

# The Software Engineering of Mobile Application Development

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Pace University, NY, USA

Thanks:  
NCIIA  
IBM

# Agenda

- Audience
- Context
- Java ME
- Process

**Mobiles**

**Java ME**

**Android**

**Designing**

**Coding**

**Testing**

**Process**

# Audience

Who are the attendees?

Context

# A Unique Medium – More than a Computer

- Ubiquity
  - Everywhere and always with you
- Accessibility
  - Always on
  - Everything can be accessed from a mobile phone (e.g., Web, music, radio, photos and videos)
- Connectivity
  - Staying connected to a social circle at all times



twitter

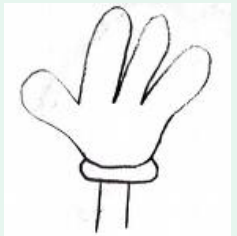
# A Unique Medium – More than a Computer



- Calls and voice commands



- Cameras, accelerometers and sensors for proximity and ambient light



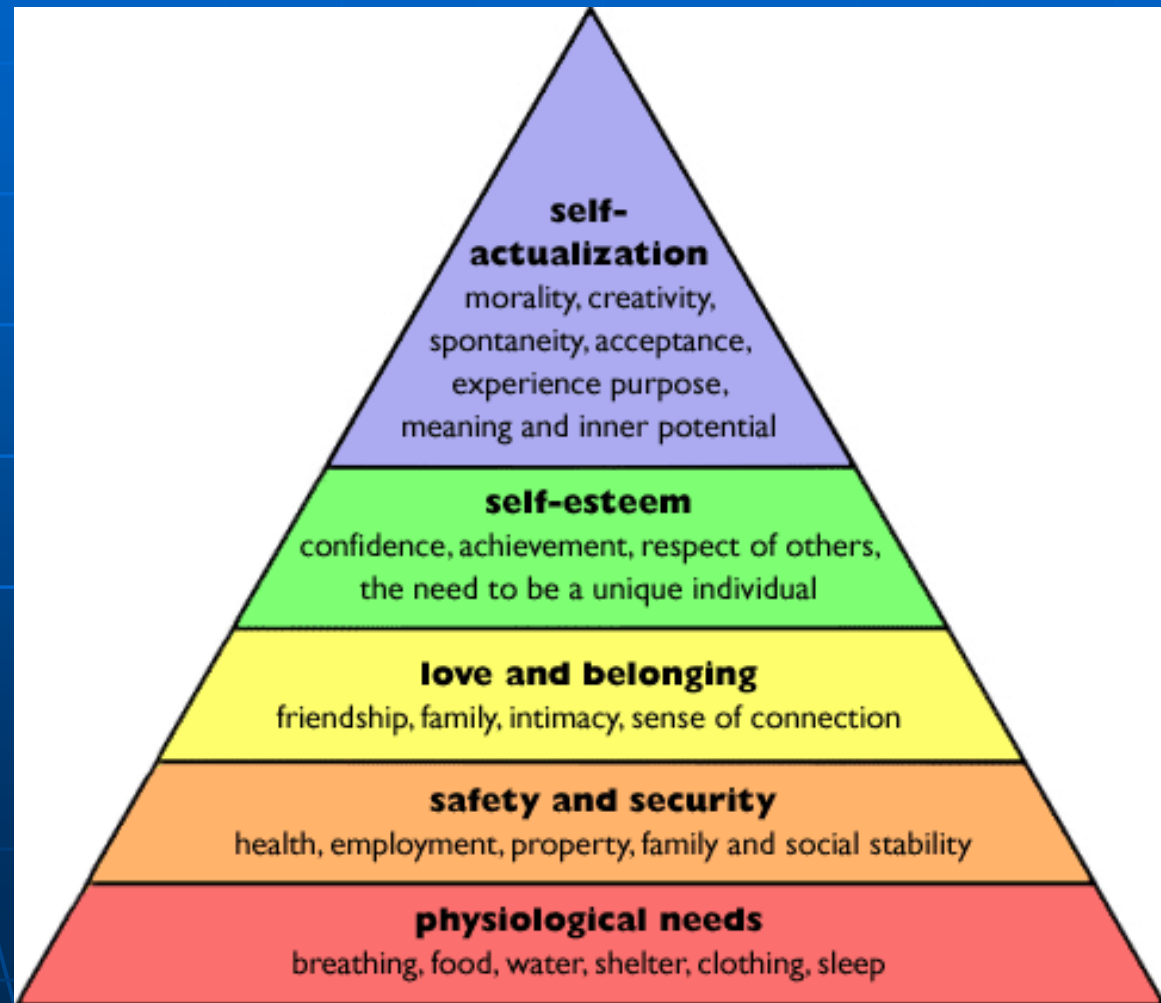
- Touch screen



- Location by triangulation or GPS

# Mobile Phones and the Maslow's Hierarchy of Needs

Who are the users?



# Global Mobile Market

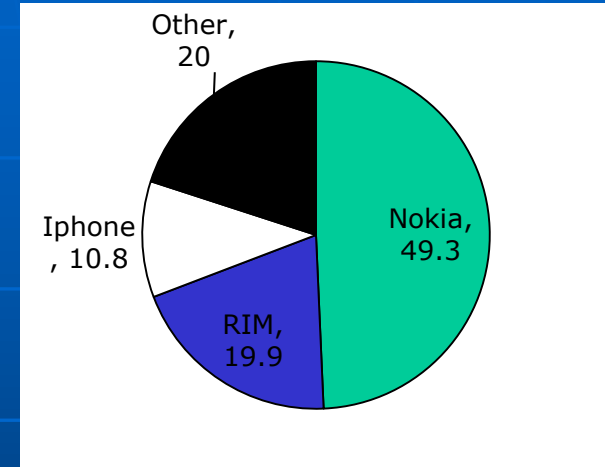
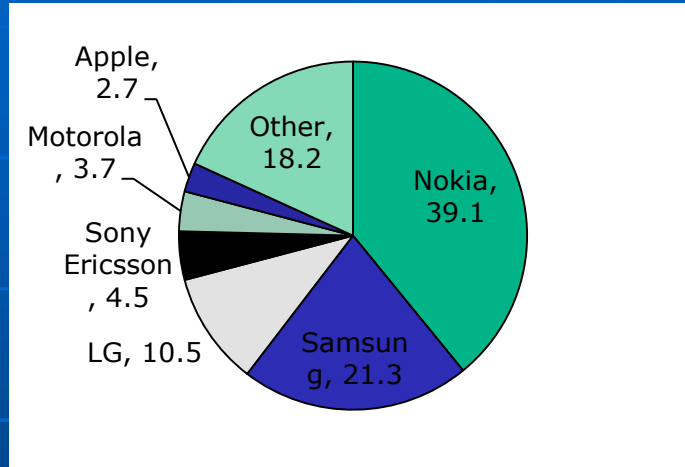
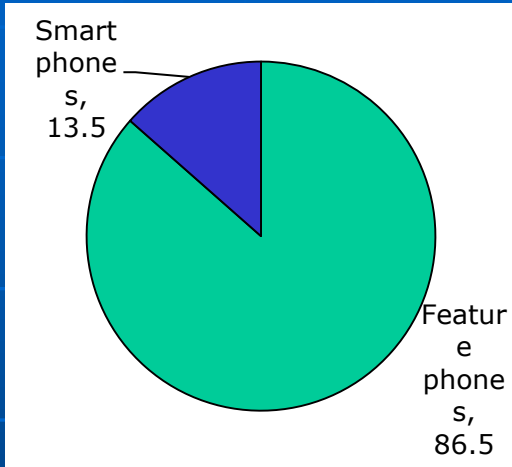
- USA
  - Engagement in mobile content and downloading applications
  - Experience with 3G
- Latin America
  - 12% of the population has mobile phones
  - 6 times the PC penetration
  - Brazil is the 5<sup>th</sup> mobile market in the world
- Asia Pacific
  - Japan uses a higher-speed transmission protocol for content (W-CDMA)
    - More emails than SMS, Flash support, QR codes, TV
  - South Korea has a very successful mobile game market
  - India has the lowest mobile Internet penetration rate in the region. It is famous for outsourcing of mobile development
- Europe, Middle East and Africa
  - Less carriers than in other parts of the world
  - UK and Spain are the largest mobile markets in Europe
  - Africa is the fastest growing market



# Devices

- A wide variety of devices by the main vendors
  - E.g., Nokia, Motorola, Sony Ericsson
- A wide variety of operating systems
  - E.g., Blackberry, Palm OS, Windows CE/Mobile, Symbian, motomagx, linux
- A wide variety of development environments
  - E.g., Java ME, Qualcomm's BREW, Google' Android, Google App Engine (GAE) for mobile web applications, JavaFX, Qt
- A wide variety of programming languages
  - Java, Python, Flash Lite, Objective C, C, C++, JavaScript, HTML and CSS for Widgets

# Global Handset Sales



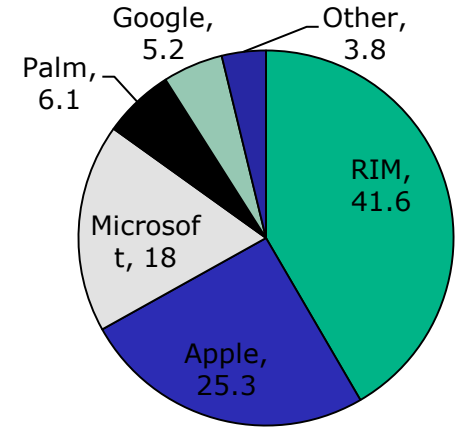
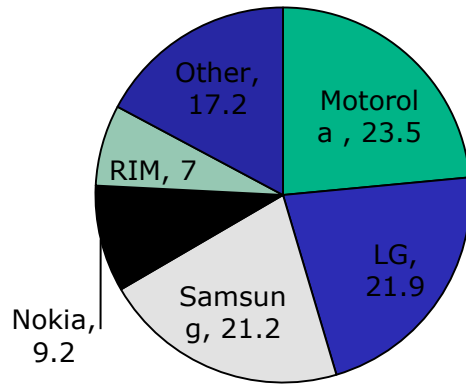
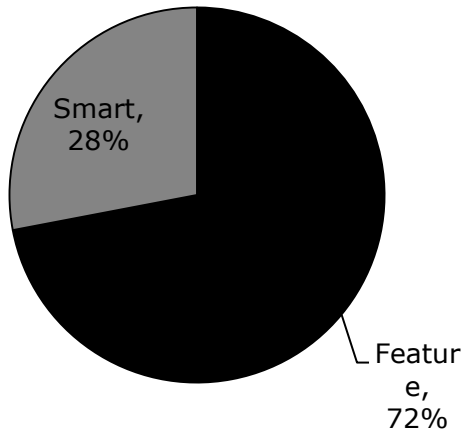
Feature / Smart phones (1Q 2009)

Feature phones (4Q 2009)

Smart phones (1Q 2009)



# US Handset Sales



Feature / Smart phones

Feature phones

Smart phones



<http://www.cellular-news.com>

# Mobile Stores

App Store	Android Market	Ovi Store	Blackberry App World
July 2008	March 2009	May 2009	November 2009
70% / 30%	70% / 30%	70% / 30%	80% / 20%

- Iphone apps
  - > 150 000 apps
  - > 500 million downloads
- Free and paid apps
- Not all phones are supported
- Not open in all countries



App Store

# App Store

Fichier Édition Présentation Contrôles Store Avancé Aide

iTunes

Afficher Recherche iTunes Store Ouvrir une session

BIBLIOTHÈQUE

- Musique
- Films
- Émissions de télévision
- Podcasts
- Radio

STORE

iTunes Store

LISTES DE LECTURE

- Mix de soirée
- Genius
- Ajouts récents
- Années 90
- Clips vidéo
- Les 25 plus écoutés
- Meilleur classement
- Morceaux récents

NOUVEAUTÉS

YETISPORTS 1 Jeux

Paris Traffic Navigation

Tours de Magic Edition Gold Divertissement

iGuerilla Jeux

HotelForYou Voyages

24 Special Ops Jeux

Ankagua3D Jeux

SILEHT SCOPE (EU) Jeux

human atlas

LEAF TROMBONE WORLD STAGE

1 000 000 000  
1 milliard d'Apps téléchargées  
Nous avons un gagnant

My Football PRO

ACTUALITÉS

FRANCE 24 LIVE Actualités

iFootball Jeux

3D Gallery Photographie

Gydes Jeux

ZXL Supercross Jeux

Bike Or Die 2 Jeux

Bloons Jeux

Earth3D+ Divertissement

RECOMMANDÉS

Heat Pad - Surface Thermosensible Re... Divertissement

Global Bond - Quantum of Solace Divertissement

Screen Cleaner Pro Divertissement

Les Blondes - Episode 16.3 Livres numériques

RACOURCIS

Explorer

Recherche avancée

Votre compte

Outils avec iTunes

Utiliser un code

Support

Mes alertes

Compléter l'album

CLASSEMENT APPS PAYANTES

1. Avertinoo Navigation
2. Métro Paris Voyages
3. Playman Track & Field Jeux
4. Wild West Pinball Jeux
5. Flight Control Jeux
6. Camera Zoom Photographie
7. Paris Traffic Navigation
8. iExpense Finance
9. allRadio Musique
10. iBière Divertissement

CLASSEMENT APPS GRATUITES

1. Fluids Divertissement
2. 9-Toolbox (Free Event) Livres
3. Tux Rider World Challenge Jeux
4. Wikango Navigation
5. iBare Jeux
6. V.B.M. Divertissement



# Android Market

ANDROID

Home

Market

Media Room

What is Android?

## Android Market

### Featured

[Top Paid](#)

[Top Free](#)

#### Are you a developer?

Publish your application on Android Market.

[Learn more](#)

### Brain Genius Deluxe



Developer: [Glu Mobile](#)

Category: **Games -- Brain & Puzzle**

Get a head start to getting smart by playing through a daily dose of teasing and original brain exercises. Brain Genius Deluxe is the Android game to train your brain, with 24 touch and motion-controlled games as well as bonus puzzles including Sudoku! It's pure Genius!

Brain Genius Deluxe

My Maps Editor by Google

Translate

1Cast

Last.fm - Personal Radio

Loopt

Quote Pro

Block Breaker Deluxe

Texas Hold'em Online

nru

1 2 3





# Nokia Ovi Store

ov<sup>i</sup> NOKIA

sign in | Register

Select your mobile | English

Radio FG Maintenant disponible sur votre Nokia!

» TELECHARGEZ ICI

FG.  
DJ RADIO

Home

Search for content for your mobile

Recommended Applications Games Audio & Video Personalisation

Prayer Times for smart phones  
Utilities  
★★★★★

AlloCiné  
News & Info  
★★★★★

The Flashlight + SOS  
Utilities  
★★★★★

Closer  
News & Info  
★★★★★

RATP Premium  
City guides & Maps  
★★★★★

ZumZum  
Puzzle  
★★★★★



# BlackBerry App World Pricing

The screenshot shows the BlackBerry App World website. At the top, there is a navigation bar with links for "North America", "Worldwide", "Partners", "Developers", and "Why BlackBerry". A search bar is located on the right. Below this is a secondary navigation bar with "SMARTPHONES", "APPS & SOFTWARE", "COMMUNITY", "SUPPORT & SERVICES", "SOLUTIONS", and "WHERE TO BUY".

The main content area features a "BlackBerry App World" header with a breadcrumb trail: "Home > Apps & Software >". Below this is a large image showing various app thumbnails, including "Twitter", "Slacker Radio", "WTAM-1100", "Magic 105.7", and "Score Mobile".

On the left side, there is a sidebar with the "BlackBerry App World" heading and a link to "Download BlackBerry App World". Below this are several categories of software:

- BlackBerry Desktop Software
- BlackBerry Device Software
- BlackBerry Messenger
- BlackBerry Theme Studio
- BlackBerry Web Signals
- Business Software
- Early Adopter Program

The main content area also includes the text "Discover a world of possibilities" and two call-to-action buttons: "Browse apps online >" and "Get it for your smartphone >".

At the bottom, there is a social media sharing bar with icons for various platforms and a "Follow BlackBerry" section with links to YouTube, my, and Facebook. The Facebook link shows "Like 40K". There is also a link to "BlackBerry on Facebook Live Stream" and a "Hide" button.

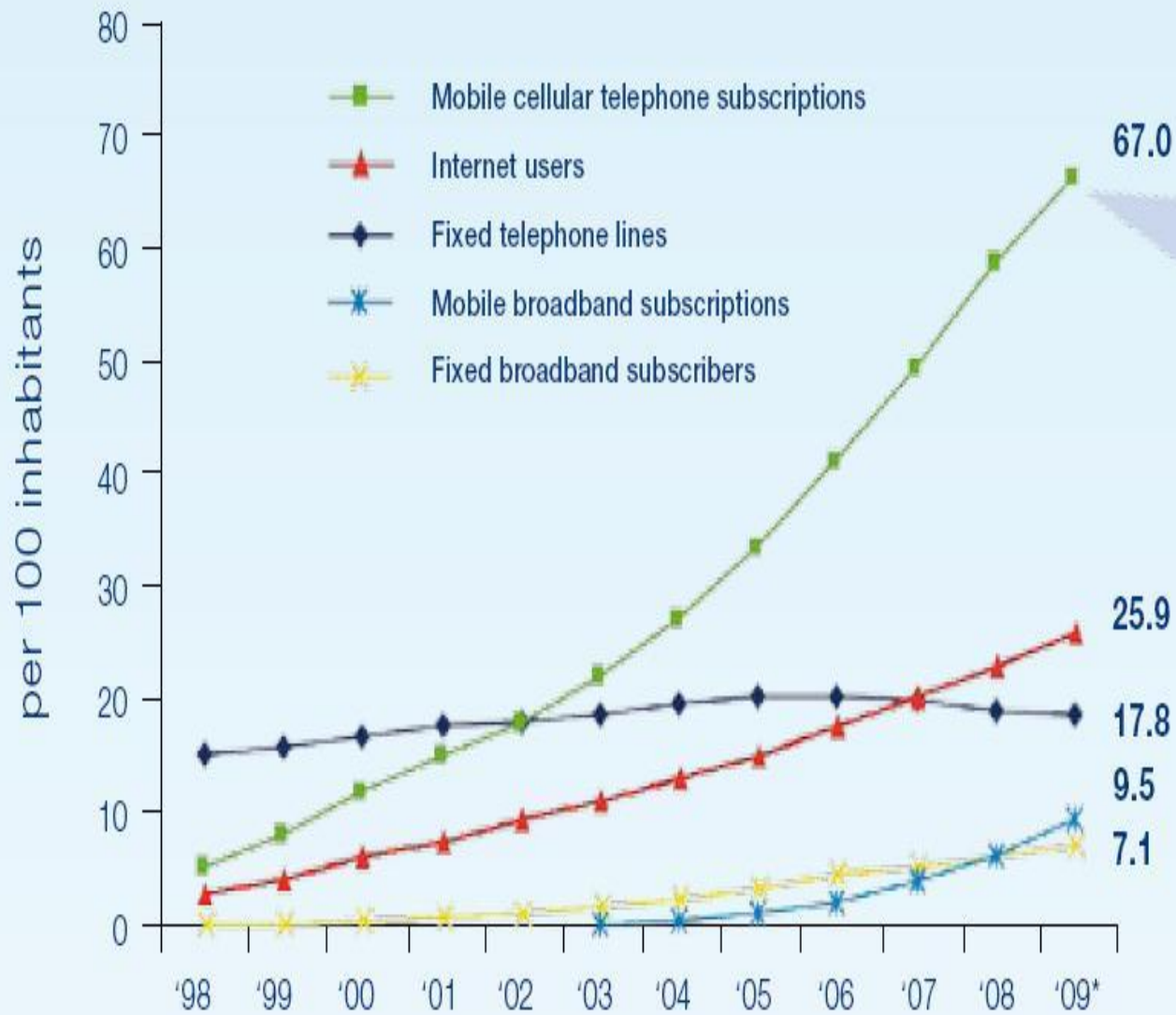


# Applications

- Featured App Store apps
  - [http://www.facebook.com/AppStore?v=app\\_380449627359](http://www.facebook.com/AppStore?v=app_380449627359)
- Featured Android market apps
  - <http://www.android.com/market/featured.html>
- Ovi Store
  - <http://store.ovi.com/content/5406/send-to-friend>
- Blackberry App World
  - <http://appworld.blackberry.com/webstore/>

# Mobile Phones in Africa

- 4 billions mobile subscribers expected worldwide by 2010
  - A large part of these subscribers will be in Africa
  - 70% of the world's mobile subscriptions are in developing countries, NY Times April 13, 2008
- A new paradigm to think about bridging the digital divide and reach the bottom of the pyramid
- Pioneering initiatives in agriculture, health, education, banking, citizen media, disaster and humanitarian relief, democratic participation...



An estimated 4.6 bn subscriptions globally by the end of 2009

Source: ITU World Telecommunication/ICT Indicators Database.

\* Estimates.



# Innovations in the African Context

## Yobalema



3G sim card

\$5  
(Senegal)



Senegal

Ghana

Nigeria

\$20

\$1.5 / day or \$30 / month for unlimited calls and Internet  
(Senegal)

\$100

\$1 / hour \$5 / day  
(Senegal)

Source:  
<http://expressotelecom.com>

# Technologies

- SMS
- MMS
- QR codes
- Mobile web sites
- IVR (Interactive Voice Response)
- Bluetooth
- Client applications
- Widgets
- USIM
- UDDI
- Mobile TV
- Wallpapers
- Ringtones



**Christelle SCHARFF** PAGE UNIVERSITY

In 3 easy steps

- Home
- Teaching
- Research
- Grants
- Publications
- Software
- Links
- Others

**Home**

Dr. Christelle Scharff is associate professor of computer science at [Pace University, Manhattan, NY](#). She obtained her PhD in Computer Science from the [Jean Monnet University of Saint-Etienne](#) in France under the supervision of [Dr. Claude Kirchner](#) and [Dr. Christopher Lynch](#) and did her research at [LORIA](#) and [INRIA Lorraine](#).

Her PhD is in **automated deduction and theorem proving**. Automated deduction and theorem proving study programs that automatize reasoning. The main applications of automated deduction and theorem proving are software and hardware verification. Proofs on software are crucial in that they provide assurance of correctness that cannot be obtained using testing techniques.

In the recent years her interest is in the development and implementation of graph-based decision procedures for special domains (e.g. congruence closure, lists). [Stribble](#), an open source little engine of proof for the empty theory, the theory of lists and the theory of encryption, has been released in July 2006.

In the last years she has also been involved in global software engineering and mobile application development.

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Christelle Scharff -

''

**More**

Sony Ericsson k750i

## Setting up an SMS Service

- What do you need to set up your own SMS service?
  - A computer
  - A GSM modem or a phone with GSM modem
  - A software that acts as a SMS gateway
    - Kannel SMS gateway (<http://kannel.org>) is open source
    - RapidSMS (<http://rapidsms.org>) is open source
    - Ozeki (<http://ozeki.com>) is a commercial software
    - FrontlineSMS (<http://www.frontlinesms.com/>) is free



OZEKI

FRONTLINE

Data Collection


Source:  
<http://rapidsms.org>

- Malnutrition surveillance



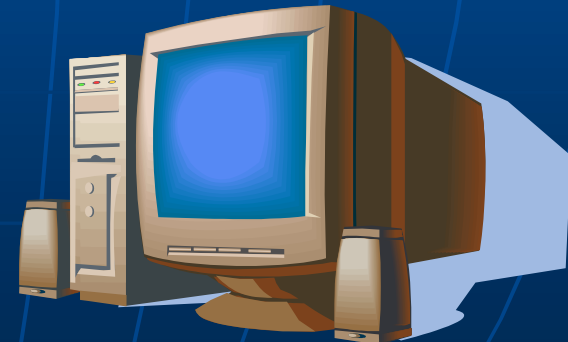
*Integrated Nutrition & Food Security Surveillance Data Collection*

Child #	Sex	Age	Weight	Height	% Weight for Height	MUAC	Oedema	Diarrhoea
70	M	24	7.5	66.5		13.5	N	N
28	F	13	6.7	66.4		12.1	N	N
42	F	42	8.6	66.8		13.8	Y	N

 **report** GMC# child# weight height MUAC oedema diarrhea

EXAMPLE: **report** 1001 70 7.5 66.5 13.5 N N

GMC number      child number      Kg (to the nearest decimal point)      cm (to the nearest decimal point)      cm (to the nearest decimal point)      N for no Y for yes





SMS

# Education

RapidSMS 



Source:  
<http://rapidsms.org>

- Sending SMS as a tool for literacy and numeracy



 **Tostan**  
Community-led Development

<http://tostan.org>



SMS

Web

# Web-to-SMS



Communicator

Welcome: christelle

Balance: [234.9](#)

Buy SMS Credits

LOGOUT

Home

Messaging

Inbox

Address Book

My Settings

Billing

Message Reports

Help

Compose Message

[Compose Message](#)  
[Message Preferences](#)

COMPOSE MESSAGE

[Mobile Number Format](#)

To:  0

Selected Contacts

- 
- 
- 
- 

Message:

Chars:  (160/SMS)

[\[Advanced\]](#) ▶

My Two-way ?

Activating your Two-Way account allows your recipients to reply to the text message.

[De-activate](#) My Two-Way

# Mobile Web

## Christelle SCHARFF



### Home



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# Does your Web site appear well on a mobile phone? <http://ready.mobi/>

Username:  Password:

Use your mobiForge sign-in - [Sign up@mobiForge](#) - [Lost password](#)

## Page results

URL tested: <http://www.csis.pace.edu/~scharff>

<http://www.csis.pace.edu/~scharff>

1

Overall

BAD

**It will definitely display very poorly on a mobile phone.**

Your mobi.readiness score is calculated from the results displayed below. Failing tests and large page sizes both lower the score. Read through the report to understand how to improve your score - and your site.

### Readiness, Size, Time & Cost

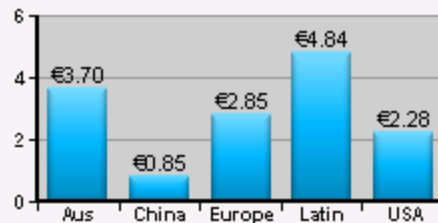
Score



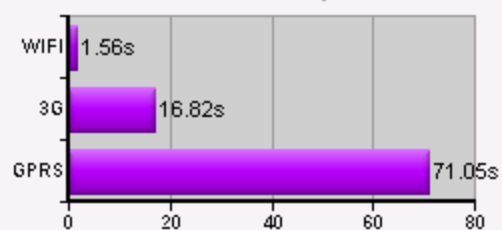
Size



Estimated cost



Estimated speed



### About this report



Ready.mobi uses industry standard tests developed with the W3C and leading mobility companies.

Ready.mobi provides an analysis of how your web content is likely to function on a mobile device.



Many tests performed by ready.mobi are defined by the W3C in the [MobileOK Basic Tests 1.0](#) document.

### More testing?



[Back to start page](#)

[Retest this page](#)

Test another page

### Feedback



How useful did you find this report?

## Visualisation

(Note: these emulators use their own device specific HTTP headers and therefore may receive a different page than that tested by the report)

Select a device

- Nokia N70
- Samsung z105
- Sony Ericsson k750i**
- Motorola v3i
- Sharp GX-10



## Test summary



10 Passes



4 Warnings



12 Fails



1 Comments

(include email for a reply)

GO

[Bugs / discuss](#) [Request a feature](#)

## What now?

Visit [mobiForge](#) for everything you need to know about developing for mobile



**Want to improve?**  
Read our [FREE Mobile Developer's Guide](#). Try our [training course](#) and get [dotMobi certified](#).



**Want some help?**  
Get all your questions answered at our [developer forums](#)



**Ready to go live?**  
If you're mobi ready why not get your site listed in the worldwide [.mobi site directory?](#)

## Other domains

You might also be interested in these domains

## Additional tests

(Click name of tests to see more detail in the panel below)

- [MIME types](#)
- [Character encoding](#)
- [Pop up windows](#)
- [Alt texts](#)
- [Image maps](#)
- [Specify image sizes](#)
- [Measures](#)
- [Page title](#)
- [Use of stylesheets](#)
- [Stylesheets dependency](#)
- [Objects or scripts](#)
- [Auto refresh](#)
- [Redirection](#)
- [Default input mode](#)
- [Provide defaults](#)
- [Page size limit](#)
- [Large graphics](#)
- [Tables](#)
- [Nested tables](#)
- [Tables for layout](#)
- [Access keys](#)
- [Caching](#)
- [External resources](#)
- [Structure](#)
- [Image Resizing](#)
- [Google sitemap](#)
- [Form submit buttons](#)

See <http://www.mobisitegalore.com/index.html>  
to see how to design a mobile web site easily!

# QR Codes

- QR codes are codes that can stock 7089 numerical characters and 4296 alphanumeric characters
- QR codes store data, addresses and urls in magazines, signs, buses and business cards
- QR codes are common forms of mobile messaging in Asia
- Require phone equipped with the correct reader software
- QR code generator
  - <http://qrcode.kaywa.com/>



# Crowdsourcing Crisis Information

- Ushahidi – <http://ushahidi.org>

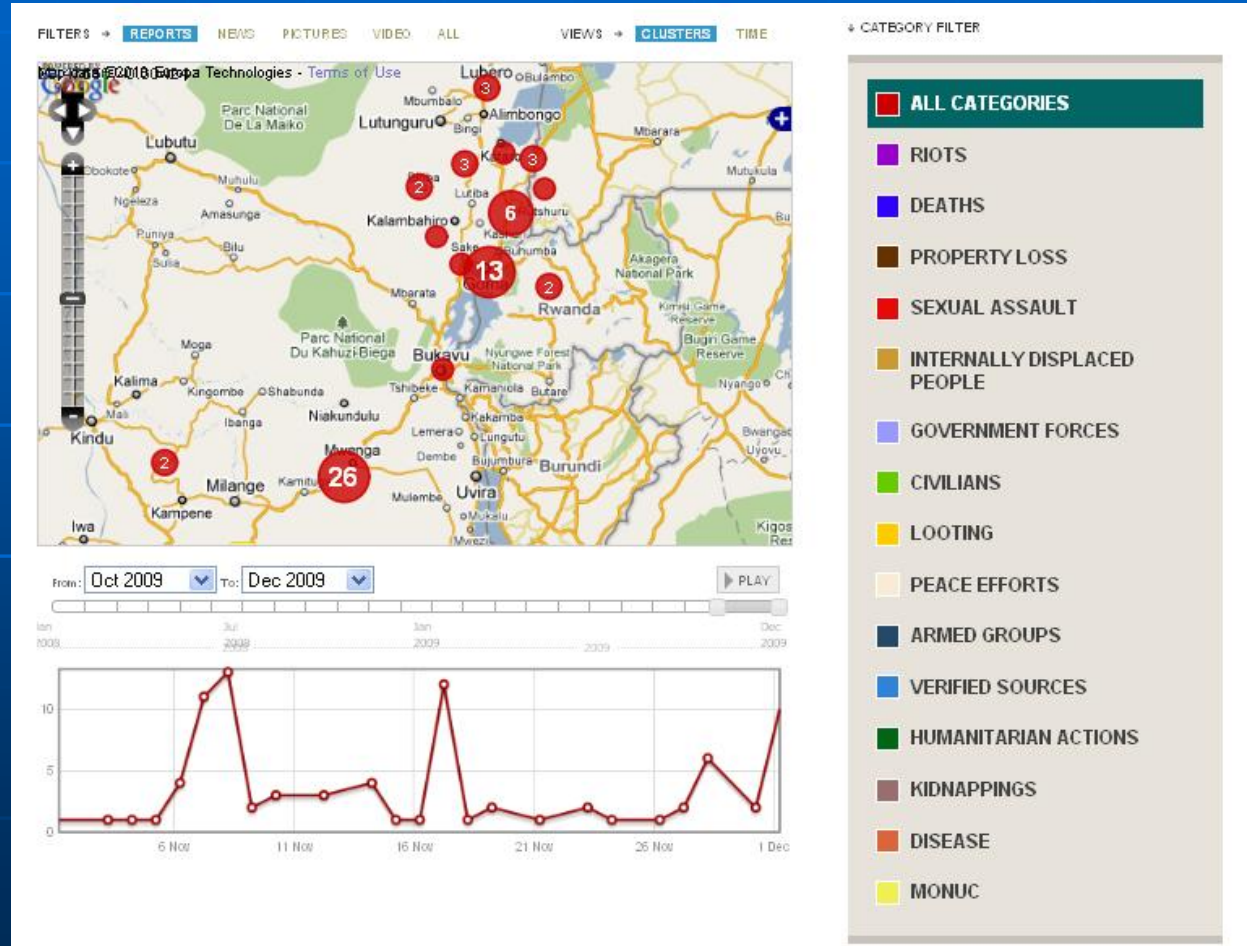
SMS



Emails



Web



*Republic Democratic of Congo*





# Project in Senegal

- Teach students the skills to engineer mobile solutions
- Educate students on the potential and procedures (technical and business levels) for creating tech startups (based on mobile technology)
- Develop mobile solutions for Senegal



**Mobile Phone  
Application Development  
and  
Web Design for Senegal**

<http://www.mobilesenegal.com>







# Project in Senegal

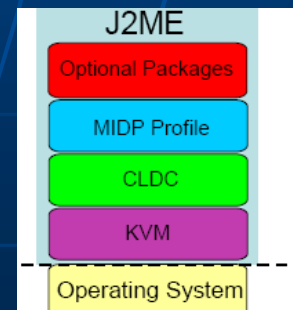
- Boot camps in mobile application development at Thies
- Courses in mobile application development in different universities in Senegal
- National competition for the development of mobile applications
- Training for faculty
- Application for children, artisans and universities
  - KomKom – accounting for artisans – Judge choice prize



Calling All Innovators.com

- More than 75 mobile Web sites

<http://www.artisanatthies.com>, <http://artthies.com>



# Java ME

# Why Java?

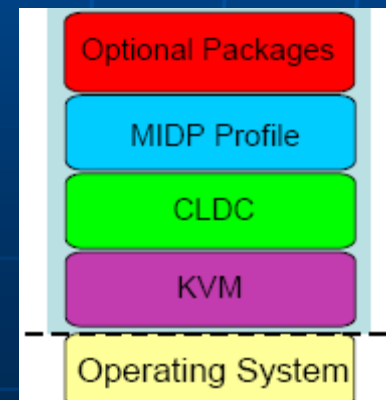
- The Java platform is
  - Safe – the code executes within the JVM
  - Robustness – automated garbage collection prevents memory management
  - Portability – a single executable can run on several devices
  - Rich set of APIs
- Market trends
  - 80% of the mobile devices are Java compliant
  - Lots of Java applications on the market
  - Operators are developing Java services
  - “Can transfer Java knowledge to Android”

# Java Platform

- Composed of 3 elements:
  - Java programming language specification
  - Virtual machine
  - APIs (Application Programming Interfaces)
- Supports a wide range of hardware:
  - Java SE (Java Standard Edition)
  - Java EE (Java Enterprise Edition)
  - Java ME (Java Micro Edition)
  - Java Card

# Java ME

- Java ME is not a piece of software like Java SE
- Java ME is a platform, a collection of technologies and specifications for small devices
- Java ME is divided into 3 components:
  - Configurations
  - Profiles
  - Optional packages



# JCP

- Java Community Process
  - <http://jcp.org/>
- JCP is a consortium of experts (companies and individuals) who develop and evolve Java technology specifications
- A *specification* is based on the description of the language, virtual machine, platform editions, profiles, and application programming interfaces
- JCP stages: New **Java Specification Request** (JSR) review, Early draft review, Public review, Proposed Final Draft, Maintenance Review, Rejected, Removed
- List of all the JSR: <http://jcp.org/en/jsr/all>
  - JSR 82 – Bluetooth, JSR 120 – SMS Messaging

# Configuration

- A *configuration* is a specification that defines the minimum virtual machine and base set of APIs to develop applications for a family of devices
  - Data types, basic systems and threads (Boolean, Long, Thread, Runtime, Throwable, Math...)
  - Utility classes (Calendar, Date, Hashtable, Random, Stack, Timer, TimerTask, Vector...)
  - etc
- Example:
  - CLDC 1.1 / JSR 139 – Connected Limited Device Configuration
  - <http://jcp.org/aboutJava/communityprocess/final/jsr139/index.html>

# Profile

- A *profile* extends a specification and add more specific APIs to provide a more complete environment to develop applications
- Profiles can include APIs for user interface and persistence storage
- Examples:
  - MIDP 2.0 / JSR 118– Mobile Information Device Profile
  - MIDP 2.0 offers advanced networking, security, gaming, and media features
  - <http://download.oracle.com/javame/config/cldc/ref-impl/midp2.0/jsr118/index.html>



# Optional Packages

- An *optional package* provides functionalities that may not be associated with a particular configuration and profile
- Examples:
  - JSR 82 - Bluetooth API
  - JSR 120 - Wireless messaging API WMA
  - JSR 172 - J2ME web services

# Stack

- A device implements a complete software stack that consists of a configuration, a profile and optional packages to make it clear to the developer on what to expect from the device
- Example: JSR 185 Stack - JTWI (Java Technology for the Wireless Industry)



# Fragmentation

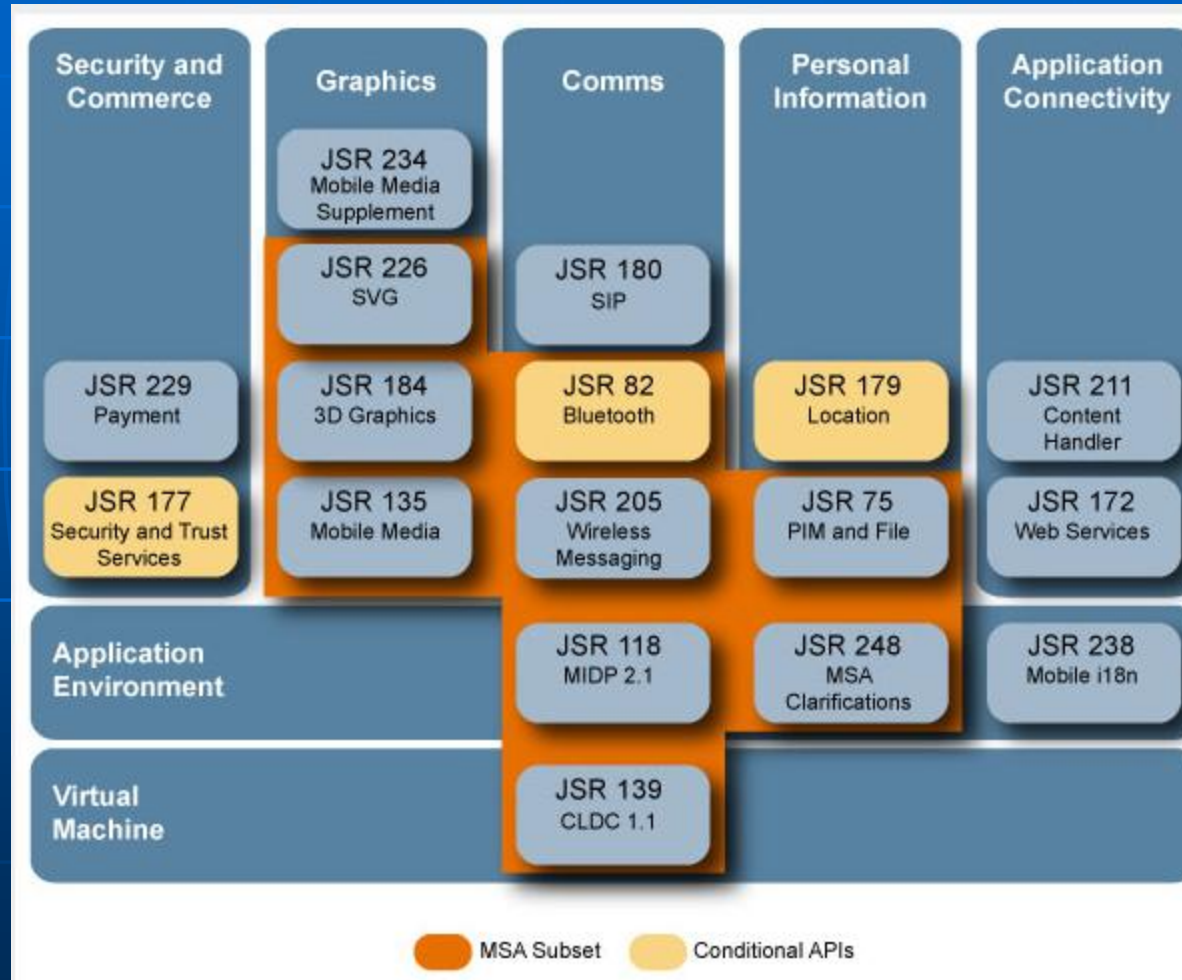
- *Fragmentation* is the inability to "write once and run anywhere" due to the multitude of vendor-specific and optional APIs
- Developing an application targeting  $n$  different devices required it to be tested on the  $n$  devices
- JTWI JSR 185 is one step to provide a comprehensive set of functionalities in a standard application development by clarifying and combining vendor-specific and optional APIs



# MSA

- Mobile Service Architecture JSR 248
- MSA is a specification built on CLDC 1.1, MIDP 2.1 and JTWI to incorporate new technology and services
- MSA is the new wireless industry-defined standard
- MSA is divided in 2 branches: MSA and MSA subset
- MSA contains a set of mandatory and conditionally mandatory APIs
  - A conditionally mandatory API is an API that is not present on all devices (e.g., JSR 179 Location API)
- Advanced Mobile Service Architecture JSR 249 is next!

# MSA



Source: unknown

# Nokia 6300



SR 139 Connected, Limited Device Configuration (CLDC) 1.1

JSR 118 MIDP 2.0

JSR 185 Java™ Technology for Wireless Industry

JSR 75 FileConnection and PIM API

JSR 82 Bluetooth API

JSR 135 Mobile Media API

JSR 172 J2ME™ Web Services Specification

JSR 177 Security and Trust Services API for J2ME™ (CRYPTO and PKI packages)

JSR 184 Mobile 3D Graphics API for J2ME™

JSR 205 Wireless Messaging API 2.0

JSR 226 Scalable 2D Vector Graphics API

Nokia UI API

HTML over TCP/IP

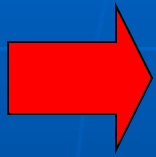
WAP 2.0

XHTML over TCP/IP

Flash Lite version    Flash Lite 2.0

# Development Environments

- Used in this tutorial
  - Java jdk 6
    - <http://www.oracle.com/technetwork/java/javase/downloads/index.html>
  - Sun Java Wireless Toolkit for CLDC
    - <http://java.sun.com/products/sjwtoolkit/>
  - Eclipse
    - <http://www.eclipse.org>
  - EclipseME plugin
    - <http://eclipseme.org>
- Optional
  - Nokia PC suite to deploy files on the devices
  - Nokia S40 6<sup>th</sup> edition SDK to have a Nokia S40 series device emulator

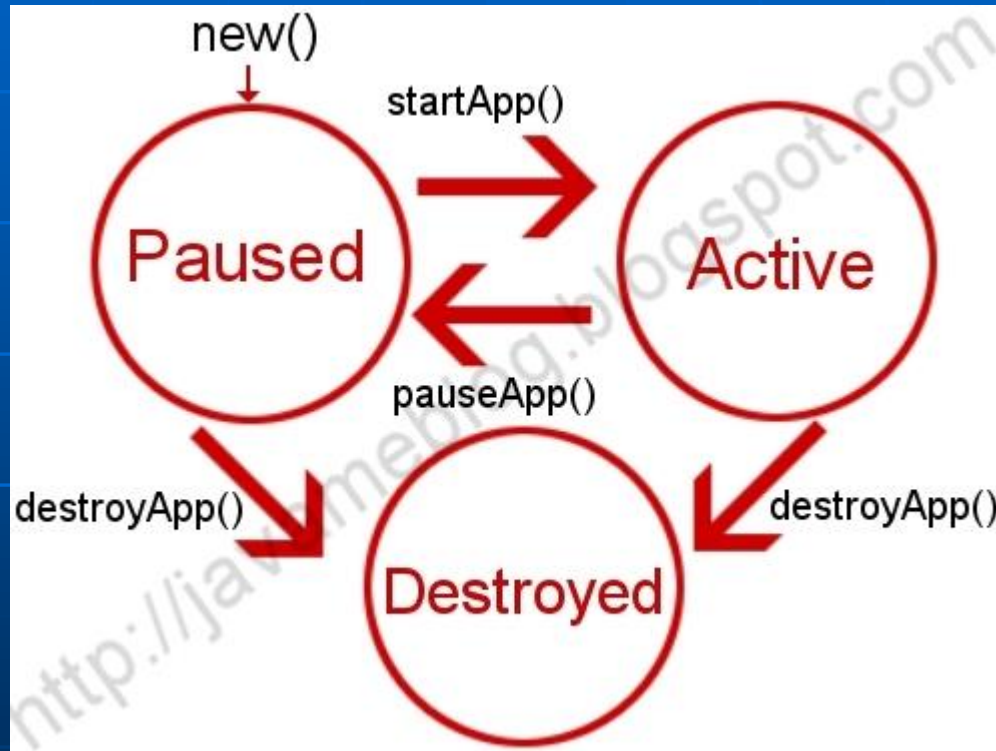


# MIDlet

- A MIDlet is an application that can run on MIDP devices
- A MIDlet is a class that inherits from `javax.microedition.midlet.MIDlet`
- A MIDlet has three methods:
  - `startApp()` – to initialize the MIDlet or resume a paused MIDlet
  - `pauseApp()` – to pause the application
  - `destroyApp()` – to clean up the application and release all resources
- These methods are *callback* – the Application Management Software (AMS) calls them whenever necessary
- These methods can also be called in the MIDlet code



# MIDlet Lifecycle



# MIDlet Suites

- One or more MIDlets are packaged together into a MIDlet suite composed of:
  - A Java Archive (JAR) file – containing the user-defined classes, images and sounds that make up the application and the JAR file manifest that describes the attributes of the MIDlet
  - A Java Descriptor (JAD) file – containing the description of the MIDlet suite
    - It permits a device to examine the descriptor before downloading the whole MIDlet suite

# Skeleton of a MIDlet Class

```
import javax.microedition.lcdui.Command;
import javax.microedition.lcdui.CommandListener;
import javax.microedition.lcdui.Displayable;
import javax.microedition.midlet.MIDlet;
import javax.microedition.midlet.MIDletStateChangeException;

public class SkeletonMIDlet extends MIDlet implements CommandListener {

    public SkeletonMIDlet() {}

    protected void destroyApp(boolean arg0) throws MIDletStateChangeException {}

    protected void pauseApp() {}

    protected void startApp() throws MIDletStateChangeException {}

    public void commandAction(Command arg0, Displayable arg1) {}

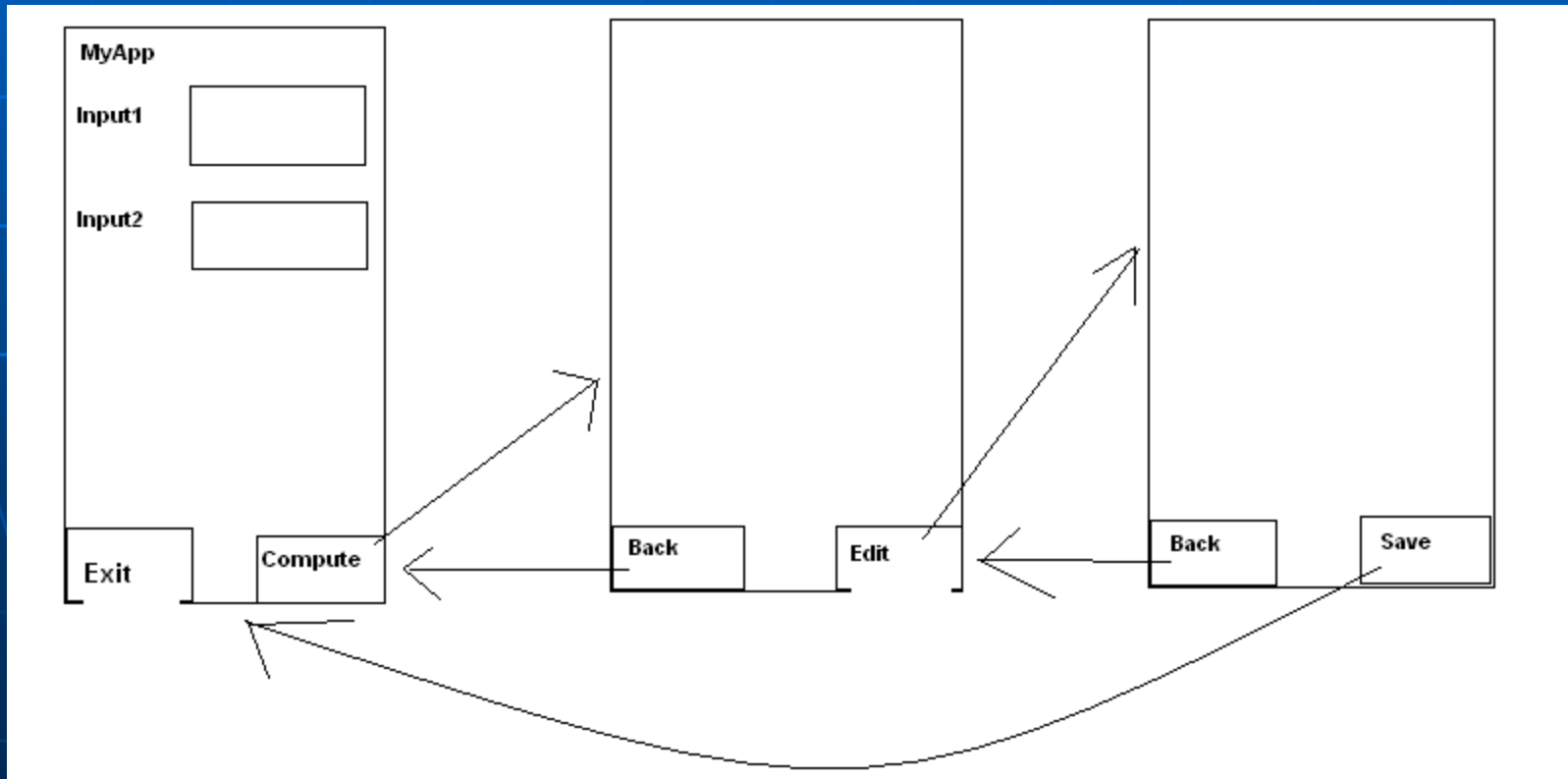
}
```

# Designing Mobile Applications in Java ME

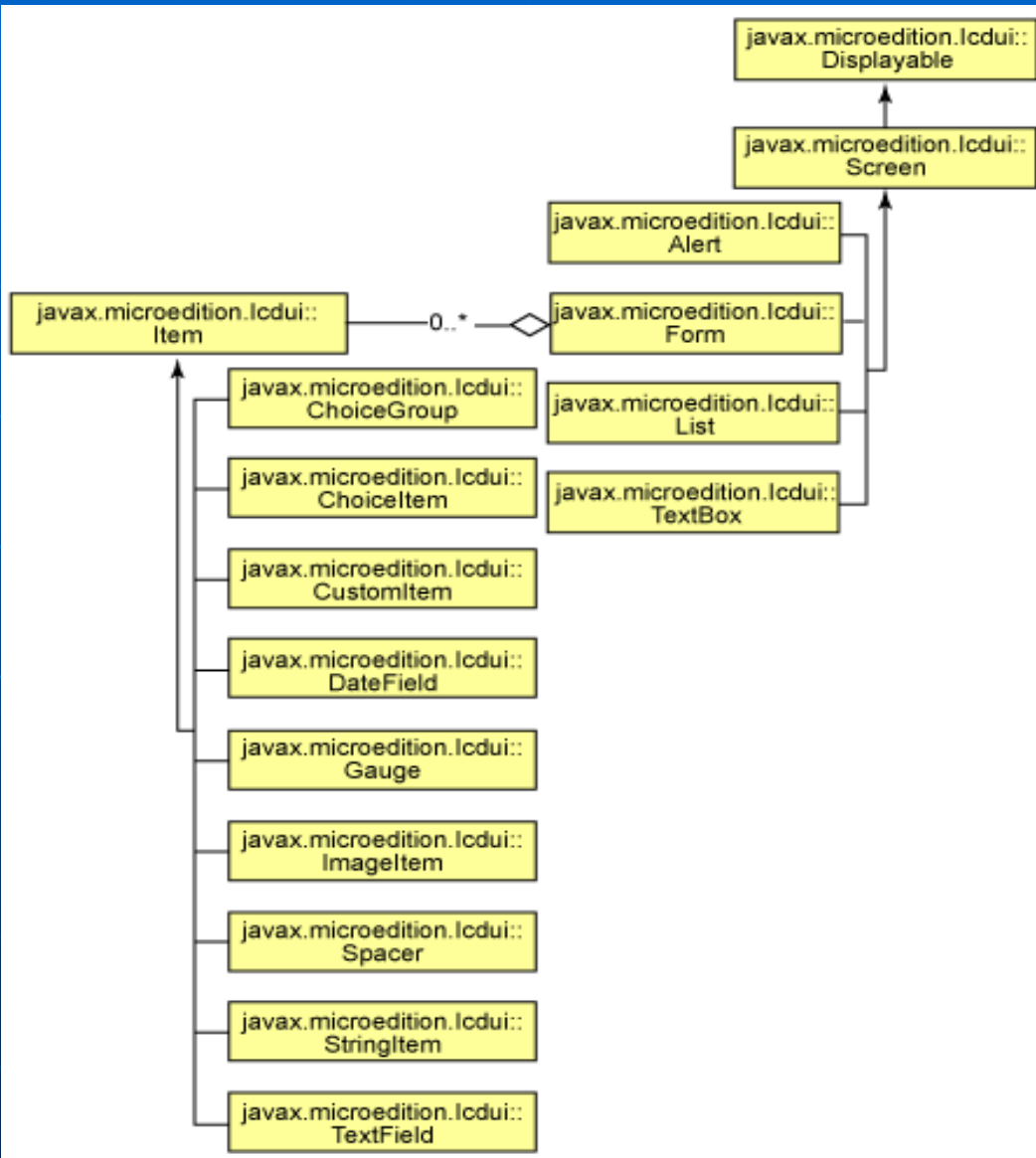
- Do not think about designing mobile phone applications like you are designing web or standard applications!
- A different GUI paradigm
  - Instead of seeing the GUI as multiple windows, the GUI could be seen as a deck of screens when only one screen is active at a given time
- High-level GUI APIs – portable, easy-to-use, little control over the GUI look and feel
- Lower-level GUI APIs – full control of graphics and inputs, based on the Canvas, Graphics, Image and Font classes, low-level drawing with specific additional classes



# Designing Mobile Applications



# Major Classes of LCDUI MIDP 2.0



<http://www.ibm.com/devel/operworks/wireless/library/wi-prep/fig8-midp2-hl-lcdui.gif>

# Display and Displayable

- The `Display` class represents the screen of a device
- The `Displayable` class describes object that can be visible on a `Display`
- To get the (unique) `Display` of a `MIDlet` use
  - `public static Display`  
**`getDisplay`** (`MIDlet` `m`)
- To request an object to be made visible on the `Display` use
  - `public void`  
**`setCurrent`** (`Displayable` `nextDisplayable`)

# Form

- A `Form` is a screen that contains an arbitrary number of items descendant of the class `Item`:
  - `StringItem`, `TextField`, `ImageItem`, `ChoiceGroup`, `Gauge`, `Spacer`, `DateField` and custom items
  - An item belongs to one form only
- A `Form` can be edited using `append`, `delete`, `insert` and `set` methods
- Items are referred by their index in the `Form`
- The device handles layout (organized by rows), traversal, and scrolling



# Command

- A Command is defined by:
  - A label
  - A type
    - Common commands - BACK, CANCEL, EXIT, HELP, OK, STOP
    - Application-specific commands – SCREEN
    - Form-specific commands - ITEM
  - A priority – lower priorities are more important

# Command and CommandListener

- The `Command` class represents an action the user can perform **WITHOUT** defining the action
- The action is defined in a `CommandListener` associated with the `Displayable`
- Actions are described in the `commandAction` methods of the `CommandListener` interface that must be implemented by the `MIDlet` class
  - `public void commandAction(Command arg0, Displayable arg1)`
- The device organizes how the commands are displayed on the screen

# Example

```
public class MyMIDlet extends MIDlet implements CommandListener {
    private Display display;
    private Form form
    private Command cmdOK;
    ...
    protected void startApp(){
        display = Display.getDisplay(this);
        form = new Form("Example of Form");
        cmdOK = new Command("OK", Command.OK, 0);
        form.addCommand(cmdOK);
        form.setCommandListener(this);
        display.setCurrent(form);
        ...
    }

    public void commandAction(Command cmd, Displayable d){
        if (cmd == cmdOK && d == mForm){
            System.out.println("OK command");
        }
    }
    ...
}
```

# Demo of Java ME

# Demo of Android

# Process

Scrum for Mobile Application  
Development

# Scrum



# Scrum

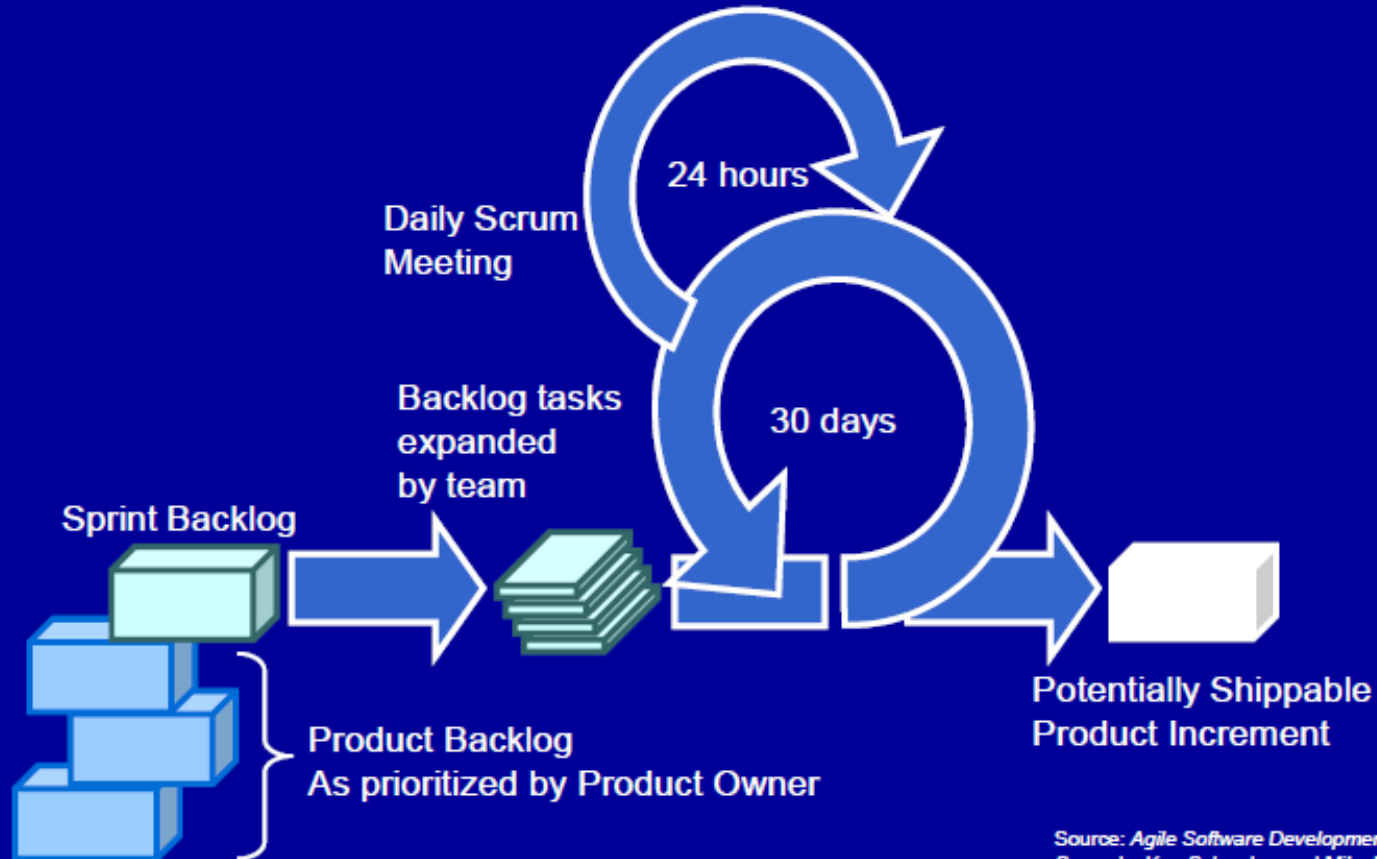
<b>Agile methodologies</b>		<b>Sprint</b>
<b>Client</b>	<b>Prioritization</b>	
<b>Product owner</b>	<b>Estimation</b>	
<b>Scrum master</b>	<b>Refactoring</b>	
<b>Scrum team</b>	<b>Velocity</b>	
<b>Chicken</b>	<b>Sprint planning</b>	
<b>Pig</b>	<b>Daily Scrum meeting</b>	
<b>Product backlog</b>	<b>Iteration</b>	
<b>Sprint backlog</b>	<b>Impediment</b>	
<b>User story</b>	<b>Sprint goal</b>	
<b>Behaviors</b>	<b>Sprint review</b>	
<b>Features</b>	<b>Burndown chart</b>	
<b>Constraints</b>	<b>Commitment</b>	
<b>Bugs</b>	<b>Sprint retrospective</b>	



# Scrum

- Developed in management in 1983 and adapted to software development in 1993 by Jeff Sutherland and Ken Schwaber
- Empirical challenges cannot be addressed successfully by generic models
- Focus on maximizing the team's ability in an agile manner to emerging challenges
- No specific process prescribed
- Short iterations (Sprint) where the software is designed, developed and tested
- Daily 30-minute stand-up meetings (Scrum)
- The requirements are initially expressed using user stories and available in the Product Backlog and then in the Spring Backlog
- The Product Owner is the owner of the requirements
- The Scrum Master facilitates Scrum and remove impediments linked with the process

# Overview of Scrum



Source: *Agile Software Development with Scrum* by Ken Schwaber and Mike Beedle. And Cohn

Source: <http://www.rallydev.com>

## Roles



Product Owner:  
Set priorities



ScrumMaster:  
Manage process,  
remove blocks



Team: Develop  
product



Stakeholders:  
observe & advise

## Key Artifacts

### Product Backlog

- List of requirements & issues
- Owned by Product Owner
- Anybody can add to it
- Only Product Owner prioritizes

### Sprint Goal

- One-sentence summary
- Declared by Product Owner
- Accepted by team

### Sprint Backlog

- List of tasks
- Owned by team
- Only team modifies it

### Blocks List

- List of blocks & unmade decisions
- Owned by ScrumMaster
- Updated daily

### Increment

- Version of the product
- Shippable functionality (tested, documented, etc.)

## Key Meetings

### Sprint Planning Meeting

- Hosted by ScrumMaster; 1/2-1 day
- In: Product Backlog, existing product, business & technology conditions
- 1. Select highest priority items in Product Backlog; declare Sprint Goal
- 2. Team turns selected items into Sprint Backlog
- Out: Sprint Goal, Sprint Backlog

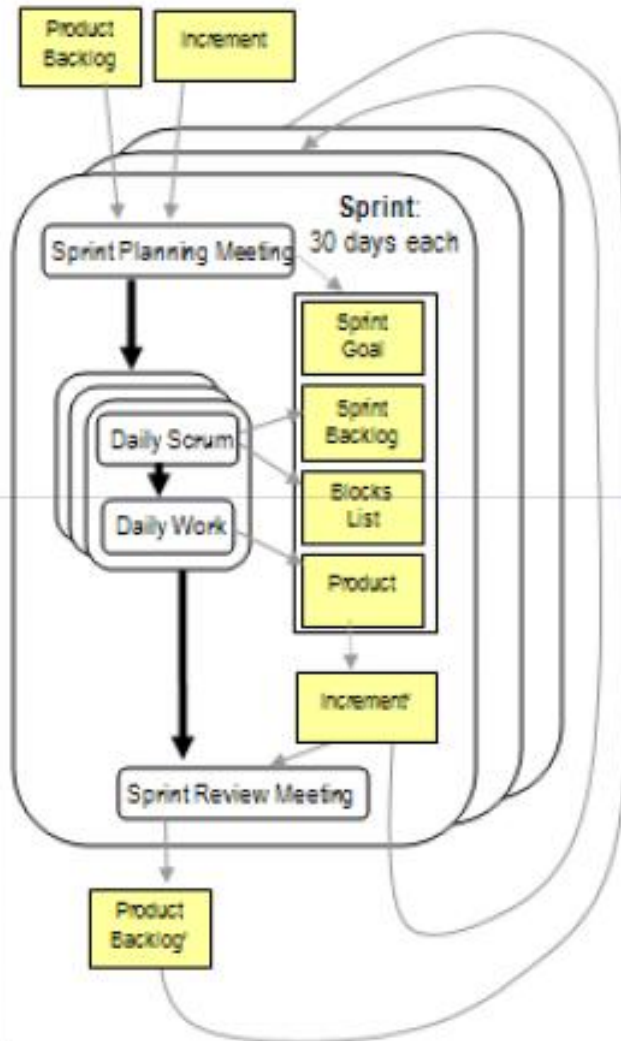
### Daily Scrum

- Hosted by ScrumMaster
- Attended by all, but Stakeholders don't speak
- Same time every day
- Answer: 1) What did you do yesterday? 2) What will you do today? 3) What's in your way?
- Team updates Sprint Backlog; ScrumMaster updates Blocks List

### Sprint Review Meeting

- Hosted by ScrumMaster
- Attended by all
- Informal, 4-hour, informational
- Team demos Increment
- All discuss
- Hold retrospective
- Announce next Sprint Planning Meeting

## Development Process



2008

Mobile



Co-located  
Developers

Scrum

USA



Senegal



2008

-  3 co-located Scrum teams (8)
-  Client (1)
-  Product owner (instructor) (1)
-  Professional certified Scrum master (1)



Product Backlog

Sprint  
planning

Sprint Demo /  
Retrospective /  
Planning

Final Sprint Demo /  
Retrospective

Sprint 1 \* (2 weeks)    Sprint 2 \* (2 weeks)

Project (4 weeks)

\* Bi-weekly Scrum meetings

# Software Development Project

- **RestoMob – Product owner: Dr. Scharff**
  - Mobile application to manage the accounting of a restaurant

Scrum



2009



*Distributed  
Developers*

*End-to-Eng  
Tooling*

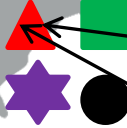
*Scrum*

*Mobile*

*Agile  
Methodologies*



USA



10h30

India

Senegal

5h30



- ▲ **Developers (5)**
- **Process coach (1)**
- **Rotating Scrum Masters (each team)**
- ★ **Product owner**

Initialization and  
training (3)

Sprint 1 (2)

Sprint 2 (2)

Sprint 3 (2)

Project (9 weeks)

\* Daily Scrum meetings



# Software Development Project

- **TargetFirstGrade – Product owner: Dr. Scharff**
  - Mobile application to assess the learning of pupils in first grade (5-6 year old) in topics such as Mathematics, Reading, Writing and Geography
  - Delivery of exercises in these topics in the form of open-ended and multiple choice questions
  - Automated computation of the scores
  - SMS of the scores to the teachers and parents

Distributed  
developers



The image features a solid blue background with a subtle, light blue grid pattern. The grid consists of both horizontal and vertical lines, creating a grid of squares. The lines are thin and evenly spaced, extending across the entire frame. In the center of the image, the year '2010' is written in a clean, white, sans-serif font. The text is centered both horizontally and vertically, standing out clearly against the blue background and grid.

2010

Quality

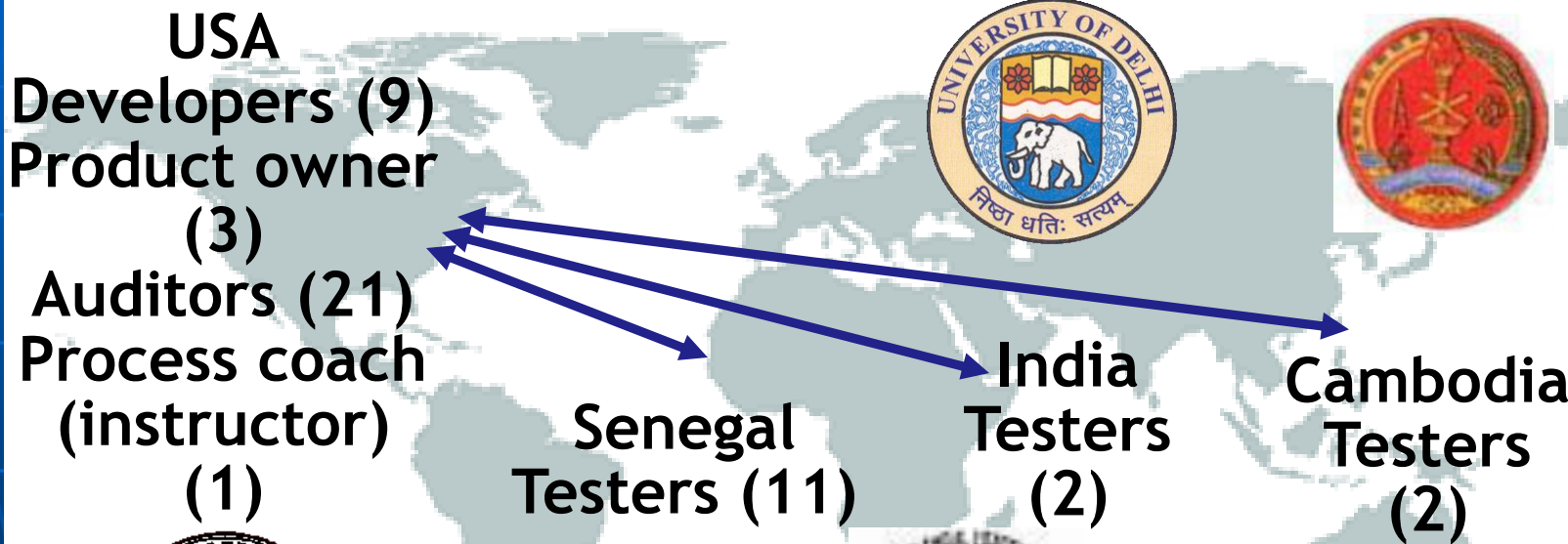
End-to-End Tooling

Scrum

Agile Methodologies

Mobile

2010



Ecole Supérieure Multinationale des Télécommunications



Rational Team Concert



# Software Development Projects

- **Project 1: No Ink** for Blackberry phones
  - Taking, annotating and organizing notes



- **Project 2: Back Pocket** for basic phones
  - Budgeting for students



- **Project 3: Godiva Flash Cards** for Android phones
  - Social flash cards to revise class topics



End-to-end tooling  
infrastructure

2008-2010

	<b>2008</b>	<b>2009</b>	<b>2010</b>
<b>Focus</b>	First experience with Scrum and mobile, mashup of technologies	Distributed developers, Scrum and agile methodologies, end-to-end tooling infrastructure, mobile	End-to-end tooling infrastructure, Scrum and agile methodologies, quality assurance, testing, mobile
<b>Number of institutions / countries</b>	1 / 2	3 / 3	5 / 4
<b>Number of instructors / students</b>	1 / 8	2 / 5	1 / 38
<b>Number of developed software systems</b>	3 versions of the same software	1 single software	3 software
<b>Customer</b>	Cambodia (ITC)	US (instructor)	US (students)
<b>Scrum master</b>	Professional Scrum master	Rotating Scrum master (student) + Professional Scrum coach	Students Scrum masters + Scrum coach (instructor)
<b>Product owner</b>	Instructor	Instructor	Student
<b>Scrum team</b>	Co-located US	Distributed across 3 countries	Co-located US
<b>Tools to support Scrum</b>	Mashup of technologies	RTC	RTC, Rally, Redmine

# Findings

Decompose user stories into tasks

Estimating

Ownership

Be realistic

Scrum and Mobile Application Development

Development time

User stories as requirements

Developing while learning

Professional Scrum Master

Technical Product Owner

Commitment

# Quotes

- “Scrum permitted us to have a working application that was developed faster than if we would have used the waterfall development process”
- “Scrum made me more productive, permitted more interaction with classmates, and facilitated constant awareness of what was achieved and how much work is left”
- “During the Scrum meeting our focus was strictly on the project and this helped get things done”
- “Scrum forced us to stay on track; it made us focus on the features we were committed to implementing”



# Introducing Scrum in Students' Projects

<b>Planning</b>	<ul style="list-style-type: none"><li>■ Define a Scrum scenario – Sprint roles, artifacts and meetings</li><li>■ Establish a strong relationship with and involve a professional certified Scrum Master</li><li>■ Select a real project</li><li>■ Identify the constraints</li><li>■ Assess the risks</li><li>■ Select tools</li><li>■ Determine research objectives</li><li>■ Set-up data collection instruments.</li><li>■ Prepare tutorials for students</li></ul>
<b>Facilitating and Monitoring</b>	<ul style="list-style-type: none"><li>■ Organize socialization activities involving all team members</li><li>■ Facilitate Scrum meetings / Scrum retrospectives and demo reviews</li><li>■ Monitor the Scrum artifacts</li><li>■ Take notes of what is happening on the project</li></ul>
<b>Reflecting</b>	<ul style="list-style-type: none"><li>■ Formally close the project with thanking the different actors involved</li><li>■ Summarize what went well on the project and what didn't, and determine how to refine the model</li></ul>

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