# Function hypergraphs.

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**0- Abstract:**

In this paper we are going to introduce the notion of function hypergraph. In hypergraphs we have sets of vertices linked by other elements (sub-sets) called edges and the sets can be distributed in many ways. My idea with function hypergraphs is develop a practical use of the theory using defined functions and variables instead of sets.

**1- Introduction:**

An hypergraph H, is a pair H=(X, E) where X is a set of elements called nodes or vertices, and E is a set of non-empty subsets of X called hyperedges or edges. [1]. A hypegraph is a generalization of a graph in which an edge can join any number of vertices. In contrast, in an ordinary graph [3], the edges connects exactly two vertices.
Function application is the act of applying a function to an argument for its domain so as to obtain the corresponding value from its range.[2]
If the operator is understood to be of low precedence and right-associative, the application operator can be used to cut down on the number of parenthesis needed in an expression. For example: f(g(h(j(x)))).
With this two definition tools from different parts of the mathematics we are going to see a compact theory.

**2- Theory:**

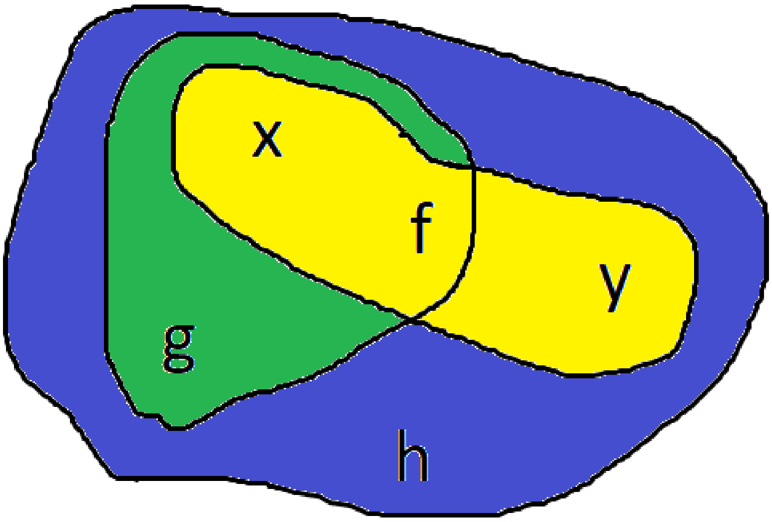
A function hypergraph, is a pair T=(Y, U) where Y are the set of functions (with one or more variables and one or more applications) which play the role of vertices and U is the set of combinations of the applications which represent the edges of the function hypergraph.
In a function hypergraph the application of the functions possibilities the generation of variations in the different steps of the combination and it is produced in a multi-directional way. In this type of hypergraphs if you have a number n of functions (f, g, h…) linked with one or more variables (x, y, z…) the number of possible link combinations are give for the next formula:

$$(1)\quad n!\cdot(n+1)$$

For example if you have two functions f (x) and g (x) linked the possible combinations will be 2 ( $(f\circ g)(x),(g\circ f)(x)$ ) and if you have three functions f (x, y), g (x, y) and h (x, y) linked the combinations will be six ( $(f\circ g\circ h)(x,y),(f\circ h\circ g)(x,y),(g\circ f\circ h)(x,y)$ , $(g\circ h\circ f)(x,y),(h\circ f\circ g)(x,y),(h\circ g\circ f)(x,y)$ )

Now we are going to see some examples with the given graphics:

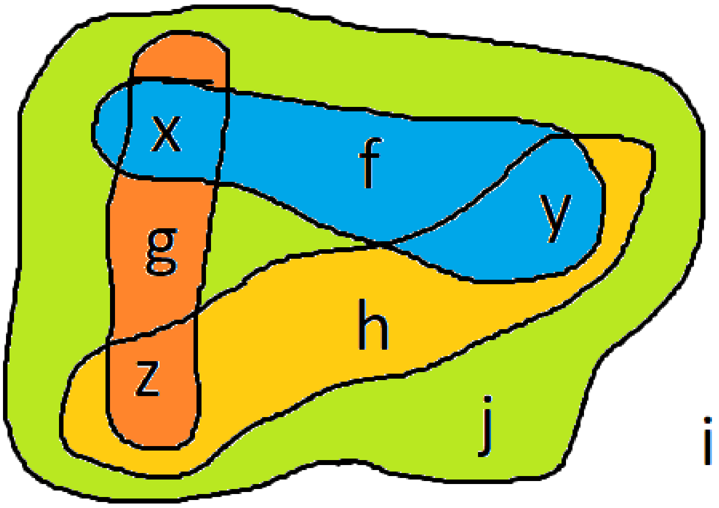
1)




In this first example, Y = { $f(x,y)$ , $(g\circ f)(x)$ , $(h\circ g\circ f)(x,y)$ } and

U={ $f,g,h$ } = {{ $f(x),f(y)$ }, { $(g\circ f)(x)$ , $(f\circ g)(x)$ },{ $(h\circ f\circ g)(x,y)$ , $(h\circ g\circ f)(x,y)$ , $(g\circ h\circ f)(x,y)$ , $(g\circ f\circ h)(x,y)$ , $(f\circ g\circ h)(x,y)$ , $(f\circ h\circ g)(x,y)$ }

2)




In this second example, Y= { $f(x,y)$ , $g(x,z)$ , $h(y,z)$ , $(j\circ f\circ g\circ h)(x,y,z)$ , $i(0)$ }

U= { $f,g,h,j,i$ } = {{ $f(x),f(y)$ }, { $g(x),g(z)$ }, { $h(y),h(z)$ ,
{ $(f\circ g\circ h\circ j)(x,y,z)$ , $(f\circ g\circ j\circ h)(x,y,z)$ , $(f\circ h\circ g\circ j)(x,y,z)$ , $(f\circ h\circ j\circ g)(x,y,z)$ , $(f\circ j\circ h\circ g)(x,y,z)$ , $(f\circ j\circ g\circ h)(x,y,z)$ , $(g\circ f\circ j\circ h)(x,y,z)$ , $(g\circ f\circ h\circ j)(x,y,z)$ ,

$(g\circ h\circ f\circ j)(x,y,z)$ , $(g\circ h\circ j\circ f)(x,y,z)$ , $(g\circ j\circ f\circ h)(x,y,z)$ , $(g\circ j\circ h\circ f)(x,y,z)$ , $(h\circ f\circ j\circ g)(x,y,z)$ , $(h\circ f\circ g\circ j)(x,y,z)$ , $(h\circ g\circ j\circ f)(x,y,z)$ , $(h\circ g\circ f\circ j)(x,y,z)$ , $(h\circ j\circ f\circ g)(x,y,z)$ , $(h\circ j\circ g\circ f)(x,y,z)$ , $(j\circ f\circ g\circ h)(x,y,z)$ , $(j\circ f\circ h\circ g)(x,y,z)$ , $(j\circ h\circ f\circ g)(x,y,z)$ , $(j\circ h\circ g\circ f)(x,y,z)$ , $(j\circ g\circ h\circ f)(x,y,z)$ , $(j\circ g\circ f\circ h)(x,y,z)$ }
, { $i(0)$ }}

## 4- Conclusions:

This theory can be adapted in different aspects of discrete mathematics, this is only an example of the power of the graph theory. My idea of combine two different mathematical areas is the result of the study of different topics in an equal way, I hope it will be an inspiration for those people who want connect apparently far way mathematical areas.

## 3- References.

[1] https://en.wikipedia.org/wiki/Hypergraph

[2] https://en.wikipedia.org/wiki/Function_application

[3] https://encyclopediaofmath.org/wiki/Graph