Compound Data

```
#include <stdio.h>

struct posn {
  int x;
  int y;
}; /* <- don't forget the semicolon! */

int main() {
  struct posn p = { 10, 20 };

  printf("Posn is at (%d, %d)\n", p.x, p.y);

  return 0;
}
```

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Functions on Structures

```
struct posn flip_posn(struct posn p) {
    struct posn p2;
    p2.x = p.y;
    p2.y = p.x;
    return p2;
}

int main() {
  struct posn p = { 10, 20 };

  p = flip_posn(p);
  printf("Posn is at (%d, %d)\n", p.x, p.y);

  return 0;
}
```

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Structure Pointers

```
void flip_this_posn(struct posn * pp) {
    int z;
    z = (*pp).x;
    (*pp).x = (*pp).y;
    (*pp).y = z;
}

int main() {
  struct posn p = { 10, 20 };

  flip_this_posn(&p);
  printf("Posn is at (%d, %d)\n", p.x, p.y);

  return 0;
}
```

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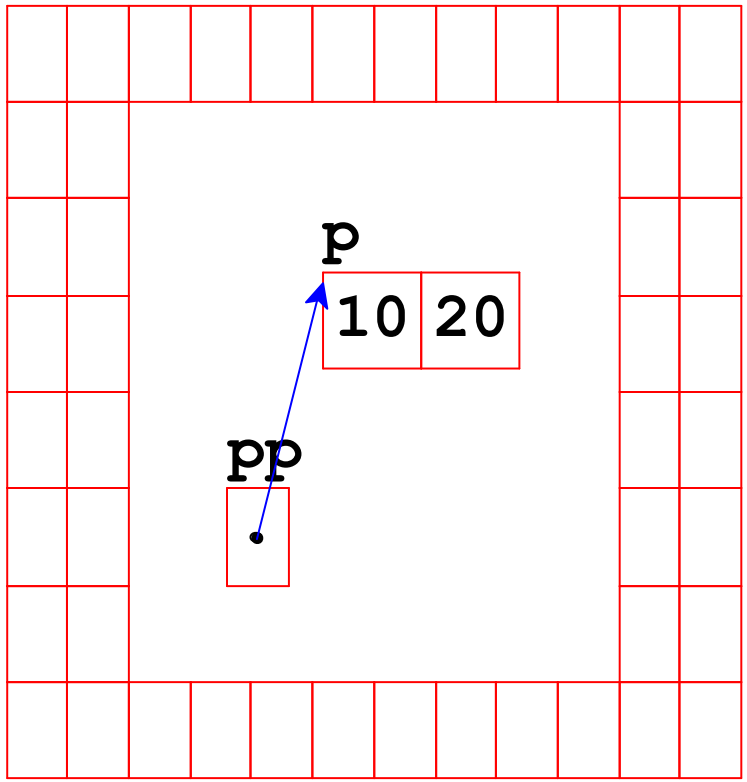
p
10
20
pp

Arrow Notation

```
void flip_this_posn(struct posn * p) {
    int z;
    z = p->x; /* same as z = (*p).z */
    p->x = p->y;
    p->y = z;
}
```

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-> abbreviates a combination of * and .

Another Structure Example

```
struct snake {
  char* name;
  double weight;
  char* food;
};
```

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Implement

```
struct snake feed_snake(struct snake s);
```

Nested Structures

```
struct ant {
  double weight;
  struct posn loc;
};
```

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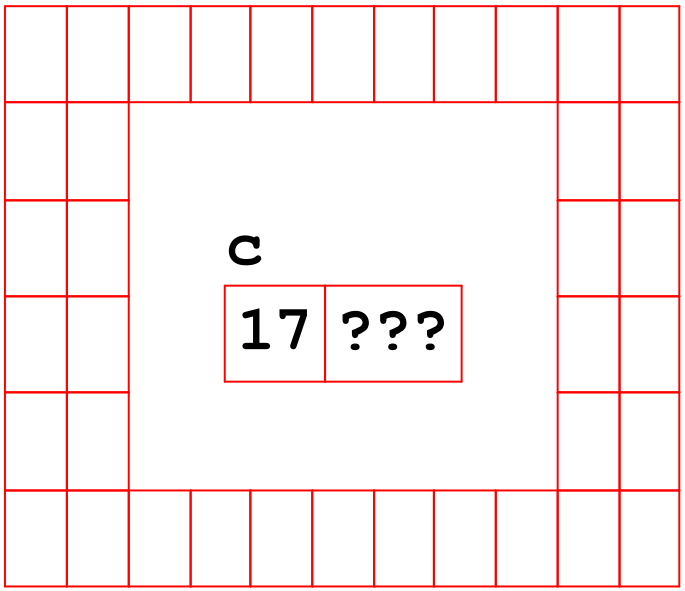
Implement

```
struct ant send_ant_home(struct ant a);
```

Cons Cells

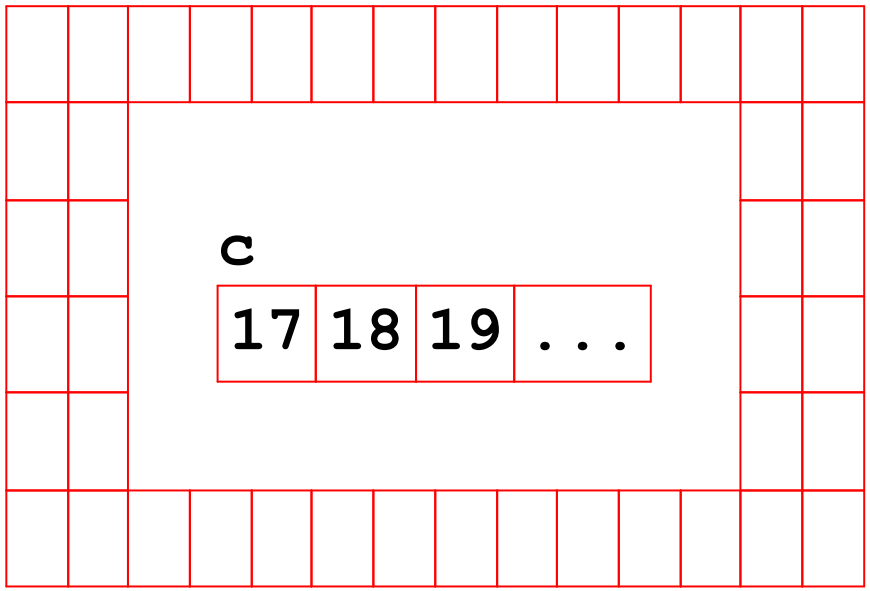
```
struct int_cons {
  int first;
  struct list rest; /* ??? */
};

struct int_cons c = { 17, ??? };
```



Cons Cells

```
struct int_cons {
  int first;
  struct int_cons rest; /* ??? */
};
```

```
struct int_cons c = { 17, { 18, { 19, ... } } };
```



Lists

```
struct int_cons {
  int first;
  struct int_cons * rest; /* NULL => empty */
};
```

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Lists

```
void print_list(struct int_cons * ls) {
  for (; ls != NULL; ls = ls->rest) {
    printf("%d\n", ls->first);
  }
}

int main() {
  struct int_cons c3 = { 19, NULL };
  struct int_cons c2 = { 18, &c3 };
  struct int_cons c1 = { 17, &c2 };
  struct int_cons * ls = &c1;

  print_list(ls);

  return 0;
}
```

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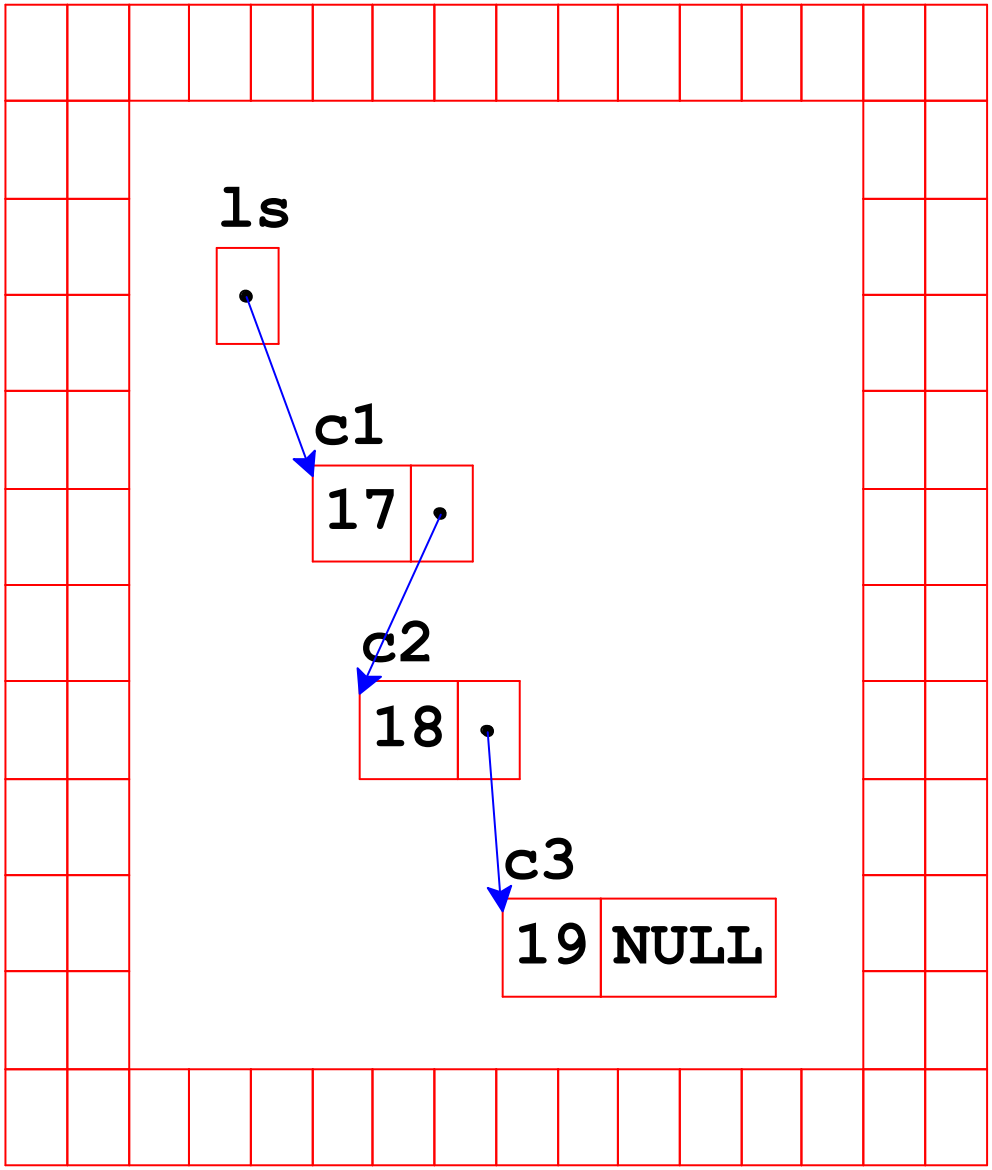
ls
c1
17
c2
18
c3
19
NULL

Building Lists

```
int main(int argc, char** argv) {
  struct int_cons * ls = NULL;
  int i;

  for (i = argc - 1; i > 0; i--) {
    ls = cons(atoi(argv[i]), ls);
  }

  print_list(ls);

  return 0;
}
```

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A Bad Allocator

```
struct int_cons * cons(int i, struct int_cons * ls) {
  struct int_cons c;

  c.first = i;
  c.rest = ls;

  return &c;
}
```

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Memory is reserved for `c` only until `cons` returns

A Good Allocator

```
struct int_cons * cons(int i, struct int_cons * ls) {
  struct int_cons * ls2;

  ls2 = (struct int_cons *)malloc(sizeof(struct int_cons));

  ls2->first = i;
  ls2->rest = ls;

  return ls2;
}
```

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Typedefs

```
typedef struct int_cons * list;

list cons(int i, list ls) {
  list ls2;

  ls2 = (list)malloc(sizeof(struct int_cons));

  ls2->first = i;
  ls2->rest = ls;

  return ls2;
}
```

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Beware: `malloc(sizeof(list))` would be wrong