

Programming Assignment 4

Due December 12 at 11:55 PM

XYZ Inc. wants to expand the utility from the previous programming assignment so that it can now read in layout files. The layout files will be in XML format and will describe the layout of tracks on layers. The utility will need to generate a netlist file from the layout file. The type of netlist file will depend upon the option. The `-N` option will produce either a `.net` or an XML netlist file. The syntax of the `-N` option is as follows:
`netlist -N <layout filename> <output filename>`

The type of netlist file generated will depend upon the extension of the output filename. If the output filename ends with `.xml` then an XML netlist file will be generated otherwise a `.net` netlist file will be generated.

Boards have tracks that exist on layers. If two tracks on the same layer intersect they are shorted together and hence are part of the same net. Vias connect different layers of the board.

This assignment can be broken up into three parts to achieve the final program:

1. Create a data structure to hold the points, vias and layers.
2. Write code to read in the layout files.
3. Write code to create nets from the layout information. Intersections can be calculated using algebra. The following equations may help.

$$y = mx + b$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$b = y_1 - mx_1$$

$$m_1x + b_1 = m_2x + b_2$$

4. Write code to output the newly generated net information.

The program will retain all of the functionality of programming assignment 3.

`-N` (generate netlist)

`Netlist <output filename> generated from layout <layout filename>.`

XML Netlist File Format

The XML Netlist files have a NETLIST element at the highest level. The NETLIST elements can have COMPONENT and NET subelements. The COMPONENT elements have DESIGNATION, FOOTPRINT, and LABEL attributes. The NET elements have a single attribute: NAME. The NET elements have CONNECTION subelements. The CONNECTION elements have a single attribute: COMPONENT, and PIN subelements. The PIN elements have no attributes and the text is the pin number. See the example below. Component designations may not be listed more than once in the net.

```
<NETLIST>
  <COMPONENT DESIGNATION="COMPONENT DESIGNATION"
    FOOTPRINT="FOOTPRINT" LABEL="LABEL"/>
  ...
  <NET NAME="NET NAME">
    <CONNECTION COMPONENT="COMPONENT DESIGNATION">
      <PIN>PinNumber1</PIN>
      <PIN>PinNumber2</PIN>
      ...
    </CONNECTION>
  </NET>
  ...
</NETLIST>
```

XML Layout File Format

The XML Layout files have a BOARD element at the highest level. The BOARD element can have a single POINTS subelement and a single VIAS subelement. The BOARD can have multiple LAYER subelements.

The POINTS element can have POINT subelements. The POINT element has NAME, XLOC and YLOC attributes. The NAME attribute specifies a tag to easily distinguish points. The XLOC and YLOC specify the X and Y location of the point.

The VIAS element can have multiple VIA subelements. The VIA element has NAME, POINT, START, and END attributes. The NAME attribute specifies a tag to easily distinguish VIAs. The POINT attribute specifies the name of a POINT from the POINTS element. The START and END attributes specify LAYERs that the VIA connects.

The LAYER element has a NAME attribute that specifies the layer name. The LAYER element can have multiple COMPONENT and TRACKS subelements. The only two layers that are allowed to have COMPONENT subelements are "TOP" and "BOTTOM". The COMPONENT element has DESIGNATION, FOOTPRINT, LABEL, ORIENTATION, and POINT attributes. The DESIGNATION, FOOTPRINT, and LABEL attributes are the same as the attributes from the XML Netlist files. The ORIENTATION attribute specifies the orientation of the component and is one of the following values: NORMAL, CW90, CW180, CW270, CCW90, CCW180, or CCW270.

The TRACKS element can have multiple TRACK subelements. The TRACK element has NAME, START, and END attributes. The NAME attribute specifies a name for the track. The START and END attributes specify either a POINT, a VIA or a COMPONENT pin. The COMPONENT pin will take the form "DESIGNATION-PINNUMBER".

```
<BOARD>
  <POINTS>
    <POINT NAME="NAME" XLOC="X-POS" YLOC="Y-POS" />
  </POINTS>
  <LAYER NAME="LAYERNAME" >
    <COMPONENT DESIGNATION="COMPONENT DESIGNATION"
      FOOTPRINT="FOOTPRINT" LABEL="LABEL"
      ORIENTATION="ORIENTATION" POINT="NAME" />
    <TRACKS>
      <TRACK NAME="TRACKNAME" START="SPOINT" END="EPOINT" />
    </TRACKS>
  </LAYER>
  <VIAS>
    <VIA NAME="VIANAME" POINT="POINTNAME" START="SLAYER"
      END="ELAYER" />
  </VIAS>
</BOARD>
```