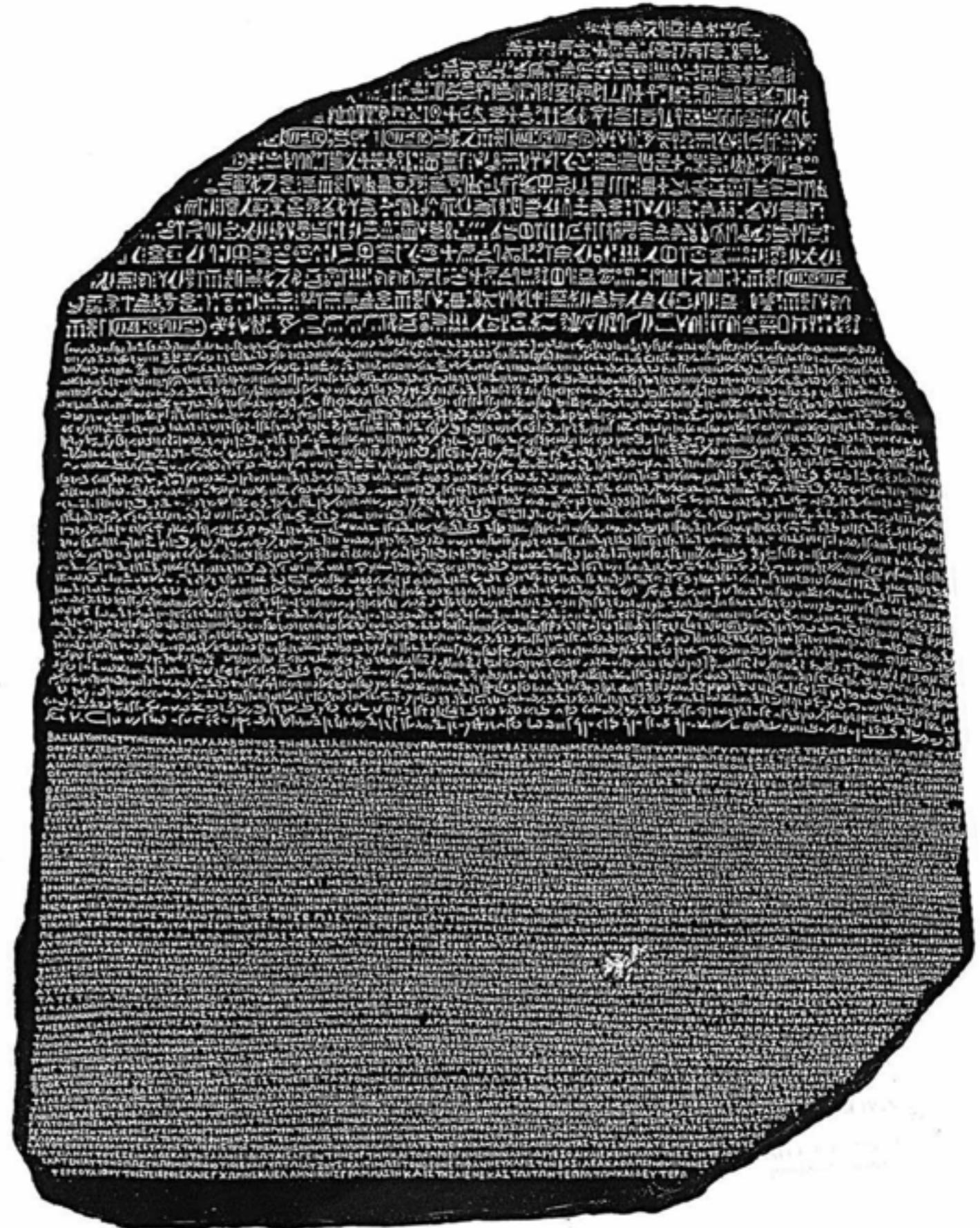
CLASSIC SOUPS

		Sm.	Lg.					
清	燉	雞	湯	57.	House Chicken Soup (Chicken, Celery, Potato, Onion, Carrot)	1.50	2.75	
雞	飯	湯	58.	Chicken Rice Soup	1.85	3.25		
雞	麵	湯	59.	Chicken Noodle Soup	1.85	3.25		
廣	東	雲	吞	60.	Cantonese Wonton Soup.....	1.50	2.75	
蕃	茄	蛋	湯	61.	Tomato Clear Egg Drop Soup	1.65	2.95	
雲	吞	湯	62.	Regular Wonton Soup	1.10	2.10		
酸	辣	湯	63.	Hot & Sour Soup	1.10	2.10		
蛋	花	湯	64.	Egg Drop Soup.....	1.10	2.10		
雲	蛋	湯	65.	Egg Drop Wonton Mix.....	1.10	2.10		
豆	腐	菜	湯	66.	Tofu Vegetable Soup	NA	3.50	
雞	玉	米	湯	67.	Chicken Corn Cream Soup	NA	3.50	
蟹	肉	玉	米	湯	68.	Crab Meat Corn Cream Soup.....	NA	3.50
海	鮮	湯	69.	Seafood Soup.....	NA	3.50		

Egyptian

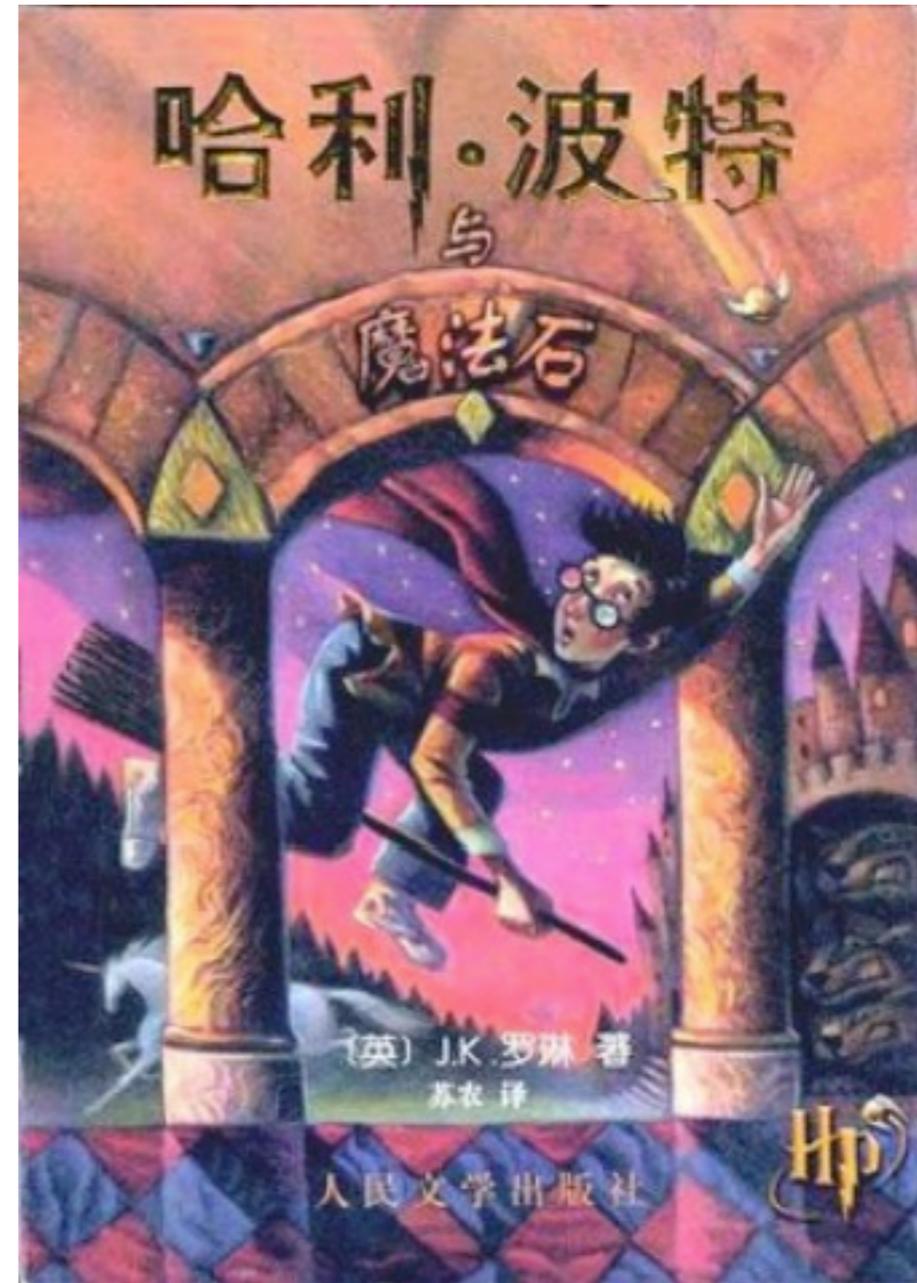
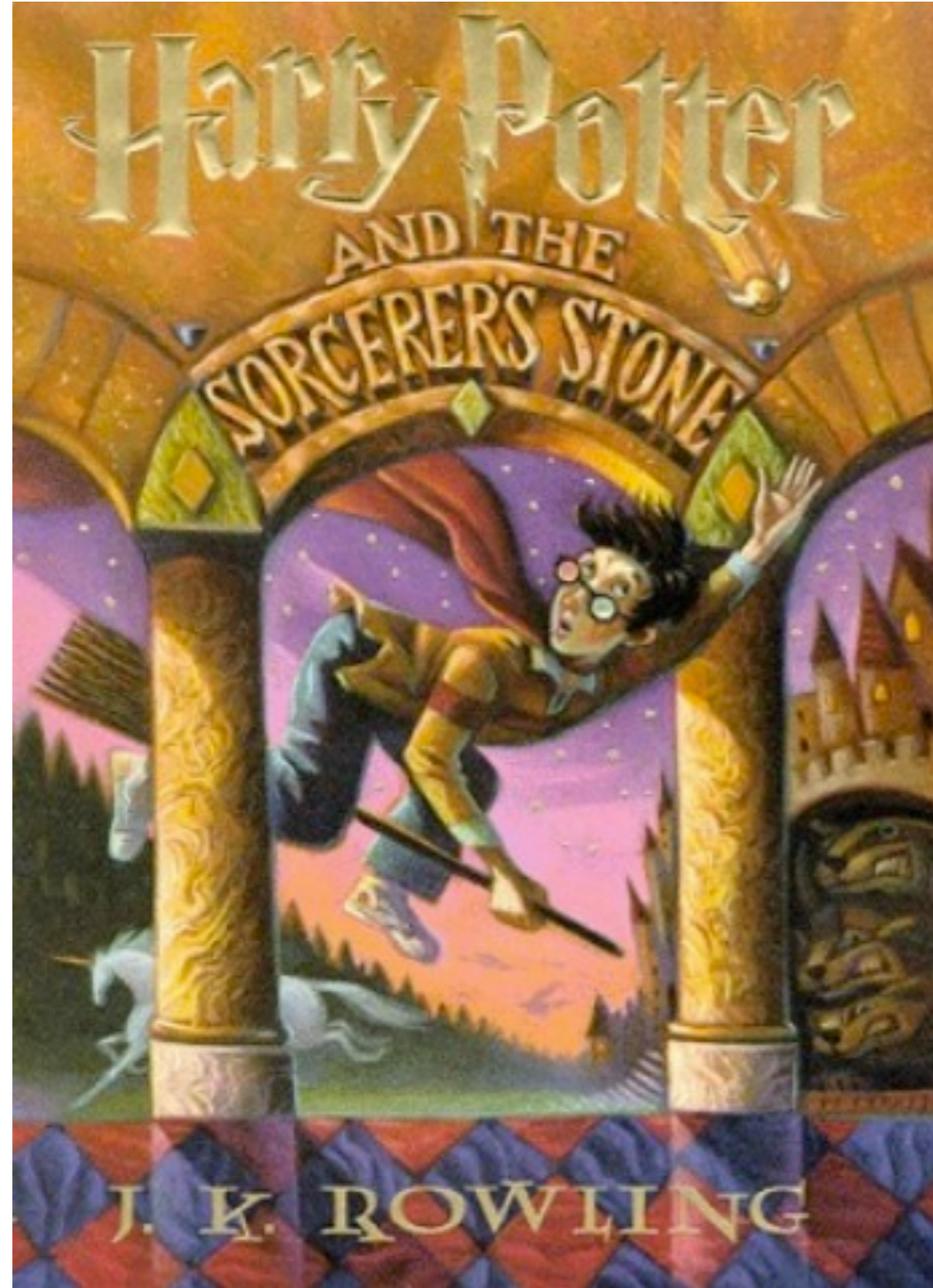


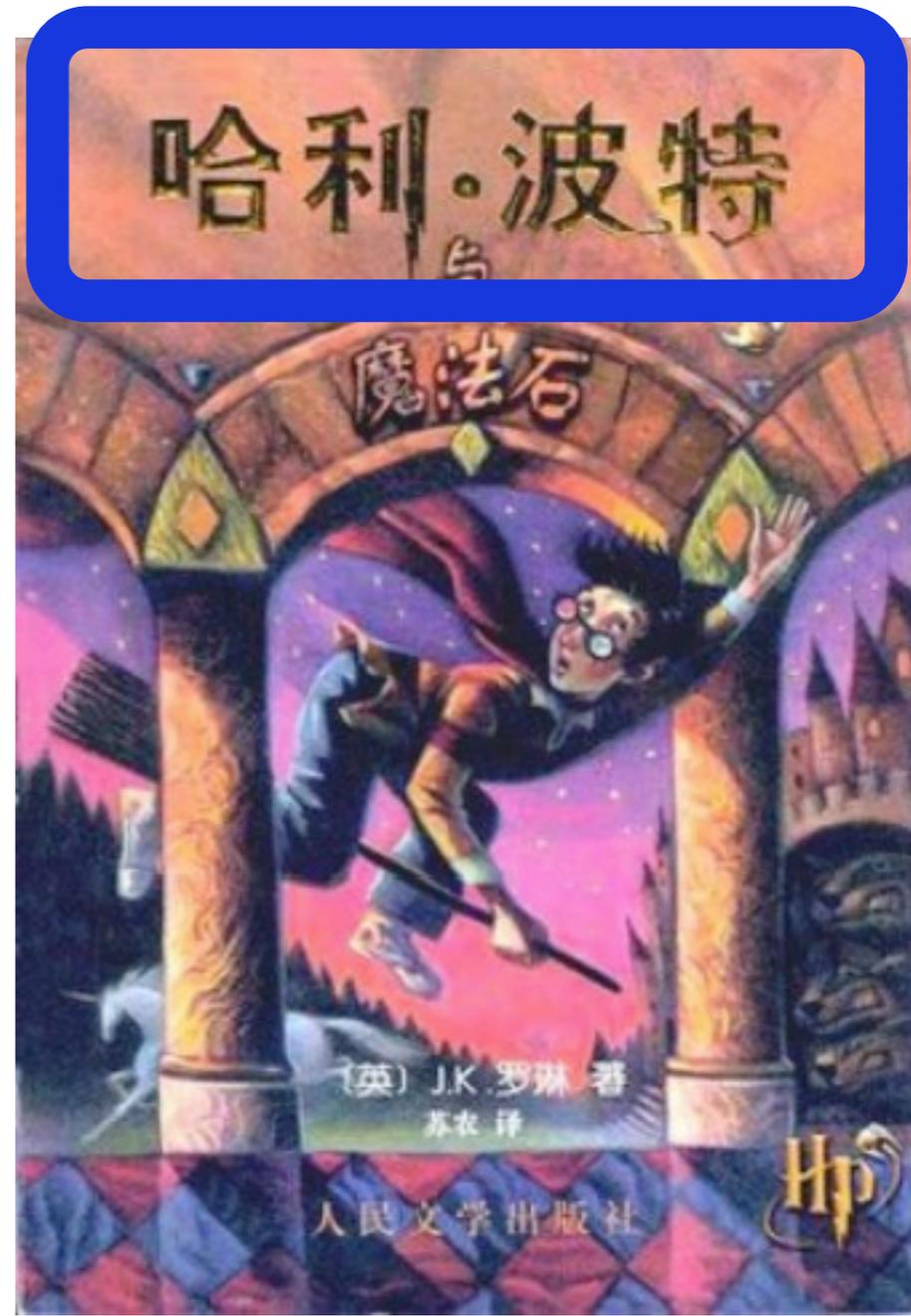
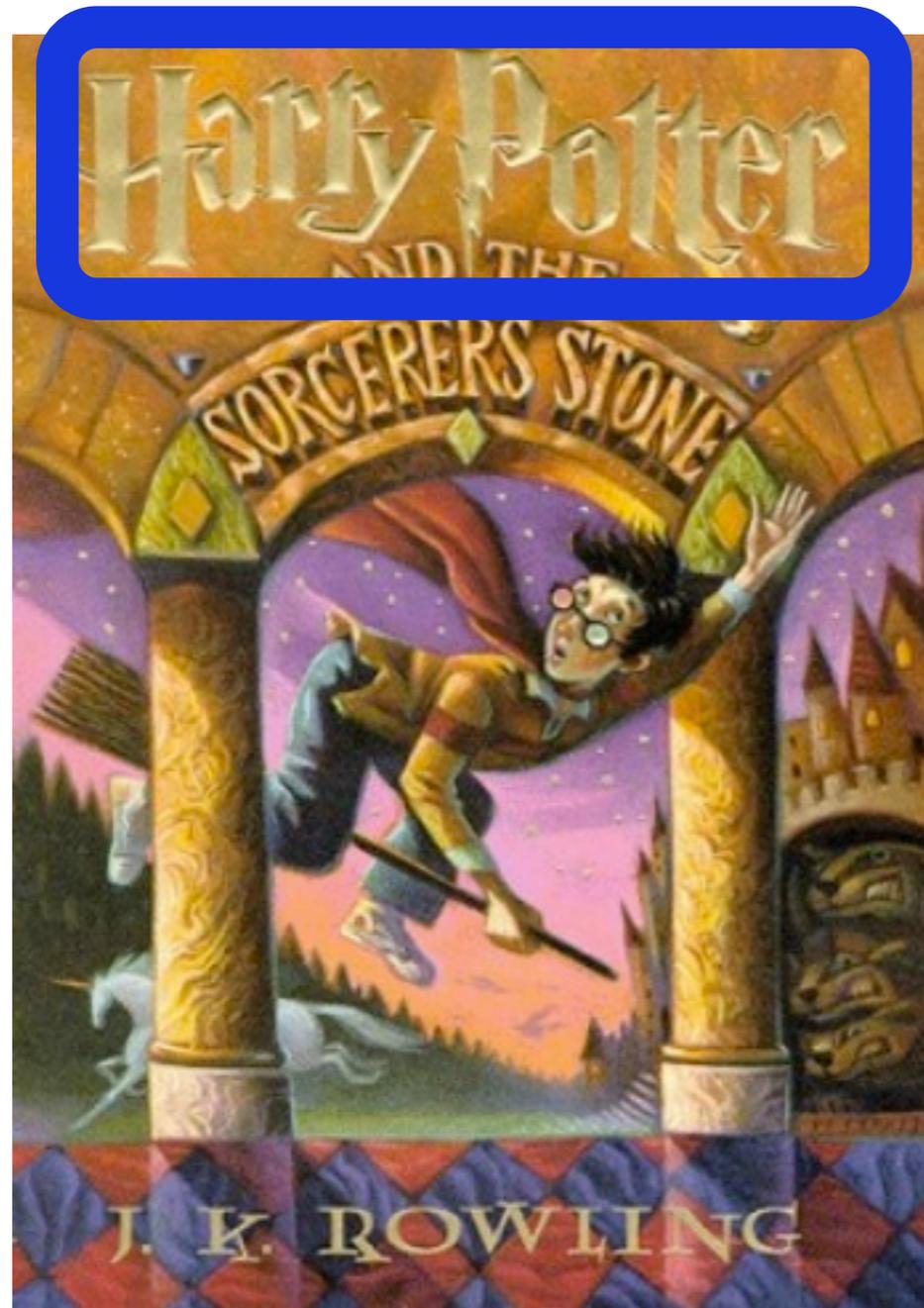
Greek

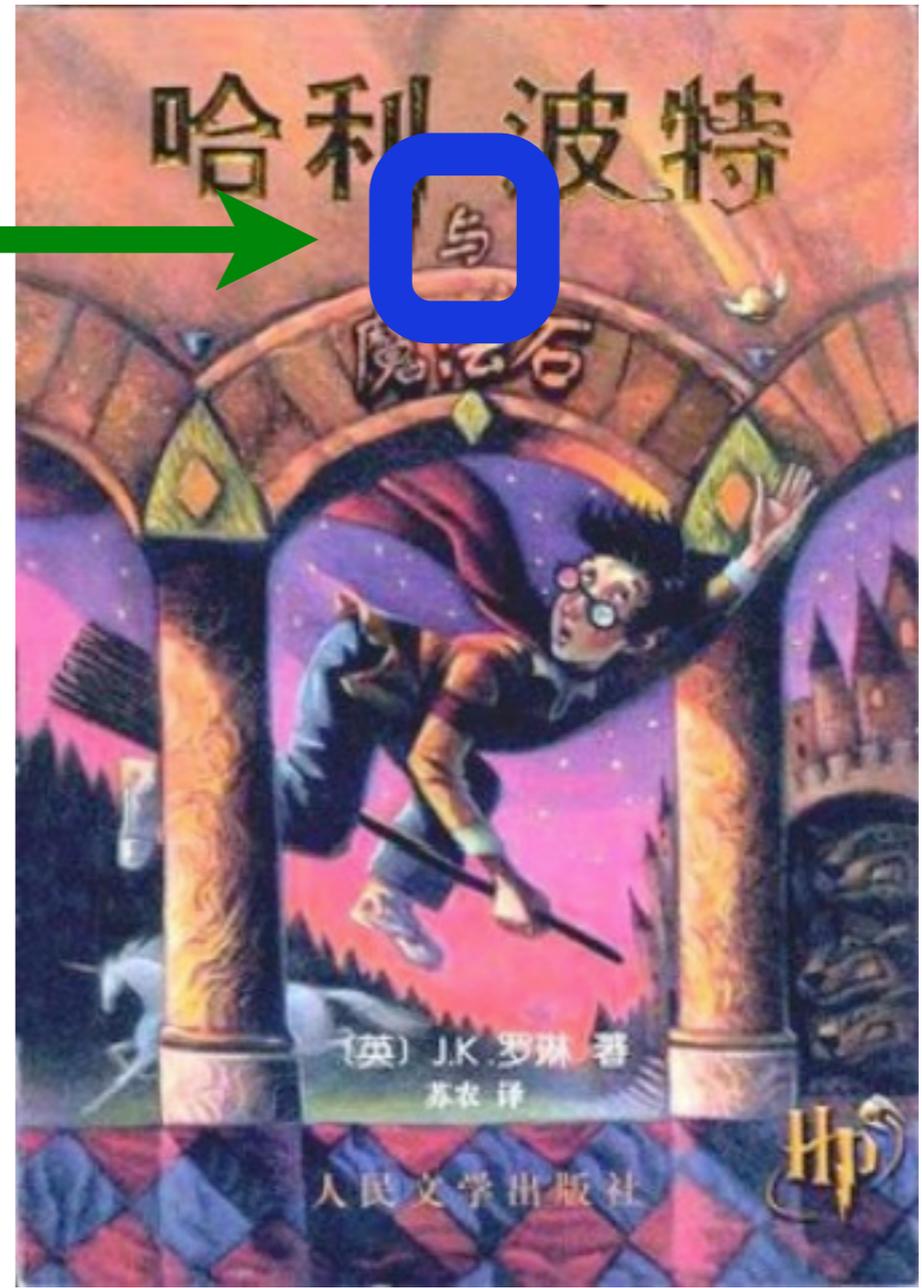
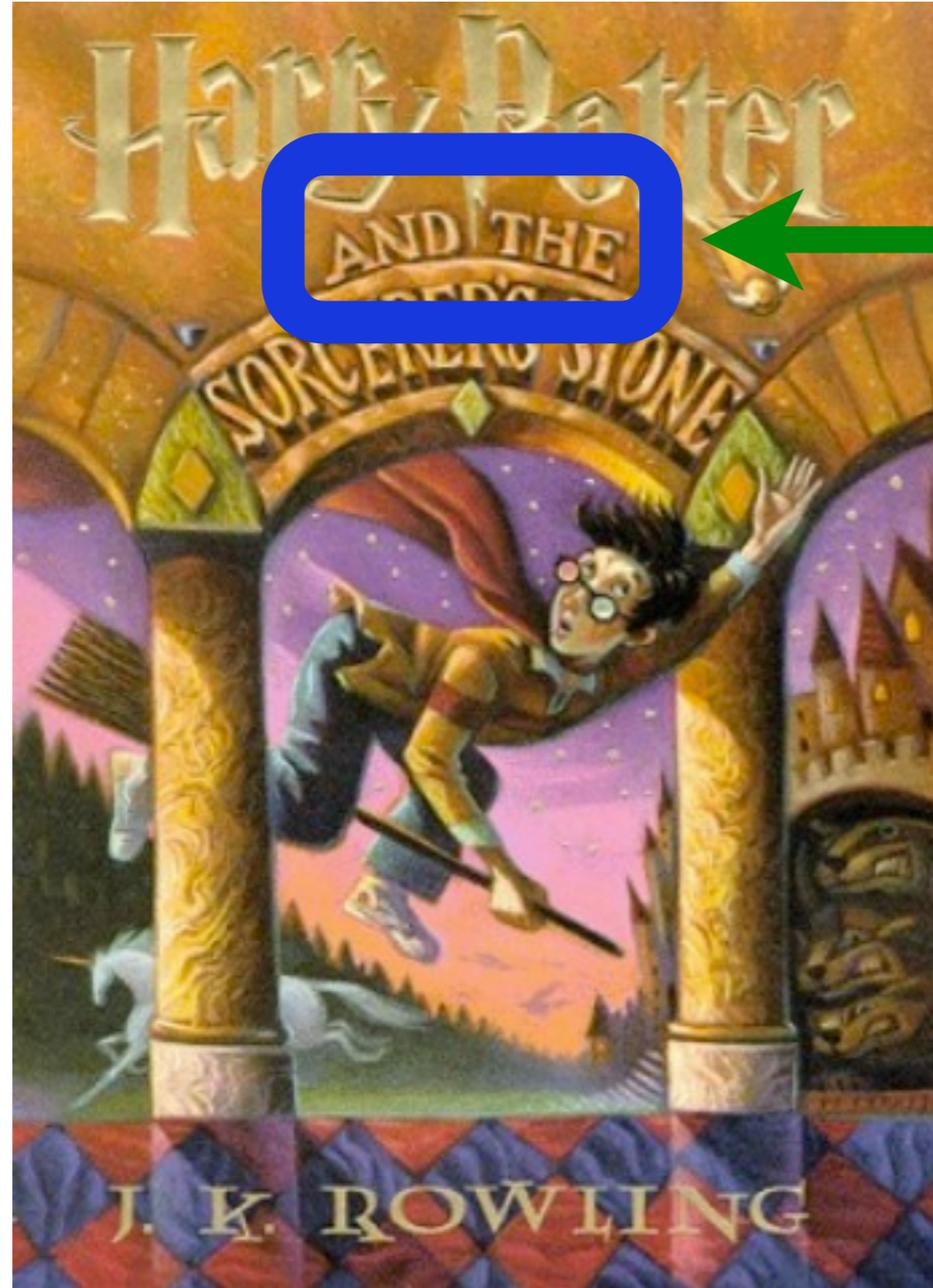


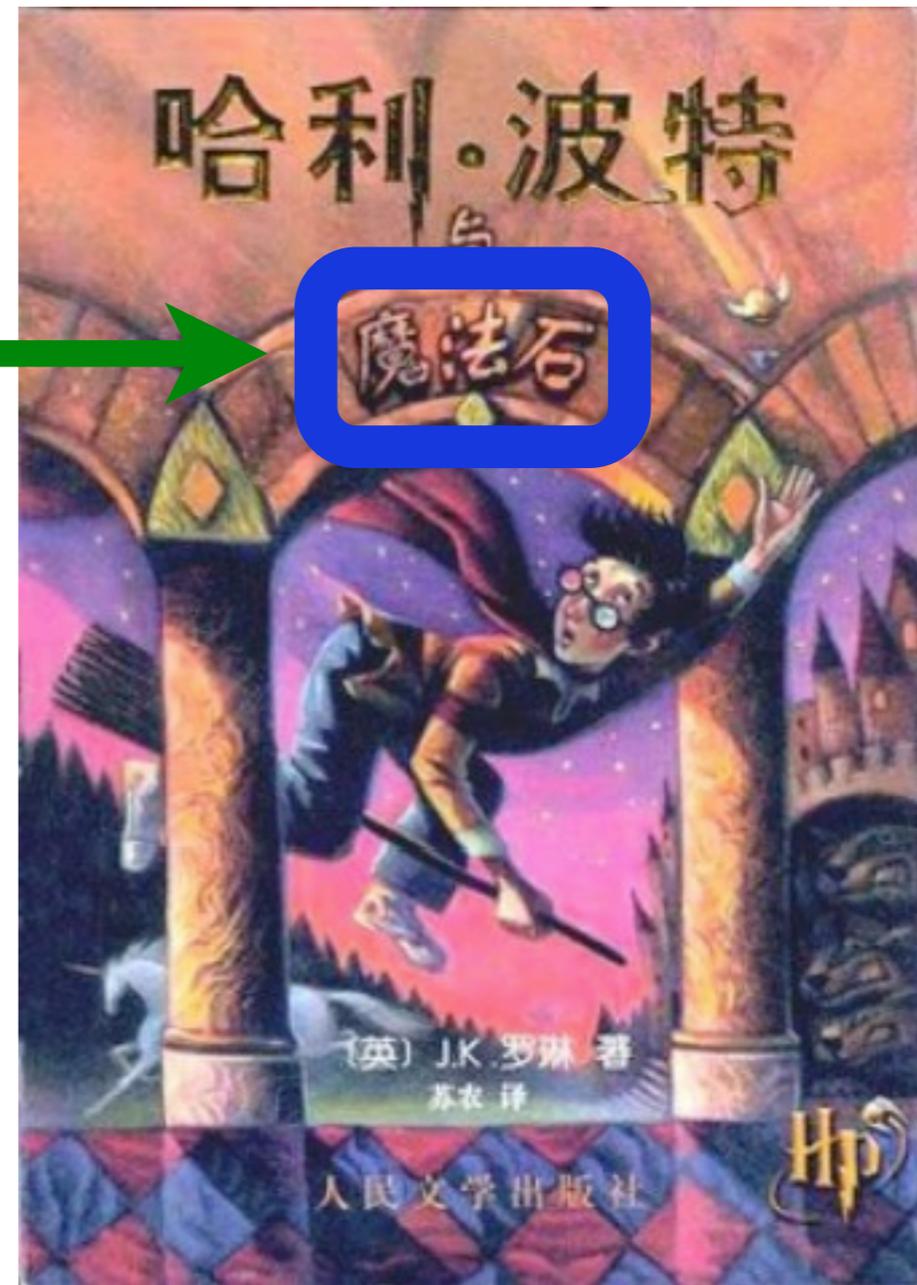
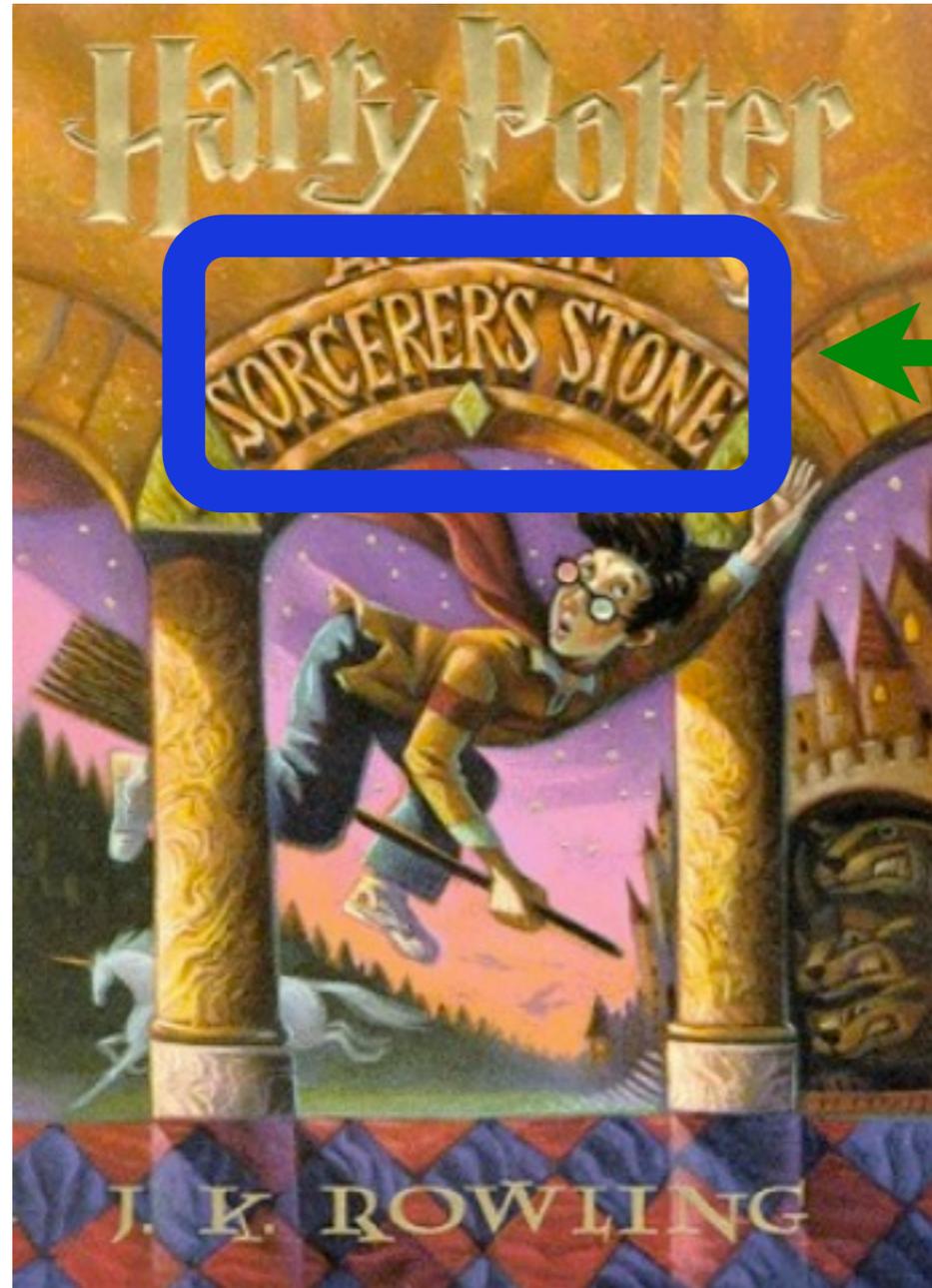
Aside: Parallel Data

- **Alignment**
 - What words / phrases correspond
- **Biingual lexicon induction**
 - Infer possible translations of each word
- **Paraphrase identification**
 - If both **a** and **b** translate as **c**, take this as evidence that **a** and **b** are *synonymous*
- **Distant linguistic supervision**
 - Languages make different things overt (e.g. English has spaces between words, Chinese does not)









CLASSIC SOUPS

		Sm.	Lg.					
清	燉	雞	湯	57.	House Chicken Soup (Chicken, Celery, Potato, Onion, Carrot)	1.50	2.75	
雞	飯	湯	58.	Chicken Rice Soup	1.85	3.25		
雞	麵	湯	59.	Chicken Noodle Soup	1.85	3.25		
廣	東	雲	吞	60.	Cantonese Wonton Soup.....	1.50	2.75	
蕃	茄	蛋	湯	61.	Tomato Clear Egg Drop Soup	1.65	2.95	
雲	吞	湯	62.	Regular Wonton Soup	1.10	2.10		
酸	辣	湯	63.	Hot & Sour Soup	1.10	2.10		
蛋	花	湯	64.	Egg Drop Soup.....	1.10	2.10		
雲	蛋	湯	65.	Egg Drop Wonton Mix.....	1.10	2.10		
豆	腐	菜	湯	66.	Tofu Vegetable Soup	NA	3.50	
雞	玉	米	湯	67.	Chicken Corn Cream Soup	NA	3.50	
蟹	肉	玉	米	湯	68.	Crab Meat Corn Cream Soup.....	NA	3.50
海	鮮	湯	69.	Seafood Soup.....	NA	3.50		

CLASSIC SOUPS

				Sm.	Lg.			
清	燉	雞	湯	57.	House Chicken Soup (Chicken, Celery, Potato, Onion, Carrot)	1.50	2.75	
雞	飯	湯	58.	Chicken Rice Soup	1.85	3.25		
雞	麵	湯	59.	Chicken Noodle Soup	1.85	3.25		
廣	東	雲	吞	60.	Cantonese Wonton Soup.....	1.50	2.75	
蕃	茄	蛋	湯	61.	Tomato Clear Egg Drop Soup	1.65	2.95	
雲	吞	湯	62.	Regular Wonton Soup	1.10	2.10		
酸	辣	湯	63.	Hot & Sour Soup	1.10	2.10		
蛋	花	湯	64.	Egg Drop Soup.....	1.10	2.10		
雲	蛋	湯	65.	Egg Drop Wonton Mix.....	1.10	2.10		
豆	腐	菜	湯	66.	Tofu Vegetable Soup	NA	3.50	
雞	玉	米	湯	67.	Chicken Corn Cream Soup	NA	3.50	
蟹	肉	玉	米	湯	68.	Crab Meat Corn Cream Soup.....	NA	3.50
海	鮮	湯	69.	Seafood Soup.....	NA	3.50		

In der Innenstadt explodierte eine Autobombe



A car bomb exploded downtown

In der Innenstadt explodierte eine Autobombe

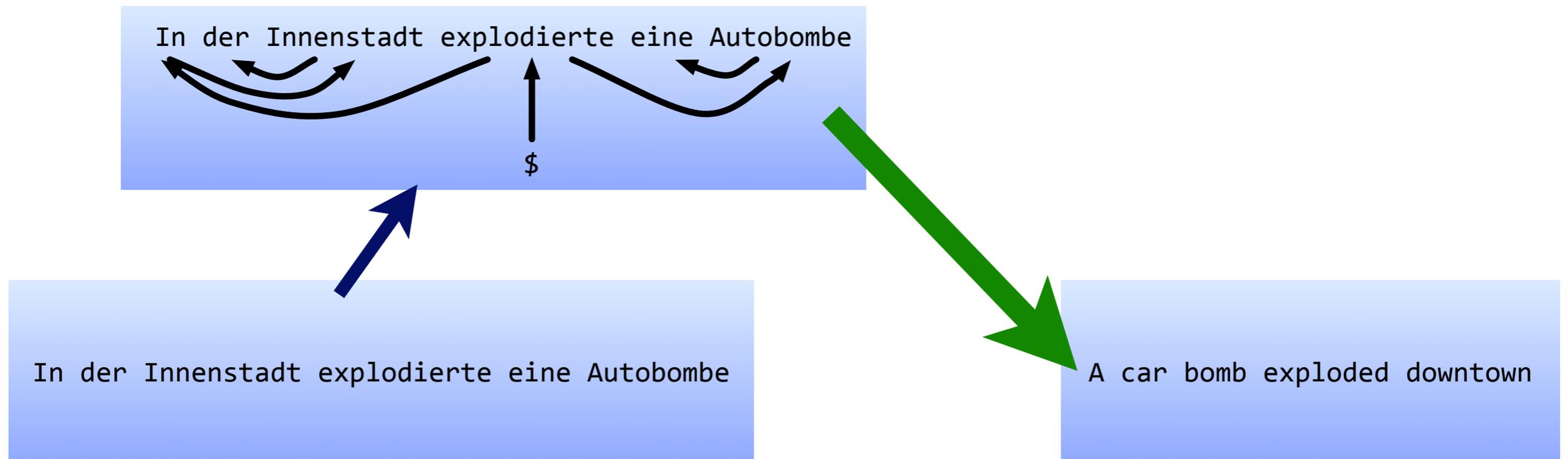


In der Innenstadt explodierte eine Autobombe

A car bomb exploded downtown

- **Tree-to-string translation**

- Syntactic *analysis* of source (parse)
- *Transfer* from tree to string
- Source trees have some benefits
 - Proxy for semantic relationships
 - Syntax is a natural source of reordering constraints



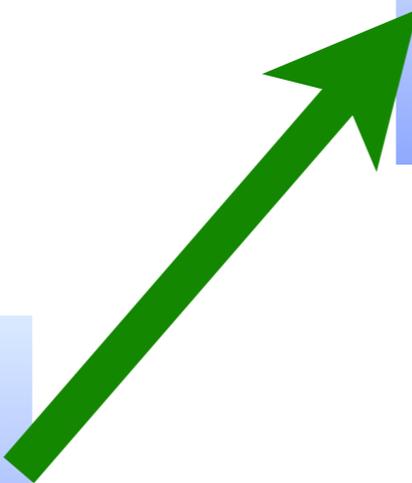
In der Innenstadt explodierte eine Autobombe



In der Innenstadt explodierte eine Autobombe

A car bomb exploded downtown

In der Innenstadt explodierte eine Autobombe



A car bomb exploded downtown



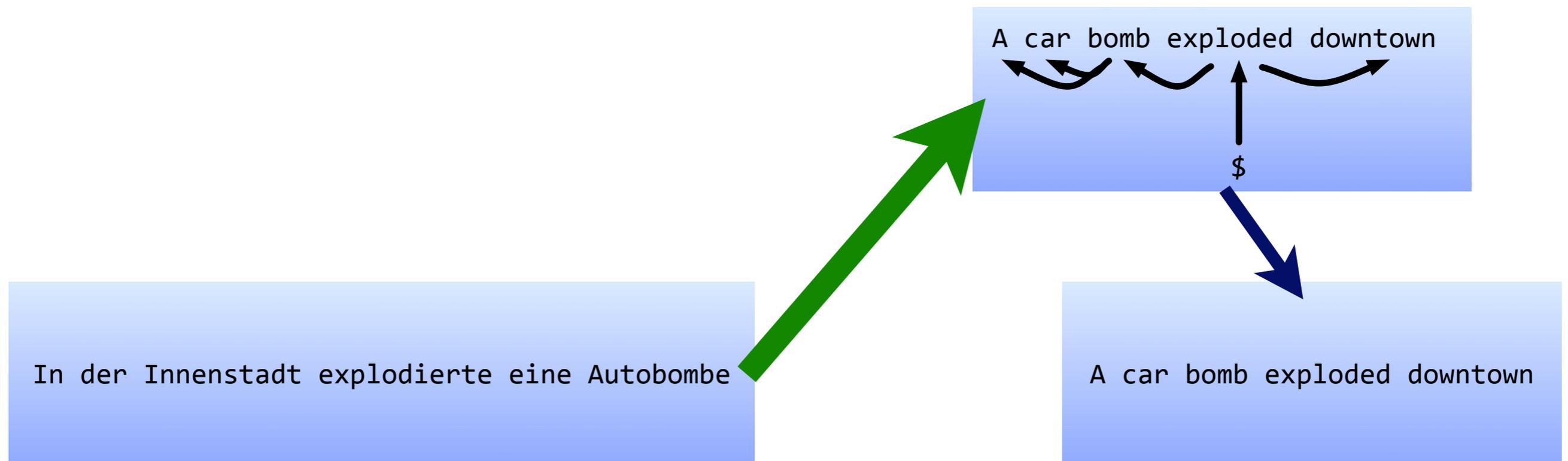
\$



A car bomb exploded downtown

- **String-to-tree translation**

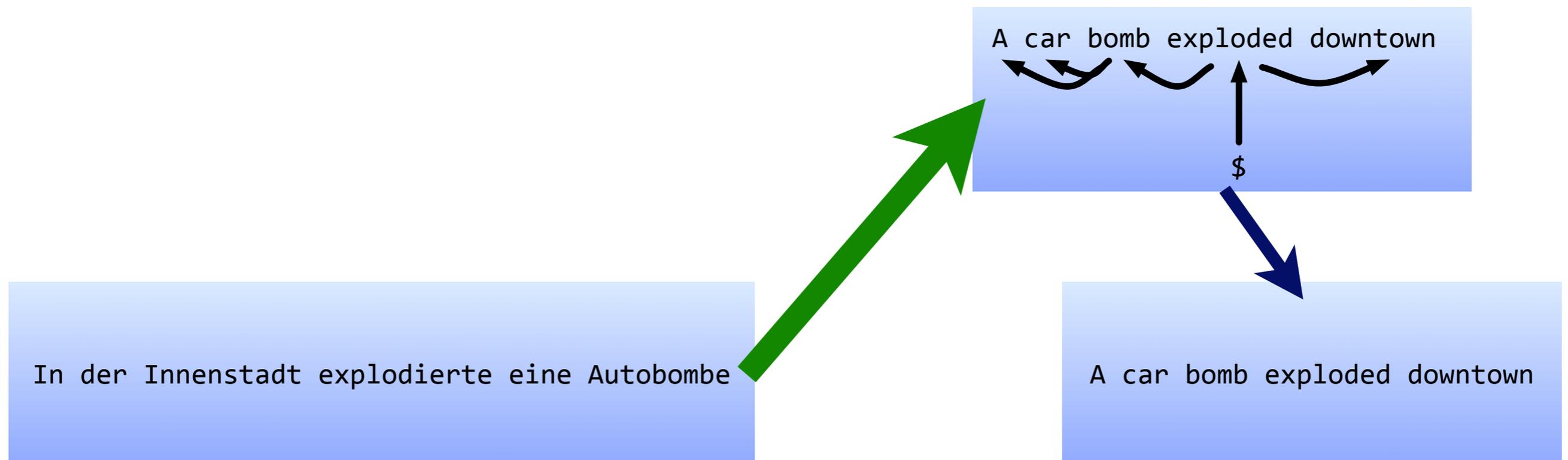
- Transfer from source tree to target string
- Formally a generalization of **monolingual parsing**
- Intuition: it is more important to know the language you are translating into well than the source language



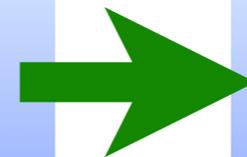
- **String-to-tree translation**

- Transfer from source tree to target string
- Formally a generalization of **monolingual parsing**
- Intuition: it is more important to know the language you are translating into well than the source language

The best Chinese-English systems are string-to-tree



In der Innenstadt explodierte eine Autobombe



A car bomb exploded downtown



In der Innenstadt explodierte eine Autobombe

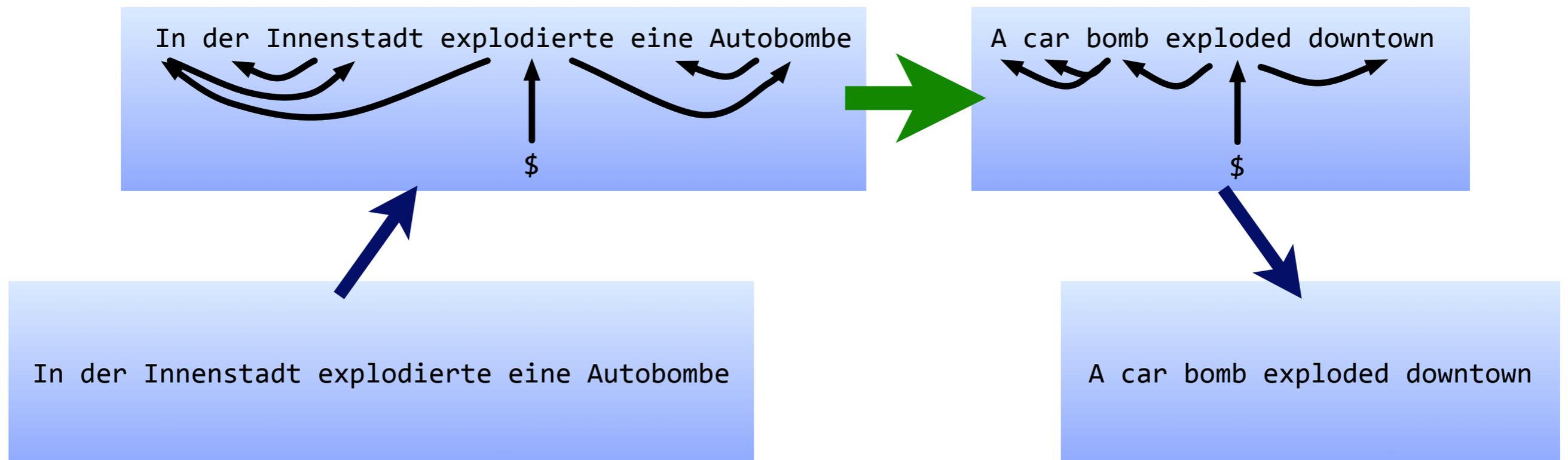


A car bomb exploded downtown



- **Tree to tree translation**

- Use syntax to predict syntax
- Benefits
 - As parsers improve, MT will improve (we hope)
 - Rich information for modeling in source and target
- Downside: where does the syntax come from?



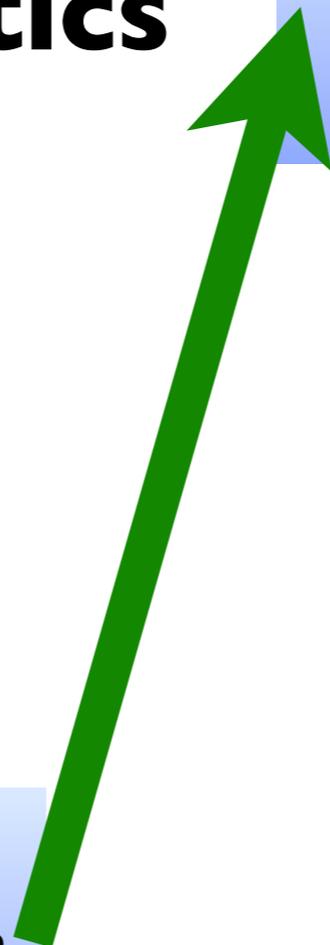
In der Innenstadt explodierte eine Autobombe

Semantics

“logical form”

detonate
:arg0 bomb
:arg1 car
:loc downtown
:time past

In der Innenstadt explodierte eine Autobombe



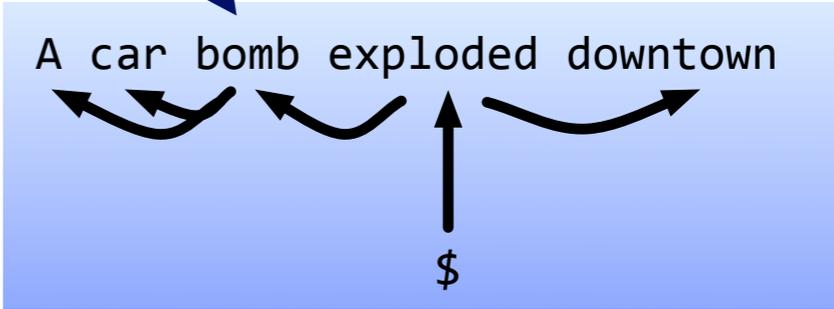
Semantics

“logical form”

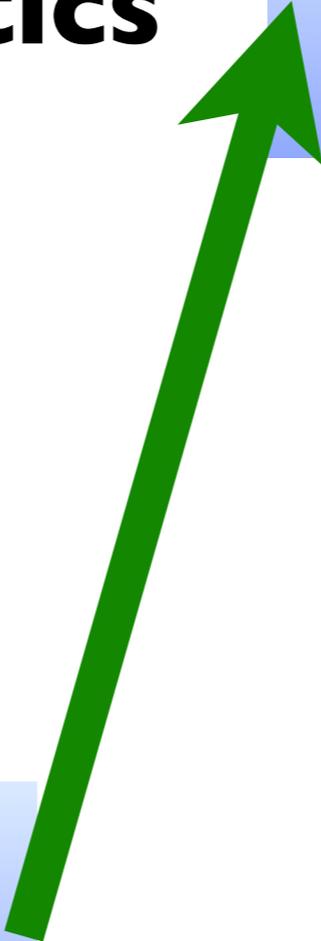
Syntax

```
detonate  
:arg0 bomb  
:arg1 car  
:loc downtown  
:time past
```

A car bomb exploded downtown



In der Innenstadt explodierte eine Autobombe



Semantics
"logical form"

Syntax

```
detonate  
:arg0 bomb  
:arg1 car  
:loc downtown  
:time past
```

A car bomb exploded downtown

\$

In der Innenstadt explodierte eine Autobombe

A car bomb exploded downtown

In der Innenstadt explodierte eine Autobombe

In der Innenstadt explodierte eine Autobombe

\$

detonate
:arg0 bomb
:arg1 car
:loc downtown
:time past

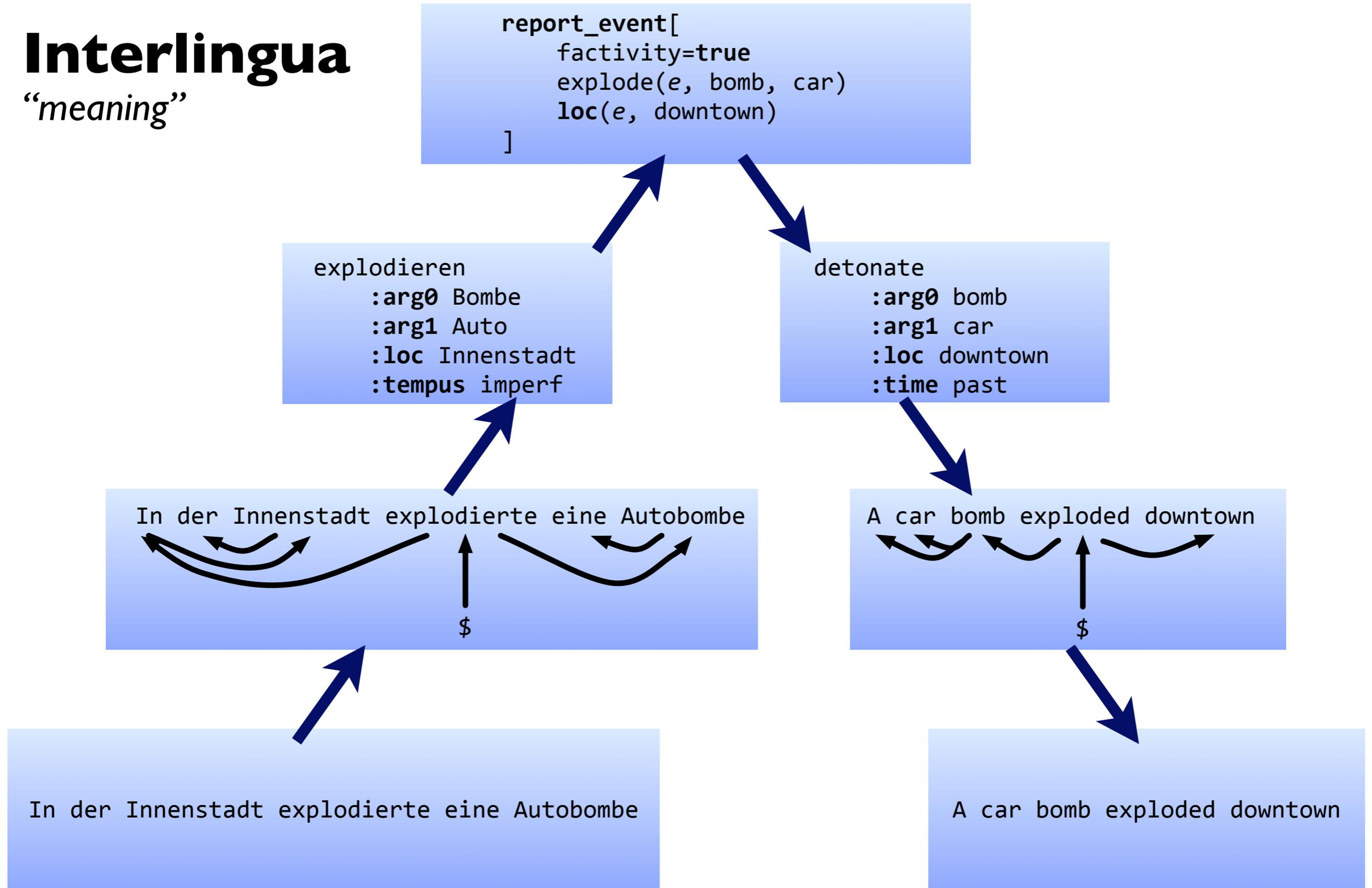
A car bomb exploded downtown

\$

A car bomb exploded downtown

Interlingua

“meaning”



More Abstract Models

More Abstract Models

- **Modeling challenges**
 - What are the right abstract representations?
 - How do we support more abstraction without sacrificing accuracy on frequent elements?

More Abstract Models

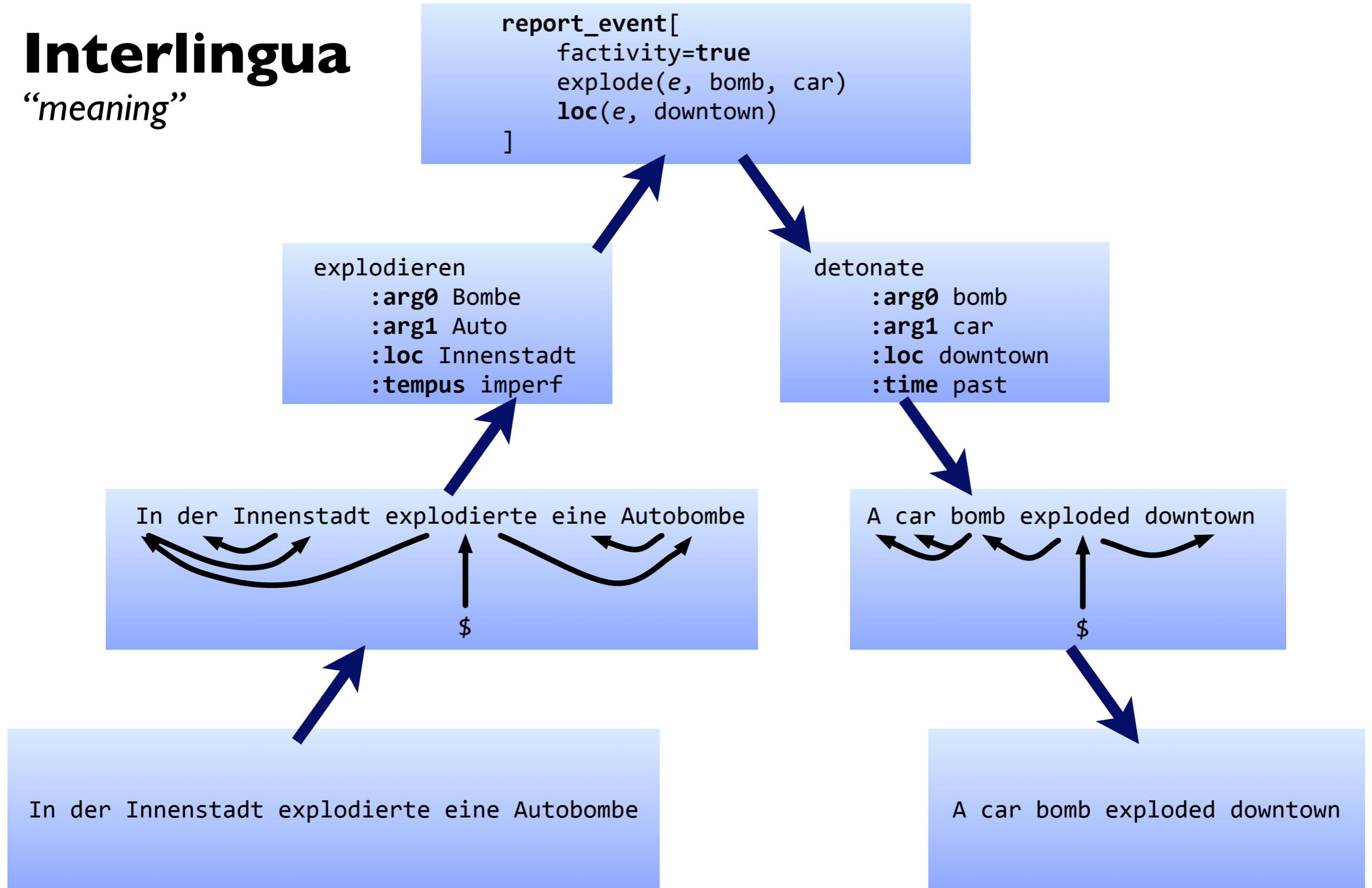
- **Modeling challenges**
 - What are the right abstract representations?
 - How do we support more abstraction without sacrificing accuracy on frequent elements?
- **Computational challenges**
 - Large search spaces
 - Error propagation in pipelines

More Abstract Models

- **Modeling challenges**
 - What are the right abstract representations?
 - How do we support more abstraction without sacrificing accuracy on frequent elements?
- **Computational challenges**
 - Large search spaces
 - Error propagation in pipelines
- **Learning challenges**
 - Nonconvexity
 - Where does the data come from?

Interlingua

“meaning”



Interlingua

“meaning”

```
report_event[  
  factivity=true  
  explode(e, bomb, car)  
  loc(e, downtown)  
]
```

Hidden

```
explodieren  
:arg0 Bombe  
:loc Innenstadt  
:tempus Imperf
```

```
detonate  
:arg0 bomb  
:arg1 car  
:loc downtown  
:time past
```

In der Innenstadt explodierte eine Autobombe

A car bomb exploded downtown

In der Innenstadt explodierte eine Autobombe

A car bomb exploded downtown

Other Challenges

European parliament language (training):

I declare resumed the session of the European Parliament adjourned on Friday 17 December 1999, and I would like once again to wish you a happy new year in the hope that you enjoyed a pleasant festive period.

Other Challenges

European parliament language (training):

I declare resumed the session of the European Parliament adjourned on Friday 17 December 1999, and I would like once again to wish you a happy new year in the hope that you enjoyed a pleasant festive period.

Human language (testing):



Its Me Edith :) @Lovelyyedi

40m

Birthday is on sunday & im pribably not doin anythin cause mom planned that other thing for sat nd sunday idk tf ima do -.-

Expand ← Reply ↻ Retweet ★ Favorite

Other Challenges

European parliament language (training):

I declare resumed the session of the European Parliament adjourned on Friday 17 December 1999, and I would like once again to wish you a happy new year in the hope that you enjoyed a pleasant festive period.

Human language (testing):



Its Me Edith :) @Lovelyyedi

40m

Birthday is on sunday & im pribably not doin anythin cause mom planned that other thing for sat nd sunday idk tf ima do -.-

Expand Reply Retweet Favorite

spelling error

Other Challenges

European parliament language (training):

I declare resumed the session of the European Parliament adjourned on Friday 17 December 1999, and I would like once again to wish you a happy new year in the hope that you enjoyed a pleasant festive period.

Human language (testing):



Its Me Edith :) @Lovelyyedi

40m

Birthday is on sunday & im pribably not doin anythin cause mom planned that other thing for sat nd sunday idk tf ima do -.-

Expand Reply Retweet Favorite

abbreviations

Other Challenges

European parliament language (training):

I declare resumed the session of the European Parliament adjourned on Friday 17 December 1999, and I would like once again to wish you a happy new year in the hope that you enjoyed a pleasant festive period.

Human language (testing):



Its Me Edith :) @Lovelyyedi

40m

Birthday is on sunday & im pribably not doin anythin cause mom planned that other thing for sat nd sunday idk tf ima do -.-

[Expand](#) [Reply](#) [Retweet](#) [Favorite](#)

nonstandard contractions

Using Translation



This page is in

Chinese ...

Would you like to translate it?

Nope

Translate

解读31位省级党委书记 下过乡扛过枪当过知青

[31位省级党委“一把手”平均年龄不到60岁][网友：全国31个省级党委换届一把手突出“三个特点”]



老党员重温入党誓词

党建纵览

党建周刊

网站联盟

- 干部“贿赂群众”说明了啥|女博士生咋患“..."
- 政务微博超45000个“电视问政”问出...
- 山东东营“的哥的姐”有了党支部|万余群众...
- 上海有个每周日跑菜场的党支部 | 杭州拱墅区...
- 辽宁抚顺：四千余名中小學生成为“娃娃楼长”...

- 全国31个省区市中省委常委任统战部长达23人
- 人民论坛：干部有危机感，群众才有幸福感
- 浙江湖州市一镇党委副书记阻挠采访被撤职

- 莒县县委书记刘守亮：脚上不沾泥很难说是好干部
- 四川宜宾市翠屏区：天都黑了 还能见到干部夜访...
- 广西百色构建乡镇书记“阳光上升通道”观察
- 聚焦来自基层一线的军队十八大代表 >>寄语留言
- 广东佛冈县率先在全省推行县直单位一把手挂任村...
- 深圳市南山区“书记信箱”开通500期 成为反...
- 记四川乐山市金口河区共安彝族乡林丰村党支部
- 江西黎川设党政班子集中办事大厅 12名乡镇领...
- 浙江省桐乡市石门镇暨丰村：80后村支书治村有...

- “联盟成员单位优秀稿件采用排行榜”（5月）
- 专题：走进基层党支部 | 历史文献纪录片《信仰》

解读31位省级党委书记 下过乡扛过枪当过知青

[31 provincial party committee "in charge" an average age of less than 60 years old] [users: the country's 31 provincial party committee leaders to highlight the "three characteristics"]



老党员重温入党誓词

Party Building Party Building Affiliate
Overview Week

- The cadres "bribe the masses," the Han | the female doctoral ye suffering from ...
- government microblogging over 45 000 | TV politics
- "asked a ...
- Shandong Dongying "the brother of the sisters have a party branch | thousand masses ...
- Shanghai party branch every Sunday ran farms |

- any of the United Front Work Department of the Provincial Standing Committee in the country's 31 provinces, autonomous regions and municipalities for up to 23 people, the People's Forum: cadres have a sense of crisis, the masses have the happiness
- Zhejiang Huzhou City, a town of the party deputy secretary obstruct interview is dismissed

- Juxian county party secretary Liu Shouliang: non-stick feet mud is hard to say the good cadres
- Sichuan Yibin City Cuiping: days are dark can see the cadres Interview ... the Guangxi Baise build township secretary sun rising channel observation
- focus from the front line of the grass-roots army 48 Congress >> Message Message
- Guangdong Fogang the first in the province implement

解读31位省级党委书记 下过乡扛过枪当过知青

[31 provincial party committee "in charge" an average age of less than 60 years old] [users: the country's 31 provincial party committee leaders to highlight the "three characteristics"]



老党员重温入党誓词

Party Building Party Building Affiliate
Overview Week

- The cadres "bribe the masses," the Han | the female doctoral ye suffering from ... government microblogging over 45 000 | TV politics "asked a ...
- Shandong Dongying "the brother of the sisters have a party branch | thousand masses ...
- Shanghai party branch every Sunday ran farms |

- any of the United Front Work Department of the Provincial Standing Committee in the country's 31 provinces, autonomous regions and municipalities for up to 23 people, the People's Forum: cadres have a sense of crisis, the masses have the happiness
- Zhejiang Huzhou City, a town of the party deputy secretary obstruct interview is dismissed

· Juxian county party secretary Liu Shouliang: non-stick feet mud is hard to say the good cadres

· Sichuan Yibin City Cuiping: days are dark can see the cadres Interview ... the

Guangxi Baise build township secretary sun rising channel observation

· focus from the front line of the grass-roots army 48

Congress >> Message Message

· Guangdong Fogang the first in the province implement

解读31位省级党委书记 下过乡扛过枪当过知青

[31 provincial party committee "in charge" an average age of less than 60 years old] [users: the country's 31 provincial party committee leaders to highlight the "three characteristics"]



老党员重温入党誓词

Party Building Party Building Affiliate
Overview Week

- The cadres "bribe the masses," the Han | the female doctoral ye suffering from ...
- government microblogging over 45 000 | TV politics "asked a ...
- Shandong Dongying "the brother of the sisters have a party branch | thousand masses ...
- Shanghai party branch every Sunday ran farms |

- any of the United Front Work Department of the Provincial Standing Committee in the country's 31 provinces, autonomous regions and municipalities for up to 23 people, the People's Forum: cadres have a sense of crisis, the masses have the happiness
- Zhejiang Huzhou City, a town of the party deputy secretary obstruct interview is dismissed

· Juxian county party secretary Liu Shouliang: non-stick feet mud is hard to say the good cadres

· Sichuan Yibin City Cuiping: days are dark can cadres Interview ... the Guangxi Baise build township secretary sun risi observation

· focus from the front line of the grass-roots army Congress >> Message Message

· Guangdong Fogang the first in the province implement

g: feet do not stick mud is l
lays a do not stick see the
"the s non - stick nnel" to
s-roots nonstick ongress
oduce does not stick vince co
zhen district, "t
on Leshan Sichuan Provi

HCI question for MT

- Statistical MT systems know **way more** about translation than any human can know
- Yet we end up with ***non-stick mud***
- **How can we help people find the information they need?**

Non-Written Languages

- **There's a bigger world than text**
 - *Spoken* language
 - *Written* language (text from images)
 - *Signed* language
- **Research questions**
 - How do we translate to languages with no (standard) orthography?
 - Non-standard dialects
 - Minority languages
 - Signed language
 - ...Twitter & Email
 - How do we deal with recognition errors?
 - How should humans use speech-to-speech translation devices?



Evaluation



More has been written about machine translation evaluation than about machine translation itself.

- Yorrick Wilks

The gold standard?

- Human evaluation
 - Have annotators read and assess translations
 - (Fluency, adequacy)
 - Have annotators read translations and do something



Is the cake delicious?



Human evaluation

- Problems
 - Humans don't like to evaluate translation, especially bad translation
 - Humans don't tend to agree with each other

A: furious nAgA on wednesday , the tribal minimum pur of ten schools also was burnt .

B: furious nAgA on wednesday the tribal pur mini ten schools of them was also burnt .

Automatic Evaluation

Automatic Evaluation

- Evaluating translation automatically is **hard**
 - There are many correct ways to say something
 - If we could measure if a sentence was grammatical and a good translation, then we would have solved the translation problem!

Automatic Evaluation

- Evaluating translation automatically is **hard**
 - There are many correct ways to say something
 - If we could measure if a sentence was grammatical and a good translation, then we would have solved the translation problem!
- But...
 - Computers are cheap and reliable
 - Computers don't mind evaluating (bad) translation output
 - During the translation process, systems must evaluate massive search spaces, but evaluation usually just looks at a few hypotheses
 - Our “bad” metrics have led to vastly improved translation quality!
 - If we had a great automatic metric, we could make things even better

In Conclusion

Machine Translation

- Algorithms & automata theory
- Human-computer interaction
- Linguistics
- Machine learning and statistics
- Many NLP technologies
 - Morphology
 - Syntax
 - Semantics
 - Discourse
- System engineering

Questions?