

## Assignment 4: Conceptual Transfer

*Instructor: Profs. Feamster/Gray**College of Computing, Georgia Tech*

*This assignment is due on **Wednesday, November 22, 2006 at 11:59 p.m.***

## 1 Purpose of this Assignment

In Assignment 2, you began exploring a way of coming up with new ideas, by combining papers from disparate and sometimes seemingly unrelated fields. This approach operationalizes what Prof. Lipton referred to in his lecture as working “at the gap” between two areas.

In assignment 2 we (deliberately) didn’t specify exactly how the combining was to be done. In this assignment you’ll explore a powerful variant of this: applying a *concept* or tool from one area to another to either

1. create an *analogous* concept in the second area
2. illuminate an existing *open problem* in the second area

This is how many ideas which have revolutionized fields came about. This assignment is intended to provide practice in generating such “deep thoughts”. Such conceptual transfer may lead to novel insight or novel methods, or both.

## 2 Some Examples

An example of a deep analogy between fields can be seen in learning theory. The notion of sample complexity, or the order of growth of the error in approximating a certain kind of function as a function of the number of data, is analogous to the concept of runtime complexity, or the order of growth of the runtime of an algorithm as a function of the size of the input (or number of data). This idea leads naturally to interesting analogs of concepts such as complexity classes, lower bounds on complexity, etc. Such concepts have provided one kind of framework for thinking about how to compare different machine learning algorithms.

An example of applying a concept from one area to help understand a problem in another is the idea of Frank Kelly, who applied the theory of markets and economics to help explain how the Internet’s congestion control algorithm induces an equilibrium such that each host gets a fair share of bandwidth, and such that the capacity of paths are utilized. This work did not result in new protocols being deployed, but it did help network protocol designers gain a much deeper understanding of why their protocols worked.

### 3 Your Task

Every group has posted its breakdown of the fundamental concepts in its area, as well as some open problems in that area. Your task is to come up with an idea in one of the two ways described:

1. adapt a concept from one area to create an *analogous* concept in a different area
2. adapt a concept from one area to illuminate an existing *open problem* in a different area

The first and second areas can be any of the group areas, not necessarily your own. You may deviate from the particular concepts and open problems listed by the various groups if that see fit, keeping in line with our usual ground rules for generating ideas in this class - as long as you are keeping in the general spirit of the assignment setup, always feel free to break the rules however you need to in order to make a good idea.

1. Each individual is responsible for one idea, and should turn in a one-page writeup.
2. After each individual has selected some idea, each group should meet to agree on one idea, which may be a selection of one of the member's ideas or some combination of members' ideas, or a jointly created idea. The group should submit a one-page writeup, which in addition to arguing for the idea, should demonstrate input from the group as a whole. For example, if one member's idea was selected, there should be an explanation of why the group chose that idea versus the others.

As usual, the one-page writeups, or white papers, should try to argue for:

- the potential impact of this idea on the field
- the novelty of the idea - this implies a *literature survey* in which you place your idea in context with previous work in the field

This is the final idea you'll create in this class. All the ideas you've created will go into a pool which you will all review in the next assignment. The review criteria are threefold: how well you argued for your idea's impact, how well you argued for your idea's novelty, and how clearly you write your one-page white paper. The paper with the top reviews will win a c.v.-worthy prize. This is your last shot so give it a good go.

**This is perhaps the hardest assignment in the class. It will require some deep thinking!** Don't be intimidated - try. Furthermore, really try to create a truly good idea. You might invent your thesis topic during this exercise.

*There will be no presentation for this assignment.*