# Randomary Numbers

by Sven Nilsen, 2020

*In this paper I present the algebraic rules of real random numbers in the unit interval.*

A real random number in the unit interval is generated by a function:

random() : real

For brevity, values generated by this function is annotated `**r**`, often with one or more index `i` or `j`.

One can then construct an algebra:

$a + b\mathbf{r}_i + c\mathbf{r}_j + d\mathbf{r}^{ij} + \ldots$ : rnd(real)

a : real
b : real
rnd : type → type

With the following rules:

$\mathbf{r}_{ij} = (\mathbf{r}_i + \mathbf{r}_j) / 2$ $\mathbf{r}_{i-j} = \mathbf{r}_i - \mathbf{r}_j$ $\mathbf{r}^{ij} = \mathbf{r}^i \cdot \mathbf{r}^j$

$a\mathbf{r}_i + b\mathbf{r}_j = (a + b)\mathbf{r}_{ij}$ $\mathbf{r}_{i-j} = 2\mathbf{r}_{ij} - 1$

The indices commute everywhere:

$\mathbf{r}_{ij} = \mathbf{r}_{ji}$ $\mathbf{r}_{i-j} = \mathbf{r}_{j-i}$ $\mathbf{r}^{ij} = \mathbf{r}^{ji}$

A randomary number is invariant when replacing every occurrence of a source with its inverse.

$\forall$ x : rnd(real), i : nat { x[$\mathbf{r}_i := 1 - \mathbf{r}_i$] <=> x }