All you wanted to know about the Depth Oral (and will ask)

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The Depth Oral or the Qualifying Examination is the second checkpoint in Department's Ph.D. program. We hope that this document helps to take the confusion away from those yet to take the qualifier. This confusion eventually leads to *Pre-Depth Syndrome.* The opinions expressed here are our own. The quoted phrases are from department's graduate handbook. (The interpretations are our own, of course.)

What is it anyway?

The Ph.D. program in the Department of Computer Science is checkpointed so as "to ensure timely progress." The checkpoints work as regular deadlines and do help in at least the "near-timely completion" of the program. Although a delayed completion of a checkpoint does not necessarily mean a delayed Ph.D., it becomes more likely. A protraction beyond 48 months has tell tale effects on both the funding and the candidate's confidence. A prolonged program for a foreign student is a nightmare, especially considering the abolition of post-program fees. Our objective is to reduce whatever time that might be wasted in satisfying the depth requirements.

A qualifier (also called a candidacy or breadth) exam exists in most Ph.D. programs. The norm is to go through a test in several related (and often unrelated) areas. The result is a candidacy that does not have much to do with your research topic. In this department, the system is rectified by having a breadth *requirement* followed by a depth oral on your research topic. The depth oral is the first significant checkpoint, and the first time a Ph.D. candidate will face his/her committee. Although many of us have had the prior experience of technical writing, the depth document is perhaps the first paper written in this department. It is the very first time that you will be critically analyzing others' work. It is also perhaps the first time that you are asked to present your material within 25 minutes.

In the process of these qualifiers, you are expected to:

- "assimilate significant research papers on the topic, understand how they relate to one another, and identify open questions",

- write a “short” document,
- identify committee members,
- distribute the document to them,
- incorporate their suggestions,
- schedule an oral exam,
- prepare a 20-25 minute presentation, and
- face the orals – a presentation of your knowledge followed by questions from the members.

The Pre-Depth Syndrome

There are many questions about the depth oral that may lead to confusion and wasted months for most of us. (At least it has been happening in the past.) What to write the depth document on? Does it suffice to write a survey paper, or should I do some research? (How much is *some*?) How long should the paper be? Do I cover all the background material? Which and how many references? Who should I have on my committee? Is the document acceptable? How to squeeze material for a 25 minute presentation? How to prepare for the oral? And many unforeseen questions.

What topic?

Although many of us have had prior research experience, it is not easy to identify a potential Ph.D. topic. The only way to get a head start is to talk to senior graduate students in your group, attend all group meetings and seminars that interest you, and more importantly meet your supervisor as often as possible. Do not hibernate. In essence start thinking about your topic from *day zero*. Collect as many papers as possible. One way is to start from the most recent conference proceedings and journals in your area and keep following the interesting references in reverse chronological order. Using citation index is a good idea. A sure way is to present some of the significant papers in your group meetings.

This helps you not only to understand the papers better and to critically analyze them, but also leads to your finding potential research problems. Your fellow students are quite forgiving and helpful. Being on the other side of the projector somehow enhances the critical mind and changes the perspective, so your colleagues can lead you to a potential open problem. Just be bold and take the initiative.

For each significant paper that you read make a one page summary of problems addressed, contributions, strengths, and weaknesses/flaws. You should have written two sentences (or a paragraph) that effectively and critically summarize the complete paper. At the end, list the open problems from that paper. While reading a paper in the area be on the look out for similarities, underlying common threads, any notational framework that works for all papers you have read, problem generalizations and restrictions. One of the things that we have learned is to keep a systematic record of all the ideas.

Rereading the papers often gives a better understanding. It may be that you need to go through a paper a few times to fully understand it and appreciate it. Don't worry; this is normal to everybody around you.

It may be the case that you have a general idea of the topic or area you want to research. A reason for reading different papers is to narrow your selection of topics. The survey papers which cover your area or some specific topics are useful, as they provide a coherent summary of all the previous work in one perspective, a bibliography, and also pointers to open problems. You may initially be reading papers that later turn out to be unrelated. This happens quite often, but helps you to focus, and gives you a broader view of the area. However, you should attempt to narrow down the topics by pursuing ones which interest you most. Since you will be working with your supervisor almost all the time, take into account his/her interests as well. Regular meetings would steer you in that direction anyway.

When am I ready?

By now, you have about 15-20 significant papers and their summaries covering up to the most recent conference in your area. You have identified some open problems that you and your supervisor think are worth pursuing. You have identified the common framework underlying all the research, and possibly some consistent notation. There is always a temptation to research the problems you have identified. We know of many who delayed their checkpoints because they become busy with their research, and sidelined the depth oral. The department is becoming particular about timely completion of checkpoints, and moreover, the depth oral is only to demonstrate you are ready to do research in the area. If you can present all the current work, the strengths and weaknesses, and open problems in a coherent manner in about an hour, you are ready. It is better to keep a deadline for yourself and the suggested time frame, and work towards it from day start. *The earlier the better.* If it helps you to think so, take the view that you are taking the depth oral so as to be free to work on your research. All the effort that goes into the preparation for the depth oral helps in your dissertation. You *will* actually benefit from your committee's advice on the problems you are working on.

Ideally, the work you put into the literature search and area synopsis should bear fruit by way of a definite research topic. In this way, the time to the next phase, the research proposal, will be partly taken care of by the work you have done for the depth. The transition from depth oral to proposal should ideally be seamless. Keep this in mind. It is normal to discuss in your depth oral an area that could encompass your eventual research topic.

An indicator of your understanding of the area, and thus the time to start writing the depth, is when you begin: to grasp a new (and related) paper fairly quickly; to accept a paper as relevant or irrelevant to your topic; to debate whether it is a significant contribution or not; to place the paper in relation to others that you have read before; and to relate it to the central theme you have been weaving. You may still be reading papers and accepting them while writing your depth. Completing the literature survey today and beginning to write the paper tomorrow is usually not the case.

It is okay to ask your supervisor if he/she thinks you are ready.

Writing the document

The depth document is a self-contained critical survey. It presents the current work in a coherent framework. The contributions and drawbacks of each approach, and its comparison with other approaches, are clearly brought out. The potential research directions, and some of the specific open problems, are usually discussed. The depth document will ideally be used as "Chapter 2" of your thesis: the "Related Work" chapter.

There are at least three questions that you face before beginning to write the paper:

- What should be the scope of the paper?
- How to present a melange of results?
- How much background material to present?

The topic should be sufficiently broad to address a general issue of significance and narrow enough to delineate specific open problems. A narrow topic does not give enough leeway if you reach a dead-end. A good way to judge the scope is counting the summaries of papers you have prepared. Too many implies you have not been focusing enough. Too few means you have to identify a broader perspective. We think about 10 or so significant summaries can form the core of the paper. Make a good bibliography file of the papers in your area.

One of Danny's committee members said that the members do not expect the student to be a dictionary of knowledge in the area. They expect the student to have read and analyzed the papers, and understood their relationship to each other and intuitions behind their approaches. They are interested in evaluating your ability to order the ideas, identify and classify the most important points, and choose suitable papers in the area. These are especially evident in the structure of your document, e.g. the subtitles.

Build a top-down design of the paper around the core results and the open problems. Spend time to make this design as detailed as possible. Make notes of what you will discuss in each section and subsection, what citations are needed, what needs to be still thought out, what figures and examples you think are necessary, etc. This keeps a good control over the length of your document, and reduces the number and extent of later revisions. Show it to your seniors and supervisor, and get their suggestions. Do make an effort to identify results that are in effect only small extensions (which unfortunately happens too often these days), and do not devote much space to them. It is not possible to present the results in a coherent and elegant fashion without identifying a common underlying framework, a classification, a generalized problem and its restrictions etc. The best way is to start out by writing an introductory section. An introduction forces you to think of the whole paper in perspective. If you are stuck writing it, you need to think. Try explaining to a friend all the results in about an hour. Try writing the beef of it in one paragraph (this can very well become an abstract eventually, with due revisions).

The important point to note is that your depth is a way of presenting the area or topic, and *you are using the papers to back it.* The depth document should be viewed in one sense as being a (critical) tutorial on the area. Ask yourself, what is the best way to describe the area so as to give the reader a good understanding. One of Kulki's teachers said "while writing the paper pretend school children will read it." The depth document should be understandable by a person who is not an expert in the field. The document has to be self-contained. Your committee will hate refering to other papers to understand your paper. Some of the committee members may not be aware of the concepts that you think everybody in your area (or field) knows. Define all terms which are specific to your area.

The committee wants to find out your understanding of the concepts. Do not compromise the content for the length of the paper. Perhaps, include an appendix that has the background material that is not entirely necessary for the tutorial.

Tim Brecht said that his/her committee wanted to see him pick a side and agree for or against an idea. They didn't care if they agreed with him. They only cared whether he/she could present a clear and valid argument.

Although it varies from person to person, and group to group, make the document shorter than 15-20 single pages. Ask your supervisor what he/she thinks is the average length for your topic. There are those who wrote 50 page documents and also those who wrote a 10 pager. The shorter the better so that the material is crisply presented, and the committee does not spend 15 days reading it. It may not take more than 6-8 weeks to write. Get the first version out as soon as possible. A document usually needs more revisions than you think are necessary. Do request friends, and moreover your supervisor to give comments.

If you have difficulties writing technical documents in English, do not hesitate to take advantage of technical writing workshops the department arranges, as well as, technical writing handbooks. The final depth paper must be readable. Have one idea per paragraph. A paper which is hard to read usually indicates a poor understanding of the material.

Remember that you are writing a technical paper in a Computer Science department, so BE TECHNICAL. Do not use informal words, phrases, and grammar. Do care for the standard notations. Avoid conflicting notations. Too many subscripts or superscripts complicates the presentation of the ideas. Try to avoid these wherever possible.

Another suggestion is to use something like the "style" command which gives suggestions on sentence structures, but you should make a point of *un-electronically* improving you writing skills. (You could be writing many more papers in your life, and you are better off honing your skills NOW.) *Do use a spelling checker.* The accepted spelling for English papers is American. The Webster's dictionary uses American English.

Scheduling

Once you have the first version ready, you should start talking to potential committee members. Although you are required to give a copy of the paper just 2 weeks before the exam, do give them a version as early as possible. Do make sure your supervisor has read through it first and has okayed the distribution, otherwise a poor paper will reflect badly on you and your supervisor. Their comments can often be very helpful.

Once you determine the members, meet them with a calendar in hand. Mark the dates and times unsuitable to each. Doing this by e-mail can be time consuming for both you and the members. Select a few alternative dates, and fix one of them. It accounts for last minute commitments the faculty may have. Summer is a bad time; the vacations and conferences make it difficult to get a date. Since you need about 2-3 hours for the exam, try to start at 9-10am or 1-2pm. The graduate secretary can book the room for you. LP378 and LP266 are good, SF2103 although badly lit, is acceptable. Once, you've set the date, time, and place, you must fill out a depth oral form with the graduate office beforehand. This is so that they will not book anything for one of your members at the same time. (This also helps to keep a record of your progress, and prevents you from getting nasty reminders by mistake :))

Do remember to distribute the final copy of the paper to all members at least 2 weeks in advance.

Slides and Presentation

The presentation is an important component of the depth oral. It enables the committee to evaluate your ability to present your area and convey the core ideas clearly and concisely, and ability to think critically. You are given 20-25 minutes, and a longer presentation is not usually accepted. Pretend that your friend has to take a flight to Timbaktu in 20-25 minutes and has to know what you are researching.

You can talk only so much in 20-25 minutes. Do not make an attempt to cover every detail in the document – you would have distributed it anyway. About 10-12 slides, with less than 4-8 lines per slide and 24 point size, are appropriate. Do spend time to make them elegant. For instance, avoid handwritten slides – none of us are calligraphers. Coloring your world is okay, if you are not too overly jazzy. Figures are most useful because they tend to convey ideas more clearly than mere words. Try to avoid all the math. If necessary, only state the theorems. The time is quite short to do any proof, so only talk about the underlying intuitive ideas. If necessary you can refer to relevant pages of the document anyway.

Devote at least 1-2 slides to open problems and research directions. It is generally a good idea to prepare extra slides on details of what you plan to do in the future. It is the best time to tell the committee that you have started your research already (if you have). Some background material you have assumed can be put in separate slides and you can pull them out if needed. Think about the questions committee members might ask (research on their ideas, and biases might help). Preparing your answers and possibly extra slides with a rough sketch of the answers is useful. You do not have to (and cannot) anticipate every question beforehand and prepare a slide for it. Psychologically speaking, it is good to avoid getting *surprise* questions. All the slides should have serial numbers to avoid confusion because of anxiety.

Some professors try to assimilate your ideas with what they are interested in. Spend some time to find out your members' interests and how these relate to the concepts in the depth. Questions in an oral are meant to determine how much you thought about the ideas.

Answering questions from the committee members is a task you should be aware of and develop as a skill. Apart from the depth oral, you will need these techniques to function as a researcher, a teacher, a designer, or whatever. Also, if your work is related to a committee member's work, know and understand that work well and how it is related. One necessary skill is to listen fully to someone's question and answer only that question. You may be tempted to start talking as soon as you here some keywords or phrase within the questions, or you may come up with an answer as you are listening. This will cause problems because your answer may not cover all the points in the question. If you need to take some time to think after the question is asked, USE IT. Your answers should also be concise.

One question to always ask yourself at any time is "why", e.g., why do these papers use a certain approach? why do you believe certain things about the area? Being able to ask yourself these types of questions and preparing good answers will aid your preparation for the depth oral. (*Why* and *how* are the first concerns of any researcher anyway.)

Questions will fall into various categories. One class includes questions that are directly related to a paper or topic, where you are asked to further explain what was dealt with there. Another group of questions could be classified as "well what do you think" types. In these questions, you are asked to go beyond your area's boundaries and consider how it may be applied to other areas, or how to expand on some ideas.

A definite goal of the committee is to find out what you do not know. It may be the case that a member asks you a line of questions, where at some point you do not know the answer. Answering "I don't know" may sometimes be the only and best response you can give.

The whole depth oral usually lasts about 2 hours including questions from your committee. Believe us when we say that this time will fly by.

One member on the committee, usually someone other than your supervisor, acts as the chairman of the committee and is responsible for co-ordinating you and your committee members, and organizing the members' question periods. Each member asks their questions in turn with your supervisor usually being last. There may be more than one round of questions as well. (For instance, Kulki had two, Danny had one round of questions.)

Schedule a mock-presentation for your friends and group members about 2 weeks before the exam. It always helps. You can get very good feedback on your slides, and surprisingly penetrating questions. Speak firmly, and slowly. Do use a pointer to locate the material you are talking about. Just the shadow of a pen works better than nothing at all. The audience is more interesting to look at than the projector. Make brief notes of what you should speak about. Practice the talk as often as possible and time it sincerely. Also, request the people attending the practice talk to write down any comments and questions on a piece of paper, and not to ask any questions until you have completed your presentation (normally they do not). This will allow you to obtain a hard copy of their input, as well as, allow you to guage how long your talk will actually take. Try to ask people who have completed their depth, and also people who you know will ask tough questions.

A note those people reading papers and attending practice sessions for friends. BE CRITICAL. It does the person no good to just go to the talk and not say anything. Pointing out presentation problems, asking very tough questions, etc. cause the person to sweat a lot more about the depth, but help him/her to become totally prepared for the talk in front of his/her committee.

Pre-Depth Anxiety

Anxiety is common prior to any exam, and especially an oral one. It is an impatient waiting period when you cannot do anything else. Talk to friends; try to eat and sleep well. Psychologists say that some amount of anxiety is necessary to produce good performance. Depth orals seem to have a bad reputation. Some candidates can hardly sleep; some can not eat. They think as though their life depends on it. Every friend would have tried to convince them that they had worked hard and would pass.

We do not see any reason for such high anxieties, although **we have** experienced them. The committee is generally very helpful and is just trying to find out what you understand. Consider the oral as a meeting with all the members at once. The depth oral is just a high wall for a pole vaulter. You run very fast, do a good job of leaping high, and after jumping over the wall, it seems as though the wall never was. The depth examination is mostly the effort that goes into preparing for the oral and the paper.

The D-day

On the day before the exam, arrange all the slides, a few blank slides, OHP markers, and white board markers neatly. Eat and sleep well. Next day, dress with the garments you are most comfortable with. Have a good breakfast. Do not miss your lunch if the oral is in the afternoon. Check all the slides again. Briefly review the notes you have made. Make sure you have all the stationery you need. Reach the room 10 minutes beforehand, and get it opened. Check the markers, and more importantly the projector. Adjust the projector lighting, and based on the seating decide where you are going to stand and talk. Do not forget to take a coffee, soft drink, or water with you. Sit for a while, take a few deep breaths and stretch.

Once all the members are in, you will be asked to step out briefly We guess, your supervisor describes your background to the members, as they may not know you very well yet. After a few minutes you will be called in, asked by the chair to give a 20-25 minute presentation. Try to be relaxed and pretend you are speaking to a group of friends. Discuss all and only the material on slides. You won't normally be interrupted during the talk. The members then ask you questions. The questions can be clarifications on what you said, what you wrote in the document, and may point out some omitted references. You can expect quite a few questions on what you think of certain scenarios and future directions. Remember that they are only trying to understand what *you think*. Do present your ideas rationally. If you think you were wrong, admit it. If you cannot answer a question, do not get depressed. Politely give your first instance response, and say that you will think about it and get back to him/her later. You are obviously not expected to know everything. For all you know, the question might lead to a sound research problem.

When the question period is over, you will be asked to step out so that they can discuss whether you qualify. You spend an anxious 5-10 minutes outside. Some say it is mandatory to sweat. It is not that bad really – you mostly know how you have done. A good effort is always appreciated.

Post-Depth Syndrome

At least for 2 weeks after the depth oral there is a period of post-depth syndrome when you are so relaxed that no research gets done. Do not worry, you will recover from it, and get back to work. (Maybe a deadline immediately following the depth oral will help). You start explaining to others that you were overly anxious. Maybe you will start writing a document like this one. Maybe you want to start searching for *All you wanted to know about the Research Proposal.* We wish you good luck. If this helps you to reduce your anxieties, clear your mind, and satisfy the checkpoint in time, this paper will have served its purpose.