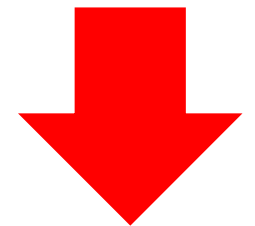


**Welcome to**  
**SENG 480A / CSC 485A / CSC 586A**  
**Self-Adaptive and**  
**Self-Managing Systems**

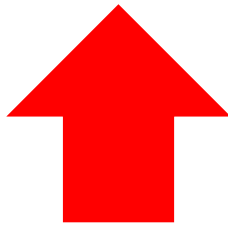
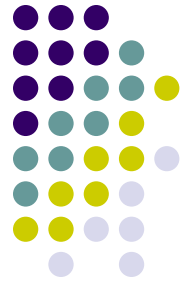


Dr. Hausi A. Müller  
Professor and Associate Dean Research  
Department of Computer Science  
University of Victoria

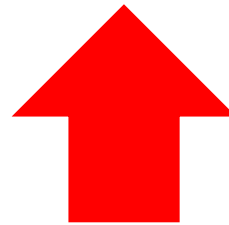


<http://courses.seng.uvic.ca/courses/2015/summer/seng/480a>  
<http://courses.seng.uvic.ca/courses/2015/summer/csc/485a>  
<http://courses.seng.uvic.ca/courses/2015/summer/csc/586a>

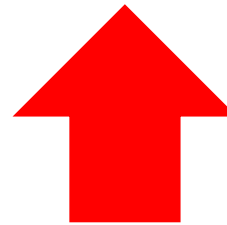
# Outstanding TAs



Lorena

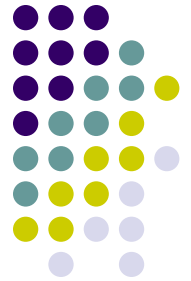


Nina



Ron

# Deadlines and Course Requirements



Unit	Undergrads Weight	Grads Weight	Remarks
A1	12%	9%	Due Fri, May 29, 2015
A2	12%	9%	Due Fri, June 19, 2015
A3	12%	9%	Due Fri, July 10, 2015
A4	12%	9%	Due Fri, July 31, 2015
Grad Project		12%	Due Sat, July 25, 2015
Participation and presentation	7%	7%	Only graduate students are required to give a presentation towards the end of the course.
Midterm 1	20%	20%	June 4, 2015 in class. Closed books, closed notes, no phones, no computers, no calculators, no gadgets.
Midterm 2	25%	25%	July 16, 2015 in class. Closed books, closed notes, no phones, no computers, no calculators, no gadgets.
Total	100%	100%	Have a great course!

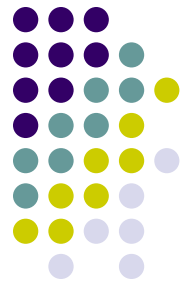
- All materials discussed in class are required for the midterm examinations
- Completing all midterms and assignments is required to pass the course
- Passing the midterms is not absolutely required to pass the course, but of course highly recommended



# What Is Class Participation?

- Students should be prepared to **speak** in class—it is completely acceptable, indeed encouraged, for students to give a mini-presentation on a relevant subject
- Class participation does not just mean signing in—attendance will be taken regularly
- Class participation means speaking up in class, both with questions and answers
- Note that 7% class participation almost corresponds to a full letter grade (up or down)





# Two Quiz Questions

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- Are you sitting next to the same person you did in the last class?
  - This course involves a lot of interaction
  - Hone your communications skills
- Did you look up any term or resource related to this course since last class?
  - This course involves a lot of reading
  - Hone your research skills
- Introduce yourself to your neighbors
  - A1 groups will be formed on Monday



# Questions?

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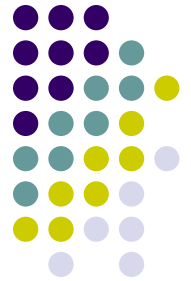


- Organization of the course?
- Evaluation scheme?
- Study course web site carefully
- Visit course web site regularly
  - Web site and materials will change almost daily
- Other questions?!?



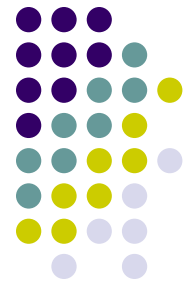
# Keep in mind ...

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- **Ask questions at any time 😊 !! 😊**
- **Let's make this a truly interactive course!!!**
- **Take full advantage of this opportunity to work on your communication skills 😊 !! 😊**





# Assignment 1 Part I

## Instructions

This assignment consists of three parts. In Part I you are to characterize four feedback systems. In Part II you are to deepen your understanding of ULS systems. In Part III is a group assignment on sensor APIs.

## Part I

Identify three (3) feedback systems from different application areas that you encounter in your everyday life. For each system, identify the type of feedback (e.g., positive, negative, or bipolar), identify the sensing and actuation mechanisms as well as the algorithm used in the controller. Describe in detail the underlying model and its assumptions. Describe the uncertainty that the feedback system provides. Describe the dynamics that are controlled through the use of feedback. At least two of the three examples should be software-intensive systems. Graduate students are strongly encouraged to pick at least one system from their research area.

### Recommended reading materials

- Murray: Control in an Information Rich World: Report of the Panel on Future Directions in Control, Dynamics, and Systems. SIAM 2003. <http://www.cds.caltech.edu/~murray/cdspanel/report/cdspanel-15aug02.pdf>
- Chapters 1 & 2

The answer for each feedback system should fit onto approximately one typeset page.

**Maximum 3 pages** for this part

**Do not copy verbatim from any source. Write your own prose.  
Cite your sources.**





# Assignment 1 Part II

## Part II

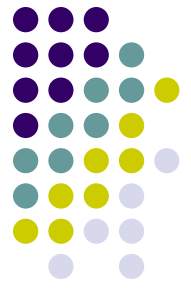
Study the following book on Ultra-Large-Scale Systems (ULS)

- Northrop, L., Feiler, P., Gabriel, R., Goodenough, J., Linger, R., Longstaff, T., Kazman, R., Klein, M., Schmidt, D., Sullivan, K., Wallnau, K.: Ultra-Large-Scale Systems. The Software Challenge of the Future. Technical Report, Software Engineering Institute, Carnegie Mellon University, 134 pages ISBN 0-9786956-0-7 (2006)
  - <http://www.sei.cmu.edu/uls>
1. What are the main characteristics of a ULS system?
  2. Contrast centralized and decentralized control.
  3. Describe two selected challenges for the design and evolution of ULS systems in detail.

**Maximum 2 pages** for this part

**Do not copy verbatim from any source.**

**Cite your sources.**



# Assignment 1 Part III

## Part III - Group Project (4-5 people per group)

1. Identify and describe sensor APIs for different platforms (e.g., different operating systems).  
Pick an interesting category of sensors or sensor network and describe its API in detail.
2. Design, implement and document a simple application using this API.
3. Describe how this API and your application can be transitioned to a cloud computing environment.

All group members have to work on all three parts together. Learn from each other!  
Articulate how the individual group members contributed to Part III.

Submission details:

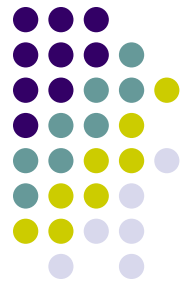
- **Maximum 3 pages** for this part
- Submit a short video of no more than 5 minutes explaining your implementation and showing a demo of your application. **NOTE:** It is recommended that you upload the video in some external repository (e.g., Dropbox or Google Drive) and submit the access link.

**You only need to submit one document and video per group.**  
**Do not copy verbatim from any source.**  
**Cite your sources.**

See SensorCloud video  
later in today's lecture

### Groups

G1	
G2	



# Self-Adaptive Systems (SAS)

- A SAS can alter its behaviour at runtime (on the fly) in response to its perception of
  - its environment
  - its own state

by adapting itself

- SAS abilities
  - Assess its own behaviour
  - Observe its context or environment
  - Adapt without shut down



➤ Oreizy, et al.: An Architecture-Based Approach to Self-Adaptive Software, *IEEE Intelligent Systems*, pp. 54-62 (1999)

➤ MacManus: Why Software is More Important Than Sensors in the Internet of Things, *ReadWriteWeb* (2010)

**10th International Symposium on Software Engineering for Adaptive and Self-Managing Systems**

**SEAMS 2015**  
Firenze, Italy  
May 18-19  
<http://www.seams-conference.org>

**Call for Papers**  
Self-adaptation and self-management are key requirements in many modern and emerging software systems, including the industrial Internet of Things, cyber-physical systems, cloud computing, and mobile computing. These systems need to adapt themselves at run time to preserve their operation in the presence of uncertain changes in their operating environments, resource availability, user needs, operations, and faults.

Solutions to complex software systems with self-managing and self-adaptive capabilities have been proposed by researchers from different areas including software architecture, fault tolerant computing, programming languages, robotics, and run time program analysis and verification. Additionally, solutions have been proposed in related areas like fault-tolerant computing, artificial intelligence, machine learning, control systems, and agent-based systems. The SEAMS symposium focuses on applying software engineering to these solutions, including methods, techniques, and tools that can be used to support self-\* properties like self-adaptation, self-management, self-healing, self-organization, and self-configuration.

The objective of SEAMS is to bring together researchers and practitioners from many of these diverse areas to investigate, discuss, and exchange knowledge on the fundamental principles, state-of-the-art, and critical challenges of engineering self-adaptive and self-managing systems.

**Topics of Interest:** All topics related to engineering self-adaptive and self-managing systems, including:

<ul style="list-style-type: none"> <li>Self-adaptation</li> <li>Self-management</li> <li>Self-healing</li> <li>Self-organization</li> <li>Self-configuration</li> </ul>	<ul style="list-style-type: none"> <li>Verification and assurance</li> <li>Verification and validation</li> <li>Requirements for their analysis and testing</li> <li>Software reuse</li> <li>Code generation and analysis</li> <li>Cloud computing</li> <li>Mobile computing</li> <li>Autonomous systems</li> <li>Service-oriented systems</li> <li>Operational computing</li> <li>Event-driven architectures</li> <li>Agent-based systems</li> <li>Decision support systems</li> <li>Reasoners, metrics, or software that can be used to manage self-adaptive systems</li> <li>Requirements with distributed self-adaptation and self-managing systems using sensors, engineering, business, or society problems</li> </ul>
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**Language:** Papers should be written and analyzed in English.

**Program:** The symposium will be held in Florence, Italy.

**Programme Language Support for Self-Adaptation:** Research papers in this area should be submitted as a PDF file.

**Programme Language Support for Self-Management:** Research papers in this area should be submitted as a PDF file.

**Programme Language Support for Self-Healing:** Research papers in this area should be submitted as a PDF file.

**Programme Language Support for Self-Organization:** Research papers in this area should be submitted as a PDF file.

**Programme Language Support for Self-Configuration:** Research papers in this area should be submitted as a PDF file.

**Submission Deadlines:** Abstract Submission: 9 January, 2015  
Paper Submission: 18 January, 2015  
Notification: 18 February, 2015  
Camera ready: 27 February, 2015

**Further Information:** Symposium related e-mail should be addressed to: [seams2015@seams-conference.org](mailto:seams2015@seams-conference.org)

**Organizers:** ETCS&S, IAS, TOSST, IEEE, IAS, IAS, IAS

# Situational Awareness (SA)

- SA is the perception of environmental and personal context with respect to time and space
- Comprehension of its meaning and its projection into the future
- Critical to decision-making in complex, dynamic situations



## ● Applications

- Mars Curiosity
- Aviation—UAV, drones
- Military command and control
- Emergency services

## ● Applications

- Driving a car
- Crossing a street
- Playing soccer
- Playing basketball
- Shopping



Intuitively we know how critical and valuable context is.  
But context is complicated.

“Context is the new battleground between  
Android, iOS, Windows, Symbian and  
Apple, Google, IBM, Microsoft, Nokia, Samsung.”

## The Age of Context

Simple can be harder than complex. You have to work hard to  
get your thinking clean to make it simple.

*Steve Jobs, BusinessWeek, 1998*

# Pillars of Context

- The Internet of Things
  - Sensors for location, light, motion, temperature
  - Record, transmit findings to control instruments
- Semantic web, Big data
  - Clouds store massive data on people, places, things
  - Information about everything accessible on the web
- Digital mapping
  - Every square inch of the world is mapped
- Really smart mobile devices
  - Every person has one
  - Highly customized smart applications
- Mature social media
  - Highly personalized virtual networks
- Wearable computers
  - Google glasses, Google driverless car

Highly Dynamical  
Software Systems

R. Scoble, S. Israel: *The Age of Context: How It Will Change Your Life & Work*, 2013.

# Nate Silver

- American statistician, sabermetrician (analysis of baseball), psephologist (scientific analysis of elections and writer
- In 2008 correctly predicted the winner of US presidential election in 49 out of 50 states and all 35 US Senate races
- In 2009 named one of The World's 100 Most Influential People by *Time Magazine*
- In 2010 his *FiveThirtyEight* blog was licensed for publication by *The New York Times*
- **Book: *The Signal and the Noise: Why Most Predictions Fail – But Some Don't*. New York: Penguin, 2012**
- In 2012 correctly predicted the winner of all 50 states and 31 out of 35 US Senate races
- On Nov 12 *The Signal and the Noise* was named Amazon's #1 Best Book of the Year for 2012





# Telepathy One Japan's Answer to Google Glass

Context through wearable computers



Takahito Iguchi  
Inventor of Telepathy One

# Context is Big Data



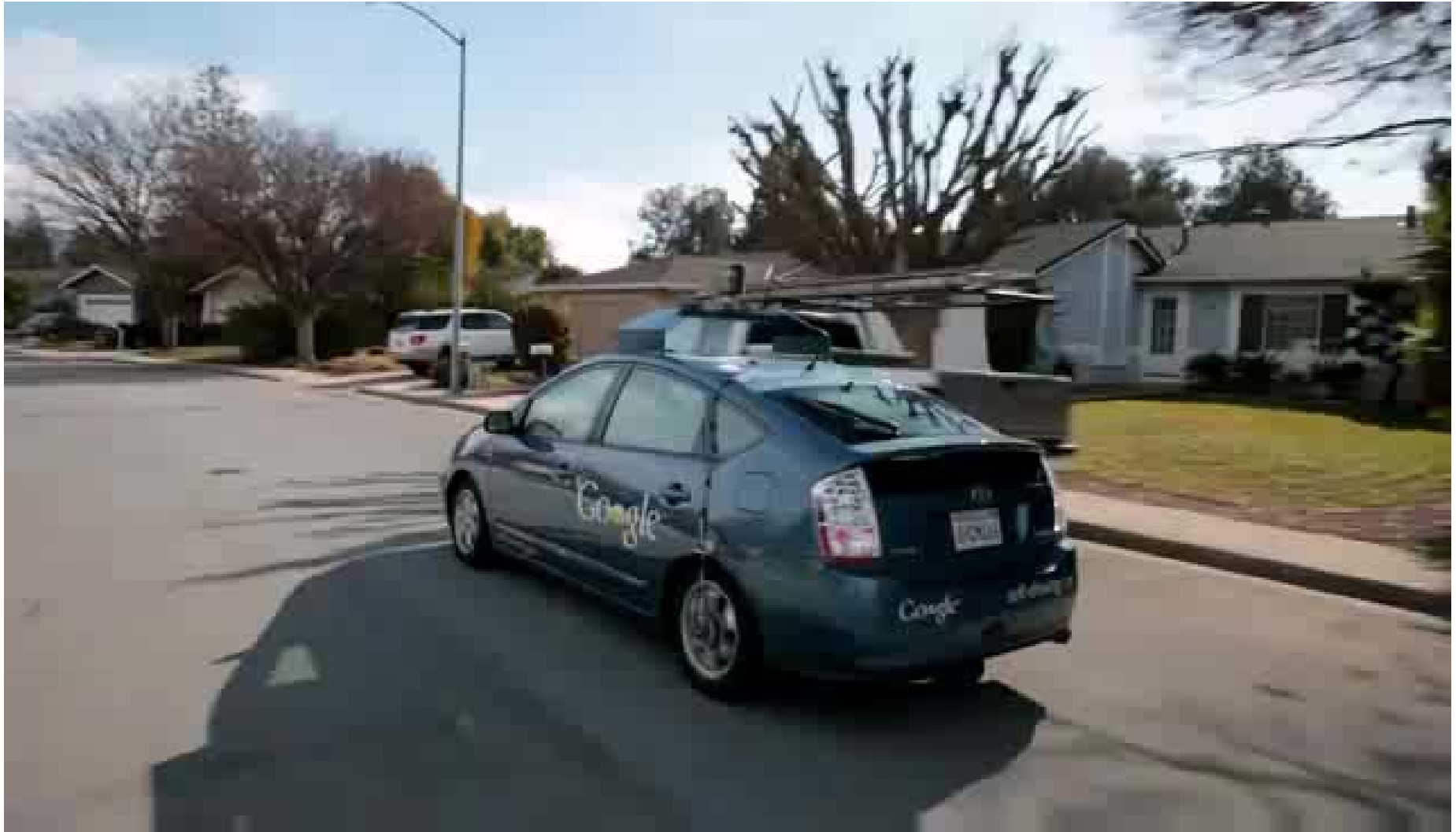
# Capture Context with Sensors and Wearable Computers



Telepathy One



# Google Driverless Car Licensed in Florida, Nevada, California



<http://www.youtube.com/watch?v=cdgQpa1pUUE>

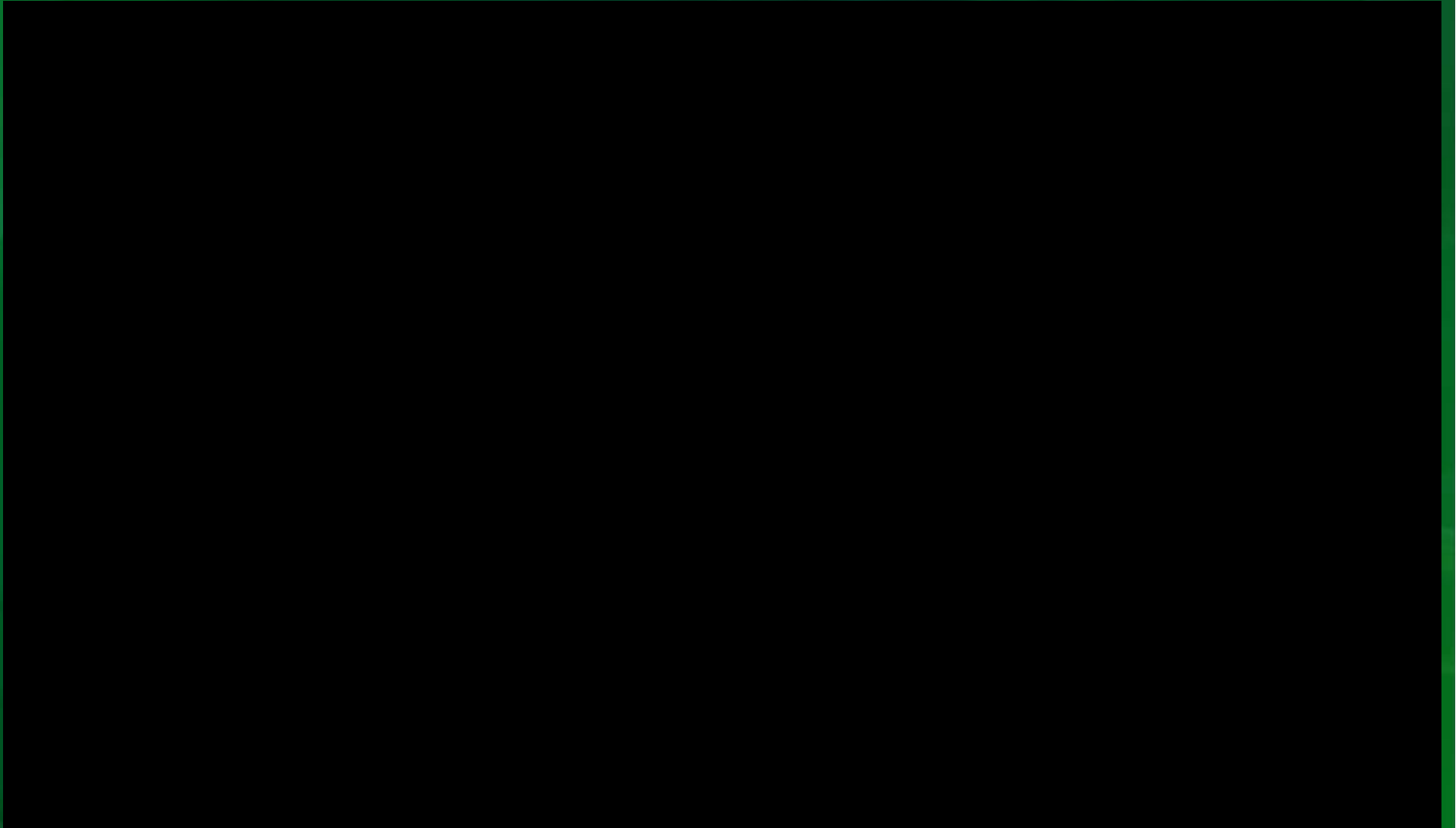
# How does it feel through Google Glass?



<http://www.google.com/glass/start/how-it-feels/>



# Sensor Data and the Cloud



<http://www.youtube.com/watch?v=Ya9Zu3PGT00>