Programming of Mobile Services, Spring 2012

HI1017

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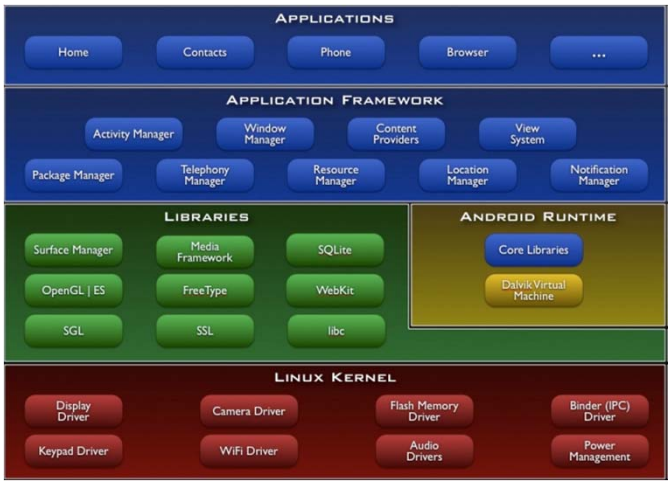
Lecture 6
Today's topics

- Android graphics
- Views, Canvas, Drawables, Paint
- Double buffering, bitmaps
- Animations
- Graphics and multi threading, SurfaceView

Android graphics



Android graphics

- 2D graphics library, package android.graphics, android.view
  - Android 4.0: Hardware accelerated rendering pipeline
- OpenGL ES 1.0, 2D and 3D, hardware acceleration, package android.opengl
- Issues:
  - Screens with different sizes and resolutions
  - Performance

Android 2D graphics

3 different needs, 3 different ways to draw

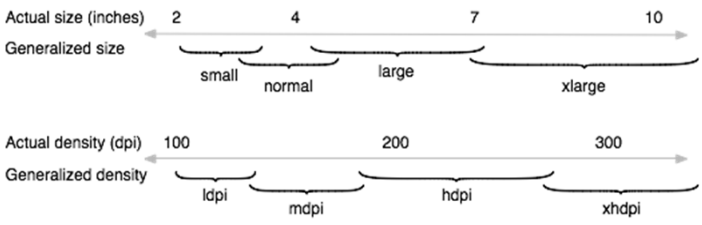
1. ”Static” – define views, drawings and animations in layout files
2. Update views when needed, e.g. on user input. Draw on a Canvas (View.onDraw), called implicitly via View.invalidate (from main-thread)
   - 1 and 2 may include Animation-objects
3. In a separate thread, wherein you manage a SurfaceView and perform painting directly to a Canvas

Drawables

- android.graphics.drawable
- Something that can be drawn, e.g. an image, shape, transition, animation
- Create Drawables from resources, xml layout or by calling a constructor
- Images are stored in res/drawable-ldpi, /…-mdpi, /…-hdpi
- Preferred format: png, 9.png (acceptable: jpg)

Drawables

- Screen size
- Screen density
- Orientation
- Resolution (pixels) or density
  - not the same as dp, density independent pixel (used in application code)



Källa: http://developer.android.com/guide/practices/screens_support.html

Drawables

- Define a view with an image in layout xml:

```
<ImageView
  android:layout_width="wrap_content"
  android:layout_height="wrap_content"
  android:src="@drawable/my_image"/>
```

- Create a drawable from resources:

```
Resources res = mContext.getResources();
Drawable myImage =
    res.getDrawable(R.drawable.my_image);
```

Drawables

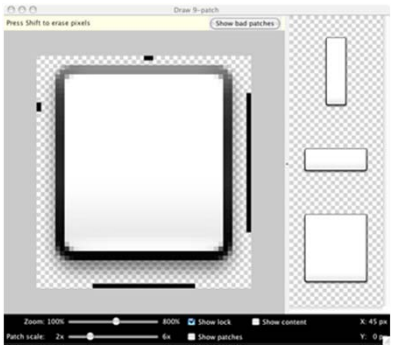
- Load image into ImageView in code:
-

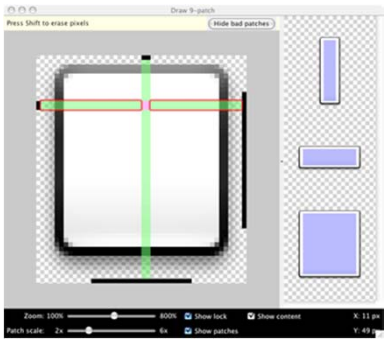
```
protected void onCreate(Bundle savedInstState) {
  . . .
  LinearLayout layout = new LinearLayout(this);

  ImageView iw = new ImageView(this);
  iw.setImageResource(R.drawable.my_image);
  iw.setAdjustViewBounds(true);
  . . .
  layout.addView(iw);
  setContentView(layout);
  . . .
```

Drawables, 9-patch stretchable

- Strechable png-image (9.png)





- Editor in SDK: tools/draw9patch.bat

Drawables, 9-patch stretchable

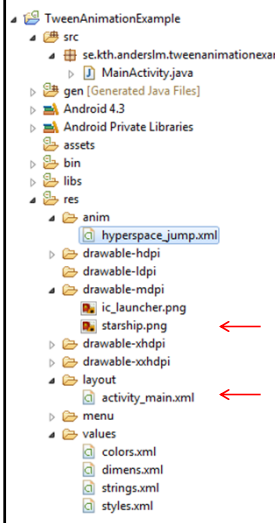
```
<Button
        …
        id="@+id/tiny"
        android:text="Tiny"
        android:textSize="8sp"
        android:background="@drawable/my_button_background”
/>

<Button id="@+id/big"
        …
        android:text="Biiiiiiig text!"
        android:textSize="30sp"
        android:background="@drawable/my_button_background”
/>
```

(be)Tween Animation

- Package android.view.animation
- Simple transformations: translation, rotation, size, transparency (alpha)
- Define the transformations that you want to occur, when they will occur, and how long they should take to apply
- Transformations can be sequential or simultaneous
- Define in res/anim/my_animation.xml

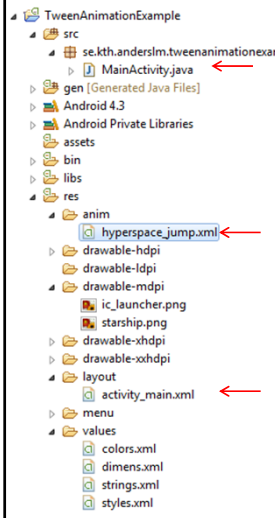
Tween Animation



I layoutfilen:

```
<ImageView
    android:id="@+id/HyperspaceImageView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:contentDescription=
        "@string/starship”
    android:src="@drawable/starship"
/>
```

Tween Animation




```
spaceshipImage = (ImageView)
  findViewById(R.id.HyperspaceImageView);
hyperspaceJumpAnimation =
  AnimationUtils.loadAnimation(
    this, R.anim.hyperspace_jump);


...
spaceshipImage.startAnimation(
  hyperspaceJumpAnimation);
```

Tween Animation

- res/anim/hyperspace_jump.xml (not complete, see code ex.)

```
<set ... >
   <scale
        android:interpolator="@android:anim/linear_interpolator"
        android:duration="700"
        android:fromXScale="1.0"
        android:fromYScale="1.0"
        android:toXScale="1.4"
        android:toYScale="0.6" />

    <set android:interpolator="@android:anim/decelerate_interpolator"
         android:duration="2000"
         android:startOffset="700">
        <scale
            android:fromXScale="1.4"
            android:fromYScale="0.6"
            ... />
        <rotate
            android:duration="2000"
            android:fromDegrees="0"
            android:toDegrees="360"
            android:pivotX="50%"
            ... />
    </set>
</set>
```

Frame Animation

- res/anim/***rocket_thrust***.xml
-
```
<animation-list
    ...
    android:oneshot="true">
    <item android:drawable="@drawable/rocket_thrust1"
          android:duration="200" />
    <item android:drawable="@drawable/rocket_thrust2"
          android:duration="200" />
    <item android:drawable="@drawable/rocket_thrust3"
          android:duration="200" />
</animation-list>
```

Frame Animation

- Corresponding code:

```
private AnimationDrawable rocketAnimation;

public void onCreate(Bundle savedInstanceState) {
   ...

   ImageView rocketView = (ImageView)
       findViewById(R.id.rocket_image);
   rocketView.setBackgroundResource(
       R.drawable.rocket_thrust);

   rocketAnimation = (AnimationDrawable)
       rocketView.getBackground();
}

public void onSomeClick(View v) {
   rocketAnimation.start();
}
```

Update views from main-thread

Graphic components

- Canvas – defines what to "draw“,
  holds a bit map representing the pixels to draw
- Drawables for drawing primitives, e.g. Rect, Path, text, Bitmap, image, Animations
- Paint - describes colors and styles when drawing
- Color (int), Typeface, …

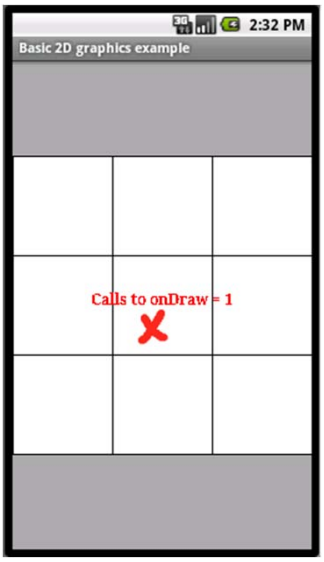
- Define what to draw by extending the View class and override onDraw(Canvas)

Canvas

- Holds the surface upon which your graphics will be drawn and thus all of your "draw" calls
-
```
public class MyView extends View {
  . . .
  public void onDraw(Canvas canvas) {
    Paint paint = new Paint();
    paint.setColor(Color.WHITE);
    canvas.drawPaint(paint);
    . . .
  }
```

-
```
  private void onSomeAction(…) {
    . . .
    invalidate(); // Request a call to onDraw
  }
```

onDraw + Canvas



onDraw + Canvas

```
public class BasicGraphicsView extends View {

  @Override
  protected void onDraw(Canvas canvas) {

    // Current size of this view
    int w = this.getWidth(), h = this.getHeight();
    int offset = (h - w)/2;

    // Background
    Paint bgPaint = new Paint();
    bgPaint.setColor(colorLightGrey);
    canvas.drawPaint(bgPaint);

    // Fill a rectangle
    Paint rectPaint = new Paint();
    rectPaint.setColor(Color.WHITE);
    canvas.drawRect(0, offset, w, h-offset, rectPaint);
```

onDraw, draw an image

```
public class BasicGraphicsView extends View {
  private Drawable cross; // An image representation
  public BasicGraphicsView(Context context) {
    super(context);
    Resources resources = context.getResources();
    cross = (Drawable)
          resources.getDrawable(R.drawable.cross);
  }

  protected void onDraw(Canvas canvas) {
    int x = 100, y = 200;
    int iw = cross.getIntrinsicWidth();
    int ih = cross.getIntrinsicHeight();
    Rect bounds = new Rect(x, y, x+iw, y+ih);
    cross.setBounds(bounds);
    cross.draw(canvas);
```

Canvas, off screen drawing

- Drawing is performed on an underlying Bitmap holding the pixels
- You can create a new Canvas, e.g. for off screen drawing
- Provide the Bitmap upon which drawing will actually be performed

```
Bitmap offscreen = Bitmap.createBitmap(
   width, height, Bitmap.Config.ARGB_8888);

Canvas temp = new Canvas(offscreen);
// Draw off screen, using the offscreen canvas
temp.drawRect(. . .);
. . .

// Copy the bitmap to the Canvas associated with screen
canvas.drawBitmap(offscreen, . . .);
```

SurfaceView

- Provides a surface on which a *secondary thread* may render into the screen at it's own chosen speed
- Surface – a handle to a raw buffer being managed by the screen composer
- Access to the surface is provided via the SurfaceHolder interface
  - retrieved by calling getHolder()
- Use SurfaceView when your view constantly needs updates, e.g. a game view
- Penalty: Memory consuming

- Implement SurfaceHolder.Callback – methods called (by the main-thread) when the surface is created, changed, or destroyed
  - the scondary thread must only touch the underlying Surface between SurfaceHolder.Callback.surfaceCreated() and SurfaceHolder.Callback.surfaceDestroyed().

SurfaceView

```
public void run() {
   while(running) {
      . . .
      // TO DO: Draw on an off screen Bitmap before
      // calling holder.lockCanvas()

      Canvas canvas = holder.lockCanvas();
      {
         Paint paint = new Paint();
         paint.setColor(Color.WHITE);
         canvas.drawPaint(paint);
         . . .
       }
       holder.unlockCanvasAndPost(canvas);

       try {
          Thread.sleep(time);
       }
       ...
```

SurfaceView

The Activity holding the SurfaceView and graphics thread must override the appropriate life cycle call-backs

```
public class SurfaceActivity extends Activity {
    private SnowSurfaceView view;

    public void onCreate(Bundle savedInstanceState) {
        . . .
        setContentView(view);
    }

    protected void onResume() {
        super.onResume();
        view.resume(); // stop drawing (thread)
    }

    protected void onPause() {
       super.onPause();
       view.pause(); // if hasSurface, start drawing (thread)
    }
```

SurfaceView + graphics thread

- Model tasks and objects in the game as classes
- Use SurfaceView + thread
- Off screen drawing
- Manage life cycle call backs
- Reuse objects (e.g. Paint)
- Check for actual screen size and changes in size and orientation

SurfaceViewExample.zip

Touch Events

- Fired when user touches the screen
- Listen to touch event:
  Extend View and override onTouchEvent (MotionEvent event) , or ...
- Implement View.OnTouchListener and override onTouch(View v, MotionEvent event)

Touch Events

```
@Override
public boolean onTouchEvent(MotionEvent event) {

        int action = event.getAction();

        switch (action) {
        case (MotionEvent.ACTION_DOWN):
                // Touch screen pressed
                break;
        case (MotionEvent.ACTION_UP):
                // Touch screen touch ended
                break;
        case (MotionEvent.ACTION_MOVE):
                // Moved across screen
                break;
        case (MotionEvent.ACTION_CANCEL):
                // Touch event cancelled
                break;
        }
        return super.onTouchEvent(event);
}
```

Touch Events

```
public class TouchView extends View {
  . . .
  @Override
  public boolean onTouchEvent(MotionEvent event) {

    if(event.getAction() == MotionEvent.ACTION_DOWN) {
       int w = cross.getIntrinsicWidth();
       int h = cross.getIntrinsicHeight();
       int x = (int) event.getX();
       int y = (int) event.getY();
       crossBounds = new Rect(x-w/2, y-w/2, x+w/2, y+h/2);

       invalidate(); // Request a redraw of this view
       return true;
    }
    return false;
  }
```

Readings

- http://developer.android.com/guide/topics/graphics/index.html
- Code examples at Bilda
- Meier, Chapter 4 and 11

Bonus: Define a ”listener callback” via a property

- The layout file

```
<Button
        ...
        android:id="@+id/StartButton"
        android:text=”@string/start"
        android:onClick="onStartClick” >
</Button>
```

- The Activity

```
public void onStartClick (View view) {
    ...
}
```