CPS 5401 Fall 2015 Name ________________________________
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Midterm Exam October 8
100 points

1. (12 pts)
a. Suppose on a Linux machine you wish to create lib, bin, and include directories under $HOME/<arch>, where <arch> is the architecture given by the
```
uname -m
```
command. Write a shell script to do this.

b. Give the Linux command you would use in the bash shell to add $HOME/bin to your execution path.

2. (12 pts) Suppose you have files foo1.c, foo2.c, foo3.c in your current working directory and that foo2.c depends on foo.h which is in $HOME/include.
a. Write a single command that will invoke the gcc compiler to compile and link the source files into an executable named foo-prog. You may assume there are no other files that start with foo in your current working directory. Don't forget to tell the compiler where to find foo.h.

b. Fill in the missing parts of the Makefile below to build the target foo-prog by default and the target clean that will remove the object and executable files. Indicate where a tab character should go by writing <TAB>. Be sure to specify all dependencies. Write the Makefile so that you can switch to a different compiler by changing just the first line.

```
CC = gcc
OBJ = foo1.o foo2.o foo3.o

foo-prog:

foo1.o:

foo2.o:

foo3.o:

clean:
```

3. (12 pts) The intent of the C program below is to input a list of integers and output the minimum and maximum integer. Complete the missing parts of the program. You may assume that input is redirected from a file so that no prompts are needed.

```
#include <stdio.h>
int main() {
    int n, i, num, max, min;

    scanf("d\n", &n);             // input the number of integers
    scanf("%d\n", &num);     // input the first integer
    min = ___________;
    max = ___________;
    for (___________________ ) {
        scanf("%d\n", &num);




   }
   printf("Maximum is : %d\n, Minimun is: %d\n", max, min);
}
```

4. (16 pts) Write a correct swap subprogram that swaps the values of its two integer arguments in both C and Fortran. The values of the variables passed in as arguments to the subprogram should be switched in the caller after the return from the subprogram.

5. (12pts) Assuming the declaration for **a** shown below, write Fortran 90 array slice expressions for the array slices specified.

```
real, dimension(8,10) :: a
```

a. the first row

b. the 5th column

c. the 4x4 block starting at (3,4)

d. every third element in the odd rows, starting with the first element in the row

6. (12 pts) Write correct and efficient Python definitions for the functions given below. Remember to do as few operations as possible.

a. $f(x) = 4x^5 - 13x^3 + 3.8\, x^2 - 7.1$

b. $g(x,y) = 2x^2 + 2y^2 - 4$

c. $h(x) = x\sqrt{\frac{x-1}{x+1}}$

7. (12 pts) Fill in the missing parts of the C and Fortran90 subroutines shown below that multiply the input matrix by the input vector and place the result in the output vector. Be sure to access the matrix elements in the most efficient order for each language, which is by rows in C and by columns in Fortran. Do not assume that the contents of any memory locations are initially zero.

C:

```
int matvec(int n, float a[n][n],
           float x[n], float y[n]) {
   int i, j;






   return 0;
}
```

Fortran90:

```
subroutine matvec(n, a, x, y, n)
    integer, intent(in) :: n
    real, dimension(n,n), intent(in) :: a
    real, dimension(n), intent(in) :: x
    real, dimension(n), intent(out) :: y






end subroutine matvec
```

8. (12 pts) Rewrite the relevant parts of the above matvec subroutines to change them to use double precision. (You can number the lines and write only the lines you change below).