Translating
from English
into Mathematics

SFWR ENG 2B03

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English and Mathematics as Languages

English is a language.

So is Mathematics.

Both have

- rules of grammar (syntax)

- semantics

When writing in any language, pay attention to grammar and semantics. Get both right.

English and Mathematics as Languages

In every language, including Mathematics,

- syntactically invalid structures have no meaning

- there are syntactically valid structures that have no meaning

When writing in mathematics,

- make sure the syntax is valid

- make sure you write what you mean

English and Mathematics: A Difference

In English and other natural languages

- ambiguity desired, intentionally possible
- unambiguous statements almost impossible

In Mathematics

- ambiguity not desired, intentionally prevented
- ambiguous statements almost impossible (even in probability theory, fuzzy logic)

Translating between Languages

Translating a statement from one language to another is not a single process.

It is a multistep process:

1. statement in source language to a mental understanding of the **meaning** of the statement

2. mental understanding of the **meaning** of the statement to a statement in the target language

The first and last statements must **mean** the same.

Example: Semantic Differences

- "Werfe Mama vom Zug einen Abschiedskuß."
- "Throw Mama from the train a kiss goodbye ."

Both are syntactically correct.

Both have meanings.

The meanings are very different.

One sentence is clearer than the other.

Example: Different Semantic Conventions

"Do you have no bananas today?"

"Yes, we have no bananas today."

"No, we have no bananas today."

Meanings?

Example: Different Semantic Conventions

"Yes, we have no bananas today."

In English, confusing or contradictory

- yes/no must agree logically with statement.

In some languages (e.g. Asian), perfectly normal

- "yes" asserts that the restatement of the question (positive or negative) is correct.

Translators

- Knowing two languages: not enough to translate

- A necessary, but not a sufficient condition.

- Also required: translating techniques, skills

A good translator knows well

- the two languages

- AND the subject being translated

- AND how to translate

These three things are **different**.

Translators

To translate from English to Mathematics, you must, therefore:

- know both English and Mathematics: grammar, semantics, vocabulary, idioms, …

- AND the subject area of the material being translated (here cards, card games and Sixty Six Up)

- AND how to translate

These three things are still **different**.

Translators

Professional translators

- translate into their native language

- *not* into their secondary languages.

To become good at translating into Mathematics

- make it your native language!

Mathematics is the language of engineering.

Organization and Style

When writing in English or any other natural language, one pays careful attention to

- organization of the essay, report, etc.

- style of expression

When writing in Mathematics, to do the same:

- clear, complete, concise — KISSS

- understandable

- interesting

Organization and Style

When writing in Mathematics

- modularize

- indent and space as in English (e.g. management and business reports)

Remember your obligation to your readers

- easily understandable

- interesting

A Small Translator's Glossary

English: Mathematics

● and, but: ∧ (and)

● or: ∨ (or)

● for all, each, every, any: ∀, ∧ (and) series, universal quantification

● for no, none: ∀, ∧ (and) series, universal quantification with a negated assertion

● there is (are), there exist(s), for some, at least one: ∃, ∨ (or) series, existential quantification

A Small Translator's Glossary

English: Mathematics

- integer: $... \in Z$

- sorted: $\wedge_{i=1}^{n-1} A(i) \leq A(i+1)$,

$$(\mathbf{A}\, i : i \in Z \wedge 1 \leq i \leq n-1 : A(i) \leq A(i+1))$$

- if (when, whenever) … then … : … $\Rightarrow$ …

- search, find, equal, present: $=$

- exchange, rearrange, different order, different sequence, merge, copy, sort: permutation

Your Translator's Glossary

A professional translator compiles his/her own translation glossary

● over time

● based on own accumulated experience

You should, too.

Modular Mathematics

We structure

- documents

- engineering artifacts and systems of all types

- software systems

- programs, etc.

modularly.

Modularize your mathematical expressions, too.

Exercise

Consider a board game with bowls, stones

Players sit around a table,
numbered from 1 to NP counterclockwise.

Each player has NB ordinary bowls in line from
left to right and one special bowl on the right.

The number of stones in each bowl is stored in
an array, index values from 0 to NP*(NB+1)-1.

Exercise

Initial state:

- 5 stones in every ordinary bowl

- every special bowl empty

Exercise: Write a mathematical expression describing the initial state of the bowls.

Solving the Exercise

- steps?

- intermediate languages?

  - which?

  - whose?

  - explicit or implicit?

- intermediate expressions?

- modularization?

Summary

- Knowledge of English and Mathematics not sufficient to translate into Mathematics

- knowledge of subject area needed

- translating skills needed

The three are different.

Summary

- Compile your own glossary
- Make intermediate steps, expressions, languages conscious
- Modularize
- Organize systematically
- KISSS

References

See list of references in course outline

especially chapter 6 in

Error Free Software: Know-How and Know-Why of Program Correctness

and

Translating English to Mathematics