Layout and Dirty Bit System

1. **What is Layout?**

   When the renderer is created and added to the tree, it does not have a position and size. Calculating these values is called layout or reflow.

2. **How does layout work?**

   - HTML uses a flow based layout model, meaning that most of the time it is possible to compute the geometry in a single pass. **Elements later ``in the flow'' typically do not affect the geometry of elements that are earlier ``in the flow''**, so layout can proceed left-to-right, top-to-bottom through the document. There are exceptions: for example, HTML tables may require more than one pass.
   - The coordinate system is relative to the root frame. Top and left coordinates are used.
   - The position of the root renderer is 0,0 and its dimensions are the viewport--—the visible part of the browser window.
   - Layout is a recursive process. It begins at the root renderer, which corresponds to the <html> element of the HTML document. Layout continues recursively through some or all of the frame hierarchy, computing geometric information for each renderer that requires it.
   - All renderers have a "layout" or "reflow" method, each renderer invokes the layout method of its children that need layout.

3. **Dirty bit system**

   - In order not to do a full layout for every small change, browsers use a "dirty bit" system. A renderer that is changed or added marks itself and its children as "dirty": needing layout.
   - There are two flags: "dirty", and "children are dirty" which means that although the renderer itself may be OK, it has at least one child that needs a layout.

Classification of Layout

1. **Global and incremental layout**

— Layout can be triggered on the entire render tree–this is "global" layout. This can happen as a result of:

- A global style change that affects all renderers, like a font size change.
- As a result of a screen being resized.

— Layout can be incremental, only the dirty renderers will be laid out.Incremental layout is triggered (asynchronously) when renderers are dirty. For example when new renderers are appended to the render tree after extra content came from the network and was added to the DOM tree.

2. **Asynchronous and Synchronous layout**

- Incremental layout is done asynchronously. Firefox queues "reflow commands" for incremental layouts and a scheduler(调度器) triggers batch execution of these commands. WebKit also has a timer that executes an incremental layout–-—the tree is traversed and "dirty" renderers are layout out.
- Scripts asking for style information, like "offsetHeight" can trigger incremental layout synchronously.
- Global layout will usually be triggered synchronously.
- Sometimes layout is triggered as a callback after an initial layout because some attributes, like the scrolling position changed.