National Aeronautics and
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Jet Propulsion Laboratory
California Institute of Technology
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Capstone Projects: The What, Who, When, Where and How

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Agenda and Purpose

- **This breakout session will cover the What, Who, When, Where and How's associated with the Capstone experience focusing on case studies representing previous, highly successful projects as well as ongoing projects.**

- **Attendees will leave with**

  - **Client-side; knowledge of how to utilize the Capstone experience to accelerate software development cycles, advance innovation and turn your hand to active mentorship all on a shoe-string budget.**

  - **Student-side; and understanding of expectations, workload, opportunities and above all an insight into the possible rewards one can aim to glean from the Capstone experience.**

Session Speaker

D. Kevin McGrath [1], Senior Instructor in Computer Science at Oregon State University.

Education

- **B.S. Mathematics, Xavier University, 2004, Honors: Summa Cum Laude, Pi Mu Epsilon**
- **B.S. Computer Science, Xavier University, 2004, Honors: Summa Cum Laude**
- **B.S. Physics, Xavier University, 2004**
  Honors: Summa Cum Laude, Sigma Pi Sigma
- **Advanced study:**
  NSF REU Program at University of Louisville (2001)
  NSF REU Program at Rensselaer Polytechnic Institute (2002)
- **M.S. Computer Science, Indiana University, 2006**

Teaching

- **CS 444 (Section 001) OPERATING SYSTEMS II**
- **CS 461 (Section 001) SENIOR SOFTWARE ENGR PROJECT**
- **CS 472 COMPUTER ARCHITECTURE**
- **CS 544 OPERATING SYSTEMS II**
- **CS 572 COMPUTER ARCHITECTURE**
- **ECE 472 COMPUTER ARCHITECTURE**
- **ECE 572 COMPUTER ARCHITECTURE**

Many path's to Capstone

http://community.apache.org/

What are Capstone Projects?

- Also called a *capstone experience*, *culminating project*, or *senior exhibition*, among many other terms, a capstone project is a multifaceted assignment that serves as a culminating academic and intellectual experience for students, typically during their final year of high school or middle school, or at the end of an academic program or learning pathway experience.

- Capstone projects are generally designed to encourage students to *think critically*, solve challenging problems, and develop skills such as oral communication, public speaking, research skills, media literacy, teamwork, planning, self-sufficiency, or goal setting—i.e., skills that will help prepare them for college, modern careers, and adult life.

- In most cases, the projects are also interdisciplinary, in the sense that they require students to apply skills or investigate issues across many different subject areas or domains of knowledge. Capstone projects also tend to encourage students to connect their projects to community issues or problems, and to integrate outside-of-school learning experiences, including activities such as interviews, scientific observations, or internships.

What do Students get out of Capstone?

- **The ability to exercise and improve skills relating to project and concept formulation, critical thinking, problem solving, development of skills such as oral communication, public speaking, research skills, media literacy, teamwork, planning, self-sufficiency, or goal setting—i.e., skills that will help prepare them for college, modern careers, and adult life.**

- **Ability to engage with industry professionals in less-formal setting e.g. remotely and not tied to a particular working environment or employer. This is not to discredit the engagement, it is merely fact that the setting can lead to a more relaxed working environment and personnel engagements.**

- **The ability to impress a potential employer...**

- **The ability to be recognized for your work. Many Capstone projects encourage excellence through formal recognition, prizes and awards. The idea is that whatever you put in, you get out.**

- **Ability to demonstrate experience working with industry.**

- **Possibility of formal publication(s)**

- **Ability to reference all of the above on a developing resume.**

What do 'Clients' get out of Capstone?

- **If you have a long standing itch, Capstone enables you to scratch it…**

- **Enables you to advance low technology readiness level (TRL) concepts to something more mature.**

- **Possibility of publication(s).**

- **Talent acquisition.**

- **Opportunity to advance university academic and professional relationships and partnerships.**

- **Opportunity for formal recognition.**

- **Opportunity to *plan* phases of a low TRL project over >1 year e.g. The gap between funding cycles such as NASA's AIST, ACCESS, CMAC, etc.**

- **Opportunity to engage in professional development. No reason why you cannot ask for some form of feedback from University program manager and/or students.**

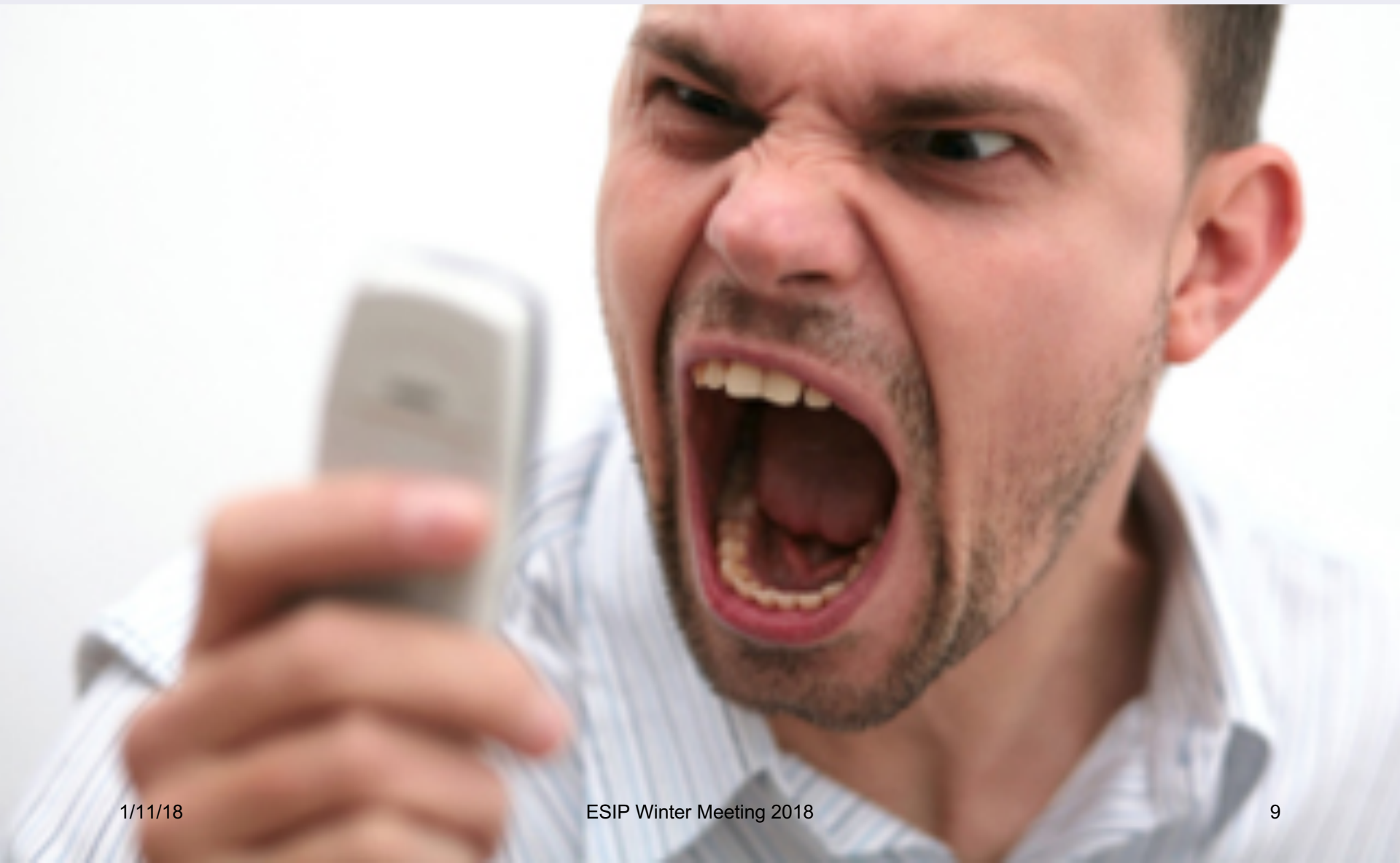- **...etc**

What do 'Clients' get out of Capstone?
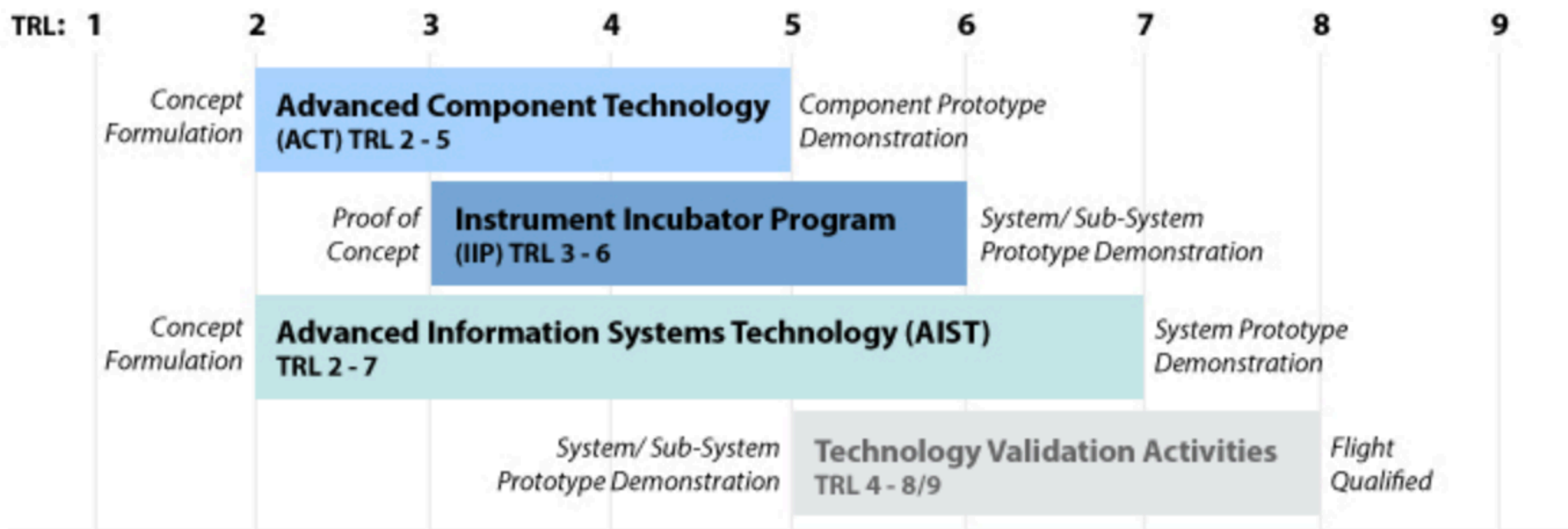
Who is involved in Capstone? – Client(s)

Who is involved in Capstone? – Client(s)

Who is involved in Capstone? – Student(s)

When do Capstone Projects take place.

The OSU program spans 3 terms!!! It begins in Q3 and curtails ~Q2 with an Engineering Expo. >200 projects >600 undergraduate students

This may seem like quite a while, needless to say time ALWAYS vanishes!

Early emphasis should be applied to project planning... more on this later on in the HOW.

The old saying below is as relevant now as ever

"Fail to prepare and prepare to fail"

Where is this all done?

- **Remotely…**

How is it all done?

First, you navigate to the relevant program Website

- **OSU's can be found at [2]**
- **USC's can be found at [3]**

Typical Workflow is as follows

- **Requirements document: Week 5**
- **Technology review: Week 8**
- **Design document: Week 10**
- **Fall progress report: Finals week, fall term**
- **Alpha level release (with demo): Week 6, winter term**
- **Beta level release (with demo): Finals week, winter term**
- **Winter progress report: Finals week, winter term**
- **1.0 level release: Monday prior to Expo**
- **Engineering Expo: Tentatively May 18, 2018**
- **Final report: Finals week, spring term**

Sample Projects

Coal and Open-pit surface mining impacts on American Lands (COAL)

COAL is a Python library for processing hyperspectral imagery from remote sensing devices such as the Airborne Visible/InfraRed Imaging Spectrometer (AVIRIS). COAL was originally developed as a 2016 – 2017 senior capstone collaboration between scientists at the Jet Propulsion Laboratory (JPL) and computer science students at Oregon State University (OSU). COAL aims to provide a suite of algorithms for classifying land cover, identifying mines and other geographic features, and correlating them with environmental data sets. COAL is Free and Open Source Software with the pycoal toolkit licensed under the terms of the GPL v2.0

More information e.g. software, publication, blog news, etc. can be found at [4].

References

1. http://eecs.oregonstate.edu/people/mcgrath
2. http://eecs.oregonstate.edu/capstone/cs/capstone.cgi?home=1
3. http://www-scf.usc.edu/~csci401/
4. https://capstone-coal.github.io/

Acknowledgements

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