CS 33

Introduction to C
Part 6

Numeric Conversions

```
short a;
int b;
float c;

b = a;    /* always works */
a = b;    /* sometimes works */
c = b;    /* sort of works */
b = c;    /* sometimes works */
```

Implicit Conversions (1)

```
float x, y=2.0;
int i=1, j=2;

x = i/j + y;
  /* what's the value of x? */
```

Implicit Conversions (2)

```
float x, y=2.0;
int i=1, j=2;
float a, b;

a = i;
b = j;
x = a/b + y;
  /* now what's the value of x? */
```

Explicit Conversions: Casts

```
float x, y=2.0;
int i=1, j=2;

x = (float)i/(float)j + y;
  /* and now what's the value of x? */
```

Fun with Functions (1)

```
void ArrayDouble(int A[], int len) {
  int i;
  for (i=0; i<len; i++)
      A[i] = 2*A[i];
}
```

Fun with Functions (2)

```
void ArrayBop(int A[],
     int len,
     int (*func)(int)) {
  int i;
  for (i=0; i<len; i++)
     A[i] = (*func)(A[i]);
}
```

Fun with Functions (3)

```
int triple(int arg) {
  return 3*arg;
}

int main() {
  int A[20];
  … /* initialize A */
  ArrayBop(A, 20, triple);
  return 0;
}
```


Swap, Revisited

```
void swap(int *i, int *j) {
  int *tmp;
  tmp = *j; *j = *i; *i = tmp;
}
/* can we make this generic? */
```

Casts, Revisited

- **Two purposes**
  - **coercion**

```
int i, j;
float a; //sizeof(float) == 4
a = (float)i/(float)j;
```

done for primitive types

  - **intimidation**

```
float x, y;
swap((int *)&x, (int *)&y);
```

done for pointer types

Quiz 1

- **Will this work?**

```
double x, y; //sizeof(double) == 8


...
swap((int *)&x, (int *)&y);
```

a) **yes**
b) **no**

Nothing, and More …

- ***void* means, literally, nothing:**

```
void NotMuch(void) {
   printf("I return nothing\n");
}
```

- **What does *void* * mean?**
  - **it's a pointer to anything you feel like**
    - » **a generic pointer**

Rules

- **Use with other pointers**

```
int *x;
void *y;
x = y; /* legal */
y = x; /* legal */
```

- **Dereferencing**

```
void *z;
*z; /* illegal!*/
```

An Application: Generic Swap

```
void gswap (void *p1, void *p2,
        int size) {
  int i;
  for (i=0; i < size; i++) {
        char tmp;
        tmp = ((char *)p1)[i];
        ((char *)p1)[i] = ((char *)p2)[i];
        ((char *)p2)[i] = tmp;
  }
}
```

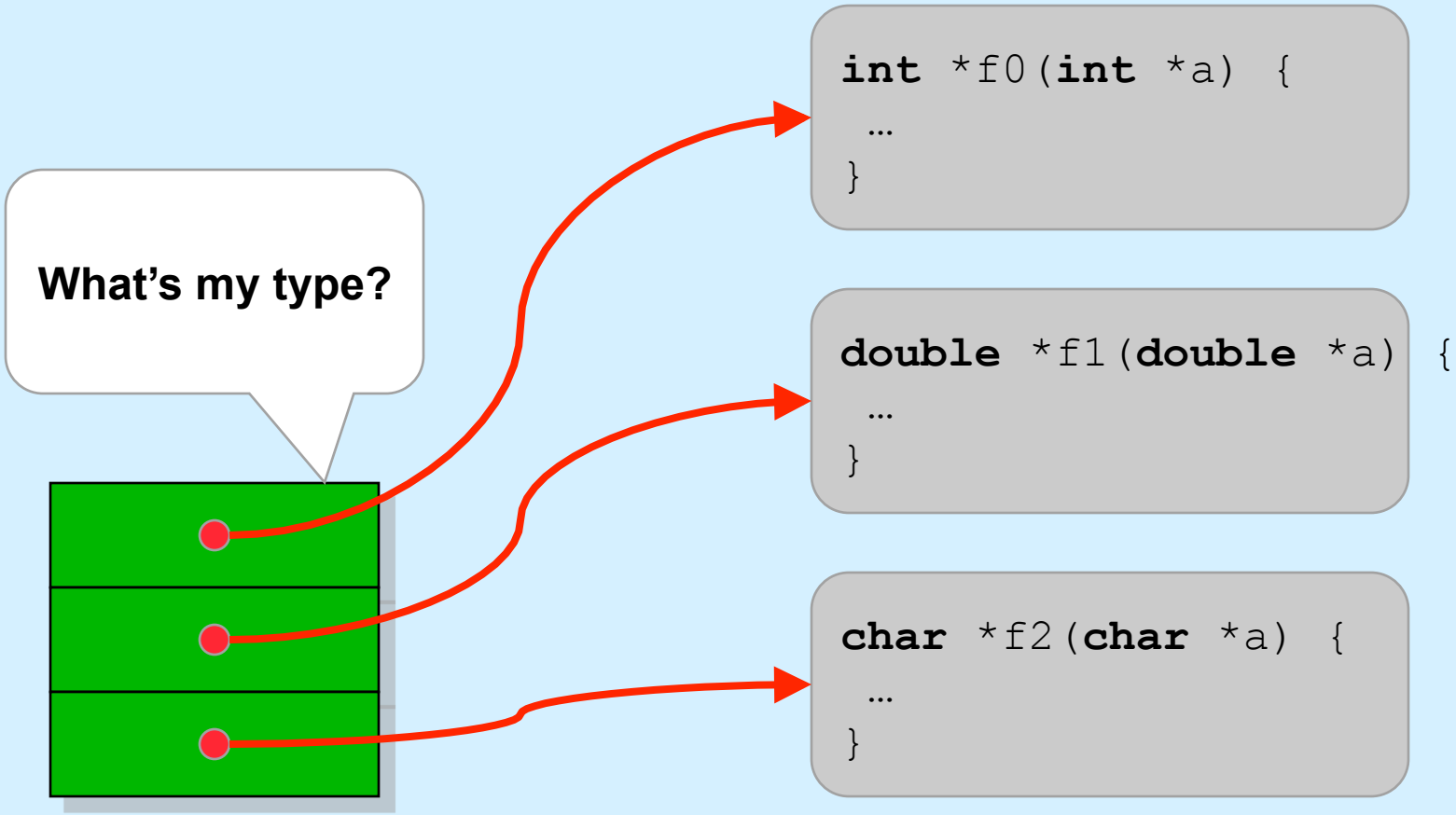
Using Generic Swap

```
short a, b;
gswap(&a, &b, sizeof(short));

int x, y;
gswap(&x, &y, sizeof(int));

int A[] = {1, 2, 3}, B[] = {7, 8, 9};
gswap(A, B, sizeof(A));
```

For Our Next Trick …



Working Our Way There …

- An array of 3 ints
  - `int A[3];`
- An array of 3 int *s
  - `int *A[3];`
- A func returning an int *, taking an int *
  - `int *f(int *);`
- A pointer to such a func
  - `int *(*pf)(int *);`

There …

- **An array of func pointers**
  - `int *(*pf[3])(int *);`
- **An array of generic func pointers**
  - `void *(*pf[3])(void *);`

Using It

```
int *f0(int *a) { *a += 1; return a; }
double *f1(double *a) { *a += 1; return a; }
char *f2(char *a) { *a += 1; return a; }
int main() {
  int x = 1;
  int *p;
  void *(*pf[3])(void *);
  pf[0] = (void *(*)(void *))f0;
  pf[1] = (void *(*)(void *))f1;
  pf[2] = (void *(*)(void *))f2;
  p = pf[0](&x);
  printf("%d\n", *p);
  return 0;
}
```

```
$ ./funcptr
2
$
```

Quiz 2

```
int *f0(int *a) { *a += 1; return a; }
double *f1(double *a) { *a += 1; return a; }
char *f2(char *a) { *a += 1; return a; }
int main() {
  int x = 1;
  int *p;
  void *(*pf[3])(void *);
  pf[0] = (void *(*)(void *))f0;
  pf[1] = (void *(*)(void *))f1;
  pf[2] = (void *(*)(void *))f2;
  p = pf[1](&x); // was pf[0]
  printf("%d\n", *p);
  return 0;
}
```

What is printed?

a) 2
b) 2.5
c) something different from the above
d) nothing: syntax error

Casts, Yet Again

- **They tell the C compiler: "Shut up, I know what I'm doing!"**
- **Sometimes true**

```
pf[0] = (void *(*)(void *))f0;
```

- **Sometimes false**

```
long f = 7;
(void(*)(int))f(2);
```

Laziness …

- Why type the declaration

```
void *(*f)(void *, void *);
```

- You could, instead, type

```
MyType f;
```

- (If, of course, you can somehow define *MyType* to mean the right thing)

typedef

- **Allows one to create new names for existing types**

```
typedef int *IntP_t;
```

```
IntP_t x;
```

  - **means the same as**

```
int *x;
```

More typedefs

```
typedef struct complex {
  float real;
  float imag;
} complex_t;

complex_t i, *ip;
```

And ...

```
typedef void *(*MyFunc_t)(void *, void *);

MyFunc_t f;

// you must do its definition the long way

void *f(void *a1, void *a2) {
  …
}
```

