Topic V1B

Parameter Passing by Value and by Reference

Reading: (Section 2.14)

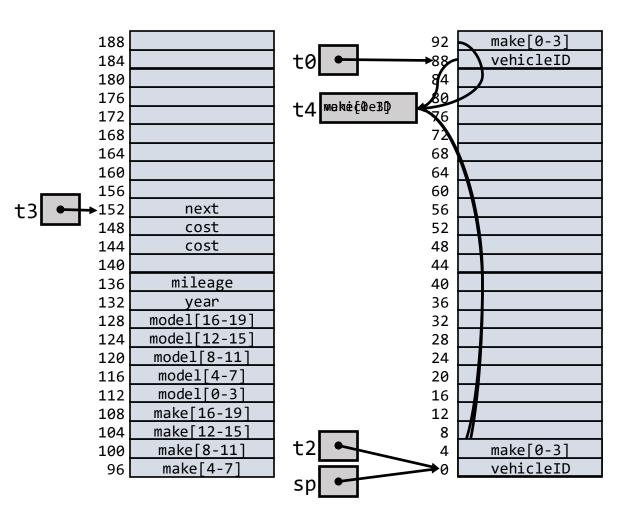
What is the Difference Between Passing a Parameter by Value and Passing it by Reference?

The car.c Program

```
#include <stdio.h>
#define STRINGLENGTH 20
                                     void ReadCar(CarNode *car){
                                      car->vehicleID = 2;
typedef struct c node{
  int vehicleID;
                                       strcpy(car->make, "Chrysler");
                                      strcpy(car->model, "Town and Country");
  char make[STRINGLENGTH];
  char model[STRINGLENGTH];
                                      car->year = 2014;
                                      car->mileage = 6000;
  int year;
  int mileage;
                                      car->cost = 45,625.74;
  double cost;
  struct c node *next;
} CarNode;
                                    void PrintCar(CarNode car){
                                       printf("vehicleID:%d\n", car.vehicleID);
                                      printf("make:%s\n", car.make);
void ReadCar(CarNode *car);
void PrintCar(CarNode car);
                                      printf("model:%s\n", car.model);
                                       printf("year:%d\n", car.year);
main(){
                                       printf("mileage:%d\n", car.mileage);
 CarNode mycar;
                                      printf("cost:%f\n", car.cost);
  ReadCar(&mycar);
  PrintCar(mycar);
```

64	next	t		
	cost			
56				
52				
#define STRINGLENGTH 20	mileage			
44	year			
<pre>typedef struct c_node{</pre>				
int vehicleID;				
<pre>char make[STRINGLENGTH]; shap model[STRINGLENGTH].</pre>	mode1[20]			
<pre>char model[STRINGLENGTH]; int year; 28</pre>				
int mileage; 24				
double cost; 20				
<pre>struct c_node *next;</pre>				
} CarNode;	make	[20]		
8				
4				
0	vehicleID			

```
#include <stdio.h>
                                                                       main:
#define STRINGLENGTH 20
                                                                                  addi
                                                                                             sp, -168
                                                                                             ra, 84(sp)
                                                                                  SW
                                                                       # 23 CarNode mycar;
typedef struct c node{
                                                                       # 25 ReadCar(&mycar);
                                                                                  add
                                                                                             a0, sp, 88
  int
         vehicleID;
                                                                                  ial
                                                                                             ra, ReadCar
  char make[STRINGLENGTH];
                                                                       # 27 PrintCar(mycar);
                                                                                             t0, sp, 88
                                                                                  add
  char
         model[STRINGLENGTH];
                                                                                            t2, sp
                                                                                  mν
  int
         year;
                                                                                  add
                                                                                             t3, t0, 72
                                                                       L1:
                                                                                  lw
                                                                                            t4, 0(t0)
  int
       mileage;
                                                                                            t4, 0(t2)
                                                                                  SW
  double cost:
                                                                                  addi
                                                                                            t0, t0, 4
  struct c node *next;
                                                                                  addi
                                                                                            t2, t2, 4
                                                                                            t0, t3, L1
                                                                                  bne
} CarNode;
                                                                                  jal
                                                                                             ra,
                                                                       PrintCar
                                                                       # 28
void ReadCar(CarNode *car);
                                                                                             a0, zero
                                                                                  mν
void PrintCar(CarNode car);
                                                                                  lw
                                                                                             ra, 84(sp)
                                                                                  addi
                                                                                             sp, 168
                                                                                  jalr
                                                                                             zero, ra, 0
main(){
  CarNode mycar;
  ReadCar(&mycar);
  PrintCar(mycar);
```



main: addi sp, -168 ra, 84(sp) SW # 23 CarNode mycar; # 25 ReadCar(&mycar); add a0, sp, 88 jal ra, ReadCar # 27 PrintCar(mycar); add t0, sp, 88 mν t2, sp t3, t0, 72 add L1: lw t4, 0(t0) t4, 0(t2) SW addi t0, t0, 4 addi t2, t2, 4 t0, t3, L1 bne jal ra, PrintCar # 28 } mν a0, zero lw ra, 84(sp) addi sp, 168 jalr zero, ra, 0

188	
184	
180	
176	
172	
168	
164	
160	
156	
152	next
148	cost
144	cost
140	
136	mileage
132	year
128	model[16-19]
124	model[12-15]
120	model[8-11]
116	model[4-7]
112	model[0-3]
108	make[16-19]
104	make[12-15]
100	make[8-11]
96	make[4-7]

92	make[0-3]
88	vehicleID
84	
80	
76	
72	
68	
64	next
60	cost
56	cost
52	
48	mileage
44	year
40	model[16-19]
36	model[12-15]
32	model[8-11]
28	model[4-7]
24	model[0-3]
20	make[16-19]
16	make[12-15]
12	make[8-11]
8	make[4-7]
4	make[0-3]
0	vehicleID

```
main:
             addi
                          sp, -168
                          ra, 84(sp)
             SW
# 23 CarNode mycar;
# 25 ReadCar(&mycar);
             add
                          a0, sp, 88
             jal
                          ra, ReadCar
# 27 PrintCar(mycar);
             add
                          t0, sp, 88
                          t2, sp
             ΜV
             add
                          t3, t0, 72
L1:
             lw
                          t4, 0(t0)
                          t4, 0(t2)
             SW
             addi
                          t0, t0, 4
             addi
                          t2, t2, 4
             bne
                          t0, t3, L1
             jal
                          ra,
PrintCar
# 28
                          a0, zero
             mν
             lw
                          ra, 84(sp)
             addi
                          sp, 168
             jalr
                          zero, ra, 0
```

Why so Much Copying?

The program car.c passes the data structure CarNode to the PrintCar function by value

A copy of each byte of CarNode must be made in the stack for each call of the function PrintCar

Instead, we could have passed the address of the copy of CarNode that we already had in the stack

```
#include <stdio.h>
#define STRINGLENGTH 20
                                   void ReadCar(CarNode *car){
                                    car->vehicleID = 2;
typedef struct c node{
  int vehicleID;
                                    strcpy(car->make, "Chrysler");
  char make[STRINGLENGTH];
                                    strcpy(car->model, "Town and Country");
  char model[STRINGLENGTH];
                                    car->year = 2014;
                                    car->mileage = 6000;
  int year;
  int mileage;
                                    car->cost = 45,625.74;
  double cost;
  struct c node *next;
} CarNode;
                                   void PrintCar(CarNode *car){
                                     printf("vehicleID:%d\n", car->vehicleID);
                                     printf("make:%s\n", car->make);
void ReadCar(CarNode *car);
void PrintCar(CarNode *car);
                                     printf("model:%s\n", car->model);
                                     printf("year:%d\n", car->year);
main(){
                                     printf("mileage:%d\n", car->mileage);
 CarNode mycar;
                                     printf("cost:%f\n", car->cost);
  ReadCar(&mycar);
  PrintCar(&mycar);
```

```
#include <stdio.h>
#define STRINGLENGTH 20
typedef struct c node{
  int
      vehicleID;
  char make[STRINGLENGTH];
  char
       model[STRINGLENGTH];
  int
       year;
  int
      mileage;
  double cost;
  struct c node *next;
} CarNode;
void ReadCar(CarNode *car);
void PrintCar(CarNode *car);
main(){
  CarNode mycar;
  ReadCar(&mycar);
  PrintCar(&mycar);
```

```
main:
             addi
                           sp, -112
                           ra, 28(sp)
             SW
# 23 CarNode mycar;
# 25 ReadCar(&mycar);
             add
                           a0, sp, 32
             jal
                           ra, ReadCar
# 27 PrintCar(&mycar);
             add
                           a0, sp, 32
             jal
                           ra,
PrintCar
# 28
                           a0, zero
             mν
             lw
                           ra, 28(sp)
                           sp, 112
             addi
             jalr
                           zero, ra, 0
```