You, human

Having got us thinking like robots in his previous article, Michael Farrell explains the solutions – and the thinking behind them

In the article 'I, robot' in the May-June *Bulletin*, I left you with two puzzles and a provocative question ('Do these puzzles demonstrate that, given enough examples…, it is always possible to translate accurately between two languages that you do not know without understanding the meaning of the sentence you need to translate?'). The idea behind the puzzles was to get you thinking like machines, and the purpose of the provocative question was, well, to provoke.

However, before I give you the answers to the puzzles, I'd like to briefly mention the organiser of the first International Conference on Mechanical Translation. Yehoshua Bar-Hillel was one of the first people to go so far as to say that since machines do not have access to real-world knowledge, they will never be able to translate like humans. In an appendix to a report he published in 1960, he gave a demonstration of the non-feasibility of fully automatic high-quality translation (FAHQT). The example he used was: 'Little John was looking for his toy box. Finally, he found it. The box was in the pen. John was very happy.'

The word 'pen' in this example does not mean a writing instrument but a child's playpen. Bar-Hillel argued that 'no existing or imaginable program will enable an electronic computer to determine that the word pen in the given sentence within the given context has the second of the above meanings, whereas every reader with a sufficient knowledge of English will do this automatically'. To disambiguate the meaning of the word 'pen', according to Bar-Hillel's reasoning, you need to infer the consequences of the relative sizes of boxes, writing pens and playpens – something that machines cannot do. Indeed, if you ask GPT-4 to translate this example into Italian today, 'pen' is translated as 'penna', the writing tool.

However, if you ask Google Translate or DeepL Translator to do the same thing, the picture is not so rosy for human translators. They both translate the English word as 'recinto', which means pen as in a sheep pen. So have computers acquired dimensional awareness? Was Bar-Hillel wrong?

The answer to both questions is no; and the puzzles I've set should help show you why. Bar-Hillel's test wording is in fact ambiguous even for a human translator. Who tells us that little John doesn't live on a farm and doesn't find his toy box in a sheep pen? Especially since playpens are much less in use now than when Bar-Hillel devised the original test. In fact, two well-known machine translation (MT) engines today come up with dimensionally plausible translations.

Answering the puzzles set in the previous issue

Now, let's look at our puzzles. They were of course deliberately simplified. We do not have the number-crunching capacity of computers or the patience to calculate the values of vector elements. Our task was to identify blocks of words (n-grams in natural-language-processing parlance) and notice how they are put together. In some ways, what we did was more similar to pre-neural MT (phrase-based statistical MT) than to today's systems, where words may be broken down into smaller parts (subwords). However, the principle that a word or subword's meaning (or vector representation) is dependent on the other words or subwords surrounding it applies both to our puzzles and to the latest technology.

I'll start by giving you the answer to the second puzzle, which most people would assume was more difficult but still generally get right:

Zzs zzr zzq zzv zzu zzt.

The trick is to observe, as Firth put it, the *company each word keeps* (see 'I, robot' article). Here is the reasoning:

Alphaese source	Zetaese target
Aab aac aad aae aaf aab aag.	*Zzy zzx zzw zzv zzu zzt.*
Aab aac aah aae aai.	*Zzs zzr zzq zzv zyz.*

Therefore:

Alphaese source (the problem)	Zetaese target (the solution)
Aab aac aah aae aaf aab aag.	*Zzs zzr zzq zzv zzu zzt.*

The solution becomes even more apparent when it is revealed that Alphaese is in reality English written in code, and Zetaese is Italian. Don't panic. We are talking about basic, lesson-one-level Italian.

Alphaese source	Zetaese target
Aab aac aad aae aaf aab aag. *The red pen is on the table.*	*Zzy zzx zzw zzv zzu zzt.* *La penna rossa è sul tavolo.*
Aab aac aah aae aai. *The red book is good.*	*Zzs zzr zzq zzv zyz.* *Il libro rosso è buono.*
Aab aac aah aae aaf aab aag. *The red book is on the table.*	*Zzs zzr zzq zzv zzu zzt.* *Il libro rosso è sul tavolo.*

In light of this puzzle, we might be forgiven for thinking that it is possible to translate without being able to speak either the source or the target language and without even understanding the sentence we have to translate, which is in reality what computers do. However, we are immediately put right by the other puzzle, which most people initially think is easier.

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Generative artificial intelligence is not an information retrieval system

The correct answer – which no one has ever come up with so far – is this:

'Bbl Bbm Bbn bce Bcd' bbe bbf bbg bbh.

How can this be? Some of those Betaese words are not even in the examples. Well, it was a trick question, of course.

The erroneous – but totally logical – reasoning that virtually everyone follows is the following:

Upilonese source	Betaese target
'Yyx yyw yyv' yyu yyt yys yyr yyq.	*'Bbc Bbd' bbe bbf bbg bbh.*
Yyp Yxy yxx yxw yxv yxu 'Yxt yxs Yxr'.	*Bbi Bbj bbk bcb bcc 'Bcd bce Bcf'.*

Therefore:

Upilonese source (the problem)	Betaese target (the *wrong* solution)
'Yxt yxs Yxr' yyu yyt yys yyr yyq	*~~'Bcd bce Bcf' bbe bbf bbg bbh.~~*

Again, the reason this answer is wrong becomes apparent when you find out that Betaese is English written in code, and Upsilonese is Italian.

Upsilonese source	Betaese target
'Yyx yyw yyv' yyu yyt yys yyr yyq. *'Roba che scotta' è un film del 1979.*	*'Bbc Bbd' bbe bbf bbg bbh.* *'Hot Stuff' is a 1979 film.*
Yyp Yxy yxx yxw yxv yxu 'Yxt yxs Yxr'. *Michael Palin propendeva per il titolo 'Brian di Nazareth'.*	*Bbi Bbj bbk bcb bcc 'Bcd bce Bcf'.* *Michael Palin preferred the title 'Brian of Nazareth'.*
'Yxt yxs Yxr' yyu yyt yys yyr yyq. *'Brian di Nazareth' è un film del 1979.*	*~~'Bcd bce Bcf' bbe bbf bbg bbh.~~* *~~'Brian of Nazareth' is a 1979 film.~~*

What did AI ever do for us?

The correct solution to the puzzle is *'Monty Python's Life of Brian' is a 1979 film* (or in Betaese, *'Bbl Bbm Bbn bce Bcd' bbe bbf bbg bbh*, as we saw before).

So what went wrong? It's very simple. When the film was released in Italy, the Italian distributor chose the original title Michael Palin had proposed: 'Brian of Nazareth'.

But isn't that cheating? No. It's Bar-Hillel's real-world knowledge at work. There is a useful distinction in linguistics between co-text and context. Co-text refers to the linguistic elements that surround a particular word, phrase or passage in a text. Context adds in the situational, cultural and social factors that influence the interpretation of language. Machines can only see co-text. Humans have full access to context. Any half-decent human translator knows that translating the titles of films, TV shows and novels is a minefield. We would immediately double-check any literal translation in all these cases. IMDb even used to define the foreign titles of films as *also-known-as* titles and not translations at all.

Importantly, AI wouldn't get the answers even if the real English title were in the training data (in this case the examples you were given for the puzzle). Any automatic alignment software worth its salt would almost certainly flag *'Monty Python's Life of Brian = Brian di Nazareth'* as suspect and reject it. And even if it somehow got into the training corpus, it would most likely be drowned in a sea of (im)probability and stand virtually no chance of being fished out by the algorithm. Indeed, to date, neither DeepL Translator nor Google Translate have managed to come up with the right translation.

What about generative artificial intelligence (GenAI)? Well, GenAI's training data is not aligned. It can't be. The majority of the data is in English (93 per cent by word count in GPT-3), and all languages are thrown in together higgledy-piggledy. However, what if the large language models (LLMs) which GenAI systems are based on were made truly enormous? Would that compensate for the computer's inability to access context in its wider meaning?

Well, GenAI is not an information retrieval system. It can give reasonable replies when the questions are quite common, but it is capable of making things up when things get tough, rather than owning up to not knowing the answers. In my opinion, this is actually one of the most human-like aspects of its behaviour. But what humans also do – as Bar-Hillel argued back in 1960 – is *not just remember*. We also know *additional* facts because we can work them out by inference. And if he is right, no LLM will ever be large enough. Which means there is still a place for the human in the loop.

This argument may not convince you, but I have tried several times: GPT-4 does not translate *'Brian di Nazareth* è un film del 1979' into English correctly.

The biggest threat to translators from AI today is not what it can currently do but what our clients think it can do. If we want to hold onto our jobs, we've got to explain that the existing technology cannot totally replace humans and that Bar-Hillel is still right – unless we want to allow AI to rewrite history and start renaming Monty Python classics.

Michael Farrell is primarily a freelance translator and transcreator. Over the years he has acquired experience in the cultural tourism field and in transcreating advertising copy and press releases, chiefly for the promotion of technology products. Being a keen amateur cook, he has also translated texts on Italian cuisine. In addition, he is an untenured lecturer in post-editing, machine translation and computer tools for translators at IULM University, Milan, Italy; the developer of the terminology search tool IntelliWebSearch; a qualified member of the Italian Association of Translators and Interpreters (AITI); and a member of the Council of Mediterranean Editors and Translators (MET).

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