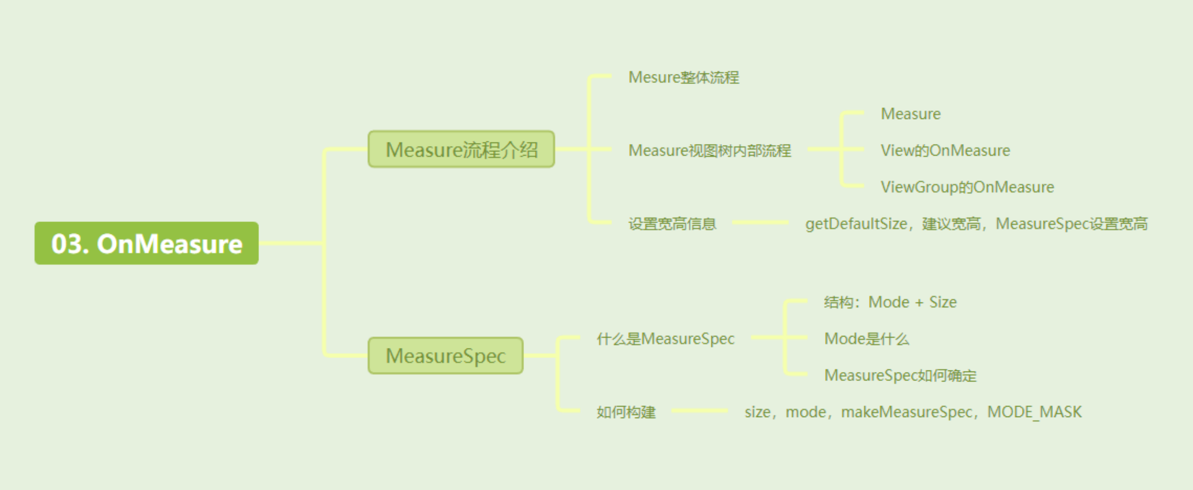


不足：

- Measure流程分析
  - 什么是DecorView
  - Measure视图树内部流程
  - 设置宽高信息

# 01.Measure介绍

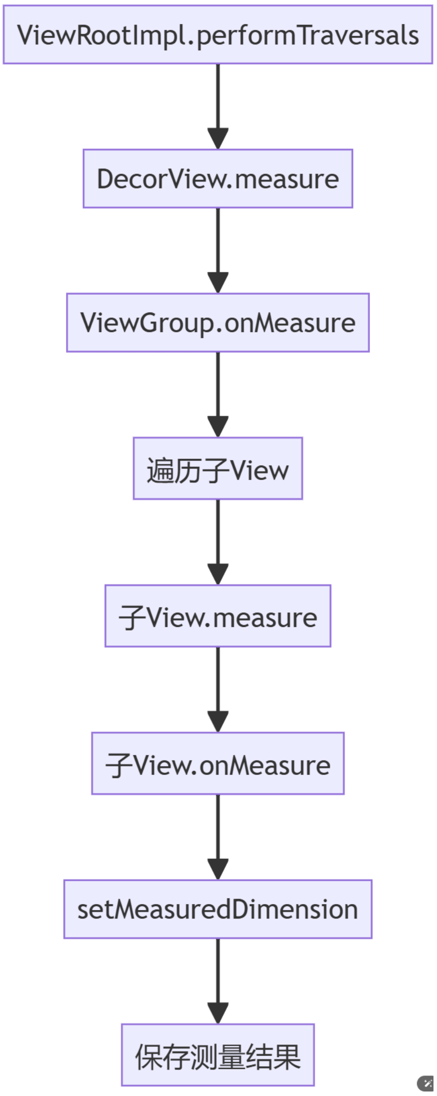
- 请问测量的本质是什么，**View是一块矩形区域**，测量就是去设置这个矩形区域的宽高。
- 那么这个宽高怎么来的？宽高有两个来源，一个是measurespec中的size，另一个是我们通过getsuggested + padding得到的desireSize。
- 我们最终通过setmeasuredemission完成设置

# 01.Measure流程分析

## 1.1 Measure整体流程

- 整体介绍Measure从ViewRootImpl到View树的调用过程
- ViewRootImpl调用performTraversals后，经过performMeasure进入到DecorView的measure过程中（也就是视图树的View过程中）。

- 到这里，可能会困惑，什么是DecorView？我日常开发中怎么没见过？确实，我们日常见到的是布局文件，其里面是Activity的View，然后我们通过setContentView设置。可是实际上上，DecorView是是Android视图树的根节点视图，也是FrameLayout的子类。我们上面通过布局文件创建的View，其实是被添加到DecorView中的一个子View中，通常是id为content的FrameLayout。因为他也是一个FrameLayout，因此其会调用自身ViewGroup的onMeasure，在内部调用布局文件中子View的Measure，在他们测量完成并最终返回后，其最终确定自身尺寸。

-
  ```
  ViewRootImpl.performTraversals()
      → performMeasure()
          → DecorView.measure()
              → FrameLayout.onMeasure()
                  → 遍历measureChildWithMargins()测量子View
                  → setMeasuredDimension()确定自身尺寸
  ```
- 对应如下：
- 

## 1.2 Measure视图树内部流程

- 视图树中就两个部分，一个是View，一个是ViewGroup，所以其实就是介绍View和ViewGroup的measure流程。
- 不管如何，他们都会先调用measure()方法，但是它不关键，只是进行一些逻辑处理，最终它会调用onMeasure，并在里面完成测量的逻辑。View和ViewGroup的差距关键就在于OnMeasure的执行。

```
// 测量入口（final方法，不可重写）
public final void measure(int widthMeasureSpec, int heightMeasureSpec) {
    // 1. 检查是否需要重新测量（通过PFLAG_FORCE_LAYOUT标记）
    if ((mPrivateFlags & PFLAG_FORCE_LAYOUT) != 0 || ...) {
        // 2. 调用onMeasure进行实际测量
        onMeasure(widthMeasureSpec, heightMeasureSpec);
        // 3. 设置测量完成标记
        mPrivateFlags |= PFLAG_LAYOUT_REQUIRED;
    }
    // 4. 保存父容器传递的MeasureSpec
    mOldWidthMeasureSpec = widthMeasureSpec;
    mOldHeightMeasureSpec = heightMeasureSpec;
}
```

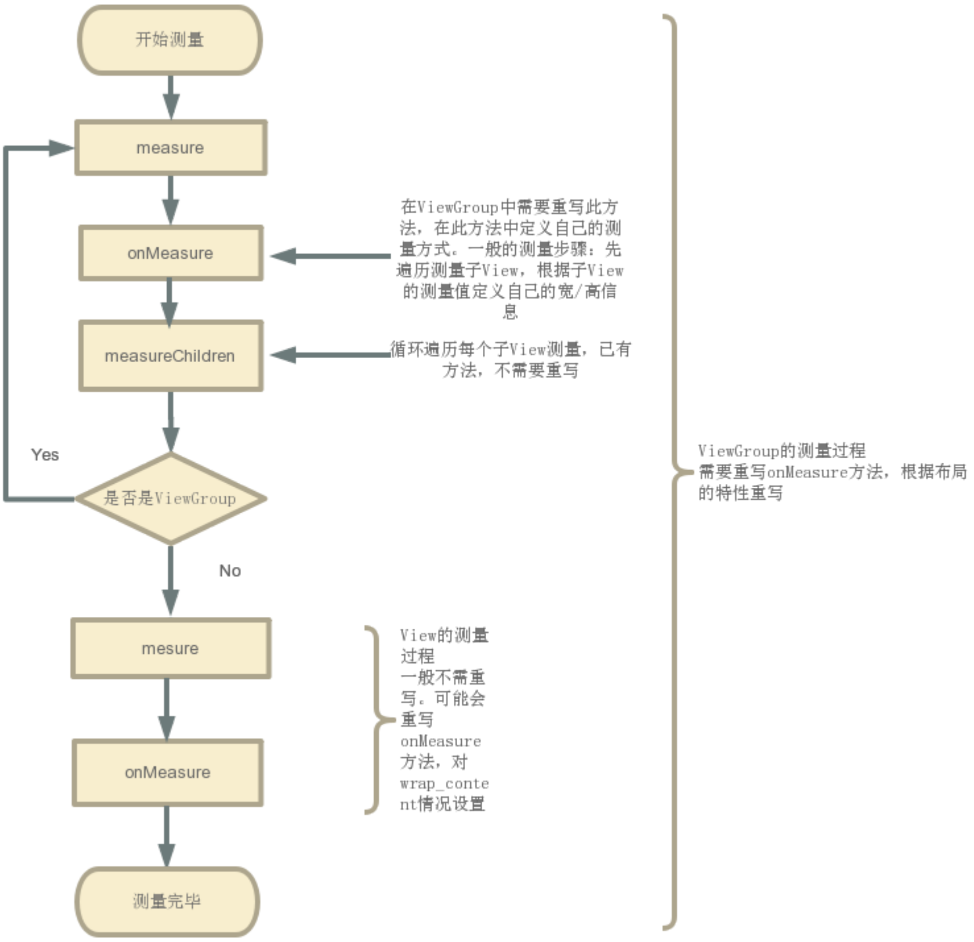
- 普通View的OnMeasure
    - 我们会传递给他widthMeasureSpec和heightMeasureSpec。
    - 它会通过getSuggestedMinimumWidth获取建议尺寸。
    - 最终通过getDefaultSize从传递的参数和建议尺寸中二选一，具体选择要根据传递的MeasureSpec的Mode决定。并最终通过setMeasuredDimension进行设置

    -
      ```
      protected void onMeasure(int widthSpec, int heightSpec) {
          /super.onMeasure(widthMeasureSpec, heightMeasureSpec);
          //从中获取View的宽/高
          int width = getDefaultSize(getSuggestedMinimumWidth(),
      widthMeasureSpec);
          int height = getDefaultSize(getSuggestedMinimumHeight(),
      heightMeasureSpec);
          //指定View的宽高，完成测量工作
          setMeasuredDimension(width,height);
      }
      ```

- **ViewGroup的测量**
    - ViewGroup内部可以容纳子View，所以其比较特殊
    - 其首先测量所有子View，然后根据子View的尺寸计算自身尺寸，并考虑自身padding和父容器大小限制，得到最终的尺寸。并调用setMeasuredDimension应用。
    - 具体代码如下：类似于后序遍历，先遍历完子View的大小，然后计算自身尺寸。

    -
      ```
      protected void onMeasure(int widthSpec, int heightSpec) {
          // 1. 测量所有子View
          measureChildren(widthSpec, heightSpec);

          // 2. 根据子View尺寸计算自身尺寸
          int totalWidth = 0;
          for (View child : children) {
              totalWidth += child.getMeasuredWidth();
          }

          // 3. 考虑自身padding
          totalWidth += getPaddingLeft() + getPaddingRight();

          // 4. 应用父容器限制
      ```

```
    int finalWidth = resolveSize(totalWidth, widthSpec);
    setMeasuredDimension(finalWidth, ...);
}

protected void measureChildren(int widthMeasureSpec, int
heightMeasureSpec) {
    final int size = mChildrenCount;
    final View[] children = mChildren;
    // 遍历所有子View（包括GONE状态的View）
    for (int i = 0; i < size; ++i) {
        final View child = children[i];
        if ((child.mViewFlags & VISIBILITY_MASK) != GONE) {
            // 关键方法：计算子View的MeasureSpec
            measureChild(child, widthMeasureSpec, heightMeasureSpec);
        }
    }
}
```

- 好，至此我们知道了Measure的流程了，其对应测量过程如下：
  - 
开始测量
measure
onMeasure
measureChildren
是否是ViewGroup
Yes
No
mesure
onMeasure
测量完毕
在ViewGroup中需要重写此方法，在此方法中定义自己的测量方式。一般的测量步骤：先遍历测量子View，根据子View的测量值定义自己的宽/高信息
循环遍历每个子View测量，已有方法，不需要重写
ViewGroup的测量过程
需要重写onMeasure方法，根据布局的特性重写
View的测量过程
一般不需重写。可能会重写onMeasure方法，对wrap_content情况设置

## 1.3 最终结果：设置宽高信息

- 我们上面最终都会通过setMeasuredDimension()来完成测量，设置自身的宽高信息，我们设置的宽高究竟是什么呢？

- 宽高通过getDefaultSize获取，该方法接收两个参数，并选择一个作为宽高。这两个参数分别是getSuggestedMinimumWidth()和MeasureSpec。具体的选择方式是：根据MeasureSpec的MODE进行选取。
    - 如果View的MODE为无限制，他的宽高将设置getSuggestedMinimumWidth() + padding；
    - 如果View的MODE为 EXACTLY 或 AT_MOST，则会被设置为从MeasureSpec中获取的specSize。
- 其具体代码如下：

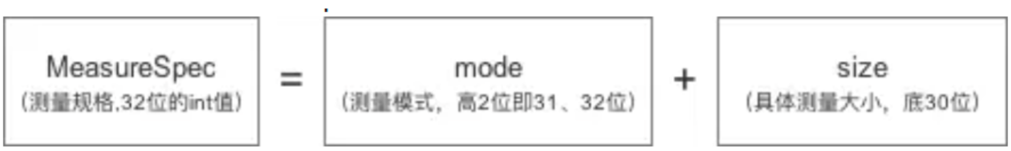
```
@Override
protected void onMeasure(int widthMeasureSpec, int heightMeasureSpec) {
    //super.onMeasure(widthMeasureSpec, heightMeasureSpec);
    //从中获取View的宽/高
    int width = getDefaultSize(getSuggestedMinimumWidth(), widthMeasureSpec);
    int height = getDefaultSize(getSuggestedMinimumHeight(),
heightMeasureSpec);
    //指定View的宽高，完成测量工作
    setMeasuredDimension(width,height);
}

/**
 * 为宽度获取一个建议最小值
 */
protected int getSuggestedMinimumWidth () {
    return (mBackground == null) ? mMinWidth : max(mMinWidth ,
mBackground.getMinimumWidth());
}
/**
 * 获取默认的宽高值
 */
public static int getDefaultSize (int size, int measureSpec) {
    int result = size;
    int specMode = MeasureSpec. getMode(measureSpec);
    int specSize = MeasureSpec. getSize(measureSpec);
    switch (specMode) {
    case MeasureSpec. UNSPECIFIED:
        result = size;
        break;
    case MeasureSpec. AT_MOST:
    case MeasureSpec. EXACTLY:
        result = specSize;
        break;
    }
    return result;
}
```

- 从源码可以知道：

## 02.MeasureSpec的确定

getSuggestedMinimumWidth是给出的建议值。MeasureSpec是我们自己设置的值，那么MeasureSpec值的来源是什么？

## 2.1 MeasureSpec是什么

- 先介绍下什么是MeasureSpec?
  - 他是一个int类型，有32位大小，高两位是mode测量模式，低30位是size测量的尺寸大小。
  - 

- 其中，Mode模式共分为三类
  - UNSPECIFIED ： 无限制，不对View进行任何限制，要多大给多大。
  - EXACTLY：精确尺寸，表示父容器要求子 View 的大小必须是精确的值。
  - AT_MOST ： 表示子 View 的大小不能超过父容器允许的最大值。这种模式通常与 LayoutParams 设置为 `wrap_content` 对应。

## 2.2 MeasureSpec如何构建?

- 代码如下所示:

  -
    ```
    //view.class
    public static class MeasureSpec {
        private static final int MODE_SHIFT = 30;
        private static final int MODE_MASK  = 0x3 << MODE_SHIFT;

        /**
         * 这种模式不用关心
         */
        public static final int UNSPECIFIED = 0 << MODE_SHIFT;

        /**
         * 精确模式，对应的是match_parent和具体值，比如100dp
        public static final int EXACTLY     = 1 << MODE_SHIFT;

        /**
         * 最大模式，对应的就是wrap_content
         */
        public static final int AT_MOST     = 2 << MODE_SHIFT;


        public static int makeMeasureSpec(@IntRange(from = 0, to = (1 <<
    MeasureSpec.MODE_SHIFT) - 1) int size,
                                          @MeasureSpecMode int mode) {
            if (sUseBrokenMakeMeasureSpec) {
                return size + mode;
            } else {
            //尺寸与低30为全1相与。模式与高两位全1相与。
                return (size & ~MODE_MASK) | (mode & MODE_MASK);
            }
        }

        /**
         * 获取测量的模式
         */
        @MeasureSpecMode
    ```

```
    public static int getMode(int measureSpec) {
        //noinspection ResourceType
        return (measureSpec & MODE_MASK);
    }

    /**
     * 获取测量到的尺寸大小
     */
    public static int getSize(int measureSpec) {
        return (measureSpec & ~MODE_MASK);
    }
}
```

- 关键代码如下：
  - 构建MeasureSpec时，会传递size和mode，调用makeMeasureSpec，构建，具体构建原理如下：
  - (size & ~MODE_MASK) | (mode & MODE_MASK)
  - MODE_MASK是0x3左移30位。

  -
    ```
    // 创建MeasureSpec示例：
    int mode = MeasureSpec.EXACTLY;
    int size = 1080;
    int measureSpec = MeasureSpec.makeMeasureSpec(size, mode);

    // 位操作分解：
    size & ~MODE_MASK → 保留低30位（000...001111）
    mode & MODE_MASK  → 保留高2位（1100...0000）
    两者按位或 → 合并模式与尺寸

    // 验证结果：
    getMode(measureSpec) == EXACTLY  // true
    getSize(measureSpec) == 1080     // true
    ```

## 2.3 Measure的size和Mode如何确定?

- MeasureSpec 由**父布局的 MeasureSpec**和**自身的 LayoutParams**共同确定。如果是 DecorView，没有父布局，其根据屏幕的尺寸和 LayoutParams确定 MeasureSpec。由于屏幕大小是固定的，DecorView 的尺寸不应超过屏幕的限制。
- 举例：

  -
    ```
    假设屏幕的宽度为 1080px，高度为 1920px。

    Activity 的根布局（DecorView）的 LayoutParams 设置为具体的尺寸 500px 宽，800px 高。
    在这种情况下，DecorView 的宽高 MeasureSpec 为：
    宽度 MeasureSpec：EXACTLY 500px
    高度 MeasureSpec：EXACTLY 800px

    如果我们设置超过3680PX，那么还是1080PX
    ```
- 从上面可以看出MeasureSpec的指定也是从顶层布局开始一层层往下去，父布局影响子布局。

# 03. 实际案例

## 3.1 View中onMeasure方法

- 下面是真是开发案例中的代码，如下所示

```
//Android7.0以后，优化了View的绘制，onMeasure和onSizeChanged调用顺序有所变化
//Android7.0以下：onMeasure--->onSizeChanged--->onMeasure
//Android7.0以上：onMeasure--->onSizeChanged
@Override
protected void onMeasure(int widthMeasureSpec, int heightMeasureSpec) {
    int heightSize = MeasureSpec.getSize(heightMeasureSpec);
    int heightMode = MeasureSpec.getMode(heightMeasureSpec);
    /*
     * onMeasure传入的widthMeasureSpec和heightMeasureSpec不是一般的尺寸数值，而是
将模式和尺寸组合在一起的数值
     * MeasureSpec.EXACTLY 是精确尺寸
     * MeasureSpec.AT_MOST 是最大尺寸
     * MeasureSpec.UNSPECIFIED 是未指定尺寸
     */

    if (heightMode == MeasureSpec.EXACTLY) {
        heightSize = MeasureSpec.makeMeasureSpec(heightSize,
MeasureSpec.EXACTLY);
    } else if (heightMode == MeasureSpec.AT_MOST && getParent() instanceof
ViewGroup
            && heightSize == ViewGroup.LayoutParams.MATCH_PARENT) {
        heightSize = MeasureSpec.makeMeasureSpec(((ViewGroup)
getParent()).getMeasuredHeight(), MeasureSpec.AT_MOST);
    } else {
        int heightNeeded;
        if (gravity == Gravity.CENTER) {
            if (tickMarkTextArray != null && tickMarkLayoutGravity ==
Gravity.BOTTOM) {
                heightNeeded = (int) (2 * (getRawHeight() -
getTickMarkRawHeight()));
            } else {
                heightNeeded = (int) (2 * (getRawHeight() -
Math.max(leftSB.getThumbScaleHeight(), rightSB.getThumbScaleHeight()) / 2));
            }
        } else {
            heightNeeded = (int) getRawHeight();
        }
        heightSize = MeasureSpec.makeMeasureSpec(heightNeeded,
MeasureSpec.EXACTLY);
    }
    super.onMeasure(widthMeasureSpec, heightSize);
}
```

- 下面是ImageView的源代码

```
@Override
protected void onMeasure(int widthMeasureSpec, int heightMeasureSpec) {
    resolveUri();
    int w;
    int h;

    // Desired aspect ratio of the view's contents (not including padding)
    float desiredAspect = 0.0f;

    // We are allowed to change the view's width
    boolean resizeWidth = false;

    // We are allowed to change the view's height
    boolean resizeHeight = false;

    final int widthSpecMode = MeasureSpec.getMode(widthMeasureSpec);
    final int heightSpecMode = MeasureSpec.getMode(heightMeasureSpec);

    if (mDrawable == null) {
        // If no drawable, its intrinsic size is 0.
        mDrawableWidth = -1;
        mDrawableHeight = -1;
        w = h = 0;
    } else {
        w = mDrawableWidth;
        h = mDrawableHeight;
        if (w <= 0) w = 1;
        if (h <= 0) h = 1;

        // We are supposed to adjust view bounds to match the aspect
        // ratio of our drawable. See if that is possible.
        if (mAdjustViewBounds) {
            resizeWidth = widthSpecMode != MeasureSpec.EXACTLY;
            resizeHeight = heightSpecMode != MeasureSpec.EXACTLY;

            desiredAspect = (float) w / (float) h;
        }
    }

    final int pleft = mPaddingLeft;
    final int pright = mPaddingRight;
    final int ptop = mPaddingTop;
    final int pbottom = mPaddingBottom;

    int widthSize;
    int heightSize;

    if (resizeWidth || resizeHeight) {
        /* If we get here, it means we want to resize to match the
            drawables aspect ratio, and we have the freedom to change at
            least one dimension.
        */

        // Get the max possible width given our constraints
        widthSize = resolveAdjustedSize(w + pleft + pright, mMaxWidth,
widthMeasureSpec);

        // Get the max possible height given our constraints
        heightSize = resolveAdjustedSize(h + ptop + pbottom, mMaxHeight,
heightMeasureSpec);

        if (desiredAspect != 0.0f) {
            // See what our actual aspect ratio is
            final float actualAspect = (float)(widthSize - pleft - pright) /
                                    (heightSize - ptop - pbottom);

            if (Math.abs(actualAspect - desiredAspect) > 0.0000001) {

                boolean done = false;

                // Try adjusting width to be proportional to height
                if (resizeWidth) {
                    int newWidth = (int)(desiredAspect * (heightSize - ptop -
pbottom)) +
                            pleft + pright;

                    // Allow the width to outgrow its original estimate if
height is fixed.
                    if (!resizeHeight && !sCompatAdjustViewBounds) {
                        widthSize = resolveAdjustedSize(newWidth, mMaxWidth,
widthMeasureSpec);
                    }

                    if (newWidth <= widthSize) {
                        widthSize = newWidth;
                        done = true;
                    }
                }

                // Try adjusting height to be proportional to width
                if (!done && resizeHeight) {
                    int newHeight = (int)((widthSize - pleft - pright) /
desiredAspect) +
                            ptop + pbottom;

                    // Allow the height to outgrow its original estimate if
width is fixed.
                    if (!resizeWidth && !sCompatAdjustViewBounds) {
                        heightSize = resolveAdjustedSize(newHeight,
mMaxHeight,
                                heightMeasureSpec);
                    }

                    if (newHeight <= heightSize) {
                        heightSize = newHeight;
                    }
                }
            }
        }
    } else {
        /* We are either don't want to preserve the drawables aspect ratio,
           or we are not allowed to change view dimensions. Just measure in
           the normal way.
        */
        w += pleft + pright;
        h += ptop + pbottom;

        w = Math.max(w, getSuggestedMinimumWidth());
        h = Math.max(h, getSuggestedMinimumHeight());

        widthSize = resolveSizeAndState(w, widthMeasureSpec, 0);
        heightSize = resolveSizeAndState(h, heightMeasureSpec, 0);
    }

    setMeasuredDimension(widthSize, heightSize);
}
```

## 3.2 ViewGroup中onMeasure方法

- 下面是真是开发案例中LinearLayout的代码，如下所示

```
@Override
protected void onMeasure(int widthMeasureSpec, int heightMeasureSpec) {
    int myWidth = -1;
    int myHeight = -1;

    int width = 0;
    int height = 0;

    final int widthMode = MeasureSpec.getMode(widthMeasureSpec);
    final int heightMode = MeasureSpec.getMode(heightMeasureSpec);
    final int widthSize = MeasureSpec.getSize(widthMeasureSpec);
    final int heightSize = MeasureSpec.getSize(heightMeasureSpec);

    // Record our dimensions if they are known;
    if (widthMode != MeasureSpec.UNSPECIFIED) {
        myWidth = widthSize;
    }

    if (heightMode != MeasureSpec.UNSPECIFIED) {
        myHeight = heightSize;
    }

    if (widthMode == MeasureSpec.EXACTLY) {
        width = myWidth;
    }

    if (heightMode == MeasureSpec.EXACTLY) {
        height = myHeight;
    }

    View ignore = null;
    int gravity = mGravity & Gravity.RELATIVE_HORIZONTAL_GRAVITY_MASK;
    final boolean horizontalGravity = gravity != Gravity.START && gravity !=
0;
    gravity = mGravity & Gravity.VERTICAL_GRAVITY_MASK;
    final boolean verticalGravity = gravity != Gravity.TOP && gravity != 0;

    int left = Integer.MAX_VALUE;
    int top = Integer.MAX_VALUE;
    int right = Integer.MIN_VALUE;
    int bottom = Integer.MIN_VALUE;

    boolean offsetHorizontalAxis = false;
    boolean offsetVerticalAxis = false;

    if ((horizontalGravity || verticalGravity) && mIgnoreGravity !=
View.NO_ID) {
        ignore = findViewById(mIgnoreGravity);
    }

    final boolean isWrapContentWidth = widthMode != MeasureSpec.EXACTLY;
    final boolean isWrapContentHeight = heightMode != MeasureSpec.EXACTLY;

    // We need to know our size for doing the correct computation of children
positioning in RTL
    // mode but there is no practical way to get it instead of running the
code below.
    // So, instead of running the code twice, we just set the width to a
"default display width"
    // before the computation and then, as a last pass, we will update their
real position with
    // an offset equals to "DEFAULT_WIDTH - width".
    final int layoutDirection = getLayoutDirection();
    if (isLayoutRtl() && myWidth == -1) {
        myWidth = DEFAULT_WIDTH;
    }

    View[] views = mSortedHorizontalChildren;
    int count = views.length;

    for (int i = 0; i < count; i++) {
        View child = views[i];
        if (child.getVisibility() != GONE) {
            LayoutParams params = (LayoutParams) child.getLayoutParams();
            int[] rules = params.getRules(layoutDirection);

            applyHorizontalSizeRules(params, myWidth, rules);
            measureChildHorizontal(child, params, myWidth, myHeight);

            if (positionChildHorizontal(child, params, myWidth,
isWrapContentWidth)) {
                offsetHorizontalAxis = true;
            }
        }
    }

    views = mSortedVerticalChildren;
    count = views.length;
    final int targetSdkVersion =
getContext().getApplicationInfo().targetSdkVersion;

    //省略部分代码

    setMeasuredDimension(width, height);
```

```
}
```

# 其他介绍

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