DigiPen Institute of Technology Singapore

Final Practice– Nov., 2019

High-level Programming I: The C Programming Language

CS120

Name: _____

Time: 180 Minutes

100 112
↓P1 104 108 ↓P2

int S[4] = { 1, 2, 3, 4 }

P1 = &S[0]; P2 = &S[3]

$P_2 - P_1 = 3 = \frac{112 - 100}{sizeof(int)} = 3$

Wed Q:

For this exam, you can assume that the sizes of the data types (in bytes) are as follows: **char**=1, **short**=2, **int**=4,**long**=8,**float**=4,**double**=8. You may also assume that **pointers** are 8 bytes.

Part I Structured Questions (38 points)

1. (4 points) For each identifier below, write **YES**, if it's a valid identifier and **NO**, if it's invalid.

   (a) No `is-integer`
   (b) Yes `printf` → function name
   (c) Yes `bottles100_`
   (d) No `sizeof` key word
   (e) Yes `myname50`
   (f) Yes `_tmp`
   (g) Yes `include` not key word #directive
   (h) Yes `Const` const

2. (4 points) Give the precise **type** of each expression and **value** (base 10) of the expression. If the expression is illegal, write **ILLEGAL**.

```
char c;
int x;
char *p = &c;
```

   (a) type int value 0 `'\0'`
   (b) type char value 0 `c= '\0'`
   (c) type int value 1 `x= '\0' + 1` '0'+1
   (d) type char * value 0 `p = '\0'` == p=NULL; 0

3. (2 points) Give a C expression to implement the following math expressions:

   (a) (m>='a') && (m<='z') $'a' \leq m \leq 'z'$
   (b) s=3.0f/4 * r * r $s = \pi/4 * r^2, (\pi = 3)$
   3/4 3/4

4. (2 points) Given the following declarations and initializations, what does the code below print out?

```
5==3>6+11*7.5||1&&flag
a=0  b*  c 1
```

   1 || 1 && flag

   (a) 1 flag is 1
   (b) 0 flag is 0

5. (8 points) Given the definitions below, give the precise type of each expression and the value of the expression. If the expression doesn't compile write **CTE**, or it cause run time error, write **UDB** in the type column and leave the value blank. Assume that the modifications are **not** carried over from one expression to the next.

```
int i=3, k[]={2,4,6,8,10,12}, *x=&i, *y=k;
double d=1.5;
struct point {
  int x;
  int y;
  char *name;
} pt[]={{200,40,"begin"}, {300,100,"end"}}, *pp=pt;
```

(a) type int value 201 `++pp->x`

(b) type int value 180 `pt[1].x*i/5`

(c) type int value 8 `k[i++]`

(d) type double value 11.5 `k[++i]+d`

(e) type UDB value _____ `pt[i--].y+50`

(f) type int value 0 `strcmp((*pp).name,"begin");`

(g) type CTE value _____ `*(*pp.name+2);`

(h) type char value 'g' `*((*pp).name+2);`

6. (9 points) Given the following declarations, determine the value of the expressions given below. If the expression doesn't compile write **CTE**. If it cause run time error, write **UDB**.

```
float arrf[]={4.7};
char arrc[]="4.7";
char animals[][10]={"lion","elephant","tiger","cat"};
char *pc = &animals[0][0];
int arri[10] = {1,2,3};
```

(a) 1x4=4 `sizeof(arrf)`

(b) 4 `sizeof(arrc)`

(c) 4x10=40 `sizeof(animals)`

(d) 40 `sizeof(arri)`

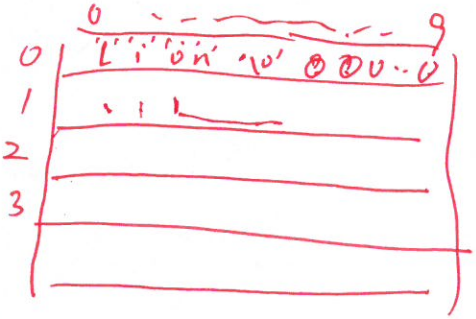
(e) 2 `strlen(arrc+1)`

(f) 3 `strlen(*(animals+3))`

(g) 4 `strlen(pc)`

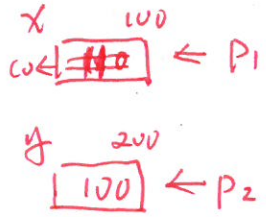
(h) 6 `strlen(pc+12)`

(i) CTE `strlen(++arrc)` read only. arrc+1



7. (4 points) Given the following declarations, determine the value of the expressions given below.

```
int x=100, y=10;
int *p1=&x, *p2=&y;
x=*p1+*p2;
y=x-*p2;
*p1=*p1-*p2;
```

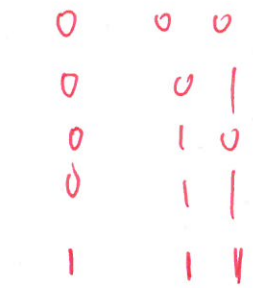


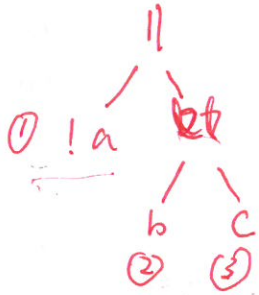
(a) 10 x

(b) 100 y

8. (5 points) Let a, b and c be variables set to either 0 or 1. For which sets of values is the Boolean expression below equal to 1 (true)? (For each of your answer, write something of the form a=1, b=0, c=1.) Write one answer per line.

```
!a || (b && c)
```





Part II C Declarations (10 points) Provide the correct declarations of functions or variables and their initialization(if needed). Use **single statement**. The following variables are declared in global scope:

1. (2 points) A variable p of type structure `position` contains two members, an integer called x, and another integer called y. Initialize it using (4,5).

```
struct position { int x; int y; } p = {4, 5};
```

2. (4 points) A variable o of type structure `object` contains two members, a struct `position` called `pos`, and a string called `name`. Initialize it using variable p as its position and "Hero" as its name.

```
struct object { struct position pos; char* name; } o = {p, "Hero"};
```

3. (4 points) foo is an array of 2 pointers pointing to structure `object`. First element of this array is pointing to variable `o`.

struct object* foo[2] = { &o };

Part III Giving the printout (25 points) This question is reading code and finding the correct printout. Assume that all necessary headers are already included. If there's a compile warning, compile error, or run-time error, write **ERROR**.

1. (2 points) For the following code snippet, write its printout for each of the input values typed by the user.

```
int bar(int t)
{
  return t%3;
}
int main(void)
{
  printf("%d", bar(bar(bar(19))));
}
```

bar(19)
bar(1)
bar(1)

1

2. (4 points) Write the printout of the following program.

```
int main(void) {
  int i,j,k;
  int b[3][3]={5,3,9,4,1,2,6,7,8};
  for(k=0;k<3;k++) {
    j=0;
    for(i=k;i>=0;i--){
      printf("%d ", b[i][j]);
      j++;
    }
    printf("\n");
  }
  return 0;
}
```

5 3 9
4 1 2
6 7 8

b[0][0]
b[1][0] b[0][1]
b[2][0] b[1][1] b[0][2]

5
4 3
6 1 9

3. (4 points) Write the printout of the following program.

```
int f(int a, int *b) {
  *b=(a+3)*2 + (*b)%4;
  a=*b-a%6;
  printf("a=%d,b=%d\n", a, *b);
  return 2*a - (*b);
}
int main(void) {
  int a=3,b=7,c=4;
  c=f(b,&a) + 3;
  printf("a=%d,␣b=%d,␣c=%d\n", a, b, c);
  b=f(a,&c);
  printf("a=%d,␣b=%d,␣c=%d\n", a, b, c);
  return 0;
}
```

a=22, b=23

a=23, b=7, c=24

a=47, b=52

a=23, b=42, c=52.

4. (3 points) For the following code snippet, write its printout.

```
int x=7, y=4, z;
printf("%d\n",x--);
z=--x * y++;
printf("%d\n",z);
```

7

20

5. (2 points) For the following code snippet, write its printout.

```
void main (int) {
  int  a=0;
  for (; a ;);
  a++;
}
```

printf("%d", a);

1

6. (4 points) Write the printout of the following program.

```
int foo(int i)
{
  static int f=1;
  return f*=++i;
}
int main(void)
{
  printf("%d␣", foo(0));
  printf("%d␣", foo(1));
  printf("%d␣", foo(2));
  return 0;
}
```

f = f * 1; 1 · 2.

f = f * 3; 2.

3.

163

1␣2␣6

7. (4 points) Write the printout of the following program.

```
int mystery(int a,int b,int c) {
  c=a+b;
  return b-a;
}
int main(void) {
  int x=1,y=2,z=0;
  z=mystery(x,y,z);
  printf("z=%d␣",z);
  if(z!=3)
    printf("STRANGE\n");
  else printf("FUNNY\n");
}
```

y - x

z=1␣STRANGE

8. (2 points) Write the printout of the following program.

```
void main(int){
  char *p="Hello␣world";
  int  *q;
  p++;
  q = (int *)p;
  q++;
  printf("%s\n%s",p,q);
}
```

p+1

q+1

q+1 × sizeof(int)

ello␣world

␣world

Part IV Programming Questions (27 points)

1. (3 points) Write code for the following function (four lines maximum).

```
void sumdif(int x, int y, int *sum, int *dif)
/* put the sum of x and y into *sum
   and the difference (x-y) into *dif */
{
```

*sum = x+y;

*dif = x-y;

```
}
```

2. (2 points) Show how the function **sumdif** declared in the previous problem would be called, by filling in the missing two lines of code:

```
int x=10;
int y=5;

line1: ____int sum, dif;____

line2: ____sumdif(x, y, &sum, &dif);____
```

3. (3 points) The following short programs contains a programming error(not necessarily a syntax error). State clearly what the error is. Provide line number when specifying the error.

```
1. #include <stdlib.h>
2. #include <stdio.h>
3. int *findMax(int *a, int *b) {
4.   int max;
5.   if(*a>*b) max=*a;
6.   else max=*b;
7.   return &max;
8. }
9. int main(void) {
10.  int x=7, y=15, max;
11.  max =*findMax(&x,&y);
12.  return 0;
13. }
```

return the Adress of a local variable.

4. (3 points) The following short programs contains a programming error(not necessarily a syntax error). State clearly what the error is. Provide line number when specifying the error.

```
1. #include <stdlib.h>
2. #include <stdio.h>
3. int main(void) {
4.    typedef struct {
5.       int start;
6.       int end;
7.       char letter;
8.    }note;
9.    note *p;
10.   p=(note*)malloc(2*sizeof(int)+sizeof(char));
11.   if(p==NULL) return 0;
12.   p->start=80; p->end=100; p->letter='A';
13. return 0;
14. }
```

structure alignment.

32 bits 4 bytes

64 bits 8 bytes.

sizeof(note)

9 12

5. (3 points) The following short programs contains a programming error(not necessarily a syntax error). State clearly what the error is. Provide line number when specifying the error.

```
struct student{
    char *name;
    int score;
}*pstu;
int main(void){
    pstu = (struct student *)malloc(sizeof(struct student));
    strcpy(pstu->name, "Jimy");
    pstu->score = 99;
    free(pstu);
    return 0;
}
```

char name[20];

=> dangling pointer.

name = "Jimy";

6. (3 points) The following short programs contains a programming error(not necessarily a syntax error). State clearly what the error is. Provide line number when specifying the error.

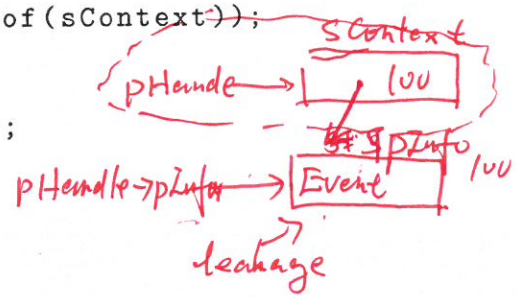
```
typedef struct {
  char *pInfo;
}sContext;
int main(void){
sContext  *pHandle = malloc(sizeof(sContext));

pHandle-> pInfo  = malloc(81);
strcpy(pHandle-> pInfo, "Event");

free(pHandle);
}
```

memory leakage

free(pHandle->pInfo);



7. (5 points) Write a C language program to read one matrix and find the sum of it's major diagonal elements.

square

```
#define M 3
int main(void){
    int **p;    int i,j, sum=0;
    p= malloc( sizeof(int*) * M );
    for(i=0; i<M ; ++i)
    { *(p+i) = malloc ( sizeof(int) * M );
      for( j=0; j<M; ++j )
        scanf("%d", *(p+i)+j);
    }
    for(i=0; i<M; ++i)
      for( j=0; j<M; ++j )
        if(i==j) sum+= p[i][j];
    return 0;
    free(p[i]);
}   free(p);
```

8. (5 points) Write a C language program using structure to define employee record containing employee number , name and salary. Read 10 records.