

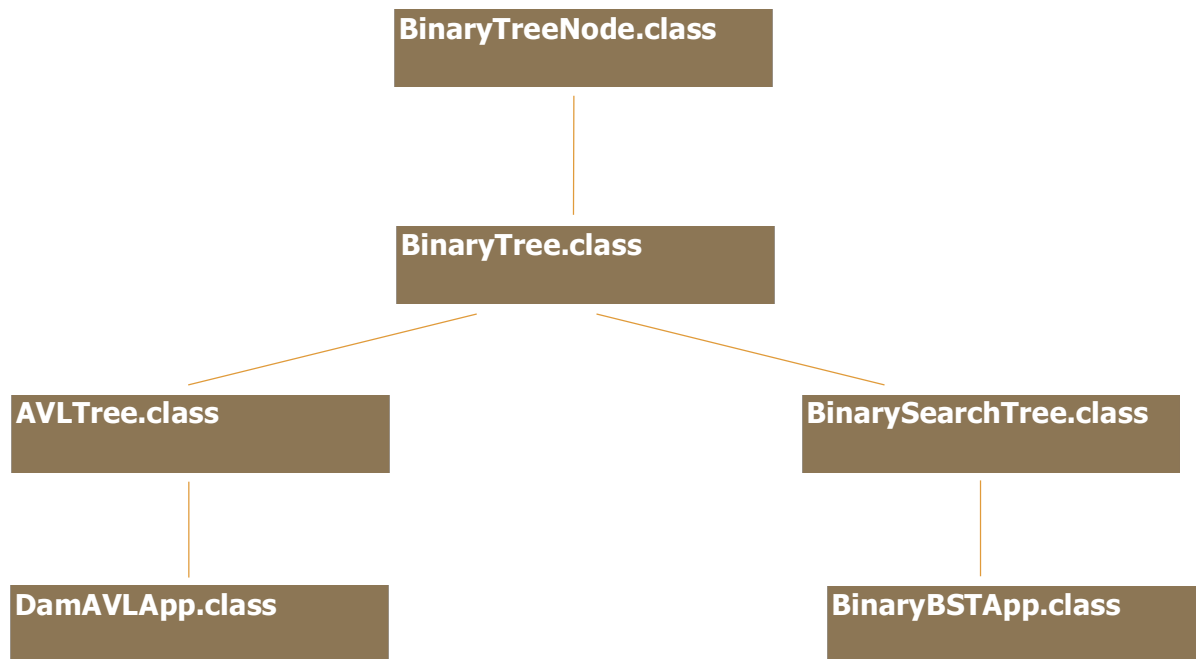
REPORT

ASSIGNMENT 2. BLNMAN002

OO DESIGN

I decided to make several classes to give me the ability to compare processing of a Binary Search Tree versus processing of an AVL Tree. The diagram below lists all classes involved.

CLASSES



- **BinaryTreeNode.class** is a class that creates a node that stores a single data item in it.
- **BinaryTree.class** is a class that has certain methods necessary for the **DamBSTApp.class** and **DamAVLApp.class**. It has a `preOrder()` method and an `inOrder()` method that arranges the data from the Binary Search Tree or AVL Tree in order. The class also uses variables, a constructor and method from **BinaryTreeNode.class**
- **BinarySearchTree.class** has most of the methods that the **DamBSTApp.class** will use. Such methods include `insert()`, `find()`, `getInsertCount()` and `getSearchCount()` that store the data items into the Binary Search Tree, find a requested tree and counts the number of insertion and search operations respectively.

- **AVLTree.class** has most of the methods that the **DamAVLApp.class** will use. Similarly to the **DamBSTApp.class**, such methods include **insert()**, **find()**, **getInsertCount()** and **getSearchCount()** that store the data items into the AVL Tree, find a requested tree and counts the number of insertion and search operations respectively.
- **DamBSTApp.class** is the class that accesses methods, constructors and variables from the **BinarySearchTree.class** in order to process the data items into a Binary Search Tree. It has processes that can be used to print all the data items or search for a single dam data item.
- **DamAVLApp.class** is the class that accesses methods, constructors and variables from the **AVLTree.class** in order to process the data items into a AVL Tree. It has processes that can be used to print all the data items or search for a single dam data item.

EXPERIMENT

In this assignment, my ultimate objective was to store data items into two different data structures and compare the efficiency of reading or accessing said data items.

For the experiment I decided to design code that would count the no. of comparisons made to search for an item and the no. of comparisons made to insert an item for each dam in a BST and AVL tree. The goal was to extract these values and put them in a graph to compare the no. of comparisons for the data structures respectively.

PART 2 AND PART 4 RESULTS

	Dam info	No. of AVL comparisons for Search (Part 2)	No. of AVL comparisons for Insert (Part 2)	No. of BST comparisons for Search (Part 4)	No. of BST comparisons for Insert (Part 4)
Test 1	Lindleyspoort Dam	1	13	3	15
Test 2	Ngotwane Dam	25	0	1	0
Test 3	Albasini Dam	25	110	4	106
Test 4	Unknown Dam	15		24	

printAllDams() output

DamAVLApp	DamBSTApp
First 10 lines:	First 10 lines:
Lindleyspoort Dam 14.208 2.7	Albasini Dam 28.199000000000002 69.2
Flag Boshielo Dam 185.13 40.200000000000003	Albert Falls Dam 288.14 36.4
Buffelspoort Dam 10.183 71.400000000000006	Allemanskraal Dam 174.52 13.5
Blyderivierpoort Dam 54.369 50	Armenia Dam 12.957000000000001 10
Armenia Dam 12.957000000000001 10	Beervlei Dam 85.778999999999996 1.5
Albert Falls Dam 288.14 36.4	Belfort Dam 0.413 98
Albasini Dam 28.199000000000002 69.2	Bellair Dam 4.241 78.3
Allemanskraal Dam 174.52 13.5	Berg River Dam 127.05 31.1
Berg River Dam 127.05 31.1	Binfield Dam 36.848999999999997 96.6
Belfort Dam 0.413 98	Bloemhof Dam 1240.24 15.5
Last 10 lines:	Last 10 lines:
Welbedacht Dam 9.592 97.5	Wemmershoek Dam 58.71 52.3
Waterdown Dam 37.441000000000003 90.1	Westoe Dam 60.094999999999999 48.3
Witbank Dam 104.02 52.2	Witbank Dam 104.02 52.2
Westoe Dam 60.094999999999999 48.3	Witklip Dam 12.519 39.299999999999997
Witklip Dam 12.519 39.299999999999997	Wolwedans Dam 24.626000000000001 95.4
Wriggleswade Dam 91.471000000000004 98.7	Woodstock Dam 373.25 77.099999999999994
Woodstock Dam 373.25 77.099999999999994	Wriggleswade Dam 91.471000000000004 98.7
Xonxa Dam 115.86 100	Xilinx Dam 13.823 27.2
Xilinx Dam 13.823 27.2	Xonxa Dam 115.86 100
Zaaihoek Dam 184.63 58.5	Zaaihoek Dam 184.63 58.5

Part 5 Results and Discussion

Column1	Cumulative Insert Count		Search Count		Individual Insert Count	
	AVL	BST	AVL	BST	AVL	BST
Ngotwane Dam	0	0	0	1	0	0
Hartbeespoort Dam	1	1	1	2	1	1
Bon Accord Dam	3	3	2	3	2	2
Olifantsnek Dam	5	4	1	2	2	1
Rietvlei Dam	8	6	2	3	3	2
Buffelspoort Dam	10	9	3	4	2	3
Bospoort Dam	13	13	4	5	3	4
Lindleyspoort Dam	16	15	2	3	3	2

Warmbad Dam	19	18	3	4	3	3
Roodeplaat Dam	23	22	4	5	4	4
Kosterrivier Dam	27	25	3	4	4	3
Klipvoor Dam	31	29	4	5	4	4
Swartruggens Dam	35	34	5	6	4	5
Vaalkop Dam	39	40	6	7	4	6
Roodekopjes Dam	43	45	5	6	4	5
Marico-Bosveld Dam	47	48	3	4	4	3
Klein Maricopoort Da	51	53	5	6	4	5
Kromellenboog Dam	55	57	4	5	4	4
Molatedi Dam	60	61	4	5	5	4
Sehujwane Dam	64	67	6	7	4	6
Madikwe Dam	69	71	4	5	5	4
Pella Dam	73	74	3	4	4	3
Mokolo Dam	78	79	5	6	5	5
Doorndraai Dam	82	83	4	5	4	4
Glen Alpine Dam	87	88	5	6	5	5
Nzhelele Dam	92	90	2	3	5	2
Luphephe Dam	98	95	5	6	6	5
Nwanedzi Dam	104	98	3	4	6	3
Mutshedzi Dam	110	103	5	6	6	5
Albasini Dam	114	106	3	4	4	3
Vondo Dam	119	113	7	8	5	7
Nandoni Dam	125	119	6	7	6	6
Witbank Dam	130	123	4	5	5	4
Middelburg Dam	135	129	6	7	5	6
Bronkhorstspruit Dam	140	134	5	6	5	5
Rust Der Winter Dam	146	141	7	8	6	7
Loskop Dam	152	147	6	7	6	6
Rhenosterkop Dam	157	151	4	5	5	4
Tonteldoos Dam	163	158	7	8	6	7
Vlugkraal Dam	169	166	8	9	6	8
Buffelskloof Dam	175	172	6	7	6	6
De Hoop Dam	181	177	5	6	6	5
Flag Boshielo Dam	187	183	6	7	6	6

Ohrigstad Dam	192	186	3	4	5	3
Blyderivierpoort Dam	198	190	4	5	6	4
Klaserie Dam	202	196	6	7	4	6
Tours Dam	209	204	8	9	7	8
Ebenezer Dam	215	211	7	8	6	7
Hans Merensky Dam	221	217	6	7	6	6
Magoebaskloof Dam	227	222	5	6	6	5
Vergelegen Dam	234	231	9	10	7	9
Tzaneen Dam	241	240	9	10	7	9
Dap Naude Dam	247	246	6	7	6	6
Middel-Letaba Dam	253	253	7	8	6	7
Nsami Dam	259	257	4	5	6	4
Vaal Dam	266	267	10	11	7	10
Grootdraai Dam	271	274	7	8	5	7
Boskop Dam	277	279	5	6	6	5
Johan Nesor Dam	283	286	7	8	6	7
Klerkskraal Dam	289	292	6	7	6	6
Potchefstroom Dam	295	297	5	6	6	5
Klipdrift Dam	301	304	7	8	6	7
Elandskuil Dam	306	312	8	9	5	8
Rietspruit Dam	312	317	5	6	6	5
Spitskop Dam	319	324	7	8	7	7
Taung Dam	325	332	8	9	6	8
Allemanskraal Dam	331	337	5	6	6	5
Erfenis Dam	337	346	9	10	6	9
Tierpoort Dam	344	355	9	10	7	9
Kalkfontein Dam	349	363	8	9	5	8
Rustfontein Dam	356	371	8	9	7	8
Krugersdrift Dam	362	376	5	6	6	5
Groothoek Dam	368	384	8	9	6	8
Koppies Dam	374	389	5	6	6	5
Sterkfontein Dam	381	397	8	9	7	8
Saulspoort Dam	389	406	9	10	8	9
Fika-Patso Dam	395	416	10	11	6	10
Vaalharts Storage Weir	401	427	11	12	6	11
Bloemhof Dam	408	433	6	7	7	6

Douglas Storage Weir	414	441	8	9	6	8
Sterkspruit Dam	422	450	9	10	8	9
Katse Dam	428	459	9	10	6	9
Mohale Dam	434	466	7	8	6	7
Egmont Dam	440	475	9	10	6	9
Armenia Dam	447	482	7	8	7	7
Welbedacht Dam	453	487	5	6	6	5
Knellpoort Dam	460	493	6	7	7	6
Gariep Dam	466	500	7	8	6	7
Vanderkloof Dam	473	510	10	11	7	10
Disaneng Dam	478	516	6	7	5	6
Setumo Dam	486	524	8	9	8	8
Boegoeberg Dam	492	529	5	6	6	5
Bulshoek Dam	498	536	7	8	6	7
Clanwilliam Dam	505	544	8	9	7	8
Karee Dam	511	554	10	11	6	10
Voelvlei Dam	518	563	9	10	7	9
Wemmershoek Dam	525	569	6	7	7	6
Misverstand Dam	532	577	8	9	7	8
Berg River Dam	539	585	8	9	7	8
Steenbras Dam Lower	546	594	9	10	7	9
Eikenhof Dam	553	604	10	11	7	10
Steenbras Dam - Upper	561	614	10	11	8	10
Debe Dam	567	621	7	8	6	7
De Bos Dam	574	628	7	8	7	7
Brandvlei Dam	581	634	6	7	7	6
Stettynskloof Dam	588	644	10	11	7	10
Ceres Dam	595	653	9	10	7	9
Roode Els Berg Dam	603	659	6	7	8	6
Lakenvallei Dam	609	665	6	7	6	6
Poortjieskloof Dam	617	671	6	7	8	6
Pietersfontein Dam	625	678	7	8	8	7
Keerom Dam	631	688	10	11	6	10
Klipberg Dam	637	696	8	9	6	8
Kwaggaskloof Dam	644	703	7	8	7	7

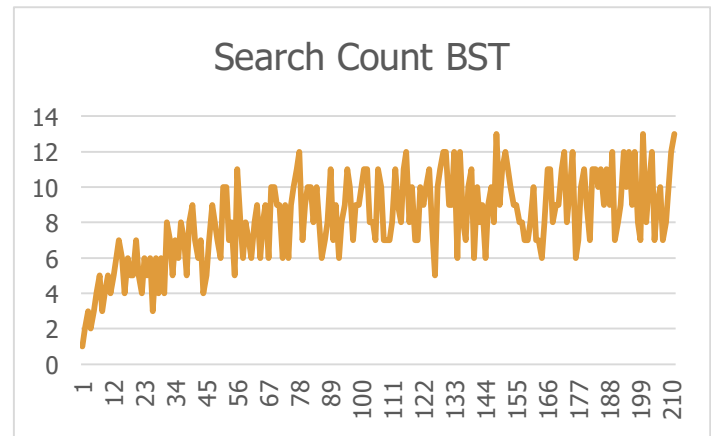
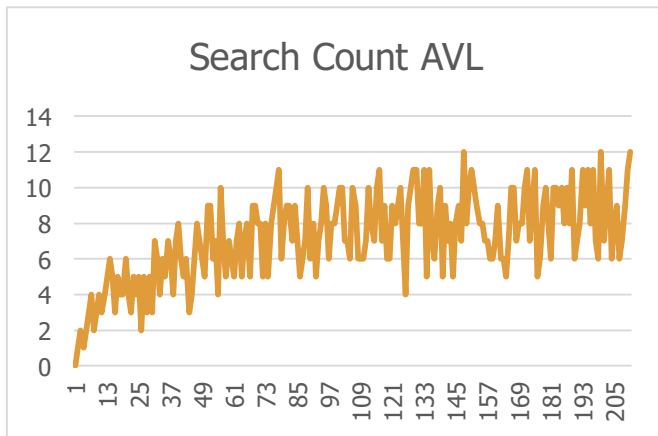
Theewaterskloof Dam	652	713	10	11	8	10
Elandskloof Dam	660	724	11	12	8	11
Buffeljags Dam	667	731	7	8	7	7
Duiwenhoks Dam	674	740	9	10	7	9
Korentepoort Dam	681	746	6	7	7	6
Prinsrivier Dam	689	752	6	7	8	6
Bellair Dam	696	761	9	10	7	9
Floriskraal Dam	703	769	8	9	7	8
Miertjieskraal Dam	711	778	9	10	8	9
Calitzdorp Dam	719	788	10	11	8	10
Leeugamka Dam	726	795	7	8	7	7
Oukloof Dam	732	799	4	5	6	4
Gamka Dam	739	808	9	10	7	9
Gamkapoort Dam	747	818	10	11	8	10
Kammanassie Dam	754	829	11	12	7	11
Stompdrift Dam	761	840	11	12	7	11
Hartebeestkuil Dam	768	848	8	9	7	8
Klipheuwel Dam	774	856	8	9	6	8
Ernest Robertson Dam	781	867	11	12	7	11
Wolwedans Dam	788	872	5	6	7	5
Garden Route Dam	796	883	11	12	8	11
Roodefontein Dam	803	890	7	8	7	7
Kromrivier Dam	810	896	6	7	7	6
Impofu Dam	818	905	9	10	8	9
Beervlei Dam	825	915	10	11	7	10
Kouga Dam	832	920	5	6	7	5
Haarlem Dam	839	929	9	10	7	9
Loerie Dam	846	936	7	8	7	7
Groendal Dam	854	944	8	9	8	8
Nqweba (V. Rynevelds)	862	949	5	6	8	5
Darlington Dam	870	957	8	9	8	8
Grassridge Dam	878	966	9	10	8	9
Kommandodrift Dam	885	973	7	8	7	7
Elandsdrift Dam	893	985	12	13	8	12

De Mistkraal Dam	900	993	8	9	7	8
Glen Melville	908	1003	10	11	8	10
Katrivier Dam	914	1014	11	12	6	11
Sandile Dam	921	1024	10	11	7	10
Binfield Dam	928	1033	9	10	7	9
Laing Dam	935	1041	8	9	7	8
Rooikrantz Dam	942	1049	8	9	7	8
Bridle Drift Dam	949	1056	7	8	7	7
Nahoon Dam	956	1063	7	8	7	7
Macubeni Dam	963	1069	6	7	7	6
Xonxa Dam	971	1075	6	7	8	6
Lubisi Dam	978	1082	7	8	7	7
Doornrivier Dam	985	1091	9	10	7	9
Boesmanskrantz Dam	992	1097	6	7	7	6
Waterdown Dam	999	1103	6	7	7	6
Oxkraal Dam	1006	1108	5	6	7	5
Ncora Dam	1014	1115	7	8	8	7
Tsojana Dam	1020	1125	10	11	6	10
Gubu Dam	1028	1135	10	11	8	10
Wriggleswade Dam	1036	1142	7	8	8	7
Gcuwa Dam	1044	1150	8	9	8	8
Xilinx Dam	1052	1158	8	9	8	8
Toleni Dam	1059	1168	10	11	7	10
Umtata	1066	1179	11	12	7	11
Mabeleni Dam	1074	1186	7	8	8	7
Corana Dam	1082	1195	9	10	8	9
Belfort Dam	1090	1206	11	12	8	11
Ntenetyana Dam	1097	1211	5	6	7	5
Nqadu Dam	1104	1217	6	7	7	6
Mlanga Dam	1111	1226	9	10	7	9
Midmar Dam	1119	1236	10	11	8	10
Nagle Dam	1127	1244	8	9	8	8
Albert Falls Dam	1134	1250	6	7	7	6
Inanda Dam	1142	1260	10	11	8	10
Hazelmere Dam	1150	1270	10	11	8	10
Spioenkop Dam	1156	1279	9	10	6	9
Driel Barrage	1164	1289	10	11	8	10

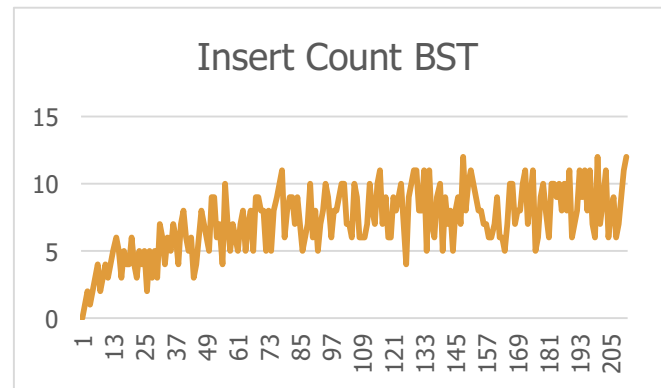
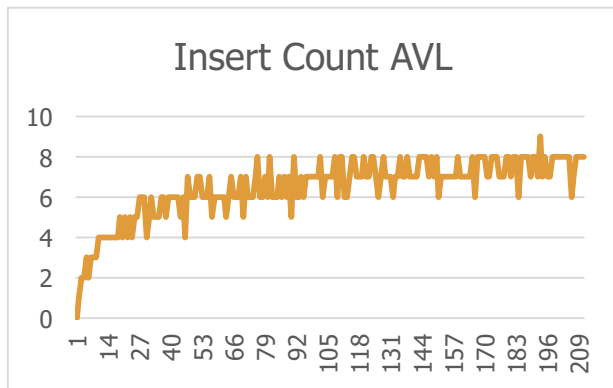
Woodstock Dam	1172	1297	8	9	8	8
Craigie Burn Dam	1180	1307	10	11	8	10
Mearns Dam	1188	1315	8	9	8	8
Spring Grove Dam	1195	1326	11	12	7	11
Ntshingwayo Dam	1203	1332	6	7	8	6
Zaaihoek Dam	1211	1339	7	8	8	7
Wagendrift Dam	1218	1347	8	9	7	8
Goedertrouw Dam	1227	1358	11	12	9	11
Klipfontein Dam	1234	1367	9	10	7	9
Hluhluwe Dam	1242	1378	11	12	8	11
Pongolapoort Dam	1249	1386	8	9	7	8
Jericho Dam	1256	1397	11	12	7	11
Westoe Dam	1264	1404	7	8	8	7
Morgenstond Dam	1272	1410	6	7	8	6
Heyshope Dam	1280	1422	12	13	8	12
Nooitgedacht Dam	1288	1429	7	8	8	7
Vygeboom Dam	1296	1438	9	10	8	9
Driekoppies Dam	1304	1449	11	12	8	11
Maguga Dam	1312	1455	6	7	8	6
Longmere Dam	1320	1463	8	9	8	8
Klipkopjes Dam	1326	1472	9	10	6	9
Witklip Dam	1333	1478	6	7	7	6
Primkop Dam	1341	1485	7	8	8	7
Kwena Dam	1349	1494	9	10	8	9
Da Gama Dam	1357	1505	11	12	8	11
Inyaka Dam	1365	1517	12	13	8	12

The table above depicts a sample of the data and shows the number of search comparisons that were made for each dam for a BST and AVL. Furthermore, it shows the cumulative insertion count as the dataset got bigger (to n=211). The table has all cumulative insertion counts listed and as the dataset gets bigger we can see that the BST had a higher growing and total insertion count compared to the AVL tree. This goes to show the insertion process for a BST takes more

time than an AVL tree. The table also shows the individual insertion comparisons that were made for each dam and the values had a higher range for a BST than that of an AVL, further proving the better efficiency of an AVL.



In the two graphs above, we can see that search counts for all data items plotted for both data structures took on a similar form, but the BST had slightly higher values in general than the AVL. This hence shows that an AVL is slightly more efficient in searching.



In the two graphs above, we can see that the insert counts for all data items plotted for the AVL tree was more alike an $O(\log n)$ graph than the BST. (When the data items are sorted, the graph takes on the exact shape of an $O(\log n)$ graph). The counts for the AVL also treaded along smaller values than the BST. This also shows that insertion is more efficient in an AVL than a BST.

Time Complexities

	AVL		BST	
	Insert comparisons	Search comparisons	Insert comparisons	Search comparisons
Best	$O(1)$	$O(1)$	$O(1)$	$O(1)$
Average	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$
Worst	$O(\log(n))$	$O(\log(n))$	$O(n)$	$O(n)$

The table above shows the best, worst and average case of comparisons for a data set. The AVL tree and BST share the same the best cases $O(1)$ and average case $O(\log(n))$ for both insert and search comparisons. However, the insert and search comparisons' worst case differ for an AVL Tree and a BST. An AVL's tree

worst case of insertion and search for a single data item is $O(\log(n))$ in comparison to that of a BST which is $O(n)$.

Git usage log

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Mandisas-MacBook-Pro:~
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logout