Introduction to

ActionScript 3.0 Multi-touch
Designing and coding prototypes for a touch-device

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In this lecture we’ll discuss and practice the following topics:

- Programming introduction, examples & exercises:
  - Touch-input categories
  - TUIO
  - Touch technologies
  - Resistive and capacitive screens
  - Multi-touch all point screens *(The Future of User Interface Design)*
  - Gestures & Recognition
  - Flash CS5 Multi-touch API
  - GestureWorks
  - Adobe AIR *(Publishing for Android and iPhone)*
  - Simulators
  - Multi-touch examples
What is Multi-touch?

- Multi-touch is an enhancement to touch-screen technology, which provides the user with the ability to apply multiple finger gestures simultaneously onto the electronic visual display to send complex commands to the device.
Touch-input categories

- **Touch Event** - A term used to describe when a system knows that an object has touched the touch device

- **Single Touch** - Single Touch occurs when a finger or stylus creates a touch event on a touch device so it is detected by the touch controller and the application can determine the X,Y coordinates of the event

- **Multi-touch** - An interactive technique that allows single or multiple users to control graphical displays with more than one simultaneous finger (+3 fingers)

- **Gesture** - A physical movement that can be sensed, and often an action assigned to it. Some common gestures are single finger panning, and two finger zoom-pinching

- **Gesture-enhanced single-touch** - Also known as "Dual Control", "Gesture Touch" and often "Dual-Touch" describes the ability of a touchscreen to register certain two-finger gestures, even though the display hardware does not have full Dual-Touch capabilities
TUIO (1/3): overview

- **TUIO** (Tangible User Interface Objects) is an open framework that defines a common protocol and API for tangible multi-touch surfaces.
- The protocol encodes control-data (position, size, and relative velocity of blobs) from a tracker application and sends it to a client application.
- TUIO is based on Open Sound Control - an emerging standard for interactive environments.
- Example of TUIO usage: **NUI** (The Natural User Interface Group) Group is an open source interactive media community researching and creating sensing and display techniques to benefit artistic, commercial and educational applications.

http://www.tuio.org
Computer vision: is the science and technology of machines that see (extract information from an image)

Blobs: Are referring to a bright luminescent object, that can be detected through a process of picking out bright areas of a camera image and somehow relaying them to a computer as a touch

Flosc: is a Java server that can communicate with anything that uses the Open Sound Control protocol (acts as a gateway between TUIO and Flash)

CCV (tBeta): Takes a video input stream and outputs tracking data (e.g. coordinates and blob size) and events (e.g. finger down, moved and released) that are used in building multi-touch applications (TUIO/OSC/XML enabled applications)
FTIR stands for **Frustrated Total Internal Reflection** – an optical multi-touch methodology developed by Jeff Han based on **Total Internal Reflection**.

- On contact: The frustrated light is scattered downwards towards an infrared webcam, capable of picking these ‘blobs’ up, and relaying them to tracking software.

  + Supports Multi-touch, allows unique ‘table-design’, large installations
  - Requires specific setup, calibration & configuration, no mobility

- This technique is quite often used for DIY (do it yourself) tables.
Here is an example of a class called BlobLines, that creates lines and move them according to finger positions. Part of the code looks like this:

```actionscript
package BlobsFunction{
    import flash.display.Sprite;
    import flash.events.TUIO;
    import flash.events.Event;

    public class BlobLines extends Sprite{

        public function BlobLines():void{
            TUIO.init(this,'localhost',3000,'',true);
            addEventListener(Event.ENTER_FRAME, test_returnBlobs);
        }

        public function test_returnBlobs(event:Event):void{
            trace(TUIO.returnBlobs().length);
        }
    }
}
```

http://wiki.nuigroup.com/Blob_Lines
Touch technologies

- Bending Wave
- Infrared (Grid) (IR)
- Optical (Camera)
- Projected Capacitive (Matrix)
- Resistive
- Surface Acoustic Wave (SAW)
- Surface Capacitive

http://solutions.3m.com/wps/portal/3M/en_US/TouchTopics/Home/Technologies/
Resistive screens

- Resistive touch-screens are composed of two flexible sheets coated with a resistive material and separated by an air gap or microdots.
- When contact is made to the surface of the touch screen, the two sheets are pressed together, registering the precise location of the touch.

Advantages
- Most widely used touch technology
- Can be activated by bare finger, gloved hand, or stylus
- Low cost

Disadvantages
- Top sheet is highly susceptible to scratches, cuts and cigarette burns
- Transmission typically in 80% to 85%

Touch functionality
- Single touch

Examples
- Nokia 5800 and Samsung Omnia
Capacitive screens (*Surface Capacitive Touchscreens*)

- In *Capacitive screens* a small voltage is applied to the four corners of the screen.
- The human body also conducts electricity so when a person touches the screen with their finger, there is a change in the capacitance of the screen where the person touched it.
- The computer then registers the exact location of the person's touch.

**Advantages**
- Very light finger touch required for activation
- Technology with fastest touch response time
- Transmission typically 88% to 92%

**Disadvantages**
- Severe scratch can affect operation within the damaged area
- Supports only finger or tethered pen
- Cannot be used in all weather scenarios

**Touch functionality**
- Multi-touch

**Examples**
- Apple iPhone and the T-Mobile G1
How the iPhone works (Capacitive touch-screen)

- The iPhone touch-sensitive screen includes a layer of capacitive material
- The iPhone's capacitors are arranged according to a coordinate system
- Every point on the grid generates its own signal when touched and relays that signal to the iPhone's processor
- This allows the phone to determine the location and movement of simultaneous touches in multiple locations
- The processor uses software to analyze the raw data and determine the features of each touch (size, shape, location...)

http://electronics.howstuffworks.com/iphone.htm
Multi-Touch All-Point Touch-screens: The Future of User Interface Design

- Single-touch touch-screens, which optimize design space and provide unlimited numbers of buttons, still only allow users to select one function at a time

- With multi-touch gesture touch-screens, users can perform more complicated inputs like sizing photos, rotating and adjusting web pages

- Multi-touch all-point touch-screens tear down the boundaries of user input, which is only limited by the designer’s imagination (design your own complex gestures)

http://mobiledevdesign.com/tutorials/multitouch-touchscreens-0723/
Gestures: Gestures & Recognition

- Gestures are the synthesis of multiple touch events into a single event
- Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms
- Gesture recognition can be seen as a way for computers to begin to understand human body language (humans to interface with the machine)
- Basic gesture recognition can be done in three steps:
  - Capture user input
  - Homogenize and normalize input
  - Match to a predefined pattern

- The Touch Gesture Reference Guide is a unique set of resources for software designers and developers working on touch-based user interfaces

![Gestures and Recognition Diagram](http://blog.sqrtof5.com/?p=173)

The Flash Platform currently supports *Multi-touch & Gestures*

- Windows 7 and later (with touch-enabled hardware), including both browser-based Flash Player 10.1 SWF content, AIR 2 applications (Android) and Windows.exe – files
- Macs running Mac OS X 10.5.3 and later with multi-touch track-pads (only Gestures)
- iPhone, iPod touch, iPad OS 3.0 and later

The Multi-touch class can be used to determine the current environment's support for touch interaction

Flash player 10.1 can support as many touch points as the touch-device and underlying operating system supports (*Multitouch.maxTouchPoints*)

**HP TouchSmart** (Touch-enabled All-in-One PC)
- Microsoft Windows 7 Home Premium
- Memory: 4/500 GB, GeForce 256MB
- 23”, 1920 x 1080 (16:9), 64-bit, 2 touch-points
The Flash CS5 Multi-touch API is based on “events” (like Mouse-events), which makes it very intuitive and easy to use.

Classes for handling of Touch-events in Flash CS5:
- `TouchEvent`: Single-touch, finger contact
- `TransformGestureEvent`: Multi-touch, handles complex movement
- `GestureEvent`: Multi-touch events, complex contact
- `PressAndTapGestureEvent`: Press-and-tap gesture on touch-enabled devices
- `GesturePhase`: Detect gesture-phases

Supported gestures on various platforms:
`Windows 7, Mac OS X 10.5.3 and later, and iPhone, iPod touch and iPad`
- `TransformGestureEvent.GESTURE_PAN`
- `TransformGestureEvent.GESTURE_ROTATE`
- `TransformGestureEvent.GESTURE_ZOOM`
- `GestureEvent.GESTURE_TWO_FINGER_TAP`
- `PressAndTapGestureEvent.GESTURE_PRESS_AND_TAP` (not Mac OS, iPhone, iPod touch and iPad)

The Flash Platform automatically synthesizes the most common gestures across different platforms, but also provides developers with the APIs necessary to synthesize their own
Flash CS5 Multi-touch API (3/5): Gesture coding example (Rotate)

- Here is an example of using the TransformGestureEvent class and the Event GESTURE_ROTATE for rotating a movie-clip (square_mc)

```actionscript
Multitouch.inputMode = MultitouchInputMode.GESTURE;

square_mc.addEventListener(TransformGestureEvent.GESTURE_ROTATE, onRotate);

function onRotate(event:TransformGestureEvent):void{
    square_mc.rotation += event.rotation;
}
```

✓ Note! Make sure you have set the

```
Multitouch.inputMode = MultitouchInputMode.GESTURE;
```
In this example we are using the `GESTURE_ZOOM` event for scaling a movieclip

```actionscript
Multitouch.inputMode = MultitouchInputMode.GESTURE;

my_mc.addEventListener(TransformGestureEvent.GESTURE_ZOOM, onZoom);

function onZoom(event:TransformGestureEvent):void{
    event.target.scaleX = event.target.scaleY *= event.scaleX;
}
```
Flash CS5 Multi-touch API (5/5): Gesture coding example (Two Finger Tap)

- The following example shows event handling for the GESTURE_TWO_FINGER_TAP event. When the user performs a two-finger tap gesture mySprite rotates.

```actionscript
Multitouch.inputMode = MultitouchInputMode.GESTURE;

var mySprite = new Sprite();
mySprite.addEventListener(GestureEvent.GESTURE_TWO_FINGER_TAP, onTwoFingerTap);
mySprite.graphics.beginFill(0x336699);
mySprite.graphics.drawRect(0, 0, 100, 80);
addChild(mySprite);

function onTwoFingerTap(event:GestureEvent):void{
    event.target.rotation -= 45;
}
```
GestureWorks (1/4): Overview

- GestureWorks is an open source framework that provides a simplified and standardized approach to multi-touch application development.
- The most advanced solution for creating true multi-touch applications with Adobe Flash CS4/CS5, AIR and Flex.
- Supports various Touch-events and multiple & simultaneous gestures.
- Multi-touch authoring (Flash and Mac) solution for Windows 7-compatible multi-touch devices.
- GestureWorks can run with Android 2.2.
- From the GW labs: “we’ve got a GestureWorks app running on the iPad” (16 sept).
- GestureWorks trial version restricts running time to 1 hour.
- Multi-touch simulation functionality.

http://www.gestureworks.com
GestureWorks (2/4): The default Gesture Library

- GestureWorks default gesture-library contains over 20 unique gestures built upon an open source gesture framework, allowing developers to customize and extend the “gesture object” to create support for new gestures.

- This gives the designer/developer the flexibility to customize gestures to suit the project, and, as new gestures become common, they can be easily incorporated, helping to “future proof” your applications.

- With the “Multi-touch all-point touch-screen technology” this opens up new doors...

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http://gestureworks.com/about/open-source-gesture-library
The GestureWorks development approach is very similar to Flash CS5 MT API – it’s easy to create custom applications by extending a single GestureWorks object. For example, the code below is all that’s required to make an object scalable (with a multi-touch gesture) in AS3.

```actionscript
//create the touchsprite holder for the content
var holder:Touchsprite = new Touchsprite();

//add eventlistener to the holder, gesture-event scale, call function
holder.addEventListener(GestureEvent.GESTURE_SCALE, onScale);

//function for scaling the movie-clip on scale-gesture
function onScale(event:GestureEvent):void {
    holder.scaleX += event.value;  //scale content
    holder.scaleY += event.value;
}
```
Since we are going to be using touch events and gesture events, we will need to import these classes – this provides a reference to all available gesture analysis modules.

In this example we have a movie-clip on stage, with a rotate gesture-event:

```actionscript
//import gestureworks related classes
import id.core.Application;
import id.core.TouchSprite;
import gl.events.GestureEvent;

var holder = new TouchSprite(); //create the touchesprite holder
holder.addChild(my_mc); //add movie-clip on stage to container/holder
holder.blobContainerEnabled = true; //enable local blob containment

//add eventlistener, gesture-event rotate, call function
holder.addEventListener(GestureEvent.GESTURE_ROTATE, gestureRotateHandler);
addChild(holder); //add container to displaylist

//function for scaling the movie-clip on scale-gesture
function gestureRotateHandler(event:GestureEvent):void{
    event.target.rotation += event.value; //rotate movie-clip
}
```
Adobe AIR (1/4): Standalone applications

- Adobe AIR (Adobe Integrated Runtime) is a powerful technique for developing Flash-based cross-platform standalone applications that can run on several operating systems and devices such as computers (desktop-apps), mobile phones, tablets etc

- AIR applications can access a computer file system, clipboard, drag-and-drop events, system tray/notifications, USB, and handle native processes

- The same ActionScript 3 coding as traditional Flash-web apps (except for the AIR-specific features such as native processes)

- An easy-to-use API for installation and updates; Installed applications have more persistence, power, and functionality

- Design your own AIR-interface (or use the native style), code and publish both for web and desktop/devices

- AIR on Android is a growing market today!

http://www.alienanthology.com/  http://www.youtube.com/watch?v=va33sU-_Bzk
Developing a basic AIR application for the desktop can be done by following these steps:

1. Create a new AIR 2 document from Flash CS5
2. Write your AS3 code, for example the fullScreen view function can be done like this:

   ```javascript
   stage.displayState = StageDisplayState.FULL_SCREEN_INTERACTIVE;
   stage.scaleMode = StageScaleMode.NO_SCALE;
   stage.align = StageAlign.TOP_LEFT;
   ```

3. Publish the document by using the AIR-publishing dialogue; from here you can create a digital certificate and sign the AIR-file (or just publish without) - You can also choose to just publish the traditional way, embedded in a HTML-file or as a Windows.exe file

4. Finished, publish and test!
Adobe AIR (3/4): Building AIR applications for Android

- From Flash CS5 we can create AIR applications for Android devices, this can be done by first downloading the following:
  1. Google Android SDK
  2. AIR for Android

- Once you have the AIR for Android extension for Flash Professional CS5 installed, you can create a new AIR/Android app from the template
- Now you’re ready for design/dev Air/Android apps!
- To the right a video demonstrating Flash Player 10.1 on Android 2.2 "Froyo"

http://www.youtube.com/watch?v=vJiqLivSUHE
Adobe AIR (4/4): Building AIR applications for iPhone

- You can use Adobe Flash Platform tools and ActionScript 3.0 code to build Adobe AIR applications for the iPhone and iPod touch. These applications are distributed, installed, and run just like other iPhone applications.

- Flash CS5 and AIR 2.0.1 SDK includes the Packager for iPhone.
- The Packager for iPhone compiles ActionScript 3.0 bytecode into native iPhone application.
- You also need to obtain an iPhone developer certificates from Apple.
- When publishing from Flash CS5, you’ll sign the certificate and then use iTunes for transferring the file to your device.
- More info about Flash/AIR on iPhone: http://labs.adobe.com/technologies/packagerforiphone/
- Down to the right is a video of Adobe AIR on 5 different devices, including iPhone and iPad.

Flash and Multi-touch simulators

- **SimTouch** is an Adobe Air application that simulates native touch events on the Flash platform. By using the SimConnect class you can use your iPhone to simulate Touch Events

  http://multitouchup.com/?p=428

- The TUIO Simulator can be used for simulating TUIO-based Multi-touch on your own machine

  http://www.tuio.org/?software

- GestureWorks Multi-touch simulator; The blue MT-markers are placed on the interfaced by a “mouse-press + ctrl”

  http://www.gestureworks.com
Flash-based Multi-touch links & examples

- Multi-touch and the Flash Platform (Adobe TV 64 min)

- Example of GestureWorks running on a 3M 22" Multitouch Screen
  http://www.youtube.com/watch?v=QF3-D0SvxEs

- Tanki online on Multi-touch

- Adobe Flash Player 10.1 on Galaxy tab
  http://www.youtube.com/watch?v=L-TPvlj8fs

- Flash Works On Touch-Based Devices
  http://blogs.adobe.com/flashplatform/tag/multi-touch