# Wild Experimenting in Machine Translation

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# Outline

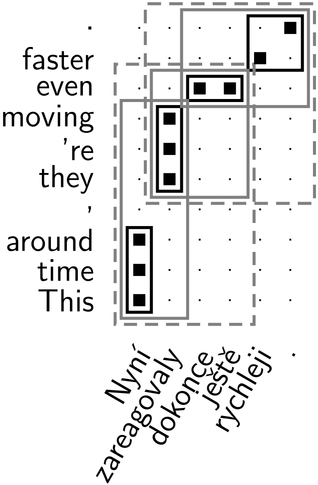
Statistical Machine Translation:

- Word order issues:
    - of PBMT, RBMT and hierarchical MT.
- Morphology issues of PBMT:
    - Along the whole MT pipeline.
    - With focus on target-side rich morphology.

Wild Experimenting:

- Motivation for experiment management.
- Key features of Eman.

# Phrase-Based Machine Translation



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- a parallel corpus (Czech sent = English sent)
- automatic word alignment (Czech word ∼ English word)

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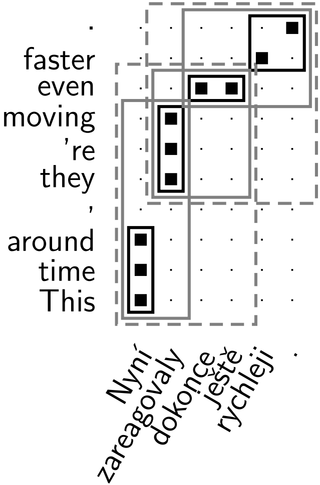

This time around = Nyní
they 're moving = zareagovaly
even = dokonce ještě
even faster = dokonce ještě rychleji
... = ...

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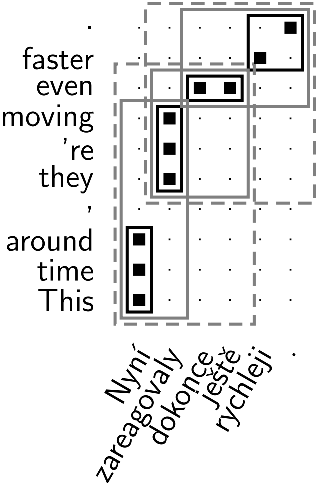

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- such a segmentation of the input sentence into "phrases"
- and such phrase translations

to make the output most probable.

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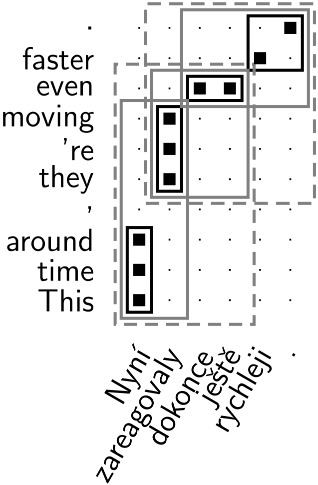

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# Warm-Up: Prove Google is Phrase-Based

| | | |
|---|---|---|
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Pumping words into phrases:

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| Jan s Marií se vzali. | John and Mary were married. | ✓ |

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| Jan s Marií se včera v kostele vzali. | John and Mary are married in church yesterday. | ∼ |

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Jan s Marií se včera v kostele vzali.

John and Mary are married in church yesterday. ~

Jan s Marií se včera v kostele svatého Ducha vzali.

John and Mary yesterday in the Church of the Holy Spirit took. ×

# PBMT vs. RBMT

(Prove Systran is not phrase-based.)

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| | Stell dir das vor. | |
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| Google | Imagine a small house in front. | × |
| Systran | Imagine a small house. | √ |
| | Stell dir ein kleines Haus mit vierzehn Fenster vor. | |
| Google | Imagine a small house with fourteen windows in front. | × |
| Systran | Imagine a small house with fourteen windows. | √ |

# Limitations of RBMT

- "Pump" grammatical constructions, not just words.

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- What’s worse: non-grammatical input breaks it.

Stell dir ein Haus, das ⊘ Garten hat, vor.
⇒ Place to you a house, the garden intends. ×

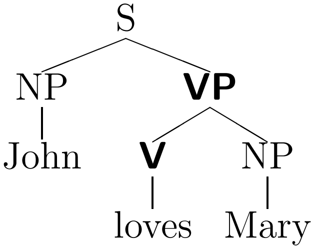
# Constituency vs. Dependency

Constituency trees (CFG) represent only bracketing:
= which adjacent constituents are glued to each other.
Dependency trees represent which words depend on which.
+ usually, some agreement/conditioning along the edge.

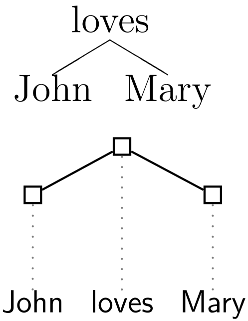
**Constituency**

John (loves Mary)

John ${}_{\text{VP}}$(loves Mary)



**Dependency**



# What Dependency Trees Tell Us

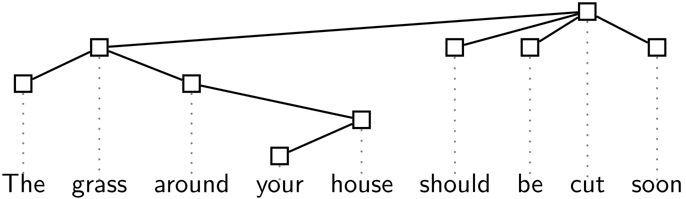
Input: The **grass** around your house should be **cut** soon.
Google: **Trávu** kolem vašeho domu by se měl **snížit** brzy.

- Bad lexical choice for *cut* = *sekat/snížit/krájet/řezat/. .*
  - Due to long-distance lexical dependency with *grass*.
  - One can "pump" many words in between.
  - Could be handled by full source-context (e.g. maxent) model.
- Bad case of *tráva*.
  - Depends on the chosen active/passive form:

| active⇒accusative | passive⇒nominative |
|---|---|
| trávu . . . by**ste** ~~se~~ měl posekat | tráva . . . by **se** měl**a** posekat |
| | tráva . . . by měl**a** **být** posek**ána** |

Examples by Zdeněk Žabokrtský, Karel Oliva and others.

# Tree vs. Linear Context

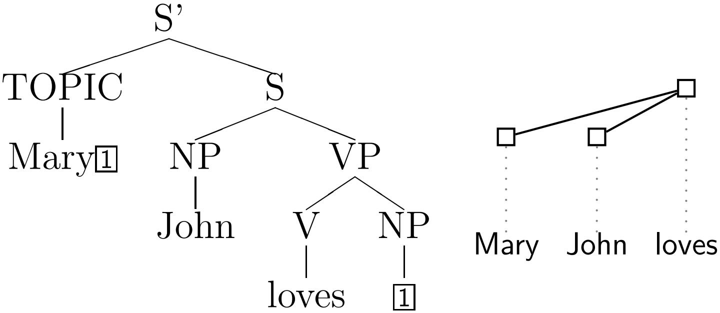


- Tree context (neighbours in the dependency tree):
  - is better at predicting lexical choice than *n*-grams.
  - often equals linear context:
    Czech manual trees: 50% of edges link neighbours,
    80% of edges fit in a 4-gram.
- Phrase-based MT is a very good approximation.
- Hierarchical MT can even capture the dependency in one phrase:

$X \rightarrow <$ the grass $X$ should be cut, trávu $X$ byste měl posekat $>$

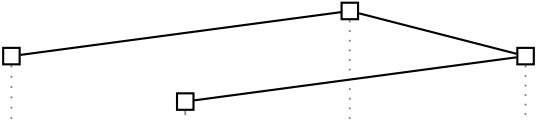
# “Crossing Brackets”

- Constituent outside its father’s span causes “crossing brackets.”
    - Linguists use “traces” ($\boxed{1}$) to represent this.
- Sometimes, this is not visible in the dependency tree:
    - There is no “history of bracketing”.
    - See Holan et al. (1998) for dependency trees including derivation history.



# Non-Projectivity

= a gap in a subtree span, filled by a node higher in the tree. Ex. Dutch “cross-serial” dependencies, a non-projective tree with one gap caused by *saw* within the span of *swim*.



| | | | | |
|---|---|---|---|---|
| . . . dat | Jan | kinderen | zag | zwemmen |
| . . . that | John | children | saw | swim |

. . . that John saw children swim.

- 0 gaps = projective tree ⇒ representable in CFG.
- ≤ 1 gap & “well-nested” ⇒ mildly context sensitive (TAG). See Kuhlmann and Möhl (2007) and Holan et al. (1998).

# Why Non-Projectivity Matters?

- CFGs cannot handle non-projective constructions:

  Imagine John **grass** saw **being cut**!

- No way to glue these crossing dependencies together:
  - Lexical choice:

    $$X \rightarrow < \text{grass } X \text{ being cut}, \text{trávu } X \text{ sekat} >$$

  - Agreement in gender:

    $$X \rightarrow < \text{John } X \text{ saw}, \text{Jan } X \text{ viděl} >$$
    $$X \rightarrow < \text{Mary } X \text{ saw}, \text{Marie } X \text{ viděl}\textbf{a} >$$

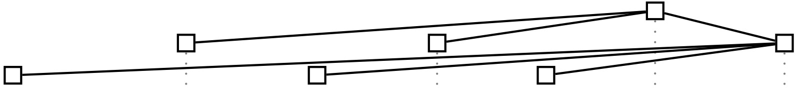
- Phrases can memorize <u>fixed</u> sequences containing:
  - the non-projective construction
  - and all the words in between! ($\Rightarrow$ extreme sparseness)

# Is Non-Projectivity Severe?

Depends on the language.

In principle unlimited:

- Czech allows long gaps as well as many gaps in a tree.



| | | | | | | |
|---|---|---|---|---|---|---|
| Proti odmítnutí | se | zítra | Petr | v práci | rozhodl | protestovat |
| Against dismissal | aux-refl | tomorrow | Peter | at work | decided | to object |

Peter decided to object against the dismissal at work tomorrow.

In treebank data:

⊖ 23% of Czech sentences contain a non-projectivity.

⊕ 99.5% of Czech sentences are well nested with $\leq 1$ gap.

# Parallel View

- Ignoring formal linguistic grammar, do we have to reorder beyond swapping constituents?
  - This is the ITG (Hiero with $\leq 2$ nonterminals) limitation.

| | | English-Czech Parallel Sents | |
|---|---|---|---|
| Domain | Alignment | Total | Beyond ITG |
| WSJ | manual Sure | 515 | 2.9% |
| WSJ | manual S+P | 515 | 15.9% |
| News | GIZA++, gdfa | 126k | 10.6% |
| Mixed | GIZA++, gdfa | 6.1M | 3.5% |

- searched for (discontinuous) 4-tuples of alignment points in forbidden shapes (3142 and 2413).
- additional alignment links were allowed to intervene (and could force different segmentation to phrases) $\Rightarrow$ we overestimate.
- no larger sequences of tokens were considered as a unit $\Rightarrow$ we underestimate.

# Don't Care Approach (cs→en)

Input: Zítra **se** v kostele Sv. Trojice budou **brát** Marie a Honza.
Ref: Mary and John get married in the Holy Trinity church tomorrow.

---

Goog: Tomorrow **is** the Holy Trinity church will **take** Mary and John.

- Bad lexical choice:
  *brát* = *take* vs. *brát se* = *get married*
- Superfluous *is*:
  - *se* is very often mis-aligned with the auxiliary *is*.

The straightforward bag-of-source-words model fails here:

- *se* is very frequent and it often means just *with*.
- An informed model would use the source parse tree.
  - Remember to use a non-projective parser!

# Tentative Conclusion on Reordering

For Indo-European languages, PBMT seems acceptable.

- Dependencies are most often local enough.
- Distant dependencies can be non-projective
  $\Rightarrow$ Hierarchical model does not help much either.

Other languages?

- We will try Tamil (Dravidian language, SOV) in the lab.
- ...but you'll see we will first hit another issue:
  rich morphology.

# Rich Morphology in PBMT Pipeline

- Word Alignment.
- Extraction of Translation Units.
- Translation of New Text.
- (Reordering.)
- Language Modelling.
- MT Evaluation.
- Model Optimization.

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    - New forms of known words.
    - Unknown words.
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- MT Evaluation.
    - Fewer matches with the reference.
- Model Optimization.

. . . rich morphology makes everything harder.

# Rich Morphology in PBMT Pipeline

- Word Alignment. ⇒ Lab: Stem, chop (or lemmatize or LEAF).
- Extraction of Translation Units.
- Translation of New Text.
    - New forms of known words. ⇒ Here: Two-Step; Lab: Split+Join.
    - Unknown words. ⇒ Word derivations in Treex.
- (Reordering.)
- Language Modelling.
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- MT Evaluation. ⇒ Here: Problems of BLEU.
    - Fewer matches with the reference.
- Model Optimization. ⇒ Here: SemPOS+BLEU.

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# Morphological Explosion in Czech

**(In)flective lang.**: suffix encodes many categories:

- Czech nouns and adjs: 7 cases, 4 genders, 3 nums, . . .
- Czech verbs: gender, num, aspect (im/perfective), . . .

| I | saw | two | green | striped | cats | . |
|---|---|---|---|---|---|---|
| já | pila | dva | zelený | pruhovaný | **kočky** | . |
| | pily | **dvě** | zelená | pruhovaná | koček | |
| | . . . | dvou | **zelené** | **pruhované** | kočkám | |
| | viděl | dvěma | zelení | pruhovaní | kočkách | |
| | viděla | dvěmi | zeleného | pruhovaného | kočkami | |
| | . . . | | zelených | pruhovaných | | |
| | uviděl | | zelenému | pruhovanému | | |
| | uviděla | | zeleným | pruhovaným | | |
| | . . . | | zelenou | pruhovanou | | |
| **viděl jsem** | | | zelenými | pruhovanými | | |
| viděla jsem | | | . . . | . . . | | |

# Result: Out-of-Vocabulary Rates

| Dataset | | *n*-grams Out of: Corpus Voc. | | Phrase-Table Voc. | |
|---|---|---|---|---|---|
| (# Sents) | Language | 1 | 2 | 1 | 2 |
| 7.5M | Czech | 2.2% | 30.5% | 3.9% | 44.1% |
| | English | 1.5% | 13.7% | 2.1% | 22.4% |
| | Czech + English input sent | 1.5% | 29.4% | 3.1% | 42.8% |
| 126k | Czech | 6.7% | 48.1% | 12.5% | 65.4% |
| | English | 3.6% | 28.1% | 6.3% | 45.4% |
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- OOV of Czech lemmas lower than in English.
- Free word order of Czech apparent.

# Two-Step Moses 1/2

- English → lemmatized Czech
  - meaning-bearing morphology preserved
  - max phrase len 10, distortion limit 6
  - large target-side (lemmatized LM)
- Lemmatized Czech → Czech
  - max phrase len 1, monotone

| | | | | |
|---|---|---|---|---|
| 0 | **Src** | after a sharp drop | | |
| 1 | **Mid** | po+6 | ASA1.prudký | NSA-.pokles |
| | **Gloss** | after+voc | adj+sg...sharp | noun+sg...drop |
| 2 | **Out** | po | prudkém | poklesu |

- Only 1-best output passed, lattices on our todo list.
- See also works by Alex Fraser for targetting German.
- Alternative: Exponential models (Subotin, 2011).

# Two-Step Moses 2/2

| Data Size | | Simple | | Two-Step | | Diff |
|---|---|---|---|---|---|---|
| Parallel | Mono | BLEU | SemPOS | BLEU | SemPOS | B. S. |
| 126k | 126k | 10.28±0.40 | 29.92 | 10.38±0.38 | 30.01 | ↗↗ |
| 126k | 13M | 12.50±0.44 | 31.01 | 12.29±0.47 | 31.40 | ↘↗ |
| 7.5M | 13M | 14.17±0.51 | 33.07 | 14.06±0.49 | 32.57 | ↘↘ |

Manual micro-evaluation of ↘↗, i.e. 12.50±0.44 vs. 12.29±0.47:

| | Two-Step | Both Fine | Both Wrong | Simple | Total |
|---|---|---|---|---|---|
| Two-Step | **23** | 4 | 8 | - | **35** |
| Both Fine | 7 | 14 | 17 | 5 | 43 |
| Both Wrong | 8 | 1 | 28 | 2 | 39 |
| Simple | - | 3 | 7 | **23** | 33 |
| Total | **38** | 22 | 60 | 30 | 150 |

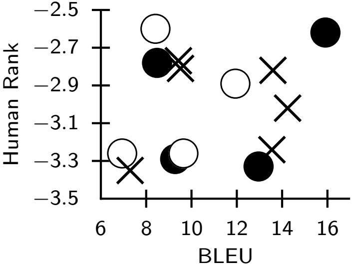
- Each annotator weakly prefers Two-step
  - but they don't agree on individual sentences.

# Effect of Rich Morphology on BLEU

- Large vocabulary impedes the performance of BLEU.

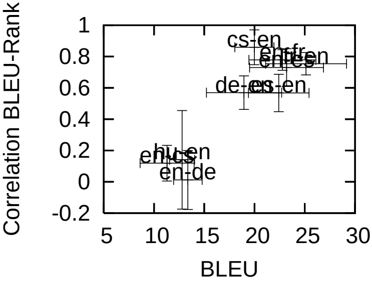
En→Cs Systems

WMT08, WMT09



Various Language Pairs

WMT08, WMT09, MetricsMATR



⇒ BLEU does not correlate with human rank if below ∼20.

# Reason 1: Focus on Forms

| | |
|---|---|
| SRC | Prague Stock Market falls to minus by the end of the trading day |
| REF | pražská burza se ke konci obchodování propadla do minusu |
| cu-bojar | praha stock market klesne k minus na konci obchodního dne |
| pctrans | praha trh cenných papírů padá minus do konce obchodního dne |

- Only a single unigram in each hyp. confirmed by the reference.
- Large chunks of hypotheses are not compared at all.

| Confirmed by Reference | Yes | Yes | No | No |
|---|---|---|---|---|
| Contains Errors | Yes | No | Yes | No |
| Running words | 6.34% | 36.93% | 22.33% | **34.40%** |

# Reason 2: Sequences Overvalued

BLEU overly sensitive to sequences:

- Gives credit for 1, 3, 5 and 8 four-, three-, bi- and unigrams,
- Two of three serious errors not noticed,
  ⇒ Quality of cu-bojar overestimated.

| | |
|---|---|
| SRC | Congress yields: US government can pump 700 billion dollars into banks |
| REF | kongres ustoupil : vláda usa může do bank napumpovat 700 miliard dolarů |
| cu-bojar | kongres výnosy : vláda usa může čerpadlo 700 miliard dolarů v bankách |
| pctrans | kongres vynáší : us vláda může čerpat 700 miliardu dolarů do bank |

⇒ Bojar et al. (2010) use SemPOS, a coarse metric that correlates better with humans for Czech and English.

# Optimizing Towards SemPOS

SemPOS compares bags of lemmas, not sequences of forms.

- Sequences not overvalued
  ⇒ better correlation with human ranking.
- Not fit for selecting best output from n-best list.
  ⇒ Need to combine with e.g. BLEU.

WMT11 Tunable Metrics Task, manual ranking:

| System | ≥others | >others |
|---|---|---|
| bleu● | **0.79** | 0.28 |
| bleu-single● | 0.77 | 0.27 |
| cmu-meteor● | 0.76 | 0.27 |
| rwth-cder | 0.76 | 0.26 |
| cu-sempos-bleu● | 0.74 | **0.29** |
| stanford-dcp● | 0.73 | 0.27 |
| nus-tesla-f | 0.68 | 0.28 |
| sheffield-rose | 0.05 | 0.00 |

- Among the many "winners" (●).
- Best in ">others", i.e. when ties are not rewarded.

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- Among the many "winners" (●).
- Best in ">others", i.e. when ties are not rewarded.
- Generally hard to interpret the ranking.

# Motivation for Experiment Mgmt (1/2)

Research needs reproducibility.

- Console-based environment alone helps a lot:
  - Bash history of past commands.
  - Log files.
- Complications:
  - Experiments carried out in parallel.
    Experiments can take days.
    ⇒ Easy to lose track.
  - Should reuse large intermediate files.
  - Different versions of the research software.
    (Both daily updates as well as yearly updates.)

# Motivation for Experiment Mgmt (2/2)

Research is search.
(for the best procedure, the best configuration, . . . )

You can think of research in AI/machine-learning terms.

- Heuristics:
  - Run quick probes (small data) first, then replicate on full.
- Beam Search: Increase *your* beam size:
  - Run ˜10 variations of each experiment.
- Genetic Algorithms:
  - Clone and modify most successful experiments.
- ("The best" varies based on the metric chosen.)
  - So look at more metrics at once.

# Features of Eman

- Console-based ⇒ easily scriptable (e.g. in bash).
- Versatile: “seeds” are up to the user, any language.

- Support for the manual search through the space of experiment configurations.
- Support for finding and marking (“tagging”) experiments of interest.
- Support for organizing the results in 2D tables.

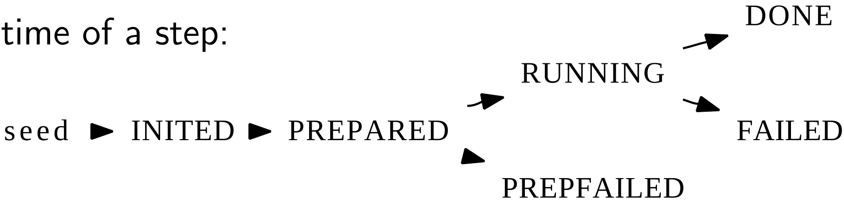
- Integrated with SGE
  ⇒ easy to run on common academic clusters.

**eman --man** will tell you some details.

# Eman's View

- Experiments consist of processing STEPS.
- Steps are:
  - of a given type, e.g. **align**, **tm**, **lm**, **mert**,
  - defined by immutable variables, e.g. **ALISYM=gdfa**,
  - all located in one directory, the "**playground**",
  - timestamped unique directories, e.g. **s.mert.a123.20120215-1632**
  - self-contained in the dir as much as reasonable.
  - dependent on other steps, e.g. first **align**, then build **tm**, then **mert**.

Lifetime of a step:



# Eman is Versatile

What types of steps should I have?

- Any, depending on your application.

What language do I write steps in?

- Any, e.g. bash.

What are the input and output files of the steps?

- Any, just make depending steps understand each other.
- Steps can have many output files and serve as prerequisites to different types of other steps.

What are measured values of my experiments?

- Anything from any of the files any step produces.

# What the User Implements: Just Seeds

Technically, a seed is any program that:

- responds to arbitrary environment variables,
- runs **eman defvar** to register step variables with eman,
- produces another program, **./eman.command** that does the real job.

The seed is actually run twice:

- At “init”: to check validity of input variables and register them with eman.
- At “prepare”: to produce **eman.command**.

The user puts all seeds in **playground/eman.seeds**.

- Eman runs a local copy of the seed in a fresh step dir.

# Why INITED→PREPARED→RUNNING?

The call to **eman init** *seed*:

- Should be quick, it is used interactively.
- Should only check and set vars, “turn a blank directory to valid eman step”.

The call to **eman prepare** *s.step.123.20120215*:

- May check for various input files.
  - Less useful with heavy experiments where even corpus preparation needs cluster.
- Has to produce **eman.command**.
  ⇒ A chance to check it: are all file paths correct etc.?

The call to **eman start** *s.step.123.20120215*:

- Sends the job to the cluster.

# Bells and Whistles

Experiment management:

- **ls**, **vars**, **stat** for simple listing,
- **select** for finding steps,
- **traceback** for full info on experiments,
- **redo** failed experiments,
- **clone** individual steps as well as whole experiments.

Meta-information on steps:

- **status**,
- **tag**s, autotags,
- **collect**ing results,
- **tabulate** for putting results into 2D tables.

# eman select

- Step dirs don't have nice names.
- You need to locate steps of given properties.

What all language models do I have?

- **eman ls lm**
- **eman select t lm**

If we need just the finished ones:

- **eman stat lm | grep DONE**
- **eman select t lm d**

And just 5-gram ones for English:

- **eman select t lm d vre ORDER=5 vre CORPAUG=en**

# eman traceback

## eman traceback s.evaluator.8102edfc.20120207-1611

```
+- s.evaluator.8102edfc.20120207-1611
|  +- s.mosesgiza.b6073a00.20120202-0037
|  +- s.translate.b17f203d.20120207-1604
|  |  +- s.mert.272f2f67.20120207-0013
|  |  |  +- s.model.3e28def7.20120207-0013
|  |  |  |  +- s.lm.608df574.20120207-0004
|  |  |  |  |  +- s.srilm.117f0cfe.20120202-0037
|  |  |  |  +- s.mosesgiza.b6073a00.20120202-0037
|  |  |  |  +- s.tm.527c9342.20120207-0012
|  |  |  |  |  +- s.align.dec45f74.20120206-0111
|  |  |  |  |  |  +- s.mosesgiza.b6073a00.20120202-0037
|  |  |  |  |  +- s.mosesgiza.b6073a00.20120202-0037
|  |  +- s.mosesgiza.b6073a00.20120202-0037
```

Options: **--vars --stat --log ... --ignore=***steptype*

# eman redo

On cluster, jobs can fail nondeterminically.

- Bad luck when scheduled to a swamped machine.
- Bad estimate of hard resource limits (RAM exceeds the limit ⇒ job killed).

Eman to the rescue:

- **eman redo** *step* creates a new instance of each failed step, preserving the experiment structure.
- **eman redo** *step* **--start** starts the steps right away.

To make sure eman will do what you expect, first try:

- **eman redo** *step* **--dry-run**

# eman clone

CLONING is initing a new step using vars of an existing one.
Cloning of individual steps is useful:

- when a step failed (used in **eman redo**),
- when the seed has changed,
- when we want to redefine some vars:
  **ORDER=4 eman clone s.lm.1d6f791c...**

Cloning of whole tracebacks:

- The text of a traceback gets instantiated as steps.
- Existing steps are reused if OK and with identical vars.
- **eman traceback** *step* | **eman clone**
- **eman traceback** *step* | **mail bojar@ufal**
  followed by **eman clone** < **the-received-mail**.

# Deriving Experiments using **clone**

The text form of traceback allows to tweak the experiment:

- **eman tb** *step* | **sed ’s/cs/de/’** | **eman clone**
  replicates our experiment on German instead of Czech.

The derivation is now available in eman itself:

- **eman tb** *step* **-s ’/cs/de/’ -s ’/form/lc/’**
  shows the traceback with the substitutions highlighted.
  - A good chance to check if the derivation does the intended.
- **eman tb** *step* **-s ’/cs/de/’ -s ’/form/lc/’** \\
  | **eman clone --dry-run**
  - Last chance to check if existing steps get reused and what vars will new steps be based on.
  - Drop **--dry-run** to actually init the new steps.

# **eman tag** or **eman ls --tag** shows tags

TAGS and AUTOTAGS are:

- arbitrary keywords assigned to individual steps,
- inherited from dependencies.

Tags are:

- added using **eman add-tag** *the-tag steps*,
- stored in `s.stepdir.123/`**eman.tag**.

⇒ Use them to manually mark exceptions.

Autotags are:

- specified in `playground/`**eman.autotags** as regexes over step vars, e.g.: **/ORDER=(.*)/$1gr/** for LM,
- (re-)observed at **eman retag**.

⇒ Use them to systematically mark experiment branches.

# eman collect

Based on rules in **eman.results.conf**, e.g.:

```
BLEU  */BLEU.opt                      BLEU\s*=\s*([^\s,]+)
Snts  s.eval*/corpus.translation      CMD: wc -l
```

eman collects results from all steps into **eman.results**:

```
# Step Name                        Status   Score Value Tags and Autotags
s.evaluator.11ccf590.20120208-1554 DONE      TER   31.04 5gr DEVwmt10 LMc-news towards-
s.evaluator.11ccf590.20120208-1554 DONE      PER   44.61 5gr DEVwmt10 LMc-news towards-
s.evaluator.11ccf590.20120208-1554 DONE      CDER  33.97 5gr DEVwmt10 LMc-news towards-
s.evaluator.11ccf590.20120208-1554 DONE      BLEU  12.28 5gr DEVwmt10 LMc-news towards-
s.evaluator.11ccf590.20120208-1554 DONE      Snts   3003 5gr DEVwmt10 LMc-news towards-
s.evaluator.29fa5679.20120207-1357 OUTDATED TER   17.66 5gr DEVwmt10 LMc-news
...                                ...       ...     ...
s.evaluator.473687bb.20120214-1509 FAILED    Snts  3003
```

- Perhaps hard to read.
- Easy to grep, sort, whatever, or **tabulate**.

# **eman tabulate** to Organize Results

The user specifies in the file **eman.tabulate**:

- which results to ignore, which to select,
- which tags contribute to col labels, e.g. **TER**, **BLEU**,
- which tags contribute to row labels, e.g. **[0-9]gr**, **towards-[A-Z]+**, **PRO**.

Eman tabulates the results, output in **eman.niceresults**:

```
                  PER   CDER  TER   BLEU
5gr towards-CDER 44.61 33.97 31.04 12.28
5gr              44.19 33.76 31.02 12.18
5gr PRO          43.91 33.87 31.49 12.09
5gr towards-PER  44.44 33.52 30.74 11.95
```

# Hacking Welcome

Eman is designed to be hacking-friendly:

- Selfcontained steps are easy to inspect:
  - all logs are there,
  - all (or most of) input files are there,
  - the main code (**eman.command**) is there,
  - often, even the binaries are there, or at least clearly identifiable.
- Step halfway failed?
  ⇒ Hack its **eman.command** and use **eman continue**.
- Seed not quite fit for your current needs?
  ⇒ Just init the step and hack **eman.seed**.
  ⇒ Or also prepare and hack **eman.command**.

Remember to **eman add-tag** *tag step* for further reference.

# Fit for Cell-Phone SSH ☺

- Experiments run long but fail often.
- You don't want to be chained to a computer.

Most eman commands have a short nickname.

- How are my last 10 merts?
  ```
  eman sel t mert l 10 --stat
  ```

Specify steps using any part of their name/hash or result:

- `s.foobar.`**a0f3**`b123.20120215-1011` failed, retry it:
  ```
  eman redo a0f3 --start
  ```
- How did I achieve this great BLEU score of 25.10?
  ```
  eman tb 25.10 --vars | less
  ```

# Related Experiment Mgmt Systems

Eman is just one of many, consider also:

- LoonyBin (Clark et al., 2010)
  - ⊖ Clickable Java tool.
  - ⊕ Support for multiple clusters and scheduler types.
- Moses EMS (Koehn, 2010)
  - Experiment Management System primarily for Moses.
  - Centered around a single experiment which consists of steps.
- Pure Makefiles

  Yes, you can easily live with fancy Makefiles.
  - You will use commands like **make init.mert** or **cp -r exp.mert.1 exp.mert.1b**
  - You need to learn to use **$***, **$@** etc.
  - You are likely to implement your own eman soon. ☺

There are also the following workflow management systems: DAGMan, Pegasus, Dryad.

# Work in Progress

- Eman is being heavily used by a rather few people.
- Eman is still evolving
    - ⇒ not everything well documented (read the source code).
    - ⇒ not everything well tested.

Halfway finished: eman teamwork!

- **eman add remote** */home/fred/playground freds-exps*
- You can re-interpret Fred's results.
- You can clone Fred's experiments.
- You can make your steps depend on Fred's steps.

# Summary

- Word order issues of PBMT, RBMT and hierarchical MT.
- Rich morphology issues in PBMT:
    - Producing target forms never seen in parallel data.
    - Evaluating MT to morphologically rich languages.
    - Model optimization.

- General motivation for experiment management.
- Introduced eman.
- Highlighted useful tricks in experimenting.
    - Experiment cloning or deriving.
    - Tabulating results.
    - ? Team experimenting.

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