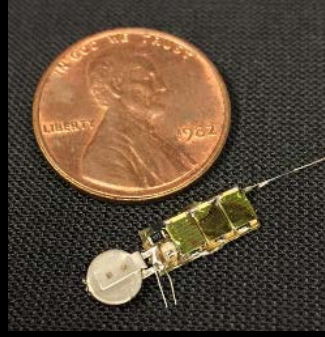
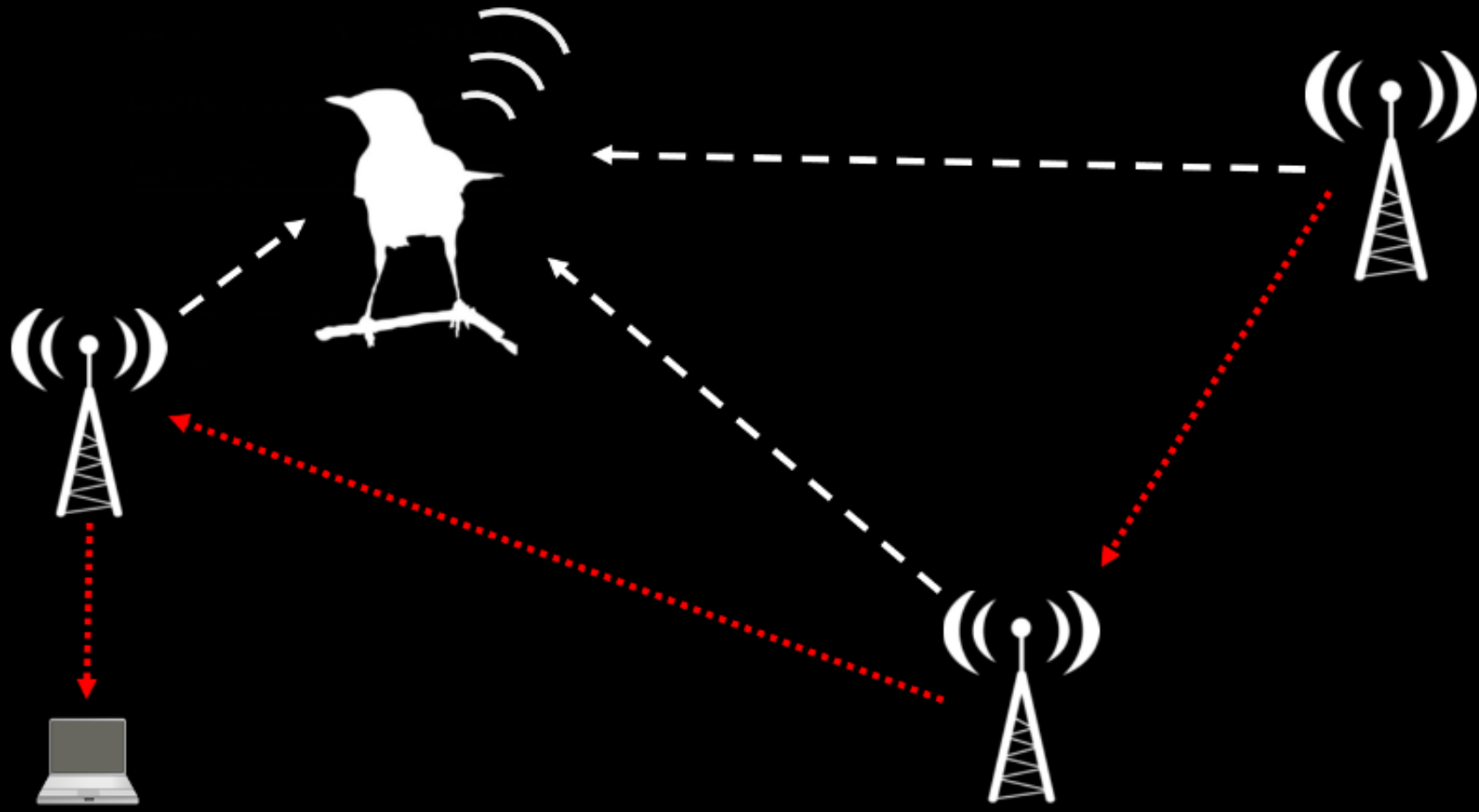
AMRUPT

(Animal Movement Research Using Phase-based Trilateration)





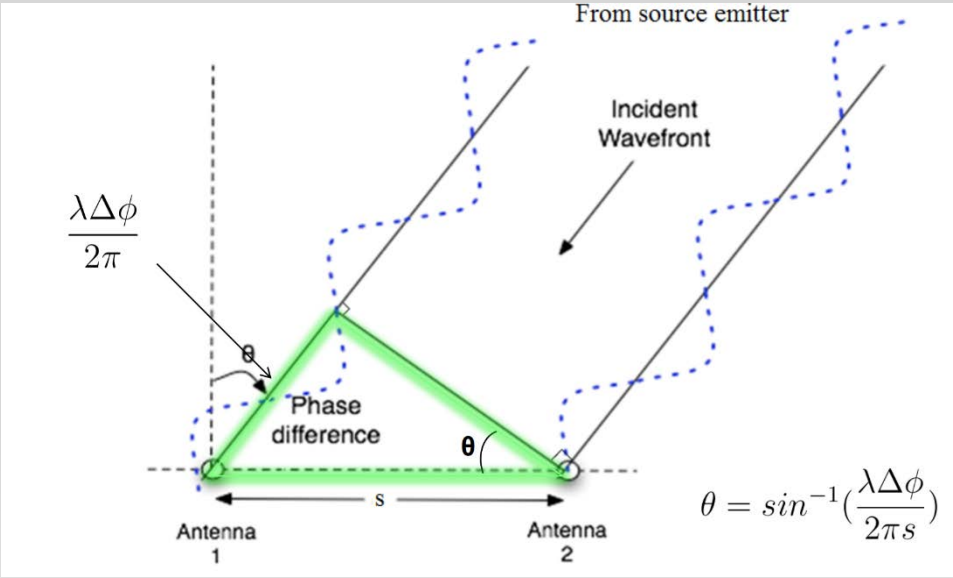
AMRUPT

(Animal Movement Research Using Phase-based Trilateration)

1. Tracking animals for long periods of time, non-invasively, and with high-precision is challenging, but important

2. Existing techniques inadequate

3. AMRUPT attempts to solve these problems using “phase interferometry”



Animal Movement Research Using Phase-based Trilateration (AMRUPT)

-Help design cutting-edge radio electronics for wildlife movement research-

Spring, 2018
Location: **233 Phillips Hall**
Weekly meeting time: **Tuesdays 4:30 – 5:30 PM**

Co-Instructor:	Dr. Julian Kapoor	vak9@cornell.edu, (408) 316-3148
Co-Instructor:	Dr. Joe Skovira	jfs9@cornell.edu

Aims and Outcomes

- *Develop new skillsets*
- *Learn to communicate*
- *Work on a real-world problem*
- *Publish your work*

Expectations

This is a design project!!

- *Take the initiative*
- *Communicate well and often*
- *Read datasheets closely*
- *Translate non-technical requests into efficient technical solutions*
- *Document your work*
- *Challenge others' assumptions and assertions*
- *Voice your confusion*

Assignments

1. Project work
2. Weekly reports
3. Weekly discussions
4. Project proposal
5. Project report

Project Format and Requirements

1. Project work

- *Phase I of the project: basic direction-finding*
- *Individual responsibilities, group outcomes*
- *Individual milestones for work*
- *DOCUMENTATION!*
  - *"Read Me" text files for code or empirical test results*
  - *In-line comments*
  - *Upload everything to GitHub repository: AMRUPT*

Project Format and Requirements

2. Weekly reports

- *Miss no more than 3!!*
- *Format*
  - *Goals*
  - *Problems/challenges*
  - *General approach to solve problem(s)*
  - *Code-level attempts at solutions, empirical tests*
  - *Planned course of action for the following week*
  - *Resources/Forum posts*
- *Example/Template on Blackboard*

Project Format and Requirements

3. Weekly discussions

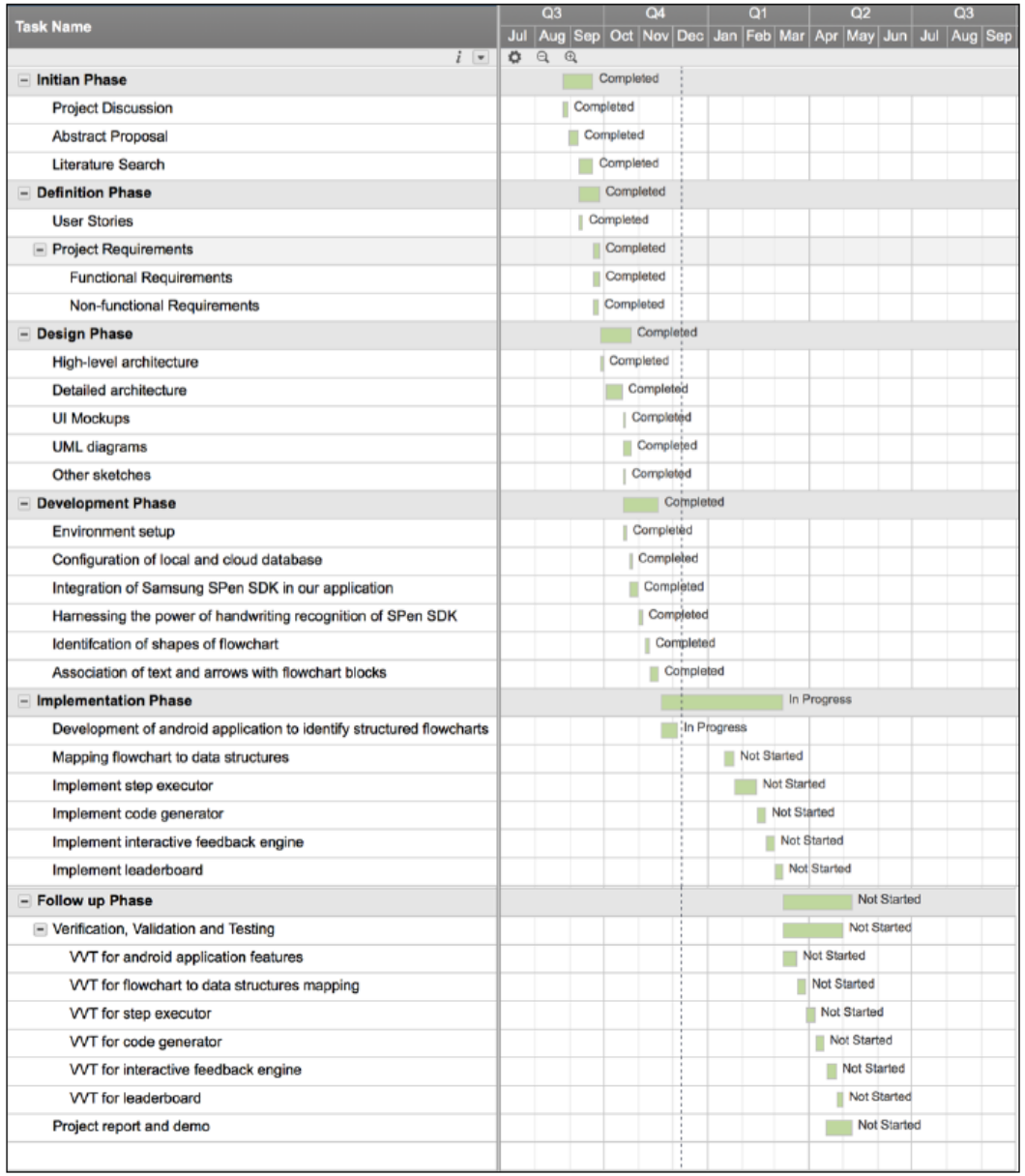
- *Miss no more than 3!!*
- *Checkpoints to evaluate progress and do "course corrections."*
- *Discuss relevant primary literature*
- *Come on time and prepared to contribute*
- *Participate actively in discussions (**No coding!**)*

Project Format and Requirements

4. Proposal (Due Feb 20th)

- *Group proposal*
- *Format*
  - *Statement of the problem*
  - *Objectives*
  - *Plan of Action*
  - *Management Plan (Gantt chart)*

Gantt Chart



Task Assignments

Task Name	Start	Finish	Assigned To	Dependencies	Comments
Initian Phase	**08/25/17**	**09/20/17**			**Completed**
Project Discussion	08/25/17	08/29/17	Karan, Nitish, Nrupesh, Anshul		Completed
Abstract Proposal	08/30/17	09/07/17	Karan, Nitish, Nrupesh, Anshul	2	Completed
Literature Search	09/08/17	09/20/17	Karan, Nitish, Nrupesh, Anshul	2, 3	Completed
Definition Phase	**09/08/17**	**09/26/17**			**Completed**
User Stories	09/08/17	09/11/17	Nitish, Nrupesh	3	Completed
Project Requirements	09/21/17	09/26/17	Karan, Nitish, Nrupesh, Anshul	3, 4, 6	Completed
Functional Requirements	09/21/17	09/26/17	Karan, Anshul	3, 4, 6	Completed
Non-functional Requirements	09/21/17	09/25/17	Nitish, Nrupesh	3, 4, 6	Completed
Design Phase	**09/27/17**	**10/24/17**			**Completed**
High-level architecture	09/27/17	09/29/17	Karan, Nrupesh	3, 6, 7	Completed
Detailed architecture	10/02/17	10/16/17	Nitish, Anshul	7, 11	Completed
UI Mockups	10/17/17	10/19/17	Karan, Nrupesh	11, 12	Completed
UML diagrams	10/17/17	10/24/17	Karan, Nitish	11, 12	Completed
Other sketches	10/17/17	10/19/17	Nitish, Anshul	11, 12	Completed
Development Phase	**10/17/17**	**11/17/17**			**Completed**
Environment setup	10/17/17	10/20/17	Karan, Nitish, Nrupesh, Anshul	11, 12	Completed
Configuration of local and cloud database	10/23/17	10/25/17	Nitish, Nrupesh	12, 17	Completed
Integration of Samsung SPen SDK in our application	10/23/17	10/30/17	Karan, Nrupesh	17	Completed
Harnessing the power of handwriting recognition of SPen SDK	10/31/17	11/03/17	Nitish, Anshul	19	Completed
Identifcation of shapes of flowchart	11/06/17	11/09/17	Karan, Nitish	19, 20	Completed
Association of text and arrows with flowchart blocks	11/10/17	11/17/17	Karan, Nrupesh	20, 21	Completed
Implementation Phase	**11/20/17**	**03/07/18**			**In Progress**
Development of android application to identify structured flowcharts	11/20/17	12/04/17	Nrupesh, Karan	19, 20, 21, 22	In Progress
Mapping flowchart to data structures	01/15/18	01/23/18	Nitish, Anshul		Not Started
Implement step executor	01/24/18	02/12/18	Nitish, Karan	24, 25	Not Started
Implement code generator	02/13/18	02/20/18	Nrupesh, Anshul	24, 25, 26	Not Started
Implement interactive feedback engine	02/21/18	02/28/18	Karan, Nitish	24, 25, 26, 27	Not Started
Implement leaderboard	03/01/18	03/07/18	Anshul, Nrupesh	24, 25, 26, 27, 28	Not Started
Follow up Phase	**03/08/18**	**05/08/18**			**Not Started**
Verification, Validation and Testing	03/08/18	04/30/18	Karan, Nitish, Nrupesh, Anshul		Not Started
VVT for android application features	03/08/18	03/20/18	Nitish, Anshul	29	Not Started
VVT for flowchart to data structures mapping	03/21/18	03/28/18	Karan, Nrupesh	32	Not Started
VVT for step executor	03/29/18	04/05/18	Nrupesh, Anshul	32, 33	Not Started
VVT for code generator	04/06/18	04/13/18	Nitish, Karan	32, 33, 34	Not Started
VVT for interactive feedback engine	04/16/18	04/24/18	Nrupesh, Anshul	32, 33, 34, 35	Not Started
VVT for leaderboard	04/25/18	04/30/18	Karan, Nitish	32, 33, 34, 35, 36	Not Started
Project report and demo	04/15/18	05/08/18	Karan, Nitish, Nrupesh, Anshul		Not Started

Project Format and Requirements

4. Proposal (Due Feb 20th)

- *Group proposal*
- *Format*
  - *Statement of the problem*
  - *Objectives*
  - *Plan of Action*
  - *Management Plan (Gantt chart)*
  - *Deliverables*
  - *Resource Requirements*
  - *Bibliography*
- *Example/Template on Blackboard*

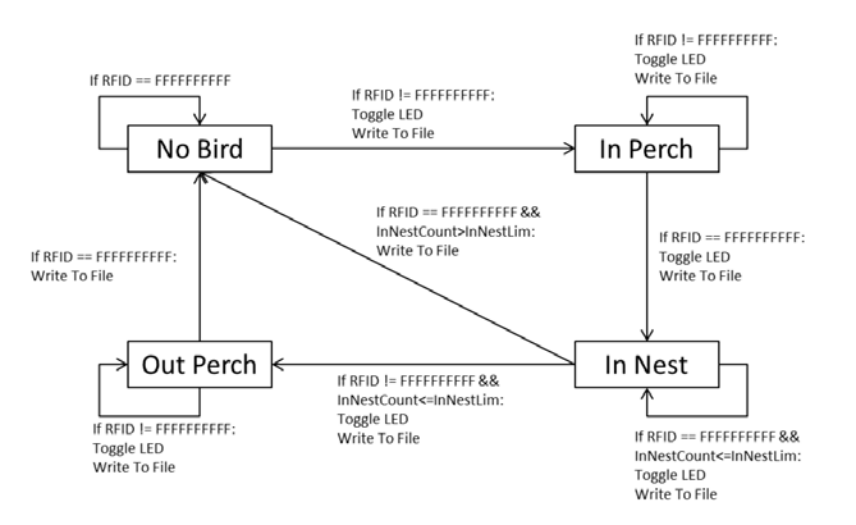
} *Contract detailing what you will do in the semester!!*

Project Format and Requirements

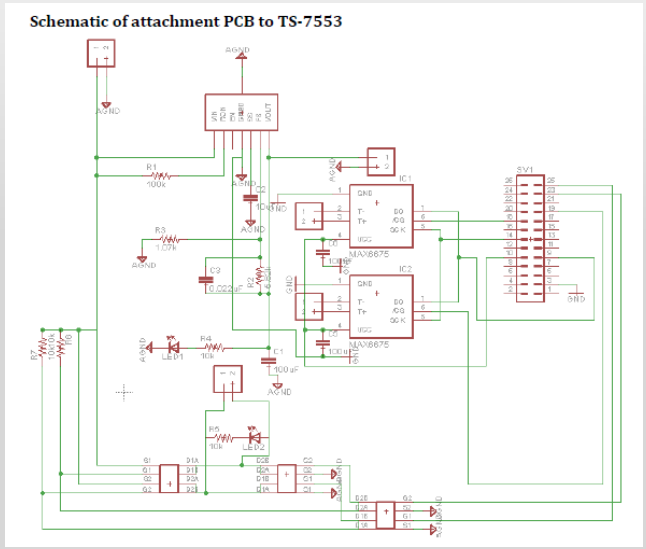
5. Project Report & Oral Presentation

- *Individual report*
- *Report format*
  - *Executive Summary*
  - *Introduction / Literature Review / State of the Art*
  - *Design Requirements and Considerations (high level)*
  - *Design Implementation*

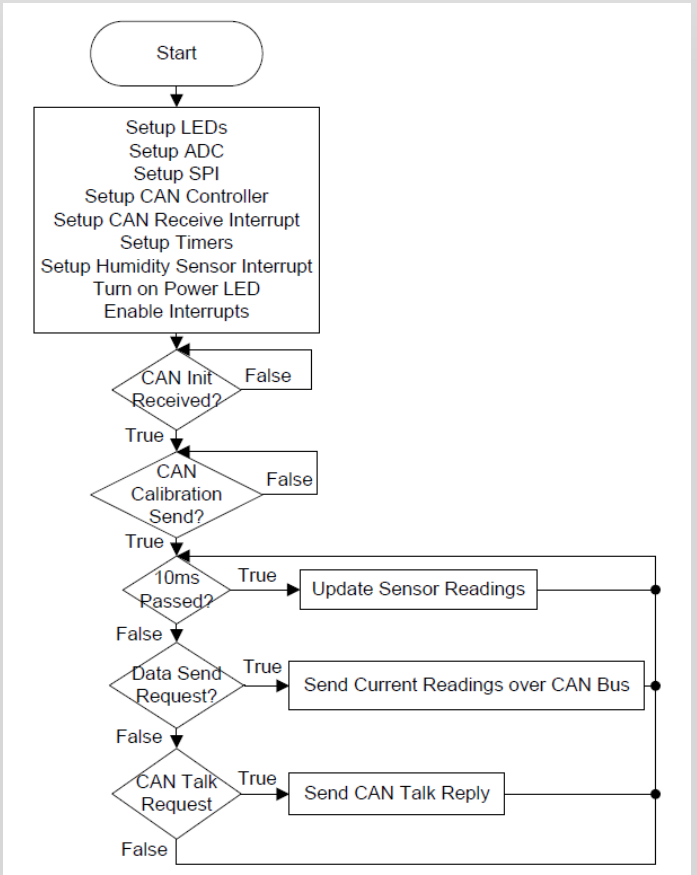
State machines



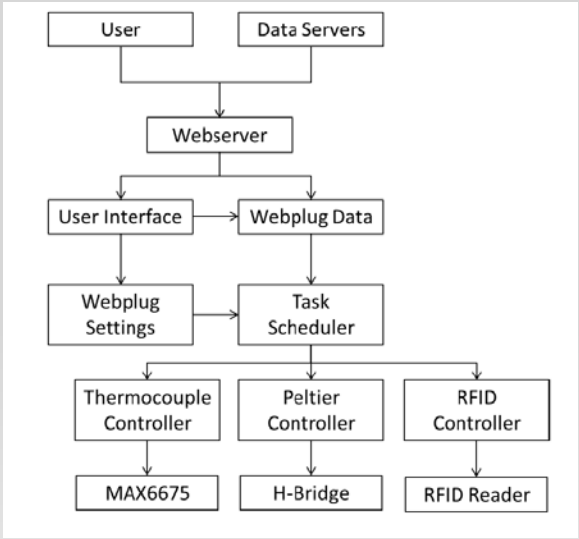
Schematics



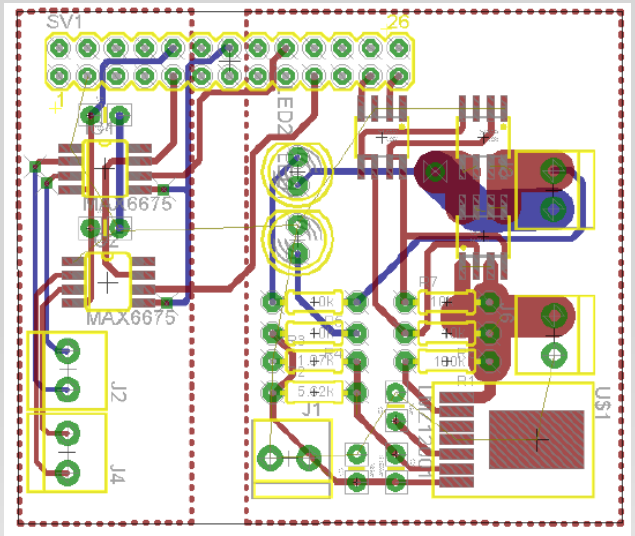
Flowcarts



Software structure



Board layouts



Project Format and Requirements

5. Project Report & Oral Presentation

- *Individual report*
- *Report format*
  - *Executive Summary*
  - *Introduction / Literature Review / State of the Art*
  - *Design Requirements and Considerations (high level)*
  - *Design Implementation*
  - *Test Results / Performance*
  - *Conclusions*
  - *Acknowledgements*
  - *Bibliography*
  - *Appendices*
  - ***Upload materials to GitHub!***
- *Oral presentation*
- *M. Eng. Poster Session*

Grading

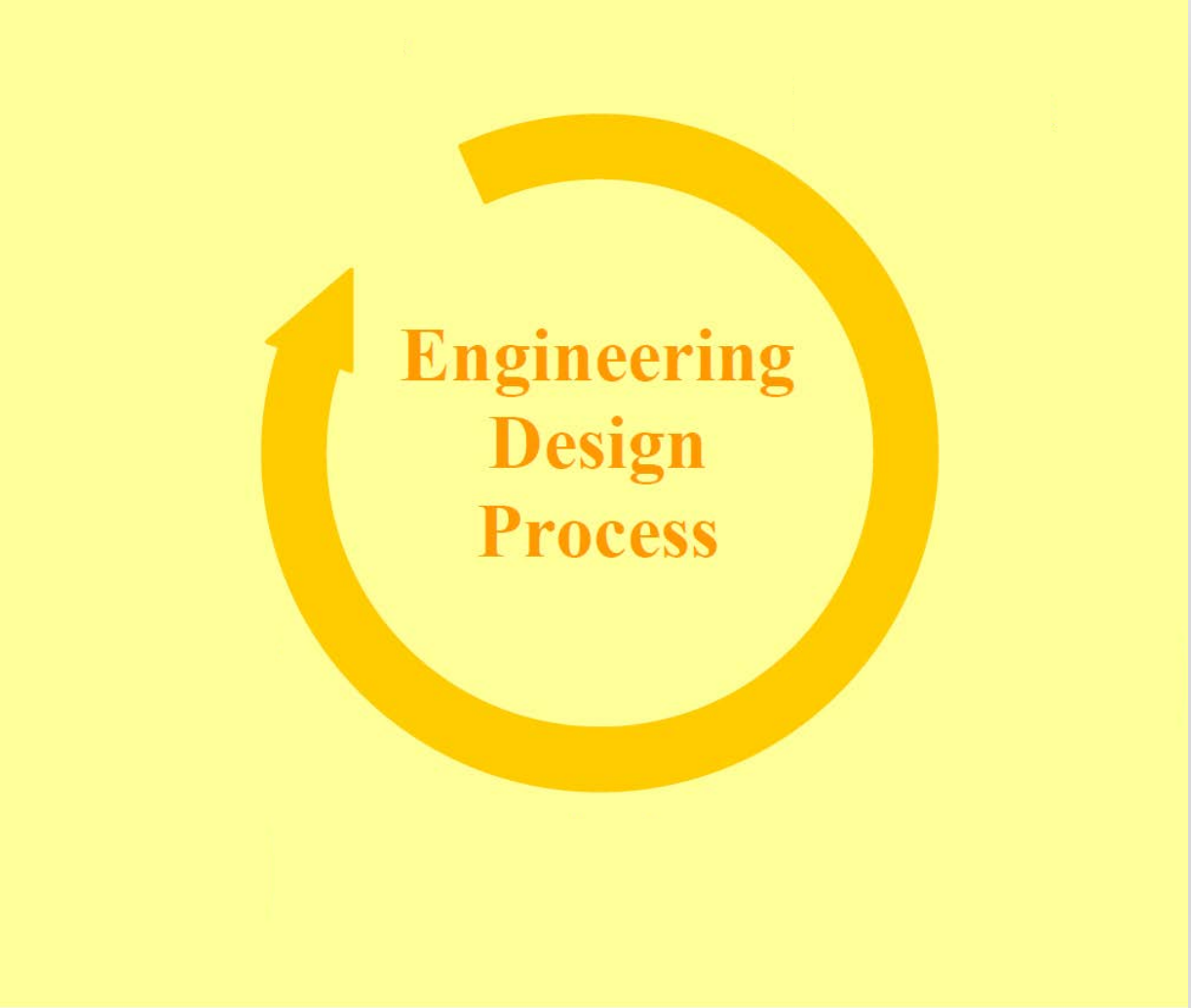
- *Must take AMRUPT project for letter grade*
- *Dr. Skovira and Dr. Kapoor will be grading jointly*
- *Grade calculations:*
  - *Project proposal (**30%**)*
  - *Weekly progress reports and attendance (**20%**)*
  - *End-of-semester project report (**50%**)*
    - *35% for written report*
    - *15% for oral presentation*

Integrity

Absolute integrity is expected of every Cornell student!

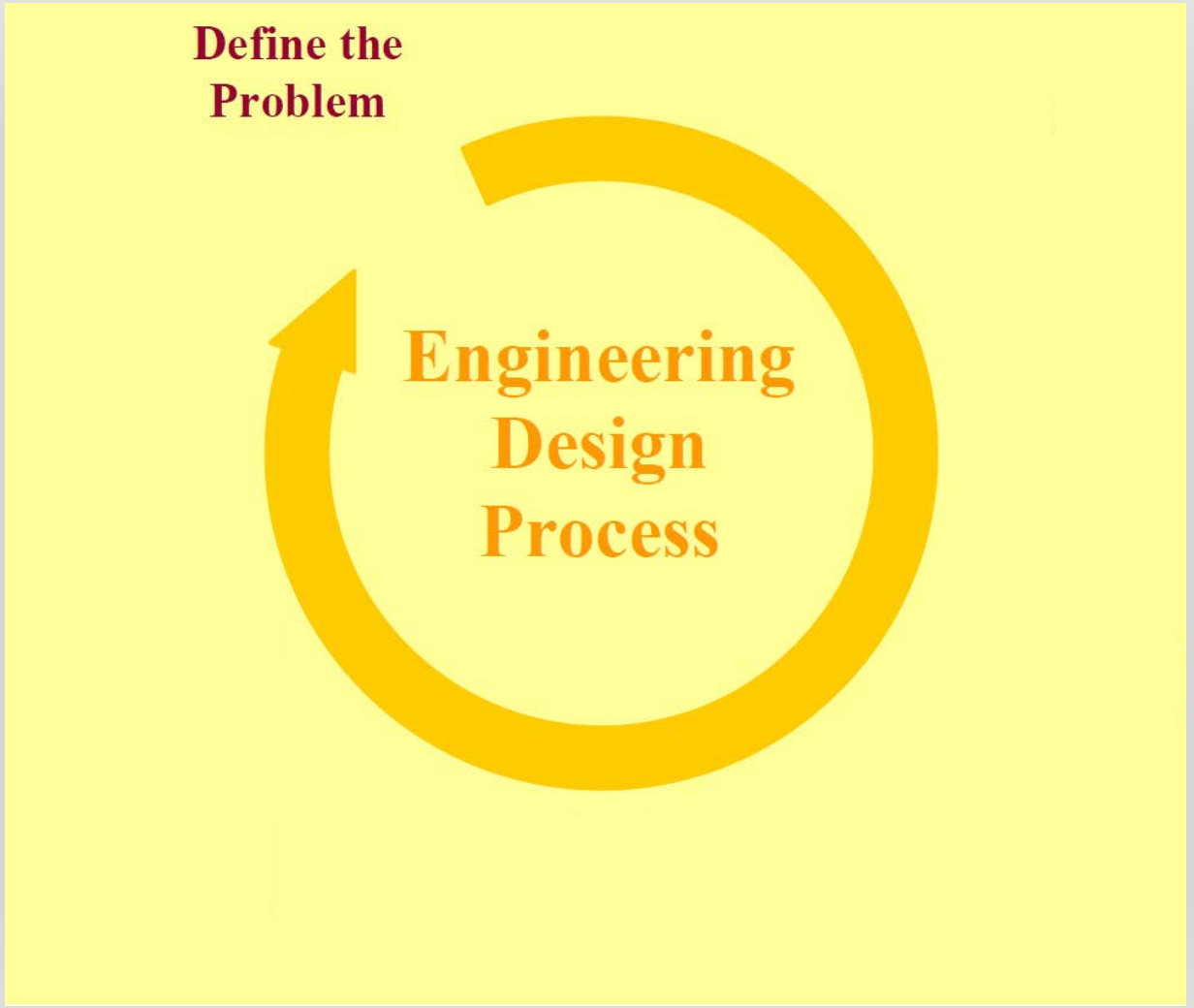
Questions…

Step 1: Begin planning for the design process



Khandani, 2005

Step 1: Begin planning for the design process



Khandani, 2005

Define the problem

1. Identify and establish the need

"A common tendency is to begin generating a solution to an apparent problem without understanding the problem."

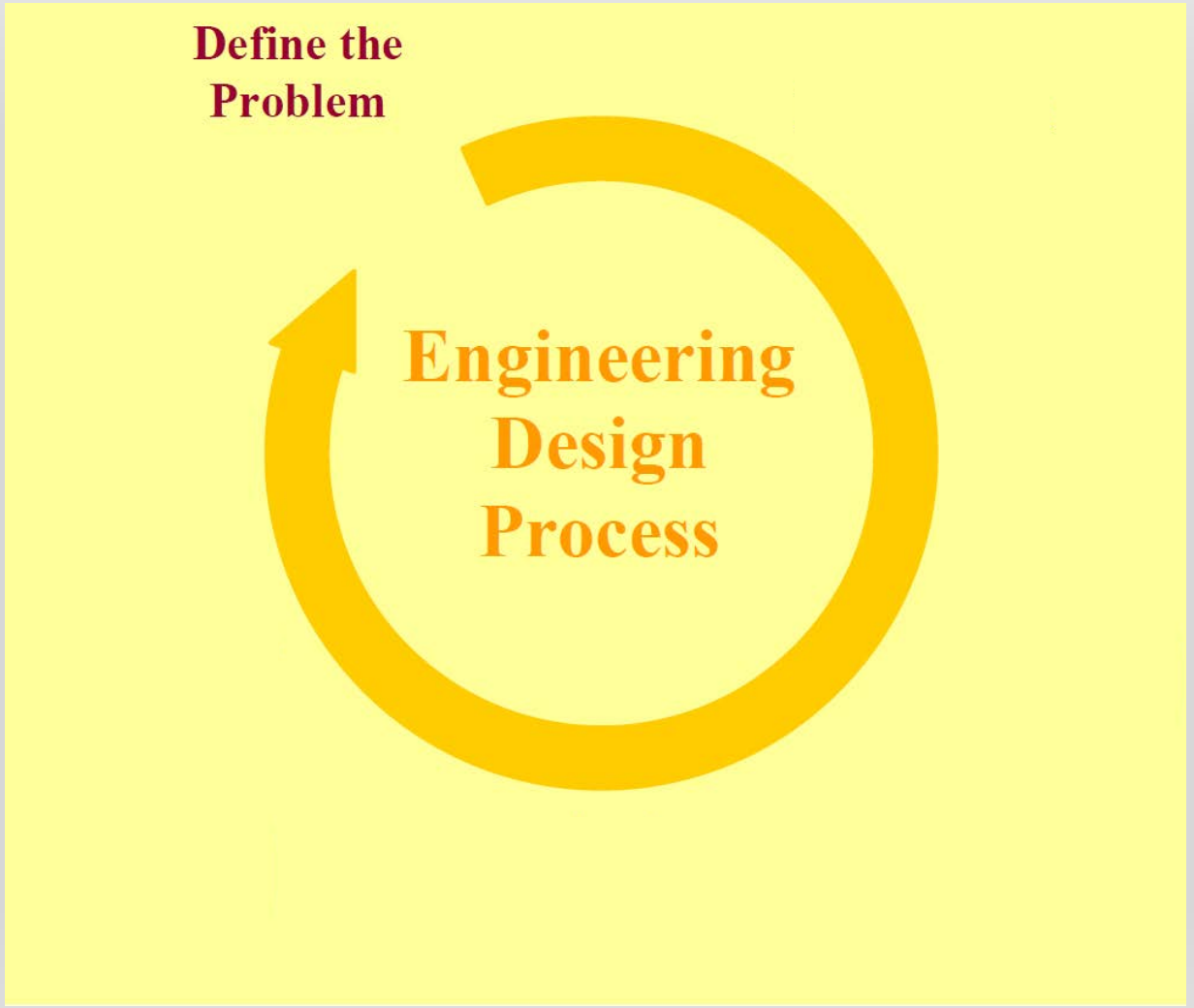
2. Develop a problem statement

"To reach a clear definition, [engineers] *collect data*, *run experiments*, and *perform computations* that allow a need to be expressed as part of an engineering problem-solving process."

3. Establish explicit criteria for success

- The design must collect *accurate* data.
- The design must collect sufficiently *precise* data.
- The design must be *fast*.
- The design must be *low cost*.
- The design should be *safe*.
- The design should be *simple* to operate, with minimum human effort.

Engineering design process



Khandani, 2005

Gather pertinent information

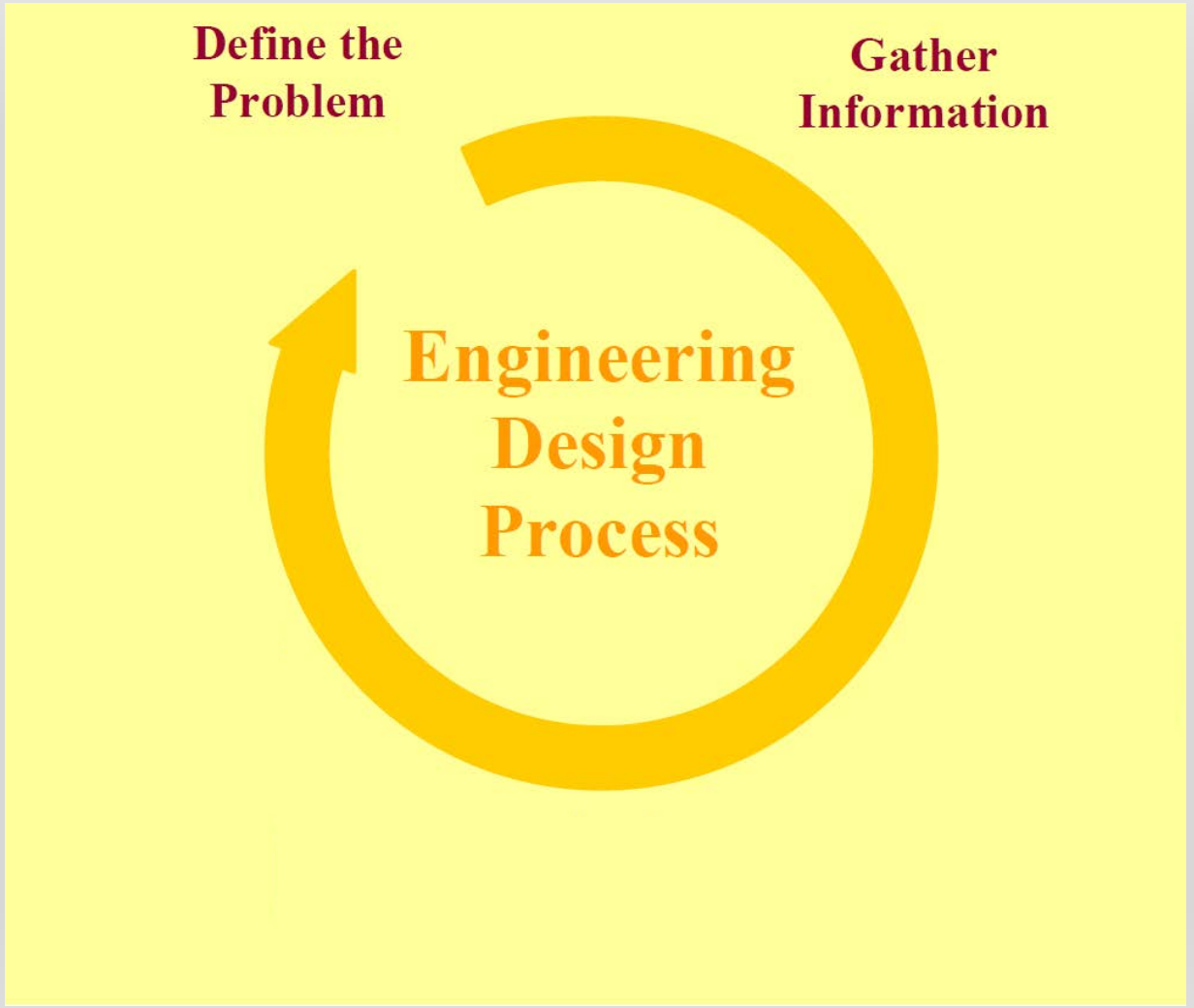
1. Refine your thinking about the problem, and place it in context

- Is the problem real and its statement accurate?
- Is there really a need for a new solution or has the problem already been solved?
- What are the existing solutions to the problem?
- What is wrong with the way the problem is currently being solved?
- What is right about the way the problem is currently being solved?

2. Search for information sources

- Scientific encyclopedias and technical handbooks.
- Primary articles
- Faculty in ECE and beyond
- Company websites and brochures

Engineering design process



Khandani, 2005

Generate multiple solutions

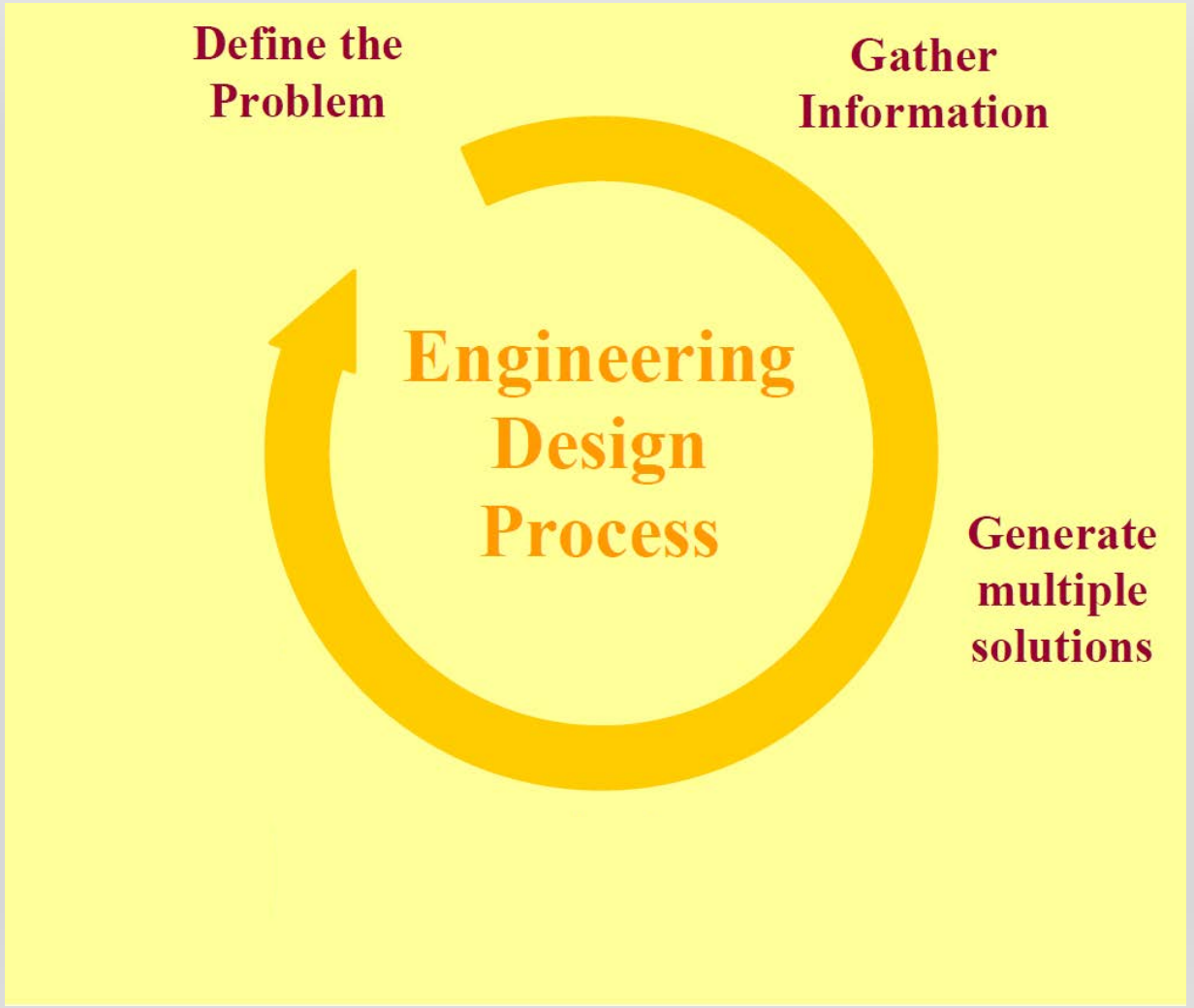
Synthesize ideas from existing work

- "Start with existing solutions to the problem and then tear them apart to find out out what's wrong with those solutions and focus on how to improve their weaknesses."

Brainstorming important!!

- "Ideas are generated when people are free to take risks and make mistakes."
- "Brainstorming at this stage is often a team effort in which people from different disciplines are involved in generating multiple solutions to the problem."

Engineering design process



Khandani, 2005

Analyze and select a solution

1. Systematic analysis of design solutions

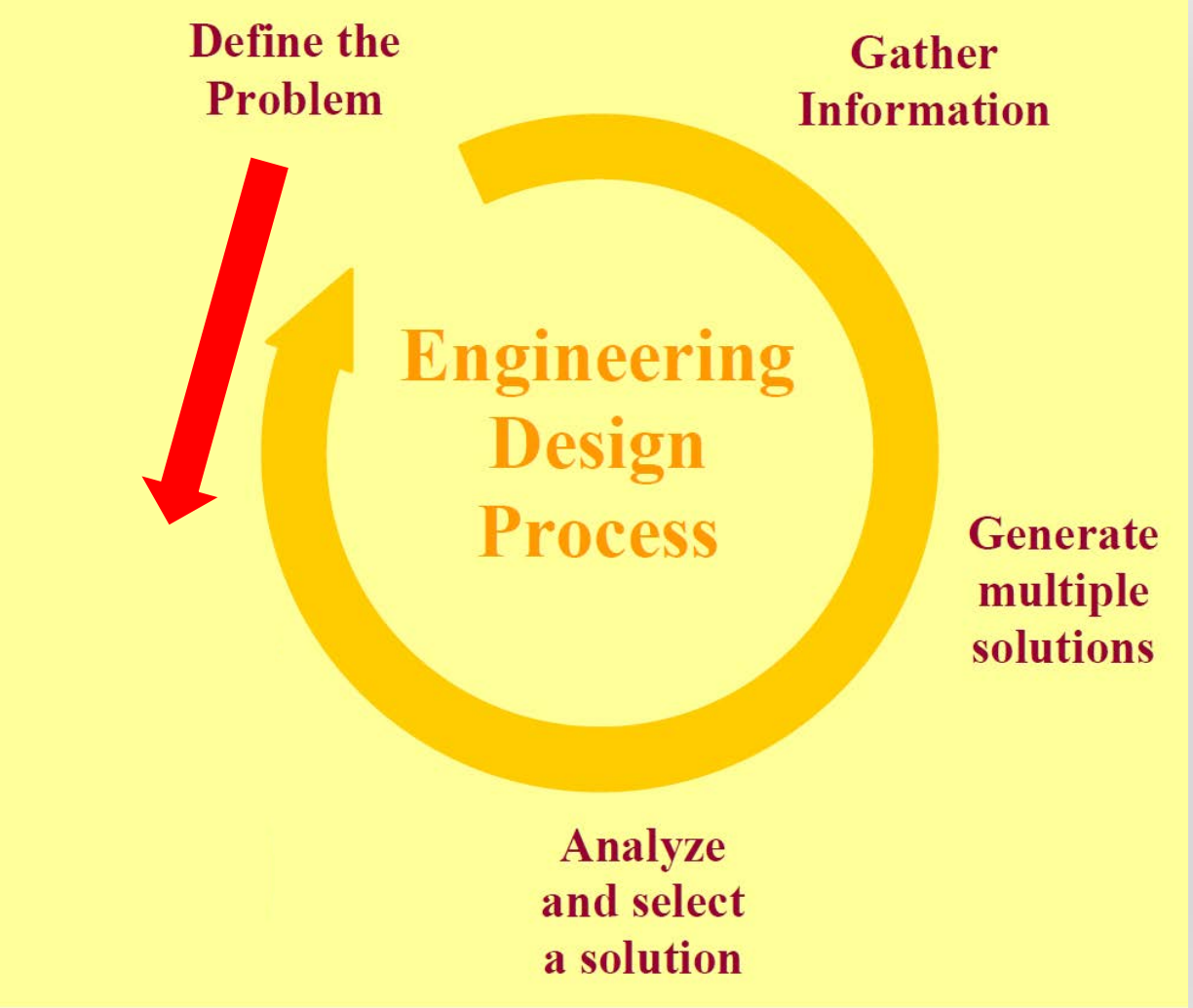
- Functional analysis – **will it function the way it should?**
- Mechanical/Strength analysis – **is it physically durable?**
- Manufacturability/Testability – **can it be produced easily? Is it overly complex?**
- Product safety and liability – **will it be safe for the user?**
- Economic and market analysis – **is it affordable / cost-effective?**
- Regulatory and Compliance – **is it legal (think about FCC regulations)?**

2. The decision process: how to choose among the options?

- Think about using a decision matrix:
  - Functionality: 30 %
  - Cost: 20 %
  - Complexity: 20 %
  - Safety: 20 %
  - Use of standard parts: 10 %

A	B	C
25	30	15
20	15	20
10	20	20
20	20	20
5	10	5
80	**95**	**80**

Engineering design process



Khandani, 2005

Test and implement the solution

1. Prototyping

- **Simulations** and **simplified models** to evaluate if you're on the right track. Help define what other considerations may be need to be met before getting too far.

2. Documentation (!!!!)

- "One of the most important activities in design is documenting your work, clearly clearly communicating the solution to your design problem so someone else can understand what you have created."

Good documentation is essential!

In-line comments

```r
#' Create a complete ggplot appropriate to a particular data type
#'
#' \code{autoplot} uses ggplot2 to draw a particular plot for an object of a
#' particular class in a single command. This defines the S3 generic that
#' other classes and packages can extend.
#'
#' @param object an object, whose class will determine the behaviour of autoplot
#' @param ... other arguments passed to specific methods
#' @return a ggplot object
#' @export
#' @seealso \code{\link{ggplot}} and \code{\link{fortify}}
autoplot <- function(object, ...) {
  UseMethod("autoplot")
}
```

"ReadMe" file

Project Title

One Paragraph of project description goes here

Getting Started

These instructions will get you a copy of the project up and running on your local machine for development and testing purposes. See deployment for notes on how to deploy the project on a live system.

Prerequisites

What things you need to install the software and how to install them

```
Give examples
```

Installing

A step by step series of examples that tell you have to get a development env running

Say what the step will be

```
Give the example
```

And repeat

```
until finished
```

End with an example of getting some data out of the system or using it for a little demo

Running the tests

Explain how to run the automated tests for this system

Break down into end to end tests

Explain what these tests test and why

```
Give an example
```

Test and implement the solution

1. Prototyping

- **Simulations** and **simplified models** to evaluate if you're on the right track. Help define what other considerations may be need to be met before getting too far.

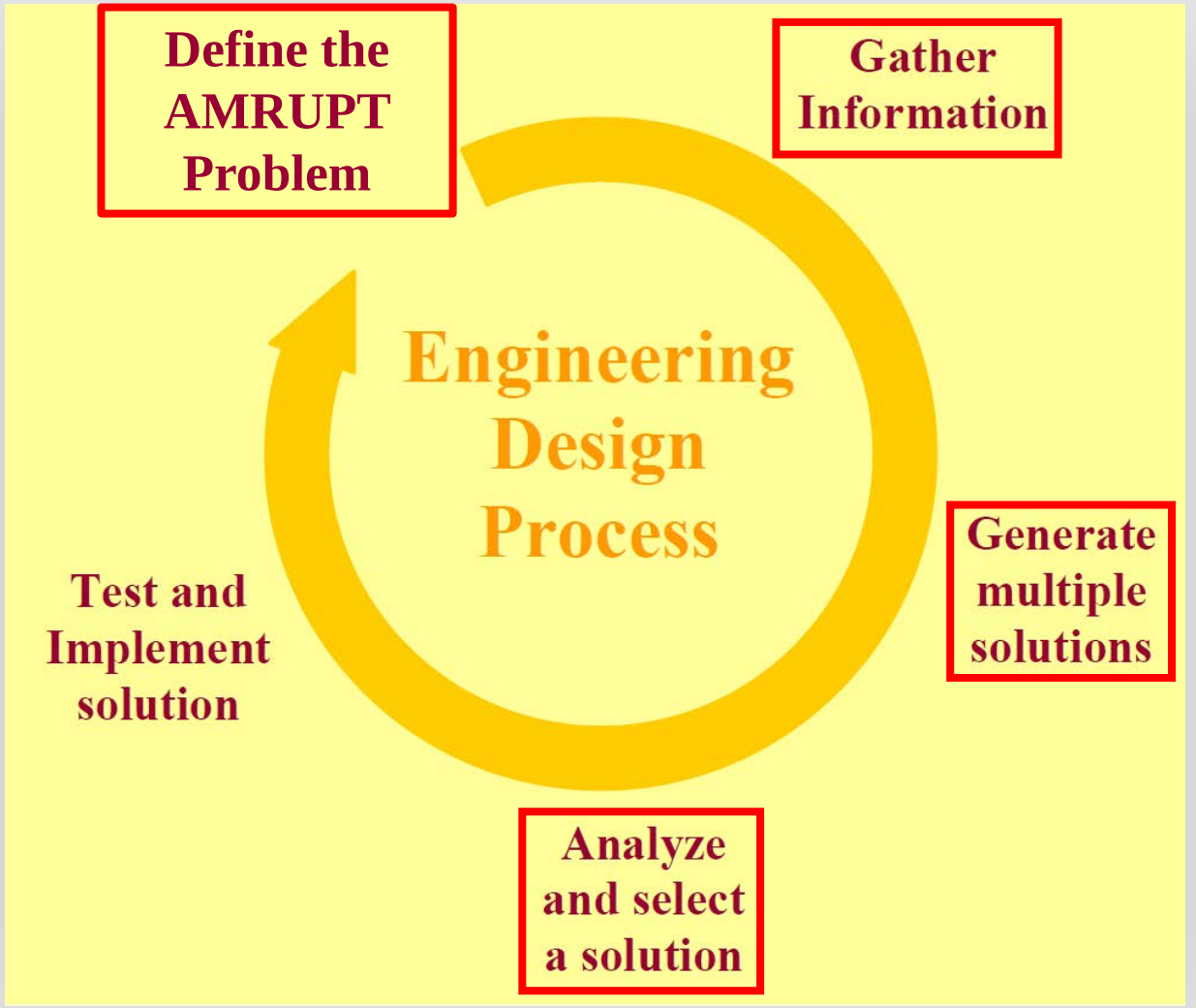
2. Documentation (!!!!)

- "One of the most important activities in design is documenting your work, clearly clearly communicating the solution to your design problem so someone else can understand what you have created."

3. Testing and verification

- Without proper testing at all stages in the process, you may find yourself making making costly mistakes later.
- **Standardized test sets** to evaluate functionality across semesters

Engineering design process



Project Proposal

Khandani, 2005

For next week

Read:

1. “Engineering design process”
2. AMRUPT project description

Prepare:

“Consultation” with me (Julian) to obtain pertinent information in generating a proposal for this semester’s work.

1. Generate list of questions to help you define the problem, and to gather background information