SOFTWARE DEV FOR IOT SYSTEMS

CSCI 7000-008
TUE/THU @2PM,

Danny Dig

University of Colorado
Boulder

Today's goals

- Discovery: learning about each other (**F**amily **O**ccupation **R**ecreation **M**otivation)

- What is Pervasive Personalized Intelligence?
- Examples of Research themes on IoT

- How can I be successful in CSCI 7000-005/6?

Boulder

Family

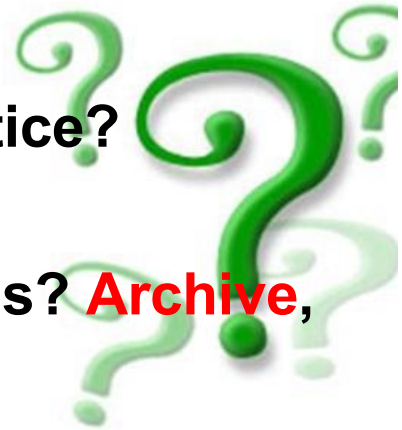
Boulder


adidas

Occupation:
Faculty in Software Engineering

Change is the heart of software development

Programming is program transformation



Q1: Analyze what software changes occur in practice?

Q2: How can we automate them?

Q3: Can we represent programs as transformations? Archive, retrieve, and visualize them?

Q4: Can we infer higher-level transformations?

Automated changes in (i) upgrading library APIs, (ii) convert sequential to parallel code, (iii) improve responsiveness in mobile

Boulder

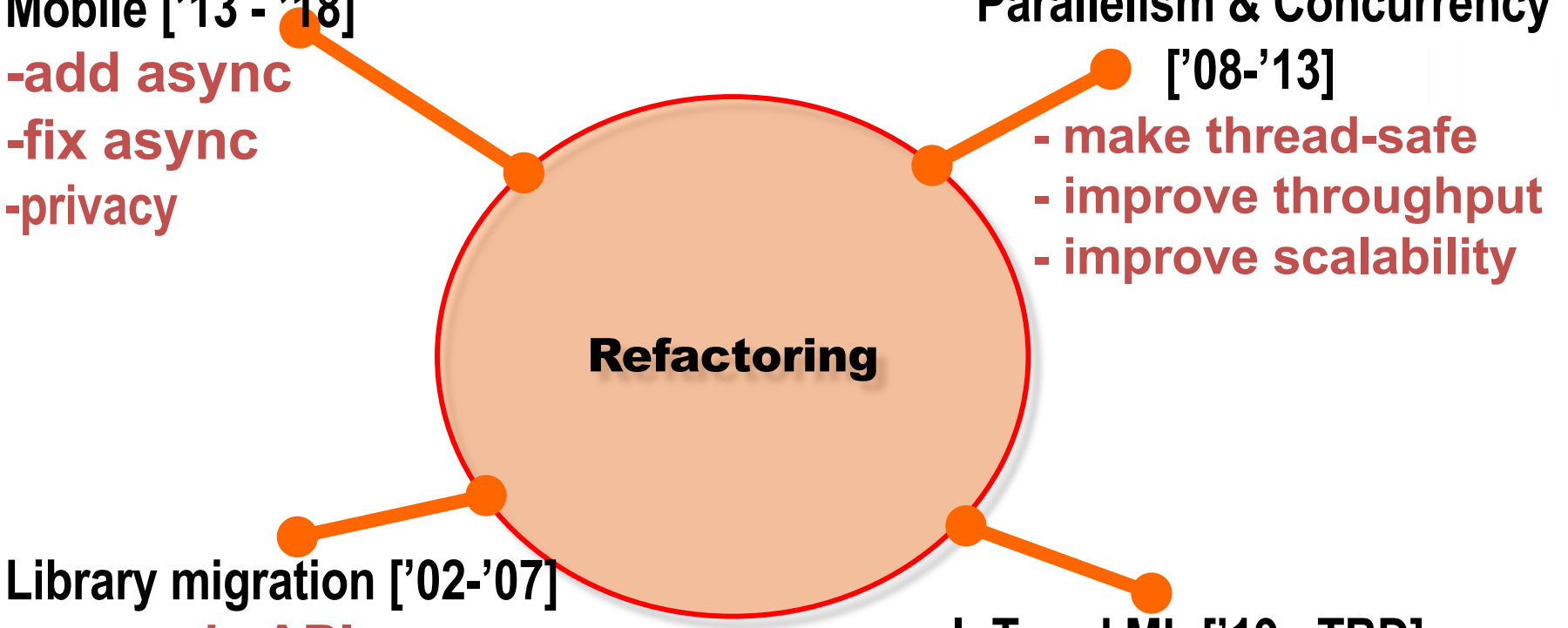
Visual Studio

NetBeans IDE

eclipse

Android Studio

Work in Your Strength Zone but Reinvent Yourself



Principles for changing between different programming models

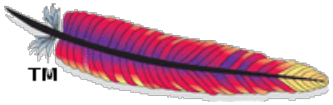
Boulder

What is Your Dream?
Mine is Practical Impact on SW Development

Automating

-ship with official

- hundreds of accepted patches



- first open-source refactoring

Refactoring

Inferring

- used at 

- dozen labs

founded Workshop on Refactoring Tools, HotSwUp, Dagstuhl S.

Understanding

- shaped APIs in Java and .NET official concurency libraries

Testing

-learnparallelism.net
150,000+ visitors

Recreation

Boulder


TRIPLE ZERO

On Aug 5, 2015 …

From personal success to significance

From a ladder climber to a ladder holder

Motivation

Dominicana se transforma

Boulder

Quiz #1: About YOU

- Write down your name
- FORM (family, occupation, recreation, motivation)
- Grad Program (e.g., CS PhD, MS, etc.), year of study, who is your grad advisor
- Your background (e.g., industry experience, other CS background – such as strong ML, Systems, IoT, SE, etc.)
- What is the ONE Thing that you expect to take out of CSCI 7000-008?
- What are your plans post graduation?

Boulder

What are your expectations from CSCI 7000-008?

A. ..How to communicate technical material to outsiders

B. Do a cool IoT Project that helps society

C. Learn about exciting IoT Applications

D. Learn about Security for IoT Devices /Blockchain

E Want exposure to the research of IOT in AI and Do some automation project.

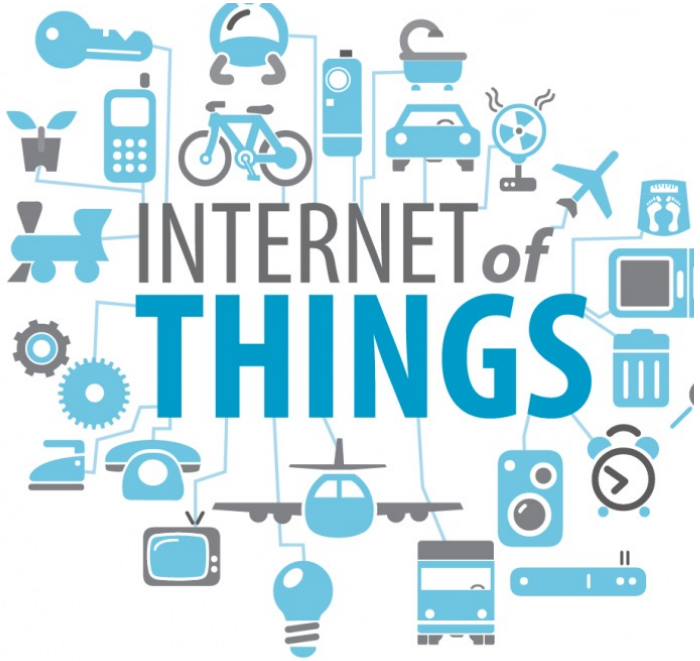
F. Want to expose to the research of IOT in AI and Do some automation project.

G Challenges in IoT industry

H How IoT software differs from classical software

Boulder

Theme: IoT



IoT revolution: digitization & connection of everything

In 15 years, smart Infrastructure estimated to become $59T market

Q: What do you envision as some Killer Feature for IoT?

Boulder

Q: What are the Killer Features for IoT?

K1: Save our resources (green, sustainable world)

K2: Track health and alert authorities when in danger

K3: Everything is easy to control without hassle (e.g., home automation)

K4: Making resource consumption more efficient (Nest thermostat)

K5: Using IoT to detect cancer and serious diseases faster

K6: Using IoT to detect cancer and serious diseases faster

K7: Reduce risk of working in dangerous areas

Q: What are the Killer Features for IoT?

Smart home:

- managing the home (monitoring energy and resources), scheduling family activities, housekeeping (auto-replenish consumables, cleaning, pet feeding), health monitoring (assistive care)

Smart City:

- transportation (find parking), environmental monitoring of pollution, manage resources (control street lighting), enhances perception of city activities (e.g., sporting events)

Smart Manufacturing:

- virtual chief foreman assisting managers

Boulder

From IoT 1.0 to 2.0

V 1.0: sensors and actuators to collect data

V 2.0: augmenting our intelligence with knowledge to expedite decision-making, everyday activities, and processes

Boulder


Center on Pervasive Personalized Intelligence
Oregon State University
Boulder
NSF
DAIMLER
Daimler Trucks North America
intel
Itron
Trimble
DELL
NEC
galois
http://ppicenter.org

Listening to Industry during Discovery Visits

Pervasive Personalized Intelligence (PPI)

Connecting everything for remote monitoring and service

From Reactive to Predictive Analytics:

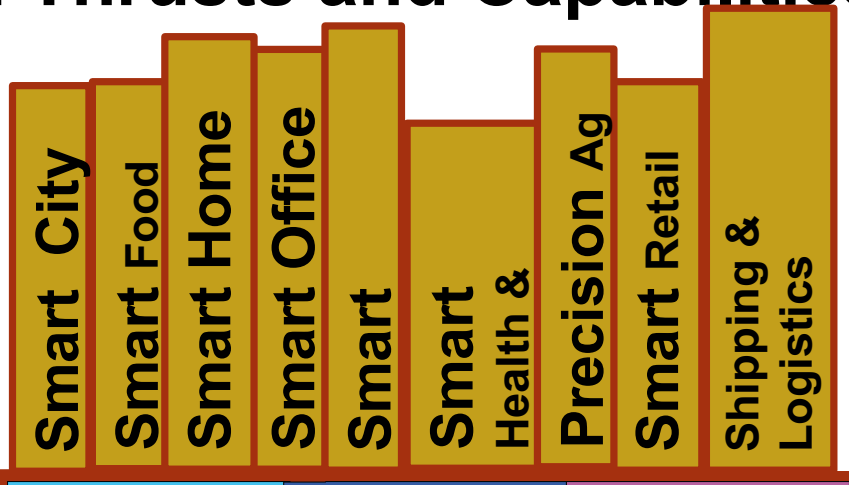
- **Smart Energy: safe energy mode for e-cars**
- **Precision Ag: predict diseases, harvest**
- **Industry 4.0: preventive maintenance**

Pervasive to the Edge

Personalized

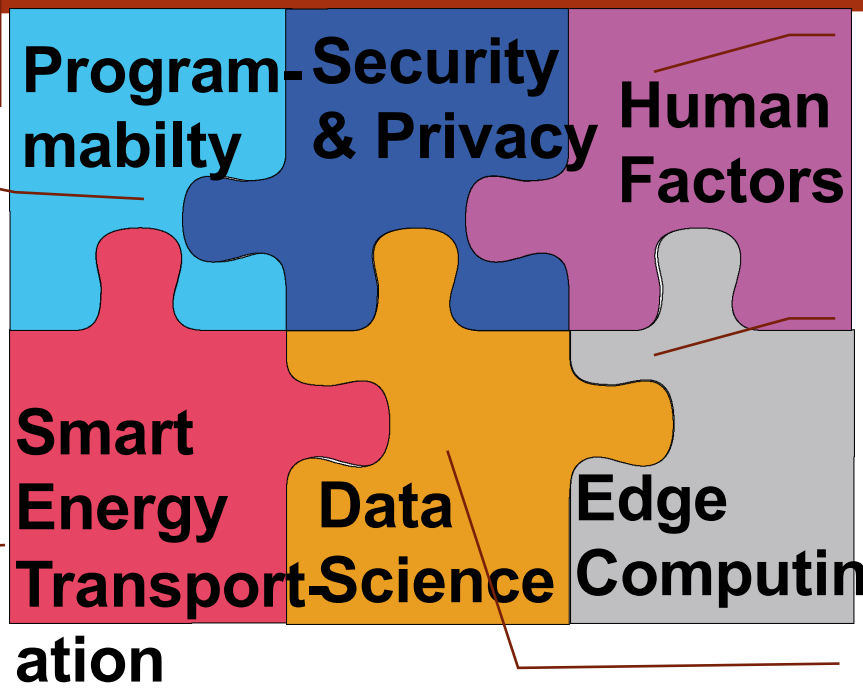
CENTER ON Pervasive Personalized Intelligence

Research Thrusts and Capabilities of PPI Center



Runtime Safety for Autonomous Systems
Code Rennovation

AI
Eco-driving and Routing for EV



Explainable AI:
Debugging NLP and Computer Vision

AR applications on Edge

Fraud Detection
Open set detection
Data

CENTER ON Pervasive Personalized Intelligence

Value that PPI Center brings to you, students in CSCI 7000-008

Connecting you with movers and shakers in IoT:

- **access to thinking partners from industry**
- **broadens your perspective**

Networking opportunities: internships, jobs

Practical impact for your projects:

- gives you a chance for significance, not only personal success

Course Administration

Check webpage:
https://danny.cs.colorado.edu/courses/csci7000-008_Sp22/

Work items due Thu (Jan 13):

- **Familiarize with class webpage**
- **sign up on Piazza (all communications through Piazza, no email after this week)**
- **Read and write a critique for a research paper (see template on webpage)**

Check prereqs: computing background (either practical experience or undergrad-level knowledge of SE, Systems, ML), please check with me after the class

Boulder

CS 7000-008 is Different!!!

Research-based course:

- **at times it would feel it is not ”organized”**
- **there are lots of choices, you need to select**
- **structure is fixed, but content is dynamic**

Complete a research or industrial-novel project of your choice (teams of 2-3 students)

- **follow the steps of open-ended/risky research (proposal, fit in literature, evaluate empirically)**

- **at the end of the term you would have produced a research paper that you can submit to conference**

- **WHY: equips you to conduct novel R&D**

Boulder

CS 7000-008 is Different!!!

Participate in class discussion and activities.

Read 1-2 research papers for every class meeting (11 pages each, double column => total of 500+ research pages)

- later on, you choose papers that match your project

- 1 book chapter /week (Put Your Dream to the Test)

Paper Critiques: for each class meeting, for each research paper, submit before class (by 5pm previous day)

- WHY: equips you with critical thinking

Research presentation: you prepare and deliver for the selected research papers

- WHY: equips you to communicate your ideas

Boulder

Projects Focus on IoT-related topics

For new grad student, project gives ideas for dissertation

For experienced PhD student, project advances your research

Technological shifts/opportunities for IoT:

- **constraints on memory/CPU/bandwidth/battery usage**
- **connectivity with the cloud**
- **rapid evolution of the platform**
- **reliance on ML/AI solutions**

Industrial-innovation: availability of rich data from sensors (e.g., dataset from City of Denver)

Boulder

Research projects (not an app), teams of 2-3 people

Example Transformations for IoT

What are the new transformations we need to automate?

- inspiration from explorative studies

- empirical studies to find performance or energy anti-patterns

Examples of transformations:

- candidate programs with trade-offs between performance & power consumption

- adaptation to different display technologies

- split functionality between the device and cloud

Boulder

CS 7000-008 is Different! Lots of Guests

Interviews with C-level executives from PPI Center:

- **e.g., Jason Shepherd, CTO of Dell Technologies**
- **Ricky Singh, VP of IoT at Software AG**
- **Bob Wold, VP of Trimble**
- **Rahul Khanna (Lead ML architect Intel IoT Group)**

Watch segments from lead industry events (e.g., IoT World)

- **Broadcast of keynote speakers**
- **Panel discussions**

Faculty:

- **E.g., Tom Dietterich, father of the ML field, ACM Fellow**

Boulder

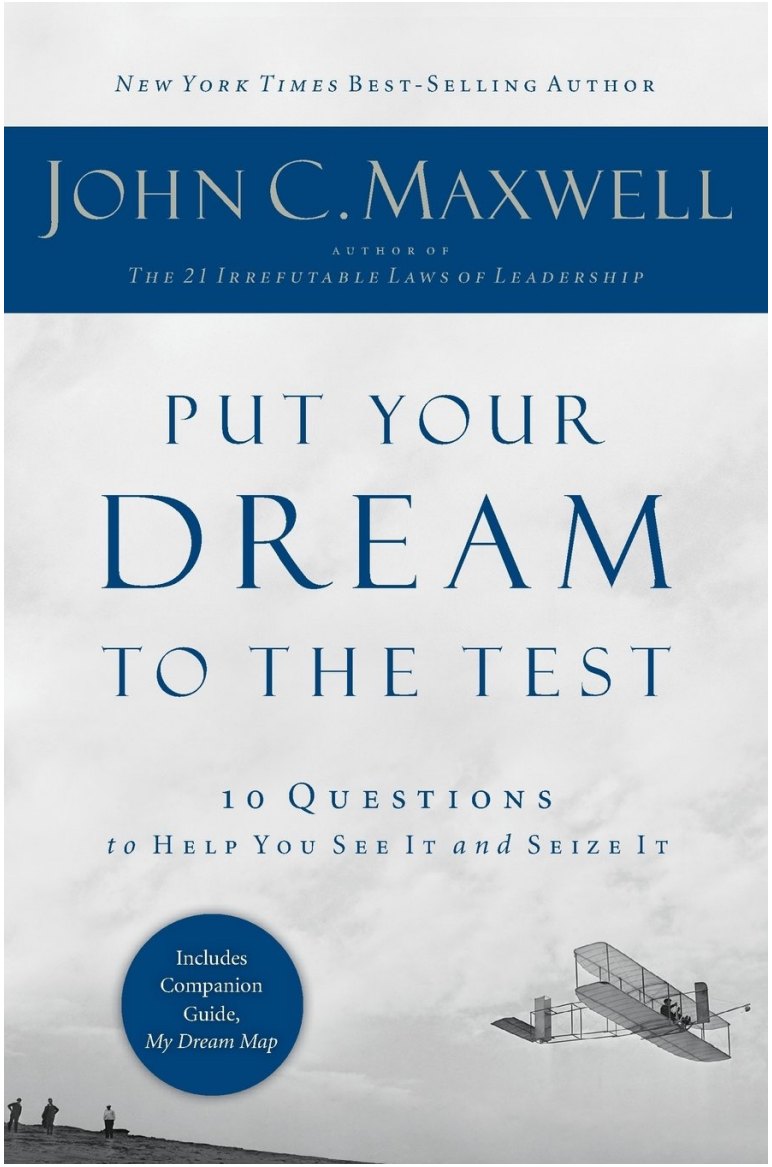
1-hour Group Discussion

Soft Skills: leadership, creating a vision and plan for accomplishing

WHY: Soft Skills make a greater Difference in life than "Hard Skills"

WHAT: Take your dream through 10-step process to see, own, reach it

HOW: learning environment in a roundtable format



Boulder