Dr. Everitt's Neighborhood

An independent guide to ECE at Illinois

- Course reviews
- Interview with Prof. Pop
- Choosing between EE and CompE
- Things I wish I knew as a freshman
- Job search advice

http://hkn.ec.uiuc.edu

ISSUE #1, SPRING 2009
A special acknowledgment

Dr. Everitt’s Neighborhood would not have been possible without the help from MIT’s Beta Theta chapter of Eta Kappa Nu, which has been publishing its Underground Guide to Course 6 for over 20 years. It is the Underground Guide to Course 6 from which Dr. Everitt’s Neighborhood draws its inspiration.

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What is the story behind the cover art (courtesy of Jake Thompson)?

According to the article “Everitt Led Engineering College to Prominence” from the ECE Website, Dr. Everitt is “remembered by former students and colleagues as the only UI engineering dean who would rather use his head than think on his feet. One of Everitt’s quirkiest traits was his ability to stand on his head. According to an old newspaper report, he would perform this feat on demand, often at service club meetings or charity fundraisers.

The dean claimed he started standing on his head at age 30 to keep from becoming bald." But, he once noted after running his hand over his fairly hairless head, as you see, I did not succeed."
Dear Reader,

On behalf of the Alpha chapter of Eta Kappa Nu (HKN) here at Illinois, I am happy to present to you the first edition of *Dr. Everitt’s Neighborhood*. For the last year a group of HKN members and initiates, led by Chris Li, have been working to bring you an independent resource to help you navigate your time here at Illinois. It has been through many different revisions, with the focus changed several times, but the end result is something that HKN is proud to stand behind.

Eta Kappa Nu, the national Electrical and Computer Engineering honor society, was founded here at Illinois in 1904. Since then it has spread to over 200 chapters nationwide, with the purpose of honoring and developing the best students in the country. While this is the national goal, and something we strive to do as well, we have refined our mission statement to the following:

“Eta Kappa Nu, the Electrical and Computer Engineering honor society, is a community that promotes Leadership, Scholarship, and Character through service to the Department, members, and student.”

Everything we do is focused around this mission. Each semester we initiate qualified students into our society. As part of the initiation, the students help plan events, provide services to the ECE community, and attend social events. Among our services are the office in Rm. 243 Everitt, where we sell snacks and packets of past exams for most classes, review sessions for many classes, and peer tutoring.

Recently, we have been trying to find new ways to give back to the community. In the spring of 2008 Chris Li brought up the idea of creating an underground guide to the ECE curriculum. This was inspired by the HKN chapter at MIT, which has for many years been publishing an “Underground Guide to Course VI.” Over the past year, with help from several HKN members, and with some faculty support, we have been able to define our own guide, and now have it ready for you.

It is by no means perfect. I am sure that, despite our best efforts, there will be grammar and spelling errors (we are all engineers, after all). And while these are course honest evaluations by your peers, trying to be as objective as possible, there will inevitably be biases. We look forward to revising and expanding this guide over the coming semesters to increase its accuracy and usefulness.

HKN here at Illinois is a strong community, and I encourage everyone invited to join. It is a great place to meet the best and the brightest, whether you are planning an event with them, playing broomball, flag football, or just relaxing at one of our cookouts. It is also a place where you can become involved, and actively help your fellow students. I hope you find this guide as useful as we intend it to be, and enjoy your experience here at Illinois.

Sincerely,

Nicholas Hardy

Alpha Chapter President
So, What is Dr Everitt’s Neighborhood?

Purpose

*Dr. Everitt’s Neighborhood* is an independent, student-run guide intended to provide all sorts of useful knowledge about life as an ECE student. Our philosophy is that it is important not to simply repeat the department’s published information, but to supplement it by adding students’ perspectives.

Disclaimer

Engineers thrive on the fact that there is always more than one way to do something well. Accordingly, some of thoughts and suggestions expressed in this guide, while respectful, are different from the ones you will hear from the advising office. We encourage you to make your own judgment based on advice from several sources, such as this guide, the advising office, professors, professionals, alumni, friends, and upperclassmen.

In addition, various ECE student organizations offer services that give such advice to students. For example, each semester, IEEE offers a “Gripe Session”, in which IEEE collects student opinions on various courses and communicates these opinions to the ECE department. HKN and the ECE Student Advisory Committee (ECESAC) usually offer peer advising services at the beginning of each semester and around class registration time, respectively.

Getting Involved

*Dr. Everitt’s Neighborhood* is an independent resource written for ECE students, by ECE students; under the oversight of Eta Kappa Nu, the ECE honor society; and with the support, but minimal involvement, of the ECE department.

Ultimately this resource is what you, the fellow ECE student, make of it. It may help you choose courses, research interests, learn more about professors and their personal and professional interests, stay informed on student opinions, etc. Accordingly, this resource lives on the feedback and ideas of the students in ECE. If you can think of other articles or features to include, we want to know, and if you want, you can even help write them.

If you would like to get involved with this guide, please contact Christopher Li at cli20@illinois.edu.
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Dr. Everitt’s Neighborhood: Features
So you've made it into one of the most highly regarded, challenging, and exciting Electrical and Computer Engineering programs in the country. Congratulations! Don't screw it up. But seriously, if you intend to make it through your time here without dropping out, switching majors, or waking up in the middle of the afternoon in Grainger using your 440 book as a pillow, there are a few things you should know about right off the bat:

1. **There is a Student Lounge in Everitt Lab.**

   No, really, it's in the northeast hallway on the first floor. Already knew that? Good for you. I, however, didn't find it until the end of Sophomore year. I guess I never undertook the typical Freshman adventure of wandering around Everitt looking scared and lost until I knew where everything was. Anyway, the student lounge has study tables, computers, and printers, which are handy for finding creative ways to use the 300 pages of free printing we get every semester. On top of that, it's just been remodeled this year, so there's no excuse not to make use of this great resource.

2. **Don't Blow Through your Social Science/ Humanities Electives in the First Few Semesters.**

   They are by far the easiest classes you will take. If you do rush through them, like I did, you'll end up with no choice but to take only technical classes for your last three or four semesters. Ouch.

3. **Taking 210 and 290 in the Same Semester is Not That Bad**

   Contrary to what you might have heard from, say, every ECE upperclassman you’ve ever talked to (most of whom didn’t even do it themselves), Sure, it’s a steaming load of homework and labs, but it really only gets worse from then on, so you might as well get used to it. Plus, these classes are pre-requisites for just about everything, so you’ll be able to take almost whatever you want after you get them out of the way.

4. **SSH is your new best friend.**

   I saved myself about 59483 trips to the EWS labs by logging in remotely with SSH. Why is this useful, you might ask? Well, it allows you to do all of your workstation-based labs from anywhere with an internet connection, which comes in mighty handy on those cold, rainy nights when you'd rather stay inside in your jammies and eat bagel bites while you do your lab. A great guide can be found here: http://www.ews.uiuc.edu/userguide/clrtxt/

5. **Make Sure That You Have FUN!**

   With everything! All the time! OK, that might sometimes seem kinda tough to do in your lectures, but seriously, you have to find some way to enjoy your ECE work or your personality will melt. More importantly, make time to enjoy yourself now and then. I've seen too many of my peers walk into class 20 minutes late looking like zombies because they spent all night studying for a test that was three weeks away. Sure, you have to take your work seriously and start building a resume, but at the same time, you're in college. You're only going to be here for four years. Live it up while you can!

Looking back on my four years in ECE, it's hard to say I didn't enjoy them. It's also hard to say that it feels like it took forever, because I still feel like a freshman sometimes. In only a few short semesters, you too will be preparing to graduate and head off into that intimidating, inevitable, and somewhat unfortunate thing called the “real world.” I suggest you make your time here the best time of your life, because frankly, it's the only time you've got left to truly enjoy being young. Make it last, and learn as much as you can along the way. Relax, you'll be fine.
Faculty Spotlight: Professor Eric Pop

Interview by Austin J. Kim

HKN welcomes Prof. Pop as our new faculty adviser starting in the Spring 2009 semester. Prof. Pop teaches ECE 440 and an offering of ECE 598 (Hot Chips: Atoms to Heat Sinks). But did you know that he is also a DJ? In this interview, Prof. Pop talks about his background, research, interests, and gives advice to students.

Tell us a little bit about your upbringing, where you grew up, and anything else relevant.
I am originally from Romania, and I moved to the US when I was 17 years old.

To put this in historical context was this before or after the Berlin Wall fell?
This was a few years after the Berlin Wall fell. About the time that all of us started listening to Nirvana.

How is your Romanian tongue? Are you still fluent in it?
I would say that my Romanian is good. I cannot give a technical talk or lecture in Romanian, since I learned all the scientific terms in English. But I can hold conversations with the other Romanian faculty such as Professor Popescu and Gross here in our ECE department. My Hungarian is on the other hand awful.

Ah so you grew up in the part of Romania with a lot of Hungarians, in Transylvania?
Yes, I grew up bilingual speaking Hungarian and Romanian. My grandmother was Hungarian, but I learned most of it from watching TV, and because half the kids at the playground spoke Hungarian.

So, how did you become interested in electrical engineering?
Well, I wanted to become an astrophysicist and wanted to study stars. I became interested in it because I read a lot of sci-fi books, from Jules Verne to A.C. Doyle. So, I entered MIT as an undergrad in physics, but after taking a few EE classes, I became more interested in solid-state physics. There are many open-ended questions still remaining in this area, and the applications of solid-state are also much more relevant and immediate (transistors, lasers, carbon nanotubes). A lot of the MIT undergrad curriculum is shared between EE and CS, but it turned out I liked EE better than CS too. Eventually, I still finished my major in physics, but double-majored with EE.

How did you come to the ECE department here at U of I?
Well, I then did my Ph.D. in Electrical Engineering at Stanford, followed by a post-doctorate studying the electronic and thermal aspects of single carbon molecules, working with a chemist. I also worked at Intel for a year and a half, having spent a total of seven years in the Bay Area.

I got contacted by U of I for an interview. Faculty positions in top departments are very difficult to get (universities typically hire only enough to replenish their faculty, about 1-2 people per year in a given area), so naturally it was great to get this job. It’s been a great fit for my interests, which lie more along teaching and basic research, rather than applied product-driven development.

What specific fields in electrical engineering are you interested?
I study nanoscale energy transport, more specifically power dissipation in nanoscale circuits and semiconductor devices. From a materials perspective, we are focusing on carbon nanotubes and graphene, which have electrical and thermal properties superior to silicon. Some of the work we are now doing is similar to early ground-breaking work done with silicon 40 or 50 years ago. So, there is a lot of excitement in the field, and many unknowns which we hope to contribute towards. (continued on next page)
So do you have any hobbies or any interests?
At the moment, I don’t have that many hobbies due to work, but my interests are music, soccer, and snowboarding, probably in that order. During graduate school, I used to be a DJ for four years at the Stanford Radio station, KZSU 90.1 FM. I also DJ-ed at various Stanford parties and San Francisco clubs, which was a great way to earn some money on the side, and meet people who were not necessarily in electrical engineering. What’s interesting is that preparing for a radio show is similar to classroom teaching. I had to be ahead of my playlist and the musical trends at the time, just like when teaching I need to be ahead while preparing my lectures for ECE 440.

So could you expound on what genres of music you are interested?
I am interested in House, Techno, Drum and Bass; to be more specific, Deep-house, Tech-house, Micro-house. Also, 80’s “golden age” hip-hop... I’m not a big fan of gangster rap.

What were the most recent concerts you’ve attended?
The last concert I attended was Atmosphere at the Canopy Club, which is an underground hip-hop act from Minnesota. Before that, I was glad to catch Hot Chip up in Chicago.

Where do you go to attend concerts normally?
I find the stuff they play at Assembly Hall too main-stream and tend to avoid those. I frequently attend Canopy Club for its good, live music. Canopy Club was a good find for me, and helped me adjust to Champaign-Urbana after moving here from San Francisco.

“I had to be ahead of my playlist and the musical trends at the time, just like when teaching I need to be ahead while preparing my lectures for ECE 440.”

How interested are you in soccer?
I am quite interested in soccer. I’d wake up at any odd morning hour for the World Cup soccer games in Korea (2002) or Germany (2006). Luckily, there’s TiVo now, so I don’t have to do that as often. I also will go out of my way to watch the UEFA Cup, but not so much with normal club games. Of course, I am still a fan of the Romanian national football team.

What is your favorite quote?
My favorite quote is from Dr. Strangelove, and it is: “Gentlemen, you cannot fight in here. This is the war room!” I love the absurdity of that particular situation, and in general how well the movie relates to some of our present-day conflicts.

Ah, are you interested in old movies?
Not particularly. I am not really a movie buff, although I did take an acting class at MIT, but ended up with a B.

Do you have a Facebook account?
Yes, I do. Every young professor who was a grad student in 2004, when Facebook first came out, probably has one. Some have probably joined since then. As for the students out there on Facebook, unlike the average employer, I personally do not care if you have pictures doing silly things. If you work with me or take my class, I only care if you can do good work. (continued on next page)
“As for the students out there on Facebook, unlike the average employer, I personally do not care if you have pictures doing silly things. If you work with me or take my class, I only care if you can do good work.”

**What is your research area?**
My research area is in nanoscale energy transport, specifically power dissipation. I research carbon nanotubes, phase-change materials, and graphene.

**Do you have any possible undergraduate research ideas?**
Currently, there are four undergraduates in my lab. More specifically, some of them are doing Matlab simulations on carbon nanotube mobility, and taking measurements to help graduate students. We are generally interested in undergraduates who want to get some hands-on experience setting up lab equipment, or those who enjoy Matlab or C programming to solve interesting problems related to our research (e.g. transistors, or nanoscale energy dissipation).

**What courses should students have enjoyed to talk to you about research?**
I would say, Physics 213/214, and ECE 329, 440, and 444, although not all are prerequisites. This is just the general undergraduate area that we operate in.

**How many students are currently working under you?**
There are currently 5 grad students and 4 undergrad students in my group.

**For credit which courses will you sign off?**
I allow ECE 396 (Honors Project), 497 (Senior Research), and 499 (Senior Thesis).

**What qualities should a student have in order to work with you?**
Two qualities are probably most important: “smart” and “can get things done.” Beyond that, we can teach them most of the details, although some of the classes mentioned above are nice to have. Depending on the project, preferably some programming knowledge and hands-on skills are useful. For example, C/Matlab/Java programming, or the types of people who can take their car or bike apart and put it back together. We have had freshmen working in our group as well, so students do not have to consider 440 as a “prerequisite” for us at all. But it is nice if they come to talk to me with some previous knowledge and curiosity about our area of research... three words of advice: check our website!

**What are the weekly requirements for undergraduates in your lab?**
Undergrads typically work 5-10 Hrs/week average, but it depends on their class load, or any deadlines that may be approaching. Almost any workload can be accommodated as long as there is good communication between the undergrad, myself, and the graduate student involved in the project.

**How many semesters would you expect a project under you to take for completion?**
At least two semesters, or a semester plus summer. *(continued on next page)*
What are your immediate and long term goals, both outside and inside the classroom?

Inside the classroom, I would like to create more student excitement toward ECE 440. I think this course has gotten a poor reputation in the recent past, much of it undeserved. This topic is a true gateway to the Nanotechnology area of our Department, with historical roots tracing back to John Bardeen. Thus, both its history as well as its future are extremely important. I am now working with several students to bring a small hands-on component to 440, which should give future generations a better sense of the excitement created by measuring (and understanding) how nanoscale electronics, like carbon nanotube transistors, work. Outside the classroom, my plan is to evolve my lab and research group into the world leader in nanoscale energy transport, and low-power nanoelectronics. I would like to see my research students, both graduate and undergraduate receive the best training, and take key leadership roles in shaping the future of this area.

Professor Pop’s Suggestions for Students Interested in Research Opportunities

In addition to working at Intel, Prof. Pop has interned at IBM. However, as an undergraduate at MIT, he also started performing research as early as his freshman year in a nuclear physics lab. Here is Prof. Pop’s advice for undergraduates who are seeking to perform research.

• “First, look up professors using the ECE website. In fact, you don’t have to limit yourself to our department alone – there are people doing related work in MatSE, MechE, Physics, CS, etc.

• Keep in mind that often, faculty websites are out of date, so it’s important to talk to (graduate) students in the groups as well. If possible, read over some of the recent technical publications from the group.

• Then, narrow the list to a few professors whose interests match your own, and send them a quick email concerning research. Make these emails short, to the point, and attach a resume with GPA and relevant coursework, or other experience listed.

• Get yourself invited to a group meeting, and attend as many of those as you can. On one hand, this will show your commitment to the faculty member, and on the other it will give you a good idea if you want to work in the particular area.

• Talk to many of the graduate (and undergraduate) members of the research group to find out what kind of problems are “open” and interesting. Ultimately, of course you will want to connect to the faculty member directly, but doing a lot of groundwork before approaching them is key, shows that you are well-prepared, and it can also eliminate “false leads” in research areas which you may not be ultimately interested in.”
It is exceedingly rare for a freshman to arrive on campus with enough knowledge to pick between Computer Engineering and Electrical Engineering. If you are a little uncertain, you are normal and in the majority. It is your friends who are 100% sure about their decision who are unusual.

A little history

Seventy-five years ago there was no such thing as Computer Engineering. Computer Engineering was born with the invention of the computer. People will fight to the death over when the first computer was invented, but the majority say somewhere around the 1940s. Computer Engineering began as a sub-discipline within Electrical Engineering, and became its own major in 1972.

The technical differences

The simplest way to describe the difference is that CompEs focus on waves with square edges and EEs focus on waves with curvy edges. CompEs deal with binary, ones and zeros; while EEs deal with continuous numbers. CompEs do more software and programming, while EEs do more analysis of waves. Both majors are math intensive, and the underlying fundamentals of each are rooted in mathematics, but on the surface, EEs typically do much more with math and equations while CompEs do more with algorithms and logic.

The career differences

CompEs typically take one of a few routes. One, they work on designing processors or ASICs (which will make sense after ECE 190). Two, they work on developing FPGAs (which will make sense after ECE 385). These two options involve designing the functionality (as opposed to physical aspects) of hardware. Topics include devising ways to do addition and multiplication with logic gates, ways to read and write memory, and ways to send and display output to things like a monitor. The third option is developing software. The third option is very similar to what someone with a Computer Science degree would do. At the risk of offending CS majors, some say that a CompE can do most of the things a CS major can do. The difference, then, between CompE and CS is that CompE emphasizes hardware, and the hardware aspects of programming. Many CompEs take jobs just like CS majors, programming software applications, ranging from online banking tools, to PC applications like media players and word processors, to behind the scenes database software for customized for any company’s own system. CompEs, however, often take jobs in low level programming, meaning that instead of designing database software for a bank, they write code to control the combination of ones and zeros sent from a keyboard to a computer, from a Wii-mote to a Wii, or from a wireless internet card to a processor.

EEs focus less on software, and more on the physical design of hardware. Some EEs design systems to generate power, and carry power from power plants to homes and factories. Others design circuits, finding ways to build and connect resistors, capacitors, transistors, and gates, to make things like amplifiers. Others devise ways to make 3-D pictures of an object by shooting electromagnetic waves through the object and using sensors to see how the waves bounce around. Others do processing on signals to do anything from removing red eye and improving contrast in digital photos, to isolating frequencies in music so you can pump up the bass on your stereo. Others work with antennas, developing methods of sending signals between cell phones, satellites, and TVs. Others work on medical applications. Others develop control systems to steer planes and manipulate robots. What all of these fields have in common, is a focus on waves (math that involves sines, cosines, and Fourier transforms). (continued on next page)
How to choose

In most cases, CompEs and EEs take the exact same classes for their first two years. By the end of their sophomore year, most students have had enough exposure to both fields to know which they like best. You don’t need to decide today. Following are some things to think about and aid in your gradual decision.

Below is a list of several topics covered in ECE 110, showing which field of ECE each topic most closely belongs to. If you like all the topics in one field, and can’t stand any of the topics in the other, that’s a good indication.

<table>
<thead>
<tr>
<th>ECE 110 Topics</th>
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<td>Computer Engineering</td>
<td>Electrical Engineering</td>
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<td>Logic</td>
<td>Power</td>
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<td>Multiplexers</td>
<td>Circuits</td>
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<td>Counters</td>
<td>Bipolar Junction Transistors (BJTs)</td>
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<td>Coding</td>
<td>Sampling</td>
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<tr>
<td>Encryption</td>
<td>Norton and Thevenin Equivalents</td>
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The three classes which follow ECE 110 will help you sort out your decision. If you like ECE 190 and ECE 290 more than ECE 210, you likely belong in CompE. If you like ECE 210 more than ECE 190 and ECE 290, you likely belong in EE. By the time you get to ECE 329, hopefully you will have already made the decision, but preferring ECE 329 over ECE 190 and ECE 290 is confirmation that you belong in EE. Ideally, you will enjoy all of these classes, but these guidelines can help you choose a major based on which ones you enjoy the most.

The curriculum differences

The skeleton of both the EE and CompE curriculum is identical. Students from both degrees will take almost all the same classes for the first two years. That’s great news, because it means you don’t need to know which is right for you until you register for your junior year. The major difference is in how you choose your technical electives. EEs need 35 hours of technical electives, while CompEs only need 23.

CompEs make up for those 12 hours with four additional requirements: a math class (MATH 213), two upper level CompE classes (ECE 391 and ECE 411), and a CS class (CS 225). Although these 12 hours are not part of the technical elective requirement, you can think of them as 12 extra hours of technical electives that you don’t get to pick, in order to see the similarities between the two curricula. It makes sense, since in a way, CompE is a subset of EE. CompEs are free to pick pretty much any ECE or CS class for the remaining 23 hours, except that they must take one engineering class outside ECE and CS. CompEs do not take senior design (ECE 445), but ECE 411 is commonly considered the senior design for CompEs.
The Job Hunt: Techniques That Work

Trying to find a job, internship or co-op?
ECE Senior Rahul Yargop might be able to help you.

Today’s economy has made getting the jobs you want harder than ever. At a top school like Illinois, there will always be jobs for our students, but when that company you’ve always dreamt of working for has a hiring freeze, is there very much you can do?

There are definitely a lot of students affected by the recession, and then there are some for whom the job hunt has been pretty much the same as it would be any other year. These students aren’t always the ones with the highest grades or the densest resumes. But, they know how to find a job. Here are a few of the techniques I’ve seen used successfully:

Be specific.
When the one employer who is still hiring is flooded with applicants, he’s not likely to want to spend time and effort trying to find a good place for you. You need to know specifically which positions you are interested in, and why. When you can explain this to an employer, it shows that you’ve done your research, you have high interest in the company, and you’ve saved him some time. Being specific may extend to such items as the objective line on your resume and applying to specific positions online. If there is something specific you are looking for, being clear about it with employers can only help.

Make one friend.
If you can really impress a single person at the company, it helps a lot more than if multiple people think you’re good. The fact is that there are a lot of opportunities for your application to fall through the cracks. If you’ve made one friend, a well-wisher that wants you to get that job, he or she will make sure you get at least as good a shot at the job as anyone else.

Be persistent.
If an employer didn’t respond to an email, don’t hesitate to write again, or call. As long as you are nice to the employer in every communication you have, all you’re doing is showing interest. At the same time, you’re making sure you are not forgotten. On the flip side of this, be sure to respond to any contact made by an employer as soon as you can. I remember at my first internship, my boss said he would email some people just to see whether they were on top of things and would respond within a day.

Have a backup plan.
One last trick up your sleeve. Always maintain a back up plan, whether it be maintaining relations with various recruiters, or keeping the option of research on campus open. It is better to do something than nothing. In today's economy of rescinded offers and crumbling companies, you're far better off safe than sorry.

These techniques should help you in your search for a job, but also be sure to get your resume critiqued and do a mock interview with Engineering Career Services. The resume critique will not only help you make your resume more clear and remove any glaring mistakes, but ECS will also tell you about keywords and how employers use these to find your resume online. ECS will also give you a list of ways to prepare for the job hunt. Also, be sure to talk to peers about your job search. You can often find someone you know who has interviewed with the company you are looking at, if not better.

Good luck with your job hunt!
Dr. Everitt’s Neighborhood: Course Reviews

*Dr. Everitt’s Neighborhood* attempts to supplement the ECE department’s official course descriptions with course reviews written by students who have taken the courses. These course reviews describe the courses in a way that someone who hasn’t already taken the course can understand. They also go into depth about professors, student opinions about the prerequisites, workload, and future opportunities that each course prepares you for.

Please note that the course reviews were written based on the way courses were taught in the past. The ECE department and professors can, and do change the way courses are taught.

If you see a course review that is outdated, let us know. If you think the author was crazy and the opinions are totally wrong, help us fix it. If you want to write a review for a course that doesn’t have one yet, get to it.
ECE 110 – Introduction to Electrical and Computer Engineering

Updated Fall 2008

Instructors:
This course is directed by Professor Brunet and Professor Haken. Professor Brunet teaches a section of this course every semester. Professor Loui and Professor Haken, however, are also experienced in teaching ECE 110. A separate professor directs the labs, Professor Franke, but most lab sections are taught by a teaching assistant (TA).

Prerequisites:
Credit or concurrent registration in MATH 220 or MATH 221 is listed as a prerequisite for this course. The class rarely touches on calculus, but it is helpful to understand concepts such as the average value of a function and to be comfortable doing simple math quickly. The class works well with prior credit or concurrent registration in PHYS 212 because ECE 110 applies the basic physics of electricity.

When to Take It:
All ECE students take ECE 110 as freshmen, or immediately when they transfer to Illinois. Those who already have a solid foundation in math and physics from high school, who are eager to jump into engineering, should take it their first semester. Students often find it better to take the class first semester because the class opens doors to the next level of ECE classes. A large portion of the class is GE students during spring semesters. Students are often concerned about taking ECE 110 with ECE 190 in the same semester. For a discussion on taking both classes at once, please see the ECE 190 course review.

Class Content:
ECE 110 introduces students to various subfields in ECE. The course consists of a lecture and a lab. ECE 110 distinguishes ECE Illinois from other universities’ programs because it brings freshman into ECE laboratories during their first weeks on campus. Students immediately gain hands-on experience with electronic components like logic gates. Throughout the semester, students design circuits that control a small car, making it follow a path using sensors alone... no remote controls! Students experience the excitement of building real-world applications with ECE theory. The class focuses equally on electrical engineering and on computer engineering. The physical foundation of electronics is developed early in ECE 110, including extensive use of Kirchhoff’s Current and Voltage Laws. Students study various electrical components including resistors, diodes, capacitors, current sources, voltage sources, and transistor. From there, students learn about the application of transistors to digital computers and study encoding, encryption, compression, and logic gates. All topics are extensively described in the lecture notes, lectures, Mallard notes, and lecture transparencies. The lab experiments also line up well with lecture content, allowing students to combine knowledge from both lab and lecture.

Work:
All assigned lecture homework is provided and interactively graded by an online system called Mallard. Each week, students work on several graded online homework assignments. An interactive grader is used on Mallard which tells users whether their answer is correct, accepting a corrected answer afterward if available. Students attend a three hour lab session once a week. A significant portion of the course grade comes from exams. There are three midterm exams and a final exam. Exams can be mastered by diligently completing online assignments and lecture notes problems on paper without notes.

Life After:
ECE 110 is the first ECE class students take, and helps students determine whether ECE is right for them. It is normal for students to be frustrated at some point during ECE 110, but any student who finds some part of ECE 110 fascinating will be prepared for the challenge ahead. The next level of ECE classes includes Computing Systems (ECE 190), Analog Signal Processing (ECE 210), and Computer Engineering (ECE 290). Any of these classes can be taken next, though ECE 190 precedes ECE 290.
ECE 190 - Introduction to Computing Systems

Updated Fall 2008

Instructors:
This course is taught by many CompE professors. Professor Steve Lumetta has taught this course multiple times. Professor Sanjay Patel is an author of the textbook for this course and has taught it here in the last year. They both have a lot of experience teaching this course. The textbook, Introduction to Computing Systems by Patt and Patel has been the textbook for the course for the last couple years and all instructors follow the format of the book very closely. Thus, the approach to the course and its format is consistent among all instructors.

Prerequisites:
Officially, ECE 110 is listed as a prerequisite. A lot of students take both classes together and manage well. The digital logic material is the only real overlap between the classes. Digital logic design is explored in detail in ECE 110 while it is a small topic in ECE 190. ECE 110 is a useful prerequisite for freshmen who have not been exposed to the workload that ECE classes tend to have. ECE 190 is a programming intensive class and any background in programming will make this class easy to understand. Getting familiar with the first 2-3 chapters of the textbook before the class is useful as those chapters are meant as revision and are not explicitly covered in class.

When to Take It:
In rare cases, exceptional freshmen with a background in computing-related topics (familiarity with bits, logic, algorithms, programming syntax) may be able to take ECE 110 and 190 together in the same semester. For such students, it is the practice of the ECE department to send a 'friendly warning' that explains the course load and gives statistics on past students who take the two classes concurrently. However, students who are not yet accustomed to the workload necessary to complete successfully the core math and science courses should not take ECE 110 and 190 together, regardless of previous programming experience. For students interested in CompE, it is ideal to take this course during the freshman year because the class is a good window into the curriculum. EE majors often take this class their third semester with ECE 210 as it is not a prerequisite for any higher EE class.

Class Content:
The class gives an introduction to the many layers of computing. It starts at the lower level with bits, logic units and state machines, and moves to machine language, assembly language, and finally to C, which is a high-level programming language widely used in the CompE curriculum. The class teaches problem solving methods and good practices in code implementation and debugging techniques, all of which are valuable concepts to learn and practice early. Assembly language, the LC3 ISA, and C programming are all concepts used in higher CompE classes like ECE 290, ECE 391, and ECE 411.

Work:
As mentioned before, the textbook is followed closely, so staying up to date with the textbook is necessary for assignments and exams. The class has written exercises for the first month which involve extensive problems which are mostly from the textbook. The class introduces the concept of Machine Problems, which are programming assignments to be electronically turned in every week. There are 5 assignments as follows: The first is a simple problem to be implemented in machine code (bits). The second is done in assembly language using the LC3s instruction set. The last 3 are in C. The third and fifth MP are usually a game or something similar. The fourth MP is the LC3 assembler or simulator. The MPs are divided into 2 checkpoints each which means that one checkpoint is due every week after the first month. The MPs take 10-20 hours a week, which varies with the difficulty of the checkpoint. There are two midterms in the class and a cumulative final. The exams can be tricky; solving past exams and textbook exercises is a good way to study for them.

Life After:
The class is an overview of the CompE classes to follow and is an essential introduction to programming before venturing into other classes that cover data structures, systems programming, network programming, the DSP lab and system organization classes.
ECE 210 – Analog Signal Processing

Updated Fall 2008

Instructors:
This course is directed by Prof. Kudeki. Instructors vary from semester to semester. However, Profs. Trick, Basar, Franke, and other professors from the areas of signal processing, control systems, and communications have made repeat appearances.

Prerequisites:
ECE 110, PHYS 212, and credit or concurrent registration in MATH 285 or MATH 286 are listed as the prerequisites of this course. Relevant topics from 110 and 212 include basic circuit analysis and lab work involving breadboards, oscilloscopes, and function generators. An ability to understand topics in MATH 285/286 will be beneficial towards the latter half of the course when dealing with topics such as phasors, time-invariant systems, and Fourier and Laplace transforms.

When to Take It:
Students who know they are interested in electrical engineering (EE) should take ECE 210 as soon as possible since it is the prerequisite for many required and elective EE courses such as ECE 313, 329, 410, 430, and so forth. Taking this course in accordance with the stated prerequisites is a logical choice.

Debate exists among students regarding whether or not to take ECE 210 simultaneously with ECE 290 as per the flow chart posted on the ECE website – the combination of which is described colloquially as "ECE 500" among students to describe the alleged difficulty of said combination. Written weekly homework assignments from both classes are due on Wednesdays. Whether or not one should take the course concurrently with ECE 290 varies on the individual’s academic progress. However, a student who has performed well above average in ECE 110 and ECE 190 and has completed the physics requirements (213 and 214) should have no issue taking "ECE 500" in the same semester. Generally, students taking "ECE 500" along with both Physics 213 and 214 may find the combined workload more strenuous. With that said, “ECE 500” is just the tip of the iceberg and students inevitably will deal with heavier semesters anyway.

Class Content:
ECE 210 will be, for most students, the first real synthesis of electrical engineering and mathematics. The first quarter of the course comprises a review of basic circuit analysis. Being able to apply and understand topics such as source-transformation, Thevenin/Norton equivalent circuits, and transient analysis is quite important. Students will learn that many analog circuits can be treated as a linear system. At this point, the course becomes increasingly mathematical when first-order differential equations, phasor analysis, Fourier series, and Fourier transforms are introduced (in the order mentioned). To complement the material covered in lecture, lab work involves the development of an AM radio receiver. Each week, students construct and analyze a component of the receiver using oscilloscopes and function generators.

Work:
Each week, students will work on a graded written homework assignment and a lab assignment. Homework problems are assigned from the textbook and typically do not require significant investment of time, as each chapter contains many examples that are comparable to homework problems. Each lab assignment consists of 1-3 pre-lab questions and questions to be answered as the lab is completed that will be due within a week. Aside from verifying results/responses or completing incomplete lab work, there is no additional work involved for the lab. Exams reflect material covered in homework, but will more often than not contain 1-2 “tricky” problems that test the student’s ability to apply concepts to somewhat unfamiliar situations.

Life After:
The proceeding required courses (313, 329) and virtually all technical electives under the EE curriculum build on the mathematic principles/practice introduced in ECE 210. As mentioned, students should have a better idea of their academic interests after taking this course. Generally, students who dislike this class as a whole do not intend to pursue EE as a major. Students who especially find the signal processing portion of ECE 210 interesting should consider taking ECE 410 (Digital Signal Processing) in the following semester, which takes frequency-domain analysis in a new realm. ECE 430 (Power Circuits and Electromechanics) builds on the power-related topics in 210 such as circuit equivalents, resonance, and phasors.
ECE 290 – Introduction to Computer Engineering

Updated Fall 2008

Instructors:
Prof. Donna Brown, the course director, almost always teaches the course. Prof. Brown is responsive and accommodating (holds an extra weekly review session to go over material). In addition, she is generally clear and concise in her explanations.

Prerequisites:
ECE 110 is listed as a prerequisite, whereas ECE 190 is listed as a pre or corequisite.

When to Take It:
Experience in ECE 110 is a must. Exposure to ECE 190 either before or during the semester in which 290 is taken is also essential. Advisors and the ECE 290 course website recommend against taking ECE 190 and 290 during the same semester. However, some above-average students who have taken ECE 190 and 290 at the same time in the past have opined that taking the two courses together is a logical choice as far as material covered goes. Many of the topics in ECE 190 dealing with logic gates and sequential and combinational circuits are covered in ECE 290 at an accelerated pace. The LC-3 assembly code (developed by Prof. Sanjay Patel featuring simple instruction sets) is covered in both courses (but in greater depth in 290).

Class Content:
ECE 290 takes a “bottom-up approach”. That is, each topic in the course is a synthesis of previous topics. Students begin at the gate level and then learn techniques in Boolean algebra. Afterwards, combinational and circuits are covered and form a logical transition into discussion of counters, registers, and memory. The material culminates on the next level of abstraction, the LC-3 assembly language and its implementation. Towards the end of the course, ethics also become a focal point as students study The Incident at Morales.

Work:
For much of the course, students will have three weekly assignments: (1) a written assignment in the form of a problem set, (2) online homework on Mallard, and (3) a weekly lab that is completed through the EWS workstations. Students who enjoy design-oriented work will enjoy these assignments. For the most part, timely completion of these assignments requires a thorough understanding of the material before beginning these assignments. Although completion of these assignments can be time consuming, help is readily available through online discussions on Compass and resources written by Prof. Brown on Mallard.

Life After:
Despite it being demanding, students generally learn a lot about the essentials of computer engineering in ECE 290. There are two follow-on courses in the curriculum. ECE 385 is a lab course that puts the principles learned in ECE 290 into practice. ECE 391 is a lecture and lab course that teaches a more complex assembly language (x86), and drifts toward the software side of computer engineering. Neither class is a prerequisite for the other, but it is wise to take ECE 385 before ECE 391. ECE 385 will introduce you to the difficulty and time commitment of an open format ECE lab. In an open format lab, you can spend tons of time on lab work in addition to your regularly scheduled weekly time slot. ECE 391 is also an open lab format, and the difficulty and time commitment is greater than ECE 385. Like ECE 210, 290 is a course in which students develop a good sense of whether they are interested in electrical or computer engineering.
ECE 313 - Probability with Engineering Applications

Updated Fall 2008

Instructors:
Prof. Sarwate is the course director and teaches the course most frequently. ECE professors (usually in the areas of communications, systems, and/or signal processing) such as Profs. Singer, Bresler, Meyn, Hajek, and Milenkovic have also taught this course in the past.

Prerequisites:
The official prerequisite is ECE 210, although the material in ECE 210 is not directly related to that of ECE 313. However, completion of Math 241 (Calculus 3) is necessary as the second half of the class discusses multiple random variables, which requires an understanding of 3-D surfaces and multiple integration. Other essential mathematical topics include geometric and Taylor series. Other than this, your poker instincts should help you succeed. ECE 313 requires the students to develop a certain kind of thinking not seen in other classes. Uncertainty is a new dimension, and it may be difficult to develop an intuitive grasp.

When to Take It:
Since Math 241 is the only topical prerequisite, talented students may, in theory, be capable of taking ECE 313 immediately afterwards. However, such an action is really only advantageous for students interested in taking courses that have 313 as a prerequisite (361: digital communications, 418: image and video processing, 438: communication networks, 439: wireless networks, to name a few). Otherwise, students may find taking ECE 210 beforehand helpful in sharpening analytical skills that connect mathematics and electrical engineering - hence the stated prerequisite of ECE 210.

STAT 410 (which has STAT 400 as a prerequisite) can be substituted for ECE 313. Students may opt to take STAT 410 if they are not interested in probability theory, which in general can be more challenging than statistics. According to the ECE 313 website (http://courses.ece.uiuc.edu/ece313/faq.html#haveto), the STAT courses and ECE 313 “are not equivalent in terms of course syllabi, as STAT 400 + STAT 410 mostly teaches...about statistics, and relatively little about probability as it is needed for advanced ECE courses” in the areas of communications and signal processing.

Class Content:
The first half focuses on discrete random variables (binomial, geometric, Poisson) and introduces the principles of expected value, mean, variance, likelihood, and conditional probability. Examples in lecture and problems in the homework involving topics such as communications networks and industrial/manufacturing situations are where the “application” aspect of the course is found. Otherwise, ECE 313 is primarily a math course. The second half of the course primarily deals with continuous and multiple random variables. In this portion of the course, students are introduced to fundamental topics such as the continuous distribution function and the probability density function, hypothesis testing, jointly Gaussian random variables, correlation, and expectation and variance of multiple random variables. As mentioned, an understanding of 3-D surfaces and multiple integration (learned in Math 241) is especially important during this portion of the course.

Work:
Work consists of a total of 13-14 weekly problem sets, two midterm exams, and a final (which is usually worth 45% of the students final grade). The assignments usually contain problems that are intended to be neither too challenging nor too trivial for students who are up to speed with the material. These problems are a mixture of simple calculation, application to real-world situations, and derivation of relations that may save time and work.

Life After:
Probability theory forms the basis of communications, control systems, and areas of other fields within electrical and computer engineering. Not surprisingly, ECE 313 is a prerequisite for upper level technical electives in many of these areas. For students seeking to broaden their intellectual (and possibly career) horizons, probability theory is applicable to modeling in many areas such as finance and economics. Students interested in further strengthening their background with related math courses may be interested in the courses such as 347 (fundamentals of mathematics), 415 (linear algebra), and 447 (real variables).
ECE 329 – Introduction to Electromagnetic Fields

Updated Fall 2008

Instructors:
The course is directed by Professor Kudeki. Past lecturers have included Profs Michael Oelze, Kevin Kim, Lara Waldrop, Timothy Peck, and Lynford Goddard. Aside from electromagnetics, lecturers tend to have backgrounds in related fields within biomedical imaging/instrumentation, remote sensing, and solid-state electronics.

Prerequisites:
ECE 205 or 210 are listed as prerequisites to the course. Circuit fundamentals from these classes are applied towards the end of ECE 329 when dealing with transmission lines. In addition, a familiarity with basic differential equations and vector calculus is helpful when dealing with mathematical expressions such as Maxwell’s equations and potential functions.

When to Take It:
Officially, ECE 205 or 210 are listed as prerequisites. Exceptional students who have excelled in math may find it feasible to take ECE 210 and 329 concurrently because there are few topical overlaps between the two courses. For most students, however, taking ECE 210 helps them become accustomed to the mathematical rigor involved in electrical engineering. ECE 205 is a course on circuits for students not in electrical and computer engineering and is considerably less math intensive than ECE 210.

Class Content:
It is important to note that the content in ECE 329 has been revised. As of fall 2008, polar coordinates have been omitted and the course now covers transmission lines analysis with the aid of the Smith chart, which is a topic that traditionally been saved for ECE 450. In comparison with past offerings of ECE 329 before spring 2008, the course has become less math-intensive.

The first part of the course is a survey of Maxwell’s equations, which are relevant to electromagnetic fields, in both differential and integral form. Afterwards, students learn about potential functions, electromagnetic wave behavior in material media such as conductors, dielectrics, and magnetic materials. Towards the end of the course, students learn about transmission lines and how to determine quantities like reflection coefficients and input impedances using the Smith Chart.

Work:
Homework consists of 14 weekly homework problem sets that usually contain up to six problems. These problems are generally not too difficult and tend not to contain calculations, but rather derivation of expressions. These assignments will not be time-consuming for students who are capable of making the connection between the mathematics and the concepts involved.

Life After:
Wave and field behavior is relevant to topics ranging from theory to application in areas such as wireless communications, optics, GPS, and modeling of interconnects in circuits. Since most ECE students complete ECE 329 in their junior year, they should have a better idea of their intellectual and professional interests after completing this course. Students will also find that a background in electromagnetics is beneficial in the solid-state electronics area. Simulation of electromagnetics in various media is a major research undertaking. The follow-on elective, ECE 450, takes a broader and more in-depth survey of lines, fields, and waves and their behavior in transmission lines and antennas. As of Spring 2009, ECE 329 (originally ECE 450) and ECE 442 are the prerequisites for 453: Wireless Communication Systems. ECE 437: Sensors and Instrumentation also lists ECE 329 as a prerequisite.
ECE 385 - Digital Systems Laboratory

Updated Fall 2008

Instructors:
There is one lecture section for ECE 385 taught by Janak H. Patel, who is your only option for professor. He explains the week’s lab well. However, you will interact more with TAs for the duration of the class, which is mostly laboratory work

Prerequisites:
You must take ECE 290 before ECE 385. An understanding of the concepts presented in ECE 290 is essential to completing the labs in this course, as most of the labs don’t build on 290 material, but are simply an application of the concepts covered. ECE 110 is also a prerequisite, for similar reasons.

When to Take It:
Many students take ECE 385 first semester junior year, after completing ECE 290. The material from ECE 290 will still be fresh.

Class Content:
The purpose of the course is to get experience constructing circuits, instead of only working with theoretical design. Each week is a new lab and, unlike other lab courses, much of the work designing and constructing the lab is done outside of class. The lab time itself is usually used for demonstration of your work or debugging if something goes wrong. The first half of the semester, you will use ICs and wires to build your circuits on a breadboard. The 7th lab switches to VHDL design to be implemented on an FPGA. VHDL is a unique language in the code you write is compiled into instructions that the FPGA uses to rewire its hardware – you aren’t writing code that is executed on set hardware, you are writing code that creates hardware to perform a function. It is a good language to know for interviews as VHDL can be used to simulate complicated circuits, so employers will be interested that you have had exposure to it. The class as a whole is good to take as it introduces you to some of the difficulties encountered in actually building circuits, as opposed to simply making a theoretical design. Some people also refer to this course as a debugging course, since you learn almost as much about debugging as you do about circuit design.

Work:
Don’t be fooled by the fact that ECE 385 is a 2 hour class. The class requires extensive work each week completing the labs, often taking 10 to 20 hours. There are ten total labs and a final project. Each lab is completed with a partner that you must meet with outside of lab, so it's good to know a partner beforehand. Additionally, the labs require reports which will take several hours to complete. You will spend more time on the labs as the semester progresses and the difficulty of the labs increases. You will get several weeks to work on the final project; make sure you start early in case you run into difficulties. It is possible to take this class with other work intensive classes, but you will have a heavy semester.

Life After:
If you were thrilled with this class, hopefully you are a computer engineer. You should take ECE 391 right away, which is a prerequisite for ECE 411, the next course using VHDL. VHDL is in a family of languages with Verilog, SystemVerilog, and SystemC, called Hardware Description Languages (HDLs). HDLs are similar to CS languages in that once you've learned one, the similarities of concepts between HDLs overwhelm the differences of syntax. Learning VHDL in 385 prepares you well to use any HDL in the workplace. There is a huge job market for working with FPGAs. Additionally, the concepts learned in this class are applicable to ASICs and processors. The “Life After” section for ECE 411 elaborates on career opportunities.
ECE 391 – Computer Systems Engineering

Updated Fall 2008

Instructors:
This class is taught by many professors. Matt Frank is known for being down to earth, in touch with students’ experience in the lab, and his willingness to meet with students to discuss anything. Steve Lumetta is known for his good presentation of material, and his high expectations.

Prerequisites:
You really do need ECE 290 before you take ECE 391. Your understanding of LC3 assembly and processor architecture will be crucial in transitioning to x86 assembly.

When to Take It:
Many students take ECE 391 first semester senior year, just in time to serve as a pre-req for ECE 411, which they take their last semester. If you are a consistently good student, you will benefit from taking this class earlier. This is an outstanding class to discuss in interviews if you want an internship or career in low-level programming. It is a requirement for CompEs, and a good class for any EE interested in a software career.

Class Content:
This course is all about bridging the gap between hardware and software. Students begin by learning x86 assembly. x86 is similar to the LC3 in many ways, but is more complex; while the LC3 is just a textbook example, x86 is an industry standard. Students learn how processors organize and access RAM, and how processors keep track of and switch between multiple programs running at once. Students learn about how computers handle inputs like key-strokes and moving the mouse, and how programs use an operating system’s system calls to execute commands in the processor. The final goal is a thorough understanding of how operating systems work, using Linux as an example.

Work:
This course is lab based (open lab), and has a substantial work load. Try to avoid taking other heavy labs at the same time. There are three MPs. Each MP has a pre-lab. Pre-labs are a small time commitment, and can be completed in groups. Do pre-labs diligently, and you will thank yourself on the exam, since exam problems are typically very similar. The MPs themselves are the bulk of the work, but rest assured there are no post-lab reports. The first two MPs are individual; the third MP is in a group of three or four. In the first MP, students write several routines in x86 assembly. In the second MP, students write hardware device drivers for a hand-held controller, for an already-written computer game. They also modify the given code to expand the VGA graphics capabilities. In the third MP, students write their very own basic version of Linux, starting from almost nothing. All MP’s are done in an emulator, but for your own satisfaction, it is possible to load your own operating system onto your actual computer. This MP is extremely challenging, but even more rewarding.

Life After:
If you liked this class more than ECE 290 and ECE 385, you are probably on track for a software career. If you liked ECE 385 better, you are probably on track for a hardware career, and should hurry up to take ECE 411, so you can talk about it in your interviews. The combination of ECE 391 and ECE 411 leads to the deep understanding of hardware, software, and their interactions, which defines a quality computer engineer. ECE 391 trains students to be good coders. You can use this course to help you into any software job. Specifically, it is good preparation for low level programming jobs, such as operating systems and device drivers for PCs, smart phones, or any handheld electronic gadget. Any company that makes processors, ASICs, or FPGAs, needs software written for their specific hardware. Other low level programming classes you would likely enjoy are ECE 428 (Distributed Systems), ECE 435 and 438 (Communication Networks and Lab), and almost any 400 level CS class.
**ECE 402 - Electronic Music Synthesis**

Updated Fall 2007

**Instructors:**
This class is taught exclusively by Professor Haken, inventor of the Continuum Fingerboard. Prof. Haken is fairly laid back. He wants you to enjoy the class and appreciate computer music, and students always do. He enjoys teaching the class, presents material in a very understandable way, and often reminds students that anyone who put forth a decent amount of effort will get an A or B.

**Prerequisites:**
The University states prerequisites for this class, but most are not actually necessary. If you have any musical background at all (i.e. took piano lessons when you were 7, or played trumpet for a year in 5th grade), you do not need MUS 103. You just need a basic understanding of music. You should take ECE 290 first. ECE 410 is absolutely unnecessary, as long as you won’t get too upset about having difficulty with a small percentage of the material.

**When to Take It:**
This course is only offered in the Fall. It is a good class to take as an early tech elective, right after taking ECE 290.

**Class Content:**
This course is a great technical elective. It is extremely interesting and not an overwhelming workload. The course is mostly conceptual. There is some math, but it is not a primary part of the course. Throughout the class, you learn the history of electronic music. You learn about how the ear hears, and how you can create sounds and music using sine waves as building blocks.

**Work:**
Homework consists of reading one article a week, two to ten pages, and writing a page of answers to qualitative questions, which all in all, takes about three hours, once a week. You also spend two hours per week in the lab with a partner, working with music synthesis software. The lab won’t show up on your schedule; you sign up for a time during the first week of class. There are no lab write-ups, and no time required beyond the two hours spent in lab. Labs are fun, informative, and not tough. You spend the last four weeks of class on an open ended final project. Again, it’s neat, but not overwhelming.

**Life After:**
Students who enjoy ECE 402 will likely also enjoy ECE 403, Audio Engineering. The job market for computer music engineers is primarily in the film industry, and is not overwhelmingly expansive. Professor Haken has introduced students to internships with Lucasfilm in the past.
ECE 410 - Digital Signal Processing I

Updated Fall 2008

Instructors:
Directed by Prof. Singer, this course is usually taught by recognized veterans in the digital signal processing (DSP) field such as Profs Bresler, Jones, and Singer.

Prerequisites:
The official prerequisite is ECE 210 (analog signal processing). Many of the topics in the last third of ECE 210 (LTI Systems, stability, Fourier and Laplace transforms, frequency response and block diagrams) will be found again in ECE 410—in the digital domain.

When to Take It:
Students who intend to specialize in DSP, Communications, or control systems may find it advantageous to take ECE 410 immediately after 210. However, students who do not do so will not be at a significant disadvantage because the first one to two weeks of ECE 410 are spent refreshing concepts from ECE 210.

Class Content:
The crux of this course, as the title suggests, is to essentially digitize what was seen in 210. In the first part of the course, students take an idealized look to the digital frequency domain and the discrete time Fourier transform, which is ultimately a special case of the Z-transform. Many of the characteristics of systems covered in ECE 210 such as linearity, causality, and stability along with operations such as convolution surface once again—only this time with respect to the digital domain. Analog to digital and digital to analog converters, along with considerations of aliasing are also discussed. Each of these topics forms a building block to digital filter design, in which students participate towards the end of the course. At this point, practical considerations are introduced and finite impulse response (FIR) and infinite impulse response (IIR) filter design methods and the advantages and disadvantages of each are taught. ECE 410 wraps up with discussions of application and other methods that can reduce the computational cost of filter implementation.

Work:
The workload in ECE 410 comprises 14 weekly problem sets, quizzes (there are six of these), and a final. The problem sets cover a wide spectrum and contain a variety of types of problems: computations, derivations, coding in MATLAB, and conceptual explanations. Although there isn't really any new mathematics introduced in ECE 410, computations in these problem sets and quizzes can be complex and demand some time and thought. On that note, successful and timely completion of homework assignments generally suggests readiness for quizzes.

Life After:
ECE 420 (DSP Lab) gives students hands-on experience with design related problems. Multimedia Signal Processing (ECE 417), Image and Video Processing (ECE 418), and MRI (ECE 480) give students a glimpse into other applications of DSP. Although there aren't any undergraduate speech processing courses, several efforts have been made in the past with special topics (398, 498, etc). Other relevant and related courses include digital communications (ECE 361), analog communications (ECE 459), control Systems (ECE 486), and audio engineering (ECE 403). In general, 410 is a rigorous preparation for any field related to signals and systems—to the extent that even graduate students enroll in the course.
ECE 411 – Computer Organization and Design

Updated Fall 2008

Instructors:
This class is taught every semester by various professors, including Rakesh Kumar and Steve Lumetta. Professor Kumar is known for taking student suggestions and concerns seriously. Professor Lumetta is known for clear presentation of material and high expectations.

Prerequisites:
You really do need ECE 391 before you take this class.

When to Take It:
ECE 411 is commonly known as the Computer Engineering Senior Design class. Most students take this class as a senior. If you can take it second semester junior year, or first semester senior year, you will be able to talk about it while you interview for full-time jobs. Interviewers will drool over you in awe when you talk about this class.

Class Content:
This course is a requirement for CompEs, and any EE specializing in Computer Engineering should take it. The class teaches topics similar to 290, but far more advanced. In 290, you learn how to make a processor work. In 411, you learn how to make a processor fast, by adding optimizations. You learn about pipelining, a method of dividing an instruction into multiple steps. You learn about speculation, which means guessing what the processor will do next, so you can do it early, which leaves you a few steps ahead if you guessed right. You also learn about cache design, the topic of adding a tiny bit of fast memory, and using it wisely, to reduce the wait time for accessing memory.

Work:
This class is difficult and time consuming, and is primarily lab based. Required time commitment is similar to ECE 391. Typically there is no homework; all work is lab related. During the labs, which you do on your own time in the EWS labs, you design the LC3b processor in VHDL, similar to ECE 385, but with many new features. Design is done in Mentor HDL Designer, a software CAD tool, and no FPGAs are involved. In the first lab, you implement only part of the LC3b instruction set. In the second lab, you complete the instruction set. After that, you add a memory system (cache) to your processor. The first several labs are all individual. The final project is done in a group of two or three. In the final project, you implement all the features from previous labs, and add an entire new field of complexity, called pipelining. You will spend at least ten hours a week in lab, and many, many more during the last few weeks of the final project. You should avoid taking any other difficult lab classes at the same time, and should try to take a light course load.

Life After:
Students who enjoy the lab portion will probably enjoy ECE 412, an embedded systems lab class which mixes concepts from ECE 391 and ECE 411, dabbling in both hardware development on an FPGA and software development for a processor on that FPGA. Students who enjoy ECE 411 might pursue careers in computer architecture with Intel, AMD, or NVIDIA. They may also go into other fields of digital design, such as ASICs and FPGAs. There are lots of ASIC and FPGA jobs in the defense industry, with companies like Lockheed Martin, Northrop Grumman, and Raytheon.
ECE 420 – Digital Signal Processing Laboratory

Updated Fall 2008

Instructors:
This class is usually taught by Prof. Allen or Prof. Jones. Prof. Allen does a great job of making the class a one-stop introduction to hands-on DSP. Prof. Jones is known for his excellent guidance and encouragement. The online course materials are also very good.

Prerequisites:
The only prerequisite listed for the class is ECE 410. While ECE 410 is the only class that is absolutely essential background, experience with assembly programming, C programming and MATLAB is a plus. Students who have previously taken ECE 391 definitely have an advantage, but the exposure to assembly programming through ECE 190 is sufficient before taking this class.

When to Take It:
This class is usually offered every semester. Taking this class within a couple of semesters of taking ECE 410 is a good idea, as solid understanding of the material in ECE 410 makes this class a lot easier. It might also be enjoyable to take this class after taking other electives so that you can do something cool for your final project.

Class Content:
This is a very enjoyable and rewarding lab for undergraduates. The class can be challenging, but the skills taught are very applicable. The focus is on implementing most of what is taught in ECE 410, so you deal with practical issues of DSP implementations. You code in TI (Texas Instruments) Assembly code, C, and some minor work in MATLAB for this class—the assembly and C code are used to program the DSP chip, whereas MATLAB is mainly used for simulation before programming the DSP. The structured labs walk you through implementing various DSP schemes, and the final project gives you the freedom to explore a project of personal interest under the guidance of the professor and TAs.

Work:
The work required for this class is 5 required weekly labs, each of which includes a pre-lab assignment and a demonstration of the assignment. You will also be quizzed on the weekly lab assignments. After the 5 labs, you work on the final project. Work involves a project proposal, a helper lab assignment, a design review presentation, and a demonstration of the final project. The nice part about ECE 420 is that the weekly labs do not require you to spend time writing up reports, but instead require you to spend the time understanding the theory and practical considerations. The final projects in this class are usually substantial, and are very rewarding once completed. Some examples of past final projects include a guitar effects mixer, number-recognition processors, and a modem. The average student can expect to devote 6-10 hours per week on this class outside class hours.

Life After:
If you enjoy ECE 420, classes to check out include ECE 417/418, ECE 486, ECE 463. ECE 417/418 are classes that teach further signal processing theory and have associated lab work. ECE 486, the control systems lab, and ECE 463, the digital communications lab, are related electives. Students have been known to be offered full-time/internship positions on the spot when discussing their work in this class with employers. This class should prepare you for technical interviews with leading companies such as Texas Instruments, Qualcomm, and Analog Devices.
ECE 440 - Solid State Electronic Devices

Updated Fall 2008

Instructors:
Prof. Hsieh is the director of the course. Other professors who have taught ECE 440 include Profs. Pop, Feng, Leburton, and Tucker, to name a few. Many professors who teach ECE 440 specialize in quantum and physical electronics, both at the physics and device level.

Prerequisites:
PHYS 214 is listed as a prerequisite, while ECE 329 is listed as a pre/corequisite. Since ECE 440 ties together physics with electrical engineering, it will help to have completed PHYS 213 as well. In fact, a portion of PHYS 213 deals with semiconductor physics at a basic level. The first part of ECE 440 will mention various topics from PHYS 214 such as Schrödinger’s wave equation, the concept of discrete energy levels, and Bohr’s model of the atom. Relevant topics from ECE 329 used throughout the course are mathematical expressions (e.g., Poisson’s equation, Maxwell’s equations in material media) that are used to derive expressions in ECE 440 in a variety of cases such as those of p-n junctions. Overall, these courses should help the student develop an intuition for what is happening at the physics level inside electronic devices.

For students who are interested in learning about solid state electronics, but with a different flavor, various sections of ECE 398 have been offered as substitutions for ECE 440. Of these offerings of 398, one covers photonic devices, while another does not have ECE 329 as a prerequisite.

When to Take It:
Taking this course in accordance with the stated prerequisites and corequisites is a wise decision. As is the case with any other area elective, it is beneficial for students interested in the areas of physical and quantum electronics and circuits to take ECE 440 as early as possible, provided that this is feasible as far as workload goes. Students who have succeeded in PHYS 213 and 214 and MATH 286 may be capable of taking this course without ECE 329.

Class Content:
Much of the theory discussed in ECE 440 can be traced back to discoveries made in ECE at Illinois. The material in ECE 440 is cumulative in a very clear-cut manner; new topics build on previous topics continuously in the course. In the beginning, students learn about semiconductor physics in the form of topics such as carrier drift and diffusion, band-diagrams, and doping. These topics are the basis of p-n diodes, which create an intuition behind metal-oxide and bipolar junction transistors, which are covered at the end of the course. Although equation sheets are provided on quizzes and exams, it is essential to have an understanding of the concepts underlying the equations. Throughout the course, it is emphasized that various approximations can be made that can simplify analysis and calculations in various situations such as heavy-doping or ignoring the effects of recombination of carriers.

Work:
Homework assignments are assigned each week and usually consist of two to three problems that may involve plotting in MATLAB, calculations, derivations, drawing of band-diagrams, or conceptual explanations. Sometimes the problems in the homework will mimic examples found in the textbook. It is important to keep up with the material as quizzes are offered once every two weeks. On that note, it is advisable to do work beyond the homework (such as reading the textbook) in order to prepare for quizzes and exams. Grading is performed and quizzes are offered by a section-by-section basis, so it is helpful to attend lecture.

Life After:
Not surprisingly, ECE 440 is the prerequisite to many courses in the area of solid state electronics, including ECE 441 (Physics and Modeling of Semiconductor Devices), ECE 442 (Electronic Circuits), ECE 444 (Theory and Fabrication of Integrated Circuits), and ECE 482 (Digital IC Design). It is reputed that ECE 440 as a required course is one of ECE at Illinois’ hallmarks, as all students in ECE graduate with some sort of exposure to the area of solid state physics. Such an exposure is becoming increasingly important in a day and age where terms like Moore’s Law and ‘nanotechnology’ have pervaded popular culture.
ECE 442/443 – Electronic Circuits/ Electronic Circuits Laboratory

Updated Fall 2008

Instructors:
This course is taught by couple different professors. In recent semesters, professors Chiu and Schutt-Aine have taught the class. Professor Chiu lectures well, covering not only the topic, but also digresses to various aspects related to that topic. He knows the topic fairly well, and can answer just about any question that a student throws at him. There are a few TAs that run each lab session. The lab is fairly easy: any student can obtain an A simply by following the lab directions, working carefully, and composing a decent lab report.

Prerequisites:
The Department states that the prerequisite for 442 is ECE 440 – Solid State Electronic Devices. Though taking 440 previous is helpful in understanding some of the material covered in 442, it is not necessary for a student to do well in the class. In fact, many students take 440 and 442 concurrently, and do well in 442. 443 should be taken in concurrence with 442, as the topics taught in 442 are demonstrated in the lab of 443 – though some students do well without taking the classes concurrently.

When to Take It:
442/443 is offered every semester, and fulfills an electrical engineer’s 3/5 curriculum requirement.

Class Content:
This course is a basic overview of all the common circuits that electrical engineers will commonly come across. The range of circuits covered in the class includes anything from a rectifier to a CMOS amplifier. Understanding how these circuits work and how to characterize those circuits using equations is the key to success in this class. This course is important for anyone interested in how modern electronics works, and comes with a medium-to-light work load. You need to understand the equations that model these circuits, but the work is more conceptually difficult than computationally difficult.

Work:
The course load for 442 is not too demanding. Homework can be decently challenging, but does not take too much of one’s time. The first test is mostly review from previous classes, and is generally easier than the later tests. As for 443, the work load is fairly light. There are four lab reports spaced fairly evenly throughout the semester. Be careful though when the deadline for a lab report is near, as the lab report could take up a substantial amount of time to complete. The labs are pretty simple overall and merely reaffirm the concepts learned in 442.

Life After:
Students who have taken and enjoyed ECE 442/443 are open to wide range of choices from the different subspecialties of ECE. There are courses such as ECE 453 – Radio Communications Circuits, ECE 483 – Analog IC Design and ECE 464 – Power Electronics which have 442/443 as a prerequisite.
ECE 444 - Theory and Fabrication of Integrated Circuits

Updated Fall 2008

Instructors:
The lecture part of this course is taught by various professors, including Xiuling Li and James Coleman. You will learn well from either professor. The two lecture sections are not interchangeable. Each professor covers slightly different material, and gives their own exams on their own schedule. The lab part of the course is overseen by Dane Sievers, but run on a daily basis by TAs.

Prerequisites:
You need to take ECE 440 or ECE 398 before ECE 444 in order to understand anything at all about this course.

When to Take It:
Most people take this class shortly before graduating, since it always fills up quickly, and is difficult to get into. If you want to take this class, register the minute your registration window opens. Our university is famous for the lab portion of this class. It is a unique opportunity not available to undergraduates at any other university in the country. Alumni rave about this class. It is an opportunity you should make every effort to capitalize on. If you enjoyed ECE 440 and intend to pursue a career in semiconductors, you absolutely must take this course.

Class Content:
This lecture portion of this course explains how devices like transistors, capacitors, and gates are built into silicon chips used in computers, called Integrated Circuits. Students begin by learning about how silicon wafers are formed. Students then learn about doping regions of silicon by using masks, photolithography, etching, and furnaces. Students also learn how different devices are connected with miniscule wires. In addition to learning the basic techniques used in lab, students learn more advanced techniques which are too expensive for the lab portion of this course, but are used commonly in industry. The course is primarily qualitative, with a few brief, heavily math based portions. Students who were overwhelmed by the intense math of ECE 440, but were fascinated by the underlying concepts, will enjoy and succeed in ECE 444.

In the lab portion of this course, you make an integrated circuit, in the famous clean room in the basement of Everitt, starting with a bare slab of Silicon. You perform oxidation, photolithography, etching, doping, and metallization in several steps to produce capacitors, diodes, BJTs, and MOSFETs. Producing one wafer full of these devices takes about ten weeks. Testing the devices takes the remainder of the semester. Yes, your devices will actually work at the end of the semester!

Work:
Homework is assigned in class, averaging a few written problems each week. The homework is outstanding for both solidifying the material learned in class and preparing for the exams. Homework is a moderately small time commitment. The lab is closed form, meaning you only work 3 hours a week, during your scheduled time. For the first three quarters of the lab, time commitments are minimal. There are a few quick pre-labs at the beginning of the semester. Halfway through the semester there is a moderately time consuming lab report, intended to familiarize you with software used in class. Toward the end of the class there are two substantial, time intensive lab reports. Although tedious, these lab reports bring most students to an epiphany of understanding of integrated circuits. All of the abstract concepts learned in ECE 440 become real, and you finally understand.

Life After:
Taking ECE 444 opens up doors to research opportunities, graduate school, and jobs. The ECE 444 website lists hundreds of semiconductor companies that will fight to hire students who have taken ECE 444. Students who love ECE 444 could enjoy working at a company with an integrated circuit fabrication facility (a “fab”). A big keyword for job searches is “process technology”. This career path can also open up opportunities for travel to China and Taiwan, where a huge portion of the world's integrated circuits are manufactured. Anyone interested in moving to Taiwan should consider TSMC and UMC, Taiwan’s semiconductor powerhouses. Major US companies are AMD, IBM, and Intel. The course is also helpful for circuit designers, helping them understand the physical aspects of the devices they design on CAD systems.
ECE 486 – Control Systems

Updated Fall 2008

Instructors:
Faculty in the area of controls generally rotate as far as teaching this class. Prof. Meyn has been teaching the class for around 15 years now and does an excellent job of pushing students to learn the most they can while imparting a great deal of the philosophy of control.

Prerequisites:
The listed prerequisite is ECE210. This class is a lab class, so it might be wise to have taken ECE 385 before it to have an idea of the work a lab class entails. MATLAB experience is also a plus, but this class is one of the best places to learn MATLAB.

When to Take It:
This class is offered every semester. Take it in a semester when you have the time to devote 10 hours a week to this class. This is a great class and will change the way you think about systems, but there are no other control systems electives for undergrads, so it is not clear what the best time is to take this class.

Class Content:
Through the lecture portion of this class, you will learn the basics of control theory, including dealing with system responses, how to design stable systems, using state-space models, and related mathematical concepts. In the lab portion of the class, you will use MATLAB and Simulink as you learn to model simple systems and ultimately program a controller that balances a pendulum in the inverted position. You also get to do fun things like riding a Segway.

Work:
This class requires an above average time commitment since it has both a lecture portion and a lab portion. In terms of regular work outside class, you will have to do one homework every week for the lecture section, and complete a pre-lab, lab report and sometimes work on lab experiments which take place every two weeks.

Life After:
Unfortunately, this is the only class on controls at the undergraduate level. Related classes include ECE 470, Math 415, ECE 410. ECE 470 is the class on robotics, Math 415 is a class on linear algebra, and ECE 410 is the class on discrete-time signal processing.
CS 225 - Data Structures

Updated Fall 2008

Instructors:
Cinda Heeren has been teaching this course for a couple semesters now. She is a very capable instructor who is also very friendly to students. She also tries to keep class interesting, sometimes involving the class in activities not normally seen in traditional "lectures." In general, her explanations are clear and thorough. She always uploads her lecture slides to the course website, and these generally are good enough to make the textbook unnecessary.

Prerequisites:
Officially, one of either ECE 190 or CS 125 AND one of either CS 173 or MATH 213 (Discrete Math). Since ECE 190 teaches C while CS 125 teaches Java, during the early part of the course the ECE students need to pick up the concept of “classes” while the CS students need to learn how to use pointers. It seems like the students coming from ECE 190 have a slightly easier time, but after a couple of weeks everyone is pretty much on the same page. Although officially it says Discrete Math (CS 173 or MATH 213) is required, not having taken either of those two courses doesn't put a student at much of a disadvantage. The only important skill from those classes that's needed in CS 225 is the ability to see induction and do inductive proofs. This can be learned fairly easily with a little bit of effort. If a student is taking Discrete Math at the same time as CS 225, then induction would have already been covered by the time CS 225 may need it.

When to Take It:
For EE students using this class as one of the 3 out of 5 courses, it doesn't really matter when CS 225 is taken. However, for CompE students, this class is much more important as it is the gateway to many upper level ECE and CS courses. CS 225 should be taken soon after taking ECE 190, and as mentioned earlier, it can be taken before or in conjunction with Discrete Math. Another reason to take this class early is so the student will have an advantage if applying for internships related to software development.

Class Content:
For students interested in pursuing any kind of software development in their careers, the material covered in CS 225 will be extremely important and useful. The class introduces students to many types of data structures such as lists, stacks, queues, and trees, as well as searching and sorting techniques. These are all fundamental concepts that interviewers will test time and time again. Students will learn the inner workings of how to implement these data structures in code as well as learn to analyze its performance.

Work:
Students who enjoy programming will love CS 225. The ENTIRE workload for the class is contained in the form of usually 7 MPs. 2-3 weeks are given for each MP. Many of the MPs are really cool, such as compressing an image using a quadtree or building a random maze and then solving it. Students who start early and work at a steady pace will find doing the MPs to be pretty fun. There is also a lab section for this course; however, these lab assignments are purely for practicing new concepts. Labs are not graded and solutions are distributed every week.

Life After CS 225:
As mentioned earlier, CS 225 is a prerequisite to many higher level ECE and CS courses. Many course options open after taking this class. But in addition to this academic aspect, there's a real world benefit as well. Students looking towards software development as a possible career will find that the concepts learned from this class will help greatly in competing for internships in this field.