



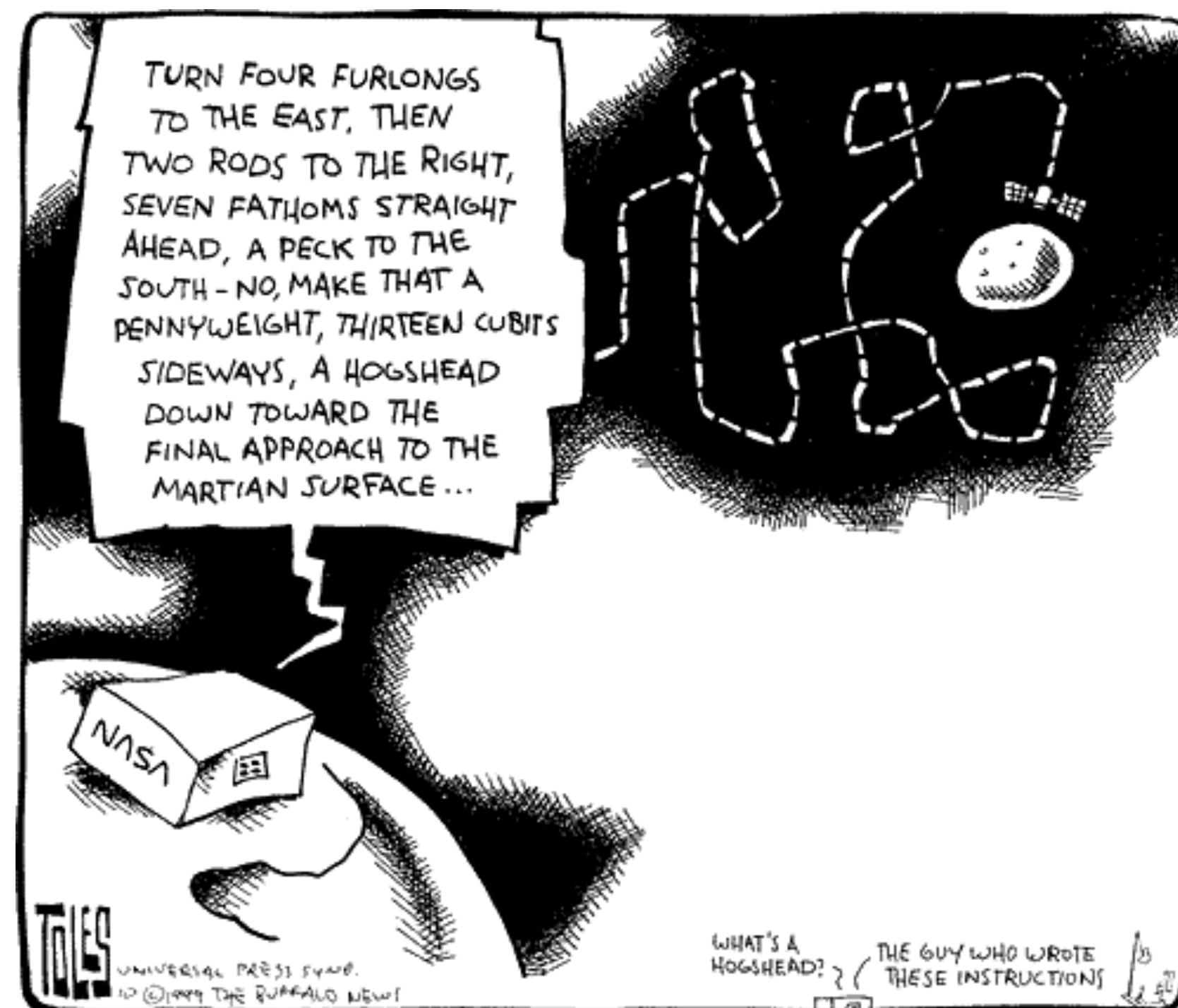
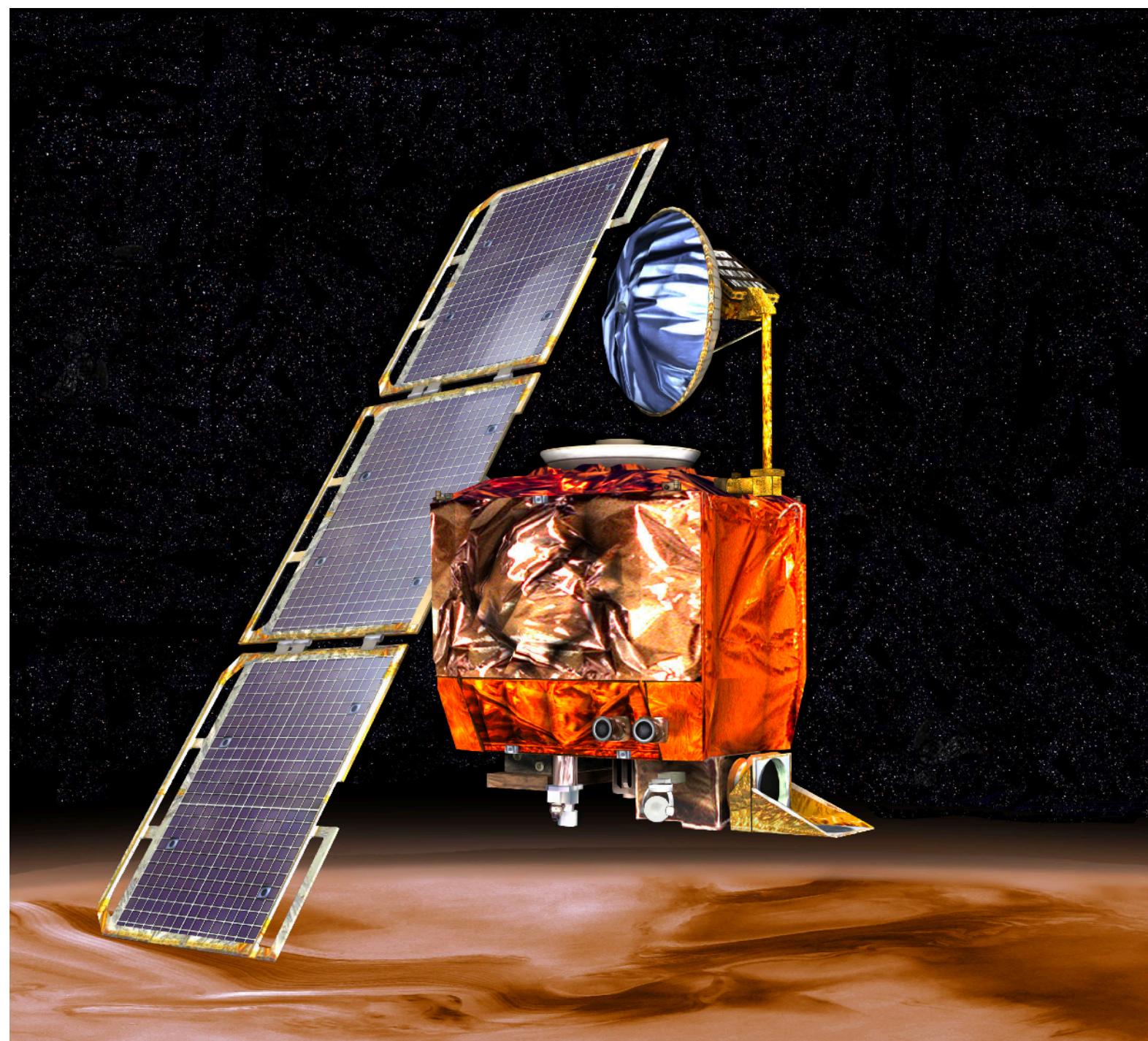
Things that don't matter

- Conventions matter in engineering
- They matter not in category theory



In engineering, conventions matters

- ▶ Disasters happen when there are **mismatching conventions**.
- ▶ In 1999, the Mars Climate Orbiter was lost because NASA used metric units, while contractor Lockheed Martin used imperial units.



10/4/99



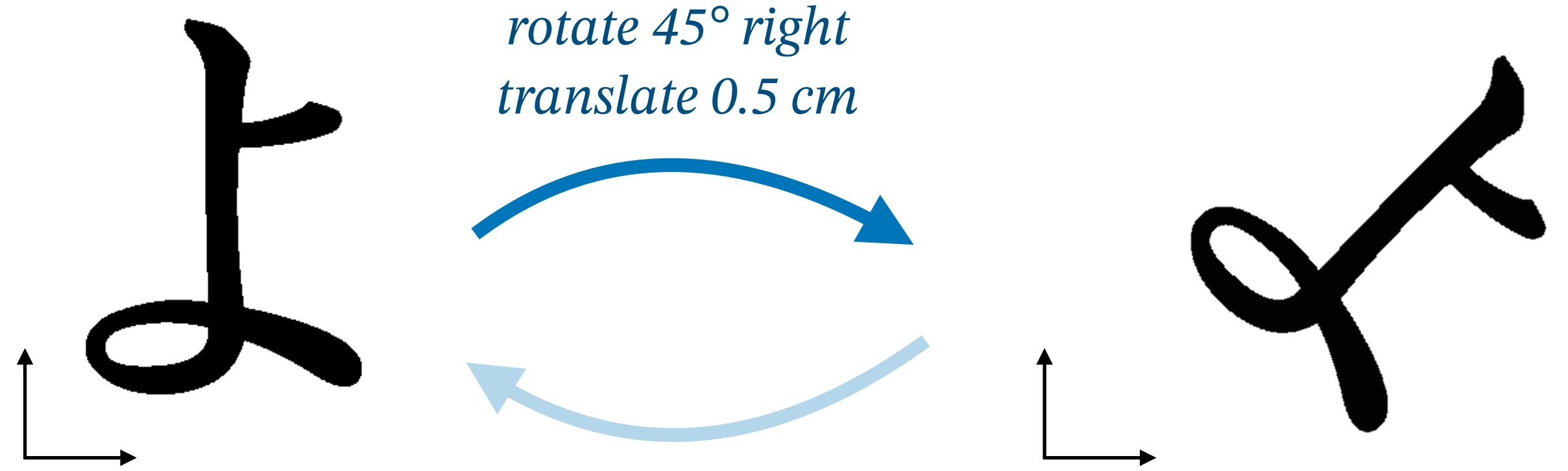
In category theory, substance matters

- ▶ We study what is true **independently of conventions**.
- ▶ We will see a concept called *isomorphism* that formalizes this technically.
- ▶ We give an intuitive explanation.



Isomorphisms in geometry

- Remember the concept of **isomorphism** in 2D geometry.



- Properties **not preserved**: barycenter
- Properties **preserved**: area, perimeter.

iso- equal
morphe shape

- There are some properties of the drawing that we can discuss that are **independent of where the symbol is located and oriented** (our “convention”).
- There is an **invertible transformation** between conventions.



Examples of invertible transformations

- If you take an algebra book and convert the numerals, truth and falsity are preserved.

♦ ۰ ۱ ۲ ۳ ۴ ۵ ۶ ۷ ۸ ۹

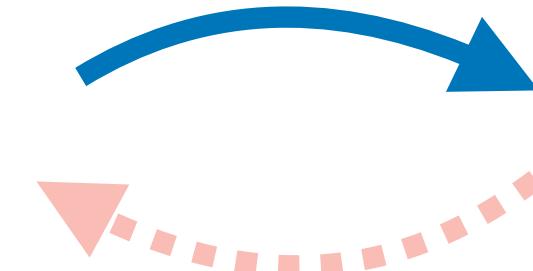
- ▶ If you **change the font family or size**, the meaning is preserved.
 - ▶ If you **translate it to a different language**, the meaning is preserved.



Counterexamples

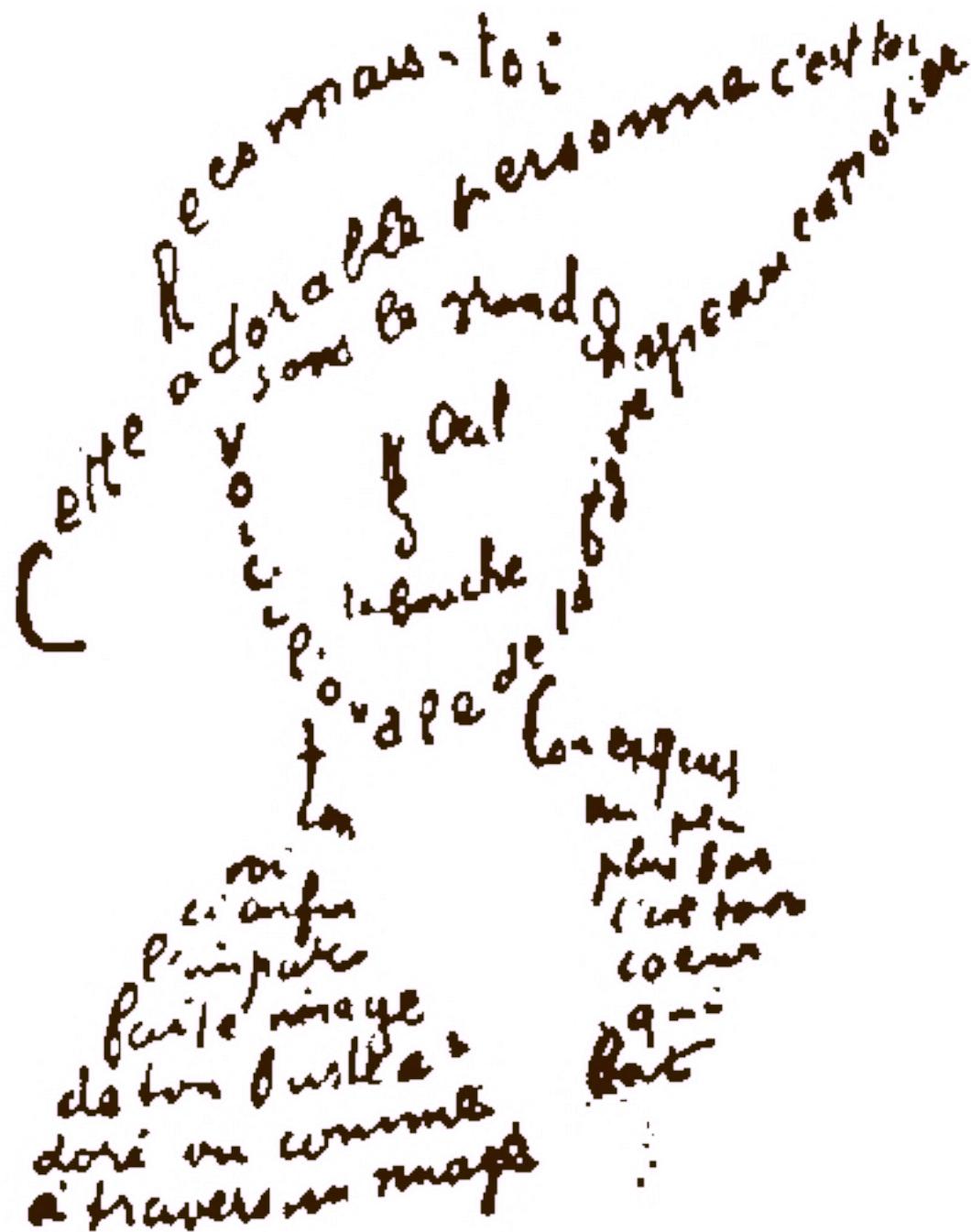
- Non-technical text typically loses some meaning when translated.

VENI VIDI VICI

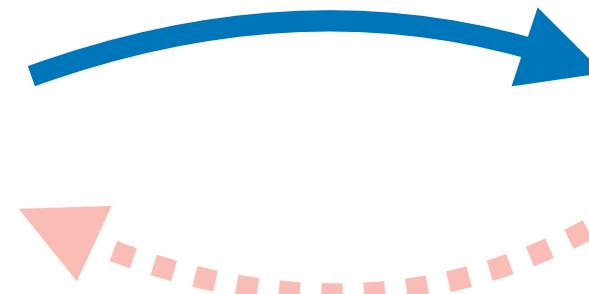


I came; I saw; I conquered.

- Sometimes meaning is in the typography itself.



Cette adorable personne c'est toi
Reconnais-toi
Sous le grand chapeau canotier
Oeil
Nez
La bouche
Voici l'ovale de ta figure
Ton cou exquis
Voici enfin l'imparfaite image de ton buste adoré
vu comme à travers un nuage
Un peu plus bas c'est ton coeur qui bat



Reconnais-toi
Cette adorable personne c'est toi
Sous le grand chapeau canotier
Oeil
Nez
La bouche
Voici l'ovale de ta figure
Ton cou exquis
Voici enfin l'imparfaite image de ton buste adoré
vu comme à travers un nuage
Un peu plus bas c'est ton coeur qui bat



Convention for representing composition

- Two different notations for composition:

$$f ; g$$

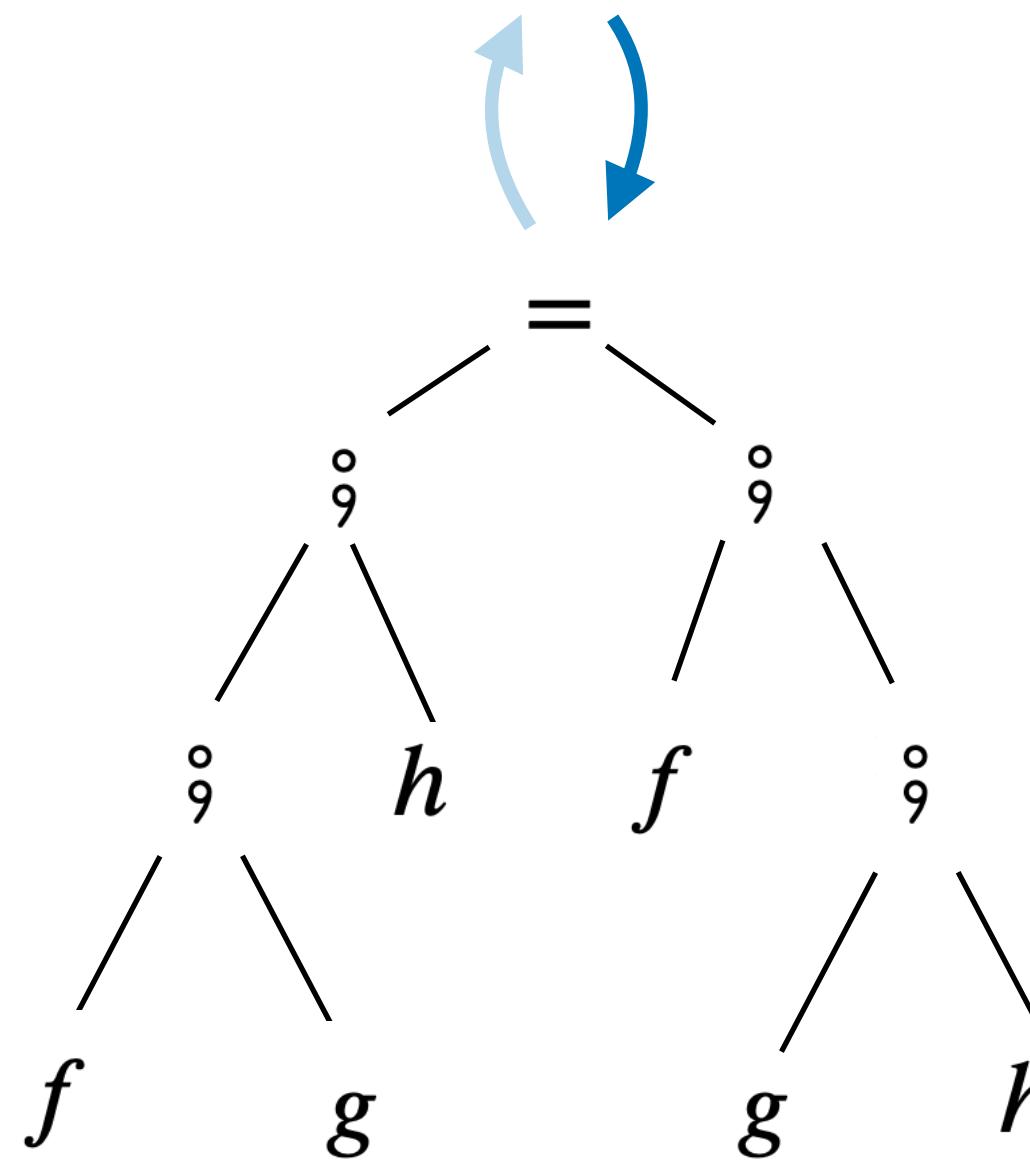
“*f then g*”

$$g \circ f$$

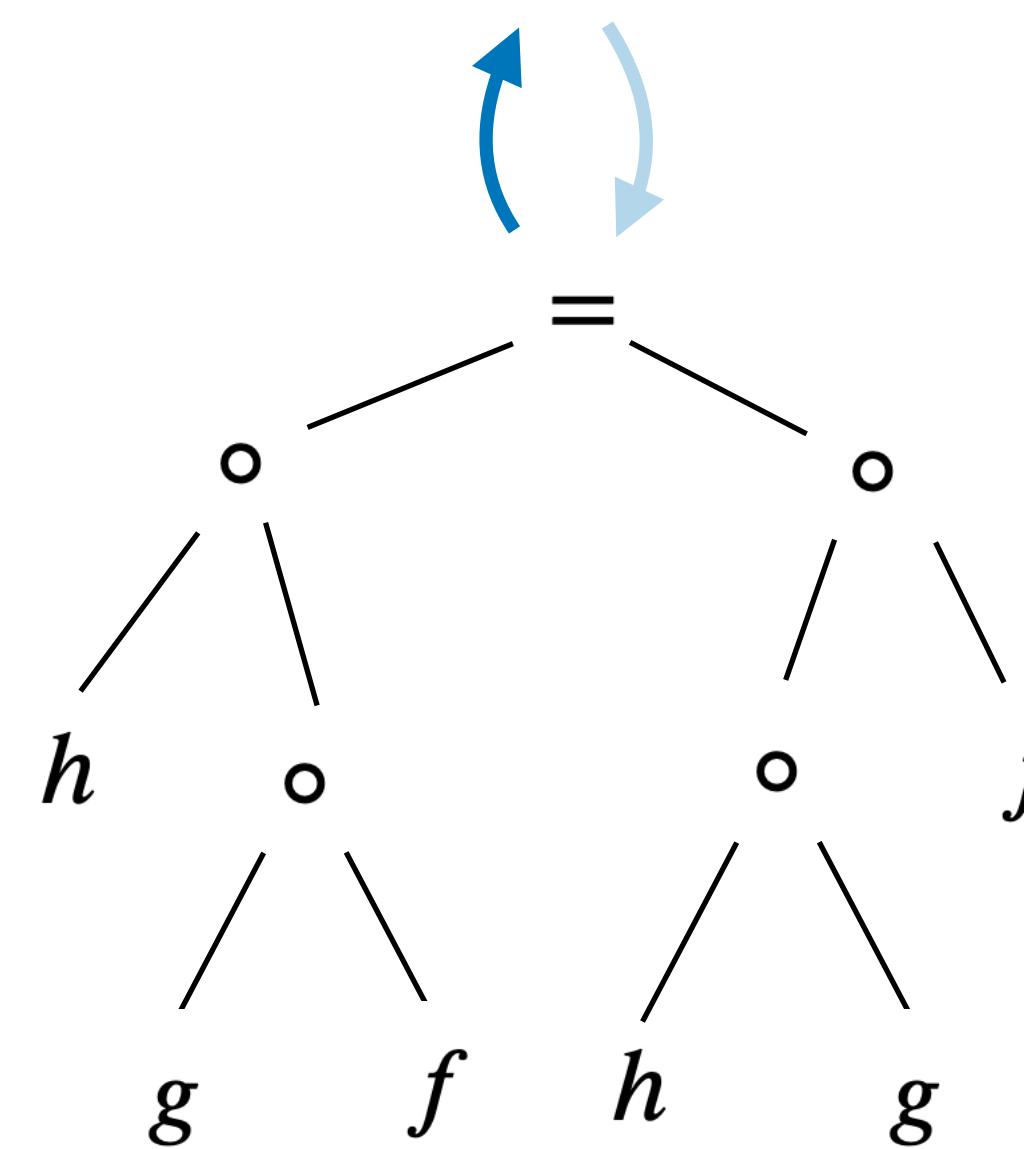
“*g after f*”

- They are **isomorphic** in the sense that we can transform back and forth:

$$(f ; g) ; h = f ; (g ; h)$$



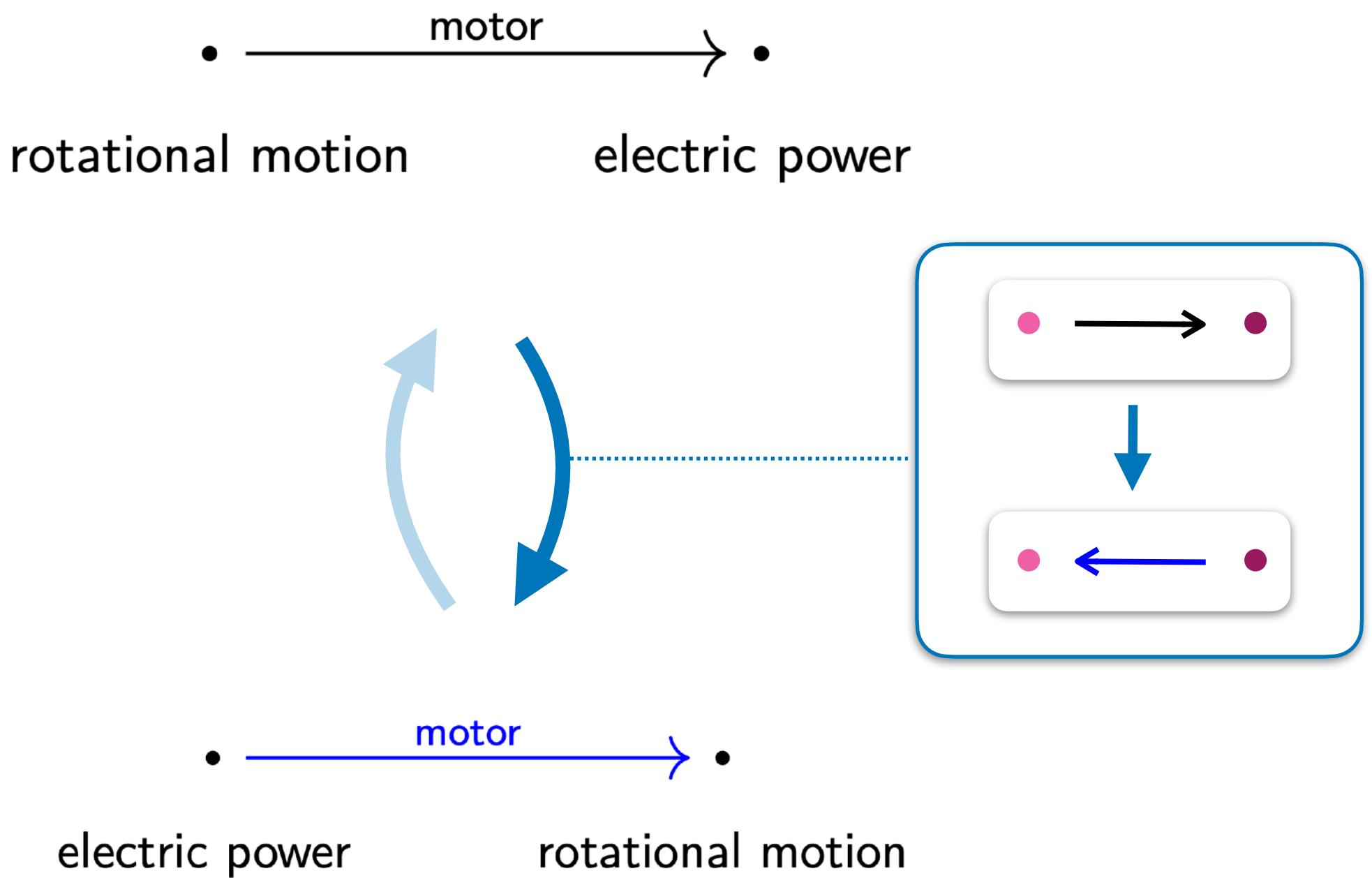
$$h \circ (g \circ f) = (h \circ g) \circ f$$



Direction of the arrows

“The **motor** can produce **rotational motion** given **electric power**”

motor : rotational motion → electric power

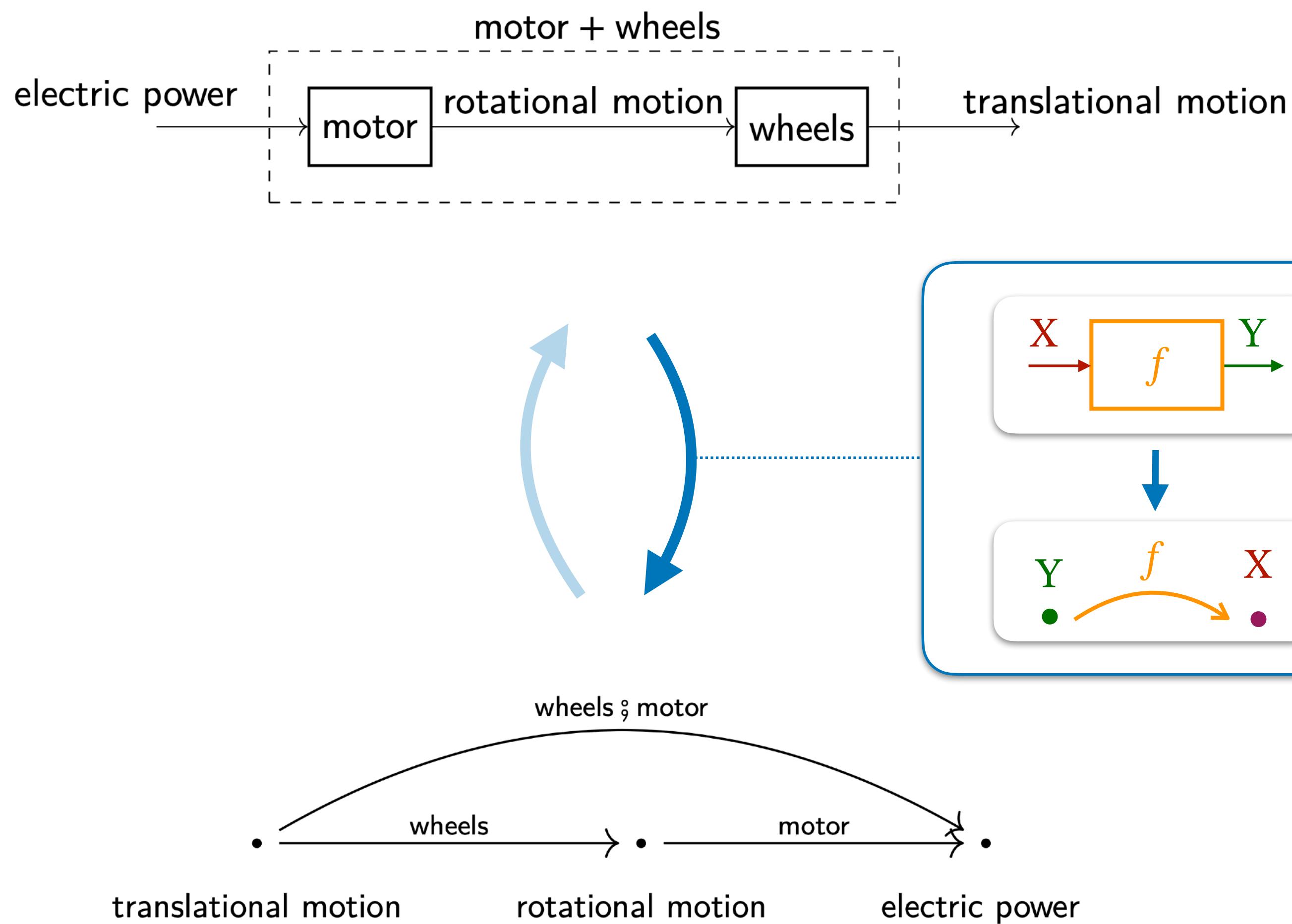


motor : electric power → rotational motion

“The **motor** consumes **electric power** to produce **rotational motion**.”



Are these diagrams isomorphic?



These diagrams have different semantics

