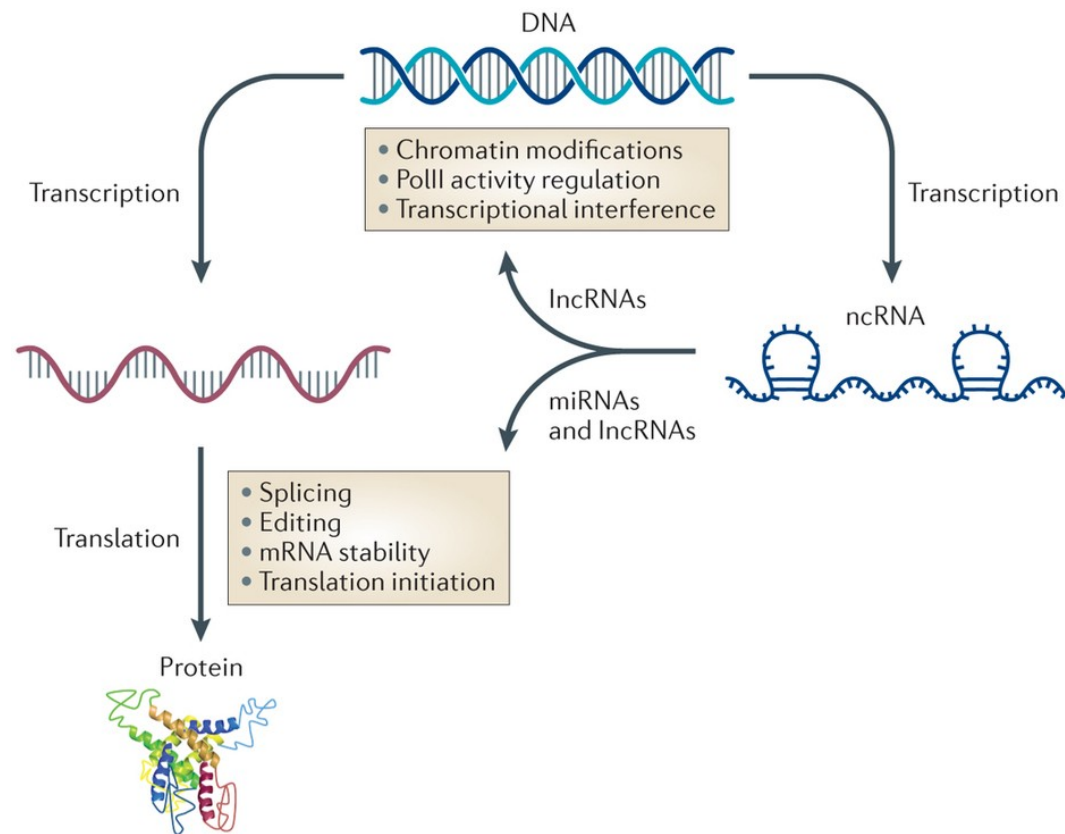
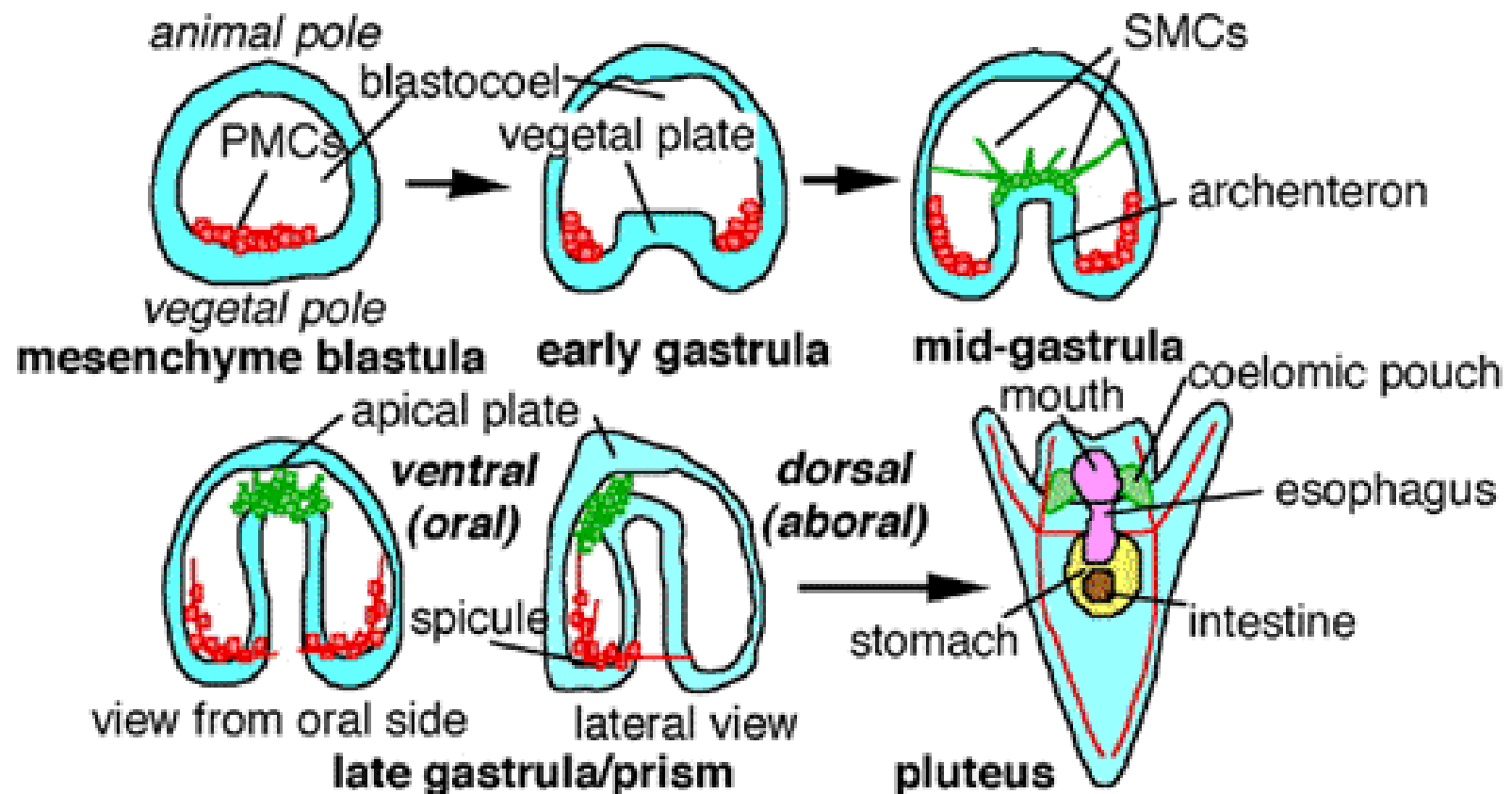


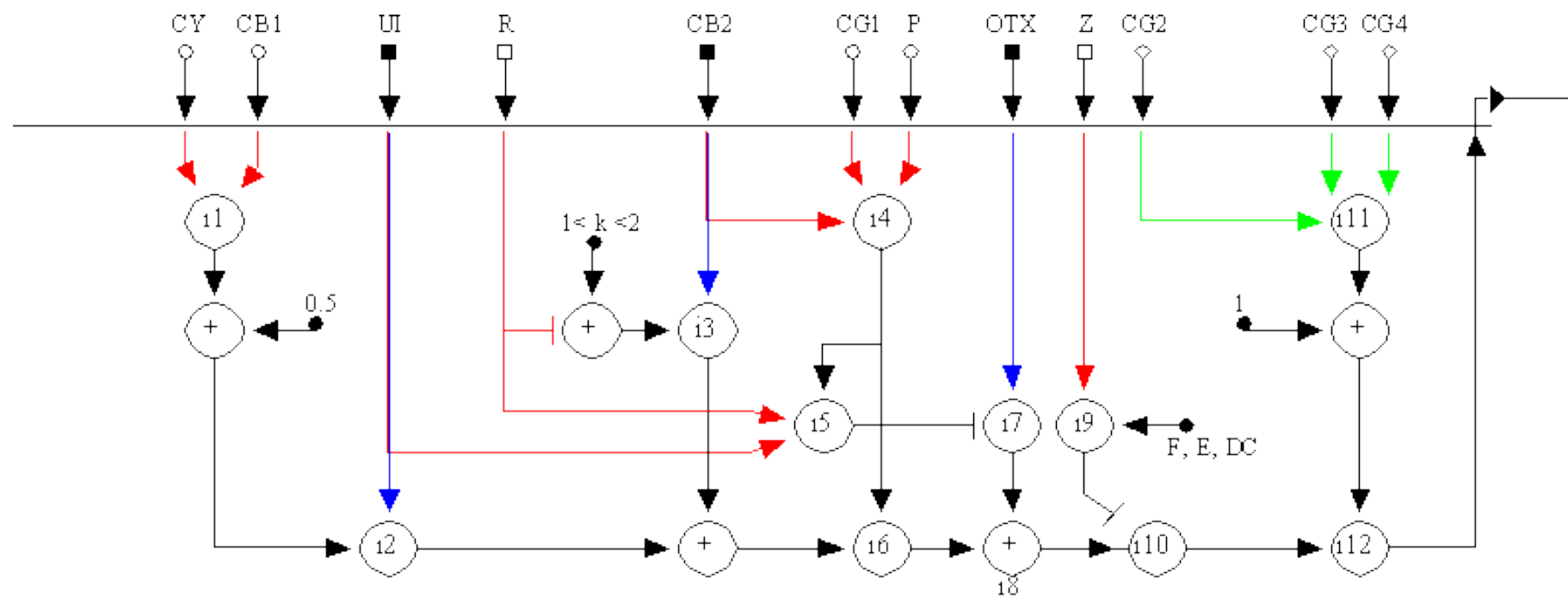
Central Dogma of Gene Expression.

Through the production of mRNA (transcription) and the synthesis of proteins (translation), the information contained in DNA is expressed.



An Overview of Sea Urchin Gastrulation

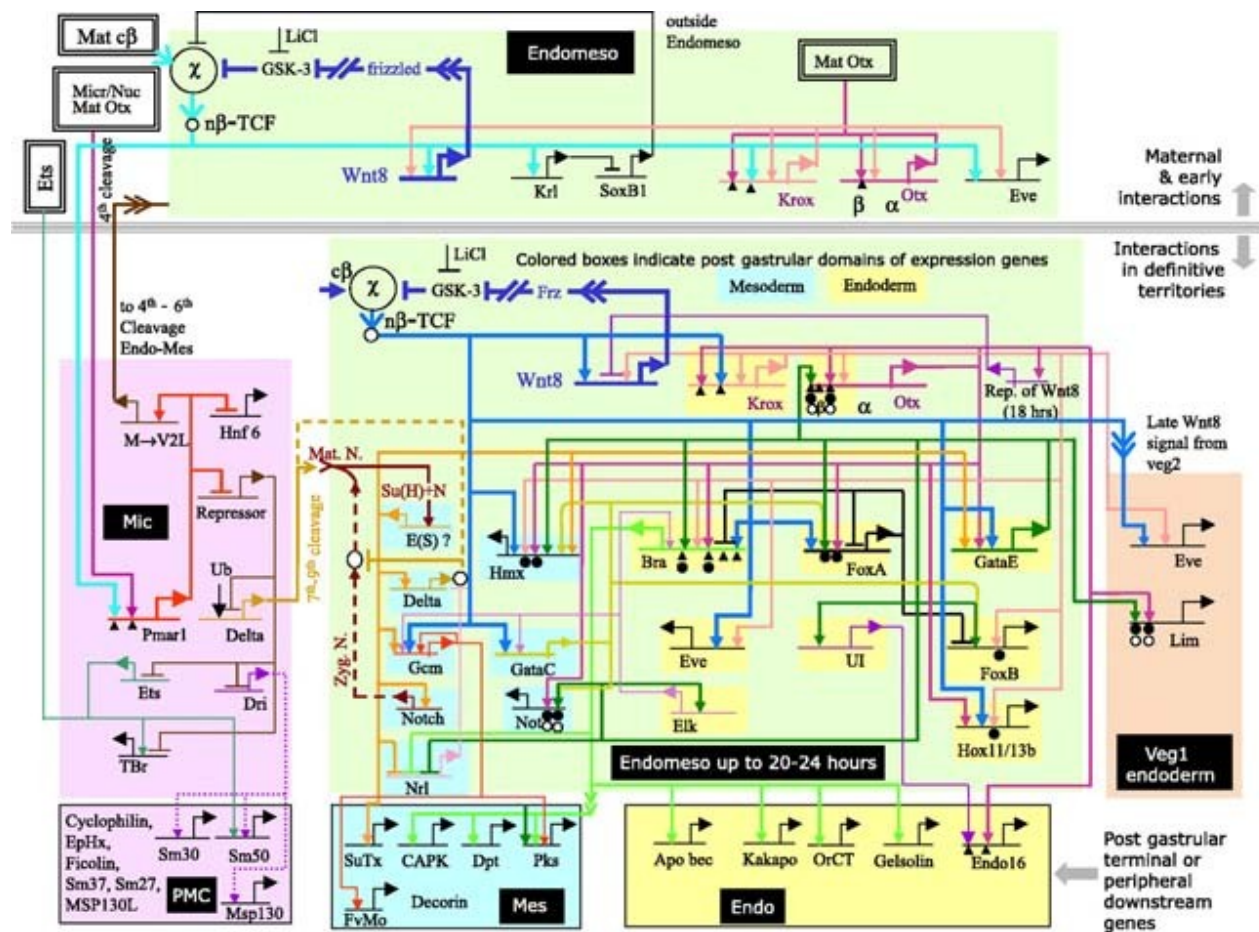




- █ Boolean functions
- █ Scalar functions
- █ Quantitative functions (time dependant)

+ sum

i "and" (Boolean) or product (continuous)

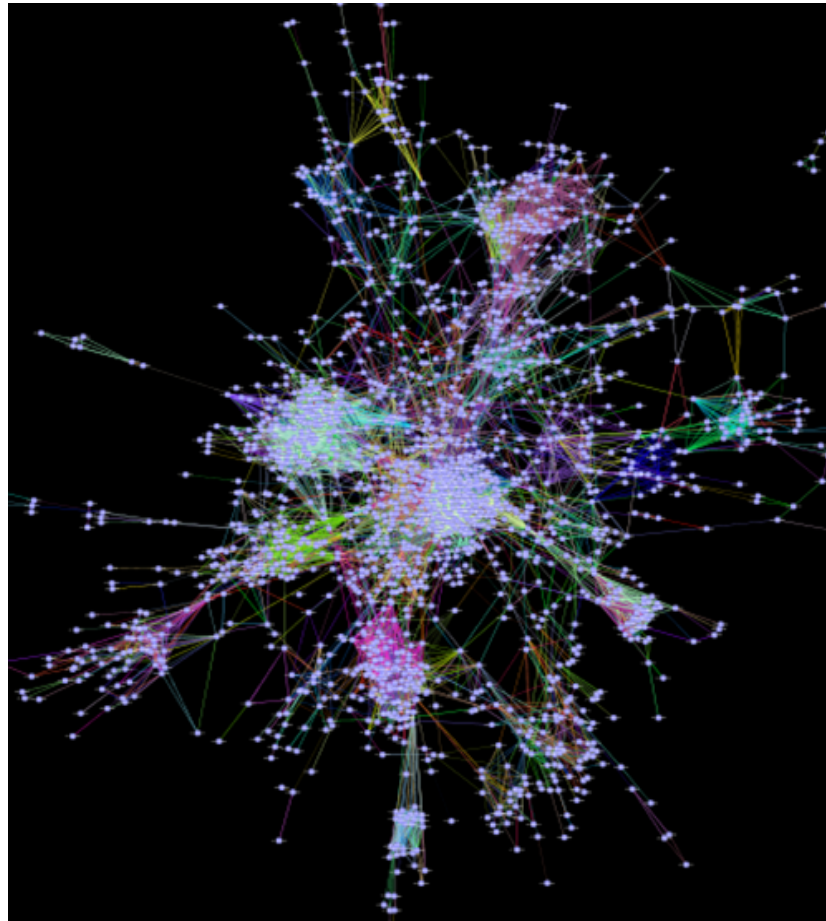


Biological networks

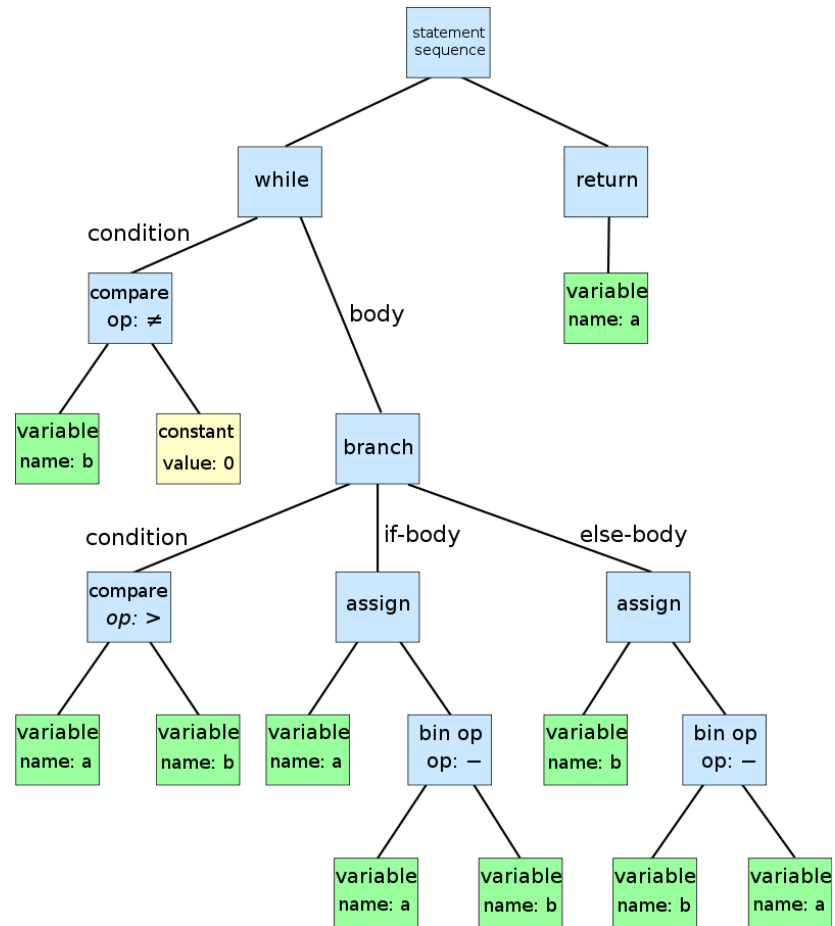
- Some links specified by regions of DNA
- Protein interactions, RNA/RNA, RNA/DNA, RNA/Protein, cell signalling
- Exhibit modular structure
 - Components
 - Scalability

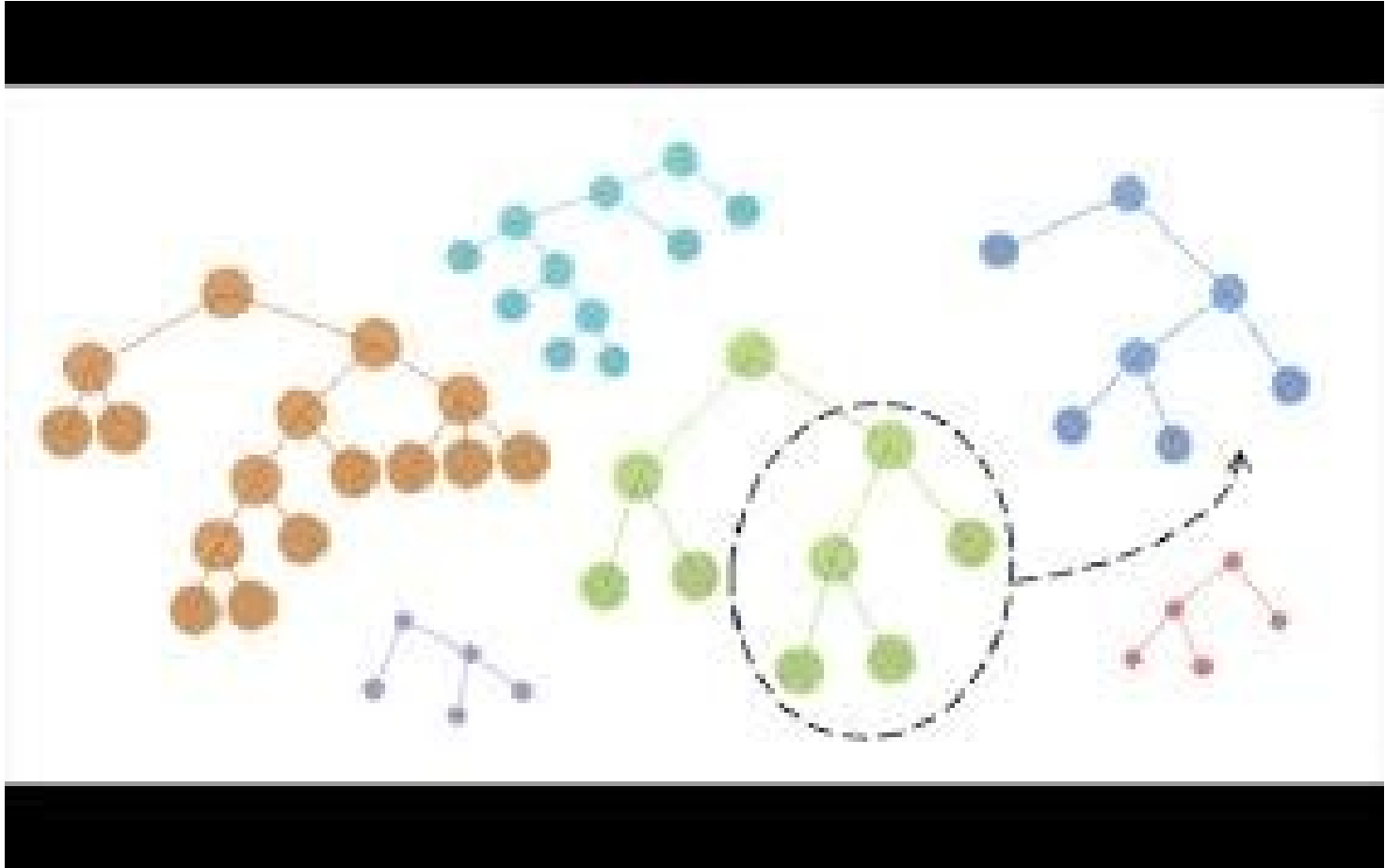
Modularity

- System built of components

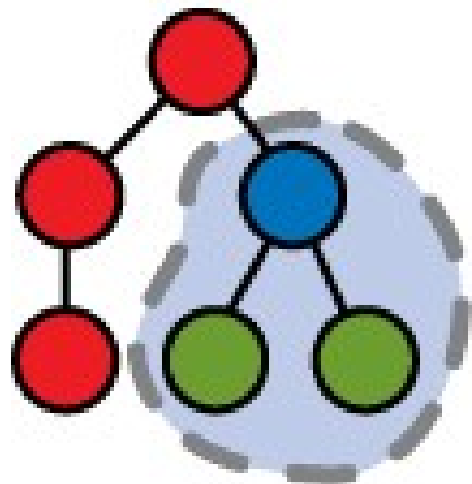


Program as tree



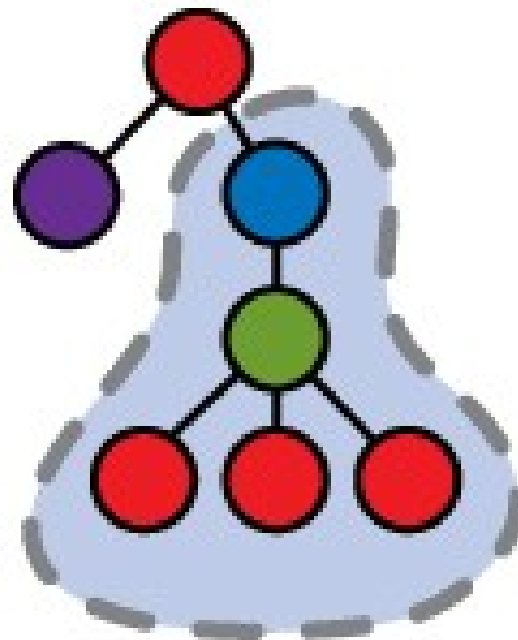


Father



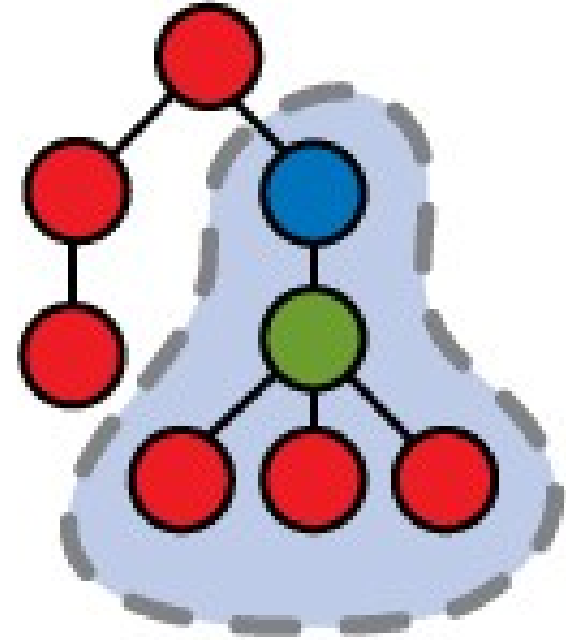
Randomly
Selected Subtree

Mother

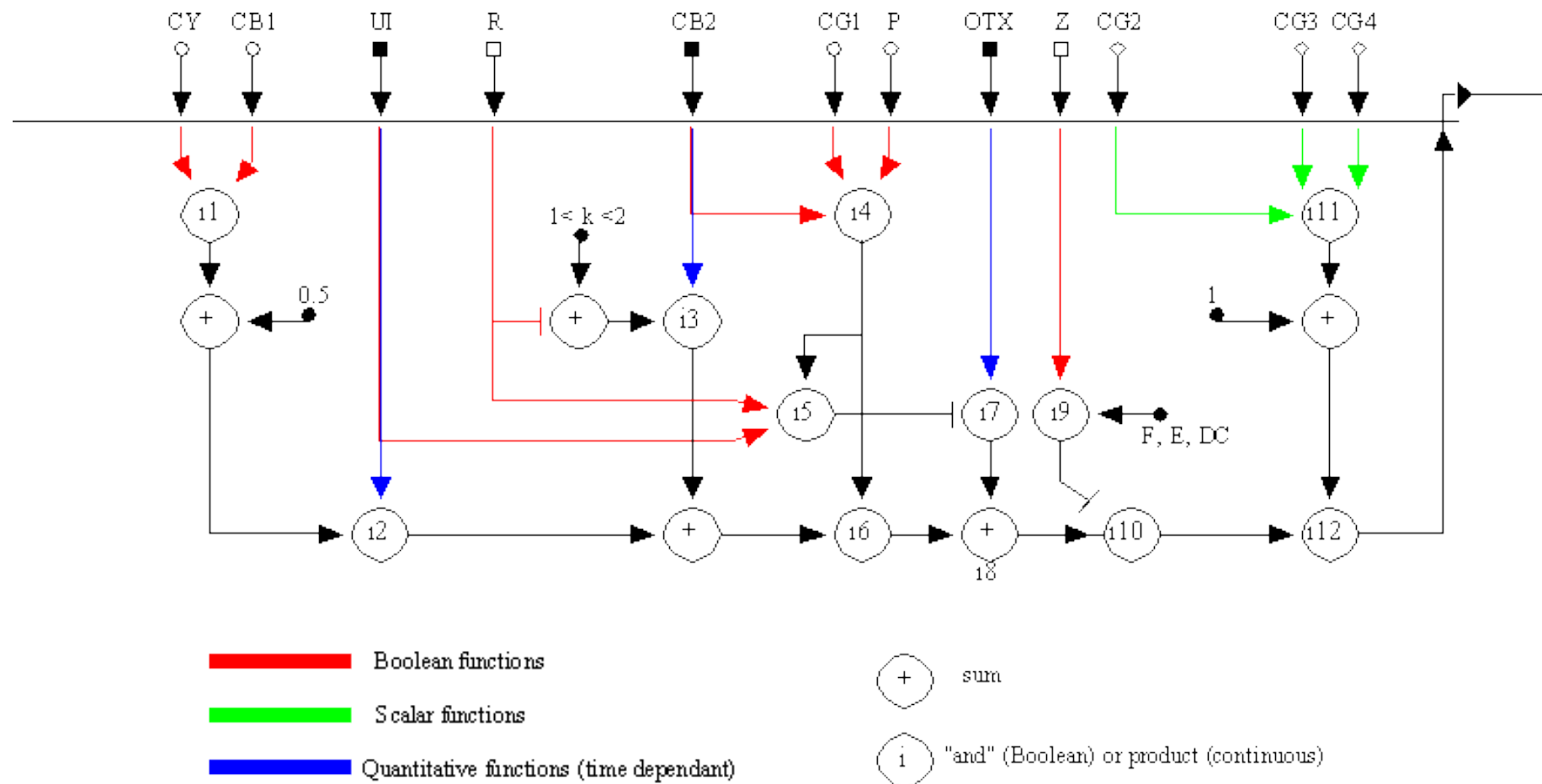


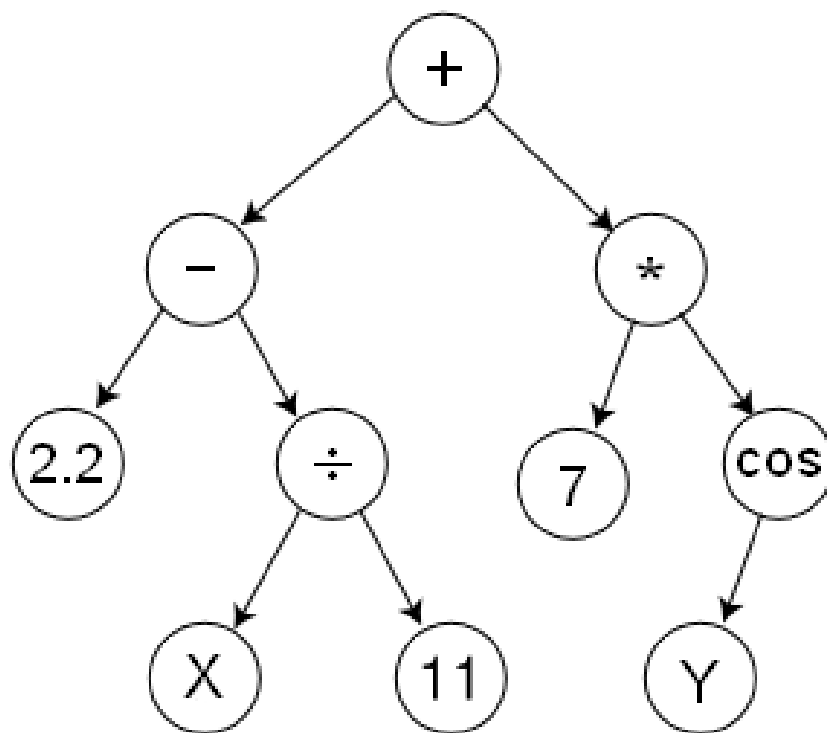
Randomly
Selected Subtree

Offspring



Replace Old Subtree
With New Tree





$$\left(2.2 - \left(\frac{X}{11} \right) \right) + \left(7 * \cos(Y) \right)$$

meetup.com/biocoders

@resurgo

peter@fourpartswater.com

@biocoders_uk

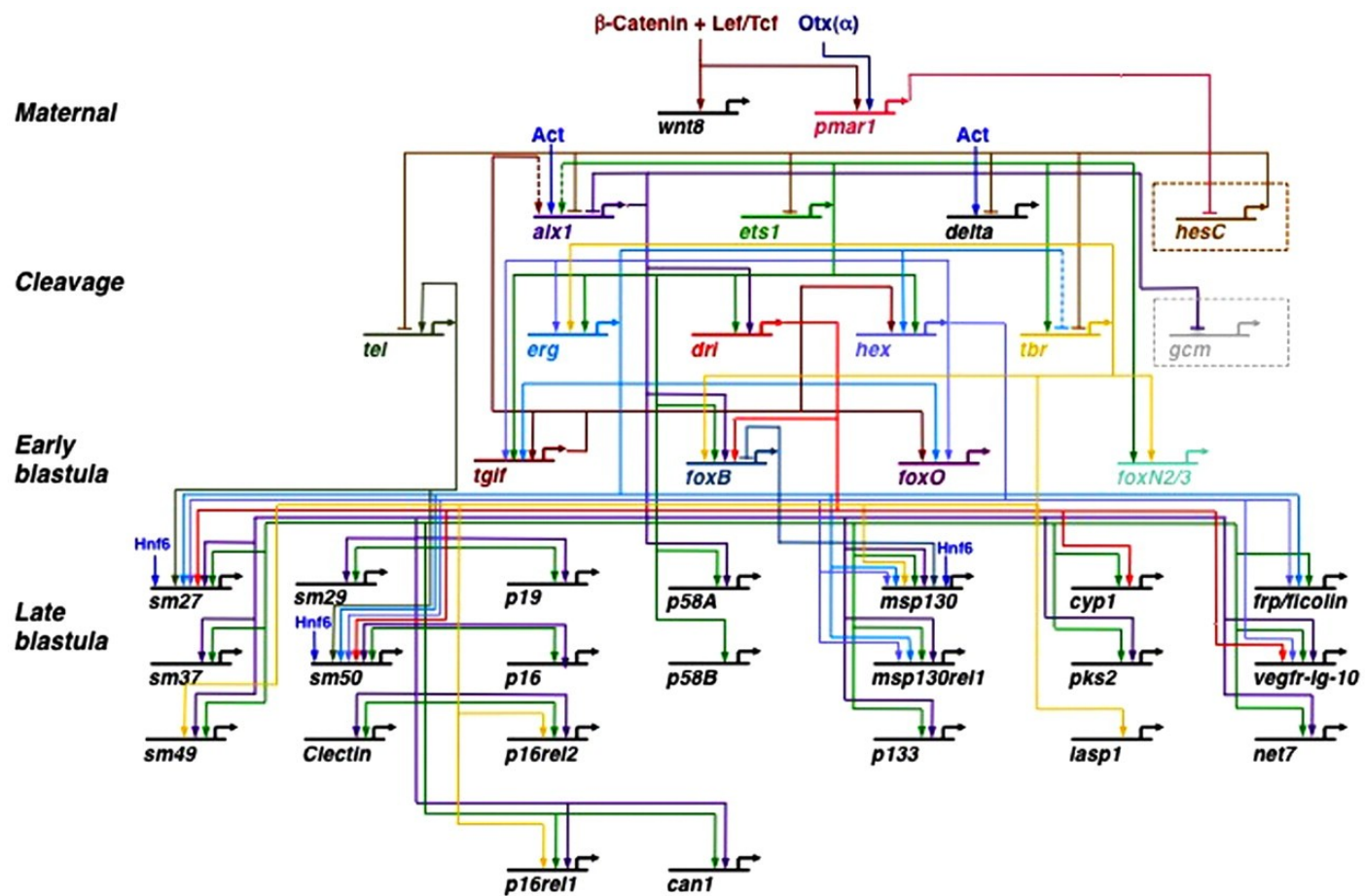
TensorFlow + 3D genome hackathon

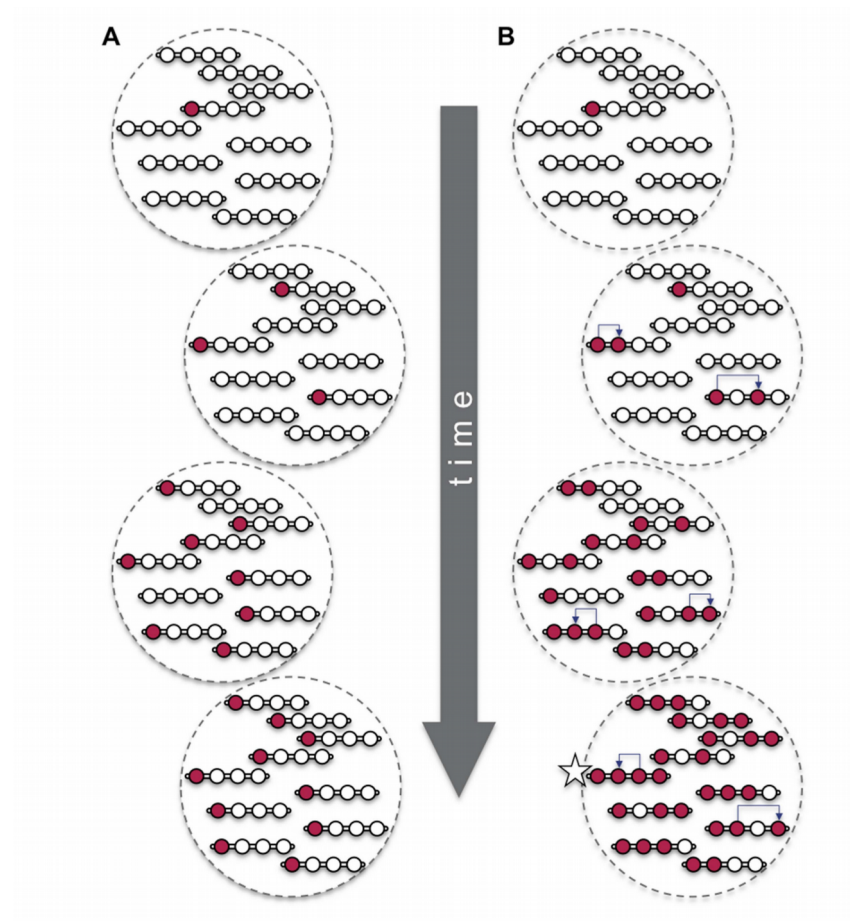
Complexity and networks

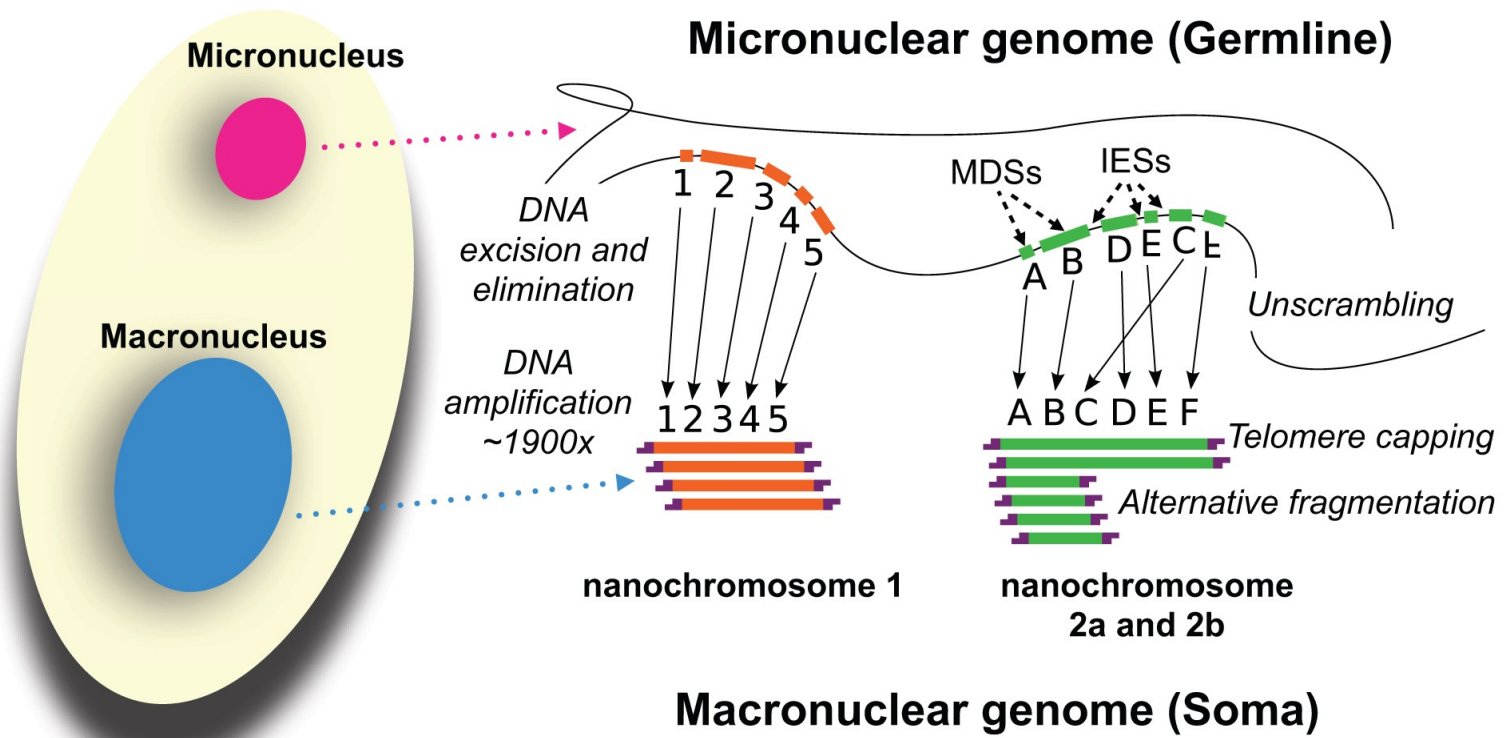
- Small simple networks can lead to complex structure/function = phenotype
- Network links swapped changes higher level behaviour
- Preferential swapping within modules allows scaling → more complex life

Genetic Programming

- One type of genetic algorithm
 - Populations of solutions
 - Evolve by natural selection inspired processes
 - Selection, mutation, recombination
- Represent solutions to problems as computational trees
- Human competitive for small systems
 - Breaks patents

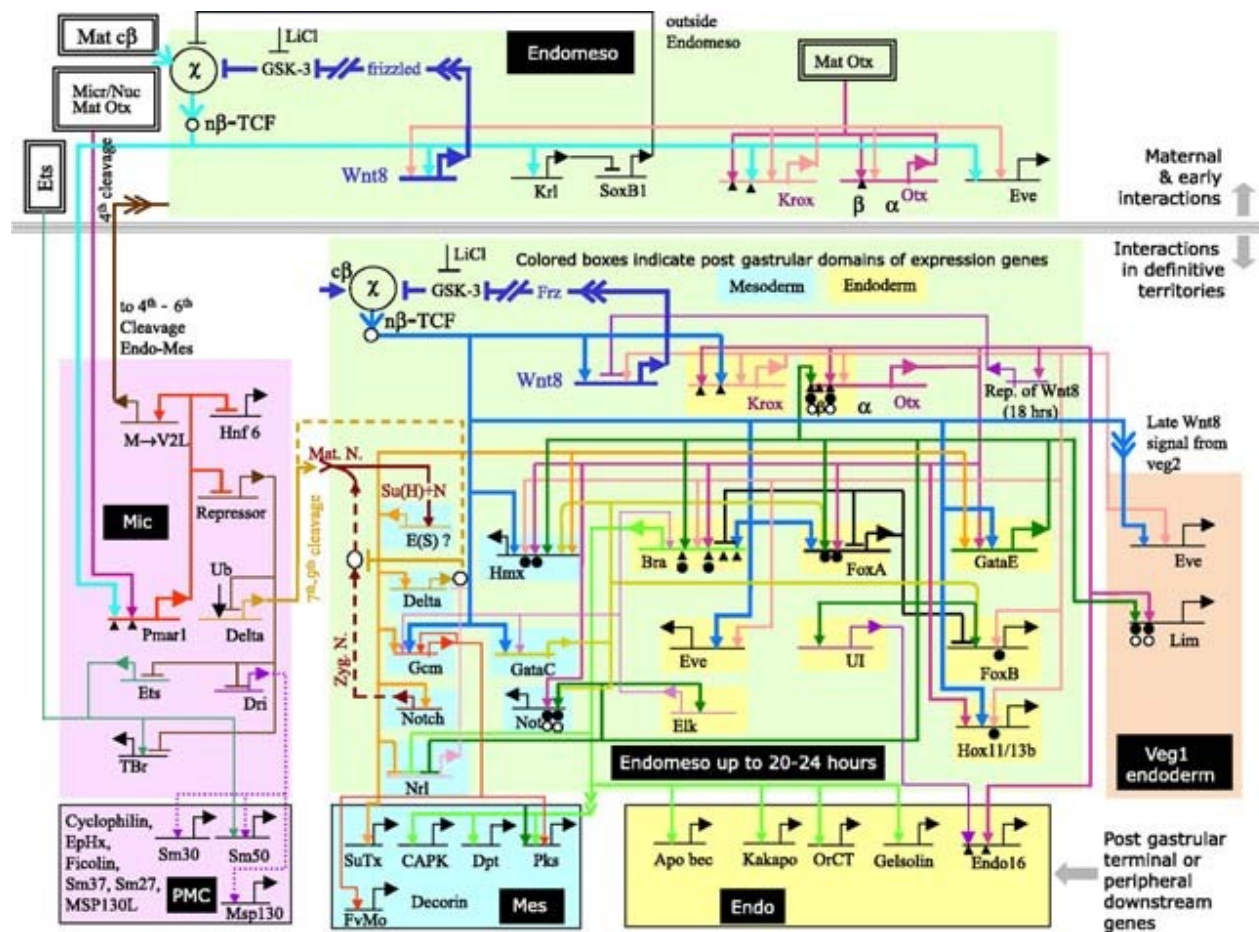


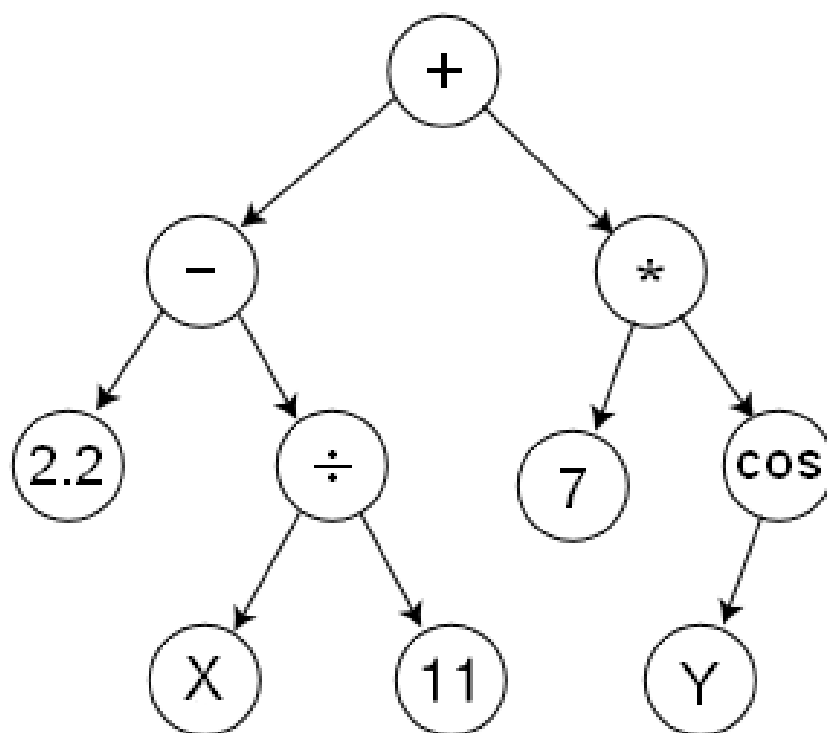




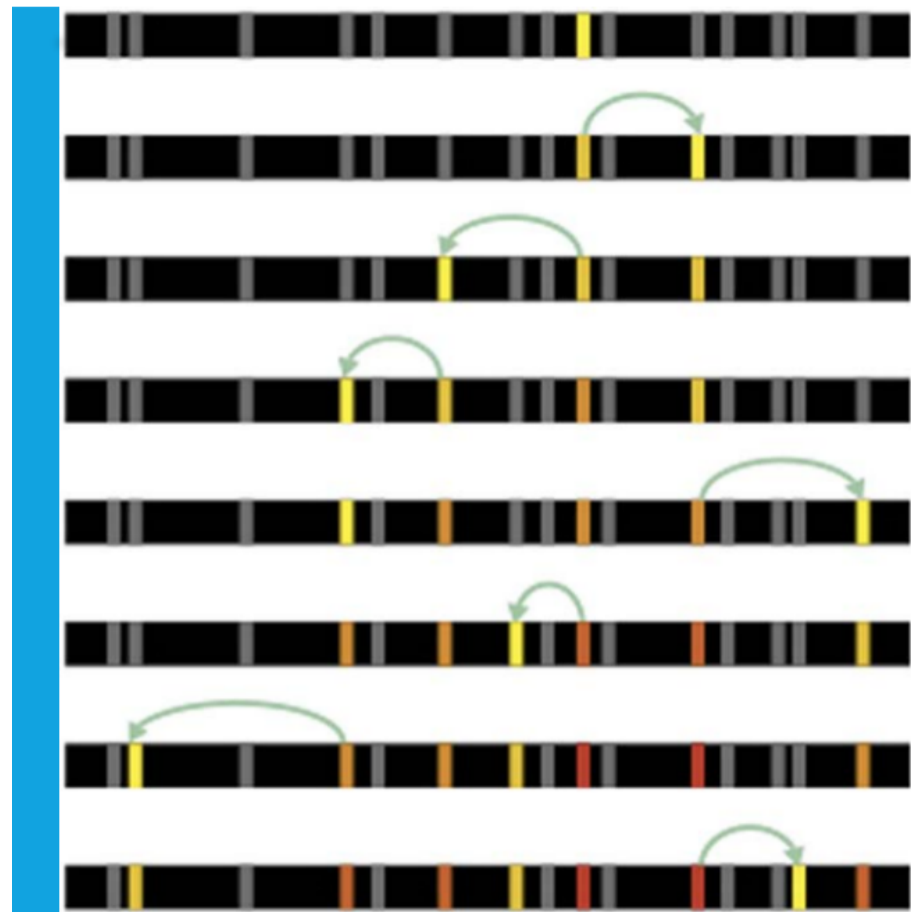
Scalability

- GP not very scalable
- Specialisation in subtrees broken by swapping
- Network evolution
 - Network connectivity determines behaviour
- Modular evolvability
- How might the genome do this?





$$\left(2.2 - \left(\frac{X}{11} \right) \right) + \left(7 * \cos(Y) \right)$$



Gene conversion and repeats

- Majority of genome repetitive sequence
- Provides template for exchange of DNA – network connections
- Maintained by short term selection on new links – hitchhiking homology
- Repetitive landscape conserved and evolves
- Links selected for increase linkage
 - Not the case if no selection