

# Exercise 1

sumsum , a competitor of appy , developed some nice smart phone technology called galactica-s3 , all of which was stolen by stevey , who is a boss of appy . It is unethical for a boss to steal business from rival companies. A competitor of is a rival. Smart phone technology is business.

## 1. Translation of natural language to First Order Logic (FOL)

sumsum , a competitor of appy

A competitor of is a rival.

This statement implies that both sumsum and appy are companies within the same industry. The following logical deduction can be made, with the assumption that not all companies are competitors to each other.

$$\exists_x \exists_y \text{ Company}(x) \wedge \text{ Company}(y) \rightarrow \text{ Competitor}(x, y)$$

Furthermore, since competitors are rivals with each other, we can deduce the following equivariance relation.

$$\exists_x \exists_y \text{ Competitor}(x, y) \iff \text{ Rival}(x, y)$$

...developed some nice smart phone technology called galactica-s3 ...

A company can develop smart phone technology, but not all the smart phone technology used by the company is developed from the same company.

$$\exists_x \exists_t \text{ Company}(x) \wedge \text{ SmartPhoneTechnology}(t) \rightarrow \text{ Develop}(x, t)$$

Smart phone technology is business.

We can further deduce a logical statement that all smart phone technology is business.

$$\forall_t \text{ SmartPhoneTechnology}(t) \rightarrow \text{ Business}(t)$$

...all of which was stolen by stevey ...

We can infer that stevey is a person. This suggests that a person can steal technology.

$$\exists_t \exists_h \text{ SmartPhoneTechnology}(t) \wedge \text{ Person}(h) \rightarrow \text{ Steals}(h, t)$$

... stevey , who is a boss of appy .

From the earlier deduction that stevey is a person, this informs us that the boss of appy (a company) is a person. Thus, for every company, there is a person as its boss.

$$\forall_x \text{Company}(x) \rightarrow (\exists_h \text{Person}(h) \rightarrow \text{Boss}(x, h))$$

It is unethical for a boss to steal business from rival companies.

A boss is a person, who is the boss of a company. This statement suggests that it is only unethical if the two companies involved are rivals.

We can break this statement down into smaller logical statements to follow. Statements (2) and (3) are transitive, as the boss is a person, and a person can steal technology.

1. There are two companies that are rivals.
2. The boss of one of these companies is a person.
3. The boss can steal business from rival companies.
4. Stealing business from rival companies is always unethical.

Therefore these statements can be expressed in natural language -- there are two companies which are rivals, where the boss of one company steals business from the rival company; this is unethical.

$$\exists_x \exists_y \exists_t \exists_h \text{Boss}(x, h) \wedge \text{Rival}(x, y) \wedge \text{Steals}(h, t) \wedge \text{Develop}(y, t) \rightarrow \neg \text{ethical}$$