# Event-B

Event-B uses predicate logic with the following features:

* Predicates and expressions are distinguished.
* All expressions have a data type, e.g. integer or set of integers.
* Quantification over variables, not predicates, is supported. This includes quantification over sets.
* A partial function semantics is included, e.g. the predicate 1 ÷0 = 1÷0  is not a tautology because 1 ÷0 does not represent a valid value.
* Comprehension sets are supported.
* Predicates can be evaluated to a Boolean value.

## Know-how:

* Trouble with formal model for system: It can be daunting and unclear especially for beginners to recognize ***where to start with the model***, ***what kind of data structures*** and ***abstractions to use***, and so on.

## What is Predicate logic:

* + **It is also called First-Order Logic, First-order predicate calculus.**
    - **For logic admitting predicate or function variables => High-order logic**
      * **High-order logic: predicate and function are used as argument.**
      * predicates are often associated with sets
      * In interpreted higher-order theories, predicates may be interpreted as sets of sets.
    - **Use quantifier & relations in sentence of variable -> {true, false}**
      * **Propositional logic doesn’t use quantifier & relation.**
  + **Propositional calculus** is a formal system. It contains **propositions** that can either be false or true. Those propositions can be combined (∧,∨,⇒,⇔,¬∧,∨,⇒,⇔,¬ and more, but all others can be represented by those logical connectives).
  + A **predicate** is a function p:X→{true,false}, where X is any set.
  + A **predicate logic** is a formal system that uses variables and quantifiers (∀, ∃, ∃!) to formulate propositions.

# Misc:

* Sound: all provable statements are true in all models
* Complete: all statements which are true in all models are provable
* No first-order theory, however, has the strength to uniquely describe a structure with an infinite domain, such as the [natural numbers](https://en.wikipedia.org/wiki/Natural_number) or the [real line](https://en.wikipedia.org/wiki/Real_line).
* Axioms systems that do fully describe these two structures (that is, [categorical](https://en.wikipedia.org/wiki/Categorical_theory) axiom systems) can be obtained in stronger logics such as [second-order logic](https://en.wikipedia.org/wiki/Second-order_logic).
* Propositional logic -> First-order logic -> second-order logic -> high-order logic.
  + Propositional logic: statement of variable is true or false
  + First-order logic: statement of variable with quantifier, relation is true or false
  + Second-order logic: statement of variable, relation with quantifier, relation is true for false.
    - Second-order logic also includes quantification over sets, functions, other variables and ***relations***.
    - For example: ∀P∀x(x∈P, x∉P)
  + High-order logic: statement of variable, statement is true or false

## Support link:

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|  | <https://www.benricho.org/symbol/kigou_09.html> |
|  | <https://www.benricho.org/> |
| Up to date list of Rodin’s plug-in | <http://wiki.event-b.org/index.php/Rodin_Plug-ins> |
| Traceability between Event-B formal model and textual requirement | <http://wiki.event-b.org/index.php/ProR>  <http://www.formalmind.com/en/blog/using-rmf-integrate-your-models> |
|  | http://www.cs.hhu.de/lehrstuehle-und-arbeitsgruppen/softwaretechnik-und-programmiersprachen.html |
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