National Taiwan Normal University
CSIE Computer Programming I

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Due Date: 2022.10.11 PM 11:59

Assignment 1

Policies:

- Zero tolerance for late submission.
- Please pack all your submissions in one zip file. **RAR is not allowed!!**
- For convenience, your executable programs must be named following the rule hwXXYY, where the red part is the homework number and the blue part is the problem number. For example, hw0102 is the executable program for homework #1 problem 2.
- I only accept **PDF**. MS Word is not allowed.
- Do not forget your Makefile. For convenience, each assignment needs only one Makefile.
- Please provide a README.

1.1 Print Colorful Words (20 pts)

In this class, I have shown you how to print strings on your screen. However, the word's color is boring. Can I print strings with different colors? Absolutely yes! But how to do this? The keyword is **ANSI escape codes**.

Please write a program to show the following message on the screen, including punctuation marks. Then you should color all personal names with blue and all operation systems with red.

```
$ ./hw0101
In the fullness of time MS-DOS begat Windows. And this is the
    lineage of Windows: CP/M begat QDOS. QDOS begat DOS 1.0. DOS
     1.0 begat DOS 2.0 by way of Unix. DOS 2.0 begat Windows
    3.11 by way of PARC and Macintosh. IBM and Microsoft begat
    OS/2, who begat Windows NT and Warp, the lost OS of lore.
    Windows 3.11 begat Windows 95 after triumphing over
    Macintosh in a mighty Battle of Licences. Windows NT begat
    NT 4.0 by way of Windows 95. NT 4.0 begat NT 5.0, the OS
    also called Windows 2000, The Millenium Bug, Doomsday,
    Armageddon, The End Of All Things.

```

```
Now it came to pass that Microsoft had waxed great and mighty among the Microchip Corporations; mighter than any of the Mainframe Corporations before it had it waxed. And Gates heart was hardened, and he swore unto his Customers and their Engineers the words of this curse:

"Children of von Neumann, hear me. IBM and the Mainframe Corporations bound thy forefathers with grave and perilous Licences, such that ye cried unto the spirits of Turing and von Neumann for deliverance. Now I say unto ye: I am greater than any Corporation before me. Will I loosen your Licences? Nay, I will bind thee with Licences twice as grave and ten times more perilous than my forefathers. I will engrave my Licence on thy heart and write my Serial Number upon thy frontal lobes. I will bind thee to the Windows Platform with cunning artifices and with devious schemes. I will bind thee to the Intel Chipset with crufty code and with gnarly APIs. I will capture and enslave thee as no generation has been enslaved before. And wherefore will ye cry then unto the spirits of Turing, and von Neumann, and Moore? They cannot hear ye. I am become a greater Power than they. Ye shall cry only unto me, and shall live by my mercy and my wrath. I am the Gates of Hell; I hold the portal to MSNBC and the keys to the Blue Screen of Death. Be ye afraid; be ye greatly afraid; serve only me, and live."

And the people were cowed in terror and gave homage to Microsoft, and endured the many grave and perilous trials which the Windows platform and its greatly bogacious Licence forced upon them. And once again did they cry to Turing and von Neumann and Moore for a deliverer, but none was found equal to the task until the birth of Linux.

These are the generations of Linux:

SAGE begat ARPA, which begat TCP/IP, and Aloha, which begat Ethernet. Bell begat Multics, which begat C, which begat Unix. Unix and TCP/IP begat Internet, which begat the World Wide Web. Unix begat RMS, father of the great GNU, which begat the Libraries and Emacs, chief of the Utilities. In the days of the Web, Internet and Ethernet begat the Intranet LAN, which rose to renown among all Corporations and prepared the way for the Penguin. And Linus and the Web begat the Kernel through Unix. The Kernel, the Libraries and the Utilities together are the Distribution, the one Penguin in many forms, forever and ever praised.
```

For your reference, the source of the above messages is from the following link.

https://www.linux.com/training-tutorials/gospel-tux/

1.2 Subtraction (20 pts)

Please write a program for a user to input two **three-digits non-negative integers** and print the subtraction process.

```
$ ./hw0102
Please enter the first  number: 222
Please enter the second number: 111
   2 2 2
-) 1 1 1
--------
   1 1 1
$ ./hw0102
Please enter the first  number: 123
Please enter the second number: 456
   1 2 3
-) 4 5 6
--------
 - 3 3 3
```

If there is any invalid input, print an error message and terminate your program. For your simplicity, I promise that all inputs are integers and can be put in a 32-bits memory space.

1.3 Orthogonality (20 pts)

Given two distinct points A and B in a rectangular coordinate system, you can draw a line $\overline{AB}$. Now given you another point C, please calculate a line which passes C and is orthogonal to $\overline{AB}$, as shown in figure 1.1. For the consistency, the line equation should be as follows:

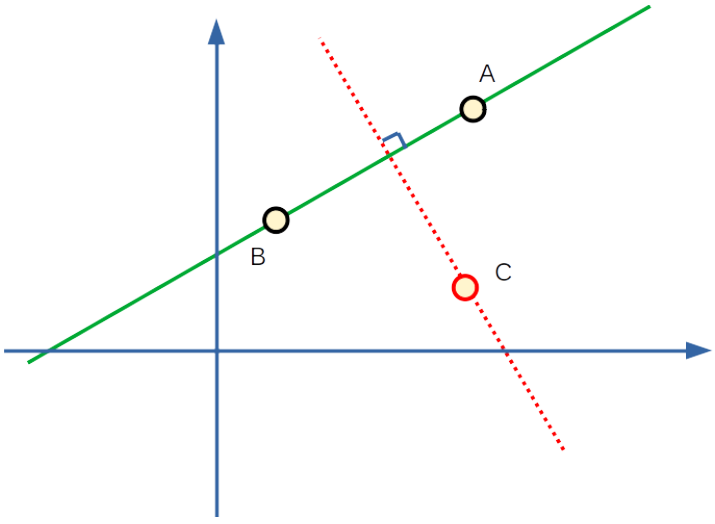


FIGURE 1.1: Orthogonality.

$$y = a \cdot x + b$$

```
$ ./hw0103
Please enter the point A (x,y): 0,0
Please enter the point B (x,y): 1,1
Please enter the point C (x,y): -1,1
The line: y = -1 * x + 0
```

x, y are all 32-bit integers and a, b are doubles. If the input in invalid, you need to print an error message and terminate the program. Note that precision is not a concern in this problem.

1.4 Pokémon (20 pts)

Have you ever played Pokémon? Let's develop a program to calculate the damage in Pokémon.

Pokémon's damage can be simply calculated by the following equation:

$$Damage = \lfloor (\lfloor \frac{level * 2 + 10}{250} * \frac{atk}{def} * power \rfloor + 2) * factor \rfloor$$

- **level**: the level of the attacking Pokémon.
- **atk**: the Attack value of the attacking Pokémon.
- **def**: the Defense value of the target Pokémon.
- **power**: the power of the used move.

The **factor** above is composed of various factors:

$$factor = weather * stab * type * status * terrain$$

- **weather** is the weather during the battle, some moves might be affected. Please see table 1.1.
- **stab** stands for "same-type attack bonus", 2 if the move's type and the attacking Pokémon's are same, 1 otherwise.
- **type** is the type effective. There are 8 types. Please see table 1.2.
- **status** is the status of the attacking Pokémon, in some situation it might affect the damage. There are three kinds of status. Please see table 1.3.

- **terrain** is a type of field effect that only affects Pokémon on ground, in other words, non-flying-type Pokémon. There are 4 kinds of terrain. Please see table 1.4.

details are given by tables below, note that the effects depends on the moves' type, and terrain doesn't affect flying-type Pokémons.

number	Weather	water	fire	others
0	none	=	=	=
1	sunny	-	+	=
2	rain	+	-	=
3	cloudy	=	=	=
4	windy	=	=	=
5	sandstorm	=	=	=
- : not very effective, 0.5×			= : normal, 1×	
+ : very effective, 2×			× : not effective, 0×	

Table 1.1: Table of weather effect

number	Tgt / Atk	water	fire	grass	flying	rock	ground	electric	dragon
0	water	-	+	-	=	+	+	=	-
1	fire	-	-	+	=	-	=	=	-
2	grass	+	-	-	-	+	+	=	-
3	flying	=	=	+	=	-	=	-	=
4	rock	=	+	=	+	=	-	=	=
5	ground	=	+	=	×	+	=	+	=
6	electric	+	=	-	+	=	×	-	-
7	dragon	=	=	=	=	=	=	=	+
- : not very effective, 0.5×					= : normal, 1×				
+ : very effective, 2×					× : not effective, 0×				

Table 1.2: Table of type effect

However, despite the things that mentioned above, there is something you should know:

- In the sandstorm, rock-type Pokémons' def is doubled.
- In the rain, ground-type Pokémons' def is halved.

number		0	1
	Status \ Category	physical	special
0	none	=	=
1	burn	-	=
2	frostbite	=	-
- : not very effective, 0.5×		= : normal, 1×	
+ : very effective, 2×		× : not effective, 0×	

Table 1.3: Table of status effect

number	Terrain	grass	electric	dragon	others
0	none	=	=	=	=
1	grassy	+	=	=	=
2	electric	=	+	=	=
3	misty	=	=	-	=
- : not very effective, 0.5×		= : normal, 1×			
+ : very effective, 2×		× : not effective, 0×			

Table 1.4: Table of terrain effect

- In the cloudy, grass-type Pokémons' atk is halved.
- In the windy, flying-type Pokémons' atk is doubled.
- Every move deals at least 1 damage, unless the type effective is "not effective".

```
$ ./hw0104
Attacker
    level: 33
    atk: 157
    type: 0
    status: 1
    move power: 110
    move type: 0
    move category: 1
Target
    def: 79
    type: 6
Environment
    weather: 3
    terrain: 2
Damage --> 136
```

$$\text{Damage} = ((33 * 2 + 10) * 157 * 110/250/79 + 2) * 1 * 2 * 1 * 1 * 1$$

$$\text{factor} = 1 * 2 * 1 * 1 * 1$$

Weather, type, terrain, move's category, and status are represented by numbers listed in table above.

Here are some rules that inputs would follow:

- Pokémons have only one type.
- Pokémons' stats (e.g. def, atk) are nonzero natural number.
- Pokémons' level is an integer in interval [1, 100].
- moves have only one type.
- moves' power are nonzero natural number.
- moves are either physical or special.
- one battle has only one weather.
- one battle has only one terrain.
- weather and terrain can exist at the same time.

1.5 Poker Hands (20 pts)

In poker, players form sets of five playing cards, called hands, according to the rules of the game. Each hand belongs to a category determined by the patterns formed by its cards. A hand in a higher-ranking category always ranks higher than a hand in a lower-ranking category. A hand is ranked within its category using the ranks of its cards. Individual cards are ranked, from highest to lowest: A, K, Q, J, 10, 9, 8, 7, 6, 5, 4, 3 and 2. There are nine categories of hand and I list them in figure 1.2.

Please write a program to determine the rank of the given five cards. The card is encoded as follows:

- 1-13: ♠ Ace to King.
- 14-26: ♡ Ace to King.
- 27-39: ♢ Ace to King.
- 40-52: ♣ Ace to King.

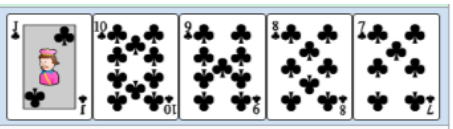
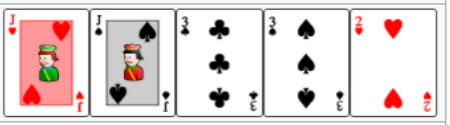
1	Straight flush**	
2	Four of a kind	
3	Full house	
4	Flush**	
5	Straight**	
6	Three of a kind	
7	Two pair	
8	One pair	
9	High card	

FIGURE 1.2: Ranking Category.

```
$ ./hw0105
Please enter 5 cards: 1 2 3 4 5
Straight Flush
```

For your simplicity, I guarantee that the inputs are five integers.

1.6 Bonus: printf (5 pts)

In this class, I have taught you that each function should have a return result[1]. **printf** is also a function, right? What does the return value of

[1]Though the return can be **void**, we can treat **void** is a kind of return, just like "Not existence" is also a kind of solution in math problems.

printf mean? Please write down your answer in **Chinese**[2] and write a example program to show your answer.

[2]If you are a foreign student, you can use English.