SmartFarm: Turning Data Analytics into Farm Implements

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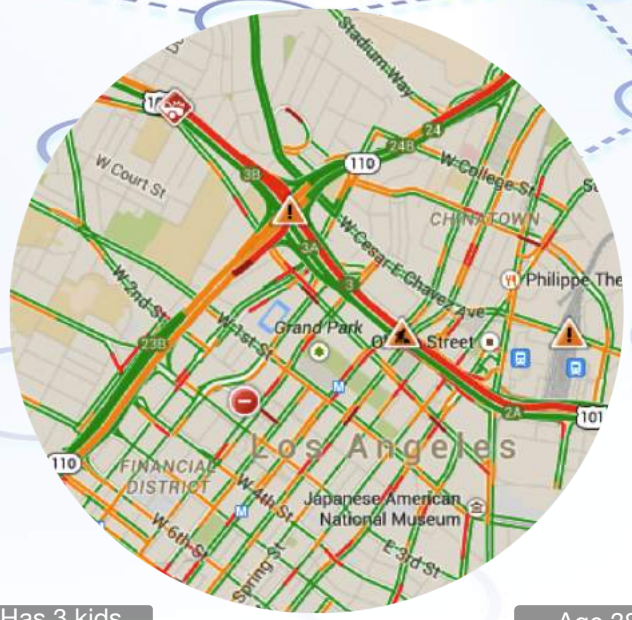
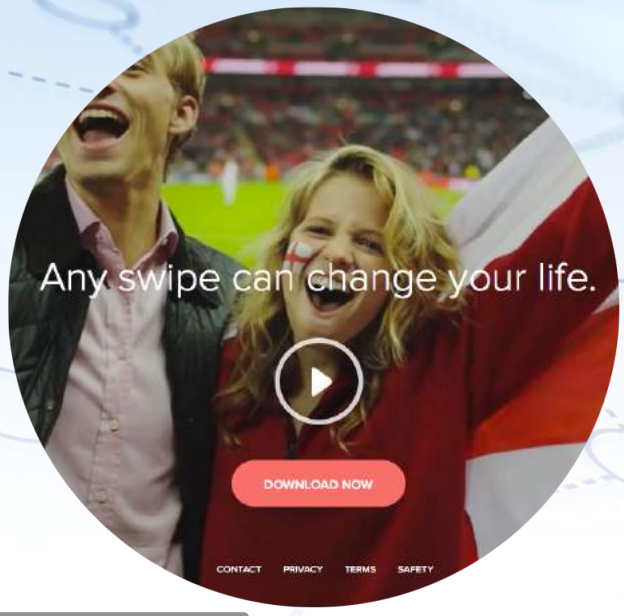




Has 3 kids

Age 38-40

Reads crime dramas

Likes Jimmy Fallon

Male

Household Income: 150000

Drives a Ram truck

Mother lives in Florida

Is active on Twitter

Likes basketball

Is politically active

Works out at a gym

Likes spicy food recipes

Children play hockey

Sister is a lawyer

Likes hiking

House value: $500,000

Dislikes Actor Robert Redford

Republican

Owns a SmartTV

Salesman

Owns an RV

Likes online news sites

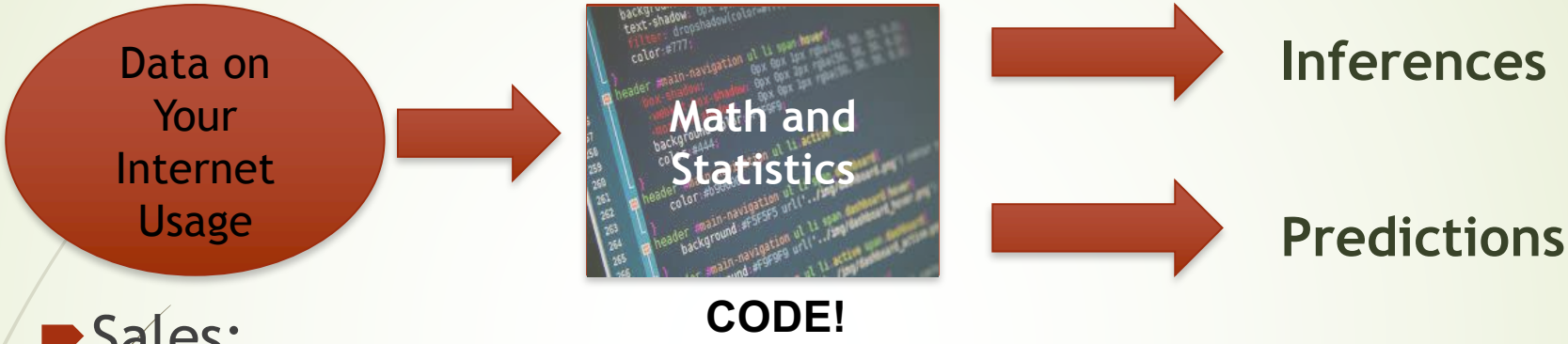
2013 Salesman of Year

Dislikes snakes

Hates doing dishes

Major life insurance holder

Analytics: Statistical Analysis of Internet Usage



CODE!

- Sales:
  - What **products** you will buy and when you will buy them
- Marketing:
  - **Opinion** shaping
- Politics:
  - Who will vote if contacted **before** the election and for whom

Data analytics has *transformed* our economy… and turned us into amazing *consumers*

Can Analytics Turn Us Into Better ***Producers***?

- To solve a *very hard*, *impending* problem: **feeding the planet**
  - Understanding is key to Food-Energy-Water management
  - Global: *500M people today are food-insecure
    - *15M US children going hungry tonight;
    - *9B people to feed by 2050
- Vast amounts of **data** surrounding the crop lifecycle
  - Weather, historical records, sensors, images (NDVI/thermal)
- Yet, the **data analytics** boom has not yet come to Ag
  - Despite the need to increase efficiencies and productivity
    - Do more with the same or fewer resources (land, water, $$)

http://www.cdfa.ca.gov/statistics/
http://www.ers.usda.gov/topics/international-markets-trade/global-food-security.aspx
Andrews-Speed et. al 2015

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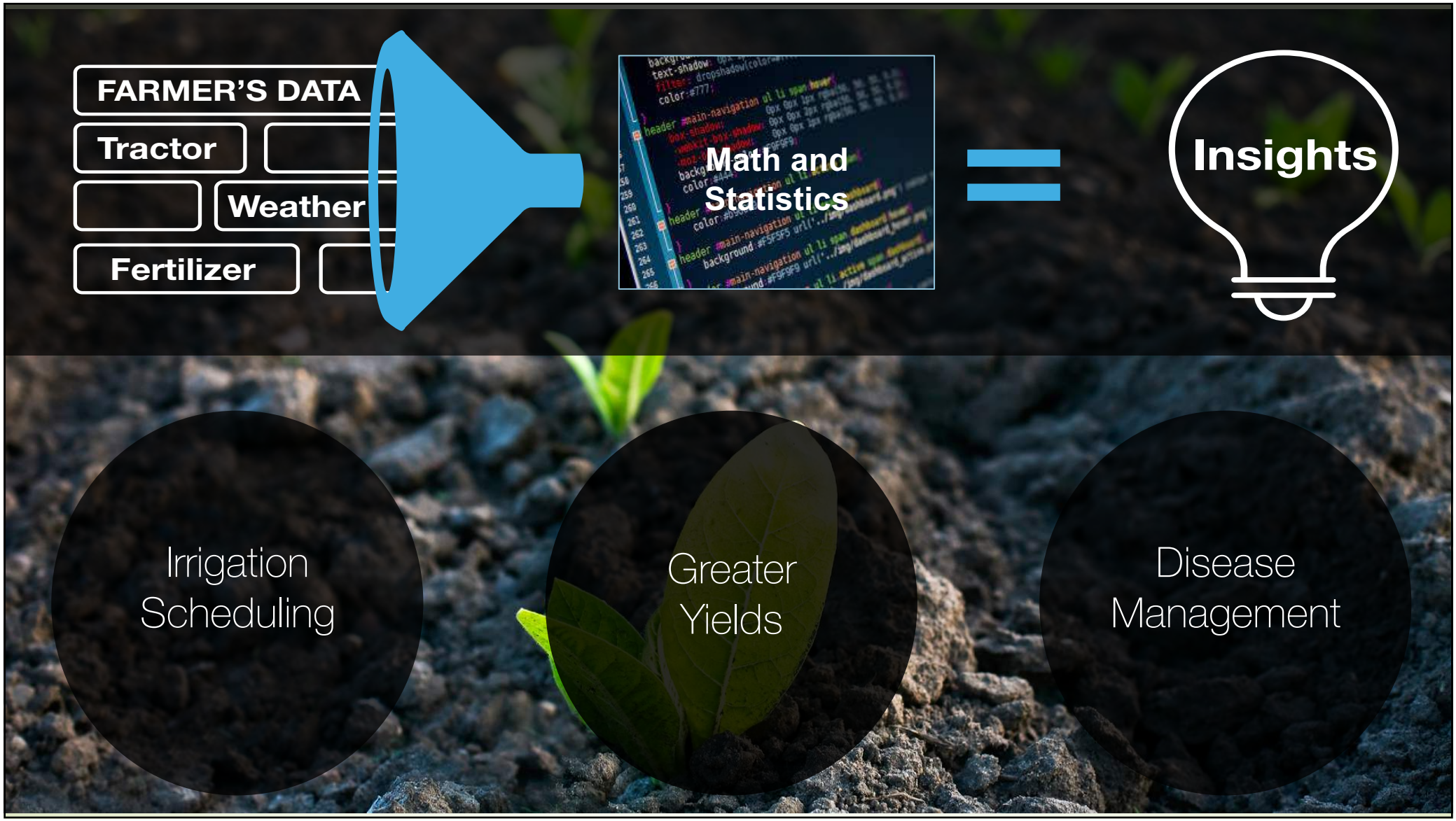
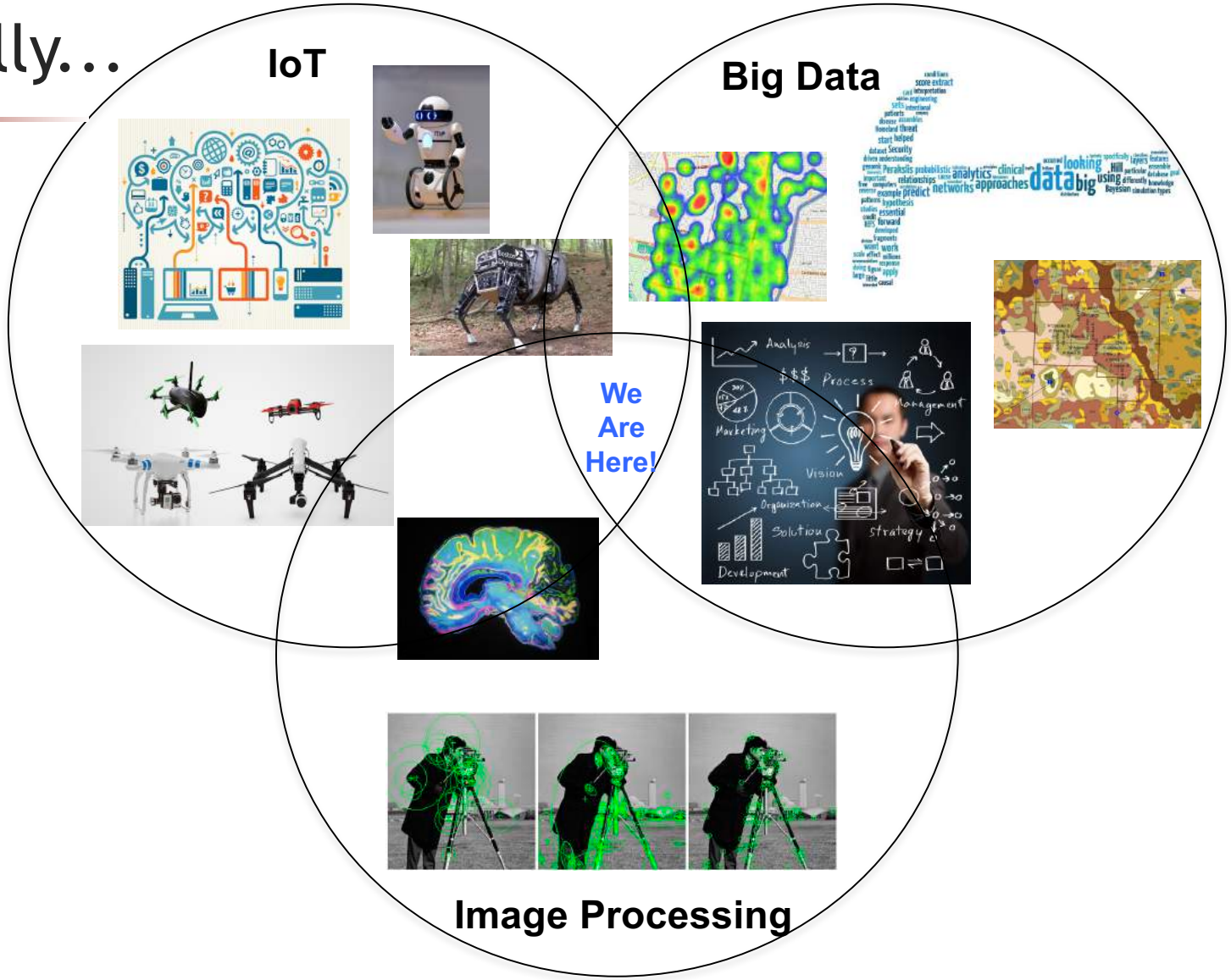

FARMER'S DATA
Tractor
Weather
Fertilizer
Math and Statistics
Insights
Irrigation Scheduling
Greater Yields
Disease Management

Technologically…



A New Infrastructure For Things (I4T)

Sensing Tier

Private Wireless/Radio Networks:
Low Latency / High BW

Edge Clouds

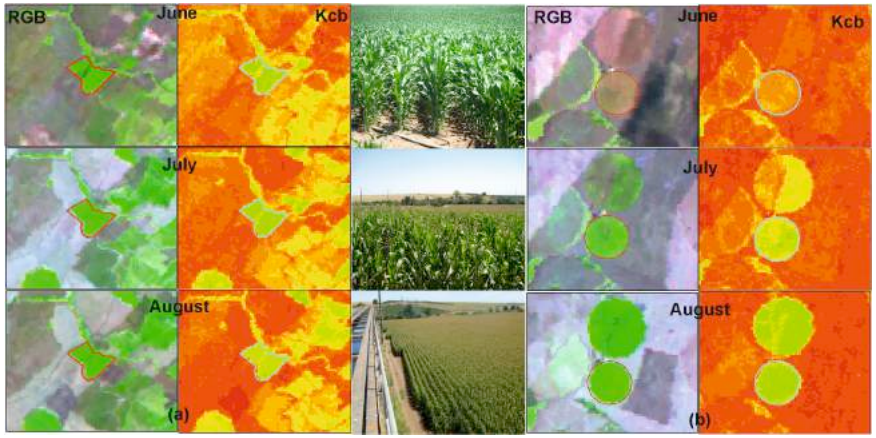
Edge Tier

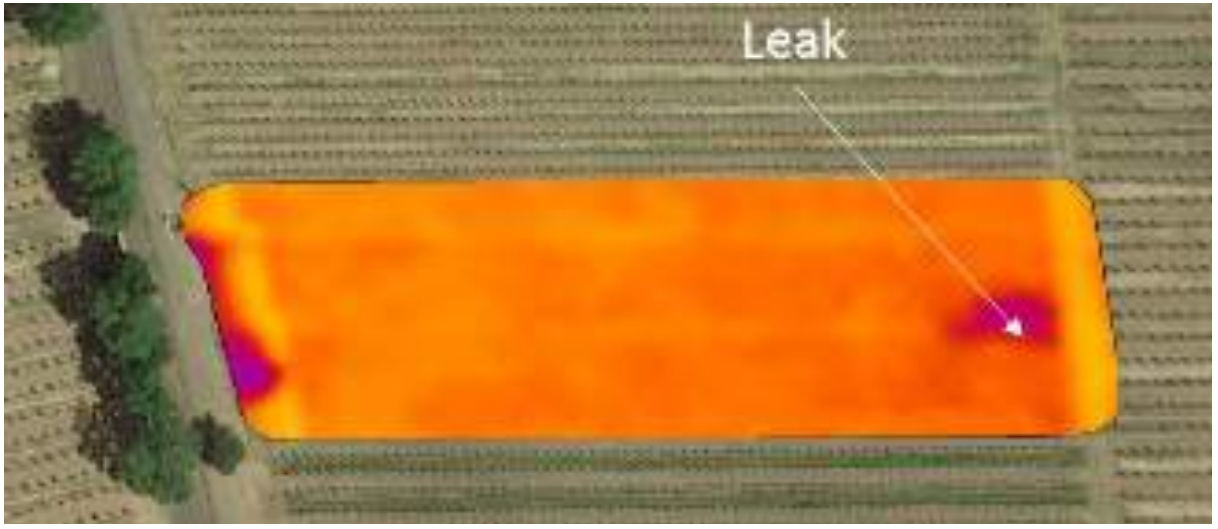
Internet: High Latency,
Low and Variable Bandwidth,
Intermittent Connectivity

Cloud Tier

UCSB Edge Clouds
- API-Compatible with Amazon/Google Clouds
- Multi-analytics (Hadoop, Spark; DNNs, ML, image proc.)
- Highly available and fault tolerant (self managing)

Example App: Droning On…





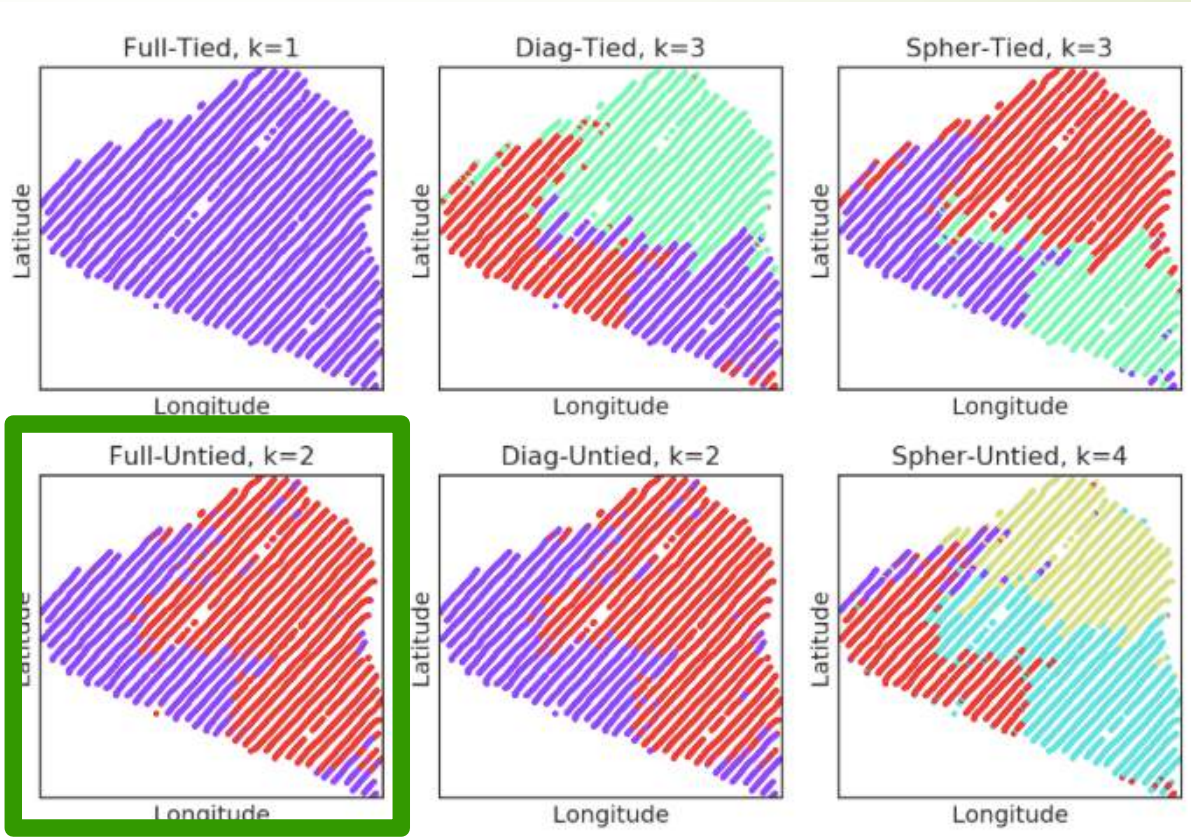
Example App: Field Management

- Identify contiguous management zones
  - Using electro-conductivity and other metrics about the soil
    - Moisture holding capacity, composition, elevation, Lat/Lon
  - Guide precision/differential irrigation, fertilization, harvesting
    - Root cause identification, estimate yields, and more
  - Goal: cluster measurements into "similar" zones; each managed differently

SmartFarm Clustering Service

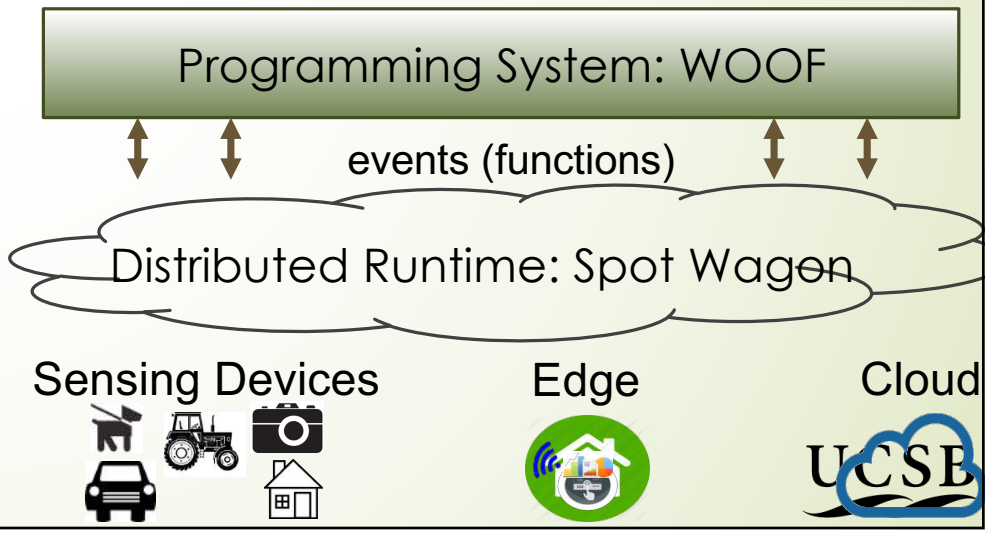
- Upload your data
- Performs multi-dimensional clustering using multiple statistical techniques
- Identifies best via a scoring function (info criterion)
- Visualizes results spatially

CalPoly SmartFarm



I4T Programming Platform

- Serverless Platform of Things (SPOT)
  - Self-service, easy to use by all
  - **Programming support**
    - Portable across IoT tiers → Simple event-triggered functions
  - **Distributed runtime system**
    - Open source, fault-resilient
    - Efficient function placement



SmartFarm Problem-Driven Research

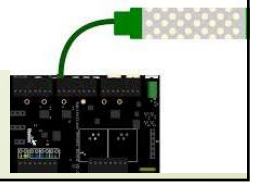
- **Hybrid-cloud approach**
  - Move the data to the code or the code to the data, whichever is better
  - Give growers control over their data

agTunes

- **Make it simple**
  - Needs to be like a household appliance
  - App Store for Ag
  - Soil library for farmers

- **Make it general**
  - Multi-analytics
  - End-to-end programming platform for IoT

SPOT



- **Make it inexpensive**
  - Sensor systems and microcontroller systems

Make It Useful For Students

- Validating research through
  - Collaborations with start-ups
  - Innovation partnerships

UC ANR

OBSERVANT™

tule

PowWow

gThrive

TerrAvion

UCSB

A New Kind of Computer Science

- Problem driven and empirical
  - Food-Energy-Water nexus
- Societal and regional impact
- Multidisciplinary collaboration
- Leverages entrepreneurial activity
- Engages the community

UCSB

Thanks!

UCSB RACELab

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