Pascal Triangle MLP

Combinations can easily solved and fibonacci derived. Constants such as e, natural numbers and common fractions can be derived. We can look at Bernoulli's triangle too for cake numbers and dividing circles etc

```
pascal(10)
```

```
ans = 10×10
           1           1           1           1           1           1 ⋯
           1           2           3           4           5           6
           1           3           6          10          15          21
           1           4          10          20          35          56
           1           5          15          35          70         126
           1           6          21          56         126         252
           1           7          28          84         210         462
           1           8          36         120         330         792
           1           9          45         165         495        1287
           1          10          55         220         715        2002
```

If we were to rotate this 45° we'd see the triangle we know and love.

```
levels = 10;
first = fullyConnectedLayer(1,'Bias',zeros(1,1),'Weights',ones(1,1),'Name','unit11');

layers = [imageInputLayer([1 1 1],'Name','in','Normalization',"none")
    first]
```

```
layers = 
  2×1 Layer array with layers:

     1   'in'       Image Input       1×1×1 images
     2   'unit11'   Fully Connected   1 fully connected layer
```

```
lgraph = layerGraph(layers)
```

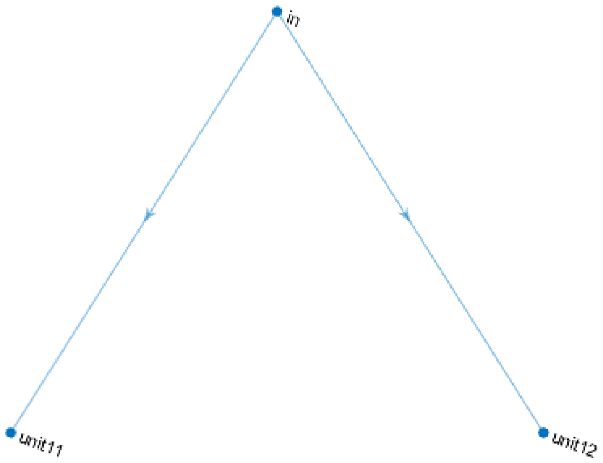
```
lgraph = 
  LayerGraph with properties:

         Layers: [2×1 nnet.cnn.layer.Layer]
    Connections: [1×2 table]
     InputNames: {'in'}
    OutputNames: {1×0 cell}
```

```
nextlayer = fullyConnectedLayer(1,'Bias',zeros(1,1),'Weights',ones(1,1),'Name','unit12');

lgraph = addLayers(lgraph,nextlayer);
lgraph = connectLayers(lgraph,'in','unit12');

plot(lgraph);
axis off
```

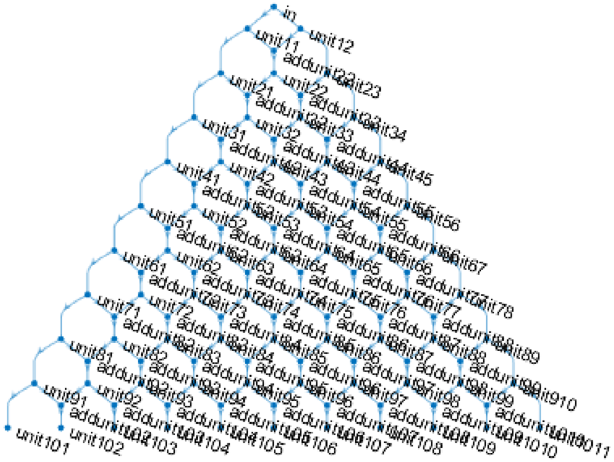


```
for i = 2:levels
    for j = 1:i+1
        lgraph = branchme(lgraph,i,j);
    end
end
```

```
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit10
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit13
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit20
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit24
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit30
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit35
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit40
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit46
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit50
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit57
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit60
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit68
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit70
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit79
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit80
```

```
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit810
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit90
nnet_cnn:nnet:cnn:LayerGraph:LayerDoesNotExist
Edge of the triangle! Connects to 0, unit911
```

```
plot(lgraph);
axis off
```



```
outs = [depthConcatenationLayer(levels+1,'Name','output_prep');regressionLayer("Name","rmse")]

lgraph = addLayers(lgraph,outs);
for i = 1:levels+1
lgraph = connectLayers(lgraph,"unit"+int2str(levels)+int2str(i),"output_prep/in"+int2str(i));
end
```

```
pascal_triangle = assembleNetwork(lgraph)
```

```
pascal_triangle = 
  DAGNetwork with properties:

         Layers: [113×1 nnet.cnn.layer.Layer]
    Connections: [167×2 table]
     InputNames: {'in'}
    OutputNames: {'rmse'}
```

```
predict(pascal_triangle,[1])
```

```
ans = 1×11 single row vector
     1    10    45   120   210   252   210   120    45    10     1
```

```
function lgraph = branchme(lgraph,x,y)
```

```
name = "unit"+int2str(x)+int2str(y);
con1 = "unit"+int2str(x-1)+int2str(y-1); con2 = "unit"+int2str(x-1)+int2str(y);
if y == 1 || y == x+1
    nextlayer = fullyConnectedLayer(1,'Bias',zeros(1,1),'Weights',ones(1),'Name',name);
    lgraph = addLayers(lgraph,nextlayer);
    try
        lgraph = connectLayers(lgraph,con1,name);
    catch ME
        disp(ME.identifier)
        disp("Edge of the triangle! Connects to 0, " + "unit"+int2str(x-1)+int2str(y-1))
    end
    try
        lgraph = connectLayers(lgraph,con2,name);
    catch ME
        disp(ME.identifier)
        disp("Edge of the triangle! Connects to 0, " + "unit"+int2str(x-1)+int2str(y))
    end
else
    nextlayer = [depthConcatenationLayer(2,'Name',"add"+name);fullyConnectedLayer(1,'Bias',zero
    lgraph = addLayers(lgraph,nextlayer);
    try
        lgraph = connectLayers(lgraph,con1,"add"+name+"/in1");
    catch ME
        disp(ME.identifier)
        disp("Edge of the triangle! Connects to 0, " + "unit"+int2str(x-1)+int2str(y-1))
    end
    try
        lgraph = connectLayers(lgraph,con2,"add"+name+"/in2");
    catch ME
        disp(ME.identifier)
        disp("Edge of the triangle! Connects to 0, " + "unit"+int2str(x-1)+int2str(y))
    end
end

end
```