Mathematics – Special subject:

Category Theory for Scientists

Spring 2013, Course 18 – S996

Course information

Offered by:	David I. Spivak
Units:	12
Room:	2-131
Meeting times:	MWF 10am – 11
Workload:	Weekly homework and an oral presentation.
Course website:	`http://math.mit.edu/~dspivak/teaching/sp13`

Course description

This course will cover some of the fundamental notions of category theory, including:

- categories, functors, natural transformations;
- universal properties;
- limits, colimits, and adjoint functors;
- functor categories and sheaves;
- monads and operads.

Since this course is geared toward scientists, we will work as often as possible with applications that are simple but that show off the main features of the subject. In particular, we will ground our discussion in terms of information. Information consists of a conceptual framework, or *schema*, filled in with concrete *data*. The pursuit of conceptual models and supporting data could be considered a basis of the scientific method, and it also serves to ground a discussion of category theory. We will include applications to such fields as computer science, materials science, economics, and cognitive neuroscience.

I will also attempt to get across what I perceive to be the underlying principle, philosophy, or spirit of category theory, which might be expressed as follows.

> It is often useful to focus ones study by viewing an individual thing, or a group of things, as though it exists in isolation. However, the ability to rigorously change our point of view, seeing our object of study in a different context, often yields unexpected insights. Moreover this ability to change perspective is indispensable for effectively communicating with and learning from others. It is the relationships between things, rather than the things in and by themselves, that are responsible for generating the rich variety of phenomena we observe in the physical, informational, and mathematical worlds.