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A reasoning system with a diagram for intuitionistic logic

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Human beings often use a diagram for problem solving. It is because diagrams bring us some advantages. For example, under the favor of diagram, complex situations become easy and implicit information become clear. The consideration for a diagram role in reasoning or problem solution is interesting for proving a mental work and it is very important for system implementation with good interface.

The approaches to description of a logical system with a diagram has long been studied since early times. For example, there are Venn diagram, Euler diagram and Pierce diagram. But many mathematicians and logicians have looked askance at problem solvings and proofs that make use of a diagram. Because they looked upon diagrams as imprecise and ambiguity description. Therefore diagram was used for just as heuristic and pedagogic tools.

Though recently, there are works for description of logical system with diagrams and reasoning with it. In these works rigorous define for diagram is attached a high value. However most study aim at classical logic. The study for Non-classical logic like intuitionistic logic with a diagram is not enough done.

Intuitionistic logic has a strong connection to computer science, though its correspondence with constructive programming. Though intuitionistic logic is not so widely accepted in practice. One reason is the difficulty of the semantics of the logic. We hope a good diagram which represent intuitionistic logic easily and clearly. There is a diagram represents a kripke semantics of intuitionistic logic named Hasse diagram. This diagram is good for the representation of reachability relations between possible worlds, however, this diagram does not represent assignments in possible worlds adequately. In intuitionistic logic, internal state of possible worlds are differ accordingly its location, even if its assignments are same. With the result that we cannot reason the assignment of formula in the possible worlds or Kripke model.

In the present thesis, we show a betterment and extension of Hasse diagram intended for intuitionistic propositional logic. We propose a diagram which can represent information of Kripke model more clearly than Hasse diagram, bring through understanding for learners.

We proposed two diagram for this purpose. One is 3D-Hasse diagram. This diagram can represent relations of assignments between possible worlds explicitly. And in this diagram assignments in the possible worlds are represented as lines. We can use this lines as diagram operation without a hitch for reasoning operation of formula. Though this diagram has a problem. If there are so many formula in this diagram, this diagram become very complex. In this case it becomes very hard to check it out the assignments of the formulas in the possible worlds.

Second diagram solves this problem. We propose a diagram which is combined Venn diagram and Hasse diagram named I-Venn+Hasse diagram. Usually Venn diagram is used for classical logic. So its basic philosophy is principle of bivalence. But in intuitionistic logic, principle of bivalence is not adopted. It is necessary to expand Venn diagram for intuitionistic logic We call this diagram as I-Venn diagram(Intuitionistic Venn diagram). I-Venn diagram represents possible world for intuitionistic logic. We combine this I-Venn diagram and Hasse diagram which is good for represent reachability relations. this diagram called I-Venn+Hasse diagram. This diagram can represent the Kripke models totally. I-Venn diagram can represent a lot of assignment of propositions and formulas in the possible worlds same time with simple description. Therefore I-Venn+Hasse diagram can describe formula easily viewably, even if its formula is complex. But I-Venn+Hasse diagram has a problem, too. Its problem is that I-Venn+Diagram cannot describe Kripke model with over fore propositions. If we tried the description of fore propositions, we should use 3D representation.

We construct a system which represents Kripke model of intuitionistic logic based I-Venn+Hasse diagram. In this system, input data are Kripke model and formula described text data, and output data are Hasse diagram and I-Venn+Hasse diagram which adapt to Kripke model. So we can see the difference of Hasse diagram and I-Venn+Hasse diagram. In the one of output of this system, that is Hasse diagram, the information for the possible worlds are only assignment of proposition and physical relationship. But in the output of I-Venn+Hasse diagram internal states of the possible worlds are represented. Therefore we can know viewably why formula which entered consist or not in the possible worlds.