

REQUIREMENTS FOR FINAL PROJECT

The final project will be worth 30% of your grade. Its purpose is to examine a non-trivial application or use of linear algebra. You may work in groups of up to 4 people, but each person will submit their own write-up, written in their own words. The submission should have the following three parts:

i) **Introduction** - (up to 5 pages)

In this section you will qualitatively explain the application you are looking at, why it is important, and its various uses/limitations.

For example, you may be looking at various ways of measuring whether a matrix is well-conditioned (sensitive to small numerical perturbations). This is important because many industrial applications involve row-reducing large matrices - this arises for instance in solving differential equations. Here you would give a few concrete examples of this. You would perhaps also illustrate industrial failures/errors that have arisen because of bad conditioning (like spacecraft that have gone missing etc.). You may also explore whether there is a way of getting rid of these errors completely.

ii) **The mathematics of your application** - (pp to 10 pages)

Here you describe the mathematics behind your application, give examples, and show how the linear algebra concepts we have been studying are applied.

In the above hypothetical example, you may study different conditioning schemes. You would give a precise description of the different algorithms you are looking at, illustrate their differences on some small examples, and discuss their strengths/weaknesses in precise terms. You may discuss computational complexity issues (i.e. one algorithm requires more space/time than another etc.).

iii) **Implementation**

This would typically be done in Maple. The purpose is to illustrate a few non-trivial computational examples of your application. You may write some code/routines or simply carry out a few computations. Note that while the examples in part 2 are “toy examples” meant only to

illustrate the concept, the ones in this section should be non-trivial. If you are not familiar with Maple, it has a variety of on-line tutorials.

Suggestions:

One place you may start is the website:

`http://www.laylinalgebra.com/free_site/case_studies/cs_index.html`

which contains a number of case studies/applications. Note that this is only a starting point. Other possibilities include:

- page-ranking algorithms, such as the one used by Google
- applications to cryptography - linear algebra over finite fields
- applications in economics, such as game theory
- predator-prey models with multiple species
- different numerical algorithms for solving differential equations