Impulse Response

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In this document I discuss the relation between prime numbers and the Impulse Response.

An invariant (prime number is defined by the relation $a = a\left(\frac{a}{a}\right) = a\left(1_a\right)$

Multinomial Theorem

$$c = a + b$$
$$c^n = \left(a+b\right)^n = \left[a^n + b^n\right] + \left[f(a,b,n)\right]$$
$$\left(a+b\right)^n\left(a+b\right) = \left(a+b\right)^n\left(a+b\right)$$
$$\left(a+b\right)^n\frac{\left(a+b\right)}{\left(a+b\right)} = \left(a+b\right)^n\left(1_{(a+b)}\right) = \left(a+b\right)^n, \left(1_{(a+b)}\right) := \frac{\left(a+b\right)}{\left(a+b\right)}$$

$$\left(ct\right) := a, \left(vt'\right) := b$$
$$\left(ct\right) + \left(vt'\right) = \left\{\left(ct\right) + \left(vt'\right)\right\}\frac{\left\{\left(ct\right) + \left(vt'\right)\right\}}{\left\{\left(ct\right) + \left(vt'\right)\right\}} = \left\{\left(ct\right) + \left(vt'\right)\right\}1_{\left\{(ct)+(vt')\right\}}$$

Multinomial (System Impulse Response)

First Order System Response

A single System is defined as $\left(\#_m\right) := \left(x_1\right) + \left(x_2\right) + \cdots + \left(x_m\right) = \sum_{i=1}^{m}\left(x_i\right)$

Then the System Impulse Response is defined as

$$(\#_m) := (x_1)+(x_2)+\cdots+(x_m) = \sum_{i=1}^{m}(x_i) = \left[\sum_{i=1}^{m}(x_i)\right]\frac{\left[\sum_{i=1}^{m}(x_i)\right]}{\left[\sum_{i=1}^{m}(x_i)\right]} = \left[\sum_{i=1}^{m}(x_i)\right]1_{\left[\sum_{i=1}^{m}(x_i)\right]}$$, where the impulse

is defined as $1_{\left[\sum_{i=1}^{m}(x_i)\right]}$ and the impulse response (equivalent to the "system" is defined as $\sum_{i=1}^{m}(x_i)$. That is, in first order, the system is unchanged by the Impulse.

Nth Order Impulse Response

$$(\#_m)^n = \left\{\sum_{i=1}^{m}(x_i)^n\right\} + \left\{\left[\sum_{k_1+k_1+\cdots k_m=n;k_1,k_2\cdots k_{m\geq 0}}\binom{n}{k1,k2,\cdots .k_m}\prod_{t=1}^{m} x_t^{k_t}\right]\right\}$$ where $\left\{\sum_{i=1}^{m}(x_i)^n\right\} \neq \left(\sum_{i=1}^{m}(x_i)\right)^n$

where $\binom{n}{k1,k2,\cdots,k_m} = \frac{n!}{k_1!k_2!\cdots k_m!}$

However, $(\#_m)^n = (\#_m)^n\frac{(\#_m)^n}{(\#_m)^n} = (\#_m)^n\left(1_{(\#_m)^n}\right)$

Impulse Response for n=2

$$(\#_m)^2 = \left\{\sum_{i=1}^{m}(x_i)^2\right\} + \left\{\left[\sum_{k_1+k_1+\cdots k_m=2;k_1,k_2\cdots k_{m\geq 0}}\binom{2}{k1,k2,\cdots .k_m}\prod_{t=1}^{m} x_t^{k_t}\right]\right\}$$

where $\binom{2}{k1,k2,\cdots,k_m} = \frac{2!}{k_1!k_2!\cdots k_m!} = \frac{2}{k_1!k_2!\cdots k_m!}$

and where $\left\{\sum_{i=1}^{m}(x_i)^2\right\} \neq \left(\sum_{i=1}^{m}(x_i)\right)^2$ so there is no impulse response in second order.

However, $(\#_m)^2 = (\#_m)^2\frac{(\#_m)^2}{(\#_m)^2} = (\#_m)^2\left(1_{(\#_m)^2}\right)$

$$\psi := \left(c^n\right) = \left(a + ib\right)^n = \left[a^n + \left(ib^n\right)\right] + i\left[f(a,b,n)\right] = a^n + i\left[b^n + f(a,b,n)\right]$$

$$\psi := \left(c^n\right) = a^n + i\left[b^n + f(a,b,n)\right]$$

$$\psi^* := \left(c^n\right)^* = a^n - i\left[b^n + f(a,b,n)\right]$$

$$\psi\psi^* = \left(a^n\right)^2 + \left[b^n + f(a,b,n)\right]^2 + i\left(a^n\right)\left\{\left[b^n + f(a,b,n)\right] - i\left[b^n + f(a,b,n)\right]\right\}$$

$$\psi\psi^* = \left(a^n\right)^2 + \left[b^n + f(a,b,n)\right]^2 = \left(\psi\psi^*\right)\left(\frac{\psi\psi^*}{\psi\psi^*}\right) = \left(\psi\psi^*\right)\left(1_{\psi\psi^*}\right)$$