Aliasing a type name with typedef

- Simple rule: *typedef* original_type_name new_type_name;

```
typedef unsigned long ulong;
ulong x; // equivalent to long x;
```

- More general rule: *typedef* type definition of new_type_name;

```
typedef int IntAry[20];
IntAry y[30]; // equivalent to int y[30][20];
```

```
typedef double (*(*FP)( ))[10];
FP fp; // equivalent to double (*(*fp)())[10];
meaning: "a function pointer fp to a function that takes no argument and
          returns a pointer to a 10-element array of double"
Equivalent and more self explaining definitions:
    typedef double DoubleArray[10];
    typedef PtrDoubleArray *DoubleArray;
    typedef PtrDoubleArray (*FP)();
```

Aliasing a type name with typedef

- You can also define multiple new type names in one typedef statement

```
typedef struct
{
   int x;
   int y;
} Point, *PtrPoint;
Point point;          // equivalent to struct { int x; int y; } point;
PtrPoint ptrPoint; // equivalent to struct { int x; int y; } *ptrPoint;
```

Complex Data Type Definitions

- Examples:

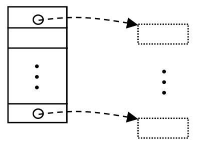
```
int *x;
int *x[10];
int (*x)[10];
int (**x)[10];
int *(**x)[10];
void (*funcPtr)();
void *funcPtr();  // definition of a function
void (*signal(int, void(*)(int)))(int);  // definition of a function
void *(*(*fp1)(int))[10];
float (*(*fp2)(int, int, float))(int);
double (*(*(*fp3)())[10])();
int (*(*f4())[10])();
```

Using typedef can simplify these definitions

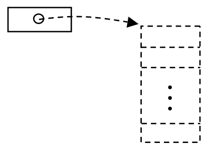
Complex Data Type Definitions

- Two simplest examples first:

int *x[10]; // 10-element ARRAY of (PTR to integer)



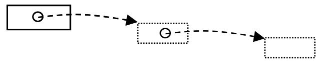
int (*x)[10]; // PTR to (10-element ARRAY of integers)



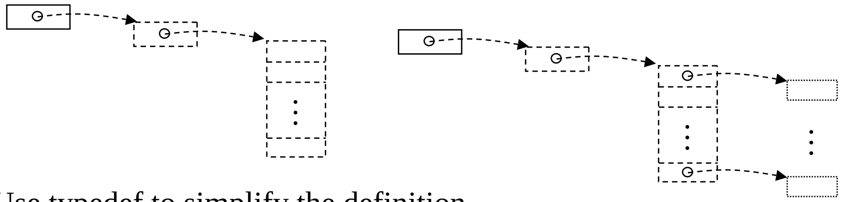
TYPE [n]   means "n-element ARRAY of TYPE"
TYPE *   means "PTR to TYPE"
[ ] has higher precedence than *, ( ) can change the priority

Complex Data Type Definitions

- Some more



```
int **x1;           // PTR to (PTR to int)
int (**x2)[10];     // PTR to (PTR to (10-element ARRAY of int))
int *(**x3)[10];    // PTR to (PTR to (10-elem ARY of (PTR to int)))
```



- Use typedef to simplify the definition

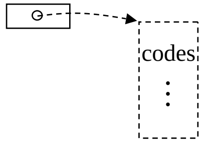
```
typedef int *IPTR;
IPTR *x1;
typedef int IARY[10];
typedef IARY *PTRIARY;
PTRIARY *x2;
```

```
typedef IPTR IPTRARY[10];
typedef IPTRARY *PTR_IPTRARY;
PTR_IPTRARY *x3;
```

Complex Data Type Definitions

- Function pointers

void (*funcPtr)(); // PTR to a function that takes no argument and return void



- Real example:

void (*(*fp)(int, void(*)(int)))(int);

// fp is a PTR to a function that takes two arguments, an int, (a function pointer that takes one int argument and returns void), and returns (a function pointer that takes one int argument and returns void)

Equivalently,

typedef void (*sig_t)(int);

sig_t (*fp)(int, sig_t);

Complex Data Type Definitions

- Ex: PTR to a function that takes an int and returns a PTR to (10-element array of (PTR to void))

void *(*(*fp1)(int))[10];

- Ex: PTR to a function that takes three arguments: int, int, float and returns (PTR to a function that takes an int and returns float)

float (*(*fp2)(int, int, float))(int);

- Ex: PTR to a function that takes no argument, returns (PTR to (10-element ARRAY of (PTR to a function that takes no argument and returns double)))

double (*(*(*fp3)())[10])();

- Ex: function that takes no argument, returns (PTR to (10-element ARRAY of (PTR to function that takes no argument and returns int)))

int (*(*f4())[10])();