

CSC343 Worksheet 8 Solution

June 25, 2020

1. a)

```
1  #include <float.h>
2
3  #include sqlcli.h
4
5  void askUserForPrice() {
6
7      float targetPrice, minDiff, speedSol, minDiff = FLT_MAX;
8      int modelSol;
9      char makerSol;
10
11      SQLHENV myEnv;
12      SQLHDBC myCon;
13      SQLHSTMT execStat;
14
15      SQLINTEGER model, modelInfo, speedInfo, ram, ramInfo, hd,
hdInfo, priceInfo, makerInfo;
16      SQLREAL speed, price;
17      SQLCHAR maker;
18
19
20      errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
21                                  SQL_NULL_HANDLE, &myEnv);
22
23      if (!errorCode1) {
24          errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
);
25      }
26
27      if (!errorCode2) {
28          errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
execStat)
29      }
30
31      if (!errorCode3) {
32          SQLPrepare(execStat,
33                    "SELECT model, speed, ram, hd, price, maker "
34                    "FROM Product NATURAL JOIN PC", SQL_NTS);
35          SQLExecute(execStat);
```

```

36         SQLBindCol(execStat, 1, SQL_INTEGER, &model, sizeof(model
), &modelInfo);
37         SQLBindCol(execStat, 2, SQL_FLOAT, &speed, sizeof(speed),
&speedInfo);
38         SQLBindCol(execStat, 3, SQL_INTEGER, &ram, sizeof(ram), &
ramInfo);
39         SQLBindCol(execStat, 4, SQL_INTEGER, &hd, sizeof(hd), &
hdInfo);
40         SQLBindCol(execStat, 5, SQL_FLOAT, &price, sizeof(price),
&priceInfo);
41         SQLBindCol(execStat, 6, SQL_CHAR, &maker, sizeof(maker),
&makerInfo);
42
43         printf("Enter target price:");
44         scanf("%f", &targetPrice);
45
46         while (SQLFetch(execStat) != SQL_NO_DATA) {
47
48             if (abs(price - targetPrice) >= minDiff) {
49                 continue;
50             }
51
52             minDiff = abs(price - targetPrice);
53             modelSol = model;
54             speedSol = speed;
55             makerSol = maker;
56         }
57
58         printf("maker=%c, model=%d, speed=%.2f\n", makerSol,
modelSol, speedSol);
59
60     }
61 }
62

```

Notes:

- Using Call-Level Interface
 - Uses host language to connect to and access a database
 - Replaces embedded SQL
 - Standard SQL/CLI
 - Is database CLI for C
 - Included in file *sqlcli.h*
 - Creates deals with four kinds of records
1. Environment handle
 - * Prepares one or more connections to database server
 - * Is required
 - * Is allocated using **SQLHENV**

- * Is established via function **SQLAllocHandle**

```

1) #include sqlcli.h
2) SQLHENV myEnv;
3) SQLHDBC myCon; ← Is declared here :)
4) SQLHSTMT execStat;
5) SQLRETURN errorCode1, errorCode2, errorCode3;

6) errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV, SQL_NULL_HANDLE, &myEnv); ← Connection is prepared here :)
   (Hey DB, can I connect with you?)
7) if(!errorCode1) {
8)     errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon);
9) if(!errorCode2)
10)     errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &execStat); }

```

2. Connection handle

- * Connects application program to database
- * Is required
- * Is declared after **SQLHENV**
- * Is allocated using **SQLHDBC**
- * Is established via function **SQLAllocHandle**

Sure you can

```

1) #include sqlcli.h
2) SQLHENV myEnv;
3) SQLHDBC myCon; ← Is declared here :)
4) SQLHSTMT execStat;
5) SQLRETURN errorCode1, errorCode2, errorCode3;

6) errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV, SQL_NULL_HANDLE, &myEnv);
7) if(!errorCode1) {
8)     errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon); ← Connection established here :)
   (Yay!!! Thank you database)
9) if(!errorCode2)
10)     errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &execStat); }

```

3. Statements

- * Created by application program (the user)
- * Can be created as many as needed
- * Holds information about a single SQL statement, including cursor
- * Can represent different SQL statements at different times
- * Is required
- * Is declared after **SQLHDBC**
- * Is allocated using **SQLHSTMT**
- * Is sent using the function **SQLAllocHandle**

```

1) #include sqlcli.h
2) void worthRanges() {

3)     int i, digits, counts[15];
4)     SQLHENV myEnv;
5)     SQLHDBC myCon;
6)     SQLHSTMT execStat; ← Is declared here :)
7)     SQLINTEGER worth, worthInfo;

8)     SQLAllocHandle(SQL_HANDLE_ENV,
9)         SQL_NULL_HANDLE, &myEnv);
10)    SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon);
11)    SQLAllocHandle(SQL_HANDLE_STMT, myCon, &execStat); ← Statement pointer established here :)
12)    SQLPrepare(execStat,                                     (Hey DB, thank you so much for the connection!!
    "SELECT netWorth FROM MovieExec", SQL_NTS);              I will send you my SQL statement via execStat)
13)    SQLExecute(execStat);
14)    SQLBindCol(execStat, 1, SQL_INTEGER, &worth,
    sizeof(worth), &worthInfo);
15)    while(SQLFetch(execStat) != SQL_NO_DATA) {
16)        digits = 1;
17)        while((worth /= 10) > 0) digits++;
18)        if(digits <= 14) counts[digits]++;
19)    }
20)    for(i=0; i<15; i++)
21)        printf("digits = %d: number of execs = %d\n",
22)            i, counts[i]);
23) }

```

4. Descriptions

- * Holds information about either tuples or parameters
- * Each statement has this information implicitly

• Processing Statements

- is done using **SQLPrepare** and **SQLExecute**

SQLPrepare(*sh*, *st*, *SQL_NTS*) (1)

SQLExecute(*sh*) (2)

- *sh* is the statement handle created using **SQLHSTMT**
- *SQL_NTS* evaluates the length of string in *st*

Example:

```

1    SQLPrepare(execStat, "SELECT netWorth FROM MovieExec",
2    SQL_NTS);
3    SQLExecute(execStat);

```

- the function **SQLExecDirect** combines **SQLPrepare** and **SQLExecute**

Example 2:

```

1    SQLExecDirect(execStat, "SELECT netWorth FROM MovieExec",
2    SQL_NTS);

```

• Fetching Data From

- Fetch
 - * **Syntax:** **SQLFetch**(*sh*)

- * Executes statement in **SQLPrepare** and **SQLExecute** and stores result to variable in **SQLBindCol**
 - * Fetches a row per call
 - * Returns a value of type **SQLRETURN**, indicating either success or error
- **SQLBindCol**
- * **Syntax:** `SQLBindCol(sh, colNo, colType, pVar, varSize, varInfo)`
 - **sh**: the handle of statement (e.g. `execStat`)
 - **colNo**: the position of column in tuple we obtain
 - **colType**: the SQL data type of variable (e.g. `SQL_INTEGER`, `SQL_CHAR`)
 - **pVar**: the pointer to variable the value is placed
 - **varSize**: the length in bytes of the value in `pVar`
 - **varInfo**: a pointer to an integer used by `SQLBindCol` for additional value about the value produced
 - * Stores data from **SQLFetch** to host-language variable
 - * Must be setup before `SQLFetch(sh)` is run

```

1) #include sqlcli.h
2) void worthRanges() {

3)     int i, digits, counts[15];
4)     SQLHENV myEnv;
5)     SQLHDBC myCon;
6)     SQLHSTMT execStat;
7)     SQLINTEGER worth, worthInfo;

8)     SQLAllocHandle(SQL_HANDLE_ENV,
9)         SQL_NULL_HANDLE, &myEnv);
10)    SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon);
11)    SQLAllocHandle(SQL_HANDLE_STMT, myCon, &execStat);
12)    SQLPrepare(execStat,
13)        "SELECT netWorth FROM MovieExec", SQL_NTS);
14)    SQLExecute(execStat);
15)    SQLBindCol(execStat, 1, SQL_INTEGER, &worth,
16)        sizeof(worth), &worthInfo);
17)    while(SQLFetch(execStat) != SQL_NO_DATA) {
18)        digits = 1;
19)        while((worth /= 10) > 0) digits++;
20)        if(digits <= 14) counts[digits]++;
21)    }
22)    for(i=0; i<15; i++)
23)        printf("digits = %d: number of execs = %d\n",
24)            i, counts[i]);
25) }

```

The value to fetch is defined here :)

The storage location is defined here :)
(Hey DB, when data is fetched, could you store the fetched value of SQL_INTEGER datatype to worth variable? Here is the address)

Value is fetched here :)

b)

```

#include sqlcli.h

void findLaptops() {

    float minSpeed, minPrice;
    int minRam, minHd;

    SQLINTEGER model, modelInfo, speedInfo, ram, ramInfo, hd,
    hdInfo, priceInfo, makerInfo, screen, screenInfo;
    SQLREAL speed, price;
    SQLCHAR maker;

    errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,

```

```

13         SQL_NULL_HANDLE, &myEnv);
14
15         if (!errorCode1) {
16             errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
17         );
18         }
19
20         if (!errorCode2) {
21             errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
22             execStat)
23         }
24
25         if (!errorCode3) {
26             SQLPrepare(execStat,
27                 "SELECT model, speed, ram, hd, screen, price,
28                 maker "
29                 "FROM Product NATURAL JOIN Laptop", SQL_NTS);
30             SQLExecute(execStat);
31             SQLBindCol(execStat, 1, SQL_INTEGER, &model, sizeof(model
32             ), &modelInfo);
33             SQLBindCol(execStat, 2, SQL_FLOAT, &speed, sizeof(speed), &
34             speedInfo);
35             SQLBindCol(execStat, 3, SQL_INTEGER, &ram, sizeof(ram), &
36             ramInfo);
37             SQLBindCol(execStat, 4, SQL_INTEGER, &hd, sizeof(hd), &
38             hdInfo);
39             SQLBindCol(execStat, 5, SQL_INTEGER, &screen, sizeof(
40             screen), &screenInfo);
41             SQLBindCol(execStat, 6, SQL_FLOAT, &price, sizeof(price),
42             &priceInfo);
43             SQLBindCol(execStat, 7, SQL_CHAR, &maker, sizeof(maker),
44             &makerInfo);
45
46             printf("Enter minimum speed:");
47             scanf("%f", &minSpeed);
48
49             printf("Enter minimum ram:");
50             scanf("%f", &minRam);
51
52             printf("Enter minimum hard-drive space:");
53             scanf("%f", &minHd);
54
55             printf("Enter minimum price:");
56             scanf("%f", &minPrice);
57
58             while(SQLFetch(execStat) != SQL_NO_DATA) {
59                 if (
60                     speed >= minSpeed &&
61                     ram >= minRam &&
62                     hd >= minHd &&
63                     screen >= minScreen
64                 ) {
65                     printf("model=%d, speed=%.2f, ram=%d, hd=%d,
66                     screen=%d, price=%.2f, maker=%c",

```

```

56         model, speed, ram, hd, screen, price, maker);
57     }
58 }
59 }
60 }
61

```

```

c) #include <stdbool.h>
2  #include <string.h>
3  ...
4  void printSpecifications() {
5      char targetMaker;
6
7      SQLHENV myEnv;
8      SQLHDBC myCon;
9      SQLHSTMT execStat, subExecStat;
10
11     SQLINTEGER model, modelInfo, speedInfo, ram, ramInfo, hd,
hdInfo, priceInfo, makerInfo, screen, screenInfo, color, colorInfo
, printTypeInfo;
12     SQLREAL speed, price;
13     SQLCHAR maker, printType[50];
14
15     SQLRETURN errorCode1, errorCode2, errorCode3;
16
17     errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
18                               SQL_NULL_HANDLE, &myEnv);
19
20     if (!errorCode1) {
21         errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
);
22     }
23
24     if (!errorCode2) {
25         errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
execStat);
26         errorCode4 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
subExecStat);
27     }
28
29     if (!errorCode3 && !errorCode4) {
30         printf("Enter manufacturer:");
31         scanf("%c", &targetMaker);
32
33         SQLBindCol(execStat, 1, SQL_CHAR, &maker, sizeof(maker),
&makerInfo);
34         SQLBindCol(execStat, 2, SQL_CHAR, &productType, sizeof(
productType), &productTypeInfo);
35
36         while (SQLFetch(execStat) != SQL_NO_DATA) {
37             if (strcmp(productType, 'pc')) {
38                 SQLPrepare(subExecStat,
39                             "SELECT speed, ram, hd, price FROM PC
"

```

```

40         "NATURAL JOIN Product "
41         "WHERE type= ?", SQL_NTS);
42         SQLBindParameter(subExecStat, 1, ...,
productType, ...);
43         SQLExecute(subExecStat);
44
45         SQLBindCol(subExecStat, 1, SQL_FLOAT, &speed,
sizeof(speed), &speedInfo);
46         SQLBindCol(subExecStat, 2, SQL_INTEGER, &ram,
sizeof(ram), &ramInfo);
47         SQLBindCol(subExecStat, 3, SQL_INTEGER, &hd,
sizeof(hd), &hdInfo);
48         SQLBindCol(subExecStat, 4, SQL_FLOAT, &price,
sizeof(price), &priceInfo);
49
50         while(SQLFetch(subExecStat) != SQL_NO_DATA) {
51             printf("model=%d, speed=%.2f, ram=%d, hd=%d,
price=%.2f, maker=%c, type=%s",
52                 model, speed, ram, hd, screen, price, maker,
productType);
53         }
54     } else if (strcmp(productType, 'laptop')) {
55
56         SQLPrepare(subExecStat,
57             "SELECT speed, ram, hd, screen, price
FROM Laptop "
58                 "NATURAL JOIN Product "
59                 "WHERE type= ?", SQL_NTS);
60         SQLBindParameter(subExecStat, 1, ...,
productType, ...);
61         SQLExecute(subExecStat);
62
63         SQLBindCol(subExecStat, 1, SQL_FLOAT, &speed,
sizeof(speed), &speedInfo);
64         SQLBindCol(subExecStat, 2, SQL_INTEGER, &ram,
sizeof(ram), &ramInfo);
65         SQLBindCol(subExecStat, 3, SQL_INTEGER, &hd,
sizeof(hd), &hdInfo);
66         SQLBindCol(subExecStat, 4, SQL_INTEGER, &screen,
sizeof(screen), &screenInfo);
67         SQLBindCol(subExecStat, 5, SQL_FLOAT, &price,
sizeof(price), &priceInfo);
68
69         while(SQLFetch(subExecStat) != SQL_NO_DATA) {
70             printf("model=%d, speed=%.2f, ram=%d, hd=%d,
screen=%d, price=%.2f, maker=%c, type=%s",
71                 model, speed, ram, hd, screen, screen, price,
maker, productType);
72         }
73     } else if (strcmp(productType, 'printer')) {
74         SQLPrepare(subExecStat,
75             "SELECT color, printType, price FROM
Printer "
76                 "NATURAL JOIN Product "

```



```

77         "WHERE type= ?", SQL_NTS);
78         SQLBindParameter(subExecStat, 1, ...,
productType, ...);
79         SQLExecute(subExecStat);
80
81         SQLBindCol(subExecStat, 1, SQL_INTEGER, &color,
sizeof(speed), &speedInfo);
82         SQLBindCol(subExecStat, 2, SQL_CHAR, &printType,
sizeof(printType), &printTypeInfo);
83         SQLBindCol(subExecStat, 3, SQL_FLOAT, &price,
sizeof(price), &priceInfo);
84
85         while(SQLFetch(subExecStat) != SQL_NO_DATA) {
86             printf("model=%d, color=%s, price=%.2f, maker
=%c, type=%s",
87                 model, color ? "true" : "false", price, maker
, type);
88             }
89         }
90     }
91 }
92 }
93

```

d)

```

e) #include <sqlcli.h>
2  #include <string.h>
3  ...
4  void insertNewPC() {
5
6      int model, ram, hd;
7      float speed, price;
8      char maker;
9
10     SQLINTEGER modelCount;
11
12     SQLHENV myEnv;
13     SQLHDBC myCon;
14     SQLHSTMT execStat, subExecStat;
15
16     SQLRETURN errorCode1, errorCode2, errorCode3;
17
18     errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
19                               SQL_NULL_HANDLE, &myEnv);
20
21     if (!errorCode1) {
22         errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
);
23     }
24
25     if (!errorCode2) {
26         errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
execStat);
27     }

```

```

28
29     if (!errorCode3) {
30         printf("Enter manufacturer:\n");
31         scanf("%c", &maker);
32
33         printf("Enter model:\n");
34         scanf("%d", &model);
35
36         printf("Enter speed:\n");
37         scanf("%f", &speed);
38
39         printf("Enter ram:\n");
40         scanf("%d", &ram);
41
42         printf("Enter hd:\n");
43         scanf("%d", &hd);
44
45         printf("Enter price:\n");
46         scanf("%f", &price);
47
48         printf("Enter maker:\n");
49         scanf("%c", &maker);
50
51         SQLPrepare(execStat,
52                     "SELECT COUNT(model) FROM ("
53                     "(SELECT model FROM Product WHERE model=:model)
54                     "
55                     "UNION "
56                     "(SELECT model FROM PC WHERE model= ?)",
57                     SQL_NTS);
58         SQLBindParameter(execStat, 1, ..., model, ...);
59         SQLExecute(execStat);
60         SQLBindCol(execStat, 1, SQL_INT, &modelCount, sizeof(
61             modelCount), &modelCountInfo);
62
63         if (modelCount != 0) {
64             printf("Error. Model already exists in database.");
65         } else {
66             SQLPrepare(execStat,
67                         "INSERT INTO PC(model, speed, ram, hd, price)
68                         "
69                         "VALUES(?, ?, ?, ?, ?)", SQL_NTS);
70             SQLBindParameter(execStat, 1, ..., model, ...);
71             SQLBindParameter(execStat, 2, ..., speed, ...);
72             SQLBindParameter(execStat, 3, ..., ram, ...);
73             SQLBindParameter(execStat, 4, ..., hd, ...);
74             SQLBindParameter(execStat, 5, ..., price, ...);
75             SQLExecute(execStat);
76
77             SQLPrepare(execStat,
78                         "INSERT INTO Product(model, maker, type)"
79                         "VALUES(?, ?, 'pc')", SQL_NTS);
80             SQLBindParameter(execStat, 1, ..., model, ...);
81             SQLBindParameter(execStat, 2, ..., maker, ...);

```

```

78         SQLExecute(execStat);
79     }
80 }
81 }
82

```

2. a)

```

1 void classWithLargestPower() {
2
3     SQLINTEGER classInfo;
4     SQLCHAR class[100];
5
6     SQLHENV myEnv;
7     SQLHDBC myCon;
8     SQLHSTMT execStat, subExecStat;
9
10    SQLRETURN errorCode1, errorCode2, errorCode3;
11
12    errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
13                               SQL_NULL_HANDLE, &myEnv);
14
15    if (!errorCode1) {
16        errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
17    );
18    }
19
20    if (!errorCode2) {
21        errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
22    execStat);
23    }
24
25    if (!errorCode3) {
26        SQLPrepare(execStat,
27                  "SELECT class FROM FROM Classes"
28                  "WHERE numGuns * POWER(bore, 3) >= ALL ( "
29                  "SELECT numGuns * POWER(bore, 3) FROM Classes "
30                  ")", SQL_NTS);
31        SQLBindParameter(execStat, 1, ..., model, ...);
32        SQLExecute(execStat);
33        SQLBindCol(execStat, 1, SQL_CHAR, &class, sizeof(class),
34    &classInfo);
35
36        while(SQLFetch(execStat) != SQL_NO_DATA) {
37            printf("Class = %s\n", class);
38        }
39    }
40 }

```

b)

```

1 #include <sqlcli.h>
2 #include <string.h>
3 ...
4 void countryWithMostShipsSunk() {
5     char targetBattle[255];

```

```

6      char mostSunkCountry[100];
7      int maxSunkCount = 0, loopIndex = 0;
8
9      char mostDamagedCountry[100];
10     int maxDamagedCount = 0;
11
12     SQLCHAR country[100];
13     SQLINTEGER count, countInfo. countryInfo;
14
15     SQLHENV myEnv;
16     SQLHDBC myCon;
17     SQLHSTMT execStat, subExecStat;
18
19     SQLRETURN errorCode1, errorCode2, errorCode3;
20
21     errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
22                               SQL_NULL_HANDLE, &myEnv);
23
24     if (!errorCode1) {
25         errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
26 );
27     }
28
29     if (!errorCode2) {
30         errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
31 execStat)
32     }
33
34     if (!errorCode3) {
35         printf("Enter name of battle:\n");
36         scanf("%s", &targetBattle);
37
38         SQLPrepare(execStat,
39                   "SELECT country, COUNT(Outcomes.result) FROM
40 Classes "
41                   "INNER JOIN Ships ON Classes.class = Ships.
42 class "
43                   "INNER JOIN Outcomes ON Ships.name = Outcomes
44 .ship "
45                   "INNER JOIN Battles ON Battles.name = Outcome
46 .battle "
47                   "GROUP BY country "
48                   "HAVING Battles.name=:targetBattle AND"
49                   "Outcomes.result='sunk'", SQL_NTS);
50         SQLExecute(execStat);
51         SQLBindCol(execStat, 1, SQL_CHAR, &country, sizeof(
country), &countryInfo);
52         SQLBindCol(execStat, 2, SQL_INTEGER, &count, sizeof(count
), &countInfo);
53
54         while(SQLFetch(execStat) != SQL_NO_DATA) {
55             if (loopIndex == 0) {
56                 strcpy(mostSunkCountry, country);

```

```

52         }
53
54         if (count > maxSunkCount) {
55             maxSunkCount = count;
56             strcpy(mostSunkCountry, country);
57         }
58         loopIndex = loopIndex + 1;
59     }
60
61     printf("Country with most sunk ships: %s",
mostSunkCountry);
62
63
64     count = 0;
65     loopIndex = 0;
66     SQLPrepare(execStat,
67         "SELECT country, COUNT(Outcomes.result) FROM
Classes "
68         "INNER JOIN Ships ON Classes.class = Ships.
class "
69         "INNER JOIN Outcomes ON Ships.name = Outcomes
.ship "
70         "INNER JOIN Battles ON Battles.name = Outcome
.battle "
71         "GROUP BY country "
72         "HAVING Battles.name=:targetBattle AND"
73         "Outcomes.result='damaged'", SQL_NTS);
74     SQLExecute(execStat);
75
76     while(SQLFetch(execStat) != SQL_NO_DATA) {
77         if (loopIndex == 0) {
78             strcpy(mostDamagedCountry, country);
79         }
80
81         if (count > maxDamagedCount) {
82             maxDamagedCount = count;
83             strcpy(mostDamagedCountry, country);
84         }
85         loopIndex = loopIndex + 1;
86     }
87
88     printf("Country with most damaged ships: %s",
mostDamagedCountry);
89     }
90 }
91

```

```

c) #include <sqlcli.h>
2
3 void insertClassAndShip() {
4
5     char class[100], type[2], country[100], shipName[100],
dateLaunched[11];
6     int numGuns, bore, displacement;

```

```
7
8
9     SQLHENV myEnv;
10    SQLHDBC myCon;
11    SQLHSTMT execStat, subExecStat;
12
13    SQLRETURN errorCode1, errorCode2, errorCode3;
14
15    errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
16                               SQL_NULL_HANDLE, &myEnv);
17
18    if (!errorCode1) {
19        errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
20    );
21    }
22
23    if (!errorCode2) {
24        errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
25    execStat)
26    }
27
28    if (!errorCode3) {
29        printf("Enter name of class:\n");
30        scanf("%s", class);
31
32        printf("Enter name of type ('bb' or 'bc'):\n");
33        scanf("%s", type);
34
35        printf("Enter name of country:\n");
36        scanf("%s", country);
37
38        printf("Enter name of numGuns:\n");
39        scanf("%d", &numGuns);
40
41        printf("Enter name of bore:\n");
42        scanf("%d", &bore);
43
44        printf("Enter name of displacement:\n");
45        scanf("%d", &displacement);
46
47        printf("Enter name of ship (if first ship, skip by
48    pressing ENTER):\n");
49        fgets(shipName, sizeof shipName, stdin);
50
51        if (shipName[0] == '\n') {
52            strncpy(shipName, class, sizeof(class));
53        }
54
55        printf("Enter date launched (YYYY-MM-DD):\n");
56        scanf("%s", dateLaunched);
57
58        SQLPrepare(execStat,
59                  "INSERT INTO Classes(class, type, country,
60    numGuns, bore, displacement)"
```

```

57         "VALUES (?, ?, ?, ?, ?, ?)", SQL_NTS);
58         SQLBindParameter(execStat, 1, ..., class, ...);
59         SQLBindParameter(execStat, 2, ..., type, ...);
60         SQLBindParameter(execStat, 3, ..., country, ...);
61         SQLBindParameter(execStat, 4, ..., numGuns, ...);
62         SQLBindParameter(execStat, 5, ..., bore, ...);
63         SQLBindParameter(execStat, 6, ..., displacement, ...)
64     ;
65     SQLExecute(execStat);
66     SQLPrepare(execStat,
67         "INSERT INTO Ships(name, class, launched)"
68         "VALUES (?, ?, ?)", SQL_NTS);
69     SQLBindParameter(execStat, 1, ..., shipName, ...);
70     SQLBindParameter(execStat, 2, ..., class, ...);
71     SQLBindParameter(execStat, 3, ..., dateLaunched, ...)
72 ;
73     SQLExecute(execStat);
74 }
75

```

```

d) #include <sqlcli.h>
2
3 void correctError() {
4     SQLCHAR battle[101], shipName[101];
5     DATE_STRUCT dateLaunched;
6     DATE_STRUCT dateBattle;
7
8     int newDateLaunchedDay;
9     int newDateLaunchedMonth;
10    int newDateLaunchedYear;
11
12    int newDateBattleDay;
13    int newDateBattleMonth;
14    int newDateBattleYear;
15
16    SQLCHAR name[101], class[101]
17
18    SQLHENV myEnv;
19    SQLHDBC myCon;
20    SQLHSTMT execStat, subExecStat;
21
22    SQLRETURN errorCode1, errorCode2, errorCode3, errorCode4;
23
24    errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
25                                SQL_NULL_HANDLE, &myEnv);
26
27    if (!errorCode1) {
28        errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
29    );
30    }
31
32    if (!errorCode2) {

```

```

32         errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
execStat);
33         errorCode4 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
subExecStat);
34     }
35
36     if (!errorCode3 && !errorCode4) {
37
38         SQLPrepare(execStat,
39             "SELECT Ships.name, Ships.class, Outcomes.
battle"
40             "FROM Ships "
41             "INNER JOIN Outcomes ON Ships.name = Outcomes
.ship "
42             "INNER JOIN Battles ON Outcomes.battle =
Battles.name "
43             "WHERE Ships.launches > Battles.date",
SQL_NTS);
44         SQLExecute(execStat);
45         SQLBindCol(execStat, 1, SQL_CHAR, &shipName, sizeof(
shipName), &shipNameInfo);
46         SQLBindCol(execStat, 2, SQL_FLOAT, &class, sizeof(class),
&classInfo);
47         SQLBindCol(execStat, 3, SQL_INTEGER, &battle, sizeof(
battle), &battleInfo);
48
49         while(SQLFetch(execStat) != SQL_NO_DATA) {
50
51             printf("Error. Ship %s is launched after date of
battle.\n");
52
53             printf("Enter correct launched date (YYYY-MM-DD. Type
0-0-0 to skip):\n");
54             scanf("%d-%d-%d", &newDateLaunchedDay, &
newDateLaunchedMonth, &newDateLaunchedYear);
55
56             if (!newDateLaunchedDay == 0 &&
57                 !newDateLaunchedMonth == 0 &&
58                 !newDateLaunchedYear == 0) {
59                 // Correct date of launch
60                 SQLPrepare(subExecStat,
61                     "UPDATE Ships "
62                     "SET launched = ? "
63                     "WHERE name = ? AND class = ?",
SQL_NTS);
64                 SQLBindParameter(subExecStat, 1, ...,
newDateLaunched, ...);
65                 SQLBindParameter(subExecStat, 2, ...,
shipName, ...);
66                 SQLBindParameter(subExecStat, 3, ..., class,
...);
67                 SQLExecute(subExecStat);
68             }
69

```



```

70         printf("Enter correct launched date (YYYY-MM-DD. Type
           0-0-0 to skip):\n");
71         scanf("%d-%d-%d", &newDateBattleDay, &
newDateBattleMonth, &newDateBattleYear);
72
73         if (!newDateBattleDay == 0 &&
74             !newDateBattleMonth == 0 &&
75             !newDateBattleYear == 0) {
76             // Correct date of battle
77             SQLPrepare(subExecStat,
78                 "UPDATE Battles "
79                 "SET date = ? "
80                 "WHERE name = ?", SQL_NTS);
81             SQLBindParameter(subExecStat, 1, ...,
newDateBattle, ...);
82             SQLBindParameter(subExecStat, 2, ..., battle,
...);
83             SQLExecute(subExecStat);
84         }
85     }
86 }
87
88

```

3. a)

```

import java.sql.*;
import java.util.Scanner;

class Q3a {
    public static void main(String[ ] args) {

        int model, ram, hd, modelSol;
        float targetPrice, minDiff, speedSol, minDiff = Float.
MAX_VALUE;

        String makerSol;

        try {
            // The newInstance() call is a work around for some
            // broken Java implementations

            Class.forName("com.mysql.jdbc.Driver").newInstance();
            Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q3");
            Statement execStat = myCon.createStatement();

            Scanner scanObj = new Scanner(System.in);
            System.out.println("Enter target price:");

            String targetPriceRaw = scanObj.nextLine(); // Read
user input
            float targetPrice = Float.parseFloat(targetPriceRaw);

```

```

26         ResultSet results = execStat.executeQuery("SELECT
model, speed, ram, hd, price, maker FROM Product NATURAL JOIN PC")
;
27
28         while (results.next()) {
29             model = results.getInt(1);
30             speed = results.getFloat(2);
31             ram = results.getFloat(3);
32             hd = results.getInt(4);
33             price = results.getInt(5);
34             maker = results.getString(6);
35
36             if (abs(price - targetPrice) >= minDiff) {
37                 continue;
38             }
39
40             minDiff = abs(price - targetPrice);
41             modelSol = model;
42             speedSol = speed;
43             makerSol = maker;
44         }
45
46         System.out.println(String.format("maker=%c, model=%d,
speed=%.2f\n", makerSol, modelSol, speedSol));
47
48     }
49
50     } catch (SQLException ex) {
51         // handle the error
52         System.out.println("Error occured while establishing
database connection");
53     }
54 }
55 }
56

```

Notes:

- JDBC
 - Setup
 1. Import JDBC


```
import java.sql.*;
```
 2. Load a driver for the database system to use (i.e. sqlite, postgresql, mysql)


```
Class.forName(< driver name >);
```

Example:

```

1      Class.forName("com.mysql.jdbc.Driver");
2

```

3. Establish a connection to the database

```

Connection myCon = DriverManager.getConnection(< URL >, < user name >,
< password >);

```

* The url for jdbc is

```

jdbc:mysql://< host name >/< database name >

```

– Creating Statements in JDBC

1. **createStatement():**

- * Prepares a statement object
- * Is similar to **SQLAllocHandle** in C

2. **prepareStatement(Q):**

- * Prepares a statement object but with query
- * Is similar to **SQLAllocHandle** and **SQLPrepare** combined in C

3. **executeQuery(Q):**

- * takes a query statement Q and executes it.
- * Used for SELECT
- * Is similar to **SQLPrepare** and **SQLExecute**

4. **executeQuery():**

- * Is used with **prepareStatement(Q)**
- * Used for SELECT
- * Is similar to **SQLExecute** in C

5. **execUpdate(U):**

- * takes a non-query statement U and executes it.
- * Used for UPDATE AND INSERT
- * Is similar to **SQLPrepare** and **SQLExecute**

6. **executeQuery():**

- * Is used with **prepareStatement(Q)**
- * Used for UPDATE AND INSERT
- * Is similar to **SQLExecute** in C

Example:

```

1      // Example 1
2      Statement execStat = myCon.createStatement();
3      ResultSet worths = execStat.executeQuery(
4          "SELECT netWorth FROM MovieExec");
5

```

```

6      // Example 2
7      PreparedStatement execStat = myCon.prepareStatement(
8          "SELECT netWorth FROM MovieExec");
9      ResultSet worths = execStat.executeQuery()
10
11     // Example 3
12     Statement starStat = myCon.createStatement();
13     starStat.executeUpdate("INSERT INTO StarsIn VALUES('
14 Remember the Titans', 2000, 'Denzel Washington')");
15
16     // Example 4
17     PreparedStatement starStat = myCon.prepareStatement(
18         "INSERT INTO StarsIn VALUES('Remember the Titans',
19         2000, 'Denzel Washington')");
20     starStat.executeUpdate();

```

– Cursor Operations in JDBC

- * **next():**
 - Moves to next tuple
- * **getString(*i*), getInt(*i*), getFloat(*i*):**
 - Fetches and converts value at *i*th column in tuple

Example:

```

1      Statement execStat = myCon.createStatement();
2      ResultSet worths = execStat.executeQuery(
3          "SELECT netWorth FROM MovieExec");
4
5      while (worths.next()) {
6          int worth = worths.getInt(1);
7          ...
8      }
9

```

– Parameter Passing

- * **Syntax:** < PreparedStatement object >.setString(< column position >, < insert variable >);
- * Is similar to **SQLBindCol** in C

Example:

```

1      PreparedStatement studioStat = myCon.prepareStatement(
2          "INSERT INTO Studio(name, address) VALUES(?, ?)");
3
4      studioStat.setString(1, studioName);
5      studioStat.setString(2, studioAddr);
6      studioStat.executeUpdate();
7

```

```
b) import java.util.Scanner;
2
3 class Q3b {
4     public static void main(String[ ] args) {
5         float minSpeed
6         float minPrice
7         float speed;
8         float price;
9         int minRam;
10        int minHd;
11        int model;
12        int ram;
13        int hd;
14        int screen;
15        String maker;
16
17        try {
18            Class.forName("com.mysql.jdbc.Driver").newInstance();
19            Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q3");
20
21            Scanner scanObj = new Scanner(System.in);
22
23            System.out.println("Enter minimum speed:");
24            String minSpeedRaw = scanObj.nextLine();
25            minSpeed = Float.parseFloat(minSpeedRaw);
26
27            System.out.println("Enter minimum ram:");
28            String minRamRaw = scanObj.nextLine();
29            minRam = Integer.parseInt(minRamRaw);
30
31            System.out.println("Enter minimum hard-drive space:");
32            ;
33            String hdRaw = scanObj.nextLine();
34            hd = Integer.parseInt(hdRaw);
35
36            System.out.println("Enter minimum price:");
37            String priceRaw = scanObj.nextLine();
38            hd = Integer.parseInt(priceRaw);
39
40            PreparedStatement execStat = myCon.prepareStatement(
                "SELECT model, speed, ram, hd, screen, price,
maker" +
41                "FROM Product NATURAL JOIN Laptop");
42            ResultSet results = execStat.executeQuery();
43
44            while(results.next()) {
45                model = results.getInt(1);
46                speed = results.getFloat(2);
47                ram = results.getFloat(3);
48                hd = results.getInt(4);
49                screen = results.getInt(5);
50                price = results.getInt(6);
51                maker = results.getString(7);
```

```

52
53         if (
54             speed >= minSpeed &&
55             ram >= minRam &&
56             hd >= minHd &&
57             screen >= minScreen
58         ) {
59             System.out.println(String.format("model=%d,
speed=%.2f, ram=%d, hd=%d, screen=%d, price=%.2f, maker=%c",
60             model, speed, ram, hd, screen, price,
maker));
61         }
62     }
63
64     } catch (SQLException ex) {
65         // handle the error
66         System.out.println("Error occured while establishing
database connection");
67     }
68 }
69 }
70

```

c)

```

import java.util.Scanner;

2
3 class Q3c {
4     public static void main(String[ ] args) {
5
6         int model;
7         bool color;
8         char printType[50];
9         float price;
10
11         float speed;
12         int ram;
13         int hd;
14         int screen;
15         int productModel;
16         String productType;
17         String targetMaker;
18         String maker;
19
20
21         try {
22             Class.forName("com.mysql.jdbc.Driver").newInstance();
23             Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q3");
24             Statement execStat = myCon.createStatement();
25             Statement subExecStat = myCon.createStatement();
26
27             System.out.println("Enter minimum speed:");
28             targetMaker = scanObj.nextLine();
29
30             ResultSet results = execStat.executeQuery("SELECT

```

```

31     maker, productType FROM Product" +
32                                     "GROUP BY
33     maker, productType");
34
35     while (results.next()) {
36         maker = results.getString(1);
37         productType = results.getString(2);
38
39         if (maker.toLowerCase() != targetMaker.
40 toLowerCase()) continue;
41
42         if (productType == 'pc') {
43             PreparedStatement subExecStat = myCon.
44 prepareStatement("SELECT speed, ram, hd, price FROM PC " +
45
46                 "NATURAL JOIN Product " +
47
48                 "WHERE type= ?");
49             subExecStat.setString(1, productType);
50             ResultSet subResults = subExecStat.
51 executeQuery();
52
53             while(subResults.next()) {
54                 speed = results.getFloat(1);
55                 ram = results.getFloat(2);
56                 hd = results.getInt(3);
57                 price = results.getInt(4);
58
59                 System.out.println(String.format("model=%
60 d, speed=%.2f, ram=%d, hd=%d, price=%.2f, maker=%c, type=%s",
61 model, speed, ram, hd, screen, price,
62 maker, productType));
63             }
64         } else if (productType == 'laptop') {
65             PreparedStatement subExecStat = myCon.
66 prepareStatement("SELECT speed, ram, hd, screen, price FROM Laptop
67 " +
68
69                 "NATURAL JOIN Product " +
70
71                 "WHERE type= ?");
72             subExecStat.setString(1, productType);
73             ResultSet subResults = subExecStat.
74 executeQuery();
75
76             while(subResults.next()) {
77                 speed = results.getFloat(1);
78                 ram = results.getFloat(2);
79                 hd = results.getInt(3);
80                 screen = results.getInt(4);
81                 price = results.getInt(5);
82
83                 System.out.println(String.format("model=%
84 d, speed=%.2f, ram=%d, hd=%d, screen=%d, price=%.2f, maker=%c,

```

```

70     type="%s",
71         model, speed, ram, hd, screen, screen,
72         price, maker, productType));
73     }
74     } else if (strcmp(productType, 'printer')) {
75         EXEC SQL DECLARE printerCursor CURSOR FOR
76         SELECT color, printType, price FROM
77         Printer
78         NATURAL JOIN Product
79         WHERE type=productType;
80         EXEC SQL OPEN printerCursor;
81         while(1) {
82             EXEC SQL FETCH FROM printerCursor INTO :
83             color,
84             :printType, :price;
85             if (NO_MORE_TUPLES) break;
86             printf("model=%d, color=%s, price=%.2f,
87             maker=%c, type=%s",
88             model, color ? "true" : "false", price,
89             maker, type);
90             EXEC SQL CLOSE printerCursor;
91         }
92     }
93     } catch (SQLException ex) {
94         // handle the error
95         System.out.println("Error occurred while establishing
96         database connection");
97     }
98 }
99

```