

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：

```

tree10 1
is complete
full
count 2 degree511
tree10 2
is complete
not full
count 2 degree411
tree10 3
not complete
not full
count 2 degree37
tree11 1
is complete
full
count 2 degree1023
tree11 2
is complete
not full
count 2 degree898
tree11 3
not complete
not full
count 2 degree145
tree12 1
is complete
full
count 2 degree2047
tree12 2
is complete
not full
count 2 degree1897
tree12 3
not complete
not full
count 2 degree760
tree13 1
is complete
full
count 2 degree4095

```

```
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
```

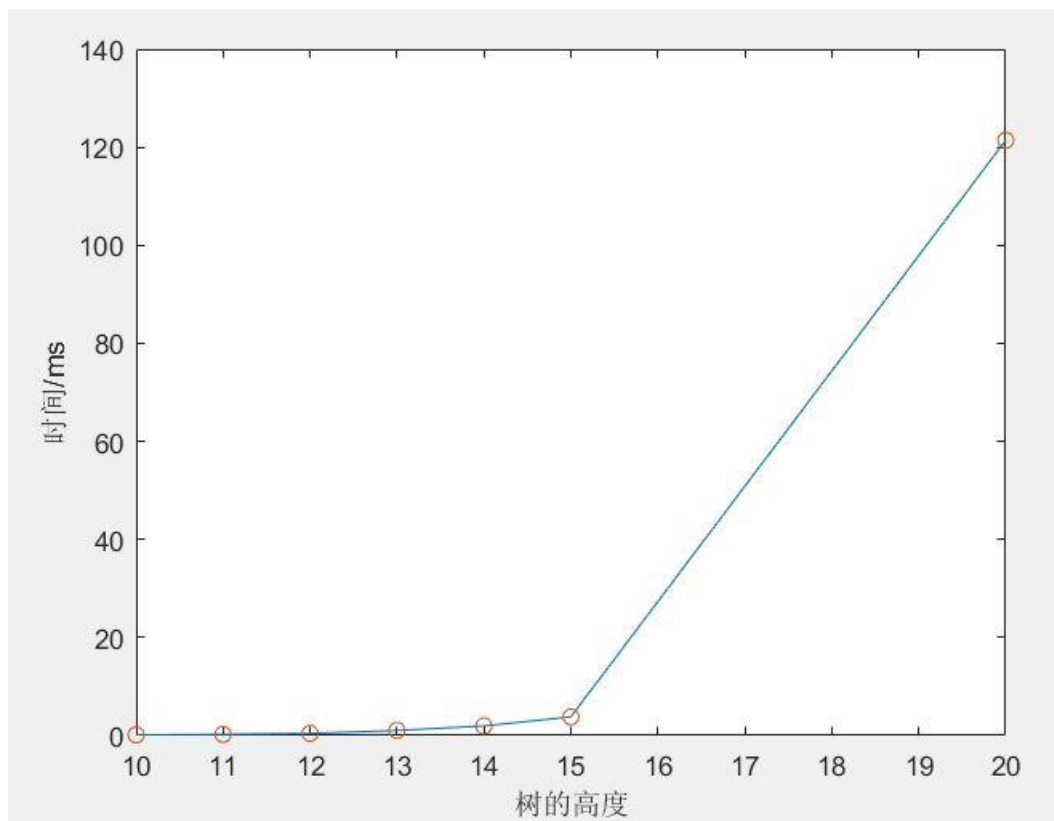
递归前序遍历时间如下图：

```
the pre time of tree10 1:0.008ms
the pre time of tree10 2:0.006ms
the pre time of tree10 3:0.001ms
the pre time of tree11 1:0.015ms
the pre time of tree11 2:0.013ms
the pre time of tree11 3:0.002ms
the pre time of tree12 1:0.029ms
the pre time of tree12 2:0.035ms
the pre time of tree12 3:0.015ms
the pre time of tree13 1:0.066ms
the pre time of tree13 2:0.064ms
the pre time of tree13 3:0.013ms
the pre time of tree14 1:0.142ms
the pre time of tree14 2:0.154ms
the pre time of tree14 3:0.122ms
the pre time of tree14 1:0.128ms
the pre time of tree14 2:0.149ms
the pre time of tree14 3:0.127ms
the pre time of tree15 1:0.299ms
the pre time of tree15 2:0.3ms
the pre time of tree15 3:0.274ms
the pre time of tree20 1:10.475ms
the pre time of tree20 2:10.342ms
the pre time of tree20 3:1.96ms
```

非递归前序遍历时间如下图：

```
the pre_time of tree10 1:0.148ms
the pre_time of tree10 2:0.082ms
the pre_time of tree10 3:0.009ms
the pre_time of tree11 1:0.241ms
the pre_time of tree11 2:0.194ms
the pre_time of tree11 3:0.036ms
the pre_time of tree12 1:0.436ms
the pre_time of tree12 2:0.476ms
the pre_time of tree12 3:0.205ms
the pre_time of tree13 1:1.039ms
the pre_time of tree13 2:0.906ms
the pre_time of tree13 3:0.127ms
the pre_time of tree14 1:1.961ms
the pre_time of tree14 2:1.861ms
the pre_time of tree14 3:0.973ms
the pre_time of tree14 1:1.907ms
the pre_time of tree14 2:1.803ms
the pre_time of tree14 3:1.083ms
the pre_time of tree15 1:3.818ms
the pre_time of tree15 2:3.85ms
the pre_time of tree15 3:2.304ms
the pre_time of tree20 1:121.407ms
the pre_time of tree20 2:122.828ms
the pre_time of tree20 3:29.69ms
```

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。