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# **PERVASIVE PERSONALIZED INTELLIGENCE FOR IOT**

**CSCI 7000-025  
MON/WED @4PM,**

**Danny Dig**



University of Colorado  
Boulder



# Today's goals

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- Discovery: learning about each other (Family Occupation  
Recreation Motivation)
- What is Pervasive Personalized Intelligence?
- Examples of Research themes on IoT
- How can I be successful in CSCI 7000-025?

# Family

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# Occupation: Faculty in Software Engineering

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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



Visual Studio



NetBeans IDE



Android  
Studio

# Recreation

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On Aug 5, 2015 ...



**From personal success to significance**



**From a ladder climber to a ladder holder**





# Quiz #1: About YOU

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- 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, PL, etc.)
- What is the **ONE Thing that you expect to take out of CSCI 7000-025?**
- **What are your plans post graduation?**



# **What are your expectations from CSCI 7000-025?**

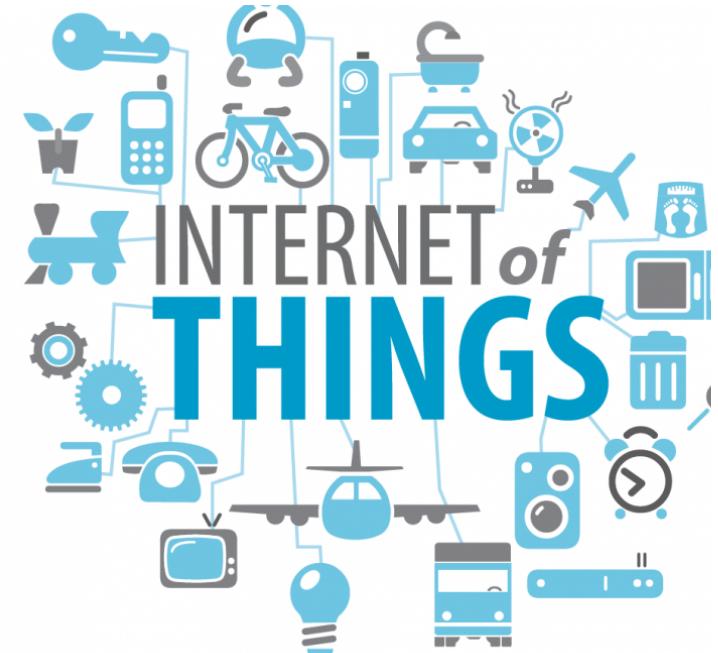
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- A. ..How to communicate technical material to outsiders**
- B. .. How do we conduct industry-relevant research**
- C. .. Understand limitations and opportunities of IoT**
- D. ... Learn applications of IoT for human users**
- E. ... Whole picture vantage of IoT, how to process IoT data**
- F. Overview of IoT applications in healthcare, and the rest of the field**
- G. Common challenges across different applications and how we approach them with reuse**

## 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?**



## **Q: What are the Killer Features for IoT?**

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- K1: Precision Ag: automate food production, and eliminate waste**
- K2: Transportation across the board**
- K3: Big data: data-driven decision making**
- K4: Climate control improvement**
- K5: Predict & improve human health**
- K6: Smart city**
- K7: Distributed, custom production and manufacturing**

# **Q: What are the Killer Features for IoT?**

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## **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**

## **Smart Manufacturing:**

- virtual chief foreman assisting managers**

# From IoT 1.0 to 2.0

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**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**

# Center on Pervasive Personalized Intelligence



Oregon State  
University



Boulder



<http://ppicenter.org>

# Listening to Industry during Discovery Visits



# Pervasive Personalized Intelligence (PPI)

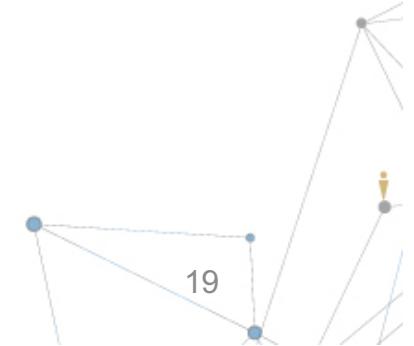
**From Reactive to Predictive Analytics:**

- City: resource utilization, new infrastructure
- Ag: predict diseases, harvest
- Industry 4.0: auto-diagnosis on device

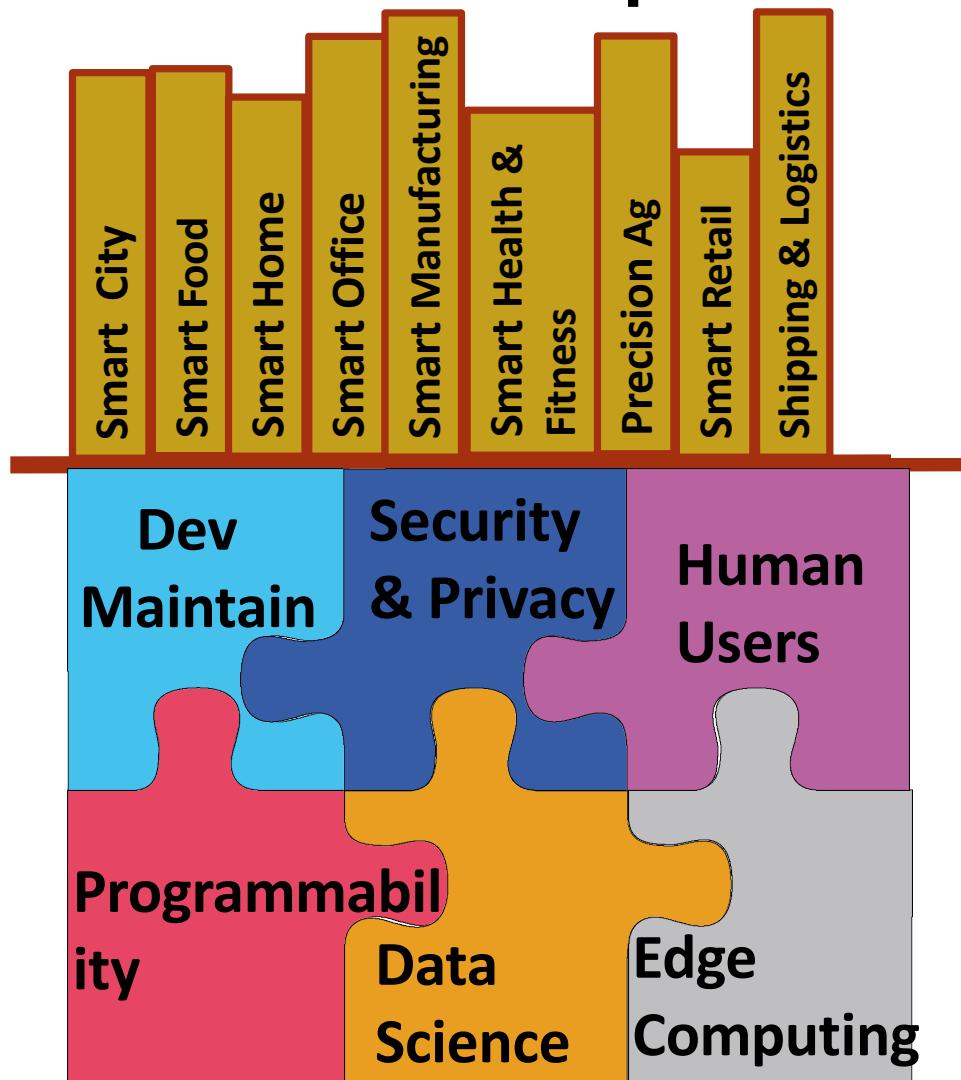


**Pervasive to the Edge**

**Personalized**



# Research Thrusts and Capabilities of PPI



# Course Administration

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**Check webpage:**

**TBA through email**

**Work items due Wed:**

- Familiarize with class webpage
- sign up on Piazza (all communications through Piazza, no email after Wed)

**Prereqs are enforced: computing background (SE, systems, PL, ML)**

# CS 7000-025 is Different!!!

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## **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**

# CS 7000-025 is Different!!!

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**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

# Projects Focus on IoT-related topics

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**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 Portland)**



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

# Example Transformations for IoT

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**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

# **CS 7000-025 is Different! Lots of Guests**

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**Interviews with C-level executives from PPI Center:**

- e.g., Jason Shepherd, CTO of Dell Technologies
- Lutz Beck, CIO of Daimler Trucks
- Bob Wold, VP of Trimble

**Live from IoT World 2020 (April 6th, 8th)**

- Broadcast of keynote speakers
- Interviews with people on the booths

**Faculty:**

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

# 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**



NEW YORK TIMES BEST-SELLING AUTHOR

**JOHN C. MAXWELL**

AUTHOR OF  
*THE 21 IRREFUTABLE LAWS OF LEADERSHIP*

PUT YOUR  
DREAM  
TO THE TEST

10 QUESTIONS  
to HELP YOU SEE IT and SEIZE IT

Includes  
Companion  
Guide,  
*My Dream Map*

