# Term Project Information
# CS 860 — Fall 2008
Jonathan Buss

### Purpose of the project

A major intent of the term project is to help you develop your research skills. You will find references, you will read, correlate and critique previous work, and you will have some ideas of your own.

The Web will likely be a major resource, but use it with care, and don't neglect other sources. Not everything useful is on-line, and not everything on-line is correct. When you cite something, you claim that it is valid.

I have listed some possible avenues for investigation below. You may find that you end up with a project different than the one you had in mind at the start. If you found something interesting, great!

### Project outlines

Hand in an outline of your project by Tuesday, November 11 (in class), or earlier if you have a topic. Describe in three or four **double-spaced** pages (about 700–1000 words) what you plan to do for your project. Be as specific as you can; give the topics you will cover and explain how you will treat them. Include a preliminary bibliography.

I will check your outlines for suitability of the project and for your ability to explain it. Style, grammar and spelling will form part of my judgment. I will return unsatisfactory outlines for revision (including single-spaced ones). I will not accept your final paper unless you previously submitted a satisfactory outline.

### Final papers

Submit your papers by noon on Tuesday, December 16. A typical paper will be approximately fifteen to twenty-five **double-spaced** pages in length. I will look for content and presentation much more than length.

## Expected content of the paper

When reading your papers, I will hope to find some contribution from you. Originality can take many forms—choose from my list or do your own thing.

- Summarize or give a better presentation of results in the literature. Usually, the first presentation of a result is not the simplest possible. Also, important ideas may develop over time rather than appearing in any one place.
- Compare and contrast two or more different approaches.
- Expose and perhaps correct errors in published work. (Even famous people can make a mess of things.)
- Suggest new approaches or possible avenues of investigation. If you discover that your ideas don't work, report on that.
- Do something new. Feel free to speculate on what might be possible, but make sure to differentiate between conjecture and proof.

Note that quoting or paraphrasing previous work does none of the above. Quoting and paraphrasing do have their appropriate uses, but they don't count toward originality. If in doubt, try to err on the side of quoting too little. Definitions, theorems and so forth do need to be stated precisely and accurately, but that doesn't require quoting.

Cite any use you make of any source, unless the information is "general knowledge" (within the context of computational complexity). Other people's inspiring ideas and lucid explanations require acknowledgement just as much as theorems and quotations do.

**Some possible areas of investigation**

The topics listed below are but a subset of the possibilities. If you have some other area that you'd like to investigate, I'd be happy to discuss it with you.

1. Investigate the relationships among expanders, extractors, and error-correcting codes. Summarize and critique recent work; suggest possible further avenues or ideas.

2. Investigate the use of Kolmogorov complexity and the universal distribution in the theory of machine learning. Summarize and critique recent work; suggest possible further avenues or ideas.

3. Investigate the construction of random graphs, especially regular graphs. How should one test a randomly generated graph for expansion, or a similar property? What size of graph can one feasibly handle? How might one make improvements in construction or testing?

4. Do the methods and analyses of pseudo-random generators that we have seen in the course apply to "Monte Carlo" computations? Are extractor-based generators used in practice? Should they be used, or considered for use?

5. Chaotic systems are sometimes recommended as pseudo-random generators. Do they have any useful complexity-theoretic properties? Conversely, do pseudo-random generators (or families of generators) qualify as chaotic systems?

   (This one is rather speculative; I don't know whether or not there's anything much to say here.)