The exam scripts were a pleasure to mark! Most students had clearly understood and revised most of the material and gave full and accurate answers, even for the very technical parts of questions.

The overall average for this small class (23 registered) was therefore high, approximately 68%.

Question 1 (Modelling) - Very few students undertook this and answers were mainly quite weak, with little attempt to link modelling ideas to FSP. Question 2 (Rules, derivations, and LTSs) - many attempted this and approx half gave a full or almost full derivation of a transition, other partial answers or slightly incorrect attempts still gained good marks. The construction of an LTS was in general poorly answered. Question 3 (Process equivalence) - many answered this - and quite a few got almost 100%, explaining an algorithm and its application. Question 4 (Monitor classes in Java) - Some answers were book quality, both in the code and its explanation. Marks in general were lost in incomplete code (use of thread primitives, exceptions etc), or in poor explanations of the thread mechanism, including process queues etc. Question 5 (Process properties) - Again, in general very well answered - though the construction of an LTS for a parallel composition resulted in a variety of answers - but most realised what was incorrect in the FSP program and how to fix it.
Q1 18/18 Av. 12.7
a) Generally reasonably answered.

b) A disappointing number of misconceptions, mixing setup time, hold
time, propagation delay, edge speed, refresh period (?) and some
less well defined quantities.

c) Generally understood but some strange conceptions about the FPGAs
using extra (or spare) hardware which is 'not possible' in an ASIC.

d) Generally candidates identified a credible example. The word
'functional' was not always noted as indicating a high-level
hardware test.

e) Most candidates got this right - at least in principle. Several
thought that '1 == x' would be 'TRUE', which is disappointing. One
or two thought one was an assignment.

f) Fairly clearly understood although not always well explained. The
context, such as impacting on setup or hold times was usually
missed.

g) Generally answered well, but often missed out the fact that it is
the system inputs and outputs that are important in determining
controllability and observability.

h) i) Not indicating the importance of the bypass register was the
main mistake.
ii) Most answered this well, main problem was not indicating that
a command would be required for this mode.

i) Several answers showed that there was some confusion between gate
and circuit level simulation and the information that each could
supply.

j) This was answered very well by all candidates that attempted it.

k) This was also answered well.

l) There seemed to be very few problems in doing this calculation.

Q2 8/18 Av. 11.8
a) Many variants and small syntactic mistakes (ignored) but basically
well answered. Although not the original intention, many
candidates made the memory block synchronous (which changes
subsequent answers somewhat); this was within the scope of the
question as worded and was credited appropriately.

b) Easy marks!

c) This required some lateral thinking and many of the answers did not
cover the scope of the question as asked. Thus - for example -
some checkers just tested (say) hold time rather than the duration
of the write 'pulse', earning only some of the available marks.

d) To do this reasonably representatively is not easy. Most
candidates simply inserted a delay into the 'always' block but this
will not respond to subsequent changes within the '#50', so only
partial credit. Those with clocked memories made this somewhat
easier - probably unintentionally.

e) Most people who attempted this question had a good idea of what was
This year, there were a significant number of average marks (between 55 and 70%), and a lower number of high marks (between 75 and 90%) and very low marks (between 0 and 30%). As in previous years, the students were supposed to choose 3 out of the 5 questions from the exam, each worth 20 marks. Each question covered a specific unit of the material. Again, as in previous years, Questions 1, 2 and 4 were the most popular questions, probably because the topics related to these questions were well covered in the coursework for this unit, where the students had a chance to implement solutions to various practical problems in the lab. In each of the questions, there were three different types of question parts: bookwork, application and original thought.

In general, bookwork and application question parts were well answered, indicating that the majority of the students revised for the exam, using the suggested reading material. However, a much smaller percentage of the students were able to answer well the original thought questions, which may indicate that everyday reading and revising which can lead to a deeper understanding of the material is not practiced by the majority of the students. Question 1: This question covered the technology choices for relational and object-relational databases, and it was the most popular question in the exam. In general, the students who solved this question scored highly, with a few exceptions. Question 2: This question covered the topics related database functionalities implemented on server side. Most students scored highly for the bookwork parts, but fewer students scored highly for the original thought parts. Question 3: This question covered the topics related to object database applications. It was not a very popular question, but the majority of the students that solved it, answered it quite well. Question 4: This question covered the topic of semi-structured data management and it was a very popular question. Most students did very well for most of this question, doing less well when mapping the semi-structured schema into a structured one. Question 5: This question was the least popular one, covering the topic of distributed databases. It was the last topic delivered in the course, and was not at all covered in the coursework, so the students did not have a chance to try it in practice. Although the question was not a hard one, covering bookwork and application aspects of the topic, very few students tried it, and the ones that did, did not answered it quite well.
See attached pdf.
Question 1

a) The question asked for a summary of each type of change and identification of those aspects of the requirements, code, and business and technological environments for affected. Not all of the answers covered the second part of the question.
b) Many of the answers were generic and did not consider how the scenario affected would should do. For example, the person had just taken over and was looking for an overall understanding, this implies top-down reading. There was no driver of a problem to fix or enhancement to add to justify bottom-up reading. Many answers also omitted that could ask staff about how they see the system.
c) Many answers omitted the requested language independent form of the idiom. Several answers also did not relate language independent elements to variables of code given.
d) Generally well answers. However, several answers did not identify/label the true and false arcs from a decision node.

Question 2

a) Some answers assumed decomposability came from splitting into functions, when it is the splitting of a function into different layers.
b) Generally, answers lack justification of why the migration of the database was the most risky task. Answers also failed to identify what tasks would give the most business advantage and, thus, should be candidates for doing first.
c) The major problems with most answers were a lack of justifications for choices made and insufficient stages. For example, all application level elements migrated in one step, rather than considering which gave the greatest business value or carried the most risk to decide the order in which elements were migrated.

Question 3

a) Several answers failed to recognise that date problems that span countries almost always stem from a portability issue.
b) There was generally a lack of relating answers to the scenario described. For example, many did not indicate that the immediacy of a Timestamp update resulted in data significantly more fresh than was required. Also some answers mentioned that timestamp needs extra space, but not that it also adds an additional load. Many answers indicating that the queries to support timestamps were a costly operation when they are not. A significant number of answers failed to indicate that the logs needed to support a Log analysis approach may not be available.
c) A significant number of answers missed the fact that the limited functionality provided on the hosting system meant that a push approach was impossible.

Question 4

a) The question asked for a compare and contrast of the evolution of back-box systems to non-black-box systems. Many answers only discussed the evolution of black-box systems and lacked the comparison to non-black-box systems.
b) Most answers missed the fact that the business value made the quality of analysis the paramount consideration. Thus, they did not discuss options in relation to the business. Answers also failed to truly consider long term maintenance of a bought in solution and the risks associated with having a key element of the business dependent on something that is not within the business’ control.
c) ditto
Questions 1 and 2

The following only concerns Questions 1 and 2 of this exam. It should be pointed out that the exam mark is not the final mark for this course unit. The final mark is calculated by applying a factor of \( \frac{4}{100} \) to the exam mark (taken out of 100), multiplying each of the coursework marks with \( \frac{3}{100} \), and adding the three together. General remarks: 44 students sat the exam.

Question 1. Again I disappointed with the many serious mistakes found in many of the answers for this question. Overall, performance was better than in the previous year. The question was worth twenty marks, and of the 37 students attempting it eleven received a mark of seven or lower (that is a failing grade) and while six managed a first class mark. The average mark was 9.5. Students who had marks of five or lower wrote down very little that was both relevant and true.

A) I thought this was easy, but a surprising number of students did not follow the simple instructions of the game given. In particular, the first thing that happens is that Alice draws a card. Since she is allowed to see her card this does make a difference for her strategies! Apart from not following the structure of the game typical mistakes were forgetting probabilities for the chance move, not drawing information sets correctly (Bob does not know which card Alice has, and that is the only point of uncertainty), and giving incorrect pay-offs. The game tree consists of a maximum of three moves and has thirteen nodes.

Alice has four strategies, but many students did not describe the correct ones. Her strategies are:

- Bet on either card.
- Fold on either card.
- Bet on King, fold on Queen.
- Fold on King, bet on Queen.

I was happy to accept any definition, either verbally or as a subtree of the game tree. Since Bob does not know which card Alice has he has three strategies: Fold, accept the bet, double the bet.

Many students did not describe the strategies at all but tried to argue somehow how the two players should play based on pay-offs they might reach. The notion of \('\text{strategy}'\) is mathematically defined in the introductory chapter of my notes, which seems to have escaped a number of students.

B) There are two pure strategy equilibrium points in the game, including the choice of strategy that leads to the pay-off of \((5; 5)\). This is the best outcome either player can hope for so that is the choice of strategy they will both play in practice. A few students missed the second equilibrium point, losing a mark, but by and large this was well answered.

C) Most students only addressed the issue of playing such a game in normal form, and then they described the same calculation in a number of different ways. The model answer reserved quite a few marks for discussing the extensive case which most students missed out on.

D) I probably shouldn't have specified a particular form of game here, but in practice that doesn't seem to have made a difference. Many students could write down either a game tree or a matrix that satisfied the requirement (if in normal form it must have either two identical entries in one row that are
maximal in their respective columns, or two identical entries in a column that are minimal in their respective rows). This cannot be achieved with four different pay-offs since in a two-person zero-sum game all equilibrium points must lead to the same pay-off.

Question 2. This question was attempted by 36 students. The average mark was 10.1 out of 20. Eight students got a failing mark and four managed a first class answer. This was a bit different from last year by specifically asking about what students have taken away from the Semester 1 project.

A) Almost all students correctly stated that Kalah is a 2-person zero-sum game of perfect information without chance (although quite a few forgot one of these properties), which means that Theorem 1.1 applies. A solution is given by an equilibrium point, and we know that it must be the case that either one of the two players has a winning strategy or that they can both force a draw. (It is currently not known which of these applies for Kalah with seven or more wells, but the solution is still known to exist--something I made a big song and dance about in the relevant lecture.) I got the impression that those who listened well in the revision session had an advantage here. This part was certainly better answered than last year.

B) There were a lot of descriptions that weren't very meaningful--most students were able to list components, but the description of how it all fit together to produce a move were often missing, vague, or did not make sense (I'm sure the evaluation function is not applied to each position encountered, for example--or at least I hope so). Ironically a number of students claimed components as the best feature in part c) which they hadn't even mentioned in part b).

C) Giving a best/worst feature plus 'one extra idea' is, of course, easy. Each of these questions was worth four marks, and I expected arguments to be given for why the feature mentioned was as important as claimed. Very little evidence was provided, and very few students even referred to their program's performance in the tournament. For the 'best feature' I also wanted to know why students thought it was as good (not just as important) as they claimed, and again very little evidence was given. Similarly for the worst feature. Again, for the 'single additional idea' I was looking for arguments as to

- why it would have made a big difference to the performance of the program in question (and it should be a big one),
- why the supposed idea would have been feasible,
- why nothing else would have worked so well.

Often students gave one fairly general issue ('Our program would have been better if it had had an opening database') but then struggled to give more than very generic reasons for why this would be the one important change.

I was surprised with how little some students wrote for the four marks, and how little reference was made to any testing the students had performed themselves. (I wasn't looking for detail, just the big picture.)
Overall students did well with this exam paper. In the small number of cases where the overall mark was low, the scripts showed little evidence that the principles expounded in the course unit had been understood.

Questions 2 and 3 were similar to questions in last year's paper and all candidates opted to answer these. Marks were mostly high although a small number of candidates fared badly. The average mark for Question 3 was higher than that for Question 2.

Question 1 was the next most popular choice - again marks were mostly high.

Question 4 was the least popular choice and also received the lowest average mark. Mostly marks were lost because not all parts were attempted.
Section A

Overall the students showed a good level of understanding about the material in questions 1 and 2. More students chose question 2 over question 1. In question 1 some students did not understand that the question was about "multivariate" functions and covered the bisection method, which is for univariate functions. Some students seem to be confused that the Newton method is a global optimiser, which is not true (it is a local optimiser just as steepest descent).

In question 2a some students answered with generic evolutionary algorithms rather than specifically with Genetic Programming. Most students described the tree representation and a few discussed other representations as well (but many did not mention any other representation). Part 2b was perhaps the one which had lower scores overall; it seems that most tried to make a parallel between GP and human programmers that was too specific, the question was open to a more generalized view, where in both cases programming goes on by a combination of copying and reusing existing code, and creating entirely new code. Also in 2b most forgot to discuss the tension between variability versus selection, where neither can dominate and a balance is required.

Overall I am satisfied with the outcome of the exam, as most students showed that they have assimilated the most fundamental aspects of this part of the course

Section B

A majority of the students (~70%) attempted question 2, which was a bit surprising, having in mind that it was, in my opinion, a more difficult choice. The reason for that might be that the lecture material for the first question was taught in the first two weeks of the course, while the material covered by the second question was taught before the Easter break, and is more fresh in students' memories. The quality of answers was generally quite good, and it demonstrated proper understanding of the fundamental issues in the course material. A majority of the marks were >50% with some exceptionally good cases. As always, there was a small number of disappointing answers. Overall, I think that the quality is slightly better than last year.

Section C

This part of the course corresponds to the module of 'Complex Networks and Collective Behaviour'. Question 5 was related to the first part of the module of 'Network Models and Topological Properties'. Question 6 was related to the second part of the module of 'Network Dynamics and Collective Behaviour'.

All the students chose question 5. This must be due to the fact that, through the poster session, we put more emphasis on networks models and their topological properties. Question 6 was more related to dynamical systems and dynamical behaviours, and this is not a very familiar topic for students of Computer Science.

With regard to question 5, in general, the students showed a good level of understanding of topological properties of complex networks (mainly, size, density and connectivity). 11 students out of 26 have obtained between 70%-100% (>17.5/25). There are a few students with very low marks. The average mark of this module has been 14.78/25, which represents a 59.1% out of 100%. I think that the attendance to the lectures might have influenced the difference between marks. The number of students with high and medium marks corresponds to the number of students who usually attended the lectures. The numbers might be a coincidence or might be relevant to consider.
A total of 77 students sat the exam.

Q1: Only 9 students answered this. No specific issues, although (b) proved to be challenging to many students.

Q2: A popular question, only 7 students didn't answer it. Common problems: In (b) or (e) there was no need to convert an NFA to DFA. The question didn't ask for it. In (d), it was disappointing that some students didn't realize that E may be the exponential part of a floating point constant and included any letter in the expression. Also some students failed to notice the key requirement that the decimal point should be followed and preceded by a digit.

Q3: Also popular - only 12 students did not try it. In (a)(i), several students failed to notice that this was both a left- and right-recursive grammar. Also, in (a)(iii) some students failed to include all 3 rules for E in the transformation to get rid of left-recursion.

Q4: A total of 32 students answered this question. No particular issue standing out. In (b) some students didn't show the code after each transformation as requested. In (c) some of the approaches changed the semantics of the loop index i, without showing how to derive a value for i.

Q5: A total of 55 students answered this question. In (a)(i) some of the answers failed to realize that by using live ranges it is easy to find out the maximum number of registers needed. Reasonably good answers to (c) and (d), questions never discussed in the module.
Questions 1 & 2

Summary
Marks were lost on standard bookwork parts of questions, lack of detail and missing key-steps being the main problems there. In other parts, not paying sufficient attention to what exactly was being asked also lost marks, as did the usual neglecting to contrast and compare when asked. Being presented with arithmetic and an equation in Question 1 seemed to phase quite a few people.

Question 1
a): Most people who remembered how to do a convolution did okay on this part, but quite a few people mistakenly performed it as a matrix multiplication rather than a convolution. There were a few errors in reading numbers from the Figure, or errors in arithmetic, but credit was still given for the correct method, as long as enough working had been included that it was possible to track down where the arithmetical error occurred. Some people mistakenly included a denominator in the convolution.

B): Mostly well-done, although the mixture of modulus and sign seemed to slightly confuse some people.

C): Most people managed to reorganize the filter correctly (although some changed the overall sign!), but few people correctly described the object as a single-pixel line of varying orientation, despite the singlepixel line displayed in Figure 1.

d): Few people spotted the significance of the given equation as being an approximate second derivative, or spotted the 1; 2; 1 pattern as being the same pattern that had appeared in the previous parts of the question. Hence the ‘tuned second derivative’ part of the edgetrailer was missed by many people. Zero-crossing was slightly better done, in that quite a few people remembered the sketch-graphs from the lectures, even if they hadn’t spotted that the filters being used were second-derivatives.

E): These short pieces of bookwork, appearing at the end of what looked like a long question on the exam paper, weren’t terribly well-done, although quite a few people remembered the diagram for nonmaximum suppression, if not all the accompanying text.

Question 2
a): Most people remembered something about the Hough Transform, but in general people didn’t include enough precise detail. It wasn’t always made clear that what was going on was considering all possible lines through all points, rather than just trying to identify the single line that passed through two particular points. Not everyone remembered the problem with vertical lines and the need for an alternative, polar representation.

B): There was quite a bit of confusion here about what was intended as a non-trick question! People mentioned smoothing, but forgot to mention edge filters and edge strength images. When it came to the second part, some people were confused about what would be detected, and drew piecewise-linear approximations to the object outlines, rather than the unbounded straight lines that were expected. But quite a few people spotted the converging straight lines pattern for the tines (even if they didn’t know the exact word!)

c): This piece of standard bookwork was completed to some degree by many people. Lack of detail (e.g., mentioning PCA, but not mentioning the covariance matrix or the eigenproblem), or forgetting key steps such as alignment, were the reason for the loss of quite a few marks.

D): There was some confusion here as to what was meant by overlapping. The missing-the-indentations aspect of the ACM was remembered by many people. Again, there was some confusion about the Hough Transform results, and some problems in going from the expected results on a fork asked earlier, to the performance when applied to the task of locating a fork (i.e. spotting that the converging straight lines pattern of the tines might be a useful fork detector!)
Comments on examination

1. General comments

These comments are made in relation to unmoderated, unapproved marks.

29 candidates took the examination. Of these, 4 (13.8%) achieved a First Class mark, 3 (10.35%) an Upper Second, 9 (31.03%) a Lower Second and 9 (13.03%) a Third Class mark. 4 candidates (13.8%) failed the examination, with a mark under 40%. Roughly a quarter of candidates achieved an Upper Second or First (24.15%). The average mark was 51.55%. The top mark was 77.5%, the bottom mark 22.5%. The standard deviation, keeping in mind the small population, was 13.91.

28 candidates answered question 1; 28 answered question 2; 24 answered question 3; 2 answered question 4; and 4 answered question 5.

1 candidate answered only 2 questions, representing the abovementioned bottom mark. The bottom mark for a candidate answering all 3 questions was 23.33%.

Overall, many answers were characterized by the following:
• Avoidance (no answer at all) or major underdevelopment (in relation to marks available) of parts requiring argumentation, discussion, analysis, evaluation and critique.
• An apparent concomitant lack of awareness of major concepts, techniques and trends.
• Apparent ability to describe only, without supplying required examples and/or assessment of issues or impact.
• Vagueness, to the point of leaving the examiner with no option but to decide that the candidate had no understanding of the issue/notion, as nothing concrete was forthcoming.
• Inattention to detail, leading to inconsistencies.
• Lack of justification for some choice or decision, despite this being explicitly required in the question part, for full marks.
• Not answering the question asked.

Several answers essentially were experiential in nature, demonstrating an inability by some candidates to relate an answer to core principles, techniques and issues of the field. (Personal experience is nevertheless welcome, and indeed some candidates brought in by way of exemplification and justification experience from, e.g., their industrial experience year or part-time job. However, these latter wove this experience into an answer that demonstrated deep learning and their knowledge of the topic, whereas the former were unable to do so.)

One may hypothesise that such features of answers point to a lack of engagement with study resources, little in the way of reading up on topics (even of the relevant chapters in the recommended textbook), and reliance on personal experience of search while ignoring underlying concepts, techniques and mechanisms that support search. In other words, where candidates were unable to move beyond description or fact, it appears that they may have severely limited their chances of obtaining good marks by not assimilating enough from wider study (e.g., via the external resources listed on the course unit website) to enable them to provide examples, justifications, analyses, discussions, etc. It is demonstration of these “higher” levels of intellectual ability that, after all, typically characterise the graduate who obtains a good degree grade. The majority of candidates may indeed have such ability, but were unable to surface it, perhaps due to poor study technique, lack of study time due to other pressures or any number of other causes, one can but speculate.

2. Specific comments

Question 1

The average mark was 13.02/20, with the top mark being 20/20 and the bottom mark 5/20.

Q1a: Several candidates displayed little or no knowledge of the core information retrieval concepts of task, need and query, the relationships among them, or of attempts by the field to subclassify types of need.

Q1b was mainly well answered, although several candidates failed to explain their indexing decisions properly leading to inconsistencies in establishment of matrices and...
Students had either remembered this or not. This is basic information that everybody should know.

Book Work. I was shocked how many did not know this. Most probably those who had not attended the lectures.

Some good answers but too few clearly discussed delay spread between line of sight arrival and reflections. The simple use of delay spread to determine the maximum symbol rate was expected to be trivial but obviously not. The answers to this then caused some very odd answers to 1.4 which expanded this.

This had to be marked checking 1.3's answers as so few answered 1.3 as expected or fully correctly. I expected to give almost maximum marks to 1.3 and 1.4 was to filter students but it was not to be.

Most knew what SIFS is and its main purpose but clearly not much thought about its value has taken place.

This was harder. Clearly students have struggled with the trade-off between power usage and data rate. The meaning of "efficient" was not defined. This is quite hard but there is a paper about it in the Moodle materials which concludes with some general advice.

Most assumed that sparse networks require higher power whereas sparse actually says little about distance it is about density. In most networks it makes sense to use enough power for your headers to be heard by at least the furthest away device you wish to communicate with, ideally everybody who could cause you interference hears and understands your header data.

In a central control situation you almost certainly have some sort of timed slot allocation so it makes sense to leave tiny gaps between transmissions and all things being equal and with little overlap between APs to transmit at the highest possible data rate. Perhaps, the power used can be modified to try and ensure little overlap between APs. However, these problems all need a global view with all information available to optimize the parameters.

Marks were allocated for each reasonable point.

Mainly good answers.

Some good answers. A few students have read about 802.11s and realised it has 2 routing methods matching this scenario. One is a tree router to/from the AP and driven by the AP. The other is a normal graph search like method. There were heavy hints dropped about this during several
Q1. mean 15.47, SD 3.94
Q2. mean 14.45, SD 3.35
Q3. mean 14.25, SD 5.09
Q4. one good answer
Q5. one exc. Answer