Architecture and Dynamics of Biomolecular Networks Facilitate Evolution of Persistence Strategies in Living Organisms

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I. Introduction to Persistence Strategies and Why it Matters

II. Methods of Investigation and Rationale

III. Future Direction of Investigation

What is Life

life

[lahyf]

Spell | Syllables

Synonyms Examples Word Origin

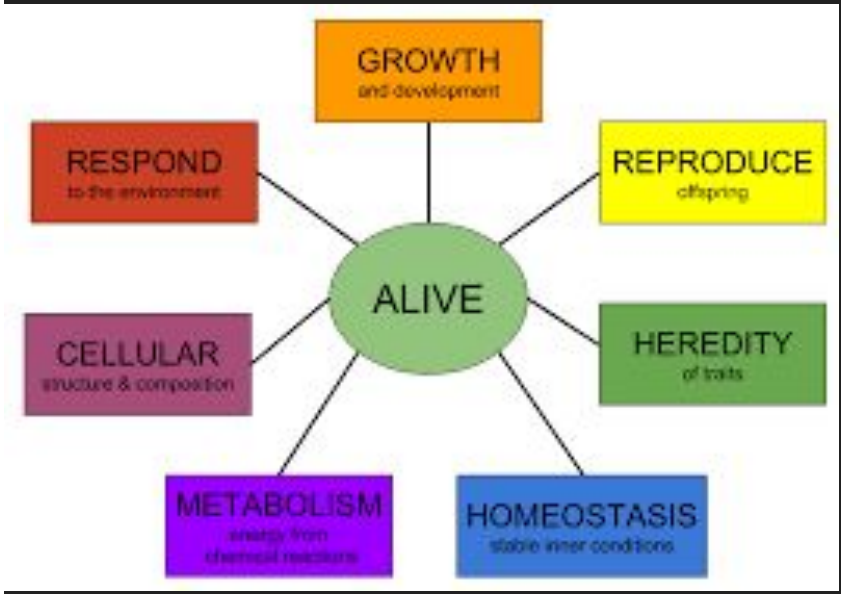
See more synonyms on Thesaurus.com

noun, plural **lives** [lahyvz] (Show IPA)

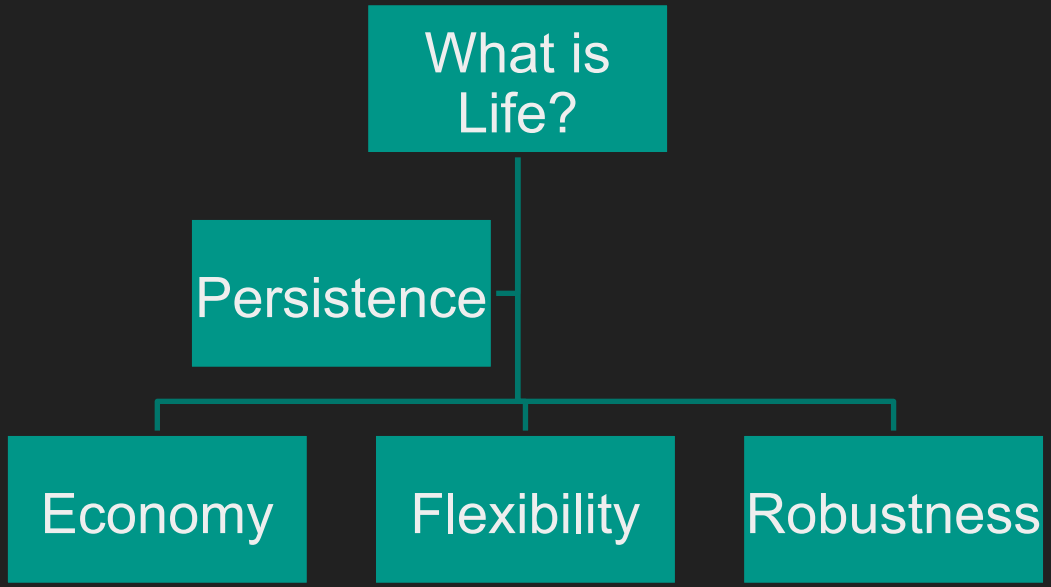
1. the condition that distinguishes organisms from inorganic objects and dead organisms, being manifested by growth through metabolism, reproduction, and the power of adaptation to environment through changes originating internally.

2. the sum of the distinguishing phenomena of organisms, especially metabolism, growth, reproduction, and adaptation to environment.

3. the animate existence or period of animate existence of an individual: *to risk one's life; a short life and a merry one.*



What are Persistence Strategies



Why Does it Matter

Understanding persistence strategies is important.

1. **Crops in Extreme Environments, and meeting growing economical needs**

   Martins, L. M. V., Xavier, G. R., Rangel, F. W., Ribeiro, J. R. A., Neves, M. C. P., Morgado, L. B., & Rumjanek, N. G. (2003).

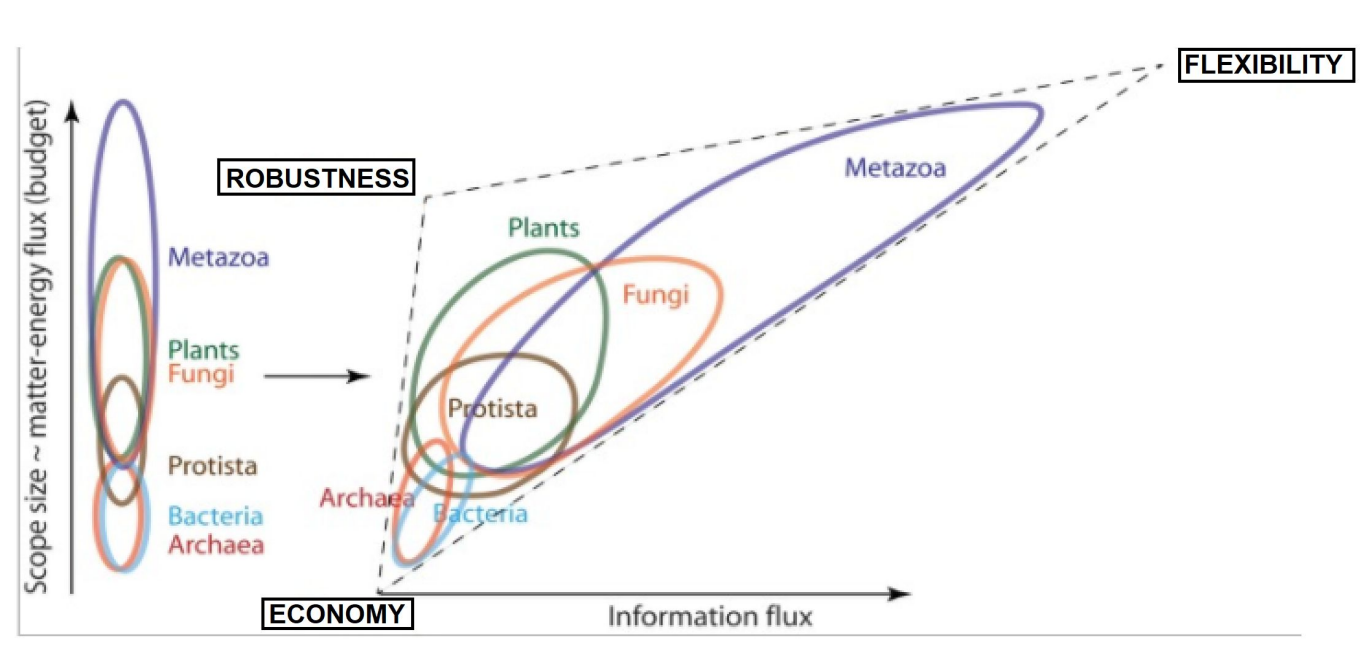
2. **Growing Resistance of Bacteria to Most Antibiotics**

   Andersson, D. I. (2003).

3. **Synthetic Biology and Astrobiological Systems**

   Andrianantoandro, E., Basu, S., Karig, D. K., & Weiss, R. (2006).

Spectrum of EFR



- Prokaryotes tend to gravitate towards the Economic vertex
- Single cell organisms tend to gravitate towards the robustness vertex
- Eukaryotes gravitate toward trade offs between economy and flexibility

Yafremava, L. S., Wielgos, M., Thomas, S., Nasir, A., Wang, M., Mittenthal, J. E., & Caetano-Anollés, G. (2013).

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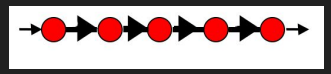
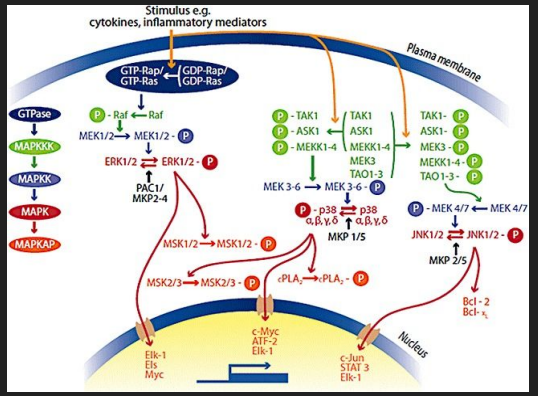
Implementation & Analysis

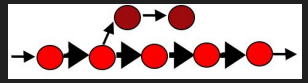
Persistence

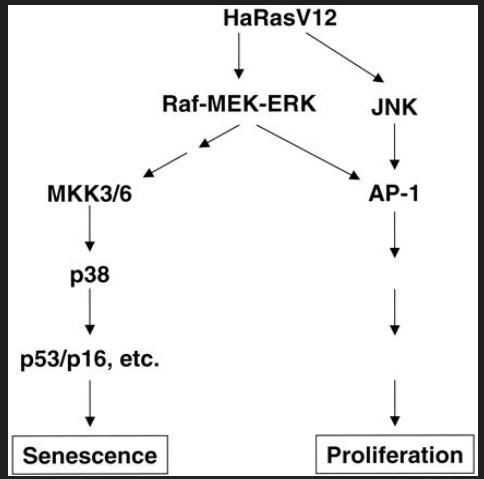
Economy



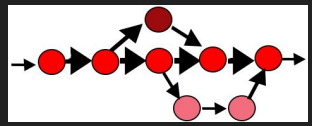


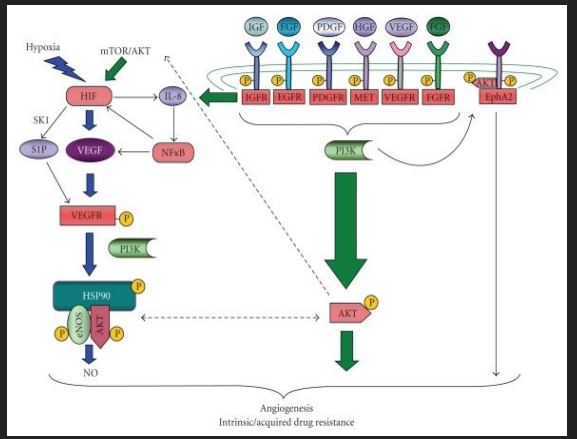
Flexibility



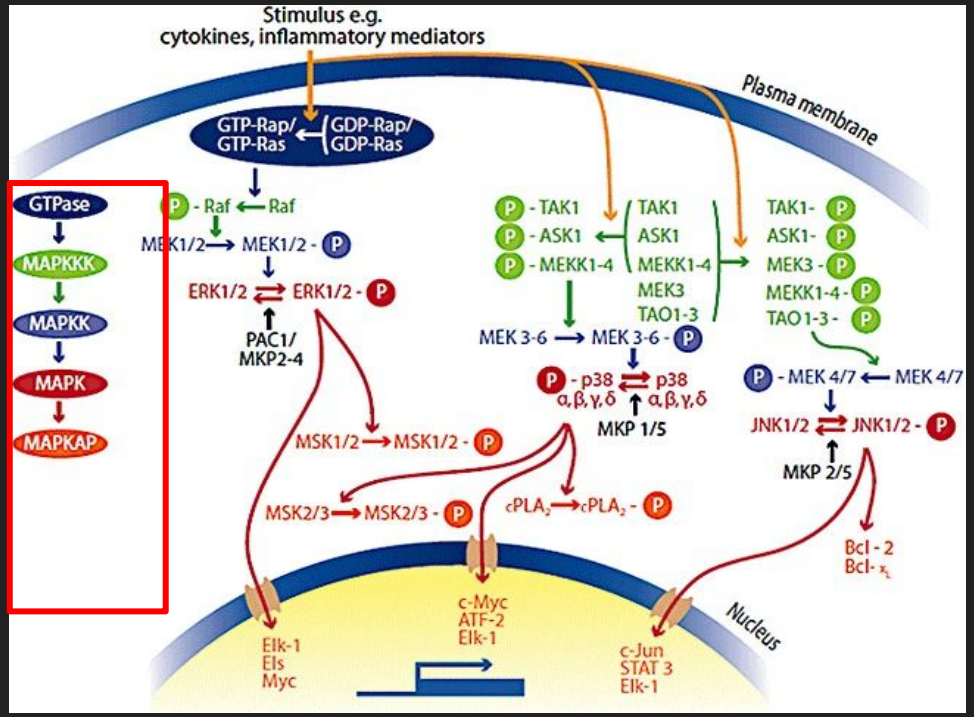


Robustness



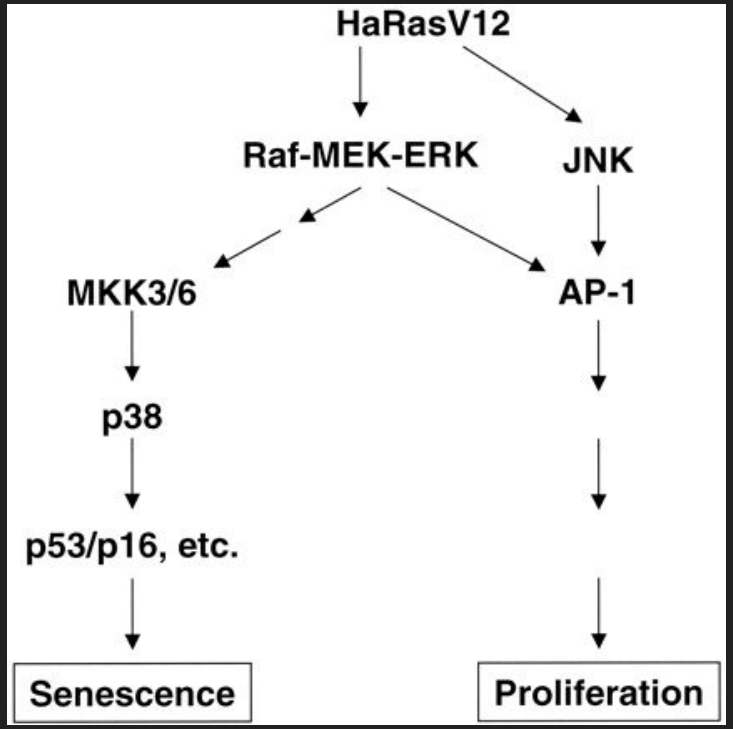


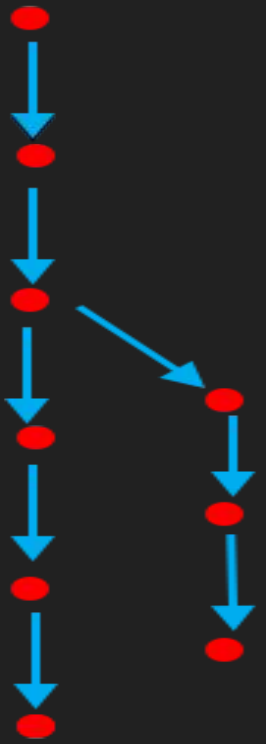
Economy



Broom, Oliver & Widjaya, Budiman & Troelsen, J & Olsen, J & Nielsen, Ole. (2009).

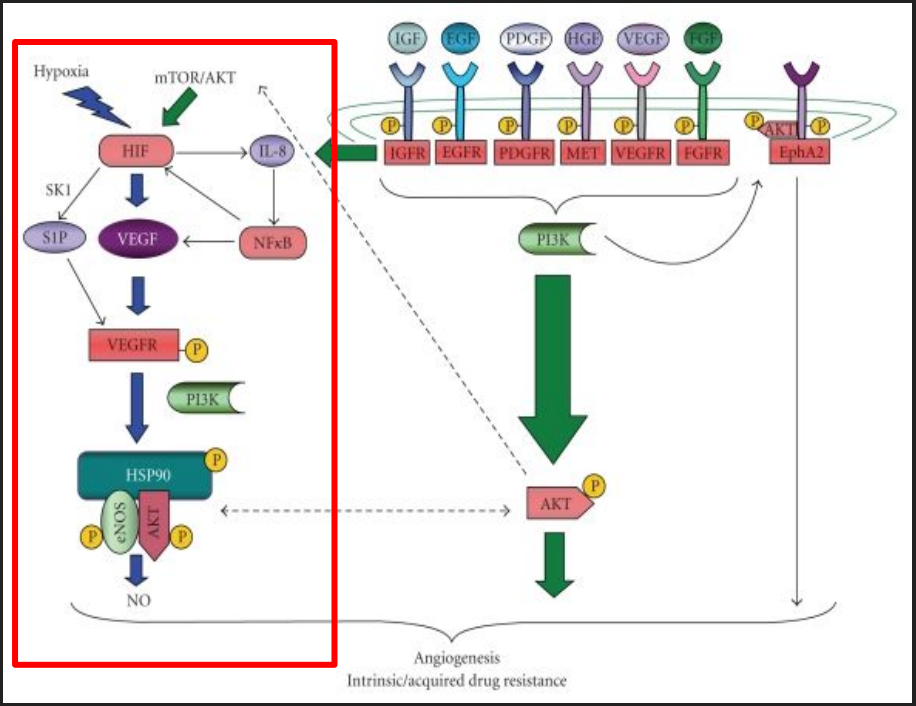
Flexibility

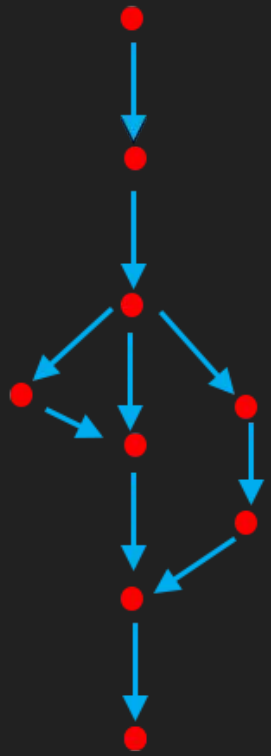




Wang, W., Chen, J. X., Liao, R., Deng, Q., Zhou, J. J., Huang, S., & Sun, P. (2002).

Robustness





E Bohonowych, J & Gopal, U & Isaacs, Jennifer. (2010).

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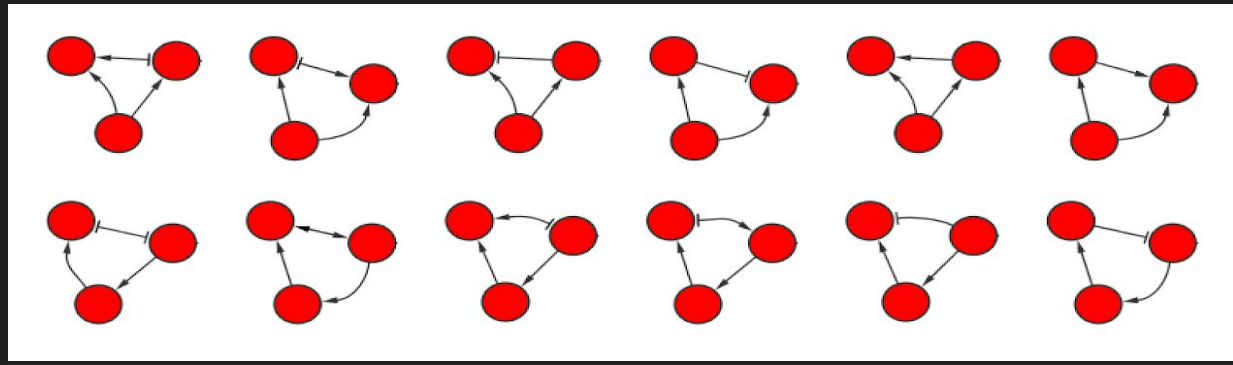
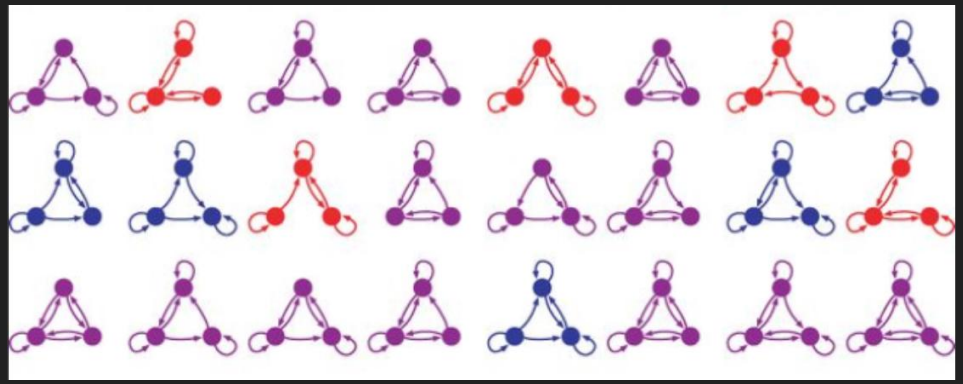
Implementation and design constraints

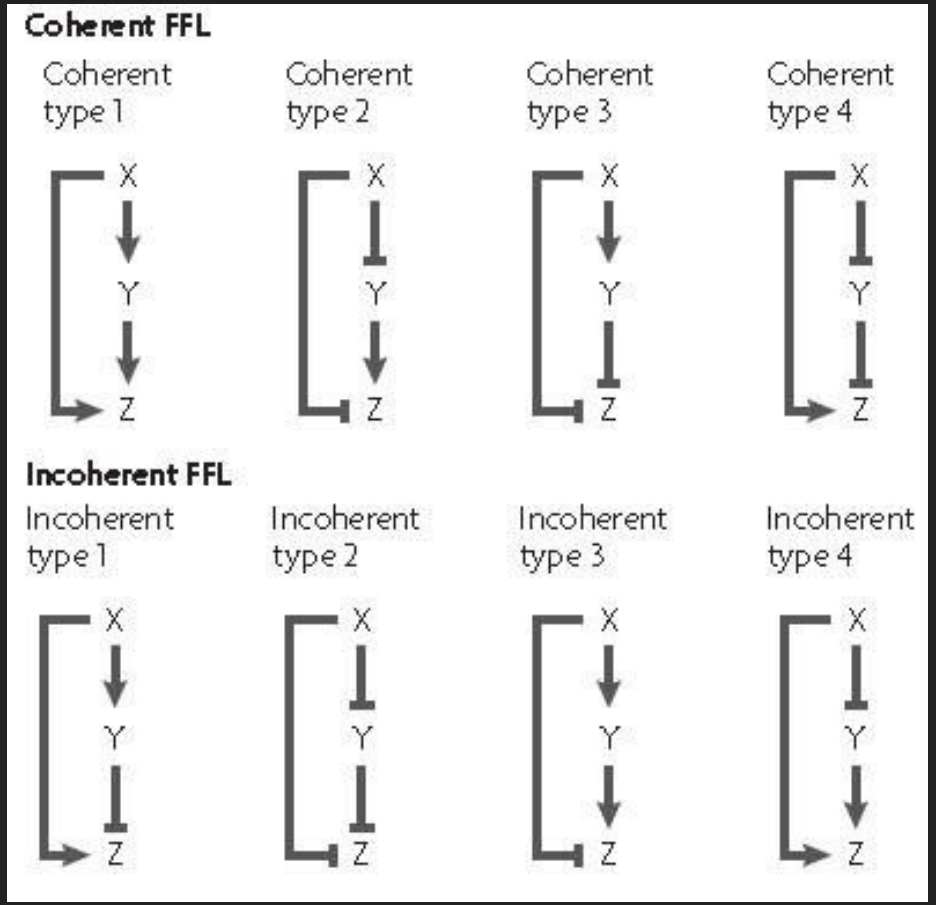
- 3-node networks https://github.com/Araj6/EFR
- Connections: inhibitory, excitatory, self-activation, self-inhibition
- Only one node receives input





Ahnert, S. E., & Fink, T. M. A. (2016).

Interesting network motifs

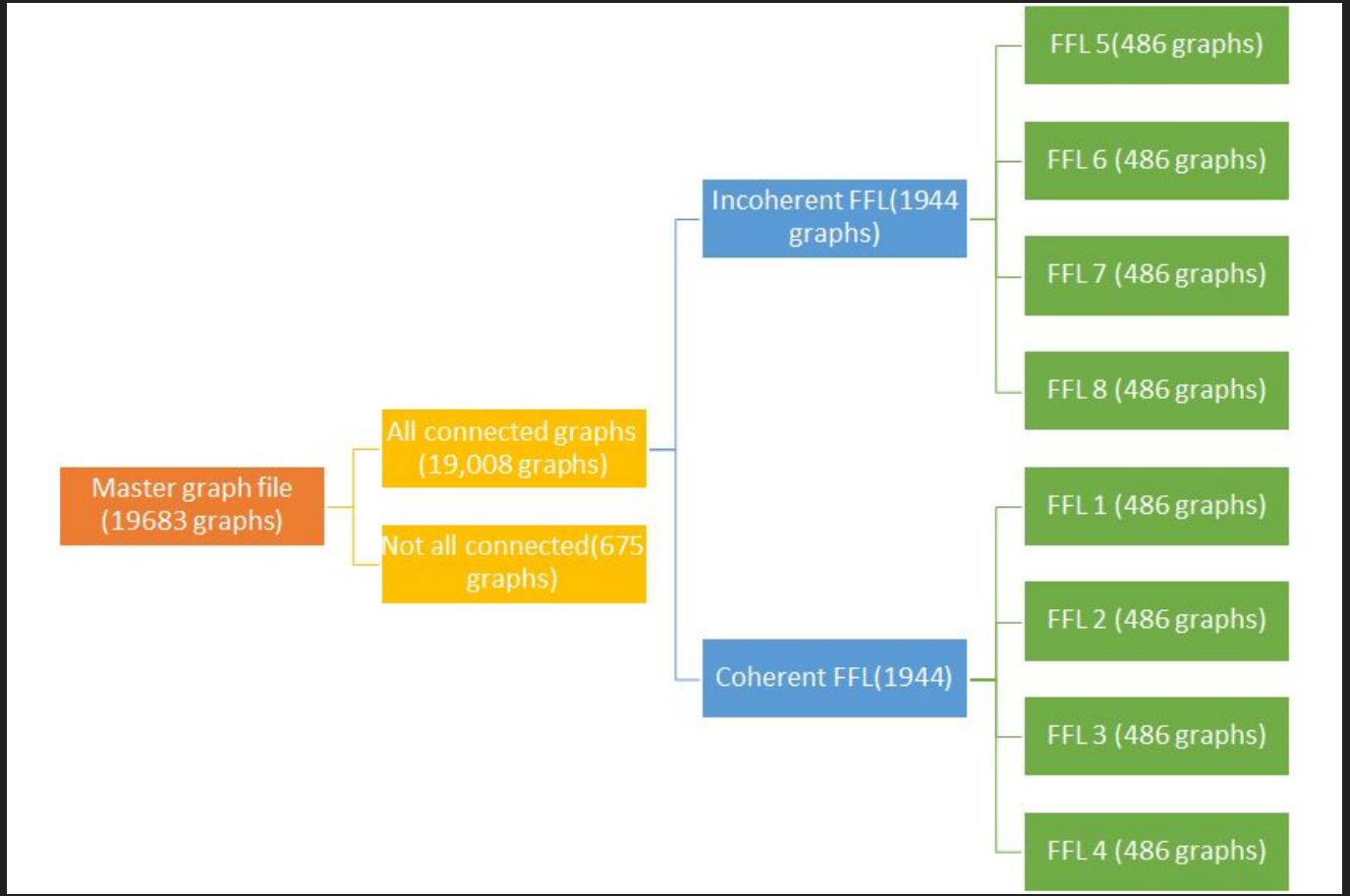


- direct
- Feed-forward
- Feed-back
- Coherent
- incoherent

Grouping the graphs

Total number of 3-node networks:19683

We looked for interesting motifs that could help us classify networks by persistence strategy



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Takeaway and Next Steps

- Group by Characteristics
  - Patterns exhibiting certain traits(EFR)
  - Number of FFLs, FBLs, Coherent, Incoherent
- Network Behavior & Dynamics
  - Analysis beyond architecture via modelling
- Expand Beyond 3 Nodes
  - Are the patterns observed for 3-node diagrams present at higher level network topologies?

Acknowledgments

I would like to thank both my advisers Dr. Mainzer and Dr. Mittenthal, as well as the National Center for Supercomputing Applications, the Informatics Department, and the Office of Undergraduate Research.

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