

King Fahd University of Petroleum and Minerals

Electrical Engineering Department

Center for Energy and Geo-Processing (CeGP)

Undergraduate Research

Term XXXX

EE490: Undergraduate Research

Guidelines for Post Doctors and Graduate Students Mentoring Undergraduate (UG) Students Conducting Research

KFUPM- Georgia Tech

Important Disclaimer

This version is a draft. It cannot be used for any legal action and the institutions are not responsible for the content. It is only meant to provide early information. Your feedback and questions are welcomed at muqaibel@kfupm.edu.sa

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Recommendations

- Mentor to hold at least one meeting every week with the UG student.
- Mentor to make himself available to the students outside the scheduled meetings.
- Have the UG students spend time in the same lab as the graduate students to do the work. Provide special desk if possible.
- UG students need to record meeting minutes to briefly record discussions between mentors and students. It would be convenient for professors to follow the current status.
- Objective should be defined clearly and beforehand. Even most of the objectives can change with time, it is important to have solid goals and make appropriate changes properly. A Gantt chart is a good practice to report objective and estimated dates
- Mentor and students should be connected all the time. The more the interaction, the sooner the issues are fixed and the progress is achieved.
- The workload of students should be considered while planning the objectives. If the assignments are more than students can handle, students can get burnt out and eventually less productive.
- The motivation of students should also be considered while planning the objectives. If the student wants to perform research just to get some credits and write the experience down on the CV, he/she will probably do the minimum. In that case, the mentor should find a way to motivate students.

General Workflow and Tasks

- 1) **Explanation:** Mentor will start by explaining the overall idea and share the vision while stating the current state of the art. Of course, the mentor has to be aware that the UG students do not know many of the terms and thus the mentor has to learn how to explain advanced concepts to a non-expert (part of the training for the mentor).
- 2) **Summary & literature survey:** Then, the mentor will share a set of papers with the students and ask the students to summarize one or two of the papers. The mentor has to be specific in what the expectations are and must give a reasonable time to allow the students to read a paper and summarize it. In here, the mentor must teach the students how to read a paper and the iterative process of reading and summarizing a paper.
 - i) The student should not provide solely verbal summary. The more the summary becomes visual, the better.
 - ii) During the process in 2 above, the students should be judged to see if any of them went beyond the provided papers and tried to search for other papers or other information. Usually the students who do these things on their own are the ones who get the most out of the experience. For the students who do not do this, the mentor has to ask them to go out there and find related papers, systems, lectures, and come up with a summary that may counter or agree with the first batch of papers. All these papers and the findings must be well discussed by the mentor and I personally prefer if at least 50% of the discussions/talking are done by the UG students and not by the mentor.
- 3) **Discussions**, many of them ...

- i) The discussions between the mentor and student should be interactive, they should not be only one way.
 - ii) Meeting with the professor for the UG to present their work so far.
 - iii) During the discussions, the mentor should make the student feel that he should be the lead. Whenever the mentor proposes a task, it should be a suggestion, not an order. Students are willing to work harder and be more active if they believe that they have the control. Mentor should be a mentor not the one who is doing the work otherwise there is something wrong.
- 4) **Hands on:** Next, the mentor has to prepare a set of codes and tools for the students to start playing with codes/hardware/systems/equations to observe what they read in the papers in action.
- i) The students should be able to make a few **changes** to the code and see/observe/study/analyze/assess their results.
 - ii) Then, the students are asked to come up with a list of current **shortcoming** in the current codes/algorithm/theory compared to the overall vision identified early on.
 - iii) In this process, the mentor must emphasize the importance of **debugging**. The mentor needs to show them debugging as an example.
 - iv) A **coding standard** should be set beforehand including but not limited to naming, commenting, length of the code, using external libraries.
- 5) Then, the students are left to **jump in the swimming pool** and start trying their ideas or ideas they learned in classes or they read somewhere to see if they can do the thing right. During this period, the mentor's job is to get the students to think of why more than anything else. In the extreme case the students are stuck, the mentor could give them a direction that get them out of the frustration hole.
- 6) When the course offer the mentor is expected to follow up with the students to submit their work to a professional conference/ Journal. It is important that UG student go through the submission experience. The presence of their name and/or the order of the author list shall depend on their commitment till the paper get published.

Notes and Feedback from Experience

1. **Rewards and Encouragement:** UG students usually work on rewards and encouragements. There should be some feedback or encouragement mechanism to keep them motivated. For everything they do right, there should be an encouragement from mentor or professor to not only keep them motivated but eager to learn more and do better than before.
2. **Self-motivation:** The mentor should make UG student feel that the student is doing the work for himself not for the mentor or any others. If the student is doing the work just as a course or homework, external motivation should constantly be provided by the mentor. However, if the motivation of the student is understood carefully, the mentor can present the problem in a way that the one who is going to benefit from a good performance is the student himself not the mentor. Once this is achieved, the student will do his best.
3. **Organizational Skills:** The mentor should also teach how to manage research/data/codes etc as well. With time, the research data/papers/codes pile up together to create a big mess. The management of research papers/codes etc should also be part of mentorship program, which will also be useful later in their career. The mentor

should also help UG students to maintain a good record/versions/reports/history of what he/she has done over his/her efforts in research over time. They may be introduced to research management software like Mendeley®.

4. **Flexibility:** Since UG students are very busy with preparing their exams in some weeks, mentors may need to flexibly adjust the working assignments depending on the schedule of UG students. For example, the reading assignments in the first several weeks can be heavier than the coding tasks in exam weeks.
5. **Writing/Coding Style:** The mentor should see to it that UG students form good habit in writing and coding at the very beginning. They will benefit from this in their future career, whether in academia or industry. At the same time, this will make it much easier for the mentor to work with the students throughout the process. The mentor can do this by providing template writings (with the desired format, structure, points of content) and template codes (with the right coding standard, comments, naming conventions, etc.) for them to start with. Correcting things at the beginning is much easier than later.
6. **Understanding Students:** It will always help for the mentor to put him/herself in the shoes of the students. Keeping in mind how things were like for him/herself while doing research as a UG student, it will become easier for the mentor to make the process more beneficial and enjoyable for both parties.
7. **One to one interaction:** An ideal mentor should not be a mentor just in the specific research topic. Students are trying to figure out what they will do with their lives. The more the mentor knows the students and asks them about how they are doing (honestly, not symbolically), the more he/she can help students to figure out their issues. Once the students trust and respect the mentor, they will work harder not just to finish the assignment but also not to frustrate the mentor.

Please send in your feedback and any suggested update or correction to this document:

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