

Connecting to Databases

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SQL & Databases Overview

What is SQL

- Structured Query Language
 - Some people pronounce it “sequel”
 - Others insist that “ess-cue-ell” is the only correct pronunciation



What is SQL

- Structured Query Language
 - Some people pronounce it “sequel”
 - Others insist that “ess-cue-ell” is the only correct pronunciation
- A language for accessing and updating databases



What is a Database?

- A relational database (schema) is a collection of information stored in *tables* (entities) that relate to each other in some way
- Object oriented databases represent information in the form of *objects*



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- Object oriented databases represent information in the form of *objects*
- This lecture will focus on accessing relational databases from Java

Relational Databases

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Relational Databases

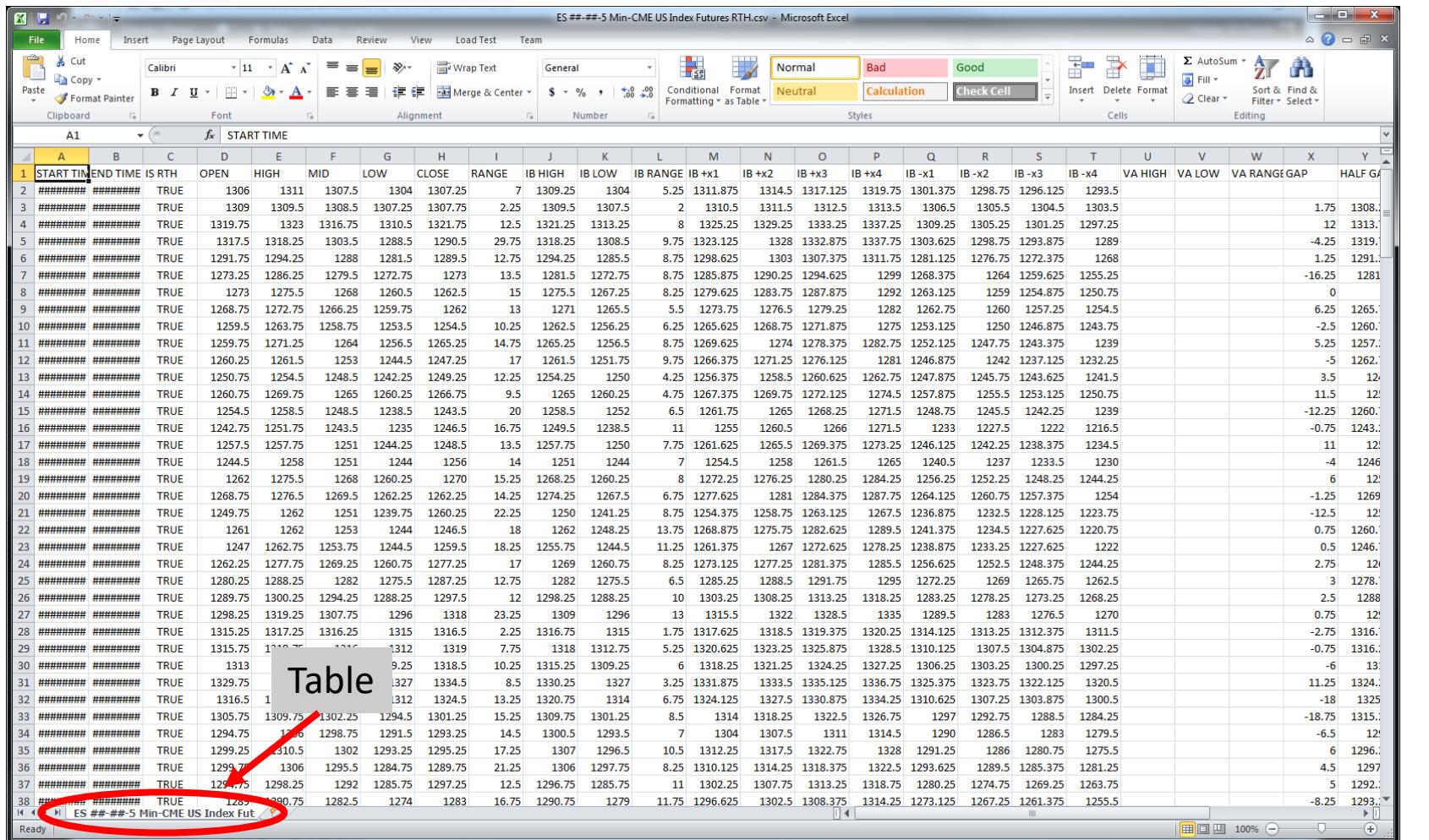
- Each *table* stores a particular type of thing (such as “Customers”)
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- A *column* (attribute) is a set of data values of a particular type
 - Each column defines a property of the entity (such as “Address”)
- A *row* is a single record in a table
 - It contains a single instance of the entity (such as one individual Customer)
- A *value* is a single column attribute for a single *row*



A Database is Sort Of Like Excel

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y		
1	START TIME																									
2	#####	#####	TRUE	1306	1311	1307.5	1304	1307.25	7	1309.25	1304	5.25	1311.875	1314.5	1317.125	1319.75	1301.375	1298.75	1296.125	1293.5						
3	#####	#####	TRUE	1309	1309.5	1308.5	1307.25	1307.75	2.25	1309.5	1307.5	2	1310.5	1311.5	1312.5	1313.5	1306.5	1305.5	1304.5	1303.5		1.75	1308.			
4	#####	#####	TRUE	1319.75	1323	1316.75	1310.5	1321.75	12.5	1321.25	1313.25	8	1325.25	1329.25	1332.25	1337.25	1309.25	1305.25	1301.25	1297.25		12	1313.			
5	#####	#####	TRUE	1317.5	1318.25	1303.5	1288.5	1290.5	29.75	1318.25	1308.5	9.75	1323.125	1328	1332.875	1337.75	1303.625	1298.75	1293.875	1289		-4.25	1319.			
6	#####	#####	TRUE	1291.75	1294.25	1288	1281.5	1289.5	12.75	1294.25	1285.5	8.75	1298.625	1303	1307.375	1311.75	1281.125	1276.75	1272.375	1268		1.25	1291.			
7	#####	#####	TRUE	1273.25	1286.25	1279.5	1272.75	1273	13.5	1281.5	1272.75	8.75	1285.875	1290.25	1294.625	1299	1268.375	1264	1259.625	1255.25		-16.25	1281			
8	#####	#####	TRUE	1273	1275.5	1268	1260.5	1262.5	15	1275.5	1267.25	8.25	1279.625	1288.75	1287.875	1292	1263.125	1259	1254.875	1250.75		0				
9	#####	#####	TRUE	1268.75	1272.75	1266.25	1259.75	1262	13	1271	1265.5	5.5	1273.75	1276.5	1279.25	1282	1262.75	1260	1257.25	1254.5		6.25	1265.			
10	#####	#####	TRUE	1259.5	1263.75	1258.75	1253.5	1254.5	10.25	1262.5	1256.25	6.25	1265.625	1268.75	1271.875	1275	1253.125	1250	1246.875	1243.75		-2.5	1260.			
11	#####	#####	TRUE	1259.75	1271.25	1264	1256.5	1265.25	14.75	1265.25	1256.5	8.75	1269.625	1274	1278.375	1282.75	1252.125	1247.75	1243.375	1239		5.25	1257.			
12	#####	#####	TRUE	1260.25	1261.5	1253	1244.5	1247.25	17	1261.5	1251.75	9.75	1266.375	1271.25	1276.125	1281	1246.875	1242	1237.125	1232.25		-5	1262.			
13	#####	#####	TRUE	1250.75	1254.5	1248.5	1242.25	1249.25	12.25	1254.25	1250	4.25	1256.375	1258.5	1260.625	1262.75	1247.875	1245.75	1243.625	1241.5		3.5	12			
14	#####	#####	TRUE	1260.75	1269.75	1265	1260.25	1266.75	9.5	1265	1260.25	4.75	1267.375	1269.75	1272.125	1274.5	1257.875	1255.5	1253.125	1250.75		11.5	12			
15	#####	#####	TRUE	1254.5	1258.5	1248.5	1238.5	1243.5	20	1258.5	1252	6.5	1261.75	1265	1268.25	1271.5	1248.75	1245.5	1242.25	1239		-12.25	1260.			
16	#####	#####	TRUE	1242.75	1251.75	1243.5	1235	1246.5	16.75	1249.5	1238.5	11	1255	1260.5	1266	1271.5	1233	1227.5	1222	1216.5		-0.75	1243.			
17	#####	#####	TRUE	1257.5	1257.75	1251	1244.25	1248.5	13.5	1257.75	1250	7.75	1261.625	1265.5	1269.375	1273.25	1246.125	1242.25	1238.375	1234.5		11	12			
18	#####	#####	TRUE	1244.5	1258	1251	1244	1256	14	1251	1244	7	1254.5	1258	1261.5	1265	1240.5	1237	1233.5	1230		-4	1246			
19	#####	#####	TRUE	1262	1275.5	1268	1260.25	1270	15.25	1268.25	1260.25	8	1272.25	1276.25	1280.25	1284.25	1256.25	1252.25	1248.25	1244.25		6	12			
20	#####	#####	TRUE	1268.75	1276.5	1269.5	1262.25	1262.25	14.25	1274.25	1267.5	6.75	1277.625	1281	1284.375	1287.75	1264.125	1260.75	1257.375	1254		-1.25	1269			
21	#####	#####	TRUE	1249.75	1262	1251	1239.75	1260.25	22.25	1250	1241.25	8.75	1254.375	1258.75	1263.125	1267.5	1236.875	1232.5	1228.125	1223.75		-12.5	12			
22	#####	#####	TRUE	1261	1262	1253	1244	1246.5	18	1262	1248.25	13.75	1268.875	1275.75	1282.625	1289.5	1241.375	1234.5	1227.625	1220.75		0.75	1260.			
23	#####	#####	TRUE	1247	1262.75	1253.75	1244.5	1259.5	18.25	1255.75	1244.5	11.25	1261.375	1267	1272.625	1278.25	1238.875	1233.25	1227.625	1222		0.5	1246.			
24	#####	#####	TRUE	1262.25	1277.75	1269.25	1260.75	1277.25	17	1269	1260.75	8.25	1273.125	1277.25	1281.375	1285.5	1256.625	1252.5	1248.375	1244.25		2.75	12			
25	#####	#####	TRUE	1280.25	1288.25	1282	1275.5	1287.25	12.75	1282	1275.5	6.5	1285.25	1288.5	1291.75	1295	1272.25	1269.5	1265.75	1262.5		3	1278.			
26	#####	#####	TRUE	1289.75	1300.25	1294.25	1288.25	1297.5	12	1298.25	1288.25	10	1303.25	1308.25	1313.25	1318.25	1283.25	1278.25	1273.25	1268.25		2.5	1288			
27	#####	#####	TRUE	1298.25	1319.25	1307.75	1296	1318	23.25	1309	1296	13	1315.5	1322	1328.5	1335	1289.5	1283	1276.5	1270		0.75	12			
28	#####	#####	TRUE	1315.25	1317.25	1316.25	1313	1316.5	2.25	1316.75	1315	1.75	1317.625	1318.5	1319.375	1320.25	1314.125	1313.25	1312.375	1311.5		-2.75	1316.			
29	#####	#####	TRUE	1315.75	1319.75	1316	1312	1319	7.75	1318	1312.75	5.25	1320.625	1323.25	1325.875	1328.5	1310.125	1307.5	1304.875	1302.25		-0.75	1316.			
30	#####	#####	TRUE	1313	1319.5	1314.5	1309.25	1318.5	10.25	1315.25	1309.25	6	1318.25	1321.25	1324.25	1327.25	1306.25	1303.25	1300.25	1297.25		-6	13			
31	#####	#####	TRUE	1329.75	1335.5	1331.25	1327	1334.5	8.5	1330.25	1327	3.25	1331.875	1333.5	1335.125	1336.75	1325.375	1323.75	1322.125	1320.5		11.25	1324.			
32	#####	#####	TRUE	1316.5	1325.25	1318.75	1312	1324.5	13.25	1320.75	1314	6.75	1324.125	1327.5	1330.875	1334.25	1310.625	1307.25	1303.875	1300.5		-18	1325			
33	#####	#####	TRUE	1305.75	1309.75	1302.25	1294.5	1301.25	15.25	1309.75	1301.25	8.5	1314	1318.25	1322.5	1326.75	1329.25	1297	1292.75	1288.5	1284.25		-18.75	1315.		
34	#####	#####	TRUE	1294.75	1306	1298.75	1291.5	1293.25	14.5	1300.5	1293.5	7	1304	1307.5	1311	1314.5	1290	1286.5	1283	1279.5		-6.5	12			
35	#####	#####	TRUE	1299.25	1310.5	1302	1293.25	1295.25	17.25	1307	1296.5	10.5	1312.25	1317.5	1322.75	1328	1291.25	1286	1280.75	1275.5		6	1296.			
36	#####	#####	TRUE	1299.75	1306	1295.5	1284.75	1289.75	21.25	1306	1297.5	8.25	1310.125	1314.25	1318.375	1322.5	1293.625	1289.5	1285.375	1281.25		4.5	1297			
37	#####	#####	TRUE	1294.75	1298.25	1292	1285.75	1297.25	12.5	1296.75	1285.75	11	1302.25	1307.75	1313.25	1318.75	1280.25	1274.75	1269.25	1263.75		5	1292.			
38	#####	#####	TRUE	1289	1290.75	1282.5	1274	1283	16.75	1290.75	1279	11.75	1296.625	1302.5	1308.375	1314.25	1273.125	1267.25	1261.375	1255.5		-8.25	1293.			

A Database is Sort Of Like Excel



The screenshot shows a Microsoft Excel spreadsheet titled "ES ##-##-5 Min-CME US Index Futures RTH.csv - Microsoft Excel". The data consists of approximately 38 rows of financial futures information. The columns represent various time intervals and price metrics. The status bar at the bottom left displays the word "Table". A red arrow points from this word to the bottom-left corner of the data grid.

START TIME	END TIME IS RTH	OPEN	HIGH	MID	LOW	CLOSE	RANGE	IB HIGH	IB LOW	IB RANGE	IB +x1	IB +x2	IB +x3	IB +x4	IB -x1	IB -x2	IB -x3	IB -x4	V A HIGH	V A LOW	V A RANGE GAP	HALF G...	
1	TRUE	1306	1311	1307.5	1304	1307.25	7	1309.25	1304	5.25	1311.875	1314.5	1317.125	1319.75	1301.375	1298.75	1296.125	1293.5					
2	TRUE	1309	1309.5	1308.5	1307.25	1307.75	2.25	1309.5	1307.5	2	1310.5	1311.5	1312.5	1313.5	1306.5	1305.5	1304.5	1303.5			1.75	1308.5	
3	TRUE	1319.75	1323	1316.75	1310.5	1321.75	12.25	1321.25	1313.25	8	1325.25	1329.25	1332.875	1337.75	1303.625	1298.75	1293.875	1289			12	1313.5	
4	TRUE	1317.5	1318.25	1303.5	1288.5	1290.5	29.75	1318.25	1308.5	9.75	1323.125	1328	1332.875	1337.75	1303.625	1298.75	1309.25	1305.25	1301.25	1297.25		-4.25	1319.5
5	TRUE	1291.75	1294.25	1288	1281.5	1289.5	12.75	1294.25	1285.5	8.75	1298.625	1303	1307.375	1311.75	1281.125	1276.75	1272.375	1268			1.25	1291.5	
6	TRUE	1273.25	1286.25	1279.5	1272.75	1273	13.5	1281.5	1272.75	8.75	1285.875	1290.25	1294.625	1298.75	1269.625	1268.375	1264	1259.625	1255.25			-16.25	1281.5
7	TRUE	1273	1275.5	1268	1260.5	1262.5	15	1275.5	1267.25	8.25	1279.625	1283.75	1287.875	1292	1263.125	1259	1254.875	1250.75			0		
8	TRUE	1268.75	1272.75	1266.25	1259.75	1262	13	1271	1265.5	5.5	1273.75	1276.5	1279.25	1282	1262.75	1260	1257.25	1254.5			6.25	1265.5	
9	TRUE	1259.5	1263.75	1258.75	1253.5	1254.5	10.25	1262.5	1256.25	6.25	1265.625	1268.75	1271.875	1275	1253.125	1250	1246.875	1243.75			-2.5	1260.5	
10	TRUE	1259.75	1271.25	1264	1256.5	1265.25	14.75	1265.25	1256.5	8.75	1269.625	1274	1278.375	1282.75	1252.125	1247.75	1243.375	1239			5.25	1257.5	
11	TRUE	1260.25	1261.5	1253	1244.5	1247.25	17	1261.5	1251.75	9.75	1266.375	1271.25	1276.125	1281	1246.875	1242	1237.125	1232.25			-5	1262.5	
12	TRUE	1250.75	1254.5	1248.5	1242.25	1249.25	12.25	1254.25	1250	4.25	1256.375	1258.5	1260.625	1262.75	1247.875	1245.75	1243.625	1241.5			3.5	1258.5	
13	TRUE	1260.75	1269.75	1265	1260.25	1266.75	9.5	1265	1260.25	4.75	1267.375	1269.75	1272.125	1274.5	1257.875	1255.5	1253.125	1250.75			11.5	1261.5	
14	TRUE	1254.5	1258.5	1248.5	1238.5	1243.5	20	1258.5	1252	6.5	1261.75	1265	1268.25	1271.5	1248.75	1245.5	1242.25	1239			-12.25	1260.5	
15	TRUE	1242.75	1251.75	1243.5	1235	1246.5	16.75	1249.5	1238.5	11	1255	1260.5	1266	1271.5	1233	1227.5	1222	1216.5			-0.75	1243.5	
16	TRUE	1257.5	1257.75	1251	1244.25	1248.5	13.5	1257.75	1250	7.75	1261.625	1265.5	1269.375	1273.25	1246.125	1242.25	1238.375	1234.5			11	1257.5	
17	TRUE	1244.5	1258	1251	1244	1256	14	1251	1244	7	1254.5	1258	1261.5	1265	1240.5	1237	1233.5	1230			-4	1246.5	
18	TRUE	1262	1275.5	1268	1260.25	1270	15.25	1268.25	1260.25	8	1272.25	1276.25	1280.25	1284.25	1256.25	1252.25	1248.25	1244.25			6	1270.5	
19	TRUE	1268.75	1276.5	1269.5	1262.25	1262.25	14.25	1274.25	1267.5	6.75	1277.625	1281	1284.375	1287.75	1264.125	1260.75	1257.375	1254			-1.25	1269.5	
20	TRUE	1249.75	1262	1251	1239.75	1260.25	22.25	1250	1241.25	8.75	1254.375	1258.75	1263.125	1267.5	1236.875	1232.5	1228.125	1223.75			-12.5	1262.5	
21	TRUE	1261	1262	1253	1244	1246.5	18	1262	1248.25	13.75	1268.875	1275.75	1282.625	1289.5	1241.375	1234.5	1227.625	1220.75			0.75	1260.5	
22	TRUE	1247	1262.75	1253.75	1244.5	1259.5	18.25	1255.75	1244.5	11.25	1261.375	1267	1272.625	1278.25	1238.875	1233.25	1227.625	1222			0.5	1246.5	
23	TRUE	1262.25	1277.75	1269.25	1260.75	1277.25	17	1269	1260.75	8.25	1273.125	1277.25	1281.375	1285.5	1256.625	1252.5	1248.375	1244.25			2.75	1278.5	
24	TRUE	1280.25	1288.25	1282	1275.5	1287.25	17.25	1282	1275.5	6.5	1285.25	1288.5	1291.75	1295	1272.25	1269	1265.75	1262.5			3	1278.5	
25	TRUE	1289.75	1300.25	1294.25	1288.25	1297.5	12	1298.25	1288.25	10	1303.25	1308.25	1313.25	1318.25	1288.25	1278.25	1273.25	1268.25			2.5	1288.5	
26	TRUE	1298.25	1319.25	1307.75	1296	1318	23.25	1309	1296	13	1315.5	1322	1328.5	1335	1289.5	1283	1276.5	1270			0.75	1298.5	
27	TRUE	1315.25	1317.25	1316.25	1315	1316.5	2.25	1316.75	1315	1.75	1317.625	1318.5	1319.375	1320.25	1314.125	1313.25	1312.375	1311.5			-2.75	1316.5	
28	TRUE	1315.75	1317.75	1317.25	1316.25	1319	7.75	1318	1312.75	5.25	1320.625	1323.25	1325.875	1328.5	1310.125	1307.5	1304.875	1302.25			-0.75	1316.5	
29	TRUE	1313	1313	9.25	1318.5	10.25	1315.25	1309.25	6	1318.25	1321.25	1324.25	1327.25	1306.25	1303.25	1297.25				-6	1313.5		
30	TRUE	1329.75	1316.5	1	1324.5	1325.5	13.25	1320.75	1314	6.75	1324.125	1327.5	1330.875	1334.25	1310.625	1307.25	1303.875	1300.5			11.25	1324.5	
31	TRUE	1305.75	1309.75	1302.25	1294.5	1301.25	15.25	1309.75	1301.25	8.5	1314	1314.25	1322.5	1326.75	1297	1292.75	1288.5	1284.25			-18.75	1315.5	
32	TRUE	1294.75	1298.75	1298.25	1291.5	1293.25	14.5	1300.5	1293.5	7	1304	1307.5	1311	1314.5	1290	1286.5	1283	1279.5			-6.5	1298.5	
33	TRUE	1299.25	1310.5	1302	1293.25	1295.25	17.25	1307	1296.5	10.5	1312.25	1317.5	1322.75	1328	1291.25	1286	1280.75	1275.5			6	1296.5	
34	TRUE	1299.75	1306	1295.5	1284.75	1289.75	21.25	1306	1297.75	8.25	1310.125	1314.25	1318.375	1322.5	1293.625	1289.5	1285.375	1281.25			4.5	1297.5	
35	TRUE	1298.75	1298.25	1292	1285.75	1297.25	12.25	1296.75	1285.75	11.75	1302.25	1307.75	1313.25	1318.75	1293.625	1289.5	1285.375	1281.25			5	1292.5	
36	TRUE	1298.75	1298.25	1292	1285.75	1297.25	12.25	1296.75	1285.75	11.75	1302.25	1307.75	1313.25	1318.75	1280.25	1274.75	1269.25	1263.75			-8.25	1293.5	
37	TRUE	1294.75	1298.25	1292	1285.75	1297.25	12.25	1296.75	1285.75	11.75	1296.625	1302.5	1308.375	1314.25	1273.125	1267.25	1261.375	1255.5					
38	TRUE	1285	1290.75	1282.5	1274	1283	16.75	1290.75	1279	11.75	1296.625	1302.5	1308.375	1314.25	1273.125	1267.25	1261.375	1255.5					

A Database is Sort Of Like Excel

Column/Attribute

Table

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	
1 START TIME																									
2 #####	#####	TRUE	1306	1311	1307.5	1304	1307.25	7	1309.25	1304	1311.75	1314.5	1317.125	1319.75	1301.375	1298.75	1296.125	1293.5							
3 #####	#####	TRUE	1309	1309.5	1308.5	1307.25	1307.75	2.25	1309	1307.5	1310.5	1311.5	1312.5	1313.5	1306.5	1305.5	1304.5	1303.5					1.75	1308.	
4 #####	#####	TRUE	1319.75	1323	1316.75	1310.5	1321.75	12.5	1321.25	1313.25	1325.25	1329.25	1333.25	1337.25	1309.25	1305.25	1301.25	1297.25					12	1313.	
5 #####	#####	TRUE	1317.5	1318.25	1303.5	1288.5	1290.5	29.75	1318.25	1308.5	1323.125	1323.125	1323.125	1323.125	1323.125	1323.125	1303.625	1298.75	1293.875	1289				-4.25	1319.
6 #####	#####	TRUE	1291.75	1294.25	1288	1281.5	1289.5	12.75	1294.25	1285.5	1298.625	1303	1307.375	1311.75	1281.125	1276.75	1272.375	1268					1.25	1291.	
7 #####	#####	TRUE	1273.25	1286.25	1279.5	1272.75	1273	13.5	1281	1272.75	1285.875	1290.25	1294.625	1299	1268.375	1264	1259.625	1255.25					-16.25	1281	
8 #####	#####	TRUE	1273	1275.5	1268	1260.5	1262.5	15	1275	1267.25	1279.625	1283.75	1287.875	1292	1263.125	1259	1254.875	1250.75					0		
9 #####	#####	TRUE	1268.75	1272.75	1266.25	1259.75	1262	13	1273	1265.5	1273.75	1276.5	1279.25	1282	1262.75	1260	1257.25	1254.5					6.25	1265.	
10 #####	#####	TRUE	1259.5	1263.75	1258.75	1253.5	1254.5	10.25	1262	1256.25	1265.625	1268.75	1271.875	1275	1253.125	1250	1246.875	1243.75					-2.5	1260.	
11 #####	#####	TRUE	1259.75	1271.25	1264	1256.5	1265.25	14.75	1265.25	1256.5	1269.625	1274	1278.375	1282.75	1252.125	1247.75	1243.375	1239					5.25	1257.	
12 #####	#####	TRUE	1260.25	1261.5	1253	1244.5	1247.25	17	1261	1251.75	1266.375	1271.25	1276.125	1281	1246.875	1242	1237.125	1232.25					-5	1262.	
13 #####	#####	TRUE	1250.75	1254.5	1248.5	1242.5	1249.25	12.25	1254.25	1250	1256.375	1258.5	1260.625	1262.75	1247.875	1245.75	1243.625	1241.5					3.5	12	
14 #####	#####	TRUE	1260.75	1269.75	1265	1260.25	1266.75	9.5	1265	1260.25	1267.375	1269.75	1272.125	1274.5	1257.875	1255.5	1253.125	1250.75					11.5	12	
15 #####	#####	TRUE	1254.5	1258.5	1248.5	1238.5	1243.5	20	1258	1252	1261.75	1265	1268.25	1271.5	1248.75	1245.5	1242.25	1239					-12.25	1260.	
16 #####	#####	TRUE	1242.75	1251.75	1243.5	1235	1246.5	16.75	1249	1238.5	1250.25	1255.75	1260.25	1267.25	1271.5	1233	1227.5	1222	1216.5					-0.75	1243.
17 #####	#####	TRUE	1257.5	1257.75	1251	1244.25	1249.5	13.5	1257.75	1250	1261.625	1265.5	1269.375	1273.25	1246.125	1242.25	1238.375	1234.5					11	12	
18 #####	#####	TRUE	1244.5	1258	1251	1244	1256	14	1258	1244	1254.5	1258	1261.5	1265	1240.5	1237	1233.5	1230					-4	1246	
19 #####	#####	TRUE	1262	1275.5	1268	1260.25	1270	15.25	1268.25	1260.25	1272.25	1276.25	1280.25	1284.25	1256.25	1252.25	1248.25	1244.25					6	12	
20 #####	#####	TRUE	1268.75	1276.5	1269.5	1262.25	1262.25	14.25	1274.25	1267.5	1276.625	1281	1284.375	1287.75	1264.125	1260.75	1257.375	1254					-1.25	1269	
21 #####	#####	TRUE	1249.75	1262	1251	1239.75	1260.25	22.25	1250	1241.25	1254.375	1263.75	1267.5	1268.75	1272.25	1232.5	1228.125	1223.75					-12.5	12	
22 #####	#####	TRUE	1261	1262	1253	1244	1246.5	18	1262	1248.25	1270.25	1275.75	1282.625	1289.5	1241.375	1234.5	1227.625	1220.75					0.75	1260.	
23 #####	#####	TRUE	1247	1262.75	1253.75	1244.5	1259.5	18	1255.25	1244.5	1266.375	1272.25	1276.25	1280.25	1256.25	1252.25	1248.25	1244.25					0.5	1246.	
24 #####	#####	TRUE	1262.25	1277.75	1269.25	1260.75	1277.25	17	1260	1270.75	1273.125	1277.25	1281.375	1285.5	1256.625	1252.5	1248.375	1244.25					2.75	12	
25 #####	#####	TRUE	1280.25	1288.25	1282	1275.5	1287.25	12.75	1282	1275.5	1285.25	1288.5	1291.75	1295	1272.25	1269	1265.75	1262.5					3	1278.	
26 #####	#####	TRUE	1289.75	1300.25	1294.25	1288.25	1297.5	12	1298.25	1288.25	1308.25	1313.25	1318.25	1323.25	1283.25	1278.25	1273.25	1268.25					2.5	1288	
27 #####	#####	TRUE	1298.25	1319.25	1307.75	1296	1318	23.25	1300	1296	1315.25	1328.5	1332.25	1337.25	1308.25	1303.25	1300.25	1297.25					0.75	12	
28 #####	#####	TRUE	1315.25	1317.25	1316.25	1315	1316.5	2.25	1316.25	1315	1317.625	1318.5	1319.375	1320.25	1314.125	1313.25	1312.375	1311.5					-2.75	1316.	
29 #####	#####	TRUE	1315.75	1315	2	1319	7.75	1323	1312.75		1318.25	1321.25	1324.25	1327.25	1306.25	1303.25	1300.25	1297.25					-0.75	1316.	
30 #####	#####	TRUE	1313	131	5	1318.5	10.25	1315.25	1309.25		1334.5	1335.125	1336.75	1332.75	1323.75	1322.125	1320.5					11.25	1324.		
31 #####	#####	TRUE	1329.75	1313	7	1334.5	8.5	1330.25	1327		1324.5	1325.125	1330.375	1332.75	1323.75	1322.125	1320.5					-18	1325		
32 #####	#####	TRUE	1316.5	1325	2	1324.5	13.25	1320.25	1314		1324.5	1325.125	1327.25	1330.375	1321.25	1319.75	1318.25	1316.5					5	1329.	
33 #####	#####	TRUE	1305.75	1309.75	1302.25	1294.5	1301.25	15.25	1309.25	1301.25	1312.25	1316.75	1326.75	1329.75	1288.5	1284.25	1282.25	1279.5					-18.75	1315.	
34 #####	#####	TRUE	1294.75	1290	1298.75	1291.5	1293.25	14.5	1300	1293.5	1304.25	1314.5	1320	1286.5	1283.5	1280.75	1275.5					-6.5	12		
35 #####	#####	TRUE	1299.25	1310.5	1302	1293.25	1295.25	17.25	1307	1296.5	1304.25	1314.25	1320.25	1322.25	1293.625	1289.5	1285.375	1281.25					6	1296.	
36 #####	#####	TRUE	1299	1306	1295.5	1284.75	1289.75	21.25	1305	1297.75	1304.25	1314.25	1320.25	1322.25	1293.625	1289.5	1285.375	1281.25					4.5	1297	
37 #####	#####	TRUE	1294.75	1298.25	1292	1285.75	1297.25	12.5	1296.75	1285.75	1304.25	1314.25	1320.25	1322.25	1293.625	1289.5	1285.375	1281.25					5	1292.	
38 #####	#####	TRUE	1289	1300.75	1282.5	1274	1283	16.75	1290	1279	1304.25	1314.25	1320.25	1322.25	1293.625	1289.5	1285.375	1281.25					-8.25	1293.	

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Column/Attribute

Row

Table

START TIME	END TIME	IS RTH	OPEN	HIGH	MID	LOW	CLOSE	RANGE	IB HIGH	IB LOW	IB RANGE	IB +x1	IB +x2	IB +x3	IB +x4	IB -x1	IB -x2	IB -x3	IB -x4	VA HIGH	VA LOW	VA RANGE	GAP	HALF GA
1 #####	1306	TRUE	1306	1311	1307.5	1304	1307.25	7	1309.2	1304	1.25	1311.875	1314.5	1317.125	1319.75	1301.375	1298.75	1296.125	1293.5					
2 #####	1309	TRUE	1309	1309.5	1308.5	1307.25	1307.75	2.25	1309.	1307.5	2	1310.5	1311.5	1312.5	1313.5	1306.5	1305.5	1304.5	1303.5			1.75	1308.	
3 #####	1319.75	1323	1316.75	1310.5	1321.75	12.5	1321.2	1313.25		1313.25	8	1325.25	1329.25	1333.25	1337.25	1309.25	1305.25	1301.25	1297.25					
4 #####	1317.5	1318.25	1303.5	1288.5	1290.5	29.75	1318.2	1308.5		1308.5	9.75	1323.125	1328	1332.875	1337.75	1303.625	1298.75	1293.875	1289			-4.25	1319.	
5 #####	1291.75	1294.25	1288	1281.5	1289.5	12.75	1294.2	1285.5		1285.5	8.75	1298.625	1303	1307.375	1311.75	1281.125	1276.75	1272.375	1268			1.25	1291.	
6 #####	1273.25	1286.25	1279.5	1272.75	1273	13.5	1281.	1272.75		1272.75	8.75	1285.875	1290.25	1294.625	1299	1268.375	1264	1259.625	1255.25			-16.25	1281	
7 #####	1268.75	1272.75	1266.25	1259.75	1262	13	127	1265.5		1265.5	8.25	1279.625	1283.75	1287.875	1292	1263.125	1259	1254.875	1250.75			0		
8 #####	1268.75	1272.75	1266.25	1259.75	1262	15	1275.	1267.25		1267.25	5.5	1273.75	1276.5	1279.25	1282	1262.75	1260	1257.25	1254.5			6.25	1265.	
9 #####	1259.5	1263.75	1258.75	1253.5	1254.5	10.25	1262.	1256.25		1256.25	6.25	1265.625	1268.75	1271.875	1275	1253.125	1250	1246.875	1243.75			-2.5	1260.	
10 #####	1259.75	1271.25	1264	1256.5	1265.25	14.75	1265.2	1256.5		1256.5	8.75	1269.625	1274	1278.375	1282.75	1252.125	1247.75	1243.375	1239			5.25	1257..	
11 #####	1260.25	1261.5	1253	1244.5	1247.25	17	1261.	1251.75		1251.75	9.75	1266.375	1271.25	1276.125	1281	1246.875	1242	1237.125	1232.25			-5	1262.	
12 #####	1250.75	1254.5	1248.5	1242.25	1249.25	12.25	1254.2	1250		1250	4.25	1256.375	1258.5	1260.625	1262.75	1247.875	1245.75	1243.625	1241.5			3.5	1245.	
14 #####	1260.75	1269.75	1265	1260.25	1266.75	9.5	126	1260.25		1260.25	4.75	1267.375	1269.75	1272.125	1274.5	1257.875	1255.5	1253.125	1250.75			11.5	1257.	
15 #####	1254.5	1258.5	1248.5	1238.5	1243.5	20	1258.	1252		1252	6.5	1261.75	1265	1268.25	1271.5	1248.75	1245.5	1242.25	1239			-12.25	1260.	
16 #####	1242.75	1251.75	1243.5	1235	1246.5	16.75	1249.	1238.5		1238.5	11	1255	1260.5	1266	1271.5	1233	1227.5	1222	1216.5			-0.75	1243..	
17 #####	1257.5	1257.75	1251	1244.25	1248.5	13.5	1257.7	1250		1250	7.75	1261.625	1265.5	1269.375	1273.25	1246.125	1242.25	1238.375	1234.5			11	1257.	
18 #####	1244.5	1258	1251	1244	1256	14	125	1244		1244	7	1254.5	1258	1261.5	1265	1240.5	1237	1233.5	1230			-4	1246.	
19 #####	1262	1275.5	1268	1260.25	1270	15.25	1268.2	1260.25		1260.25	8	1272.25	1276.25	1280.25	1284.25	1256.25	1252.25	1248.25	1244.25			6	1257.	
20 #####	1268.75	1276.5	1269.5	1262.25	1262.25	14.25	1274.2	1267.5		1267.5	6.75	1277.625	1281	1284.375	1287.75	1264.125	1260.75	1257.375	1254			-1.25	1269	
21 #####	1249.75	1262	1251	1239.75	1260.25	22.25	125	1241.25		1241.25	8.75	1254.375	1258.75	1263.125	1267.5	1236.875	1232.5	1228.125	1223.75			-12.5	1257.	
22 #####	1261	1262	1253	1244	1246.5	18	126	1248.25		1248.25	13.75	1268.875	1275.75	1282.625	1289.5	1241.375	1234.5	1227.625	1220.75			0.75	1260.	
23 #####	1247	1262.75	1253.75	1244.5	1259.5	18.25	1255.7	1244.5		1244.5	11.25	1261.375	1267	1272.625	1278.25	1238.875	1233.25	1227.625	1222			0.5	1246.	
24 #####	1262.25	1277.75	1269.25	1260.75	1277.25	17	126	1260.75		1260.75	8.25	1273.125	1277.25	1281.375	1285.5	1256.625	1252.5	1248.375	1244.25			2.75	1257.	
25 #####	1280.25	1288.25	1282	1275.5	1287.25	12.75	128	1275.5		1275.5	6.5	1285.25	1288.5	1291.75	1295	1272.25	1269	1265.75	1262.5			3	1278.	
26 #####	1289.75	1300.25	1294.25	1288.25	1297.5	12	1298.2	1288.25		1288.25	10	1303.25	1310.25	1313.25	1318.25	1283.25	1278.25	1273.25	1268.25			2.5	1288	
27 #####	1298.25	1319.25	1307.75	1296	1318	23.25	130	1296		1296	13	1315.5	1322	1328.5	1335	1289.5	1283	1276.5	1270			0.75	1257.	
28 #####	1315.25	1317.25	1316.25	1315	1316.5	2.25	1316.7	1315		1315	1.75	1317.625	1318.5	1319.375	1320.25	1314.125	1313.25	1312.375	1311.5			-2.75	1316.	
29 #####	1315.75	1317.75	1316	1312	1319	7.75	131	1312.75		1312.75	5.25	1320.625	1323.25	1325.875	1328.5	1310.125	1307.5	1304.875	1302.25			-0.75	1316.	
30 #####	1313	13	13	13	1318.5	10.25	1315.2	1309.25		1309.25	6	1318.25	1321.25	1324.25	1327.25	1306.25	1303.25	1300.25	1297.25			-6	13	
31 #####	1329.75	13	13	1334.5	8.5	1330.2	1327		1327	3.25	1331.875	1333.5	1335.125	1336.75	1325.375	1323.75	1322.125	1320.5			11.25	1324..		
32 #####	1316.5	132	13	1324.5	13.25	1320.7	1314		1314	6.75	1324.125	1327.5	1330.875	1334.25	1310.625	1307.25	1303.875	1300.5			-18.75	1315..		
33 #####	1305.75	1309.75	1302.25	1294.5	1301.25	15.25	1309.7	1301.25		1301.25	8.5	1314	1318.25	1322.5	1326.75	1297	1292.75	1288.5	1284.25			-18.75	1315.	
34 #####	1294.75	1304.75	1306	1291.5	1293.25	14.5	1300	1293.5		1293.5	7	1304	1307.5	1311	1314.5	1290	1286.5	1283	1279.5			-6.5	1257.	
35 #####	1299.25	1310.5	1302	1293.25	1295.25	17.25	130	1296.5		1296.5	10.5	1312.25	1317.5	1322.75	1328	1291.25	1286	1280.75	1275.5			6	1296..	
36 #####	1299.75	1306	1295.5	1284.75	1289.75	21.25	130	1297.75		1297.75	11	1302.25	1314.25	1318.375	1322.5	1293.625	1289.5	1285.375	1281.25			4.5	1297	
37 #####	1294.75	1298.25	1292	1285.75	1297.25	12.5	1296.7	1285.75		1285.75	11.75	1296.625	1302.5	1308.375	1314.25	1273.125	1267.25	1261.375	1255.5			5	1292..	
38 #####	1289	1289	1275	1282.5	1274	1283	16.75	1290.7		1290.7	11.75	1296.625	1302.5	1308.375	1314.25	1273.125	1267.25	1261.375	1255.5			-8.25	1293..	

A Database is Sort Of Like Excel

The diagram shows a Microsoft Excel spreadsheet titled "ES #-##-5 Min-CME US Index Futures RTH.csv - Microsoft Excel". The spreadsheet contains a single data table with columns labeled A through Y. A grey arrow points from the word "Table" to the overall structure of the data. Another grey arrow points from the word "Row" to a specific row in the table. A third grey arrow points from the word "Column/Attribute" to a specific column in the table. A green circle highlights the value "1251.75" in cell K12, which is also highlighted by a green arrow pointing from the word "Value". The table has approximately 38 rows of data.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	START TIME		OPEN	HIGH	MID	LOW	CLOSE	RANGE	IB HIGH	IB LOW	5.25	1311.875	1314.5	1317.125	1319.75	1301.375	1298.75	1296.125	1293.5					
2	#####	TRUE	1306	1311	1307.5	1304	1307.25	7	1309.25	1304	2	1310.5	1311.5	1312.5	1313.5	1306.5	1305.5	1304.5	1303.5					
3	#####	TRUE	1309	1309.5	1308.5	1307.25	1307.75	2.25	1309.5	1307.5	8	1325.25	1329.25	1333.25	1337.25	1309.25	1305.25	1301.25	1297.25					
4	#####		1319.75	1323	1316.75	1310.5	1321.75	12.5	1321.25	1313.25	9.75	1323.125	1328	1328.875	1337.75	1303.625	1298.75	1293.875	1289					
5	#####		1317.5	1318.25	1303.5	1288.5	1290.5	29.75	1318.25	1308.5	8.75	1298.625	1303	1307.375	1311.75	1281.125	1276.75	1272.375	1268					
6	#####		1291.75	1294.25	1288	1281.5	1289.5	12.75	1294.25	1285.5	8.75	1285.875	1290.25	1294.625	1299	1268.375	1264	1259.625	1255.25					
7	#####		1273.25	1286.25	1279.5	1272.75	1273	13.5	1281.5	1272.75	8.25	1279.625	1283.75	1287.875	1299	1263.125	1259	1254.875	1250.75					
8	#####		1273	1275.5	1268	1260.5	1262.5	15	1275.5	1267.25	5.5	1273.75	1276.5	1279.25	1282	1262.75	1260	1257.25	1254.5					
9	#####		1268.75	1272.75	1266.25	1259.75	1262	13	1272.75	1265.5	6.25	1265.625	1268.75	1271.875	1275	1253.125	1250	1246.875	1243.75					
10	#####		1259.5	1263.75	1258.75	1253.5	1254.5	10.25	1262.5	1256.25	12	1260.25	1261.5	1253.25	1256.25	1246.875	1243.75	1240.25	1237.25					
11	#####		1259.5	1263.75	1258.75	1253.5	1254.5	10.25	1262.5	1256.25	12	1260.25	1261.5	1253.25	1256.25	1246.875	1243.75	1240.25	1237.25					
12	#####	TRUE	1260.25	1261.5	1253	1244.5	1247.25	17	1261.5	1251.75	9.75	1266.375	1271.25	1276.125	1281	1246.875	1242	1237.125	1232.25					
13	#####		1260.25	1261.5	1253	1244.5	1247.25	17	1261.5	1251.75	9.75	1267.375	1269.75	1272.125	1274.5	1257.875	1255.5	1253.125	1250.75					
14	#####		1260.75	1269.75	1265	1260.25	1266.75	9.5	1268	1251.75	4.75	1267.375	1269.75	1272.125	1274.5	1257.875	1255.5	1253.125	1250.75					
15	#####		1254.5	1258.5	1248.5	1238.5	1243.5	20	1258.5	1251	6.5	1261.75	1265	1268.25	1271.5	1248.75	1245.5	1242.25	1239					
16	#####		1242.75	1251.75	1243.5	1235	1246.5	16.75	1249.5	1238.5	11	1255	1260.5	1266	1271.5	1233	1227.5	1222	1216.5					
17	#####		1257.5	1257.75	1251	1244.25	1248.5	13.5	1257.75	1250	75	1261.625	1265.5	1269.375	1273.25	1246.125	1242.25	1238.375	1234.5					
18	#####		1244.5	1258	1251	1244	1256	14	1255	1244	1244.5	1254.5	1258	1261.5	1265	1240.5	1237	1233.5	1230					
19	#####		1262	1275.5	1268	1260.25	1270	15.25	1268.25	1260.25	8	1272.25	1276.25	1280.25	1284.25	1265.25	1252.25	1248.25	1244.25					
20	#####		1268.75	1276.5	1269.5	1262.25	1262.25	14.25	1274.25	1267.5	1	1284.375	1287.75	1284.125	1260.75	1257.375	1254							
21	#####		1249.75	1262	1251	1239.75	1260.25	22.25	1250	1241.25	5	1263.125	1267.5	1263.875	1232.5	1228.125	1223.75							
22	#####		1261	1262	1253	1244	1246.5	18	1262	1248.25	5	1282.625	1289.5	1241.375	1234.5	1227.625	1220.75							
23	#####		1247	1262.75	1253.75	1244.5	1259.5	18.25	1255.75	1244.5	1	1272.625	1278.25	1238.875	1233.25	1227.625	1222							
24	#####		1262.25	1277.75	1269.25	1260.75	1277.25	17	1269.25	1260.75	8.25	1273.125	1277.25	1281.375	1285.5	1256.625	1252.5	1248.375	1244.25					
25	#####		1280.25	1288.25	1282	1275.5	1287.25	12.75	1282	1275.5	6.5	1285.25	1288.5	1291.75	1295	1272.25	1269	1265.75	1262.5					
26	#####		1289.75	1300.25	1294.25	1288.25	1297.5	12	1298.25	1288.25	10	1303.25	1308.25	1313.25	1318.25	1283.25	1278.25	1273.25	1268.25					
27	#####		1298.25	1319.25	1307.75	1296	1318	23.25	1308	1296	13	1315.5	1322	1328.5	1335	1289.5	1283	1276.5	1270					
28	#####		1315.25	1317.25	1316.25	1315	1316.5	2.25	1316.75	1315	1.75	1317.625	1318.5	1319.375	1320.25	1314.125	1313.25	1312.375	1311.5					
29	#####		1315.75	1316.25	1316.25	1316.25	1316.25	1316.25	1316.25	1312.75	5.25	1320.625	1323.25	1325.875	1328.5	1310.125	1307.5	1304.875	1302.25					
30	#####		1315.75	1316.25	1316.25	1316.25	1316.25	1316.25	1316.25	1309.25	6	1318.25	1321.25	1324.25	1327.25	1306.25	1303.25	1300.25	1297.25					
31	#####		1329.75	1330.25	1334.5	1327	1334.5	8.5	1330.25	1327	3.25	1331.875	1333.5	1335.125	1336.75	1325.375	1323.75	1322.125	1320.5					
32	#####		1316	1316	1324.5	1312	1324.5	13.25	1320.75	1314	6.75	1324.125	1327.5	1330.875	1334.25	1310.625	1307.25	1303.875	1300.5					
33	#####		1305.75	1309.75	1302.25	1294.5	1301.25	15.25	1309.75	1301.25	8.5	1314	1318.25	1322.5	1326.75	1329.75	1292.75	1288.5	1284.25	1281.25				
34	#####		1294.75	1306	1298.75	1291.5	1293.25	14.5	1300.5	1293.5	7	1304	1307.5	1311	1314.5	1290	1286.5	1283	1279.5					
35	#####		1298.25	1310.5	1302	1293.25	1295.25	17.25	1301	1296.5	10.5	1312.25	1317.5	1322.75	1328	1291.25	1286	1280.75	1275.5					
36	#####		1299.75	1306	1295.5	1284.75	1289.75	21.25	1300	1297.75	8.25	1310.125	1314.25	1318.375	1322.5	1293.625	1289.5	1285.375	1281.25					
37	#####		1294.75	1298.25	1292	1285.75	1297.25	12.5	1296.75	1285.75	11	1302.25	1307.75	1313.25	1318.75	1280.25	1274.75	1269.25	1263.75					
38	#####		1289	1290.75	1282.5	1274	1283	16.75	1290.75	1279	11.75	1296.625	1302.5	1308.375	1314.25	1273.125	1267.25	1261.375	1255.5					

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 - A database runs inside of a database management system (DBMS)
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- For this lecture, the data will be hosted in MySQL and we'll connect to it from Java



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JDBC

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- It's an API for accessing relational databases from Java
- JDBC allows you to:
 - Create a connection to a database in a DBMS (for example, MySQL)
 - Issue database queries
 - Make updates
 - Receive results



JDBC Driver

- To use JDBC, you'll need the database specific implementation of the JDBC driver



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- Select your operating system or “platform independent”, download the .tar.gz or .zip file, and extract the JAR file
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 - A JAR (Java ARchive) is a package file typically used to aggregate multiple Java class files for distribution
 - For example, mysql-connector-java-<version>.jar
- Create a new Java Project and put the JAR file where Java can find it
 - Add the JAR file to your CLASSPATH, or
 - In Eclipse, go to: Project --> Properties --> Java Build Path --> Libraries --> Add External Jars...



Feedback Database Project

MySQL Server & Database

- To connect to a MySQL database from Java, first make sure your MySQL server is running



MySQL Server & Database

- To connect to a MySQL database from Java, first make sure your MySQL server is running
- Then create a database and table

```
1 CREATE DATABASE feedback;
2 USE feedback;
3
4 CREATE TABLE comments (
5     id INT NOT NULL AUTO_INCREMENT,
6     my_user VARCHAR(30) NOT NULL,
7     email VARCHAR(30),
8     webpage VARCHAR(100) NOT NULL,
9     datum DATETIME NOT NULL,
10    summary VARCHAR(40) NOT NULL,
11    comments VARCHAR(400) NOT NULL,
12    PRIMARY KEY (ID)
13 );
```

- The SQL code to the left creates a database “feedback” and then selects it for use
- It then creates a new table “comments” with 7 columns
- The “comments” table will store individual reviews of websites
- Each review will be a row in the table

DatabaseConnection Class: Database Credentials

```
J DatabaseConnection.java X
1 package connection;
2+import java.sql.Connection;[]
5
6 /**
7  * Manages database connection.
8  * @author lbrandon
9 */
10 public class DatabaseConnection {
11
12 /**
13  * JDBC database connection String.
14 */
15 private static String url = "jdbc:mysql://100.26.51.170:3306/feedback";
16
17 //FOR DEMO PURPOSES ONLY
18 //YOU SHOULD NEVER STORE HARD-CODED CREDENTIALS IN YOUR PROGRAM
19 //Instead, you should store in environment variables,
20 //encrypted configuration files,
21 //or some other external authentication method.
22 /**
23  * Database username.
24 */
25 private static String username = "5e53b2";
26
27 /**
28  * Database password.
29 */
30 private static String password = "b72bca";
31}
```

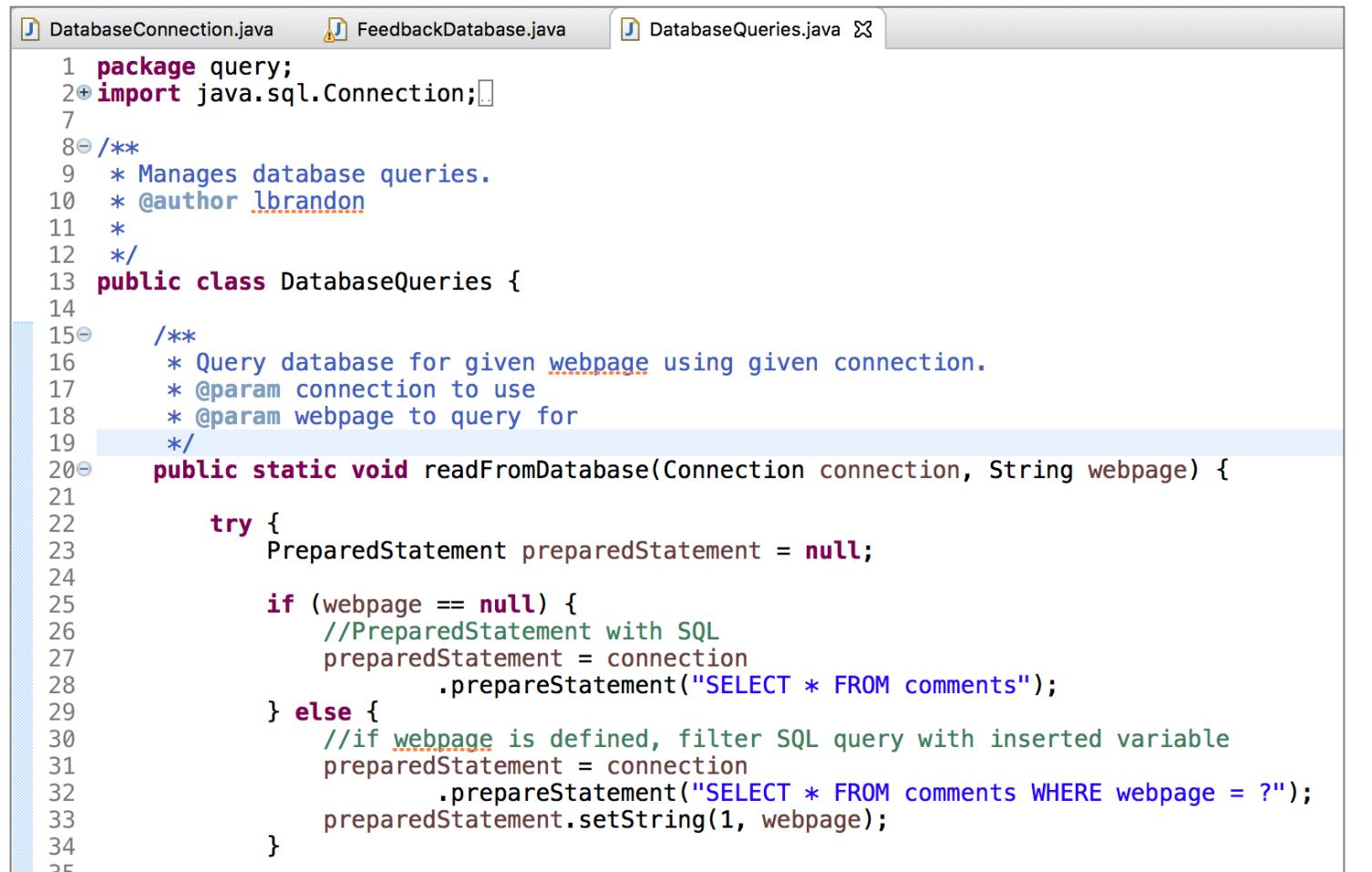
DatabaseConnection Class: Open Database

```
27  /**
28  * Opens a database connection.
29  * @return the db connection
30  */
31 public static Connection openDatabase() {
32
33     Connection connection = null;
34
35     try {
36         // Load the appropriate MySQL driver
37         Class.forName("com.mysql.cj.jdbc.Driver");
38
39         //create connection using JDBC driver
40         connection = DriverManager
41             .getConnection(
42                 DatabaseConnection.url,
43                 DatabaseConnection.username,
44                 DatabaseConnection.password);
45     } catch (ClassNotFoundException e) {
46         // TODO Auto-generated catch block
47         e.printStackTrace();
48     } catch (SQLException e) {
49         // TODO Auto-generated catch block
50         e.printStackTrace();
51     }
52
53     return connection;
54 }
```

DatabaseConnection Class: Close Database

```
52
53     /**
54      * Closes given database connection.
55      * @param connection to close
56      */
57     public static void closeDatabase(Connection connection) {
58         try {
59             connection.close();
60         } catch (SQLException e) {
61             // TODO Auto-generated catch block
62             e.printStackTrace();
63         }
64     }
65 }
```

DatabaseQueries Class: Read From Database



```
1 package query;
2 import java.sql.Connection;
3
4 /**
5  * Manages database queries.
6  * @author lbrandon
7  */
8
9 public class DatabaseQueries {
10
11     /**
12      * Query database for given webpage using given connection.
13      * @param connection to use
14      * @param webpage to query for
15     */
16     public static void readFromDatabase(Connection connection, String webpage) {
17         try {
18             PreparedStatement preparedStatement = null;
19
20             if (webpage == null) {
21                 //PreparedStatement with SQL
22                 preparedStatement = connection
23                     .prepareStatement("SELECT * FROM comments");
24             } else {
25                 //if webpage is defined, filter SQL query with inserted variable
26                 preparedStatement = connection
27                     .prepareStatement("SELECT * FROM comments WHERE webpage = ?");
28                 preparedStatement.setString(1, webpage);
29             }
30         }
31     }
32 }
```

DatabaseQueries Class: Read From Database

```
35
36     //execute query and get result set
37     ResultSet resultSet = preparedStatement.executeQuery();
38
39     DatabaseQueries.printResultSet(resultSet);
40
41     resultSet.close();
42     preparedStatement.close();
43
44 } catch (SQLException e) {
45     // TODO Auto-generated catch block
46     e.printStackTrace();
47 }
48 }
```

DatabaseQueries Class: Read From Database

```
50  /**
51  * Query database using given connection.
52  * @param connection to use
53  */
54  public static void readFromDatabase(Connection connection) {
55      //call overloaded method readFromDatabase with null webpage argument
56      DatabaseQueries.readFromDatabase(connection, null);
57  }
58
```

DatabaseQueries Class: Write to Database

```
61  /**
62  * Writes given attributes to a record in the database using the given connection.
63  * @param connection to use
64  * @param my_user writing comments
65  * @param email of user
66  * @param webpage for review
67  * @param summary of webpage
68  * @param comments about webpage
69  * @return number of records inserted into the db
70 */
71 public static int writeToDatabase(Connection connection, String my_user, String email,
72                                     String webpage, String summary, String comments) {
73
74     int ret = 0;
75
76     try {
77         PreparedStatement preparedStatement = connection
78             .prepareStatement("INSERT INTO comments VALUES (default, ?, ?, ?, ?, ?, ?)");
79     }
```

DatabaseQueries Class: Write to Database

```
79      //set parameter values via index, starting at 1
80      preparedStatement.setString(1, my_user);
81      preparedStatement.setString(2, email);
82      preparedStatement.setString(3, webpage);
83
84
85      //dynamically create date via Date object
86      long millis = System.currentTimeMillis();
87      preparedStatement.setDate(4, new java.sql.Date(millis));
88
89      preparedStatement.setString(5, summary);
90      preparedStatement.setString(6, comments);
91
92      //execute SQL and get return value (number of inserted rows)
93      ret = preparedStatement.executeUpdate();
94
95      preparedStatement.close();
96
97  } catch (SQLException e) {
98      // TODO Auto-generated catch block
99      e.printStackTrace();
100  }
101
102  return ret;
103}
104}
```



DatabaseQueries Class: Print Result Set

```
105  * Prints given result set.  
106  * @param resultSet to print  
107  */  
108  private static void printResultSet(ResultSet resultSet) {  
109  
110      try {  
111          while (resultSet.next()) {  
112  
113              // Get the column values via name  
114              String user = resultSet.getString("my_user");  
115              String email = resultSet.getString("email");  
116              String website = resultSet.getString("webpage");  
117              String summary = resultSet.getString("summary");  
118              Date date = resultSet.getDate("datum");  
119              String comment = resultSet.getString("comments");  
120  
121              // Note:  
122              // You can also get the column values via the column number which starts at 1  
123              // e.g. resultSet.getString(2);  
124  
125
```

DatabaseQueries Class: Print Result Set

```
126         //print column values
127         System.out.println("User: " + user);
128         System.out.println("Email: " + email);
129         System.out.println("Website: " + website);
130         System.out.println("Summary: " + summary);
131         System.out.println("Date: " + date);
132         System.out.println("Comment: " + comment);
133         System.out.println("____");
134     }
135 } catch (SQLException e) {
136     // TODO Auto-generated catch block
137     e.printStackTrace();
138 }
139 }
140 }
141 }
```

FeedbackDatabase Class: Query or Insert Records



```
1+ import java.sql.Connection;..  
6  
7+ /**  
8  * Query or insert records into a feedback database, allowing users to review websites.  
9  * @author lbrandon  
10 */  
11 */  
12 public class FeedbackDatabase {  
13  
14+     public static void main(String[] args) {  
15  
16         //open db connection  
17         Connection connection = DatabaseConnection.openDatabase();  
18  
19         //create scanner for user input  
20         Scanner scanner = new Scanner(System.in);  
21  
22         String input = null;  
23         boolean usingDB = true;  
24 }
```

FeedbackDatabase Class: Query or Insert Records

```
35     while (usingDB) {
36
37         //ask user what they want to do, query or input
38         System.out.println("What do you want to do? 'Query', 'Input', or 'Quit':");
39         input = scanner.nextLine().trim();
40
41         //switch statement: multi-way branch statement
42         switch(input.toLowerCase()) {
43
44             //query database
45             case "query":
46
47                 System.out.println("Which website or 'all'?:");
48                 input = scanner.nextLine().trim();
49
50
51             //query entire database
52             if ("all".equals(input)) {
53                 DatabaseQueries.readFromDatabase(connection);
54             //query database with filter
55             } else {
56                 DatabaseQueries.readFromDatabase(connection, input);
57             }
58
59             break;
60 }
```



FeedbackDatabase Class: Query or Insert Records

```
60
61     case "input":
62
63         //input record into database
64         System.out.println("(Separated by a comma) enter your name, email, "
65             + "webpage, a summary, and your comments:");
66         input = scanner.nextLine().trim();
67
68         //prepare attributes
69         info = input.split(",");
70         my_user = info[0].trim();
71         email = info[1].trim();
72         webpage = info[2].trim();
73         summary = info[3].trim();
74         comments = info[4].trim();
75
76         DatabaseQueries.writeToDatabase(connection, my_user, email, webpage, summary, comments);
77         DatabaseQueries.readFromDatabase(connection, webpage);
78
79     break;
80
```

FeedbackDatabase Class: Query or Insert Records

```
79
80     default:
81
82         //quit the program
83         usingDB = false;
84
85         break;
86     }
87
88     System.out.println();
89 }
90
91 scanner.close();
92 DatabaseConnection.closeDatabase(connection);
93 }
```

