ECE 298/241 Digital Systems Project 2006

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Project #2 in ECE 298

- In previous years, this was a 3 week project in ECE 241
- We decided to move the 241 project into ECE 298
  - To reduce your workload
  - (rather than have both the 241 project and separate 298 project)
- The marks for this project will show up in your ECE 298 course and in ECE 241
- Will be supported by TAs & Instructors from 241 and 298

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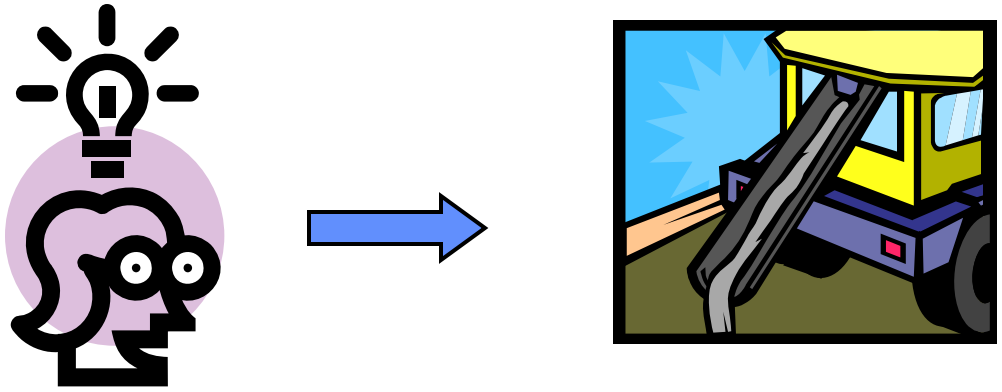
Projects

- Are great things!
- They are where you put together the pieces of knowledge that you have learned in labs & lectures
- They are what real engineers do:
  - Take fuzzy ideas, and make them into concrete reality!



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When I Interview People For Jobs

- I don't ask "canned" technical questions
- I ask candidates to describe projects they've worked on

- I look to see if they understood:
  - What was the goal?
  - How did the work go? - Did it work?
  - How ambitious was it?
  - Do they speak about it with passion?
  - Do they understand the technical details of the project?
  - Do the understand the bigger picture in which the project sits?

ECE 298 Digital Systems Project 2

- Done in groups of 2 – the same group from ECE 241
  - Were arranged to be in same ECE 298 Seminar group

ECE 298 Digital Systems Project 2

Basic Process:

1. You must select your own unique topic
   - A chance to start coming up with your own ideas
   - Getting away from “cookbook” labs where we tell you what to do
   - We want each project to be different!

Project Process

2. Once you have your project idea
   - Email your ECE 241 Instructor (yes 241) **a one or two line** description of the project, requesting “uniqueness” approval
   - The instructor will only allow one project for a topic in the same lecture/lab section.
   - He or she will respond with an email saying either:
     1. You have “uniqueness” approval, proceed
     2. Sorry, that topic has been taken, please try again.

Project Process, continued

3. Once you have a topic, you must work out the details
   - You will work with your TA (from ECE 241) to determine what is a reasonable "scope" (amount of work) for the project
   - The same topic could be too simple or far too complex depending on the details
     - e.g. a "computer" could be
       - an adder
       - or a super-computer
   - The 241 TAs will be available either
     - During ECE 298 labs
     - Or you should arrange, during 241 labs, a separate time to meet with them

Meeting with the TA

- When meeting with TA, **YOU MUST PREPARE a single sheet of paper which contains:**

1. The Names of the 2 Team Members
2. A Point form description of project
3. A Block diagram of the hardware of the project
4. A list of weekly milestones
   - to be met by the end of each ECE 241 lab period
   - there are 3 of these

The Big Question

What is a reasonable “scope” for the project?

- A hard question, because
  - for each piece of work, you need to know how long it will take to do
- It is difficult, even for experienced engineers, to know how long it will take to do a task
  - Often they’ll say: make a guess and multiply by 2
- However, they do learn, over time, to make good estimates
- The only way to learn, is to try and fail.
- In design project courses, you’ll be trying and failing, but learning!
- Your TA will help you make guesses as to what is reasonable
- Take into account the placements in the week of your ‘241 and ‘298 lab times; this will dictate the number of labs slots and timing of the last labs

Some Guidelines

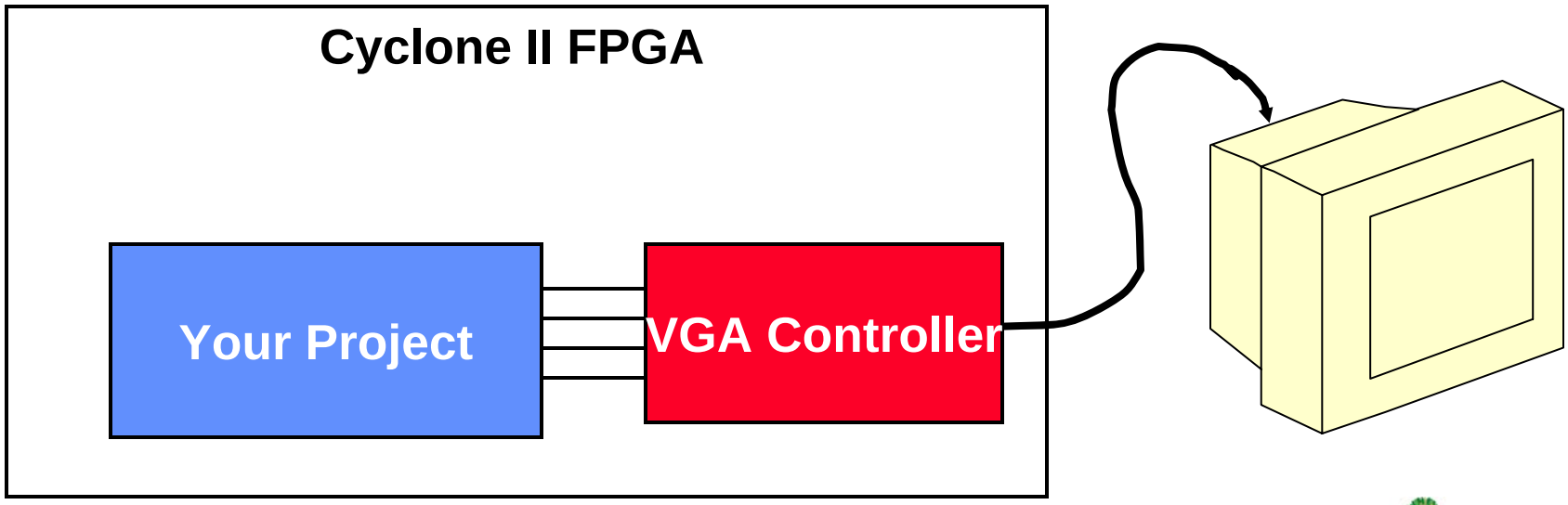
- Your project should have a reasonably large Finite State Machine in it.
  - At least 10 States, probably many more
- There should be a some “datapath” of significance
  - A datapath is a computation/communication of multi-bit numbers
  - The adders in labs 5 and 7 are considered datapath,
    - but simple and small ones
- You will have done a lab using the VGA display;
  - Anything that makes stuff move on the display intelligently

Key Part of Project: Inputs and Outputs

- One of the key questions in your project is finding interesting ways to get inputs and see outputs
- In ‘241 lab you’ve used switches as inputs, and LEDs as outputs; maybe you used others in your first ‘298 project
- Interesting projects often use other methods
- I’ll show some examples shortly

Popular/Available Output: VGA Display

- i.e. a CRT monitor
- Use digital hardware to draw pictures on the display:
- Lab 7 in ECE 241 will show you how to use



The VGA Display

- We provide you with a pre-designed circuit that does the most difficult parts
- To understand this, you'll need to understand how larger scale digital memories work (beyond flip-flops)
  - will soon be taught in ECE 241
- A way to guarantee a good scope project is to use a VGA display

Example Projects

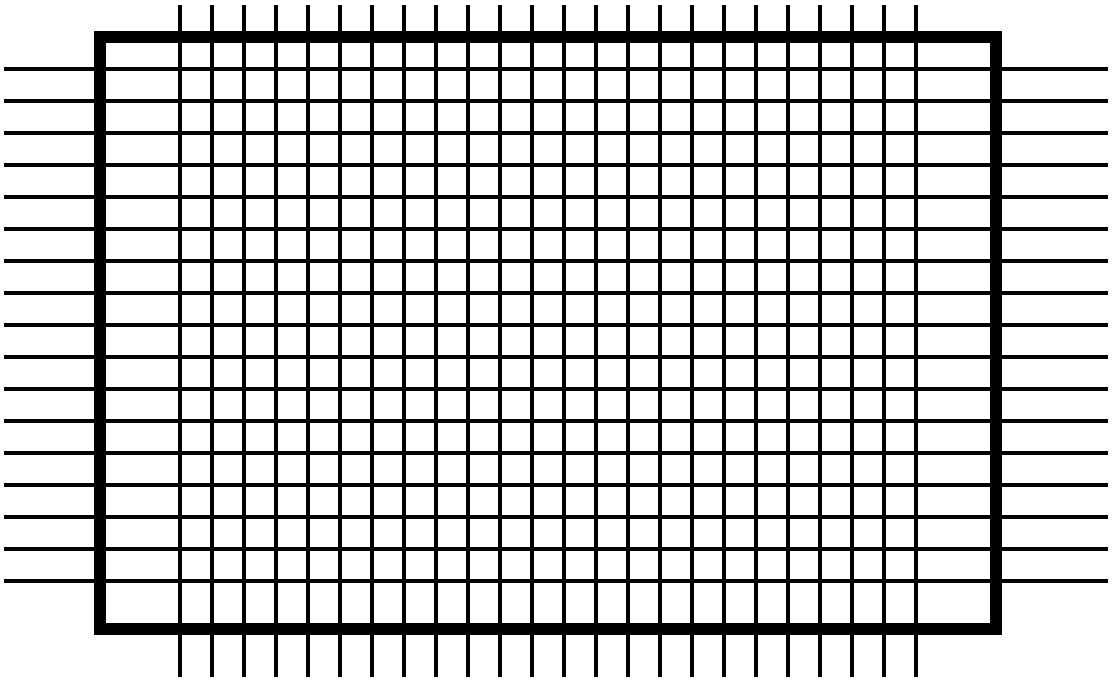
Almost everyone's first idea:

- Clock
- Alarm Clock
- Elevator controller
- Calculator

- After that, people start thinking harder,
  - often based on interesting input & output devices
  - you will be spending a lot of time at it – make it fun!

Example Projects

- Interesting project from three years ago:
  - Built a board with horizontal & vertical wires
  - Wires didn't touch, but when pressed on they would
  - Used hardware to make a touch pad & draw dots on screen where touched:



Other Projects

- Morse code sender
- Square root calculator
- Tone Frequency measuring device

- Video game –
  - Move left and right based on switches, try to collect “gold”
  - Move up and down on elevator to different levels
  - Avoid Nasties coming after you
  - VGA display output
- Video game – ping pong
- Processor – outboard DRAM display, outboard SRAM instruction memory, mouse, assembler, drawing program

Last Year's Projects

WARNING:

The projects you are about to see were all designed in hardware, **NOT SOFTWARE**

- **They just sort of look like software.**

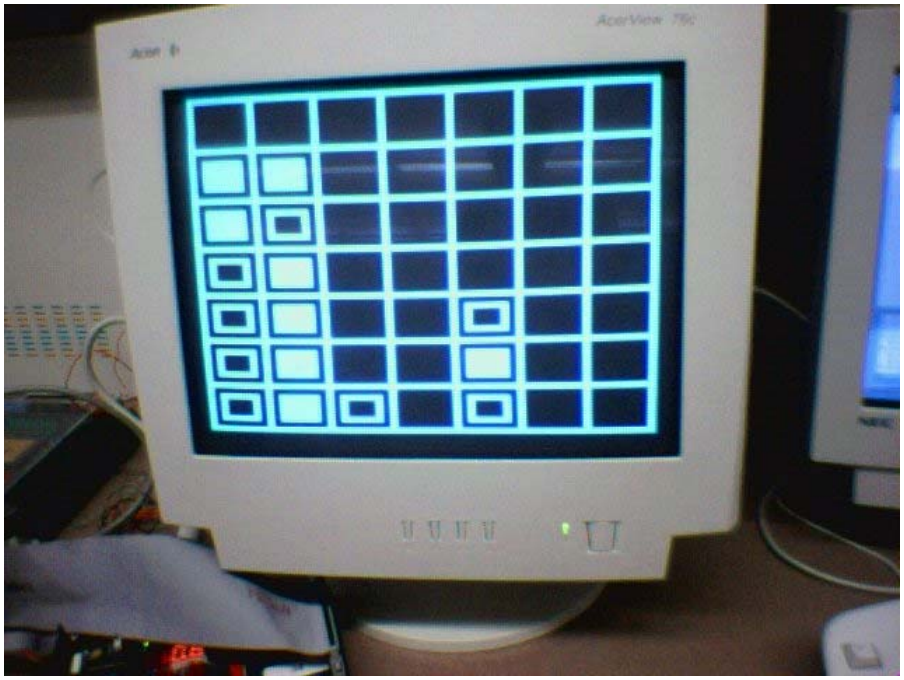
Tetris

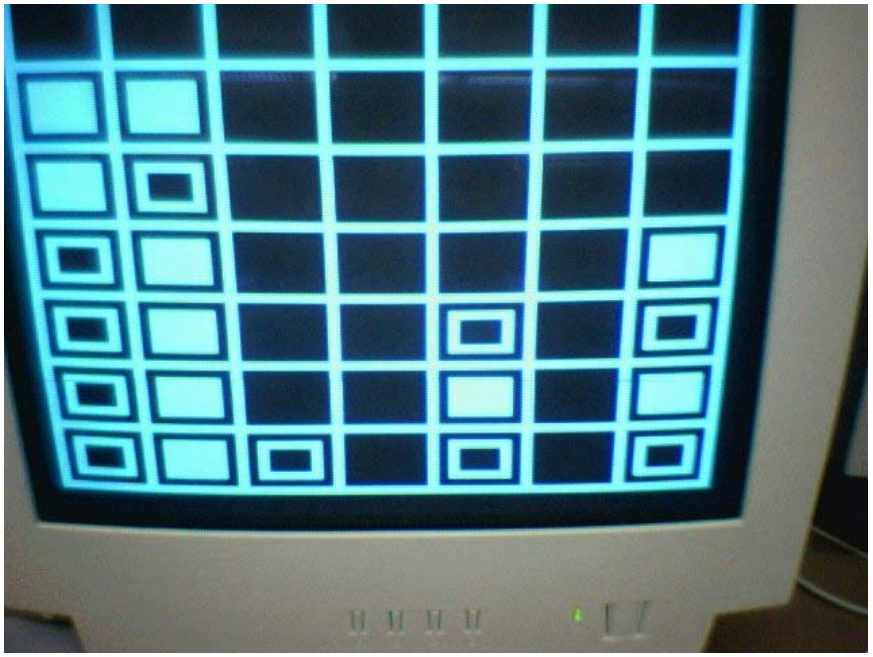
- Click link below for video: (it is a 34Mbyte file and will take a long time to download)

http://www.eecg.utoronto.ca/~jayar/ece241_06F/projectvids/Tetris_Demo.avi

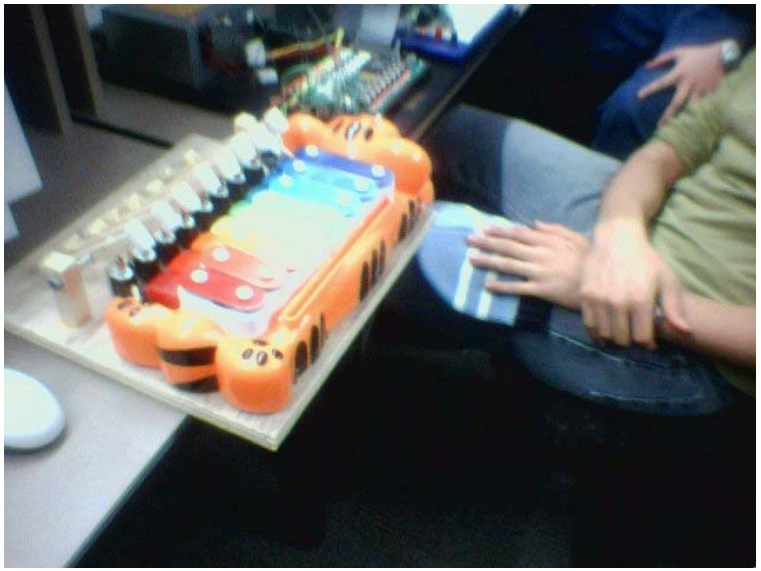
Missile Command

Connect Four





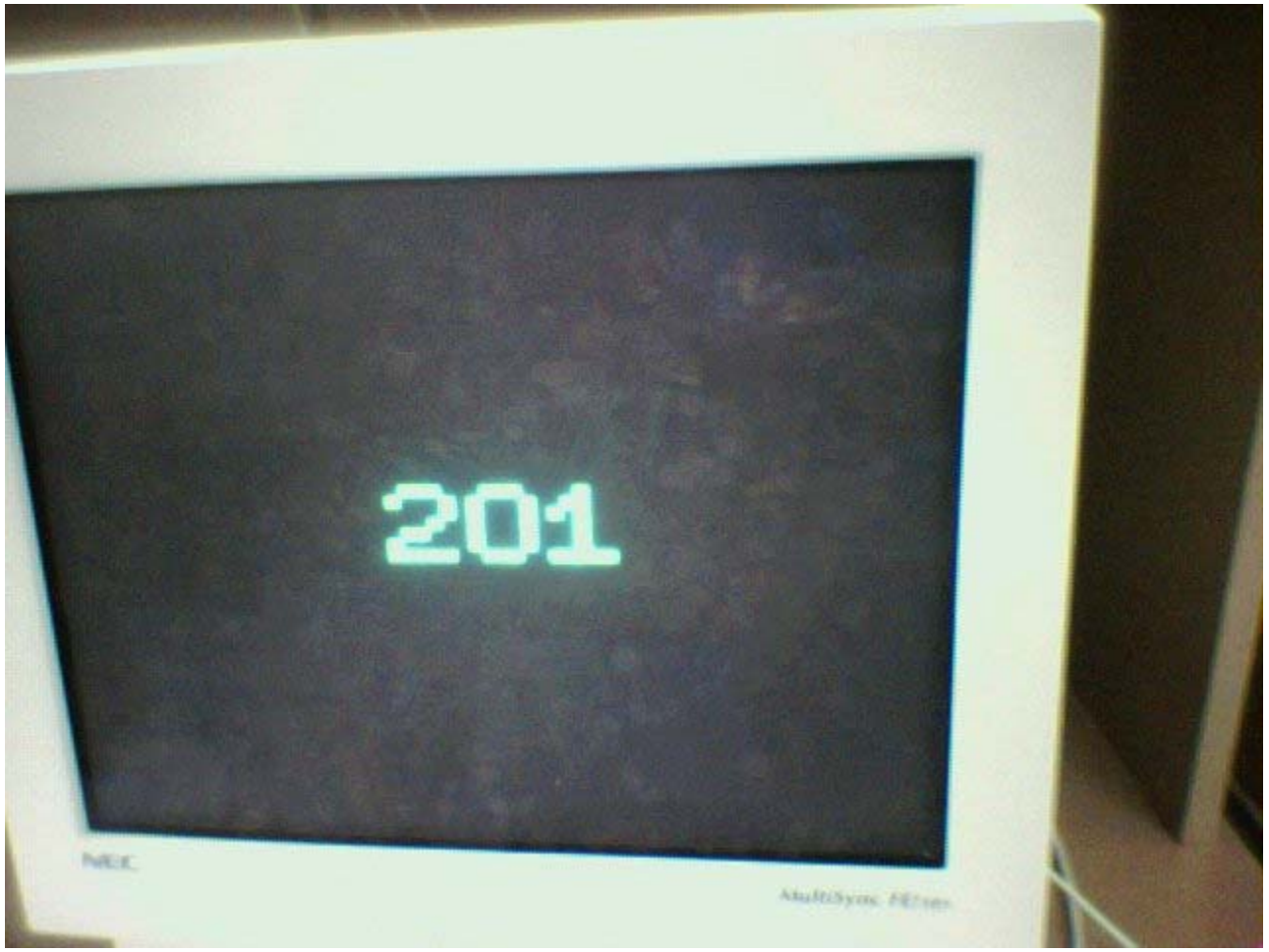
Xylophone



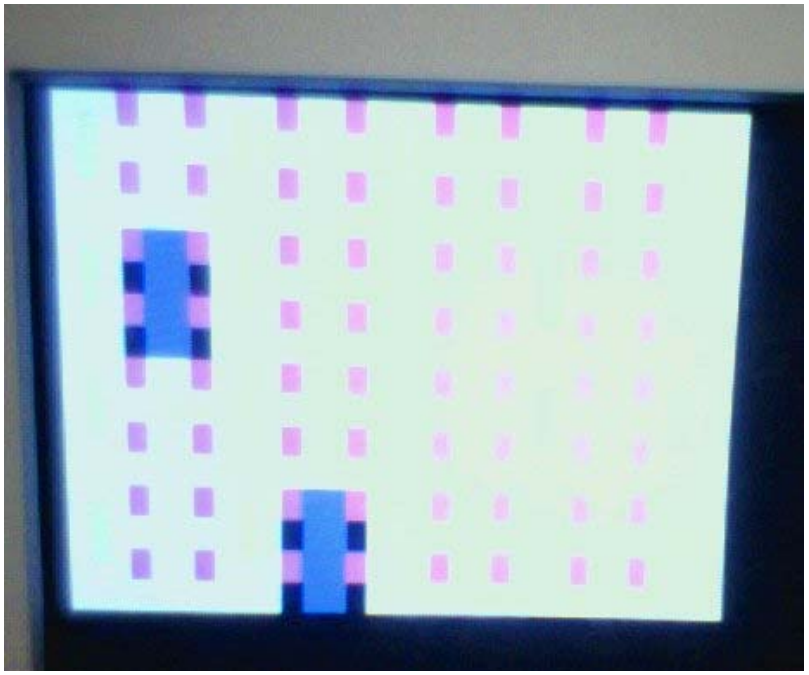
- Electromagnetics pull down hammers on to keys
- Hardware could record and play back music
- Also displayed notes on screen

Gambling Machine

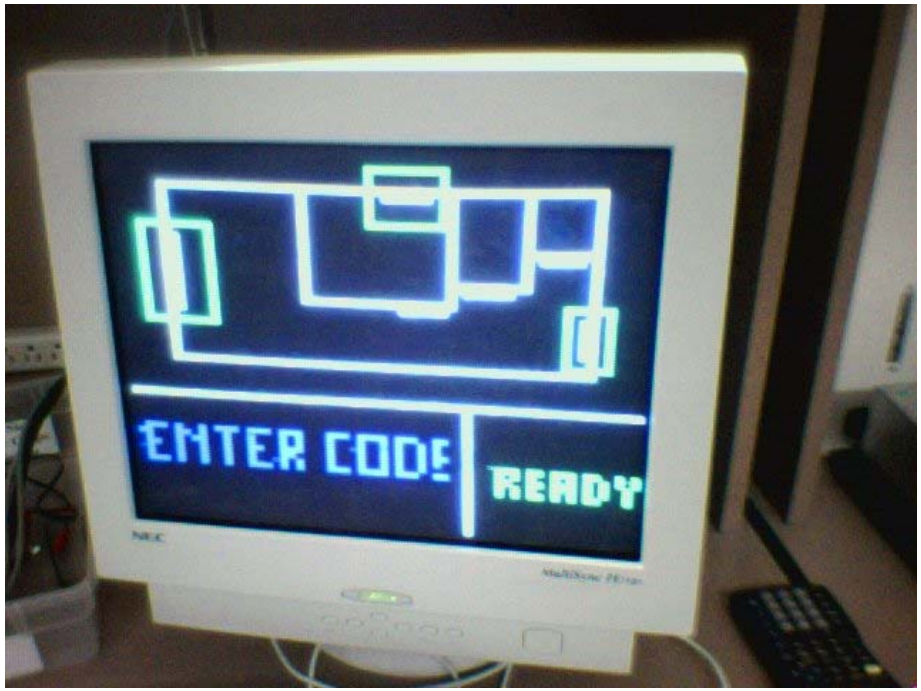
A Special Kind of Processor

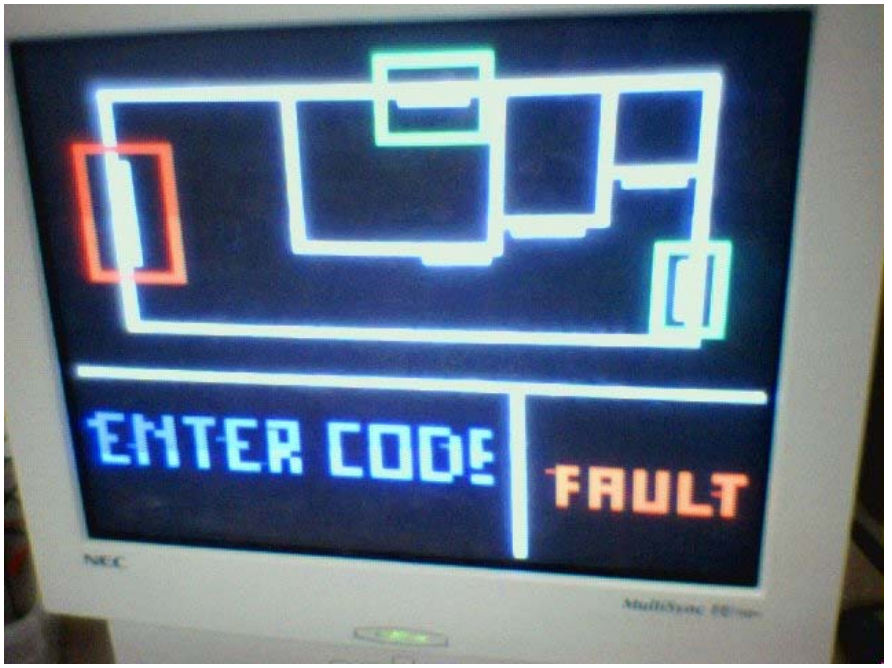


Racing Cars

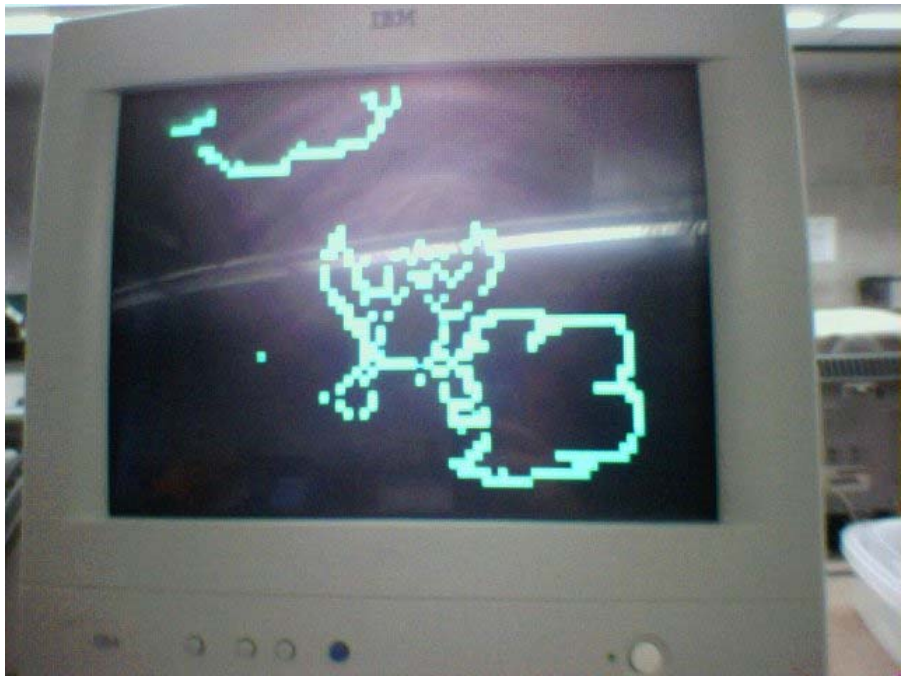


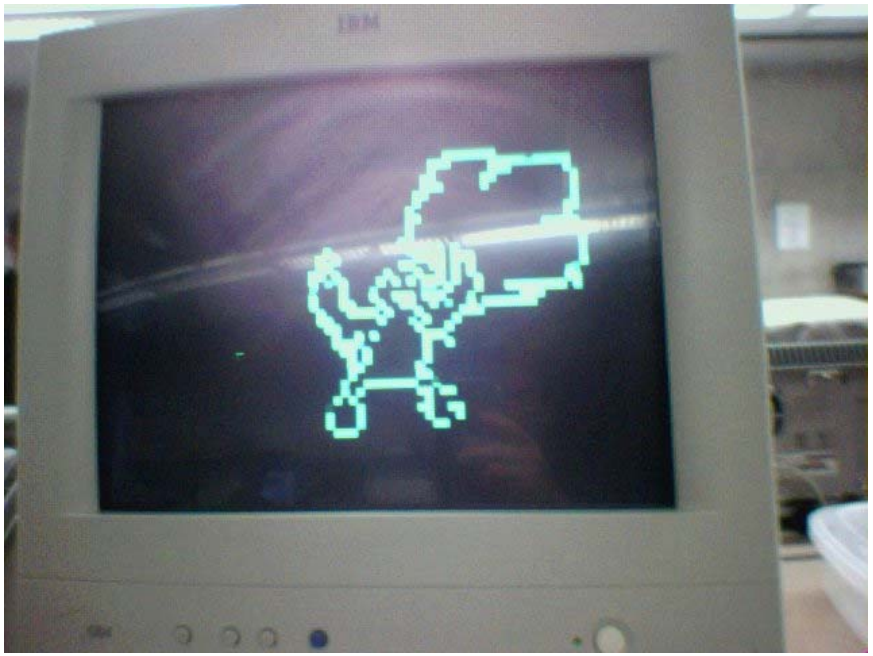
Burglar Alarm



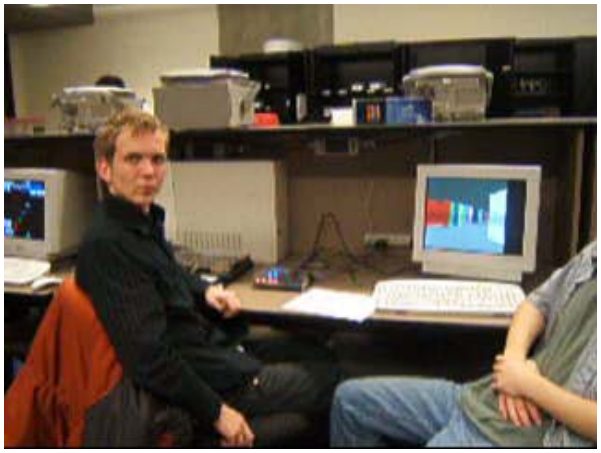


Animation





3D Ray Caster - Video



- Click link below for video: (it is a 10Mbyte file and will take a long time to download)

http://www.eecg.utoronto.ca/~jayar/ece241_06F/projectvids/3DRayCaster1.AVI

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Ping Pong – “Crazy Pong” - Video

- Click link below for video: (it is a 10Mbyte file and will take a long time to download)

http://www.eecg.utoronto.ca/~jayar/ece241_06F/projectvids/CrazyPong1.AVI

Dance Master 2005 - Video

- Click link below for video: (it is a 10Mbyte file and will take a long time to download)

http://www.eecg.utoronto.ca/~jayar/ece241_06F/projectvids/DanceSteps.AVI

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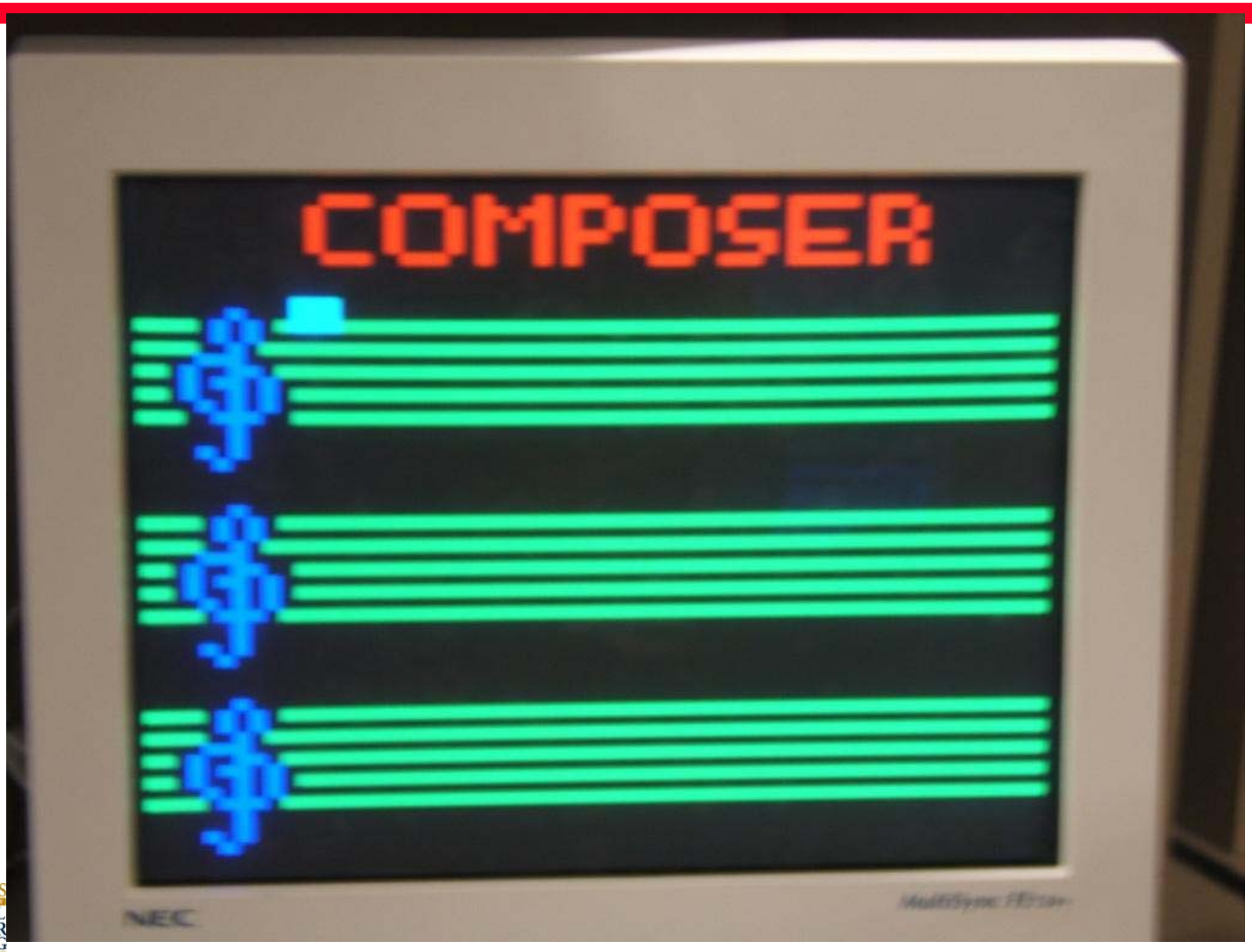
Music Maker



Mine Sweeper

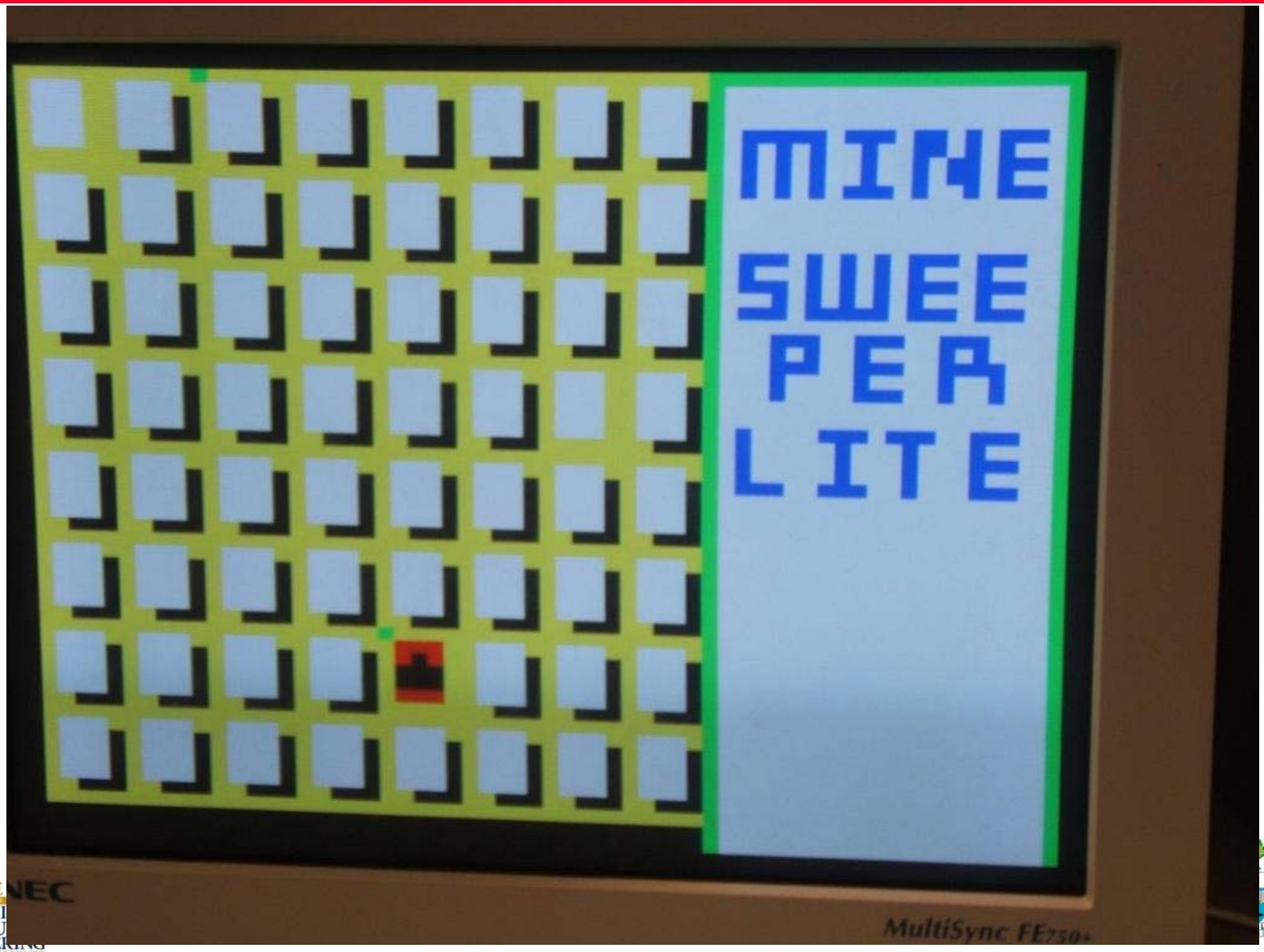


Photo Draw - Video

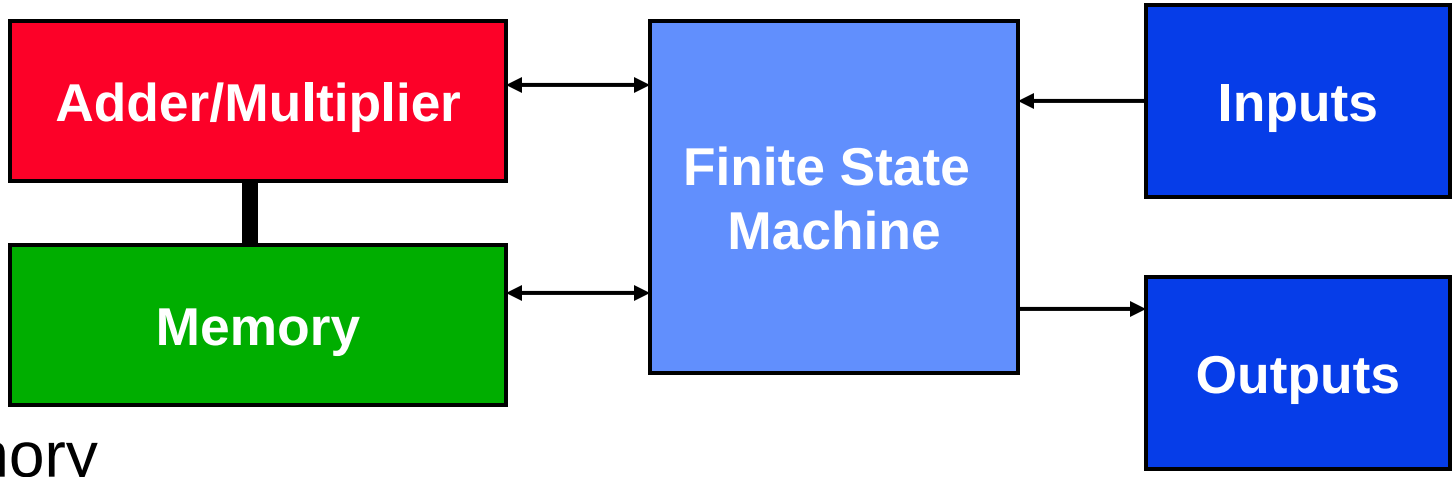
- Click link below for video: (it is a 10Mbyte file and will take a long time to download)

http://www.eecg.utoronto.ca/~jayar/ece241_06F/projectvids/PhotoTransistorDraw1.AVI

Shoot Sensor

Useful Topics to Come in ECE 241

- "Debouncing Switches"
  - If you want to make your own input switches, this deals with the problem that simple switches creating noisy inputs
- Larger Finite State Machines



- "Memory
  - You likely want larger memory to store things
  - The VGA display sort of works like a memory

Timetable – Project 2

	ECE241 Labs	ECE298 Labs	Outside Labs
Week 1 (Week Oct 23)		P1 demo & oral, P2 work with TAs	P2 uniqueness approval by '241 instructor
Week 2	241 Lab 6	P2 Planning	
Week 3	241 Lab 7	P2	Design Centre is also available
Week 4 Planning Doc due	P2 "Scope Check" with TA	P2	
Week 5	P2	P2	
Week 6 Final report due	P2	May not be useful for all teams	

Oral Report is during exam period

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Marking

- **Project is worth 40% of your ECE298 grade (project components plus 20% final oral presentation)**
- **Project is worth 10% of your ECE 241 grade**
  - Much more in your engineering life!

- Grade will come from
  - Technical assessment (by ECE 241 TAs)
  - Organization and communication assessment (by ECE 298 TAs/instructors)
  - Final oral presentation (by ECE241 and ECE298 TAs/instructors)

- Technical grades will be “normalized” across TAs
  - Through a meeting between TAs & Instructors

Other Issues

- If you are in 298 but not 241
  - Assumed to have ECE 241 knowledge
- In 241 but not 298 (presumably not in this room)
  - If you have partner in this state, talk to Prof. Anderson
- Can’t stand partner
- Partner doesn’t do any work.

Summary

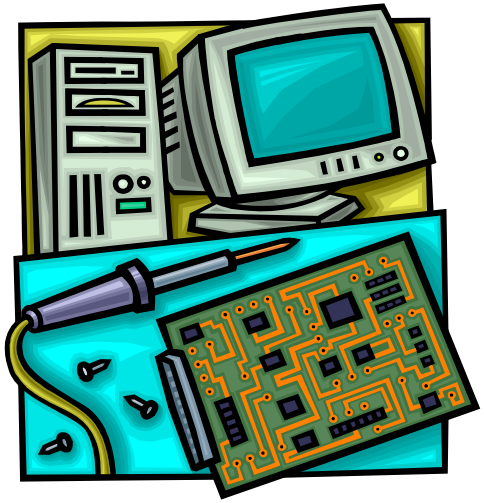
- Projects are Good! – they're real engineering

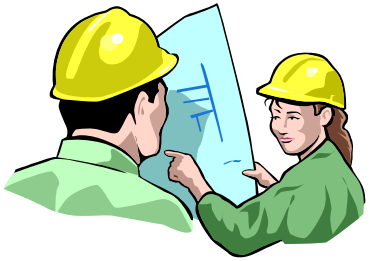
- Start thinking about your topic now

1. Get "Uniqueness" Approval by email from 241 instructor
2. Discuss more details with ECE 241 TA
3. Work on project – before (prepare!) and during labs
4. Write Report – details to come from ECE 298

Good Luck

- Projects are crucial to your engineering education!





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