7.29 *(Arrays of Pointers to Functions)* Rewrite the program of Fig. 6.17 to use a menu-driven interface. The program should offer the user four options as follows:

```
Enter a choice:
   0  Print the array of grades
   1  Find the minimum grade
   2  Find the maximum grade
   3  Print the average on all tests for each student
   4  End program
```

One restriction on using arrays of pointers to functions is that all the pointers must have the same type. The pointers must be to functions of the same return type that receive arguments of the same type. For this reason, the functions in Fig. 6.17 must be modified so that they each return the same type and take the same parameters. Modify functions minimum and maximum to print the minimum or maximum value and return nothing. For option 3, modify function average of Fig. 6.17 to output the average for each student (not a specific student). Function average should return nothing and take the same parameters as printArray, minimum and maximum. Store the pointers to the four functions in array processGrades and use the choice made by the user as the subscript into the array for calling each function.

ANS:

```
Enter a choice:
  0  Print the array of grades
  1  Find the minimum grade
  2  Find the maximum grade
  3  Print the average on all tests for each student
  4  End program
? 0

                 [0] [1] [2] [3]
studentGrades[0]  77  68  86  73
studentGrades[1]  96  87  89  78
studentGrades[2]  70  90  86  81

Enter a choice:
  0  Print the array of grades
  1  Find the minimum grade
  2  Find the maximum grade
  3  Print the average on all tests for each student
  4  End program
? 1

The lowest grade is 68

Enter a choice:
  0  Print the array of grades
  1  Find the minimum grade
  2  Find the maximum grade
  3  Print the average on all tests for each student
  4  End program
? 2

The highest grade is 96
```

```
Enter a choice:
  0  Print the array of grades
  1  Find the minimum grade
  2  Find the maximum grade
  3  Print the average on all tests for each student
  4  End program
? 3

The average for student 1 is 76.0
The average for student 2 is 87.5
The average for student 3 is 81.8

Enter a choice:
  0  Print the array of grades
  1  Find the minimum grade
  2  Find the maximum grade
  3  Print the average on all tests for each student
  4  End program
? 4

Program Ended.
```

7.18 *(Projects: Card Shuffling and Dealing – Which Poker Hand is Better?)* Use the functions developed in Exercise 7.17 to write a program that deals two five-card poker hands, evaluates each, and determines which is the better hand. This is equivalent to determine the probabilities of the following 5-card poker hands (royal flush, straight flush, four of a kind, full house, flush, straight, three of a kind, two pair, one pair, and no pair) and compare your results with theoretical predictions.

Frequency of 5-card poker hands: C(52,5)=2,598,960

Hand	Distinct hands	Frequency	Probability	Cumulative probability	Odds	Mathematical expression of absolute frequency
Royal flush	1	4	0.000154%	0.000154%	649,739 : 1	$\binom{4}{1}$
Straight flush (excluding royal flush)	9	36	0.00139%	0.0015%	72,192 : 1	$\binom{10}{1}\binom{4}{1} - \binom{4}{1}$
Four of a kind	156	624	0.0240%	0.0256%	4,164 : 1	$\binom{13}{1}\binom{12}{1}\binom{4}{1}$
Full house	156	3,744	0.1441%	0.17%	693 : 1	$\binom{13}{1}\binom{4}{3}\binom{12}{1}\binom{4}{2}$
Flush (excluding royal flush and straight flush)	1,277	5,108	0.1965%	0.367%	508 : 1	$\binom{13}{5}\binom{4}{1} - \binom{10}{1}\binom{4}{1}$
Straight (excluding royal flush and straight flush)	10	10,200	0.3925%	0.76%	254 : 1	$\binom{10}{1}\binom{4}{1}^5 - \binom{10}{1}\binom{4}{1}$
Three of a kind	858	54,912	2.1128%	2.87%	46.3 : 1	$\binom{13}{1}\binom{4}{3}\binom{12}{2}\binom{4}{1}^2$
Two pair	858	123,552	4.7539%	7.62%	20.0 : 1	$\binom{13}{2}\binom{4}{2}^2\binom{11}{1}\binom{4}{1}$

One pair	2,860	1,098,240	42.2569%	49.9%	1.37 : 1	$\binom{13}{1}\binom{4}{2}\binom{12}{3}\binom{4}{1}^3$
No pair / High card	1,277	1,302,540	50.1177%	100%	0.995 : 1	$\left[\binom{13}{5}-10\right]\left[\binom{4}{1}^5-4\right]$
Total	7,462	2,598,960	100%	---	0 : 1	$\binom{52}{5}$

```
C:\0.JOBs\0.Notes\Programing Languages\Misc\PlayCards_v2c\PlayCards.exe      —    □    ×

Total number of hands dealt:      2598960
The occurance of Royal Flush:           5
The occurance of Straight Flush:        31
The occurance of Four of a Kind:       637
The occurance of Full House:          3731
The occurance of Flush:               5085
The occurance of Straight:            9154
The occurance of Three of a Kind:    55057
The occurance of Two Pairs:         123200
The occurance of One Pair:         1099196
The occurance of Nothing:          1302864

Time elapsed in second: 20
```

ANS: