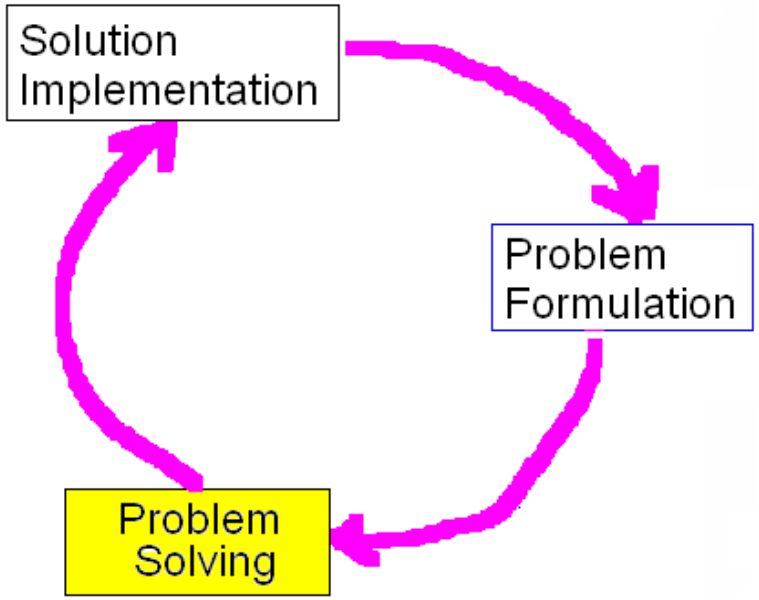
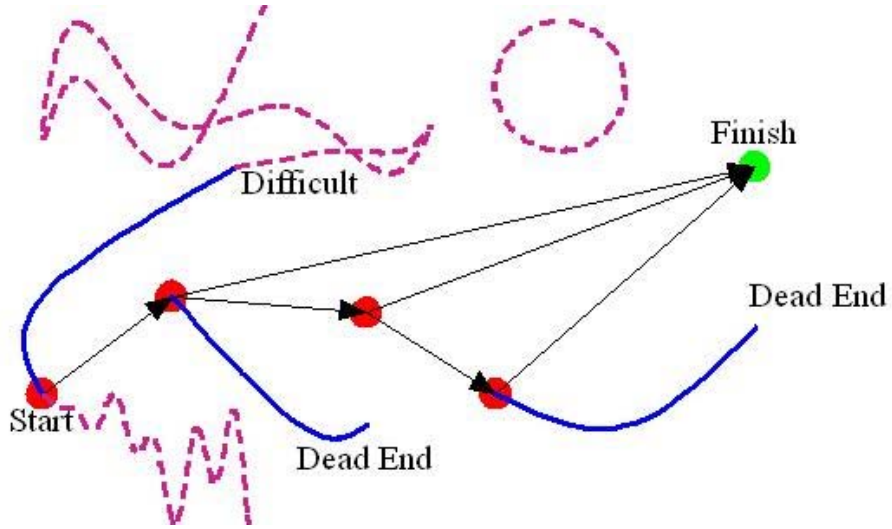
EECE 404: Senior Design 2

Objectives

- Maximize the teamwork and productivity efficiently
- Finish what we started in Senior Design 1
  - Completion of Solution Design
  - Alternative (contingency) Solutions
  - Final Top Design
  - Implementation and Evaluation Plan for the Design
  - Implementation
  - Evaluation
- ECE Day – Presentation and Demonstration

Problem Solving





- Objectives:
  - –The steps of problem solving
  - –Strategies for generating, analyzing, and selecting alternatives
  - –Making Progress

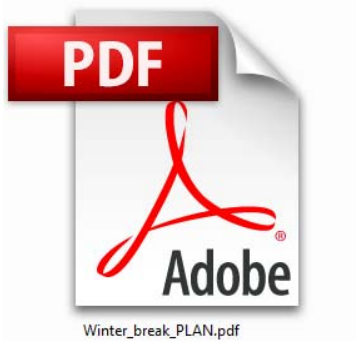
Class Schedule

- Schedule
  - –January: Initial System Design and Alternative Solution Generation
    - Presentation of the planned work during Winter Break
    - System Design and Alternative solutions generation
    - Final System Design
    - Progress Report & Presentation
  - –February: Implementation of the Project
    - Implementation Plan + Evaluation Plan (Presentation)
    - Implementation Process
  - –March: Continuation of the Implementation
    - ECE Progress Presentation
    - Completion of the implementation
    - Evaluation
  - April: Final Month of the class (2 – 3 weeks) + ECE Day
- ECE Day
  - –WEDNESDAY April 18, 2012 (*April 26 --- PG grade posting /End of formal class)
- **Class Policy**
  - –More time to teams
  - –Progress Report Presentations

Grading Policy

- **Grading:**
  - Team Works (t) 70%
    - Class activities + Presentation + contents (25%)
    - Team Binder + Final Report Submission (5 %)
    - Progress Report + Presentation (20%)
    - ECE Day judgment (20%)
    - **"No participation, no team work point"**
  - Attendance (a) 10%
  - Peer Evaluation (p)
  - Final Score = a + 0.6*t + 0.4*t*p
- A> 90
- 89>B>80
- 79>C>70
- 69>D>60
- 59>F

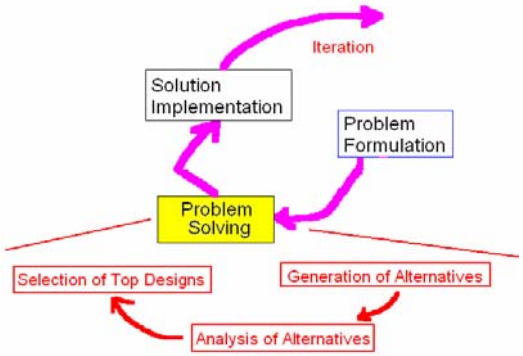
First Class Activity: Let's Talk about the Winter Break Activities



- Self-Assessment
  - SM: 8/10
  - F2E: 7/10
  - CPS1: 6/10
  - INTL2: 8/10
  - CPS2: 9/10
  - RTV: 8/10
  - INTL1: 5/10

Problem Solving Process

- Problem Solving Process
  - **Finding** design solutions to a well-understood problem ---" Solutions Generation"
  - **Exploring and Analyzing** those designs, and ---"Analysis of Alternatives" - ***NOTE: this may apply to the <u>entire system</u> or <u>a part</u> or <u>multiple parts</u> of the solution system design.**
  - **Selecting** the most promising (sub)system design for a final system solution---"Top Design"
- System Design
  - Subject of next lecture



Class Activity – Are we certain?

- Sketches and Descriptions
  - What Issues bother you in terms of systems design? In other words, is there still uncertainty in designing your system? What are they? Are there multiple possible ways to solve the problem?
  - All circuit behaviors known and well understood? PCB design capable? Are you comfortable with your platform? All interface determined and in accordance with regulation or code?

Step 1: Generation of Alternatives

- The act of expansion - all possible solutions
- Overcome the temptation to adopt the first idea
- Developing ideas individually and pooling them together generate more ideas
- Wide design space but true to the problem (functional requirements)
- Building onto existing solutions

Step 2: Analysis of Alternatives

- Screening
  - Remove those that do not meet the functional requirements (“concept screening”)
- In-depth analysis of final candidates
  - Modeling analytically with equations
  - Modeling with a simulation
  - Experimentation (with prototype)
  - Qualitative Reasoning

Analysis with Equations

- Key Tools
  - Use equations to model a design before building it
- Examples
  - Cell Phone battery : Prediction of battery life (electrical analysis)
  - Airplane : Prediction of Lift-to-Drag ratio (Fluid mechanics analysis)
  - Power Plant: Prediction of the amount of sulfur in the emission for different combustion process or fuel types (Chemical and Thermal Analysis)
  - Database: Prediction of MB needed for data storage (Software Analysis)
  - Wireless Amplification: Prediction of Signal Power for wireless transmission (Signal Analysis)
- Cautions
  - Equations are representations of reality, not reality itself
    - Example: Diode models

Analysis with Models and Computer Simulation

- When hand-derived equations are too complex
- Examples of Computer Simulation:
  - Fault Current Calculation
  - Torque Requirements
  - Magnetic Induction
  - Response Time
  - Temperature of computer chip for different cooling methods
  - Size for electrical component in a thermostat circuit used to turn on and off heating or cooling
- Weakness:
  - Assumption, restrictions, and limitations of computer simulation tools
  - You get what is modeled, not the reality

Analysis with Experimentation

- Note: This is NOT the solution implementation. Still in the screening and selection process.
- Purpose of Experimentation/Prototyping
  - When Analysis is inadequate or model is too complex
- Cautions
  - Starting prototype without clear sense of learning from prototype → trial-end-error process that may not lead to a good design
  - Must be a rigorous process with clear sense of purpose driving experiments
  - Requires more time and money

Analysis with Qualitative Reasoning

- Analysis with Expert Opinions
- Analysis with Customer Preferences and Requirements and specific circumstances
- Your advisor
- Your sponsor

Problems Observed

- The problems observed in the previous Senior Designs
  - No Serious Alternative Designs
  - Simulation for Simulation's Sake
  - No rigorous analysis for design comparison
  - No effort of designing a circuit
    - Instead, let Internet do for them
    - A purchased kit replaced the design
  - No evaluation of the design

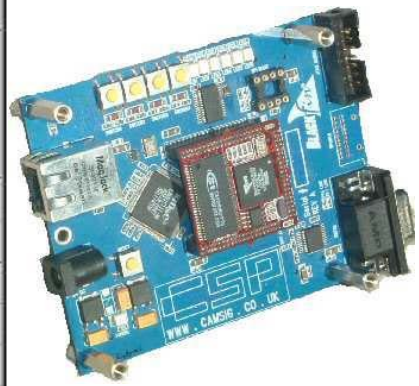
Selection of Top Designs

- Selection is decision-making
- Decision-making involves making trade-offs
  - The results of the four types of analysis
  - Requirements from customer
  - Conflicting requirements
  - Requirements of different importance
- Decision Tool
  - Decision Matrix

Using a Decision Matrix

- Step 1: Collect Information (Analyses)
- Step 2: Determine and Weight Attributes
- Step 3: Rate the Concepts
- Step 4: Rank the Concepts
- Step 5: Combine and Improve the Concepts
- Step 6: Resolve the Decision
- **EXAMPLE: selection of the best Bluetooth communication subsystem for Lane Departure Warning System**

		Bluetooth Development Boards							
		Teleca Comtec		Stonestreet One		GCT		Atmel	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Price	40	4	1.6	3	1.2	1	0.4	1	0.4
Power	15	4	0.6	4	0.6	4	0.6	1	0.15
Software	35	2	0.7	4	1.4	3	1.05	2	0.7
Version	10	1	0.1	4	0.4	4	0.4	4	0.4
Total Score			3		3.6		2.45		1.65
Rank			**2**		**1**		**3**		**4**



Decision Matrix Exercise

Purchase of a used car

CAR	COST	ODOMETER READING	MECHANIC'S RATING (1 - 10)	LOOKS (1 - 10)
RED	$2000	50,000	7	5
BLACK	$2500	40,000	5	6
BLUE	$3000	20,000	8	8

- Which car do you buy under the following two different weight scenarios
  - You concerned about all four attributes equally.
  - You concerned about cost and fairly indifferent about looks. Mileage and the mechanic's ratings are equally important for you.

System Design - Sidebar

Class Activity

- Sketches and Descriptions
  1. Initial Solution
     - Appearance
     - Connections
     - Functions
  2. Alternative Solution(s)
     - Appearance
     - Functions
     - Connections

Top design Selection

- How to prioritize and weigh the attributes
  - Not for convenience
  - Not toward the already-chosen direction
  - Toward true to the design requirements
- Solution Generation Presentation (February 1)
  - **Contents to be included** (Description of)
    - Alternative Solutions
    - Analysis of Alternatives
    - Decision Making Process
    - Top Design Selection
  - **Presentation Format**
    - 15 minutes of presentation time (~15 slides) + Q&A
    - 2 presenters and 1 Answerer from each team
      - Presenter 1: Alternative Solutions and Analyses of them (5 min)
      - Presenter 2: Decision Making and Top Design Selection (5 min)
      - Answerer: Answer to Questions (5 min)