# The Base Functions of the RelView System, Version 7.0*

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The base functions of RelView can be divided into several parts:

1. Base functions for calculating constant relations and domains:

| Syntax | Meaning |
|---|---|
| `L(R)` | Universal relation with the same dimension as `R` |
| `O(R)` | Empty relation with the same dimension as `R` |
| `I(R)` | Identity relation with the same dimension as `R` |
| `Ln1(R)` | Universal column vector with the same row number as `R` |
| `On1(R)` | Empty column vector with the same row number as `R` |
| `L1n(R)` | Universal row vector with the same column number as `R` |
| `O1n(R)` | Empty row vector with the same column number as `R` |
| `dom(R)` | Domain `R*Ln1(R^)` of relation `R` as column vector |

2. Base functions for calculating Boolean operations:

| Syntax | Meaning |
|---|---|
| `-R` | Negation (complement) of relation `R` |
| `R \| S` | Union (join) of `R` and `S` |
| `R & S` | Intersection (meet) of `R` and `S` |

3. Base functions for calculating relationalgebraic operations:

| Syntax | Meaning |
|---|---|
| `R^` | Transposition of relation `R` |
| `R * S` | Composition (product) of `R` and `S` |

4. Base functions for calculating residuals and symmetric quotients:

| Syntax | Meaning |
|---|---|
| `S / R` | Left residual of `R` and `S` |
| `R\S` | Right residual of `R` and `S` |
| `syq(R,S)` | Symmetric quotient of `R` and `S` |

*WWW: http://www.informatik.uni-kiel.de/~progsys/relview.shtml

5. Base functions for calculating closures:

| Syntax | Meaning |
|---|---|
| `trans(R)` | Transitive closure of `R` |
| `refl(R)` | Reflexive closure of `R` |
| `symm(R)` | Symmetric closure of `R` |

6. Various base functions concerning vectors and points without choice operations:

| Syntax | Meaning |
|---|---|
| `inj(v)` | Injection induced by the non-empty vector `v` |
| `init(v)` | Initial point with the same dimension as the vector `v` |
| `succ(v)` | Homogeneous successor relation with a dimension given by the number of rows of the vector `v` |
| `next(p)` | Successor of the point `p` with the same dimension as `p` |

7. Base operations for choices:

| Syntax | Meaning |
|---|---|
| `point(v)` | A point included in the non-empty column vector `v` |
| `atom(R)` | An atom (a relation consisting of one pair) included in the non-empty relation `R` |

8. Base operations which generate random relations. In the following, `XY` stands for two digits between `00` and `99` and denotes the probability that a pair is contained in the result:

| Syntax | Meaning |
|---|---|
| `randomXY(R)` | Generation of a random relation with the same dimension as `R` |
| `randomcfXY(R)` | Generation of a cyclefree random relation with the same dimension as the homogeneous relation `R` |
| `randomperm(v)` | Generation of a random permutation, where the dimension is given by the number of rows of the vector `v` |

9. Base functions for certain tests on relations. The result is *true* (represented by the universal relation on a singleton set) or *false* (represented by the empty relation on a singleton set):

| Syntax | Meaning |
|---|---|
| `empty(R)` | Test, whether `R` is empty |
| `unival(R)` | Test, whether `R` is univalent |
| `eq(R,S)` | Test, whether `R` and `S` are equal |
| `incl(R,S)` | Test, whether `R` is included in `S` |
| `cardeq(R,S)` | Test, whether the cardinalities of `R` and `S` are equal |
| `cardlt(R,S)` | Test, whether the cardinality of `R` is less than that of `S` |
| `cardgt(R,S)` | Test, whether the cardinality of `R` is greater than that of `S` |

10. Base functions concerning operations on powersets:

| Syntax | Meaning |
|---|---|
| `epsi(v)` | Membership relation, where the cardinality of the base set is given by the row number of the vector `v` |
| `cardrel(v)` | Size comparison relation on a powerset, where the cardinality of the base set is given by the row number of the vector `v` |
| `cardfilter(v,w)` | If `v` is a vector with a powerset $2^X$ as argument set and `w` is a vector with $n \leq \lvert X \rvert + 1$ columns, then the operation selects from `v` all sets $s$ fulfilling $\lvert s \rvert < n$ |

11. Base functions concerning relational product and sum domains. Most of these base functions take a domain definition as argument, the result however is always a relation:

| Syntax | Meaning |
|---|---|
| `1-st(DD)` | 1st component (`DD` domain) |
| `2-nd(DD)` | 2nd component (`DD` domain) |
| `p-1(PP)` | Projection onto the 1st component (`PP` product domain) |
| `p-2(PP)` | Projection onto the 2nd component (`PP` product domain) |
| `p-ord(PP)` | Product order (`PP` product domain) |
| `[R,S]` | Tupling of relations |
| `i-1(SS)` | Injection into 1st component (`SS` sum domain) |
| `i-2(SS)` | Injection into 2nd component (`SS` sum domain) |
| `s-ord(SS)` | Sum order (`SS` sum domain) |
| `R + S` | Sum of relations |

12. Base functions concerning function domains:

| Syntax | Meaning |
|---|---|
| `part-f(R,S)` | Columnwise representation of partial functions |
| `tot-f(R,S)` | Columnwise representation of total functions |