THE EXAMINATION OF POST-GRADUATE THESES:
A DISCUSSION OF REQUIREMENTS FOR POST-GRADUATE THESES IN THE DEPARTMENT OF COMPUTER SCIENCE, MONASH UNIVERSITY

A.Y. Montgomery
Monash University

My purpose is to outline some current problems relating to the examination of post-graduate theses at Monash University. The discussion, as well as being of general interest, may well be of value in other Computer Science departments in Australia and to the maintenance of the standard of their post-graduate programmes compared to those of overseas universities.

Introduction: Monash Regulations

> ***Degree of Master of Science Regulations***
> *5.1.1 The candidate shall submit a thesis embodying the results of an investigation carried out by him, under supervision, showing independence of thought and demonstrating the candidate's ability to carry out research in the field concerned.*
>
> ***Degree of Doctor of Philosophy Regulations***
> *4. Subject to and in accordance with these regulations, the degree of Doctor of Philosophy shall be awarded for a thesis, which in the opinion of the examiners is a significant contribution to the knowledge or understanding of any field of study, with which a faculty in the University is directly concerned and which demonstrates the capacity of the candidate to carry out independent research.*

Independence of Thought

As stated in the introduction, the Monash MSc. regulations require that "independence of thought" needs to be exhibited by the candidate in the thesis. This, of course, is difficult to evaluate, but should be made less so if the candidate clearly states which part of the work was of his or her own invention and own doing and, if he or she has some new approach, why this way is to be preferred. In my opinion, the requirement to indicate independence of thought should not be interpreted as requiring or inviting the candidate to slate all previous contributions to the field, even if such assertions can be proved by his or her work. Suffice to say it is not entirely a simple matter to assess the degree of independence of thought from a piece of written work, but if a supervisor bearing this criterion in mind has been happy to recommend that a thesis is suitable for examination, this should, I believe, be used as a starting guide.

Significance & Originality of Contribution

The Monash regulations governing the Ph.D. degree require that the candidate make *a significant contribution to the knowledge or understanding of any field. . .*

The Concise Oxford Dictionary gives as the definition of "significant": *noteworthy, of considerable amount or effect or importance.*

Frequently examiners equate the significance of a piece of work with its originality.

The Concise Oxford Dictionary gives the following definitions of the word "original":

- first hand
- not imitative
- novel in character or style
- inventive
- creative
- thinking or acting for oneself

The question arises "significant to whom and at what time?" My belief is that, if the candidate can demonstrate:
(a) That he or she has thoroughly researched and evaluated all literature available up to the time of **commencing to write up,**
(b) That if at the time and place of the commencement to write up, the contribution was original as certified by the supervisor, then the contribution **was** at least original even if not significant. What other guide can the examiners be expected to use than the advice of a supervisor as to which material was available to the candidate?

The criteria (a) and (b) above) are not currently used at Monash and in my view should be.

Now I am not suggesting that the supervisor's judgement should be final as to significance; the assessment of the thesis should continue to rest with the two external examiners. But the examiners should be guided by the supervisor's indication that the candidate could not reasonably have had access to other material which would have improved that candidate's knowledge of other researchers' work.

The time of commencement of write up is the appropriate time since, after that time, it is unreasonable to expect that a candidate will commence new experimental work to verify or deny material received from other sources. Since write up commencement is such an important time it should be formally recorded by the supervisor, department and university. This criterion will help to reduce the number of extensions sought because of new work coming to hand after write up has commenced. Finally, is it reasonable for a person "writing up" away from university to meet any other criterion than the one suggested? For equity, therefore, that timing should be applied to all.

Once there is a clear cut-off date for original work defined, there are still further definitional problems to be overcome. It is of interest to examine the wording of the current Ph.D. regulations of other Australian universities. There are variations in the wording which may or may not be intentional. These quotations (except where noted otherwise) are from the relevant universities' regulations governing Ph.D. examinations:

Melbourne University:
(Computer Science Departmental Handbook)
"Significant original contribution to knowledge —"

The Australian National University:
"Examiners are invited to judge a thesis at the highest contemporary standard for European and North American Universities" . . . "the candidate must make a substantial contribution to learning."

University of Newcastle:
". . . significant contribution to the knowledge of the subject."

Flinders University:
". . . containing a significant contribution to knowledge or scholarship . . ."

University of Sydney:
". . . a substantially original contribution to the subject concerned."

University of Western Australia:
". . . substantial and original contribution to knowledge of the subject with which it deals."

University of New South Wales:
". . . an original and significant contribution to the knowledge of the subject."

But note also the DSc. regulations for the University of Melbourne, which state, inter alia, *". . . the work must be original and must be a substantial contribution to the knowledge and understanding of a branch of Science."*

Are we to believe that the wording "substantially original" is intended to mean the same as "substantial and original"? And are contributions to "knowledge", "learning", "scholarship", the "subject concerned" and "understanding of a branch of science" all to be interpreted as equivalent, in the minds of examiners? None of the guidelines, except perhaps those of the Australian National University, indicates the meaning of the terms substantial, original, etc , and ANU suggests that the highest contemporary European and North American standards be used as a basis for judgement. But ANU regulations do not prescribe that both examiners should be from overseas; and if the examiners are not both from overseas how likely is it that they would have up-to-date knowledge of overseas standards since most of us are not able to travel to overseas conferences and talk to the people there except on very rare occasions? Nor are we in sufficiently frequent correspondence with people overseas to be aware of their current standards.

Without such regular contact is it possible for local examiners to have the same perspective or knowledge base as those overseas? How can we be aware of an appropriate interpretation for "highest contemporary standard"?

So the major criterion for assessing the degree (namely that of significance) is poorly defined: I believe that the definition is unclear within universities and not commonly agreed between academics in disparate universities.

Another factor which affects the assessment of originality is the question of whether, and at what time, reference material was available. Knowledge about the availability of reference material is a continuing source of problems for and from examiners, particularly those overseas. How can an examiner assess what reference material the candidate should reasonably have garnered, since what is reasonable depends upon the financial and information resources of the candidate and the department within which he was working? Is it reasonable to expect that every department should be aware of (even the title of) every Ph.D. or Master's thesis worldwide relating to the topics of theses in hand? If one only refers to the work in the open literature, most of which has its source in the U.S.A. or Europe, with publication and postage delays there is sometimes a delay of three or four years from the completion of a research report to its appearance

in an Australian library. If reliance is placed upon only those works appearing in the open literature, it is not surprising that several people around the world should be investigating the same or closely related problems at overlapping times. Is it reasonable to expect that work done in Australia should be significant/original to overseas workers at any time during the (typically) four-year period outlined above, because such a time span could apply where an examiner is chosen who is at the very forefront of the field? In my view, it is not, and the criterion should be "the work will be judged significant/original by comparison with work by other authors which might reasonably be expected to be available to the candidate **at the time of commencing writing up.**"

At Monash we have had some particularly vexing cases where overseas examiners have criticised Australian Ph.D. material on the grounds that reference was not made to works judged relevant by the examiner. In some of these cases on careful scrutiny by an independent reviewing panel the works (authored by the examiner!) were found to be **not** relevant. On another occasion the examiner expected that the candidate should have assessed his or her work in the light of recent theses by the examiner's students. There is a moral here: that the supervisor should select examiners well in advance of the completion of the local thesis and obtain copies of all relevant material from the examiner's department to prevent repetitions of such a situation.

One way to pre-empt these situations is, of course, for the supervisor to goad the student into obtaining theses and reports on all relevant topics from all possible sources. Literature searching using INSPEC, Science Citations Index, etc., is a "must", and a supervisor should ensure that the student writes away for copies of hard-to-get reports. Most Ph.D. and Masters theses in the U.S.A. are listed in Dissertation Abstracts International. Usually copies of theses or reports can be airmailed direct from the departments concerned with delays of only four to five weeks if the report/thesis is available. Paying for such material is a legitimate charge against departmental maintenance grants. Nevertheless, sometimes reports are not made available to local researchers either because of copyright embargoes (preventing the publication of the material before the passage of time), inter-departmental rivalries, commercial secrecy, or total failure to respond to requests. We have suffered all of these situations which indicates that a section of the thesis should report, where appropriate, the titles and sources of material which were thought to be relevant and the reasons they were not accessed. Thus, the student should at least include in his or her thesis references to unobtainable works and summaries of reports received too late to be incorporated into the body of the thesis.

The question of significance/originality is a particularly unhappy one when comparison is made with the work required of Ph.D. students in some other science and non-science disciplines at some universities. It is not uncommon practice in some disciplines to apply a well-developed and documented methodology to yet another slightly different situation, which, although requiring some originality to overcome some minor hurdles, mostly requires considerable application; a parallel might be drawn to the writing of yet another FORTRAN Compiler for yet another machine. By the standards of other science disciplines, I believe we should be aware that we are expecting a very high standard of our computer science candidates (Ph.D. in particular).

I am **not** suggesting that the standard be reduced. What I am requesting is that the standard be clearly defined, for the great benefit of all concerned: supervisor, examiner and candidate. And students should be made aware that the standards ar tough.

Some Insights into Expected Standards from Past Experience

After reviewing the reports of a range of overseas and local examiners, I see that examiners expect that Ph.D. candidates, if they write a program, must relate the programming work to some theoretical contribution, showing how the principles developed in the program are more widely applicable. We should remember that the programming work for many overseas Ph.D.s is done by professional programmers funded by a Research Grant, or by undergraduate students, and definitely not by the Ph.D. himself. Examiners also expect students to measure the performance of the program and compare it with other methods. In this latter context it would not generally be considered sufficient to simply measure the performance of established techniques; the presentation and comparison with some alternative proposal which appears prima facie superior (I believe most examiners would still accept such comparison were the proposed method to turn out to be **inferior** when actually measured) is necessary.

Candidates for a Masters degree are generally expected by examiners to illustrate the capability to get a practical, though not predominantly original, system working. At Monash the minimum period of full-time MSc. candidature is one year. In such a time demonstrating a grip on the field, relating the proposed work to that of others and implementing some system within one year is indeed a tight schedule. Nevertheless, in the past both local and overseas examiners of Monash theses have shown themselves unwilling to accept the implementation of a half-working program or the adding on of a few new facilities to a system which was substantially working already, as being a sufficient piece of work. Examiners seem to demand some novel content, even in a Masters thesis, and such novelty is not considered to have been demonstrated by simply documenting design decisions made, unless such decisions are compared with, contrasted with, or extrapolated from established techniques. Indeed, there needs to be some specific research objective sought in designing or building the system in the first place. The hypothesis being tested might simply be that there are better ways to design or build the system concerned; if such is the hypothesis, evidence should be given that the hypothesis has been proven or disproven.

The insights above are sparse but do shed some light on the relationship between writing programs and the work expected in Computer Science Post-Graduate Theses.

Ph.D. & Masters Proposals

One way for students and supervisors to ensure that the work to be done will have the appropriate significance or demonstrate the required independence of thought is to insist on the candidate writing a Research proposal and to have that **proposal** assessed before work is commenced. This is the recommendation of Lauer[1] and leads to a situation where, although much preliminary work may have been done to familiarize the student with the field, experimental or implementation work is not commenced until some assessors, who will very probably be the final examiners, agree that the work proposed, if completed and written up successfully, will most likely lead to the awarding of the degree. Such a proposal should be written up after six months of study for a Masters candidate or one year of study for a Ph.D. candidate, and should ideally be supported by an oral presentation of the proposal to the examiners.

The components of such a research proposal recommended by Lauer are:

- A statement of the problem and why it should be solved
- Reference to and comments upon relevant work by others on the same or similar problems
- The candidate's ideas and insights for solving the problem and any preliminary results he may have obtained
- A statement or characterisation of what kind of solution is being sought
- A plan of action for the remainder of the research; and
- A rough outline of the thesis itself.

Following the completion of the written manuscript, the candidate would benefit greatly from once again making a formal oral presentation giving an overview of the work actually completed, highlighting the objectives and the conclusions drawn from the work.

Conclusions & Recommendations

The conclusions I draw from this brief survey (and not strictly following from the evidence presented) are:

(1) That there would be great benefit in defining more closely:
- The contents of a thesis.
- The criteria of thesis judgement both Ph.D. and MSc.
- The criterion of originality to be by comparison with works reasonably available to the candidate up to the time of commencement of writing up and, consequently,
- The formal recording of that time.

(2) That students and supervisors would both benefit from having available to them clearer specifications of their various roles.

(3) That a thesis proposal should be written **and assessed** before formal detailed experimental work be commenced.

(4) That Australian academics would do well to reach understandings as to the standards of thesis content and presentation expected by various universities, if the standards are to be consciously different, or on a common standard if this is deemed worth while.

Acknowledgements

Several members of the Monash Computer Science Department and Professor J.M. Bennett of the University of Sydney made valuable contributions to this work. Many Australian computer science departments assisted by providing their Post-Graduate Regulations and details of other material made available to supervisors, examiners and students.

Copies of a more extensive paper including detailed suggestions on guidelines for students[2] are available from the author.

References

1. Lauer, H.C.: "On Ph.D. Thesis Proposals in Computing Science," in *Computer Journal*, Vol. 18, No. 3, 1975, pp. 279-281.
2. "A Handbook for Ph.D. Students", Monash University, Jan. 1977.