第五次实验报告

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任务一结果汇总如下表所示：

tree	10 1	10 2	10 3	11 1	11 2	11 3
complete	√	√	×	√	√	×
full	√	×	×	√	×	×
2degree	511	411	37	1023	898	145
tree	12 1	12 2	12 3	13 1	13 2	13 3
complete	√	√	×	√	√	×
full	√	×	×	√	×	×
2degree	2047	1897	760	4095	3920	521
tree	14 1	14 2	14 3	15 1	15 2	15 3
complete	√	√	×	√	√	×
full	√	×	×	√	×	×
2degree	8191	7991	3997	16383	16158	9176
tree	20 1	20 2	20 3			
complete	√	√	×			
full	√	×	×			
2degree	524287	524012	76663			

任务一运行情况如下三张图所示：

```
tree13 2
is complete
not full

count 2 degree3920
tree13 3
not complete
not full

count 2 degree521
tree14 1
is complete
full

count 2 degree8191
tree14 2
is complete
not full

count 2 degree7991
tree14 3
not complete
not full

count 2 degree3997
tree15 1
is complete
full

count 2 degree16383
tree15 2
is complete
not full

count 2 degree16158
tree15 3
not complete
not full

count 2 degree9176
tree20 1
is complete
full

count 2 degree524287
```

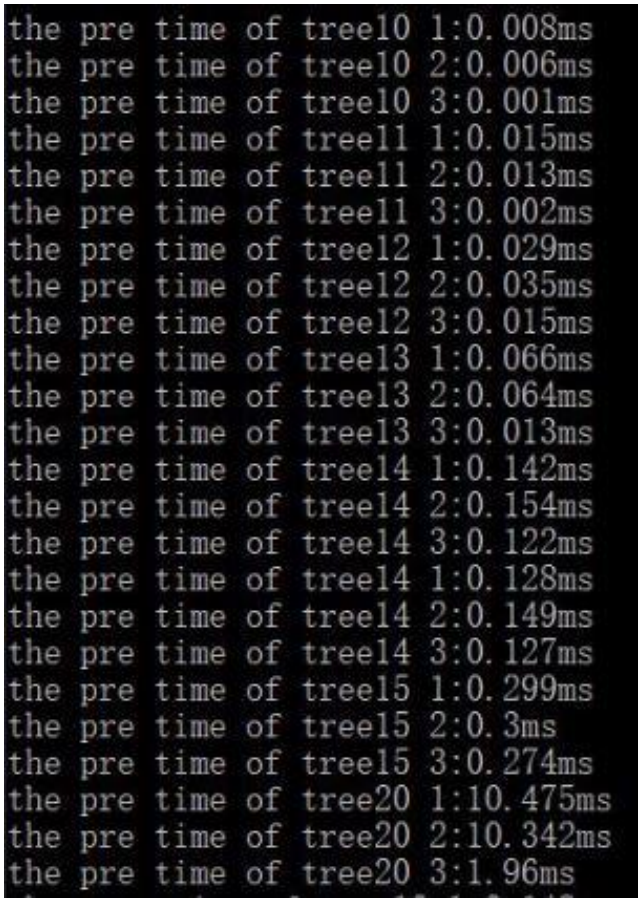
```
tree20 2
is complete
not full

count 2 degree524012
tree20 3
not complete
not full

count 2 degree76663

Process returned 0 (0x0)   execution time : 1.940 s
Press any key to continue.
```

任务二：

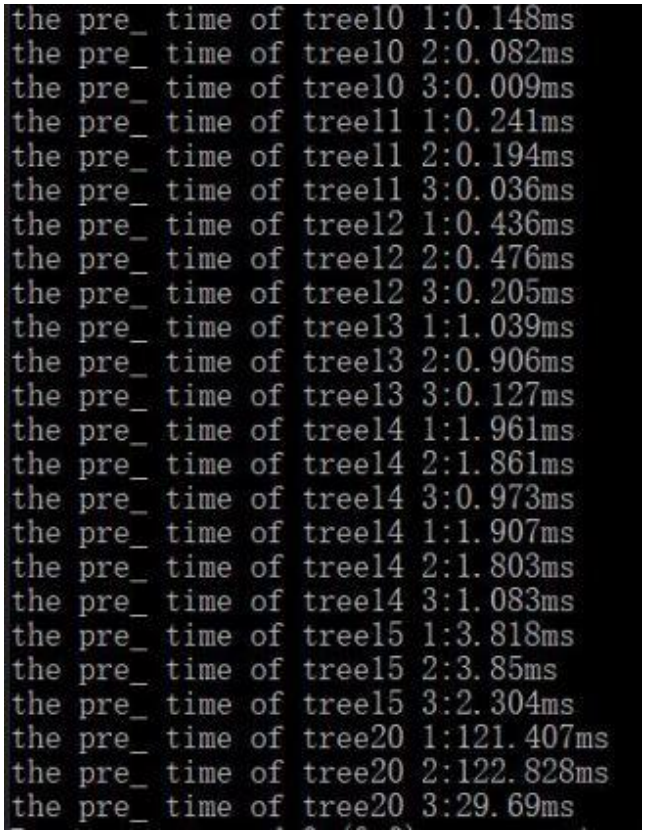
首先测试了递归前序和中序遍历所需的时间，如下两图所示，发现两者非常接近，容易推测得知前中后序遍历时间相近，故只需比较递归前序遍历和非递归前序遍历的时间差异。

```
the mid time of tree10 1:0.007ms  the pre time of tree10 1:0.006ms
the mid time of tree10 2:0.007ms  the pre time of tree10 2:0.006ms
the mid time of tree10 3:0.001ms  the pre time of tree10 3:0ms
the mid time of tree11 1:0.015ms  the pre time of tree11 1:0.014ms
the mid time of tree11 2:0.015ms  the pre time of tree11 2:0.013ms
the mid time of tree11 3:0.003ms  the pre time of tree11 3:0.002ms
the mid time of tree12 1:0.031ms  the pre time of tree12 1:0.03ms
the mid time of tree12 2:0.029ms  the pre time of tree12 2:0.027ms
the mid time of tree12 3:0.016ms  the pre time of tree12 3:0.014ms
the mid time of tree13 1:0.078ms  the pre time of tree13 1:0.06ms
the mid time of tree13 2:0.078ms  the pre time of tree13 2:0.063ms
the mid time of tree13 3:0.013ms  the pre time of tree13 3:0.01ms
the mid time of tree14 1:0.169ms  the pre time of tree14 1:0.169ms
the mid time of tree14 2:0.179ms  the pre time of tree14 2:0.195ms
the mid time of tree14 3:0.155ms  the pre time of tree14 3:0.162ms
the mid time of tree14 1:0.186ms  the pre time of tree14 1:0.132ms
the mid time of tree14 2:0.121ms  the pre time of tree14 2:0.203ms
the mid time of tree14 3:0.104ms  the pre time of tree14 3:0.192ms
the mid time of tree15 1:0.297ms  the pre time of tree15 1:0.257ms
the mid time of tree15 2:0.28ms   the pre time of tree15 2:0.309ms
the mid time of tree15 3:0.323ms  the pre time of tree15 3:0.28ms
the mid time of tree20 1:9.899ms  the pre time of tree20 1:12.478ms
the mid time of tree20 2:9.935ms  the pre time of tree20 2:10.396ms
the mid time of tree20 3:1.934ms  the pre time of tree20 3:1.888ms
```

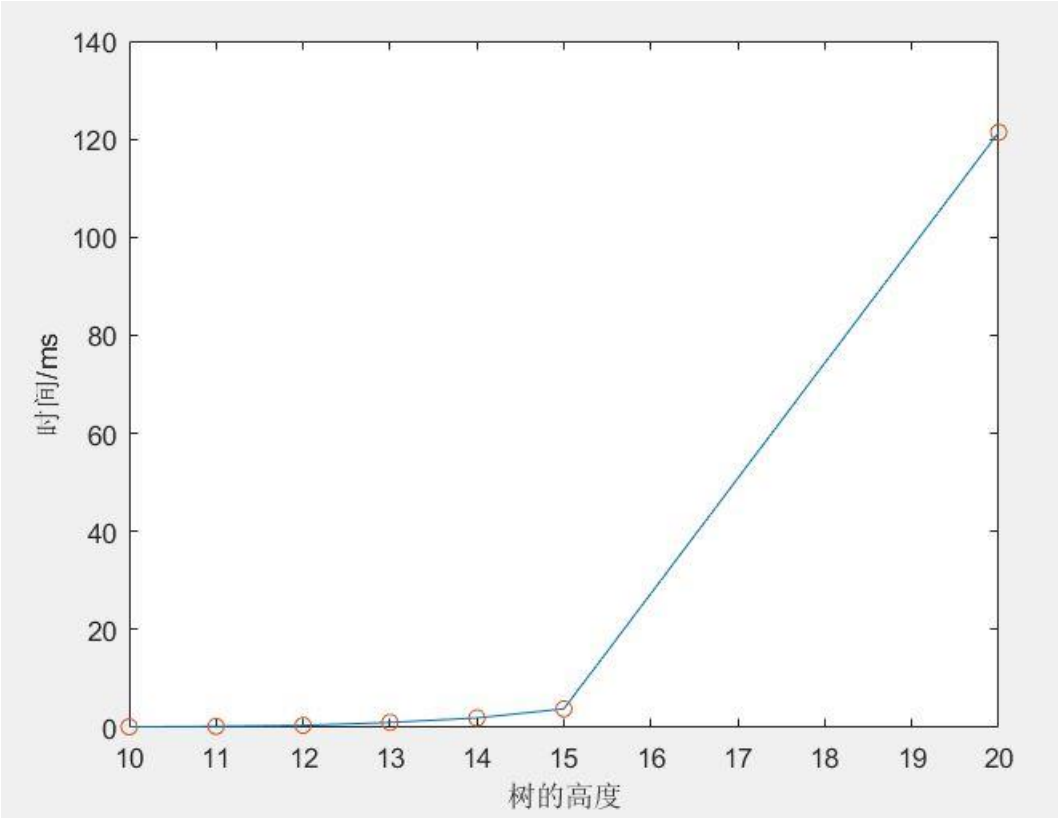
递归前序遍历时间如下图：



非递归前序遍历时间如下图：



比较可见，对于同一种方式，树的高度越大，遍历所需的时间越长，



Matlab 绘图如上，可见时间近似随树的高度增长成指数增长。

对于同一高度的树，非递归遍历要比递归遍历所需的时间要长，但是根据书本，理论上非递归的时间要比递归短一些。我认为一方面是因为树的节点数还不够大，非递归的优势显示不出来，另一方面是非递归使用了自定义的栈，可能栈的调用效率比较低。