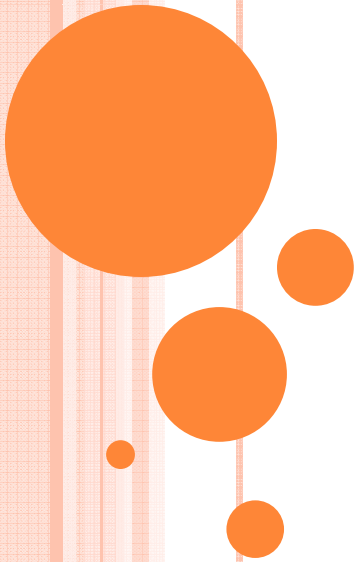

Activity Theory in Action

Brian Tran, CS 260

Activity Theory (AT) Review

- Activities are key structure in AT
  - Composed of *subjects, tools*, and *objective*
  - Ex. Bob (subject) is using the weights and treadmills (tools) to become physically fit (objective)
- Activities can be broken down into objectives
  - *Actions* are steps taken to complete the objectives
  - Ex. Bob is lifting the weights.

Activity-Centered Design (ACD)

- Methodology for ubiquitous computing (ubicomp) design
- Encourages designers to focus on higher-level activities and offers activity-centric view of HCI
  - Orienting designs toward human needs
- Allows everyday context to be systematically incorporated into designs
- Design process should address how activities shape requirements of tools and how creation of tools reshapes activity

Challenges to Applying ACD

- ACD is mainly a set of perspectives and concepts
- Three Main Challenges
  - Hard to represent everyday observations as activity models
  - Human activities span extended time-period
    - Actions can affect evolving activities
    - Certain interaction behaviors of an activity must take into account a collective status of a stream of individual events
  - Application impact can only be tested in real world
    - Needs great deployment and cost

ACTIVITYDESIGNER

- Attempt by Yang Li and James A. Landay to create tool that allows designers to apply ACD
- Designers iterate on design based on human activities, thus orienting design towards users' high-level needs
- Key Features
  - Model human activities based on field data
  - Design based on stream of events over period of time
  - Generates prototypes that can run on various devices for continuous in situ testing

Activity Models as Everyday Observations

- Everyday observations represented as scenes
  - Designer adds concrete scenarios about everyday life to design as *scenes* (action, media, situation, comments)
  - Designers describe *roles* involved in scene and their activity of interest
- Aspects of everyday life represented as themes
  - Scenes are sorted into themes
    - Ex. Staying physically active

Activity Stream-Based Behaviors

- ActivityDesigner allows multiple prototypes to see their sum effect on activities
- Activity query language designed because multi-dimensional and uncertainty
  - Query specifications: Action, role, scene, frequency, period of time, etc.

Testing Prototypes

- Local Tools
  - Designer can take user role to debug
- In Situ (Real World)
  - Installing prototypes on target devices
    - Virtual machine provided for running ActivityDesigner prototype
    - Web application for low-end devices
  - Incorporating appropriate activity sensing components
    - Users self-report
    - Automatically detect users' activites based on real sensors and inference

STUDIES WITH ACTIVITYDESIGNER

- Laboratory User Study
  - Participants (CS/HCI/UI/IS background) overall found easy to use and useful
- Health Monitor
  - Shows nutrition and workout status of user and friends
  - Researchers collected data about eating healthy and staying active to import field data into ActivityDesigner
- UbiGreen
  - Displays user transportation patterns
    - Give positive feedback when patterns are less harmful to motivate users to make changes to improve environment
  - Researchers observed people's transportation activities and used ActivityDesigner to create mobile phone prototype of UbiGreen
- Social Garden
  - Creates display for students and faculty to improve social awareness
  - Scenes: seminars, student-advisor meetings, hallway chats

Activity-Based Computing (ABC)

- Addresses mobility and cooperation in human work activities
- Activities can be broken down into 3 dimensions
  - Tasks and materials
    - Activity is carrying out task which use/manipulate some material
    - Service and application is decoupled
  - Time and space
    - Activities are stateful
    - Each service needs to be stateful and able to provide own state
  - Users
    - Users can see state of activity
    - Users can work together or separately on same activity

THE ABC FRAMEWORK

- Described in Jakob E. Bardram's paper
- Goal is to provide runtime and programming platform for development and deployment of ABC applications
- Features
  - Runtime infrastructure that handled complexities of managing distributed and collaborative activities
  - API helps programmer create ABC-aware applications that can be deployed in runtime infrastructure

ABC Framework Implementing ABC Principles

- Mobility: activity suspend and resume
  - Enable activities to be suspended in one device, and resumed in another
  - State management and stateful applications
    - Applications retain state and can give state to manager so user can resume state from a different application
- Collaboration
  - Asynchronous
    - Users take turns suspending/resuming shared activity
    - Require app to handle state info for entire application
  - Synchronous
    - Real-time activity sharing
    - Require app to handle state info for each of its components

CAAD (Context-Aware Activity Display)

- Designed to improve task management for information workers through information management
- Automates creation and maintenance of task representations that are then displayed to user
  - Minimizes user overhead
  - Generates contextual awareness
- Motivating scenarios
  - Information access scenario
    - Citing a paper that you do not remember the author, title, etc.
  - Work awareness scenario
    - Checking collaboration between multiple teams without interviewing members of each team

Logging Component

- Gathers evidence of information use on computer
  - File access and modification, email transmission, application use and state, and web browsing activity
- Tracks what, when, how long, tools used, and people communicated with

Pattern Mining Component

- Input to data mining algorithm
  - Logged events are grouped into contiguous segments of time
  - Time segments aggregated together as large nonnegative matrix with integer elements
- Offline vs. online context structure calculations
  - Offline calculations run daily and create context structures
  - Online updates calculate how likely user is working on each particular context structure
- Determining number of context structures
  - Greedy algorithm. Merge context structures with similar events and time intervals

Awareness Component

- Shows user's activity by context structures grouping information items
- Dynamically configured according to online predictions on which context structures are relevant to user
- Leverages what is most relevant to user in display
- Represents implicit context of user's work-flow and cause reflection

SUMMARY: ACTIVITY THEORY APPLICATION

- ActivityDesigner centers design focus on activities rather than tasks and gives the designer tools to track the evolution of an activity over time
- The ABC framework put the focus on the activity rather than the platform so that users could interact with the activity independent of a given device
- CAAD used context structures to group similar information items similar to how activities group actions

Q&A

Discussion Questions

- Discuss institutions aside from healthcare that the ABC framework could be applied to.
- Do you believe that some prototypes could be designed better without applying activity theory? Justify your reasoning. If so, list some examples.