CS 4518 Mobile and Ubiquitous Computing
Lecture 17: Smartphone Sensing Apps: StudentLife

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StudentLife
College is hard...


- **Lots of Stressors in College**
  - Lack of sleep
  - Exams/quizzes
  - High workload
  - Deadlines
  - 7-week term
  - Loneliness (e.g. freshmen, international students)

- **Consequences**
  - Burnout
  - Decline in psychological well-being
  - Academic Performance
Students who Need Help Not Noticed

- Many stressed/overwhelmed students not noticed
  - Even worse in large classes (e.g. intro classes with 150-200 students)
  - Many do not seek help
  - E.g. < 10% of clinically depressed students seek counseling
Research questions: Are sensible patterns (sleep, activity, social interactions, etc) reliable indicator of suffering student (e.g. low GPA, depressed, etc)?

Stressors
- Deadlines
- Exams
- Quiz
- Break-ups
- Social pressure

Consequences
- Anxiety
- Depression
- Poor exam scores
- Low GPA
- ??

Sensible signs
- Sleep
- Social interactions
- Conversations
- Activity Level
- ??
StudentLife Continuous Sensing App

- Use smartphone sensing to assess/monitor student:
  - Psychological well-being (depression, anxiety, etc)
  - Academic performance
  - Behavioral trends, stress patterns as term progresses
- Demonstrates strong correlation between sensed data and clinical measures of mental health (depression, loneliness, etc)
- **Shows smartphone sensing COULD be used to give clinically valid diagnoses?**
  - Get clinical quality diagnosis without going to clinic
- Pinpoint factors (e.g. classes, profs, frats) that increase depression/stress
Potential Uses of StudentLife

- Student planning and stress management
- Improve Professors’ understanding of student stress
- Improve Administration’s understanding of students’ workload
General StudentLife Approach

- Semester-long Study of 49 Dartmouth College Students
  - Continuously gather sensible signs (sleep, activity level, etc)
  - Administer mental health questionnaires periodically as pop-ups (called EMA)
  - Also retrieve GPA, academic performance from registrar
- **Labeling:** what activity, sleep, conversation level = high depression

**Mental Health Questionnaires (EMA)**
- Anxiety
- Depression
- Loneliness
- Flourishing

**Data Gathering app, automatically sense**
- Sleep
- Social interactions
- Conversations
- Activity Level, etc

Labels
(for classifier)

GPA
(from registrar)
Specifics: Data Gathering Study

- Entry and exit surveys at Semester start/end
  - on Survey Monkey
  - E.g. PHQ-9 depression scale

- 8 MobileEMA and PAM quizzes per day
  - Stress
  - Mood (PAM)

- Automatic Sensed data
  - Activity Detection: activity type, WiFi’s seen
  - Conversation Detection:
  - Sleep Detection: duration

PAM: Pick picture depicting your current mood
StudentLife Data Gathering Study Overview

**Automatic Continuous Sensing**
- accelerometer
- microphone
- light Sensor
- GPS/Bluetooth

**Behavioral Classifiers**
- activity
- conversation
- sleep
- location/co-location

**Self-reports**
- SurveyMonkey
- mobile EMA

**Statistical Analysis**
- mental health
- academic performance
- Dartmouth term lifecycle
- EMAs
- outcomes

**Android Phone**

**Cloud**

Figure 2. StudentLife app, sensing and analytics system architecture.
Clinical Mental Health Questionnaires

- MobileEMA popped up mental health questionnaires (widely used by psychologists, therapists, etc)

  - **Patient Health Questionnaire (PHQ-9)**
    - Measures depression level

  - **Perceived Stress Scale**
    - Measures Stress level

  - **Flourishing Scale**
    - Measures self-perceived success in relationships, self-esteem, etc

  - **UCLA loneliness survey**
    - Measures loneliness (common in freshmen, int’l students)
Study Details

- 60 Students started study
  - All enrolled in CS65 Smartphone Programming class
  - 12 students lost during study (NR’d class?)
  - 30 undergrad/18 graduate level
  - 38 male/10 female

- Incentives given to study participants
  - StudentLife T-shirt (all students)
  - **Week 3 & 6**: 5 Jawbone UPs (like fitbit) to 5 in raffle
  - **End of study**: 10 Google Nexus phones in raffle

- 10 weeks of data collection
Some Findings

- Fewer conversations or co-locations correlate with
  - Higher chance of depression

- Higher stressed correlated with
  - Higher chance of depression

- More social interactions correlated with
  - Higher flourishing, GPA scores
  - Lower stress

- More sleep correlates with
  - Lower stress
Findings (cont’d)

- Less sleep?
  - Higher chance of depression

- Less activity?
  - More likely to be lonely, lower GPAs

- No correlation between class attendance and academic performance (Hmm... )

- As term progressed:
  - Positive affect and activity duration plummeted
Findings (cont’d)

- Plotted total values of sensed data, EMA etc for all subjects through the term
Study Limitations/Trade Offs

- **Sample Selection**
  - Voluntary - CS65 Smartphone Programming class (similar to CS 4518)

- **User participation**
  - **Burden**: Surveys, carrying phone
  - Disinterest (Longitudinal study, EMA annoyance)

- **Lost participants**

- **Sleep measurement inaccuracy**
  - Naps
Discussion

- Expand to other colleges
  - Semester vs 10 week vs 7 week term
  - Similar results?

- Privacy concerns