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Thus the difference between the two definitions of real numbers can be thought of as the difference in the interpretation of the statement "for all Different versions of constructivism diverge on this point. Constructions can be defined as broadly as free choice sequences , which is the intuitionistic view, or as narrowly as algorithms or more technically, the computable functions , or even left unspecified. If, for instance, the algorithmic view is taken, then the reals as constructed here are essentially what classically would be called the computable numbers. Cardinality[edit] To take the algorithmic interpretation above would seem at odds with classical notions of cardinality. By enumerating algorithms, we can show classically that the computable numbers are countable. Furthermore, the diagonal argument seems perfectly constructive. To identify the real numbers with the computable numbers would then be a contradiction. We can indeed enumerate algorithms to construct a function T, about which we initially assume that it is a function from the natural numbers onto the reals. But, to each algorithm, there may or may not correspond a real number, as the algorithm may fail to satisfy the constraints, or even be non-terminating T is a partial function , so this fails to produce the required bijection. Still, one might expect that since T is a partial function from the natural numbers onto the real numbers, that therefore the real numbers are no more than countable. And, since every natural number can be trivially represented as a real number, therefore the real numbers are no less than countable. They are, therefore exactly countable. However this reasoning is not constructive, as it still does not construct the required bijection. The classical theorem proving the existence of a bijection in such circumstances, namely the Cantorâ€"Bernsteinâ€"Schroeder theorem , is non-constructive and no constructive proof of it is known. Axiom of choice[edit] The status of the axiom of choice in constructive mathematics is complicated by the different approaches of different constructivist programs. One trivial meaning of "constructive", used informally by mathematicians, is "provable in ZF set theory without the axiom of choice. In intuitionistic theories of type theory especially higher-type arithmetic , many forms of the axiom of choice are permitted. For example, the axiom AC11 can be paraphrased to say that for any relation R on the set of real numbers, if you have proved that for each real number x there is a real number y such that R x,y holds, then there is actually a function F such that R x,F x holds for all real numbers. Similar choice principles are accepted for all finite types. The motivation for accepting these seemingly nonconstructive principles is the intuitionistic understanding of the proof that "for each real number x there is a real number y such that R x,y holds". According to the BHK interpretation , this proof itself is essentially the function F that is desired. The choice principles that intuitionists accept do not imply the law of the excluded middle. However, in certain axiom systems for constructive set theory, the axiom of choice does imply the law of the excluded middle in the presence of other axioms , as shown by the Diaconescu-Goodman-Myhill theorem. Measure theory[edit] Classical measure theory is fundamentally non-constructive, since the classical definition of Lebesgue measure does not describe any way to compute the measure of a set or the integral of a function. In fact, if one thinks of a function just as a rule that "inputs a real number and outputs a real number" then there cannot be any algorithm to compute the integral of a function, since any algorithm would only be able to call finitely many values of the function at a time, and finitely many values are not enough to compute the integral to any nontrivial accuracy. For example, this approach can be used to construct a real number that is normal to every base. The place of constructivism in mathematics[edit] Traditionally, some mathematicians have been suspicious, if not antagonistic, towards mathematical constructivism, largely because of limitations they believed it to pose for constructive analysis. These views were forcefully expressed by David Hilbert in , when he wrote in.

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This book, Foundations of Constructive Analysis, founded the field of constructive analysis because it proved most of the important theorems in real analysis by constructive methods. The author, Errett Albert Bishop, born July 10, , was an American mathematician known for his work on analysis.

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