* One model (physical) is defined as a parameter set p, element of the parameter space $\mathcal{P}$:

$$p \in \mathcal{P} \text{ with } p = (l_\mu, \dots, \alpha_{\mu i}, \gamma_{i\mu}, \dots)$$

* $\alpha_{\mu i}$, $\gamma_{\mu i}$ are matrices with <u>real elements</u>

$$\alpha_{\mu i}, \gamma_{\mu i} \in \mathbb{R} \quad \forall i, \mu$$

* The $\alpha_{\mu i}$ and $\gamma_{\mu i}$ are generated with two elements:
  - A <u>binary</u> matrix (called G for $\gamma_{\mu i}$, A for $\alpha_{\mu i}$)
  - A metaparameter (real number) called α_0 for $\alpha_{\mu i}$, γ_0 for $\gamma_{\mu i}$

These pairs <u>generate</u> a parameter set p through a random distribution process:

$$\alpha_{\mu i} = A_{\mu i}\, \text{Rand}(\alpha_0)$$

$$\gamma_{i\mu} = G_{i\mu}\, \text{Rand}(\gamma_0)$$

$A_{\mu i} \in \{0,1\}$, $G_{i\mu} \in \{0,1\}$ binary matrices

* How are these metaparameters and binary matrices chosen?

  - Metaparameters
  - G (cons-mpion binary matrix) } user-input

  - A is different. We have multiple possibilities:
    - random structure
    - fully connected
    - "optimized"

* We focus on the generation of "optimized" A matrices. The general idea is to use an Monte Carlo procedure which generates matrices A_k^* with low energy:

$$E(G, A_k^*) \text{ is minimal for}$$
$$\text{all } k = 1, 2, \ldots, N$$

  - N is the number of runs of the MCP
  - A_k^* is a binary matrix

~~Until recently~~,

Because the A_k^* might be (and are!) different – there are multiple local energy minima, their average $\tilde{A}$ is used to generate a single A-matrix:

$$\tilde{A} \equiv \frac{1}{N} \sum_{k=1}^{N} A_k^*$$

$\tilde{A}$ is refered to as a metamatrix sometimes. Each of its elements is between 0 and 1. and can be seen as a probability that the A-matrix of a model is 1:

$$A_{\mu i} = \begin{cases} 1 & \text{if } \text{Unif}(0,1) \leq \tilde{A}_{\mu i} \\ 0 & \text{else} \end{cases}$$

↑ binary, either 0 or 1

Usually this procedure is used to generate the "optimized" A-matrix. (these are green in the plots)

I recently did new computations, called "binary optimized" which are slightly different (orange in the plots):

$$A_{\mu i} = A^*_{1\,\mu i}$$

↑ binary; ↑ binary; → random run of the MCP