Johan Glimming 2 januari 2007 CSC KTH

Kursanalys för Avancerad Funktionell Programmering, D-nivå, läsperiod 4 läsåret 2005/2006

Kursdata

Momentindelning
LAB1, laboration 3/4/5 (2p)
TEN1, tentamen 3/4/5 (2p)

Kursen genomförd
period 4 2006, april-maj

Föreläsningar
28h föreläsningar, 14h laborationer

Kursledare
Johan Glimming

Kurslitteratur
B.C. Pierce, *Types and Programming Languages*, MIT Press, 2002.
R. Bird, *Introduction to Functional Programming*, Prentice Hall, 1998.

Antal registrerade studenter
10

Gjort moment LAB1 laboration
4

Gjort moment TEN1 tentamen
6

Prestationsgrad
50%

Examinationsgrad
45%

Mål

Kursen syftar till att

- ge förståelse av den teoretiska grunden för funktionella språk, dvs lambdakalkyl i olika former, speciellt typsystem.
- ge erfarenhet av att använda avancerade koncept inom moderna funktionella språk, t ex polymorfism, monader, lat evaluering, moduler mm.
- ge studenterna möjlighet att fördjupa sig i ett relativt självständigt programmeringsprojekt av något mer avancerad karaktär

Sammanfattning

Kursen har givits två gånger på KTH. Flera av eleverna presterade väl i mini-projekt och/eller tentamen (höga betyg således). De elever som gjorde hemuppgifterna presterade över lag bäst. Nästan alla som följde föreläsningarna och även deltog på laborationerna blev godkända.

Den laborativa delen av kursen resulterade i ett par riktigt väl utförda projekt (med betyg 5 således). Studenter som deltog på laborationerna har i de flesta fall också varit framgångsrika med sina projekt. De miniprojekt som krävt speciellt mycket individuellt arbete verkar samtidigt ha varit svåra för vissa studenter. De som baserats på studium av en forskningsartikel blev i vissa fall inte klara.

Examinationsgraden var lägre det andra året. Kursutvärderingen visar att studenterna (dvs de c:a 8 som var aktiva) även denna gång i genomsnitt var nöjda med kursen, trots att den uppfattas som svår. Medelvärdet är "över medel" på föreläsningarna. Samtliga studenter anger att kursen varit givande/intressant. En student ställer sig dock kritisk till det mesta på kursen inklusive språket (engelska) och föreläsaren samtidigt som en annan skriver att kursen var den bästa han läst bland över 340 poäng kurser. En intervju med en student som läst kursen bifogas som bilaga till denna analys.

Faktiskt innehåll i kursen

Kursen har haft följande huvudmoment:

- Introduktion/repetition av Haskell, lat evaluering, vissa grundläggande funktioner t ex fold och map och deras egenskaper
- Algoritmer och grundläggande komplexitetsanalys för funktionella program, tekniker för att optimera program, rent funktionella datastrukturer (träd mm)
- Monader, parser monader, monadiska tolkar, monadtransformatorer
- Otypad lambdakalkyl, grundläggande egenskaper och exempel, reduktionsrelationer, evalueringsstrategier.
- Typad lambdakalkyl, grundläggande typteori/formell teori
- Polymorfisk lambdakalkyl (System F), exempel och vissa grundläggande egenskaper
- Typinferens: unifiering, grundläggande algoritmer, let-polymorfism
- Mycket kort om mer avancerad typteori, Curry-Howard isomorfismen

I den första elevenkäten efterlystes färre teoretiska föreläsningar i början av kursen. Man ville komma igång tidigare med mini-projekten. Föreläsningarna omorganiserades därför med praktiska föreläsningar i början av kursen och de mer teoretiska (lambdakalkyl) mot slutet. Således inleddes föreläsningsserien med praktisk programmeringsteknik, t ex monader och programtransformationer i funktionella språk. Studiet av funktonella algoritmer och datastrukturer fick det andra året också mer plats i kursen. Detta visade sig i miniprojekten.

Trots det förstärkta praktiska programmeringstekniska momentet har kursen fortsatt fokuserat på den teoretiska grunden för funktionella språk, dvs typad lambdakalkyl. Detta ger en djupare förståelse för hur funktionella språk exekverar sina program och för hur två program kan bevisas ekvivalenta. Det sistnämnda är viktigt för formella metoder. Efter en genomgång av lambdakalkylen gick vi vidare till typinferensproblemet och studerade Hindley-Milner typsystemet steg för steg. Det som eftersträvas är en god förståelse av Haskells typsystem.

I år bjöds docent Patrik Jansson från Chalmers in för att hålla en gästföreläsning om generisk programmering. Patrik gav en introduktion till ämnet så att studenterna erbjöds inblick i ett aktuellt forskningsområde kopplat till kursinnehållet. Detta avviker från tidigare år då generisk programmering på grund av tidsbrist inte kunde behandlas i kursen.

Anpassning till andra kurser

Förkunskaperna i Haskell varierade något. De studenter som hade läst kursen Programmeringsparadigmer bedömer jag har haft bra förkunskaper för kursens programmeringsmoment.

Som tidigare finns det genom teoretiska kopplingar förutsättning för samarbete med kursen teoretisk grund för objekt-orienterad programming.

Fortsättningskursen (Semantik för Programmeringsspråk) passar bra ihop med innehållet i denna kursomgång eftersom grunderna i lambdakalkylen diskuterats noggrant.

Examination

Kursen har examinerats i form av hemtenta tillsammans med ett projekt, och slutbetyget utgörs av medelvärdet av de två resulterande betygen (3/4/5).

Min uppfattning är att laborationsmomentet i flera fall fungerat mycket bra men delvis blev för svåra för vissa studenter (främst studenter som inte var vana att arbeta självständigt på detta sätt). Några miniprojekt blev aldrig klara, typiskt sådana som baserades på självständigt arbete baserat på någon forskningsartikel (från Journal of Functional Programming, etc), eller då studenterna inte deltagit på laborationerna och/eller föreläsningarna. Å andra sidan blev i princip alla som gjort hemuppgifterna,

deltagit på föreläsningar och laborativa moment också godkända på kursen, dvs dessa studenter klarade både projekt och hemtenta (och i flera fall med högt betyg).

Hemtentamen tycker jag också fungerade bra som examinationsform. Jag har haft som princip att studenter som följt kursen och gjort alla hemtal ska ha goda förutsättningar att klara av hemtentamen men även lära sig mer av tentamen (som alltså också utgör ett inlärningstillfälle).

Kursens belastning på eleverna

Ett stort antal studenter anger i enkäten att de har läst kurser parallellt i högre takt än 1 poäng per vecka. I enkäten anger t ex hälften av studenterna att de läste två eller fler andra kurser samtidigt. Fyra studenter deltog i över 80% av föreläsningarna. Dessa två faktorer inverkar sannolikt på examinationsgraden som är låg. Kursens svårighet är troligtvis en annan faktor som inverkar (kursen upplevs enligt enkäten som svår). Ett problem är enligt enkäten att miniprojektet har tagit mycket mer tid än förväntat, vilket troligtvis bidragit till att vissa projekt inte blivit klara alls (och därmed har några studenter gett upp med kursen). Detta kan delvis bero på att studenterna själva valt att arbeta ensamma istället för (som rekommenderat) i grupper om två personer. Sådana projekt har dock i de flesta fall utförts mycket väl, men enligt elevenkäten tagit mycket tid till anspråk.

Planerade förändringar

Examinationsmodellen bör revideras något. Idag består den både av hemuppgifter som ger bonuspoäng (för att eleverna ska arbeta under hela kursen och inte bara mot slutet av den), miniprojekt samt hemtenta. Hemtentamensmomentet kan utgå nästa gång kursen ges, och hemuppgifterna ersätter därmed detta moment (där den sista hemuppgiften möjligen kan bli ett slags mästarprov för kursen, dvs något svårare). Opposition av andras projektredovisningar planeras som obligatoriskt moment. Miniprojekten bör vidare integreras ytterligare med föreläsningarna och i möjlig mån även med hemuppgifterna för att eleverna ska motiveras att komma igång med dem i tid och reducera arbetsbördan i slutet av kursen. Slutligen har det visat sig viktigt att miniprojekten verkligen utförs i grupper om minst två personer för att inte arbetet ska bli för omfattande för vissa studenter.

BILAGA 1: Elevenkät

COURSE DESIGN

Before you answer this question, consider if you had the required prerequisites.

1. Estimate the level of difficulty of this course.
    1. 0% (0 st) Very Easy.
    2. 0% (0 st) Easy.
    3. 0% (0 st) Average.
    4. 38% (3 st) Relatively hard.
    5. 63% (5 st) Very hard.

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2. Was the course interesting, meaningful and/or rewarding?
    1. 13% (1 st) Yes, this course was one of the most interesting courses I have taken so far.
    2. 0% (0 st) Yes, very.
    3. 88% (7 st) Yes.
    4. 0% (0 st) Not sure.
    5. 0% (0 st) No.
    6. 0% (0 st) Entirely uninteresting.

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3. The prerequisites for the course were stated in Lecture 1 and include logic and algorithms, and discrete mathematics. Do you think your own prerequisites were sufficient?
    1. 25% (2 st) Yes.
    2. 75% (6 st) Not sure.
    3. 0% (0 st) No.

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4. Since there is no single good enough course book for the material of this advanced course, we had to use two textbooks. What do you think about the first course book (Pierce, Types and Programming Languages)?
    1. 13% (1 st) Outstanding/superb.
    2. 25% (2 st) Very good.
    3. 38% (3 st) Good.
    4. 25% (2 st) Reasonable.
    5. 0% (0 st) Not so good.
    6. 0% (0 st) Bad.
    7. 0% (0 st) Never used it...

    You have the option of adding a comment (e.g. did you actually use this book, and to what extent did it clarify the material given on-line, in additional recommended textbooks, and in lectures?):

    The book was quite easy to understand, with many examples. Useful and easy to use.

    It explains all necessary things very well.

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5. Similarly, what did you think about the Haskell course book by Bird?
    1. 13% (1 st) Very good.
    2. 63% (5 st) Good.

3. 13% (1 st) Reasonable.
4. 13% (1 st) Not so good.
5. 0% (0 st) Bad.
6. 0% (0 st) I managed without it.

You again have the option of commenting on this textbook (and if you managed without it, how did you manage)?:

During this course I only used it for answering an exercise (there was no other way, because the question wasn't transcribed to the course webpage). On the other hand, I used the book in another course years ago. I must say that I find it too formal and theoretic. Too formal for being a programming book and too practical when trying to show theoretic concepts. I personally don't like the book.

Much better than Haskell School of Expression

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6. Since this is a D-level course, a lot of references for additional reading are provided. Many of these references are on-line. Similarly, we used some on-line research papers (mostly tutorials). All in all, do you think the material provided was enough?
    1. 50% (4 st) Yes, it allowed for me to find more information about special areas etc.
    2. 38% (3 st) Yes, it was ok.
    3. 0% (0 st) Not sure.
    4. 0% (0 st) No.

    You have the option of giving an additional comment:

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7. Did you actually use the proposed reference literature, the links to additional resources, etc?
    1. 100% (8 st) Yes.
    2. 0% (0 st) Don't remember...
    3. 0% (0 st) No.

    You have the option of giving an additional comment:

    Sometimes there was no other way of completing the homework ;) (but I like consulting external material anyway)

    I only used one of the references for one homework assignment.

LECTURES

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8. Give an estimate on the number of lectures you attended?
    1. 13% (1 st) Less than 20%.
    2. 25% (2 st) 20-40%.
    3. 0% (0 st) 40-60%.
    4. 13% (1 st) 60-80%.
    5. 50% (4 st) More than 80%.

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9. Did you come prepared to the lectures (i.e. did you read the suggested material before you went to each lecture)?
    1. 0% (0 st) Yes, of course.
    2. 13% (1 st) Frequently.
    3. 25% (2 st) Sometimes.
    4. 38% (3 st) Rarely.
    5. 25% (2 st) Never!

    If not, why not?

    It'd be a good idea to hang online the slides a couple of days before the lecture, so the students can have a quick view and also take notes on them.

    I lacked the motivation to do this since I did not find it essential to do so.

    Due to time constraints from other activities.

    For the same reason as I attended less than 20% of the lectures. I had a 20-credit absorbing and overlapping course.

    Not enough time.

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10. Was the pace/speed of each lecture adequate?
    1. 75% (6 st) Too fast.
    2. 0% (0 st) Too slow.
    3. 25% (2 st) Just about the right pace.

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11. What is your overall opinion about the lectures?
    1. 0% (0 st) Superb - as good as it gets!
    2. 13% (1 st) Very Good.
    3. 38% (3 st) Reasonably Good.
    4. 25% (2 st) Average.
    5. 13% (1 st) Not so good.
    6. 13% (1 st) Very Bad.
    7. 0% (0 st) Completely worthless.
    8. 0% (0 st) Could not attend.

    Give motivation to your answer by means of constructive criticism to make room for improvements for next year's course:

    The rhythm of the classes from my point of view is too fast. the lectures planning is very strict. There should be some days without assigning lectures, so in case the teacher notices some parts are harder to understand can take more than one class to explain them more slowly.

    Teacher walks around in classroom, should not use slides (use whiteboard instead) - slides are just confusing, English decreases quality of course by 50% (talk Swedish even if you have foreign students since it is much better even then)...

    I think the lectures should be slower with less content and really consider how bad most students are at interpreting mathematical or Haskell syntaxes. I struggled with understanding on a basic level, while the lecture was already discussing higher-level topics. Preparing through reading in advance would probably solve much of this, so more encouragement regarding that would probably be good.

    Has great knowledge of the field, sometimes there are to many slides to go through, so some must be

skipped. It would be better to have fewer slides and go through them more thoroughly.

More examples are needed and sometimes the lectures are far too theoretical!

If you are going to use English during the lectures make sure that you master the language first...

The pace was too slow during some lectures. The lecture schedule had to be revised several times and one, in my opinion, interesting lecture had to be removed (the one about implementation of functional languages). Parsers were covered so late that I had to learn the material on my own.

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12. Did the teacher answer and encourage your questions (during lectures)?
    1. 75% (6 st) Very much so.
    2. 25% (2 st) To some degree.
    3. 0% (0 st) Not really.

    What could the teacher have done to improve the interactive form of the teaching in this course? Do you prefer interaction during lectures or should the lecturer just talk and you listen?

    Talk listen.

    Just talk and don't try to be so pedagogical.

    You tried but you overdid it...
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    Yes, I suppose anyway it's the student fault not to ask more, but the schedule for each lesson is so tight for the concepts that we have to see, that it feels like spending some time with questions will imply not seeing some concepts planned for the lecture.

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13. One lecture was given using modern pedagogic techniques, i.e. it was entirely centered around student activities. Was this a good way for you to learn or do you prefer traditional teaching?

    I prefer traditional style.

    I learnt little but well and was more enthusiastic during this lecture because I did not feel over run. It also contributed to students talking to each other which is of extra value in the beginning of the course.

    To some extend. Requires student to come prepared which is not always the case.

    Although I don't dislike new methods I must say I'd rather prefer traditional teaching, probably because I'm used to it and I know how it works.

    I prefer traditional teaching (after 20 years of studying I am used to them).

    It was not a good idea. I didn't learn very much during that lecture. Traditional lectures are better.

    Did not attend.

MINI-PROJECTS, HOMEWORK EXERCISES AND BONUS SYSTEM

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14. Generally, did you attempt to solve the homework (even if you did not submit anything)?

1. 100% (8 st) Yes.
2. 0% (0 st) No.

In the event you did not hand in homework, what are the main reasons for this? What could have made you actually submit homework?

I put too little time aside for doing it.

I didn't hand in homework cause the level was too high and I didn't think that my answers were good enough.

Not enough time. I did not understand some of the questions.

I am not going to hand in something that is not 100% if I am to be forced to present it in front of the group

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15. Give your opinion on the difficulty of the homework (with exception for one question in homework 3 which was too complicated and removed)?
    1. 63% (5 st) Homework difficulty is consistent with the inherent difficulty of the course.
    2. 13% (1 st) Homework was easy, which was good for my learning!
    3. 0% (0 st) Homework was too easy.
    4. 13% (1 st) Neither applies, see my comments.
    5. 13% (1 st) Homework was too hard; I think it goes beyond the requirements for examination.

    Comments (e.g. how should the homework exercises change for next year, if at all, and was the homework useful for your motivation and learning experience, and also changes in the bonus system etc?):

    Depends on the homework, some of them were reasonable and some (e.g H3) were too hard.

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16. Estimate the difficulty of your project?
    1. 50% (4 st) Too hard, we barely made it.
    2. 13% (1 st) Hard, but doable.
    3. 38% (3 st) As expected.
    4. 0% (0 st) Quite easy.
    5. 0% (0 st) Very easy.
    6. 0% (0 st) Trivial!

17. Would you prefer a different form for the mini-projects (e.g. individually, larger groups, fewer projects to choose from, more freedom, etc)? If so, please explain it here:

    It may not be so difficult if you know more about functional programming. But I wont call it a "mini" project. I would prefer having practice labs, doing exercises on each laboratory (programming some functions using things given in class, using monads, creating parsers... whatever) and maybe at last a small project where you could apply some things together.
    Work in groups or all the same exercises in class, so you can check with other students how to do them if you don't get it.

    The mini projects were OK but It would be good if we were informed and warned about the difficulty of the project in a better way, just by reading the suggested steps I would never have imagined how hard it was going to be (in my case it would have been nice if I was informed that in order to implement integration I needed differentiation)

    More freedom would be nice...

My impression is that the mini projects were not really chosen for pedagogic reasons but because you wanted something particular project carried out!

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18. How much time did you (roughly) spend on the mini-project (just your own portion of the work, not including other group members)?
    1. 0% (0 st) Less than 5 hours.
    2. 0% (0 st) 5-10 hours.
    3. 25% (2 st) 10-20 hours.
    4. 13% (1 st) 20-30 hours.
    5. 0% (0 st) 30-40 hours.
    6. 25% (2 st) 40-50 hours.
    7. 38% (3 st) More than 50 hours.

    Comments:

    Hours don't matter if you don't get the concepts. For me is easier to see how to do something by seeing some examples, and explanations about them.

    I had to learn Lisp and implement another subproject (differentiation) in other to be able to succeed on mine
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    Way more than 50h.

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19. Was the teacher engaged in your mini-project and did he answer your questions and helped you whenever you got problems, etc?
    1. 38% (3 st) Super good.
    2. 38% (3 st) Good.
    3. 25% (2 st) Enough.
    4. 0% (0 st) Not enough.
    5. 0% (0 st) Little.

    Expand on it:

    Lots of help, thanks, but I think previous labs before the mini project are a good idea. Maybe the level of help I need is in a lower level. I will try anyway, even if I don't pass this course it'd be a nice reward to do something with my project once I've finished all the exams.

    Provided very good resources to aide work and also very helpful and friendly when i had questions.

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20. How did the teamwork sort out for you? Did all team members contribute evenly to the final outcome of the project?
    1. 13% (1 st) Absolutely not.
    2. 0% (0 st) Not really.
    3. 0% (0 st) Somewhat.
    4. 13% (1 st) Very much so.
    5. 63% (5 st) Totally so.

    How could the teacher have helped you to sort it out (if applicable), and what do you in general propose to improve the situation with teamwork next year?

I tried alone, I would have preferred to be in a group. Maybe that way a student can receive help/simple explanations from the students in the group and not get stucked. Also the load of the work is then less as there are more than one head thinking.

I have a hard time working with myself. :-)

FINAL EXAMINATION

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21. Estimate the difficulty of the take-home examination?
    1. 25% (2 st) Bloody hard.
    2. 50% (4 st) Hard.
    3. 13% (1 st) Average/what I would expect.
    4. 0% (0 st) Easy.
    5. 0% (0 st) Man, this is too easy! ;-)
    6. 13% (1 st) Did not take the exam.

Additional comments:

Even I've just had a look I see it hard but not for the contents, but most of the course concepts are too abstract or i dont know how to apply them. More simple examples (easy, clear) should be given in the lessons. Preferably different from the book, so students have more variety where to try to understand.

... yet

Very much work.

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22. Is 14 days too generous for this sort of examination? (The idea was to allow for more creative problems, such that the examination itself is a learning experience!)
    1. 50% (4 st) No, it should be 14 days.
    2. 38% (3 st) Don't know.
    3. 0% (0 st) No, should be less.
    4. 13% (1 st) It should be more...

GENERAL QUESTIONS

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23. How many other courses did you take in parallel with this course (i.e. in this second half of the spring)?
    1. 0% (0 st) Zero (just this one).
    2. 38% (3 st) One.
    3. 50% (4 st) Two.
    4. 13% (1 st) Three.
    5. 0% (0 st) Four.
    6. 0% (0 st) Five or more.

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24. How demanding in terms of your total study time (full time study during 8 weeks for 4 credits means formally 4 hours per workday)?

    1. 0% (0 st) On average less than 1 hour per workday (5h/week).
    2. 13% (1 st) Between 1h/day (5h/week) and 2h (10 h/week).
    3. 38% (3 st) Between 2h/day (10h/week) and 4h (20h/week).
    4. 25% (2 st) Between 4h/day (20h/week) and 5h (25h/week).
    5. 25% (2 st) Between 5h/day (20h/week) and 7h (35h/week).
    6. 0% (0 st) More than 7h/day (35h/week).

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25. The course can give you 4 points (2 for lab and 2 for exam). What is your opinion about the number of credits rewarded for your work?

    1. 25% (2 st) 4 credits is suitable.
    2. 25% (2 st) Should be 5 credits.
    3. 50% (4 st) Should be 6 credits.
    4. 0% (0 st) 4 credits are too much!

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26. Here we allow for you final suggestions for improvements of this course. What was bad? What was good?

    23. If I'd have know before I wouldn't have sign in for so many courses.

    25. 5-6 credits labs or tutorials where to show how to program/apply some studied concepts when programming.

    Most of my answers are very subjective taking into account the fact that I had too many lessons this term and more projects/homework/study to do during the week. I'd recommend not to have lots of courses with this one in order to have more time to view/review/"rereview" the concepts one does nott understand and go to the lecture with a clearer view of what one needs to study in more detail.

    Despite of this, I enjoyed going to the lectures because I think the course is very interesting and gives an opportunity of having a good view to functional programming and get used to something different of the imperative programming most of us are used to.

    The theory part of the course was much better than the practical part (the teacher was better in the theory part than in the practical part). We received far too little help with our mini project... The course should be more focused and go beyond Haskell and monads...
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    All in all a good, but very difficult, course

    Homework, "mini"-project and take home exam feels almost too much for a 4 credit course.

    The most interesting course I have taken (in > 340 credits) but at the same time I feel it is too much to learn in a very condensed period of time. It would be better to have the course over two periods.

BILAGA 2: Elevintervju

Teacher (T): Could you tell me what sort of things you did as a student of the Advanced Functional Programming Course ...
Student (S): You mean the standard stuff or what I did in general?
T: You can just start to explain … I mean you passed the course very well … what did you do in order to do that?
S: Ok, all right. I was reading the lectures every time after the lectures … the lecture slides and the recommended literature... well not all, but some recommended literature … and then I read the course book and also I have sometimes done the homework [laughter] well I had too much courses, but still I was like doing it, because it was very useful in the exam .. so.. yeah, that was the basic things that I did. And I was coming to the labs… so I was trying to keep going with the project [laughter] … well, that was not very successful [laughter] … that was the basic things … and I was listening to the lectures … I think that is an important thing …
T: what do you think about when you do these things? what are your goals when you sit and study the lecture [notes]? how do you approach your learning?
S: okay, well, I have never thought about it but, the thing I am trying on the lectures is not to sleep [laughter] well the students are tired sometimes and you are trying convince yourself to stay awake… but it was not the case when the lectures were interesting. that was the case for the advanced functional programming. the material *was* interesting really, ehh, so I was trying to understand the things that were going on on the lectures … yeah
T: so after the lectures, and before the lectures, did you prepare yourself for the lectures?...
S: I was refreshing, yes, after the lectures
T: you looked things up?
S: yes, it was not possible with the time to look before the lectures, but well, I was trying to do that afterwards to keep everything in mind
T: so you tried to go back to contents of the lectures?
S: yes
T: how did you do that? did you try to deepen your knowledge from the lectures by doing exercises or did you … read mostly?
S: yeah, the homework also, [thinking] and also the book .. I was reading the book after the lectures … that was, sort of, I was trying to bind the lectures and the book together.
T: did you read exactly the contents of the lecture or did you go over it, adding more stuff?
S: I was going first through the slides, and then I was reading the book, and … was seeing the things from the lectures … trying to deepen that knowledge
T: So basically you studied the coursebook after the lectures mostly then?
S: yes, but I always wanted to do that before the lectures so that I could understand the lectures, but as I said it was not possible with the time
T: time constraints...
S: yes
T: during the lectures did you use any particular methods to take in the material, or did you mostly passively listen? did you use any strategies?
S: stay awake [laughing], no I am kidding, … well that is the case in some lectures, but not in the one we are talking about so … ehh .. no there was no particular strategy … I wonder how I could do that with some particular strategy …
T: would have helped you to be more active during the lectures, sort of doing small tasks and so on…?
S: yes…. yes, probably so, it helps not just to listen but also to do something to – again – to keep awake, evolving your self into the procedure, the lecture procedure … sort of interactive communication [laughing]
T: good answer, when did you do the exercises, and how did you select the exercises you did – where they particularly interesting or so?
S: homework exercises?
T: yes .. and when did you do them?
S: yes, that was during the weekends when I had free time, and … that was … both for particular interest and also I thought it would be useful to do them ….
ad the slides you are just reading the words, I mean, after some time you will forget those things, but if you do it with pen and paper I think it is very useful and will keep in your mind [laughing]
T: … would you say that you did these because they were interesting for your own education, you thought “this is going to be useful for me in the future”, or what was the motivation for selecting those particular homework exercises? did you think “ah! this is interesting for my future career”?
S: yes, I thought I would be working in a formal methods area but… the functional programming is

related to this area and so that would be interesting... and also the most important thing was that I was interested in the binding to imperative programming ... to have some other approach or overview to the programming ... that was the most important point ...
T: do I understand correctly that you choose the exercises in order to broaden your ...
S: yes, just to follow the material properly [laughing]
T: what did you think about the way we presented the exercises, the student were asked to give presentations ... randomly selected and given bonus points? was that a good idea?
S: I think that was an original idea [laughing] to randomly select the students ...
T: pseudo-randomly ...
S: [laughing] yeah ... I think it is good to present the exercises because the rest of the students can sort of see another solution where they see another approach, or even for the student who did not do the homework to see how people are doing, and randomly selecting is motivating...
T: so you did indeed learn from these presentations?
S: yes
T: right ... and this bonus system did it help you to keep you motivated?
S: yes ... though I was not doing it for the bonuses, but yes I think it is good motivation ... of course in some cases, but in this case it was mostly those that I found particularly interesting, but on other courses I have the same thing and I was motivated by taking some bonus to make something in time, homework, the project in time ...
T: to follow the structure...?
S: yes, I think it was good take-home exam was not easy ... so it gave me some [laughing] extra points
T: when you read the course book do you do something practical like taking notes or do you just read it like a ... thriller?
S: yes, I was highlighting the words
T: did you do exercises from the book?
S: no I have no time for that, but I was trying to follow the examples that they gave...
T: aah good, how did you plan for the mini project before you went to the lab?
S: to make sort of a schedule you mean?
T: ... for example, yes
S: aah, well yes, I was planning like on this lab I will do this, this, and this, but it was by screwed up by my partner so [laughing] maybe it is good sometimes to work alone because you know what you are doing in advance, but if you do something in advance ...
T: you depend on them?
S: yes, you should, I don't know, somehow fit your schedule into the schedule of your partner [laughing]
T: practically, how did you work with your mini-project? did you work during lab hours or did you work afterwards...
S: mostly I was trying to do that all the time I had free time, so it was on the lab and it was afterwards ... even before I was trying to do something.
T: did it take too much time to do the project?
S: yes, because I was working alone so sometimes I could not discuss things with someone, so it took me a lot of time to just come up with some solutions .. that's it.
T: during this mini-project, at which point did you feel that you learned the most? ... when you wrote the report or...?
S: when I wrote the first monad transformer [laughing]
T: so it was when you actually programmed?
S: yeah, I finally got the idea of these monads and I did understand them somehow because I didn't understand them before ...
T: ... you did it?
S: yeah, it just came when I was doing the mini-project, so then I thought that actually I feel myself stronger now [laughing]....
T: so it was a positive experience? [laughing]
S: yes
T: ... good ... did you use the course book also when you programmed ... and also the course material ... did you switch between the course book and articles and labs?
S: yes...
T: how?
S: I think that the more technical things I was taking from the book, from the second book ... the Hudak book ... from that book I was taking more technical details ... and I was also using the recommended material that was compilers by ... eh ... modern implementation of compilers?
T: ah, modern compiler implementation?
S: yes, because I had a copy, I do not remember what was the name but I had some material on that...

T: so you added some material yourself?
S: yes…
T: so you actually did a little bit of literature search outside the course?
S: yes
T: interesting… what did you do the days before the take-home exam was handed out?
S: I was doing another project [laughing] …
T: [laughing] okay, so you did not actually prepare for the take-home exam?
S: no, well for the first time I had take-home exam so I did not know what it can be, so I don't think that if I had the time I would be sort of preparing for the …
T: is it quite generous with two weeks perhaps?
S: yeah [firmly]
T: how did you use those weeks?
S: well, the first week [laughing] … to be honest … I was doing another course …
T: did you not even look at it first?
S: yes I had a look at that but I convinced myself that I need actually to do that because the time was running out but I had also the presentation based course … project based course … the advanced formal methods course and I was doing the project and trying to prove something that was actually not… [laughing] … but I could not prove them [laughing] but I proved that finally but I spent all my time for that …
T: one week or two?
S: yeah, one week cut off the whole to weeks, and then I started to do the home-take exam for one week…
T: how did you work? from morning to night? all around the clock?
S: it was not from the morning to the night, but yeah, it was most of the day I guess by just interrupting myself for the .. writing the report for another course [laughing] but that was just taking some 2 hours a day so it was not very much… I was waking up, trying to prove some things from the take-home exam and then I was ok I'm stuck, I just do something like report writing or just checking e-mail [laughing] entertainment, listening to music, and then switching to it again …
T: how did you work with the take-home exam, did you use books or did you … go back to lectures notes or did you …
S: yes I did …
T: can you explain a little bit more …
S: when I was feeling like … because I was like following the material when I was reading the course but I thought that … I felt the lack of the knowledge … something is going wrong … I don't [didn't] think myself experienced enough to do this to the end so I need some more materials … something more .. I was switching to the literature … and sometimes it was not only the course literature but some extra literature …
T: how did you find that literature?
S: that was your recommendations actually …
T: the Bird book?
S: yes [laughing]
T: yes, that's a good book … how did you all in all like the idea of having a take-home exam?
S: I think it was very good for this course at least. aah, I feel that it's more time consuming than a normal written exam but it's fair because it is an advanced course so … I think it is a good choice … and from the student point view [laughing], *well* … it' awful! [laughing]
T: and why is that?
S: well it takes a lot of time and you need to know the things rather than to … well for the written exam you should learn the things and then ….
T: forget them?
S: well, yes … it is not the case [laughing] like history you are learning things and then you write the things on the exam and then you forget about them, no that's not the case …
T: so you think you learn more from this sort of exam?
S: yes [firmly]
T: was it also more fun?
S: well … [laughing] except for hitting the wall, yes it was.
T: so if you would have had less to do it would have been quite ok?
S: yes, I think the volume of the material was quite ok for an advanced course so … for this kind of course I think it was okay.
T: If you think about how you worked in this course. Is it anything in particular in this course that made you study in this way? For example, in the end of the course you spent a lot of time with the take-home exam … what in this course made you move much of the workload to the end?
S: aha, well, I don't think it was overloaded at the end more than it was somewhere [laughing]… I think it was sort of distributed uniformly … I think it was ok, there was no workload at the end. I

would say that I had more workload at the end in the other courses, but this course I was studying all the time. But I think it is okay.
T: comparing to your other courses, is this course different to them?
S: yes it is…
T: the things you do during this course …
S: I was studying all the time when following this course, and on the other courses we had one .. actually two more advanced courses .. for one course I was doing the project at the same time so it was 5 credits actually so it was quite a lot of work … and that took also like all the time of the term, but for the other advanced course I was just listening to the lectures … there was no lab, no exercises, nothing, it was just the exam at the end. I don't think that this related to more advanced course...
T: if you compare to that particular course. How did you work with that course? Did you work more towards the end with that course?
S: yeah... I was attending the lectures, listening to them, but I think that was most of the … I was not taking the first exam but the re-exam because I had too much courses, I was taking four courses … [laughing] yes, four advanced courses actually. I studied before the exam for that particular course X, I was studying two weeks before the exam and I was reading the book and reading the lectures notes …
T: that was a ten-week course?
S: yes five credits…
T: … but over the whole term?
S: yes …
T: how did you know that you had reached the required level of knowledge of this course, in the sense that your answers did not need more work, that you had to do the weekly exercises to keep in pace with the lectures, … how did you know …
S: hmm, I did not know that! [Laughing] I just felt that my level was growing up, that sort of broadening, sort of, the knowledge, but I am trying to hit the level, my level, of understanding things, I felt that...
T: did not the presentations help you, the presentations of other students .. could you see *their level* and somehow use that? did it help at all...
S: well, yes in some cases … for some students I was seeing the things, but probably it was a lot of students that was not doing the homework, but they were in higher level, they were not presenting, that's the point. I think it is a bit difficult to see...
T: [short pause] what do you think you learned from this course?
S: everything that was required... [laughing] lambda calculus, programming in Haskell
T: all in all was this an effective way of studying for you
S: yes it was, very [firmly] effective, and I would take that into consideration for the future.
T: That's all. I thank you for the interview...