Notes on the draft proposal for a benchmarking statement for Masters-level degrees in Computing in the UK

My general comment is that this is a product of a philosophy that tries to control academic developments and practices far too much "from the centre" instead of depending on the professional competence of external examiners and advisory boards (in some cases industrial advisory boards) to ensure that standards are maintained.

Fortunately our coalition goverment claims to be in favour of reducing centralised control. So perhaps they can be encouraged to dismantle the QAA or at least give it a much reduced role.

What follows is in two parts

A. A short message about the draft benchmark sent to cphc and ukcrc mailing lists in case the opportunity to comment on it had not been widely enough advertised. This has caused some people in other departments to read the document and circulate some comments.

B. My own detailed comments on the draft.

I think they whole thing needs to be done in a quite different style, with more clearer acknowledgement of the scientific, as opposed to the engineering, aspects of computing, and the diversity of functions that Masters degrees can have.

Apologies for poor formatting. This is available in two forms:
http://www.cs.bham.ac.uk/research/projects/cogaff/misc/qaa-computing-masters.html
http://www.cs.bham.ac.uk/research/projects/cogaff/misc/qaa-computing-masters.pdf

I typed in the html version (with a purely textual layout) and used html2ps and ps2pdf to generate the pdf version.

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A. Message sent to ukcrc+cphc about the draft

http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/Computing10.pdf

Points that struck me on a first quick reading:

Like many documents produced by computing professionals, including responses to consultations about what should be taught in schools, this has an excessively narrow view of computation as connected with computers and computing technology (and the science thereof), ignoring the large and growing amount of teaching and research on other forms of information processing, e.g. in evolution, in metabolism and other biological processes close to the cellular level, in animal learning and development, in perception, in communication, in ontology development, in problem-solving and reasoning, in generation and control of behaviour.

There’s no mention of work on novel forms of computation: e.g. chemical computation, quantum computation and other things in the remit of UKCRC Grand Challenge 7:

    http://www.cs.york.ac.uk/nature/gc7/

There’s also no mention of important philosophical issues either raised by computing or advanced because of developments in computing -- e.g. the connections between old philosophical problems about causation and the causal roles of virtual machinery; or the potential relevance for old philosophical problems about mind body relationships.

Those are not topics that can be left to other departments: at present most of the other disciplines lack the knowledge and competences required for deep theorising about information processing systems if left to do it all on their own.
(That may change in future.)

There is similar narrowness of vision in the undergraduate computing benchmark which caused considerable dissent when it was first produced in 2000 -- last revised in 2007 http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/computing07.asp

Though it does include a contrary view in the paragraph on AI.

(It still promotes the view that the notion of ’architecture’ in computing refers only to hardware.)

The masters document makes no mention of "conversion" masters which played a very important role in computing education in the UK after about 1984 (when they were initiated under the auspices of the Alvey Programme) and should not be allowed to die, even if there are no longer earmarked studentships for them. There are still graduates in other disciplines willing to enrol in such degrees even if they have to pay themselves, and this is an important source of researchers with cross-disciplinary knowledge and competences.

The current draft will probably raise additional concerns for many CS departments with an interest in masters degrees.

I expect the ’industry’ viewpoint will mostly be different, though some of the leading industrial research groups will share some of these concerns.

Anther colleague here has drawn my attention to the wikipedia entry

http://en.wikipedia.org/wiki/Computer_science

which shows much greater breadth of vision than many documents about computing, including quoting Dijkstra: "Computer science is no more about computers than astronomy is about telescopes."

[end of message to ukcrc+cphc]
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Note added 19:50 GMT 17 Dec 2010

I think the QAA is likely to be dismantled along with other forms of central control, leaving universities the task of regulating themselves and one another.

That’s all to the good, as long as the diversity of universities is acknowledged -- not all are, or need to be, examples of the traditional type of university, namely a centre for leading edge research, doing teaching that is informed, if not always by the content of that research, at least by the experience of doing it.

There are now other kinds of university (previously called Polytechnics) in the UK, whose tradition is closer to teaching and technology transfer.

It is quite reasonable that the two sorts of university should provide different sorts of bachelors and masters level degrees. There should be no attempt to try to force them all to fit the same mould -- not least because diversity is essential to effective research and education in complex and diverse societies with partly unpredictable future needs.

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B. Further comments on the draft Masters Benchmark proposal

General comment:

(partly repeating the above:)

The document says nothing about study of natural information processing, which should be, and will increasingly be, a major part of teaching and research in computing (as shown by conferences, workshops, books, journals). E.g. recent book by a professor at Imperial:

```
@Book
{shanahan-embodied,
  author = {Shanahan, M.P.},
  title = {{Embodiment and the inner life: Cognition and Consciousness in the Space of Possible Minds}},
```

```
  year = {2010},
  publisher = {OUP},
  address = {Oxford},
}
```

and a new journal related to that:

http://www.worldscinet.com/ijmc/

(along with many older journals).

Specific comments on the text follow.

My comments from now on are {{in double braces}} after extracts from the document.

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Foreword

> This draft new subject benchmark statement should be seen in part as a culmination of many years of effort, but principally it should be seen as a new and fresh initiative.

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It does not read like the result of many years of effort, and instead of reading like a new and fresh initiative it seems to be buried in an old and narrow view of computing and computing masters degrees.

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1.1 Computing is the discipline associated with the structuring and organisation of information as well as the automatic processing of that information. The application of ideas from computing underpins innovation across a wide range of activity, including engineering, business, education, science and entertainment. The application of computer technology has altered lives and its continuing impact will be felt into the future.

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This should be replaced by something closer to the text in the wikipedia entry, which shows a deeper understanding of what has been happening in computing in the last half century:

[BEGIN EXTRACTS:]

http://en.wikipedia.org/wiki/Computer_science

Computer science or computing science (sometimes abbreviated CS) is the study of the theoretical foundations of information and computation and of practical techniques for their implementation and application in computer systems. It is frequently described as the systematic study of algorithmic processes that create, describe, and transform information. Computer science has many sub-fields; some, such as computer graphics, emphasize the computation of specific results, while others, such as computational complexity theory, study the properties of computational problems. Still others focus on the challenges in implementing computations. For example, programming language theory studies approaches to describe computations, while computer programming applies specific programming languages to solve specific computational problems, and human-computer interaction focuses on the challenges in making computers and computations useful, usable, and universally accessible to people.

Despite its name, a significant amount of computer science does not involve the study of computers themselves. The renowned computer scientist Edsger Dijkstra stated, "Computer science is no more about computers than astronomy is about telescopes."

Computer science research has often crossed into other disciplines,

such as philosophy, cognitive science, linguistics, mathematics, physics, statistics, and economics.
[END EXTRACTS:]

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1.2 To maintain and ideally enhance the UK's capacity to innovate and to lead, companies and organisations need to be able to recruit well-qualified graduates who are at the forefront of developments in computing/IT and can play a leadership role in sustaining and enhancing such developments across the wide range of industrial sectors. Master's degrees in computing/IT are an important vehicle whereby this can be achieved.

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Add something like:

To ensure the continued growth and development of knowledge about natural and artificial information processing systems the UK also needs to ensure that some of its ablest students are introduced to the deep and difficult problems, concepts, techniques and discoveries in the field. Masters degrees can help to produce a stream of new researchers ready to begin PhD research. The need for this is particularly great since unlike the older scientific disciplines (e.g. physics, chemistry, biology) many new university students start CS degrees with very little knowledge of the subject. So they are correspondingly less well informed about the breadth and depth of their subject by the time they graduate, and less ready to begin PhD research.

There is also a deep need for "Conversion Masters" degrees, originally identified during the Alvey Programme around 1984. These degrees take in high calibre graduates in other disciplines and given them an accelerated introduction to a subset of Computing, usually culminating in a project which may relate to the topic of their first degree. These students are also much better suited to begin PhD-level interdisciplinary research than the bachelors degree graduates in the relevant subjects.

Some commercial/industrial employers also find it useful to have graduates with a deep understanding of more than one field, with a masters level of maturity.

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The European context

1.6 ...
The Bologna Process is intended to promote student and staff mobility across Europe and to enhance the attractiveness of European higher education worldwide.

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It is important NOT to require ALL degrees to give top priority to the mobility goal, since that could produce a degree of uniformity that could both stifle innovation and also reduce the diversity of educational qualifications, thereby depleting the gene-pool of ideas and competences for the future.

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Footnote 13 states:
    See www.equanie.eu

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Part of that web site states:

http://www.eqanie.eu/pages/euro-inf-spread-project.php

The Euro-Inf Project aimed at the creation of a framework for setting up a European system for accreditation of informatics education at the First Cycle and Second Cycle level (as defined within the Bologna process).

The system of accreditation of degrees in the UK alone has shown (not only in computing) that there can be serious **dis**incentives to exploration of new topics and modes of assessment.

So no such accreditation system should be allowed to constrain the **content** of degrees. At most it should be allowed to ensure that the descriptions provided by degree providers are suitable for communication across the EU (without obscurity or ambiguity) and that the level of difficulty or sophistication of the degree course reaches to what can be achieved in the time required for the degree.

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2.1 The discipline of computing/IT includes study of the nature of computation, effective ways to exploit computation, and the practical limitations of computation in application terms.

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Add:

The study of the nature of computation is not restricted to what can be done with computers as we now know them, but includes various kinds of natural information processing, including chemical information processing which is the basis of all life, evolutionary processes which transform designs of living system, developmental processes which transform the information processing of individuals, neural and other processes that support such processing, and various kinds of collaborative and social information processing including swarming, flocking and communication through changes to the environment (stigmergy).

It also includes investigation of entirely new forms of computation, such as quantum computation, new forms of chemical computation and others investigated within UKCRC Grand Challenge 7
http://www.cs.york.ac.uk/nature/gc7/

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Foundational issues

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This should include investigation of new forms of representation of information, including attempts to find out how animals achieve competences currently unmatched by machines.

Could also include

- study of forms of computation involving closely coupled interactions between an information processing system and an arbitrarily complex environment (physical, chemical, psychological, social, ...) e.g. in chemical plants, airliner control system and human machine interfaces of many kinds.

- the role of virtual machines of various kinds, e.g. for defining programming languages, for specifying a cpu architecture, for specifying an operating system, or network, or distributed computation, for co-hosting operating systems on the same hardware, ...

- notions of explanatory requirements and ways of testing theories and models

- study of different forms of computational specification, e.g. algorithm-based, rule-based, event-driven, neural, dynamical system-based, deterministic, stochastic...

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o professional, legal, social, cultural and ethical concerns

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This should not be a compulsory requirement for a scientific masters in computing any more than it should be for a masters in physics, mathematics, biology, etc.

This does not belong under Foundational issues, nor under Major technologies.

It should be a separate topic, perhaps a separate heading after "Major technologies"

Which could have subdivisions that would be specially relevant to certain types of masters degrees, e.g. degrees concerned with business, medical, legal, educational applications of computing, or with social issues related to advanced automation -- e.g. de-skilling, or removing jobs, etc.

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Major technologies

....

o computer architectures, including multi-core processors and their exploitation; parallel and vector processing systems; distributed systems, cloud computing and grid computing

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"computer architectures" this expresses a restricted way of thinking about architectures -- mostly limited to hardware. There are software architectures and abstract (e.g. distributed) system architectures.

Perhaps rewrite as something like this:

o computing system architectures, based on different kinds of physical components, different kinds of connectivity, different forms of software integration, various mixtures of sequential and parallel computation, distributed computation or redundant computation, including various kinds of internet-based computing.

Recent and not so recent developments that might be studied include raid arrays, multi-core processors and their exploitation; parallel and vector processing systems; distributed systems, cloud computing and grid computing

Could also include new technologies used in connection with biological information processing and biological problems, e.g. genome sequencing, drug research based on Inductive Logic Programming, et.c

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NB
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Energy is nowhere mentioned. There are major issues connected with (a) the amount of energy used globally by information processing (and transfer) (b) the use of information to control many systems to as to make them more energy efficient (e.g. vehicles, buildings, factories, etc.

Andy Hopper’s video presentations on this are outstanding but presumably can’t be referenced. But the issue should be.

http://www.youtube.com/watch?v=LN4H6vk1xYA

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Recognised specialisms and sub-disciplines

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The word "Recognised" suggests that there is some list of recognised topics, and only things on it are acceptable. There cannot be such a list because there is too much diversity of opinion and also because the field is constantly changing -- mostly growing.

So that heading should be replaced, e.g. with something like:

Example specialisms and sub-disciplines

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information systems, defined as ’what emerges from the usage and adaptation of the IT and the formal and informal processes by all of its users’.

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The restriction to usage and adaptation by ALL users is much too strong.

Different things are used in different geographical areas, in different professional and scientific communities, in different social business groupings, and new things come into use experimentally that should not be excluded just because they are not accepted by ALL users.

Just drop the phrase "all of its users".

Perhaps add

including novel and experimental systems not yet widely adopted.

That could be very important for some masters students going on to do research.

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computer engineering ... as well as embedded and real time systems whose operation may have safety or security implications

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It’s bizarre to bring in "safety or security implications" just for this context.

Safety and security issues are pervasive, and if mentioned at all should be given a separate heading, not combined with some arbitrarily selected sub-topic.

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artificial intelligence and computational aspects of linguistics, cognitive computing and associated areas, including simulation and modelling and decision support entertainment systems and computer graphics, including animation

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This is a strange mixture.

Computer graphics should not be there. It is probably being confused with "computer vision" which is a totally different topic (though many people do confuse them -- including some of the people who think they are studying vision when they are only studying graphics).

There are other areas whose importance has been steadily growing and are nowhere mentioned.

biological modelling including computational neuroscience, evolutionary computation, cognitive robotics, robot models of insects and other animals.

Also important:

manufacturing robotics, domestic robots, robots in rehabilitation, robotic surgery, robots for uninhabitable environments, ..

I understand that it is impossible to mention all topics. But if a sample list of topics is provided then it should be as generic and as representative as possible, and something added to indicate ways in which the list can be extended including, for instance, topics related to empirical investigation, theoretical work, mathematical works, applications, and cross-disciplinary topics.

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Master’s degrees may also be offered in areas such as e-science, bio-informatics, medical computing, software project management, e-commerce, and virtual environments, where students with a first degree in science or mathematics, as well as some reasonable background in computing/IT, may enrol for study.

{{

This is the closest the document gets to mentioning conversion masters degrees. But it does so in a much too restrictive context.

Conversion degrees can be offered to outstanding graduates in a much wider range of subjects (including philosophy, medicine, history, archeology, economics, law, etc.)

After studying some aspect of computing (not just the ones listed here) they may either go back to their own disciplines and help to bring in new ideas, theories and techniques from computing, or else stay in computing and enrich the fields with what they have got from their first degrees.

The potentially useful combinations are too varied to be listed: no suggestion should be made that only some small list of subjects can fruitfully be combined with computing. Doing that could prevent departments with unique combinations of talents from introducing pioneering new masters degrees.

At least one message sent to CPHC STRONGLY supported conversion masters degrees.
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3.2
....
interdisciplinary degree programmes which involve advanced scholarship in the use or applications of computing

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This seems to be an attempt to meet the previous point but is too narrow. It suggests that the role of computing is only to provide applications to help the other discipline. It doesn’t allow for the possibility that computing could be expanded by using ideas from other disciplines, or that a new kind of synergy could advance both disciplines (as is happening in computational neuroscience, for example, and has happened for decades in computational linguistics).

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For the generalist degree it is important that:

in their conception there is a focus on employment needs

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WHY NOT a generalist introduction for researchers???

(as opposed to specialist Masters, e.g. in security, or networking, etc.)

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- o the topic and learning outcomes are identified and defined clearly, and their relationship to the subject of computing is carefully captured in the title of the award

{{

Could stifle innovation.

The justification could be in the description. The title might be innovative.

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- o the relevant theoretical underpinnings (which may or may not be mathematical in nature) are identified and should result in emphasis on those fundamental aspects of a subject which do not change in the context of rapid technological development

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"do not change" is unnecessarily restrictive
Could stifle innovation.

}}

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- o there is an apparent ethos that reflects an integration between theory and practice as well as the planned development of a set of attitudes and an appreciation of a range of applications and their impact on users

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first part is either vacuous or too constraining since a scientific masters need not have any such ethos.

the second part is far too constraining, and probably irrelevant to many masters degrees. "planned development of a set of attitudes" ... etc. is probably not part of most computing masters in most of the world. Why should the UK hobble itself this way.

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- o all master’s degree programmes will meet the outcomes of the qualification descriptor identified in The framework for higher education qualifications in England, Wales and Northern Ireland (2008) or The framework for qualifications of higher education institutions in Scotland (2001)

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Should say where to find these descriptors

Otherwise mentioning them is useless.

Whether they are acceptable restriction depends on what they state.

(Perhaps current governmental moves to reduce centralised control will apply to this sort of thing also.)

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- o where credit is used, national guidance identifies a typical minimum of 180 credits for a master's degree, of which at least 150 will be at master's level. A typical minimum of 480 credits (600 in Scotland) is identified for an integrated master's degree, with at least 120 at master's level. 16

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Pointless in a national document, though it might make sense for accounting purposes within an institution.

Minimum workloads could be mentioned, but trying to legislate in such detail at national level is excessive and unnecessary control.

It should be enough that external examiners (and where appropriate, industrial advisory boards) regard the balance of work as appropriate.

Perhaps this is a complaint that needs to go to the QAA not this panel.

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4.2 Integrated master's degrees (such as MEng or MComp) should possess a strong appropriate ethos and orientation reflecting professional practice and/or applications within the discipline, and this will typically include attention to:

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over-stresses the technology

undervalues the science

expresses a very narrow view of computing.
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4.4 For all students, choosing to study for a master's degree represents a real commitment and, for some, perhaps even a change of direction for their studies. For all students it is important that there is a strong opportunity for progression through to employment or further study. Approval of master's degree programmes by institutions should reflect this concern.

{{

too restrictive. Why not allow masters degrees to have educational value for people who just want to learn more?

Must all education be justified in utilitarian or economic terms?

(Not in a civilised society.)

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5 Subject knowledge, understanding and skills

Subject knowledge and understanding
5.1

{{

This is appallingly narrow and fails to allow for scientific masters degrees.

Needs to be completely rewritten.

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5.4 For any master's degree programme it will be essential to identify both the technical and the transferable skills that are particular to the programme of study. The technical skills will also depend on the orientation of the programme but acquiring new skills with a range of up-to-date software will often be a key requirement.

{{

Why is it necessary to make this kind of stuff part of a national specification?

It's too vague to be of use, but risks being interpreted too narrowly by committees or individuals judging masters degrees.

Best to omit, and leave such things to the judgements of external examiners and advisory boards/committees.

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5.5 Master's degree programmes in computing/IT should seek to include development of the following generic skills:

o those required for the creation of the lifelong learner, who can set goals and identify resources for the purpose of learning

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All very worthy but has nothing specific to do with MSc in computing -- and should be listed as generic, not subject specific.

Allowing 'lifelong learning' as a motive contradicts the narrowness of some other parts of the document.

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o leadership skills, which tend to be characterised by acquiring a vision (based on sound technical insights) coupled with the ability to encourage others to share in that vision and to ensure that this will not be to their detriment.

{{
WHY include this?

A masters degree in computing does not need to be a degree in management.

Would you want that to be a requirement for a degree in a degree in physics, or mathematics, or chemistry?

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6.2 In keeping with the nature of a continuously evolving subject, currency of a master's degree programme in computing/IT can be demonstrated through association with external points of reference, such as developments in pedagogy and/or subject research.

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Omit. There’s a serious danger of holding back pioneering new masters degrees.

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6.3 Students on master’s degree programmes typically enter from a variety of backgrounds. In order to enable all students to become or remain up to date, there is merit in having a resource centre that includes hardware as well as software-related materials. In most cases, a range of modern up-to-date software will be required. This will provide convincing evidence of attention to recent developments at the forefront of the subject. In short, there should be easy access to a set of resources from which students can benefit and learn.

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either vacuous or too constraining.

These are details to be checked by external examiners.

Whether they are relevant constraints will depend on the type of degree.

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6.4 Given the diversity of possible master’s degrees, there will be considerable scope for variety and variability in terms of pedagogy.

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Good emphasis on flexibility -- but inconsistent with other aspects of the document which express a very narrow view of a computing masters.

Most of the rest of the paragraph is pretty vacuous stuff: such as might come from "experts" in education who don’t know much about any particular discipline.

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6.5 Learning and teaching

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Better to omit this paragraph altogether instead of wasting space on vacuous wording.

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The major individual activity

6.8 In many institutions, major projects are seen as providing an opportunity for students to apply a systematic approach to solving a substantial problem and this typically builds on a variety of classes/modules. The range of skills required to successfully complete such an individual activity is often considerable and students invariably benefit from the experience. In the context of master’s degrees, such activity provides a rich and interesting set of possibilities.

{{
Waffle.

What’s wrong with the well understood word "project"?

A project can take many forms -- software development, analysing the IT requirements of a small local business, inventing a new programming language or other formalism, proving a theorem.

Remove the waffle.

invariably benefit ??

Not in this universe.

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6.9 There are additional ways in which students at master’s level can demonstrate the achievement of master’s level outcomes, for example:

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Additional to what??

These are not additional to 6.8: they are special cases of 6.8.

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Threshold level

7.2 All students graduating with a master’s degree in computing are expected to be able to have demonstrated:

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What follows is either too specific (i.e. should not be required of ALL students) or too general, i.,e. not particularly relevant to computing as opposed to other subjects, and should not be required for all computing masters.

Comments on individual bullet points follow (they should have been numbered):

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o a systematic understanding of the knowledge of the domain of their programme of study, with depth being achieved in particular areas, including both foundations and issues at the forefront of the discipline and/or professional practice in the discipline;

{{

Not specific to computing.

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this should include an understanding of the role of these in contributing to the effective design, implementation and usability of relevant computer-based systems

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too specific to be required of all.

Seems to consider only engineering masters degrees.

Not all computing projects are concerned with something usable.

A project could be a purely mathematical investigation of e.g. properties of some formalism, or virtual machine.

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o a comprehensive understanding, and a critical awareness of: the essential principles and practices of the domain of the programme of study as well as current research and/or advanced scholarship; current standards, processes, principles of quality and the most appropriate software technologies to support the specialism; the relevance of these to the discipline and/or professional practice in the discipline; and an ability to apply these

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not relevant to all computing masters projects:

e.g. not relevant to projects that are purely theoretical/mathematical or concerned with trying to understand and model some form of natural computation.

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o consistently produced work which applies to and is informed by research and/or practice at the forefront of the developments in the domain of the programme of study;

{{

Not specific to computing.

Also what is meant by "consistently produced". Why should there not be significant variation during the course of the degree.

Vacuous verbiage gives far too many opportunity to pedants on monitoring panels to raise irrelevant objections.

Alos the wording is too much to require of ALL master’s degrees.

E.g. for some sub-areas the forefront of research may be too remote from competences of recent graduates.

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this should demonstrate critical evaluation of aspects of the domain, including appropriate software support, the ability to recognise opportunities for software or hardware tool use as well as possible tool improvement, an understanding of the importance of usability and effectiveness in computer systems development,

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This is much too specific.

Relevant to some software engineering projects perhaps.

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and generally the acquisition of well-developed concepts

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What does this mean??

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- o understanding of the professional, legal, social and ethical framework within which they would have to operate as professionals in their area of study; this includes being familiar with and being able to explain significant applications associated with their programme of study and being able to undertake continuing professional development as a self-directed lifelong learner across the elements of the discipline

{{

Much too specific.

Not relevant to all computing masters degrees -- e.g. those that are likely to lead to pure research.

Remove or specify that this is only for masters degrees of a certain type.

Of course, a subset of this is specially important for people who want to go into computing education (of a certain sort).

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- o the ability to apply the principles and practices of the discipline in tackling a significant technical problem; the solution should demonstrate a sound justification for the approach adopted as well as originality (including exploration and investigation) and a self-critical evaluation of effectiveness, but also critical awareness of current problems and new insights, and a sense of vision about the direction of developments in aspects of the discipline

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Badly worded because it suggests that all projects should be engineering oriented.

Theoretical/mathematical/philosophical/scientific projects should also be possible.

The wording would have to be changed for those.

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Integrated master’s degrees

7.3 Students graduating with an integrated master’s degree, such as an MComp, will:

,,,,

- o possess an appropriate ethos and orientation as described in section 4.2.

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No. Section 4.2 is too narrowly focused both for Masters and and for integrated degrees.

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