COMP9596 & COMP9945 RESEARCH PROJECTS

1. Doing one of COMP9596 and COMP9945

If you are a student enrolled in the Masters of Computing and Information Technology (program 8543 MIT), then you have the option of taking a 12uoc research project (COMP9596) or an 18uoc research project (COMP9945) as a replacement for 2 or 3 courses, respectively. Additional constraints are:

- The project must be undertaken in the final semester of study.
- You must not have failed any course during your enrolment in a CSE program.
- You must have a distinction average at the time of applying for the project.

You must obtain agreement on a research proposal from a CSE or NICTA academic supervisor before you submit your application. You might have more or less precise ideas on what project you would like to work on and discuss those ideas with the supervisor, until both of you eventually converge to a precise topic that might be very close, rather close or not close at all to what you first had in mind; or you might just want to do research in a particular area, with no view on what the work would involve, and ask the supervisor whether he or she would have a suitable project to suggest. For the more practical topics, the research might also be a group project, where 2, and exceptionally 3 students will have to work in a coordinated manner.

It is important to determine which of COMP9596 and COMP9945 is more suitable. Of course, depending on how much coursework you want to do, you might have a preference for one over the other. But it is essential to eventually make sure that the expected workload is consistent with 12uoc in case you apply for COMP9596, and with 18uoc in case you apply for COMP9945. We expect that you spend at least 10 hours (that is really a lower bound...) of study a week for 6uoc. For standard courses, that includes attending lectures and possibly labs or tutorials. As we have rather high expectations on students undertaking a research project, you should expect to spend around 30 hours a week, and possibly more, on a COMP9596 research project, and around 45 hours a week, and possibly more, on a COMP9945 research project, which includes regular meetings with your supervisor. In case of group projects, these figures apply to all members of the group taken individually... Your supervisor is best placed to estimate the expected workload and make sure that your project is consistent with which of COMP9596 or COMP9945 you apply for. This issue will also be closely considered by the Postgraduate Coursework Academic Advisor who processes your application.

2. The research proposal

Your application should include a precise and detailed research proposal, that will on average require 1 or 2 pages of text, possibly including diagrams. The length of the proposal is not of paramount importance. What is essential is that it be very clearly and very precisely formulated. Here are the key points that your proposal should address.

- What problem will you tackle? Is the research theoretical, practical, or does it mix theory and implementation?
  - If the research is theoretical, then you are expected to express in a suitable theoretical framework significant statements, whose proofs are nontrivial and properly written. An example of such a result would be the precise description of a new algorithm that solves a given problem, a statement on the running time complexity of the algorithm, and a nontrivial proof that justifies that statement. For the work to be significant, the underlying problem should be known to be important, and the algorithm should have advantages over existing ones, being either more efficient, or no less efficient but markedly more elegant, or simpler.
  - If the research is practical, then you are expected to deliver a stable, well designed, well tested implementation of a system that could be released as beta software. As this is a research project, there should be challenges to solve before you can proceed with the implementation. For instance, you might have to modify some data structures or algorithms in a nontrivial way to perform some crucial computations. For the work to be significant, it should be known that there is a community of potential users who would be keen to try your system to address some of the needs they have, and your implementation should have advantages over existing ones, being more powerful, or more user-friendly.
  - If the research mixes theory and implementation, then you would typically improve an algorithm that is known to have important practical use, and accordingly modify an existing implementation, or implement a prototype. The modifications to the algorithm would not by themselves be substantial enough and the proof of correctness of the algorithm, or the proof that is has such and such complexity, would not be difficult enough to result in a successful theoretical research project. Also, the implementation would not be challenging enough to result in a successful practical research project. But taken together, theoretical results and implementation would require substantial work and validate the interest of the approach.

  It is definitely not enough to use existing techniques on a given problem and determine which one performs better on the basis of experimental results. Though this kind activity could be part of a research project, it would not be enough to fully qualify the work as research, whereas you are expected to complete a full fledged, comprehensive piece of research. Hence it is essential to pitch the difficulty of the

project at the right level, neither too easy nor too challenging, and make sure that you will have to demonstrate enough creativity, inventiveness, cleverness, rigour, knowledge, and more, but within the limits of what you can achieve in less than 5 months of work.
- Why is the problem you want to tackle significant, what tells you it is an important problem?
- What are the limitations of the current approaches, what do you claim your research will bring to the current state of the art?
- What do you expect your research to deliver, in terms of theoretical results or implementation? By its very nature, research is unpredictable, and the outcome of your research might be significantly different to what you had envisioned. What will be evaluated is the outcome itself, and not whether the outcome matches what you had envisioned. But it is important when you write your proposal to have views on what are the significant and achievable aims that will first guide your research.
- What are the fundamental features of your approach? Successful research usually starts with one or two very good ideas, that appear as promising and fruitful. You should be able to express these ideas as clearly and precisely as possible, so that interested readers can appreciate their potential.

Writing a good research proposal is essential to put your research project on the right footing. The exercise will help you considerably in getting a clear picture of the work that lies ahead. It is likely that you will have to go through a number of drafts, discussing each of them with your supervisor, before you write and submit the final version. If your research proposal is not good enough, then the Postgraduate Coursework Academic Advisor will not approve your application. If your application is successful, then an assessor will be assigned to the project, who together with your supervisor, will eventually evaluate your work and assign a final mark.

3. The written report and the seminar

Your work will be assessed on the basis of both a project report and a seminar.

By default, the project report is expected to be submitted by Friday of week 12 of session. If you need more time to complete the work, then you may submit the report up to seven weeks after the conclusion of semester. No formal application for extension is necessary if you meet that deadline, but if you intend to submit after week 12, then you should notify the Postgraduate Coursework Academic Advisor and the Postgraduate Team of the Student Office of your intentions by email (sent to emartin@cse.unsw.edu.au and postgrad@cse.unsw.edu.au). Still note that in case you complete the project during the second semester of the academic year, taking advantage of the full seven week extension may delay graduation, so if graduating as early as possible and attending the graduation ceremony is important to you, please contact the Student Office to find out how many

weeks of extension you can afford. The seminar will be given after you have submitted your report and supervisor and assessor have been given enough time to read it. Send an email to both asking for their availability and agree on a day and time. When an agreement has been met, and a room has been booked (ask your supervisor to assist), inform the Postgraduate Coursework Academic Advisor and the Postgraduate Team of the Student Office of the day, time and place where the seminar will take place.

Lots of efforts and time have to be put into writing the report. Do not wait till you get to the end of session to start writing it; instead, keep writing as you make progress in your research. First, writing considerably helps in clarifying one's ideas, detecting mistakes in some arguments or flaws in some approaches, suggesting extensions or further developments, etc. Second, you are most likely not to express your ideas or results clearly and precisely enough the first time you write them down, and you will have to produce many versions before you can be satisfied with the outcome. As indicated below, the quality of your report weighs a lot in the final mark. You might have produced excellent results; if they are not presented in a very clear, accurate, rigorous and precise manner, then you will loose many marks. Actually, if you do not have good writing skills then you should not consider a research project and rather do courses that require different kinds of skills, as you will otherwise most likely be considerably disappointed with the final mark. Keep in mind that conveying one's results properly is as important as getting good results; your work, be it theoretical or practical, will not be valued as you might hope it will if it is not described properly because your writing skills are too poor or your writing style is imprecise or lacks rigour. Here are the key points about the report.

- You are strongly encouraged to use Latex and not Word. If you have to write some mathematical formulas, even only very few of them, consider that Word is not an option. There is no specific requirement on fonts, layout, structure, etc.
- The length of the report is not relevant. What is expected from the report is evidence that you can address a scientific or technological matter clearly and precisely, from describing the problem to explaining the proposed solution and evaluating the benefits and limitations of your approach.
  - If your research is theoretical, then the report will include all the results you have obtained, described with complete details and aiming at maximum clarity. Besides reporting on your results, you should include some background, but no complete literature review is expected. You will not provide an overview or describe the state of the art of a whole field, but only refer to the literature and explain the fundamental concepts and results that are strictly necessary to describe the problem you have tackled, explain where your work fits with what was known about the problem, and explain the concepts and results that you have used to conduct your research. This should not necessitate to refer to more than a few papers, definitely less than a dozen.
  - If your research is practical, then the questions of "what to write" and "how much to write" are more meaningful. The report is not meant to include

every implementation detail, and certainly not include appendices of program code. You should describe the needs that your implementation is meant to address, the main features and weaknesses of existing software designed for that same purpose, and what your approach provides that was not available so far. The report should include a clear and precise description of the main challenges that had to be solved, and of the solutions you came up with. So besides explaining what your work is about, what has been achieved and how your implementation compares with known alternatives, the report should focus exclusively on that part of your work where the true research really is. Reference to the literature is expected to be more limited than for a theoretical piece of work. It is understood that your main aim is to impress supervisor and assessor with a clever implementation, and not with a thick report.

Plan for a one hour seminar, with between half an hour and 45 mns devoted to your presentation or software demonstration, and the rest of time left to answer questions. For a practical project, the seminar is absolutely essential for demonstration purposes. Prepare carefully how you will present the features of your system, and be ready for using it as requested by the supervisor and assessor. For a theoretical project, you will want to explain the key ideas, without going over all the details that have been included in the report; whereas the report should demonstrate your ability to work at a low level of detail, the seminar should demonstrate that you can show "the big picture." For all kinds of projects, the seminar gives the supervisor and assessor a chance to ask questions on the report.

4. The assessment

There are 3 components to the evaluation of your work.

- The **significance and difficulty of the outcomes** (theoretical results, implementation) count for 70%. They will reflect how much hard work you have invested in the project and how much creativity and cleverness you have demonstrated in your work. To get high marks for that component, you will need to have obtained significant results with difficult proofs, or a stable implementation that required to overcome difficult challenges.
- The **quality of the written report** accounts for 20% for a purely theoretical project and for 10% for a purely practical project. For intermediate projects, supervisor and assessor are free to choose a weight in this interval that they think is appropriate. To get high marks for that component, you will need to have described the background, explained your results, and evaluated your approach very clearly, precisely and thoroughly.

- The **quality of the presentation** accounts for the rest, hence 10% for a purely theoretical project and 20% for a purely practical project.To get high marks for that component, you will need to have impressed the audience with the system you have built, and have made everyone get a clear picture of what you have achieved and what contribution you have made to the problem you have tackled.