

# When and Where Conceptual Maths Equals to Conceptual Modeling: Reasons for Using in Cognitive Modeling. *Viacheslav Wolfengagen\*1, Larisa Ismailova\*1, Sergey Kosikov\*2* (*jir.vew@gmail.com*).

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## SUMMARY

The means and constructions of conceptual mathematics that are most closely related to conceptual modeling are selected. This selection is made in full accordance with the doctrine of computational thinking.

## INTRODUCTION

An example of a construction representing the processability of individuals and concepts is given.

It is shown that functors and natural transformations can serve as a basis for the subsequent construction of non-standard conceptual modeling based on variable domains.

On the basis of conceptual mathematics, a conceptual framework of cognitive modeling has been laid, which allows taking into account the stages of knowledge and the transitions between them. It turns out that using conceptual mathematics, one can express cognitive maps.

Category theory alone does not solve difficult problems in topology or algebra. It clears out a confusing set of individually trivial problems. This puts difficult problems in clear garb and makes their solution possible..

## APPROACH

What is the role and place given to cognitive modeling?

The defended thesis is that computational thinking is considered as one of the skills in solving problems of cognitive modeling, and quite useful.

The functor category turns out to be quite representative, functors are associated with 'stages of knowledge', natural transformations model transitions between states. The presence of stages of knowledge is characteristic of the whole variety of cognitive models.

## METHODS

**Decomposition:** 1) Individual objects are distinguished, which are subdivided into actual, possible and virtual. 2) Are established relationships between individuals, and these relationships are named. In the **recognition** phase, we collect the individuals in the aggregate – into Lawvere's variable domains.

At the **abstraction** phase, a representation is chosen to be the functorial category.

At the **algorithmization** phase, it remains to arrange one or another model of information processes, which are the 'legitimate representatives' of individuals and individual concepts.

## RESULTS

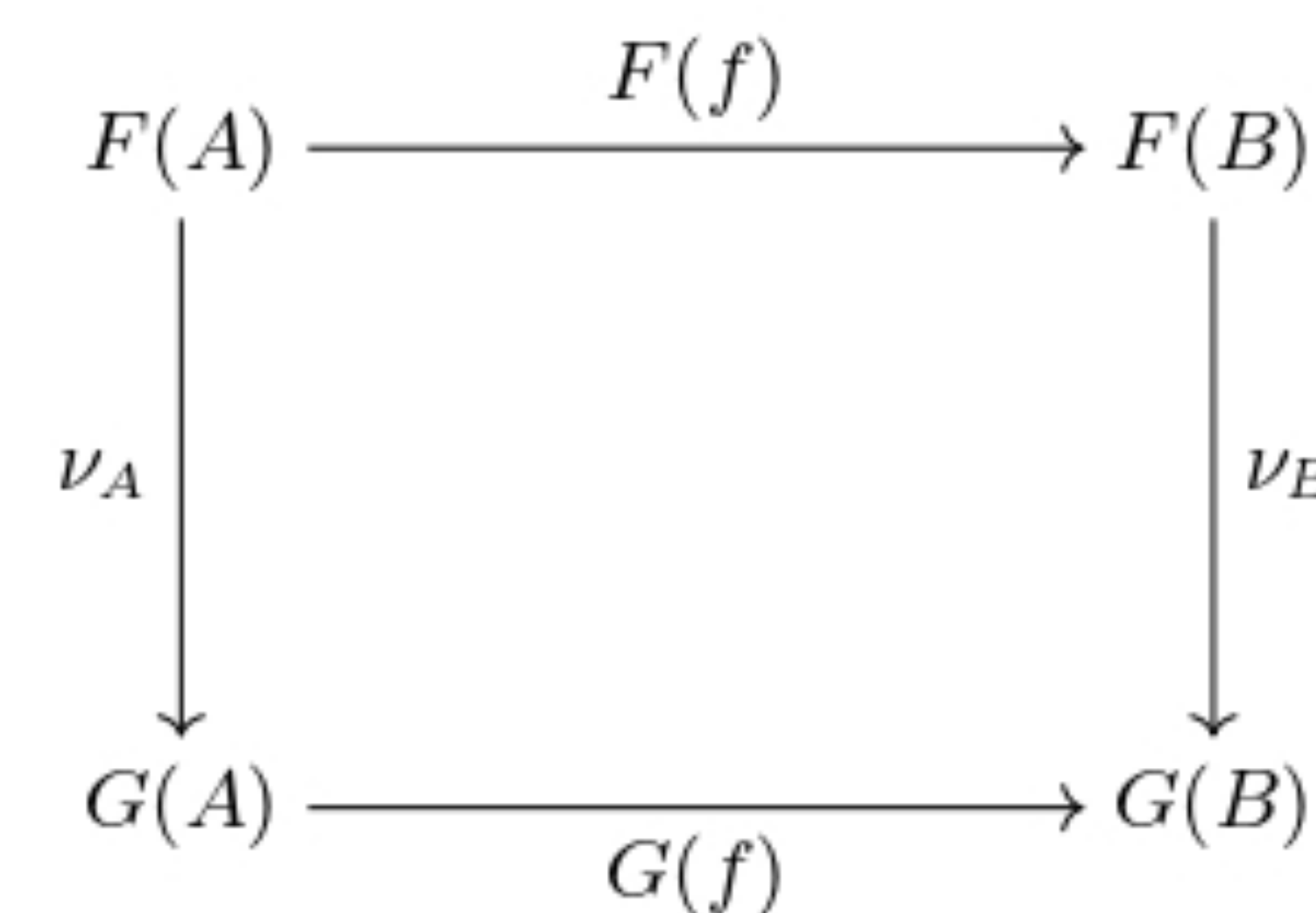


Fig. 1. Commutative diagram for natural transformations

## ANALYSIS

Category theory is used in various branches of mathematics, both to unify some of the 'natural' definitions and to the tools it can help develop. Its origins lie in the algebraic topology of the mid-20s, but in less than a century since its development, the subject has become widespread. In particular, category means are used in homological and cohomological algebra, algebraic geometry, and algebraic topology. They appear as knot invariants, abstract vector spaces, and more. They also used outside of pure mathematics: in mathematical physics, biology, and (especially) computer science, where categories provide a useful language for functional programming. or, in other terminology, mappings.

## DISCUSSION

The means and constructions of conceptual mathematics that are most closely related to conceptual modeling are selected.

This selection is made in full accordance with the doctrine of computational thinking. An example of a construction representing the processability of individuals and concepts is given.

– It is shown that functors and natural transformations can serve as a basis for the subsequent construction of non-standard conceptual modeling based on variable domains.

## CONCLUSIONS

1. On the basis of conceptual mathematics, the conceptual framework of cognitive modeling is laid, which allows taking into account the stages of knowledge and the transitions between them. It turns out that using conceptual mathematics it is possible to express cognitive maps, but a more detailed example is left for the future.

2. It seems possible to build a property change model. This is left for the future,

## ACKNOWLEDGMENTS