Capstone Course: ICOM 5047: Computer Engineering Design

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Who are we?

- Fernando Vega
  - PhD Electrical Engineering
  - Professor
  - Capstone creator in 2002
  - Coordinator of ABET accreditation since 2004

- Nayda Santiago
  - PhD Electrical and Computer Engr.
  - Professor
  - ECE Department
  - Teaching Capstone since 2006

Why are we here?

- Capstone students who have become entreprenuers
  - Aldo Briano, Yiftee
  - Arnaldo Rivera, Artisoft, Alias Payment, Gasolina Movil
  - Jonathan Gonzalez, Founders Institute, Kytelabs
  - Ramon Gonzalez, IOS Foundation, Kytelabs
  - Angel Viera, Kytelabs
  - Manuel Ortiz Bey, Citamed (con Abdiel Aviles)
  - Gabriel Perez, Koipun
  - Ricardo Rodriguez, Handy, Qlovi

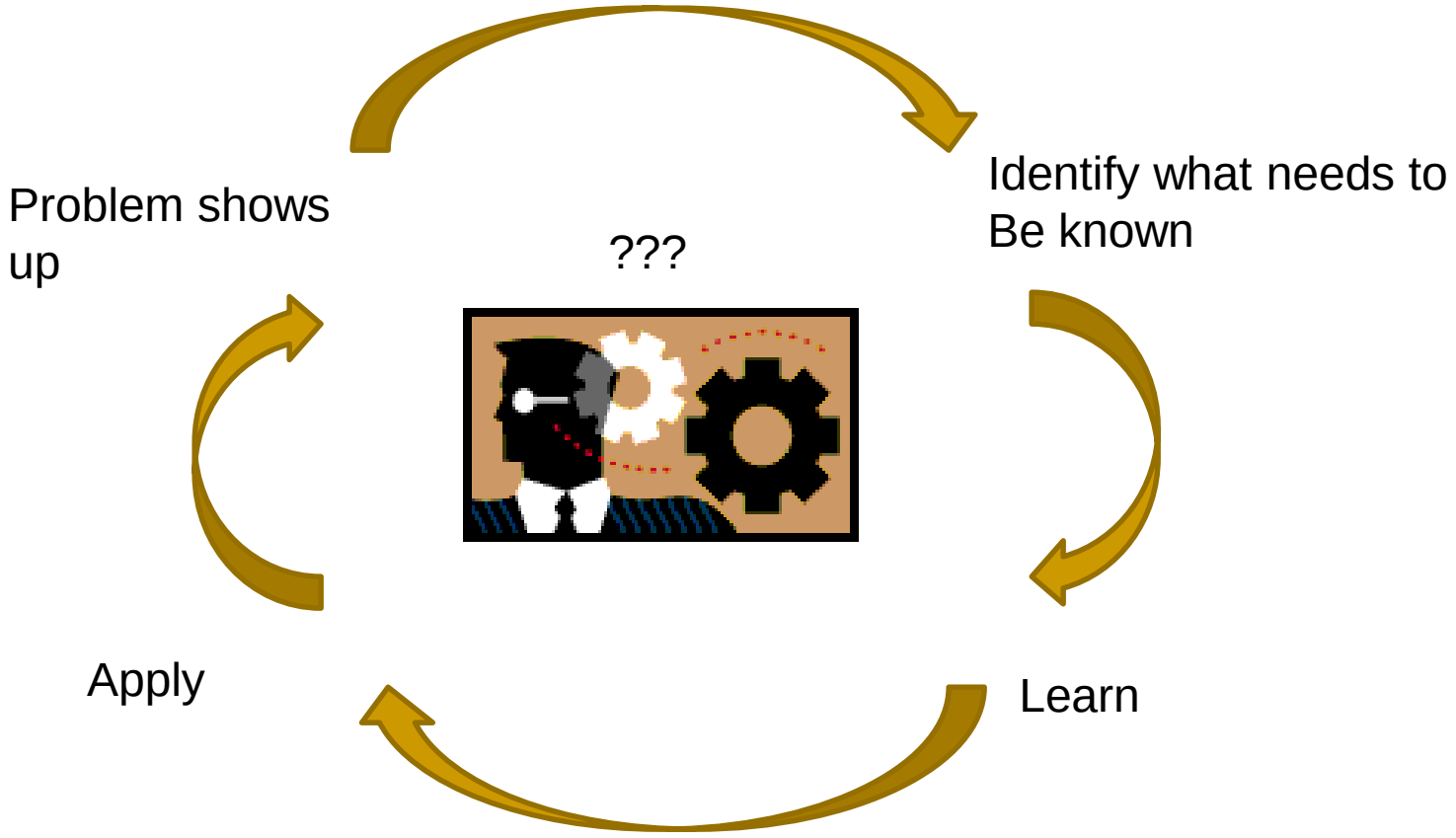
Cont.

- Alfredo Alvarez, Martin Ramirez, Edward Betancourt, Lisnel Morales, Jose Ortiz, Leonardo Ortiz, Jose Acevedo, etc…
- Laboratory for Erroneous Design
  - Albith Delgado
- P18
  - Artisoft
- Rock Solid
  - Angel Perez
- Students behind other products/startups
  - Maricarmen – esports
  - Pedro – Mappaleo, Udiscover
- Others

What is Capstone?

- Definition
  - “the crowning achievement or final stroke; the culmination or acme”.
  - “A capstone course is one which will utilize all the knowledge gained from previous courses.”
- ABET
  - Major Design Experience
- Open ended problem
- Real world problem

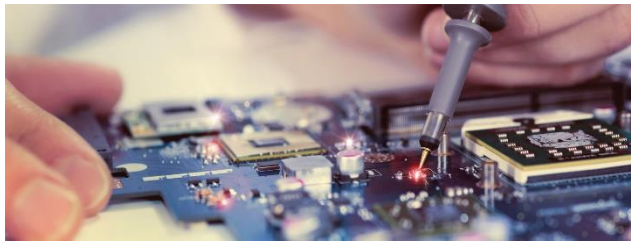
Problem Based Learning



Tomado de Ruth A Streveler; Karl A. Smith; Rocío Chavela Guerra (2010), "CAP Session 3 - Pedagogy," http://cleerhub.org/resources/56.

Computer Engineer

- Computer engineering students study the design of digital hardware systems including communications systems, computers, and devices that contain computers. They study software development, focusing on software for digital devices and their interfaces with users and other devices.
- CE has a strong engineering flavor.



ICOM have been makers for the past 30 years!

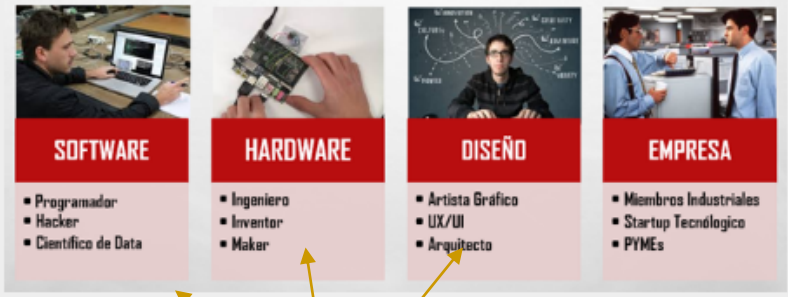
PRIMER HACKATHON ANUAL
ASOCIACIÓN DE INDUSTRIALES PUERTO RICO

¿Qué es HackPRMA?

HackPRMA es un HACKATHON o maratón de programación a celebrarse en el Fideicomiso de Ciencia de Puerto Rico. Por 24 horas continuas HACKERS trabajan en soluciones tecnológicas a retos reales de la membresía de industriales. Compiten por premios y la oportunidad de convertir su idea en un STARTUP u oportunidad comercial.

¿Quién participa?

Los participantes podrán participar en cualquiera de las siguientes categorías:



Reglas

Las reglas que todo hacker debe cumplir son las siguientes:

- Todo participante debe ser mayor de edad.
- Pueden participar programadores novatos o expertos, estudiantes y profesionales.
- Límite de 4 participantes en total por equipo.
- Es necesario que todos los participantes asistan al fideicomiso de ciencias el 28 y 29 de mayo del 2016 durante evento.
- Deben presentar físicamente su hack al panel de jueces el 29 de mayo para ser considerados para premios.

I can do them all!

¿Qué dicen nuestros ex estudiantes?

ABET

- "Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.“
  - Quotation from ABET. Criteria for Accrediting Engineering Programs. Effective for Evaluations During the 2008-2009 Accreditation Cycle.

What is Capstone Design?

- Apply the engineering sciences to the design of a system, component or process.
- Students choose the particular design project with approval of appropriate faculty.
- Computer Engineering
  - "The solution must involve the design and **implementation of some product** containing hardware and/or software components" [2].

Capstone Project

- Project
  - Open-ended problems
  - Development and use of design methodology, formulation of design problem statements and specification, consideration of alternative solutions
  - Feasibility consideration
  - Market considerations
  - Detailed system descriptions
  - Realistic constraints
    - Economic factors, social impact, ethical, environmental, and others

Design Experience [2]

- The culminating design experience should provide students with a wealth of learning benefits. The benefits stemming from this experience include:
  - Demonstration of the ability to integrate concepts from several different subjects into a solution
  - Demonstration of the application of disciplines associated with computer engineering
  - Production of a well-written document detailing the design and the design experience
  - Demonstration of creativity and innovation
  - Development of time management and planning skills
  - Self-awareness opportunities provided by an assessment of achievement as part of a final report

We build prototypes!

DEMO OR DIE…

Moreover….

- Capstone faculty MUST demonstrate that all students in ICOM 5047 have attained all a-k ABET outcomes:
  a. An ability to apply knowledge of mathematics, science, and engineering
  b. An ability to design and conduct experiments, as well as to analyze and interpret data

Moreover…

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. An ability to function on multidisciplinary teams
e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility

Moreover…

g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global and societal context
i. A recognition of the need for, and an ability to engage in lifelong learning
j. Knowledge of contemporary issues
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

What do we expect from students before they come to the course?

- Knowledge
  - Hardware Design
    - Architecture
    - Programming firmware (micro I)
    - Digital Electronics
  - Software Design
    - ER, Use case diagrams, Class diagrams, test cases
    - Design patterns
  - Soft skills
    - Presentations, writing, working in teams, time management

Seminars

- Project Management
- Budget Writing
- Proposals
- Teamwork
- Effective Meetings
- Document and Info. Management
- Patents
- Conflict Management
- Oral Communication
- Creativity
- Writing a Report
- Environmental Impact
- Ethics
- Entreprenuership

We require

- Added Value
  - Value proposition
- Lean Business Model Canvas
- Brochure
- Prototype
  - Minimum Viable Product
- Creative
- Project Management
- Budget
- ROI
- User centered design

Assessment

- “Happy Hours”
- Homework
- Presentations
- Evaluation sheets
- Reports and Documentation
  - Proposal
  - Reports
  - Technical Documentation
  - Code and Schematics

Happy Hours, Homeworks, Presentations

- "Happy Hour"
  - Defined by Dr. Noack – Oral exam, demonstration
  - Not happy, not an hour, more than one evaluator
  - Rubric is based on the project
- Homework
  - Evaluate specific outcomes of the program
    - Example: Ethics, Environmental Impact
- Presentations
  - Presentation skills, rubric
    - Example: Candela

Example Evaluation Sheet

Problem Statement	Score	5	15%	Comments
Clearly describes the problem to be solved by the product/service		R		
Identifies variables involved in the problem (qualitative or quantitative)		R		
Identifies project stakeholders		R		
States how the project provides a solution to the problem		R		
Presents the scope of the project based on the variables of the problem that can be feasibly addressed by the project		R		

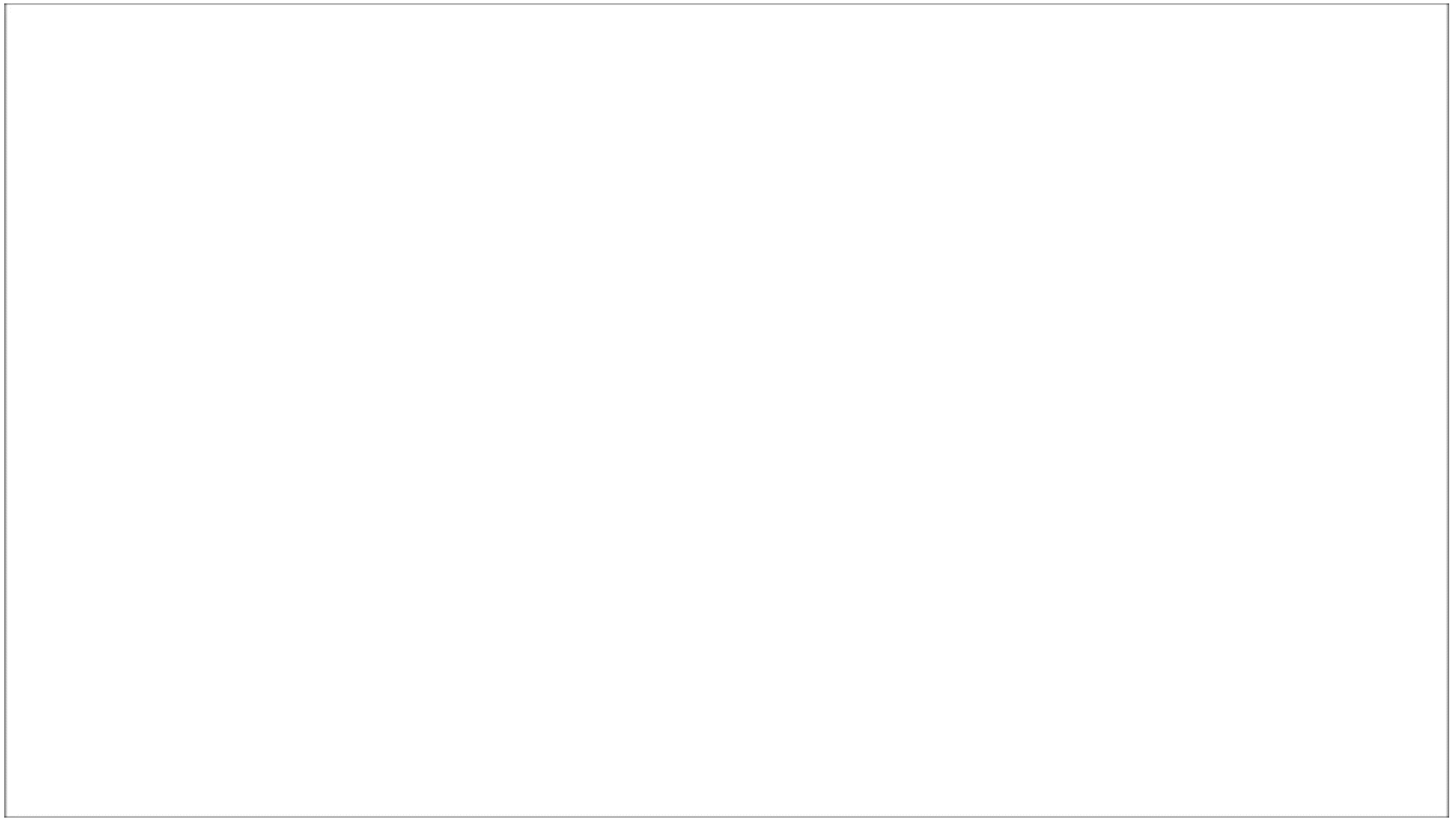
Example Evaluation Sheet

SMART Objectives, Outcomes and Metrics	Score	6	15%	Comments
Objectives are specific		R		
Objectives are measurable (provide metrics to measure achievement for each objective)		R		
Objectives have been agreed upon with client (client must have been identified among the stakeholders)		R		
Objectives are realistic taking into account available skills, expertise and resources.		R		
Objectives can be achieved within the time assigned for the project taking into account available skills, expertise and resources.		R		
Provides detailed description of project's deliverables as related to objectives' achievement		R		

Reports and Documentation

- Proposal
  - Project Management Plan
  - Resources Plan
  - Task assignment
  - Scope
- Progress Report
  - Testing sheets, accountability
- Final Report
- Repository

Examples of past and current projects

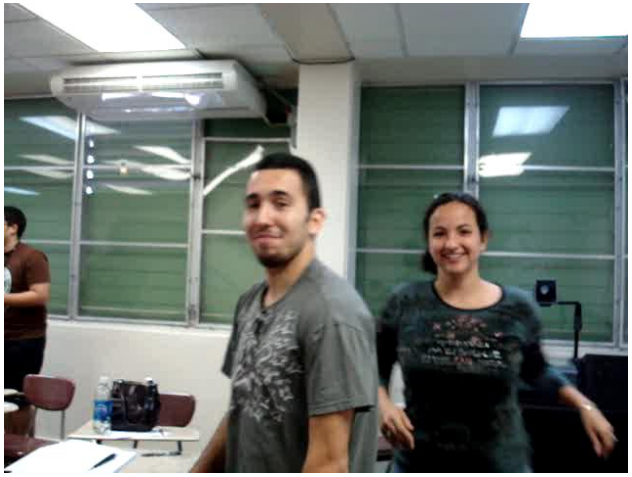


Capstone at the End

Lessons learned

- Groups that start late have a very hard time.
  - No sleep, health problems.
- One person can spoil a group.
  - Team players are needed.
- If you did not learn what you were supposed to learn in five years, capstone becomes daunting….
- Happy Hours become unhappy when you did not do what you were supposed to do.

Not all is bad...



Proud students

Final Comments

- Continuous Process
- Students change, time change, skillsets change
  - Student profile is dynamic
- We have never taught a capstone course in the same way, ever.
- Expect the unexpected
  - Receptive faculty

Questions?

http://ece.uprm.edu/~icom5047/

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