Project Management & OneNote

ECE 403 Senior Design II

Week #2

Please visit Bison Academy for corresponding lecture notes,
homework sets, and videos
www.BisonAcademy.com

Project Management

Project Management looks at how to manage projects. A project is an activity that has

- A start date
- An end date, and
- A specific outcome or deliverable

Some things are *not* projects:

- Reading your emails is not a project. It has no start date, no end date, and no specific deliverable
- Your ECE 401 term project *is* a project: it has all three of these.

When is Project Management Needed?

Sometimes, project management isn't necessary
- If a project is small enough or
- If you have enough experience,

You can simply start the design process right away.

However, when dealing with a project which is
- Complex.
- Large in scope,
- With a large number of people, and
- Which has a hard deadline for completion,

a little organization up front helps to increase the odds of the project being successful. That's the goal of project management.

Project management isn't easy.

- People make careers out of being good at project management.
- You can get a degree in project management (MBA)
- Have respect for MBA's - they're really useful.

Where project management was vital:

- The James Webb Space Telescope

    1200+ scientists, engineers, and technicians from 14 countries and 27 states working on it.,

- The F35 Fighter

    *125,000+ people
    46 states working on it*

- TerraPower

    *600+ employees
    designing the next generation Thorium fueled nuclear reactors.*

Projects of this size take considerable organization to complete successfully.

Project Management in Design II & III

In Senior Design II and III, you won't be given a project anywhere near as complicated as these. However, you will be given

- A fairly complex project,
- With a team of three people,
- With a hard deadline: the end of the second semester.

It really pays off to spend some time at the start of ECE 403 to get the project organized. We'll be doing this in Senior Design I with a smaller, simpler project. Hopefully when you get to ECE 403, the ideas behind project management make more sense and can be applied.

Project Life Cycle

Any given project usually goes through:

- Initiation: Where you start the project. In companies, this is usually at the start of the fiscal year when money is allocated to the project.
- Planning: When the project manager defines the scope of the project, the time allocated to it, and the budget to complete the project. This also includes the organization of the project.
- Executing: Doing the work
- Monitor and Control: Feedback during execution to make sure the project remains on track.
- Closing: Finishing the paperwork and documentation, closing the accounts, releasing personnel.

This doesn't have to be sequential: the middle three (planning / executing / monitoring) can be repeated over and over as often as needed to get the project right.

Initiating

Planning

Executing

repeat

Monitor & Control

Closing
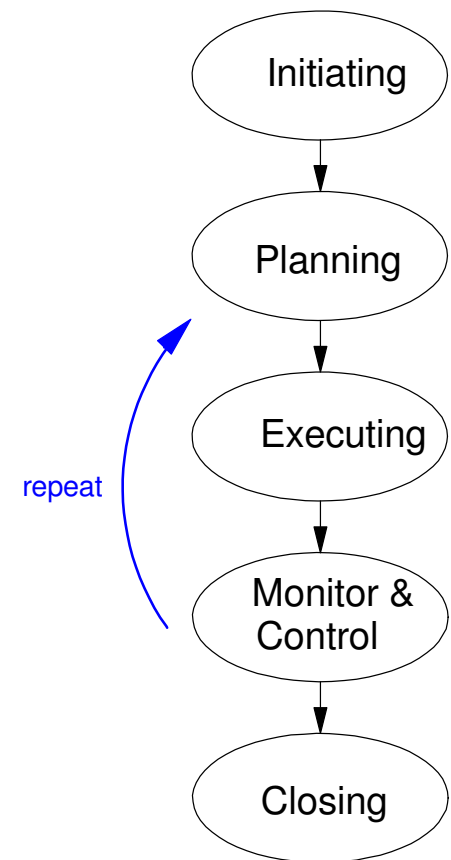
Project Constraints

The project manager (or project management) seeks to compete these tasks within the constraints of

- Scope: What the project is and what it isn't,
- Time: The time allocated to the project (start and end date), and
- Cost: How much money and resources are allocated to the project

Constraints

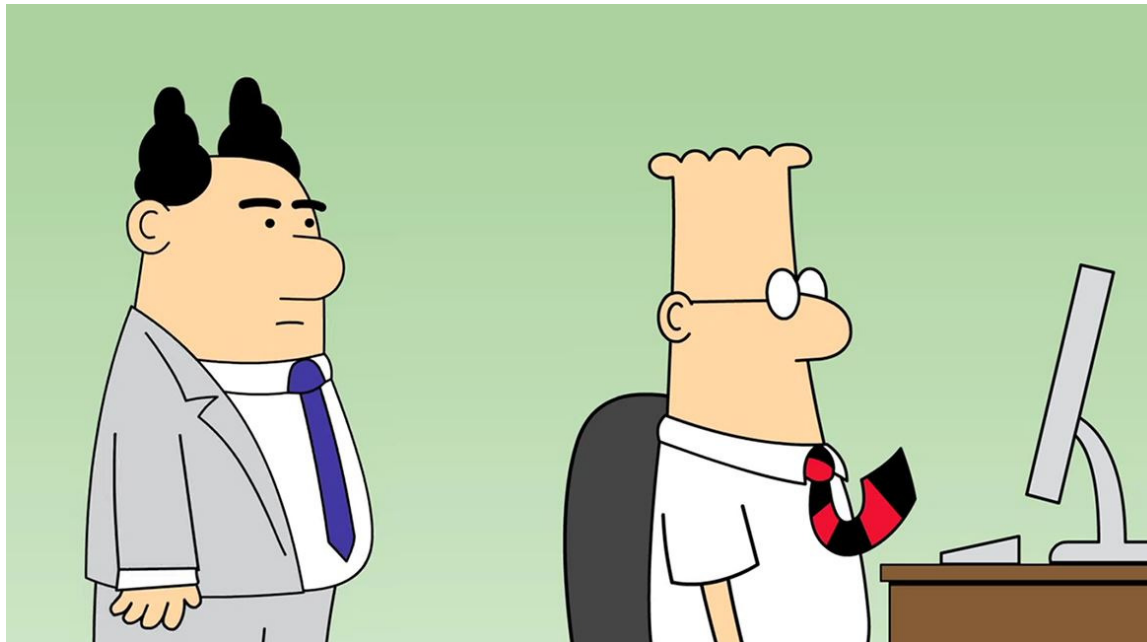Scope   Time   Cost
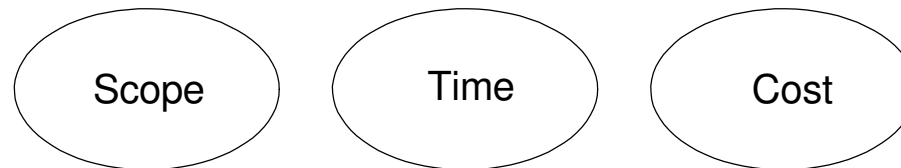
Project Manager's Job:

- Make sure the time and budget allocated are sufficient for the scope of the project.
- Protects the project against project creep

  Others trying to increase the scope of the project
  Others trying to change the scope of the project
  Without allocating any more time or budget.

Project Charter

One way to prevent project creep is to start with the *project charter*. This is a document which specifies

- What are the deliverables for the project
- What are the key elements for the project
- How much time is allocated for the project, and
- What's the budget

Project Charter (cont'd)

The *project charter* is the most important document in the project.

- When someone joins the team, the *project charter* helps him/her know what the project is all about.
- When a manager tries to change the scope of the project (project creep), the *project charter* defines what the project is, what it isn't, and whether this new mission is or isn't within the scope of this project.
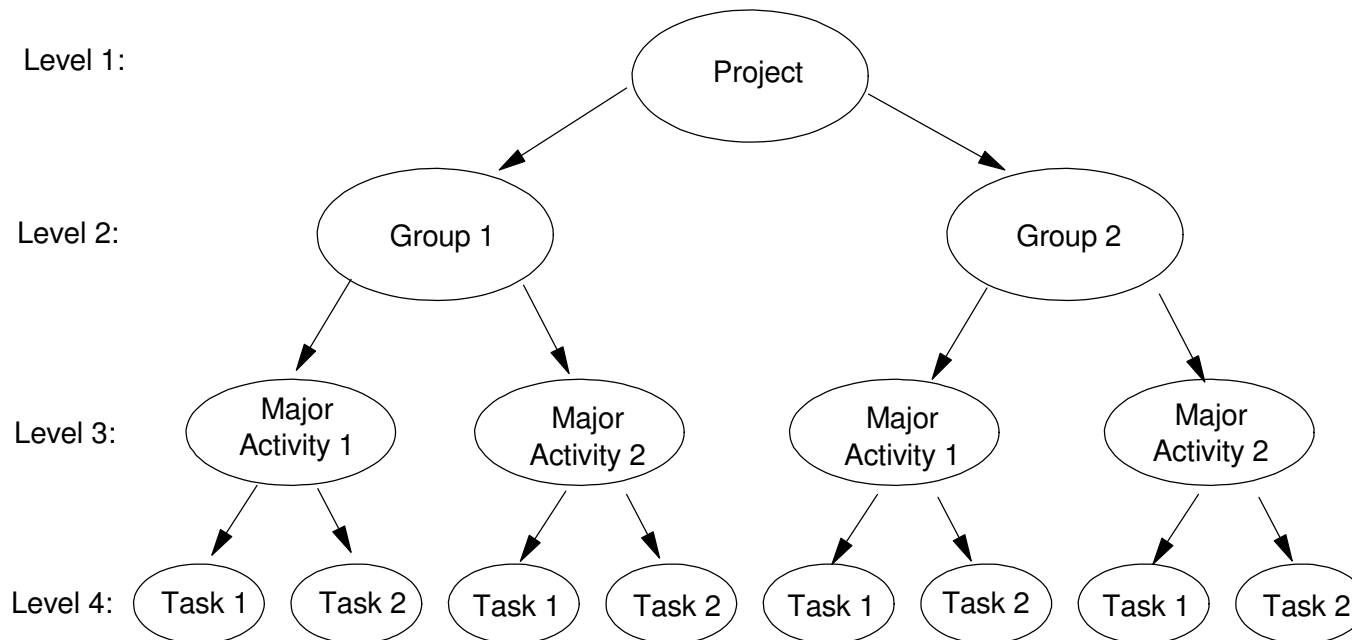
As a note - everyone at your company is part of the same team. If something important comes up and it needs to be added to a project, you'd like to say yes, we can do that. However, given a limited time and budget, there's only so much you can do.

If the new task is really that important and it significantly changes the project, you might need more time, people, and resources. The project charter helps the project manager make that argument.

Work Breakdown Structure

Once the project is defined, the next task is to split the project into smaller tasks

- Sort of a divide and conquer technique.
- Once the tasks are small enough, you can start knocking them off one by one.

Level 1:   Project

Level 2:   Group 1   Group 2

Level 3:   Major   Major   Major   Major
          Activity 1   Activity 2   Activity 1   Activity 2

Level 4: Task 1 Task 2   Task 1 Task 2   Task 1 Task 2   Task 1 Task 2

Work Breakdown Structure

Level 1: Define by the *project charter*.
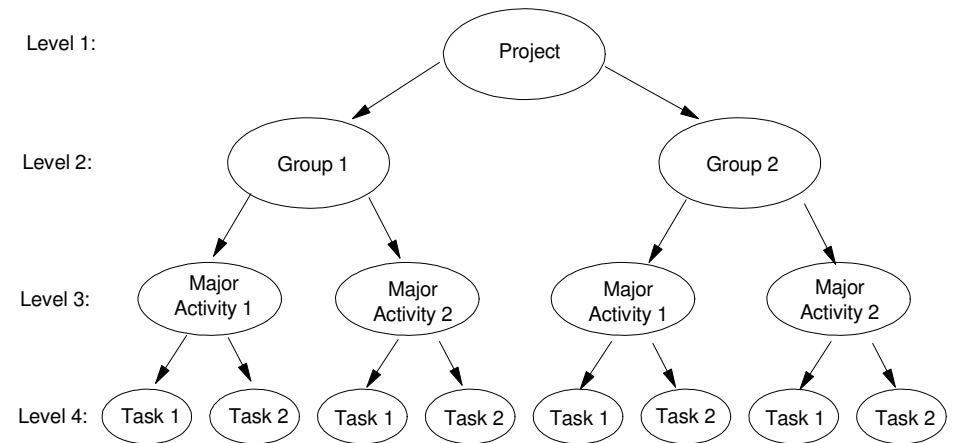

Level 2: Split the project

- by department
- by functionality

Level 3: Specify the major parts

- Major technical challenges for Sr Design

Level 4: Tasks.

- What are the tasks that need to be completed

Level 1:   Project

Level 2:   Group 1   Group 2

Level 3:   Major Activity 1   Major Activity 2   Major Activity 1   Major Activity 2

Level 4:   Task 1   Task 2   Task 1   Task 2   Task 1   Task 2   Task 1   Task 2

Gantt Chart

Once the major tasks to complete a project are defined, you can start defining

- how much time is allocated to each task,
- what the start date of each task is to be, and
- when the end date of each task is.

A Gantt Chart is a graphical way of displaying that information. We'll talk more about Gantt charts in week #3.
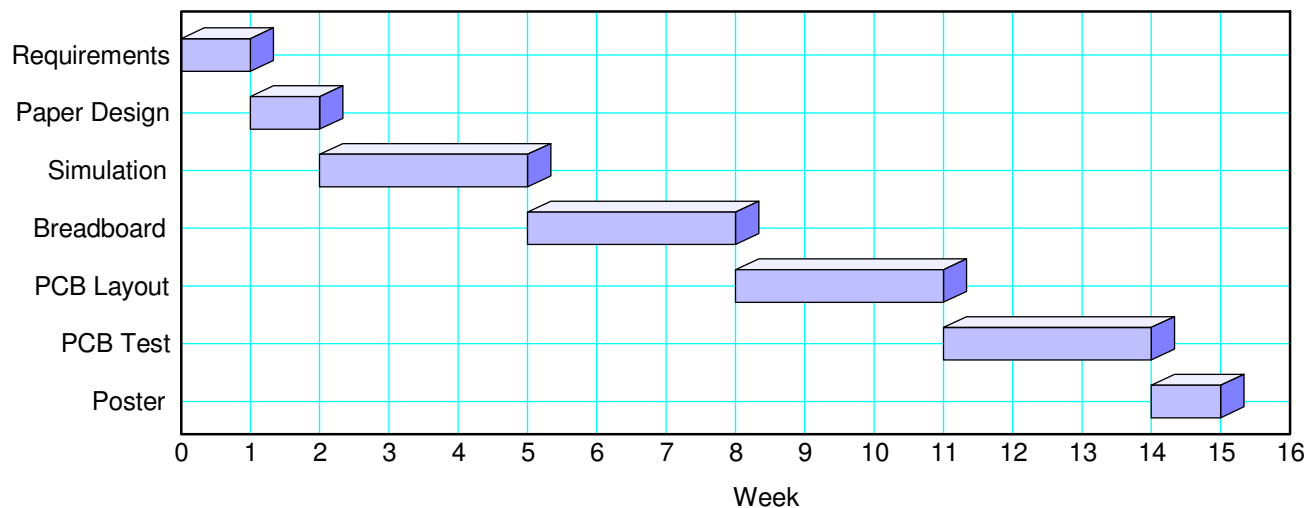
Project Management Techniques

In terms of what project management is, there are about as many styles of project management as there are graduates with an MBA. Coursara, for example offers over 2700 different courses on project management. Four different version of Project Management are

- Critical Path
- Waterfall
- Agile
- Total Quality Management

Waterfall

The idea behind *Waterfall* is

- A given project can usually be split into a set of tasks that need to be completed.
- One way to complete the overall project is to complete these tasks one at a time.
- The *waterfall* shows you the order in which these tasks will be completed.

Reqirements → Paper Design → Simulation → Breadboard → PCB → Testing → Packaging
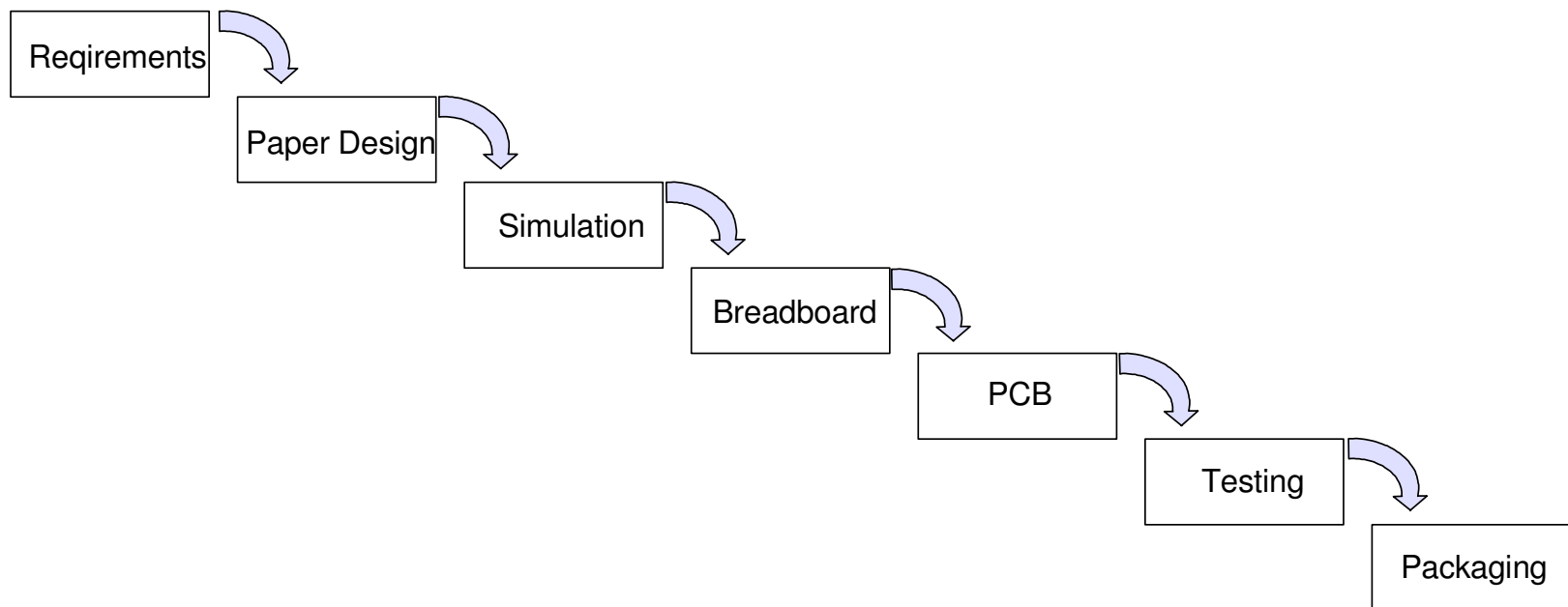
Waterfall for Senior Design

- Requirements Capture: Define the inputs, outputs, and how they relate.
- Paper Design: Analysis and calculations for circuits and/or programs which meet these requirements.
- Simulation: Test your hardware design in simulation or test your software with test programs.
- Breadboard: If your design works in simulation, build it on a breadboard to get the schematics correct.
- PCB: Transfer your breadboard design to a printed circuit board.
- Testing: Check that final design meets the system requirements.
- Packaging: Place your final design in a package for delivery to your customer (ECE 405 only).

Waterfall projects can be very agile and responsive to customer input.

- There is nothing stopping you from having customer input and alterations to the design along the way.
- Often times, this is necessary: customers often times don't know what they want until they see it.

As the customer sees your project progress, he/she may get a better understanding of what they really need and what can be delivered.
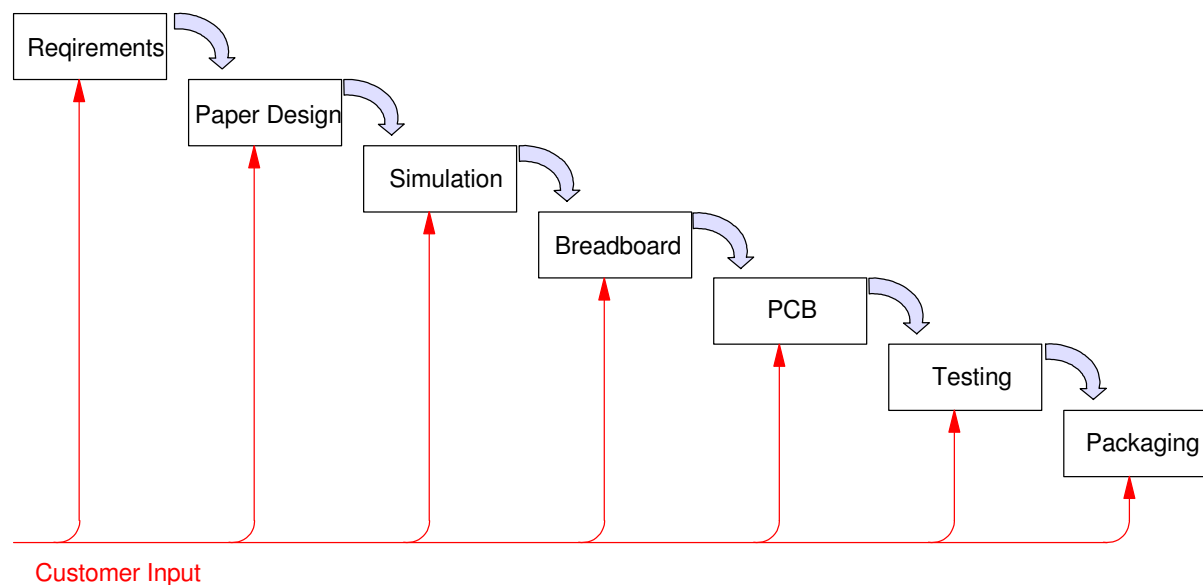
Critical Path

The idea behind Critical Path is that

- Most projects can be broken down into smaller parts.
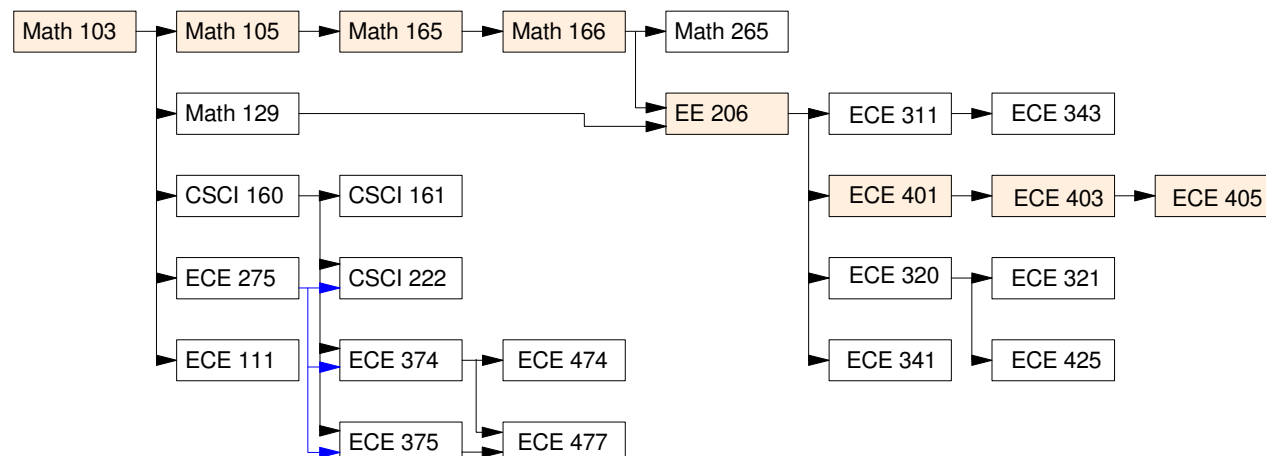
  To graduate from NDSU in Computer Engineering, for example, you need to take and complete forty courses.

- Some things have to be done sequentially.

  You can't shingle a roof until you have a roof.
  You can't take Calculus II until you complete Calculus I.

If you lay out all of the tasks in the order of when they can be completed, you'll see the longest path from start to finish, This is the critical path.

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Math 103 → Math 105 → Math 165 → Math 166 → Math 265

         Math 129 ─────────────────→ EE 206 → ECE 311 → ECE 343

         CSCI 160 → CSCI 161                  ECE 401 → ECE 403 → ECE 405

         ECE 275    CSCI 222                  ECE 320 → ECE 321

         ECE 111    ECE 374 → ECE 474         ECE 341 → ECE 425

                    ECE 375    ECE 477
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What the critical path tells you is

- If you want to graduate in the minimum time possible, you *need* to be taking the next course in this sequence each semester. If you skip a semester, you postpone graduating.
- The other courses can be moved around to even out the workload each semester - providing you are abiding by the prerequisites.

The same holds in Senior Design.

- If you break your project down into smaller chunks then arrange these by the order they need to be completed, you'll see which activities form the critical path.
- At any given time, you need to be working on the next item in this path.
- If you don't, your end date will slip.

Agile

An iterative design

The idea is to

- Split the project into smaller tasks, then
- Go through the entire design sequence for each task, one by one (requirements, paper design, breadboard, PCB design, validation)

Essentially, the goal is to slap out a prototype quickly, then iterate on improving this prototype over and over.

Task 1

Plan → Execute → Evaluate

Task 2

Plan → Execute → Evaluate

Task 3

Plan → Execute → Evaluate
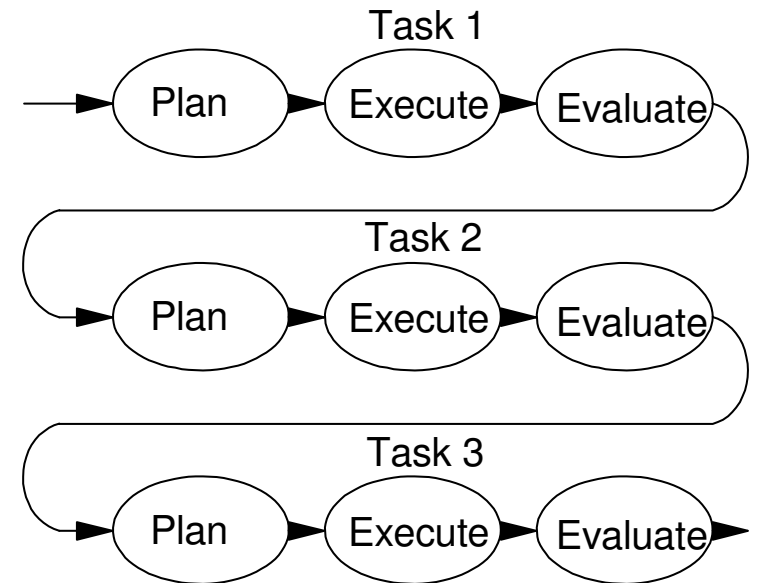
Agile Example

- Build a stoplight

One way to split up the tasks are

- Physical Design
- User Interface
- Traffic Sensors

1st Iteration: user interface

- Cell phone app

  shows you what the stoplight is doing
- Go through the design cycle

  plan - execute - evaluate

2nd Iteration: physical stoplight

- Hardware controlled by cell phone app

  controlled by the cell phone app
- Go through the design cycle

  plan - execute - evaluate

Task 1

Plan → Execute → Evaluate

Task 2

Plan → Execute → Evaluate

Task 3

Plan → Execute → Evaluate
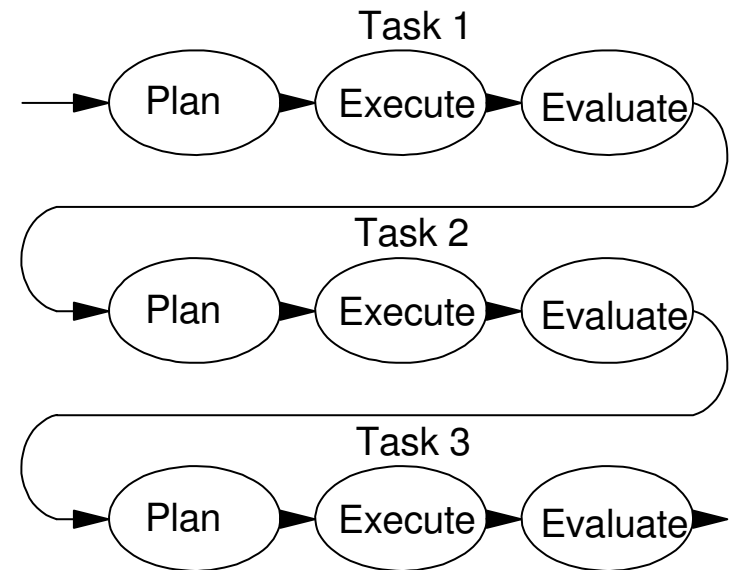
Total Quality Management (TQM)

Problem: Company A is trying to design and build a widget.

- The hardware group starts with the design.

  When done, it passes their final design over the wall to the software group.

- Software looks at the hardware design and it doesn't really work for them.

  Software redesigns the hardware and then
  Writes the corresponding software.
  When done, they pass the final design over the wall to manufacturing.

- Manufacturing looks at the design and it really doesn't work for them either.

  Manufacturing redesigns the hardware and software so that the product can be built.

Hardware   Software   Manufacturing
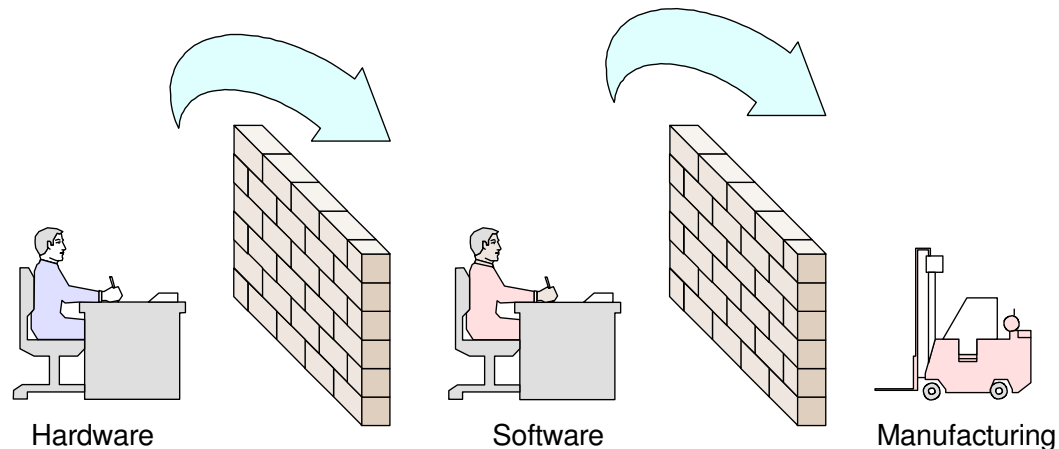
Total Quality Management

The idea behind TQM is to get the design right, right from the start.

To do that,

- You need to have an initial design meeting with everyone right from the start.
- Once you hash out a framework that hardware, software, and manufacturing can live with, *then* you start the design process.

The hope is that you won't have to redesign the widget each step of the way, saving both time and money.

Project Management in ECE 403 & 405

Use whatever method you like

As long as you complete the project under the constraints of
- Time,
- Budget, and
- Scope

you meet the expectations for Senior Design.

Design Notebooks & OneNote

What is a Design Notebook?

Essentially your diary

- Where you keep all of your records
- What your ideas were,
- How you tested them, and
- What the results were.

Design notebooks are also very common and very old: Leonardo Da-Vinci, for example, kept extensive notes on his work

Purpose of Design Notebooks:

Help you organize your thoughts.
- "If you're stuck, write up what you have."

They serve as a reminder.
- If you ever want to go back and refresh your memory on what you were thinking, what you tried, and what the results were, all of that information is in your design notebook.

They help your successor
- Design Notebooks help the engineers who pick up where you left off when you get promoted.
- Often times, the design notebook is all that's available to help get your replacement up to speed in terms of what you did, what worked, and what didn't.

They can also be used in the patent process

Patent Law - What is a Patent?

From Wikipedia:

A patent is a type of intellectual property that gives the owner the legal right to exclude others from making, using, or selling an invention for a limited period of time in exchange for publishing and enabling disclosure of the invention.

Issued by the United States Patent and Trademark office (USPTO).

Used in industry to prevent competitors from stealing their ideas and designs.

Note:
- Patents do not allow you to making, using, or selling an invention
- They only block others from doing so.
- If identical patents are issued to two different parties, there is no conflict
  *The two patents simply block each party from making use of the patent.
  It's up to them to negotiate*

USPTO Web Site

https://ppubs.uspto.gov/pubwebapp/static/pages/landing.html

The USPTO actually has a very friendly, easy to use web site. On that site, you can search for patents fairly easily, free of charge.

https://ppubs.uspto.gov/pubwebapp/static/pages/landing.html
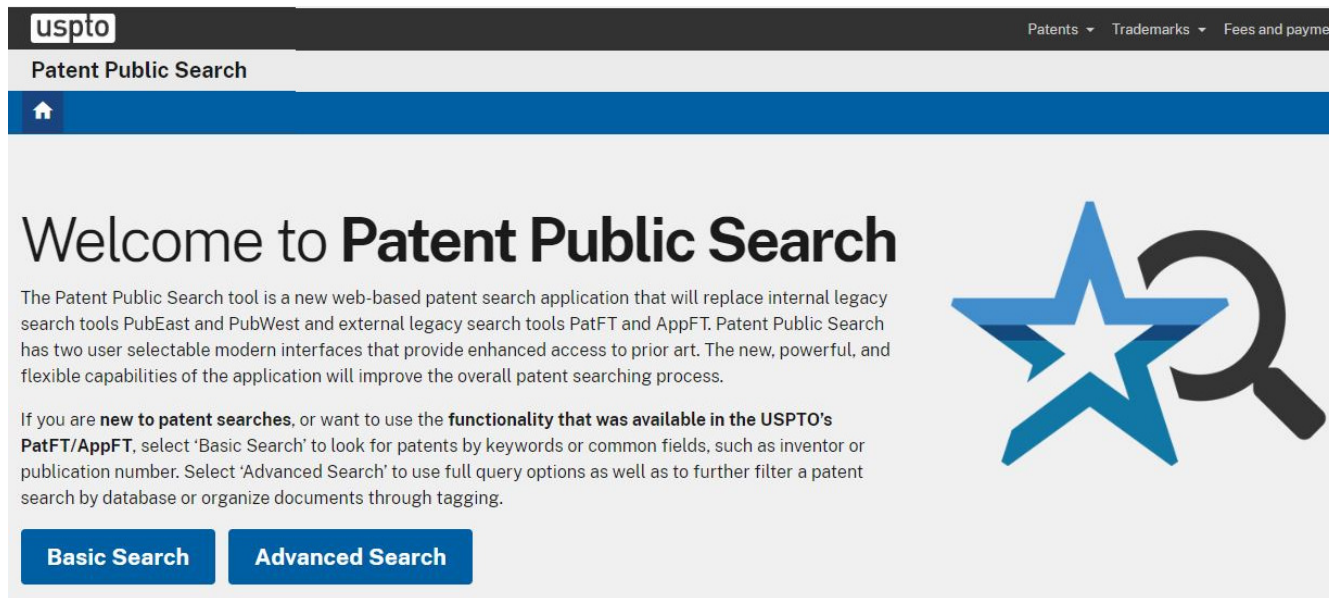
Sample Patent Search:

Example: Search for "Talking Football"

- Results in 3624 patants

Search results

Results for query **"talking AND football"**   Showing 1 to 50 of 3624 records 50 of 3624 records

Result #	Document/Patent number			Title	Inventor name	Publication date	Pages
1	US-11775052-B1	Preview	PDF	Smart room system	Douglas; Robert Edwin et al.	2023-10-03	62
2	US-11771366-B2	Preview	PDF	Method, apparatus, and system for radio based sleep tracking	Wu; Chenshu et al.	2023-10-03	52
3	US-11778138-B2	Preview	PDF	System and methods providing supplemental content to internet-enabled devices synchronized with rendering of first content	Verna; Anthony F. et al.	2023-10-03	17
4	US-20230306218-A1	Preview	PDF	METHOD FOR TRACEABILITY OF RAW MATERIALS, COMPONENTS, OBJECTS, AND PRODUCTS EXPOSED TO HARSH OPERATIONAL CONDITIONS IN INDUSTRY	Kayalar; Mete et al.	2023-09-28	38
5	US-20230308303-A1	Preview	PDF	SYSTEMS, METHODS, AND APPARATUS FOR MEETING MANAGEMENT	Jorasch; James et al.	2023-09-28	407

3624 patents contain the words "talking" and "football"

Viewing Patents

- Click on "Preview" or "pdf"
- Gives you the entire patent

Typical Patent

Cost to Patent

The USPTO is very egalitarian: anyone can file for a patent or a trademark for not a lot of money.

- Trademark: one-time filing fee of $250
- If granted, this trademark lasts for six years and can be renewed
- Hiring lawyers for a bulletproof patent costs more
- Individuals are more than welcome to submit a patent on their own

Revoking a Patent

Patents can be ruled null and void.

This is usually done if

- It can be shown that the invention was used prior to the patent, or
- The invention is obvious to an expert in the field.

Example: The Wheel

- Sort of a fad to try and sneak a patent for the wheel through the patent office.
- Granted in 2001 in Australia as a "circular transportation fascination device." [1]

But...

- If the owner tried to enforce the patent, it would be revoked (wheels were being used prior to 2001)

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[1] https://www.newscientist.com/article/dn965-wheel-patented-in-australia/
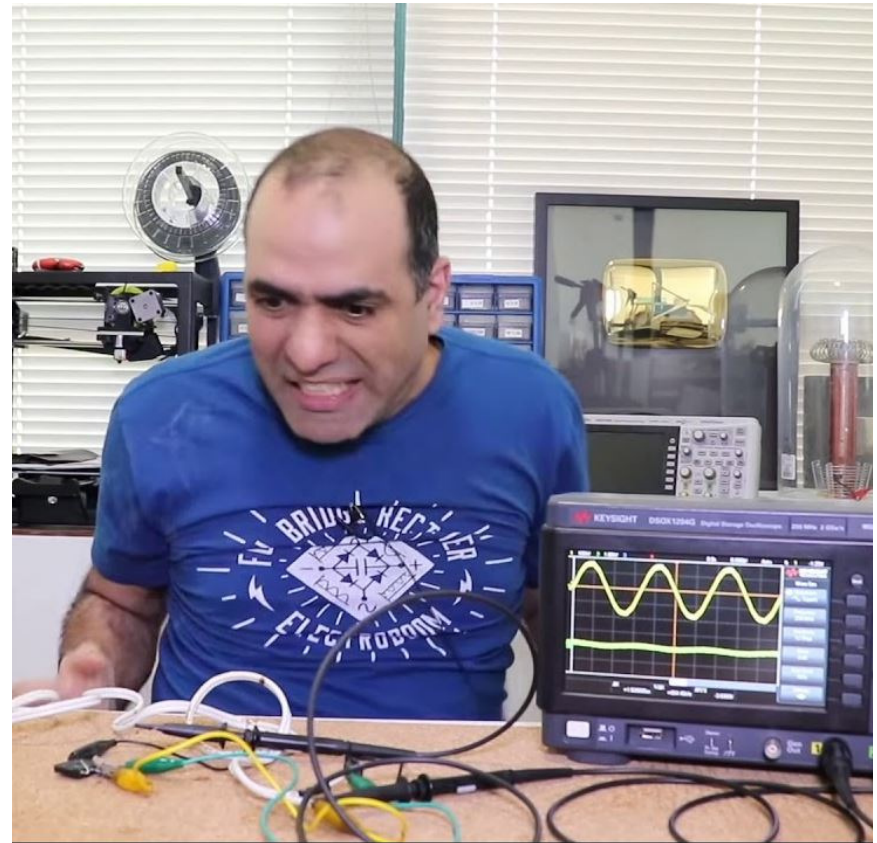
Who owns a patent?

Depends...

Pre-2019: First to bring to practice

- Very friendly to engineers

Doesn't matter who pays for and who files the patent

- The patent goes to whoever was the first one to bring that invention to practice.

Design Notebooks: Pre 2019

Engineering design notebooks were legal documents:

- Who first brought an invention to practice.

Rules for design notebooks:

- Must be hardbound
- Pages must be numbered consecutively
- Entries must be on consecutive pages
- Each page had to be dated, signed, and cosigned.
- All entries must be in non-erasable pen.

Necessary so you can determine who was the first one to bring an invention to practice.
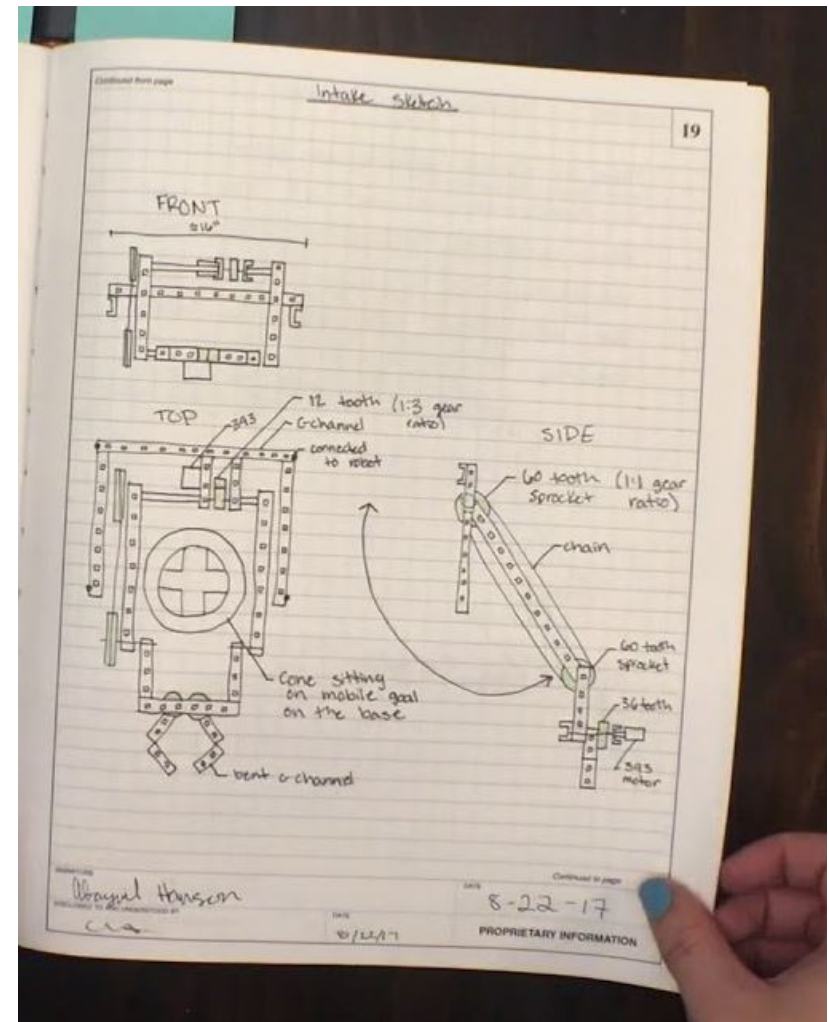
Example: Patent for the Laser

USPTO awarded to Townes in 1959.

- For 18 years, Townes (or the company he worked for) owned the patent on the laser
- Anyone wanting to use a laser had to get permission (i.e. pay royalties) from Townes (or his company)

In October 1977 the patent for the laser was reassigned to Gould

- Gould had design notebooks from 1957 showing he was the first to bring the laser to practice
- Made no difference who filed for the patent and who paid for the patent.[2]

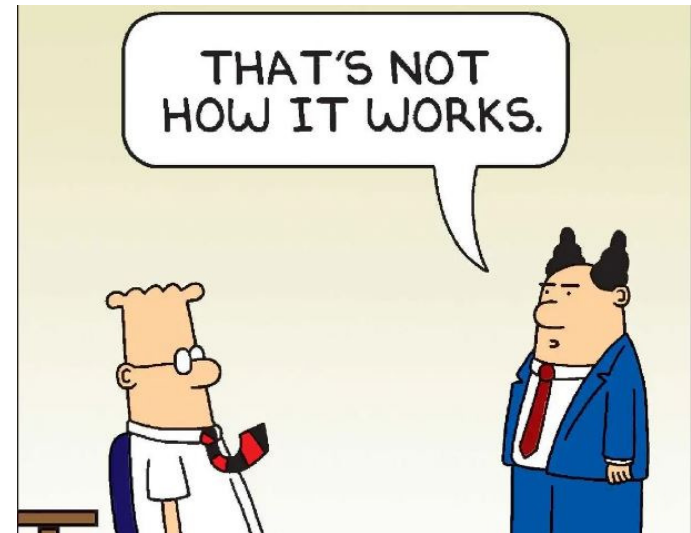Gordon Gould in 1950. Source: American Institute of Physics

Who Owns a Patent: Post 2019

Law changed in 2019
- Industry did not like "first to derive to practice"
- Meant uncertainty in who owns a patent

In 2019, patent law was changed to "first to file"
- Provides certainty (good for industry)
- Means your invention can be taken from you

Also means engineering design notebooks are no longer legal documents
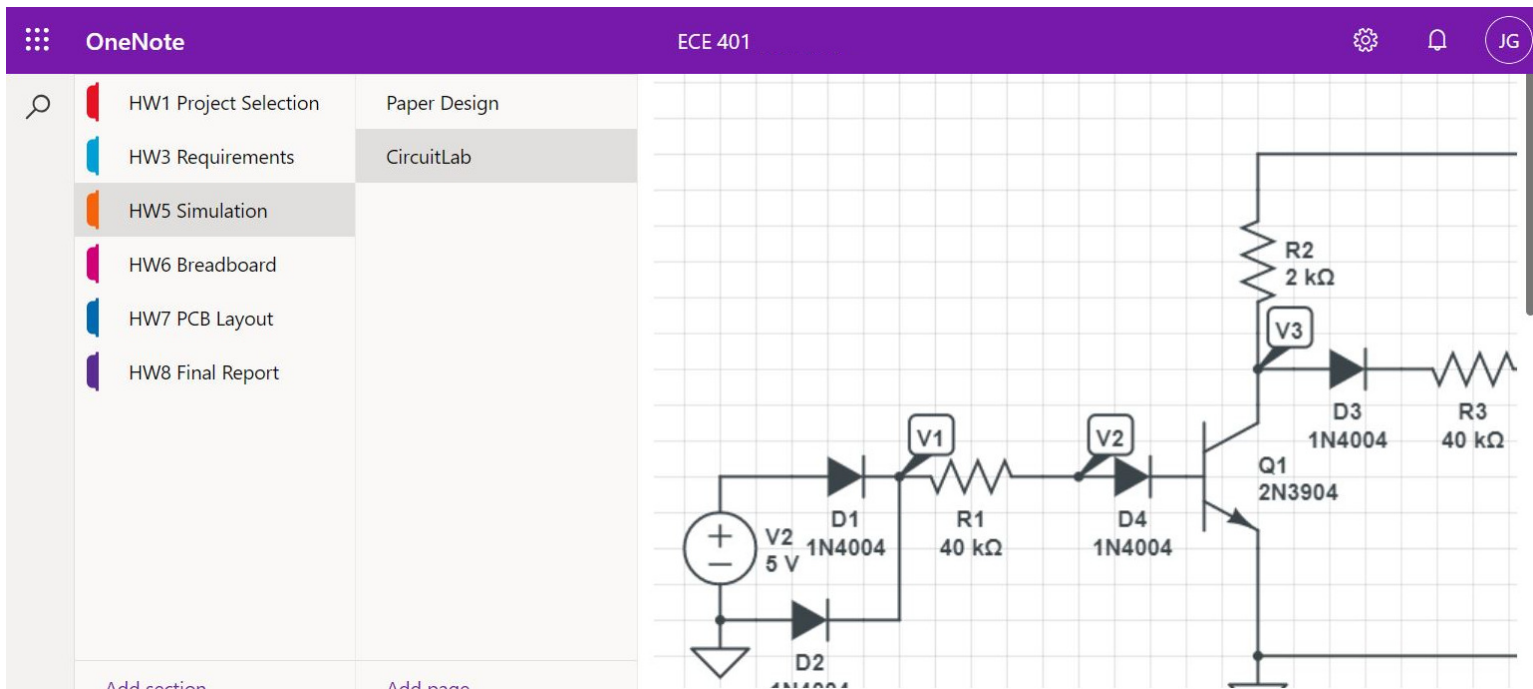- Electronic design notebooks are now OK
- Power-Point, MS Word, OneNote, etc.

MicroSoft OneNote

Just another option for an electronic notebook

Advantages of OneNote:

- Easy to use, easy to read
- Versatile: you can include text, photos, excel files, videos
- Collaborative: several people can be adding to a single OneNote file

OneNote in Senior Design

Good for groups

- Each student has access to the same OneNote document
- Each student can add material
- Each student can see what their partners have done

Easy to see previous work

- All homework sets are in the same document
- Easy to refer back to HW3 when working on HW5
- Helps with grading (can see all work up to this point)

Basically, OneNote works really well for senior design.

Suggested OneNote Organization for ECE 403

Split into sections	Section major activities	Page tasks	Content
Add pages to each section • Parts of homework sets • Add content to each page as the semester moves along. notes: • It's OK to go back and revise previous work in this class. • Grading of sections will be revised throughout the semester	HW1: Project Selection	Contact Information	Student A: phone, email Student B: phone, email Sponsor: email
	HW2: Work Breakdown Structure	Project Description	short description
		Project Charter	What are the deliverables? What are the key elements for the project? Time is allocated (two semesters), and Budget (usually $300)
		Work Breakdown Structure	How you split your project into parts Role of each student in your prject
	Student A (Waterfall)	HW3: Work Breakdown	*Level 3 & 4 of Work Breakdown Structure*
		HW4: Task #1	*document your work*
		HW5: Task #2	
		HW6: Task #3	
		HW7: Task #4	
		HW8: ECE Tools	
	Student B (Agile)	HW3: Work Breakdown	*Level 3 & 4 of Work Breakdown Structure*
		HW4: Iteration #1	*document your work*
		HW5: Iteration #2	
		HW6: Iteration #3	
		HW7: Iteration #4	
		HW8: ECE Tools	

Grading OneNote

To make your OneNote document easy to navigate, I suggest

- Group homeworks are placed in their own section (HW1 and 2), then
- Separate sections for each student,
- With separate pages in those sections for each homework set (HW3+)

You can then add content to each page as the semester moves along.

- It's OK to go back and revise previous work in this class.
- If you find a mistake or a better way of doing something, go right ahead and revise your work.
- Sections are graded every two weeks

  We'll also regrade sections where you lost points if you add content and/or fix the mistakes.

ECE 403: Homework for Week #2

Set up a OneNote document for your group

- One document per group
- Label it SD403_XX_YY where XX is the semester, YY is your group number

Set up the sections as

- HW1: Project Selection
- HW2: Project Charter
- Student A
- Student B
- Student C

Determine the role of each student in your project

- Level 2 of your Work Breakdown Structure

Fill in sections #1 and #2 of your OneNote document

Share your document with each member and the instructors