GOTChA chart for the extended information flow methodology

Goals:

- Extend and develop the theory of information flow to the interconnected, discrete transition systems with interface constraints.
- Improve tools from graph theory, control theory, dynamical systems theory to develop algorithms for analyzing and generalizing information flow.
- Apply the above results to vehicle management systems, energy management systems and cooperative control of multi-vehicle systems.

Technical Challenges:

- The direction of discrete transition systems is relatively unfamiliar to me. How do I learn the definition of such systems and understand their properties?
- How do I learn more about temporal logic and the ways of synthesizing a control protocol to ensure that the behavior satisfies a given specification?
- I am not sure if these are the right applications? And how do I explore the potential applications of the theoretical results?

Objectives:

- Develop a definition of stability for interconnected, discrete transition systems that captures gossip algorithms and load balancing as special cases.
- State and prove a theorem that gives necessary and sufficient conditions for stability of an interconnected, discrete transition system in terms of the topology (graph structure) of the interconnection and the temporal properties of the transition system (in LTL or some other temporal logic).
- Demonstrate the applicability of the theoretical results to at least two different examples; candidate examples include leader election and load balancing.

Approach:

- I am going to find some references on DTS and work through them such as the papers on *contracts for the design of embedded systems*, *introduction to discrete event systems*-second edition. Springer, and so on.
- Before I arrive, I will learn the course "*Specification, Design, and Verification of Distributed Embedded Systems*" according to the slides on the web. I will continue to take some corresponding classes at Caltech after I arrive.
- I am going to read more references on real interconnected discrete transition systems, such as vehicle management systems, to understand their characteristics. And I will read more papers on some concrete cases, such as leader election, gossip algorithms and load balancing, to further explore the potential applications.