

CSC343 Worksheet 8 Solution

June 26, 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>
#include <string.h>
...
void insertNewPC() {
    int model, ram, hd;
    float speed, price;
    char maker;

    SQLINTEGER modelCount;

    SQLHENV myEnv;
    SQLHDBC myCon;
    SQLHSTMT execStat, subExecStat;

    SQLRETURN errorCode1, errorCode2, errorCode3;

    errorCode1 = SQLAllocHandle(SQL_HANDLE_ENV,
        SQL_NULL_HANDLE, &myEnv);

    if (!errorCode1) {
        errorCode2 = SQLAllocHandle(SQL_HANDLE_DBC, myEnv, &myCon
    );
    }

    if (!errorCode2) {
        errorCode3 = SQLAllocHandle(SQL_HANDLE_STMT, myCon, &
execStat);
    }
}

```

```

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.getFloat(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
class Q3c {
3
4     public static void main(String[ ] args) {
5
6         int model;
7         boolean color;
8         String printType;
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
26             System.out.println("Enter minimum speed:");
27             targetMaker = scanObj.nextLine();
28
29             ResultSet results = execStat.executeQuery("SELECT
maker, productType FROM Product" +

```

```

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

```

```

69         model, speed, ram, hd, screen, screen,
price, maker, productType));
70     }
71
72     } else if (strcmp(productType, 'printer')) {
73         PreparedStatement subExecStat = myCon.
prepareStatement("SELECT color, printType, price FROM Printer " +
74
75         "NATURAL JOIN Product " +
76
77         "WHERE type= ?");
78         subExecStat.setString(1, productType);
79         ResultSet subResults = subExecStat.
executeQuery();
80
81         while(subResults.next()) {;
82             color = results.getBoolean(1);
83             printType = results.getString(2);
84             price = results.getFloat(3);
85
86             printf("model=%d, color=%s, price=%.2f,
maker=%c, type=%s",
87
88             model, color ? "true" : "false", price,
maker, type);
89
90         }
91     }
92 }
93
94 } catch (SQLException ex) {
95     // handle the error
96     System.out.println("Error occurred while establishing
database connection");
97 }
98 }
99
100 }

```

d)

e)

```

import java.util.Scanner;
2
3
4 class Q3c {
5     public static void main(String[ ] args) {
6
7         int model;
8         boolean color;
9         String printType;
10        float price;
11
12        float speed;
13        int ram;
14        int hd;
15        int screen;
16        int productModel;
17        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
26             System.out.println("Enter minimum speed:");
27             targetMaker = scanObj.nextLine();
28
29             ResultSet results = execStat.executeQuery("SELECT
maker, productType FROM Product" +
30                                                         "GROUP BY
maker, productType");
31
32             while (results.next()) {
33                 maker = results.getString(1);
34                 productType = results.getString(2);
35
36                 if (maker.toLowerCase() != targetMaker.
toLowerCase()) continue;
37
38                 if (productType == 'pc') {
39                     PreparedStatement subExecStat = myCon.
prepareStatement("SELECT speed, ram, hd, price FROM PC " +
40                                                         "NATURAL JOIN Product " +
41                                                         "WHERE type= ?");
42                     subExecStat.setString(1, productType);
43                     ResultSet subResults = subExecStat.
executeQuery();
44
45                     while(subResults.next()) {
46                         speed = results.getFloat(1);
47                         ram = results.getFloat(2);
48                         hd = results.getInt(3);
49                         price = results.getInt(4);
50
51                         System.out.println(String.format("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 (productType == 'laptop') {
55                     PreparedStatement subExecStat = myCon.
prepareStatement("SELECT speed, ram, hd, screen, price FROM Laptop
" +
56                                                         "NATURAL JOIN Product " +
57
```

```

58         "WHERE type= ?");
59         subExecStat.setString(1, productType);
60         ResultSet subResults = subExecStat.
executeQuery();
61
62         while(subResults.next()) {
63             speed = results.getFloat(1);
64             ram = results.getFloat(2);
65             hd = results.getInt(3);
66             screen = results.getInt(4);
67             price = results.getInt(5);
68
69             System.out.println(String.format("model=%
d, speed=%.2f, ram=%d, hd=%d, screen=%d, price=%.2f, maker=%c,
type=%s",
70             model, speed, ram, hd, screen, screen,
price, maker, productType));
71         }
72         } else if (strcmp(productType, 'printer')) {
73             PreparedStatement subExecStat = myCon.
prepareStatement("SELECT color, printType, price FROM Printer " +
74             "NATURAL JOIN Product " +
75             "WHERE type= ?");
76             subExecStat.setString(1, productType);
77             ResultSet subResults = subExecStat.
executeQuery();
78
79             while(subResults.next()) {;
80                 color = results.getBoolean(1);
81                 printType = results.getString(2);
82                 price = results.getFloat(3);
83
84                 printf("model=%d, color=%s, price=%.2f,
maker=%c, type=%s",
85                 model, color ? "true" : "false", price,
maker, type);
86             }
87         }
88     }
89
90     } catch (SQLException ex) {
91         // handle the error
92         System.out.println("Error occurred while establishing
database connection");
93     }
94 }
95 }
96

```

f)

g) `import java.util.Scanner;`

```
2
3  class Q3e {
4      public static void main(String[ ] args) {
5
6          int model, ram, hd;
7          float speed, price;
8          String maker;
9
10         try {
11             Class.forName("com.mysql.jdbc.Driver").newInstance();
12             Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q3");
13
14             Scanner scanObj = new Scanner(System.in);
15
16             System.out.println("Enter manufacturer:");
17             maker = scanObj.nextLine();
18
19             System.out.println("Enter model:");
20             String modelRaw = scanObj.nextLine();
21             model = Integer.parseInt(modelRaw);
22
23             System.out.println("Enter speed:");
24             String speedRaw = scanObj.nextLine();
25             speed = Float.parseFloat(speedRaw);
26
27             System.out.println("Enter ram:");
28             String ramRaw = scanObj.nextLine();
29             ram = Float.parseFloat(ramRaw);
30
31             System.out.println("Enter hd:");
32             String hdRaw = scanObj.nextLine();
33             hd = Float.parseFloat(hdRaw);
34
35             System.out.println("Enter price:");
36             String priceRaw = scanObj.nextLine();
37             price = Float.parseFloat(priceRaw);
38
39
40             PreparedStatement execStat = myCon.prepareStatement("
SELECT Product.model AS m1, PC.model AS m2 FROM " +
41                                     "
Product FULL OUTER JOIN PC" +
42                                     "
WHERE model = ?");
43             execStat.setString(1, model);
44             ResultSet results = execStat.executeQuery();
45
46             while (results.next()) {
47                 productModel = results.getString(1);
48                 pcModel = results.getString(2);
49
50                 if (productModel != null & pcModel != null) {
51                     System.out.println("Error. Model already
```

```

51     exists in database.");
52         } else {
53             PreparedStatement subExecStat = myCon.
54             prepareStatement(
55                 "INSERT INTO PC(model, speed, ram, hd,
56                 price) " +
57                 "VALUES(?, ?, ?, ?, ?)"
58             );
59             subExecStat.setString(1, model);
60             subExecStat.setString(2, speed);
61             subExecStat.setString(3, ram);
62             subExecStat.setString(4, hd);
63             subExecStat.setString(5, price);
64             subExecStat.executeUpdate();
65
66             subExecStat = myCon.prepareStatement(
67                 "INSERT INTO Product(model, maker, type)
68                 "VALUES(?, ?, 'pc')"
69             );
70             subExecStat.setString(1, model);
71             subExecStat.setString(2, maker);
72             subExecStat.executeUpdate();
73         }
74     } catch (SQLException ex) {
75         // handle the error
76         System.out.println("Error occurred while establishing
77         database connection");
78     }
79 }
80

```

4. a)

```

1  import java.sql.*;
2  import java.util.Scanner;
3
4  class Q4a {
5      public static void main(String[] args) {
6          int class;
7
8          try {
9              Class.forName("com.mysql.jdbc.Driver").newInstance();
10             Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q3");
11
12             Scanner scanObj = new Scanner(System.in);
13
14             PreparedStatement execStat = myCon.prepareStatement("
SELECT class FROM FROM Classes " +
15
WHERE numGuns * POWER(bore, 3) >= ALL ( " +

```

```

16         SELECT numGuns * POWER(bore, 3) FROM Classes)");
17
18     ResultSet results = execStat.executeQuery();
19
20     while (results.next()) {
21         class = results.getString(1);
22         System.out.println(String.format("Class = %s\n",
23 class));
24     }
25
26     } catch (SQLException ex) {
27         // handle the error
28         System.out.println("Error occured while establishing
29 database connection");
30     }
31 }
32

```

Correct Solution:

```

1     import java.sql.*;
2     import java.util.Scanner;
3
4     class Q4a {
5         public static void main(String[ ] args) {
6             int class;
7
8             try {
9                 Class.forName("com.mysql.jdbc.Driver").
10 newInstance();
11                 Connection myCon = DriverManager.
12 getConnection("jdbc:mysql://localhost/Q4"); // <- Corrected
13
14                 Scanner scanObj = new Scanner(System.in);
15
16                 PreparedStatement execStat = myCon.
17 prepareStatement("SELECT class FROM FROM Classes " +
18
19 "WHERE numGuns * POWER(bore, 3) >= ALL ( " +
20
21 "SELECT numGuns * POWER(bore, 3) FROM Classes)");
22
23                 ResultSet results = execStat.executeQuery();
24
25                 while (results.next()) {
26                     class = results.getString(1);
27

```

```

22         System.out.println(String.format("
23         Class = %s\n", class));
24     }
25
26     } catch (SQLException ex) {
27         // handle the error
28         System.out.println("Error occurred while
29         establishing database connection");
30     }
31 }
32

```

b)

```

2  import java.sql.*;
3  import java.util.Scanner;
4
5  class Q4b {
6      public static void main(String[] args) {
7          String targetBattle;
8          String country;
9          int count;
10
11          String mostSunkCountry;
12          int maxSunkCount = 0;
13
14          String mostDamagedCountry;
15          int maxDamagedCount = 0;
16
17          try {
18              Class.forName("com.mysql.jdbc.Driver").newInstance();
19              Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q4"); // <- Corrected
20
21              Scanner scanObj = new Scanner(System.in);
22
23              Scanner scanObj = new Scanner(System.in);
24              System.out.println("Enter name of battle:");
25              targetBattle = scanObj.nextLine();
26
27              PreparedStatement sunkStat = myCon.prepareStatement("
28              SELECT country, COUNT(Outcomes.result) FROM Classes " +
29              "
29              INNER JOIN Ships ON Classes.class = Ships.class " +
30              "
30              INNER JOIN Outcomes ON Ships.name = Outcomes.ship " +
31              "
31              INNER JOIN Battles ON Battles.name = Outcome.battle " +
32              "
32              GROUP BY country " +
33              "
33              HAVING Battles.name= ? AND " +
34              "

```

```

34     Outcomes.result='sunk');
35         sunkStat.setString(1, targetBattle);
36         ResultSet sunkResults = sunkStat.executeQuery();
37         while(sunkResults.next()) {
38             country = sunkResults.getString(1);
39             count = sunkResults.getInt(2);
40
41             if (count > maxSunkCount) {
42                 maxSunkCount = count;
43                 mostSunkCountry = country;
44             }
45         }
46
47         printf("Country with most sunk ships: %s",
mostSunkCountry);
48
49         PreparedStatement damagedStat = myCon.prepareStatement
("SELECT country, COUNT(Outcomes.result) FROM Classes " +
50                                     "
51 INNER JOIN Ships ON Classes.class = Ships.class " +
52                                     "
53 INNER JOIN Outcomes ON Ships.name = Outcomes.ship " +
54                                     "
55 INNER JOIN Battles ON Battles.name = Outcome.battle " +
56                                     "
57 GROUP BY country " +
58                                     "
59 HAVING Battles.name= ? AND " +
60                                     "
61 Outcomes.result='damaged'");
62
63         sunkStat.setString(1, targetBattle);
64         ResultSet damagedResults = damagedStat.executeQuery()
65 ;
66
67         while(damagedResults.next()) {
68             country = damagedResults.getString(1);
69             count = damagedResults.getInt(1);
70
71             if (count > maxDamagedCount) {
72                 maxDamagedCount = count;
73                 mostDamagedCountry = country;
74             }
75         }
76
77         printf("Country with most damaged ships: %s",
mostDamagedCountry);
78
79     } catch (SQLException ex) {
80         // handle the error
81         System.out.println("Error occurred while establishing
database connection");

```

```

76         }
77     }
78 }
79
80

```

```

c)  import java.sql.*;
    2  import java.util.Scanner;
    3
    4
    5  class Q4c {
    6      public static void main(String[ ] args) {
    7          try {
    8              Class.forName("com.mysql.jdbc.Driver").newInstance();
    9              Connection myCon = DriverManager.getConnection("jdbc:
mysql://localhost/Q4");
10
11              Scanner scanObj = new Scanner(System.in);
12
13              System.out.println("Enter name of class:");
14              String class = scanObj.nextLine();
15
16              System.out.println("Enter name of type ('bb' or 'bc'
:");
17
18              String type = scanObj.nextLine();
19
20              System.out.println("Enter name of country:");
21              String country = scanObj.nextLine();
22
23              System.out.println("Enter name of numGuns:");
24              String numGunsRaw = scanObj.nextLine();
25              numGuns = Integer.parseFloat(numGunsRaw);
26
27              System.out.println("Enter name of bore:");
28              String boreRaw = scanObj.nextLine();
29              bore = Integer.parseFloat(boreRaw);
30
31              System.out.println("Enter name of displacement:");
32              String displacementRaw = scanObj.nextLine();
33              displacement = Integer.parseFloat(displacementRaw);
34
35              System.out.println("Enter name of ship (if first ship
, skip by pressing ENTER):");
36              String shipName = scanObj.nextLine();
37
38              if (shipName.trim().equals("")) {
39                  shipName = class;
40              }
41
42              System.out.println("Enter date launched (YYYY-MM-DD):
");
43              String dateLaunched = scanObj.nextLine();
44

```



```

45         PreparedStatement classExecStat = myCon.
prepareStatement(
46             "INSERT INTO Classes(class, type, country,
numGuns, bore, displacement) " +
47             "VALUES (?, ?, ?, ?, ?, ?)"
48         );
49         classExecStat.setString(1, class);
50         classExecStat.setString(2, type);
51         classExecStat.setString(3, country);
52         classExecStat.setString(4, numGuns);
53         classExecStat.setString(5, bore);
54         classExecStat.setString(6, displacement);
55         classExecStat.executeUpdate();
56
57         PreparedStatement shipsExecStat = myCon.
prepareStatement(
58             "INSERT INTO Ships(name, class, launched) " +
59             "VALUES (?, ?, ?)"
60         );
61         shipsExecStat.setString(1, shipName);
62         shipsExecStat.setString(2, class);
63         shipsExecStat.setString(3, dateLaunched);
64         shipsExecStat.executeUpdate();
65
66     } catch (SQLException ex) {
67         // handle the error
68         System.out.println("Error occured while establishing
database connection");
69     }
70 }
71 }
72

```

5. a)

```

<?php
2 include(DB.php);
3
4 function Q5a() {
5     $targetPrice = INF;
6
7     $modelSol;
8     $speedSol;
9     $makerSol;
10
11     $myCon = DB::connect(mysql://root:dbPassword@localhost/Q5);
12
13     $stdin = fopen('php://stdin', 'r');
14     echo("Enter target price:");
15     $targetPrice = fscanf(STDIN, "%f\n");
16
17     $results = $myCon->query("SELECT model, speed, ram, hd, price
, maker FROM Product NATURAL JOIN PC");
18
19     while ($tuple = $results->fetchRow()) {
20         $model = $tuple[0];

```

```

21         $speed = $tuple[1];
22         $ram = $tuple[2];
23         $hd = $tuple[3];
24         $price = $tuple[4];
25         $maker = $tuple[5];
26
27         if (abs($price - $targetPrice) >= $minDiff) {
28             continue;
29         }
30
31         $minDiff = abs($price - $targetPrice);
32         $modelSol = $model;
33         $speedSol = $speed;
34         $makerSol = $maker;
35     }
36
37     sprintf("maker=%c, model=%d, speed=%.2f\n", makerSol,
38 modelSol, speedSol);
39     $myCon->disconnect();
40 }
41 ?>

```

Notes:

- PHP basics
 - code is put inside a special tag


```

<?php
PHP code goes in here
? >

```
- Variables
 - starts with '\$'.
- String
 - is surrounded by single quote or double quote
 - single quote → literal string
 - double quote → can replace special symbols inside quote with values

Example:

```

1 // Here, $ in single quote is printed as is
2 $foo = 'bar';
3 $x = 'step up to the $foo'
4
5 // Here, $ in double quote is replaced with corresponding
6 value of variable
7 $foo = "bar";
8 $x = "step up to the $foo" // <- prints "step up to the bar"

```

- concatenates two strings using dot

```
1 $foo = "foo" . " bar"; // <- $foo has value "foo bar";
2
```

- Arrays

- **Syntax 1:** array(< val 1 >, < val 2 >, < val 3 >, ...)
- **Syntax 2:** array(< key 1 > => < val 1 >, < key 2 > => < val 2 >, < key 3 > => < val 3 >, ...)

```
1 $seasons = array('spring' => 'warm')
2
```

- Connecting to Database

- **Syntax:** \$myCon = DB::connect(< vendor >://< user name >:< password >@< host name >/< database name >);
- connection to server disconnect via DB_Object_Instance->disconnect()

- Executing SQL statements

- **Syntax:** DB_Object_Instance->query(statement)

Example:

```
1 $result = $myCon->query("INSERT INTO StarsIn VALUES("
2 'Denzel Washington', 2000, 'Remember the Titans')")
3
```

- Cursor Operations in PHP

Example:

```
1 $worths = $myCon->query("SELECT netWorth FROM MovieExec");
2 while ($tuple = $worths->fetchRow()) {
3     $worth = $tuple[0];
4 }
5
```

- Dynamic SQL in PHP

Example:

```
1 $worths = $myCon->prepare("INSERT INTO Studio(name, address)
VALUES(?,?)");
2 $args = array('MGM', 'Los Angeles');
3 $result = $myCon->execute($prepQuery, $args);
4
```

```
b)
1  <?php
2  function Q5b() {
3
4      $myCon = DB::connect(mysql://root:dbPassword@localhost/Q5);
5
6      echo("Enter minimum speed:");
7      $minSpeed = fscanf(STDIN, "%f\n");
8
9      echo("Enter minimum ram:");
10     $minRam = fscanf(STDIN, "%d\n");
11
12     echo("Enter minimum hard-drive space:");
13     $minHd = fscanf(STDIN, "%d\n");
14
15     echo("Enter minimum price:");
16     $minPrice = fscanf(STDIN, "%f\n");
17
18     $results = $myCon->query("SELECT model, speed, ram, hd,
19 screen, price, maker" +
20                             "FROM Product NATURAL JOIN Laptop");
21
22     while($tuple = $results->fetchRow()) {
23         $model = $tuple[0];
24         $speed = $tuple[1];
25         $ram = $tuple[2];
26         $hd = $tuple[3];
27         $screen = $tuple[4];
28         $price = $tuple[5];
29         $maker = $tuple[6];
30
31         if (
32             $speed >= $minSpeed &&
33             $ram >= $minRam &&
34             $hd >= $minHd &&
35             $screen >= $minScreen
36         ) {
37             sprintf("model=%d, speed=%.2f, ram=%d, hd=%d, screen
38 =%d, price=%.2f, maker=%c",
39                     model, speed, ram, hd, screen, price, maker);
40         }
41     }
42     $myCon->disconnect();
43 }
```

```
c)
1  <?php
2  function Q5c() {
3
4      $myCon = DB::connect(mysql://root:dbPassword@localhost/Q5);
5
6      echo("Enter maker:");
7      $targetMaker = fscanf(STDIN, "%s\n");
8 }
```

```

9      $results = $myCon->query("SELECT maker, productType FROM
Product" +
10                                     "GROUP BY maker, productType");
11
12
13      while ($tuple = $results->fetchRow()) {
14          $maker = $tuple[0];
15          $productType = $tuple[1];
16
17          if (strtolower(maker) != strtolowertargetMaker)))
continue;
18
19          if (productType == 'pc') {
20              $subQuery = $myCon->prepare("SELECT speed, ram, hd,
price FROM PC " +
21                                     "NATURAL JOIN Product " +
22                                     "WHERE type= ?");
23
24              $args = array($productType);
25              $subResults = $myCon->execute($subQuery, $args);
26
27              while($tuple = $subResults->fetchRow()) {
28                  $speed = $tuple[0];
29                  $ram = $tuple[1];
30                  $hd = $tuple[2];
31                  $price = $tuple[3];
32
33                  sprintf("model=%d, speed=%.2f, ram=%d, hd=%d,
price=%.2f, maker=%c, type=%s",
34                      model, speed, ram, hd, screen, price, maker,
productType);
35              }
36          } else if (productType == 'laptop') {
37              $subQuery = $myCon->prepare("SELECT speed, ram, hd,
screen, price FROM Laptop " +
38                                     "NATURAL JOIN Product " +
39                                     "WHERE type= ?");
40
41              $args = array($productType);
42              $subResults = $myCon->execute($subQuery, $args);
43
44              while($tuple = $subResults->fetchRow()) {
45                  $speed = $tuple[0];
46                  $ram = $tuple[1];
47                  $hd = $tuple[2];
48                  $screen = $tuple[3];
49                  $price = $tuple[4];
50
51                  sprintf("model=%d, speed=%.2f, ram=%d, hd=%d,
screen=%d, price=%.2f, maker=%c, type=%s",
52                      model, speed, ram, hd, screen, screen, price,
maker, productType);
53              }
54          } else if (strcmp(productType, 'printer')) {

```

```

55         $subQuery = $myCon->prepare("SELECT color, printType,
56 price FROM Printer " +
57                                     "NATURAL JOIN Product " +
58                                     "WHERE type= ?");
59         $args = array($productType);
60         $subResults = $myCon->execute($subQuery, $args);
61
62         while($tuple = $subResults->fetchRow()) {;
63             $color = $tuple[1];
64             $printType = $tuple[2];
65             $price = $tuple[3];
66
67             sprintf("model=%d, color=%s, price=%.2f, maker=%c
68 , type=%s",
69                 model, color ? "true" : "false", price, maker,
70 type);
71         }
72     }
73     $myCon->disconnect();
74 }
75

```

d)

e)

```

function Q5e {
2
3     $myCon = DB::connect(mysql://root:dbPassword@localhost/Q5);
4
5     echo("Enter manufacturer:");
6     $maker = fscanf(STDIN, "%f\n");
7
8     System.out.println("Enter model:");
9     String modelRaw = scanObj.nextLine();
10    model = Integer.parseInt(modelRaw);
11
12    echo("Enter model:");
13    $model = fscanf(STDIN, "%d\n");
14
15    echo("Enter speed:");
16    $speed = fscanf(STDIN, "%f\n");
17
18    echo("Enter ram:");
19    $ram = fscanf(STDIN, "%d\n");
20
21    echo("Enter hd:");
22    $hd = fscanf(STDIN, "%d\n");
23
24    echo("Enter price:");
25    $price = fscanf(STDIN, "%f\n");
26
27    $execStat = $myCon->prepare("SELECT Product.model AS m1, PC.
model AS m2 FROM " +

```

```

28         "Product FULL OUTER JOIN PC" +
29         "WHERE model = ?");
30     $args = array(model);
31     $results = $myCon->execute();
32
33     while ($tuple = $results->fetchRow()) {
34         $productModel = $tuple[0];
35         $pcModel = $tuple[1];
36
37         if (!is_null($productModel) && !is_null($pcModel)) {
38             echo("Error. Model already exists in database.");
39         } else {
40             $subExecStat = $myCon->prepare(
41                 "INSERT INTO PC(model, speed, ram, hd, price) " +
42                 "VALUES(?, ?, ?, ?, ?)"
43             );
44             $args = array(model, speed, ram, hd, price);
45             $myCon->execute($subExecStat, $args);
46
47             $subExecStat = $myCon->statement(
48                 "INSERT INTO Product(model, maker, type) " +
49                 "VALUES(?, ?, 'pc')"
50             );
51             $args = array(model, maker);
52             $myCon->execute($subExecStat, $args);
53         }
54     }
55 }
56 }
57
58

```

6. a)

```

1 <?php
2 function Q6a () {
3     $myCon = DB::connect(mysql://root:dbPassword@localhost/Q6);
4
5     $results = $myCon->query("SELECT class FROM FROM Classes " +
6         "WHERE numGuns * POWER(bore, 3) >=
7         "SELECT numGuns * POWER(bore, 3)
8         FROM Classes)");
9
10    while ($tuple = $results->fetchRow()) {
11        class = $tuple[1];
12        sprintf("Class = %s\n", class);
13    }
14 }
15 ?>

```

b)

```

1 <?php
2 function Q6b () {
3     $maxSunkCount;

```

```
4      $mostSunkCountry;
5      $maxDamagedCount;
6      $mostDamagedCountry;
7      $myCon = DB::connect(mysql://root:dbPassword@localhost/Q6);
8
9      Scanner scanObj = new Scanner(System.in);
10     System.out.println("Enter name of battle:");
11     targetBattle = scanObj.nextLine();
12
13     $query = $myCon->prepare("SELECT country, COUNT(Outcomes.
14 result) FROM Classes " +
15                                "INNER JOIN Ships ON Classes.class =
16                                "INNER JOIN Outcomes ON Ships.name =
17                                "INNER JOIN Battles ON Battles.name
18 = Outcome.battle " +
19                                "GROUP BY country " +
20                                "HAVING Battles.name= ? AND " +
21                                "Outcomes.result='sunk'");
22
23     $args = array(targetBattle);
24     $sunkResults = $myCon->execute($query, $args);
25
26     while ($tuple = $results->fetchRow()) {
27         $country = $tuple[0];
28         $count = $tuple[1];
29
30         if ($count > $maxSunkCount) {
31             $maxSunkCount = $count;
32             $mostSunkCountry = $country;
33         }
34     }
35
36     sprintf("Country with most sunk ships: %s", mostSunkCountry);
37
38     $query = $myCon->prepare("SELECT country, COUNT(Outcomes.
39 result) FROM Classes " +
40                                "INNER JOIN Ships ON Classes.class =
41                                "INNER JOIN Outcomes ON Ships.name =
42                                "INNER JOIN Battles ON Battles.name
43 = Outcome.battle " +
44                                "GROUP BY country " +
45                                "HAVING Battles.name= ? AND " +
46                                "Outcomes.result='damaged'");
47
48     $args = array(targetBattle);
49     $damagedResults = $myCon->execute($query, $args);
50
51     while($tuple = $results->fetchRow()) {
52         $country = $tuple[0];
```



```

50         $count = $tuple[1];
51
52         if ($count > $maxDamagedCount) {
53             $maxDamagedCount = $count;
54             $mostDamagedCountry = $country;
55         }
56     }
57
58     sprintf("Country with most damaged ships: %s",
mostDamagedCountry);
59 }
60 ?>
61

```

```

c) <?php
2 function Q6c () {
3     $myCon = DB::connect(mysql://root:dbPassword@localhost/Q5);
4
5     echo("Enter name of class:");
6     $class = fscanf(STDIN, "%s\n");
7
8     echo("Enter name of type ('bb' or 'bc')");
9     $type = fscanf(STDIN, "%s\n");
10
11     System.out.println("Enter name of country:");
12     String country = scanObj.nextLine();
13
14     echo("Enter name of country:");
15     $country = fscanf(STDIN, "%s\n");
16
17     echo("Enter name of numGuns:");
18     $numGuns = fscanf(STDIN, "%d\n");
19
20     echo("Enter name of bore:");
21     $bore = fscanf(STDIN, "%d\n");
22
23     echo("Enter name of displacement:");
24     $bore = fscanf(STDIN, "%d\n");
25
26     echo("Enter name of ship (if first ship, skip by pressing
ENTER):");
27     $bore = fscanf(STDIN, "%d\n");
28
29     if (shipName.trim().equals("")) {
30         shipName = class;
31     }
32
33     System.out.println("Enter date launched (YYYY-MM-DD):");
34     String dateLaunched = scanObj.nextLine();
35
36
37     PreparedStatement classExecStat = myCon.prepareStatement(
38         "INSERT INTO Classes(class, type, country, numGuns, bore,
displacement) " +

```

```
39         "VALUES (?, ?, ?, ?, ?, ?)"
40     );
41     classExecStat.setString(1, class);
42     classExecStat.setString(2, type);
43     classExecStat.setString(3, country);
44     classExecStat.setString(4, numGuns);
45     classExecStat.setString(5, bore);
46     classExecStat.setString(6, displacement);
47     classExecStat.executeUpdate();
48
49     PreparedStatement shipsExecStat = myCon.prepareStatement(
50         "INSERT INTO Ships(name, class, launched) " +
51         "VALUES (?, ?, ?)"
52     );
53     shipsExecStat.setString(1, shipName);
54     shipsExecStat.setString(2, class);
55     shipsExecStat.setString(3, dateLaunched);
56     shipsExecStat.executeUpdate();
57
58
59     $myCon->disconnect();
60
61 }
62 ?>
63
```

d)

```
<?php
2 function Q6d () {
3
4 }
5 ?>
6
```