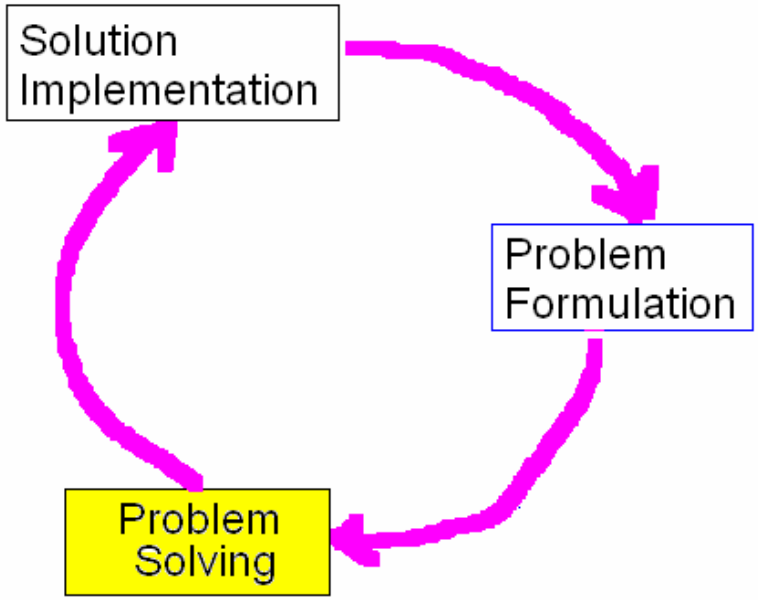
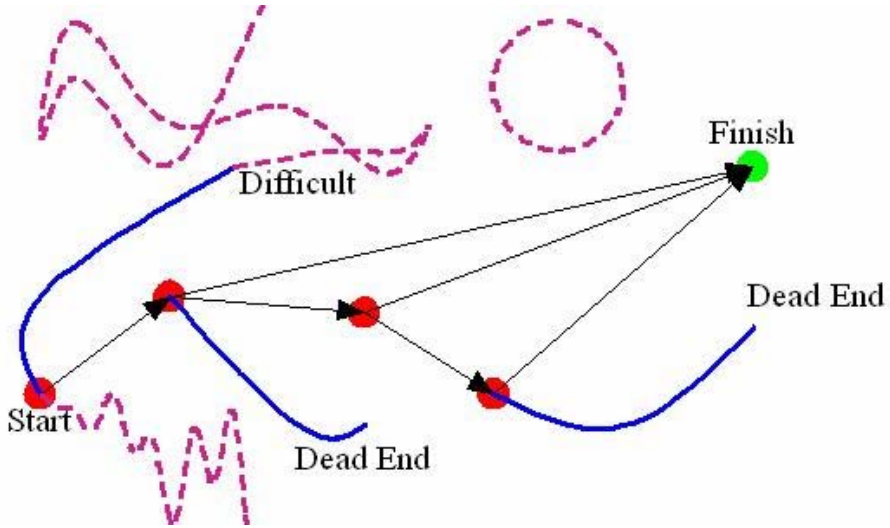
Problem Solving





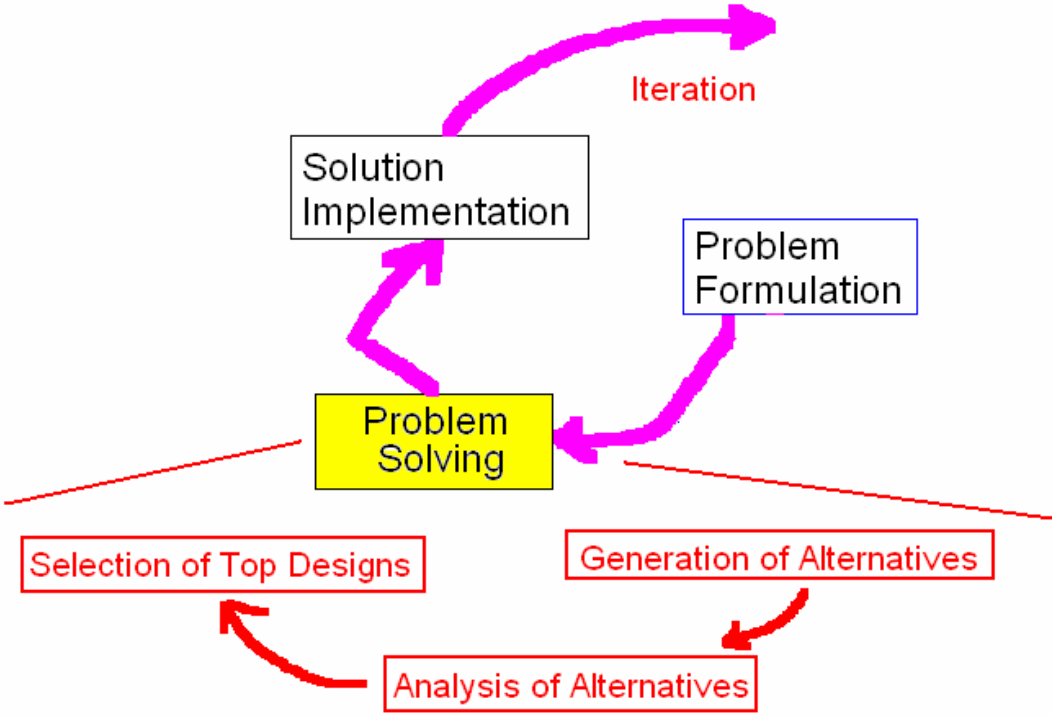
- Objectives:
  - –The steps of problem solving
  - –Strategies for generating, analyzing, and selecting alternatives

Side Bar

- Schedule
  - –January: Alternative Solutions are merged into THE solution
  - –February: Implementation of the Project
  - –March: Continuation of the Implementation
- Final Project Presentation (ECE Day)
  - –Thursday, April 17, 2008
  - –Blackburn Center
- Class Policy
  - –More time to teams
  - –Progress Report Presentation

Problem Solving

- Problem Solving Process
  - **Finding** design solutions to a well-understood problem --- "Alternative Solution Generation"
  - **Exploring and Analyzing** those designs, and ---"Analysis of Alternatives"
  - **Selecting** the most promising design for implementation ---"Top Design"



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”)
- Further Analysis
  - Expert Opinion
  - Customer Preference
  - In-depth analysis of final candidates.
    - Modeling analytically with equations
    - Modeling with a simulation
    - Experimentation (with prototype)
    - Qualitative Reasoning

Analysis with Equations/Models

- 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 Computer Simulation

- When hand-derived equations are too complex
- Examples of Computer Simulation:
  - New wing shape for a plane
  - 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
  - Computer Simulation Tools for wireless communication?
- Weakness:
  - Assumption, restrictions, and limitations of computer simulation tools
  - You get what is modeled, not the reality

Simulation Tools – a Web page

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

Problems Observed

- The problems observed in the previous Senior Designs
  - No Needs, No Functional Requirements
  - No constraints, no standards, no regulations
  - No Alternative Designs
  - Simulation for Simulation's Sake
  - 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
  - Multiple requirements
  - Conflicting requirements
  - Requirements of different importance
- Decision Tool
  - Decision Matrix

Using a Decision Matrix

- Step 1: Collect Information
- 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

		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.