ICTD Capstone
Software Design for
Underserved Populations

CSE 482b
Course Overview, March 31, 2021
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Today

- Capstone Courses
- Project Ideas
- My background
Development Engineering

• Technological interventions to improve human and economic conditions in low-resource settings

• An engineering discipline aimed at addressing global inequity

• Develop principles for design, introduction, scaling, and sustainability of Global Good technology
What are the challenges


• Resource constraints: Finance, Infrastructure, Distance, Education and literacy, Governance

• Shocks: Climate Change, Global Pandemics
Setting

• Rapid, global economic and technological change
  • Many technologies are globally accessible

• Not just a split between “Developed” and “Developing Countries”, but within countries between “Urban-Affluent” and “Rural/Urban-Poor”

• In many ways, the world is getting better
  • Increasing literacy rates
  • Decline in maternal mortality rates
  • Near elimination of diseases such as polio
ICTD, Information and Computing Technologies for Development

• Technology with global impact
• Appropriate for ‘low resource’ settings
• Target development domains
  • Health, Education, Livelihood, Agriculture, Disaster Relief
• This quarter – many of the proposed projects around global Covid-19 immunization
CSE Capstone courses

• **Capstone Goals**
  • Projects must be large enough to require teams of several students to work on over one quarter.
  • Students must apply concepts from more than one sub-area of CSE (at the 300-level and above).
  • The work must involve a substantial design effort.
  • Students must present their work using formal oral presentations and written reports.
  • Efforts must culminate in an interesting, working artifact.
What I expect in a capstone

• Group projects
  • About five people
  • Different roles
• Design and Implementation
• Multiple check points and expert review
• Working, useful software
• Reasonable software process
• Presentation of results
The capstone challenge

- Too much stuff to fit into nine weeks in the spring
- Focus on Design, Development & Implementation
- Choose at start of course from a set of project ideas
Schedule

- Today – present project ideas
- Thursday – establish project groups

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Course Mechanics

• Group development of projects
• Lectures/class meetings for first few weeks
• Regular group meetings with course staff
• Later class sessions for presentations and demos
• Specific deliverables will be specified during the quarter
• Final turn in will include code and a paper (~10 pages)
Project Ideas

1. Vaccine Stock Tracker
2. Vaccine Passport
3. Immunization Campaign Planning System
5. Vaccine Impact Modelling tool.
6. Speed Test App for Tacoma Community Cellular Network
7. Red Cross Data Reporting Tool

3/31/2021
1. Vaccine Stock Tracker

• Problem: A country needs to keep track of vaccines as they are used in immunization campaigns
  • This is going to be particularly important for Covid vaccines as they are expensive, limited in availability, and are likely to supplied irregularly
  • Tracking vaccines needed for initial allocation as well as collecting unused vaccines after a campaign
• This project could be integrated into our existing Cold-Chain Information System
  • Mobile application for vaccine logisticians
  • Dashboard for ministry of health
  • Deployment in Uganda underway
2. Vaccine Passport

- Allow verification of vaccination status
- Basic model allows established authorities to enter vaccine information and others to verify credentials
- Should have some basis in cryptography or digital signatures
- Could involve mobile apps for vaccinated and/or verifiers
- Need to consider multiple different components of the system
3. Immunization Campaign Planning Tool

- Developing countries will likely rely on campaigns for Covid immunization
  - Identify population group and locations
  - Plan for campaign with supplies and schedule
  - Required data: demographics and health system information

- Create various web based planning tools
- Will require some background research and domain knowledge
- Possible applications of Algorithms or AI
4. Notification and registration tool

- Tool to support tracking of individuals for immunization
- Target needs of a developing country (such as Uganda)
- Multi-dose vaccines complicate this problem
- Integrate across multiple messaging technologies
5. Vaccine impact modelling tool

• Develop framework for modeling impact of Covid vaccination
• Framework would allow various different models to be used
  • Fairly naïve models could be implemented initially with a mechanism for domain experts to add models later
• Scenario: tracking progress of global immunization and predicting impacts of different immunization approaches and coverages
• Variables to consider: Vaccine type, populations, coverage by dose, efficacy on different strains
• Possibly set up as a global modelling tool
6. Local Connectivity Lab

- Non-profit partnering with UW to increase free/low-cost broadband access in higher-need areas throughout the city
- Makes use of existing UW and city network infrastructure such as buildings and fiber-optic cables to extend coverage
- 4G LTE networks, powered by open5gs, operating in the Citizen’s Band Radio Service frequency spectrum (band 48)
6. Performance Measurement App

- BaiCells Nova 233 CBRS basestations can support 96 simultaneous users with a peak bandwidth of 116 Mbps per link.
- Project goal: measure network performance over time, especially how it changes with more users and under backhaul saturation.
  - Potential for gamification
  - Report to a server
  - Some level of anonymity to protect privacy.
- Skills: Android app development; user interface design.

Early example: Line-of-sight performance of LTE test network at UW, with Baicells 14 dBi Consumer Premises Equipment receiver.
7. Red Cross Data Reporting Tool

• UW has collaborated with IFRC to develop RC2, and ODK-X app for disaster response
  • [https://media.ifrc.org/ifrc/rc2-relief-tool/](https://media.ifrc.org/ifrc/rc2-relief-tool/)

• Mobile application for tracking distribution of aid

• Challenge in making use of the data and customizing reporting during field deployments

• Project would develop user-configurable system to process system information
My background

• PhD, Stanford (1985)
  • Thesis: *The Complexity of Parallel Algorithms*

• Post Doc (1985-86)
  Mathematical Science Research Institute, Berkeley

• University of Washington (since 1986)
  • Broad range of work: Algorithms, Software Engineering, Educational Technology, Computing for Development

• Sabbatical 1993-1994
  • Indian Institute of Science, Bangalore
    • Parallel Algorithms

• Sabbatical 2001-2002
  • Microsoft Research, Redmond
    • Learning Science and Technology

• Sabbatical 2008-2009
  • PATH, Seattle
    • Digital Health

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Distance Education (2001-2008)

• Sabbatical at Microsoft to develop ConferenceXP technology
  • Basis of UW PMP Distance Learning
  • Multisite courses including UW-Redmond-Pakistan

• Tablet PC Technology
  • Classroom Presenter
  • Interactive Classroom Activities
Digital StudyHall (Lucknow, India)

- Tutored Video Instruction Pedagogy
- Target: Rural schools in India
- Model
  - Lesson videos recorded at hub school
  - Training of facilitators
  - Facilitation model
  - Cost realism in technology deployment
Digital Health at PATH

• Global Health NGO Based in Seattle
  • Development of health technologies
  • Global advocacy
  • Implementation of global programs

• Increased emphasis on Digital Health
  • Promotion of Global Good software
Projecting Health

• Video based education in Health
• Implementation with PATH
• Community created video content
• Facilitated showing in Mothers’ groups
• Broad range of health messaging
  • Maternal Health
  • Immunization
  • Family Planning
  • Infectious diseases
  • Sanitation
Open Data Kit

- Digital Data Collection on Android Phones
- Launched by Gaetano Borriello (2008)
- Took over project in 2014
- ODK 1.0 Forms based data collection
  - Spun out as independent Open Source Project
- ODK-X Mobile Data Management
- Multiple current projects in immunization and with International Red Cross
Digital Financial Services

• Project with BMGF
• Funded to investigate technological challenges to adoption of Digital Financial Services
• Project Areas
  • Security and Fraud
  • USSD Technology
  • Technological Inclusion
• Established center in Lahore, Pakistan

Improved access to financial services is critical for raising people out of poverty
Cold Chain Information System

• Track information about country vaccine cold chains
  • Status of vaccine refrigerators and cold rooms
• ODK-X Application for immunization logisticians
• Dashboard for country managers
• Deployment in multiple countries with Gavi and WHO